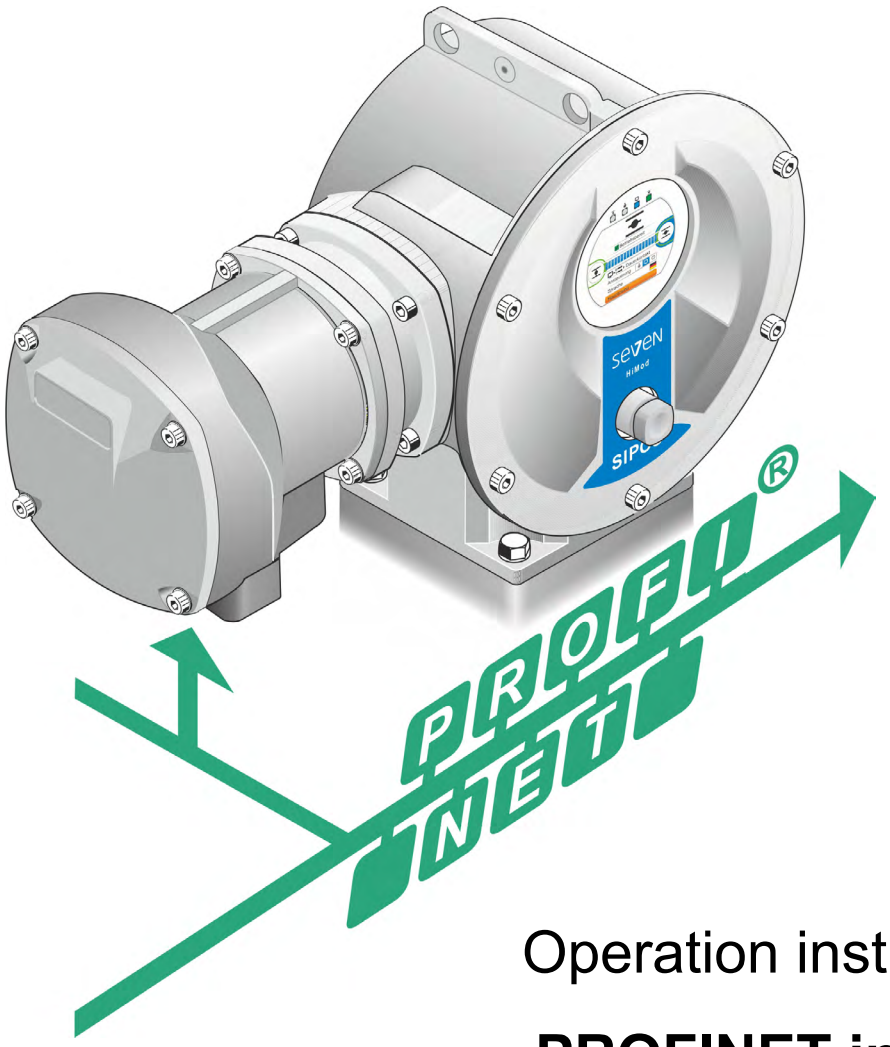
SIPOS AKTORIK

seven



Operation instructions

PROFINET interface for electric actuators

Issue: 01.23
Y070.538/EN

Contents

Contents

1 General information

1.1 Safety instructions: Used symbols and their meanings

Warning marks activities which, if not carried out correctly, can affect the safety of persons or material.

Note marks activities which have major influence on the correct operation. Non-observance of these notes may lead to consequential damage.

1.2 Notes to the operation instructions

This manual describes the PROFINET interface for SEVEN electric actuators.

For more detailed information on the actuators, refer to the pertaining operation instructions:

- PROFITRON/HiMod, article no.: Y070.302/EN and
- ECOTRON, article no..: Y070.301/EN.

These operation instructions are complete only in combination with the operation instructions of the respective actuator. The safety information contained in the operation manuals must be heeded at all times when working with the actuators.

2 General information on PROFINET

PROFINET I/O is a communication protocol for industrial automation engineering based on Ethernet and standardized by the PROFIBUS Nutzerorganisation e.V. (PNO) worldwide. PROFINET enables real time communication (RT) with short cycle times as well as acyclic communication (non RT) for configuration and diagnostics.

As communication network for field devices, PROFNET reserves many advantages across the total lifecycle of a site. Advantages include economy in cable connections and system components as well as simplification of processes within the overall business environment.

Some of the advantageous PROFINET features are:

- Virtually unlimited number of participants within the network.
- Flexible topologies (line, star, tree, ring,...).
- Topologies can easily be scaled and expanded.
- Network topology can be planned and programmed offline.
- Large network expansion by cascading via switches.
- High performance (cycle times within the range of 1 – 8 ms and high throughput), in particular for large data volumes (diagnostics, file transfer, etc.).
- Easy device replacement without requirement of new bus configuration.
- Simple maintenance.
- Use of available networks and IT know-how.
- Seamless and vertical integration of process and production data from field level into the cross-functional information systems.
- Simple access to device data on field level without proprietary gateways.
- Integration of web servers or universal interfaces such as OPC UA within the device.
- Multitude of network components, software tools and safety technologies available.
- Combination of various transmission media like copper cables, fiber optic cables or WLAN.

Based on Ethernet and IT protocols, PROFINET automatically benefits from the continuous development thanks to a large number of market competitors. Consequently, PROFINET is a future-proof device communication and protects long-term investments.

2.1 Basic characteristics

PROFINET defines the technical and functional features of a communication system based on Industrial Ethernet, used for interconnecting distributed digital automation devices.

PROFINET makes the distinction between I/O controller (master) and I/O devices (slave). PROFINET is designed for fast data exchange on the field level. Here, central control devices (PLC or PC) communicate via a fast network with peripheral field devices such as input devices, output devices, valves and actuators.

Data exchange among these field devices is based on cyclic communication. The necessary communication functions are defined by the basic PROFINET functions according to IEC 61158 and IEC 61784.

A PROFINET network comprises at least one I/O controller and one or several I/O devices. As an option, an I/O device can exchange data with several I/O controllers (shared input and shared device function). An I/O supervisor is often only available on a temporary basis for commissioning and programming. In turn, for continuous diagnostics and status monitoring the I/O supervisor is integral part of a PROFINET installation.

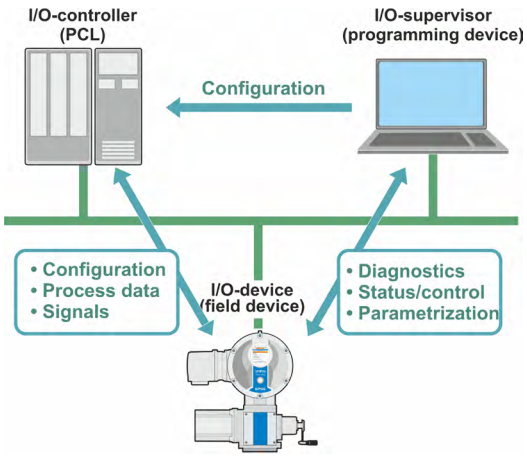


Fig.: PROFINET network

2.2 PROFINET basic functions

An I/O controller reads the input information in cyclic intervals from the I/O devices and writes the output information to the I/O devices. In addition to this cyclic data transfer of the process representation, PROFINET also provides powerful functions for diagnostic and commissioning as well as event based alarm treatment in real time. Data transfer is monitored via the monitoring function at I/O controller and I/O device level.

2.3 Communication technology

- Full duplex, 100 Mbit/s switched Ethernet (100BASE-TX) IEEE 802.3
- Wiring according to IEC 61784-5-3. Cable with twisted wire pairs for each direction RX and TX.
- Simultaneous communication into both send and receive direction.
- Ethernet switches coordinate data transmission and prevent collisions on the cable.

2.4 Bus access

- Switched Ethernet with flexible priority control, no collision domains, no coordination of the network access required – all participants have simultaneous access.
- Data exchange in compliance with provider-consumer model: The provider (I/O device) supplies process data to one or several consumers (I/O controllers).
- The maximum number of PROFINET I/O devices per network depends on the I/O controller implemented.

2.5 Topology – PROFINET device network configuration

2.5.1 General information

PROFINET is characterized by the virtually free topology implementation. If the required response times of messages for the automation application are exceeded, the maximum network depth – the number of cascaded PROFINET participants – have been reached.

The maximum distance between two network participants is 100 meters. When using switches with fiber optic cable communication, distances can be increased.

- Only use industrial switches certified for PROFINET and logically separate the PROFINET based automation network from the remaining IT infrastructure. In general, hubs may not be used since this could lead to network collision.
- Based on existing network load by office applications, uncoordinated mixing of office network and automation network can lead to unpredictable problems with the PROFINET application.
- For PROFINET networks as of conformity class CC-B, both points specified are binding.

2.5.2 Point-to-point or star topology

Devices in this topology only have one connection to the control system (point-to-point) or to the Ethernet switch (star).

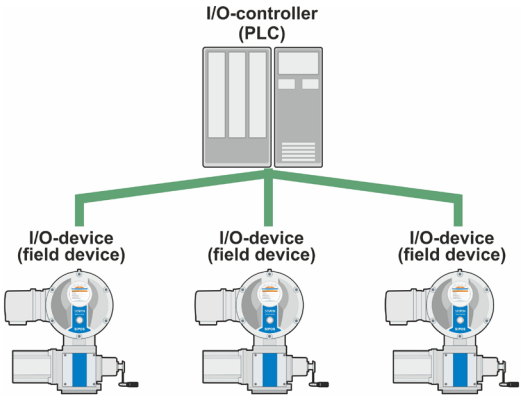


Fig.: Point-to-point or star topology

2.5.3 Line topology

With this topology, devices and control system are interconnected in series.

To connect the devices, no additional Ethernet switch is required.

For Ethernet networks, this topology is not recommended. If one participant or network switch fails, the other participants along the line are no longer accessible. Therefore, it is advised to use ring topology.

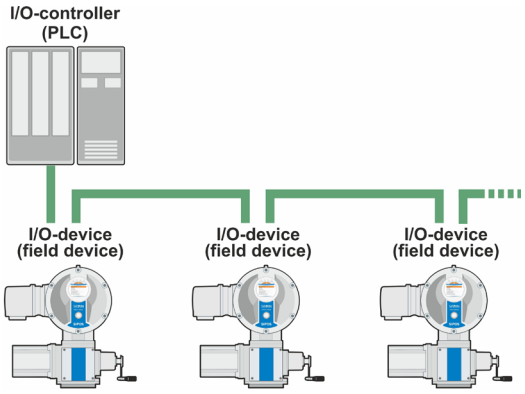


Fig.: Line topology

2.5.4 Tree topology

If you interconnect several star structures, you obtain a tree network topology. Any combination is possible.

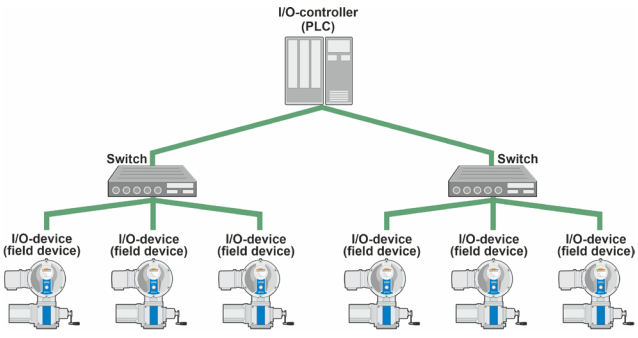


Fig.: Tree topology

2.5.5 Ring topology

When applying this topology, the devices and the control system are connected in series. The major difference to line topology is that both the first and the last device are connected to the control system.

The ring topology is recommended when redundancy structures are required. However, make sure that this topology is supported by the control system.

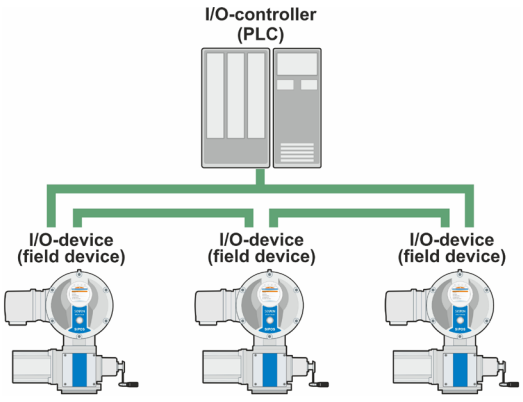


Fig.: Ring topology

2.6 PROFINET communication cable

2.6.1 Minimum requirements

According to IEC 61156-6, CAT 5 cables are specified as minimum requirement for PROFINET. However using CAT 5e and CAT 6 cables is recommended. For further references regarding planning an installation of PROFINET networks, the PROFIBUS User Organization (PNO) provides suitable guidelines.

The following tables list the available cable types PROFINET types A through C with regard to the respective application:

Cable types for dual pair PROFINET cables			
Cable types	**Application type A**	**Application type B**	**Application type C**
Version	Dual pair data cable		
Type of installation	Fixed installation, immobile after installation.	Flexible installation, occasional movement, vibration or twisting after installation.	Special applications (e.g. for continuous movement, vibration or twisting).
Cable parameter			
Designation (minimum)	“PROFINET Type A“	“PROFINET Type B“	“PROFINET Type C“
Cross section	AWG 22/1 ≥ 0.610 mm²	AWG 22/7 ≥ 0.318 mm²	AWG 22/.. ≥ 0.318 mm²
Outer cable diameter	5.5 – 8.0 mm		depending on the application
Wire diameter	1.4 ± 0.2 mm		depending on the application
Color of sheath	Green RAL 6018		depending on the application
Color of wire insulation	Pair 1: white, blue Pair 2: yellow, orange		
Number of wires	4		
Cable design	Dual pair or star quad		
Shielding	Aluminum foil + copper braid		depending on the application
Communication requirements			
Relevant standards	ISO/IEC 11801 edition 2.0, IEC 61140-1, IEC 61156-5 (Minimum category 5)		ISO/IEC 11801 edition 2.0 IEC 61140-1, IEC 61156-6 (minimum category 5)
Delay	< = 20 ns/100 m		
Coupling attenuation	>80 dB at 30 – 100 MHz “Channel class D” according to EN 50174-2		

2.6.2 Minimum cable spacing

The minimum spacing (according to IEC 61918) required between laying PROFINET cables and other cables must be respected. They are shown in the table below.

Minimum spacing for PROFINET cables			
	Spacing to PROFINET cable		
	Without or with non-metal cutoff bridge	Aluminum cutoff bridge	Steel cutoff bridge
Signal transmission cable			
for example other PROFINET cables, PROFIBUS cables, data cables for PCs, programming devices, shielded analog inputs.	0 mm	0 mm	0 mm
Cable parameter			
Unshielded power supply cables	200 mm	100 mm	50 mm
Shielded power supply cables	0 mm	0 mm	0 mm

Further notes: Available PROFINET recommendations, particularly planning, assembly and commissioning guidelines of the PROFIBUS Nutzerorganisation e.V. (PNO) (www.profibus.com) must be met.

2.7 PROFINET conformance classes

To simplify the application of PROFINET, various conformance classes are defined which specify required properties of the PROFINET components and ensure their interoperability by certifications.

The main properties of the conformance classes are shown in the table below:

Main properties of the conformance classes		
CC-A (unsynchronized)	**CC-B (unsynchronized), CC-A plus**	**CC-C (synchronized communication - IRT), CC-B plus**
▪ Basic functions for PROFINET I/O with RT communication. ▪ Standard Ethernet IEEE 802.3 Switches. ▪ Cable based. ▪ Wireless data transmission possible. ▪ TCP/IP communication (acyclic services).	▪ Certified PROFINET Switches. ▪ Network diagnostics via IT mechanism (SNMP). ▪ Simple device replacement. ▪ Neighborhood topology detection (LLDP with LLDP-MIB). ▪ Offline topology configuration possible. ▪ Optional system redundancy CC-B (PA).	▪ Hardware supported bandwidth utilization (IRT communication). ▪ Synchronization. ▪ Basis for time synchronized applications (cycle times >1 ms, jitter <1 µs).

2.8 Protective functions

- Response monitoring (watchdog).
- Access protection for inputs/outputs (sync and freeze).
- Process data exchange (DATA EX) monitoring with configurable timer interval at controller.
- Adjustable failure behavior at actuator in case of PROFINET communication loss.

Port deactivation for unused network ports

Unused Ethernet ports can be deactivated to prevent unauthorized and above all undetected access to the network in the field.

Therefore, it is no longer necessary to protect unused ports mechanically against access.

Switching off the integrated web server

The web server integrated within actuator controls can locally be switched off via local controls.

2.9 Device types

- I/O controller: e.g. central automation devices like PLC.
- I/O supervisor: e.g. programming devices or projecting devices (PC).
- I/O device: Devices with binary or analog inputs/outputs,e.g. actuators, ball valves.
- Network components, e.g. switches, access points, router.

3 Technical data

3.1 SEVEN with PROFINET interface

Electrical connection, fieldbus connection			
Power supply	**Voltage range**	**Permissible voltage tolerance**	**Frequency range**
	1-ph AC 110 – 115 V 1-ph AC 220 – 230 V 3-ph AC 190 – 200 V 3-ph AC 380 – 460 V	-10 % / +15 %	40 – 70 Hz
Automatic phase sequence correction	The direction of rotation does not depend on the phase sequence.		
Optional external electronics power supply	24 V DC ± 25 % (protected against polarity reversal). Electronics current consumption: 260 mA.		
Voltage output	24 V DC, max. 125 mA (potential-free and protected against polarity reversal).		
Electrical connection with PROFINET interface	Plug/socket connector with 50-pole screw type connections. PROFINET connection with insulation displacement connection or as an option, with RJ-45 connection.		
Inputs/outputs, further functions			
Control mode	Control and feedback via PROFINET. -> For details, refer to “Parametrization PROFINET“.		
Analog/binary inputs	**ECOTRON**		
	3 binary 24/48 V DC inputs (OPEN, CLOSE, STOP)	▪ 5 binary 24/48 V DC inputs (OPEN, CLOSE, STOP, EMERGENCY, MODE); ▪ 1 analog 0/4 – 20 mA input AI1 e.g. positioner (option for PROFITRON); ▪ 1 analog 0/4 – 20 mA input AI2 (option).	
	Transmission of states possible via PROFINET.		
Analog/binary outputs	▪ 5 binary outputs (programmable); ▪ 1 analog output AO1 for actual position value.	▪ 8 binary outputs (programmable); ▪ 1 analog 0/4 – 20 mA output AO1; ▪ 1 analog 0/4 – 20 mA output AO2 (option).	
Galvanic separation	▪ Binary inputs and outputs ▪ Analog inputs and outputs		
Local control	Standard		
	▪ Drive Controller (option: lockable); ▪ 2 indication lights for LOCAL (yellow) and REMOTE (blue); ▪ Indication lights for CLOSE (yellow) and OPEN (green): Run indication and end position signaling.		
	▪ 2 indication lights (green and red) for status and fault signals.	▪ Plaintext status indication on color graphic display.	
	▪ Internal USB interface on the control board.	▪ External USB interface at electronics housing. ▪ Bluetooth interface for parametrization and control.	
Remote control mode	Control is made depending on the parameter setting “Control mode“ and “Alternative control mode“ via: ▪ Conventional connection (24/48 V binary or 0/4 – 20 mA analog), ▪ Fieldbus interface.		

Parametrization, actuator functions		
	ECOTRON	**PROFITRON/HiMod**
Parametrization, change settings	Menu-based via illuminated LC display.	Menu-based via illuminated color graphic display with plain-text indication (operation with password protection via Drive Controller at local control).
Language settings	Setting is made via symbols	CS, DA, DE, EL, EN, ES, FI, FR, IT, NL, NO, PL, PT, RU, SV, TR, ZH. Further languages on request.
Speed and positioning time setting	▪ Adjustable in 7 levels within the selected speed range, ▪ Settings separately possible for OPEN, CLOSE, EMERGENCY OPEN and EMERGENCY CLOSE.	▪ Continuous setting within the selected speed range; ▪ Settings separately possible for OPEN, CLOSE, EMERGENCY OPEN and EMERGENCY CLOSE.
Soft start	Constant torque with reduced speed into and out of the end positions: ▪ No overtorque, ▪ Starting current < rated current.	
Positioner (option for PROFITRON/HiMod)	Not for ECOTRON	▪ Adaptive three-step controller. ▪ Setpoint via PROFINET or analog 0/4 – 20 mA signal (rising/ falling slope). ▪ Adjustable automatic adaptation of the dead band to the quality of the setpoint and actual value signal. ▪ Speed reduction before reaching the setpoint.
Process controller (option)	Not for ECOTRON	▪ Setpoint via analog input AI1 or AI2 (0/4 – 20 mA), PROFINET or as fixed setpoint. ▪ Actual process value via analog input AI2 or AI1 (0/4 – 20 mA).
Travel-dependent speed adjustment (option)	Not for ECOTRON	Travel-dependent speed adjustment via max. 10 interpolation points (value pairs): Travel [% OPEN] in 1 %-steps– speed [rpm].
External speed setpoint (option)	Not for ECOTRON	Speed setpoint via PROFINET or analog 0/4 – 20 mA signal.
Travel-dependent adjustable operating times (option)	Not for ECOTRON	Parametrization of positioning times between up to 10 travel positions: Travel from 0 to 100 [% OPEN], positioning time 0 to 60000 [sec]. Emergency operation via positioning time curve - possible with adjustable factor.
Torque curve record of valve (Not for 2SG7 and 2SQ7)	Not for ECOTRON	Recording of up to 3 torque curves for predictive monitoring of the valve: Sampling rate in 1 % travel increments; can be saved and downloaded. The recorded values are reference values and may differ in the end positions in particular and for speed variations during operation!
Retry torque block	Not for ECOTRON	Retry to get over torque block when blocked in move (max. 5 x programmable).

Diagnosis		
	ECOTRON	**PROFITRON/HiMod**
Diagnostic data	▪ Switching cycles per hour; ▪ Number of switching cycles /travel and torque cut-offs; ▪ Relative operating time; ▪ Electronic and motor operating hours.	
Maintenance limits, Maintenance intervals (with regard to valve)	---	▪ Switching cycles; ▪ Torque cut-offs; ▪ Motor operation hours.
Fault memory	Saving of the last 5 fault signals.	
Electronic name plate	▪ Manufacturer; ▪ Order number; ▪ Serial number; ▪ Original serial number; ▪ Actuator tag no.	
Monitoring and safety function	Internal diagnosis: ▪ Runtime; ▪ Full motor protection; ▪ Position sensor.	

Setting/programming of PROFINET interface		
	ECOTRON	**PROFITRON/HiMod**
Process representation output (Control commands)	▪ OPEN ▪ CLOSE ▪ Fault signal reset	▪ OPEN ▪ CLOSE ▪ EMERGENCY ▪ Setpoint for position or process ▪ Fault signal reset
Process representation input (Feedback signals) e.g.:	▪ Actual position value (0.01 % steps); ▪ Ready + Remote; ▪ Actuator in end position “OPEN“ / “CLOSED“; ▪ Intermediate contact ”OPEN“ / “CLOSE“ active; ▪ Run indication direction “OPEN“/CLOSE“; ▪ Crank handle/ hand wheel is operated; ▪ Local active; ▪ Remote active; ▪ “EMERGENCY” operation command is active; ▪ Maintenance required; ▪ PROFINET port 1 / 2 is active port; ▪ etc.	
Behavior in case of communication failure	The reaction of the actuator can be programmed: ▪ Keep position; ▪ Execute last command.	The reaction of the actuator can be programmed: ▪ Keep position; ▪ Move to EMERGENCY pos.; ▪ Keep actual process value (only with process controller); ▪ Move to fixed setpoint (only with process controller); ▪ Execute last command.

Ambient conditions				
Ambient temperature	–20 °C to +70 °C			
Enclosure protection according to EN 60529	Standard: IP68			
Fault memory	Saving of the last 5 fault signals.			
Vibration resistance		Acceleration	Frequency range	Test duration
	Germanischer Lloyd	0.7 g	5 to 200 Hz , in the resonance frequencies	min. 1.5 h In three directions
	EN 60068-2-6	2 g	5 to 500 Hz 1 octave/min	20 sweeps (10 cycles) in three directions
	Loads according to EN 60068-2-6 to 5 g for separate mounting of electronics and gear unit on request. Due to plant-specific vibration within the 5 to 500 Hz frequency range, the actuators might be continuously subjected a load of 0.5 g.			

3.2 General data of PROFINET interface

PROFINET interface	
Communication protocol	PROFINET according to IEC 61158 and IEC 61784.
Network topology	Star topology, point-to-point wiring. Due to the integrated switch function, both line topologies and redundant ring topologies (MRP) are available. Unused network ports can be switched off.
Connection	Ethernet IEEE 802.3 Dual pair cabling in compliance with IEC 61784-5-3 Auto Polarity Exchange, Auto Negotiation and Auto Crossover are supported.
Transmission rate	100 Mbits/s (100BASE-TX), full duplex
Cable length	Max. 100 m
Device classes	▪ I/O controller (typically the PLC/control system) ▪ I/O devices(field devices) ▪ I/O supervisor (programming device, PC or HMI for diagnositics/ commissioning)
Communication model	Provider – consumer model
Supported PROFINET specification	Version V2.32
Supported PROFINET functions	▪ Cyclic PROFINET communication (RT); ▪ Acyclic PROFINET communication (Read/Write Record).
Supported PROFINET alarms	▪ Status alarm; ▪ Update alarm; ▪ Port Data Change Notification alarm; ▪ Sync Data Change Notification alarm.

PROFINET interface	
Supported network diagnosis and management protocols	ACD (Address Conflict Detection) ARP (Address Resolution Protocol) DCP (Discovery and Basic Configuration Protocol) SNMP (Simple Network Management Protocol) LLDP (Link Layer Discovery Protocol) according to IEEE 802.1AB These functions allow ▪ assignment of the PROFINET device name, ▪ a graphic representation of the plant topology, ▪ port-granular diagnostics as well as ▪ neighborhood detection as the basis for quick commissioning and easy device replacement.
PROFINET redundancy	Standard: (Media Redundancy Protocol) according to IEC 62439 (switch function integrated in the SEVEN actuator). Option: S2 Single NAP system redundancy.
Conformance class	CC-B (Conformance Class B) for the PROFINET application of the SEVEN actuator. CC-C (Conformance Class C) for the integrated switch function.
Netload Class	III
Device diagnosis via Ethernet	Via TCP/IP and integral web server possible. Via FDI package & software for diagnosis/commissioning (e.g. Siemens PDM, Emerson AMS).
Device integration	Via GSD (GSDML) file.

4 Electrical connection – PROFINET functional sub-assembly

The PROFINET functional sub-assembly is located in the connection compartment of the electrical connection.

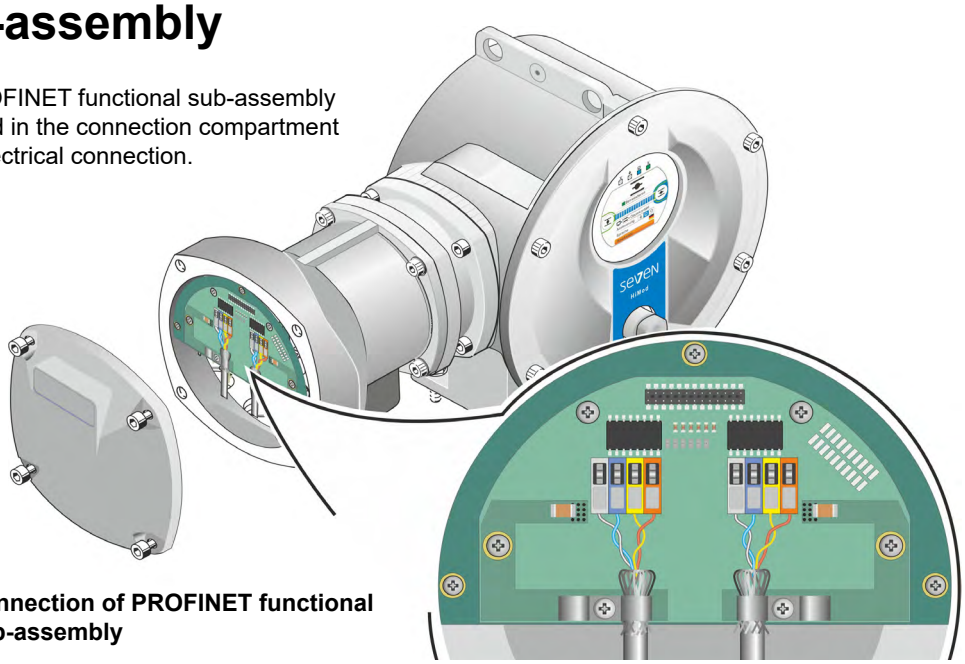


Fig.: Connection of PROFINET functional sub-assembly

4.1 Connection board with connection terminals (standard)

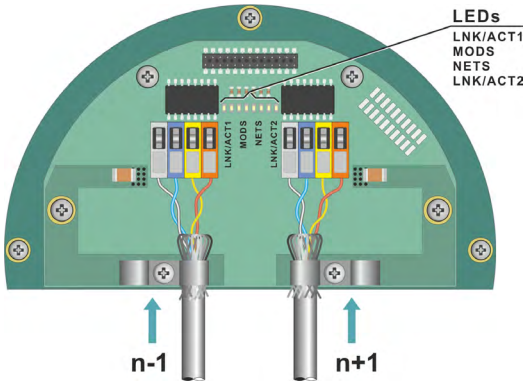


Fig.: PROFINET connection board with connection terminals

Connection terminal assignment		
Signal	Function	Color of wire insulation
TD + TD – RD + RD –	Transmit Data + Transmit Data – Receive Data + Receive Data –	yellow orange white blue

n–1 PROFINET cable from previous device.

n+1 PROFINET cable to the next device (for line topology or for redundant ring/MRP).

4.2 Connection board with RJ-45 connector (option)

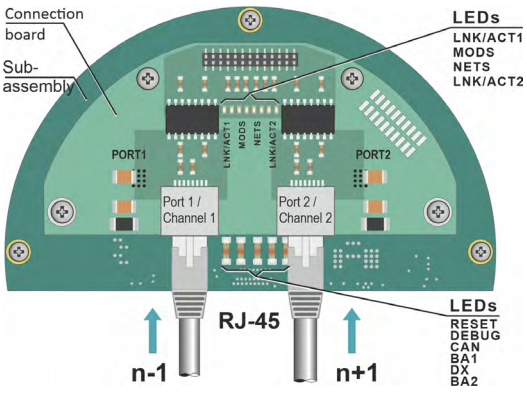


Fig.: PROFINET connection board with RJ-45 connections

n–1 PROFINET cable from previous device.

n+1 PROFINET cable to the next device (for line topology or for redundant ring/MRP).

4.3 LEDs on connection board

LEDs on connection board		
LNK/ACT1, LNK/ACT2 (Link/Activity Port 1 / 2)	**Explanation**	
Red LED: off + Green LED: off	No Ethernet network connection and no data communication on port 1 or 2.	
Green LED: illuminated	Port 1 or 2 are correctly connected to the Ethernet network, however without active data communication.	
Green LED: blinking	Port 1 or 2 are correctly connected to the Ethernet network and data communication is available.	
LED: Red	No function.	
MODS (Module Status)	**Status**	**Explanation**
Red LED: off + Green LED: off	Not Initialized	No voltage or module in “SETUP or “NW_INIT status.
Green LED: illuminated	Normal operation	The module has aborted “NW_INIT status.
Green LED: 1 brief pulse	Diagnostic events	Diagnostic signals available.
Red LED: illuminated + Red LED NETS: off	Exception Error	Device in “Exception” status.
Red LED: illuminated + Red LED NETS: illuminated	Fatal event	Internal device error.
Green/red LEDs: Alternately blinking	Firmware update	Do not cut power supply!
NETS (Network status)	**Status**	**Explanation**
Red LED: off + green LED: off	Offline	Absence of power supply or no connection to I/O controller.
Green LED: illuminated	RUN	Connection to I/O controller available.
Green LED: 1 brief pulse	STOP	Connection to I/O controller available. However, I/O controller is in STOP status or I/O data is incorrect.
Green LED: blinking	Blink	Is used by engineering tools to identify the device within the PROFINET network.
Red LED: illuminated	Fatal event	Internal error, is combined with “MODS” LED.
Red LED: 1 brief pulse	Station name error	Device name (station name) not yet set.
Red LED: 2 brief pulses	IP address error	IP address not yet set.
Red LED: 3 brief pulses	Configuration error	Identification incorrect.

4.4 Description of LEDs on basic sub-assembly

LEDs on basis sub-assembly	
LED	**Explanation**
LED RESET: illuminated	No Reset active, power supply available.
LED DEBUG: illuminated	Sub-assembly in Reset status.
LED DEBUG: 1 brief pulse	Sub-assembly in initialization status.
LED DEBUG: briefly blinking	Debug mode active.
DEBUG LED: slowly blinking	Normal status (PROFINET application active).
LED CAN: illuminated	Internal CAN communication error.
BA1 LED or BA2 LED: illuminated	Data communication active, network connection via port 1 or port 2.
LED DX: illuminated	“Data Exchange“ via PROFINET.

5 Commissioning

5 Commissioning

5.1 Introduction

Only few steps are required to integrate a SEVEN actuator into a PROFINET environment. At first, a standardized device description (GSDML file) is linked to the control system. The device name assignment for the actuator using the control system system tools is the next step. On the basis of the device name, the actuator is identified within the PROFINET system. The IP address is automatically assigned by the automation system.

Afterwards, the user can configure and parametrize the device via the programming software of the used control system. This information is then stored in the actuator controls (I/O controller) and sent to the actuators (I/O devices) each time cyclic communication is started.

The process representation is used to control the actuator and to supply the feedback signals:

- The input data provide actual values and status informations (of the actuator) to the I/O controller;
- The output data controls the I/O device (the actuator).

If a configuration with consistent data is selected, certain controllers require special function blocks for controlling the PROFINET I/O devices.

An integrated SEVEN web server additionally allows swift and easy performance of connection tests, status requests and fault diagnostic by means of a web browser.

5.1.1 Identification number (device type)

Each PROFINET I/O device and each I/O controller has an individual identification number. The ID number is required for the I/O controller to identify the type of device connected without signification protocol overhead. The controller compares the ID numbers of the connected I/O devices to the ID number in the specified configuration data. The process data transfer will only be started if the correct device types with the correct device addresses were connected to the network. This ensures a high security against configuration errors. The PNO manages the ID numbers together with the General Station Description (GSDML). SEVEN actuators are listed with the following Ident number at PNO:

- Device ID: 0x0015
- Manufacturer ID: 0x013F

5.1.2 General Station Description (GSD/GSDML)

For PROFINET, the performance features of the devices are documented by the manufacturer and made available to the users as a General Station Description in XML format. Structure, contents and coding of the General Station Description (GSDML) are standardized. They enable comfortable integration of any I/O device into different engineering tools of different manufacturers.

For SEVEN actuators the following GSDML file is available:

`GSDML-V2.42-AUMA-SEVEN-20221222.xml`

(Supports S2 system redundancy)
PROFINET I/O version 2.42

Information: GSD or GSDML files can be downloaded from our website **www.sipos.de.**

5.2 PROFINET addressing – device name assignment

The device name is assigned to the device during device name assignment. The acyclic communication is IP based and allows the use of known IT mechanisms via protocols such as UDP or TCP/IP, while cyclic PROFINET real-time data as well as event-based alarms are exclusively based on the most widely used network technology, Ethernet with MAC addressing and message prioritization. The MAC address is inseparably linked to the device and unique around the world. Using the DCP protocol (Discovery and Configuration Protocol) and the device name, the controller will identify the network devices and will assign their IP addresses. As an alternative, the IP address may also be assigned manually. PROFINET participants are therefore addressed by means of the parameters below:

- Unique MAC address;
- Assigned device name;
- Assigned IP address.

Device name and, as an option, also the IP address, is assigned by the software used for configuration of the network topology, e.g. Siemens Step7/TIA or Proneta. The described address parameters can be read via local display, using the COM - SIPOS PC program or any other (e.g. FDI based) configuration and diagnostic system.

5.3 Configuration of the PROFINET interface

Configuration of cyclic data transfer is exclusively made via the PROFINET controller which sends the configuration when establishing the cyclic data transfer to the device. Configuration of cyclic data transfer is exclusively made via the PROFINET controller which sends the configuration when establishing the cyclic data transfer to the device. No settings are made within the device itself. The configuration procedure depends on the implemented tool.

The number of input and output bytes sent or received by the I/O devices to and from the controller are predefined within actuator controls. Accordingly, once the controller starts cyclic communication, the required communication relations are negotiated with the I/O device.

5.4 Communication start

After successful device name assignment, the communication channels between I/O controller and I/O devices are established. The I/O controller creates so-called Application Relations (AR) between the participants. Communication Relations (CR) with different properties are defined via these AR:

- **Record Data CR** for the acyclic parameter transfer;
- **I/O Data CR** for the cyclic process data exchange;
- **Alarm CR** for signaling alarms in real time.

With this, all relevant parameters and times for system startup as well as transmission rates of cyclic I/O data from the I/O controller are transferred to the I/O devices.

After successful establishment of application relations and their communication relations, the network participants start productive operation.

The Internet Protocol (IP) is used for connection setup and acyclic services. The Address Resolution Protocol (ARP) has been enhanced with the detection of duplicate IP addresses. Using the Discovery and basic Configuration Protocol (DCP) is mandatory IP address assignment. As an option, DHCP may also be used.

5 Commissioning

5.5 Communication monitoring

5.5.1 Connection monitoring of PROFINET communication

The active PROFINET communication is continuously monitored. In case of failure, a failure behavior is initiated which can be defined as requested.

5.5.2 Communication status

Correct PROFINET communication to the actuator can be checked via local controls display or via the COM - SIPOS PC software. The relevant information can be found in the menu: ‘Observer‘ → ‘Inputs and outputs‘ → ‘PROFINET‘.

Notes on troubleshoortng can be found in the section „7.2 Troubleshooting“ on page 36.

5.6 I & M functions

The actuator controls support the I & M function according to PNO , guideline 3.502.

With the term Identification & Maintenance (I & M) functions, the PROFIBUS Nutzerorganisation e.V. (PNO) introduced a new functionality for all PROFIBUS and PROFINET devices with acyclic communication channel that may prove very useful for plant operators. The I & M functions define how certain device-describing data (according to name plate) is to be uniformly stored in the PROFINET devices. Engineering tools may then read and interpret the data according to a code which can be accessed on the PNO server. This provides uniform and powerful access to all important and current device data. This is a significant requirement for Asset Management.

Part of the device-specific I & M information is the unambiguous (asset) identification using a manufacturer ID (MANUFACTURER_ID actuators = 319), the product order no. (ORDER_ID) of the actuator as well as the individual serial number (SERIAL_NUMBER). Further data supplements the asset information.

I&O function			
Record	**Content**	**Size**	**Description**
I&M0	MANUFACTURER_ID	2 bytes	319 – AUMA Riester GmbH & Co. KG
	ORDER_ID	20 bytes	Order number of the device (e.g. 2SA75212DD204RB4)
	SERIAL_NUMBER	16 bytes	Serial number of the device.
	HARDWARE_REVISION	2 bytes	Hardware revision of the device (e.g. 0001).
	SOFTWARE_REVISION	4 bytes	Firmware revision of the device (e.g. ‘V3.16.0‘).
	REVISION_COUNTER	2 bytes	Revision counter (e.g. 0x0001)
	PROFILE_ID	2 bytes	Profile identification of the device (0x0000 – General device)
	PROFILE_SPECIFIC_TY- PE	2 bytes	Profile-specific type (0x0004 – communication module)
	IM_VERSION	2 bytes	I&M version (e.g. 0x0101)
	IM_SUPPORTED	2 bytes	Bit line, indicates support of I&M blocks (e.g. 0x002E – blocks 1+2+3+5)
	TAG_FUNCTION	32 bytes	Default: Blank (‘ ‘)
	TAG_LOCATION	22 bytes	Default: Blank (‘ ‘)
	INSTALLATION_DATE	16 bytes	Default: Blank (‘ ‘)
	DESCRIPTOR	54 bytes	Default: Blank (‘ ‘)
	SIGNATURE	54 bytes	Default: all bytes 0 (0x00)

6 Description of the data interface

Cyclic data

Configuration of the cyclic data transfer is only performed in the PROFINET controller. Selection of input/channel or respective input and/or output date is performed via slot/subslot configuration used to program a PROFINET controller.

All I/O data is supplied in slot 1, subslot 1. Data is structured in various blocks with different properties. The following sub-sections comprise explanations about the different blocks.

Process interface

Data structure is described on the basis of the automation system:

- Input data: → is sent by the field device to the automation system.
- Output data: → is sent by the automation system to the field device.

6.1 Input data (process representation input) – signals

The process representation input allows the consumer (controller) to read the state of the provider (actuator).

6.1.1 Process representation input (default process representation)

Module definition

- Module ID = “ID_MODULE_ADI_IN_0“
- ModuleIdentNumber = “0x00008000“

Submodule definition

- VirtualSubmoduleItem ID = “ID_SUBMOD_ADI_IN_0“
- SubmoduleIdentNumber = “0x00002200“

Byte 1: Logical signals							
Fault	Warnings	Running CLOSE	Running OPEN	Not ready REMOTE	Setpoint reached	End position CLOSE	End position OPEN
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 2: Actuator signals							
Torque CLOSE reached	Torque OPEN reached	Intermediate contact CL	Intermediate contact OP	LOCAL	REMOTE	–	Motor temp. too high
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 3: Actual position value							
Byte 3 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 4: Actual position value							
Byte 4 = low byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 5: Device status							
Device OK	Failure	Function check	Out of specification	Maintenance required	Fault	Warnings	Not ready REMOTE
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 6: Operation status							
Running LOCAL	Running REMOTE	Handwheel operation	Actuator operating	–	–	In intermedidate position	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 7:							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 8: Discrete inputs							
Bluetooth present	–	–	Binary input MODE	Binary input EMERGENCY	Binary input STOP	Binary input OPEN	Binary input CLOSE
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 9: Input AI 1							
Byte 9 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 10: Input AI 1							
Byte 10 = low byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 11: Torque							
Byte 11 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 12: Torque							
Byte 12 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 13: Not ready REMOTE 1							
–	Fault fieldbus	EMERGENCY behav. active	–	–	Motor lock active	Not REMOTE	Wrong control command
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 14: Not ready REMOTE 2							
Handwheel active	Service active		–	–	–	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 15: Fault 1							
Run time error	Hardware fault	Torque fault CLOSE	Torque fault OPEN	–	Motor temp. too high	Mains voltage faulty	Configuration error
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 16: Fault 2							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 17: Warnings 1							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 18: Warnings 2							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 19: Warnings 3							
–	–	Mainten. limit Sw. cycles	–	Warning input AI1	Warning input AI2	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 20: Warnings 4							
–	–	Failure behaviour active	–	–	–	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 21: Input AI 2							
Byte 21 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 22: Input AI 2							
Byte 22 = low byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 23: Failure							
Fault	–	–	–	–	–	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 24: Maintenance requ.							
–	–	–	Maintenance interval	–	–	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 25: Out of specification 1							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 26: Out of specification 2							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 27: Out of specification 3							
–	–	Mainten. limit Sw. cycles	–	Warning input AI1	Warning input AI2	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 28: Out of specification 4							
–	–	Failure behaviour active	–	–	–	–	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 29: Function check 1							
–	–	–	–	Handwheel active	–	Not REMOTE	–
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 30: Function check 2							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 31: Fieldbus status							
Port 2 activity	Port 1 activity	Port 2 FailSafe Fieldbus	Port 1 FailSafe Fieldbus	Port 2 DataEx	Port 1 DataEx	Port 2 active	Port 1 active
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 32 to byte 40							
Reserve							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

6.1.2 Description of the bytes in the process representation input

Byte 1: Logical signals			
Bit	**Designation (process representation)**	**Value**	**Description**
0	End position OPEN	1	The actuator has cut off in end position OPEN.
		0	No signal.
1	End position CLOSE	1	The actuator has cut off in end position CLOSED.
		0	No signal.
2	Setpoint reached	1	The position setpoint is within the dead band. Will only be signaled if the positioner is active for REMOTE control mode.
		0	No signal.
3	Not ready REMOTE	1	The actuator cannot be operated from REMOTE.
		0	No signal.
4	Running OPEN	1	The actuator operates in direction OPEN.
		0	No signal.
5	Running CLOSE	1	The actuator operates in direction CLOSE.
		0	No signal.
6	Warnings	1	**Warning**: Contains the result of a disjunction (OR-operation) of all bits of bytes 17 to 20 (Warning 1 to Warning 4).
		0	No signal.
7	Fault	1	**Collective signal**: Contains the result of a disjunction (OR-operation) of all bits of bytes 15 to 16 (Fault 1 and Fault 2).
		0	No signal.

Byte 2: Actuator signals			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Motor temp. too high	1	The motor has exceeded the maximum temperature of 155 °C.
		0	No signal.
1	Not used		
2	REMOTE	1	REMOTE status is set.
		0	No signal.
3	LOCAL	1	LOCAL status is set.
		0	No signal.
4	Intermediate contact OP	1	The actuator position is within the range from the position programmed as ‘Intermediate contact OP’ position to 100 %.
		0	No signal.
5	Intermediate contact CL	1	The actuator position is within the range from 0 % to the position programmed as "Intermediate contact CL" position.
		0	No signal.
6	Torque OPEN reached	1	Torque-dependent actuator cut-off in OPEN direction.
		0	No signal.
7	Torque CLOSE reached	1	Torque-dependent actuator cut-off in CLOSE direction.
		0	No signal.

Byte 3 and byte 4: Actual position value		
Byte 3	= High byte	The current actuator position is transmitted. The value is transmitted in per mil (value: 0 – 1,000).
Byte 4	= Low byte.	

Byte 5: Device status			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Not ready REMOTE	1	The actuator cannot be operated from REMOTE. Contains the result of a disjunction (OR-operation) of all bits of bytes 13 to 14 (Not ready REMOTE 1 to Not ready REMOTE 2).
		0	No signal.
1	Warnings	1	Warning: Contains the result of a disjunction (OR-operation) of all bits of bytes 17 to 20 (Warning 1 to Warning 4).
		0	No signal.
2	Fault	1	Collective signal: Contains the result of a disjunction (OR-operation) of all bits of bytes 15 to 16 (Fault 1 and Fault 2).
		0	No signal.
3	Maintenance required	1	Signal according NAMUR recommendation 107 to perform maintenance. Contains the result of a disjunction (OR-operation) of all bits of byte 24 (Maintenance required).
		0	No signal.
4	Out of specification	1	Signal according to NAMUR recommendation 107. The actuator is being worked on; output signals are temporarily invalid. Contains the result of a disjunction (OR-operation) of all bits of bytes 25 to 28 (Out of specification 1 to 4).
		0	No signal.
5	Function check	1	Signal according to NAMUR recommendation 107. The actuator is being worked on; output signals are temporarily invalid. Contains the result of a disjunction (OR-operation) of all bits of bytes 17 to 20 (Function check 1 and 2).
		0	No signal.
6	Failure	1	Signal according to NAMUR recommendation 107 Actuator function failure, output signals are invalid. Contains the result of a disjunction (OR-operation) of all bits of byte 23 (Failure).
		0	No signal.
7	Device OK	1	The device is ready for remote control. No warnings, faults or signals according to NAMUR are present. Bit 7 is set if bits 0 to 6 are deleted.
		0	Contains the result of a disjunction (OR-operation) of bits 0 to 6 (Device status).

Byte 6: Operation status			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	In intermedidate position	1	The actuator is in an intermediate position e.g. neither in end position OPEN nor in end position CLOSED.
		0	No signal.
2	—		No signal (reserved).
3	—		No signal (reserved).
4	Actuator operating	1	Actuator is operating (output drive is moving). Signal if one of the signals is set: ▪ Running LOCAL ▪ Running REMOTE ▪ Handwheel oper.
		0	No signal.
5	Handwheel operation	1	Handwheel/crank handle is operated.
		0	No signal.
6	Running REMOTE	1	Output drive rotates due to control command from REMOTE.
		0	No signal.
7	Running LOCAL	1	Output drive rotates due to control command from LOCAL.
		0	No signal.

Byte 7: Not used.

Byte 8: Discrete inputs			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Binary input CLOSE	1	A high signal (+24 V DC) is present at binary input CLOSE.
		0	No signal.
1	Binary input OPEN	1	A high signal (+24 V DC) is present at binary input OPEN.
		0	No signal.
2	Binary input STOP	1	A high signal (+24 V DC) is present at binary input STOP.
		0	No signal.
3	Binary input EMERGENCY	1	A high signal (+24 V DC) is present at binary input EMERGENCY.
		0	No signal.
4	Binary input MODE	1	A high signal (+24 V DC) is present at binary input MODE.
		0	No signal.
5	—		No signal (reserved).
6	—		No signal (reserved).
7	Bluetooth present	1	The Bluetooth interface is available.
		0	No signal.

Byte 9 and byte 10: Input AI 1

- Byte 9 = high byte 10 = low byte.
- In byte and byte 10, the value of the analog input 1 (AI 1) is transmitted.
- The value is transmitted in per mil (value: 0 – 1000).
- The value 1,000 corresponds to 20 mA.
- The value 0 corresponds to 0 mA.

Byte 11 and byte 12: Torque byte 11 = high byte 12 = low byte.

In byte and byte 12, the current actuator torque is transmitted. For this, the actuator must be equipped with a torque measurement flange which can be ordered separately.

The transmitted value represents the torque currently measured at the output drive in 0.1 Nm.

The value range amounts to +/- 3276.7 Nm (PNum 558).

Byte 13: Not ready REMOTE 1			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Wrong control command	1	Wrong control command. Indicates that several control commands were received simultaneously via PROFINET (e.g. REMOTE OPEN and REMOTE CLOSE simultaneously or REMOTE CLOSE/ REMOTE OPEN and REMOTE SETPOINT simultaneously) or that the max. value for a setpoint position has been exceeded (setpoint position > 1,000).
		0	Control commands are OK.
1	Not REMOTE	1	Actuator not in REMOTE status.
		0	Actuator in REMOTE status.
2	Motor lock active	1	The “Enable motor operation” function is selected for the mode input, however the signal for enabling motor operation is missing.
		0	No signal.
3	—		No signal (reserved).
4	—		No signal (reserved).
5	EMERGENCY behav. active	1	EMERGENCY behavior is active (EMERGENCY signal was sent).
		0	No signal.
6	Fault fieldbus	1	No communication to the actuator. No port in cyclic data exchange.
		0	Port 1 or port 2 in cyclic data exchange.
7	—		No signal (reserved).

Byte 14: Not ready REMOTE 2			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	—		No signal (reserved).
3	—		No signal (reserved).
4	—		No signal (reserved).
5	—		No signal (reserved)
6	Service active	1	PROFINET process representation is simulated.
		0	No signal.
7	Handwheel active	1	Handwheel is engaged.
		0	No signal.

Byte 15: Fault 1			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Configuration error	1	No end position adjustment or no valid factory parameters available.
		0	No signal.
1	Mains voltage faulty	1	Mains voltage outside tolerance (mains voltage missing, undervoltage or overvoltage).
		0	No signal.
2	Motor temp. too high	1	The motor has exceeded the maximum temperature of 155 °C.
		0	No signal.
3	—		No signal (reserved).
4	Torque fault OPEN	1	Actuator has blocked in direction OPEN.
		0	No signal.
5	Torque fault CLOSE	1	Actuator has blocked in direction CLOSE.
		0	No signal.
6	Hardware fault	1	Fault within the electronics.
		0	No internal error.
7	Run time error	1	No or insufficient change of travel.
		0	No signal.

Byte 16: Fault 2 is not used.

Byte 17: Warnings 1 is not used.

Byte 18: Warnings 2 is not used.

Byte 19: Warnings 3			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	Warning input AI2	1	Warning: Loss of signal analog input 2.
		0	No signal.
3	Warning input AI1	1	Warning: Loss of signal analog input 1.
		0	No signal.
4	—		No signal (reserved).
5	Maintenance limit switching cycles	1	Maintenance limit for switching cycles has been exceeded.
		0	No signal.
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 20: Warnings 4			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	—		No signal (reserved).
3	—		No signal (reserved).
4	—		No signal (reserved).
5	Failure behavior active	1	The failure behavior is active for wire break of control source.
		0	No signal.
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 21 and byte 22: Input AI 2 Byte 21 = high byte, Byte 22 = low byte.

- –In byte and byte 22, the value of the analog input 2 (AI 2) is transmitted.
- The value is transmitted in per mil (value: 0 – 1,000).
- The value 1,000 corresponds to 20 mA.
- The value 0 corresponds to 0 mA.

Byte 23: Failure (causes of the Failure signal according to NAMUR recommendation NE 107)			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	—		No signal (reserved).
3	—		No signal (reserved).
4	—		No signal (reserved).
5	—		No signal (reserved).
6	—		No signal (reserved).
7	Fault	1	Contains the result of a disjunction (OR-operation) of all bits of bytes 15 to 16 (Fault 1 and Fault 2).
		0	In bytes 15 and 16, no faults are active (all bits are set to 0).

Byte 24: Maintenance requ. (causes of the Maintenance required signal according to NAMUR recommendation NE 107)			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	—		No signal (reserved).
3	—		No signal (reserved).
4	Maintenance interval	1	The set maintenance interval has been reached.
		0	No signal.
5	—		No signal (reserved).
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 25: Out of specification 1 is not used.

Byte 26: Out of specification 2 is not used.

Byte 27: Out of specification 3			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	Warning input AI2	1	Warning: Loss of signal analog input 2.
		0	No signal.
3	Warning input AI1	1	Warning: Loss of signal analog input 1.
		0	No signal.
4			No signal (reserved).
5	Maintenance limit switching cycles	1	Maintenance limit for switching cycles has been exceeded.
		0	No signal.
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 28: Out of specification 4			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	—		No signal (reserved).
2	—		No signal (reserved).
3	—		No signal (reserved).
4	—		No signal (reserved).
5	Failure behavior active	1	The failure behavior is active for wire break of control source.
		0	No signal.
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 29: Function check 1 (causes of the Function check signal according to NAMUR recommendation NE 107)			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No signal (reserved).
1	Not REMOTE	1	Actuator not in REMOTE status.
		0	Actuator in REMOTE status.
2	—		No signal (reserved).
3	Handwheel active	1	Handwheel is engaged.
		0	No signal.
4	—		No signal (reserved).
5	—		No signal (reserved).
6	—		No signal (reserved).
7	—		No signal (reserved).

Byte 30: Function check 2 is not used

Byte 31: Fieldbus status			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Port 1 active	1	Port 1 is the active port and can operate the actuator.
		0	No signal.
1	Port 2 active	1	Port 2 is the active port and can operate the actuator.
		0	No signal.
2	Port 1 DataEx	0	Port 1 is in the data exchange status (DataEx).
		1	No signal.
3	Port 2 DataEx	1	Port 2 is in the data exchange status (DataEx).
		0	No signal.
4	Port 1 FailSafe Fieldbus	1	No valid network communication via port 1 (application does not communicate with the control system).
		0	No signal.
5	Port 2 FailSafe Fieldbus	1	No valid network communication via port 2 (application does not communicate with the control system).
		0	No signal.
6	Port 1 activity	1	Network communication at port 1.
		0	No signal.
7	Port 2 activity	1	Network communication at port 2.
		0	No signal.

Byte 32 to byte 40: Reserve.

6.2 Output data (process representation output)

The consumer (controller) can control the provider (actuator) via the process representation output.

For this, the fieldbus (PROFINET) must be selected as control source for the “Control” parameter and the actuator must be in the “REMOTE” state.

6.2.1 Process representation output arrangement

Module definition:

- Module ID = “ID_MODULE_ADI_OUT_0“
- ModuleIdentNumber = “0x00008100“

Submoduldefinition:

- VirtualSubmoduleItem ID = “ID_SUBMOD_ADI_OUT_0“
- SubmoduleIdentNumber = “0x10001000“

6.2.2 Description of output data

Byte 1: Commands							
				Fieldbus RESET	Setpoint valid	Fieldbus CLOSE	Fieldbus OPEN
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 2:							
Not used.							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 3: Setpoint							
Byte 3 = high byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 4: Setpoint							
Byte 4 = low byte							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 5: Additional commands							
	Fieldbus EMERGENCY						
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 6 to byte 16							
Not used							
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Byte 1: Commands			
Bit	**Designation (process representation)**	**Value**	**Description**
0	Fieldbus OPEN	1	Control command in direction OPEN.
		0	No command.
1	Fieldbus CLOSE	1	Control command in direction CLOSE.
		0	No command.
2	Setpoint valid	1	Setpoint is valid. Setpoint is used for closed-loop control (position/process controller). Setpoint is defined by bytes 3 and 4.
		0	Setpoint is not valid. Positioner is not active.
3	Fieldbus RESET	1	Reset of faults.
		0	No command.
4	—		No command (reserved).
5	—		No command (reserved).
6	—		No command (reserved).
7	—		No command (reserved).

Byte 2: Not used.

Byte 3 and 4: Setpoint/(process setpoint) Byte 3 = high byte, byte 4 = low byte.

Via bytes 3 and 4, the setpoint position (value: 0 – 1,000) is transmitted in combination with the positioner.

- The value 1,000 corresponds to the maximum setpoint i.e. end position OPEN.
- The value 0 corresponds to minimum setpoint i.e. end position CLOSED.

As an alternative, the process setpoint (value: 1 – 1,000) is transmitted via bytes 3 and 4 in combination with a process controller (option). The value 1,000 corresponds to the maximum process setpoint, the value 0 to the minimum process setpoint.

Byte 5: Additional commands			
Bit	**Designation (process representation)**	**Value**	**Description**
0	—		No command (reserved).
1	—		No command (reserved).
2	—		No command (reserved).
3	—		No command (reserved).
4	—		No command (reserved).
5	—		No command (reserved).
6	Fieldbus EMERGENCY	1	Control command EMERGENCY, actuator approaches the EMERGENCY position.
		0	No command.
7	—		No command (reserved).

Byte 6 to 16: Are not used.

6.3 Acyclic data

All actuator controls with PROFINET grant access to the actuator parameters, i.e. Factory parameters as well as customer parameters and operational data. Access to the data of all actuators connected within the PROFINET network is therefore enabled for predictive condition-based maintenance or uniform parameter setting. This acyclic data exchange is performed via UDP with lower priority than the process data exchange.

For integrating device-specific information, data and parameters, accessible via PROFINET, into the engineering station, either a Device Type Manager (DTM), Electronic Device Description (EDD) or an FDI package is required depending on the control system.

6.4 Redundancy

6.4.1 Media redundancy (ring)

The media redundancy available for PROFINET warrants for high availability within the plant. The actuator is equipped with two physically isolated communication ports to the host controller and can be connected within a simple ring topology.

If the first channel fails, e.g on the basis of line interruption, the second communication channel is automatically used. For this, the Media Redundancy Protocol as defined in the PROFINET standard is used. It allows the establishment of a redundant and protocol independent ring topology whereby the change-over time is less than 50 ms.

MRP is defined in the IEC 62439 standard. This deals with a redundancy of the transmission medium. The PROFINET interface of the device is not available twice.

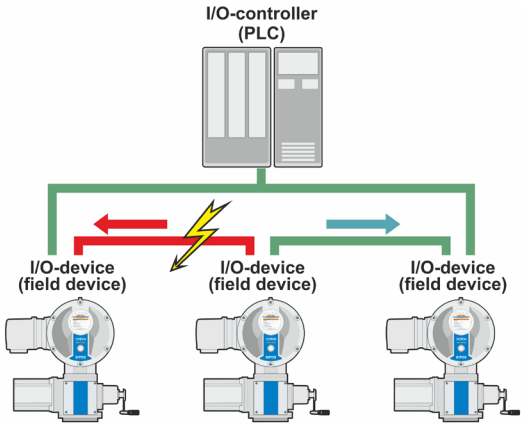


Fig.: Media redundancy

6.4.2 System redundancy S2 (Single NAP S2)

PROFINET system redundancy allows for redundant operation of several controllers or CPUs within one network. By this, failure or replacement of one controller during operation of the site is possible without interruption. Several variants of PROFINET system redundancy are available.

The S2 system redundancy (Single NAP) function enables redundant communication between a PROFINET interface in the actuator and two PROFINET actuator controls/CPUs (I/O controllers). Only one PROFINET hardware is available in the SEVEN actuator, the system has two controllers. The system redundancy allows application relations AR between the device and several controllers. PROFINET designation: S2 Single NAP.

The PROFINET interface of the device is not available in double but keeps up communication relationships to both controllers. For S2 system redundancy, a cable connection via a network port at the actuator is sufficient.

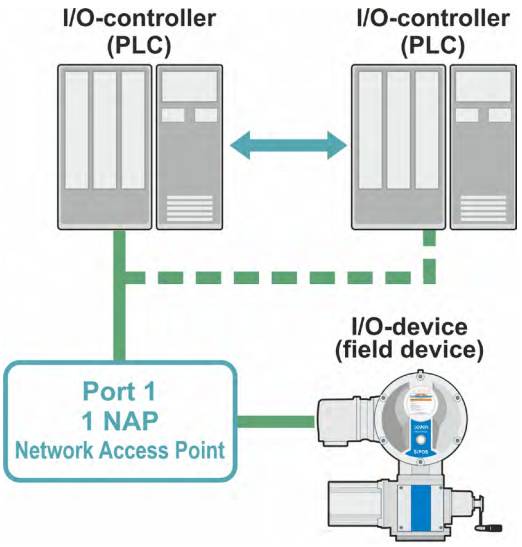


Fig.: S2 system redundancy

7 Troubleshooting

7 Corrective actions

7.1 General information

In case of problems with PROFINET communication, the actuator provides important information on troubleshooting. Select '→ 'Inputs and outputs' → 'PROFINET' in the 'Observe' menu at the actuator display.

The indication and diagnostic LEDs on the PROFINET board can also be used as support.
Assumption: Port 1/channel 1 is used as uplink in direction of the I/O controller (no ring topology).

7.2 Troubleshooting

	Troubleshooting		
No.	**Indication/status**	**Value**	**Possible remedy**
1	Actuator can be controlled via PROFINET?	Yes	No fault.
		No	Continue with step 2.
2	REMOTE is selected as control mode.	Yes	Continue with step 3.
		No	Select control mode REMOTE.
3	Fieldbus is selected as control mode? Refer to: Main menu → Parameters → Control system → Control mode	Yes	Continue with step 4.
		No	Control system – Select fieldbus control mode.
4	Select "Main menu" → Observe→ Inputs and outputs → PROFINET".		Continue with step 5 (data exchange).
5	Data exchange = cyclic operation Or LED DX on PROFIINET basic sub-assembly is illuminated?	Valid telegrams to the own address. Connection to I/O controller active and valid data received by I/O controller.	
		Yes	Check I/O controller (master), whether commands are sent.
		No	Continue with step 6 (port activity).
6	Network status: Port 1 bus activity = On or LED (LINK/ACT1) is blinking on PROFINET connection board. *Or* Port 2 bus activity = On or LED (LINK/ACT2) is blinking on PROFINET connection board.	Activity of communication interface on port 1/2. Valid telegrams, however not necessarily sent to the own address.	
		Yes	Continue with step 8 (module status).
		No	Continue with step 7 (network status).
7	Network status: Link status P1 = On or LED (LINK/ACT1) on PROFINET connection board illuminated in green. *Or* Link status P2 = On or LED (LINK/ACT2) on PROFINET connection board illuminated in green.	Yes	Network connection in direction of I/O controller available, no communication. Continue with step 8 (module status).
		No	No network connection available, check cables and connection.

	Troubleshooting		
8	Module Status = Wait Process	Yes	Device waiting for I/O connection to I/O controller. I/O controller configuration faulty. Correct parameter data within I/O controller. Check addressing.
		No	Continue with step 9.
9	Module Status = Idle I/O	Yes	Connected I/O controller in STOP - mode or I/O controller has not yet sent valid data. ‣ Check I/O controller configuration.
		No	Continue with step 10.
10	Module Status = Process Active I/O	Yes	Continue with step 13.
		No	Continue with step 11.
11	Module Status = Error	Yes	Configuration data is inconsistent or starting parameters faulty. ‣ Check I/O controller configuration.
		No	Continue with step 12.
12	Module Status = Exception	Yes	Serious error or unexpected behavior of PROFINET module or PROFINET application detected.
		No	Continue with step 13.
13	Status LOCAL: Is local actuator operation possible?	Yes	Possible causes and remedies: I/O controller does not issue an operation command, I/O controller sends wrong operation command. → Check program of control system.
		No	Possible causes and remedies: Check status indication at actuator and proceed according to operation instructions of the actuator.

8 Appendix

8 Appendix

8.1 Acyclic data

Besides the cyclic process data exchange, an additional acyclic communication can be established using the PROFINET services read record and write record.

Reading and writing parameters

Access is made via slot, subslot and index according to the following rule:

- Slot = 0
- Subslot = 1
- Index = parameter number from parameter list

If access is denied, one of the following fault indications is returned with the response telegram:

Fault signals within the response telegram			
Fault signal	**Error Class**	**Error Code**	**Cause**
Access.Invalid Index	11	0	An invalid index was accessed.
Access.write length	11	1	The data length transmitted is invalid (write access).
Access.type conflict	11	3	The data length transmitted is invalid (read access).
Access.Invalid range	11	7	The value range has been exceeded.
Access.access denied	11	6	No write access permitted.

8.2 Parameters for acyclic communication

The present appendix contains notes on acyclic parametrization of the actuator controls via PROFINET as a table (with read/write access codes).

One parameter or process date is read or written for each PROFINET request. The data lengths indicated in the tables have to be considered accordingly.

Parameters for acyclic communication		
Data type	**Description**	**Data length**
BIT	Logic value (1 = TRUE)	4 bits (included in byte)
BS8/16/32/64	Bit string	1/2/4/8 bytes
enum	Value from value list	2 bytes
I8/16/32	Integer values	1/2/4 bytes
Sxx	String	xx bytes
U8/16/32	Unsigned value	1/2/4/ bytes (8/16/32 bits)
Name	**Description**	
Parameter	Parameter name. Is indicated in the display of actuator controls.	
Access	Write and read access ▪ R = Read ▪ W = Write	
Default	Default value	
Set value	Permissible, settable value or setting range. Depending on the data type, scale factor and unit are also indicated in square brackets. Example: ▪ Min = 0 [0.1 s] ▪ Max = 50 [0.1 s] Corresponds to a setting range between 0.1 and 5.0 seconds.	

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