Smart Managed Narrow Switch

User manual

Order No. —

INSPIRING INNOVATIONS

User manual

Smart Managed Narrow Switch

2016-02-15

Designation: UM EN FL SWITCH SMN 6TX/2POF-PN

Revision: 03

Order No.: —

This user manual is valid for:

Designation	Version	Order No.
FL SWITCH SMN 6TX/2POF-PN		2700290
FL SWITCH SMN 8TX-PN		2989501
FL SWITCH SMN 6TX/2FX		2989543
FL SWITCH SMN 6TX/2FX-SM		2989556

Please observe the following notes

User group of this manual

The use of products described in this manual is oriented exclusively to:

- Qualified electricians or persons instructed by them, who are familiar with applicable standards and other regulations regarding electrical engineering and, in particular, the relevant safety concepts.
- Qualified application programmers and software engineers, who are familiar with the safety concepts of automation technology and applicable standards.

Explanation of symbols used and signal words

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety measures that follow this symbol to avoid possible injury or death.

There are three different categories of personal injury that are indicated with a signal word.

DANGER	This indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	This indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	This indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

❗ This symbol together with the signal word **NOTE** and the accompanying text alert the reader to a situation which may cause damage or malfunction to the device, hardware/software, or surrounding property.

ℹ This symbol and the accompanying text provide the reader with additional information or refer to detailed sources of information.

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Table of contents

1 Smart Managed Narrow Switch

NOTE: By default upon delivery, the Smart Managed Compact Switch switch operates in "PROFINET" mode.

1.1 Features

The **S**mart **M**anaged **N**arrow **S**witch (**Smart Managed Narrow Switch** - **SMN**) is an industrial Ethernet switch, which is available in the following versions:

- Six Fast Ethernet ports in RJ45 format and two fiber optic ports in POF format (FL SWITCH SMN 6TX/2POF-PN)
- Eight Fast Ethernet ports in RJ45 format (FL SWITCH SMN 8TX-PN)
- Six Fast Ethernet ports in RJ45 format and two fiber optic ports in SC multi-mode format (FL SWITCH SMN 6TX/2FX)
- Six Fast Ethernet ports in RJ45 format and two fiber optic ports in SC single-mode format (FL SWITCH SMN 6TX/2FX-SM)

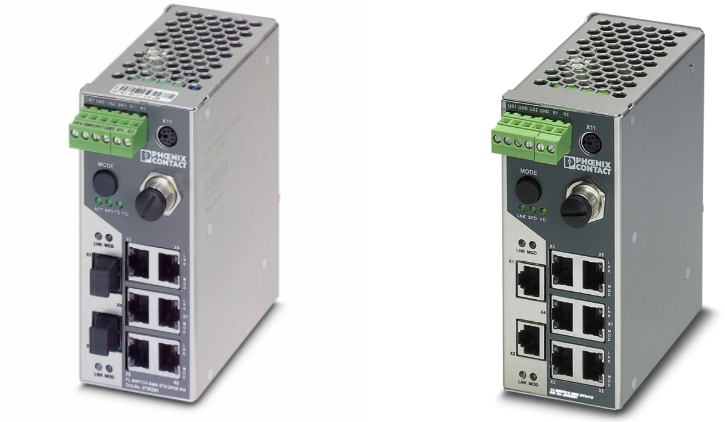


Figure 1-1 Smart Managed Compact Switch (versions)

Future-proof networks for the highest demands

Maximum performance

10/100 Mbps on each RJ45 port, 100 Mbps for fiber optic ports

Maximum availability

Maximum network availability
A device design that does not use a fan, the redundant power supply, and conformance with all relevant industrial standards in terms of EMC, climate, mechanical load, etc. ensure the highest possible level of availability.

Quick media redundancy

Redundancy can be created with standards: the (Rapid) Spanning Tree Protocol or MRP (Media Redundancy Protocol) ensure safe operation of the entire network regardless of topology, even in the event of a cable interrupt.

All information

Clear information
Two LEDs per port with switchable information ensure that you always have sufficient local information. A web server and an SNMP agent are provided for diagnostics, maintenance, and configuration via the network. A terminal access point can be used for on-site operation.

Port mirroring

Port mirroring can be used to monitor data traffic on the network connections or as an important service function.

Features and fields of application of the Smart Managed Compact Switch

- Increased network performance by filtering data traffic:
  - Local data traffic remains local.
  - The data volume in network segments is reduced.
- Easy network expansion and network configuration.
- Coupling of copper segments with different transmission speeds.
  Automatic detection of 10 Mbps or 100 Mbps data transmission speed with auto crossing for the RJ45 ports.
- Flexible use of fiber optics in SCRJ format.
- Increased availability through the use of redundant transmission paths with the shortest switch-over times using Rapid Spanning Tree and fast ring detection. Support of various topologies and meshed structures as well as ring topologies with special ring detection.
- Switch configuration using web-based management, SNMP or locally via an RS-232 interface.
- Port mirroring.
- Topology detection using LLDP (Link Layer Discovery Protocol).
- Address assignment via BootP, DCP or statically.
- Media Redundancy Protocol (MRP) supported as a client or as the MRP master. The MRP ring can thus be created using any SMN ports.
- Can be used in the PROFINET environment.
- Operating mode can be easily changed using Smart mode.
- POF port diagnostics.

1.1.0.1 View of the SMN

Figure 1-2 View of the FL SWITCH SMN 6TX/2POF-PN

– Diagnostic/status indicators
  Important information is displayed directly on the device. Each port has two LEDs. The top LED always indicates the “LINK”, the display of the bottom LED is set with the function switch.
– MODE switch for LEDs and Smart mode
  The MODE switch can be used to specify which information is displayed by the second port-specific LED. The three LEDs below the switch indicate the selected mode. This information is then displayed by all port-specific LEDs (see also example on page 14). In addition, this button is used to set the switch to Smart mode (for details, see “Using Smart mode” on page 20).
– Mini-DIN RS-232
  RS-232 interface in Mini-DIN format for on-site configuration via the serial interface.
– Signal contact
  The floating signal contact can be connected here via a 2-pos. COMBICON connector.
– Supply voltage connection
  The supply voltage can be connected via the 4-pos. COMBICON connector (redundancy is optional).

1.1.1 Dimensions of the SMN

Depth from top edge of DIN rail including MEM PLUG: 175 mm

Depth from top edge of DIN rail without MEM PLUG: 130 mm

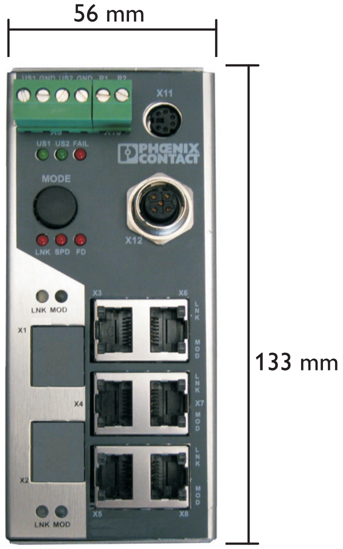


Figure 1-3 Housing dimensions of the FL SWITCH SMN in millimeters

1.2 Status and diagnostics indicators

Please note that the meaning of the LEDs differs in Smart mode (see “Using Smart mode” on page 20).

Des.	Color	Status	Meaning
US1	Green	On	Supply voltage 1 within the tolerance range
		Off	Supply voltage 1 too low
US2	Green	On	Supply voltage 2 within the tolerance range
		Off	Supply voltage 2 too low
FAIL	Red	On	Signal contact open, i.e., an error has occurred
		Off	Signal contact closed, i.e., an error has not occurred
A Link LED is located on the front of the SMN for each port			
LNK (Link)	Green	On	Link active
		Off	Link not active
An additional LED is located on the front of the SMN for each port. The function of the second LED (MODE) for each port can be set using the MODE switch (see also example below). There are three options (during the boot process the mode and port LEDs are permanently on):			
ACT (Activity)	Green	On	Transmitting/receiving telegrams
		Off	Not transmitting/receiving telegrams
SPD (Speed)	Green	ON (green)	100 Mbps
		Off	10 Mbps if Link LED is active (for RJ45 ports only)
FD (Duplex)	Green	On	Full duplex
		Off	Half duplex
FO (Fiber Optic)	Orange	Off	The system reserve of the optical path is >2 dB
		Flashing 0.5 Hz	The system reserve of the optical path is between 2 dB and 0 dB
		Flashing 2 Hz	The system reserve of the optical path is <0 dB
		On	Diagnostic alarm
ACT/SPD/FD	Yellow	Flashing	Switch is in Smart mode (see “Using Smart mode” on page 20)

Example:

In Figure 1-4, the LED indicators have the following meaning:

A: The MODE switch has been used to select duplex mode (FD); the mode LEDs now indicate that port 1 is in full duplex mode.

B: The switch has been used to select the data transmission speed (SPD); the mode LEDs now indicate that port 1 is operating at 10 Mbps, port 2 is operating at 100 Mbps, port 3 is operating at 100 Mbps, and port 4 is not operating at all.

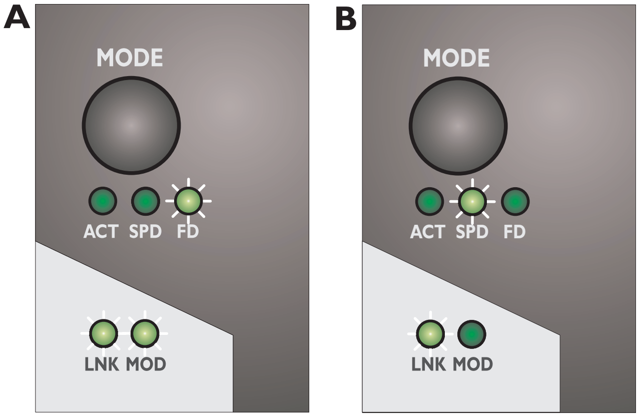


Figure 1-4 Example of status indicators

1.2.1 Firmware versions and their functions

Firmware version 1.00 provides the standard switch functions.

2 Mounting and installation

2.1 Mounting and removing the SMN

Mount the SMN on a clean DIN rail according to DIN EN 50022 (e.g., NS 35 ... from Phoenix Contact). To avoid contact resistance, only use clean, corrosion-free DIN rails. End brackets (E/NS 35N, Order No. 0800886) can be mounted to the right and left of the SMN to stop the modules from slipping on the DIN rail.

Mounting:

1 Place the module onto the DIN rail from above (1). The upper holding keyway of the module must be hooked onto the top edge of the DIN rail. Push the module from the front towards the mounting surface (2).

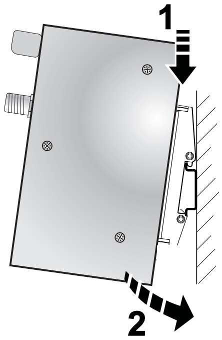


Figure 2-1 Snapping the SMN onto the DIN rail

2 Once the module has been snapped on properly, check that it is fixed securely on the DIN rail. Check whether the positive latch is facing upwards, i.e., snapped on correctly.

Removal:

1 Pull down the positive latch using a suitable tool (e.g., screwdriver). Then swivel the bottom of the module away from the DIN rail slightly (1). Next, lift the module upwards away from the DIN rail (2).

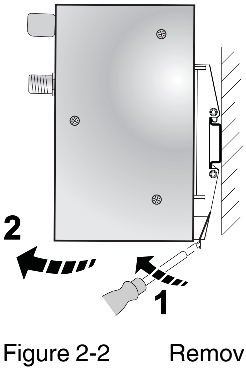


Figure 2-2 Removing the SMN

2.2 Installing the Smart Managed Narrow Switch

2.2.1 Connecting the 24 V DC supply voltage

The SMN is operated using a 24 V DC voltage, which is applied via COMBICON. If required, the voltage can also be supplied redundantly (see Figure 2-4).

If redundant power supply monitoring is active (default setting), an error is indicated if only one voltage is applied. A bridge between US1 and US2 prevents this error message. However, it is also possible to deactivate monitoring in web-based management or via SNMP.

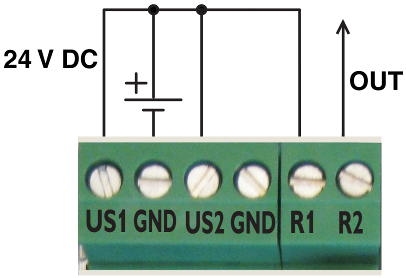


Figure 2-3 Supplying the SMN using one voltage source

Redundant 24 V DC supply

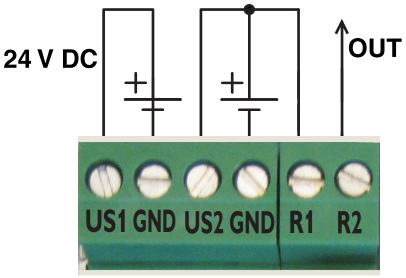


Figure 2-4 Supplying the SMN using two voltage sources

In order to reset the SMN on power up, the power supply must be interrupted for at least 3 seconds.

2.2.2 Signal contact

The switch has a floating signal contact. An error is indicated when the contact is opened.

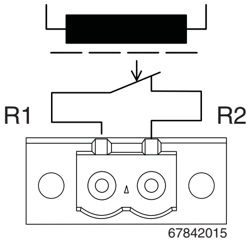


Figure 2-5 Basic circuit diagram for the signal contact

The indicated error states are configured in web-based management or via SNMP. For a list of error states that can be configured, please refer to Section ““Diagnostics, Alarm Contact” Menu” on page 44.

In the event of a non-redundant voltage supply, the switch indicates the voltage supply failure by opening the signal contact. This error message can be prevented by connecting the supply voltage to both terminal blocks in parallel, as shown in Figure 2-3, or by deactivating redundant power supply monitoring in web-based management or via SNMP.

2.2.3 Assignment of the RJ45 Ethernet connectors

Table 2-1 Pin assignment of RJ45 connectors

Pin number	10Base-T / 10 Mbps	100Base-T / 100 Mbps
1	TD+ (transmit)	TD+ (transmit)
2	TD- (transmit)	TD- (transmit)
3	RD+ (receive)	RD+ (receive)
4	-	-
5	-	-
6	RD- (receive)	RD- (receive)
7	-	-
8	-	-

2.2.4 RS-232 interface for external management

The 6-pos. Mini-DIN socket provides a serial interface to connect a local management station. It enables the connection to the management interface (for an appropriate cable, please refer to page 170) via a VT100 terminal or a PC with corresponding terminal emulation. Set the following transmission parameters:

Bits per second	38400
Data bits	8
Parity	None
Stop bits	1
Flow control	None

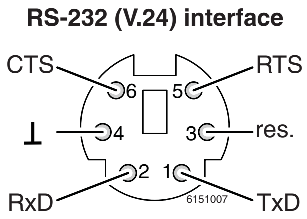


Figure 2-6 Transmission parameters and assignment of the RS-232 interface

2.3 Grounding

Grounding protects people and machines against hazardous voltages. To avoid these dangers, as far as possible, correct grounding, taking the local conditions into account, is vital.

All Factoryline devices must be grounded so that any possible interference is shielded from the data telegram and discharged to ground potential.

A wire of at least 2.5 mm^2 must be used for grounding. When mounting on a DIN rail, the DIN rail must be connected to protective earth ground via grounding terminal blocks. The module is connected to protective earth ground via the metal header.

3 Startup and functions

3.1 Basic settings

The basic Ethernet functions do not have to be configured and are available when the supply voltage is switched on.

The procedure for switching to the supported operating modes via **Smart mode** is described in Section "Using Smart mode" on page 20.

3.1.1 Delivery state/default settings

By default upon delivery or after the system is reset to the default settings, the following functions and properties are available:

- The password is: "private"
- All IP parameters are deleted. The switch has **no** valid IP parameters:
  IP address: 0.0.0.0
  Subnet mask: 0.0.0.0
  Gateway: 0.0.0.0
- PROFINET is activated as the addressing mechanism.
- All available ports are activated with the following parameters:
  - Autonegotiation
  - Autocrossing
- All counters of the SNMP agent are deleted.
- The web server, SNMP agent, and RS-232 interface are active.
- Port mirroring, Rapid Spanning Tree, broadcast limiter, and MRP are deactivated.
- The alarm contact only opens in the event of non-redundant power supply.
- The transmission of SNMP traps is deactivated and the switch has no valid trap destination IP address.
- The aging time is set to 40 seconds.
- The WBM refresh interval is set to 30 seconds.
- The switch is in "PROFINET" mode.
- The transmission of SNMP traps is deactivated and the switch has no valid trap destination IP address.

The aging time is set using the "dot1dTpAgingTime" MIB object (OID 1.3.6.1.2.1.17.4.2). The available setting range is 10 to 825 seconds. For static configuration, an aging time of 300 seconds is recommended.

3.2 Using Smart mode

Smart mode enables the user to change the operating mode of the switch without having access the management interface.

The FL SWITCH SMN offers the following setting options via Smart mode:

– Reset to the default settings
– Set PROFINET mode
– Exit Smart mode without changes

3.2.1 Activating Smart mode

The mode button is used to call/exit Smart mode and to select the desired setting. The three mode LEDs indicate the mode that is currently set and the mode which will apply when exiting Smart mode.

3.2.1.1 Calling Smart mode

- Following the switch boot phase, as soon as the three mode LEDs **go out**, press and hold down the mode button for more than five seconds. If Smart mode is active, the three LEDs will flash.
- When Smart mode is started, the switch is initially in the “Exit without changes” state.

3.2.1.2 Selecting the desired setting

- To select the various settings, press the mode button briefly and select the desired operating mode.

3.2.1.3 Exiting Smart mode

- To exit, press and hold down the mode button for at least five seconds. The previously selected operating mode is saved.

3.2.1.4 Possible operating modes in Smart mode

The FL SWITCH SMN supports the selection of the following operating modes in Smart mode (see also example below):

Table 3-1 Operating modes in Smart mode

Mode	**ACT** **LED 1**	**SPD** **LED 2**	**FD** **LED 3**
Exit Smart mode without changes	Off	Off	**On**
Reset to the default settings	Off	**On**	Off
Set PROFINET mode	Off	**On**	**On**

Example:

When the switch is in Smart mode, exiting Smart mode triggers the following action:

Example A: Resetting to the default settings

Example B: Setting PROFINET mode

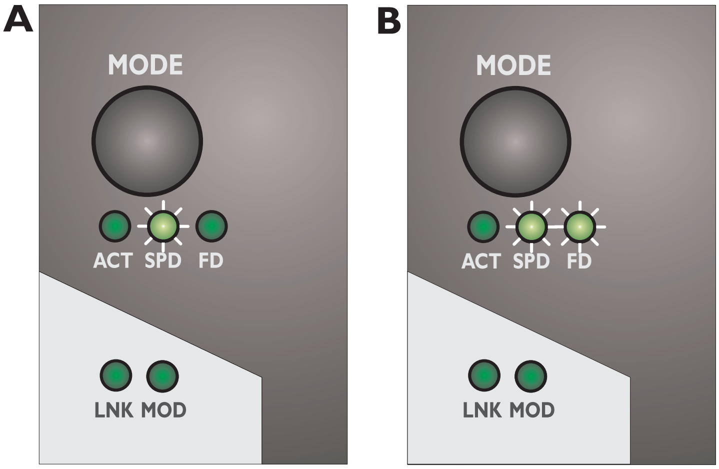


Figure 3-1 Example of Smart mode

3.3 Frame switching

The FL SWITCH SMN operates in store-and-forward mode. When receiving a data packet, the switch analyzes the source and destination addresses. The switch stores up to 4000 MAC addresses in its address table with an adjustable aging time of 10 to 825 seconds.

3.3.1 Store and forward

All data telegrams received by the switch are stored and checked for validity. Invalid or faulty data packets (>1522 bytes or CRC errors) and fragments (<64 bytes) are rejected. Valid data telegrams are forwarded by the switch.

3.3.2 Multi-address function

The switch learns all the source addresses for each port. Only packets with:

- Unknown source addresses
- A source address for this port or
- A multicast/broadcast address

in the destination address field are forwarded via the relevant port. The switch can learn up to 4000 addresses. This is important if more than one termination device is connected to one or more ports. Several independent subnetworks can be connected to one switch.

3.3.3 Learning addresses

The FL SWITCH SMN independently learns the addresses for termination devices, which are connected via this port, by evaluating the source addresses in the data telegrams. When the FL SWITCH SMN receives a data telegram, it forwards this data telegram to only that port that connects to the specified device (if the address could be learned beforehand). The FL SWITCH SMN can learn up to 4000 addresses and store them in its table. The switch monitors the age of the learned addresses. The switch automatically deletes from its address table address entries that exceed a specific age (default: 40 seconds, adjustable from 10 to 825 seconds, aging time).

All learned entries are deleted on a restart.
A link down deletes all the entries of the affected port.

A list of detected MAC addresses can be found in the MAC address table (see Section ““Diagnostics, Mac Address Table” menu” on page 46). The MAC address table can be deleted via the “Clear” button.

The aging time is set using the “dot1dTpAgingTime” MIB object (OID 1.3.6.1.2.1.17.4.2). The available setting range is 10 to 825 seconds. For static configuration, an aging time of 300 seconds is recommended.

3.3.4 Prioritization

The switch supports four priority queues for adjusting the internal packet processing sequence (traffic classes according to IEEE 802.1D). Data telegrams that are received are assigned to these classes according to the priority of the data packet, which is specified in the VLAN/prioritization tag:

– Data packets with the value “0” or “1” in the priority field are transmitted with the lowest priority (default).
– Data packets with the value “2” or “3” in the priority field are transmitted with the second lowest priority.
– Data packets with values between “4” and “5” in the priority field are transmitted with the second highest priority by the switch.
– Data packets with values between “6” and “7” in the priority field are transmitted with the highest priority by the switch.

Processing rules

The switch controller in the FL SWITCH SMN forwards received packets to one of the receive queues according to the following decisions:

– BPDU packets are always assigned to the high-priority queue.
– Packets with VLAN/prioritization tag are forwarded according to the queues listed above.
– All remaining data is assigned to the low-priority queue.

3.3.4.1 Class of Service (CoS)

Class of Service refers to a mechanism used to take into consideration the value of the priority field (values 1 to 7) in VLAN data packets with a tag. The switch assigns the data streams in various processing queues, depending on what priority information is contained in the CoS tag. The switch supports four internal processing queues.

3.3.4.2 Quality of Service (QoS)

Quality of Service affects the forwarding and handling of data streams and results in individual data streams being given differential treatment (usually preferential). QoS can be used, e.g., to guarantee a transmission bandwidth for individual data streams. The switch uses QoS in connection with prioritization (see CoS). The broadcast limiter can also be referred to as a QoS function.

3.3.4.3 Flow control

Flow control can provide advantages during transmission in large network topologies in which peak loads are to be expected. The switch supports flow control.

4 Configuration and diagnostics

The Smart Managed Narrow switch (SMN) offers several user interfaces for accessing configuration and diagnostic data. The preferred interfaces are the web interface and SNMP interface. These two interfaces can be used to make all necessary settings and request all information.
Access via the RS-232 interface only enables access to basic information and supports basic configuration. However, the RS-232 interface also enables firmware update via TFTP in the event of faulty firmware.

Settings are not automatically saved permanently. The active configuration can be saved permanently by selecting “Save current configuration” on the “Configuration Management” web page. Additional saving options are also available via SNMP or RS-232.

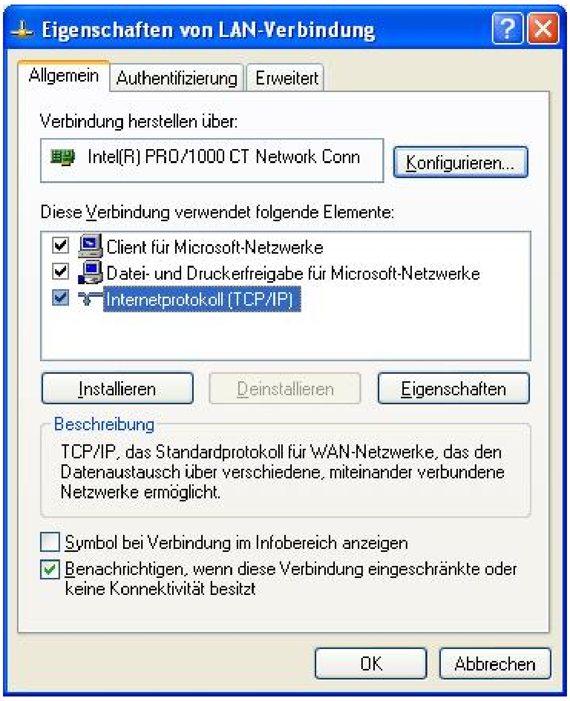
4.1 Making contact between the SMN and PC for initial configuration

4.1.1 Operation with static IP addresses

To enable the SMN to be accessed using the desired IP address, make sure that the computer and the SMN are in the same IP subnetwork. To do this, for initial contact your computer must be configured so that contact is possible. The following screenshots were created under Windows XP Professional.

Please note that the switch does not support supernetting or classless interdomain routing.

To set the IP parameters, open the Properties tab for your network adapter. Activate “Internet Protocol (TCP/IP)” and then click on “Properties”.



Verbindung herstellen über:

Intel(R) PRO/1000 CT Network Conn

Diese Verbindung verwendet folgende Elemente:

- ☑ Client für Microsoft-Netzwerke
- ☑ Datei- und Druckerfreigabe für Microsoft-Netzwerke
- ☑ Internetprotokoll (TCP/IP)

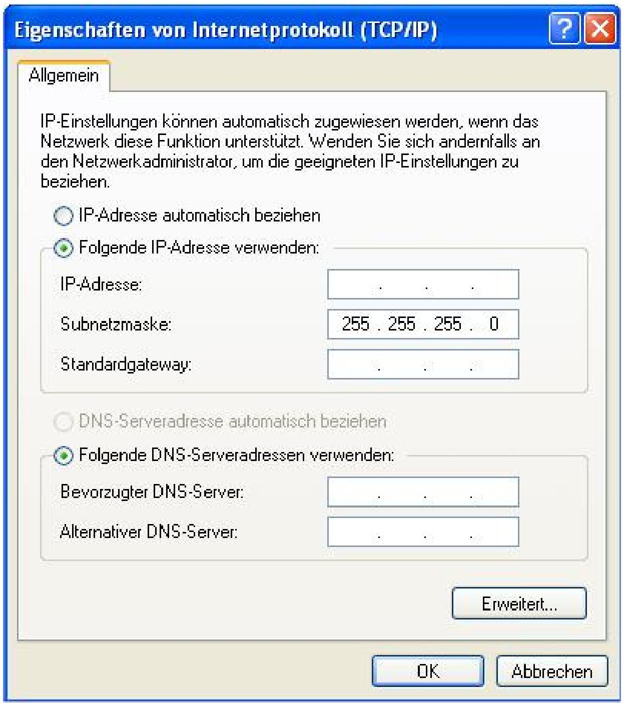
TCP/IP, das Standardprotokoll für WAN-Netzwerke, das den Datenaustausch über verschiedene, miteinander verbundene Netzwerke ermöglicht.

☐ Symbol bei Verbindung im Infobereich anzeigen

☑ Benachrichtigen, wenn diese Verbindung eingeschränkte oder keine Konnektivität besitzt

Figure 4-1 Properties dialog box for the network card

In the dialog box that opens, click the “Use the following IP address” radio button.



Eigenschaften von Internetprotokoll (TCP/IP)

Allgemein

IP-Einstellungen können automatisch zugewiesen werden, wenn das Netzwerk diese Funktion unterstützt. Wenden Sie sich andernfalls an den Netzwerkadministrator, um die geeigneten IP-Einstellungen zu beziehen.

○ IP-Adresse automatisch beziehen

● Folgende IP-Adresse verwenden:

IP-Adresse: . . .

Subnetzmaske: 255 . 255 . 255 . 0

Standardgateway: . . .

○ DNS-Serveradresse automatisch beziehen

● Folgende DNS-Serveradressen verwenden:

Bevorzugter DNS-Server: . . .

Alternativer DNS-Server: . . .

Figure 4-2 “Internet Protocol (TCP/IP) Properties” dialog box

Enter the desired IP address of your computer (not that of the SMN) in the “IP address” field and the corresponding subnet mask. Close the dialog box with “OK”.

The device can now be accessed via a web browser. In the address line of your browser, enter the IP address of the SMN in the following format:

http://xxx.xxx.xxx.xxx

After entering the IP address in the browser, an overview page is displayed for the SMN where no login is required.

After the correct user name and password have been entered, the device configuration pages are loaded.

4.2 Web-based management (WBM)

4.2.1 General function

Online diagnostics

The user-friendly web-based management interface can be used to manage the switch from anywhere in the network using a standard browser. Comprehensive configuration and diagnostic functions are clearly displayed on a graphical user interface. Every user with a network connection to the device has read access to that device via a browser. A wide range of information about the device itself, set parameters, and the operating state can be viewed.

Modifications can only be made by entering the valid password. By default upon delivery, the password is “private”.

For security reasons, we recommend changing the existing password to a new one known only to you.

4.2.2 Requirements for the use of WBM

As the web server operates using the Hyper Text Transfer Protocol, a standard browser can be used. Access is via the URL “http://IP address of the device”.
Example: http://172.16.29.112
For full operation of the web pages, the browser must support JavaScript 1.2 and Cascading Style Sheets Level 1. We recommend the use of Microsoft Internet Explorer 6.0.

WBM can only be called using a valid IP address. By default upon delivery, the switch has **no** valid IP address.

Settings are not automatically saved permanently. If the active configuration has not been saved, a flashing floppy disk icon appears in the top-right corner in WBM. The icon is linked to the “Configuration Management” web page. The active configuration can be saved permanently by selecting “Save current configuration” on this web page.

If the connection is interrupted during the transmission of web pages, a waiting time of several minutes is required before the web interface can be accessed again.

4.2.2.1 Structure of the web pages

The web pages are divided into four areas:

- Device type and device logo
- Device name (specified by the user) and loading time, to avoid mix-ups
- Navigation tree on the left-hand side
- Information tables on the right-hand side, which contain current device information during runtime.

4.2.2.2 Password concept

After having entered the valid password, no further entry of the password is necessary for a period of 300 s (default). After this period of time has elapsed or after clicking on “Logout”, the password must be re-entered.

The concept is valid for the first ten users logged in simultaneously. All other users must confirm each configuration modification by entering the password, until less than ten users are logged in.

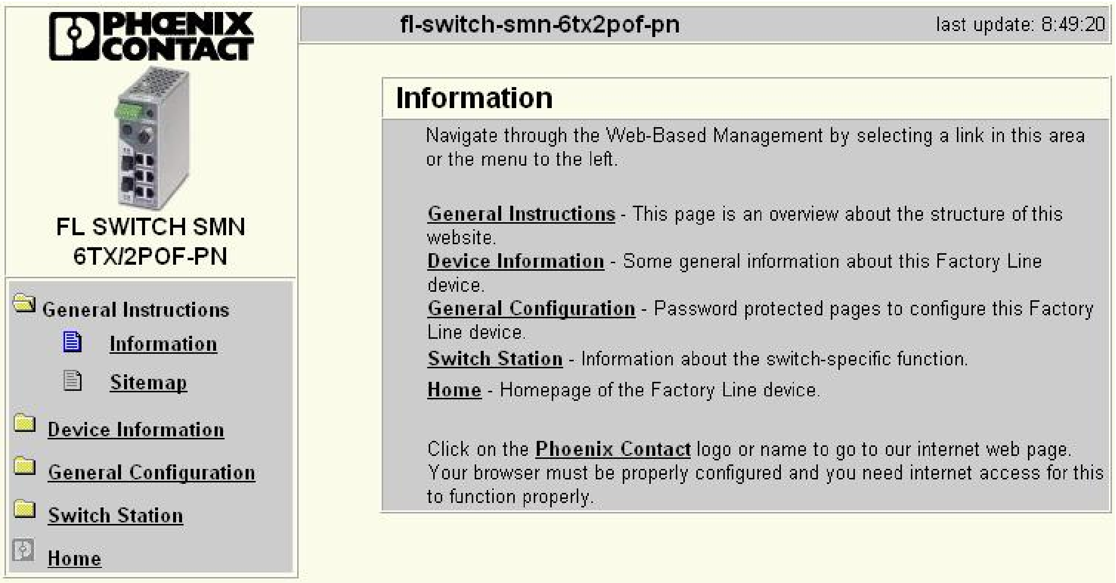
4.2.3 Functions/information in WBM

The navigation tree provides direct access to the following four areas:

- **General Instructions**
  Basic information about WBM.

- **Device Information**
  General device information.
- **General Configuration**
  Device configuration/device as a network device.
- **Switch Station**
  Device-specific configuration and diagnostics.

4.2.3.1 General instructions



Information

Navigate through the Web-Based Management by selecting a link in this area or the menu to the left.

General Instructions - This page is an overview about the structure of this website.
Device Information - Some general information about this Factory Line device.
General Configuration - Password protected pages to configure this Factory Line device.
Switch Station - Information about the switch-specific function.
Home - Homepage of the Factory Line device.

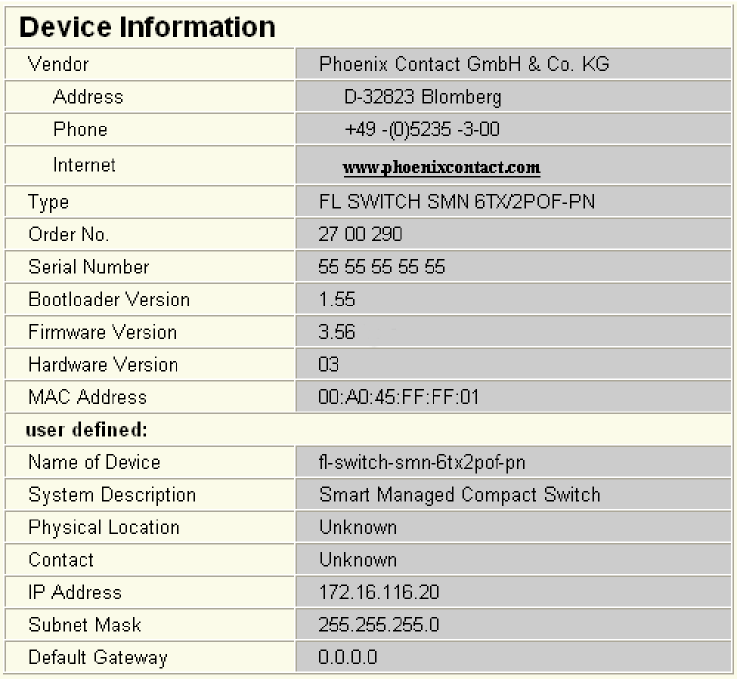
Click on the Phoenix Contact logo or name to go to our internet web page. Your browser must be properly configured and you need internet access for this to function properly.

Figure 4-3 “Information” web page for the SMN

General instructions

Contains a brief description of WBM and a navigation tree (site map), which is linked to every page of WBM.

4.2.3.2 Device information



Device Information

Vendor	Phoenix Contact GmbH & Co. KG
Address	D-32823 Blomberg
Phone	+49 -(0)5235 -3-00
Internet	www.phoenixcontact.com
Type	FL SWITCH SMN 6TX/2POF-PN
Order No.	27 00 290
Serial Number	55 55 55 55 55
Bootloader Version	1.55
Firmware Version	3.56
Hardware Version	03
MAC Address	00:A0:45:FF:FF:01
user defined:	
Name of Device	fl-switch-smn-6tx2pof-pn
System Description	Smart Managed Compact Switch
Physical Location	Unknown
Contact	Unknown
IP Address	172.16.116.20
Subnet Mask	255.255.255.0
Default Gateway	0.0.0.0

Figure 4-4 “Device Information” web page

“General” menu
Here, you will find a range of static information about the device and the manufacturer.

“Technical Data” menu
Here, you will find the most important technical data.

“Hardware Installation” menu
Here, you will find a connection diagram for connecting the redundant power supply and the signal contact.

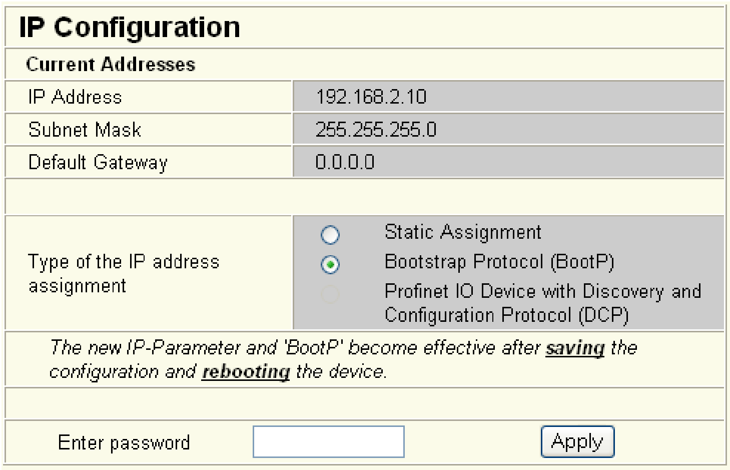
“Local Diagnostics” menu
Here, you will find a description of the meaning of the switchable diagnostics and status indicators.

“Serial Port” menu
Here, you will find the transmission parameters for serial communication.

4.2.3.3 General configuration

“IP Configuration” menu
This page displays the set IP parameters and addressing mechanism.

To change the IP parameters via WBM, “Static” must be selected.



IP Configuration

Current Addresses

IP Address	192.168.2.10
Subnet Mask	255.255.255.0
Default Gateway	0.0.0.0
Type of the IP address assignment	○ Static Assignment ● Bootstrap Protocol (BootP) ○ Profinet IO Device with Discovery and Configuration Protocol (DCP)

*The new IP-Parameter and 'BootP' become effective after **saving** the configuration and **rebooting** the device.*

Figure 4-5 “IP Configuration” web page

IP address assignment

“PROFINET” is activated by default upon delivery. The switch waits for startup by a PROFINET controller, which also assigns the IP addresses.

> While the switch waits for an IP address to be assigned (maximum of three BootP requests) the mode LED which has been selected via the mode button will also flash.

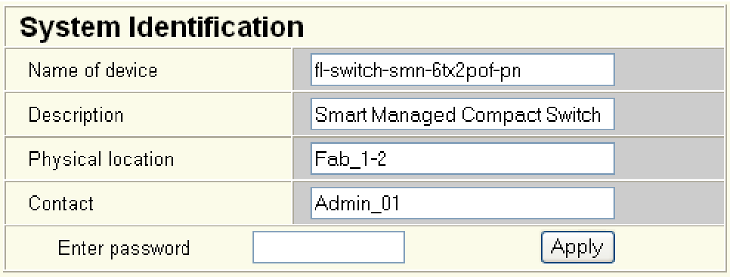
- Static Assignment
  The switch can be accessed using the set IP address and does not send any kind of requests for the receipt of IP parameters.

> Modifications to the IP parameters only take effect once the configuration is saved and a restart is then performed.

- Bootstrap Protocol (BootP)
  The switch sends a maximum of three BootP requests after every restart and receives a BootP reply with IP parameters. If there is no BootP reply, the switch starts after the third request without IP configuration.

“System Identification” menu

This menu is used to display or modify user-specific device data, e.g., location, device name or function. This device data is also available in SNMP.



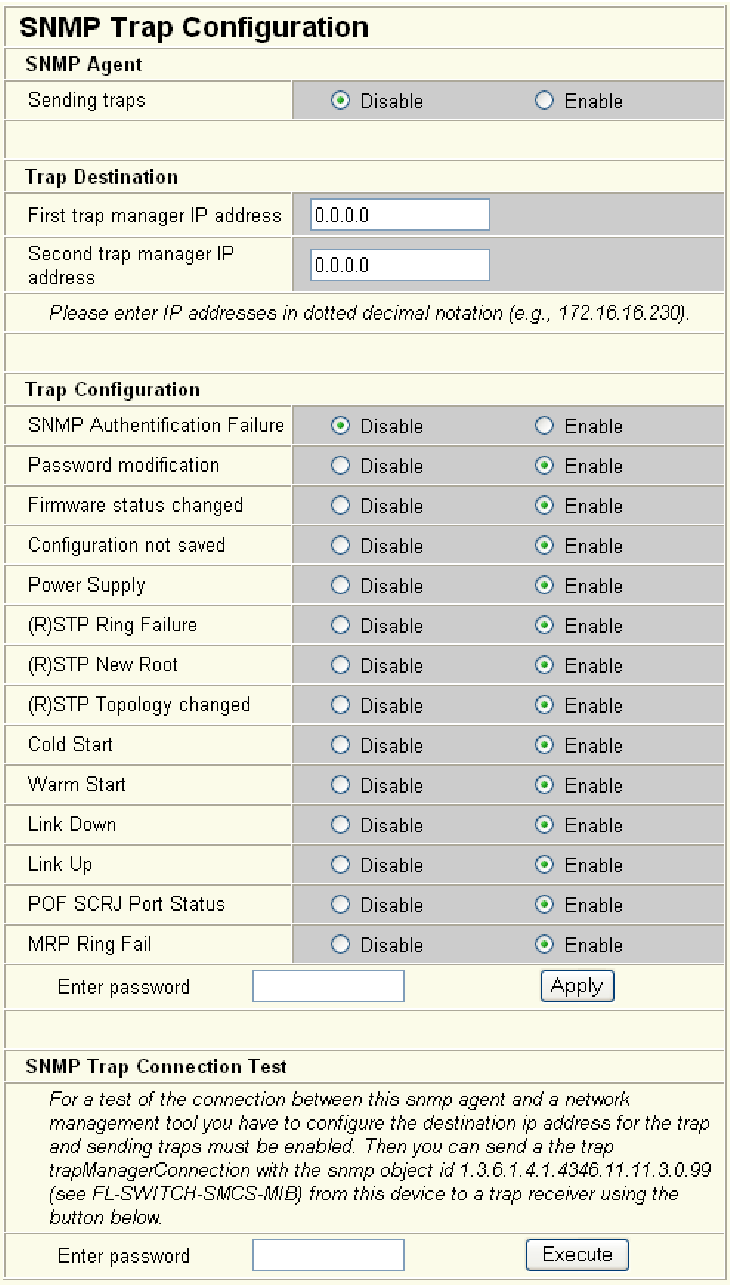
System Identification

Name of device	fl-switch-smn-6tx2pof-pn
Description	Smart Managed Compact Switch
Physical location	Fab_1-2
Contact	Admin_01

Figure 4-6 “System Identification” menu

“SNMP Trap Configuration” menu

SNMP agent The “Sending traps” function can be globally enabled/disabled here.



SNMP Trap Configuration

SNMP Agent		
Sending traps	● Disable	○ Enable

Trap Destination	
First trap manager IP address	0.0.0.0
Second trap manager IP address	0.0.0.0

Please enter IP addresses in dotted decimal notation (e.g., 172.16.16.230).

Trap Configuration		
SNMP Authentification Failure	● Disable	○ Enable
Password modification	○ Disable	● Enable
Firmware status changed	○ Disable	● Enable
Configuration not saved	○ Disable	● Enable
Power Supply	○ Disable	● Enable
(R)STP Ring Failure	○ Disable	● Enable
(R)STP New Root	○ Disable	● Enable
(R)STP Topology changed	○ Disable	● Enable
Cold Start	○ Disable	● Enable
Warm Start	○ Disable	● Enable
Link Down	○ Disable	● Enable
Link Up	○ Disable	● Enable
POF SCRJ Port Status	○ Disable	● Enable
MRP Ring Fail	○ Disable	● Enable
Enter password		Apply

SNMP Trap Connection Test

For a test of the connection between this snmp agent and a network management tool you have to configure the destination ip address for the trap and sending traps must be enabled. Then you can send a the trap trapManagerConnection with the snmp object id 1.3.6.1.4.1.4346.11.11.3.0.99 (see FL-SWITCH-SMCS-MIB) from this device to a trap receiver using the button below.

Enter password | Execute

Figure 4-7 “SNMP Trap Configuration” web page

Trap destination This part of the table is used to view or modify the IP addresses of the two trap receivers.

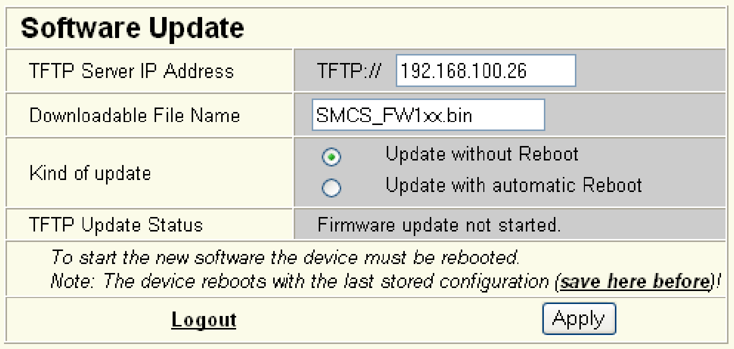
Trap configuration Sending of traps can be individually enabled/disabled here.

SNMP trap Connection test

Once the “Sending traps” function has been activated and the trap managers have been defined using the IP addresses, test traps can now be sent using “Execute” to test the communication path from the switch to the trap receiver.

“Software Update” menu

This page is used to view or modify the parameters for a software update and to trigger the update.



Software Update

TFTP Server IP Address	TFTP:// 192.168.100.26
Downloadable File Name	SMCS_FW1xx.bin
Kind of update	● Update without Reboot ○ Update with automatic Reboot
TFTP Update Status	Firmware update not started.

To start the new software the device must be rebooted.
*Note: The device reboots with the last stored configuration (**save here before**)!*

Figure 4-8 “Software Update” web page

A reset is not carried out **automatically** following a firmware update. The desired option can be selected in WBM.

Please make sure that the “TFTP Server” service program is activated in the Factory Manager toolbar.

You can monitor the download in the Factory Manager message window (25%, 50%, 75%, 100%). Always wait until all the LEDs light up after approximately two minutes and the device is available again after booting.

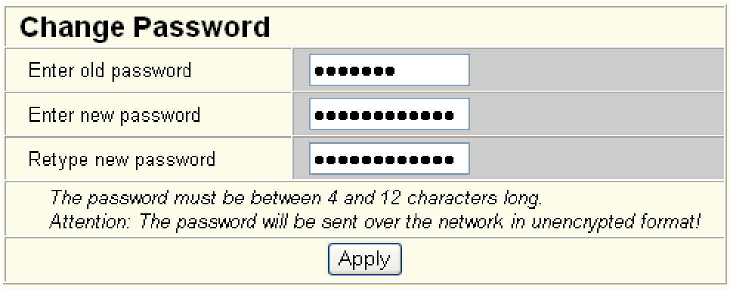
It is not ensured that all existing configuration data will be retained after a firmware update/downgrade. Therefore, please check the configuration settings or reset the device to the default delivery settings.

NOTE:

A voltage failure during a firmware update results in the destruction of the firmware on the SMN. An update via TFTP is required, see “Starting with faulty software (firmware)” on page 107.

"Change Password" menu

Here, you can enter the existing password and then change it to a new one known only to you. By default upon delivery, the password is "private" (please note that it is case-sensitive). For security reasons, the input fields do not display your password, but instead "*******" is displayed.



Change Password

Enter old password	•••••••
Enter new password	••••••••••••
Retype new password	••••••••••••

The password must be between 4 and 12 characters long.
Attention: The password will be sent over the network in unencrypted format!

Figure 4-9 "Change Password" web page

> The password must be between four and twelve characters long. Note that the password is always transferred via the network in unencrypted format.

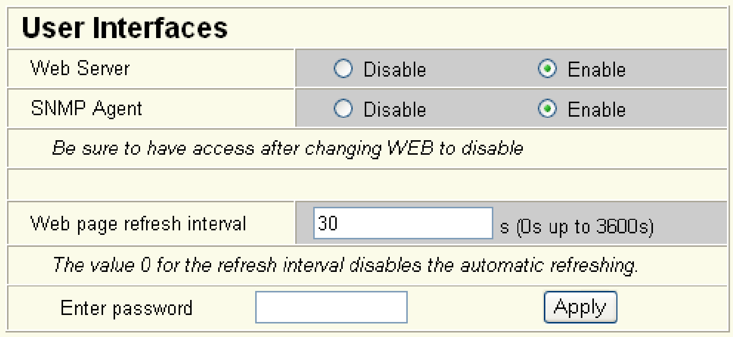
> Forgotten your password?
> Call the Phoenix Contact phone number listed in the Appendix, making sure you have the device serial number and MAC address to hand.

"User Interfaces" menu

The following actions can be performed here:

- Activating/deactivating the web server.
- Activating/deactivating the SNMP agent.
- Setting the refresh interval for the automatic updating of the web pages. Here, you can also set the refresh interval for automatic updating of different web pages. If the interval is set to "0", the pages will no longer be updated.

> Automatic updating of web pages is only possible when using Internet Explorer Version 5.5 or later.



User Interfaces

Web Server	○ Disable	● Enable
SNMP Agent	○ Disable	● Enable

Be sure to have access after changing WEB to disable

Web page refresh interval: 30 s (0s up to 3600s)

The value 0 for the refresh interval disables the automatic refreshing.

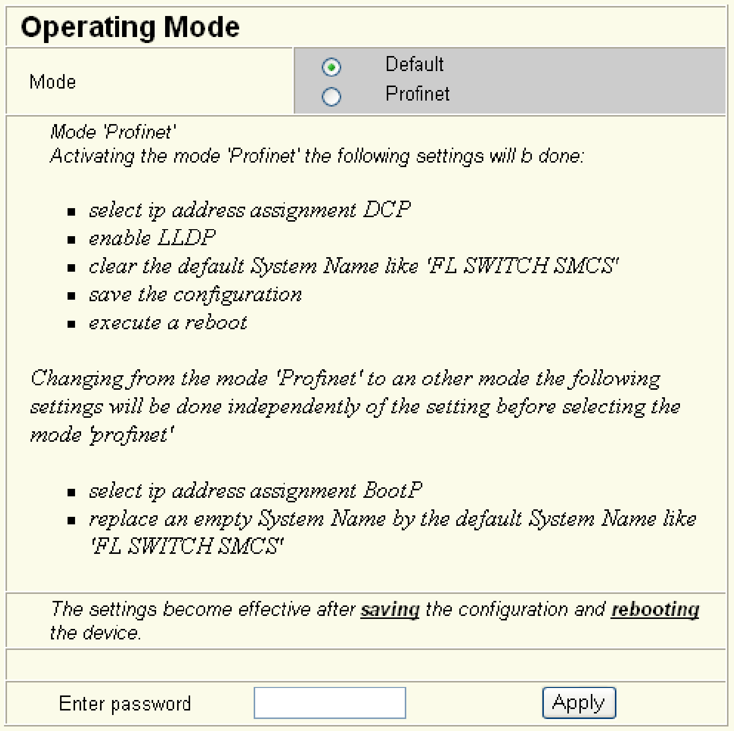
Enter password:

Figure 4-10 "User Interfaces" web page

“Operating Mode” menu

Operation as a PROFINET device

In this menu, select whether the switch is to operate as a PROFINET device. For additional information about operation as a PROFINET device, see Section 9 “Operation as a PROFINET device”.



Operating Mode

Mode ● Default ○ Profinet

Mode 'Profinet'
Activating the mode 'Profinet' the following settings will b done:

- *select ip address assignment DCP*
- *enable LLDP*
- *clear the default System Name like 'FL SWITCH SMCS'*
- *save the configuration*
- *execute a reboot*

Changing from the mode 'Profinet' to an other mode the following settings will be done independently of the setting before selecting the mode 'profinet'

- *select ip address assignment BootP*
- *replace an empty System Name by the default System Name like 'FL SWITCH SMCS'*

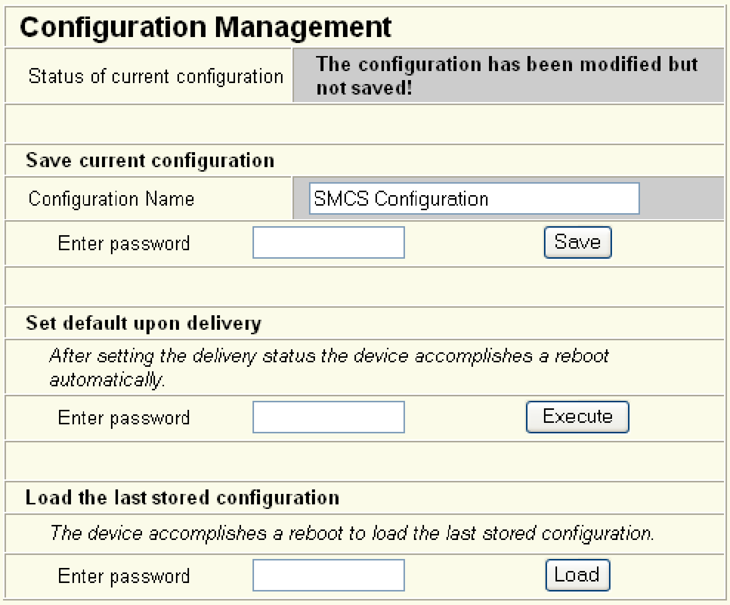
The settings become effective after ***saving*** *the configuration and* ***rebooting*** *the device.*

Enter password

Figure 4-11 “Operating Mode” web page

“Configuration Management, General” menu

This table is used to view all parameters that are required to save the active configuration or load a new configuration, and to modify them (by entering a valid password). It can also be used to restart the system with the relevant configuration or to reset the SMN to the default state upon delivery.



Configuration Management

Status of current configuration	The configuration has been modified but not saved!

Save current configuration

Configuration Name	SMCS Configuration	
Enter password		Save

Set default upon delivery

After setting the delivery status the device accomplishes a reboot automatically.

Enter password		Execute

Load the last stored configuration

The device accomplishes a reboot to load the last stored configuration.

Enter password		Load

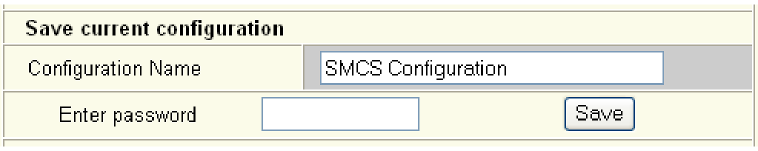
Figure 4-12 “Configuration Management” web page

Possible states for “Status of current configuration”:

- The configuration has been modified but not saved (also indicated by the flashing floppy disk icon).
- Saving the current configuration.
- The current configuration is equal to the saved one in the non-volatile memory of the switch.
- The current configuration was saved.

Save current configuration

The active configuration together with the corresponding configuration name can be saved here by entering a valid password.



Save current configuration

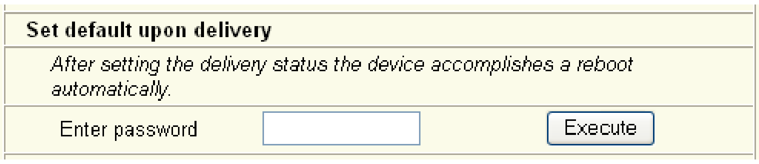
Configuration Name	SMCS Configuration	
Enter password		Save

Figure 4-13 “Save current configuration” web page

If the new configuration is not activated by a reset after a configuration download, the “Save current configuration” command overwrites the previously loaded configuration and instead saves the active configuration of the SMN.

Set default upon delivery

This option can be used to reset the switch to its default settings (default upon delivery) by entering a valid password.



Set default upon delivery

After setting the delivery status the device accomplishes a reboot automatically.

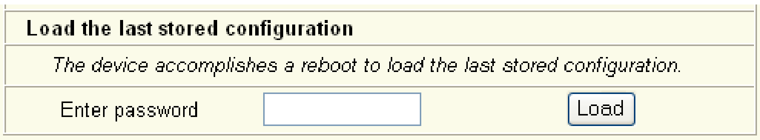
Enter password		Execute

Figure 4-14 “Set default upon delivery” web page

> WBM can only be called using a valid IP address. Once the switch has been reset to its default settings, it has **no** valid IP address and the addressing mechanism is set to BootP.

Load the last stored configuration

This option can be used to reactivate the last configuration stored on the device. All modifications made to the configuration since it was last saved are lost.



Load the last stored configuration

The device accomplishes a reboot to load the last stored configuration.

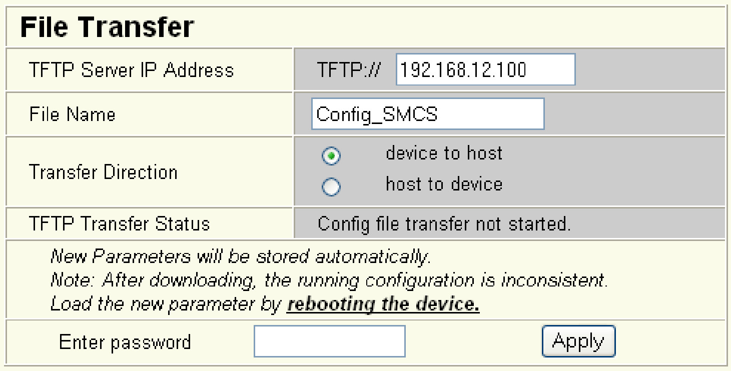
Enter password		Load

Figure 4-15 “Load the last stored configuration” web page

“Configuration Management, File Transfer” menu

Configuration file transfer

This option can be used to save your device configuration on a PC or to operate the switch using a stored configuration.



File Transfer

TFTP Server IP Address	TFTP:// 192.168.12.100
File Name	Config_SMCS
Transfer Direction	● device to host ○ host to device
TFTP Transfer Status	Config file transfer not started.

New Parameters will be stored automatically.
Note: After downloading, the running configuration is inconsistent.
Load the new parameter by ***rebooting the device.***

Enter password		Apply

Figure 4-16 “File Transfer” web page

> When a configuration is uploaded from the SMN to a PC, the last saved version is transmitted. Should you wish to transmit the active configuration, it is recommended that you save it again beforehand (“Save current configuration” function).

> When a configuration is downloaded from the PC to a SMN, the new configuration is only activated once the switch has been reset.

> The use of a configuration file does not affect an existing (“old”) password.

Following a “host to device” file transfer, some configuration modifications will take effect immediately, others will only take effect after a reset.
The SMN must be reset in order to ensure consistency.

Device replacement

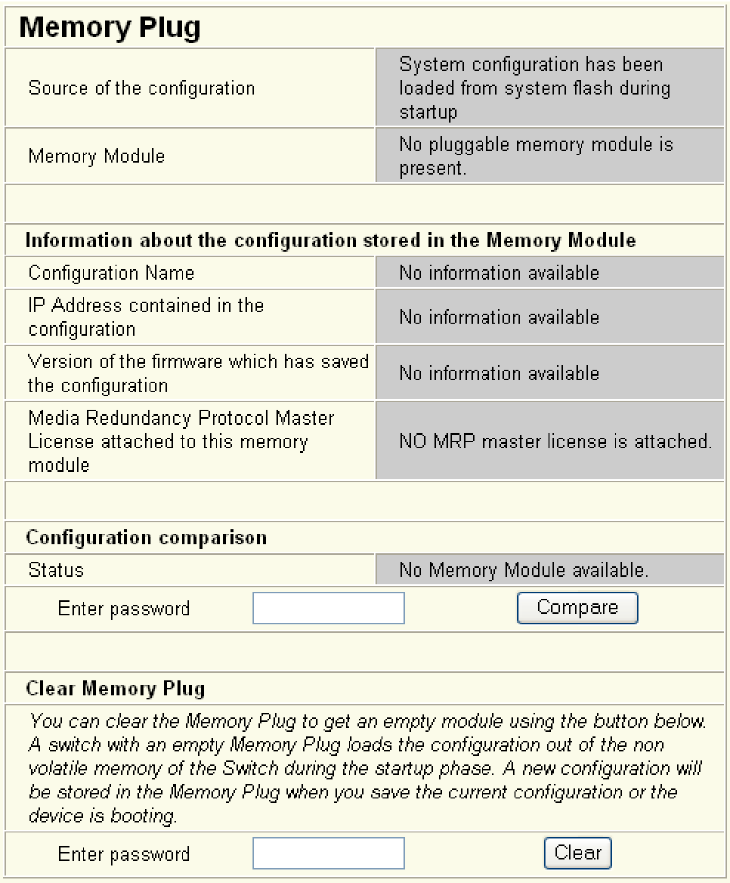
Configuration using a configuration file is used when replacing devices. To duplicate devices using a configuration file, observe the following:

- Create a point-to-point connection between an SMN and the management station.
- Load the configuration file on the SMN.
- Reset the SMN.
- Adjust the IP parameters.
- Save the configuration (“Save current configuration” function).

The duplicated switch can now be operated in the network using the adjusted IP parameters.

“Configuration Management, Memory Plug” menu

Memory plug



Memory Plug

Source of the configuration	System configuration has been loaded from system flash during startup
Memory Module	No pluggable memory module is present.

Information about the configuration stored in the Memory Module

Configuration Name	No information available
IP Address contained in the configuration	No information available
Version of the firmware which has saved the configuration	No information available
Media Redundancy Protocol Master License attached to this memory module	NO MRP master license is attached.

Configuration comparison

Status	No Memory Module available.

Enter password

Clear Memory Plug

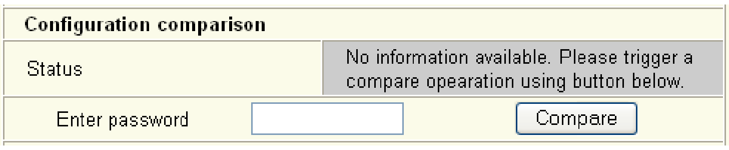
You can clear the Memory Plug to get an empty module using the button below. A switch with an empty Memory Plug loads the configuration out of the non volatile memory of the Switch during the startup phase. A new configuration will be stored in the Memory Plug when you save the current configuration or the device is booting.

Enter password

Figure 4-17 “Memory Plug” web page

Configuration comparison

Here you can compare the configuration on the memory plug with the configuration in the SMN memory. The result is displayed in text format.



Configuration comparison

Status: No information available. Please trigger a compare opearation using button below.

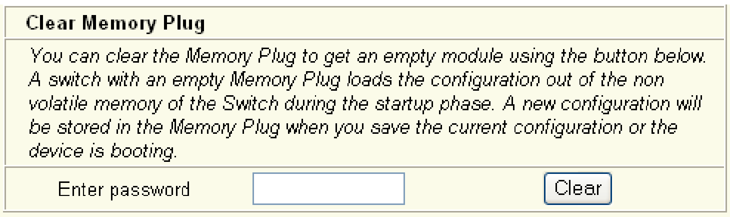
Enter password

Figure 4-18 “Configuration comparison” web page

If you replace a memory plug with another memory plug within a few seconds, the configuration comparison must be updated manually.

Clear memory plug

Here, you can delete the memory plug by entering a valid password.



Clear Memory Plug

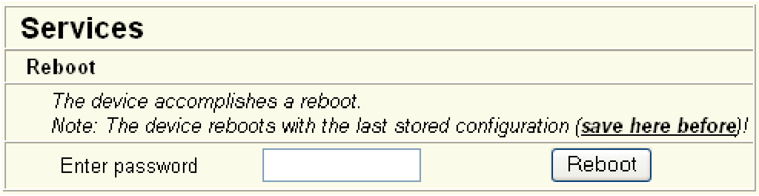
You can clear the Memory Plug to get an empty module using the button below. A switch with an empty Memory Plug loads the configuration out of the non volatile memory of the Switch during the startup phase. A new configuration will be stored in the Memory Plug when you save the current configuration or the device is booting.

Enter password

Figure 4-19 “Clear Memory Plug” web page

4.2.3.4 Switch station

“Services” menu



Services

Reboot

The device accomplishes a reboot.
*Note: The device reboots with the last stored configuration (**save here before**)!*

Enter password

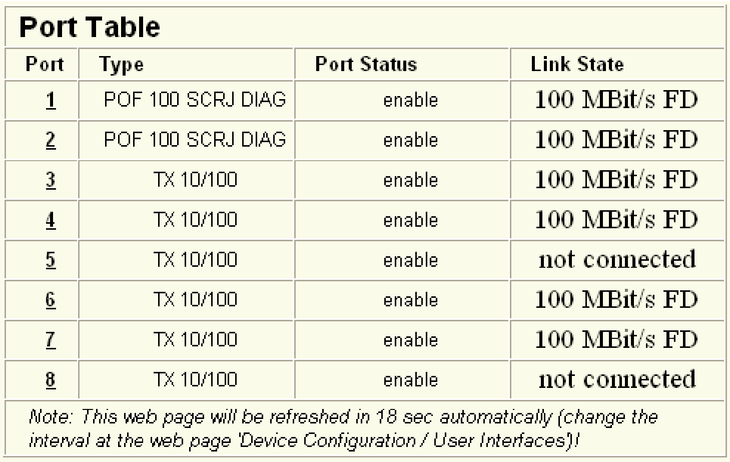
Figure 4-20 “File Transfer” web page

Reboot

To trigger a reboot via the web interface, enter a valid password. Save the configuration beforehand, so that configuration modifications are retained or can be activated via a restart.

“Ports, Port Table” menu

Overview of all available ports. Clicking on the relevant port number opens a port-specific page (“Port Configuration”).



Port Table

Port	Type	Port Status	Link State
1	POF 100 SCRJ DIAG	enable	100 MBit/s FD
2	POF 100 SCRJ DIAG	enable	100 MBit/s FD
3	TX 10/100	enable	100 MBit/s FD
4	TX 10/100	enable	100 MBit/s FD
5	TX 10/100	enable	not connected
6	TX 10/100	enable	100 MBit/s FD
7	TX 10/100	enable	100 MBit/s FD
8	TX 10/100	enable	not connected

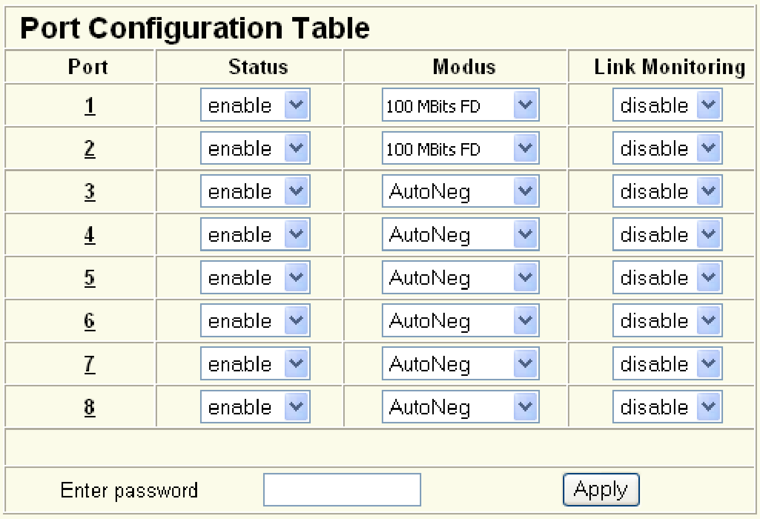
Note: This web page will be refreshed in 18 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 4-21 “Port Table” web page

When setting the transmission mode, make sure that the same settings have been made at both ends of the connection. If the settings are not the same, this can result in increased collisions or CRC errors and can adversely affect network performance.

“Ports, Port Configuration Table” menu

This menu provides an overview of the important configuration settings for all ports and also offers the option of setting the status, transmission mode, and link monitoring function for all existing ports.



Port Configuration Table

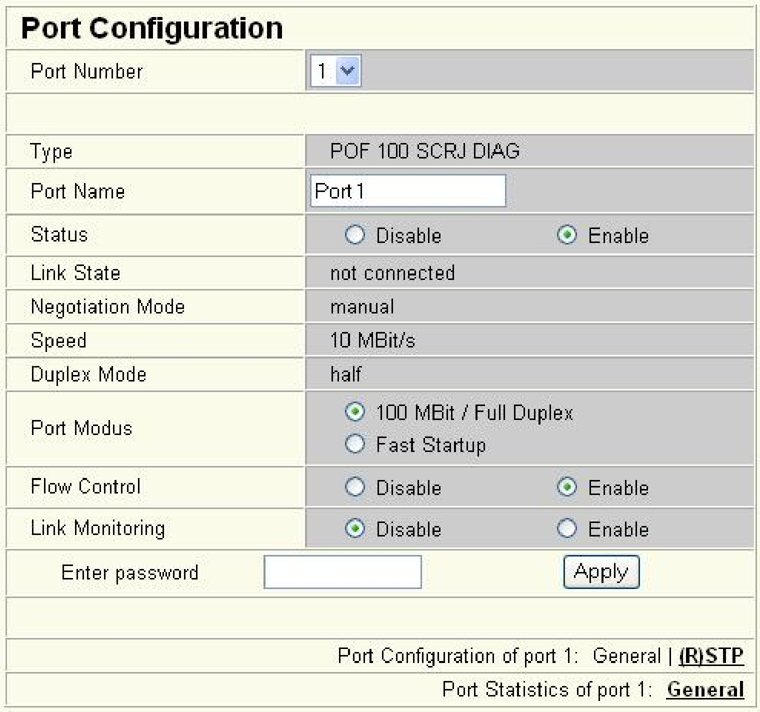
Port	Status	Modus	Link Monitoring
1	enable	100 MBits FD	disable
2	enable	100 MBits FD	disable
3	enable	AutoNeg	disable
4	enable	AutoNeg	disable
5	enable	AutoNeg	disable
6	enable	AutoNeg	disable
7	enable	AutoNeg	disable
8	enable	AutoNeg	disable

Enter password

Figure 4-22 “Port Configuration Table” web page

“Ports, Port Configuration” menu

Offers individual configuration options for each port.



Port Configuration

Port Number	1	
Type	POF 100 SCRJ DIAG	
Port Name	Port 1	
Status	○ Disable	● Enable
Link State	not connected	
Negotiation Mode	manual	
Speed	10 MBit/s	
Duplex Mode	half	
Port Modus	● 100 MBit / Full Duplex ○ Fast Startup	
Flow Control	○ Disable	● Enable
Link Monitoring	● Disable	○ Enable
Enter password		Apply

Port Configuration of port 1: General | (R)STP

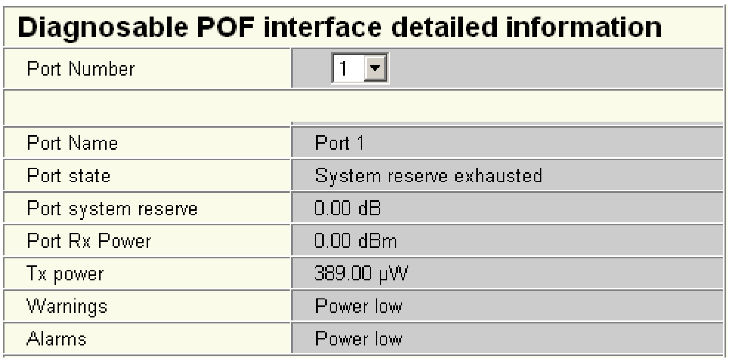
Port Statistics of port 1: General

Figure 4-23 “Port Configuration” web page

4.2.3.5 Using POF diagnostics

The following states can be displayed under “Transceiver status”:

- “POF-SCRJ Interface is OK” (The system reserve is greater than 2 dB and is displayed under “RX system reserve”.)
- “POF-SCRJ Interface the system reserve is low” (The system reserve is less than 2 dB, but greater than 0 dB.)
- “POF-SCRJ Interface the system reserve is exhausted” (No system reserve available - the received optical power is below the required minimum value.)



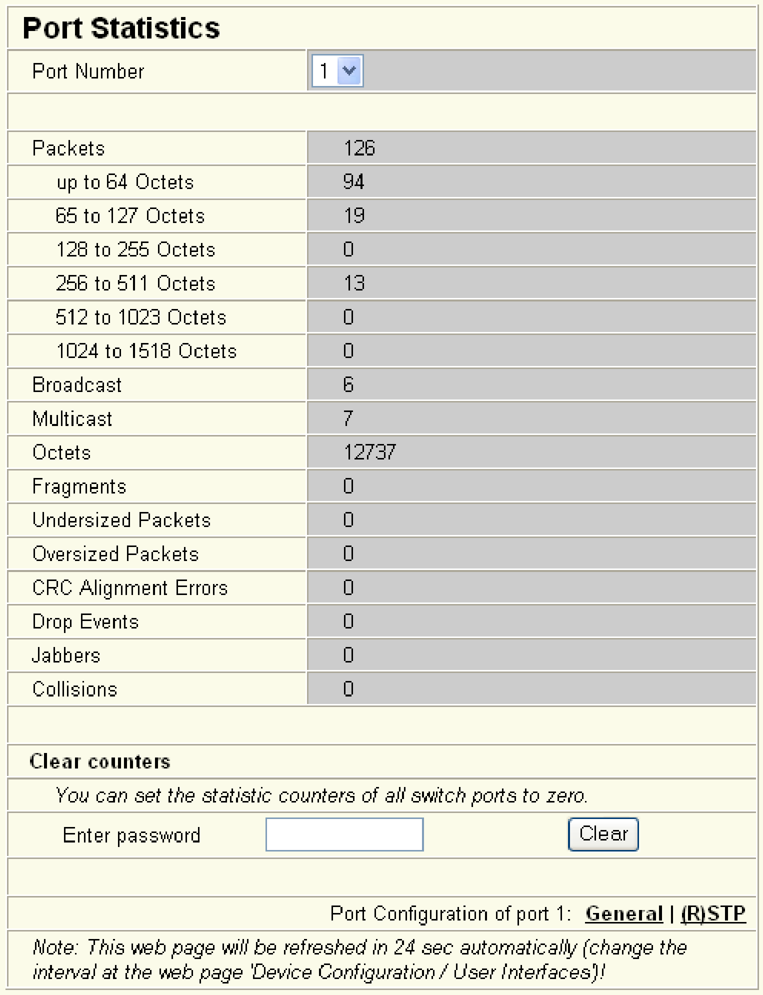
Diagnosable POF interface detailed information

Port Number	1
Port Name	Port 1
Port state	System reserve exhausted
Port system reserve	0.00 dB
Port Rx Power	0.00 dBm
Tx power	389.00 µW
Warnings	Power low
Alarms	Power low

Figure 4-24 “Diagnostics” web page

"Ports, Port Statistics" menu

This menu provides detailed statistical information about the volume of data for each individual port. On this page, additional counter states can be set to zero for all ports.



Port Statistics

Port Number	1
Packets	126
up to 64 Octets	94
65 to 127 Octets	19
128 to 255 Octets	0
256 to 511 Octets	13
512 to 1023 Octets	0
1024 to 1518 Octets	0
Broadcast	6
Multicast	7
Octets	12737
Fragments	0
Undersized Packets	0
Oversized Packets	0
CRC Alignment Errors	0
Drop Events	0
Jabbers	0
Collisions	0

Clear counters

You can set the statistic counters of all switch ports to zero.

Enter password

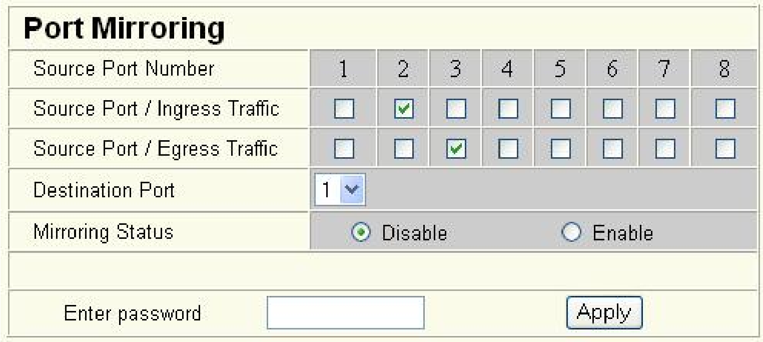
Port Configuration of port 1: **General** | **(R)STP**

Note: This web page will be refreshed in 24 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 4-25 "Port Statistics" web page

"Ports, Port Mirroring" menu

Activation/deactivation and setting of port mirroring. Port mirroring is used to passively read input or output data that is being transmitted via a selected port. To do this, a measuring instrument (PC) is connected to the destination port, which records the data, yet must not itself be activated.



Port Mirroring

Source Port Number	1	2	3	4	5	6	7	8
Source Port / Ingress Traffic	□	☑	□	□	□	□	□	□
Source Port / Egress Traffic	□	□	☑	□	□	□	□	□
Destination Port	1							
Mirroring Status	● Disable				○ Enable			

Enter password [ ] Apply

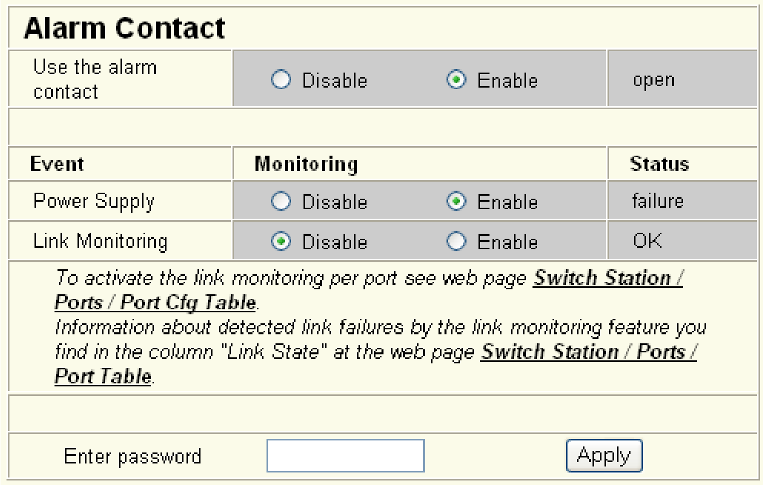
Figure 4-26 "Port Mirroring" web page

WBM prevents the same ports from being set, i.e., the source port and destination port must differ.

The port capacity is calculated according to the set transmission parameters. Example: A source port is operated at 100 Mbps and reaches a capacity of 5%. The destination port is operated at 10 Mbps. Therefore, with the same volume of data, the destination port reaches a capacity of 50%.

"Diagnostics, Alarm Contact" Menu

Here, you can set whether and for which events the signal contact (alarm contact) is used.



Alarm Contact

Use the alarm contact	○ Disable	● Enable	open
Event	**Monitoring**		**Status**
Power Supply	○ Disable	● Enable	failure
Link Monitoring	● Disable	○ Enable	OK

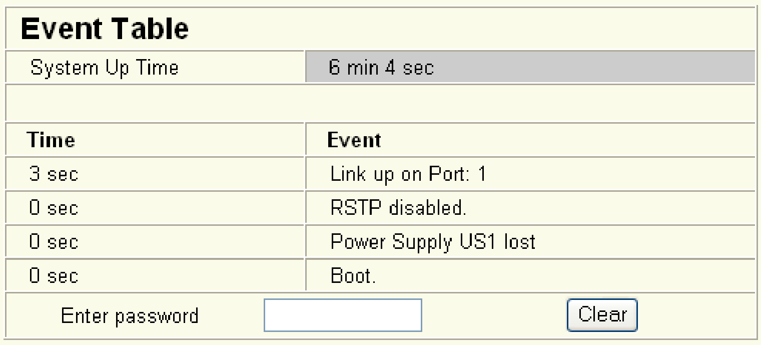
To activate the link monitoring per port see web page Switch Station / Ports / Port Cfg Table.
Information about detected link failures by the link monitoring feature you find in the column "Link State" at the web page Switch Station / Ports / Port Table.

Enter password [ ] Apply

Figure 4-27 "Alarm Contact" web page

“Diagnostics, Event Table” menu

Here, you will find a list of the latest important events. The list contains up to 200 entries. From the 200th entry onwards the oldest entries are overwritten (FIFO principle - first in, first out). If old entries are overwritten by new entries, a corresponding note is displayed under the event table.



Event Table

System Up Time	6 min 4 sec

Time	Event
3 sec	Link up on Port: 1
0 sec	RSTP disabled.
0 sec	Power Supply US1 lost
0 sec	Boot.

Figure 4-28 “Event Table” web page

The “Clear” button can be used to delete entries in the event table.

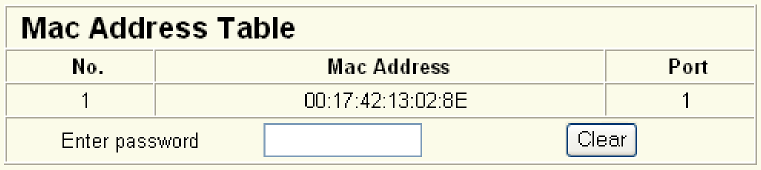
The following events are listed in the event table:

- Event Table cleared.
- Password has been changed.
- Password has not been changed successfully.
- Configuration has been saved.
- The configuration has been modified the first time after the last storing.
- Configuration File Transfer successfully executed.
- Configuration File Transfer was not successfully executed.
- Firmware Update was successfully executed.
- Firmware Update was not successfully executed.
- Link up at port xy.
- Link down at port xy.
- Enabling port xy.
- Disabling port xy.
- RSTP enabled.
- RSTP disabled.
- RSTP topology changed.
- RSTP elected this switch as new root.
- Power Supply US1 lost.
- Power Supply US2 lost.
- Power Supply US1 and US2 are connected now.
- LLDP Agent enabled.
- LLDP Agent disabled.
- LLDP recognized new neighbor at port xy.
- LLDP neighborhood information become obsolete at port xy.
- LLDP neighborhood information changed at port xy.
- MRP Client enabled/MRP disable.

- MRP Manager detects a loop failure enabled/MRP disable.
- MRP Ring failure detected/MRP Ring closed (OK).
- MRP Manager detects a closed loop.

“Diagnostics, Mac Address Table” menu

Here, you will find a list of which MAC address has been detected at which switch port, and its VLAN ID. If no packets are received at a port for a duration longer than the aging time, the entry is deleted.



Mac Address Table

No.	Mac Address	Port
1	00:17:42:13:02:8E	1

Enter password [ ] Clear

Figure 4-29 “Mac Address Table” web page

The “Clear” button can be used to delete entries in the MAC address table.

“LLDP General” menu

For information about LLDP, please refer to Section “Link Layer Discovery Protocol (LLDP)” on page 163.

4.2.3.6 (Rapid) Spanning Tree

The Rapid/Spanning Tree Protocol (RSTP) is a standardized method (IEEE 802.1w/IEEE 802.1d). For information, please refer to Section 5 “(Rapid) Spanning Tree”.

4.2.3.7 Media Redundancy Protocol

The Media Redundancy Protocol is part of PROFINET standard IEC 61158 and is described in Section 6 “Media Redundancy Protocol (MRP)”.

“Broadcast Limiter” menu

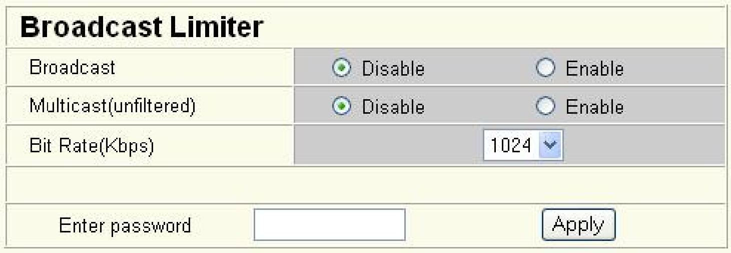
The “Broadcast Limiter” function can be used to limit broadcast and multicast traffic to an adjustable level in order to prevent a loss in performance on termination devices.

If the configurable bandwidth limit is reached, further broadcast or multicast packets are rejected. The set bandwidth applies for the incoming data traffic of each individual port.

The following configuration options are provided via WEB and SNMP:

- Activation/deactivation of broadcast traffic limiting on all ports
- Activation/deactivation of multicast traffic limiting on all ports

The bandwidth is selected from a drop-down list and is specified in kbps or Mbps.



Broadcast Limiter

Broadcast	● Disable	○ Enable
Multicast(unfiltered)	● Disable	○ Enable
Bit Rate(Kbps)	1024	

Enter password [ ] Apply

Figure 4-30 “Broadcast Limiter” menu

4.3 Simple Network Management Protocol (SNMP)

4.3.1 General function

SNMP is a manufacturer-independent standard for Ethernet management. It defines commands for reading and writing information, and defines formats for error and status messages. SNMP is also a structured model that consists of agents, their relevant Management Information Base (MIB) and a manager. The manager is a software tool that is executed on a network management station. The agents are located inside switches, BK modules, routers, and other devices that support SNMP. The task of the agents is to collect and provide data in the MIB. The manager regularly requests and displays this information. The devices can be configured by writing data from the manager to the MIB. In the event of an emergency, the agents can also send messages (traps) directly to the manager.

All configuration modifications, which are to take effect after a SMN restart, must be saved permanently using the “flWorkFWCtrlConfSave” object.

4.3.2 Schematic view of SNMP management

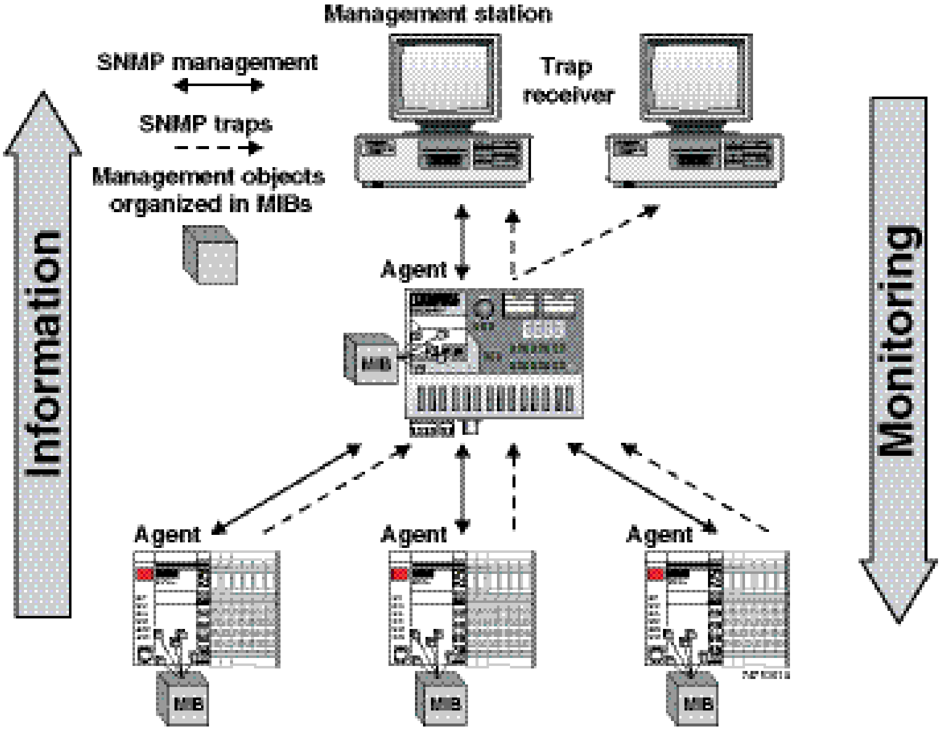


Figure 4-31 Schematic view of SNMP

SNMP interface

All managed Factoryline components have an SNMP agent. This agent of an FL SWITCH SMN manages Management Information Base II (MIB 2) according to RFC 1213, RMON MIB, Bridge MIB, If MIB, Etherlike MIB, Iana-address-family MIB, IANAifType MIB, SNMPv2 MIB, SNMP-FRAMEWORK MIB, P Bridge MIB, Q Bridge MIB, RSTP MIB, LLDP MIB, and private SNMP objects from Phoenix Contact (FL-SWITCH-M MIB).

Network management stations, such as a PC with Factory Manager, can read and modify configuration and diagnostic data from network devices via the Simple Network Management Protocol. In addition, any SNMP tools or network management tools can be used to access Factoryline products via SNMP. To do this, the MIBs supported by the relevant device must be made available to the SNMP management tools.

On the one hand, these are globally valid MIBs, which are specified and described in RFCs (Request for Comments). This includes, for example, MIB2 according to RFC1213, which is supported by all SNMP-compatible network devices. On the other hand, manufacturers can specify their own SNMP objects, which are then assigned to a private manufacturer area in the large SNMP object tree. Manufacturers are then responsible for their own private (enterprise) areas, i.e., they must ensure that only one object is assigned to an object ID (object name and parameters) and can be published. If an object is no longer needed, it can be labeled as “expired”, but it cannot be reused with other parameters under any circumstances.

Phoenix Contact provides notification of ASN1 SNMP objects by publishing their descriptions on the Internet.

Reading SNMP objects is not password-protected. However, a password is required for read access in SNMP, but this is set to “public”, which is usual for network devices, and cannot be modified. By default upon delivery, the password for write access is “private” and can be changed by the user.

SNMP, the web interface, and the serial terminal all use the same password, which can be changed by the user.

Another benefit for the user is the option of sending traps using the Simple Network Management Protocol.

Management Information Base (MIB)

Database which contains all the data (objects and variables) required for network management.

Agent

An agent is a software tool which collects data from the network device on which it is installed and transmits this data on request. Agents reside in all managed network components and transmit the values of specific settings and parameters to the management station. On a request of a manager or on the occurrence of a specific event, the agent transmits the collected information to the management station.

Traps

Traps are spontaneous SNMP alarm or information messages that are sent by an SNMP-compatible device when specific events occur. Traps are transmitted with maximum priority to various addresses, if required, and can then be displayed by the management station in plain text. The IP addresses that are to receive these traps (trap targets/receivers) must be set by the user on the relevant device.

trapPasswd

OID 1.3.6.1.4.1.4346.11.11.3.0.1

Description Sent to the defined trap receivers on each modification or attempted modification of the device password and contains information about the status of the last modification or attempted modification.

trapFWHealth

OID 1.3.6.1.4.1.4346.11.11.3.0.2

Description Sent on each firmware-related modification and contains additional information about the firmware status.

trapFWConf

OID 1.3.6.1.4.1.4346.11.11.3.0.3

Description Sent each time the configuration is saved and informs the management station that the configuration has been saved successfully.
This trap is sent in the event of configuration modifications (port name, port mode, device name, IP address, trap receiver address, port mirroring, etc.), which are not yet saved permanently. The trap also provides a warning that, if not saved permanently, the changes will be lost on a reset.

trapPowerSupply

OID 1.3.6.1.4.1.4346.11.11.3.0.4

Description Sent each time the redundant power supply fails.

trapRstpRingFailure

OID 1.3.6.1.4.1.4346.11.11.3.0.6

Description Sent in the event of a link interrupt in the redundant RSTP ring.

trapManagerConnection

OID 1.3.6.1.4.1.4346.11.11.3.0.99

Description Trap to test the connection between the SNMP agent and the network management station.

4.3.2.1 Tree structure of the MIB

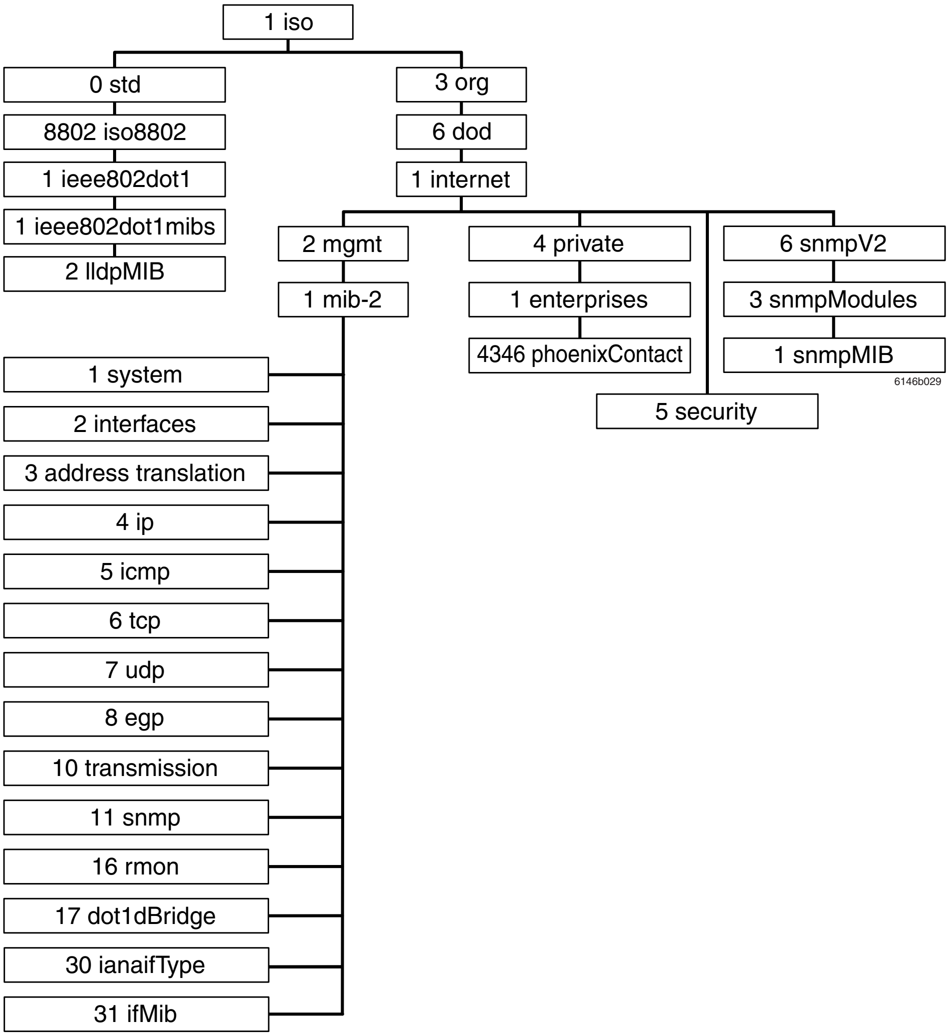


Figure 4-32 Tree structure of the MIB

Not all devices support all object classes. If an unsupported object class is requested, "not supported" is generated. If an attempt is made to modify an unsupported object class, the message "badValue" is generated.

4.3.3 RFC 1213 MIB - MIB II

4.3.3.1 System group (1.3.6.1.2.1.1)

The system group has mandatory characters for all systems. It contains system-specific objects. If an agent does not have a value for a variable, the response is a string with length 0.

(1) system
- (1) sysDescr
- (2) sysObjectID
- (3) sysUpTime
- (4) sysContact
- (5) sysName
- (6) sysLocation
- (7) sysServices
- (8) sysORLastChange
- (9) sysORTable

sysDescr

OID	1.3.6.1.2.1.1.1.0
Syntax	Octet string (size: 0 - 255)
Access	Read
Description	A textual description of the entry. The value should contain the full name and version number of: - Type of system hardware - Operation system software - Network software The description may only consist of ASCII characters that can be printed.

sysObjectID

OID	1.3.6.1.2.1.1.2.0
Syntax	Object identifier
Access	Read
Description	The authorization identification for the manufacturer of the network management subsystem, which is integrated in this device. This value is located in the SMI enterprises subtree (1.3.6.1.4.1) and describes which type of device is being managed. For example, if the manufacturer "Phoenix Contact GmbH" is assigned subtree 1.3.6.1.4.1.4346, it can then assign its bridge the identifier 1.3.6.1.4.1.4346.2.1.

sysUpTime

OID	1.3.6.1.2.1.1.3.0
Syntax	TimeTicks
Access	Read
Description	The time in hundredths of seconds since the last network management unit reset.

sysContact

OID	1.3.6.1.2.1.1.4.0
Syntax	Octet string (size: 0 - 255)
Access	Read and write
Description	The textual identification of the contact person for these managed nodes and information on how this person can be contacted.

sysName

OID	1.3.6.1.2.1.1.5.0
Syntax	Octet string (size: 0 - 255)
Access	Read and write
Description	A name for this node assigned by the administrator. According to the agreement, this is the fully qualifying name in the domain.

sysLocation

OID	1.3.6.1.2.1.1.6.0
Syntax	Octet string (size: 0 - 255)
Access	Read and write
Description	The physical location of this node (e.g., “Hall 1, 3rd floor”).

sysServices

OID	1.3.6.1.2.1.1.7.0
Syntax	Integer (0 - 127)
Access	Read
Description	Indicates a number of services that this device offers. The value is the sum of several calculations. For every layer of the OSI reference model, there is a calculation in the form of (2^{L-1}), where L indicates the layer. For example: A node which primarily executes line routing functions has the value (2^{3-1}) = 4. A node which is a host and provides application services has the value (2^{4-1}) + (2^{7-1}) = 72.

sysORLastChange

OID	1.3.6.1.2.1.1.8
Syntax	TimeTicks
Access	Read
Description	Indicates the value of the sysUpTime during the last system modification.

sysORTable

OID	1.3.6.1.2.1.1.9
Syntax	TimeTicks
Access	Read
Description	The table contains the following objects: sysORIndex, sysORID, sysORDescr, and sysORUpTime.

4.3.3.2 Interface group (1.3.6.1.2.1.2)

The interface group contains information about device interfaces.

```
(2) interfaces
    -- (1) ifNumber
    -- (2) ifTable
    -- (1) if Entry
            -- (1) ifIndex
            -- (2) ifDescr
            -- (3) ifType
            -- (4) ifMtu
            -- (5) ifSpeed
            -- (6) ifPhysAddress
            -- (7) ifAdminStatus
            -- (8) ifOperStatus
            -- (9) ifLastChange
            -- (10) ifInOctets
            -- (11) ifInUcastPkts
            -- (12) ifInNUcastPkts
            -- (13) ifInDiscards
            -- (14) ifInErrors
            -- (15) ifInUnknownProtos
            -- (16) ifOutOctets
            -- (17) ifOutUcastPkts
            -- (18) ifOutNUcastPkts
            -- (19) ifOutDiscards
            -- (20) ifOutErrors
            -- (21) ifOutQLen
            -- (22) ifSpecific
```

4.3.3.3 Address translation group (1.3.6.1.2.1.3)

The address translation group has mandatory characters for all systems. It contains information about the address assignment.

```
(3) at
    -- (1) atTable
    -- (1) atEntry
            -- (1) atIfIndex
            -- (2) atPhysAddress
            -- (3) atNetAddress
```

4.3.3.4 Internet protocol group (1.3.6.1.2.1.4)

The Internet protocol group has mandatory characters for all systems. It contains information concerning IP switching.

```
(4) ip
    -- (1) ipForwarding
    -- (2) ipDefaultTTL
    -- (3) ipInReceives
    -- (4) ipInHdrErrors
    -- (5) ipInAddrErrors
    -- (6) ipForwDatagrams
    -- (7) ipInUnknownProtos
    -- (8) ipInDiscards
    -- (9) ipInDelivers
    -- (10) ipOutRequests
    -- (11) ipOutDiscards
    -- (12) ipOutNoRoutes
    -- (13) ipReasmTimeout
    -- (14) ipReasmReqds
    -- (15) ipReasmOKs
    -- (16) ipReasmFails
    -- (17) ipFragOKs
    -- (18) ipFragFails
    -- (19) ipFragCreates
    -- (20) ipAddrTable
    -- (1) ipAddrEntry
            -- (1) ipAdEntAddr
            -- (2) ipAdEntIfIndex
            -- (3) ipAdEntNetMask
            -- (4) ipAdEntBcastAddr
            -- (5) ipAdEntReasmMaxSize
    -- (21) ipRouteTable
    -- (1) ipRouteEntry
            -- (1) ipRouteDest
            -- (2) ipRouteIfIndex
            -- (3) ipRouteMetric1
            -- (4) ipRouteMetric2
            -- (5) ipRouteMetric3
            -- (6) ipRouteMetric4
            -- (7) ipRouteNextHop
            -- (8) ipRouteType
            -- (9) ipRouteProto
            -- (10) ipRouteAge
            -- (11) ipRouteMask
            -- (12) ipRouteMetric5
            -- (13) ipRouteInfo
    -- (22) ipNetToMediaTable
    -- (1) ipNetToMediaEntry
```

```
                    -- (1) ipNetToMediaIfIndex
                    -- (2) ipNetToMediaPhysAddress
                    -- (3) ipNetToMediaNetAddress
                    -- (4) ipNetToMediaType
          -- (23) ipRoutingDiscards
```

4.3.3.5 ICMP group (1.3.6.1.2.1.5)

The Internet Control Message Protocol group has mandatory characters for all systems. It contains information about troubleshooting and control in Internet data traffic.

```
(5) icmp
     -- (1) icmpInMsgs
     -- (2) icmpInErrors
     -- (3) icmpInDestUnreachs
     -- (4) icmpInTimeExcds
     -- (5) icmpInParmProbs
     -- (6) icmpInSrcQuenchs
     -- (7) icmpInRedirects
     -- (8) icmpInEchos
     -- (9) icmpInEchoReps
     -- (10) icmpInTimestamps
     -- (11) icmpInTimestampReps
     -- (12) icmpInAddrMasks
     -- (13) icmpInAddrMaskReps
     -- (14) icmpOutMsgs
     -- (15) icmpOutErrors
     -- (16) icmpOutDestUnreachs
     -- (17) icmpOutTimeExcds
     -- (18) icmpOutParmProbs
     -- (19) icmpOutSrcQuenchs
     -- (20) icmpOutRedirects
     -- (21) icmpOutEchos
     -- (22) icmpOutEchoReps
     -- (23) icmpOutTimestamps
     -- (24) icmpOutTimestampReps
     -- (25) icmpOutAddrMasks
     -- (26) icmpOutAddrMaskReps
```

4.3.3.6 Transfer Control Protocol group (1.3.6.1.2.1.6)

The Transfer Control Protocol group has mandatory characters for all systems that implement TCP. Instances of objects, which provide information about a specific TCP connection, are valid as long as the connection is established.

```
(6) tcp
    -- (1) tcpRtoAlgorithm
    -- (2) tcpRtoMin
    -- (3) tcpRtoMax
    -- (4) tcpMaxConn
    -- (5) tcpActiveOpens
    -- (6) tcpPassiveOpens
    -- (7) tcpAttemptFails
    -- (8) tcpEstabResets
    -- (9) tcpCurrEstab
    -- (10) tcpInSegs
    -- (11) tcpOutSegs
    -- (12) tcpRetransSegs
    -- (13) tcpConnTable
    -- (1) tcpConnEntry
            -- (1) tcpConnState
            -- (2) tcpConnLocalAddress
            -- (3) tcpConnLocalPort
            -- (4) tcpConnRemAddress
            -- (5) tcpConnRemPort
    -- (14) tcpInErrs
    -- (15) tcpOutRsts
```

4.3.3.7 User Datagram Protocol group (1.3.6.1.2.1.7)

The User Datagram Protocol group has mandatory characters for all systems that implement UDP.

```
(7) udp
    -- (1) udpInDatagrams
    -- (2) udpNoPorts
    -- (3) udpInErrors
    -- (4) udpOutDatagrams
    -- (5) udpTable
    -- (1) udpEntry
            -- (1) udpLocalAddress
            -- (2) udpLocalPort
```

4.3.3.8 egp group (1.3.6.1.2.1.8)

```
(8) egp
    -- (1) egpInMsgs
    -- (2) egpInErrors
    -- (3) egpOutMsgs
    -- (4) egpOutErrors
    -- (5) egpNeighTable
    -- (1) egpNeighEntry
            -- (1) egpNeighState
            -- (2) egpNeighAddr
            -- (3) egpNeighAs
            -- (4) egpNeighInMsgs
            -- (5) egpNeighInErrs
            -- (6) egpNeighOutMsgs
            -- (7) egpNeighOutErrs
            -- (8) egpNeighInErrMsgs
            -- (9) egpNeighOutErrMsgs
            -- (10) egpNeighStateUps
            -- (11) egpNeighStateDowns
            -- (12) egpNeighIntervalHello
            -- (13) egpNeighIntervallPoll
            -- (14) egpNeighMode
            -- (15) egpNeighEventTrigger
    -- (6) egpAs
```

4.3.3.9 Transmission group (1.3.6.1.2.1.10)

(10) transmission

4.3.3.10 Simple Network Management Protocol group (1.3.6.1.2.1.11)

The Simple Network Management Protocol group has mandatory characters for all systems. In SNMP devices, which are optimized to support either a single agent or a single management station, some of the listed objects will be written with the value “0”.

```
(11) snmp
    -- (1) snmpInPkts
    -- (2) snmpOutPkts
    -- (3) snmpInBadVersions
    -- (4) snmpInBadCommunityName
    -- (5) snmpInBadCommunityUses
    -- (6) snmpInASNParseErrs
    -- (8) snmpInTooBigs
    -- (9) snmpInNoSuchNames
    -- (10) snmpInBadValues
    -- (11) snmpInReadOnlys
    -- (12) snmpInGenErrs
    -- (13) snmpInTotalReqVars
    -- (14) snmpInTotalSetVars
    -- (15) snmpInGetRequests
    -- (16) snmpInGetNexts
```

-- (17) snmpInSetRequests
-- (18) snmpInGetResponses
-- (19) snmpInTraps
-- (20) snmpOutTooBigs
-- (21) snmpOutNoSuchNames
-- (22) snmpOutBadValues
-- (24) snmpOutGenErrs
-- (25) snmpOutGetRequests
-- (26) snmpOutGetNexts
-- (27) snmpOutSetRequests
-- (28) snmpOutGetResponses
-- (29) snmpOutTraps
-- (30) snmpEnableAuthenTraps
-- (31) snmpSilentDrops
-- (32) snmpProxyDrops

4.3.4 RMON MIB (1.3.6.1.2.1.16)

This part of the MIB continuously provides the network management with up-to-date and historical network component data. The configuration of alarms and events controls the evaluation of network component counters. Depending on the configuration, the result of the evaluation is indicated to the management station by the agents using traps. The following groups are supported:

- statistics
- history
- alarm
- hosts
- hostTopN
- matrix
- filter
- capture and event.

4.3.4.1 statistics (1.3.6.1.2.1.16.1)

This MIB group contains information about, e.g., the number of unicast, multicast or broadcast telegrams, telegram rate and distribution or the number of faulty telegrams classed according to the error type.

The statistics group contains information about the network load and quality.

```
(1) etherStatsTable
    -- (1) etherStatsEntry
            -- (1) etherStatsIndex
            -- (2) etherStatsDataSource
            -- (3) etherStatsDropEvents
            -- (4) etherStatsOctets
            -- (5) etherStatsPkts
            -- (6) etherStatsBroadcastPkts
            -- (7) etherStatsMulticastPkts
            -- (8) etherStatsCRCAlignErrors
            -- (9) etherStatsUndersizePkts
            -- (10) etherStatsOversizePkts
            -- (11) etherStatsFragments
            -- (12) etherStatsJabbers
            -- (13) etherStatsCollisions
            -- (14) etherStatsPkts64Octets
            -- (15) etherStatsPkts65to127Octets
            -- (16) etherStatsPkts128to255Octets
            -- (17) etherStatsPkts256to511Octets
            -- (18) etherStatsPkts512to1023Octets
            -- (19) etherStatsPkts1024to1518Octets
            -- (20) etherStatsOwner
            -- (21) etherStatsStatus
```

4.3.4.2 history (1.3.6.1.2.1.16.2)

The history group contains statistical information, which can be read and represented, e.g., as a time curve.

```
(1) historyControlTable
    -- (1) historyControlEntry
            -- (1) historyControlIndex
            -- (2) historyControlDataSource
            -- (3) historyControlBucketsRequested
            -- (4) historyControlBucketsGranted
            -- (5) historyControlInterval
            -- (6) historyControlOwner
            -- (7) historyControlStatus
(2) etherhistoryTable
    -- (1) etherhistoryEntry
            -- (1) etherHistoryIndex
            -- (2) etherHistorySampleIndex
            -- (3) etherHistoryIntervalStart
            -- (4) etherHistoryDropEvents
            -- (5) etherHistoryOctets
```

```
                -- (6) etherHistoryPkts
                -- (7) etherHistoryBroadcastPkts
                -- (8) etherHistoryMulticastPkts
                -- (9) etherHistoryCRCAlignErrors
                -- (10) etherHistoryUndersizePkts
                -- (11) etherHistoryOversizePkts
                -- (12) etherHistoryFragments
                -- (13) etherHistoryJabbers
                -- (14) etherHistoryCollisions
                -- (15) etherHistoryUtilization
```

4.3.4.3 alarm (1.3.6.1.2.1.16.3)

The alarm group requests statistical values and compares them with the defined limit values. If a value is above or below the limit value, an alarm and a trap are generated.

```
(1) alarmTable
    -- (1) alarmEntry
                -- (1) alarmIndex
                -- (2) alarmInterval
                -- (3) alarmVariable
                -- (4) alarmSampleType
                -- (5) alarmValue
                -- (6) alarmStartupAlarm
                -- (7) alarmRisingThreshold
                -- (8) alarmFallingThreshold
                -- (9) alarmRisingEventIndex
                -- (10) alarmFallingEventIndex
                -- (11) alarmOwner
                -- (12) alarmStatus
```

4.3.4.4 hosts (1.3.6.1.2.1.16.4)

```
(1) hostControlTable
    -- (1) hostControlEntry
                -- (1) hostControlIndex
                -- (2) hostControlDataSource
                -- (3) hostControlTableSize
                -- (4) hostControlLastDeleteTime
                -- (5) hostControlOwner
                -- (6) hostControlStatus
-- (2) hostTable
    -- (1) hostEntry
                -- (1) hostAddress
                -- (2) hostCreationOrder
                -- (3) hostIndex
                -- (4) hostInPkts
                -- (5) hostOutPkts
                -- (6) hostInOctets
                -- (7) hostOutOctets
                -- (8) hostOutErrors
                -- (9) hostOutBroadcastPkts
                -- (10) hostOutMulticastPkts
-- (3) hostTimeTable
    -- (1) hostTimeEntry
                -- (1) hostTimeAddress
                -- (2) hostTimeCreationOrder
                -- (3) hostTimeIndex
                -- (4) hostTimeInPkts
                -- (5) hostTimeOutPkts
                -- (6) hostTimeInOctets
                -- (7) hostTimeOutOctets
                -- (8) hostTimeOutErrors
                -- (9) hostTimeOutBroadcastPkts
                -- (10) hostTimeOutMulticastPkts
```

4.3.4.5 hostTopN (1.3.6.1.2.1.16.5)

```
(1) hostTopNControlTable
    -- (1) hostTopNControlEntry
                -- (1) hostTopNControlIndex
                -- (2) hostTopNHostINdex
                -- (3) hostTopNRateBase
                -- (4) hostTopNTimeRemaining
                -- (5) hostTopNDuration
                -- (6) hostTopNRequestedSize
                -- (7) hostTopNGrantedSize
                -- (8) hostTopNStartTime
                -- (9) hostTopNOwner
                -- (10) hostTopNStatus
-- (2) hostTopNTable
    -- (1) hostTopNEntry
                -- (1) hostTopNReport
                -- (2) hostTopNIndex
                -- (3) hostTopNAddress
                -- (4) hostTopNRate
```

4.3.4.6 matrix (1.3.6.1.2.1.16.6)

```
-- (1) martrixControlTable
    -- (1) matrixControlEntry
                -- (1) matrixControlIndex
                -- (2) matrixControlDataSource
                -- (3) matrixControlTableSize
                -- (4) matrixControlLastDeleteTime
                -- (5) matrixControlOwner
                -- (6) matrixControlStatus
-- (2) matrixSDTable
    -- (1) matrixSDEntry
                -- (1) matrixSDSourceAddress
                -- (2) matrixSDDestAddress
                -- (3) matrixSDIndex
                -- (4) matrixSDPkts
                -- (5) matrixSDOctets
                -- (6) matrixSDErrors
-- (3) matrixDSTable
     -- (1) matrixDSEntry
                -- (1) matrixDSSourceAddress
                -- (2) matrixDSDestAddress
                -- (3) matrixDSIndex
                -- (4) matrixDSPkts
                -- (5) matrixDSOctets
                -- (6) matrixDSErrors
```

4.3.4.7 filter (1.3.6.1.2.1.16.7)

```
(1) filterTable
     -- (1) filterEntry
                -- (1) filterIndex
                -- (2) filterChannelIndex
                -- (3) filterPktDataOffset
                -- (4) filterPktData
                -- (5) filterPktDataMask
                -- (6) filterPktDataNotMask
                -- (7) filterPktStatus
                -- (8) filterPktStatusMask
                -- (9) filterPktStatusNotMask
                -- (10) filterOwner
                -- (11) filterStatus
(2) channelTable
     -- (1) channelEntry
                -- (1) channelIndex
                -- (2) channelIfIndex
                -- (3) channelAcceptTime
                -- (4) channelDataControl
                -- (5) channelTurnOnEventIndex
                -- (6) channelTurnOffEventIndex
                -- (7) channelEventIndex
                -- (8) channelEventStatus
                -- (9) channelMatches
                -- (10) channelDescription
                -- (11) channelOwner
                -- (12) channelStatus
```

4.3.4.8 capture (1.3.6.1.2.1.16.8)

```
(1) bufferControlTable
    -- (1) bufferControlEntry
            -- (1) bufferControlIndex
            -- (2) bufferControlChannelIndex
            -- (3) bufferControlFullStatus
            -- (4) bufferControlFullAction
            -- (5) bufferControlCaptureSliceSize
            -- (6) bufferControlDownloadSliceSize
            -- (7) bufferControlDownloadOffset
            -- (8) bufferControlMaxOctetsRequested
            -- (9) bufferControlMaxOctetsGranted
            -- (10) bufferControlCapturedPackets
            -- (11) bufferControlTurnOnTime
            -- (12) bufferControlOwner
            -- (13) bufferControlStatus
(2) captureBufferTable
    -- (1)captureBufferEntry
            -- (1)captureBufferControlIndex
            -- (2)captureBufferIndex
            -- (3) captureBufferPacketID
            -- (4) captureBufferPacketData
            -- (5) captureBufferPacketLength
            -- (6) captureBufferPacketTime
            -- (7) captureBufferPacketStatus
```

4.3.4.9 event (1.3.6.1.2.1.16.9)

The event group controls the generation of traps when the alarms described above occur.

```
(1) eventTable
    -- (1) eventEntry
            -- (1) eventIndex
            -- (2) eventDescription
            -- (3) eventType
            -- (4) eventCommunity
            -- (5) eventLastTimeSent
            -- (6) eventOwner
            -- (7) eventStatus
(2) logTable
    -- (1) logEntry
            -- (1) logEventIndex
            -- (2) logIndex
            -- (3) logTime
            -- (4) logDescription
```

4.3.5 Bridge MIB (1.3.6.1.2.1.17)

4.3.5.1 dot1dBase (1.3.6.1.2.1.17.1)

The dot1dBase group contains bridge-specific information.

```
(1) dot1dBaseBridgeAddress
(2) dot1dBaseNumPorts
(3) dot1dBasePortType
(4) dot1dBasePortTable
      -- dot1dBasePortEntry
                    -- (1) dot1dBasePort
                    -- (2) dot1dBasePortIfIndex
                    -- (3) dot1dBasePortPortCircuit
                    -- (4) dot1dBasePortDelayExceededDiscards
                    -- (5) dot1dBasePortMtuExceededDiscards
```

4.3.5.2 dot1dStp (1.3.6.1.2.1.17.2)

```
-- (1) dot1dStpProtocolSpecification
-- (2) dot1dStpPriority
-- (3) dot1dStpTimeSinceTopologyChange
-- (4) dot1dStpTopChanges
-- (5) dot1dStpDesignateRoot
-- (6) dot1dStpRootCost
-- (7) dot1dStpRootPort
-- (8) dot1dStpMaxAge
-- (9) dot1dStpHelloTime
-- (10) dot1dStpHoldTime
-- (11) dot1dStpForwardDelay
-- (12) dot1dStpBridgeMaxAge
-- (13) dot1dStpBridgeHelloTime
-- (14) dot1dStpBridgeForwardDelay
-- (15) dot1dStpPortTable
      -- (1) dot1dStpPortEntry
                    -- (1) dot1dStpPort
                    -- (2) dot1dStpPortPriority
                    -- (3) dot1dStpPortState
                    -- (4) dot1dStpPortEnable
                    -- (5) dot1dStpPortPathCost
                    -- (6) dot1dStpPortDesignatedRoot
                    -- (7) dot1dStpPortDesignatedCost
                    -- (8) dot1dStpPortDesignatedBridge
                    -- (9) dot1dStpPortDesignatedPort
                    -- (10) dot1dStpPortForwardTransitions
                    -- (11) dot1dStpPortPathCost32
-- (16) dot1dStpVersion
-- (17) dot1dStpTxHoldCount
-- (18) dot1dStpPathCostDefault
-- (19) dot1dStpExtPortTable
```

```
        -- (1) dot1dStpExtPortEntry
                -- (1) dot1dStpPortProtocolMigration
                -- (2) dot1dStpPortAdminEdgePort
                -- (3) dot1dStpPortOperEdgePort
                -- (4) dot1dStpPortAdminPointToPoint
                -- (5) dot1dStpPortOperPointToPoint
                -- (6) dot1dStpPortAdminPathCost
```

4.3.5.3 dot1dTp (1.3.6.1.2.1.17.4)

The dot1dTp group contains bridge-specific information.

```
(1) dot1dTpLearnedEntryDiscards
(2) dot1dTpAgingTime
(3) dot1dTpFdbTable
    -- (1) dot1dTpFdbEntry
            -- (1) dot1dTpFdbAddress
            -- (2) dot1dTpFdbPort
            -- (3) dot1dTpFdbStatus
(4) dot1dTpPortTable
    -- dot1dTpPortEntry
            -- (1) dot1dTpPort
            -- (2) dot1dTpPortMaxInfo
            -- (3) dot1dTpPortInFrames
            -- (4) dot1dTpPortOutFrames
            -- (5) dot1dTpPortInDiscards
(5) dot1dTpHCPortTable
    -- dot1dTpHCPortEntry
            -- (1) dot1dTpHCPortInFrames
            -- (2) dot1dTpHCPortOutFrames
            -- (3) dot1dTpHCPortInDiscards
(6) dot1dTpPortOverflowTable
    -- dot1dTpPortOverflowEntry
            -- (1) dot1dTpPortInOverflowFrames
            -- (2) dot1dTpPortOutOverflowFrames
            -- (3) dot1dTpPortInOverflowDiscards
```

4.3.5.4 dot1dStatic (1.3.6.1.2.1.17.5)

```
-- (1) dot1dStaticTable
    -- (1) dot1dStaticEntry
            -- (1) dot1dStaticAddress
            -- (2) dot1dStaticReceivePort
            -- (3) dot1dStaticAllowedToGoTo
```

4.3.6 pBridgeMIB (1.3.6.1.2.1.17.6)

4.3.6.1 pBridgeMIBObjects (1.3.6.1.2.1.17.6.1)

```
-- (1) dot1dExtBase
    -- (1) dot1dDeviceCapabilities
    -- (2) dot1dTrafficClassesEnabled
    -- (3) dot1dGmrpStatus
    -- (4) dot1dCapabilitiesTable
            -- (1) dot1dCapabilitiesEntry
            -- (1) dot1dPortCapabilities
-- (2) dot1dPriority
    -- (1) dot1dPortPriorityTable
            -- (1) dot1dPortPriorityEntry
            -- (1) dot1dPortDefaultUserPriority
            -- (2) dot1dPortNumTrafficClasses
    -- (2) dot1dUserPriorityRegenTable
            -- (1) dot1dUserPriorityRegenTable
            -- (1) dot1dUserPriority
            -- (2) dot1dRegenUserPriority
    -- (3) dot1dTrafficClassTable
            -- (1) dot1dTrafficClassEntry
            -- (1) dot1dTrafficClassPriority
            -- (2) dot1dTrafficClass
    -- (4) dot1dPortOutboundAccessPriorityTable
            -- (1) dot1dPortOutboundAccessPriorityEntry
            -- (1) dot1dPortOutboundAccessPriority
-- (3) dot1dGarp
    -- (1) dot1dPortGarpTable
            -- (1) dot1dPortGarpEntry
            -- (1) dot1dPortGarpJoinTime
            -- (2) dot1dPortGarpLeaveTime
            -- (3) dot1dPortGarpLeaveAllTime
-- (4) dot1dGmrp
    -- (1) dot1dPortGmrpTable
            -- (1) dot1dPortGmrpEntry
            -- (1) dot1dPortGmrpStatus
            -- (2) dot1dPortGmrpFailedRegistrations
            -- (3) dot1dPortGmrpLastPduOrigin
```

4.3.6.2 pBridgeConformance (1.3.6.1.2.1.17.6.2)

```
-- (1) pBridgeGroups
    -- (1) pBridgeExtCapGroup
    -- (2) pBridgeDeviceGmrpGroup
    -- (3) pBridgeDevicePriorityGroup
    -- (4) pBridgeDefaultPriorityGroup
    -- (5) pBridgeRegentPriorityGroup
    -- (6) pBridgePriorityGroup
    -- (7) pBridgeAccessPriorityGroup
```

```
     -- (8) pBridgePortGarpGroup
     -- (9) pBridgePortGmrpGroup
     -- (10) pBridgeHCPortGroup
     -- (11) pBridgePortOverflowGroup
-- (2) pBridgeCompliances
     -- (1) pBridgeCompliance
```

4.3.7 qBridgeMIB (1.3.6.1.2.1.17.7)

4.3.7.1 qBridgeMIBObjects (1.3.6.1.2.1.17.7.1)

```
-- (1) dot1qBase
     -- (1) dot1qVLANVersionNumber
     -- (2) dot1qMaxVLANId
     -- (3) dot1qMaxSupportedVLANs
     -- (4) dot1qNumVLANs
     -- (5) dot1qGvrpStatus
-- (2) dot1qTp
     -- (1) dot1qFdbTable
               -- (1) dot1qFdbEntry
               -- (1) dot1qFdbId
               -- (2) dot1qFdbDynamicCount
     -- (2) dot1qTpFdbTable
               -- (1) dot1qTpFdbEntry
               -- (1) dot1qTpFdbAddress
               -- (2) dot1qTpFdbPort
               -- (3) dot1qTpFdbStatus
     -- (3) dot1qTpGroupTable
               -- (1) dot1qTpGroupEntry
               -- (1) dot1qTpGroupAddress
               -- (2) dot1qTpGroupEgressPorts
               -- (3) dot1qTpGroupLearnt
     -- (4) dot1qForwardAllTable
               -- (1) dot1qForwardAllEntry
               -- (1) dot1qForwardAllPorts
               -- (2) dot1qForwardAllStaticPorts
               -- (3) dot1qForwardAllForbiddenPorts
     -- (5) dot1qForwardUnregisteredTable
               -- (1) dot1qForwardUnregisteredEntry
               -- (1) dot1qForwardUnregisteredPorts
               -- (2) dot1qForwardUnregisteredStaticPorts
               -- (3) dot1qForwardUnregisteredForbiddenPorts
-- (3) dot1qStatic
     -- (1) dot1qStaticUnicastTable
               -- (1) dot1qStaticUnicastEntry
               -- (1) dot1qStaticUnicastAddress
               -- (2) dot1qStaticUnicastReceivePort
               -- (3) dot1qStaticUnicastAllowedToGoTo
               -- (4) dot1qStaticUnicastStatus
     -- (2) dot1qStaticMulticastTable
               -- (1) dot1qStaticMulticastEntry
               -- (1) dot1qStaticMulticastAddress
               -- (2) dot1qStaticMulticastReceivePort
               -- (3) dot1qStaticMulticastStaticEgressPorts
               -- (4) dot1qStaticMulticastForbiddenEgressPorts
               -- (5) dot1qStaticMulticastStatus
-- (4) dot1qVLAN
     -- (1) dot1qVLANNumDeletes
     -- (2) dot1qVLANCurrentTable
               -- (1) dot1qVLANCurrentEntry
               -- (1) dot1qVLANTimeMark
               -- (2) dot1qVLANIndex
               -- (3) dot1qVLANFdbId
               -- (4) dot1qVLANCurrentEgressPorts
               -- (5) dot1qVLANCurrentUntaggedPorts
               -- (6) dot1qVLANStatus
               -- (7) dot1qVLANCreationTime
     -- (3) dot1qVLANStaticTable
               -- (1) dot1qVLANStaticEntry
               -- (1) dot1qVLANStaticName
               -- (2) dot1qVLANStaticEgressPorts
               -- (3) dot1qVLANForbiddenEgressPorts
               -- (4) dot1qVLANStaticUntaggedPorts
               -- (5) dot1qVLANStaticRowStatus
     -- (4) dot1qNextFreeLocalVLANIndex
     -- (5) dot1qPortVLANTable
               -- (1) dot1qPortVLANEntry
               -- (1) dot1qPvid
               -- (2) dot1qPortAcceptableFrameTypes
               -- (3) dot1qPortIngressFiltering
               -- (4) dot1qPortGvrpStatus
               -- (5) dot1qPortGvrpFailedRegistrations
               -- (6) dot1qPortGvrpLastPduOrigin
     -- (6) dot1qPortVLANStatisticsTable
               -- (1) dot1qPortVLANStatisticsEntry
               -- (1) dot1qTpVLANPortInFrames
               -- (2) dot1qTpVLANPortOutFrames
               -- (3) dot1qTpVLANPortInDiscards
               -- (4) dot1qTpVLANPortInOverflowFrames
               -- (5) dot1qTpVLANPortOutOverflowFrames
               -- (6) dot1qTpVLANPortInOverflowDiscards
     -- (7) dot1qPortVLANHCStatisticsTable
               -- (1) dot1qPortVLANHCStatisticsEntry
               -- (1) dot1qPortVLANHCInFrames
               -- (2) dot1qPortVLANHCOutFrames
               -- (3) dot1qPortVLANHCIn Discards
     -- (8) dot1qLearningConstraintsTable
               -- (1) dot1qLearningConstraintsEntry
               -- (1) dot1qConstraintVLAN
```

```
        -- (2) dot1qConstraintSet
        -- (3) dot1qConstraintType
        -- (4) dot1qConstraintStatus
    -- (9) dot1qConstraintSetDefault
    -- (10) dot1qConstraintTypeDefault
```

4.3.7.2 qBridgeConformance (1.3.6.1.2.1.17.7.2)

```
-- (1) qBridgeGroups
    -- (1) qBridgeBaseGroup
    -- (2) qBridgeFdbUnicastGroup
    -- (3) qBridgeFdbMulticastGroup
    -- (4) qBridgeServiceRequirementsGroup
    -- (5) qBridgeFdbStaticGroup
    -- (6) qBridgeVLANGroup
    -- (7) qBridgeVLANStaticGroup
    -- (8) qBridgePortGroup
    -- (9) qBridgeVLANStatisticsGroup
    -- (10) qBridgeVLANStatisticsOverflowGroup
    -- (11) qBridgeVLANHCStatisticsGroup
    -- (12) qBridgeLearningConstraintsGroup
    -- (13) qBridgeLearningConstraintDefaultGroup
-- (2) qBridgeCompliances
    -- (1) qBridgeCompliance
```

4.3.7.3 dot1dConformance (1.3.6.1.2.1.17.7.3)

```
-- (1) dot1dGroups
    -- (1) dot1dBaseBridgeGroup
    -- (2) dot1BasePortGroup
    -- (3) dot1dStpBridgeGroup
    -- (4) dot1dStpPortGroup2
    -- (5) dot1dStpPortGroup3
    -- (6) dot1dTpBridgeGroup
    -- (7) dot1dTpSdbGroup
    -- (8) dot1dTpGroup
    -- (9) dot1dStaticGroup
    -- (10) dot1dNotificationGroup
-- (2) dot1dCompliances
    -- (1) BridgeCompliances1493
    -- (2) BridgeCompliances4188
```

4.3.8 rstp MIB (1.3.6.1.2.1.17.11)

4.3.8.1 rstp Conformance (1.3.6.1.2.1.17.11.1)

rstp Groups (1.3.6.1.2.1.17.11.1.1)

```
-- (1) rstpBridgeGroups
-- (2) rstpDefaultPathCostGroup
-- (3) rstpPortGroup
```

rstp Compliance Groups (1.3.6.1.2.1.17.11.1.2)

```
-- (1) rstpCompliance
```

4.3.9 IANAifType MIB (1.3.6.1.2.1.30)

The IANAifType MIB defines the “ifTable” in MIB II. See “Interface group (1.3.6.1.2.1.2)” on page 53.

4.3.10 IF MIB (1.3.6.1.2.1.31)

4.3.10.1 ifMIBObjects (1.3.6.1.2.1.31.1)

```
-- (1) ifXTable
    -- (1) ifXEntry
            -- (1) ifName
            -- (2) ifInMulticastPkts
            -- (3) ifInBroadcastPkts
            -- (4) ifOutMulticastPkts
            -- (5) ifOutBroadcastPkts
            -- (6) ifHCInOctets
            -- (7) ifHCInUcastPkts
            -- (8) ifHCInMulticastPkts
            -- (9) ifHCInBroadcastPkts
            -- (10) ifHCOutOctets
            -- (11) ifHCOutUcastPkts
            -- (12) ifHCOutMulticastPkts
            -- (13) ifHCOutBroadcastPkts
            -- (14) ifLinkUpDownTrapEnable
            -- (15) ifHighSpeed
            -- (16) ifPromiscuousMode
            -- (17) ifConnectorPresent
            -- (18) ifAlias
            -- (19) ifCounterDiscontinuityTime
-- (2) ifStackTable
    -- (1) ifStackEntry
            -- (1) ifStackHigherLayer
            -- (2) ifStackLowerLayer
```

```
                -- (3) ifStackStatus
-- (3) ifTestTable
        -- (1) ifTestEntry
                -- (1) ifTestID
                -- (2) ifTestStatus
                -- (3) ifTestType
                -- (4) ifTestResult
                -- (5) ifTestCode
                -- (6) ifTestOwner
-- (4) ifRcvAddressTable
        -- (1) ifRcvAddressEntry
                -- (1) ifRcvAddressAddress
                -- (2) ifRcvAddressStatus
                -- (3) ifRcvAddressType
-- (5) ifTableLastChange
-- (6) ifStackLastChange
```

4.3.10.2 ifConformance (1.3.6.1.2.1.31.2)

```
-- (1) ifGroups
        -- (1) ifGeneralGroup
        -- (2) ifFixedLengthGroup
        -- (3) ifHCFixedLengthGroup
        -- (4) ifPacketGroup
        -- (5) ifHCPacketGroup
        -- (6) ifVHCPacketGroup
        -- (7) ifRcvAddressGroup
        -- (8) ifTestGroup
        -- (9) ifStackGroup
        -- (10) ifGeneralInformationGroup
        -- (11) ifStackGroup2
        -- (12) ifOldObjectsGroup
        -- (13) ifCounterDiscontinuityGroup
-- (2) ifCompliances
        -- (1) ifCompliance
        -- (2) ifCompliance2
```

4.3.10.3 etherMIBObjects (1.3.6.1.2.1.32.1)

```
-- (1) etherConformance
        -- (1) etherGroups
                -- (1) etherStatsGroup
                -- (2) etherCollisionTableGroup
                -- (3) etherStats100BbsGroup
                -- (4) etherStatsBaseGroup
                -- (5) etherStatsLowSpeedGroup
                -- (6) etherStatsHighSpeedGroup
                -- (7) etherDuplexGroup
                -- (8) etherControlGroup
```

```
                  -- (9) etherControlPauseGroup
          -- (1) etherCompliances
                  -- (1) etherCompliances
                  -- (2) ether100MbsCompliance
                  -- (3) dot3Compliance
```

4.3.10.4 lldpMIB (1.0.8802.1.1.2)

```
(1) lldpObjects
-- (1) lldpConfiguration
          -- (1) lldpMessageTxInterval
          -- (2) lldpMessageTxHoldMultiplier
-- (2) lldpStatistics
-- (3) lldpLocalSystemData
          -- (1) lldpLocChassisIdSubType
          -- (2) lldpLocChassisId
          -- (3) lldpLocSysName
          -- (4) lldpLocSysDesc
          -- (5) lldpLocSysCapSupported
          -- (6) lldpLocSysCapEnabled
          -- (7) lldpLocPortTable
                  -- (1) lldpLocPortMum
                  -- (2) lldpLocPortIdSubtype
                  -- (3) lldpLocPortId
                  -- (4) lldpLocPortDesc
          -- (8) lldpLocManAddrTable
                  -- (1) lldpLocManAddrSubtype
                  -- (2) lldpLocManAddr
                  -- (3) lldpLocManAddrLen
                  -- (4) lldpLocManAddrIfSubtype
                  -- (5) lldpLocManAddrIfId
                  -- (6) lldpLocManAddrOID
-- (4) lldpRemoteSystemsData
          -- (1) lldpRemTable
                  -- (1) lldpRemTimeMark
                  -- (2) lldpRemLocalPortNum
                  -- (3) lldpRemIndex
                  -- (4) lldpRemChassisType
                  -- (5) lldpRemChassisId
                  -- (6) lldpRemPortIdSubtype
                  -- (7) lldpRemPortId
                  -- (8) lldpRemPortDesc
                  -- (9) lldpRemSysName
                  -- (10) lldpRemSysDesc
                  -- (11) lldpRemSysCapSupported
                  -- (12) lldpRemSysCapEnabled
          -- (2) lldpRemManAddrTable
                  -- (1) lldpRemAddrSubSubtype
                  -- (2) lldpRemManAddr
                  -- (3) lldpRemManAddrIfSubtype
                  -- (4) lldpRemManAddrIfId
                  -- (5) lldpRemManAddrOID
-- (5) lldpConformance
```

4.3.11 pnoRedundancy MIB 1.3.6.1.4.1.24686

```
(1) pnoMRPDomainTable
    -- (1) pnoMRPDomainEntry
            -- (1) pnoMRPDomainIndex
            -- (2) pnoMRPDomainUuid
            -- (3) pnoMRPDomainName
            -- (4) pnoMRPDomainAdminRole
            -- (5) pnoMRPDomainOperRole
            -- (6) pnoMRPDomainManagerPriority
            -- (7) pnoMRPDomainRingPort1
            -- (8) pnoMRPDomainRingPort1State
            -- (9) pnoMRPDomainRingPort2
            -- (10)pnoMRPDomainRingPort2State
            -- (11) pnoMRPDomainState
            -- (12) pnoMRPDomainError
            -- (13) pnoMRPDomainRingOpenCount
            -- (14) pnoMRPDomainLastRingOpenChange
            -- (15) pnoMRPDomainRoundTripDelayMax
            -- (16) pnoMRPDomainRoundTripDelayMin
            -- (17) pnoMRPDomainResetRoundTripDelays
```

4.3.12 Private MIBs

The private MIBs for the SMN from Phoenix Contact can be found under object ID 1.3.6.1.4.1.4346. The SMN MIB contains the following groups:

– pxcModules (OID = 1.3.6.1.4.1.4346.1),
– pxcGlobal (OID = 1.3.6.1.4.1.4346.2)
– pxcFactoryLine (OID = 1.3.6.1.4.1.4346.11)

All configuration modifications, which are to take effect after a SMN restart, must be saved permanently using the “flWorkFWCtrlConfSave” object.

The aging time (default: 40 seconds) is not set using the private MIBs, instead it is set using the “dot1dTpAgingTime” MIB object (OID 1.3.6.1.2.1.17.4.2). The available setting range is 10 to 825 seconds.

MIB tree

The private MIB from Phoenix Contact is integrated in the MIB tree as follows (see red arrow).

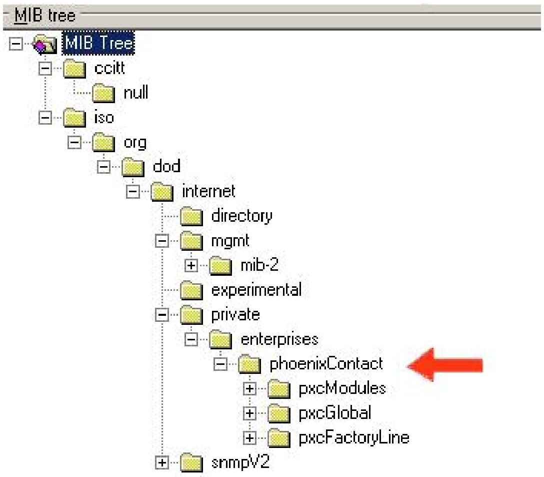


Figure 4-33 MIB tree

4.3.12.1 pxcModules OID = 1.3.6.1.4.1.4346.1

flMSwitchMModule

OID 1.3.6.1.4.1.4346.1.8

The object contains information about the manufacturer.

4.3.12.2 pxcGlobal OID = 1.3.6.1.4.1.4346.2

pxcBasic

OID 1.3.6.1.4.1.4346.2.1

pxcBasicName

OID	1.3.6.1.4.1.4346.2.1.1
Syntax	Display string
Access	Read
Description	Contains the manufacturer's name: Phoenix Contact GmbH & Co. KG.

pxcBasicDescr

OID	1.3.6.1.4.1.4346.2.1.2
Syntax	Display string
Access	Read
Description	Contains the manufacturer's name and address: Phoenix Contact GmbH & Co. KG, D-32823 Blomberg.

pxcBasicURL

OID	1.3.6.1.4.1.4346.2.1.3
Syntax	Display string
Access	Read
Description	Contains the manufacturer's web address: http://www.phoenixcontact.com.

4.3.12.3 pxcFactoryLine OID = 1.3.6.1.4.1.4346.11

flGlobal

OID	1.3.6.1.4.1.4346.11.1

flBasic

OID	1.3.6.1.4.1.4346.11.1.1

flBasicName

OID	1.3.6.1.4.1.4346.11.1.1.1
Syntax	Display string
Access	Read
Description	Contains the name of the product group: Factoryline.

flBasicDescr

OID 1.3.6.1.4.1.4346.11.1.1.2

Syntax Display string

Access Read

Description Contains a brief description of the product group:
Ethernet Installation System.

flBasicURL

OID 1.3.6.1.4.1.4346.11.1.1.3

Syntax Display string

Access Read

Description Contains a specific URL for the product group:
www.factoryline.de.

flBasicCompCapacity

OID 1.3.6.1.4.1.4346.11.1.1.4

Syntax Integer32 (1 ... 1024)

Access Read

Description Contains the number of different components that can be managed with this device.

flComponents

OID 1.3.6.1.4.1.4346.11.1.2

flComponentsTable

OID 1.3.6.1.4.1.4346.11.1.2.1

flComponentsTableEntry

OID	1.3.6.1.4.1.4346.11.1.2.1.1
Syntax	
Access	
Description	Generates a table with descriptions for components in the “Factoryline” product group, which can be managed by this management unit.
flComponentsIndex	
OID	1.3.6.1.4.1.4346.11.1.2.1.1.1
Syntax	Integer32 (1 ... 1024)
Access	Read

Description	Identifies the components for which this entry contains information.
flComponentsName	
OID	1.3.6.1.4.1.4346.11.1.2.1.1.2
Syntax	Display string
Access	Read
Description	Contains the designation of the component.
flComponentsDescr	
OID	1.3.6.1.4.1.4346.11.1.2.1.1.3
Syntax	Display string
Access	Read
Description	Contains a brief description of the component.
flComponentsURL	
OID	1.3.6.1.4.1.4346.11.1.2.1.1.4
Syntax	Display string
Access	Read
Description	Contains the URL of a Phoenix Contact website with additional information about the component.
flComponentsOrderNumber	
OID	1.3.6.1.4.1.4346.11.1.2.1.1.5
Syntax	Display string
Access	Read
Description	Contains the order number of the component.

flWorkDevice

OID 1.3.6.1.4.1.4346.11.11

flWorkBasic

OID 1.3.6.1.4.1.4346.11.11.1

flWorkBasicName

OID	1.3.6.1.4.1.4346.11.11.1.1
Syntax	Display string
Access	Read and write
Description	Contains the device name (corresponds to “sysName” from MIB2), which the user assigned to the device.

Check this entry following a firmware update, it may have been overwritten with default values.

flWorkBasicDescr

OID	1.3.6.1.4.1.4346.11.11.1.2
Syntax	Display string
Access	Read and write
Description	Contains a short description (corresponds to “sysDescr” from MIB2), which the user assigned to this component.

Check this entry following a firmware update, it may have been overwritten with default values.

flWorkBasicURL

OID	1.3.6.1.4.1.4346.11.11.1.3
Syntax	Display string
Access	Read
Description	Contains the URL of the device-specific web page for WBM in the form of the currently set IP address.

flWorkBasicSerialNumber

OID	1.3.6.1.4.1.4346.11.11.1.4
Syntax	Octet string (12)
Access	Read
Description	Contains the serial number of the device.

flWorkBasicHWRevision

OID	1.3.6.1.4.1.4346.11.11.1.5
Syntax	Octet string (4)
Access	Read
Description	Contains the hardware version of the device.

flWorkBasicPowerStat

OID	1.3.6.1.4.1.4346.11.11.1.6
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Contains status information about the connected supply voltages: - Unknown1 - Supply voltage 1 OK3 - Supply voltage 2 OK4 - Supply voltage 1 and 2 OK5

flWorkBasicCompMaxCapacity

OID	1.3.6.1.4.1.4346.11.11.1.11
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Contains the maximum number of interfaces that can be connected in theory.

flWorkBasicCompCapacity

OID	1.3.6.1.4.1.4346.11.11.1.12
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Contains the number of interfaces actually connected.

flWorkComponents

OID	1.3.6.1.4.1.4346.11.11.2

flWorkComponentsTable

OID	1.3.6.1.4.1.4346.11.11.2.1

flWorkComponentsEntry

OID	1.3.6.1.4.1.4346.11.11.2.1.1
Description	Generates a table with the available interface modules of this switch station.
flWorkComponentsIndex	
OID	1.3.6.1.4.1.4346.11.11.2.1.1.1
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Indicates the selected interface number, for which this entry contains information.
flWorkComponentsOID	
OID	1.3.6.1.4.1.4346.11.11.2.1.1.2
Syntax	OBJECT IDENTIFIER
Access	Read
Description	This OID indicates the corresponding entry in flWorkComponentsEntry.
flWorkComponentsURL	
OID	1.3.6.1.4.1.4346.11.11.2.1.1.3
Syntax	Display string
Access	Read
Description	Contains the IP address of the switch.
flWorkComponentsDevSign	
OID	1.3.6.1.4.1.4346.11.11.2.1.1.4

Syntax	Integer (0 ... 24)
Access	Read
Description	Contains the designation of the interface module.

flWorkTraps

OID	1.3.6.1.4.1.4346.11.11.3

flWorkTrapsDelemeter

OID	1.3.6.1.4.1.4346.11.11.3.0

trapPasswdAccess

OID	1.3.6.1.4.1.4346.11.11.3.0.1
Description	Sent to the defined trap receivers on each modification or attempted modification of the device password and contains information about the status of the last modification or attempted modification.

trapFWHealth

OID	1.3.6.1.4.1.4346.11.11.3.0.2
Description	Sent to the diagnostic display on each firmware-related modification and contains additional information about the firmware status.

trapFWConf

OID	1.3.6.1.4.1.4346.11.11.3.0.3
Description	Sent each time the configuration is saved and informs the management station that the configuration has been saved successfully. This trap is sent in the event of configuration modifications (port name, port mode, device name, IP address, trap receiver address, port mirroring, etc.), which are not yet saved permanently. The trap therefore provides a warning that, if not saved permanently, the changes will be lost on a reset.

> The “flWorkNetIfParamAssignment” object must be set to static (1), otherwise objects cannot be written.

trapPowerSupply

OID	1.3.6.1.4.1.4346.11.11.3.0.4
Description	Sent each time the redundant power supply fails.

trapRstpRingFailure

OID	1.3.6.1.4.1.4346.11.11.3.0.6
Description	Sent in the event of a link interrupt in the redundant RSTP ring.

trapManagerConnection

OID	1.3.6.1.4.1.4346.11.11.3.0.99
Description	This trap is used to test the connection between the device and trap manager.

flWorkNet

OID	1.3.6.1.4.1.4346.11.11.4

flWorkNetIfParameter

OID	1.3.6.1.4.1.4346.11.11.4.1

flWorkNetIfParamPhyAddress

OID	1.3.6.1.4.1.4346.11.11.4.1.1
Syntax	MacAddress
Access	Read
Description	Contains the MAC address of the switch.

flWorkNetIfParamIPAddress

OID	1.3.6.1.4.1.4346.11.11.4.1.2
Syntax	IpAddress
Access	Read and write
Description	Contains the current IP address of the SMN. Changes only take effect once the “flWorkNetIfParamSave” object has been executed.

> ℹ The “flWorkNetIfParamAssignment” object must be set to static (1), otherwise objects cannot be written.

flWorkNetIfParamSubnetmask

OID	1.3.6.1.4.1.4346.11.11.4.1.3
Syntax	IpAddress
Access	Read and write
Description	Contains the current subnet mask of the SMN. Changes only take effect once the “flWorkNetIfParamSave” object has been executed.

> ℹ The “flWorkNetIfParamAssignment” object must be set to static (1), otherwise objects cannot be written.

flWorkNetIfParamGwIpAddress

OID	1.3.6.1.4.1.4346.11.11.4.1.4

Syntax	IpAddress
Access	Read and write
Description	Contains the IP address of the current default gateway/router of the SMN. Changes only take effect once the “flWorkNetIfParamSave” object has been executed.

The “flWorkNetIfParamAssignment” object must be set to static (1), otherwise objects cannot be written.

flWorkNetIfParamStatus

OID	1.3.6.1.4.1.4346.11.11.4.1.5
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Indicates whether IP parameters were modified but not saved: No change 1 Address setting modified, but not yet activated2

Address settings must be saved permanently using the “flWorkFWCtrlConfSave” object.

flWorkNetIfParamSave

OID	1.3.6.1.4.1.4346.11.11.4.1.6
Syntax	Integer
Access	Read and write
Description	Provides the option of saving modified IP parameters or undoing the modifications: Undo modification1 Activate modification2

Address settings must be saved permanently using the “flWorkFWCtrlConfSave” object.

flWorkNetIfParamAssignment

OID	1.3.6.1.4.1.4346.11.11.4.1.7
Syntax	Integer
Access	Read and write
Description	Provides the option of modifying the assignment mechanism for IP parameters.

Static IP address1
Assignment via BootP (default)2

> Modifications to the assignment mechanism also affect the management functions via the web interface and via RS-232.

> Modifications to the assignment mechanism on BootP (2) or DCP (4) are only activated after a restart of the SMN.

> Address settings must be saved permanently using the “flWorkFWCtrlConfSave” object.

flWorkNetIfParamManagementVlanId

OID	1.3.6.1.4.1.4346.11.11.4.1.8
Syntax	Integer32 (1 ... 4094)
Access	Read and write
Description	If the switch is operated in “Tagging” VLAN mode, this object indicates in which VLAN (VLAN ID) the management agent is located.

flWorkNetPort

OID	1.3.6.1.4.1.4346.11.11.4.2

flWorkNetPortCapacity

OID	1.3.6.1.4.1.4346.11.11.4.2.1
Syntax	Integer32 (1 ... 1024)
Access	Read
Description	Contains the number of available ports depending on the configuration of the MMS.

flWorkNetPortTable

OID	1.3.6.1.4.1.4346.11.11.4.2.2

flWorkNetPortEntry

OID	1.3.6.1.4.1.4346.11.11.4.2.2.1
Description	Generates a table with a detailed description of the port configuration.
flWorkNetPortIndex	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.1
Syntax	Integer32 (1 ... 1024)

Access	Read
Description	Specifies the port number of the selected port.
flWorkNetPortLinkState	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.2
Syntax	Integer
Access	Read
Description	Indicates the port status: Connected 1 Not connected2 farEndFault3
flWorkNetPortSpeed	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.3
Syntax	Gauge32
Access	Read
Description	Contains the data transmission speed of the selected port in bps.
flWorkNetPortDuplexMode	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.4
Syntax	Integer
Access	Read
Description	Contains the duplex mode of the selected port: No link0 Full duplex1 Half duplex2
flWorkNetPortNegotiation	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.5
Syntax	Integer
Access	Read
Description	Contains the duplex mode of the selected port: Automatic1 Manual2
flWorkNetPortName	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.6
Syntax	Octet string (0 ... 16)
Access	Read and write
Description	Contains the “name” of the port, e.g., “Robot 1”.
flWorkNetPortEnable	
OID	1.3.6.1.4.1.4346.11.11.4.2.2.1.7
Syntax	Integer
Access	Read and write
Description	Here you can disable the port: Port disabled1 Port enabled2

5 (Rapid) Spanning Tree

5.1 General function

Loops

The Rapid/Spanning Tree Protocol (RSTP) is a standardized method (IEEE 802.1w/IEEE 802.1d) that enables the use of Ethernet networks with redundant data paths. Ethernet networks with redundant data paths form a meshed topology with initially impermissible loops. Due to these loops, data packets can circulate endlessly within the network and can also be duplicated. As a consequence, the network is usually overloaded due to circulating data packets, and communication is interrupted. The meshed structure is therefore replaced by a logical, deterministic path with a tree structure without loops using the Spanning Tree algorithm. In the event of data path failure, some of the previously disconnected connections are reconnected to ensure uninterrupted network operation.

IEEE 802.1w

RSTP prevents the long timer-controlled switch-over times of STP.

Example:

In the following network topology, (six) redundant paths have been created to ensure access to all network devices in the event of a data path failure. These redundant paths are impermissible loops. The Spanning Tree Protocol automatically transforms this topology into a tree by disconnecting selected ports. In this context, one of the switches is assigned the role of the root of the tree. From this root, all other switches can be accessed via a single data path.

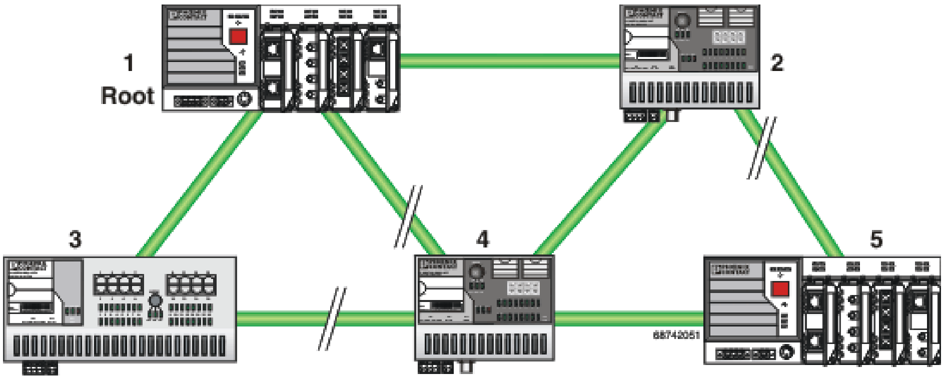


Figure 5-1 Possible tree structure with Spanning Tree

5.2 (R)STP startup

Startup consists of two parts that must be executed in the specified order:

1 Enable (R)STP on all switches that are to be operated as active (R)STP components in the network.

2 Connect the switches to form a meshed topology.

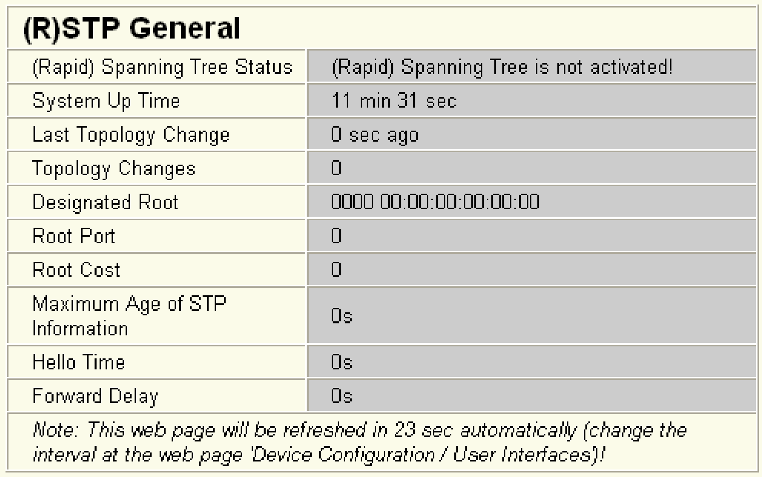
Only create the meshed topology after activating (R)STP.

5.2.1 Enabling (R)STP on all switches involved

(R)STP can be activated via web-based management, via the SNMP interface or via the serial interface.

While learning the network topology, the switch temporarily does not participate in network communication.

Now switch to the “Switch Station” menu on the “(R)STP General” page. Here, you will find various information about the Spanning Tree configuration.



(R)STP General

(Rapid) Spanning Tree Status	(Rapid) Spanning Tree is not activated!
System Up Time	11 min 31 sec
Last Topology Change	0 sec ago
Topology Changes	0
Designated Root	0000 00:00:00:00:00:00
Root Port	0
Root Cost	0
Maximum Age of STP Information	0s
Hello Time	0s
Forward Delay	0s

Note: This web page will be refreshed in 23 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 5-2 “(R)STP General” web page

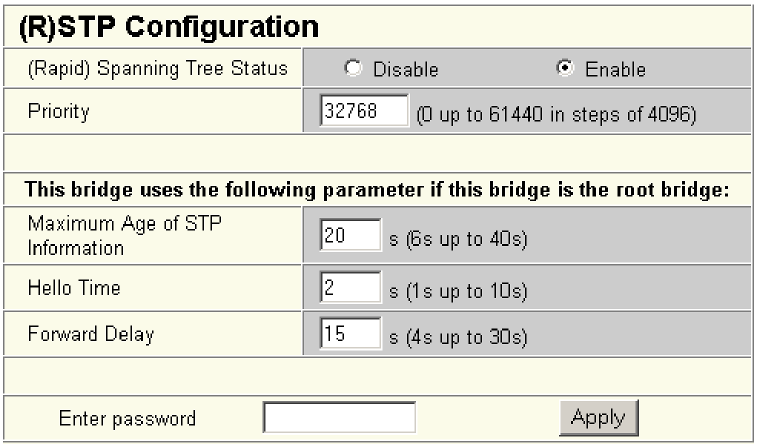
The web page displays the parameters with which the switch is currently operating.

(R)STP configuration

It is sufficient to set the “Rapid Spanning Tree Status” to “Enable” in order to start (R)STP using default settings. Priority values can be specified for the switch. The bridge and backup root can be specified via these priority values.

Only multiples of 4096 are permitted. The desired value can be entered in the “Priority” field. The value will be rounded automatically to the next multiple of 4096. Once you have confirmed the modification by entering your password, the initialization mechanism is started.

Redundant connections can now be created.



(R)STP Configuration

(Rapid) Spanning Tree Status	○ Disable ● Enable
Priority	32768 (0 up to 61440 in steps of 4096)
This bridge uses the following parameter if this bridge is the root bridge:	
Maximum Age of STP Information	20 s (6s up to 40s)
Hello Time	2 s (1s up to 10s)
Forward Delay	15 s (4s up to 30s)
Enter password	Apply

Figure 5-3 “(R)STP Configuration” web page

Large tree support

If RSTP is operated using the default values, it is suitable for up to seven switches along the relevant path (see Figure 5-17 on page 130 and Figure 5-18 on page 131 as an example of the relevant path). The RSTP protocol would therefore be possible in a ring topology for up to 15 switches.

The “Large Tree Support” option makes the ring topology suitable for 28 switches along the relevant path if RSTP is used. The “Large Tree Support” option could provide an RSTP ring topology with up to 57 devices. When using “Large Tree Support”, please note the following:

– In the large tree support RSTP topology, do not use devices that do not support large tree support.
– Enable the “Large Tree Support” option on all devices.
– If RSTP is to be activated as the redundancy mechanism in an existing network with more than seven switches along the relevant path, then the “Large Tree Support” option must first be enabled on all devices.
– It is recommended that “Large Tree Support” is not activated in networks with less than seven switches along the relevant path.

Maximum age of STP information

The parameter is set by the root switch and used by all switches in the ring. The parameter is sent to make sure that each switch in the network has a constant value, against which the age of the saved configuration is tested.

The “Maximum Age of STP Information”, “Hello Time”, and “Forward Delay” fields have the same meaning as for STP. These values are used when this switch becomes a root. The values currently used can be found under “(R)STP General”.

Hello time

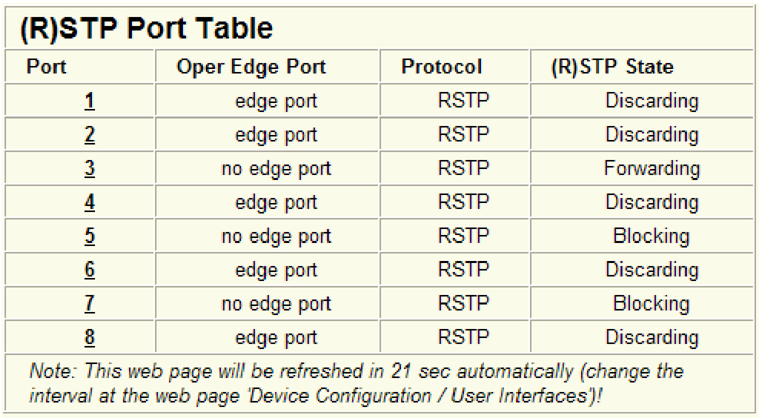
Specifies the time interval within which the root bridge regularly reports to the other bridges via BPDU.

Forward delay

The forward delay value indicates how long the switches are to wait in order for the port state in STP mode to change from “Discarding” to “Listening” and from “Listening” to “Learning” (2 x forward delay).

> The “Max Age of STP”, “Hello Time”, and “Forward Delay” parameters are optimized by default upon delivery. They should not be modified.

(R)STP port table



(R)STP Port Table

Port	Oper Edge Port	Protocol	(R)STP State
1	edge port	RSTP	Discarding
2	edge port	RSTP	Discarding
3	no edge port	RSTP	Forwarding
4	edge port	RSTP	Discarding
5	no edge port	RSTP	Blocking
6	edge port	RSTP	Discarding
7	no edge port	RSTP	Blocking
8	edge port	RSTP	Discarding

Note: This web page will be refreshed in 21 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 5-4 “(R)STP Port Table” web page

Oper edge port

All ports that do not receive any (R)STP BPDUs (e.g., termination device ports) become edge ports, i.e., ports that go to the “Forwarding” state immediately after restart. All ports that do not receive any (R)STP BPDUs (e.g., termination device ports) become edge ports, i.e., ports that go to the “Forwarding” state immediately after restart.

Protocol

Indicates the redundancy protocol used.

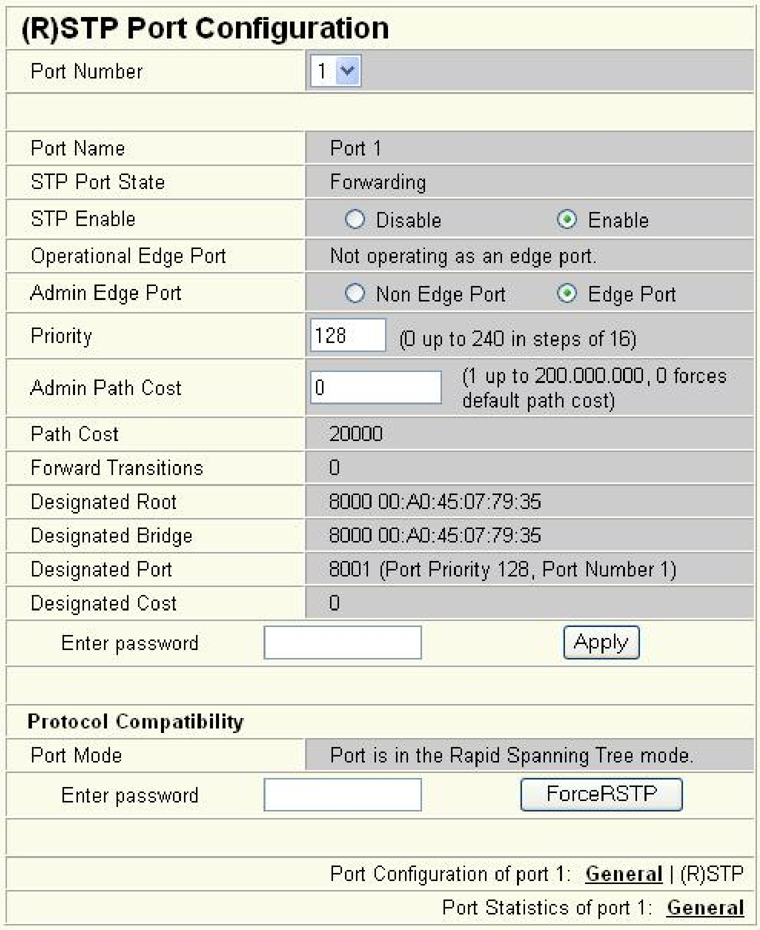
(R)STP state

Indicates the current (R)STP state of the relevant port.

Possible states:

- “Forwarding”
  The port is integrated in the active topology and forwards data.
- “Discarding”
  The port does not take part in data transmission.
- “Learning”
  The port does not take part in data transmission of the active topology, however, MAC addresses are learned.
- Blocking/Discarding
  The port has a link, but has been set to the “Discarding” state by RSTP.

(R)STP port configuration table



(R)STP Port Configuration

Port Number	1
Port Name	Port 1
STP Port State	Forwarding
STP Enable	○ Disable ● Enable
Operational Edge Port	Not operating as an edge port.
Admin Edge Port	○ Non Edge Port ● Edge Port
Priority	128 (0 up to 240 in steps of 16)
Admin Path Cost	0 (1 up to 200.000.000, 0 forces default path cost)
Path Cost	20000
Forward Transitions	0
Designated Root	8000 00:A0:45:07:79:35
Designated Bridge	8000 00:A0:45:07:79:35
Designated Port	8001 (Port Priority 128, Port Number 1)
Designated Cost	0
Enter password	

Protocol Compatibility

Port Mode	Port is in the Rapid Spanning Tree mode.
Enter password	

Apply
ForceRSTP
Port Configuration of port 1: General | (R)STP
Port Statistics of port 1: General

Figure 5-5 “(R)STP Port Configuration Table” web page

An overview of the main settings for each port is provided here.

5.2.1.1 (R)STP port configuration

> Modifications of properties can result in complete reconfiguration of (Rapid) Spanning Tree.

> It is recommended that a suitable root switch and a backup root switch are specified using corresponding priority assignment.

This page displays the valid (R)STP configuration settings for the selected port.

If termination devices or subnetworks are connected without RSTP or STP via a port, it is recommended that the “Admin Edge Port” be set to “Edge Port”. In this way, a link modification at this port does not result in a topology modification.

5.2.1.2 Switch/port ID

The validity of switches and ports is determined according to priority vectors.

Bridge identifier

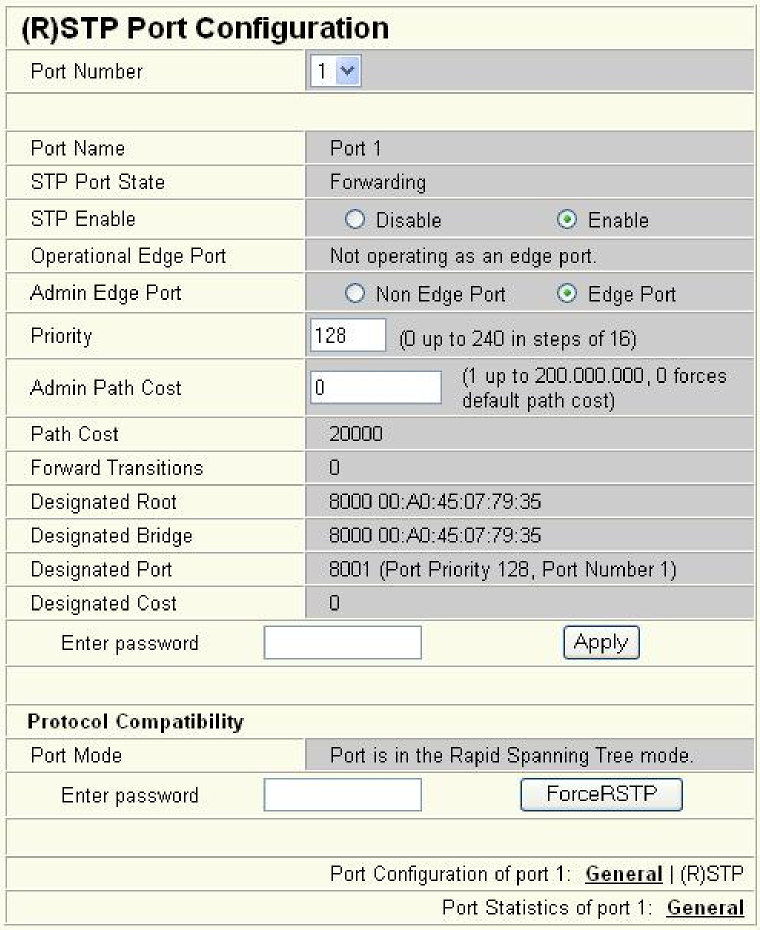
A switch ID consists of eight bytes as an unsigned integer value. When comparing two switch IDs, the one with the lowest numeric value is of higher, i.e., “better”, priority.

The first two bytes contain the priority.
The last six bytes contain the MAC address and thus ensure the uniqueness of the switch ID in the event of identical priority values.

The switch with the lowest numerical switch ID becomes the root. It is recommended that the root port and alternate port are specified using the priority.

Port identifier

The port ID consists of four bits for the port priority and twelve bits for the port number. The port ID is interpreted as an unsigned integer value. When comparing two port IDs, the one with the lowest numeric value is of higher, i.e., “better”, priority.



(R)STP Port Configuration

Port Number	1
Port Name	Port 1
STP Port State	Forwarding
STP Enable	○ Disable ● Enable
Operational Edge Port	Not operating as an edge port.
Admin Edge Port	○ Non Edge Port ● Edge Port
Priority	128 (0 up to 240 in steps of 16)
Admin Path Cost	0 (1 up to 200.000.000, 0 forces default path cost)
Path Cost	20000
Forward Transitions	0
Designated Root	8000 00:A0:45:07:79:35
Designated Bridge	8000 00:A0:45:07:79:35
Designated Port	8001 (Port Priority 128, Port Number 1)
Designated Cost	0
Enter password	Apply
Protocol Compatibility	
Port Mode	Port is in the Rapid Spanning Tree mode.
Enter password	ForceRSTP
	Port Configuration of port 1: General | (R)STP
	Port Statistics of port 1: General

Figure 5-6 “(R)STP Port Configuration” web page

Port number

Indicates the number of the port currently selected.

Port name
Indicates the name of the port.

STP port state
Indicates the status in which this port takes part in STP.

Operational edge port
Indicates whether this port is operated as an edge port.

Admin edge port
Here, you can specify whether this port is to be operated as an edge port (default setting), if possible.

Priority
Indicates the priority set for this port (default 128). Due to backward compatibility with STP, priority values can be set that are not configurable in RSTP.

Admin path cost
Indicates the path cost set for this port. A path cost equal to “0” activates the cost calculation according to the transmission speed (10 Mbps = 2000000; 100 Mbps = 200000; 1000 Mbps = 20000).

Path cost
Indicates the path cost used for this port.

Forward transitions
Indicates how often the port switches from the “Discarding” state to the “Forwarding” state.

Additional parameters provide information about the network paths in a stable topology that are used by the BPDU telegrams.

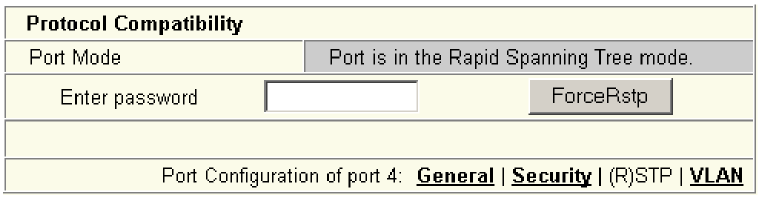
Designated root
Root bridge for this Spanning Tree.

Designated bridge
The switch from which the port receives the best BPDUs. The value is based on the priority value in hex and the MAC address.

Designated port
Port via which the BPDUs are sent from the designated bridge. The value is based on the port priority (2 digits) and the port number.

Designated cost
Indicates the path cost of this segment to the root switch.

Protocol compatibility



Protocol Compatibility

Port Mode: Port is in the Rapid Spanning Tree mode.

Enter password

Port Configuration of port 4: **General** | **Security** | (R)STP | **VLAN**

Figure 5-7 Protocol compatibility

If a port receives STP BPDUs, it switches automatically to STP mode. Automatic switching to (R)STP mode does not take place. Switching to (R)STP mode can only be forced via “ForceRstp” or via a restart.

RSTP fast ring detection

The “RSTP Fast Ring Detection” function can be activated on the “RSTP Configuration” web page (see page 111).

The “Fast Ring Detection” function is only performed for connections with 10 Mbps or 100 Mbps.

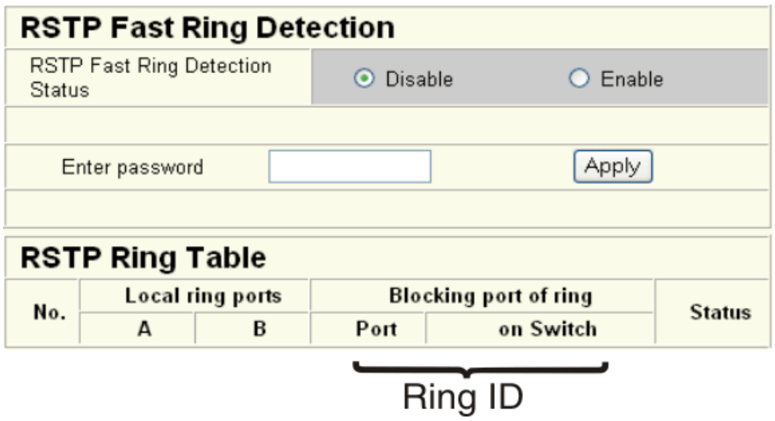
This function speeds up the switch-over to a redundant path in the event of an error and provides easy diagnostics. RSTP fast ring detection provides each ring with an ID. This ID is made known to each switch in the relevant ring. A switch can belong to several different rings at the same time.

Structure of the ring ID

The ring ID consists of the port number of the blocking port and the MAC address of the corresponding switch. Advantages of the ring ID:

– Easier to identify redundant paths and locate blocking ports.

– Possible to check whether the desired topology corresponds to the actual topology.



RSTP Fast Ring Detection

RSTP Fast Ring Detection Status ● Disable ○ Enable

Enter password [ ] Apply

RSTP Ring Table

No.	Local ring ports		Blocking port of ring		Status
	A	B	Port	on Switch	

Figure 5-8 RSTP ring table

Information in WBM

The following information is displayed on the web page (and via SNMP):

Local ring ports
These two ports of this switch belong to the ring that is listed (ring ID).

Blocking port
This port deliberately breaks the loop.

A blocking port does not receive LLDP BPDUs, but does send LLDP BPDUs.

Ring detection states

The following states can occur for ring detection:

– Not Ready - Ring detection has not yet been completed.

– OK - Ring detection has been completed and quick switch-over is possible in the event of an error.

– Broken - The ring is broken on this branch in the direction of the root switch.

– Failed on Port A - The ring was broken on this switch at port A.

In the event of a link failure in the ring, the “trapRstpRingFailure” trap is sent.

If the “Broken” or “Failed” status lasts for longer than 60 seconds, it is no longer displayed after the next topology modification, since these rings no longer exist.

When using RSTP fast ring detection, please note the following:

- For RSTP fast ring detection, do not use devices that do not support this function.
- Enable RSTP fast ring detection on all devices.
- All data paths must be in full duplex mode.

5.2.2 Connection failure - Example

The following diagram illustrates an RSTP ring with six switches, where switch 1 is the root. The ring extends over port 1 and port 2 for each switch. On switch 4, the loop is broken by a blocking port.

If a cable interrupt occurs at the point indicated by the star, this produces the following entries on the “RSTP Fast Ring Detection” web page:

Switch 3 - Failed on Port A

Switch 4 - Broken

In addition, switch 3 would also generate the “flWorkLinkFailure” trap, as long as the sending of traps is not disabled.

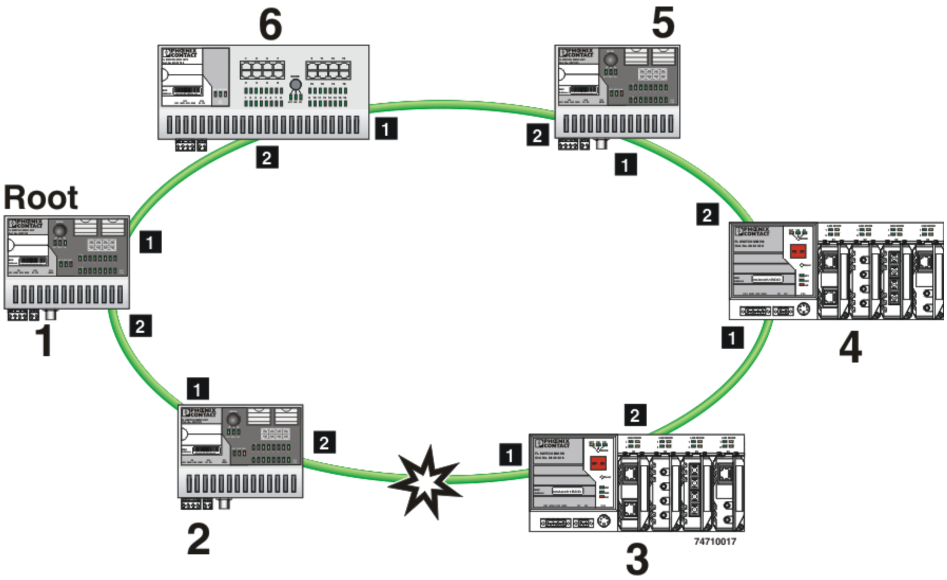


Figure 5-9 Connection failure with RSTP ring detection

5.2.3 Mixed operation of RSTP and STP

If a device with STP support is integrated into the network, only switch ports that receive STP BPDUs are set to STP mode. All other ports that receive RSTP BPDUs remain in RSTP mode.

5.2.4 Topology detection of a Rapid Spanning Tree network (RSTP)

(Rapid) Spanning Tree switches continually exchange information about the network topology using special messages (BPDUs - Bridge Protocol Data Units). In this way the switches “learn” the current network topology and - based on this information - make the following decisions:

– Which switch is selected as the root switch
– Which data paths are disabled

If a switch is started using the (Rapid) Spanning Tree Protocol, it first expects to be the root switch. However, no data communication is possible during the startup phase until the current network topology has been learned and until the decisions described above have been made. Therefore loops in the network startup phase which could occur because no data path is interrupted, are prevented.

5.2.4.1 Topology modification

A topology modification can be triggered by the following:

– Adding a data path
– Failure of a data path
– Adding a spanning tree switch, or
– Failure of a Spanning Tree switch

A topology modification is automatically detected and the network is reconfigured so that another tree is created and all the devices in this tree can be accessed. During this process, loops do not even occur temporarily.

If sending of traps was not deactivated, two traps are generated:

– newRoot (OID: 1.3.6.1.2.1.17.0.1)
– topologyChange (OID 1.3.6.1.2.1.17.0.2)

5.2.4.2 Interrupted data paths and port states

The described data path interruption by the Spanning Tree Protocol is created by disconnecting individual ports that no longer forward any data packets. A port can have the following states:

– Learning
– Forwarding
– Blocking/Discarding
– Disabled (link down or disconnected by the user)

The current port states are shown in the web interface.

The properties of the various port states are shown in the table below.

Table 5-1 Properties of the port states

	Receiving and evaluating BPDUs (learning the topology)	Learning the MAC addresses of connected devices and creating the switching table	Forwarding data packets (normal switching function)
Disabled			
Blocking/Discarding	X		
Learning	X	X	
Forwarding	X	X	X

The sequence of the five port states defined in the Spanning Tree Protocol cannot be assigned freely. The following diagram illustrates the possible sequence of the port states.

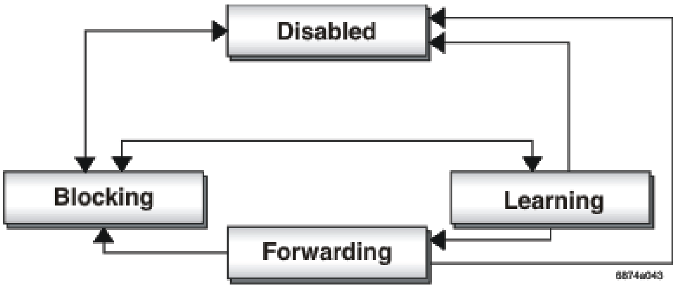


Figure 5-10 Sequence of the possible port states in STP

After device startup and, if necessary, also during topology modification, a port runs through the states in the following order:

Learning → Forwarding

or

Disabled → Blocking/Discarding

Due to the edge property of ports, they switch to “Forwarding” immediately. In the second case, the port generates a data path interruption in order to suppress loops accordingly.

At least one port in the “Forwarding” state is at a data path between two spanning tree switches so that the data path can be integrated into the network.

5.2.4.3 Fast forwarding

If the Spanning Tree Protocol is deactivated at a port, the corresponding port is in “Fast Forwarding” mode.

A fast forwarding port

- Ignores all BPDUs that are received at this port.
- Does not send any BPDUs.
- Switches to the “Forwarding” state immediately after establishing the data link. Termination devices connected to this port can be accessed immediately.

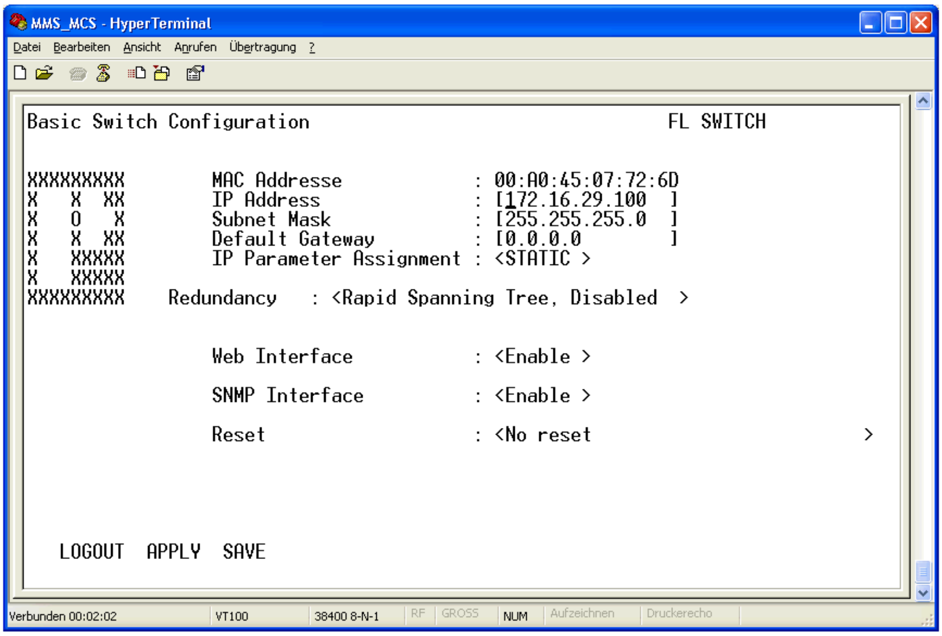
“Port STP Status” in WBM on the “STP Port Configuration” page must be set to “Disabled” to activate fast forwarding.

Frame duplication

Due to the fast switch-over times of RSTP, frames may be duplicated and the order of frames may be changed.

5.2.4.4 Enabling via serial interface

Establish a connection to the switch. The procedure is described in Section “Management via local RS-232 communication interface” on page 103. Set “Spanning Tree, Enabled” on the following page in the “Redundancy” field and select “Save”.



MMS_MCS - HyperTerminal
Datei Bearbeiten Ansicht Anrufen Übertragung ?
Verbunden 00:02:02 VT100 38400 8-N-1 RF GROSS NUM Aufzeichnen Druckerecho

```
Basic Switch Configuration                              FL SWITCH

XXXXXXXXX        MAC Address             : 00:A0:45:07:72:6D
X   X  XX        IP Address              : [172.16.29.100  ]
X   O   X        Subnet Mask             : [255.255.255.0  ]
X   X  XX        Default Gateway         : [0.0.0.0        ]
X   XXXXX        IP Parameter Assignment : <STATIC >
X   XXXXX
XXXXXXXXX    Redundancy   : <Rapid Spanning Tree, Disabled  >

                 Web Interface           : <Enable >

                 SNMP Interface          : <Enable >

                 Reset                   : <No reset                 >



   LOGOUT   APPLY   SAVE
```

Figure 5-11 Activating Rapid Spanning Tree

5.2.5 Configuration notes for Rapid Spanning Tree

In contrast to the Spanning Tree method, the Rapid Spanning Tree method supports event-controlled actions that are no longer triggered based on a timer.

If one line fails (link down), the Rapid Spanning Tree method can respond more quickly to this failure and thus the switch-over time can be kept low.

> A link down or link up must be detected at the switch so that the RSTP switches can detect a line failure and a restored line more quickly. Please take into consideration, in particular, paths where media converters are used. It might be possible that media converters offer setting options to transmit the link status of the fiber optic side to the twisted-pair side.
>
> If a link down is not detected at the switch because the cable interrupt is between the media converters, and no link down is forced at the switch, timer-based detection is activated, which may result in longer switch-over times.

– For short switch-over times, structure your network in such a way that a maximum of seven switches are located in a cascade up to the root switch. The switch-over times can range from 100 ms to 2 s.
– Use priority assignment to specify a central switch as the root.
– It is also recommended to assign a switch as the backup root.
– For short switch-over times, all switches in the redundant topology should support the Rapid Spanning Tree Protocol and no hubs should be used.

5.2.5.1 Connecting the switches to form a meshed topology

Having activated (Rapid) Spanning Tree for all switches, you can create a meshed topology with redundant data paths. Any data links can now be created without taking loops into consideration. Loops can even be added on purpose in order to create redundant links.

In this context, a data path between spanning tree switches can be
– A direct connection.
– A connection via one or more additional switches that do not support Spanning Tree.

> If Spanning Tree is not supported by all of the switches used, the reconfiguration time for Spanning Tree is extended by the aging time of the switches without Spanning Tree support.

– A connection via one or more hubs that do not support Spanning Tree.

Furthermore, a data path can consist of a connection of a spanning tree switch to
– A termination device.
– A network segment in which no loops may occur, which consists of several infrastructure components (hubs or switches) without Spanning Tree support.

For the last two data path options, no specific precautionary measures are necessary. If necessary, you can use the “Fast Forwarding” option for the respective ports (see Section “Fast forwarding” on page 120).
For the first three cases, the following rules must be observed:
– Rule 1: Spanning Tree transparency for all infrastructure components
All infrastructure components used in your network that do not actively support Spanning Tree must be transparent for Spanning Tree messages (BPDUs) and must forward all BPDUs to all ports without modifying them. When Spanning Tree is disabled, the switch is transparent for BPDUs.

- Rule 2: At least one active Spanning Tree component per loop
  An active Spanning Tree component supports the Spanning Tree Protocol, sends/receives and evaluates BPDUs, and sets its ports to the relevant STP states.
  Each loop in a network must have at least one active Spanning Tree component to disintegrate the loop.
  Example:

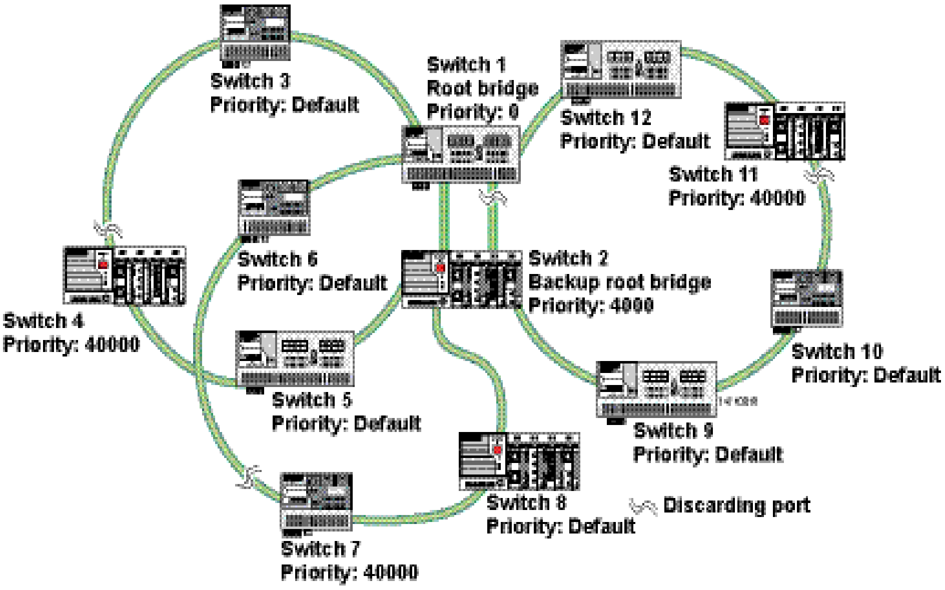


Figure 5-12 Example topology

The loops in the example topology illustrated are disabled by active RSTP components. The example topology contains three rings; the root and the backup root are components in each of the three rings. The three rings do not affect one another; a modification to the topology in one ring does not affect the topology of the other two rings.

- Rule 3: No more than ten active Spanning Tree components in the topology when using the Spanning Tree default setting
  The ability to disintegrate any topology to form a tree without loops requires a complex protocol that works with several variable timers. These variable timers are dimensioned using the default values recommended by the IEEE standard so that a topology with a maximum of ten active Spanning Tree components always results in a stable network.
  When using large tree, please note the following (see also Section “Large tree support” on page 111):
  - In the large tree support RSTP topology, only use devices that support large tree.
  - Enable the “Large Tree Support” option on all devices.
  - If RSTP is to be activated as the redundancy mechanism in an existing network with more than seven switches along the relevant path, then the “Large Tree Support” option must first be enabled on all devices.
  - It is recommended that “Large Tree Support” is not activated in networks with less than seven switches along the relevant path.

5.2.5.2 Example topologies

5.2.5.3 Redundant coupling of network segments

In this example, two network segments are connected via redundant data paths. Two RSTP components have ports in the “Blocking/Discarding” state (highlighted in gray). This is sufficient to operate the network.

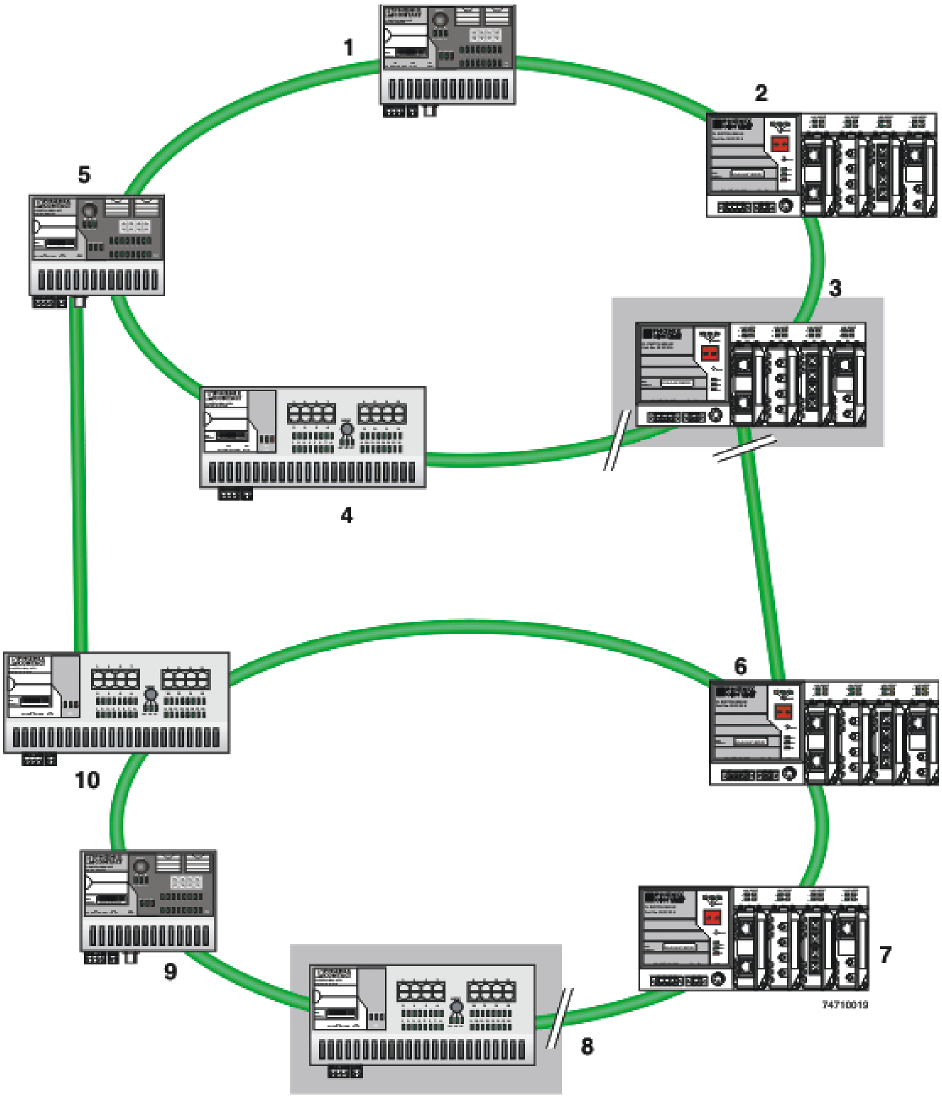


Figure 5-13 Redundant coupling of network segments

Example with fast ring detection

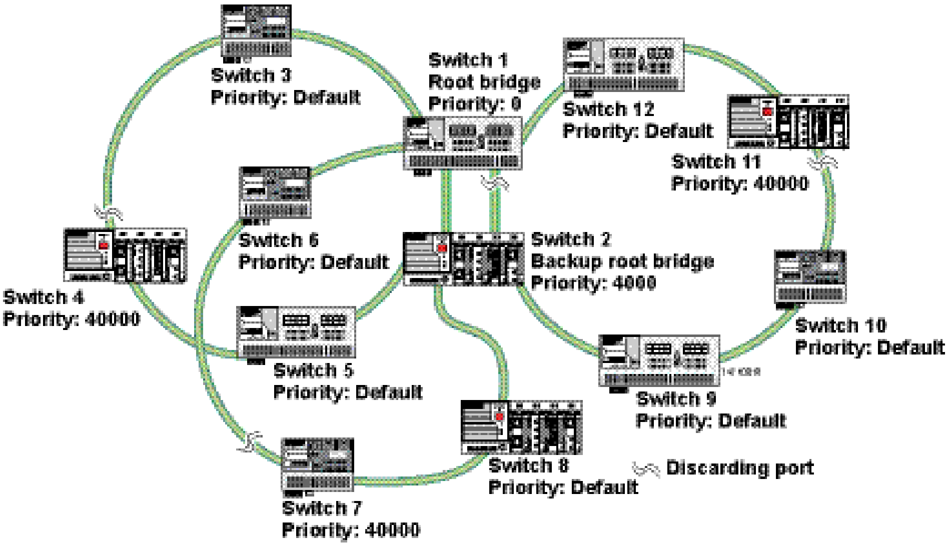


Figure 5-14 Example with fast ring detection

The switches in the illustrated example are arranged in such a way that two devices at the central position are configured as the root bridge and as the backup root bridge (via the priority).

The root bridge has the lowest priority, the backup root bridge has the second lowest priority. The root bridge and the backup root bridge are connected together redundantly. The remaining switches are networked in several rings in a ring topology. The end points of the rings are implemented on the root bridge and on the backup root bridge. The switch furthest away from the root bridge has a lower priority than the default setting, e.g., 40000.

The advantage of this constellation is that the individual rings are not adversely affected in the event of an error.

5.2.5.4 Method of operation of the Spanning Tree Protocol (STP)

Path costs

In a LAN segment, data is distributed with different speeds and methods, e.g., 100 Mbps full duplex or 10 Mbps half duplex. The interconnection of network devices involves different transmission bandwidths and different performance characteristics - which means there are also different “path costs”.

“High path costs” are associated with low-performance connections, e.g., 10 Mbps half duplex, while “low path costs” are associated with connections with a high total transmission speed, e.g., 100 Mbps full duplex.

Components of a Spanning Tree domain

Designated switch

The switch that connects a specific LAN segment (with the lowest path costs) to the root switch.

Root port

The other switches set the port with the lowest path costs (or with the highest total transmission speed) as the root switch in the forwarding state.

There is always just one root port per switch.
Exception: The switch supports several Spanning Tree domains.

Designated ports

Ports in the forwarding state of the designated switch.
These are the ports with the “best” path to the root switch.

Switch ID

Priority and
MAC address

The switch with the lowest bridge identifier is the root switch. The bridge identifier consists of the MAC address and the priority. Since the priority is placed before the MAC address, assignment of the appropriate priority clearly identifies the root switch, independent of the MAC address. The switch with the highest priority (lowest value) becomes the root switch. For every switch port within the network, a unique cost calculation is created. These root path costs are the sum of all path costs for one packet on the path between the root switch and corresponding switch port. The port of a switch with the lowest root path costs is always the active port. If the same root path costs have been calculated for two or more ports, the switch priority followed by the port priority determine the priority of the path.

Port ID

The port identifier consists of the path costs and the priority. Since the priority is placed before the path costs, the assignment of the appropriate priority clearly identifies the root port, independent of the path costs. The port with the highest priority (lowest value) becomes the root port.

5.2.5.5 Processes in the Spanning Tree Protocol (STP)

Selecting the root switch

For every topology modification, every switch first assumes that it is the root switch and thus sends its own switch ID (e.g., the MAC address) into the network. All switches receive these messages (MAC multicast) and store the contents of the “best” message. The “best” message contains the following topology information: The root ID information and the cost information.

After having received the root ID information, the switch compares the following:

- The new root ID is saved if it has a higher priority than the IDs that are already stored (including its own ID).
- The path costs are checked in case the root ID is identical to the one already saved. If they are lower, the ID is saved.
- If the root ID and the costs are the same, the ID of the sender is checked. If the ID is lower than the switch's own ID, it is saved.

– If the root ID, costs, and sender ID are the same, the priority of the sender port is the decisive criterion.

Selecting a designated switch

For every network, the switch with the most favorable root connection is selected. This switch is called the designated switch.
The root switch is the designated switch for all directly connected networks.

Selecting a root port

Once the root switch has been specified by processing the root IDs, the switches now specify the root ports.

The most favorable path is specified by minimizing all connection costs on the path to the root switch. Transmission speeds can also serve as costs. For the switch, the path costs added by each port for every HOP (the hop of a data packet from one point to the next) are preset to a value of 19 (default setting/recommended for 100 Mbps) and can be modified at any time by the user.

Selecting a designated port

At every “designated switch” the port with the most cost-effective data link in the direction of the root switch is called the designated port.

Port costs

The port costs can be set according to two different standards, 802.1D (STP) or 801.1W (RSTP).

> If, in addition to Phoenix Contact devices, devices from other manufacturers are used, it is recommended that the port costs are set according to a uniform standard.
>
> The “dot1dstpPathCostDefault” SNMP object (OID 1.3.6.1.2.1.17.2.18) can be used to change the standard that is used.

Table 5-2 Port costs according to 802.D

Transmission speed	Recommended value	Recommended range
10 Mbps	100	50 - 600
100 Mbps	19	10 - 60

Table 5-3 Port costs according to 802.W

Transmission speed	Recommended value	Recommended range
10 Mbps	2 000 000	200 000 - 20 000 000
100 Mbps	200 000	20 000 - 2 000 000
1000 Mbps	20 000	2 000 - 200 000

5.2.5.6 Flow chart for specifying the root path

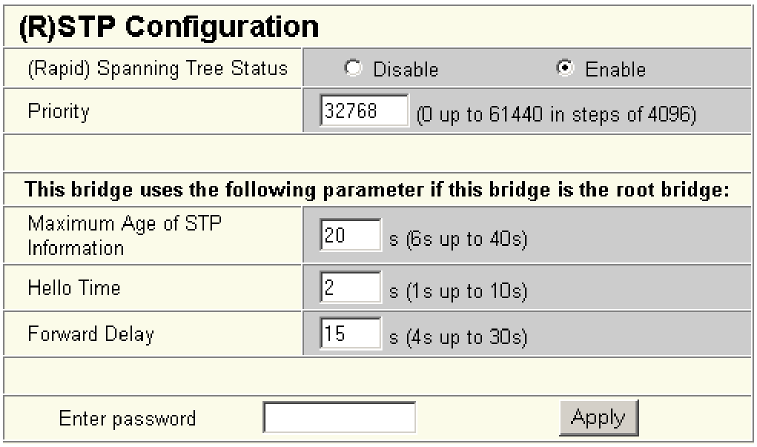
Figure 5-15 Flowchart for specifying the root path

5.2.5.7 Extended configuration

It may be practical to actively specify the topology that forms from the Spanning Tree Protocol and not to leave it to the random MAC addresses of the switches involved. Non-blocking/blocking data paths can thus be influenced and a load distribution specified. It may also be practical to explicitly deactivate the Spanning Tree Protocol at those ports that do not participate in Spanning Tree so as to benefit from the fast forwarding function. The Spanning Tree protocol also must be deactivated at individual ports if two different network segments - both using Spanning Tree - are to be coupled via these ports without the two tree structures melting to a large Spanning Tree.

Specifying the root switch

The root switch is assigned via the assignment of an appropriate priority for the Spanning Tree segment. Set the highest priority (lowest value) in the “Priority” field on the “STP Bridge Configuration” page in WBM for the switch selected as the root switch. Make sure that all the other network switches have a lower priority (higher value). Here, the set path costs are not evaluated.



(R)STP Configuration

(Rapid) Spanning Tree Status	○ Disable ● Enable
Priority	32768 (0 up to 61440 in steps of 4096)
This bridge uses the following parameter if this bridge is the root bridge:	
Maximum Age of STP Information	20 s (6s up to 40s)
Hello Time	2 s (1s up to 10s)
Forward Delay	15 s (4s up to 30s)
Enter password	Apply

Figure 5-16 Specifying the root switch priority

Specifying the root port or designated port

The root port and designated port are always the ports with the lowest path costs. If the costs are the same, the priority is the decisive criterion. If the priorities are also the same, the port number is the decisive criterion. Specify an appropriate combination of costs and priority on the “STP Port Configuration” page in WBM for the port specified as the root port or designated port. Make sure that all the other network switches either have higher costs or a lower priority (higher value).

5.2.5.8 Disabling the Spanning Tree Protocol/using the fast forwarding function

One of the following requirements must be met so that the Spanning Tree Protocol can be disabled for a port:

– A termination device is connected to the port.

– Additional infrastructure components are connected to the port. The corresponding network segment does not contain any loops.

Additional infrastructure components are connected to the port, forming a Spanning Tree of their own. No additional redundant connections to this network segment are permitted.

5.2.5.9 Modifying the protocol timers

Modifying the protocol timers may result in unstable networks.

It may be necessary to modify the protocol timers if, e.g., there are more than ten active Spanning Tree components in a single network. You can also try to reduce the reconfiguration times by modifying the timers. However, care should be taken in order to prevent unstable networks.
Please note that the protocol times are specified by the root switch and that they are distributed to all devices via BPDU. It is therefore necessary to modify the values in the root switch at first. If a root switch fails, the timer values of another active STP switch (i.e., the new root switch) will be valid for the entire network segment. Please remember this during component configuration.

Specifying the timer values (STP and RSTP)

- Maximum number of active Spanning Tree components along the path beginning at the root switch (please refer to the following two example illustrations):
  = (MaxAge / 2) - Hello Time + 1
- 2 x (Forward Delay - 1 s) ≥ MaxAge
- MaxAge ≥ 2 × (HelloTime + 1 s)

The value ((MaxAge / 2) - Hello Time) for a ring topology corresponds to the maximum number of components with active Spanning Tree.

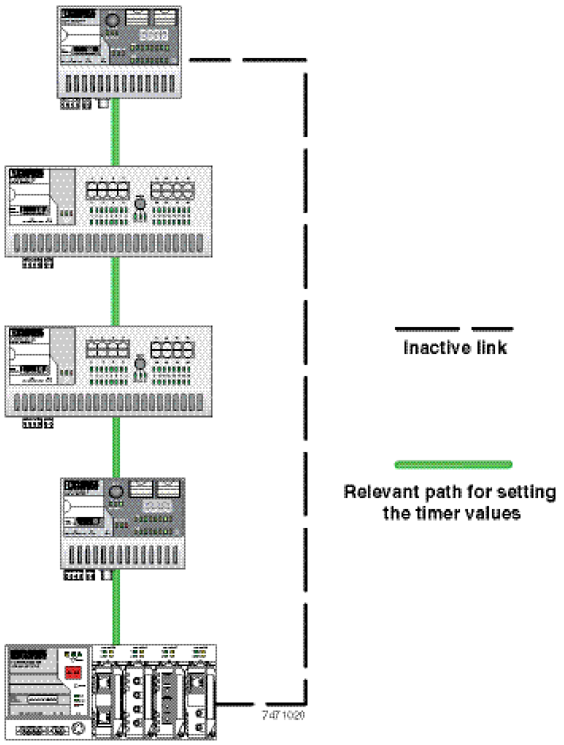


Figure 5-17 Example 1 of the “relevant path”

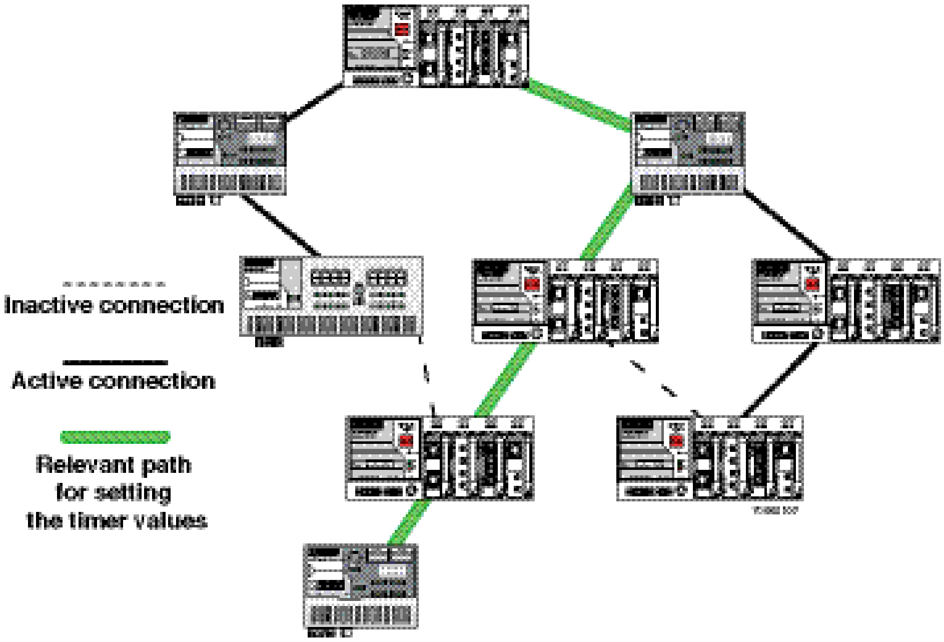


Figure 5-18 Example 2 of the “relevant path”

5.2.5.10 Reconfiguration times

The reconfiguration time for a Spanning Tree depends on the timer values for MaxAge and Forward Delay.

The minimum reconfiguration time is: 2 × Forward Delay

The maximum reconfiguration time is: 2 × Forward Delay + MaxAge

For the values recommended by the IEEE standard, the value for ten active STP switches along a path beginning with the root switch is between 30 s and 50 s.

Switch-over time response to be expected for RSTP and RSTP with activated ring detection

When using RSTP, expect switch-over times in the range from 100 ms to 2 s.

When using fast ring detection, expect switch-over times in the range from 100 ms to 500 ms.

The various roles of ports

The root port of a switch connects this switch to the root switch - either directly or via another switch (designated switch).

The designated port is the port at a designated switch that is connected to the root port of the next switch.

No additional switches/bridges are connected to an edge port. Termination devices are connected to an edge port.

An alternate port is a path to the root, which, however, did not become a root port. This means that this port is not part of the active topology.

6 Media Redundancy Protocol (MRP)

6.1 General function

Loops

A ring can be created in the network using MRP according to IEC 62439 and a redundant connection provided. Each ring must contain an MRP manager, all other devices (in the ring) must support the MRP client function. The ring is created using dedicated ports. The MRP ports must be configured in the switch management. When configured correctly, MRP offers a guaranteed maximum switch-over time of 200 ms.

For the MCS, the necessary MRP manager function can be implemented with the “FL MEM Plug/MRM” configuration memory (Order No. 2891275).

Please note that MRP is disabled by default upon delivery.

6.2 MRP manager

For the MMS/MCS, the MRP manager function is provided by an interface module/MEM plug. Since the manager function is linked to a replaceable module, the following options are available:

- If no manager module is present, “MRP Manager” mode is not available or cannot be selected.
- If a manager function module is inserted during runtime or if it is already present during the boot process, “MRP Manager” mode is available or accepted in the user interfaces.
- If a manager function module is present during the boot process and “MRP Manager” mode is activated in the saved configuration of the MMS/MCS, the MRP manager function is automatically enabled.
- If no manager function module is present during the boot process and the MRP manager is enabled in the saved configuration, the device activates a “safe state”, in which one of the ring ports is set to blocking mode to prevent loop generation. An error message appears, which would also be displayed in the event of a ring error, informing the user of this configuration error. After inserting the manager function module, the manager can be re-enabled manually or a reboot executed.
- If a manager function module is removed during runtime, the MRP manager can no longer be selected.
- If a manager function module is removed while the MRP manager is active, the mode remains active until the device is restarted or is switched to another mode (MRP client, disabled).

6.2.1 Network examples

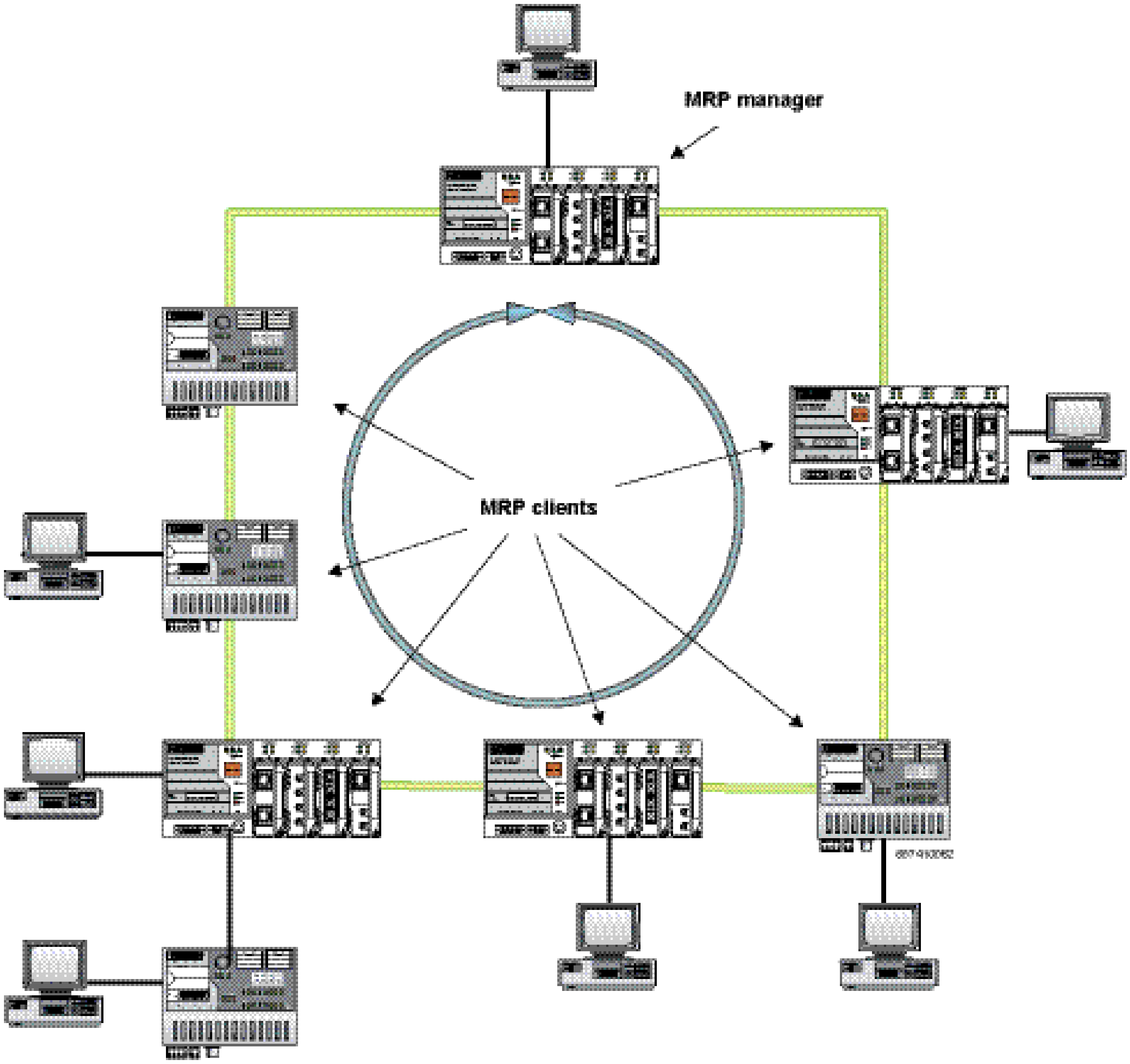


Figure 6-1 Example of an MRP ring

Make sure that the topology used does not contain an invalid mixture of RSTP and MRP, e.g., by additionally coupling two of the devices through an RSTP connection rendering them redundant.

6.2.1.1 Example of a permissible network with MRP and (R)STP

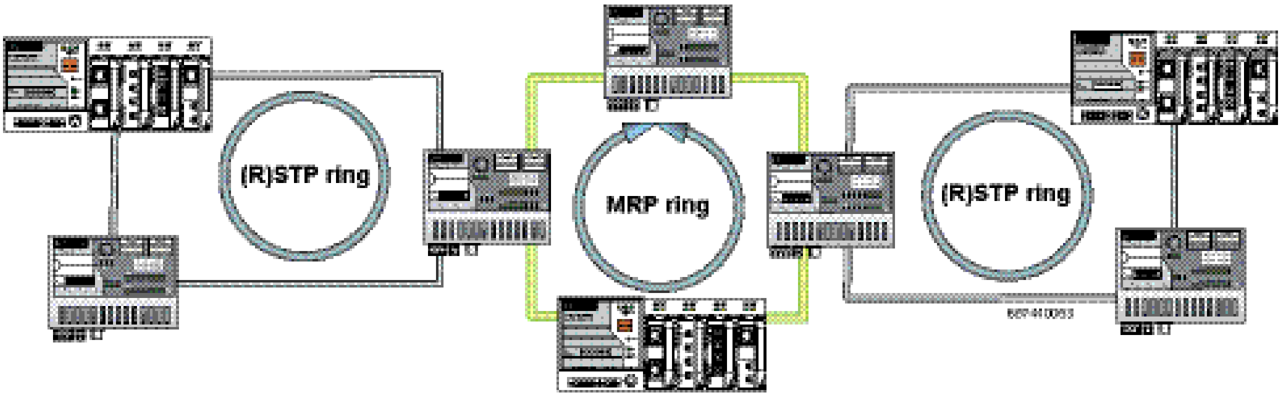


Figure 6-2 Permissible example of MRP with (R)STP

6.2.1.2 Example of an impermissible network with MRP and (R)STP

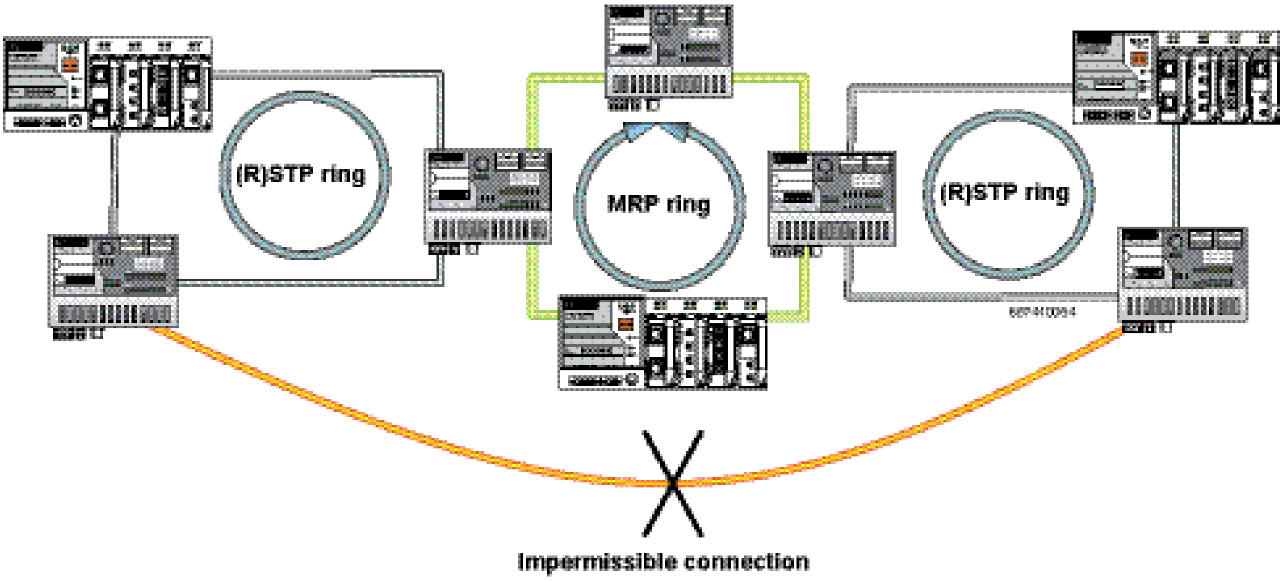


Figure 6-3 Impermissible example

6.3 Enabling web pages for using MRP in WBM

Activate WBM for the switches, e.g., using Factory Manager. Switch to the “General Configuration” menu, then select the “User Interfaces” page. Activate “Redundancy” and confirm by entering your password.

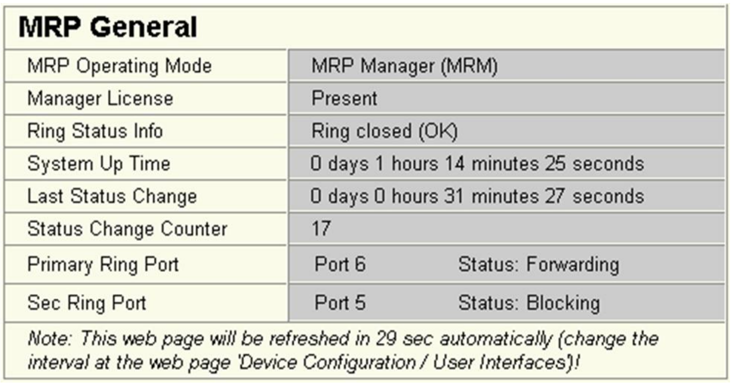
> Activating “Redundancy” under “General Configuration, User Interfaces” does not activate a redundancy mechanism. In the WBM menu, the “Media Redundancy” page - under which the function can be configured and activated - is enabled.

6.4 Configuration of MRP

6.4.1 MRP general

The “MRP General” web page shows the current parameters set for using the protocol. The following information is displayed:

- Operating mode (disabled, MRP client or MRP manager)
- Manager function (present or missing)
- Ring status if the switch is operating as an MRP manager (OK (ring closed) or Fail (ring open))
- Topology modification counter
- Time of last topology modification
- Ring port numbers and status of the ports (Forwarding or Blocking)

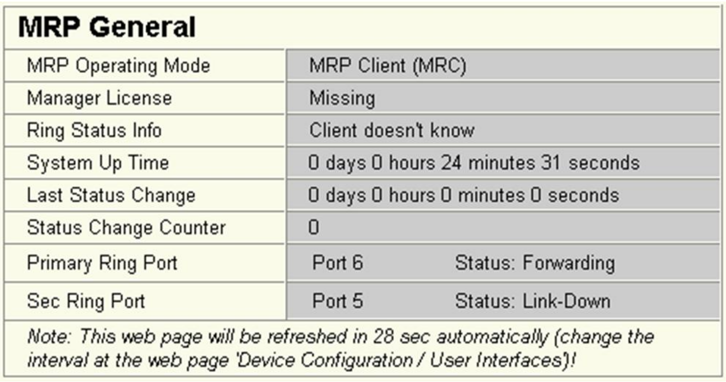


MRP General

MRP Operating Mode	MRP Manager (MRM)	
Manager License	Present	
Ring Status Info	Ring closed (OK)	
System Up Time	0 days 1 hours 14 minutes 25 seconds	
Last Status Change	0 days 0 hours 31 minutes 27 seconds	
Status Change Counter	17	
Primary Ring Port	Port 6	Status: Forwarding
Sec Ring Port	Port 5	Status: Blocking

Note: This web page will be refreshed in 29 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 6-4 “MRP General” web page for an MRP manager



MRP General

MRP Operating Mode	MRP Client (MRC)	
Manager License	Missing	
Ring Status Info	Client doesn't know	
System Up Time	0 days 0 hours 24 minutes 31 seconds	
Last Status Change	0 days 0 hours 0 minutes 0 seconds	
Status Change Counter	0	
Primary Ring Port	Port 6	Status: Forwarding
Sec Ring Port	Port 5	Status: Link-Down

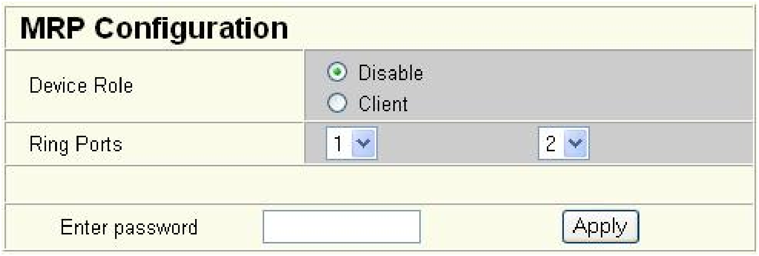
Note: This web page will be refreshed in 28 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

Figure 6-5 “MRP General” web page for an MRP client

6.4.2 MRP configuration

The “MRP Configuration” web page is used to configure the protocol parameters. The following configuration parameters are displayed:

- Device role (disabled, MRP client or MRP manager)
- Selection of the ring ports that are integrated in the MRP ring
- Selection of the VLAN ID for tagging mode



MRP Configuration

Device Role	● Disable ○ Client	
Ring Ports	1	2
Enter password		

Figure 6-6 “MRP Configuration” web page

6.4.2.1 Using MRP in VLAN mode

When using VLANs, a standard tag with the highest priority is assigned to the MRP packets. In addition, a VLAN ID can be specified in the MRP configuration. Only static VLAN entries, which are listed in WBM under “Switch, VLAN, Static VLAN”, can be used. The tag is only added to the MRP packet if the port to which the MRP packet is sent is operating in tagging mode.

7 Multicast filtering

7.1 Basics

Multicast

Multicast applications, unlike unicast applications with point-to-point communication, do not transmit their data with the MAC address of the destination, but with an independent multicast group address. Always using wireless communication, a station transmits one data packet that is received by one or more receiving stations.

Advantages:

1 If, for example, a data packet of a transmitter is to be transmitted to eight receivers, the same packet does not have to be sent eight times to the addresses of all eight devices. Instead it only needs to be sent once to the address of the multicast group that includes the eight devices.

2 When using multicast communication and filtering, the bandwidth requirement for data transmission is reduced because each packet is only transmitted once.

> A maximum of 128 multicast groups can be created automatically for IGMP snooping. In addition, a maximum of 20 static groups can be created.

7.2 Enabling the web pages for multicast filtering in WBM

Activate WBM for the switches, e.g., using Factory Manager. Switch to the “General Configuration” menu, then select the “User Interfaces” page. Activate “Multicast Filtering” and confirm by entering your password.

> When activating “Multicast Filtering” under “General Configuration, User Interfaces”, the multicast mechanism is not activated. In the WBM menu, the “Multicast” page - under which the function can be configured and activated - is enabled.

7.3 Static multicast groups

Static multicast groups must be created manually on every switch, and all ports that are used to contact group members need to be added. The advantages of static groups are:

1 Easy specification of network paths on which the multicast data traffic of known groups is limited.

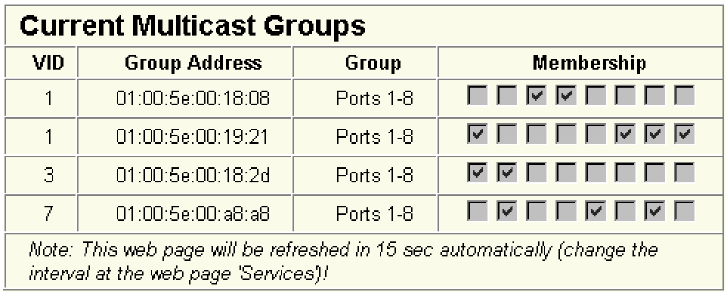
2 No querier required (see “Query” on page 145).

The following marginal conditions must be observed:

- Precise network documentation for path specification is required.
- Possible redundant paths due to Spanning Tree must be taken into account during port assignment.
- For network modifications and, during servicing or expansion, the multicast data paths must be restored.

7.3.1 “Current Multicast Groups” web page

The table on this web page provides an overview of the current multicast groups created on this MMS. These include multicast groups assigned as a result of IGMP snooping and groups that are statically created.



Current Multicast Groups

VID	Group Address	Group	Membership
1	01:00:5e:00:18:08	Ports 1-8	□ □ ☑ ☑ □ □ □ □
1	01:00:5e:00:19:21	Ports 1-8	☑ □ □ □ □ ☑ ☑ ☑
3	01:00:5e:00:18:2d	Ports 1-8	☑ ☑ □ □ □ □ □ □
7	01:00:5e:00:a8:a8	Ports 1-8	□ ☑ □ □ ☑ □ ☑ □

Note: This web page will be refreshed in 15 sec automatically (change the interval at the web page 'Services')!

Figure 7-1 “Current Multicast Groups” web page

The checkboxes indicate which port has been assigned to each individual group.

Please note that all multicast groups that are known to the switch, including the dynamically detected groups that were not created manually, are shown on this web page.

The overview for group membership is based on the “dot1qTpGroupTable” SNMP group. This table contains all groups (static entries and IGMP) and their members.

7.3.2 Creating static multicast groups

This web page is used to create and manage statically configured multicast groups. In order to create a multicast group, enter the MAC address provided (see “Multicast addresses” on page 142) for the multicast group in the “Multicast Group Address” field, add the ports of the data paths to the group members, and confirm these entries by entering a valid password. If a group address is entered as an IP address, the IP address is converted into a multicast MAC address according to the specifications of IEEE 802.1 D/p.

Overwriting a dynamic group with a static configuration means that a new port assignment for this group cannot be created dynamically. Port assignment for this group can only be started dynamically once the group has been deleted.

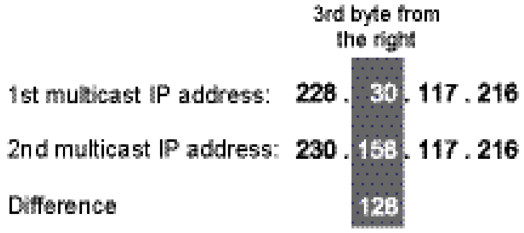
Conversion

The guidelines for converting a multicast IP addresses into a multicast MAC address require mapping of different IP groups to the same MAC group. Avoid the use of IP groups that

– Do not differ in the first and second byte from the right
– Differ by 128 in the third byte from the right

The fourth byte from the right is always replaced by 01:00:5e during conversion. See example below:

Because of the conversion from IP to MAC addresses, you should avoid using IP addresses that differ by 128 in the third byte from the right. Example:



3rd byte from the right

1st multicast IP address: 228 . 30 . 117 . 216

2nd multicast IP address: 230 . 158 . 117 . 216

Difference 128

Both multicast IP addresses are converted into multicast MAC address 01:00:5e:1e:75:d8.

The group is added to the list of existing static multicast groups. This list, which is displayed in a list box, is referred to as “dot1qStaticMulticastTable” in SNMP.

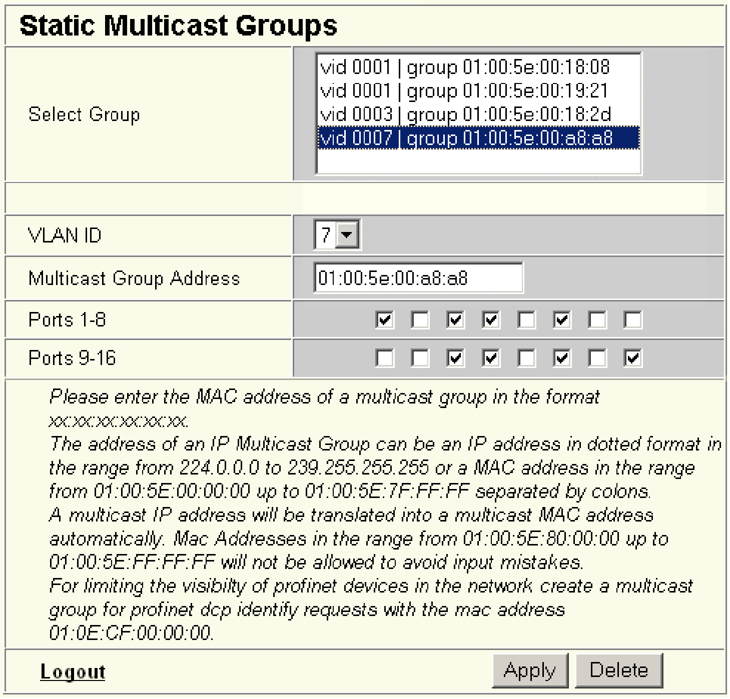
Settings are not automatically saved permanently. The active configuration can be saved permanently by selecting “Save current configuration” on the “Configuration Management” web page.

Port assignment

After entering a new group in the “Multicast Group Address” field, add the ports of the group members by selecting the corresponding checkboxes. Confirm by entering your password and clicking on “Apply”.

Modifying assignment

Select the corresponding group in the “Select Group” list box to modify or delete the port assignment. The group members are indicated by activated checkboxes and can be modified, if required. An action is completed by entering a password and clicking on “Apply” or “Delete”.



Static Multicast Groups

Select Group	vid 0001 | group 01:00:5e:00:18:08 vid 0001 | group 01:00:5e:00:19:21 vid 0003 | group 01:00:5e:00:18:2d vid 0007 | group 01:00:5e:00:a8:a8
VLAN ID	7
Multicast Group Address	01:00:5e:00:a8:a8
Ports 1-8	☑ □ ☑ ☑ □ ☑ □ □
Ports 9-16	□ □ ☑ ☑ □ ☑ □ ☑

Please enter the MAC address of a multicast group in the format xx:xx:xx:xx:xx:xx.
The address of an IP Multicast Group can be an IP address in dotted format in the range from 224.0.0.0 to 239.255.255.255 or a MAC address in the range from 01:00:5E:00:00:00 up to 01:00:5E:7F:FF:FF separated by colons.
A multicast IP address will be translated into a multicast MAC address automatically. Mac Addresses in the range from 01:00:5E:80:00:00 up to 01:00:5E:FF:FF:FF will not be allowed to avoid input mistakes.
For limiting the visibilty of profinet devices in the network create a multicast group for profinet dcp identify requests with the mac address 01:0E:CF:00:00:00.

Figure 7-2 “Static Multicast Groups” menu

Checking the group assignment

In order to check which ports are assigned to which group, select one of the existing groups. The corresponding MAC address is then displayed in the “Multicast Group Address” text field. The members of the group are indicated by the activated checkboxes.

Multicast addresses

Do not use multicast MAC addresses that are in the range from 01:00:5e:80:00:00 to 01:00:5e:FF:FF:FF.

Incorrect format

An incorrect MAC address format and the entry of “non-multicast addresses” is indicated, and the entry is not permitted.

> Please note that in multicast MAC addresses the bytes are separated by a colon (:) and in IP multicast addresses are separated by a full stop (.).

7.3.3 Procedure for creating a multicast group

Gain an overview of the multicast applications available within the network and the multicast addresses used. Create a group for every multicast application or for the multicast address used, and for each switch add the ports to which a device of the appropriate group is directly connected or via which the device can be accessed.

Example

In the following table, the ports (for each switch) to which the receivers of the multicast data are connected are indicated with an “X”. See an example configuration in Figure 7-3 on page 144

Table 7-1 Multicast port assignment on the switches

	Switch 1	Switch 2	Switch 3	Switch 4	Switch 5	Switch 6	Switch 7
Port 1							
Port 2	X	X	X	X	X	X	X
Port 3							
Port 4					X		X
Port 5				X			
Port 6						X	
Port 7	X						
Port 8			X		X		

ℹ Please note that possible redundant paths resulting from Rapid Spanning Tree must be taken into consideration for multicast group creation.

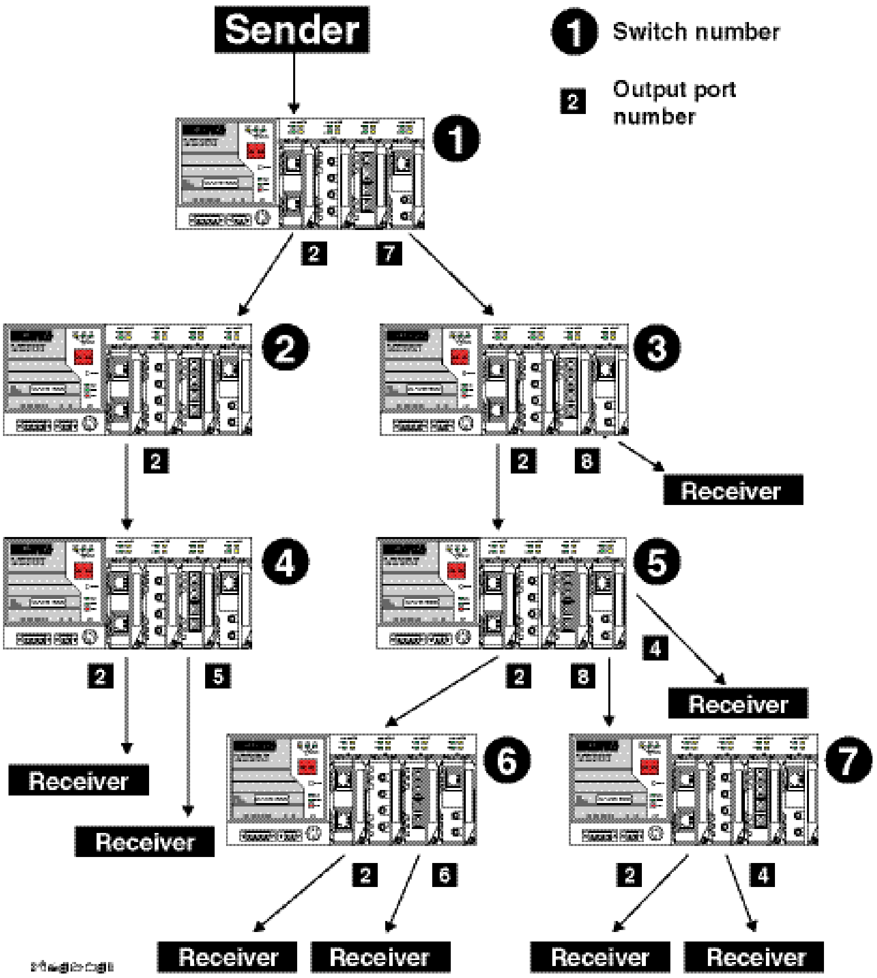


Figure 7-3 Configuration example

Possible redundant paths resulting from Rapid Spanning Tree must be taken into consideration for multicast group creation.

7.4 Dynamic multicast groups

7.4.1 Internet Group Management Protocol (IGMP)

IGMP on Layer 3

The Internet Group Management Protocol describes a method for distributing information via multicast applications between routers and terminal devices at IP level (Layer 3).

When starting a multicast application, a network device transmits an IGMP membership report and thus announces its membership of a specific multicast group. A router collects these membership reports, maintaining in this way the multicast groups of its subnetwork.

Query

At regular intervals, the router sends IGMP queries. This prompts the devices with multicast receiver applications to send another membership report.

The “IGMP Query” function only transmits in the management VLAN and only stops if there is a better querier in the management VLAN.

The router enters the IP multicast group address from the report message in its routing table. This means that frames with this IP multicast group address in the destination address field are only transferred according to the routing table. Devices that are no longer members of a multicast group log out with a leave message (IGMP Version 2 or later) and no longer send report messages.
The router also removes the routing table entry if it does not receive a report message within a specific time (aging time). If several routers with active IGMP query function are connected to the network, they determine among themselves which router performs the query function. This depends on the IP addresses, as the router with the lowest IP address continues to operate as the querier and all the other routers no longer send query messages. If these routers do not receive a new query telegram within a specific period of time, they themselves become queriers again. If there are no routers in the network, a suitably equipped switch can be used for the query function. Please note that the MMS/MCS only operates as the IGMP querier in the management VLAN.

IGMP snooping

A switch that connects a multicast receiver with a router can read and evaluate IGMP information using the IGMP snooping method. IGMP snooping translates IP multicast group addresses into multicast MAC addresses, so that the IGMP function can also be detected by Layer 2 switches. The switch enters the MAC addresses of the multicast receivers, which were obtained from the IP addresses by IGMP snooping, in its own multicast filter table. Thus the switch filters multicast packets of known multicast groups and only forwards packets to those ports to which corresponding multicast receivers are connected.

IGMP snooping can only be used on Layer 2 if all terminal devices send IGMP messages. The IP stack of multicast-compatible terminal devices with applications linked to a multicast address automatically sends the relevant membership reports.

IGMP snooping operates independently of the Internet Group Management Protocol (IGMP).

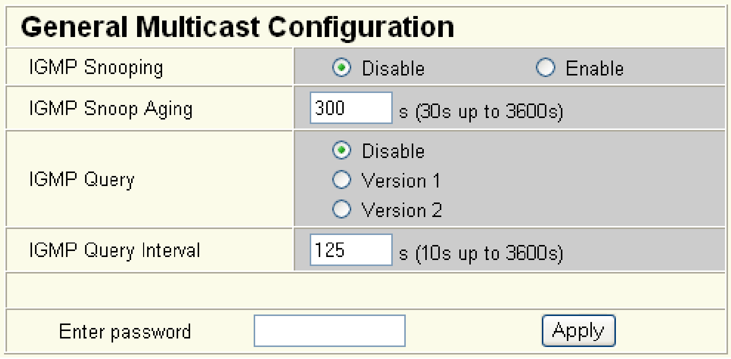
7.4.1.1 Extended multicast filtering

If IGMP snooping is active, multicast data streams for which no membership reports of possible recipients are registered are also detected. For these multicasts, groups are created dynamically. These multicasts are forwarded to the querier, i.e., the querier port is entered in the group.

If the switch itself is the querier, these multicasts are blocked.

7.4.2 “General Multicast Configuration” web page

This web page provides global settings for multicast support. Here, IGMP snooping can be activated and an aging time specified for IGMP snooping information.



General Multicast Configuration

IGMP Snooping	● Disable ○ Enable
IGMP Snoop Aging	300 s (30s up to 3600s)
IGMP Query	● Disable ○ Version 1 ○ Version 2
IGMP Query Interval	125 s (10s up to 3600s)

Figure 7-4 “General Multicast Configuration” web page

IGMP snooping
In IGMP snooping, the switch passively listens in on the IGMP messages that are sent over the network and dynamically creates the appropriate groups. The groups are not saved and will be lost during every power down or when the snooping function is switched off.

IGMP query
An MMS/MCS with activated query function actively sends queries at the “Query Interval” and evaluates the received reports. The MMS/MCS only sends IGMP query reports if IGMP snooping is enabled and only in the management VLAN.

8 Virtual Local Area Network (VLAN)

8.1 Basics

VLAN

A VLAN is a closed network, which is separated logically/functionally rather than physically from the other networks. A VLAN creates its own broadcast and multicast domain, which is defined by the user according to specified logical criteria. VLANs are used to separate the physical and the logical network structure.

– Data packets are only forwarded within the relevant VLAN.
– The members of a VLAN can be distributed over a large area.

The reduced propagation of broadcasts and multicasts increases the available bandwidth within a network segment. In addition, the strict separation of the data traffic increases system security.

A router or similar Layer 3 device is required for data traffic between VLANs.

For the switch, the VLANs can be created statically.

8.2 Enabling the VLAN web pages in web-based management

Start web-based management for the switches, e.g., using Factory Manager, switch to the “General Configuration” menu, then the “User Interfaces” page. Activate the “VLAN” function and confirm by entering your password.

When activating “VLAN” under “User Interfaces”, the VLAN mechanism is not activated. In the WBM menu, the “VLAN” page - under which the function can be configured and activated - is enabled.

When deactivating the VLAN configuration pages under “User Interfaces”, the VLAN mechanism is not deactivated. The saved VLAN configuration is retained.

8.2.1 Management VLAN ID

The management of the switch is assigned to VLAN 1 by default upon delivery. In addition, all ports are assigned to VLAN 1 by default upon delivery. This ensures that the network-supported management functions can be accessed via all ports.

Make sure that the switch is always managed in a VLAN that you can also access.

VLAN ID 1 cannot be deleted and is thus always created on the switch.

If you delete the VLAN in which the switch is managed, management is automatically switched to VLAN 1.

The “IGMP Query” function only transmits in the management VLAN and only stops if there is a better querier in the management VLAN.

8.2.2 Changing the management VLAN ID

8.2.2.1 Configuration in transparent mode

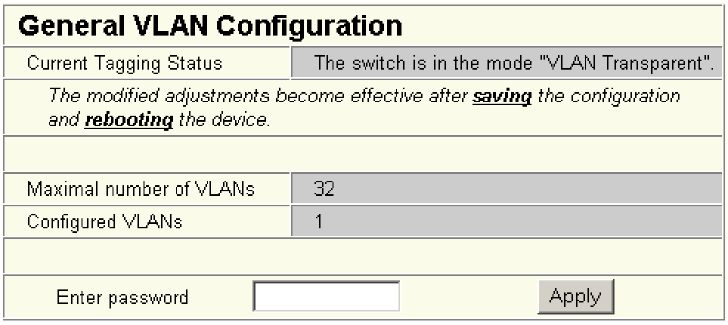
1 In WBM, enable the pages for VLAN configuration (WBM: User Interfaces, Virtual LAN).
2 Create the required VLANs on the “Static VLANs” web page.
3 On the “VLAN Port Configuration Table” web page, assign the ports for incoming packets to individual VLANs using the VLAN ID.
4 On the “IP Configuration” web page, the desired management VLAN ID can now be set.
5 On the “General VLAN Configuration” web page, set the switch to “Tagging” VLAN mode.
6 Save the configuration on the “General Configuration, Configuration Management” web page and restart the switch.

8.3 General VLAN configuration

Basic settings for VLAN operation can be made on the “Switch Station, VLAN, General VLAN Configuration” web page.

Transparent

In “Transparent” mode, the switch processes the incoming data packets as described in Section “Frame switching” (see Section 3.3 on page 22). Neither the structure nor the contents of the data packets is changed. The information about VLAN assignment from a tag that may be contained in the data packet is ignored.



General VLAN Configuration

Current Tagging Status	The switch is in the mode "VLAN Transparent".

*The modified adjustments become effective after **saving** the configuration and **rebooting** the device.*

Maximal number of VLANs	32
Configured VLANs	1

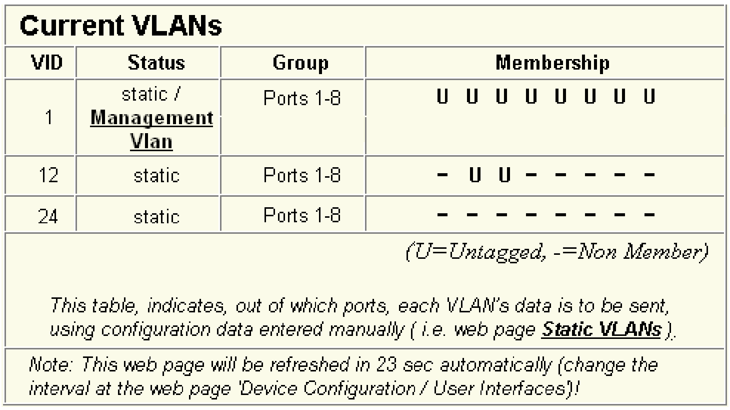
Enter password

Figure 8-1 “General VLAN Configuration” menu

The switch supports a maximum of 32 different VLANs.

8.4 Current VLANs

The “Current VLANs” web page provides an overview of the VLANs currently set up. In addition, refer to the table for the VLAN in which the switch is actually managed. All static VLANs are listed here. A distinction is made between untagged (U) group members and non-members (-) (see possible states on page 150).



Current VLANs

VID	Status	Group	Membership
1	static / **Management Vlan**	Ports 1-8	U U U U U U U U
12	static	Ports 1-8	- U U - - - - -
24	static	Ports 1-8	- - - - - - - -

(U=Untagged, -=Non Member)

This table, indicates, out of which ports, each VLAN's data is to be sent, using configuration data entered manually (i.e. web page ***Static VLANs*** *).*

Note: This web page will be refreshed in 23 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces')!

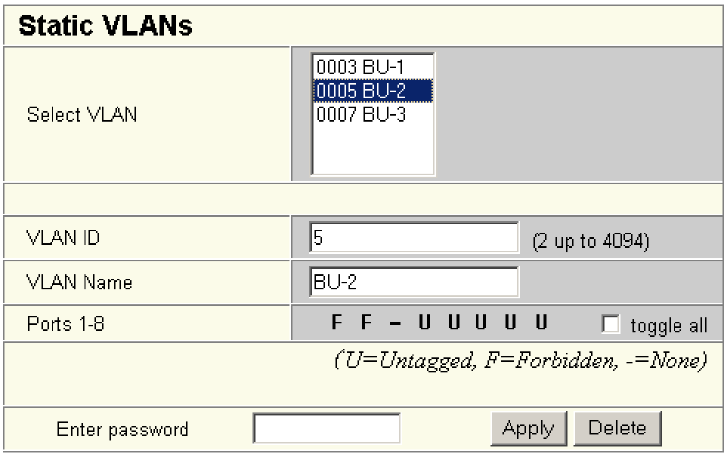
Figure 8-2 “Current VLANs” web page

When the maximum number of set up VLANs is reached, the following text appears below the key for the member states: “The switch supports only 32 VLANs! Further VLANs will be refused!”

VLAN 1 is always created statically and all ports are added to it as untagged members.

8.4.1 Static VLANs

Static VLANs can be created on this web page. Up to 31 new VLANs can be created (VLAN 2 to VLAN 32). If more are created, a corresponding message will be displayed. VLAN 1 is always created statically and all ports are added to it as untagged members. By default upon delivery, network-based management interfaces (WBM, Telnet, and SNMP) are available from VLAN 1.



Static VLANs

Select VLAN	0003 BU-1 0005 BU-2 0007 BU-3
VLAN ID	5 (2 up to 4094)
VLAN Name	BU-2
Ports 1-8	F F – U U U U U □ toggle all
	(U=Untagged, F=Forbidden, -=None)

Enter password

Figure 8-3 “Static VLANs” menu

On this web page you can create static VLANs by assigning a VLAN ID and VLAN name. The ports are then assigned to the individual VLANs by selecting the relevant VLAN and clicking on the character in the “Ports 1-8” line that indicates the current port status. Various options are selected by clicking on the status several times. By selecting “toggle all”, all available ports in the relevant port group change their status.

The possible states are:

U = Untagged

Ports with “Untagged” status belong to the selected VLAN and packets are sent to this port without VLAN tag. An “Untagged” port cannot belong to multiple VLANs - otherwise there is no logical division (except VLAN 1)

F = Forbidden

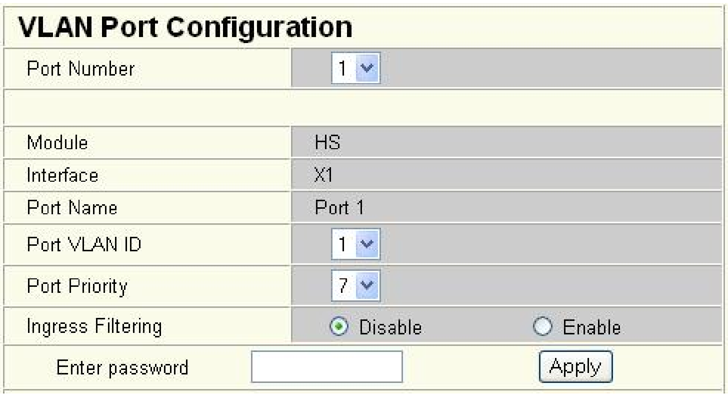
Ports with the “Forbidden” status do not belong to the selected VLAN and cannot be added dynamically to this VLAN via GVRP.

- = None

Ports with “None” status are not integrated into the VLAN.

8.4.2 VLAN port configuration

Port-specific VLAN settings can be made on this web page.



VLAN Port Configuration

Port Number	1
Module	HS
Interface	X1
Port Name	Port 1
Port VLAN ID	1
Port Priority	7
Ingress Filtering	● Disable ○ Enable
Enter password	

Figure 8-4 VLAN port configuration

If “Ingress Filtering” is set to “Enable”, the switch rejects data packets received at this port if the port is not a “tagged member” or “untagged member” of the VLAN with the VLAN ID contained in the tag of the packet.

Port priority

– A corresponding tag indicating the priority is added to packets without tags.

Port VLAN ID

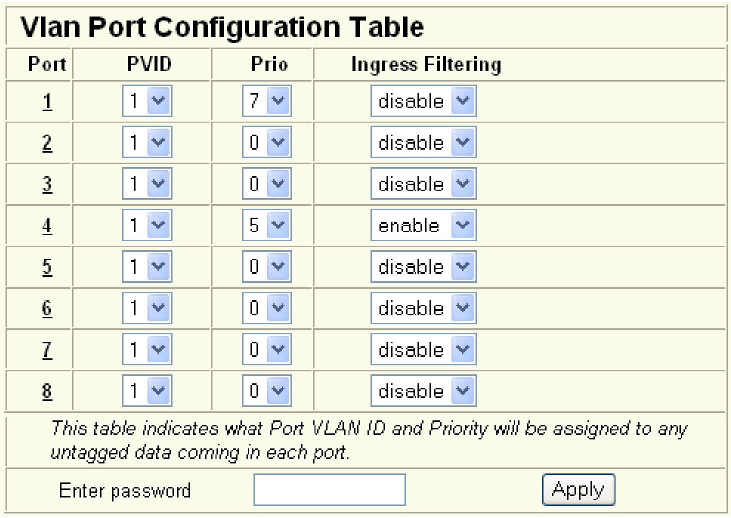
– Assignment of received, untagged packets to a VLAN. The corresponding VLAN ID must be set for the ports that are “untagged members” of a VLAN (see “Example: Communication between termination devices via VLAN” on page 153).

Only IDs of existing VLANs can be set as the port VLAN ID. If a VLAN is deleted, all port VLAN IDs that are set to this VLAN are reset to the default VLAN ID “1”.

8.4.3 VLAN port configuration table

This web page provides an overview of the main VLAN settings for the ports. Clicking on the relevant port number opens the “VLAN Port Configuration” web page, where the settings can be modified.

This table can be used to assign incoming packets to the created VLANs if the packets reached the port without a VLAN tag.



Vlan Port Configuration Table

Port	PVID	Prio	Ingress Filtering
1	1	7	disable
2	1	0	disable
3	1	0	disable
4	1	5	enable
5	1	0	disable
6	1	0	disable
7	1	0	disable
8	1	0	disable

This table indicates what Port VLAN ID and Priority will be assigned to any untagged data coming in each port.

Enter password

Figure 8-5 “Vlan Port Configuration Table” menu

8.5 Setting up static VLANs

Security recommendation: Instead of using VLAN 1 for management, it is recommended that a new separate VLAN is created for management. Ensure that the administrator has access to this VLAN.

Warnings displayed when setting up/configuring VLANs indicate configuration errors:

– An “untagged” port belongs to multiple VLANs.

The port assignment (untagged) and PVID do not match.

In order to set up a VLAN, the switches involved must be configured accordingly. In the following example, data traffic is to be enabled in VLAN 5 between termination devices A and B.

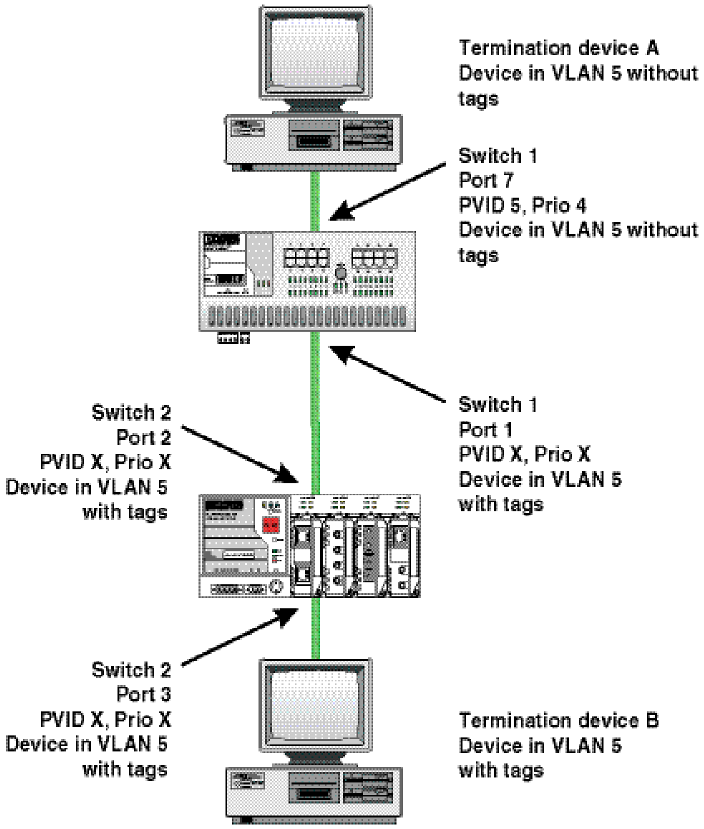

Termination device A
Device in VLAN 5 without tags
Switch 1
Port 7
PVID 5, Prio 4
Device in VLAN 5 without tags
Switch 1
Port 1
PVID X, Prio X
Device in VLAN 5 with tags
Switch 2
Port 2
PVID X, Prio X
Device in VLAN 5 with tags
Switch 2
Port 3
PVID X, Prio X
Device in VLAN 5 with tags
Termination device B
Device in VLAN 5 with tags

Figure 8-6 Example: Communication between termination devices via VLAN

Switch configuration

1 Set both switches to “VLAN Tagging” mode, save, and restart the devices.
2 Create VLAN 5 on switch 1 and specify port 7 as an “untagged” member and port 1 as a “tagged” member.
3 For port 7 at switch 1, set the port VLAN ID to 5 and the port priority to any.
4 On switch 2, set up port 2 and port 3 as “tagged” members of VLAN 5.

Both termination devices now communicate via the network path shown in the example without other switch ports forwarding the broadcast packets for both termination devices, for example.

8.6 VLAN and (R)STP

When using (R)STP and VLAN simultaneously, please note the following:

- (R)STP is not based on VLANs.
- (R)STP creates a loop-free topology in the form of a tree structure.

In the event of static VLAN configuration, all possible redundant data paths must be taken into consideration during configuration. All possible backbone ports of the network (i.e., not the termination device ports) must be inserted in all available VLANs as “tagged” members. This ensures that for every possible tree structure that can be generated by (R)STP, every VLAN can be accessed by every switch.

An example configuration is illustrated in the following diagram:

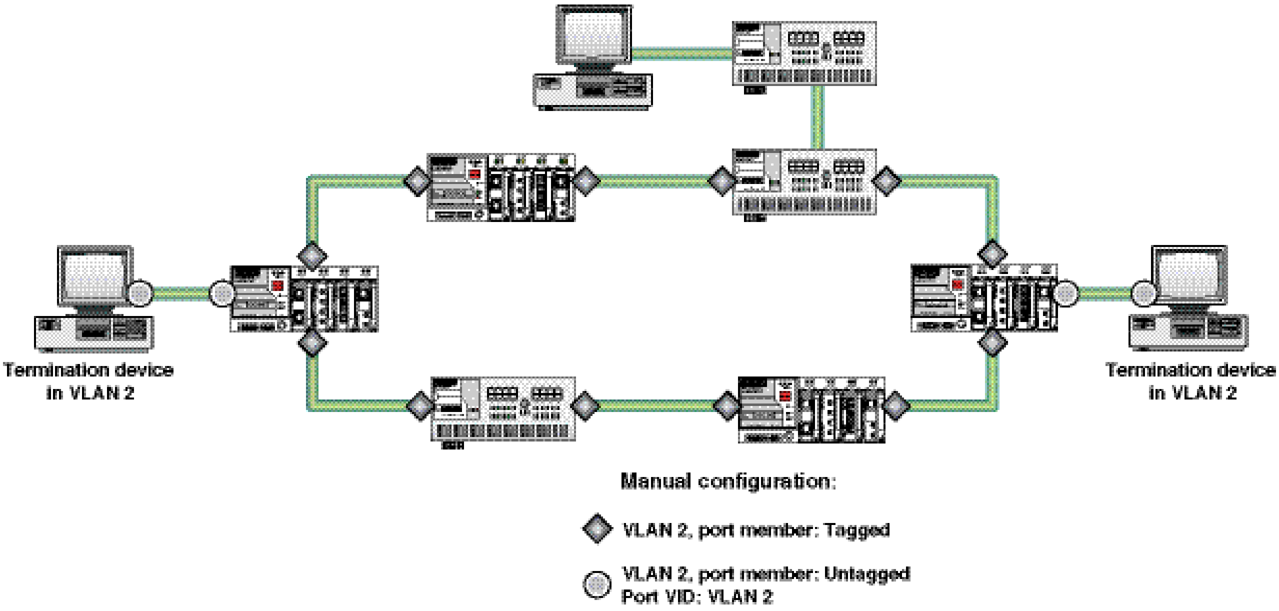

Termination device in VLAN 2
Termination device in VLAN 2
Manual configuration:
VLAN 2, port member: Tagged
VLAN 2, port member: Untagged
Port VID: VLAN 2

Figure 8-7 Typical configuration for VLAN and (R)STP

9 Operation as a PROFINET device

The switch is supported as a PROFINET device in PC Worx Version 5.00.26 or later. The PROFINET controller is then responsible for starting up the switch within a PROFINET application. This includes assigning the IP parameters, comparing the desired/actual configuration, and archiving alarms sent by the switch. In the event that a device is replaced, the controller detects the replacement device and starts it up automatically. For the controller program, the switch as a PROFINET device will make available the link states as a process data item.

9.1 Preparing the switch for PROFINET mode

When activating PROFINET mode, the following default settings are made for operation:

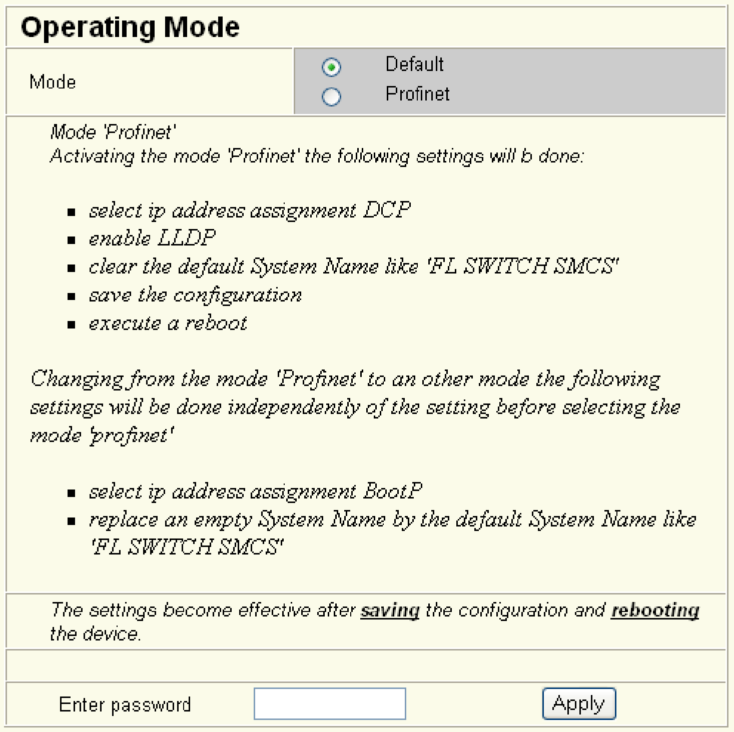
– The Link Layer Discovery Protocol (LLDP) is activated with the following configuration specifications for PROFINET components:
  - Message transmit interval: 5 s
  - Message transmit hold multiplier: 2
  - TLV port ID with subtype locally assigned in the following format: port-xyz
  - TLV chassis ID with subtype locally assigned transmits the station name
– The Discovery and Configuration Protocol (DCP) is activated as the mechanism for assigning IP parameters.
– The station name (system name) is deleted if the value for the “System Name” object contains the device type (default upon delivery).
– The MRP protocol is not activated.
– The PDEV function is supported by firmware version 2.20 or later.

In addition, when switching to “PROFINET” mode, the configuration is saved automatically and the device is restarted.

The switch then starts in “PROFINET” mode for the first time and waits for a name and a PROFINET IP address to be assigned. At this point, the switch is already visible in the network via LLDP with the default name “FL SWITCH SMN” and IP address “0.0.0.0”.

The switch indicates that it is waiting for a valid IP configuration via DCP when the LED for the mode that is currently active flashes.

The switch cannot be accessed via other network services such as ping at this time.



Operating Mode

Mode: ● Default ○ Profinet

Mode 'Profinet'
Activating the mode 'Profinet' the following settings will b done:

- *select ip address assignment DCP*
- *enable LLDP*
- *clear the default System Name like 'FL SWITCH SMCS'*
- *save the configuration*
- *execute a reboot*

Changing from the mode 'Profinet' to an other mode the following settings will be done independently of the setting before selecting the mode 'profinet'

- *select ip address assignment BootP*
- *replace an empty System Name by the default System Name like 'FL SWITCH SMCS'*

*The settings become effective after **saving** the configuration and **rebooting** the device.*

Enter password

Figure 9-1 “Operating Mode” web page

Switching to “Default” mode

When the switch is reset to “Default” mode from “PROFINET” mode, the following settings are made:

- LLDP remains active with the values set by default.
- IP address assignment is set to BootP.
- The station name for the switch does not change. If no station name has been specified, the device type is entered.

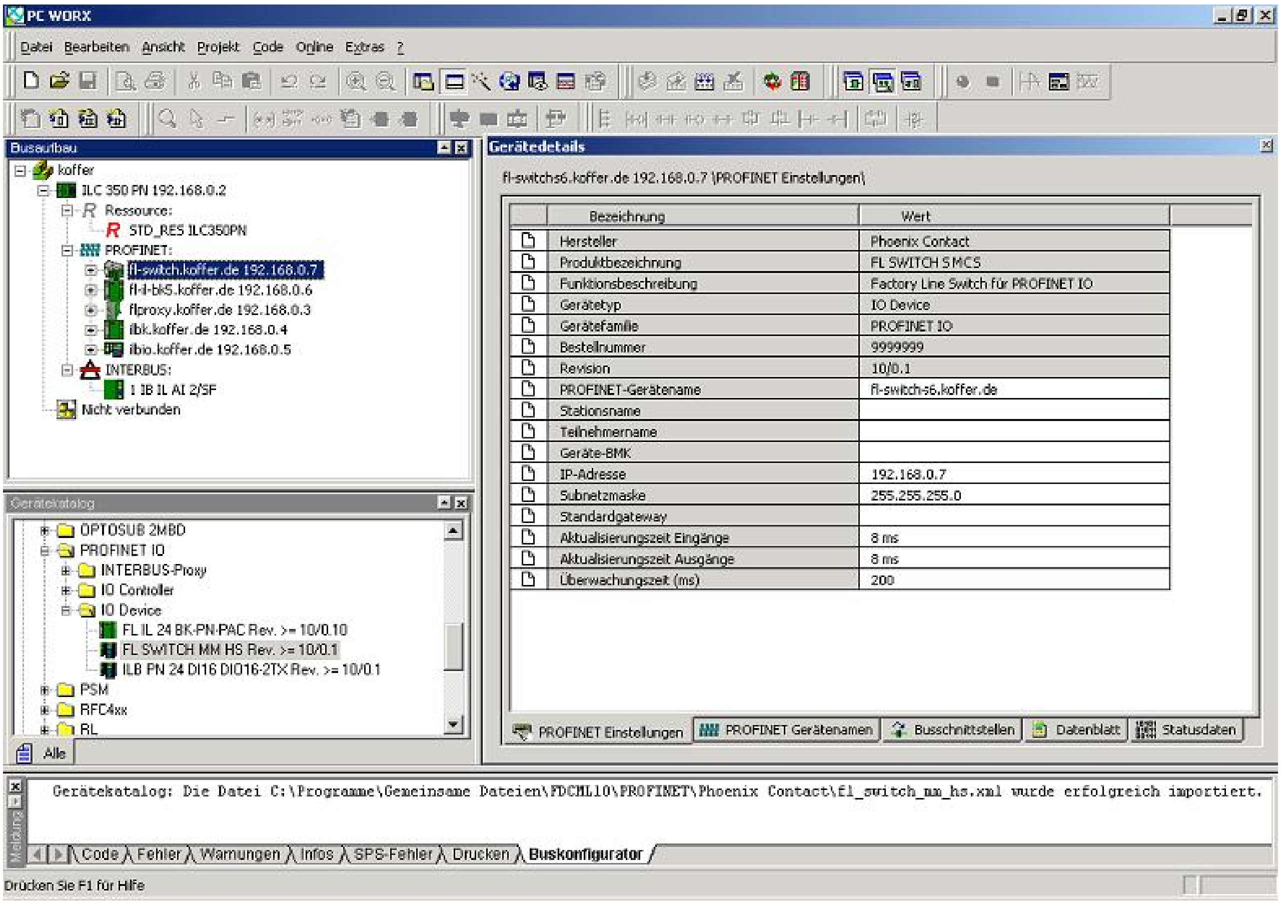
> It is recommended to save the new configuration after changing operating mode. Please note that some configuration modifications only take effect after a restart.

9.2 Switch as a PROFINET device

9.2.1 Configuration in the engineering tool

9.2.1.1 Specifying the bus configuration

The switch can be operated as a PROFINET device if it is integrated under a controller in the bus configuration in the engineering tool. A GSD file and an FDCML file for integration can be downloaded at www.download.phoenixcontact.com.



fl-switchs6.koffer.de 192.168.0.7 \PROFINET Einstellungen\

Bezeichnung	Wert
Hersteller	Phoenix Contact
Produktbezeichnung	FL SWITCH S MCS
Funktionsbeschreibung	Factory Line Switch für PROFINET IO
Gerätetyp	IO Device
Gerätefamilie	PROFINET IO
Bestellnummer	9999999
Revision	10/0.1
PROFINET-Gerätename	fl-switch-s6.koffer.de
Stationsname	
Teilnehmername	
Geräte-BMK	
IP-Adresse	192.168.0.7
Subnetzmaske	255.255.255.0
Standardgateway	
Aktualisierungszeit Eingänge	8 ms
Aktualisierungszeit Ausgänge	8 ms
Überwachungszeit (ms)	200

```
Gerätekatalog: Die Datei C:\Programme\Gemeinsame Dateien\FDCML10\PROFINET\Phoenix Contact\fl_switch_mm_hs.xml wurde erfolgreich importiert.
```

Figure 9-2 The switch in the bus configuration under PC Worx

If the switch is not listed in the device catalog, the device description provided by Phoenix Contact must be imported. The latest device description can be downloaded at www.download.phoenixcontact.com.

If the device description is available in the device catalog, the following options are available for bus configuration:

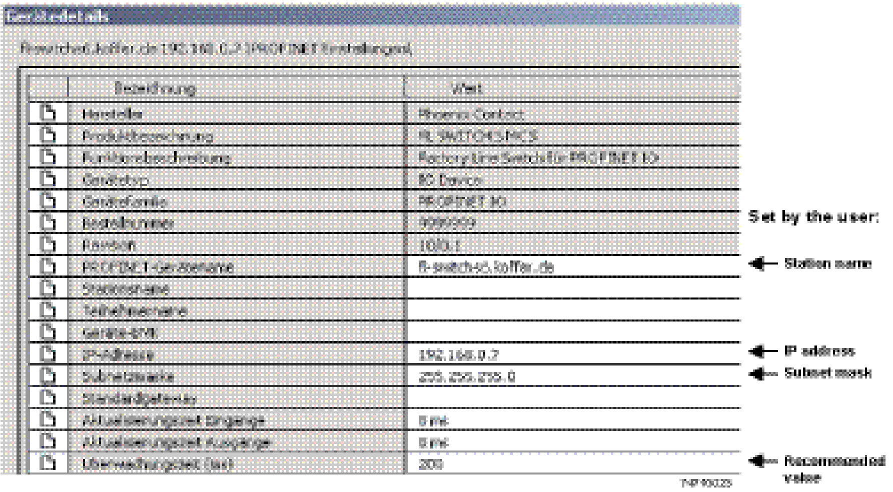
- Manual - The components are transferred to the bus configuration from the device catalog using drag & drop.
- Automatic - The devices are entered via the “Read PROFINET” function, which means that they can be accessed in the network via DCP (Discovery and Configuration Protocol). For this, the devices must be supplied with power and the operating mode must be set to “PROFINET”.

9.2.2 Configuring the switch as a PROFINET device

Once all switches have been added to the bus configuration, the following settings must be made for the individual switches via the “Detail View” tab (device details):

- The PROFINET device name must be checked and modified if necessary.

- The IP address and the subnet mask must be checked and modified if necessary.
- The update time for inputs should be set to “512 ms” (default).
- The update time for outputs should be set to “512 ms” (default).
- The monitoring time should be set to “2000 ms” (default).
- The interface modules must be selected from the module catalog and added to the station.



Gerätedetails

fl-switch-s6.koffer.de 192.168.0.7 (PROFINET Einstellungen)

Bezeichnung	Wert
Hersteller	Phoenix Contact
Produktbezeichnung	FL SWITCH SMCS
Funktionsbeschreibung	Factory Line Switch für PROFINET IO
Gerätetyp	IO Device
Gerätefamilie	PROFINET IO
Bestellnummer	9999999
Revision	10/0.1
PROFINET-Gerätename	fl-switch-s6.koffer.de
Stationsname	
Teilnehmername	
Geräte-BMK	
IP-Adresse	192.168.0.7
Subnetzmaske	255.255.255.0
Standardgateway	
Aktualisierungszeit Eingänge	8 ms
Aktualisierungszeit Ausgänge	8 ms
Überwachungszeit (ms)	200

Figure 9-3 Device details with modified settings

The PROFINET variables can then be created and used in the control program.

In addition to the “PNIO_DATA_STATE” standard variable, the switch provides the link status as a process data byte for each port. If the “PNIO_DATA_VALID” bit for the “PNIO_-DATA_STATE” variable declares the switch process data as valid, the process data item for a port can have the following values (see Section “Additional process data” on page 161):

- Value = 1 - Active link
- Value = 2 - No active link
- Value = 3 - Link present, but partner cannot establish link (only for FX ports - Far End Fault Detection)
- Value = 4 - Port is administratively disabled
- Value = 129 - Port is active, but in the “Blocking” state due to the redundancy protocol (RSTP, MRP)

Process data can only be accessed if the parameterized desired configuration on device startup corresponds to the actual configuration.
The “Status” word and the “Control” word of the management agent are not used.

9.2.3 Configuration via the engineering tool

The universal parameter editor (UPE) can be used to configure the switch via the engineering tool (PC Worx).

- Activation/deactivation of PROFINET alarms
- Configuration of port mode
- Configuration of port state

9.2.4 PROFINET flashing function

If the switch is requested to flash in PROFINET mode by the engineering tool, the LEDs selected by the mode button flash.

9.2.5 Device naming

In order to start up a switch in "PROFINET" mode, each switch must be assigned a name once, i.e., each PROFINET device is assigned a unique device name. A device search ("Read PROFINET" function in PC Worx) is performed via the engineering tool, where all the devices that can be accessed in the network are listed. After identifying unknown devices via the specified MAC address or the "Flashing" function, the device name configured in the engineering tool is saved permanently on the switch with the "Assign Name" function.

ℹ The device name can also be assigned via WBM before switching to PROFINET mode.

9.2.6 Operating in the PROFINET environment

A switch that has already been assigned a name starts in "PROFINET" mode without an IP address and waits for the assignment of an IP configuration (flashing of the LED for the currently active mode). Once the project has been translated and downloaded to the controller, the controller implements startup and configuration. As soon as a communication relationship has been successfully established between the switch and the controller, the switch starts its management interfaces. The switch indicates that the PROFINET connection has been established correctly by means of an entry in the event table.

9.3 PROFINET alarms

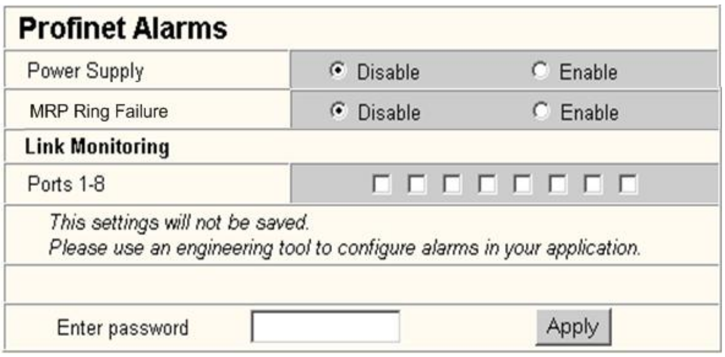
The SMN can send the following alarms:

- Redundant power supply missing (management agent alarm)
- MRP manager registered a ring interrupt (management agent alarm)
- Interface module removed (slot-specific alarm)
- Link monitoring (slot alarm for the relevant channel/port)

All the alarms are deactivated when the device is started.

9.3.1 Alarms in WBM

In “PROFINET” mode, the “PROFINET Alarms” web page appears in the navigation bar under “Switch Station, Diagnostics”. Here, all alarms supported by the IO device can be activated. The PROFINET alarms are sent to the controller by the IO devices. From there they can be read from the diagnostic archive using “Diag+” (version 2.0 is included in Service Pack 1 for PC Worx 5.00.26).



Profinet Alarms

Power Supply ● Disable ○ Enable

MRP Ring Failure ● Disable ○ Enable

Link Monitoring

Ports 1-8 □ □ □ □ □ □ □ □

This settings will not be saved.
Please use an engineering tool to configure alarms in your application.

Enter password

Figure 9-4 PROFINET alarms in WBM

> The settings made for the PROFINET alarms can be saved with the configuration. The controller can transmit a different alarm configuration to the switch and therefore overwrite the configuration settings.

9.4 Process data communication

9.4.1 Control word

The control word is a special process data item used to make settings which are not to be executed via a conventional process data item.

A command consisting of two bytes can be written to the control word of the management agent. The device responds to this with the same command in the status word. Byte 0 specifies the action and the new status; byte 1 specifies the port number. If a command is to apply to all the ports, the value 0xFF can be sent instead of the port number. A command should only be sent once, but never in a process data communication cycle.

Table 9-1 Assignment of the control word

Action	Status	Byte 0	Byte 1
Link monitoring	On	0x01	Port or 0xFF
	Off	0x02	Port or 0xFF
POF SCRJ diagnostics	On	0x03	Port or 0xFF
	Off	0x04	Port or 0xFF
Power supply	On	0x05	0x00
	Off	0x06	0x00

Table 9-1 Assignment of the control word

Action	Status	Byte 0	Byte 1
Interface removed	On	0x07	0x00
	Off	0x08	0x00
MRP ring failure	On	0x09	0x00
	Off	0x0a	0x00
Link enable status	On	0x20	Port
	Off	0x21	Port

9.4.1.1 Additional process data

The SMN can send the following process data:

– Summary of the link states of all ports (three bytes) - each port corresponds to one bit (0 - Link down; 1 - Link up)

Byte	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3	1, 2, 3
Bit	7	6	5	4	3	2	1	0
Port	8/16/24	7/15/23	6/14/22	5/13/21	4/12/20	3/11/19	2/10/18	1/9/17

– The slots transmit link information for each port. This includes:
- Link status: (0 - Link down; 1 - Link up)
- Far end fault status: (0 - No fault; 1 - Fault)
- Port enable status: (0 - Enabled; 1 - Disabled)
- Link mode: (0 - Forwarding; 1 - Blocking)

Bit	7	6	5	4	3	2	1	0
Meaning	Link mode					Port enable	Far end fault	Link status

9.5 PDEV function description

The PDEV function provides an extended scope of functions for switches in PROFINET mode. This includes displaying neighbor and topology information in the engineering tool. This information is determined using the Link Layer Discovery Protocol (LLDP) and can be used, for example, to compare the desired and actual network.

In addition, the PDEV function is used to display the transmitted information via the respective Ethernet ports.

The PDEV function uses two new submodules:

– Interface submodule with port number 0x8X00 (X: from 0 to F)

– Port submodule with port number 0x8IXX (I: Interface ID; X: Port number)

These submodules are represented in the Step7 engineering tool. PROFINET communication enables information about the port speed, duplex mode, and the link status to be read. An engineering tool reads and then displays the neighbor and topology information via SNMP.

9.5.1 PROFINET stack and PDEV function

The PDEV function is supported by PROFINET stack version 2.2. The following functions are supported by PN stack 2.2:

- Link status, port mode, and port MAC address can be requested via the port
- Storing of PDEV data
- Reorganization of submodules for integrating interfaces and new ports
- Use of the PN stack LLDP in PN mode (used for neighbor and topology detection)
- Support for device replacement and application redundancy

9.5.1.1 PDEV in the firmware

The PDEV function can be used for the FL SWITCH SMN device range in firmware version 2.2 or later. In addition, the corresponding version of the GSDML file must be used (the FDCML file does not support PDEV at present).

These files are used to describe the device function and can be imported into an engineering tool.

The PDEV function is only available in firmware version 2.2 or later.

10 Link Layer Discovery Protocol (LLDP)

10.1 Basics

LLDP

The switch supports LLDP according to IEEE 802.1ab and enables topology detection of devices that also have LLDP activated.

Advantages of using LLDP:

- Improved error location detection
- Improved device replacement
- More efficient network configuration

The following information is received by or sent to neighbors, as long as LLDP is activated:

- The device transmits its own management and connection information to neighboring devices.
- The device receives management and connection information from neighboring devices.

Displaying LLDP information

The information that is collected is presented in a table in WBM. The table includes the two port numbers that are used to connect both devices together, as well as the IP address, the device name of neighboring devices, and the device type.

> Please note that a blocking port using RSTP does not receive LLDP BPDUs, but does send them.

LLDP general

The Link Layer Discovery Protocol (LLDP) according to 802.1ab is used by network devices to understand and maintain individual neighbor relationships.

Function

A network infrastructure component transmits a port-specific BPDU (Bridge Protocol Data Unit), which contains the individual device information, at the “Message Transmit Interval” to each port in order to distribute topology information. The partner connected to the relevant port learns the corresponding port-specific neighbors from these BPDUs.

The information learned from the BPDUs is saved for a defined period of time as the TTL value (Time To Live). Subsequent receipt of the same BPDUs increases the TTL value again and the information is still saved. If the TTL elapses, the neighbor information is deleted.

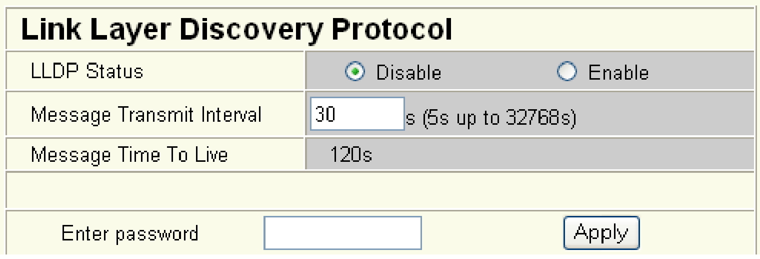
> An SMN manages a maximum of 50 items of neighbor information, all other information is ignored.

> If several neighbors are displayed on one switch port, then at least one other switch/hub, which does not support or has not activated LLDP, is installed between this switch and the neighbor indicated.

Table 10-1 Event table for LLDP

Event	Activity of the individual LLDP agent	Response of the neighboring LLDP agent
Activate LLDP agent or device startup	Transmit LLDP BPDUs to all ports	Include sender in the list of neighbors
Deactivate LLDP agent or software reset	Transmit LLDP BPDUs with a TTL value of 0 seconds to all ports	Delete sender from the list of neighbors
Link up	Transmit port-specific LLDP BPDUs	Include sender in the list of neighbors
Link down	Delete all neighbors for this port	-
Timer (Message Transmit Interval)	Cyclic transmission of BPDUs to all ports	Update information
Aging (Time To Live)	Delete neighbor information	-
Receiving a BPDU from a new neighbor	Extend list of neighbors and respond with port-specific BPDU	Include sender in the list of neighbors

Link Layer Discovery Protocol



Link Layer Discovery Protocol

LLDP Status: ● Disable ○ Enable

Message Transmit Interval: 30 s (5s up to 32768s)

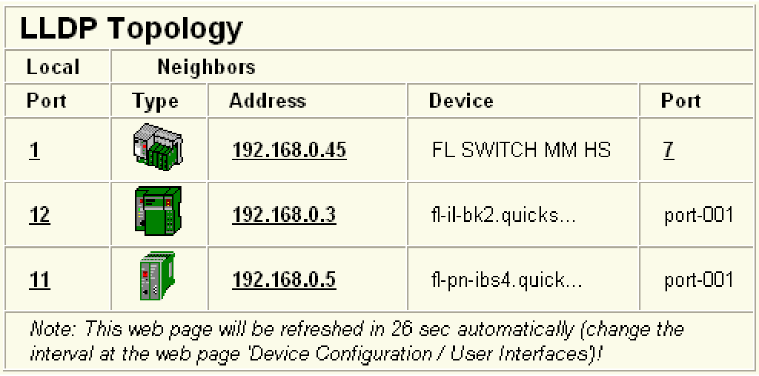
Message Time To Live: 120s

Enter password:

Figure 10-1 “Link Layer Discovery Protocol” web page

The “Message Time To Live” is determined by multiplying the “Message Transmit Interval” with the “Message Transmit Hold Multiplier”. The “Message Transmit Hold Multiplier” can only be modified via SNMP. The default value is four.

LLDP topology



LLDP Topology

Local	Neighbors			
Port	Type	Address	Device	Port
1		192.168.0.45	FL SWITCH MM HS	7
12		192.168.0.3	fl-il-bk2.quicks...	port-001
11		192.168.0.5	fl-pn-ibs4.quick...	port-001

Note: This web page will be refreshed in 26 sec automatically (change the interval at the web page 'Device Configuration / User Interfaces)!

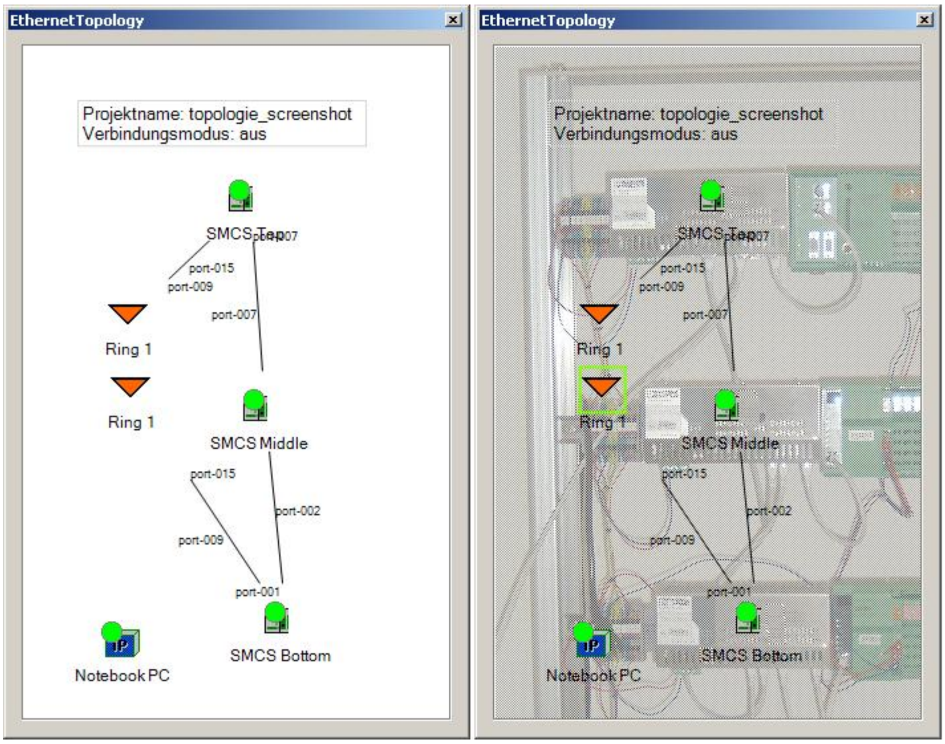
Figure 10-2 “LLDP Topology” web page

A table is created for known neighbors and contains the following five columns:

- Local port
  Contains the port number of the local switch that is used to connect a neighbor to this switch. The port number is also a link to the local “Port Configuration” web page.
- Type
  An icon is displayed here, which corresponds to the neighboring device type. “Ethernet Device” is displayed in general for devices produced by other manufacturers.
- Address
  Indicates the management IP address for the neighbor.
- Device
  Indicates the system name of the neighbor.
- Indicates the port number of the neighboring switch that is used to connect the neighbor to the local switch. If the neighbor is identified as a Phoenix Contact switch, the port number is implemented as a link to the “Port Configuration” web page for the neighbor.

10.2 Topology representation via an engineering tool

The LLDP information can be represented as such or similarly in engineering tools.



EthernetTopology

Projektname: topologie_screenshot
Verbindungsmodus: aus

Figure 10-3 Topology representation

11 Technical data and ordering data

11.1 Technical data

General data	
Function	Smart Managed Narrow Switch, Ethernet/Fast Ethernet switch; conforms to standard IEEE 802.3/802.3u/802.3ab
Switch principle	Store and forward
Address table	4000 MAC addresses
SNMP	Version 2c
Transmission capacity per port 64-byte packet size, half duplex	At 10 Mbps: 14880 pps (packets per second) At 100 Mbps: 148800 pps
Supported MIBs	MIB II and private SNMP objects from Phoenix Contact
Housing dimensions (width x height x depth) in mm	56 x 133 x 130 (depth from top edge of DIN rail) 56 x 133 x 175 (depth from top edge of DIN rail) with FL MEM PLUG (accessories)
Permissible operating temperature	0°C to 55°C
Permissible storage temperature	-40°C to +85°C
Degree of protection	IP20, IEC 60529
Protection class	Class 3 VDE 0106; IEC 60536
Humidity	
Operation	5% ... 95%, non-condensing
Storage	5% ... 95%, non-condensing
Air pressure	
Operation	86 kPa to 108 kPa, 1500 m above sea level
Storage	66 kPa to 108 kPa, 3500 m above sea level
Ambient compatibility	Free from substances that would hinder coating with paint or varnish according to VW specification
Mounting position	Perpendicular to a standard DIN rail
Connection to protective earth ground	By snapping it onto a grounded DIN rail
Weight	650 g, typical

Supply voltage (US1/US2 redundant)	
Connection	Via COMBICON; maximum conductor cross section = 2.5 mm^2
Nominal value	24 V DC
Permissible voltage range	18.0 V DC to 32.0 V DC
Permissible ripple (within the permissible voltage range)	3.6 V_{PP}
Test voltage	500 V DC for 1 minute
Current consumption at US at 24 V DC, maximum	0.6 5A
Maximum power consumption	14.5 W

Interfaces on the SMN	
Number of Ethernet ports	8
RS-232 communication interface	
Connection format	Mini-DIN socket

Interfaces on the SMN	
Floating signal contact	
Voltage	24 V DC
Current carrying capacity	100 mA

Ethernet interfaces	
Properties of RJ45 ports	
Number	6 or 8 with auto crossing and auto negotiation
Connection format	8-pos. RJ45 socket on the switch
Connection medium	Twisted-pair cable with a conductor cross section of 0.14 mm^2 to 0.22 mm^2
Cable impedance	100 ohms
Transmission speed	10/100
Maximum network segment expansion	100 m
General properties of POF ports	
Number	0 or 2
Connection format	SC-RJ sockets on the device
Data transmission speed	100 Mbps according to PROFINET standard
Wavelength	660 nm
Laser protection	Class 1 according to DIN EN 60825-1
Minimum cable length	1 m
Transmission length including 3 dB system reserve	50 m polymer fiber with F-K 980/1000 230 dB/km at 10/100 Mbps, maximum 100 m HCS fiber with F-S 200/230 8 dB/km at 100 Mbps, maximum
(Average) dynamic transmission power (fiber type) in link mode	
Minimum	-8.0 dBm (980/1000 µm)
(Average) dynamic receiver sensitivity (fiber type) in link mode	
Minimum	-23.0 dBm (980/1000 µm)
Optical overrange	1.0 dBm (980/1000 µm)
Properties of 100 Mbps multi-mode ports in SC format	
Connection format	SC-RJ sockets on the device
Data transmission speed	100 Mbps, full duplex
Wavelength	1310 nm
Maximum transmission length	7.1 km fiberglass with F-G 50/125 µm 0.7 dB/km F1200 3.1 km fiberglass with F-G 50/125 µm 1.6 dB/km F800 8.0 km fiberglass with F-G 62.5/125 µm 0.7 dB/km F1000 3.8 km fiberglass with F-G 62.5/125 µm 2.6 dB/km F600
Transmission power	
Minimum	-19 dBm 62.5/125 µm -24 dBm 50/125 µm
Maximum	-14 dBm
Receiver sensitivity	
Minimum	-32.0 dBm
Properties of 100 Mbps single-mode ports in SC format	
Connection format	SC-RJ sockets on the device
Data transmission speed	100 Mbps, full duplex
Wavelength	1310 nm
Maximum transmission length	39 km fiberglass with F-G 9/125 µm 0.36 dB/km 35 km fiberglass with F-G 9/125 µm 0.4 dB/km 28 km fiberglass with F-G 9/125 µm 0.5 dB/km 0

Ethernet interfaces [...]

Transmission power	
Minimum	-15 dBm 9/125 µm
Receiver sensitivity	
Minimum	-31.0 dBm

Mechanical tests

Shock testing according to IEC 60068-2-27	Operation:25g, Half-sine shock pulse Storage/transport: 50g, Half-sine shock pulse
Vibration resistance according to IEC 60068-2-6	Operation/storage/transport: 5g, 10 Hz ... 150 Hz
Free fall according to IEC 60068-2-32	1 m

Conformance with EMC directives

Developed according to IEC 61000-6-2	
Noise emission according to EN 55022: 1998 + A1: 2000 + A2: 2003 (interference voltage)	Class B (residential)
Noise emission according to EN55011: 1998 + A1: 1999 + A2: 2002 (electromagnetic interference)	Class B (residential)
Noise immunity according to EN 61000-4-2 (IEC1000-4-2) (ESD)	Requirements according to DIN EN 61000-6-2
Contact discharge:	Test intensity 2, criterion B
Air discharge:	Test intensity 3, criterion B
Indirect discharge:	Test intensity 2, criterion B
Noise immunity according to EN 61000-4-3 (IEC 1000-4-3) (electromagnetic fields)	Requirements according to DIN EN 61000-6-2 Test intensity 3, criterion A
Noise immunity according to EN 61000-4-4 (IEC 1000-4-4) (burst)	Requirements according to DIN EN 61000-6-2
Data cables:	Test intensity 2, criterion B
Power supply:	Test intensity 3, criterion B
Noise immunity according to EN 61000-4-5 (IEC 1000-4-5) (surge)	Requirements according to DIN EN 61000-6-2
Data cables:	Test intensity 2, criterion B
Power supply:	Test intensity 1, criterion B
Noise immunity according to EN 61000-4-6 (IEC 1000-4-6) (conducted)	Requirements according to DIN EN 61000-6-2 Test intensity 3, criterion A

Additional certification

RoHS	EEE 2002/95/EC - WEEE 2002/96/EC

Differences between this version and previous versions

Rev. 00: First version

Rev. 01: Integration of FL SWITCH SMN 8TX-PN

Rev. 02: New firmware

Rev. 03: New devices added

11.2 Ordering data

Products

Description	Order designation	Order No.	Pcs./Pkt.
Smart Managed Narrow Switch with six Fast Ethernet ports in RJ45 format and two SCRJ-POF ports, operating in “PROFINET” mode by default upon delivery	FL SWITCH SMN 6TX/2POF-PN	2700290	1
Smart Managed Narrow Switch with eight Fast Ethernet ports in RJ45 format, operating in “PROFINET” mode by default upon delivery	FL SWITCH SMN 8TX-PN	2989501	1
Smart Managed Narrow Switch with six Fast Ethernet ports in RJ45 format and two FO ports in SC multi-mode format	FL SWITCH SMN 6TX/2FX	2989543	1
Smart Managed Narrow Switch with six Fast Ethernet ports in RJ45 format and two FO ports in SC single-mode format	FL SWITCH SMN 6TX/2FX-SM	2989556	1
Replaceable configuration memory	FL MEM PLUG	2891259	1
Pluggable parameterization memory with MRP manager function	FL MEM PLUG/MRM	2891275	1

Accessories

Description	Order designation	Order No.	Pcs./Pkt.
Configuration cable, for connecting the switch to a PC, RS-232	COM CAB MINI DIN	2400127	1
Universal end bracket	E/NS 35 N	0800886	1
Network monitoring with HMI/SCADA systems	FL SMNP OPC SERVER	2832166	1
Patch box 8 x RJ45 CAT5e, pre-assembled, can be retrofitted	FL PBX 8TX	2832496	1
Patch box 6 x RJ45 CAT5e and 4 SC-RJ, glass, pre-assembled, can be retrofitted	FL PBX 6TX/4FX	2832506	1
Angled patch connector with two RJ45 CAT5e network connections including Layer 1 security elements	FL PF SEC 2TX	2832687	1
Angled patch connector with eight RJ45 CAT5e network connections including Layer 1 security elements	FL PF SEC 8TX	2832690	1
Angled patch connector with two RJ45 CAT5e network connections	FL PF 2TX CAT5E	2891165	1
Angled patch connector with eight RJ45 CAT5e network connections	FL PF 8TX CAT5E	2891178	1
Angled patch connector with two RJ45 CAT6 network connections	FL PF 2TX CAT 6	2891068	1
Angled patch connector with eight RJ45 CAT6 network connections	FL PF 8TX CAT 6	2891071	1
Patch cable, CAT6, pre-assembled, 0.3 m long	FL CAT6 PATCH 0,3	2891181	10
Patch cable, CAT6, pre-assembled, 0.5 m long	FL CAT6 PATCH 0,5	2891288	10
Patch cable, CAT6, pre-assembled, 1.0 m long	FL CAT6 PATCH 1,0	2891385	10
Patch cable, CAT6, pre-assembled, 1.5 m long	FL CAT6 PATCH 1,5	2891482	10
Patch cable, CAT6, pre-assembled, 2.0 m long	FL CAT6 PATCH 2,0	2891589	10
Patch cable, CAT6, pre-assembled, 3.0 m long	FL CAT6 PATCH 3,0	2891686	10
Patch cable, CAT6, pre-assembled, 5.0 m long	FL CAT6 PATCH 5,0	2891783	10
Patch cable, CAT6, pre-assembled, 7.5 m long	FL CAT6 PATCH 7,5	2891880	10
Patch cable, CAT6, pre-assembled, 10 m long	FL CAT6 PATCH 10	2891887	10
Patch cable, CAT6, pre-assembled, 12.5 m long	FL CAT6 PATCH 12,5	2891369	5
Patch cable, CAT6, pre-assembled, 15 m long	FL CAT6 PATCH 15	2891372	5
Patch cable, CAT6, pre-assembled, 20 m long	FL CAT6 PATCH 20	2891576	5
Patch cable, CAT5, pre-assembled, 0.3 m long	FL CAT5 PATCH 0,3	2832250	10
Patch cable, CAT5, pre-assembled, 0.5 m long	FL CAT5 PATCH 0,5	2832263	10
Patch cable, CAT5, pre-assembled, 1.0 m long	FL CAT5 PATCH 1,0	2832276	10
Patch cable, CAT5, pre-assembled, 1.5 m long	FL CAT5 PATCH 1,5	2832221	10
Patch cable, CAT5, pre-assembled, 2.0 m long	FL CAT5 PATCH 2,0	2832289	10

Description [...]	Order designation	Order No.	Pcs./Pkt.
Patch cable, CAT5, pre-assembled, 3.0 m long	FL CAT5 PATCH 3,0	2832292	10
Patch cable, CAT5, pre-assembled, 5.0 m long	FL CAT5 PATCH 5,0	2832580	10
Patch cable, CAT5, pre-assembled, 7.5 m long	FL CAT5 PATCH 7,5	2832616	10
Patch cable, CAT5, pre-assembled, 10.0 m long	FL CAT5 PATCH 10	2832629	10
Color coding for FL CAT5/6 PATCH ..., black	FL PATCH CCODE BK	2891194	20
Color coding for FL CAT5/6 PATCH ..., brown	FL PATCH CCODE BN	2891495	20
Color coding for FL CAT5/6 PATCH ..., blue	FL PATCH CCODE BU	2891291	20
Color coding for FL CAT5/6 PATCH ..., green	FL PATCH CCODE GN	2891796	20
Color coding for FL CAT5/6 PATCH ..., gray	FL PATCH CCODE GY	2891699	20
Color coding for FL CAT5/6 PATCH ..., red	FL PATCH CCODE RD	2891893	20
Color coding for FL CAT5/6 PATCH ..., violet	FL PATCH CCODE VT	2891990	20
Color coding for FL CAT5/6 PATCH ..., yellow	FL PATCH CCODE YE	2891592	20
Lockable security element for FL CAT5/6 PATCH ...	FL PATCH GUARD	2891424	20
Color coding for FL PATCH GUARD, black	FL PATCH GUARD CCODE BK	2891136	12
Color coding for FL PATCH GUARD, blue	FL PATCH GUARD CCODE BU	2891233	12
Color coding for FL PATCH GUARD, green	FL PATCH GUARD CCODE GN	2891631	12
Color coding for FL PATCH GUARD, orange	FL PATCH GUARD CCODE OG	2891330	12
Color coding for FL PATCH GUARD, red	FL PATCH GUARD CCODE RD	2891738	12
Color coding for FL PATCH GUARD, turquoise	FL PATCH GUARD CCODE TQ	2891534	12
Color coding for FL PATCH GUARD, violet	FL PATCH GUARD CCODE VT	2891835	12
Color coding for FL PATCH GUARD, yellow	FL PATCH GUARD CCODE YE	2891437	12
Key for FL PATCH GUARD	FL PATCH GUARD KEY	2891521	1
Security element for FL CAT5/6 PATCH ...	FL PATCH SAFE CLIP	2891246	20
Polymer fiber connectors (two duplex connectors in the set)	PSM-SET-SCRJ-DUP/2-POF	2708656	1
Polishing set for polymer fiber connectors (required to assemble polymer fiber connectors)	VS-SCRJ-POF-POLISH	1656673	1
Polymer fiber cable (fiber optic) for indoor installation	PSM-LWL-KDHEAVY	2744319	1
HCS fiber connectors (two duplex connectors in the set)	PSM-SET-SCRJ-DUP/2-HCS	2313070	1
Tool kit for HCS connectors (required to assemble HCS fiber connectors)	PSM-HCS-KONFTOOL/SCRJ	2708876	1
HCS cable (fiber optic) for indoor installation	PSM-LWL-HCS-RUGGED-200/230	2799885	1
HCS cable (fiber optic) for outdoor installation	PSM-LWL-HCSO-200/230	2799445	1
HCS GI fiber cable, duplex 200/230 µm, for indoor installation, suitable for use in drag chains, compliant with PROFINET installation guidelines, sold by the meter without connectors	FL FOC PN-C-HCS-GI-200/230	2313410	1
HCS-GI cable, duplex, 200/230 µm, for indoor installation, suitable for use in drag chains, compliant with PROFINET installation guidelines, pre-assembled cable with connectors	FL FOC PN-C-HCS-GI	2313504	1

HOTLINE:

If there are any problems that cannot be solved using this documentation, please call our hotline:

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💻 factoryline-service@phoenixcontact.com

B 2 List of tables

Section 1

Section 2

Section 3

Section 4

Section 5

Section 6

Section 7

Section 8

Section 9

Section 10

Section 11

Appendix A

A Appendixes

A 1 List of figures

Section 1

Section 2

Section 3

Section 4

Section 5

Section 6

Section 7

Section 8

Section 9

Section 10

Section 11

Appendix A