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FLEXtra PROFINET-Switch 16-Port, 10/100/1000 MBps

Manual

Version 1 | 5/20/2021 | for firmware V1.04 and above

Link to newest version of manual

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Notes

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1 General

This operating manual applies only to devices, assemblies, software, and services of Helmholz GmbH & Co. KG.

1.1 Structure of the manual

This manual is divided into XX sections.

Section 1 contains general information and safety instructions.

Section 2 refers to Security Recommendations.

Section 3 explains the system overview and features of the product.

Section 4 explains the installation and removal.

Section 5 shows the initial commissioning with connection and GSDML configuration.

The configuration and diagnostics of the switch via the web interface are explained in section 6.

Section 7 explains the status and control bits in the EA image in the PLC.

The use of the digital inputs and outputs is described section 8.

Section 9 contains a FAQ about PROFINET.

The technical data are documented in section 10.

1.2 Target audience for this manual

This description is only intended for trained personnel qualified in control and automation engineering who are familiar with the applicable national standards. For installation, commissioning, and operation of the components, compliance with the instructions and explanations in this operating manual is essential.

WARNING

Configuration, execution, and operating errors can interfere with the proper operation of the PN/CAN Gateways and result in personal injury, as well as material or environmental damage. Only suitably qualified personnel may operate the devices!

Qualified personnel must ensure that the application and use of the products described meet all the safety requirements, including all relevant laws, regulations, provisions, and standards.

1.3 Safety instructions

The safety instructions must be observed in order to prevent harm to living creatures, material goods, and the environment. The safety notes indicate possible hazards and provide information about how hazardous situations can be prevented.

1.4 Note symbols and signal words

HAZARD

If the hazard warning is ignored, there is an imminent danger to life and health of people from electrical voltage.

WARNING

If the warning is ignored, there is a probable danger to life and health of people.

CAUTION

If the caution note is ignored, people can be injured or harmed.

ATTENTION

Draws attention to sources of error that can damage equipment or the environment.

NOTE

Gives an indication for better understanding or preventing errors.

1.5 Intended use

The FLEXtra PROFINET-Switch (hereinafter referred to as "the device") can be used for networking Ethernet networks. The FLEXtra PROFINET switch supports the PROFINET protocol and other managed Ethernet functions.

All components are supplied with a factory hardware and software configuration. The user must carry out the hardware and software configuration for the conditions of use. Modifications to hardware or software configurations which are beyond the documented options are not permitted and nullify the liability of Helmholz GmbH & Co. KG.

The device may not be used as the only means for preventing hazardous situations on machinery and systems.

Problem-free and safe operation of the device presumes proper transport, storage, setup, assembly, installation, commissioning, operation, and maintenance.

The ambient conditions provided in the technical specifications must be adhered to.

The device has a protection rating of IP20 and must be installed in an electrical operating room or a control box/cabinet in order to protect it against environmental influences. To prevent unauthorized access, the doors of control boxes/cabinets must be closed and possibly locked during operation.

1.6 Improper use

WARNING

The consequences of improper use may include personal injuries of the user or third parties as well as property damage to the control system, the product, or the environment. Use the PN/MQTT Coupler only as intended!

1.7 Liability

The contents of this manual are subject to technical changes resulting from the continuous development of products of Helmholz GmbH & Co. KG. In the event that this manual contains technical or clerical errors, we reserve the right to make changes at any time without notice.

No claims for modification of delivered products can be asserted based on the information, illustrations, and descriptions in this documentation. Beyond the instructions contained in the operating manual, the applicable national and international standards and regulations must also be observed in any case.

1.7.1 Disclaimer of liability

Helmholz GmbH &Co. KG is not liable for damages if these were caused by use or application of products that was improper or not as intended.

Helmholz GmbH & Co. KG assumes no responsibility for any printing errors or other inaccuracies that may appear in the operating manual unless there are serious errors about which Helmholz GmbH & Co. KG was already demonstrably aware.

Beyond the instructions contained in the operating manual, the applicable national and international standards and regulations must also be observed in any case.

Helmholz GmbH & CO. KG is not liable for damage caused by software that is running on the user's equipment which compromises, damages, or infects additional equipment or processes through the remote maintenance connection and which triggers or permits unwanted data transfer.

1.7.2 Warranty

Report any defects to the manufacturer immediately after discovery of the defect.

The warranty is not valid in case of:

- Failure to observe these operating instructions
- Use of the device that is not as intended
- Improper work on and with the device
- Operating errors
- Unauthorized modifications to the device

The agreements met upon contract conclusion under "General Terms and Conditions of Helmholz GmbH & Co. KG" apply.

1.8 Open Source

Among other things, our products contain open source software. This software is subject to the relevant license terms. The relevant license terms, including a copy of the full license text, are downloadable from the product website. They are also provided in our download area of the respective products at www.helmholz.de.

Furthermore, we offer to send the complete corresponding source code of the respective open source software to you and to any third party as a DVD upon your request for a contribution towards expenses of Euro 10.00. This offer is valid for a period of three years. This offer is valid for a period of three years, calculated from the delivery of the product.

2 Security recommendations

Managed switches are network infrastructure components, and thus an important element in the security considerations of a system or network. When using the PN/MQTT Coupler, therefore please consider the following recommendations in order to prohibit unauthorized access to plants and systems.

General:

- Ensure at regular intervals that all relevant components fulfill these recommendations and possibly any other internal security guidelines.
- Evaluate your system holistically with a view to security. Use a cell protection concept with corresponding products.

You can find extensive information, for example, in the “ICS Security Compendium” of the Federal Office for Information Security (BSI):
https://www.bsi.bund.de/SharedDocs/Downloads/EN/BSI/ICS/ICS-Security_compendium.html

Physical access:

- Limit physical access to components of relevance to security to qualified personnel.

Security of the software:

- Always keep the firmware of all communications components up to date.
- Inform yourself regularly of firmware updates for the product. You can find information on firmware update in this manual.
- Only activate protocols and functions you really need

Passwords:

- Define rules for usage of the devices and the awarding of passwords.
- Update passwords and keys regularly
- Change standard passwords
- Only use strong passwords. Avoid weak passwords like, for example, “password1”, “123456789”, or similar.
- Ensure that all passwords are protected and inaccessible to unauthorized personnel.
- Do not use one password for various users and systems.

3 System overview

The managed FLEXtra PROFINET-Switch 16 port can be used to connect PROFINET components with 100 Mbps as well as Ethernet devices with up to 1000 Mbps. This enables communication from the control level with the machine or mixing of Ethernet and PROFINET components in one switch. PROFINET prioritization of the machine components according to Conformance Class B is always guaranteed.

In addition to PROFINET, functions such as SNMP, NTP, VLAN, port mirroring, QoS/CoS mapping and extensive statistics are available for managing the Ethernet network.

The functional design with the smart arrangement of the Ethernet ports saves space in the control cabinet. The status LEDs on the top of the FLEXtra PROFINET switch, which are always clearly visible, enable easy diagnostics even with full cabling.

In addition, the FLEXtra PROFINET switch supports the control of ports via inputs and the display of port states via outputs. As inputs and outputs bits in the PROFINET-IO image of the switch can be used as well as 4 digital inputs and 2 digital outputs with 24V. The assignment and functionality can be configured via the GSDML file.

The configuration set via the web interface can be downloaded or saved to an SD card as a backup or for mass commissioning.

One of the most important functions of a PROFINET switch is the prioritization of PROFINET telegram traffic in the machine network. The managed switch can distinguish whether the telegram is a web request, an FTP file transfer, a media stream, or a PROFINET telegram. In the event of a high transmission load, the important telegrams can thus be prioritized to prevent telegram losses of the machine components. The supported PROFINET protocols, such as LLDP, DCP or even diagnostic alarms, can be easily parameterized and managed.

Technical advantages of using a PROFINET switch:

- -Prioritization of PROFINET telegrams
- -Assignment of a network configuration based on the device name
- -Definition of transmission method and speed of a port
- -Topology detection
- -Device replacement without programming device
- -MRP ring redundancy
- -Each port can be enabled or disabled
- -Diagnostic messages in case of network problems
- -Identification and maintenance data

For the project engineering as a PROFINET device a GSDML file is required.

3.1 Setup

The FLEXtra PROFINET-Switch has 16 Ethernet ports (RJ45). 2 rows with 6 ports and one row with 4 ports. All ports are equivalent in their functionality.

The switch has two concealed function buttons ("RST" and "FCN") as control elements.

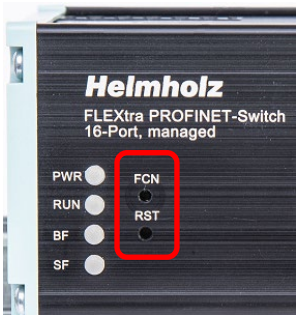
The status display at the device is done via four LEDs (PWR, RUN, BF, SF) and additionally 16 LEDs for each Ethernet port.

On the back of the device there is a connector for connecting 4 digital inputs and 2 outputs with 24 V DC.

A micro-SD card slot is accessible above the IO-connector.

3.2 Taster

The PROFINET switch has two pushbuttons "**FCN**" and "**RST**", which are located at the top behind the front panel. The buttons can only be reached with a narrow object (paper clip) to protect against improper usage.



3.2.1 "RST"-Taster (Reset)

The "**RST**" button triggers an immediate restart of the PROFINET switch. All saved settings are retained.

3.2.2 "FCN"-Taster (Function)

The "**FCN**" button can be used to reset the PROFINET switch to factory settings. If the "FCN" button is held down during the switch startup phase or after a reset, the green "PWR" and the orange "SF" LEDs light up continuously. This indicates that the switch has loaded the factory setting. After releasing the button, the switch is restarted.

3.3 Status LEDs

The two system LEDs "**PWR**", "**RUN**" and the two PROFINET LEDs "**BF**" and "**SF**" indicate the system status of the switch.

After switching on or a reset, all 4 LEDs are permanently on for approx. 5 seconds to indicate the start-up process and to check the function of the LEDs.

The LEDs P1-P16 indicate the status of the ports.

3.4 System LEDs

PWR	Off	No voltage supply or device defective
	On	Device is correctly supplied with voltage
RUN	Off	Device is defective
	On	Device is ready for operation
	Flashing	Device is booting
	Flashing (together with the BF and SF LED)	PROFINET function device identification (“Flash LED”)
BF	On	Bus error or no configuration
	Flashing (together with the BF and SF LED)	PROFINET function device identification (“Flash LED”)
SF	On	System error, network state faulty
	Flashing (together with the BF and SF LED)	PROFINET function device identification (“Flash LED”)

The **PWR LED** is on as soon as the PROFINET switch is connected to a power supply.

The **RUN LED** is on as soon as the PN switch is ready for operation. The LED flashes during initialization of the PROFINET switch.

The **BF LED** is on as long as there is no PROFINET connection. If there is a PROFINET connection and the PROFINET switch has been configured, the LED is off. The PROFINET switch can only receive a PROFINET configuration if it has been assigned the device name set in the project, see chapter 5.6.

The **SF LED** is on if there is a PROFINET alarm (diagnosis) at the PROFINET switch. If there is no PROFINET alarm, the LED is off.

The **RUN**, **BF** and **SF** LEDs flash synchronously if the user has activated the PROFINET function "Flash LED" for device identification.

3.5 Ethernet LEDs P1 – P16 (RJ45)

Off		No network cable connected or network cable defective or connected device is off
Green	steady on	Ethernet connection with 10/100 Mbps
	flashes	Ethernet communication with 10/100 Mbps
Orange	steady on	Ethernet connection with 1000 Mbps
	flashes	Ethernet communication with 1000 Mbps

4 Installation and removal

4.1 Access restriction

The modules are open operating equipment and must only be installed in electrical equipment rooms, cabinets, or housings.

Access to the electrical equipment rooms, cabinets, or housings must only be possible using a tool or key, and access should only be granted to trained or authorized personnel.

4.2 Mounting and minimum distances

The FLEXtra PROFINET switch can be mounted on a DIN rail and installed in any position. It is recommended to keep minimum distances when mounting. By keeping the minimum distances

- the modules can be mounted or dismantled without having to dismantle other parts of the system.
- there is enough space to connect all existing connections and contacting possibilities with commercially available accessories.
- There is space for any necessary cable routing.

ATTENTION

Installation must be carried out in accordance with VDE 0100/IEC 364 and applicable national standards. The device has protection level IP20. If a higher degree of protection is required, it must be installed in an enclosure or a control cabinet.

4.3 Electrical installation

Observe the regional safety regulations.

4.4 Protection against electrostatic discharges

To prevent damage through electrostatic discharges, the following safety measures are to be followed during assembly and service work:

- Never place components and modules directly on plastic items (such as polystyrene, PE film) or in their vicinity.
- Before starting work, touch the grounded housing to discharge static electricity.
- Only work with discharged tools.
- Do not touch components and assemblies on contacts.

4.5 EMC protection

To ensure electromagnetic compatibility (EMC) in your control cabinets in electrically harsh environments, the known rules of EMC-compliant configuration are to be observed in the design and construction.

ATTENTION

Observe all standards, regulations and rules regarding shielding when setting up the system and laying the necessary cables. Strictly adhere to the corresponding writings of the PROFIBUS user organization for setting up PROFINET.

Errors in the shielding can lead to malfunctions or even failure of the system.

4.6 Operation

Operate the device only in flawless condition. The permissible operating conditions and performance limits must be adhered to.

Retrofits, changes, or modifications to the device are strictly forbidden.

The device is a piece of operating equipment intended for use in industrial plants. During operation, all covers on the unit and the installation must be closed in order to ensure protection against contact

ATTENTION

When the PROFINET switch is switched off, bus connections are interrupted! Before starting any work on the device, make sure that no impermissible interference occurs in connected systems when the bus connections are interrupted.

4.7 Recycling / WEEE

The company Helmholz GmbH & Co. KG is registered as a manufacturer with the HELMHOLZ brand and the device type "Small devices of information and telecommunications technology for exclusive use in households other than private households" as well as the following registration data:

Helmholz GmbH & Co. KG,
Location / Headquarters: 91091 Großenseebach,
Address: Hannberger Weg 2,
Name of authorized representative: Carsten Bokholt,

Registration number: DE 44315750.

The electrical devices described in this document are to be recycled. According to Directive 2012/19 / EU on waste electrical and electronic equipment (WEEE), they must not be disposed of by municipal waste disposal companies.

5 Preparing the FLEXtra PROFINET-Switch

5.1 Connection

The FLEXtra PROFINET-Switch has a redundant power supply. The FLEXtra PROFINET-Switch must be supplied with 24 VDC via the supplied connector plug on at least one of the two "-/+" wide range inputs (DC 18 - 30 V).

The RJ45 sockets "X1 P1 - X1 P16" are used to connect the network nodes (PROFINET or Ethernet).

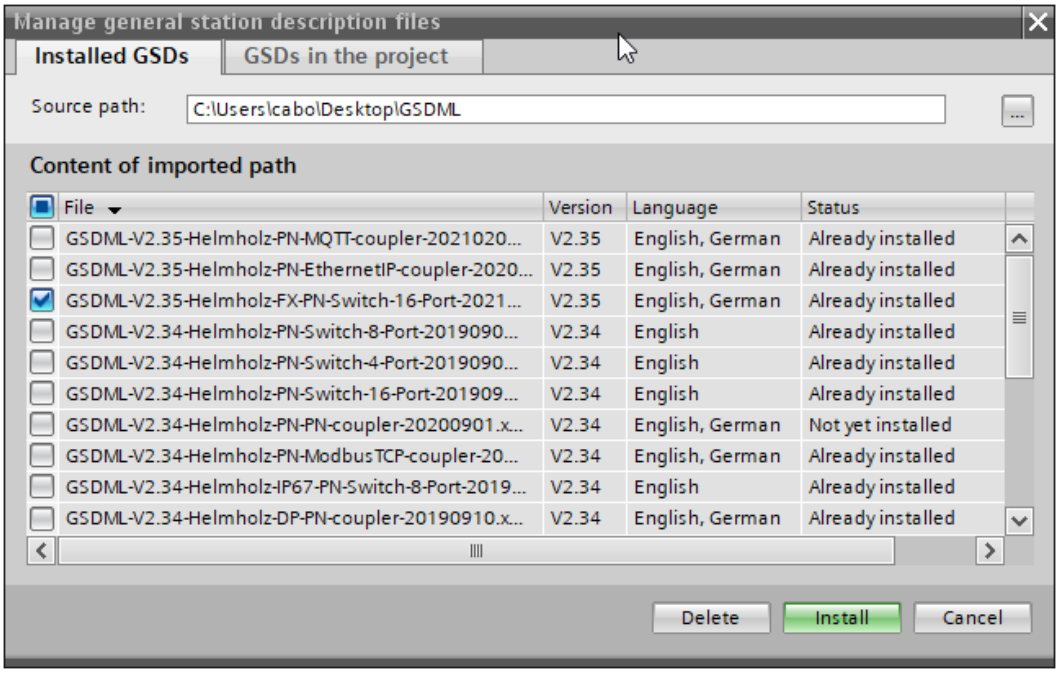
NOTE

The housing of the FLEXtra PROFINET switch is not grounded. Please connect the functional grounding connection (FG named “FE” on front) of the switch properly to the reference potential.

5.2 Install GSDML file

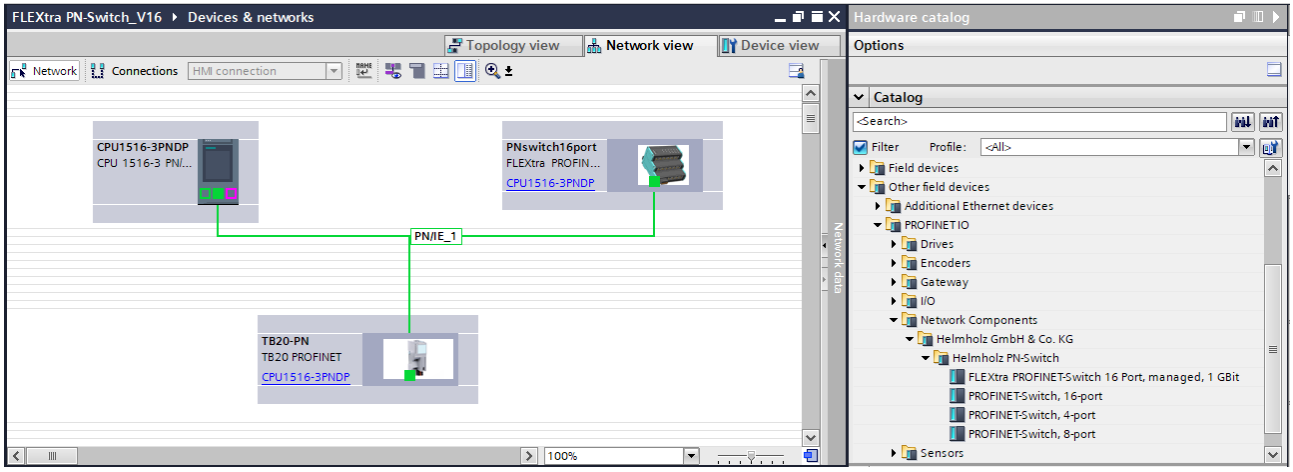
You can download the GSDML file for the FLEXtra PROFINET switch from the website www.helmholz.de in the download area of the product or use the QR code shown.

You can find the “Manage general station description files” dialog in TIA Portal in the menu “Options”.



5.3 Setup in the hardware-configuration

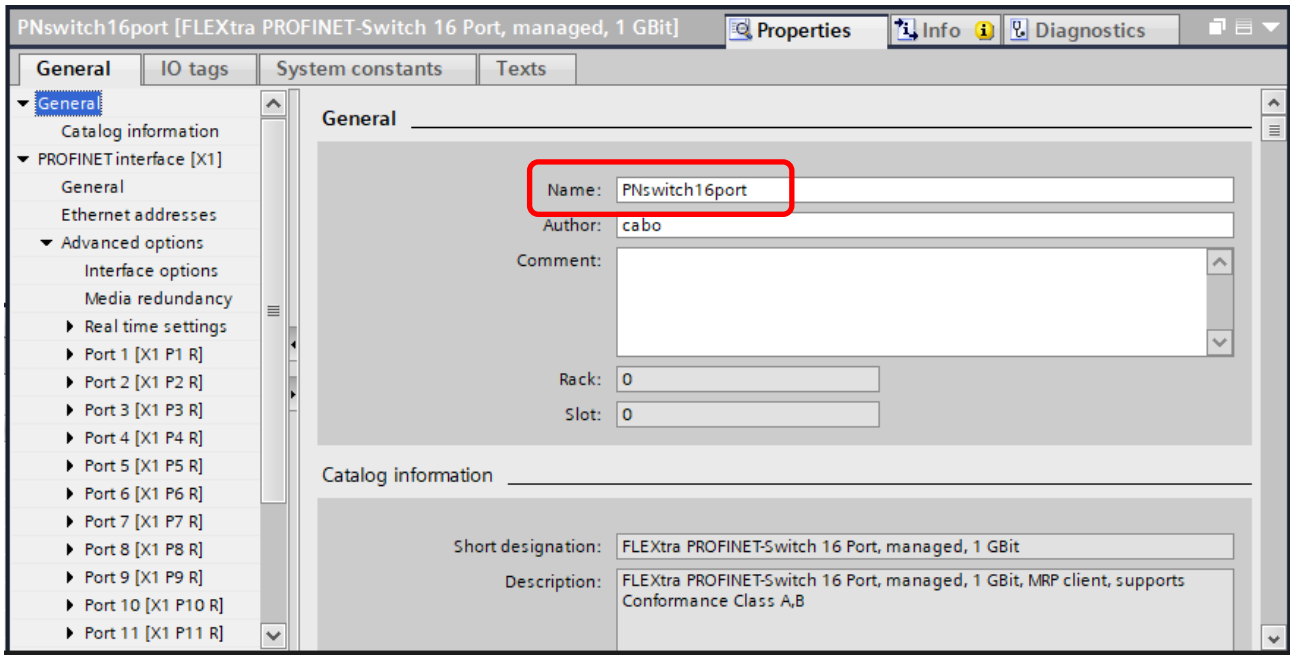
After installation, the FLEXtra PROFINET-Switch is listed in the hardware catalog under "Other field devices → PROFINET IO → Network Components → Helmholz GmbH & Co. KG → Helmholz PN-Switch" in the hardware catalog. Insert the "FLEXtra PROFINET Switch 16 port" device into the project and connect it to your PROFINET network.



By calling up the object properties, you must give the FLEXtra PROFINET switch a unique PROFINET name in the project and check the IP address for plausibility.

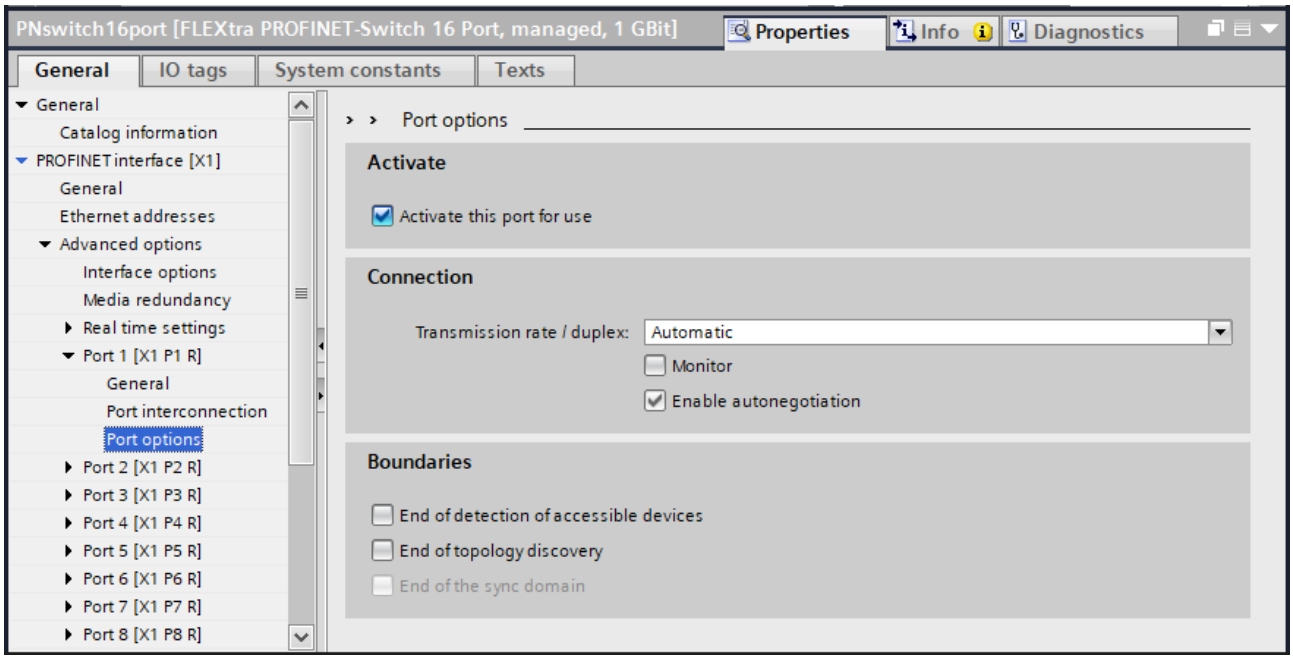
NOTE

The real device must later be assigned the same name as in the project.



5.4 Setting the port properties

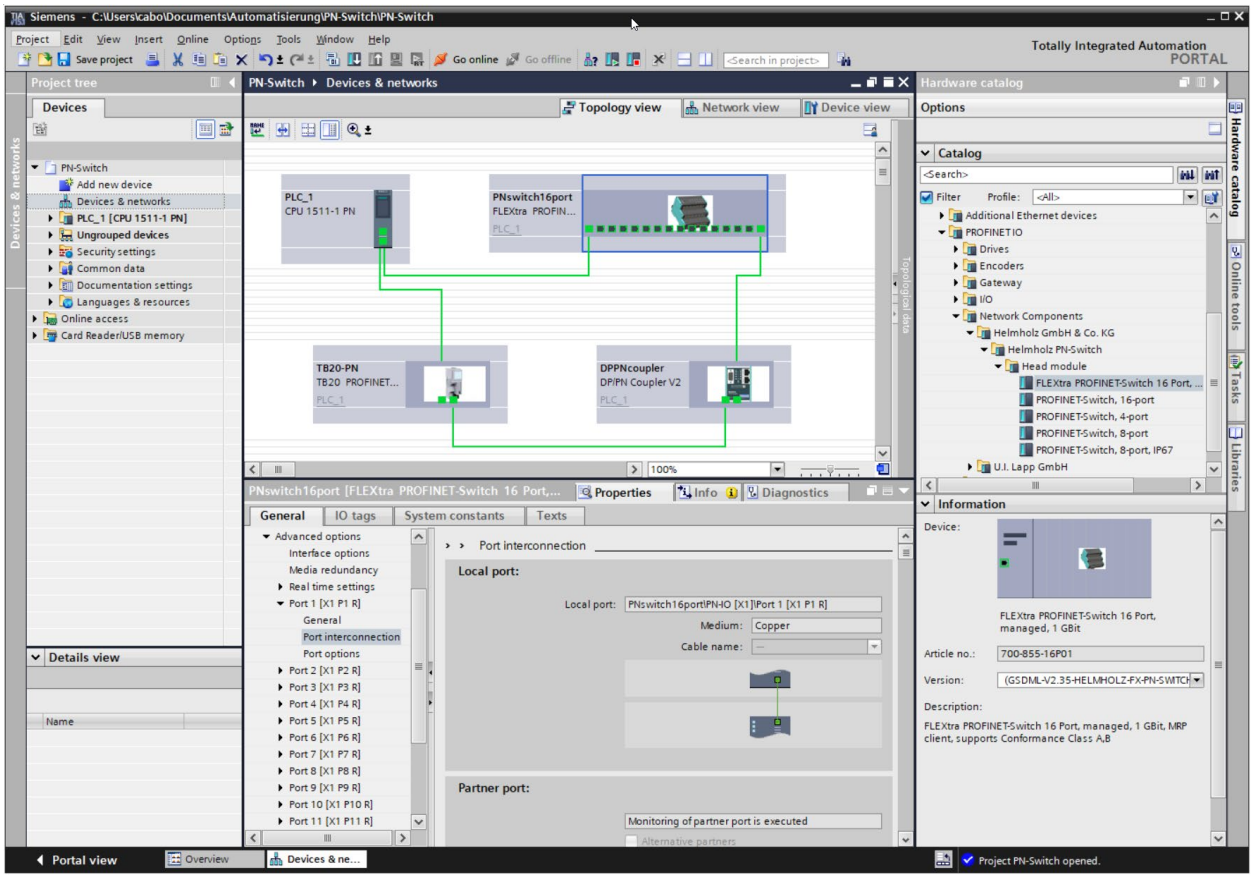
Each port of the PROFINET switch can be individually configured.



“Activate this port”	The port can be switched off here. This option is recommended when the port should not be used. Unauthorized trespass into the network is prevented.
Transmission rate / duplex “Automatic”	The port synchronizes itself automatically with the communication partner (auto-negotiation).
Transmission rate / duplex “TP 100 Mbps full duplex”	Fixed specification of the transmission rate. This option is recommended when connecting PROFINET IO devices.
Monitor	Send a diagnosis by Link Down
Enable autonegotiation	Automatic recognition of the transmission speed and the cable type (cross or patch cable)
End of detection of accessible devices	The DCP telegrams for recording accessible devices are not forwarded from this port. Subscribers behind this port are no longer displayed under "Accessible subscribers" in the topology. Users behind this port can no longer be reached by the CPU.
End of topology discovery	LLDP frames for topology discovery are not forwarded on this port.

5.5 Topology detection

The PROFINET-Switch supports the mechanisms for neighbor detection (LLDP). With this function it is possible to detect the topology of a PROFINET network or to predefine it by the configuration to control the correct setup.



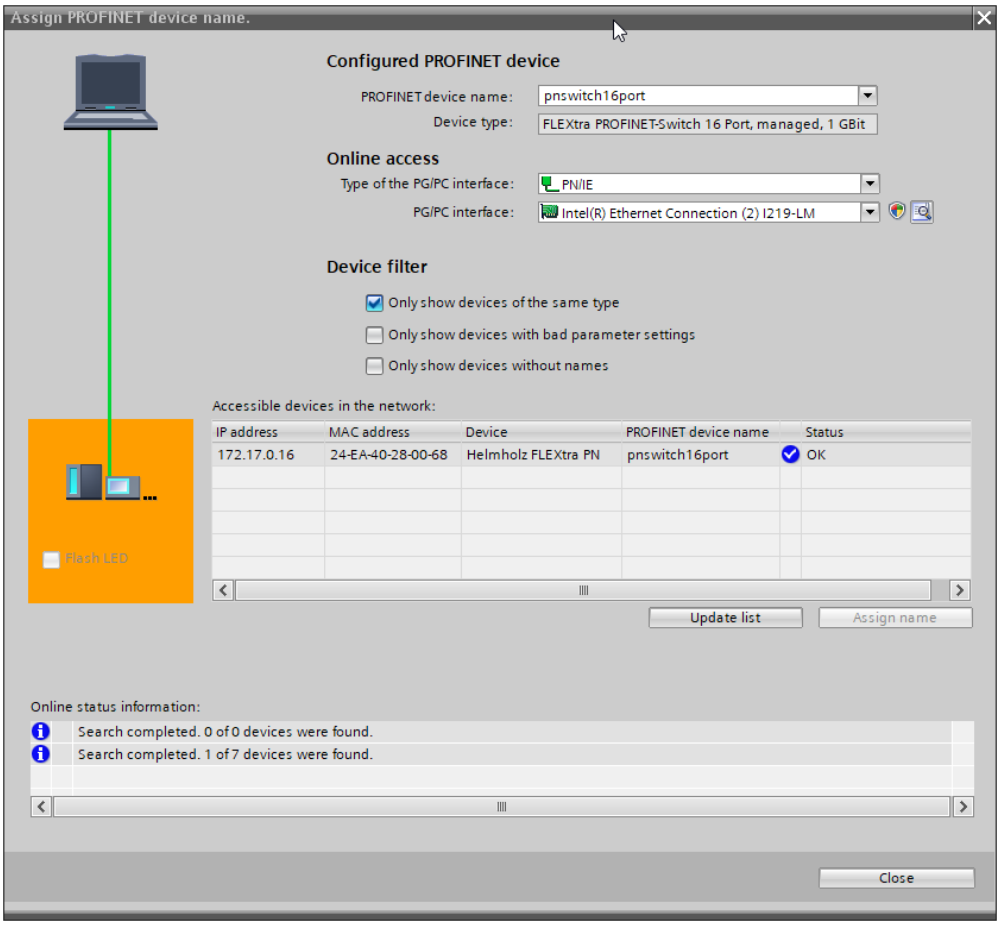
If the topology was specified in the configuration, the PROFINET name can also be assigned to neighboring devices in the event of a device swap. This makes it possible to detect and check the network topology and to "swap devices during operation" of connected PROFINET devices.

5.6 Assign the PROFINET switch a name

When the configuration of the FLEXtra PROFINET-Switch has been completed in the hardware configurator of the engineering tool, it can be loaded into the PLC.

In order that the FLEXtra PROFINET-Switch can be found by the PROFINET controller, the PROFINET device name must be assigned to the PROFINET-Switch. To this purpose, use the function “Assign device name”, which you can access in the Online menu with the right mouse button when the PROFINET-Switch is activated.

With the “Update list” button, the network can be browsed for PROFINET participants. The PROFINET device name can be assigned to the device with “Assign name”.



The clear identification of the FLEXtra PROFINET switch is ensured here by the MAC address of the device. The MAC address of the device can be found on the device front of the FLEXtra PROFINET switch.

If the PROFINET switch has been assigned the correct PROFINET name, it is recognized by the PLC and configured. If configuration has taken place correctly, the PROFINET “BF” LED is off.

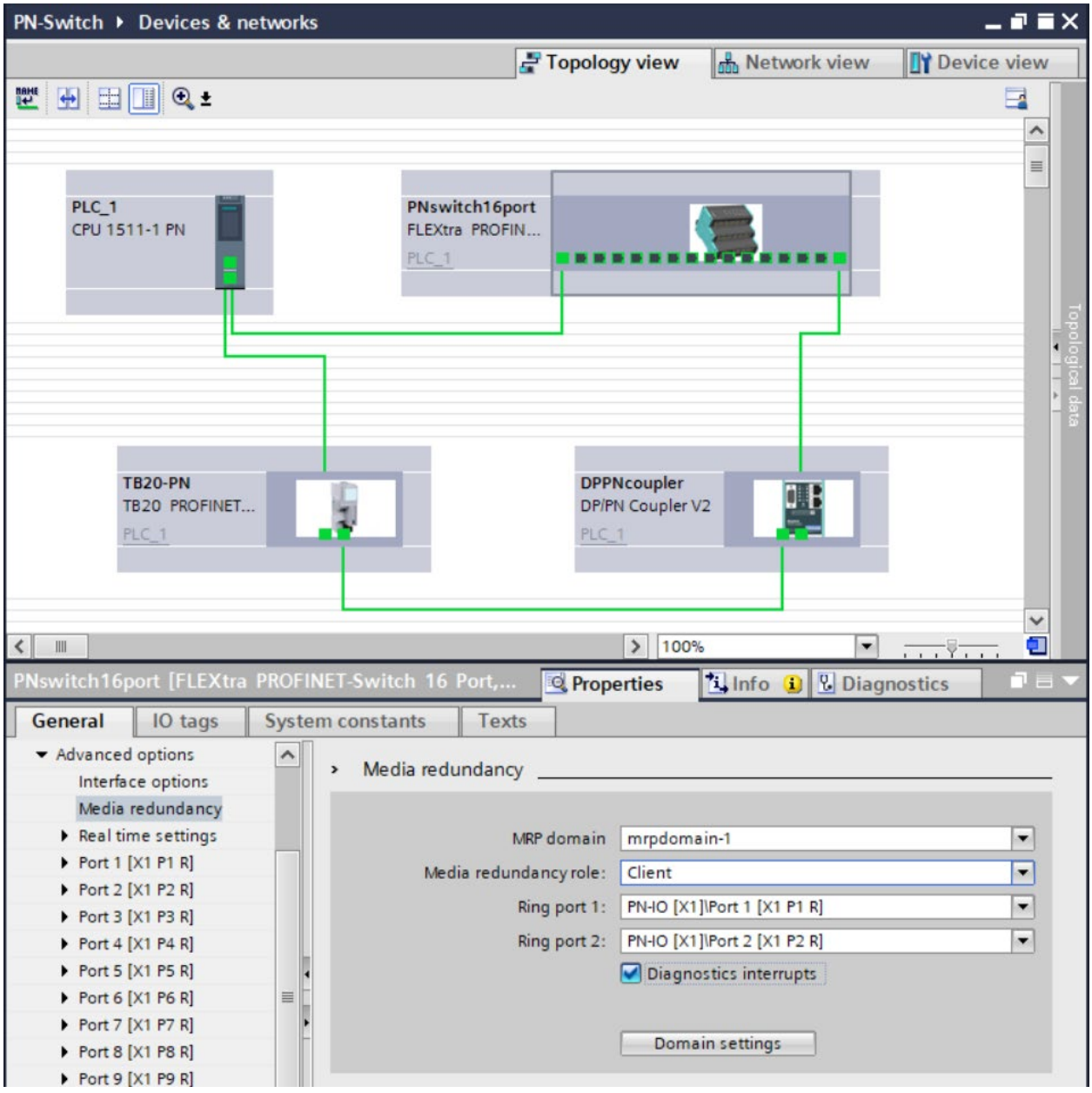
The Helmholz IPSet tool, which can be downloaded at no charge from the Helmholz website, can also be used to set the PROFINET name. Scan the following QR code to download the IPSet tool:

5.7 Media redundancy protocol (MRP)

The PROFINET switch optionally supports media redundancy (MRP) as a MRP client. MRP enables ring cabling, which allows the PROFINET network to operate even if a cable or a device fails.

In a MRP ring there must be a MRP manager (e.g. the PLC), all other participants of the ring are then MRP clients.

To assign the PROFINET switch to an MRP ring, the media redundancy role "Client" must be set under "Properties"/"General" for the "Media redundancy" option.



NOTE

If a ring cabling is established without the MRP roles being configured on all devices involved, the PROFINET network may malfunction!

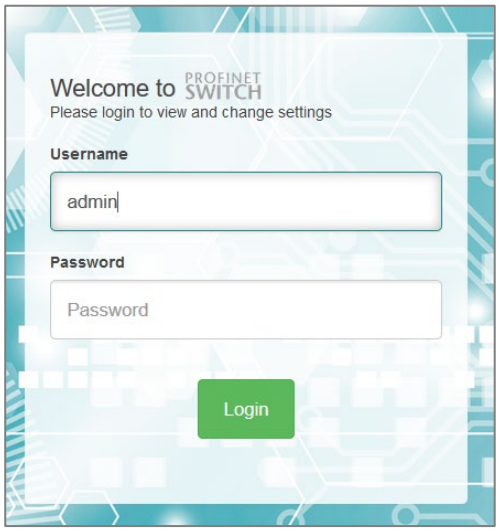
6 Configuration and diagnostics via the web interface

6.1 Login

Via the web interface, the status of the PROFINET switch can be queried and further functions can be configured. Furthermore, a firmware update can be performed via the web interface.

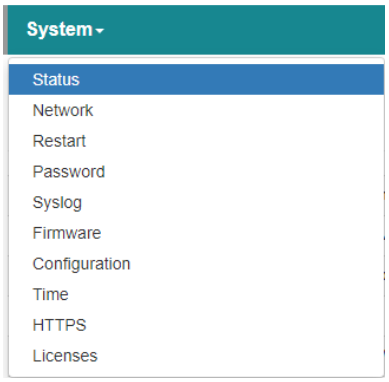
The web interface can be operated as soon as the device has a network configuration. The IP address of the device must be entered as URL.

In the following login dialog, the username is "admin" and the password is the serial number of the FLEXtra PROFINET switch, which can be read on the side of the device. When logging in for the first time, the default password must be changed.



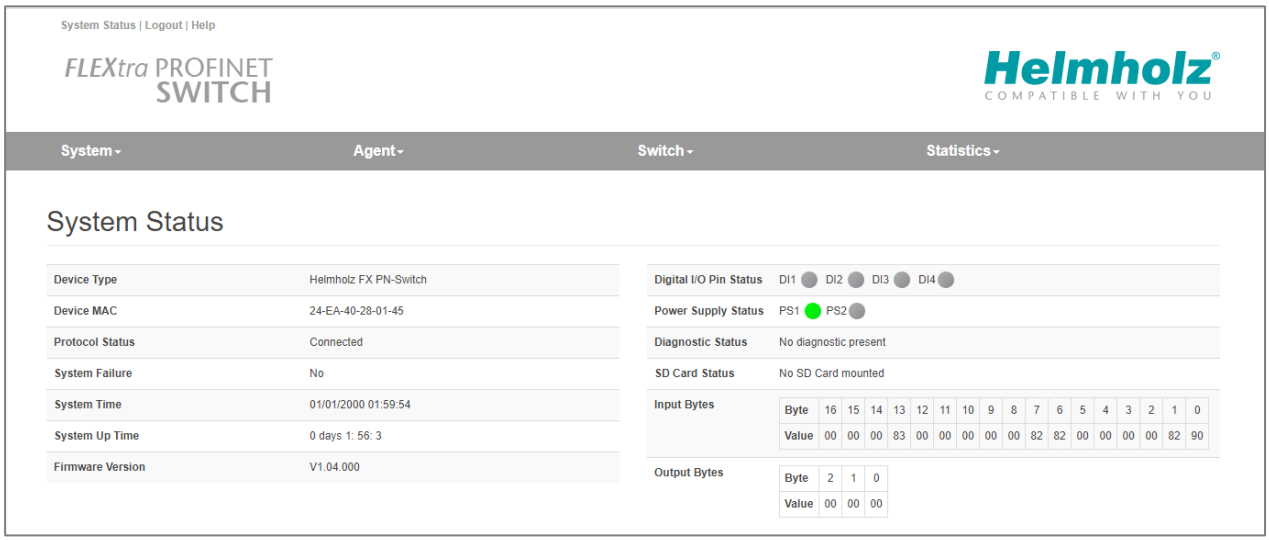
6.2 “System" menu

The "System" menu contains basic functions for operating the FLEXtra PROFINET switch.



6.2.1 Status

The “System Status” web page is the start page of the PROFINET switch, it displays basic system status and information about the switch. This includes the device type, MAC address, firmware version, system time and the status of external and internal IOs and SD card.



6.2.2 Network configuration

The network configuration consists of IP address, subnet mask, default gateway and the PROFINET device name. IP address and subnet mask together define the address of the network. The standard gateway is required for the transition to other networks.

The PROFINET switch can be operated in two modes.

1. configured via PROFINET
2. managed switch without PROFINET

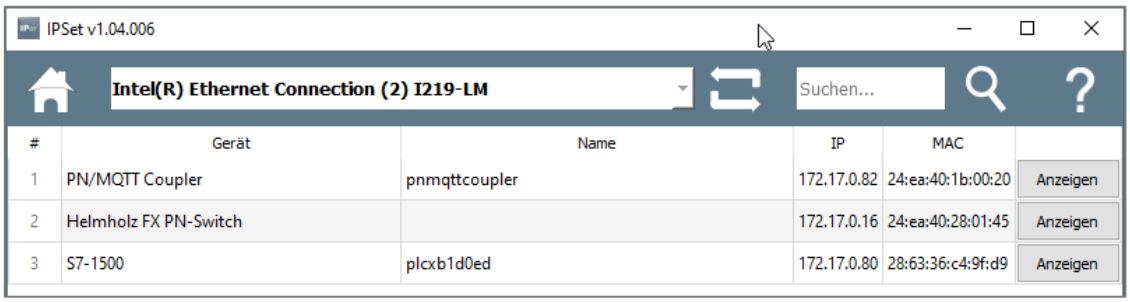
In the PROFINET configuration operating mode, the switch must be assigned a PROFINET name and then it receives its IP address, subnet mask and default gateway from the PROFINET controller's configuration when the PLC starts up.

The PROFINET device name can be set via the PROFINET configuration tool or via the Helmholz IPSet tool (see Chap. 5.6).

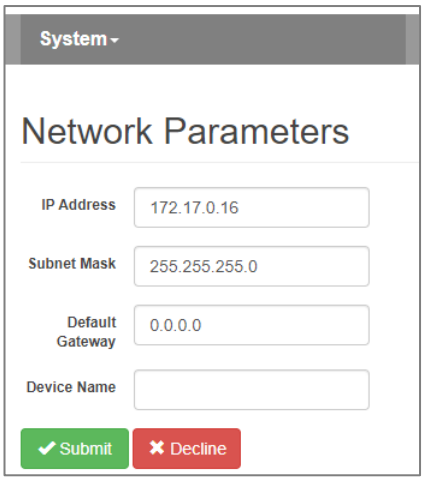
NOTE

If the PROFINET switch has been configured via PROFINET, no changes to the network parameters are possible.

In the "Managed Switch" operating mode, the IP address can be set via the "IPSet" tool in order to be able to access the web page for further configuration.

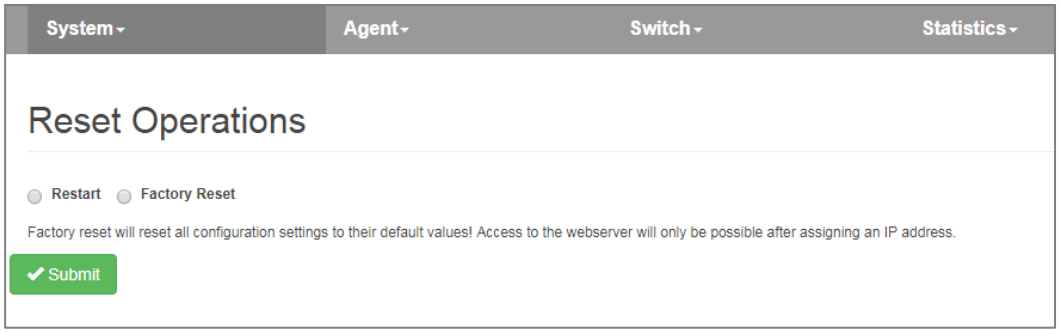


The network configuration can be displayed under "Network" (in the "System" menu) and also changed in the "Managed Switch" operating mode.



6.2.3 Restart and Factory Reset

The device can be restarted and reset to factory settings via the web interface. Both functions are available in the web interface under "Restart" ("System" menu).



The restart of the device can also be triggered at any time also by pressing the "RST" button on the front panel of the device.

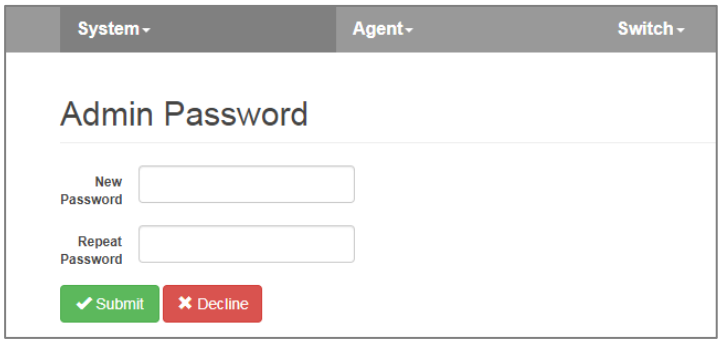
To reset the device to factory settings with the "FCN" button, the following steps are necessary:

1. Switch on or restart the device, pressing and holding the FCN button.
2. Wait until the "SF" LED lights up.
3. Release the "FCN" button.

6.2.4 Password

Access for the administrator to the web interface is protected by a password. The password must be changed after startup. The factory preset password cannot be assigned again. Passwords can be between 4 and 20 ASCII characters long.

The password can be changed under "Password" ("System" menu):

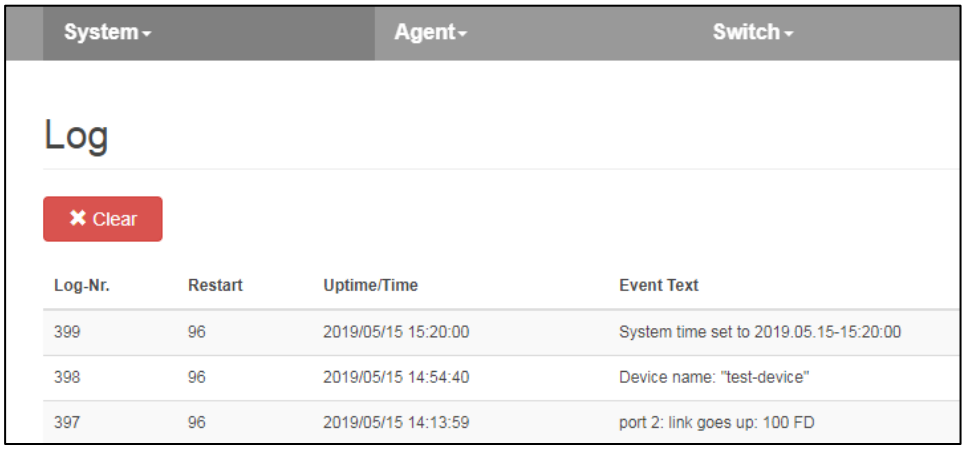


6.2.5 Event Loging

System events are stored in the device and can be retrieved even after the device has been restarted. System events consist of:

- Current entry number since restart
- Time (relative to the system restart or real time)
- Text describing the system event.

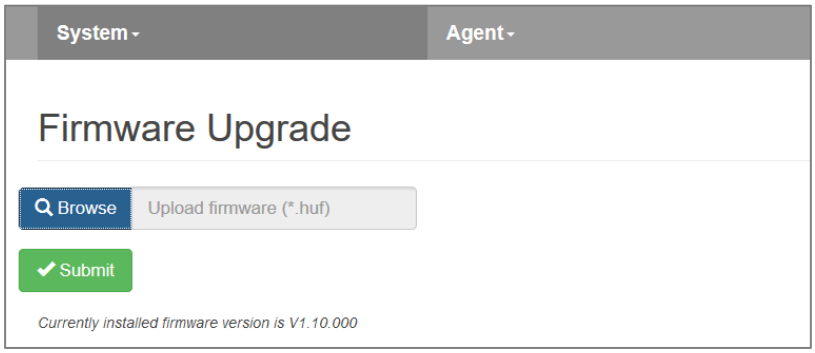
System events can be viewed and deleted under "Event Log" ("System" menu).



6.2.6 Firmware Upgrade

The firmware stored in the device can be updated. New firmware versions are delivered in files with the extension ".huf" and are available via the Helmholz homepage www.helmholz.de.

Under "Firmware" ("System" menu), a firmware file can be selected and loaded into the device. After loading, a restart is performed.

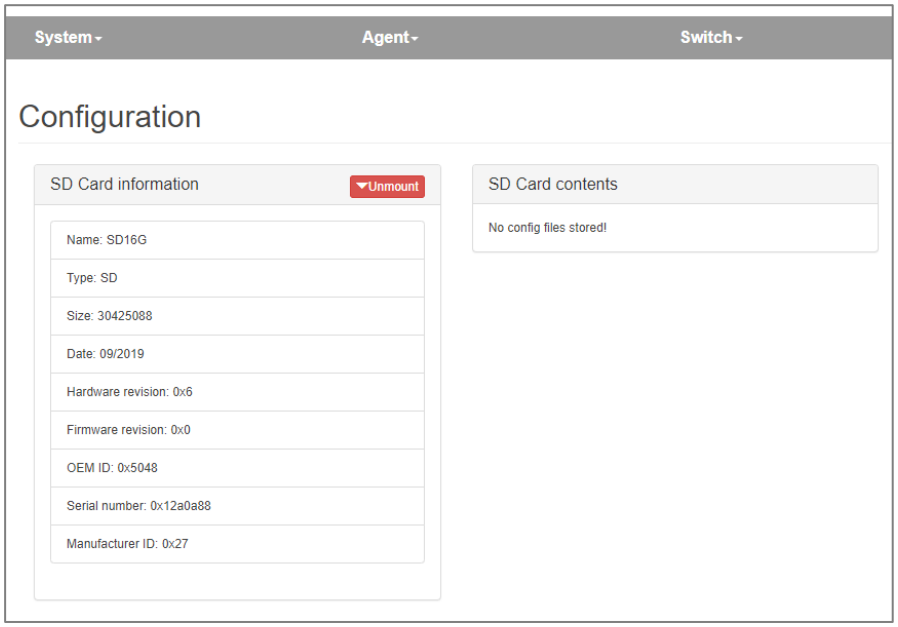


ATTENTION

Interrupting the power supply during the update process can render the device unusable.
The device must then be sent in for repair.

6.2.7 Saving and restoring a configuration

The FLEXtra PROFINET-Switch has a slot for a micro SD card on the back above the IO port. The micro SD card can be used to save and load configurations. All current settings can always be saved to the card or read. Several configurations can be stored on the micro SD card.



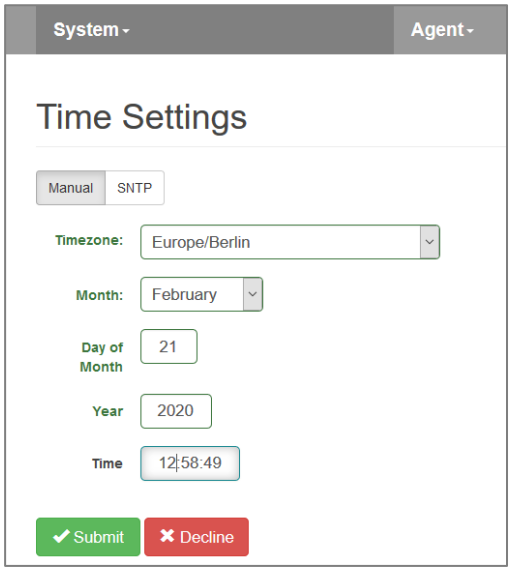
6.2.8 Time Settings

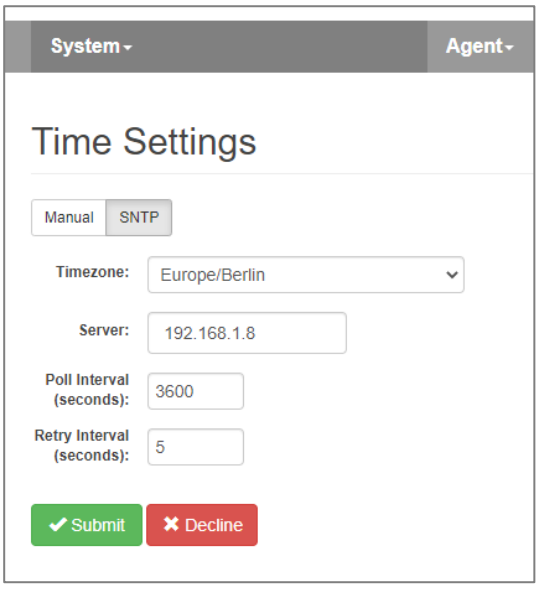
The time of the FLEXtra PROFINET-Switch can be set. The time is used for the display of system events. The time can be set manually or synchronized with a time server (SNTP).

The configuration of the time can be displayed and changed under "Time" ("System" menu). Depending on the selected synchronization mode, the web page is displayed differently.

If manual synchronization was selected, a form appears with which the current system time can be displayed and changed.

If "SNTP" is selected as synchronization, the form appears to be able to configure the SNTP server.

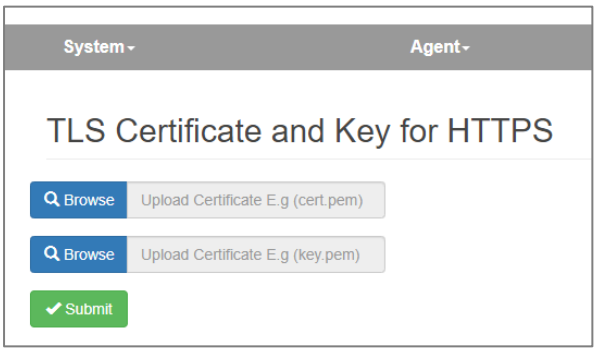




6.2.9 Certificates for website

To further secure the SSL-encrypted access to the website, it is possible to store a certificate for the device. The HTTPS access is then not only encrypted, but also with a secure authentication of the website.

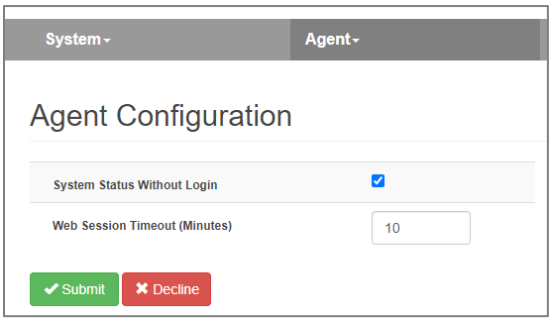
The certificate and private key for the website can be stored in the "HTTPS" menu.



6.3 „Agent“ menu

6.3.1 Web

The form for viewing and changing the settings for Ethernet-based administration is located under "Web" in the "Agent" menu.



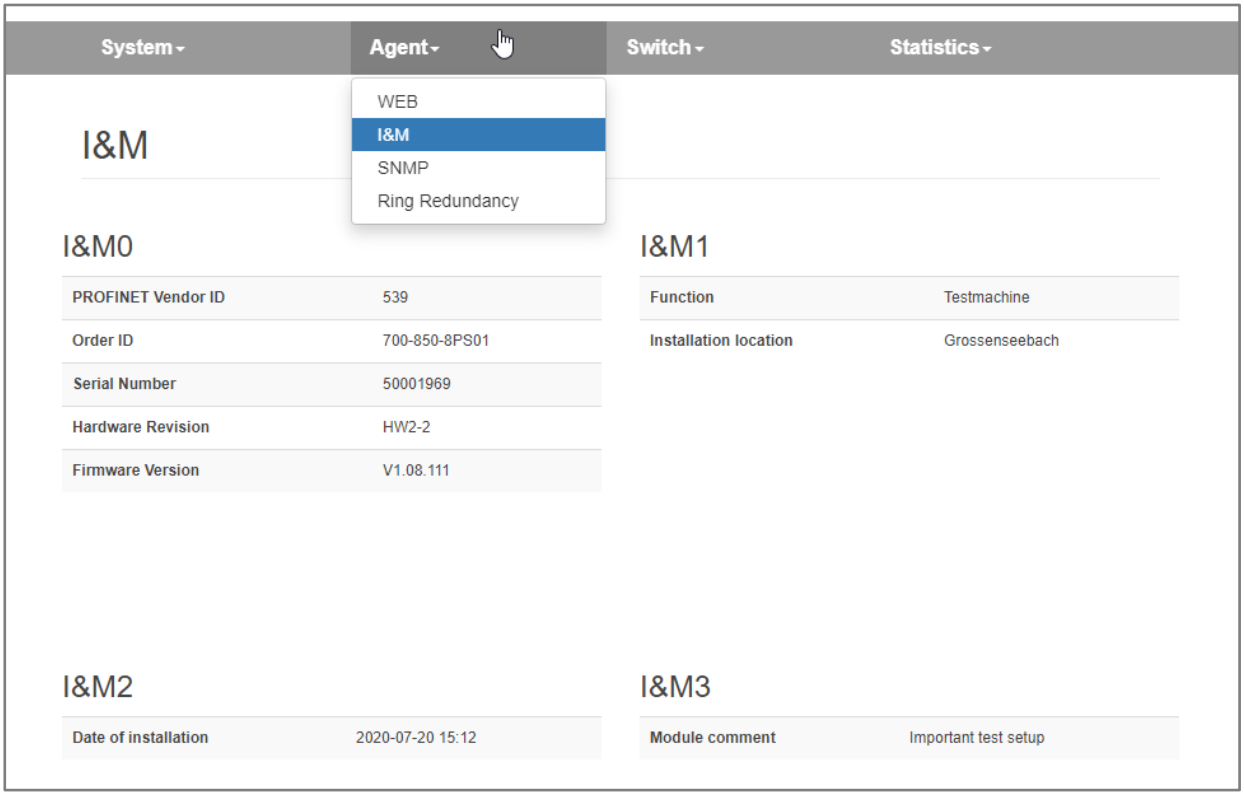
If "System status Without Login" is enabled, the system status is displayed on the login page so that the device status can be checked without logging in.

Web Session Timeout (minutes): Defines the timeout for automatic user logout due to inactivity. Valid entry is 0 - 60, where 0 disables timeout monitoring.

6.3.2 Identification & Maintenance

The information on identification and maintenance (I&M0) includes the PROFINET vendor ID, order number, serial number and information on the hardware and firmware version. The user settings for I&M1 to I&M3 are also displayed here.

The information is displayed under "I&M" in the "Agent" menu.

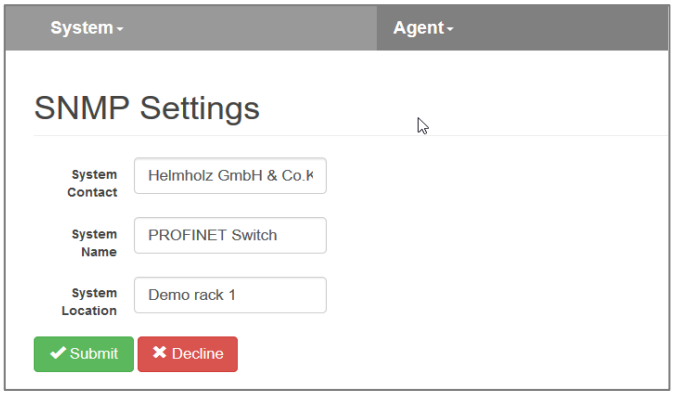


6.3.3 SNMP

SNMP (Simple Network Management Protocol) is an IP-based protocol for monitoring and controlling network components.

The following SNMP attributes can be displayed and changed:

- System Contact
  (SNMP-OID: 1.3.6.1.2.1.1.4)
- System Name
  (SNMP-OID: 1.3.6.1.2.1.1.5)
- System Location
  (SNMP-OID: 1.3.6.1.2.1.1.6)

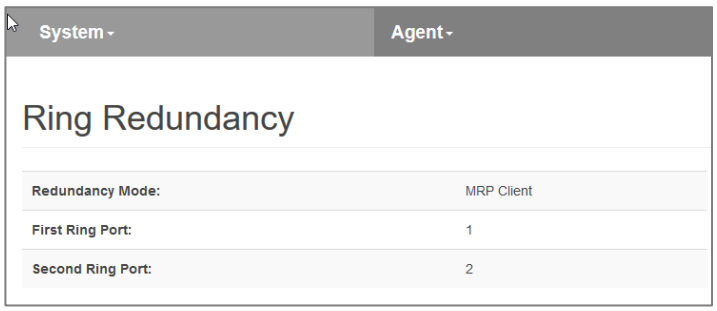


The attributes can be displayed and changed under "SNMP" (menu "Agent").

6.3.4 Topology („Ring Redundancy“)

The PROFINET switch can be used in a ring topology as MRP client. Changes to the topology settings can only be made in the PROFINET hardware configuration.

The current topology settings can be viewed under "Ring Redundancy" in the "Agent" menu.

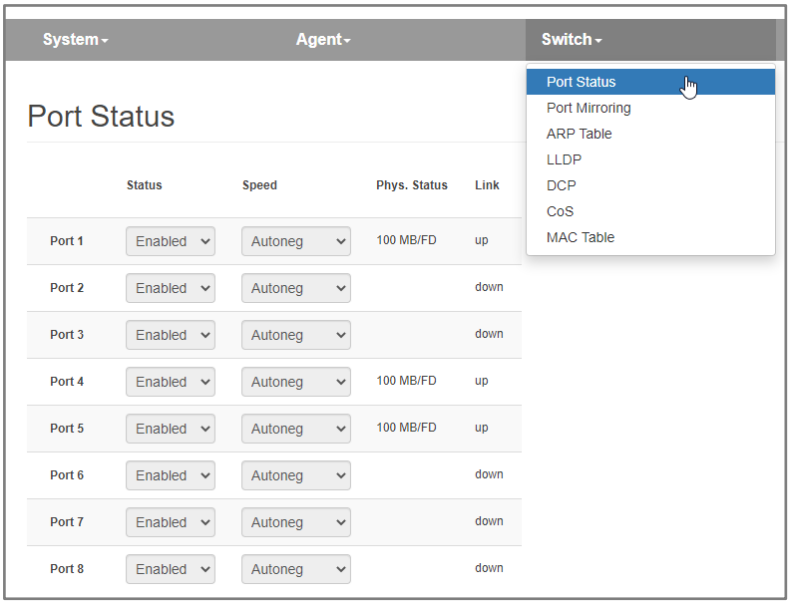


6.4 „Switch“ menu

6.4.1 Port Status

The current status and settings of the Ethernet ports can be queried and changed.

The form for displaying the port status and changing the port settings is located under "Port Status" in the "Switch" menu.



A port can be switched on or off, i.e. deactivated.

A port can operate with auto-negotiation ("auto"), with 100 Mbps/full duplex ("100MB/FD") or with 1000 Mbps/full duplex ("1000MB/FD").

With the "Autoneg" setting, the establishment of the ethernet connection is preceded by a procedure in which MDI-X is enabled and the partners jointly agree on a speed/duplex.

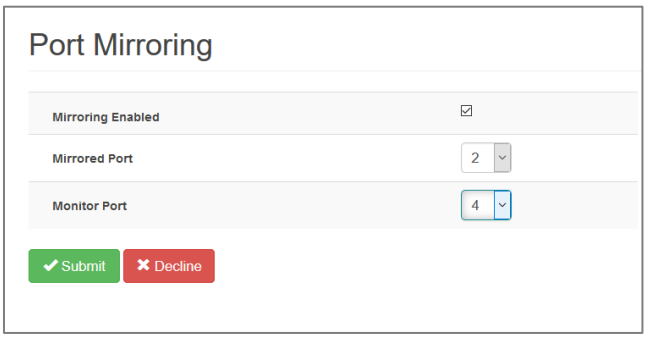
NOTE

Changes to the port settings are only possible as long as no PROFINET configuration is active in the switch.

6.4.2 Port Mirroring

The Ethernet ports of the PROFINET switch can be set up to mirror the incoming and outgoing data traffic of another port. A maximum of one port can be set up as a mirror of another. The port remains usable for its own data traffic without any restrictions.

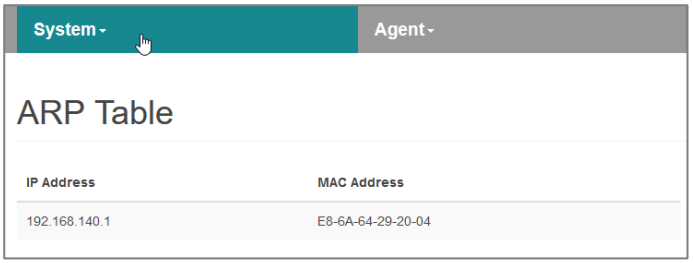
The form for viewing and changing port mirroring is located under "Switch / Port Mirroring".



6.4.3 ARP-Table

The IP addresses known to the PROFINET switch and their associated MAC addresses can be queried. The query only considers IP addresses of devices with which the PROFINET switch communicates via IP.

The query ARP table can be found at "ARP Table" (section Switch).



6.4.4 LLDP

PROFINET devices periodically send so-called LLDP frames to the devices to which they are connected via Ethernet. In this way, PROFINET devices receive information about exactly who they are connected to. This information is retained and forms the basis for determining the network topology.

If the connected device is not a PROFINET device, sending the LLDP frames and holding the corresponding information can lead to problems when detecting the network topology. Therefore this function can be disabled for each port.

For the LLDP frames, each port has its own MAC address. Example for the first ports of the PROFINET-Switch:

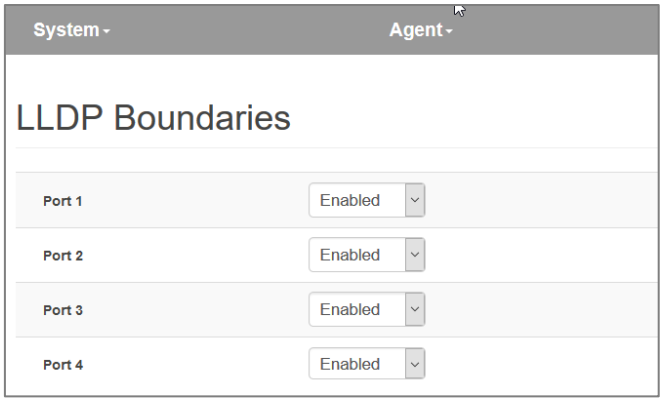
Device: 24-EA-40-20-xx-xx

Port 1: 24-EA-40-21-xx-xx

Port 2: 24-EA-40-22-xx-xx

Port 3: 24-EA-40-23-xx-xx

...



The form for querying and changing the LLDP settings is located under "LLDP" in the "Switch" menu.

NOTE

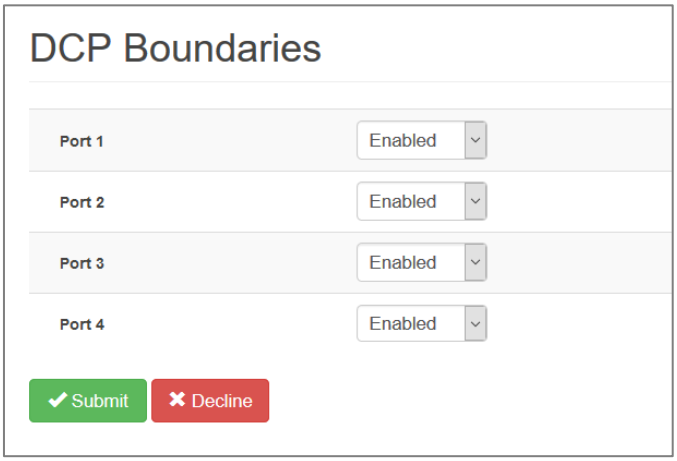
Changes to the LLDP settings are only possible on the web page as long as no PROFINET configuration is active in the switch. With a PROFINET configuration, this function can be set via the port configuration in the PROFINET tool.

6.4.5 DCP boundaries

The DCP protocol can be used to detect PROFINET devices in a network and provide them with basic parameters such as IP address and device name. For this purpose, DCP frames are forwarded to all ports.

If forwarding to a particular port is undesirable, it can be disabled. The reception of DCP frames on this port is unaffected.

The form for querying and changing the DCP settings is located under "DCP" in the "Switch" menu.



NOTE

Changes to the DCP settings are only possible on the web page as long as no PROFINET configuration is active in the switch. With a PROFINET configuration, this function can be set via the port configuration in the PROFINET tool.

6.4.6 Preferential forwarding of time-critical data („CoS“)

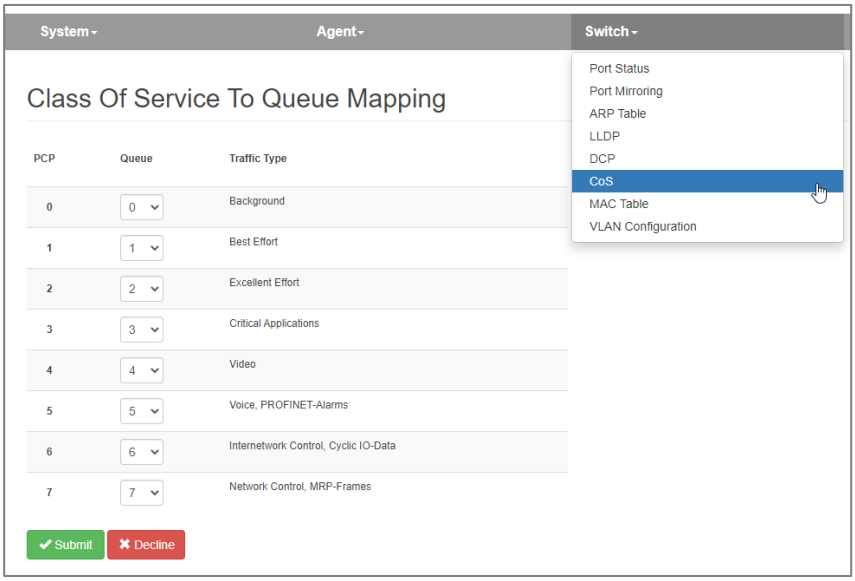
Time critical PROFINET data are sent as Ethernet frames with IEEE 802.1q header. In this header there is IEEE 801.2p data, which contains a priority specification (PCP).

The following PCP values are in use with PROFINET:

Frame	PCP-Wert (0 ... 7)
PROFINET alarms	5
Cyclic IO data	6
MRP-Frames	7

The PROFINET switch can use this priority specification for preferred forwarding. This is particularly important when larger data volumes that are less time-critical sometimes pass through the switch. The configuration allows the priority specifications to be assigned to four queues. The queues are numbered 0 through 3 with 0 being the lowest priority and 3 being the highest priority. Ethernet frames without IEEE 802.1q headers are assigned to queue 0.

The form for viewing and changing the queue assignment is located under "CoS" in the "Switch" menu.



NOTE

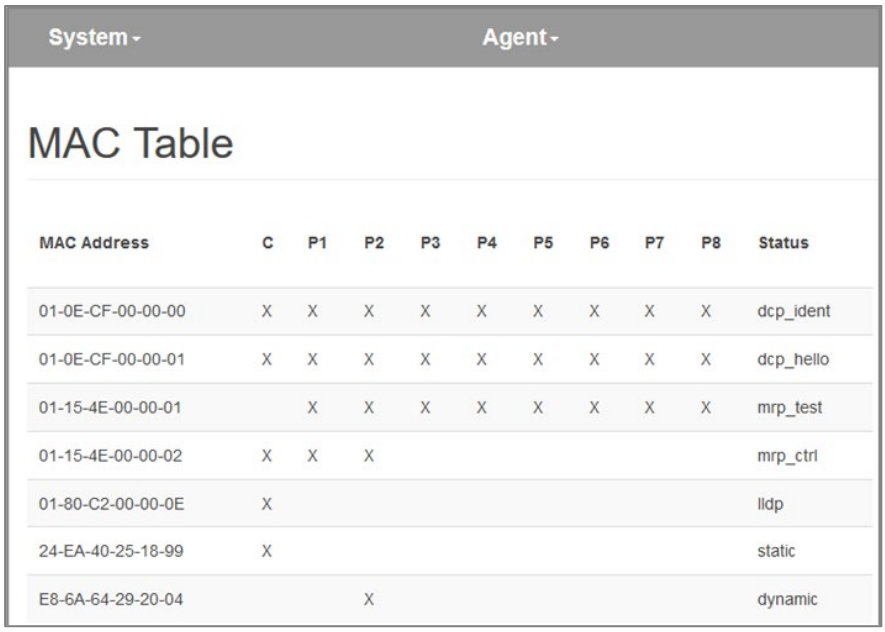
The factory default setting ensures preferential forwarding of time-critical PROFINET data ("Cyclic IO Data") and PROFINET alarms.

6.4.7 Port Forwarding rules („MAC Table“)

Ethernet frames are forwarded on the basis of forwarding rules. Such a rule consists of a MAC address and the ports to which frames with this destination address are forwarded. The currently valid forwarding rules can be queried.

In addition to the four external ports, the forwarding to the internal interface of the PROFINET switch ("C") is also shown.

The form for querying the forwarding rules is located under "MAC Table" in the "Switch" menu.



6.4.8 VLAN configuration

A Virtual Local Area Network ("VLAN") is a logical subnet within a larger physical network. It can extend across multiple switches.

A VLAN separates physical networks into subnets by ensuring that VLAN-enabled switches do not forward data packets into another VLAN. Devices logically connected via a VLAN remain among themselves. The use of VLANs in large physical networks is useful for controlling data traffic and securing access rights to devices.

The assignment of the subnets to a VLAN can be realized via special markings in the ethernet frames ("tagged") or statically via port assignment in the switches ("untagged").

Tagged: If the port is a tagged member of a particular VLAN, all packets in that VLAN are tagged when they leave the port. The VLAN tag is a 4-byte overhead on the standard Ethernet frame consisting of a 2-byte Tag Protocol Identifier (TPID), which is 0x8100, and a 2-byte Tag Control Information (TCI). The TCI contains a 12-bit VLAN identifier. Thus up to 4096 different VLANs can be managed.

Untagged: If a port is an untagged member of a particular VLAN, all packets in that VLAN - without a VLAN tag - are forwarded to that port.

NOTE

The following special features must be observed in the interaction of PROFINET and VLANs:

Management-VLAN

In the FLEXtra PROFINET switch, VLAN 1 is the management VLAN. The FLEXtra web interface and the PROFINET interface are only available in VLAN 1. To prevent the connection to the device from being lost, port 1 as management port in the VLAN configuration is always tagged member of VLAN 1.

AR Connection

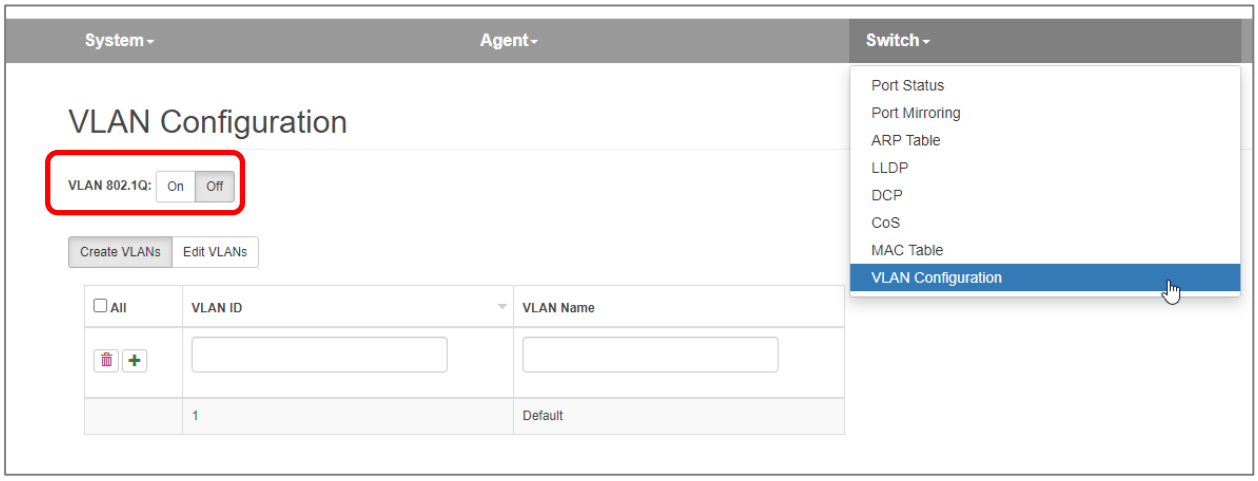
The PROFINET interface in the FLEXtra is only available in VLAN 1. The PROFINET controller can establish the AR connection only on the ports that are members of VLAN1.

MRP

If the FLEXtra PROFINET-Switch is configured as MRP client, both MRP ring ports must be members of VLAN1 for normal operation!

The FLEXtra PROFINET-Sswitch supports VLANs, both tagged and untagged. The VLAN configuration can be configured in the "Switch" menu under "VLAN Configuration". The VLAN configuration is divided into two dialogs, which can be switched between with a button.

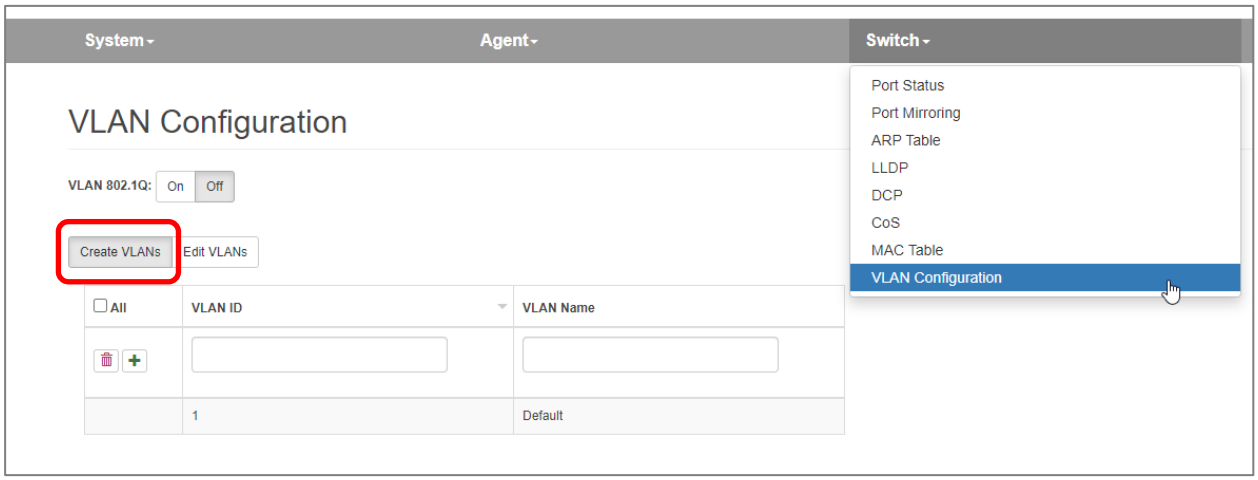
The device can operate as a VLAN active and VLAN inactive device. This is controlled with the switch "VLAN 802.1Q: ON/OFF".



NOTE

It is highly recommended to create VLANs and edit the VLAN membership and port-based settings before enabling the VLAN feature.

1. **„Create VLANs“**: Virtual LANs can be created in this dialog.

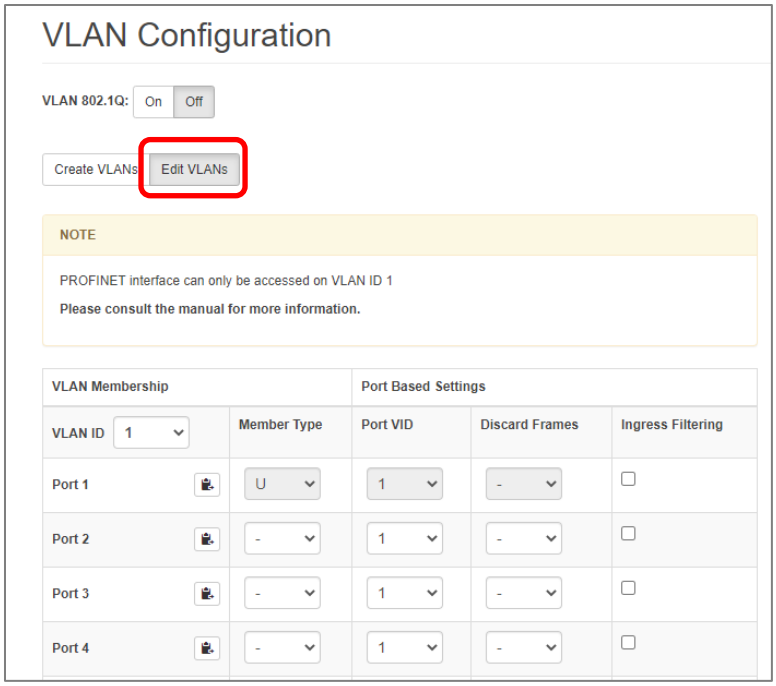


The VLAN ID can be set from 1-4095, the VLAN name is freely selectable.

The icon is used to create the new VLAN.

The icon can be used to delete a VLAN.

2. **„Edit VLANs“:** In this dialog, one or more VLANs can be assigned for each port.



“**VLAN Membership**” – In the first two columns you can see or change the membership of all ports for the selected "VLAN ID".

“VLAN ID” Current VLAN ID for which the membership configuration is displayed.

“Member Type” Port member type:

“-“ Port is not a member of the specified VLAN

“T” Port is a tagged member of the specified VLAN

“U” Port is not tagged member of the specified VLAN

Copy settings for this VLAN ID to all other ports

"**Port Based Settings**" In the rear 3 columns the VLAN ID and security settings can be defined for each port.

"Port VID" default port VLAN ID. When a frame arrives on a port without a VLAN ID, the default VID is applied and the frame is switched as if it had the specified VID.

"Discard Frames" Specifies what kind of frames should be discarded:

"- " All frames are accepted

"T" Tagged frames are discarded

"U" Untagged frames are discarded

"Ingress filtering" specifies whether the VID of incoming frames should be evaluated:

Active: Frames are only accepted if the VLAN ID in the Ethernet telegram matches the port VLAN ID. That is, if the port is a tagged member of VID 100 and an untagged member of VLAN 1000. It accepts frames with VID 100 and 1000, and all other VLAN tagged frames are discarded.

Inactive: All frames are accepted.

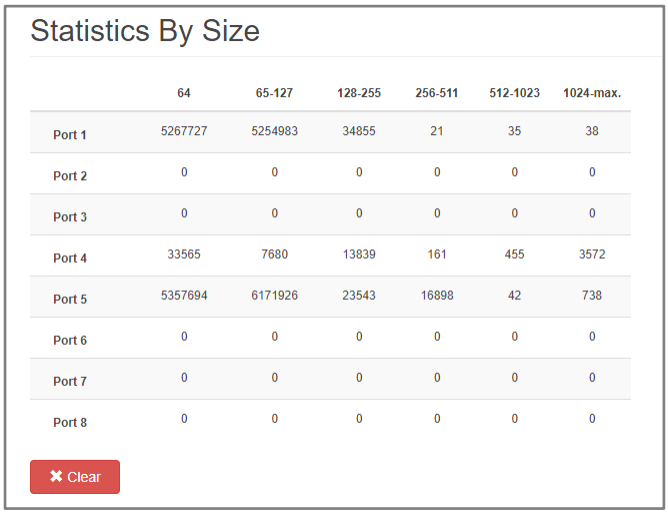
6.5 Network statistics (“Statistics“ menu)

The PROFINET-Switch collects statistical data per port about the type of incoming (RX) and forwarded (TX) frames. The statistics can be displayed and reset.

6.5.1 „Statistics By Size“

In the statistics according to telegram length, both RX and TX telegrams are taken into account. The telegrams are divided into 6 areas based on their size:

0-64 Bytes, 65-127 Bytes, 128-255 Bytes, 256-511 Bytes , 512-1023 Bytes and 1024-max. (1500 Bytes).



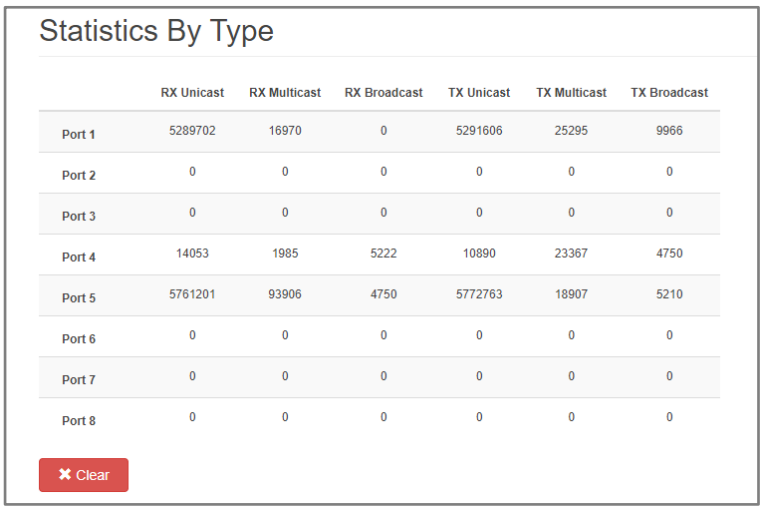
6.5.2 „Statistic By Type“

In the statistics by message type, frames are first divided into TX (transmitted) and RX (received) frames, and the following types are also distinguished:

Unicast: Frame directed directly to a device

Multicast: Frame directed to a group of devices

Broadcast: Frame directed to all devices in the network

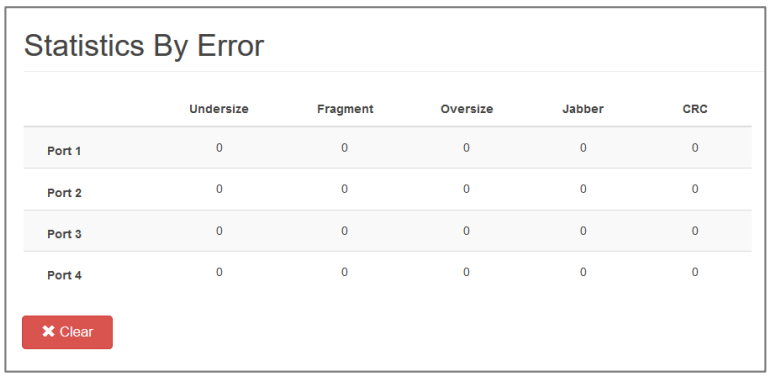


6.5.3 „Statistics By Error“

The PROFINET switch collects statistical data about arrived frames with transmission errors per port.

A distinction is made between:

- Undersize
- Fragment
- Oversize
- Jabber
- CRC



7 Status and control in the PLC

By integrating the FLEXtra PROFINET-Switch into a PROFINET project, IO data is available in the PLC for status indication and for controlling the switch.

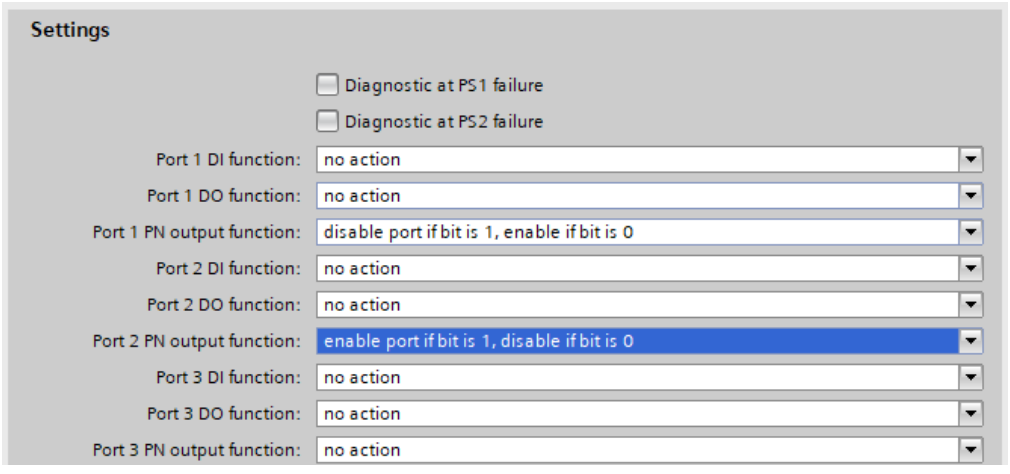
The operating status of the switch, the 4 digital inputs and the 16 ports can be queried in the input image. The input image for the status display of the switch occupies 17 bytes:

Byte/Bit	7	6	5	4	3	2	1	0
Input Byte 0	PROFINET switch ready for operation	SD-Card inserted and active	PS 2 supply present	PS 1 supply present	DI 4 status	DI 3 status	DI 2 status	DI 1 status
Input Byte 1 for Port 1	Transmission active	0	0	0	0	0	00 = not connected 01 = 10MBps 10 = 100MBps 11 = 1000Mbps	
Input Byte 2 for Port 2	Transmission active	0	0	0	0	0	00 = not connected 01 = 10MBps 10 = 100MBps 11 = 1000Mbps	
...							...	
Input Byte 16 for Port 16	Transmission active	0	0	0	0	0	00 = not connected 01 = 10MBps 10 = 100MBps 11 = 1000MBps	

With the output image the port errors can be reset, the two digital outputs can be switched and all ports can be disabled or enabled. The output image for controlling the switch occupies 3 bytes:

Byte/Bit	7	6	5	4	3	2	1	0
Output Byte 0	Reset port errors	-	-	-	-	-	switch DO 2	Switch DO 1
Output Byte 1	Port 8 disable/ enable	Port 7 disable/ enable	Port 6 disable/ enable	Port 5 disable/ enable	Port 4 disable/ enable	Port 3 disable/ enable	Port 2 disable/ enable	Port 1 disable/ enable
Output Byte 2	Port 16 disable/ enable	Port 15 disable/ enable	Port 14 disable/ enable	Port 13 disable/ enable	Port 12 disable/ enable	Port 11 disable/ enable	Port 10 disable/ enable	Port 9 disable/ enable

Whether a port can be locked and unlocked via the output image and the bit state for locking and unlocking can be set in the configuration of the PROFINET switch under the "Port X Output Function" parameter for each port.



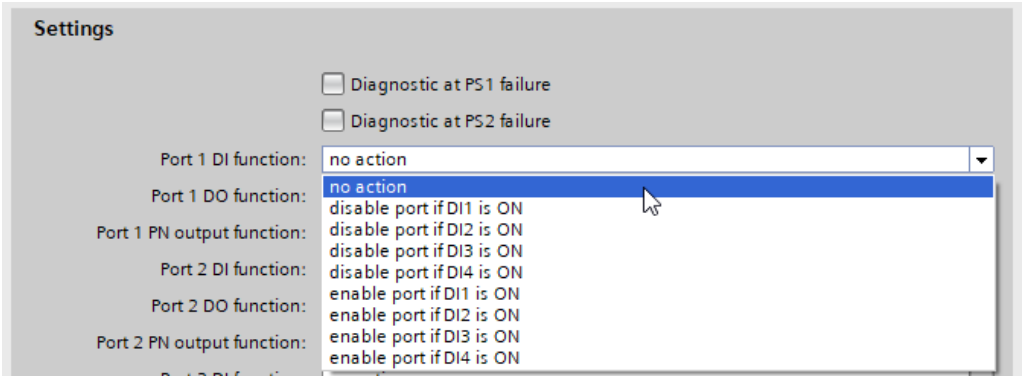
NOTE

Switching the ports via the output image has no function if the port is switched off in the port settings (see Chap. 5.4).

8 Status and control via digital inputs/outputs

The FLEXtra PROFINET Switch has 4 digital inputs and 2 digital outputs for 24V on the rear side.

The inputs can block or release any ports. In the parameterization of the switch in the PROFINET configurator, it can be set for each port whether it is to be blocked or enabled by one of the digital inputs.

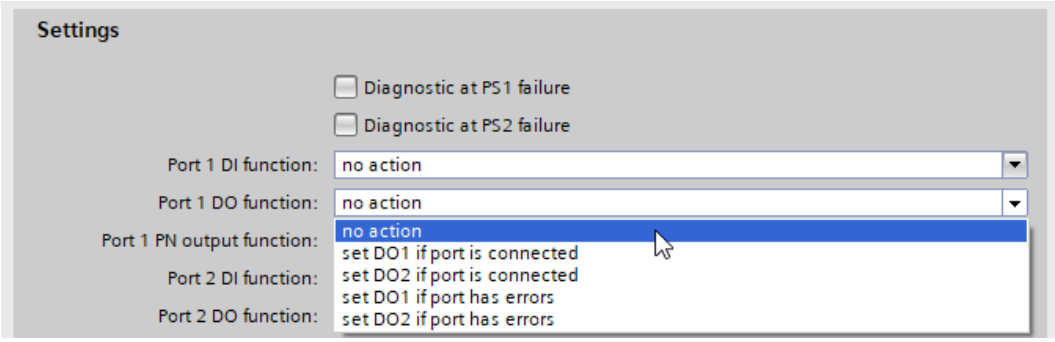


NOTE

Locking or releasing a port via the digital inputs has no function if the port is switched off in the port settings (see Chap. 5.4).

The state of the inputs can always be read out in the input image in byte 0 of the switch, regardless of its selected function (see Chap. 7).

The outputs can display the state of any port. In the parameterization of the switch in the PROFINET configurator it can be set for each port whether the connection state or an error state of the port should switch the output. The port states are "ORed" for each output. If a port has the parameterized state, the output is set.



NOTE

If outputs 1 or 2 are used, inputs 1 or 2 are no longer available.

9 PROFINET FAQ

9.1 Why do you need a PROFINET switch for a PROFINET network?

A PROFINET switch handles PROFINET frames with the highest priority and ensures that frame loss doesn't occur and that jitter in the transmission remains minor. That secures the PROFINET transmission and allows precise regulating in PROFINET systems.

A PROFINET switch supports mechanisms for neighborhood detection (LLDP protocol) in order to detect and check the topology of the network. This ensures that the setup and the network wiring of the system are correct.

PROFINET switch supports device replacement without exchangeable medium. If a PROFINET node needs to be replaced, new device is automatically recognized based on its position in network by the CPU, and thus it can be configured without the need for additional actions. This reduces the down time of the malfunction device significantly.

Because many different devices are often installed into automation systems, the "Finding devices via LED flash" function supports the easy search for a participant.

In order to improve the reliability of networks, PROFINET switches support the ring redundancy technology MRP (Media Redundancy Protocol).

However, the operation of a PROFINET network is also possible with unmanaged switches.

9.2 Is the PROFINET switch "real time-compatible"?

The PROFINET switch is "real time-compatible" and supports the PROFINET real time class 2 for cyclical data exchange. PROFINET is generally differentiated into two main real time classes: RT and IRT.

The "real time capability" of an industrial bus system generally involves the chronological precision of the cyclical IO transmission. For complex and distributed automation tasks, especially in the drive control area, it is important that the cyclical data transmission always takes place consistently. Longer interruptions due to other Ethernet traffic, for example, video cameras or project transmissions, should not influence the PROFINET IO cycle where possible.

PROFINET RT (real time) uses the standard technologies of managed switches (e.g. QoS) to always prioritize important Ethernet frames of bus communication in relation to chronologically non-critical frames.

PROFINET IRT (isochronous real time) uses special PROFINET switches to keep the jitter and the rhythm of the IO cycle as exact as possible in the network and to ensure a synchronous rhythm and the best transmission possible.

The Helmholz PROFINET switch supports PROFINET RT, but not IRT.

9.3 What do the LEDs BF and SF mean?

The “BF” LED shows logical “bus errors”, for example, that the device has not received a configuration, the configuration is defective, or no PROFINET communication is possible at all (network error).

The “SF” LED shows “collective errors”. This can include, for example, an existing PROFINET diagnosis.

9.4 What is “Device exchange during operation”, and what role does the PROFINET switch play here?

If a PROFINET participant malfunctions while in operation, a replacement device is detected following installation on the basis of its position in the topology (by the PROFINET neighbors) and is automatically provided with its IP address and its PROFINET name. The CPU can then configure the replacement device and restart. The neighboring PROFINET devices, for example, the switch, must this purpose support PROFINET in order to enable this function.

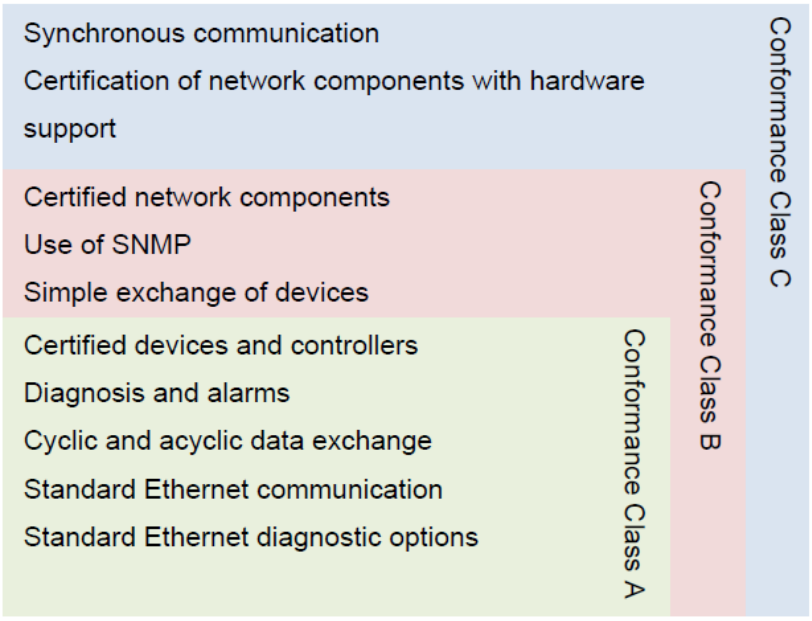
9.5 Why should PROFINET devices have PROFINET certification?

The PNO certification is carried out by accredited testing labs and is standardized by the PNO. PROFINET certification should ensure both the function of the PROFINET components in accordance with standards and the interoperability of various manufacturers in a PROFINET network.

9.6 What is behind the PROFINET conformance classes A, B, C?

PROFINET is divided into conformance classes (CC). The conformance classes define sensible function scopes and are thus decision-making criteria for system operators when using PROFINET components.

With prior definition of an application in a CC, the user can make a selection of components with clearly defined minimum properties.



From the PNO document “PROFINET Planning Guideline (Order no.: 8.061)”

You can find more information on the conformance classes in the PNO document “The PROFINET IO Conformance Classes - Guidelines for PROFINET IO (Order no.: 7.041)”.

9.7 Can the PROFINET switch also transmit 1 GBit?

No, because the PROFINET protocol is currently only specified for 100 Mbps.

9.8 Can the PROFINET switch also be operated at 10 Mbps?

Yes, the PROFINET switch also communicates with 10 Mbps participants. However, 100 Mbps are the prerequisite for performant and real time-compatible applications.

9.9 Which Ethernet cable types can be used for PROFINET?

The conformance classes B and C presume Ethernet cable in accordance with IEC61784-5-3.

In conformance class A, other cables (see PNO document “CC-A Cabling Guide”) and wireless connections can also be used.

9.10 Can PROFIsafe be transmitted via the PROFINET switch?

Yes, the PROFIsafe protocol classifies all components between the PROFIsafe controller and the PROFIsafe device as “black channel”. Any number of network participants and components can thus be used in the PROFINET route. If transmission disruptions should occur, the PROFIsafe components switch to a secure status

9.11 Why does the PROFINET switch have its own IP address and a PROFINET name?

The PROFINET switch is a managed switch. The IP address is necessary to be able to address the switch as an active infrastructure component. PROFINET switch can be reached via IP address over Web browser (web interface) or by other PROFINET participants (e.g. a CPU or a programming device can configure the switch and read out information from the switch).

For the purposes of simplifying the IP address in the PROFINET, a device name can be used that is then synonymous in a project for the IP address.

9.12 What are I&M data?

For PROFINET and PROFIBUS, I&M stands for “Identification and Maintenance”. The I&M data contain information about the PROFINET participants. Some I&M fields are programmed by the manufacturer (e.g. order number, serial number, ...), and fields can be used by users in order to store their own information in the module(e.g. location, service contact, ...)

The I&M data of all PROFINET participants can be read out and evaluated in the automation network with standard functions. The PROFINET switch has appropriate I&M data records.

9.13 Can I also use the PROFINET switch in other industrial networks without PROFINET?

PROFINET is based on the Ethernet standard and the PROFINET switch can be used in normal TCP/IP networks, especially in industrial networks, as a managed switch. In the process, the PROFINET-specific functions of the PROFINET switch are not addressed.

General Ethernet functions can be read out and configured through the switch web interface.

9.14 What happens with a PROFINET participant when the power supply fails?

PROFINET participants mostly have 2 ports for the PROFINET cabling. The two ports are connected with one another by an internal 2-port switch component. If the power supply of a PROFINET participant fails, the communication is interrupted at this point in a network line. One can get around this problem with ring cabling using MRP technology.

If the power supply of a PROFINET switch fails, the communication with all participants connected to this switch is no longer possible.

This behavior is clearly different from that of PROFIBUS networks!

9.15 Why is “Port Mirroring” necessary?

PROFINET is a complex communication protocol. In some situations, it may be necessary to read and interpret the frame traffic with a protocol analyzer.

In order to be able to monitor PROFINET network expensive coupling hardware which is looped into the line can be used. Alternative is Port mirroring feature configured on free port. The monitor port transmits all frames from mirrored port of the switch as a copy. A device or PC can then capture packets on monitor port with the corresponding analysis software.

9.16 More information on PROFINET

More information on PROFINET can be found in the documentation “PROFINET Planning Guideline (Order no.: 8.061)”, “PROFINET Installation Guideline (Order no.: 8.071)” and the “PROFINET Commissioning Guideline (Order no.: 8.081)”, which are available from PNO (https://www.profibus.com/).

10 Technical data

Order no.	**700-855-16P01**
Name	FLEXtra PROFINET-Switch 16-port, managed, 10/100/1000 Mbps
Scope of delivery	FLEXtra PROFINET switch 16-port, with power supply plug
Dimensions (D x W x H)	78 x 125 x 111 mm
Weight	Approx. 500 g
PROFINET interface	
Connection	16 x RJ45, integrated switch
Protocol	PROFINET IO as defined in IEC 61158-6-10
Transmission rate	PROFINET: 100 Mbps Ethernet: 10/100/1000 Mbps
Features	PROFINET Conformance Class B Media Redundancy (MRP) automatic addressing (DCP) and Topology detection (LLDP) Diagnostic alarms, VLAN, SNMP, Port-Mirroring, Port statistics
Digital IO	
Inputs	4, type 3 / DIN EN 61131-2
Outputs	2, 500mA DC 24V, with electronic fuse
Status indicator	4 LEDs function status, 16 LEDs Ethernet status (bicolor)
Voltage supply	24 V DC; 18 ... 30 V DC
Current draw	Max. 400 mA at 24 V DC
Power dissipation	Max. 9,6 W
Ambient conditions	
Installation position	Any
Ambient temperature	-40°C ... +75°C
Transport and storage temperature	-40°C ... +85°C
Relative air humidity	95 % r H without condensation
Protection rating	IP20
Certifications	PROFINET Conformance Class B
REACH & RoHS	Yes