PN/CAN gateway, PROFINET/CAN Layer 2

Manual

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Notes

To download the latest version of this manual, please visit our website at www.helmholz.de.

We welcome all ideas and suggestions.

Revision Record:

Version	Date	Change
1	6/29/2017	First version

Contents

1 General

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

1.1 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.

1.2 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.

1.3 Note symbols and signal words

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

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

If the hazard warning is ignored, people can be injured or harmed.

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

Gives an indication for better understanding or preventing errors.

1.4 Intended use

The PN/CAN gateway integrates CAN devices into a PROFINET network.

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 extend beyond the documented options are not permitted and nullify the liability of Helmholz GmbH & Co. KG.

The PN/CAN gateway may not be used as the only means for preventing hazardous situations on machinery and systems.

Problem-free and safe operation of the PN/CAN gateway presumes proper transport, storage, setup, assembly, installation, commissioning, operation, and maintenance.

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

The PV/CAN gateway 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 operation, the doors of control boxes/cabinets must be closed and possibly locked during operation.

1.5 Improper use

WARNING

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

1.6 Installation

1.6.1 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.

1.6.2 Electrical installation

Observe the regional safety regulations.

1.6.3 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.

1.6.4 Overcurrent protection

Overcurrent protection isn't necessary as the PN/CAN gateway transports no load current. The power supply of the PN/CAN gateway electronics is to be secured externally with a fuse of maximum 1 A (slow-blowing).

1.6.5 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.

1.6.6 Operation

Operate the PN/CAN gateway 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 PN/CAN gateway 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.

1.6.7 Liability

The contents of this manual are subject to technical changes resulting from the continuous development of products of Helmholz GmbH & Co. K. 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.

1.6.8 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 liability for any printing errors or other inaccuracies that may appear in the operating manual, unless there are serious errors of 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.

1.6.9 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.

2 System overview

2.1 General/area of application

The PN/CAN gateway connects a CAN network into a PROFINET network. Any CAN messages in 11 bit or 29 bit format (CAN 2.0A / CAN 2.0B) can be integrated into the IO area of a PROFINET CPU.

2.2 Properties of the PN/CAN gateway Layer 2

The PN/CAN gateway CAN Layer 2 has the following properties:

- PROFINET IO as defined in IEC 61158-6-10

- Up to 512 PROFINET slots

- Configuration using GSDML file

- Integrated two-port Ethernet switch

- Full-duplex transmission rate of 100 Mbps

- Media redundancy (MRP client)

- CAN 2.0A (11 bit identifier) and
  CAN 2.0B (29 bit identifier) in accordance with ISO 11898-2

- Up to 1 Mbps CAN bit rate

- Automatic and controlled reception and transmission objects for frames with projected CAN ID

- Receiving channel FIFO for the reception of any CAN frames

- Transmission channel FIFO for the transmission of any CAN frames

- No handling blocks or parameterization software necessary

- 24 V DC power supply

- 3 LEDs, bi-color

- USB device interface for online diagnosis and firmware update
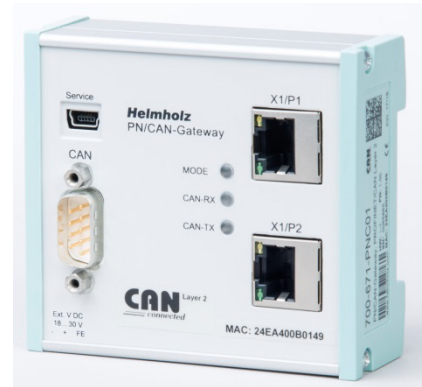
3   Installation and removal

ATTENTION

Bus connections are interrupted when the PN/CAN gateway is switched off!

Before commencing with any kind of work on the PN/CAN gateway, ensure that no impermissible disruptions of connected systems occur following interruption of the bus connections.

ATTENTION

Installation must be carried out according to VDE 0100/IEC 364 and performed in accordance with applicable national standards. The PN/CAN gateway has protection rating IP20. If a higher protection rating is required, the system must be installed in a housing or control cabinet. In order to ensure safe operation, the ambient temperature must not exceed 60 °C.

3.1   Installation position

The PN/CAN gateway can be installed in any position. The front plate must be accessible in order to plug in bus lines.

3.2   Minimum clearance

It is recommended to adhere to the minimum clearances specified when installing devices. Adhering to these minimum clearances will ensure that:

- The modules can be installed and removed without having to remove any other system components

- There will be enough space to make connections to all existing terminals and contacts using standard accessories

- There will be enough space for cable management systems (if needed)

4 Setup and wiring

4.1 EMC/safety/shielding

The PN/CAN gateway complies with EU Directive 2004/108/EC ("Electromagnetic Compatibility").

One effective way to protect against disturbances caused by electromagnetic interference is to shield electric cables, wires, and components.

> **! ATTENTION**
>
> When setting up the system and routing the required cables, make sure to fully comply with all standards, regulations, and rules regarding shielding. Precisely observe the corresponding texts of the PROFIBUS user organization for setting up PROFINET and the setup guidelines for the CAN bus. All work must be done professionally!
>
> Shielding faults can result in serious malfunctions, including the system's failure.

To ensure electromagnetic compatibility (EMC) in your control cabinets in electrically harsh environments, the following EMC rules are to be observed in the design:

- All metal parts of the cabinet are to be connected with each other over a large area with good conductivity (no paint on paint). Where necessary, use contact washers or serrated washers.

- The cabinet door must be connected to the ground straps (top, middle, bottom) over as short a distance as possible.

- Signal cables and power cables are to be laid separated spatially by a minimum distance of 20 cm from each in order to avoid coupling paths.

- Run signal lines only from one level into the cabinet if possible.

- Unshielded cables in the same circuit (outgoing and incoming conductors) must be twisted if possible.

- Contactors, relays, and solenoid valves in the closet, or in adjacent cabinets if applicable, must be provided with quenching combinations; e.g., with RC elements, varistors, diodes.

- Do not lay wires freely in the closet; instead, run them as closely as possible to the cabinet housing or mounting panels. This also applies to reserve cables. These must be grounded on at least one end, and it is better if they are grounded at both ends (additional shielding effect).

- Unnecessary line lengths should be avoided. Coupling capacitances and inductances are kept low this way.

- Analog signal lines and data lines must be shielded.

4.2 Wiring of the PN/CAN gateway

4.2.1 Voltage supply

The PN/CAN gateway is supplied with 24 V DC voltage via the 3-pin power supply plug (V+, GND, FE).

4.2.2 CAN bus connection

Pin	SubD plug CAN bus
1	-
2	CAN low
3	CAN GND
4	-
5	-
6	-
7	CAN high
8	-
9	-

NOTE

PN/CAN gateway contains no terminating resistor for use at the end of a CAN bus network segment! To this purpose use CAN bus plugs with integrated terminating resistors (see chapter 5.2).

4.2.3 PROFINET connection

Pin	Signal	RJ45 plug PROFINET	Color	Wire pair
1	TD+	Transmission data +	Yellow	1
2	TD-	Transmission data -	Orange	1
3	RD+	Receive data +	White	2
4	-	-	-	-
5	-	-	-	-
6	RD-	Receive data -	Blue	2
7	-	-	-	-
8	-	-	-	-

4.2.4 USB interface

The service USB interface is currently only required for the firmware update and for diagnostics in the event of support.

5 CAN bus

CAN bus (**C**ontrol **A**rea **N**etwork) is an international and open fieldbus standard for building, manufacturing, and process automation applications. CAN bus communications are defined in standard ISO 11898-2.

5.1 CAN bus wiring

A CAN bus cable requires at least three wires: CAN high, CAN low, and CAN ground. Only linear bus topologies are allowed, A terminating resistor of 120 ohms must be connected between CAN high and CAN low at both ends of the CAN bus cable. The PN/CAN gateway has no installed bus terminating resistor.

The maximum cable lengths will depend mainly on the bit rate being used.

Bit rate	Bus length	Bit time
1 Mbps	30 m	1 µs
800 kbps	50 m	1.25 µs
500 kbps	100 m	2 µs
250 kbps	250 m	4 µs
125 kbps	500 m	8 µs
50 kbps	1500 m	20 µs

The cable lengths specified above should only be used as reference values. The maximum cable length will also depend on the number of connected participants, on the use and the number of repeaters, and on the cable type.

5.2 CAN bus plug

Helmholz GmbH & Co. KG offers an extensive range of CAN bus connectors that can be used with the PN/CAN gateway. All CAN bus connectors come with a terminating resistor that can be switched on and off.

6 Setup and use

6.1 Install GSDML file

The GSDML file can be found on the accompanying CD or in the download area of the "PN/CAN gateway Layer 2" at www.helmholz.de.

6.2 Configuring gateway

The PN/CAN gateway can be found in the hardware under "PROFINET IO → Other field devices → Gateway → Helmholz PN/CAN gateways". Add the "PN/CAN gateway CAN Layer 2" to the project and connect it with your PROFINET network.
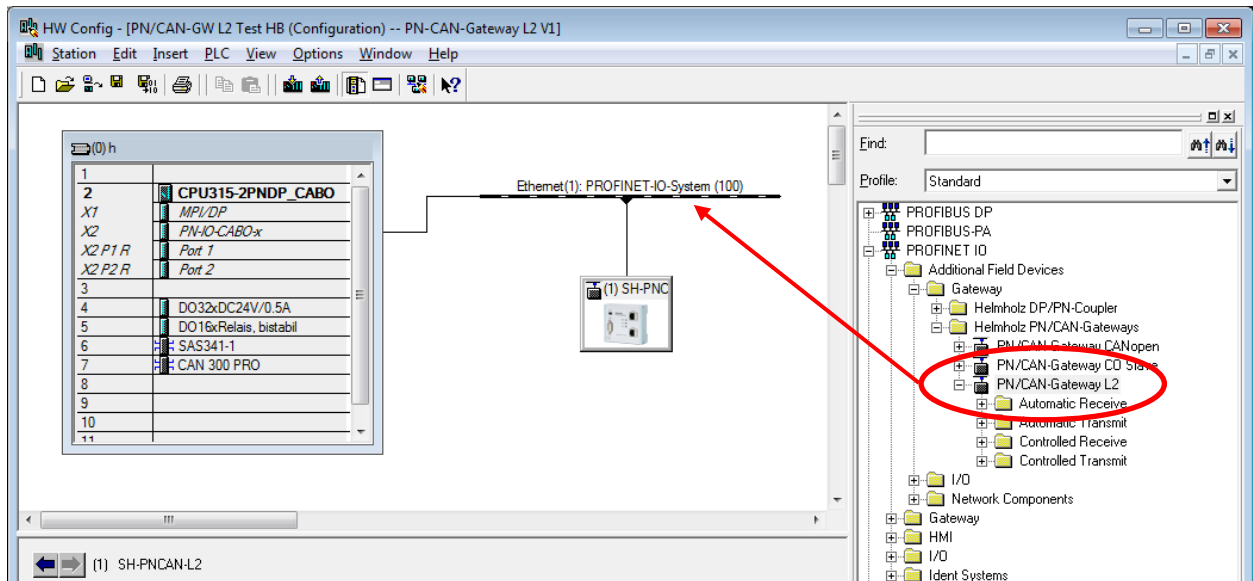
By calling up the object properties, the PN/CAN gateway should be assigned a unique PROFINET name and the IP address be checked for plausibility.

The name of the configured device must later be assigned to the physical device (see Ch. 6.8).
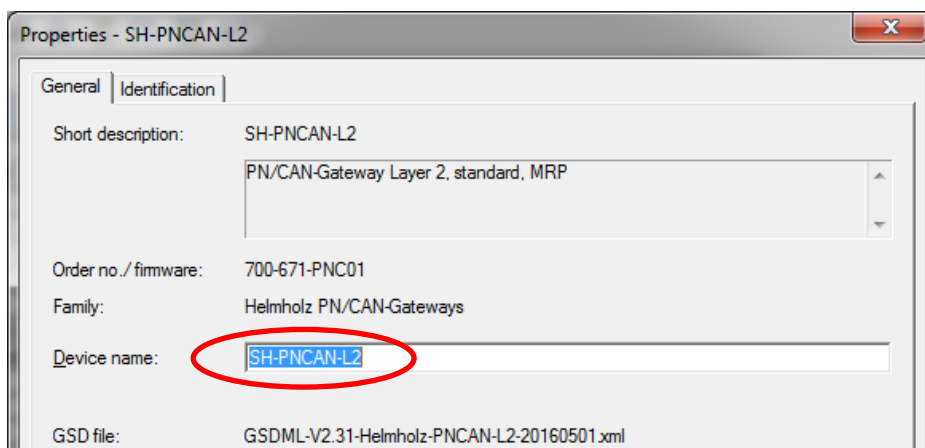
6.2.1 Configuring gateway

The first slot entry after the ports is the slot for the parameters.

CAN bit rate: 10, 50, 100, 125, 250, 500, 800 Kbps, and 1 Mbps are available as bit rates.

CAN identifier type: The PN/CAN gateway can process and transmit CAN frames with either 11 bit identifiers or with 29 bit identifiers.

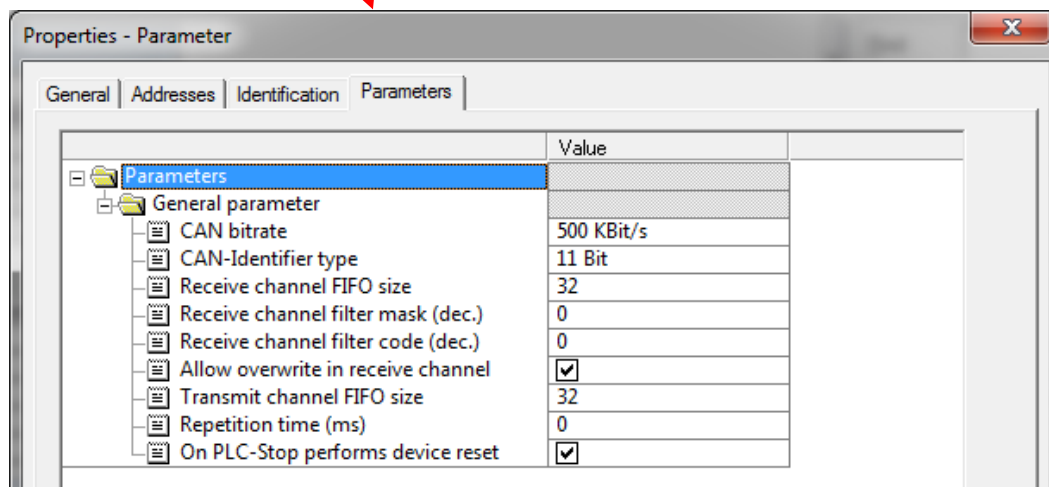Length of the receive channel FIFO: Maximum number of frames that can be stored temporarily in the receive channel. Details for the use of the receive channel are explained in chapter 7.4 "Receive channel (Rx-FIFO)".

Filter mask (dec.) / Filter code (dec.): Filter for the frames that should be accepted by the receive channel FIFO. Details for the use of the receive channel are explained in chapter 7.4 "Receive channel (Rx-FIFO)".

Allow overwriting of the receive FIFO: When the reception channel FIFO is full, because the received frames can't be picked up quickly enough by the PLC, this option can be used to set whether new frames should be rejected or whether old frames should be overwritten. Details for the use of the reception channel are explained in chapter 7.4 "Receive channel (Rx-FIFO)".

Length of the transmission channel FIFO: The size of the transmission channel FIFO can be set between 1 and 255 frames. Details for the use of the transmission channel are explained in chapter 7.5 "Transmission channel (Tx-FIFO)".

Repetition time for transmission channel (ms): The time for the cyclical transmission of a CAN frame via the transmission channel can be set here.

Carry out a device reset for PLC stop: When the PN/CAN gateway receives the "PLC in stop" signal via PROFINET, it can carry out an internal reset in order to ensure a defined basic status for a restart of the PLC.

6.3 Adding CAN frame

The PN/CAN Gateway Layer 2 can transmit and receive CAN frames with 1 to 8 bytes of data and any CAN-IDs. A module with the CAN identifier must be configured in the slots of the PN/CAN gateway for each anticipated CAN frame and each CAN frame to be transmitted.

There are two types of CAN frames:
automatic receiving/transmission and **controlled receiving/transmission**.

In the case of **automatic transmission**, the CAN frame is transmitted as soon as the output data of the frame changes. Repeat transmission of the same data is thus not possible.

In the case of the **automatic receive** of CAN frames, the data of the most recently received CAN frame is always found in the input data. If a CAN frame with identical data is received several times, this can't be recognized in the PLC.

In the case of **controlled transmission** and the **controlled receive** of CAN frames the PLC program has direct control over each telegram through control and status bits.

6.4 Automatically receiving CAN frames

In the case of the **automatic receive** of CAN frames, the data of the most recently received CAN frame is always found in the input data.

Each configured CAN frame has a clear CAN identifier.
If two reception objects with the same CAN identifier are being configured, that results in a configuration error.
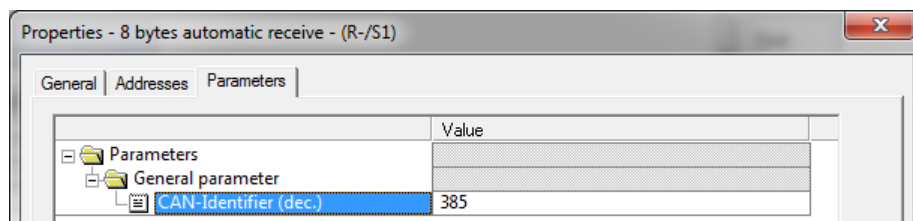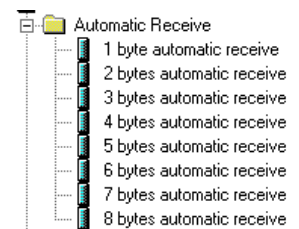
A CAN frame always has a fixed data length. In the case of automatic reception, CAN frames with 1 to 8 bytes can be configured.

If a CAN frame is received that has the correct CAN identifier but a false data length, the frame is rejected and the data is not forwarded to the PLC!

CAN frames with differing data lengths can be processed with the receiving channel (Rx-FIFO).

6.5   Automatically transmitting CAN frames

In the case of **automatic transmission** of a CAN frame, a frame is always sent to the CAN bus when the output data of the module changes.

Each configured CAN frame has a clear CAN identifier.
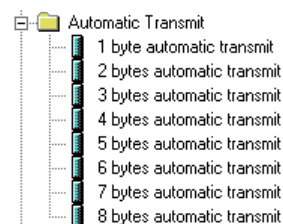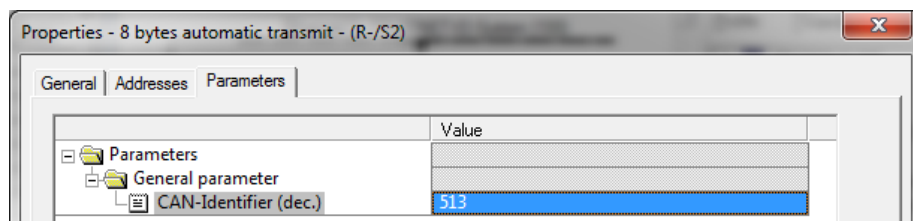
In the case of automatic transmission, CAN frames with 1 to 8 bytes can be configured. The transmission of CAN frames with a variety of data lengths can be carried out with the transmission channel (Tx-FIFO).

6.6   Controlled receiving of CAN frames

In the case of the **controlled receive** of CAN frames, the reception of each frame must be acknowledged in the PLC program.

In the case of controlled reception, CAN frames with 0 to 8 bytes can be configured. An RTR frame can also be received.

If a CAN frame is received that has the correct CAN identifier but a false data length, the frame is rejected and the data is not forwarded to the PLC!
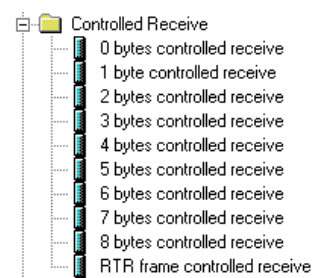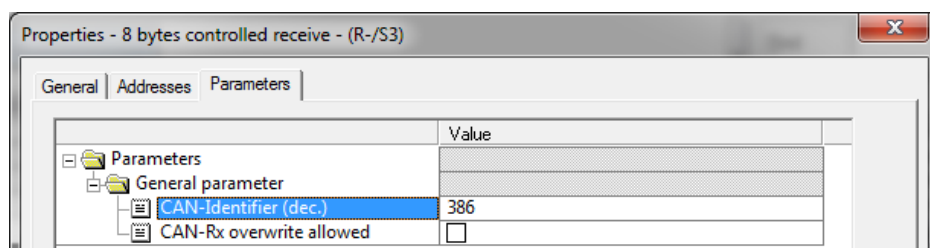
If two reception objects with the same CAN identifier are being configured, that results in a configuration error.

6.7   Controlled transmission of CAN frames

In the case of **controlled transmission** of a CAN frame, the PLC can only directly trigger the transmission of a CAN frame through a control bit, irrespective of whether the transmission data has changed.

In the case of controlled transmission, CAN frames with 0 to 8 bytes can be configured. An RTR frame can also be transmitted.
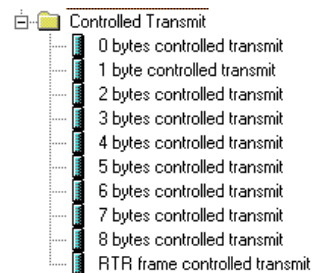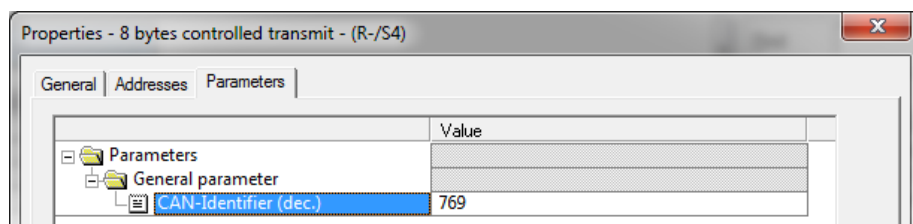
6.8 Assign the PN/CAN gateway a PROFINET name

When the configuration of the PN/CAN gateway has been completed in the hardware configurator, it can be loaded into the PLC.

In order that the PN/CAN gateway can be found on the PROFINET of the PLC (the PROFINET controller), the PROFINET name and possibly the IP address must be set.

One possibility for this is the function "Process Ethernet participant" in the Simatic Manager. With the "Browse..." button, the network can be browsed for PROFINET participants.

The clear identification of the PN/CAN gateway is ensured here by the MAC address of the device.

> **!**
> **ATTENTION**
>
> The assigned name must agree with the name established in the hardware configurator (see Ch. 6.2.1).

If the PN/CAN gateway has been assigned the correct PROFINET name, it is recognized by the PLC and configured.

When the configuration has run correctly, the blue "Mode" LED should blink.

7 Programming in the PLC

No handling blocks are required for operation of the PN/CAN gateway in the PLC. The control and status query of the PN/CAN gateway can be carried out directly via the I/O image.

7.1 Control and status

No handling blocks for simple operation are required in the PLC. The control and status query of the PN/CAN gateway can be carried out directly via the I/O image.

In order to switch to normal operation, the value 3 must be written into the "Control" output word.

7.1.1 Control (2 bytes outputs)

Byte/bit	7	6	5	4	3	2	1	0
Out 0	-	Reset	-	-	-	-	-	-
Out 1	-	-	-	-	-	-	Mode	

The **mode** bits are used for the status control of the PN/CAN gateway.

INIT (0) = CAN controller is at the bus, no frames are transmitted, received frames are discarded; outputs/inputs are set to zero; FIFOs are deleted.
The INIT (0) status is automatically active in the event of a PROFINET network cancellation or stoppage of the PLC.

PASSIV (1) = CAN Controller is at the bus; received frames are discarded, no frames are transmitted; error counters are transmitted to the PLC; FIFOs are maintained and can be operated; Rx-FIFO can be read until it is empty; Tx-FIFO can be described, but no frames are transmitted; controlled transmission modules can be operated; data from automatic receiver modules remain frozen

RX-Only (2) = Only the CAN reception is processed. No CAN frames are transmitted.

RX-TX (3) = Normal operation with transmitter and receiver.

Reset: Carrying out a user reset. After setting the bit, one must wait for the bit 6 in the status byte 0. The PN/CAN gateway is in the INIT mode following the reset. The reset bit in status control can now be reset.

> **i** NOTE
>
> In order to change to the desired operating mode, it is permitted to directly activate the desired mode.

7.1.2 Status (6 bytes inputs)

Byte/bit	7	6	5	4	3	2	1	0
In 0	1= Gateway ready	1 = Reset carried out	-	-	-	-	-	-
In 1	Error code for configuration errors				-	-	**Mode status**	
In 2	CAN receive error counter							
In 3	CAN transmit error counter							
In 4+5	first plug point with configuration error							

The two **mode status** bits show the status of the PN/CAN gateway. Principally, an attempt is made to activate the status requested in the mode of the control word. However, this can be prevented by configuration errors.

INIT (0) = CAN controller is at the bus, no frames are transmitted, received frames are discarded; outputs/inputs are set to zero; FIFOs are deleted.

PASSIV (1) = CAN controller is at the bus; received frames are discarded, no frames are transmitted; error counters are transmitted to the PLC; FIFOs are maintained and can be operated; Rx-FIFO can be read until it is empty; Tx-FIFO can be described, but no frames are transmitted; data from automatic receiver modules remain frozen

RX-Only (2) = Only the CAN reception is processed. No CAN frames are transmitted.

RX-TX (3) = Normal operation with transmitter and receiver.

Error code for configuration errors:

1: Dual CAN-ID assignment for receive modules or CAN-ID >0x7FF with 11 bit CAN application
3: Receive channel FIFO: Mask and codes result in more than 16 filter ranges
4: CAN hardware filter table is full
5: General configuration errors
6: the firmware doesn't support a configured module → Firmware update required

First plug point with configuration error: In connection with the error code for configuration errors, this value indicates the plug point of the first module with a configuration error.

CAN receive error counter: Error counter of the CAN controller

CAN transmit error counter: Error counter of the CAN controller

7.2 Controlled receiving of CAN frames

In the PLC, every controlled receive object has a status and a control byte in addition to the CAN data:

Byte/bit	7	6	5	4	3	2	1	0
In 0	-	-	-	-	-	-	1 = Overrun	Indication toggle bit of new frame
In 1 – n	CAN frame data depending upon the selected frame length (0 - 8 bytes)							
Out 0	-	-	-	-	-	-	Overrun reset	Acknowledge toggle bit of new frame

The indication and the acknowledge bit for the reception of new CAN frames are always toggled:

Indication bit = Acknowledge bit → no new frame received
Indication bit ≠ Acknowledge bit → a new frame has been received

In order to be able to receive the next frame, the acknowledge bit must simply be set to the indication bit.

7.3 Controlled transmission of CAN frames

In the PLC, every controlled transmission object has a status and a control byte in addition to the CAN data:

Byte/bit	7	6	5	4	3	2	1	0
In 0	-	-	-	-	-	-	-	Transmit Acknowledge
Out 0	-	-	-	-	-	-	-	Request transmit
Out 1 – n	CAN frame data depending upon the selected frame length (0 - 8 bytes)							

The request and the acknowledge bit for the transmission of CAN frames are always toggled:

Request bit ≠ Acknowledge bit → Transmit frame
Request bit = Acknowledge bit → Frame transmitted

7.4 Receive channel (Rx-FIFO)

The receive channel object can be used to receive any CAN frames. The CAN identifiers entered when receiving in the receive channel are defined by the configured filter (see Ch. 6.2.1. "Configuring gateway").

The PLCs can collect the CAN frames program-controlled from the FIFO, which means that no CAN frame is lost. In contrast with the reception objects, the CAN frames for the reception channel can also have differing data lengths.

The number of temporarily stored frames can be set in the parameters of the PN/CAN gateway (see ch. 6.2.1.) between 1 and 255.

7.4.1 Set receive channel filter

The filter of the receive channel is determined by the two parameters "Mask" and "Code".
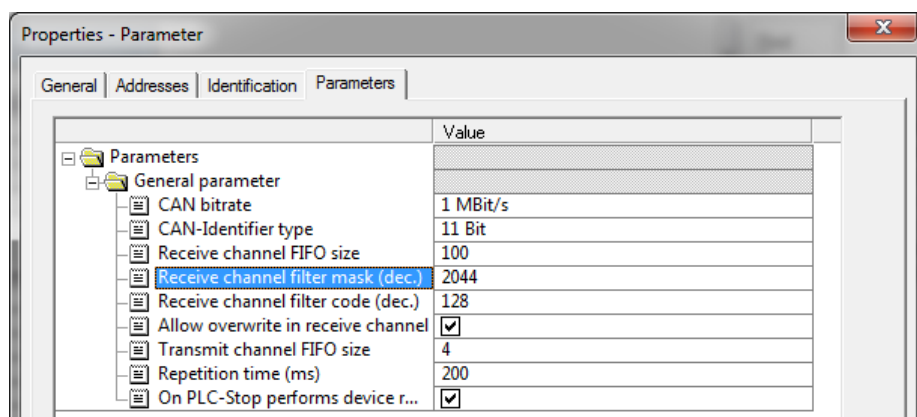
For technical reasons, the values can only be entered as decimal numbers, but must be interpreted as binary values.

For each 0 in the "Mask", 0 or 1 is accepted in the "Code" (bit in the CAN identifier is irrelevant). The CAN identifier is compared with the code for consistency for each 1 in the mask.

The PN/CAN gateway automatically derives filter ranges from the mask and the code.

Example A:

Bit			10	9	8	7	6	5	4	3	2	1	0
Mask	0x7F0	2023	1	1	1	1	1	1	1	0	0	0	0
Code	0x80	128	0	0	0	1	0	0	0	0	0	0	0

→ results in a range from 0x080 to 0x08F.

Example B:

Bit			10	9	8	7	6	5	4	3	2	1	0
Mask	0x7FD	2045	1	1	1	1	1	1	1	1	1	0	1
Code	0x80	128	0	0	0	1	0	0	0	0	0	0	0

→ results in 2 ranges from 0x080 to 0x080 and 0x082 to 0x082.

Example C:

Bit			10	9	8	7	6	5	4	3	2	1	0
Mask	0x7D0	2000	1	1	1	1	1	0	1	0	0	0	0
Code	0x80	128	0	0	0	1	0	0	0	0	0	0	0

→ results in 2 ranges from 0x080 to 0x08F and 0x0A0 to 0x0AF.

Example D:

Bit			10	9	8	7	6	5	4	3	2	1	0
Mask	0x790	1936	1	1	1	1	0	0	1	0	0	0	0
Code	0x80	128	0	0	0	1	0	0	0	0	0	0	0

→ results in 4 ranges: 0x080 to 0x08F / 0x0A0 to 0x0AF / 0x0C0 to 0x0CF / 0x0E0 to 0x0EF

The filter principle functions exactly the same for 29 bit applications.

NOTE

The PN/CAN gateway can generate and administer a maximum of 16 filter ranges. If more ranges should arise from the combination of mask and code, so error 3 "Receive channel FIFO: Mask and the code result in too many areas (max. 16)" will be displayed upon starting up of the PN/CAN gateway in status byte 1 of error 3 (see also Ch. 7.1.2).

7.4.2 Collecting frames from the receive channel

The reception channel module has 1 byte of output data for the control and 15 bytes of input data for the status and the received CAN frame. The exchange of the received CAN frame with the PLC can be controlled via this IO data.

Byte/bit	7	6	5	4	3	2	1	0
Out 0	-	-	-	-	-	Rx-FIFO reset	Reset Overrun	Rx-ACK: Toggle confirmation of receipt
In 0	-	-	-	-	-	Rx-FIFO Reset ACK	1 = RX-FIFO Overrun	Rx-Toggle: New frame in the FIFO (toggling)
In 1	Rx count: Number of CAN frames not yet collected in the FIFO							
In 2 -5	Rx CAN identifier							
In 6	Rx RTR/LEN							
In 7 - 14	Rx data (8 bytes)							

The bit 0 in the input byte 0 "**Rx-Toggle**" indicates with a change of its value that a new CAN frame is ready in the input area (bytes 2-14).

If the frame has been processed (copied or interpreted), the PLC program must also toggle the bit 0 in the output byte 0 "**Rx-ACK**" (invert value).

The PLC program can generally compare "**RX-Toggle**" and "Rx-ACK": In the event that the values are identical, nothing needs to be done. When they are unequal, a new frame can be processed and "**Rx-ACK**" must then be inverted again.

If the frames are not retrieved quickly enough, meaning that the configured FIFO size is inadequate, this will be indicated by bit 1 "**Rx-FIFO Overrun**". The most recently received frame is discarded. The error bit is static and must be reset with "Reset Overrun".

With "**Rx-FIFO Reset**", the content of the Rx-FIFO can be completely deleted.

7.5   Transmission channel (Tx-FIFO)

Any number of CAN frames can be transmitted with the transmission channel. The CAN identifier, the data, and the data length can be selected as desired. It is also possible to transmit CAN frames with identifiers that have already been configured as automatic or controlled modules.

The PN/CAN gateway provides a transmission FIFO buffer with adjustable size (see chapter 6.2.1. "Configuring gateway").

7.5.1   Sending frames

The transmission channel module has 14 bytes of output data for the control and the CAN frame, and 2 bytes of input data for the status. The transmission of CAN frames can be controlled by the PLC with this IO data.

Byte/bit	7	6	5	4	3	2	1	0
Out 0	-	-	-	-	-	Tx-FIFO reset	1 = Activate Tx-Repeat	Tx-Toggle for transmission order
Out 1 - 4	Tx CAN identifier of the transmission frame							
Out 5	Tx RTR/LEN							
Out 6 - 13	Tx data (8 bytes)							
In 0	-	-	-	-	-	Tx-FIFO Reset ACK	1 = Tx-Repeat active	Tx-ACK (toggling)
In 1	Tx Free: Number of still available FIFO entries							

In order to transmit a CAN frame, the CAN frame must be written into the output data bytes 1-13. By toggling (negate bit value) the bit 0 in byte 0 "**Tx-Toggle**", the frame is entered into the transmission FIFO in the PN/CAN gateway. The bit 0 in the input byte 0 "**Tx-ACK**" is also toggled by the PN/CAN gateway as a response.

The toggling of the "Tx-Acknowledge" bit only shows that the CAN frame has been transferred to the internal transmission FIFO of the PN/CAN gateway. The time at which the CAN frame was actually sent is not detectable in the PLC.

If a CAN frame is to be transmitted cyclically with alterable data, this can be activated by setting the bit 1 in the output byte 0 "**Activate Tx-Repeat**". The CAN frame found in the output data is now transmitted cyclically with the "Repetition time for the transmission channel (ms)" defined in the

PC/CAN parameters. All changes to the frame information are adopted for the next transmission point in time.

"**Tx-FIFO Reset**" deletes the content of the Tx-FIFO entirely. Frames that have already been forwarded to the CAN controller are still transmitted.

8 LED-based diagnosis

MODE	
Off	No power supply or device defective
Blue on	PN/CAN gateway has been correctly configured through PROFINET Mode 3 – Transmission and receiving active
Flashing blue	PN/CAN gateway has been correctly configured through PROFINET Mode is 0, 1, or 2
Flashing red	No connection with the PROFINET controller (PLC) exists, or a configuration error exists
CAN-RX	
Flashing green	CAN frame is received without errors
Red	CAN bus error in the receiver or PN/CAN gateway hasn't been configured yet
CAN-TX	
Flashing green	CAN frames are being transmitted
Red	Transmission error has occurred (e.g. false Baud rate, CAN bus disrupted) or the PN/CAN gateway has not yet been configured

9 Technical data

Order no.	700-671-PNC01
Name	PN/CAN gateway Layer 2
PROFINET interface	
Protocol	PROFINET IO as defined in IEC 61158-6-10
Transmission rate	100 Mbps full duplex
I/O image size	1440 bytes
Number of configurable slots	512
Connection	2x RJ45, integrated switch
Features	PROFINET Conformance Class C, Media redundancy (MRP client), Automatic addressing, Topology detection (LLDP, DCP), Diagnosis alarms
CAN interface	
Type	ISO/DIN 11898-2 CAN High-speed physical layer
Connection	9-pin D-sub male connector
Protocol	CAN 2.0A (11 bit identifier) or CAN 2.0B (29 identifier)
Baud rate	50, 100, 125, 250, 500, 800, 1000 kbps
USB interface	
Protocol	Full-speed USB 2.0 device
Connection	Mini-USB
Electrically isolated from USB	Yes; insulation 15 kV
Voltage supply	24 V DC, 18–28 V DC
Current draw	Max. 250mA
Dimensions (D x W x H)	35 mm x 83 mm x 72 mm
Weight	Approx. 160 g
Certifications	CE, PROFINET Conformance Class C (in progress)
Noise immunity	DIN EN 61000-6-2 "EMC Immunity"
Interference emission	DIN EN 61000-6-4 "EMC Emission"
Vibration and shock resistance	DIN EN 60068-2-6:2008 "Vibration" DIN EN 60068-27:2010 "Shock"
Protection rating	IP 20
Relative humidity	95% without condensation
Installation position	Any
Permissible ambient temperature	0° C to 60° C
Transport and storage temperature	-20° C to 80° C