**Quickstart Guide
PN/CAN Gateway CANopen Master**

Order number: 700-670-PNC01

Version
5 en

Content

1 Safety instructions

Target audience

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. The specialist personnel are to ensure that the application or the use of the products described fulfills all safety requirements, including all applicable laws, regulations, provisions, and standards.

Intended use

The device has a protection rating of IP 20 (open type) and must be installed in an electrical operating room or a control box/cabinet to protect it against environmental influences. To prevent unauthorized operation, the doors of control boxes/cabinets must be closed and possibly locked during operation. 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 device only as intended!

Operation

Successful and safe operation of the device requires proper transport, storage, setup, assembly, installation, commissioning, operation, and maintenance. Operate the device only in flawless condition. The permissible operating conditions and performance limits (technical data) must be adhered to. Retrofits, changes, or modifications to the device are strictly forbidden.

Security

The device is a network infrastructure component and therefore an important element in the security consideration of a plant. When using the device, therefore, observe the relevant recommendations to prevent unauthorized access to installations and systems.

2 Introduction

This document explains the initial commissioning of the PN/CAN-Gateway CANopen Master. The latest version of the documentation can be found at www.helmholz.de or scan the QR code directly.

3 Function of PN/CAN Gateway CANopen Master

The "PN/CAN Gateway, PROFINET/CANopen Master" integrates a CANopen network into a PROFINET network. It works on the CANopen network as a fully-fledged CANopen master and enables the integration of process and service data from CANopen slave devices into the IO area of a PROFINET CPU.

4 Connection

4.1 Power supply

The PN/CAN gateway must be supplied with DC 18 ... 30 V must be supplied with DC 24 V via the supplied connector plug.

The housing of the PN/CAN-Gateway Coupler is not grounded. Please connect the functional earth terminal of the PN/CAN-Gateway properly to the reference potential.

The device is intended to be supplied by an isolated Limited Energy Source according to UL61010-1 (3rd ed cl. 9.4) or according to UL60950-1/UL62368-1 or Class 2 according to NEC. Please use Cu power supply wires, AWG 28-12. Maximum length of removed insulation is 10 mm. Temperature cable rating is 87 °C.

4.2 CAN-Bus

The CAN bus is connected to the "CAN" interface using a SUB-D plug (e.g. Helmholz CAN bus connector) to the "CAN" interface.

The PN/CAN gateway does not contain a CAN terminating resistor. If the PN/CAN gateway is connected to the end of a CAN stub line, the terminating resistor in the CAN connector must be activated.

"CAN-GND" is isolated from the operating voltage and USB.

Pin	CAN bus D-sub-connector
1	-
2	CAN Low
3	CAN GND
4	-
5	-
6	-
7	CAN High
8	-
9	-

4.3 PROFINET

The RJ45 Ethernet sockets "X1 P1" and "X1 P2" are used to connect the PROFINET network.

The PROFINET Ethernet sockets are only intended for connection to computer networks (LANs) and must not be connected to telephone networks or telecommunications lines.

4.4 USB interface

The service USB interface is only required for the firmware update and for diagnoses in the event of support. The USB interface is isolated potential-free from the supply voltage.

5   Download and Installation of GSDML file

The latest GSDML file is available on the website www.helmholz.de. Go to the product page of the "PN/CAN Gateway CANopen Master" and then to the download area or follow the link stored in the QR code. There you can download the GSDML file of the "PN/CAN Gateway CANopen Master" in zipped form. Before installation, the zipped files must be unzipped accordingly.

The GSDML file is required for integration into an engineering tool for the PROFINET side. It has the file extension "xml" and is delivered together with an image file in BMP format. The installation of the GSDML file in the TIA Portal is described below as an example.

## 5.1   Install GSDML file in TIA Portal

You can install the GSDML file of the PN/CAN-Gateway in the TIA Portal by selecting the directory with the unzipped GSDML file as the source path in the "Extras / Manage station description file (GSD)" menu. Then the GSDML file is displayed for selection and can be installed via the corresponding button.

After successful installation, the PN/CAN-Gateway is listed in the hardware catalog of the TIA Portal under „ Other field devices → PROFINET IO → Gateway → Helmholz PN/CAN Gateways".
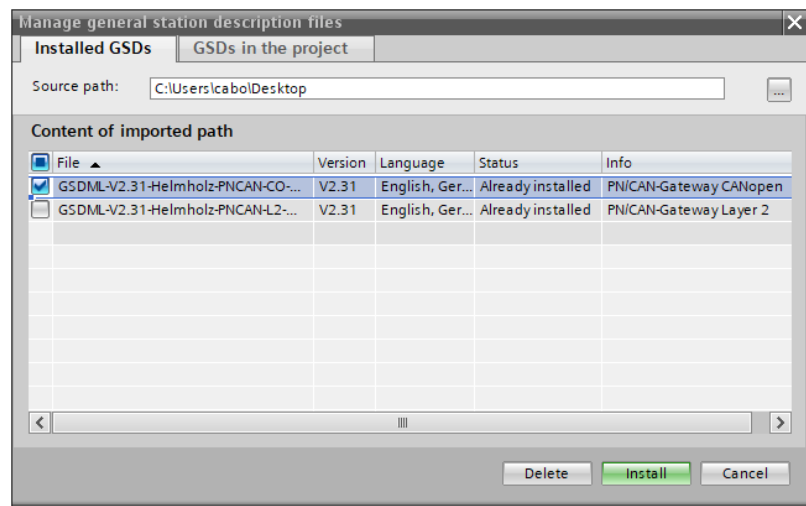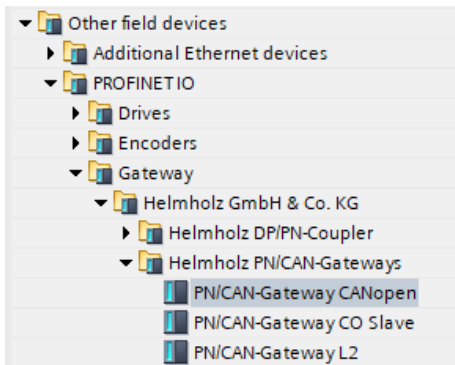
6 Configuring the PN/CAN-Gateway

Add the "PN/CAN-Gateway CANopen" to the project and connect it to your PROFINET network.
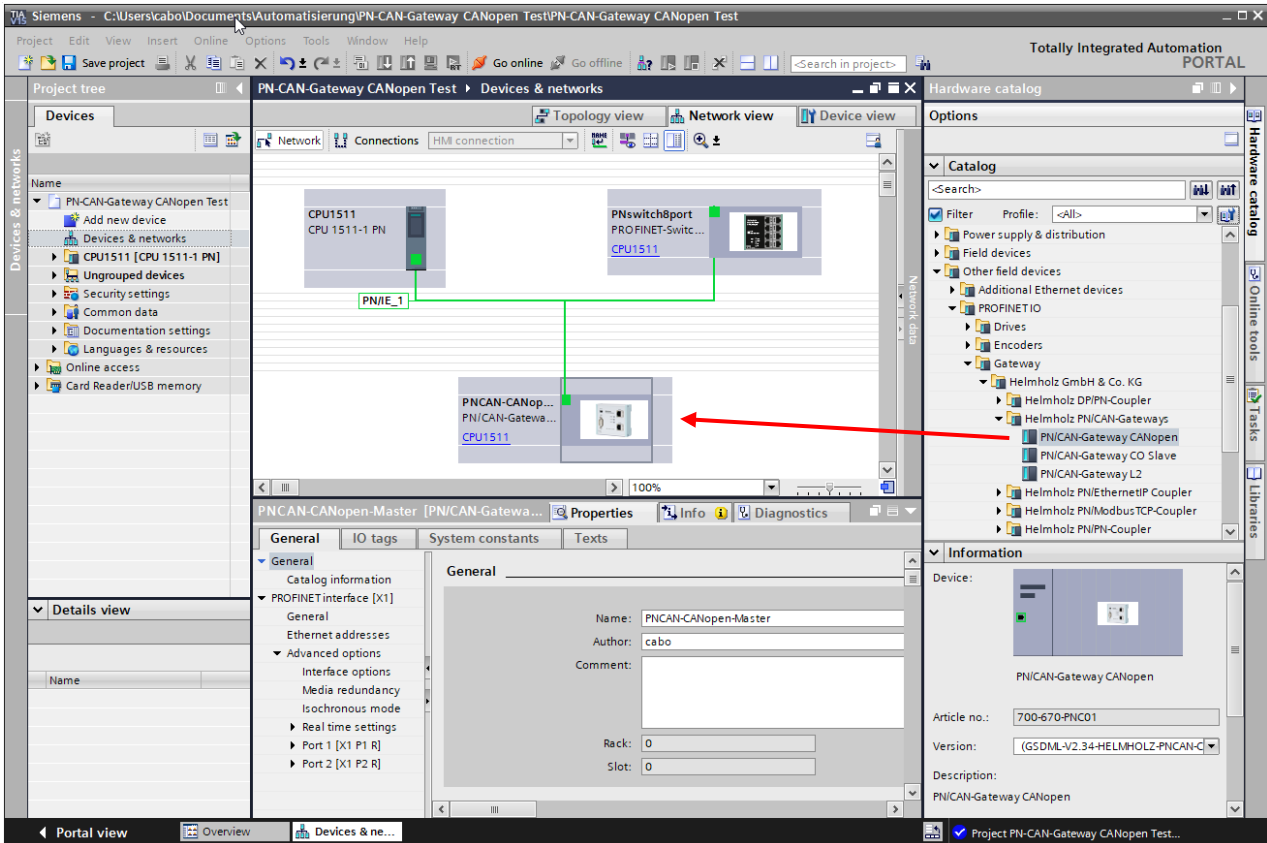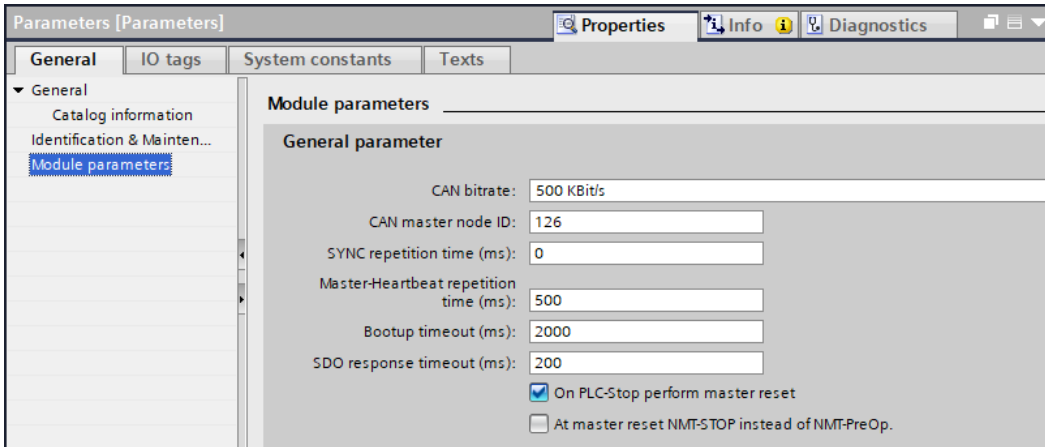

By calling the properties a unique PROFINET name should be assigned to the PN/CAN gateway and the IP address should be checked for plausibility.

The name of the configured device must be assigned to the physical device later (see Chap. 7).

6.1 Parameterize CANopen Master

The first slot entry "Parameter" contains the module parameters for the behavior of the CANopen master.

Set the CAN bit rate and the CAN master node ID. In some applications a SYNC telegram or heartbeat telegrams of the master is necessary for operation. The other "PN/CAN CO" slot entries do not contain any parameters.

6.2 Add and configure a CANopen Device

A "CANopen Device" is a CANopen slave station that is to be managed on the CAN network by the CANopen master. An entry must be created for each CANopen slave.
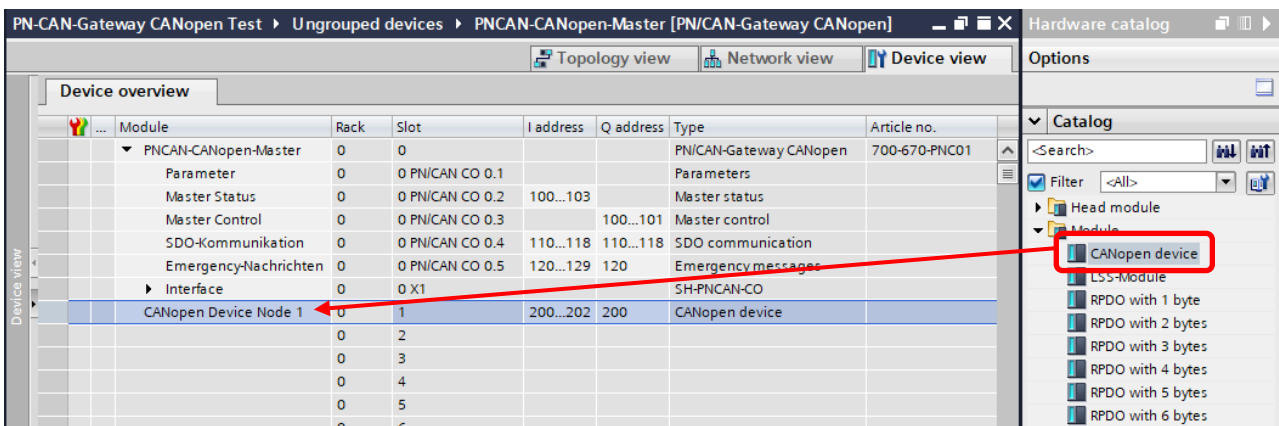

The parameters of the CANopen slave can be specified under the properties of the CANopen device entry. The device node ID of the CANopen slave must be set correctly.
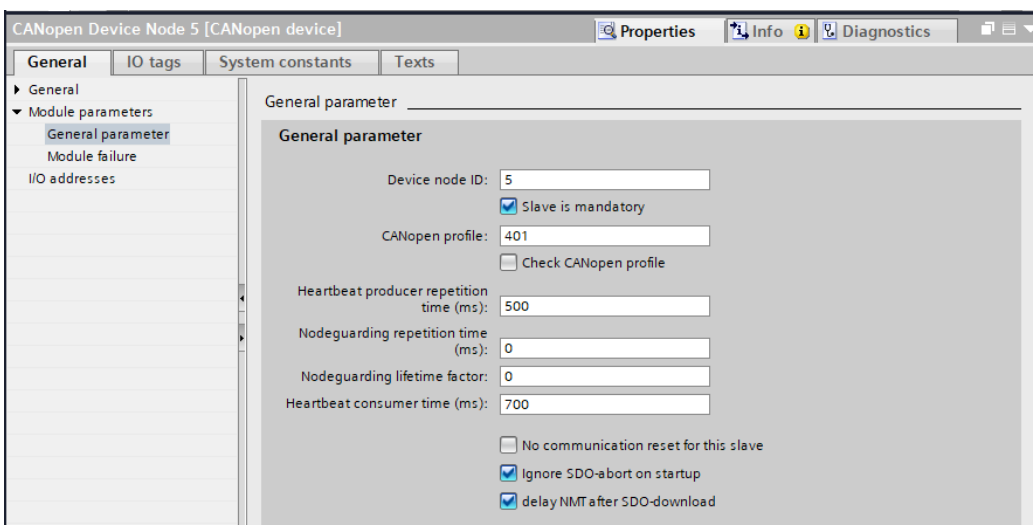
If the option "**Slave is mandatory**" is selected, all CANopen nodes on the CAN bus of the PN/CAN-Gateway are not switched to operational until this device is present and parameterized.

6.3   Add and configure PDOs (process data object)

TPDOs (Transmit Process Data Objects) are data that are sent from the CANopen slave to the PLC (input data from PLC view). RPDOs (Receive Process Data Objects) are data sent from the PLC to the CANopen slave (output data from PLC view). The data size of the PDOs depends on the data in the PDO (PDO mapping) and can be between one and 8 bytes.
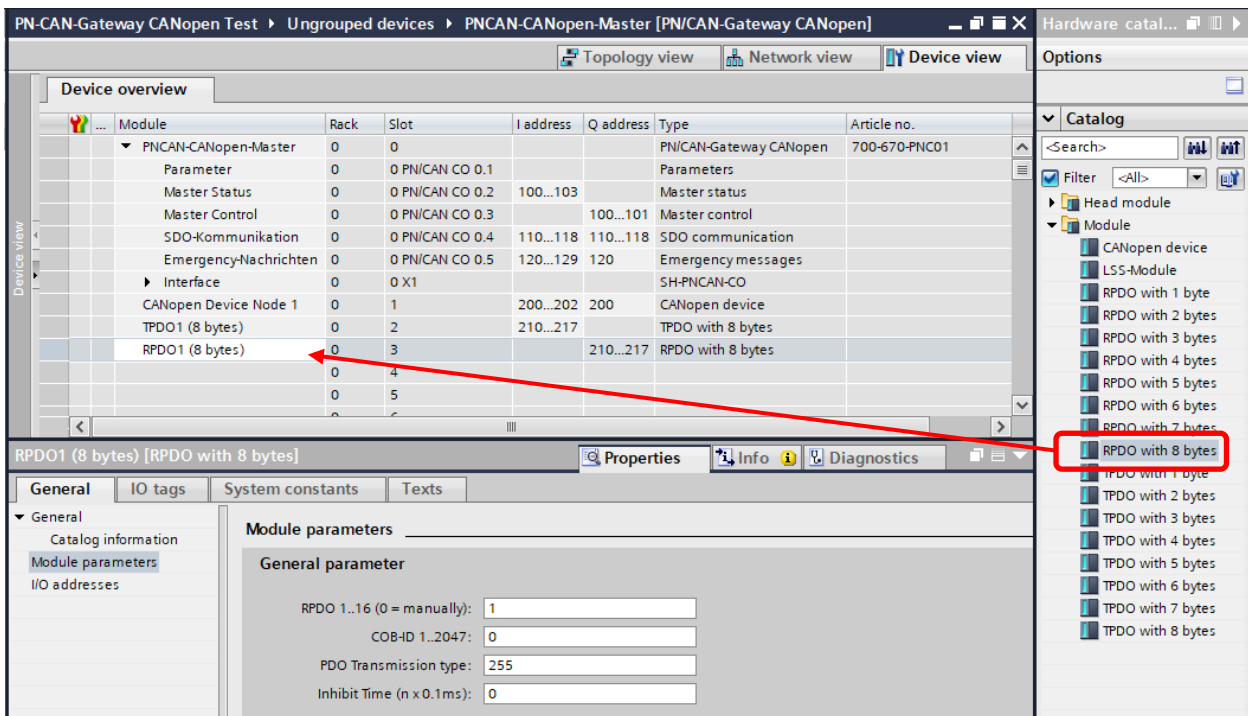
The order of the TPDO and RPDO entries in the configuration can be chosen arbitrarily. All TPDO and RPDO entries that follow a CANopen device entry belong exactly to this device.

Which PDOs with which lengths the connected CAN device contains can usually be found in the manual of the respective CANopen slave or can be requested from the manufacturer.

By specifying the PDO number (1..16), the PN/CAN gateway automatically send all the necessary settings for the PDO during startup.

Alternatively, it is also possible to specify a device-specific COB-ID (PDO number must then be '0'). In this case, it is assumed that all PDO settings have already been made in the CAN device in advance. The PN/CAN gateway will then not change the PDO settings during startup.

A maximum of 32 PDOs can be configured per slave, 16 TPDOs and 16 RPDOs.

7   Assign a PROFINET device name to the PN/CAN gateway

When the configuration of the PN/CAN gateway in the PROFINET Engineering Tool is complete, it can be imported into the PLC.

So that the PN/CAN gateway can be found by the PROFINET controller, the PROFINET device name must be assigned to the PN/CAN gateway. To do this, use the "Assign device name" function which you can access with the right mouse button or in the Online menu when the PN/CAN gateway is selected.

Use the "Update list" button to search the network for PROFINET stations. With "Assign Name" the PROFINET device name can be assigned to the device.
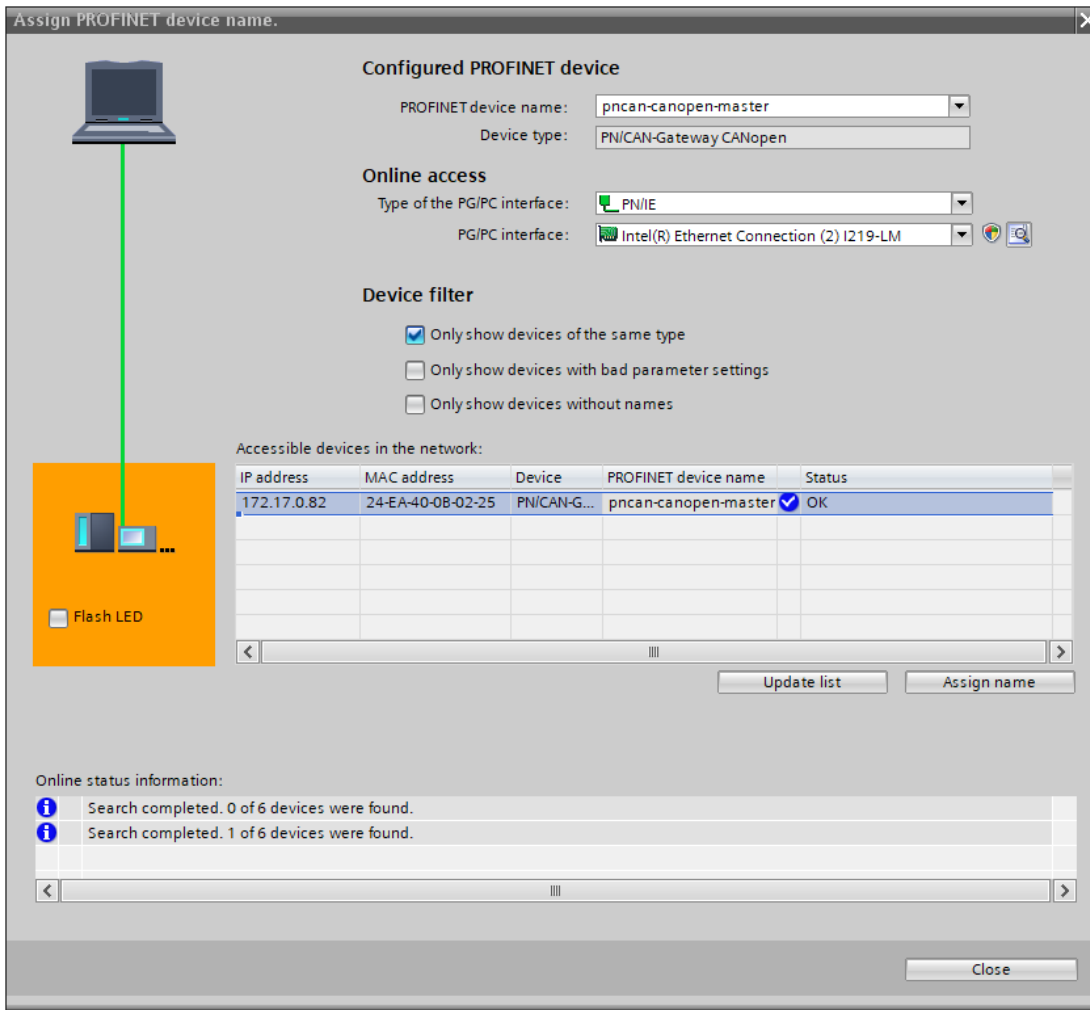
The clear identification of the PN/CAN gateway is ensured here by the MAC address of the device. The MAC address of the device is on the front of the PN/CAN gateway.

If the PN/CAN gateway has been assigned the correct PROFINET device name, it is recognized by the PLC and configured. When the configuration has run correctly, the blue "Mode" LED should blink.

To set the PROFINET name, the Helmholz "IPSet" Tool can also be used, which can be downloaded free of charge from the Helmholz website. Scan the following QR code to download IPSet Tool

8   Programming in the PLC

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

For the startup of the example project, the value 2 must be written in the output word in "Master Control" ("NMT-State Control"). After start-up of the PN/CAN gateway and initialization of the CANopen slave, the gateway also reports a 2 in the 4th byte of the master status ("NMT-State", see below).

The CANopen system is operational, and the I/O data of the slave can be read and written.

8.1   Master Control (2 Bytes Output)

The two master control bytes in the output image of the PLC can be used to control the behavior of the PN/CAN gateway.

Byte/Bit	7	6	5	4	3	2	1	0
Out 0	-	-	-	-	-	-	-	-
Out 1	User reset	activate LSS mode	Clear emergency FIFO error	Send SYNC frame	*reserved*	Clear CAN Rx overflow error	**NMT state control**	

The **NMT-State Control** bits are used to control the state of the CANopen network:

Boot up (0) = The CANopen master has been switched off. No CAN frames are being transmitted or received. If the state was previously Operational (value 2), the CANopen slaves are stopped ("NMT Pre-Operational" or "NMT Stop" depending upon the configuration).

Pre-Operational (1) = If the previous state was 0, all CANopen slaves are initialized. The status 1 is subsequently displayed in the master state. If the previous state was Operational (2) or Stop (3), only an "NMT Pre-Operational" is transmitted.

Operational (2) = If the previous status was 0, all CANopen slaves are initialized and "NMT Operational" subsequently transmitted. The PDO data is only exchanged in status 2. If the previous state was Pre-Operational (1) or Stop (3), only an "NMT Operational" is transmitted.

Stop (3) = An NMT-Stop is transmitted to all slaves.

For more information, please refer to the manual.

8.2 Master Status (4 Bytes Output)

Byte/bit	7	6	5	4	3	2	1	0
In 0	Gateway configured	-	-	-	-	-	-	-
In 1	User reset requested	LSS mode active	Emergency Lost	SYNC transmitted	No CAN connection	CAN RX-FIFO overflow	CAN bus error (Rx/Tx)	CAN bus offline
In 2	-	-	General error bits of the slave errors					
In 3	Master error				0	0	NMT state	

Gateway configured indicates that the PN/CAN gateway has been configured. The bit is also set for an incorrect configuration.

NMT state indicates the current status of the CANopen master. Principally an attempt is made to assume the state called for in the **NMT State Control**. However, this can be prevented by the absence of slaves configured as mandatory (necessary).

BootUp (0) = The master has been switched off. No CAN frames are being transmitted or received.

Pre-Operational (1) = The master is found at the end of the slave configuration; at least all mandatory slaves are initialized and in Pre-Operational.

Operational (2) = The master is in the Operational state; all mandatory slaves are in Operational.

Stop (3) = The master is in the Stop state; all accessible slaves have been brought to the Stop state.

Continuous attempts are made to find missing slaves by reading the SDO 1000. Slaves that have been newly detected at the CAN bus are automatically initialized and switched to the state wished by the **NMT State**.

8.3 CANopen Device Status (3 Bytes Output)

Byte/bit	7	6	5	4	3	2	1	0
In 0	Restart of slave active	Resend RPDOs	CANopen profile false	Slave trans-mitting false TPDO length	Slave not answering	SDO abort	Slave timeout	Incorrect confi-guration
In 1	SDO 1001 value of the slave							
In 2	Configuration error				Stop before operational	Ignore slave	Slave state	

Slave state:

0 = Slave is still in the boot up, not present or cannot be addressed

1 = Slave has been initialized, nodeguarding or heartbeat are running, and it is in the Pre-Operational state

2 = Slave is in Operational state

3 = Slave is in Stop state

8.4 PDO-Data

The PDO data are located as inputs (TPDOs) or as outputs (RPDOs) directly in the process image.

The inputs always show the last received data of the TPDO. If changed values are written to the outputs, then RPDO telegrams are sent to the corresponding CANopen slave.

8.5   SDO Communication

An SDO communication with the slaves can be executed after the initialization phase of the PN/CAN gateway both in the Pre-Operational and in the Operational mode. Only one SDO job can be executed at a time. Both reading and writing of SDOs is possible.

Refer to the manual for details on programming the SDO communication channel of the PN/CAN gateway.

8.6   Emergency messages

Emergency messages from the slaves are always received by the PN/CAN gateway and forwarded to the PLC. The PN/CAN gateway itself does not react actively to the emergency messages.

Details about programming the emergency message channel of the PN/CAN gateway can be found in the manual.

9   LED-based diagnosis

MODE	
Off	No power supply or device defective
Blue on	PN/CAN gateway is correctly configured via PROFINET & all (mandatory) CANopen slaves are in Operational state
Flashing blue	PN/CAN gateway is correctly configured via PROFINET & at least one CANopen slave is in Pre-Operational or Stop state
Red on	No connection with PROFINET controller (PLC)
Flashing red	Connection with the PROFINET controller (PLC) exists, but a configuration error exists
CAN RX	
Flashing green	CAN frame is received without errors
Red	CAN bus error in the recipient or PN/CAN gateway hasn't been configured yet or No connection
CAN TX	
Flashing green	CAN frames are being transmitted
Red	Transmission not possible (e.g. false Baud rate, CAN bus disrupted) or PN/CAN gateway has not yet been configured or No connection
BF/SF	
yellow	MODE flashes red: Configuration error MODE on blue: CAN alarm active
red	PROFINET network error

10 Technical data

Order no.	700-670-PNC01
Name	PN/CAN gateway, PROFINET/CANopen Master
Scope of delivery	PN/CAN gateway with power plug
Dimensions (D x W x H)	35,5 x 83,5 x 76 mm
Weight	Approx. 160 g
PROFINET interface (X1)	
Number	1
Connection	2x RJ45, integrated switch
Transmission rate	100 Mbps full duplex
Protocol	PROFINET IO device as defined in IEC 61158-6-10
I/O image size	max. 1440 bytes input / 1440 bytes output data
Features	PROFINET Conformance Class C, Media redundancy (MRP client), Automatic addressing, Topology detection (LLDP, DCP), Diagnosis alarms
CAN interface	
Number	1
Type	ISO/DIN 11898-2 CAN High-speed physical layer
Connection	9-pin D-sub male connector
Protocol	CANopen master as defined in DSP301 V4.2
Baud rate	10, 50, 100, 125, 250, 500, 800, 1000 kbps
Number of slaves	126
TPDOs/RPDOs per slave	16 / 16
USB interface	
Protocol	Full-speed USB 2.0 device
Connection	USB-C
Electrically isolation	500 V
Power supply	
Operating voltage	24 V DC, 18 ... 30 V DC
Current draw	Max. 150mA
Power dissipation	Max. 4 W
Ambient conditions	
Ambient temperature	0° C to 60° C
Transport and storage temperature	-20° C to 80° C
Relative humidity	95% without condensation
Pollution degree	2
Protection rating	IP 20
Mounting position	As desired
Approvals	CE