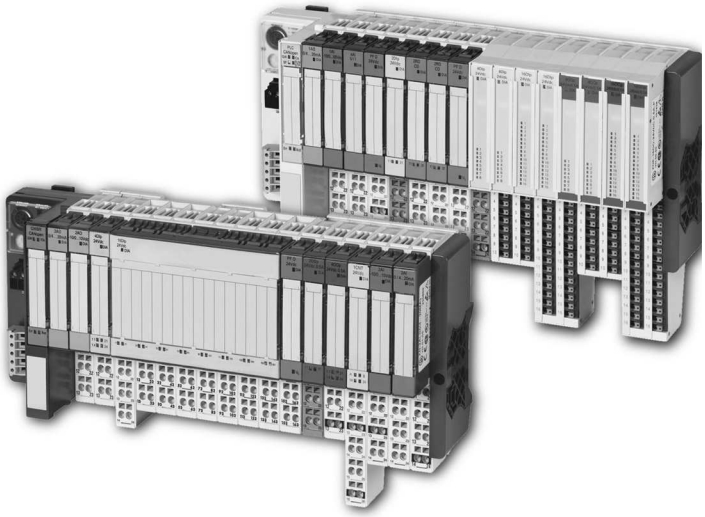
02/2016 MN05002005Z-EN
replaces M001768-03, 11/2007

Gateways for CANopen



Powering Business Worldwide

Manufacturer
Eaton Automation AG
Spinnereistrasse 8-14
CH-9008 St. Gallen
Switzerland
www.eaton-automation.com
www.eaton.com

Support
Region North America
Eaton Corporation
Electrical Sector
1111 Superior Ave.
Cleveland, OH 44114
United States
877-ETN-CARE (877-386-2273)
www.eaton.com

Other regions
Please contact your supplier or send an E-Mail to:
automation@eaton.com

Original manual
The German version of this document is the original manual.

Translations of the original manual
All non-German editions of this document are translations of the original manual.

Editorial department
Monika Jahn

Brand and product names
All brand and product names are trademarks or registered trademarks of the owner concerned.

Copyright
© Eaton Automation AG, CH-9008 St. Gallen

All rights reserved, also for the translation.

None of this document may be reproduced or processed, duplicated or distributed by electronic systems in any form (print, photocopy, microfilm or any other process) without the written permission of Eaton Automation AG, St. Gallen.

Subject to modifications.



Warning!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that the device cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (DIN VDE 0105 Part 100) may work on this device.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or tothe potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference do not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC/HD 60364-4-41 (DIN VDE 0100 Part 410).
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause uncontrolled operation or restart.
- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

- The electrical installation must be carried out in accordance with the relevant regulations (e.g. with regard to cable cross sections, fuses, PE).
- All work relating to transport, installation, commissioning and maintenance must only be carried out by qualified personnel. (IEC/HD 60364 (DIN VDE 0100) and national work safety regulations).

Table of contents

Table of contents 5

1 XI/ON gateways for CANopen. 9
Function 9
Versions 10

2 XN standard gateways 11
Gateway XN-GW-CANopen. 11
Gateway XN-GWBR-CANopen 12
Technical data 13
– Structure of a XN standard gateway 13
– Technical data for the XN station 13
– Technical data for the terminals of XN standard gateways and base modules 17
– Technical data for XN-GW-CANopen 18
– Technical data for XN-GWBR-CANopen 20
Connections at XN-GW-CANopen. 22
– Field bus termination via SUB-D sockets 22
– Field bus connection through direct wiring 24
Connections at XN-GWBR-CANopen 27
– Power supply 27
– Field bus connection via open style connector 28
Service interface connection 31
– Connection with XI/ON cable 31
Setting the bit transfer rate via DIP switches 33
Node-ID setting 35
Acceptance of the XI/ON configuration 38
Diagnostics LED indications 40

3 XNE ECO gateway 45
Gateway XNE-GWBR-CANopen 45
Technical data 46
– Structure of a XNE ECO gateway 46
– Technical data for the XNE station 46
– Approvals and tests for a XI/ON station 50

– Technical Data for the Push-in tension clamp terminals 51
Connections at XNE-GWBR-CANopen 52
– Voltage Supply 52
– Field bus connection via Push-in tension clamp terminals 53
Service interface connection 54
– Connection with XI/ON cable 54
Setting the Node-ID 56
Setting the bit rate 58
Activating the bus terminating resistor 59
Acceptance of the XI/ON station configuration 60
Diagnostic messages via LEDs 61
Maximum station extension 64

4 Communication in CANopen 67
General 67
Communication 68
– Types of telegram messages (Communication Objects) 69
XI/ON and CANopen 71
Electronic data sheet – EDS file 72
Setting up communication 73
– Minimum Boot-up 73
– Identifier for the standard objects 77
– Setting up Node Guarding protocol 80
XI/ON emergency messages 83
– Boot-up message 89
Parameterization by means of Service Data Objects (SDO) 91
– Read (Read from Object Dictionary) 92
– Write (Write to Object Dictionary) 93
– Commanded parameter storing / restoring 95
Transmission of Process Data Objects (PDO) 96
– Communication parameter COB-ID 96
– Transmission Type 97
– Inhibit Time 98
– Event Time 99
– Available PDOs 99
– Mapping of objects in PDOs 100

– Default PDOs and PDO mappings 101
– Mappable objects 107
– Procedure for altering PDO mappings 109

5 Object dictionary for XI/ON in CANopen. 111
Overview of all objects 111
Object overview of the communication profile 116
Information about the XI/ON station. 120
– Object 1000hex Device Type 120
– Object 1008hex Device Name 120
– Object 1009hex Manufacturer Hardware Version 121
– Object 100Ahex Manufacturer Software Version 122
– Object 1018hex Identity Object 123
– Object 1020hex Verify Configuration. 126
– Object 1027hex Module List 128
Error Register. 129
– Object 1001hex Error Register 129
Monitoring of operational readiness. 130
– Object 100Chex Guard Time 130
– Object 100Dhex Life Time Factor. 131
– Object 1016hex Consumer Heartbeat Time. 132
– Object 1017hex Producer Heartbeat Time. 134
"Store/Load Parameters" commands 135
– Object 1010hex Store Parameters 137
– Object 1011hex Restore Default Parameters 138
Identifiers of Synchronization and Emergency 139
– Object 1005hex Sync COB-ID 139
– Object 1014hex Emcy COB-ID 140
Transfer of service data. 142
– Objects 1200hex to 1203hex
Server SDO Parameters 142
Transfer of process output data 144
– Objects 1400hex to 141Fhex
Receive PDO Parameters 145
– Objects 1600hex to 161Fhex
Receive PDO Mapping Parameters 149
Transfer of process input data. 153
– Objects 1800hex to 181Fhex
Transmit PDO Parameters 154

– Objects 1A00hex to 1A1Fhex
Transmit PDO Mapping Parameters 159
Network management 163
– Object 1F80hex NMT Startup 163
– Object 1F81hex Slave Assignment 165
– Object 1F82hex Request NMT 167
– Object 1F83hex Request Guarding 169
Manufacturer-specific objects 170
– Object 2000hex Serial Number 171
– Object 2010hex Behaviour Modifiers 171
– Object 2400hex System Voltages 175
Diagnostic messages 176
– Diagnostics messages via software 176
Maximum topology 180
– Maximum system configuration
of a CANopen bus line 180
– Maximum bus length 183
Mixed operation with other types of station 184

6 Coupling with automation equipment 185
Commissioning the XI/ON station with MXpro 185
– Connection of programming PC, PLC and
CAN-XI/ON station 185
– Starting MXpro and creating a new project 185
– Integrating the CAN master 186
– Integrating the CAN slave 190
– Integrating the libraries
for CANopen communication 197

Index 199

1 XI/ON gateways for CANopen

Function

XI/ON gateways for CANopen enable the operation of XI/ON modules in a CANopen structure. The gateway is the link between the field bus neutral XI/ON modules and the other CANopen nodes. It handles the entire process data traffic between the I/O level and the field bus, and generates the necessary diagnostics data. A service interface is used to provide information for the I/Oassistant software.

Versions

The gateways for the CANopen field bus system are available in the following versions:

XN-GW-CANopen:



XN-GWBR-CANopen:



XNE-GWBR-CANopen:



Figure 1: Versions of the gateways for CANopen

- XN-GW-CANopen:
  XN standard gateway without integrated power supply module.
- XN-GWBR-CANopen:
  XN standard gateway with integrated power supply module.
- XNE-GWBR-CANopen:
  XNE ECO gateway with integrated power supply module.

→ The XN-GW-CANopen gateway does not have an internal power supply module!

- Install a bus refreshing module with the corresponding base module as the first module after the gateway!
- XI/ON stations with XN-GW-CANopen can only be combined with XN standard modules.

2 XN standard gateways

Gateway XN-GW-CANopen

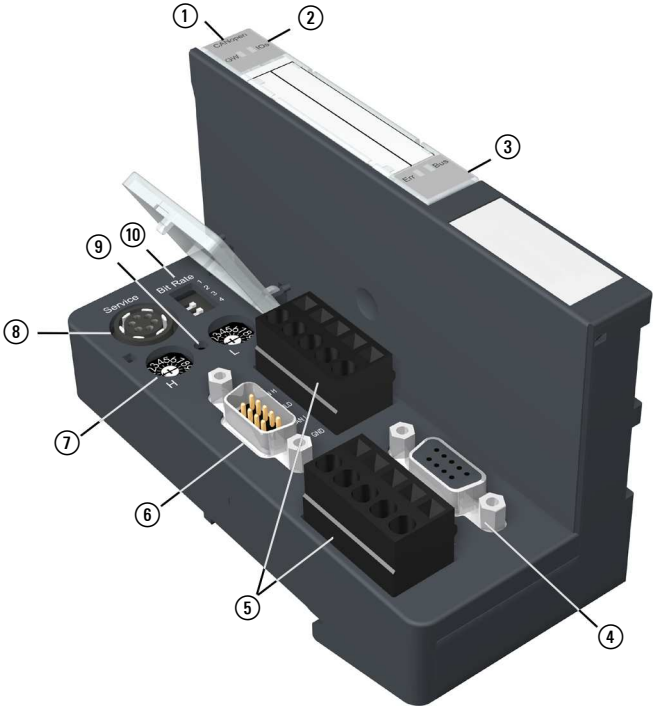


Figure 2: XN-GW-CANopen

1. Type designation
2. LEDs for XI/ON station
3. LEDs for CANopen
4. CANopen, SUB-D socket
5. CANopen, direct wiring (tension spring connector)
6. CANopen, SUB-D plug
7. Rotary hex encoding switch for the Node-ID
8. Service interface
9. Configuration button to accept the present station configuration
10. DIP switch to set the transfer rate

Gateway
XN-GWBR-CANopen

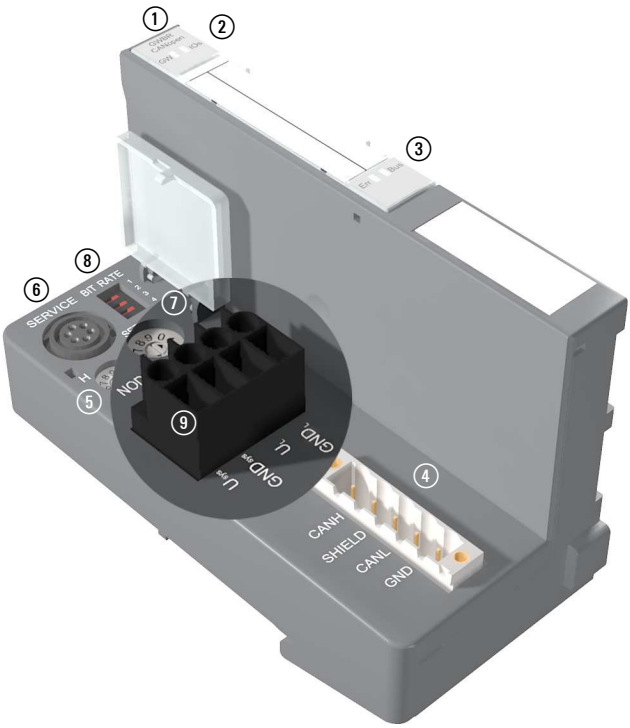


Figure 3: XN-GWBR-CANopen

① Type designation
② LEDs for XI/ON station
③ LEDs for CANopen
④ Open style connector (5-pole / supplied with matching plug, → Figure 9 Page 28)
⑤ Rotary decimal encoding switch for the Node-ID
⑥ Service interface
⑦ Configuration button to accept the present station configuration
⑧ DIP switch to set the transfer rate
⑨ Screw terminals for field supply and system supply voltage

Technical data

Structure of a XN standard gateway

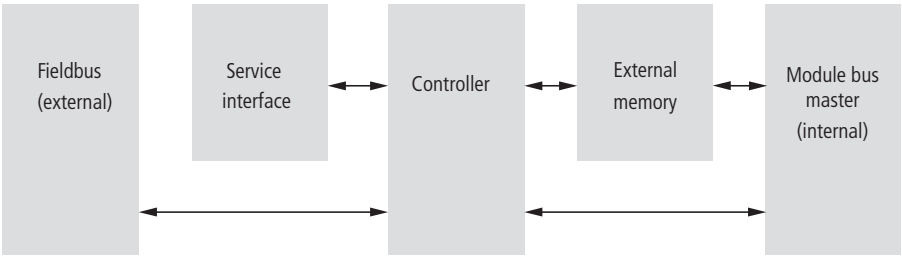


Figure 4: Gateway structure

Technical data for the XN station

Attention!
The auxiliary supply must meet the requirements for SELV (= Safety Extra Low Voltage) according to IEC 60364-4-41.

Table 1: Technical data for the XN station

Designation	Value
Supply voltage/auxiliary supply	
Nominal value (provided for other modules)	24 V DC
Residual ripple	according to IEC/EN 61131-2
Electrical isolation (U_L to U_{SYS} / U_L to field bus / U_{SYS} to field bus)	yes, via optocoupler
Environment/temperature	
Operating temperature, mounted horizontally	0 to +55 °C
Operating temperature, mounted vertically	0 to +55 °C
Storage temperature	-25 to +85 °C
Relative humidity according to IEC/EN 60068-2-30	5 to 95 % (indoor), Level RH-2, Non-condensing (storage at 45 °C, no functional test)

Designation	Value
Corrosive gases	
SO_2	10 ppm (rel. humidity < 75 %, no condensation)
H_2S	1.0 ppm (rel. humidity < 75 %, no condensation)
Vibration resistance	
10 to 57 Hz, constant amplitude 0.075 mm, 1 g	yes
57 to 150 Hz, constant acceleration 1 g	yes
Vibration type	Variable frequency runs at a rate of change of 1 octave/min
Vibration duration	20 variable frequency runs per coordinate axis
Shock resistance according to IEC/EN 60068-2-27	18 shocks half-sine 15 g peak value/11 ms, for both ± directions per spatial coordinate
Repeated shock resistance according to IEC/EN 60068-2-29	1000 shocks, half sine 25 g peak value/6 ms, for both ± directions per spatial coordinate
Drop and topple	
Fall height (weight < 10 kg)	1.0 m
Fall height (weight 10 to 40 kg)	0.5 m
Test runs	7
Instrument with packaging, electronics boards electrically tested	
Electromagnetic compatibility (EMC) according to IEC/EN 61000-6-2 (industrial)	
Static electricity according to IEC/EN 61000-4-2	
Air discharge (direct)	8 kV
Relay discharge (indirect)	4 kV

Designation	Value
Electromagnetic HF fields according to IEC/EN 61000-4-3	10 V/m
Conducted interference, induced by HF fields according to IEC/EN 61000-4-6	10 V
Fast transients (burst) according to IEC/EN 61000-4-4	1 kV / 2 kV
Radiated interference according to IEC/EN 61000-6-4 (industrial)	according to IEC/CISPR 11 / EN 55011, Class A[1)]

1) The use in residential areas may lead to functional errors. Additional suppression measures are necessary!

Table 2: Approvals and tests for a XI/ON station

Designation	Value
Approvals[1)]	CE, cULus
Tests (IEC/EN 61131-2)	
Cold	IEC/EN 60068-2-1
Dry heat	IEC/EN 60068-2-2
Damp heat, cyclical	IEC/EN 60068-2-30
Temperature changes	IEC/EN 60068-2-14
Operating life MTBF	120 000 h[2)]
Removal/insertion cycles for electronics modules	20
Pollution level according to IEC/EN 60664 (IEC/EN 61131-2)	2
Degree of protection according to IEC/EN 60529	IP 20

1) The approvals of newer XI/ON modules can still be pending
2) The lifespan of the relay module is not stated in hours. The number of operating cycles is relevant for the lifespan.

Technical data for the terminals of XN standard gateways and base modules

Table 3: Technical data for the terminals of XN standard gateways and base modules

Designation	Value
Measurement data	according to VDE 0611 Part 1/8.92 / IEC/EN 60947-7-1
TOP connection technology	Tension clamp or screw connection
Protection class	IP20
Insulation stripping length	8.0 to 9.0 mm / 0.32 to 0.36 inch
Max. wire range	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$ / AWG 24 to AWG 14
Crimpable wire	
"e" solid core H 07V-U	0.5 to 2.5 mm^2 / 0.0008 to 0.0039 $inch^2$
"f" flexible core H 07V-K	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$
"f" with ferrules according to DIN 46228-1 (ferrules crimped gas-tight)	0.5 to 1.5 mm^2 / 0.0008 to 0.0023 $inch^2$
Test finger according to IEC/EN 60947-1	A1

Technical data for XN-GW-CANopen

Table 4: Technical data XN-GW-CANopen

Designation	Value
Maximum system extension	74 modules (XN) in slice design or max. length of station: 1 m
Supply voltage (to IEC/EN 61131-2)	
Nominal value (supply via bus refreshing module)	5 V DC (4.8 to 5.2 V DC)
Restriction on IEC/EN 61131-2	The supply energy required to bridge a supply interruption up to 10 ms is not stored. Please protect the U_{SYS} for XN-BR-24VDC-D modules by using an appropriate power supply unit!
Current consumption from module bus I_{MB}	
Without service/without field bus	~ 280 mA
Without service/with field bus (12 Mbit/s)	~ 410 mA
With service/without field bus	~ 300 mA
Maximum	~ 350 mA
Dimensions	
Width/Length/Height (mm)	50.6 x 114.8 x 74.4 mm
Service	
Connections	PS/2 socket
Field bus connections	1 x 9-pole SUB-D sockets, 1 x 9-pole SUB-D plug, 2 x tension spring connector type LPZF, 5.08, 5-pole
Field bus shield connection	via SCH-1-WINBLOC
Transfer rate	10, 20, 50, 125, 250, 500, 800 and 1000 Kbit/s

Designation	Value
Field bus termination	SUB-D plug
Address setting	Via 2 rotary hex encoder switches adjustable addresses (Node-IDs): 1 to 127

Technical data for XN-GWBR-CANopen

Table 5: Technical data for XN-GWBR-CANopen

Designation	Value
Maximum system extension	74 modules (XN, XNE) in slice design or max. length of station: 1 m
Supply	
Field supply	
U_L nominal value (range)	24 V DC (18 to 30 V DC)
I_L max. field current	10 A
Insulation voltage (U_L to U_{SYS} / U_L to field bus / U_L to FE)	500 V_{rms}
Connections	2-pole screw terminal
System supply	
U_{SYS} nominal value (range)	24 V DC (18 to 30 V DC)
I_{SYS} (with I_{MB} = 1.2 A/U_{SYS} = 18 V DC)	max. 900 mA
I_{MB} (supply to the module bus participants)	1.2 A
Insulation voltage (U_{SYS} to U_L / U_{SYS} to field bus / U_{SYS} to FE)	500 V_{rms}
Connections	2-pole screw terminal
Physical interfaces	
Field bus	
Transfer rate	10 Kbit/s to 1 Mbit/s
Insulation voltage (field bus to U_{SYS} / field bus to U_L / field bus to FE)	500 V_{rms}
Field bus connections	Socket : MSTBV 2,5/5-GF-5.08 GY AU / Phoenix Contact
	Plug: TMSTBP 2,5/5-STF-5.08 AB GY AU / Phoenix Contact (included in delivery)
Field bus shield connection	via plug

Designation	Value
Address setting	via 2 rotary decimal encoding switches adjustable addresses (Node-IDs): 1 to 99
Service	
Connections	PS/2 socket
Logic interfaces	→ Chapter "Parameterization by means of Service Data Objects (SDO)", Page 91 → Chapter "Diagnostic messages", Page 176

Connections at XN-GW-CANopen

Field bus termination via SUB-D sockets

SUB-D connectors are provided for communication with the XN-GW-CANopen gateway through the CANopen field bus.

The passive bus termination must be connected externally if the XI/ON gateway is the first or last station in the bus structure. This external connection can be implemented either through separate termination resistors or through a special SUB-D plug with an integrated bus termination.

The pin assignments for the plug and socket are identical – the socket is shown as an example:

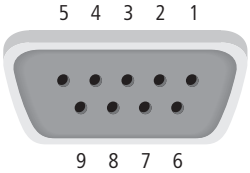


Figure 5: SUB-D socket on the gateway (top view)

Table 6: Pin assignment for gateway SUB-D plug/socket

Pin No.	Designation	Meaning
1	not used	
2	CAN_L	inverted data signal (dominant low)
3	CAN_GND	ground (optional for the CAN data signals)
4	not used	
5	(CAN_SHLD)[1)]	
6	(GND)	
7	CAN_H	non-inverted data signal (dominant high)
8	not used	
9	(CAN_V+)	

1) The shielding of the field bus is connected through the metal housing of the SUB-D plug and the contact with the mounting rails. → "Attention!", page 26.

Field bus connection through direct wiring

For making connections to the field bus you can choose between a SUB-D connection and direct wiring. Direct wiring of the XN-GW-CANopen to the CANopen field bus can be made through the two terminal blocks with tension spring connectors.

The passive bus termination must be connected externally if the XI/ON gateway is the first or last station in the bus structure.



Figure 6: XN-GW-CANopen gateway – direct wiring

Table 7: List of connecting leads for direct wiring

Designation	Meaning
CAN_L	inverted data signal (dominant low)
GND	Ground (optional)
SHLD	Shielding (→ "Attention!", page 25)
CAN_H	non-inverted data signal (dominant high)

Attention!

If the gateway is wired up directly, then the bus connection must be shielded (e.g. with the help of a SCH-1-WINBLOC clamp).

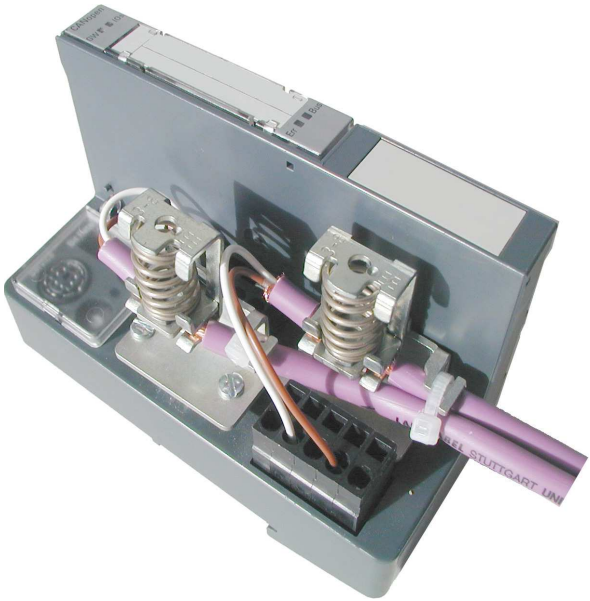


Figure 7: Shielding connection for an XN-GW-CANopen



Attention!

No compensating current should flow through the shielding.To achieve this, a reliable system of equipotential bonding must be installed.

→ Equipotential bonding impedance ≦ 1/10 shielding impedance

Connections at XN-GWBR-CANopen

Power supply

Gateways with integrated power supply module include additional terminals for connecting the:

- field supply voltage (U_L, GND_L) and
- system supply voltage (U_{SYS}, GND_{SYS})



Figure 8: Terminals for the power supply of the XN-GWBR-CANopen

Gateways without integrated power supply module must be supplied from a neighboring power supply module (XN-BR-24VDC-D)!

Field bus connection via open style connector

An open style connector (5-pole) is available for connecting the XN-GWBR-CANopen to the CANopen field bus.

The passive bus termination must be connected externally if the XI/ON gateway is the first or last station in the bus structure.

Table 8: Pin assignment for the DeviceNet socket

No. - Color	Designation	Meaning
1,2 - red		
3,4 - white	CAN H	non-inverted data signal (dominant high)
5,6 - gray	SHIELD	Shield braid, not isolated
7,8 - blue	CAN L	inverted data signal (dominant low)
9,10 - black	GND	Ground (optional)

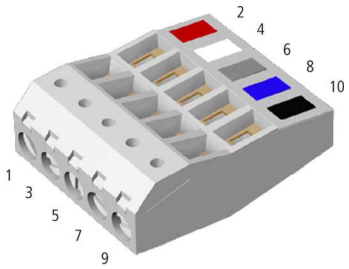


Figure 9: Open style connector (female / top)

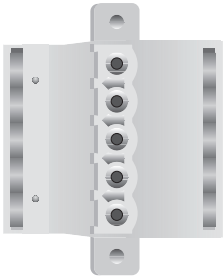


Figure 10: Open style connector (female / bottom)

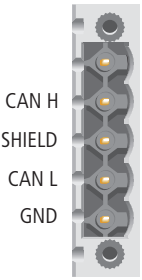


Figure 11: Open style connector (male)

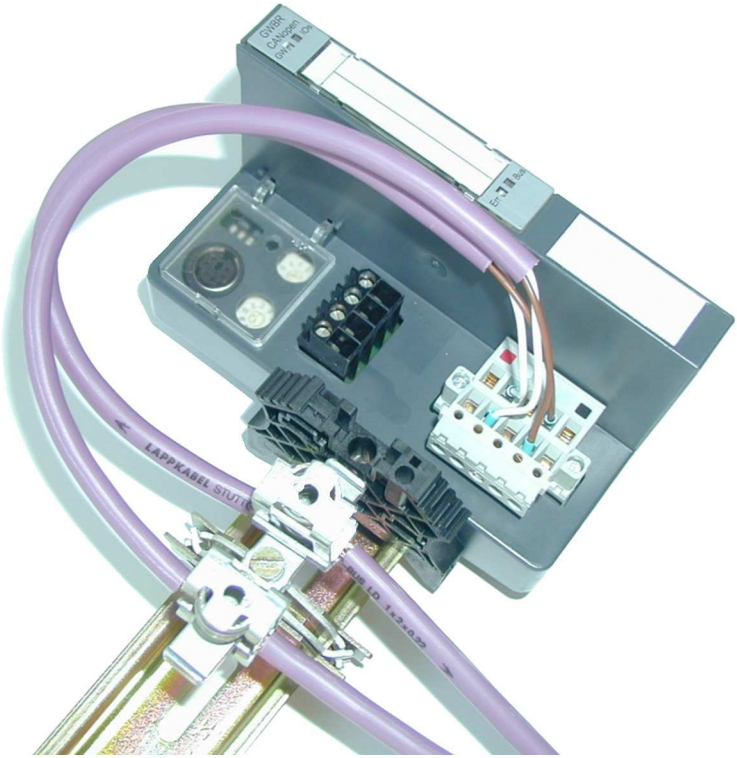


Figure 12: Shielding connection for an XN-GWBR-CANopen

Attention!
No compensating current should flow through the shielding.
To achieve this, a reliable system of equipotential bonding must be installed.

Service interface connection

In order to be able to use the service interface of the gateway to connect to a PC with the "I/O assistant" (engineering and diagnostics software), you will have to use a cable with pin assignments that are different from the PS2 standard:

- XI/ON connection cable (XN-PS2-CABLE)

Attention!
Standard commercial cables will have to be rewired!

Connection with XI/ON cable

The XI/ON cable is fitted with a PS/2 plug (connection to the socket on the gateway) and a SUB-D socket (connection to the plug on the PC).

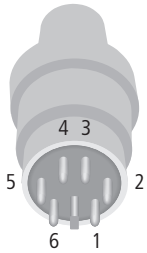


Figure 13: PS/2 plug on connecting cable to the gateway (top view)

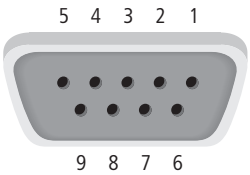


Figure 14: 9-pole SUB-D socket on connecting cable to PC (top view)

Table 9: Pin assignment for PS/2 and SUB-D interfaces

Pin	XI/ON gateway PS/2 socket	Sub-D interface on PC	Pin
1	+5V Gw	DTR, DSR	4, 6
2	GND	GND	5
3	–	–	–
4	TxD	RxD	2
5	/CtrlMode	RTS	7
6	RxD	TxD	3

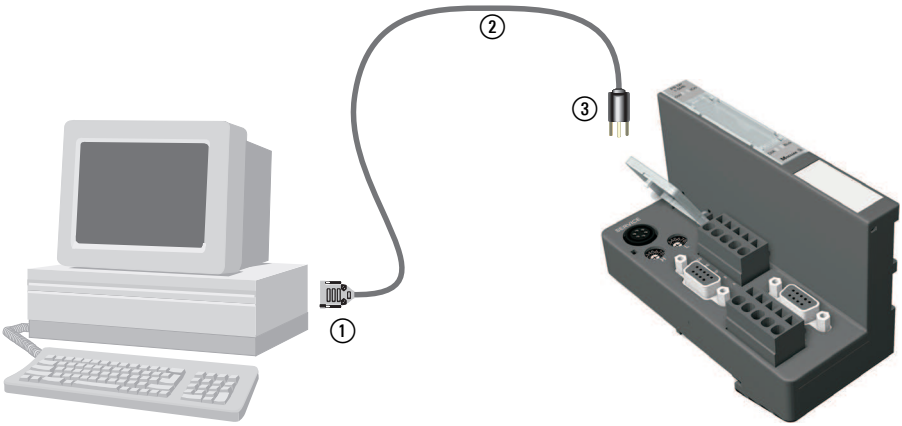


Figure 15: Connection between PC and XI/ON gateway via the XI/ON connecting cable

① SUB-D socket
② XI/ON connection cable
③ PS/2 plug

Setting the bit transfer rate via DIP switches

The XN standard gateway can communicate with other CANopen nodes at the following transfer rates:

- 10 Kbit/s
- 20 Kbit/s
- 50 Kbit/s
- 125 Kbit/s
- 250 Kbit/s
- 500 Kbit/s
- 800 Kbit/s
- 1000 Kbit/s

The default transfer rate is 125 Kbit/s.
The transfer rate can be set by the DIP switches under the cover of the XI/ON gateway.

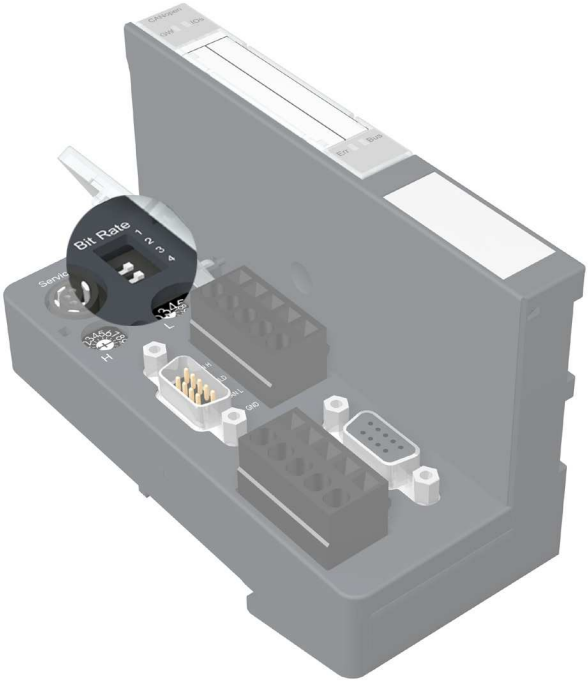


Figure 16: DIP switches to set the transfer rate

→ All the nodes in a CANopen network must be set to the same transfer rate.

To set a bit transfer rate that is supported by CANopen, proceed as follows:

▶Switch off the supply voltage for the XI/ON gateway.

▶Set the DIP switches for the required transfer rate according to the following table:

Table 10: Setting the transfer rate

Bit transfer rate (Kbit/s)	DIP switches (position)			
	1	2	3	4
1 000	0	0	0	0
800	1	0	0	0
500	0	1	0	0
250	1	1	0	0
125	0	0	1	0
50	1	0	1	0
20	0	1	1	0
10	1	1	1	0
reserved	x	x	x	1

→ The DIP switches are in the "1" position when they are set to the right, as viewed from the front.

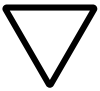
▶Switch on the supply voltage for the gateway again.

Node-ID setting

A Node-ID is assigned to every XN standard gateway in the CANopen structure.

The setting for the Node-ID of the XN-GW-CANopen in a CANopen structure is made using the two rotary hex encoding switches. The setting for the Node-ID of the XN-GWBR-CANopen in a CANopen structure is made using the two rotary decimal encoding switches. The switches can be found beneath a cover, below the service interface.

The XI/ON gateway can be used as a CANopen node at any position in the bus structure.



Attention!
If the XI/ON gateway is used as the first or last node in the bus communication, then a special bus connector with an integrated or switchable termination resistor is absolutely necessary!



Figure 17: Rotary hex encoding switch for addressing setting of the XN-GW-CANopen

Attention!
A maximum of 127 Node-IDs (1 to 127) can be assigned. Each Node-ID can only be assigned once in the complete bus structure.

The Node-ID 000 must not be assigned. It is reserved for telegrams that are directed to all the other bus nodes.

The rotary encoding switches are marked with H for High (more significant digit) and L for Low (less significant digit).

XN-GW-CANopen:
The L switch is used to set L × 16^0 (L = 0 to F).
The H switch is used to set L × 16^1 (H = 0 to F).

XN-GWBR-CANopen:
The L switch is used to set L × 10^0 (L = 0 to 9).
The H switch is used to set L × 10^1 (H = 0 to 9).

→ The NODE-ID switch on the XN-GWBR-CANopen can be used to assign Node-IDs from 1 to 99!

→ After setting the Node-ID, the protective cover over the switches must be closed again.

→ Chapter "Maximum system configuration of a CANopen bus line", Page 180.

→ XI/ON does not support the assignment of Node-IDs across the bus network.

Acceptance of the XI/ON configuration

When a new configuration of the XI/ON station is made or the existing station structure ("Module list") is altered, the current configuration must be accepted in the CANopen image of the XI/ON gateway. This is done using the configuration button located between the two rotary encoding switches.

→ The green IOs LED indicates that the current XI/ON configuration matches the stored reference module list.

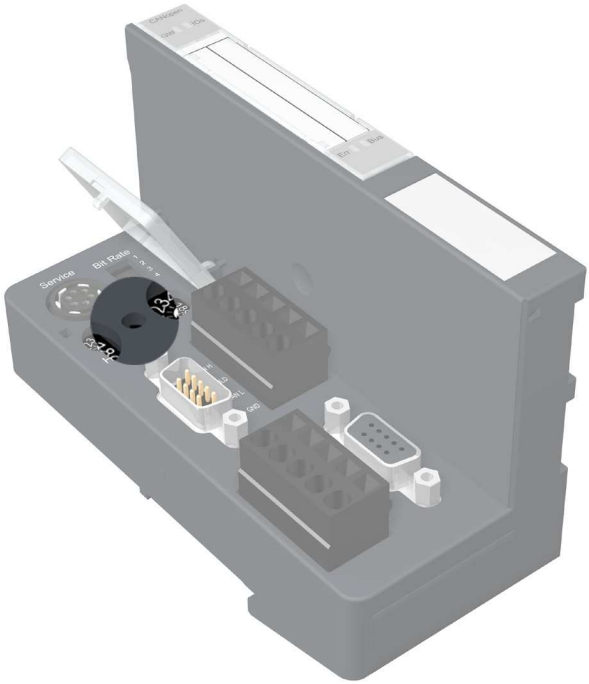
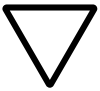


Figure 18: Configuration button to accept the XI/ON configuration ("Module list")

Pressing the button with a pointed object for at least 2 seconds retentively stores the current station configuration. A hardware reset will then be carried out automatically. With this reset, all the CANopen parameters will be restored to their default values, if the newly saved configuration is different to the old one.



Attention!
When the XI/ON configuration is saved, all the CANopen objects must be parameterized again, if their parameter values differ from the default values. The complete parameterization of the station must then be reloaded into the XI/ON station.

The actuation of the button is indicated by a rapid (4 Hz) green flashing of the "IOs" LED. After 2 seconds, the LED changes to yellow flashing at 4 Hz, thus indicating that the station configuration is being saved. When the storage procedure is completed, the LED changes to a continuous green light.

Diagnostics LED indications

Each XI/ON gateway is fitted with the following LEDs for status indication:

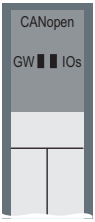
- 2 LEDs for module bus communication (module bus LEDs): **GW** and **IOs**
- 2 LEDs CANopen communication (field bus LEDs): **Err** and **Bus**

The LED diagnostics shown below apply to both gateway versions:

- XN-GW-CANopen
- XN-GWBR-CANopen

An additional diagnostics indication is shown for the XN-GWBR-CANopen via the LED **GW**.

Table 11: LEDs

LED	Status	Meaning	Remedy
GW 	Green	5 V DC operating voltage present firmware active; gateway ready for operation and transfer	–
	green flashing, 4 Hz	Firmware active, gateway hardware faulty	Replace the gateway.
GW & IOs	GW: green flashing, 1 Hz IOs: red	Firmware not active	Reload firmware!
Additional diagnostics indication for XN-GWBR-CANopen			
GW	green flashing, 1 Hz	U_{SYS}: Undervoltage or overvoltage U_L: Undervoltage	Check that the supply voltage is within the permissible range. → Chapter "Technical data for XN-GWBR-CANopen", Page 20.

LED	Status	Meaning	Remedy
IOs	green	Configured arrangement of the module stations matches the actual configuration; communication active.	–
	green flashing, 1 Hz	Station is in Force Mode of I/O**assistant**.	Deactivate Force Mode of I/O**assistant**
	red and GW LED is OFF	Controller is not for operation, or the U_{SYS} level is not within the required limits.	Test the bus refreshing module on the right of the gateway and its wiring. If the applied supply voltage is correct, please contact your Eaton partner.
	red	Module bus not ready for operation	Check that the individual XI/ON modules are properly installed
	red flashing, 1 Hz	There is a non-adaptable alteration of the actual arrangement of the module bus stations	Compare the configuration of your XI/ON station with the actual arrangement. Test the implementation of your XI/ON station for faulty or incorrectly inserted electronics modules.
	red/green flashing, 1 Hz	There is an adaptable alteration of the actual arrangement of the module bus stations	Check the XI/ON station for missing or new, unconfigured modules.
	red flashing, 4 Hz	No communication via the module bus	Check that the rules for the application of power supply modules have been observed.

LED	Status	Meaning	Remedy
Err 	OFF	No errors in communication between the XI/ON-CANopen gateway and other CANopen nodes	–
	red	Faulty or interrupted communication between the XI/ON-CANopen gateway and other CANopen nodes Possible causes: • CAN-BusOff • Heartbeat error • Guarding error • Transmit timeout	• Check that the field bus ends with a termination resistor if the XI/ON-CANopen gateway is the last node in the bus topology. • Check the seating of the CANopen bus connector (or the joints in the case of direct wiring). All connections must be correct and properly seated. • Check the CANopen cable for possible damage, and for correct connections. • Check that the correct bit rate has been set. • Check that the NMT master is still functioning properly.

LED	Status	Meaning	Remedy
Bus	OFF	Field bus not operating	• Wait until the firmware download is finished. • If the download is finished: hardware error; replace the gateway.
	red	NMT slave state of the XI/ON-CANopen gateway is "Stopped"	–
	orange	NMT slave state of the XI/ON-CANopen gateway is "Pre-Operational"	–
	green	NMT slave state of the XI/ON-CANopen gateway is "Operational"	–
ERR & Bus	red flashing alternately, 4 Hz	Invalid Node-ID has been set	Set the correct Node-ID with the rotary hex or decimal encoding switches.

3 XNE ECO gateway

Gateway XNE-GWBR-CANopen

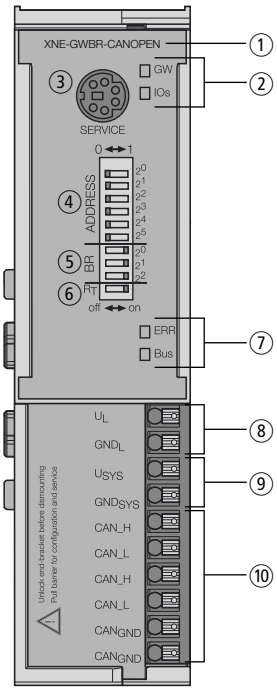


Figure 19: XNE-GWBR-CANopen

1. Type designation
2. LEDs for XI/ON station
3. Service interface
4. DIP switch for the Node-ID
5. DIP switch for the bit rate
6. DIP switch for the terminating resistor
7. LEDs for CANopen
8. Push-in tension clamp terminals for field supply
9. Push-in tension clamp terminals for system supply
10. Push-in tension clamp terminals for CANopen

Technical data

Structure of a XNE ECO gateway

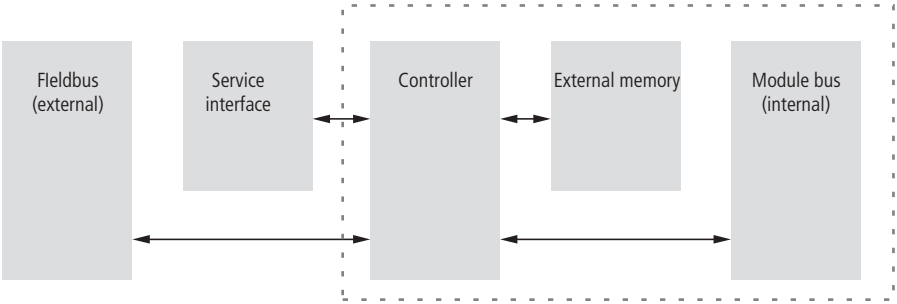


Figure 20: Structure of a XNE-GWBR-CANopen

Technical data for the XNE station

Attention!
The auxiliary supply must meet the requirements for SELV (= Safety Extra Low Voltage) according to IEC 60364-4-41.

Table 12: Technical data for the XNE station

Designation	Value
Maximum system extension	2–62 modules (XN, XNE) in slice design or max. length of station: 1 m
Supply voltage/ auxiliary voltage	
Field supply	
U_L nominal value (range)	24 V DC (18 to 30 V DC)
I_L max. field current	10 A
Insulation voltage (U_L to U_{SYS} / U_L to field bus / U_L to FE)	500 V_{rms}
System supply	
U_{SYS} nominal value (range)	24 V DC (18 to 30 V DC)

Designation	Value
I_{SYS} (at maximum station extension → Chapter "Maximum station extension", Page 64)	max. 500 mA
I_{MB} (supply to the moudle bus participants)	700 mA
Insulation voltage (U_{SYS} to U_L / U_{SYS} to field bus / U_{SYS} to FE)	500 V_{rms}
Residual ripple	according to IEC/EN 61131-2
Voltage anomalies	according to IEC/EN 61131-2
Connection technology	Push-in tension clamp terminals
Physical interfaces	
Field bus	
Protocol	CANopen
Transmission rate	20 kBit/s to 1 Mbit/s
Insulation voltage (field bus to U_{SYS} / field bus to U_L / field bus to FE)	500 V_{rms}
Field bus connection	Push-in tension clamp terminals
Address setting	Via DIP-switches adjustable addresses (Node-IDs): 1 to 63
Service interface	
Connection	RS232 at PS2/ mini DIN female connector
Ambient conditions	
Ambient temperature	
$t_{Ambient}$	0 to +55 °C / 32 to 131 °F
t_{Store}	-25 to +85 °C / 13 to 185 °F
Relative humidity according to IEC/EN 60068-2-30	5 to 95 % (indoor), Level RH-2, no condensation (storage at 45 °C, no function test)
Climatic tests	according to IEC/EN 61131-2

Designation	Value
Resistance to vibration	
10 to 57 Hz, constant amplitude 0.075 mm / 0.003 inch, 1g	Yes
57 to 150 Hz, constant acceleration 1 g	Yes
Mode of vibration	Frequency sweeps with a change in speed of 1 Octave/min
Period of oscillation	20 frequency sweeps per axis of coordinate
Shock resistant according to IEC/EN 60068-2-27	18 shocks, sinusoidal half-wave 15 g peak value/11 ms, in each case in ± direction per space coordinate
Resistance to repetitive shock according to IEC/EN 60068-2-29	1 000 shocks, half-sinus 25 g peak value/6 ms, in each case in ± direction per space coordinate
Drop and topple	
Height of fall (weight < 10 kg)	1.0 m
Height of fall (weight 10 to 40 kg)	0.5 m
Test runs	7
Device with packaging, electrically tested printed-circuit board.	Yes
Electromagnetic compatibility (EMC) according to IEC/EN 61000-6-2 (Industry)	
Static electricity according to IEC/EN 61000-4-2	
Discharge through air (direct)	8 kV
Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to IEC/EN 61000-4-3	10 V/m
Conducted interferences induced by HF fields according to IEC/EN 61000-4-6	10 V

Designation	Value
Fast transients (Burst) according to IEC/EN 61000-4-4	
Emitted interference according to IEC/EN 61000-6-4 (Industry)	according to IEC/CISPR 11 / EN 55011 Class A [1)]

1) This device can cause radio disturbances in residential areas. Additional measures to suppress the disturbance are necessary.

Approvals and tests for a XI/ON station

Table 13: Approvals and tests for a XI/ON station

Designation	Value
Approvals[1]	CE, cULus
Tests (IEC/EN 61131-2)	
Cold	IEC/EN 60068-2-1
Dry heat	IEC/EN 60068-2-2
Damp heat, cyclical	IEC/EN 60068-2-30
Temperature changes	IEC/EN 60068-2-14
Operating life MTBF	120 000 h[2]
Removal/insertion cycles for electronics modules	20
Pollution level according to IEC/EN 60664 (IEC/EN 61131-2)	2
Degree of protection according to IEC/EN 60529	IP 20

1) The approvals of newer XI/ON modules can still be pending
2) The lifespan of the relay module is not stated in hours. The number of operating cycles is relevant for the lifespan.

Technical Data for the Push-in tension clamp terminals

Table 14: Technical data for the Push-in tension clamp terminals

Designation	Value
Measurement data	according to VDE 0611 Part 1/8.92 / IEC/EN 60947-7-1
Protection class	IP20
Insulation stripping length	8.0 to 9.0 mm / 0.32 to 0.36 inch
Max. wire range	0.14 to 1.5 mm^2 / 0.0002 to 0.0023 $inch^2$ / AWG 24 to AWG 16
Crimpable wire	
"e" solid core H 07V-U	0.25 to 1.5 mm^2 / 0.0004 to 0.0023 $inch^2$
"f" flexible core H 07V-K	0.25 to 1.5 mm^2 / 0.0004 to 0.0023 $inch^2$
"f" with ferrules **without** plastic collar according to DIN 46228-1 (ferrules crimped gas-tight)	0.25 to 1.5 mm^2 / 0.0004 to 0.0023 $inch^2$
"f" with ferrules **with** plastic collar according to DIN 46228-1 (ferrules crimped gas-tight)	0.25 to 0.75 mm^2 / 0.0004 to 0.0012 $inch^2$
Test finger according to IEC/EN 60947-1	A1

Connections at XNE-GWBR-CANopen

The field bus connection as well as the power supply connection are realized via Push-in tension clamp terminals.

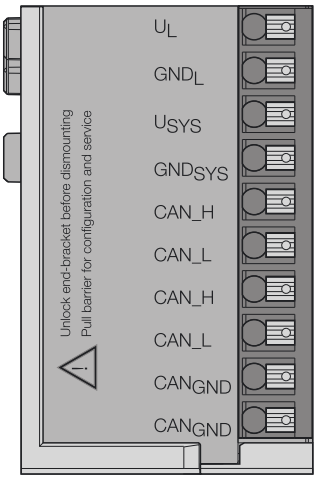


Figure 21: Push-in tension clamp terminals at XNE-GWBR-CANopen

Attention!
Mixing-up the connectors for power supply and bus connection can lead to the destruction of the gateways electronics!

Voltage Supply

The XNE-GWBR-CANopen provides an integrated power supply and has connectors for:

- field supply voltage (U_L, GND_L) and
- system supply voltage (U_{SYS}, GND_{SYS})

Field bus connection via Push-in tension clamp terminals

Push-in tension clamp terminals are also used for the gateway's communication via CANopen.

The CAN bus is provided with T-function. The Push-in tension clamp terminals with the same name (CAN_H, CAN_L und CAN_{GND}) are internally conected.

→ The shielding of the field bus cable is established directly on the mounting rail using a SHLD terminal.

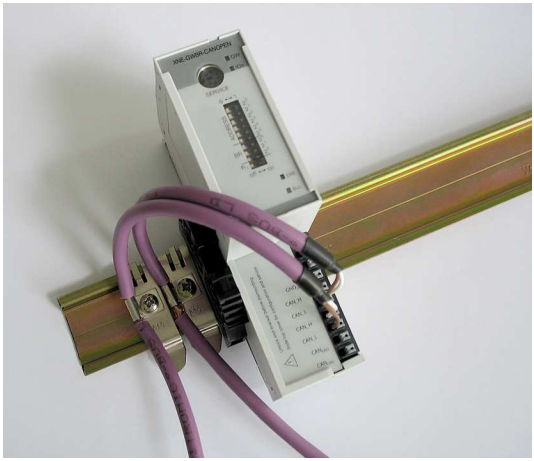


Figure 22: Shielding the bus cable via shielding brackets on the mounting rail

→ Equipotential bonding impedance ≦ 1/10 shielding impedance.

Service interface connection

In order to be able to use the service interface of the gateway to connect to a PC with the "I/O assistant" (engineering and diagnostics software), you will have to use a cable with pin assignments that are different from the PS2 standard:

- XI/ON connection cable (XN-PS2-CABLE)

Attention!
Standard commercial cables will have to be rewired!

Connection with XI/ON cable

The XI/ON cable is fitted with a PS/2 plug (connection to the socket on the gateway) and a SUB-D socket (connection to the plug on the PC).

→ The service interface can be found under the upper label of the gateway. Pull the label upwards out of the housing in order to reach the service interface.

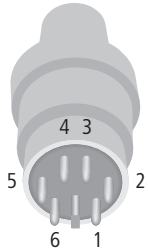


Figure 23: PS/2 plug on connecting cable to the gateway (top view)

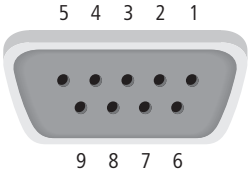


Figure 24: 9-pole SUB-D socket on connecting cable to PC (top view)

Table 15: Pin assignment for PS/2 and SUB-D interfaces

Pin	XI/ON gateway PS/2 socket	Sub-D interface on PC	Pin
1	+5V Gw	DTR, DSR	4, 6
2	GND	GND	5
3	–	–	–
4	TxD	RxD	2
5	/CtrlMode	RTS	7
6	RxD	TxD	3

Setting the Node-ID

The setting of the Node-ID for the XNE ECO gateway for CANopen is done via the DIP switches at the gateway.

These DIP switches can be found under the gateway's upper label.

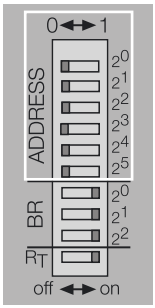


Figure 25: DIP-switches on the gateway

→ Pull the label upwards out of the housing in order to reach the DIP-switches.

Attention!
The Node-ID of an XNE ECO gateway is limited to values of 1 to 63. Other nodes at the CANopen bus can use Node-IDs up to 127. Each Node-ID can only be assigned once in the entire CANopen bus structure.

The gateway's bus address results from the addition of the valences (2^0 to 2^5) of the switched DIP-switches
(position = 1).

Default setting:
0×01H = ADR 01

Example:
Bus address 38 = 0×26 = 100110



Figure 26: Bus address 38

The internal module bus does not require any addressing.

Setting the bit rate

The gateway XNE-GWBR-CANopen offers 3 DIP switches for setting the bit rate (**BR**).



Figure 27: DIP switches for setting the bit rate

Table 16: Setting the bit rate

DIP switch no.	Bit rate							
	reserved	20 kBit/s	50 kBit/s	125 kBit/s	250 kBit/s	500 kBit/s	800 kBit/s	1 MBit/s
2^0	1	0	1	0	1	0	1	0
2^1	1	1	0	0	1	1	0	0
2^2	1	1	1	1	0	0	0	0

Activating the bus terminating resistor

If the XNE ECO gateway is used as the first or the last station in the bus communication, the field bus line has to be terminated using a terminating resistor.

The XNE-GWBR-CANopen allows the activation of the resistors $\mathbf{R_T}$ using the last DIP-switch.

Bus terminating resistor switched off:



Bus terminating resistor switched on:



Figure 28: Bus terminating resistor R_T

Acceptance of the XI/ON station configuration

When making a new configuration of the XI/ON station or an alteration of the existing station structure ("module list"), the current configuration must be accepted in the CANopen mirror of the XI/ON gateway.

The configuration acceptance at this device is done via the DIP switches set to address 0.

Please proceed as follows:

- ▶ Set the DIP switches at the gateway to a Node-ID ≠ "0".
- ▶ Switch on the system supply U_{SYS} and the field supply U_L.
- ▶ Set the Node-ID to "0".
  → The device stores the station's configuration. This is indicated by the flashing of the "IOs" LED.
  → After the storage procedure, the "IOs" LED shortly flashes orange and than stops flashing.
  → The LEDs "Err" and "Bus" flash alternately red with 4 Hz due to the invalid Node-ID "0" which is still set at the gateway.
- ▶ De-energize the gateway and set a Node-ID [1] "0" at the gateway.
  → After power-on, the "IOs" LED changes to green after approximately 2 seconds.



The green "IOs" LED indicates that the current XI/ON configuration matches the stored reference module list.



Attention!
If the new configuration stored to the gateway does not match the old configuration, all CANopen-parameters are set to their default values. Therefore it is necessary, to reload the whole station parameterization.

Diagnostic messages via LEDs

Every XI/ON gateway displays the following statuses via LEDs:

- 2 LEDs for module bus communication (module bus LEDs): **GW** and **IOs**
- 2 LEDs for CANopen communication (field bus LEDs): **ERR** and **Bus**

Table 17: LED displays

LED	Status	Meaning	Remedy
GW	OFF	CPU not supplied.	Check the wiring at the gateway or at the Bus refreshing module.
	Green	5 V DC operating voltage is present; firmware is active; gateway is ready for operation and transfer	–
	green flashing, 1 Hz	Undervoltage at U_{SYS} or U_L	Check that the supply voltage is within the permissible range.
	GW: green flashing, 1 Hz IOs: red	Firmware not active	Reload the firmware!
	Green flashing, 4 Hz	Firmware active, gateway hardware is defect	Replace the gateway.

LED	Status	Meaning	Remedy
IOs	OFF	CPU not supplied.	Check the voltage supply.
	Green	Module bus is running, the configured module bus station corresponds to the physically connected station, communication is active.	–
	Green flashing 1 Hz	Station is in the I/O**assistant** Force Mode.	Deactivate the I/O**assistant** Force Mode.
	Red and LED "GW" off	Controller is not ready, U_{SYS} level is not within the required range.	Check the wiring for U_{SYS} at the gateway.
	Red	Module bus not ready-to-operate	Check the correct mounting of the single XI/ON-modules
	Red flashing, 1 Hz	Non-adaptable modification of the physically connected station.	Compare the planned XI/ON station with the physical station. Check the physical station for defective or incorrectly fitted electronics modules.
	Red flashing, 4 Hz	No module bus communication	Check the station configuration and the voltage supply at the gateway and at the supply modules.
	Red/green flashing, 1 Hz	Adaptable modification of the physically connected station; data transfer possible	Check the physical station for pulled or new but not planned modules.

LED	Status	Meaning	Remedy
ERR	Off	No errors in communication between the XI/ON-CANopen gateway and other CANopen nodes	–
	Red	Faulty or interrupted communication between XI/ON-CANopen gateway and other CANopen. Possible causes: • CAN-BusOff • Heartbeat error • Guarding error • Transmit timeout	Check that the field bus ends with a termination resistor, if the XI/ON-CANopen gateway is the last node in the bus topology. Check the seating of the CANopen bus connector (or the joints in the case of direct wiring). All connections must be correct and properly seated. Check the CANopen cable for possible damage, and for correct connections. Check that the correct bit rate has been set. Check that the NMT-master is still functioning properly.
BUS	green	NMT-slave state of the XI/ON-CANopen gateway is "Operational"; communication active.	–
	red	NMT-slave state of the XI/ON-CANopen gateway is "Stopped"	The state can be passed by the command "Reset-Node" and "Start-Node"
	orange	NMT-slave state of the XI/ON-CANopen gateway is "Pre-Operational"	"Start-Node"-command from NMT- Master necessary, to get into state "Operational".
ERR & BUS	red flashing alternately, 4 Hz	Invalid Node-ID has been set	Set the correct Node-ID with the DIP switches (1 to 63).

Maximum station extension

The maximum number of modules within XI/ON station with the gateway XNE-GWBR-CANopen depends on the following factors:

- The maximum permissible number of **252** communication bytes which are transmitted via the module bus from the modules to the gateway must not be exceeded (see below Table 18, Page 65).
- If the maximum sum of the modules' nominal current consumptions (see below Table 18, Page 65) right to the gateway (max. sum ΣI_{MB} = **700 mA**) is reached, a Bus Refreshing module has to be used in order to provide the module bus voltage.
  Right to the Bus Refreshing module, the sum of the modules' current consumptions can amount to **1.5 A**.
- The station must not exceed the station limits of **1 m** of station length and the maximum number of **62 modules**.

Further limitations can occur using Power Feeding modules (XN-PF-24VDC-D and XN-PF-120/230VAC-D). They are used to build up potential groups or in case of insufficient power supply.



Attention!
Ensure that a sufficient number of Bus Refreshing and Power Feeding modules are used if the system is extended to its maximum.



If the system limits are exceeded, the software I/O**assistant** generates an error message when the user activates the command [Station] > [Verify].

For the calculation of the maximum system extension, the following table contains an overview about communication bytes as well as about the modules' nominal current consumptions.

Table 18: Communication bytes and nominal current consumptions of the XI/ON modules

Module	Number of communication bytes	Nominal current consumption from module bus I_{MB}
XN-BR-24VDC-D	2	-
XN-PF-24VDC-D	2	≦ 28 mA
XN-PF-120/230VAC-D	2	≦ 25 mA
XN-2DI-24VDC-P	1	≦ 28 mA
XN-2DI-24VDC-N	1	≦ 28 mA
XN-2DI-120/230VAC	1	≦ 28 mA
XN-4DI-24VDC-P	1	≦ 29 mA
XN-4DI-24VDC-N	1	≦ 28 mA
XN-16DI-24VDC-P	2	≦ 45 mA
XN-32DI-24VDC-P	4	≦ 30 mA
XNE-8DI-24VDC-P	1	≦ 15 mA
XNE-16DI-24VDC-P	2	≦ 15 mA
XN-1AI-I(0/4...20MA)	3	≦ 41 mA
XN-2AI-I(0/4...20MA)	5	≦ 35 mA
XN-1AI-U(-10/0...+10VDC)	3	≦ 41 mA
XN-2AI-U(-10/0...+10VDC)	5	≦ 35 mA
XN-2AI-PT/NI-2/3	5	≦ 45 mA
XN-2AI-THERMO-PI	5	≦ 45 mA
XN-4AI-U/I	9	≦ 20 mA
XNE-8AI-U/I-4PT/NI	9	≦ 30 mA
XN-2DO-24VDC-0.5A-P	2	≦ 32 mA
XN-2DO-24VDC-0.5A-N	2	≦ 32 mA
XN-2DO-24VDC-2A-P	2	≦ 33 mA

Module	Number of communication bytes	Nominal current consumption from module bus I_{MB}
XN-2DO-120/230VAC-0.5A	2	≦ 35 mA
XN-4DO-24VDC-0.5A-P	2	≦ 30 mA
XN-16DO-24VDC-0.5A-P	3	≦ 120 mA
XN-32DO-24VDC-0.5A-P	5	≦ 30 mA
XNE-8DO-24VDC-0.5A-P	2	≦ 15 mA
XNE-16DO-24VDC-0.5A-P	2	≦ 25 mA
XN-1AO-I(0/4...20MA)	4	≦ 39 mA
XN-2AO-I(0/4...20MA)	7	≦ 40 mA
XN-2AO-U(-10/0...+10VDC)	7	≦ 43 mA
XNE-4AO-U/I	9	≦ 40 mA
XN-2DO-R-NC	1	≦ 28 mA
XN-2DO-R-NO	1	≦ 28 mA
XN-2DO-R-CO	1	≦ 28 mA
XN-1CNT-24VDC	9	≦ 40 mA
XNE-2CNT-2PWM	9	≦ 30 mA
XN-1RS232	9	≦ 140 mA
XN-1RS485/422	9	≦ 60 mA
XN-1SSI	9	≦ 50 mA
XNE-1SWIRE	9	≦ 60 mA

4 Communication in CANopen

General

CANopen is an open, non-proprietary network protocol. It consists of a profile family, based on a communication profile and several device profiles. The CANopen communication profile is standardized as CiA DS-301 (Application Layer and Communication Profile).

The CANopen device profile for I/O modules has been published as CiA DS-401 (Device Profile for I/O Modules).

CANopen is based on the following standards:

- • ISO 11 898 (Physical and Data Link Layer)
  Layers 1 and 2 of the ISO/OSI communication model
- CiA DS-301 (Application Layer and Communication Profile)
  CANopen communication profile
- • CiA DS-302 (Framework for Programmable CANopen Devices)
  CANopen Network Management NMT
- CiA DS-401 (Device Profile for I/O modules)
- CiA DS-406 (Device Profile for Encoders)
  CANopen device profile for counter modules
- CiA DS-102 (CAN Physical Layer for Industrial Applications)
  General industrial application in the field sector (connectors and bit rates) on the basis of ISO 11898

Communication

The lower layers of CANopen are defined according to the ISO-OSI model in the ISO 11898 standard.

Communication between the individual nodes is made by transmitting "Telegrams".

6 different types of telegram messages (Communication Objects) are defined for CANopen:

- Network Management Messages (NMT)
- Service Data Objects (SDO)
- Process Data Objects (PDO)
- Synchronisation Objects (Sync)
- Emergency Objects (Emcy)
- Time Stamp Objects (Time)

In addition, there are a number of transmission/transfer settings (Transmission Types) for process data. The telegrams moving through the network have their priorities marked through their identifiers (a low ID = high priority). An arbitration procedure ensures fast delivery of important telegrams if the network is heavily loaded.

Types of telegram messages (Communication Objects)

Network Management Messages (NMTs)
Network management messages are used in the network to control the nodes and their operating states. The network management objects include boot-up message, heartbeat protocol and NMT message.

Service Data Objects (SDOs)
Service data objects (SDOs) are used for transferring low-priority acyclic data. SDOs are typically used for the configuration of CANopen nodes, to set device parameters, and to download programs. SDOs can be used to transfer data of any length, by using the technique known as "segmented transfer".

Process Data Objects (PDOs)
Process data objects (PDOs) are used for the fast transfer of high-priority data. PDOs are unconfirmed services, so they do not carry a protocol overhead. They are therefore a method of fast and flexible data transfer from one node to any number of other nodes. PDOs can contain a maximum of 8 data bytes, and can be specifically configured and assembled by the user to meet specific requirements.

PDO transmissions:

- **Event- or timer-driven:**
  An event (specified in the device profile) triggers message transmission. An elapsed timer additionally triggers the periodically transmitting of a PDO message.
- **Remotely requested:**
  Another device may initiate the transmission of an asynchronous PDO by sending a remote transmission request (remote frame).
- **Synchronous transmission:**
  In order to initiate simultaneous sampling of input values of all nodes, a periodically transmitted Sync message is required. Synchronous transmission of PDOs takes place in cyclic and acyclic transmission mode. Cyclic transmission means that the node waits for the Sync message, after which it sends its measured values. Acyclically transmitted synchronous PDOs are triggered by a defined application-specific event.

Synchronisation Objects (Sync)
The Sync Object is broadcast periodically by the Sync Producer. The time period between Sync messages is defined by the Communication Cycle Period, which may be reset by a configuration tool to the application devices during the boot-up process. There can be a time jitter in transmission by the Sync Producer due to some other objects with higher prior identifiers or by one frame being transmitted just before the Sync message. The Sync message is mapped to a single CAN frame with the identifier 128.

Emergency Objects (Emcy)
The Emergency message is triggered by the occurrence of a device internal error situation and are transmitted from an Emergency producer on the concerned application device. This makes them suitable for interrupt type error alerts. An Emergency message is transmitted only once per 'error event'. As long as no new errors occurs on a device, no further Emergency message can be transmitted. Zero or more Emergency consumers may receive these. The reaction of the Emergency consumer is application-specific. CANopen defines several Emergency Error Codes to be transmitted in the Emergency message, which is a single CAN frame with 8 data byte.

Time Stamp Objects (Time)
By means of Time-Stamp, a common time frame reference is provided to application devices. This objekt includes a value of the type "Time-of-day" and it's transmission follows the producer/consumer model.

XI/ON and CANopen

XI/ON supports the following CANopen functions:

- SDO transfer, any length of information
- Emergency object
- Sync frame evaluation
- Event-driven PDOs
- Synchronous PDOs (clock synchronous)
- Remote Requested PDO/polling

Electronic data sheet – EDS file

The XI/ON gateway is embedded in the CANopen structure with the help of a standardized EDS file (Electronic Data Sheet).

The EDS file lists all the Objects with their corresponding Sub-indices and the matching entries.

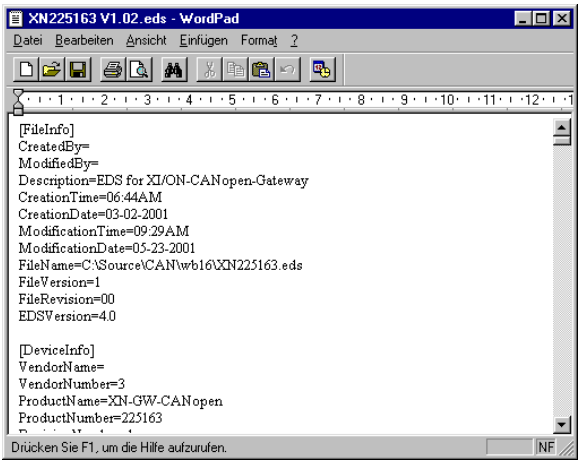


Figure 29: Header of an EDS file for XI/ON

The latest version of a particular EDS file can be obtained from our website (www.eaton-automation.com), under “DOWNLOADS”.

Setting up communication

Minimum Boot-up

XI/ON supports the Minimum Boot-up function described in CiA DS-301.

Table 19: Meaning of the abbreviations

Abbreviation	Meaning	Explanation
cs	NMT command specifier	A designation label for the required service
Node-ID	Node Identifier	Identifier for the node; an identification byte that is set through the encoding switches for the CAN node.

Booting with the Minimum Boot-up function is the typical application option for CANopen, and runs according to the following state diagram:

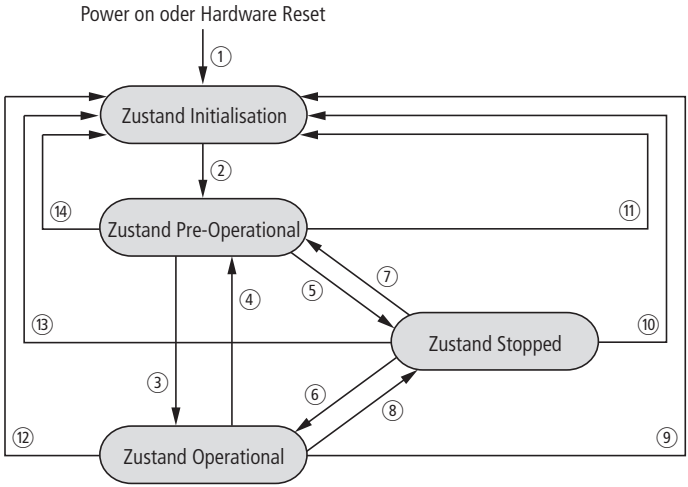


Figure 30: Boot procedure with Minimum Boot-up

① Power on (automatic change of state to "Initialization")
② Initialization Finished (automatic change of state to "Pre-Operational")
③ Start Remote Node (start the CAN node)
④ Enter Pre-Operational (change to "Pre-Operational")
⑤ Stop Remote Node (stop the CAN node)
⑥ Start Remote Node (start the CAN node)
⑦ Enter Pre-Operational (change to "Pre-Operational")
⑧ Stop Remote Node (stop the CAN node)
⑨ Reset Node (reset the complete CAN node)
⑩ Reset Node (reset the complete CAN node)
⑪ Reset Node (reset the complete CAN node)
⑫ Reset Communication (reset communication for the CAN node)
⑬ Reset Communication (reset communication for the CAN node)
⑭ Reset Communication (reset communication for the CAN node)

The following messages are exchanged in the states mentioned:

- Operational:PDO and SDO communication
- Pre-Operational:only SDO communication

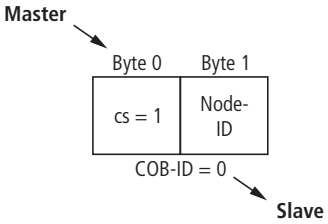
The services listed above (1 to 14) are required by CANopen or are performed independently by the nodes in order to change from one state to another.

The "Stopped" state can be skipped when using Minimum Boot-up.

① Power on (automatic change of state to "Initialization")

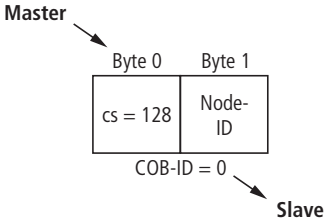
② Initialization Finished (automatic change to "Pre-Operational")

③, ⑥ Start Remote Node (start the CAN node)



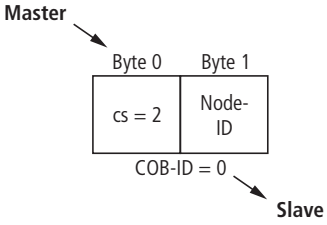
The internal change of state of the CANopen slave then requires a pause of at least 20 ms, before another request may be made by the master.

④, ⑦ Enter Pre-Operational (change to "Pre-Operational")



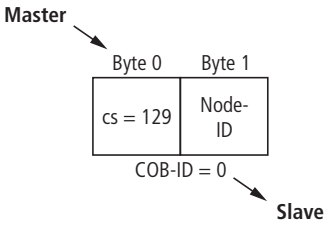
The internal change of state of the CANopen slave then requires a pause of at least 20 ms, before another request may be made by the master.

⑤, ⑧ Stop Remote Node (stop the CAN node)



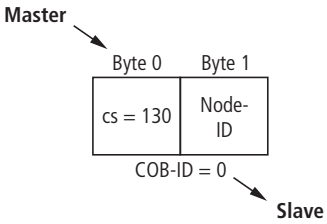
The internal change of state of the CANopen slave then requires a pause of at least 20 ms, before another request may be made by the master.

⑨, ⑩, ⑪ Reset Node (reset complete CAN node)



The execution of this command is confirmed by a boot-up message. This is in the form of a guard frame with the data contents 00_{hex}.

⑫, ⑬, ⑭ Reset Communication (reset communication for the CAN node)



The execution of this command is confirmed by a boot-up message. This is in the form of a guard frame with the data contents 00_{hex}.

Identifier for the standard objects

Node-ID

The identifier for each device in a CANopen network is the Node-ID. The CANopen slaves can be assigned the Node-IDs 1 to 127.

Setting of the Node-ID:

- XN standard gateways:
  → Chapter "Node-ID setting", Page 35.
- XNE ECO gateways:
  → Chapter "Setting the Node-ID", Page 56.

COB-ID

The identifier for each communication object in a CANopen network is the COB-ID.

The COB-IDs for the standard objects (digital input, digital output, analog input, analog output) are assigned automatically. The ranges for the COB-IDs are defined by the "Predefined Master-Slave Connection Set".

Each range for the COB-IDs has 127 numerical values.

The COB-IDs are calculated according to the following rule:

COB-ID = Base-ID + Node-ID

Base-ID: 128; 384; 512; 640; 768; 896; 1024; 1152; 1280; 1408; 1536; 1792

Table 20: Identifiers for Basic Objects

COB-ID (decimal)	COB-ID (hexadecimal)	Function	Application
0	000_{hex}	Network Management (NMT)	Broadcast Object
1 to 127	001_{hex} to $07F_{hex}$	free	
128	080_{hex}	Synchronization (SYNC)	Broadcast Object
129 to 255	081_{hex} to $0FF_{hex}$	Emergency Message	
256	100_{hex}	Timestamp Message	Broadcast Object
257 to 384	101_{hex} to 180_{hex}	free	
385 to 511	181_{hex} to $1FF_{hex}$	Transmit PDO 1	Digital input
512	200_{hex}	free	
513 to 639	201_{hex} to $27F_{hex}$	Receive PDO 1	Digital output
640	280_{hex}	free	
641 to 767	281_{hex} to $2FF_{hex}$	Transmit PDO 2	Analog input
768	300_{hex}	free	
769 to 895	301_{hex} to $37F_{hex}$	Receive PDO 2	Analog output
896	380_{hex}	free	
897 to 1023	381_{hex} to $3FF_{hex}$	Transmit PDO 3	Analog input
1024	400_{hex}	free	
1025 to 1151	401_{hex} to $47F_{hex}$	Receive PDO 3	Analog output
1152	480_{hex}	free	
1153 to 1279	481_{hex} to $4FF_{hex}$	Transmit PDO 4	Analog input

COB-ID (decimal)	COB-ID (hexadecimal)	Function	Application
1280	500_{hex}	free	
1281 to 1407	501_{hex} to $57F_{hex}$	Receive PDO 4	Analog output
1408	580_{hex}	free	
1409 to 1535	581_{hex} to $5FF_{hex}$	Transmit SDO	
1536	600_{hex}	free	
1537 to 1663	601_{hex} to $67F_{hex}$	Receive SDO	
1664 to 1772	680_{hex} to $6EC_{hex}$	free	
1793 to 1919	701_{hex} to $77F_{hex}$	NMT Error (Node Guarding, Heartbeat, Boot-Up)	
1920 to 2014	800_{hex} to $7DE_{hex}$	free	
2015 to 2031	$7DF_{hex}$ to $7EF_{hex}$	NMT, LMT, DBT	

Setting up Node Guarding protocol

→ Further information on Node Guarding is provided in the CiA DS-301.

Node Guarding is the name for the monitoring of network nodes by a network manager.

In addition, the CANopen network nodes check that their network manager is operating correctly and that the network is functioning reliably.

In the default state, Node Guarding is inactive.

To activate the Node Guarding protocol at a node, various parameters must be set via the Object Dictionary:

- [100C] = Guard Time
  Given in milliseconds; the query interval (polling) that is to be expected from the network slave
  Default = 0
- [100D] = Life time factor
  This factor, multiplied by the Guard Time, produces the time that should elapse after a Node Guarding protocol error until the network slave generates an error message via EMCY. In this way, a temporary communication problem, such as may be caused by heavy bus loading, can be bridged without a Guarding Error.
  Default = 0
- Guard-ID
  This is fixed and cannot be changed.

Guarding is initiated with the first Guard remote frame (Guarding RTR) from the CANopen network manager.

The Guarding Frame of the network manager has the COBID "1793 - 1 + Node-ID" and does **not** have a data field.

Furthermore, the RTR bit in the message header must be set and the Data Length code = 1.

The node answers the telegram sent out by the network manager within the preset time (Guard Time) in the "Operational" state, with the data contents **5**. The gateway answers the next polling query with the contents **133**. The following response from the gateway is with **5** again, and so on. This means that the gateway changes the state of the most significant bit after each query (i.e. the bit is toggled). If the node is in the "Pre-Operational" state, then the value of the data contents of the response telegram toggles between 127 and 255. If the node is in the "Stop" state, the value toggles between 4 and 132.

If there is no query from the network manager within the preset time, then the gateway changes to the state "Guard Fail". If output modules are fitted in the XI/ON station, then their outputs will be put into defined states, depending on Output Fault Mode and Fault Output States, or will retain the last state that was received. Any RxPDOs that are received will continue to be processed and output. If the Guarding starts up again, the XI/ON gateway leaves the Guard Fail state, but remains in the Pre-Operational state. A "Start Node" must be generated by the network manager in order to restart the XI/ON gateway (see CiA DS-301).

If the setting is Guard Time = 0, then passive Guarding will take place. This means that the gateway answers the Guard Remote frames, without starting its own internal Guard Timer.

As an alternative to Node/Life Guarding, the Heartbeat mechanism newly introduced with DS301 V4.0 is supported, which, unlike Guarding, does not require Remote frames.

XI/ON emergency messages

XI/ON CANopen supports Emergency Frames (EMCY).

The COB-IDs for the EMCY telegrams are defined by the Predefined Master-Slave Connection Set:

COB-ID = 129 - 1 + Node-ID

In the event of a communication error, not only the Emergency Error Code but also the Error Register (see "Object 1001_{hex}") and additional information will be transmitted, so that the error can be more precisely identified. Only a portion of the 5 bytes is used for the additional information. The remaining bytes are then 0.

Table 21: Data contents of the Emergency Frame

Byte	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Data contents	Emergency Error Code		Error Register	Additional information				

Table 22: Bit assignments for the Error Register

Error Register	M/O	Meaning
Bit 0	M[1)]	Generate the error message
Bit 1	O[2)]	Current error
Bit 2	O	Voltage error message
Bit 3	O	Temperature error
Bit 4	O	Communication error (Overrun, Error State)
Bit 5	O	Device-profile specific error
Bit 6	O	reserved
Bit 7	O	Manufacturer-specific error

1) M = mandatory
2) O = optional

The contents of the error register are frequently displayed as a decimal or hexadecimal value. An overview of the possible decimal and hexadecimal values and their assignments to the individual bits of the error register is provided in the Appendix.

Emergency Frames are sent out by the gateway autonomously, if one of the following error conditions occurs:

Table 23: Overview of byte 0 to 5 of the CANopen Emergency Frames

Designation	Byte 0,1	Byte 2	Byte 3	Byte 4	Byte 5	Meaning
	Error code	Error register	Additional information[1)2)]			
Error Reset / No Error	0000_{hex}	–	0	0	0	Error reset
Input current too high	2110_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-#AI-I(0/4…20MA), XN-4AI-U/I: The input current is outside of the permissible range (threshold: 1 % over the upper measurement range value or 1 % below the lower measurement range value).
Input current too low	2130_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-#AI-I(0/4…20MA), XN-4AI-U/I: Open circuit or input current for the measuring range 4…20 mA too low. The threshold is 3 mA.
Output current too high	2310_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-#DO-24VDC-…, XN-1CNT-24VDC: Output current too high
	2310_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-2AI-PT/NI-2/3: Current too high (threshold: approx. 5 Ω; only with temperature measuring ranges)

Designation	Byte 0,1 Error code	Byte 2 Error register	Byte 3 Additional information[1)2)]	Byte 4	Byte 5	Meaning
Output current out of range	2323_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-2AI-PT/NI-2/3: The current is outside of the permissible range (threshold: 1 % of the positive measurement range limit value; unterflow diagnostics only in temperature measurements).
	2323_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-1CNT-24VDC: The output current is outside of the permissible range.
Load dump at outputs	2330_{hex}	Bit 1 = 1	Module No.	Chn. No.	0	XN-2AI-PT/NI-2/3: Open circuit or current too low (threshold: positive converter limit value)
AI U voltage out of range	3003_{hex}	Bit 2 = 1	Module No.	Chn. No.	0	XN-#AI-U(-10/0…+10VDC), XN-4AI-U/I: The input voltage is outside of the permissible range (threshold: 1 % over the upper measurement range value or 1 % below the lower measurement range value).
AI U voltage out of range	3003_{hex}	Bit 2 = 1	Module No.	Chn. No.	0	XN-2AI-THERMO-PI: Open circuit (only in temperature measurements) or input voltage is outside of the permissible range (threshold: 1 % of the positive measurement range limit value).

Designation	Byte 0,1 Error code	Byte 2 Error register	Byte 3 Additional information[1)2)]	Byte 4	Byte 5	Meaning
Mains voltage too high	3110_{hex}	Bit 2 = 1	0	Chn. No.	0	System voltage too high
Mains voltage too low	3120_{hex}	Bit 2 = 1	Module No.[3)]	Chn. No.	0	System voltage too low
Output voltage too low	3320_{hex}	Bit 2 = 1	Module No.	Chn. No.	0	Field voltage too low
Additional modules	7000_{hex}	Bit 7 = 1	Module No.	Chn. No.	See column meaning	XN-1SSI[4)]: Setting of byte 5: 01_{hex} = SSI diag 02_{hex} = SSI error 04_{hex} = Overflow error 08_{hex} = Underflow error 10_{hex} = Parameter error
	7000_{hex}	Bit 7 = 1	Module No.	Chn. No.	See column meaning	XN-1RS232, XN-1RS485/4224): Setting of byte 5: 08_{hex} = Parameter error 10_{hex} = Hardware failure 20_{hex} = Handshake error 40_{hex} = Frame error 80_{hex} = RX buffer overflow
Additional modules	7000_{hex}	Bit 7 = 1	Module No.	Chn. No.	Channel diagnostic	XNE-8AI-U/I-4PT/NI, XNE-4AO-U/I: Furture information about the channel diagnostic (byte 5) of the respective module, you can find in: User Manual XI/ON: Analog I/O Modules.
	XNE-1SWIRE: At error code 7000_{hex} of XNE-1SWIRE, all z bytes are used. Description see Table 24, Page 89.					

Designation	Byte 0,1 Error code	Byte 2 Error register	Byte 3 Additional information[1)2)]	Byte 4	Byte 5	Meaning
General module error	7010_{hex}	Bit 0 = 1 Bit 7 = 1	Module No.	0	0	XNE-2CNT-2PWM: General module error in the station
Change of Dia.	7011_{hex}	Bit 0 = 1 Bit 7 = 1	Module No.	0	0	XNE-2CNT-2PWM: Change in bytes 0 to 3 of the diagnostic data
Additional modules	$707A_{hex}$	Bit 7 = 1	Module No.	0	0	I/O module list, adaptable change, e.g. module removed
	$707D_{hex}$	Bit 7 = 1	Module No.	0	0	I/O module list, incompatible change
	$707E_{hex}$	Bit 7 = 1	Module No.	0	0	I/O module list, expanded
	$707F_{hex}$	Bit 7 = 1	Module No.	0	0	1 module removed from I/O module list
Communication	8100_{hex}	Bit 4 = 1	2	0	0	"CAN Warning level"
Communication	8100_{hex}	Bit 4 = 1	3	0	0	"CAN Transmit Timeout"
Life guard error or heartbeat error	8130_{hex}	Bit 4 = 1	0	0	0	Error in Guarding or Heartbeat protocol
Recovered from Bus-Off	8140_{hex}	Bit 4 = 1	0	0	0	CAN bus Off state could be left
External Error	9009_{hex}	Bit 7 = 1	0	0	0	ForceMode of I/O**assistant** activated

1) Byte 6 and 7 of the emergency frames are only used for the error code 7000_{hex} of XNE-1SWIRE. For the other error codes, byte 6 and 7 are always 0

2) Unused bytes in the additional information are presented as the value 0.

3) If the error message refers to the gateway itself (voltage error for XN-GWBR-CANopen), then the value 0 will be reported for the module number and the channel number.
4) It is only possible to interpret this additional information if the type of module that is affected is known from the module number.

Table 24: Error code 7000_{hex} of XNE-1SWIRE

Designation	Byte 0,1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
	Error code	Error register	Additional information				
Additional modules	7000_{hex}	Bit 7 = 1	Module No.	Diag-byte 0	Diag-byte 1	Diag-byte 2 | 4 | 6	Diag-byte 3 | 5 | 7

1) Bytes 6 and 7 of the emergency frame contain the result of the bit OR operation of the stated diag bytes.

The Error Code for an Emergency Frame can only be read with the assistance of specific analysis tools.

Boot-up message

After initialization (after Power-On, Reset-Node and Reset-Communication), a Boot-up message according to CiA DS-301 V4.0 is sent out. This is in the form of a Guard Frame with the contents 00_{hex}.

Under certain circumstances, a network manager may fail to detect the temporary drop-out of a XI/ON gateway (for example, as a result of voltage fluctuations). This could occur under the following conditions:

- The drop-out and initialization of the gateway happen in the time between two Guarding Frames

- The gateway was already in the Pre-Operational state beforehand
- The last state of the toggle bit was 1

If a Boot-up message is sent out after a reset or initialization, then the drop-out mentioned above will also not be missed by the network manager.

Parameterization by means of Service Data Objects (SDO)

SDO (= Service Data Object) is a confirmed CANopen service that is primarily used for parameterization and configuration of the CANopen slaves (XI/ON) and less frequently for transmitting process data. "Confirmed" means that a XI/ON-CANopen gateway (SDO server) that is addressed by this procedure must acknowledge it with a response. In this way, the SDO client obtains information about whether the XI/ON gateway that it addressed was contacted, and whether the access was achieved without any errors (error code in the response from the SDO server). SDO access means that the contents of the Object Dictionary entries for an SDO server can be read or written, and that the settings for an XI/ON station can be made in this way.

Four parallel SDO servers are supported. There are three "additional" SDOs, as well as the default SDO. As a default, these are inactive, but can be parameterized and enabled through the Object Dictionary entries 1201_{hex} to 1203_{hex}.

The communication parameters for the default SDO follow the Predefined Connection Set, and cannot be modified (see CiA DS-301, V4.01)

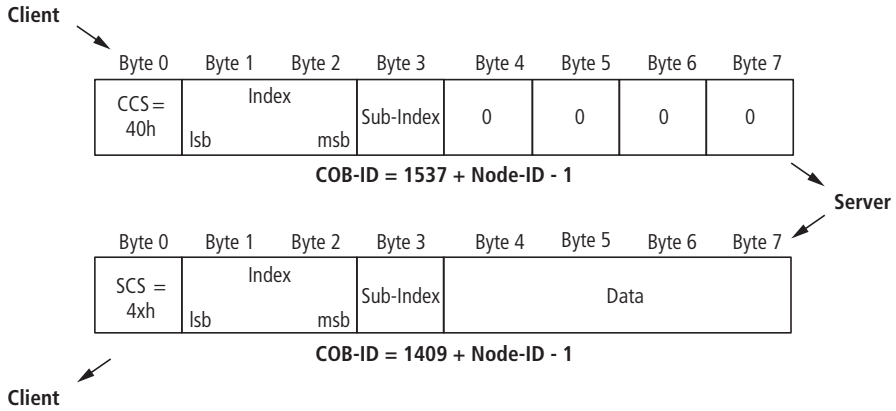
In the following representations of the messages, the identifier of the CANopen message that is to be transmitted is shown below the frame, and the content of the data bytes to be transmitted are shown inside the frame.

The following representations use the Expedited SDO Transfer, i.e. a maximum of 4 bytes of user data can be transferred.



CANopen also offers the possibility of segmented SDO-transfer of data with data length of more than 4 bytes.

Read (Read from Object Dictionary)



x ... depending on the length of data read

lsb = least significant byte

msb = most significant byte

SCS = Server Command Specifier

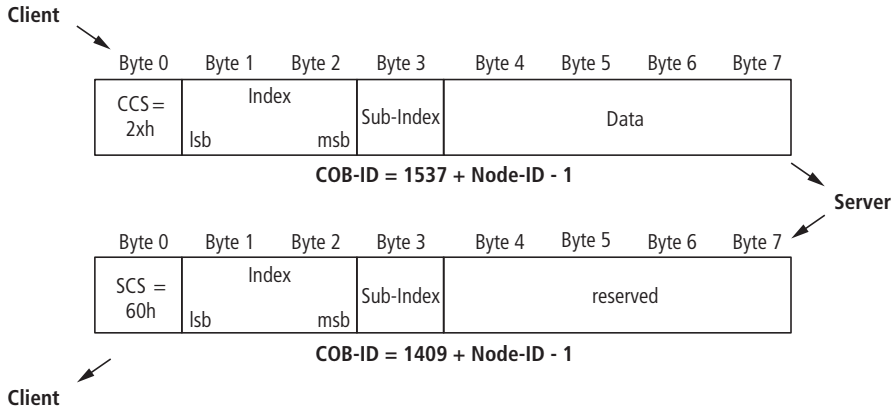
CCS = Client Command Specifier

(see CiA DS-301)

The stated COB-ID refers to the default SDO server.

→ The XI/ON gateway generates length information as to how many data bytes are to be read (see CiA DS-301). This information is found in byte 0 "SCS = 4xh". The value x depends on the length of data read.

Write (Write to Object Dictionary)



lsb	=	least significant byte
msb	=	most significant byte
SCS	=	Server Command Specifier
CCS	=	Client Command Specifier

(see CiA DS-301)

The stated COB-ID refers to the default SDO server.

→ The information in byte 0 "CCS = 2xh" can optionally contain the length information for the transmitted data bytes (see CiA DS-301). The information byte 0 "CCS = 20h" means that no length information is present.

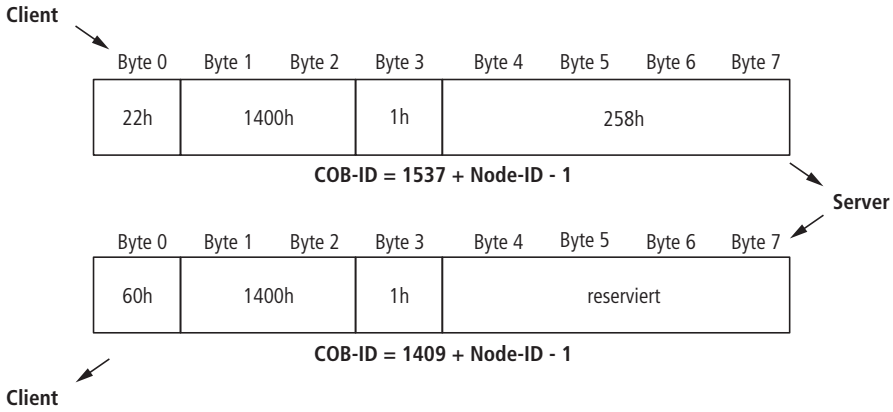
Attention!
If an incorrect data length is given, the error code "Abort SDO Transfer Service" will be generated (see CiA DS-301).

Table 25: Cancel codes for errors in data length information

Cancel code	Description
$0607\ 0012_{hex}$	Data length of Service parameter is too large
$0607\ 0013_{hex}$	Data length of Service parameter is too short

Example:

Write a new COB-ID for RxPDO 1 (ID = 258_{hex})



Commanded parameter storing / restoring

Saving of communication and application parameters is executed by a command. This means that the parameters transferred through an SDO are held in volatile memory, until they are saved by using the command "Store Parameters" (Object 1010_{hex}, sub-indices 0 to 3). All the communication and application parameters that are supported by the gateway will be saved.

The command "Restore Default Parameters" (Object 1011_{hex}, sub-indices 0 to 3) is also supported. This command resets all the communication and/or application parameters to the default values.

Transmission of Process Data Objects (PDO)

CANopen provides PDO communication (PDO = Process Data Object). PDOs are fast real-time process data that are handled as unconfirmed services without a protocol overhead. PDOs can contain a maximum of 8 bytes of data. They can be assembled and configured by the user to suit the specific requirements. In addition, there are a number of transmission/transfer settings (Transmission Types) for process data.

The following attributes can be set for each PDO by means of the object "PDO Communication Parameter":

Communication parameter COB-ID

The COB-ID is the CAN identifier that is used for the transmission (Object 1800_{hex} ff).

COB-IDs are used to define the priority of the message telegrams. The lowest COB-ID has the highest priority.

For communication between 2 nodes, the COB-ID of the transmit PDO must be the same as the COB-ID of the receive PDO.

→ As delivered, each XI/ON gateway has from none to eight active PDOs, with COB-IDs that are taken from the Predefined Master-Slave Connection Set.

All other PDOs are inactive. This state can be seen from the invalid bit (Bit 31) of the COB-ID.

Transmission Type

The Transmission Type determines under which circumstances a PDO can be transmitted or received.

The following PDO Transmission Types are supported by
XI/ON:

- Type 0 (sync, acyclic)
- Type 1 (sync, cyclic)
- Type 253 (remote request)
- Type 255 (event driven)

Table 26: Overview of the PDO transmission types

Transmission type	PDO transmission				
	cyclic	acyclic	synchro-nous	asynchro-nous	only with RTR
0		x	x		
1	x		x		
253				x	x
255				x	

Type 0 = The PDO is always transmitted (TPDO) or evaluated (RPDO) if this is permitted by a SYNC Frame transmitted by the SYNC producer and the mapped contents of the XI/ON-CANopen gateway have changed since the last transmission.

Type 1 = Immediately after receiving each Sync Frame, the XI/ON-CANopen gateway puts out the mapped contents as a PDO on the network, even if this has not changed since the last transmission.

Type 253 = The PDO is only transmitted if a transmitted Remote Frame requests this from the XI/ON-CANopen gateway.



Attention!
This Transmission Type is only permissible for TPDOs.

Type 255 = In this mode of operation, the XI/ON-CANopen gateway does not depend on any Sync or Remote Request for PDO communication. Whenever this is provided for an internal event within the XI/ON-CANopen gateway, the gateway will transmit a PDO to the CANopen network.

The Transmission Types of the individual PDOs are independent, which means that a freely mixed operation with synchronous and asynchronous PDOs is possible.

Inhibit Time

An Inhibit Time setting for the PDOs (Object 1800_{hex} ff, sub-index 03_{hex}) is only supported for TPDOs. Unlike the other time values, which are given as multiples of 1 ms, the Inhibit Time is defined as a multiple of 100 µs. However, since the time resolution of the system clock in the XI/ON-CANopen gateway is 1 ms, Inhibit Time values below 10 × 100 µs have no effect.

Event Time

The Event Time (Object 1800_{hex} ff, sub-index 05_{hex}) defines the maximum interval after which a TPDO will be transmitted, even though no event has occurred. This means that the Event Time determines the maximum interval between two transmissions of a TPDO.

The expiry of the interval set for the Event Time is detected as an event. If any other event occurs, the Event Time is reset and restarted.

The value of the object is interpreted as a multiple of 1 ms.

Available PDOs

64 PDOs are supported:

- 32 Receive PDOs: TPDO1 to TPDO32 (Index 1800_{hex} to $181F_{hex}$)
- 32 Transmit PDOs: RPDO1 to RPDO32 (Index 1400_{hex} to $141F_{hex}$)

The Default Master-Slave Connection Set is supported for each of the PDOs 1 to 4, so that a COB-ID distribution is not necessary for these PDOs.

If one of the COB-IDs from xPDO1 to xPDO4 is reconfigured, then the use of a COB-ID from the Default Master-Slave Connection Set can be achieved by setting this COB-ID to 0.

Mapping of objects in PDOs

Mapping is the assignment of objects from an Object Dictionary to a PDO for transmission/reception via the CAN bus. More than one object can be transmitted in a single PDO.

The Mapping Parameters determine which items of information are transmitted in a PDO:

Table 27: Object dictionary entries or mapping parameters

PDO		Object dictionary entries
Type	**Range**	**Range**
Transmit PDOs	TPDO1 to TPDO32	$1A00_{hex}$ to $1A1F_{hex}$
Receive PDOs	RPDO1 to RPDO32	1600_{hex} to $161F_{hex}$

Default PDOs and PDO mappings

The 4 Transmit and 4 Receive PDOs which are specified by the Communication Profile CiA DS-301 are supported by
XI/ON. The mapping of these PDOs and their Transmission Types are specified by the I/O-Device Profile CiA DS-401.

→ The Default PDOs are only activated if the objects and sub-indices intended for the corresponding PDO actually exist. If, for instance, no analog I/Os are used in a XI/ON station, then the PDOs 2 to 4 are set to "Invalid" and no mapping entries will be present.

In addition to the default PDOs which are standardized by the CiA DS-301 and DS-401 profiles, other PDOs for an
XI/ON-CANopen gateway may be provided with mapping entries and communication parameters. These additional PDOs (5 to 16) are set to "Invalid" by default.

Default PDOs as per CiA DS-301 and DS-401
The TPDOs of the following table have the following properties:

- The COB-ID is part of sub-index 01_{hex}
- The PDO is active!
  The first digit of the 8-digit hexadecimal number of the COB-ID also indicates whether the PDO is enabled. Active PDOs are identified by a HEX digit < 7. Normally the digits 0 or 4 are used.
  → Table 71, Page 157.

Table 28: Overview of the default TPDOs as per CiA DS-301 and DS-401

Meaning	TPDO	Sub-index 01_{hex} - "COB-ID"
1st group, digital input channels (bits 0 to 63)	PDO1 1800_{hex}	0000 0180_{hex} + Node-ID
1st group, analog input channels (channels 0 to 3)	PDO2 1801_{hex}	0000 0280_{hex} + Node-ID
2nd group, analog input channels (channels 4 to 7)	PDO3 1802_{hex}	0000 0380_{hex} + Node-ID
3rd group, analog input channels (channels 8 to 11)	PDO4 1803_{hex}	0000 0480_{hex} + Node-ID

Table 29: Overview of the default RPDOs as per CiA DS-301 and DS-401

Meaning	RPDO	COB-ID
1st group, digital output channels (bits 0 to 63)	PDO1 1400_{hex}	0000 0200_{hex} + Node-ID
1st group, analog output channels (channels 0 to 3)	PDO2 1401_{hex}	0000 0300_{hex} + Node-ID
2nd group, analog output channels (channels 4 to 7)	PDO3 1402_{hex}	0000 0400_{hex} + Node-ID
3rd group, analog output channels (channels 8 to 11)	PDO4 1403_{hex}	0000 0500_{hex} + Node-ID

XI/ON-specific default PDOs
These additional PDOs are always set to "Invalid" by default.

The relevant parameters must be checked before enabling these PDOs. This particularly applies to the COB-IDs as these come from the Default Master-Slave Connection Set and are assigned to other Node-IDs. The network should not therefore contain nodes with the corresponding node ID, and these nodes should not use the corresponding COB IDs.
The transmission type of these PDOs is normally 255.

Table 30: Overview of XI/ON-specific default TPDOs

Meaning	TPDO	COB ID TPDO[1)]
2nd group, digital input channels (bits 64 to 127)	PDO5 1804_{hex}	8000 $01C0_{hex}$ + Node-ID
3rd group, digital input channels (bits 128 to 191)	PDO6 1805_{hex}	8000 $02C0_{hex}$ + Node-ID
4th group, digital input channels (bits 192 to 255)	PDO7 1806_{hex}	8000 $03C0_{hex}$ + Node-ID
5th group, digital input channels (bits 256 to 319)	PDO8 1807_{hex}	8000 $04C0_{hex}$ + Node-ID
1st group, encoders (channels 0 + 1)	PDO9 1808_{hex}	8000 $01E0_{hex}$ + Node-ID
2nd group, encoders (channels 2 + 3)	PDO10 1809_{hex}	8000 $02E0_{hex}$ + Node-ID
3rd group, encoders (channels 4 + 5)	PDO11 $180A_{hex}$	8000 $03E0_{hex}$ + Node-ID
4th group, encoders (channels 6 + 7)	PDO12 $180B_{hex}$	8000 $04E0_{hex}$ + Node-ID
4th group, analog input channels (channels 12 to 15)	PDO13 $180C_{hex}$	8000 $01A0_{hex}$ + Node-ID
5th group, analog input channels (channels 16 to 19)	PDO14 $180D_{hex}$	8000 $02A0_{hex}$ + Node-ID
6th group, analog input channels (channels 20 to 23)	PDO15 $180E_{hex}$	8000 $03A0_{hex}$ + Node-ID
7th group, analog input channels (channels 24 to 27)	PDO16 $180F_{hex}$	8000 $04A0_{hex}$ + Node-ID
1st group, RS232/RS4xx (channel 0)	PDO18 1811_{hex}	8000 0000_{hex}
1st group, RS232/RS4xx (channel 1)	PDO19 1812hex	8000 0000_{hex}

1) Applicable from firmware version 2.03

Table 31: Overview of XI/ON-specific default RPDOs

Meaning	RPDO	COB ID RPDO
2nd group, digital I/Os channels (bits 64 to 127)	PDO5 1804_{hex}	8000 0240_{hex} + Node-ID
3rd group, digital I/Os channels (bits 128 to 191)	PDO6 1805_{hex}	8000 0340_{hex} + Node-ID
4th group, digital I/Os channels (bits 192 to 255)	PDO7 1806_{hex}	8000 0440_{hex} + Node-ID
5th group, digital I/Os channels (bits 256 to 319)	PDO8 1807_{hex}	8000 0540_{hex} + Node-ID
1st group, encoders (channels 0 + 1)	PDO9 1808_{hex}	8000 0260_{hex} + Node-ID
2nd group, encoders (channels 2 + 3)	PDO10 1809_{hex}	8000 0360_{hex} + Node-ID
3rd group, encoders (channels 4 + 5)	PDO11 $180A_{hex}$	8000 0460_{hex} + Node-ID
4th group, encoders (channels 6 + 7)	PDO12 $180B_{hex}$	8000 0560_{hex} + Node-ID
4th group, analog I/Os channels (channels 12 to 15)	PDO13 $180C_{hex}$	8000 0220_{hex} + Node-ID
5th group, analog I/Os channels (channels 16 to 19)	PDO14 $180D_{hex}$	8000 0320_{hex} + Node-ID
6th group, analog I/Os channels (channels 20 to 23)	PDO15 $180E_{hex}$	8000 0420_{hex} + Node-ID
7th group, analog I/Os channels (channels 24 to 27)	PDO16 $180F_{hex}$	8000 0520_{hex} + Node-ID
1st group, RS232/RS4xx (channel 0)	PDO18 1811_{hex}	8000 0000_{hex}
1st group, RS232/RS4xx (channel 1)	PDO19 1812_{hex}	8000 0000_{hex}

→ The COB-IDs for the RS232/RS4xx modules must be defined by the user!

Example
The Node-ID of a XI/ON-CANopen gateway is 1. There are more than 12 analog input channels. As a result, appropriate mapping entries are set up for TPDO13 (Object $1A0C_{hex}$) and the COB-ID (Object 180C, sub-index 1) is preloaded with the value 8000 $01A1_{hex}$. This PDO can only be enabled without alteration if a node with the Node-ID 33 (own Node-ID + 32) does not exist, or at least its TPDO1 is not used.

The following table illustrates this systematic relationship:

Table 32: Relationship between a Node-ID and XI/ON-specific PDOs

PDO	Node-ID which is assigned to this COB-ID in the Default Master-Slave Connection Set	Original PDO, to which this COB-ID is assigned in the Default Master-Slave Connection Set
PDO5	own Node-ID + 64 (40_{hex})	PDO1
PDO6	own Node-ID + 64 (40_{hex})	PDO2
PDO7	own Node-ID + 64 (40_{hex})	PDO3
PDO8	own Node-ID + 64 (40_{hex})	PDO4
PDO9	own Node-ID + 96 (60_{hex})	PDO1
PDO10	own Node-ID + 96 (60_{hex})	PDO2
PDO11	own Node-ID + 96 (60_{hex})	PDO3
PDO12	own Node-ID + 96 (60_{hex})	PDO4
PDO13	own Node-ID + 32 (20_{hex})	PDO1
PDO14	own Node-ID + 32 (20_{hex})	PDO2
PDO15	own Node-ID + 32 (20_{hex})	PDO3
PDO16	own Node-ID + 32 (20_{hex})	PDO4

Mappable objects

The maximum of 64 mapping entries per PDO that is specified by Communication Profile CiA DS-301 is supported.

The following objects from the Object Dictionary can be mapped:

Table 33: Overview of mappable objects

Name	Index	Subindex	Direction
Dummy Mapping Boolean	0001_{hex}	-	Receive
Dummy Mapping Boolean Integer8	0002_{hex}	-	Receive
Dummy Mapping Boolean Integer16	0003_{hex}	-	Receive
Dummy Mapping Boolean Integer32	0004_{hex}	-	Receive
Dummy Mapping Boolean Unsigned8	0005_{hex}	-	Receive
Dummy Mapping Boolean Unsigned16	0006_{hex}	-	Receive
Dummy Mapping Boolean Unsigned32	0007_{hex}	-	Receive
Error Register	1001_{hex}	-	Transmit
Manu Spec Analog Input Range	5420_{hex}	1 to n	Transmit
RS232/RS4xx RxD	5601_{hex}	1 to n	Receive
RS232/RS4xx TxD	5602_{hex}	1 to n	Transmit
Encoder Status	5802_{hex}	1 to n	Transmit
Encoder Flags	5803_{hex}	1 to n	Transmit
SSI Native Status	5805_{hex}	1 to n	Transmit
SSI Optional Encoder Status	5806_{hex}	1 to n	Transmit
Encoder Control	5808_{hex}	1 to n	Receive
Read Input 8-Bit	6000_{hex}	1 to n	Transmit
Read Input Bit (1 to 128)[1)]	6020_{hex}	1 to n	Transmit

Name	Index	Subindex	Direction
Read Input 16-Bit	6100_{hex}	1 to n	Transmit
Read Input 32-Bit	6120_{hex}	1 to n	Transmit
Write Output 8-Bit	6200_{hex}	1 to n	Receive
Write Output Bit (1 to 128)[1)]	6220_{hex}	1 to n	Receive
Write Output 16-Bit	6300_{hex}	1 to n	Receive
Write Output 32-Bit	6320_{hex}	1 to n	Receive
Read Analog Input 16-Bit	6401_{hex}	1 to n	Transmit
Write Analog Output 16-Bit	6411_{hex}	1 to n	Receive
Position Value for Multi-Sensor Devices	6820_{hex}	1 to n	Transmit
Cam1 State Register	$6B00_{hex}$	1 to n	Transmit
Area State Register	$6C00_{hex}$	1 to n	Transmit

1) Objects XXX1 and XXX2 will be generated if the number of digital input or output channels exceeds the value 128 or 256 respectively.

Procedure for altering PDO mappings

The Communication Profile CiA DS-301 Version 4 defines a detailed procedure for altering PDO mappings.

For the XI/ON gateway, this results in the following method for modifying PDO mappings:

- • The node state of the gateway must be "Pre-Operational" (Bus LED orange).
- • The number of mapping entries (Sub-index 0) for a PDO must be set to 0.
- The mapping entries (Sub-index 1 to 64) can be written.
- The number of mapping entries (Sub-index 0) must now be set to the valid number of mapped objects.
- Alternatively, the new mapping can be saved in non-volatile memory (Store Communication Parameters).

The following Cancel Codes (Abort Domain Protocol) may be sent back by the gateway if there is an error:

Table 34: Cancel codes

Cancel code	Description as per CiA DS-301	Possible cause
0604 0041_{hex}	Object cannot be mapped	Invalid Object-Index transferred while writing the mapping entries.
0604 0042_{hex}	Number or length of the objects exceeds the PDO length	Attempted to map too many or excessively long objects to a PDO. This will be returned on writing to the Sub-index 0.
0609 0011_{hex}	Sub-index does not exist	A Sub-index > 64 was addressed.
0800 022_{hex}	Access not possible in this node state	Write access is only possible in the "Pre-Operational" node state. Write access to Sub-indices 1 to 64 is only possible if Sub-index 0 is written with the value 0.

5 Object dictionary for XI/ON in CANopen

Overview of all objects

The following table provides an overview of all the objects that are supported by XI/ON CANopen.

Table 35: Overview of all objects

Index	Page	Name
1000_{hex}	→ Page 120	Object 1000hex Device Type
1001_{hex}	→ Page 129	Object 1001hex Error Register
1005_{hex}	→ Page 139	Object 1005hex Sync COB-ID
1008_{hex}	→ Page 120	Object 1008hex Device Name
1009_{hex}	→ Page 121	Object 1009hex Manufacturer Hardware Version
$100A_{hex}$	→ Page 122	Object 100Ahex Manufacturer Software Version
$100C_{hex}$	→ Page 130	Object 100Chex Guard Time
$100D_{hex}$	→ Page 131	Object 100Dhex Life Time Factor
1010_{hex}	→ Page 137	Object 1010hex Store Parameters
1011_{hex}	→ Page 138	Object 1011hex Restore Default Parameters
1014_{hex}	→ Page 140	Object 1014hex Emcy COB-ID
1016_{hex}	→ Page 123	Object 1016hex Consumer Heartbeat Time
1017_{hex}	→ Page 134	Object 1017hex Producer Heartbeat Time
1018_{hex}	→ Page 123	Object 1018hex Identity Object
1020_{hex}	→ Page 142	Object 1020hex Verify Configuration
1027_{hex}	→ Page 142	Object 1027hex Module List
1200_{hex} to 1203_{hex}	→ Page 142	Objects 1200hex to 1203hex Server SDO Parameters
1400_{hex} to $141F_{hex}$	→ Page 145	Objects 1400hex to 141Fhex Receive PDO Parameters
1600_{hex} to $161F_{hex}$	→ Page 149	Objects 1600hex to 161Fhex Receive PDO Mapping Parameters

Index	Page	Name
1800_{hex} to $181F_{hex}$	→ Page 154	Objects 1800hex to 181Fhex Transmit PDO Parameters
$1A00_{hex}$ to $1A1F_{hex}$	→ Page 159	Objects 1A00hex to 1A1Fhex Transmit PDO Mapping Parameters
$1F80_{hex}$	→ Page 163	Object 1F80hex NMT Startup
$1F81_{hex}$	→ Page 165	Object 1F81hex Slave Assignment
$1F82_{hex}$	→ Page 167	Object 1F82hex Request NMT
$1F83_{hex}$	→ Page 169	Object 1F83hex Request Guarding
2000_{hex}	→ Page 171	Object 2000hex Serial Number
2010_{hex}	→ Page 171	Object 2010hex Behaviour Modifiers
2400_{hex}	→ Page 175	Object 2400hex System Voltages
3000_{hex} to 3097_{hex}	→ Page 170	Objects 3000hex to 3097hex

The descriptions of the following objects can be found in the product manuals for the XI/ON modules

Index	Name
5420_{hex}	Analog Input Mode
5440_{hex}	Analog Output Mode
5800_{hex}	Encoder Basic Mode
5801_{hex}	Encoder Config
5802_{hex}	Encoder Status
5803_{hex}	Encoder Flags
5804_{hex}	Encoder Diag
5805_{hex}	SSI Native Status
5806_{hex}	SSI Optional Encoder
5808_{hex}	Encoder Control
5810_{hex}	Encoder Load Prepare Value
5811_{hex}	Encoder Pulse Width
5820_{hex}	Measuring Integration Time

Index	Name
5821_{hex}	Measuring Low Limit
5822_{hex}	Measuring High Limit
5823_{hex}	Measuring Units per Revolution
5824_{hex}	Encoder Measuring Divisor
5825_{hex}	Encoder Measuring Factor
5827_{hex}	Encoder Measuring Time Out
5830_{hex}	Encoder Measuring Value
5831_{hex}	Encoder Latch Value
5901_{hex}	PWM Config
5902_{hex}	PWM Status
5903_{hex}	PWM Flags
5904_{hex}	PWM Diag
5908_{hex}	PWM Control
5910_{hex}	PWM Load Prepare Value
5913_{hex}	PWM Duty Cycle
5920_{hex}	PWM Period Duration
5931_{hex}	PWM Latch Value
6000_{hex}	Read Input 8-Bit
6020_{hex}	Read Input Bit 1 to 128
6021_{hex}	Read Input Bit 129 to 256
6022_{hex}	Read Input Bit 257 to 288
6100_{hex}	Read Input 16-Bit
6120_{hex}	Read Input 32-Bit
6200_{hex}	Write Output 8-Bit
6206_{hex}	Error Mode Output 8-Bit
6207_{hex}	Error Value Output 8-Bit
6220_{hex} to 6222_{hex}	Write Output Bit 1 to 128 to Write Output Bit 257 to 288

Index	Name
6250_{hex} to 6252_{hex}	Error Mode Output Bit 1 to 128 to Error Mode Output Bit 257 to 288
6260_{hex} to 6262_{hex}	Error Value Output Bit 1 to 128 to Error Value Output Bit 257 to 288
6300_{hex}	Write Output 16-Bit
6306_{hex}	Error Mode Output 16-Bit
6307_{hex}	Error Value Output 16-Bit
6320_{hex}	Write Output 32-Bit
6326_{hex}	Error Mode Output 32-Bit
6327_{hex}	Error Value Output 32-Bit
6401_{hex}	Read Analog Input 16-Bit
6411_{hex}	Write Analog Output 16-Bit
6421_{hex}	Analog Input Interrupt Source
6422_{hex}	Analog Input Interrupt Source
6423_{hex}	Analog Input Global Interrupt Enable
6424_{hex}	Analog Input Interrupt Upper Limit Integer
6425_{hex}	Analog Input Interrupt Lower Limit Integer
6426_{hex}	Analog Input Interrupt Delta Unsigned
6427_{hex}	Analog Input Interrupt Negative Delta Unsigned
6428_{hex}	Analog Input Interrupt Positive Delta Unsigned
6443_{hex}	Analog Output Error Mode
6444_{hex}	Analog Output Error Value Integer
$67FF_{hex}$	Device Type
6800_{hex}	Operating Parameters
6810_{hex}	Preset Value For Multi-Sensor Devices
6820_{hex}	Position Value for Multi-Sensor Devices
$6B00_{hex}$	CAM State Register
$6B01_{hex}$	CAM Enable register
$6B02_{hex}$	CAM Polarity register

Index	Name
$6B10_{hex}$	CAM1 Low Limit
$6B20_{hex}$	CAM1 High Limit
$6B30_{hex}$	CAM1 Hysteresis
6C00hex	Area State Register
$6C01_{hex}$	Work Area Low Limit
$6C02_{hex}$	Work Area High Limit
$6D00_{hex}$	Operating Status
$6D01_{hex}$	SingleTurn Resolution (rotary), Measuring Step (linear)
$6D02_{hex}$	Number Of Distinguishable Revolutions
$6FFF_{hex}$	Device Type

Object overview of the communication profile

The following table provides an overview of the supported entries in the Object Dictionary that are defined by the Communication Profile CiA DS-301:

Table 36: Object overview for the communication profile

Index (hex)	Object	Name	Type	Access	M/O
1000_{hex}	VAR	device type	Unsigned32	const	M
1001_{hex}	ARRAY	error register	Unsigned8	ro	M
1005_{hex}	VAR	COB-ID Sync Message	Unsigned32	rw	O
1008_{hex}	VAR	Manufacturer device name	Vis-String	const	O
1009_{hex}	VAR	Manufacturer hardware version	Vis-String	const	O
$100A_{hex}$	VAR	Manufacturer software version	Vis-String	const	O
$100C_{hex}$	VAR	Guard time	Unsigned32	rw	O
$100D_{hex}$	VAR	Life time Factor	Unsigned32	rw	O
1010_{hex}	ARRAY	Store Parameters	Unsigned32	rw	O
1011_{hex}	ARRAY	Restore Default Parameters	Unsigned32	rw	O
1014_{hex}	VAR	COB-ID Emergency	Unsigned32	rw	O
1016_{hex}	ARRAY	Consumer Heartbeat Time	Unsigned32	rw	O
1017_{hex}	VAR	Producer Heartbeat Time	Unsigned16	rw	O
1018_{hex}	RECORD	Identity Object	Identity	ro	O
1020_{hex}	ARRAY	Verify Configuration	Unsigned32	rw	O
1027_{hex}	ARRAY	Module List	Unsigned16	ro	M
Server SDO Parameter (22_{hex})					
1200_{hex}	RECORD	1st Server SDO Parameter	SDOParameter	ro	O
1201_{hex}	RECORD	2nd Server SDO Parameter	SDOParameter	rw	O

Index (hex)	Object	Name	Type	Access	M/O
1202_{hex}	RECORD	3rd Server SDO Parameter	SDOParameter	rw	O
1203_{hex}	RECORD	4th Server SDO Parameter	SDOParameter	rw	O
Receive PDO Communication Parameter (20_{hex})					
1400_{hex}	RECORD	1st receive PDO Parameter	PDOCommPar	rw	O
1401_{hex}	RECORD	2nd receive PDO Parameter	PDOCommPar	rw	O
1402_{hex}	RECORD	3rd receive PDO Parameter	PDOCommPar	rw	O
...	...	...	...	...	...
$141F_{hex}$	RECORD	32nd receive PDO Parameter	PDOCommPar	rw	O
Receive PDO Mapping Parameter (21_{hex})					
1600_{hex}	ARRAY	1st receive PDO Parameter	PDOMapping	rw	O
1601_{hex}	ARRAY	2nd receive PDO Parameter	PDOMapping	rw	O
1602_{hex}	ARRAY	3rd receive PDO mapping	PDOMapping	rw	O
...	...	...	...	...	...
$161F_{hex}$	ARRAY	32nd receive PDO mapping	PDOMapping	rw	O
Transmit PDO Communication Parameter (20_{hex})					
1800_{hex}	RECORD	1st transmit PDO Parameter	PDOCommPar	rw	O
1801_{hex}	RECORD	2nd transmit PDO Parameter	PDOCommPar	rw	O
1802_{hex}	RECORD	3rd transmit PDO Parameter	PDOCommPar	rw	O
...	...	...	...	...	...

Index (hex)	Object	Name	Type	Access	M/O
$181F_{hex}$	RECORD	32nd transmit PDO Parameter	PDOCommPar	rw	O
Transmit PDO Mapping Parameter (21_{hex})					
$1A00_{hex}$	ARRAY	1st transmit PDO mapping	PDOMapping	rw	O
$1A01_{hex}$	ARRAY	2nd transmit PDO mapping	PDOMapping	rw	O
$1A02_{hex}$	ARRAY	3rd transmit PDO mapping	PDOMapping	rw	O
...	...	...	...	...	...
$1A1F_{hex}$	ARRAY	32nd transmit PDO mapping	PDOMapping	rw	O
NMT master-related objects					
$1F80_{hex}$	VAR	NMT Startup	Unsigned32	rw	O
$1F81_{hex}$	ARRAY	Slave Assignment	Unsigned32	rw	O
$1F82_{hex}$	ARRAY	Request NMT	Unsigned8	rw	O
$1F83_{hex}$	ARRAY	Request Guarding	Unsigned8	rw	O

The column **Index (hex)** describes the position of the entry in the Object Dictionary.

The **object** column indicates the type of object.

The **Name** column shows a predefined symbolic name for the entry.

The **Type** column shows the data type of the entry predefined in CiA DS-301.

The **Access** column shows the access possibilities to the entry. These are as follows:

- rw (read/write) = write and reason
- ro (read only) = read only
- wo (write only) = write only
- const (constant) = constant / read only

The column **M/O** indicates whether the entry is mandatory or optional.

Information about the XI/ON station

Object 1000_{hex} Device Type

Object 1000_{hex} contains the Type and Function of the XI/ON station.

The value FFFF 0191_{hex} indicates that all Device Profiles are supported.

Table 37: Object 1000_{hex} Description

Features	Sub-index	Description / Value
Name		Device Type
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	FFFF 0191_{hex}

Object 1008_{hex} Device Name

The object 1008_{hex} contains the manufacturer-specific device name.

Table 38: Object 1008_{hex} Description

Features	Sub-index	Description / Value
Name		Device Name
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Visible String

Features	Sub-index	Description / Value
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	XN-GW-CANopen (with EDS file XN225163Vxxx) XN-GWBR-CANopen (with EDS file XN270325Vxxx) XNE-GWBR-CANopen (with EDS file XNE107591Vxxx)

Object 1009_{hex} Manufacturer Hardware Version

The object 1009_{hex} contains the designation for the Hardware Version.

Table 39: Object 1009_{hex} Description

Features	Sub-index	Description / Value
Name		Manufacturer Hardware Version
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Visible String
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	X/00 (XN-GW-CANopen) X/01 (XN-GWBR-CANopen) X/02 (XNE-GWBR-CANopen)

→ The value description corresponds to the state as delivered at the time this Product Description was printed.

Object $100A_{hex}$ Manufacturer Software Version

The object $100A_{hex}$ contains the designation for the Software Version.

Table 40: Object $100A_{hex}$ description

Features	Sub-index	Description / Value
Name		Manufacturer Software Version
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Visible String
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	4.04 (XN-GW-CANopen) 2.04 (XN-GWBR-CANopen) 1.04 (XNE-GWBR-CANopen)

→ The value description corresponds to the state as delivered at the time this user manual was printed.

Object 1018_{hex} Identity Object

The object 1018_{hex} contains the general information about the XI/ON gateway.

The Vendor-ID (Sub-index 01_{hex}) is a unique ID which precisely identifies the manufacturer. The manufacturer-specific Product Code (Sub-index 02_{hex}) identifies a specific device version. The manufacturer-specific Revision Number (Sub-index 03_{hex}) consists of a main revision number and a sub-revision number. The main revision number defines a special CANopen functionality. If the CANopen functionality is expanded, then the main revision number must be incremented. The sub-revision number identifies various versions that have the same CANopen functionality.

Table 41: Object 1018_{hex} Description

Features	Sub-index	Description / Value
Name		Identity Object
Object Code		RECORD
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to 04_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to 04_{hex}	ro
Function	Sub-index 00_{hex}	No. of entries
	Sub-index 01_{hex}	Manufacturer ID
	Sub-index 02_{hex}	Product Code (here: order number)
	Sub-index 03_{hex}	Revision number
	Sub-index 04_{hex}	Series number
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01_{hex}	00000003_{hex}
	Sub-index 02_{hex}	Order number: 225163 (XN-GW-CANopen) 270325 (XN-GWBR-CANopen) 107591 (XNE-GWBR-CANopen)
	Sub-index 03_{hex}	Revision numbers[1]: 00040004_{hex} (XN-GW-CANopen) 00020004_{hex} (XN-GWBR-CANopen) 00010004_{hex} (XNE-GWBR-CANopen)
	Sub-index 04_{hex}	No

1) The revision numbers are up to date as of the date of publication of this Product Description.

Table 42: Bit structure for the revision number

msb		**lsb**
31	15	0
Main revision number	Sub-revision number	

Object 1020_{hex} Verify Configuration

The object 1020_{hex} is used for checking the station configuration after a device reset.

The XI/ON-CANopen gateway supports the non-volatile storage of parameters. A network configuration tool or a CANopen Manager can use object 1020_{hex} to test the station configuration after a reset, and so check whether a reconfiguration is necessary. The configuration tool saves the time and date simultaneously in object 1020_{hex} and the corresponding DCF file. After a reset, the most recent configuration and the signature will be restored, either automatically or on request. If the configuration values are altered by some other command, then the object will be set to 0.

The Configuration Manager compares the signature and the configuration with the values from the DCF file. If it discovers any deviations, a reconfiguration will be necessary.

Table 43: Object 1020_{hex} Description

Features	Sub-index	Description / Value
Name		Verify Configuration
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to 04_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to 02_{hex}	ro
Function	Sub-index 00_{hex}	No. of entries
	Sub-index 01_{hex}	Configuration data
	Sub-index 02_{hex}	Configuration time
XI/ON default value	Sub-index 00_{hex} to 02_{hex}	No

→ The configuration date contains the number of days since January 01 1984.
The configuration time contains the number of milliseconds since midnight.

Object 1027_{hex} Module List

The object 1027_{hex} describes all the currently installed modules in a XI/ON station.

Table 44: Object 1027_{hex} Description

Features	Sub-index	Description / Value
Name		Module List
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to $4A_{hex}$	Unsigned16
Function	Sub-index 00_{hex}	Number of modules in this station
	Sub-index 01_{hex} to $4A_{hex}$	Identifier for the modules of the station (max. 74)
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	No

The sequential Sub-indices $01_{hex} \leqq nh \leqq 4A_{hex}$ (74 dec) describe the corresponding XI/ON modules in the order in which they are installed in the XI/ON station. Each entry contains a number that identifies the particular module.

→ One identifier exists for each type of XI/ON module.

The EDS file contains the individual extensions of object 1027_{hex} (e.g. M1SubExt1027) for all the optional XI/ON module types listed in the section [SupportedModules]. The default values (e.g. DefaultValue=0x8000) correspond to the identifiers for the particular module types (e.g.[M1ModuleInfo] ProductName=Generic XN-BR/-PF).

Error Register

Object 1001_{hex} Error Register

The object 1001_{hex} Error Register contains the Error Register for the XI/ON-CANopen gateway. It thus contains in one byte the internal errors that occur.

Table 45: Object 1001_{hex} Description

Features	Sub-index	Description / Value
Name		Error Register
Object Code		VAR
PDO Mapping		Yes
Data Type	Sub-index 00_{hex}	Unsigned8
Access	Sub-index 00_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	No

Error Register

Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
generic	Current	Voltage	0	Comm.	0	0	Manu.

Abbreviations		I/O module type
generic	General error	all
Current	Output short-circuit/ current error	DO, AI,THERMO
Voltage	Voltage error	BR, PF, DO, AI, AO
Comm.	Communication error	all
Manu.	Manufacturer specific error	all

Monitoring of operational readiness

Object $100C_{hex}$ Guard Time

A message is sent to the CANopen node at fixed intervals. The length of the interval is defined with the "Guard time". If the CANopen node does not signal with the defined Guard COB-ID, it is assigned the Timeout status. The number of failed attempts until the CANopen node is classified as "not OK" is defined as the "Lifetime factor" (Object $100D_{hex}$).

Table 46: Object $100C_{hex}$ description

Features	Sub-index	Description / Value
Name		Guard Time
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned 16
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	0

Object $100D_{hex}$ Life Time Factor

The number of failed attempts until the CANopen node is classified as "not OK" is defined as the "Lifetime factor".

The length of the interval between the attempts is defined with the "Guard time" (Object $100C_{hex}$).

Table 47: Object $100D_{hex}$ description

Features	Sub-index	Description / Value
Name		Life Time Factor
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned 8
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	0

Object 1016_{hex} Consumer Heartbeat Time

The Heartbeat Protocol is used to monitor the operational readiness of other CANopen bus nodes.

The failure of a CANopen node can be registered by all stations.

Object 1016_{hex} defines the cycle time (interval) at which the Heartbeat is expected.

A device generates the Heartbeat with a specific cycle time (see object 1017_{hex} "Producer Heartbeat Time"). Another device receives the Heartbeat and monitors the cycle time.

This cycle time should be longer than the corresponding cycle time for the transmitter (see object 1017_{hex}). The monitoring of the Heartbeat starts when the first Heartbeat Frame is received.
If the Consumer Heartbeat Time = 0, then the corresponding entry will not be used.

The time is set as a multiple of 1 ms.

The Heartbeat Protocol must be seen as an alternative to Node/Life Guarding, which, unlike Guarding, does not use Remote Frames.

Table 48: Object 1016_{hex} Description

Features	Sub-index	Description / Value
Name		Consumer Heartbeat Time
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	0001_{hex}
	Sub-index 01_{hex}	0

Table 49: Structure of the entry for Consumer Heartbeat Time (Unsigned32)

	msb		lsb
Bits	31 to 24	23 to 16	15 to 0
Value	reserved (Default: 00_{hex})	Node-ID	Heartbeat Time
Data Type	–	Unsigned8	Unsigned16

Object 1017_{hex} Producer Heartbeat Time

The CANopen node uses the Heartbeat signals to indicate to all nodes of a CANopen network that it is operational, even if data traffic has not taken place for a long time.

The object 1017_{hex} defines the cycle time for the Heartbeat.

The failure of a CANopen node can be registered by all stations.

If the cycle time = 0, the Heartbeat is not used. The content of the object is interpreted as a multiple of 1 ms.

Table 50: Object 1017_{hex} Description

Features	Sub-index	Description / Value
Name		Producer Heartbeat Time
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned16
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	0

"Store/Load Parameters" commands

Parameter changes that are made through SDO access are only stored in volatile memory. All alterations that are made by the user will be replaced by default values at the next Reset Communication, Reset Node or Power-ON Boot-Up.

With XI/ON, it is possible to use a command to make a permanent save of the communication and/or application parameters. This is done through the "Store Parameters" command (Object 1010_{hex} Sub-index 1 to 3). The command is executed by using an SDO to write the data contents 6576 6173_{hex} ("save") to one of the following entries:

- 1010_{hex} Sub-index 1 saves all parameters
- 1010_{hex} Sub-index 2 saves all communication parameters
- 1010_{hex} Sub-index 3 saves all device parameters

(see CiA DS-301 V4.01)

Table 51: Data contents 6576 6173_{hex} ("save")

	msb			**lsb**
ASCII	e	v	a	s
HEX	65_{hex}	76_{hex}	61_{hex}	73_{hex}

Since in some circumstances it may not be possible to restore the original memory contents after a lot of alterations, XI/ON supports the "Restore Default Parameter" command (Object 1011_{hex} Sub-index 1 to 3) with the following data contents: 6461 $6F6C_{hex}$ ("load").

Table 52: Data contents 6461 $6F6C_{hex}$ ("load")

	msb			**lsb**
ASCII	d	a	O	l
HEX	64_{hex}	61_{hex}	$6F_{hex}$	$6C_{hex}$

The division of the sub-entries corresponds to that for the "Store Parameters" command.

After the command "Restore Default Parameters", a Reset Node must be executed, followed by a "Store Parameters" command. The default values are only saved again when this last command is executed.

Object 1010_{hex} Store Parameters

The object 1010_{hex} can be used to store parameter changes in non-volatile memory. The command is executed by writing the data contents $6576\ 6173_{hex}$ ("save") to the sub-index with the required function.

Table 53: Object 1010_{hex} Description

Features	Sub-index	Description / Value
Name		Store Parameters
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to 03_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to 03_{hex}	rw
Function	Sub-index 01_{hex}	Store all parameters
	Sub-index 02_{hex}	Store the communication parameters
	Sub-index 03_{hex}	Store the application parameters
XI/ON default value	Sub-index 00_{hex}	3
	Sub-index 01_{hex} to 03_{hex}	00000001_{hex}

Object 1011_{hex} Restore Default Parameters

Object 1011_{hex} can be used to restore the default parameters. The command is executed by writing the data contents 6461 $6F6C_{hex}$ ("load") to the sub-index with the required function.

Table 54: Object 1011_{hex} Description

Features	Sub-index	Description / Value
Name		Restore Default Parameters
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to 03_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to 03_{hex}	rw
Function	Sub-index 01_{hex}	Restore all parameters
	Sub-index 02_{hex}	Restore the communication parameters
	Sub-index 03_{hex}	Restore the application parameters
XI/ON default value	Sub-index 00_{hex}	3
	Sub-index 01_{hex} to 03_{hex}	00000001_{hex}

Identifiers of Synchronization and Emergency

Object 1005_{hex} Sync COB-ID

The object 1005_{hex} defines the COB-ID and thus the priority (→ Chapter "Identifier for the standard objects", Page 77) of the Synchronization object (SYNC). The XI/ON-CANopen gateway cannot generate SYNC messages, only receive them. The reception of a synchronization message initiates the transfer of the process data simultaneously for all recipients. In this way, outputs can be set simultaneously or inputs read in parallel.

Table 55: Object 1005_{hex} Description

Features	Sub-index	Description / Value
Name		SYNC COB-ID
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned32
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	$0000\ 0080_{hex}$

Table 56: Structure of the SYNC COB-ID entry (Unsigned32)

	msb				lsb
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID[1)]	X	0	0	00 0000 0000 0000 0000	00010000000 11-bit Identifier
29-bit ID	X	0	1	29-bit Identifier	

1) XI/ON

Table 57: Description of the SYNC COB-ID entry

Bit number	Value	Description
31 (MSB)	X	fixed
30	0[1)] 1	Module does not generate a SYNC message Module generates SYNC message
29	0[1)] 1	11-bit ID (CAN 2.0A) 29-bit ID (CAN 2.0B)
28 to 11	0 X	if Bit 29 = 0 if Bit 29 = 1: Bits 28 to 11 of the SYNC-COB-ID
10 to 0 (lsb)	X	Bit 10 to 0 of the SYNC-COB-ID

1) XI/ON

→ Bit 30 is static, i.e. cannot be changed.

Object 1014_{hex} Emcy COB-ID

Object 1014_{hex} contains the identifier for the Emergency messages (→ Chapter "Identifier for the standard objects", Page 77).

Table 58: Object 1014_{hex} Description

Features	Sub-index	Description / Value
Name		Emcy COB-ID
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned32
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	0000 0080_{hex}+Node-ID

Table 59: Structure of the Emcy COB-ID entry (Unsigned32)

	msb				lsb
Bits	**31**	**30**	**29**	**28 to 11**	**10 to 0**
11-bit ID	0/1	0	0	00 0000 0000 0000 0000	11-bit Identifier
29-bit ID	0/1	0	1	29-bit Identifier	

Table 60: Description of the Emcy COB-ID entry

Bit number	Value	Description
31 (MSB)	0 1	EMCY exists / is valid EMCY does not exist / is not valid
30	0	reserved (always 0)
29	0 1	1-bit ID (CAN 2.0A) → for XI/ON 29-bit ID (CAN 2.0B)
28 to 11	0 X	if Bit 29 = 0 if Bit 29 = 1: Bits 28 to 11 of the 29-bit-COB-ID
10 to 0 (LSB)	X	Bit 10 to 0 of the COB-ID

→ Bit 30 is static, i.e. cannot be changed.

Transfer of service data

Objects 1200_{hex} to 1203_{hex} Server SDO Parameters

The objects 1200_{hex} to 1203_{hex} define the priority for the transfer of SDO**1** to SDO4.

The priority of the data is defined by the identifier/COB-ID.

Table 61: Object 1200_{hex} to 1203_{hex} Description

Features	Sub-index	Description / Value
Name		Server SDO Parameter
Object Code		RECORD
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex}	Unsigned32
	Sub-index 02_{hex}	Unsigned32
Function	Sub-index 00_{hex}	No. of entries
	Sub-index 01_{hex}	COB-ID Client->Server
	Sub-index 02_{hex}	COB-ID Server->Client
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex}	• ro: Object 1200_{hex} • rw: Object 1201_{hex} to Object 1203_{hex}
	Sub-index 02_{hex}	• ro: Object 1200_{hex} • rw: Object 1201_{hex} to Object 1203_{hex}

Features	Sub-index	Description / Value
XI/ON default value	Sub-index 00_{hex}	2
	Sub-index 01_{hex}	• Node ID + 00000600_{hex}: Object 1200_{hex} • No: Object 1201_{hex} to Object 1203_{hex}
	Sub-index 02_{hex}	• Node ID + 00000580_{hex}: Object 1200_{hex} • No: Object 1201_{hex} to Object 1203_{hex}

Transfer of process output data

The objects 1400_{hex} to $141F_{hex}$ define together with objects 1600_{hex} to $161F_{hex}$ which output data with which priority and with which transmission type are to be transferred with the RPDO transfer.

The object 1400_{hex} defines the priority and the transmission type for the RPDO**1**. The object 1600_{hex} states the object index, sub-index and the data length for the data to be transferred with RPDO**1**.

The object 1401_{hex} together with object 1601_{hex} provides this information accordingly for the RPDO**2** etc.

The priority of the data is defined by the identifier/COB-ID.

For objects 1400_{hex} to 1403_{hex} and 1600_{hex} to 1603_{hex} the values are already entered by default.

A station with up to 64 digital outputs and 12 analog outputs therefore transfers the process output data automatically via RPDOs.

Objects 1400_{hex} to $141F_{hex}$ Receive PDO Parameters

The objects 1400_{hex} to $141F_{hex}$ define the priority and the transmission type for the RPDO1 to RPDDO32.

The priority is defined with the identifier/COB-ID (→ Chapter "Identifier for the standard objects", Page 77) via the sub-index 01_{hex}. The remaining content can be defined as invalid/valid with the most significant bit of sub-index 01_{hex}. The corresponding most significant hexadecimal number is then >8.

The transmission type is defined with the sub-index 02_{hex}. Possible transmission types are shown in Table 65, Page 148.

Which data content is to be transferred with the RPDO1 to RPDO32 is defined with the objects 1600_{hex} to $161F_{hex}$.

Table 62: Object 1400_{hex} to $141F_{hex}$ Description

Features	Sub-index	Description / Value
Name		Receive PDO Parameters
Object Code		RECORD
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex}	Unsigned32
	Sub-index 02_{hex}	Unsigned8
Function	Sub-index 00_{hex}	No. of entries
	Sub-index 01_{hex}	PDO COB-ID (→ Chapter "Identifier for the standard objects", Page 77)
	Sub-index 02_{hex}	Transmission Type (→ Table 65, Page 148)
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex}	rw
	Sub-index 02_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	02_{hex}
	Sub-index 01_{hex}	• Node ID + 00000200_{hex}: Object 1400_{hex} • Node ID + 00000300_{hex}: Object 1401_{hex} • Node ID + 00000400_{hex}: Object 1402_{hex} • Node ID + 00000500_{hex}: Object 1403_{hex} • Node ID + $80000XXX_{hex}$: Object 1404_{hex} to $140F_{hex}$: The identifiers are provided but not enabled • 80000000_{hex}: Object $140F_{hex}$ to $141F_{hex}$
	Sub-index 02_{hex}	FF_{hex} (255)

COB-ID:

Sub-index 01_{hex} shows the following structure:

Table 63: Structure of the COB-ID entry (Sub-index 01_{hex})

	msb				lsb
Bits	31	30	29	28 to 11	10 to 0
11-bit ID	0 / 1	0 / 1	0	00 0000 0000 0000 0000	11-bit Identifier
29-bit ID	0 / 1	0 / 1	1	29-bit Identifier	

Table 64: Description of the COB-ID entry (Sub-index 01_{hex})

Bit number	Value	Meaning
31 (msb)	0	PDO exists / is valid
	1	PDO does not exist / is invalid
30	0	RTR is possible with this PDO
	1	RTR is not possible with this PDO
29	0	11-bit ID (CAN 2.0A) (standard application)
	1	29-bit ID (CAN 2.0B)
28 to 11	0	If Bit 29=0 (standard application)
	X	If Bit 29=1: Bits 28 to 11 of the COB-ID
10 to 0 (lsb)	X	Bit 10 to 0 of the COB-ID

Transmission type:

Sub-index 02_{hex} can assume the following structure:

Table 65: Description of transmission type

Value	PDO transmission				
	cyclic	acyclic	synchronous	asynchronous	only with RTR
0		X	X		
1	X		X		
2 to 254	reserved				
255				X	

Objects 1600_{hex} to $161F_{hex}$ Receive PDO Mapping Parameters

The objects 1600_{hex} to $161F_{hex}$ state which data content is to be transferred with the RPDO1 to RPDO32. The data content itself (in this case: process output data) is represented with product-specific, mappable objects.

→ Chapter "Mappable objects", Page 107.

The process output data for the digital channels is entered, for example, in the objects 6200_{hex}, 6220_{hex} etc.

These objects are described in the respective user manuals.

The entry in the sub-index 01_{hex} to 40_{hex} of the objects 1600_{hex} to $161F_{hex}$ comprises the object number, the sub-index and the length of the data content which is to be transferred with the respective RPDO.

An RPDO can transfer up to 8 bytes (64 bits).

The number of sub-indices depends on the data length and must be calculated and entered by the user for larger projects (see below).

Eight sub-indices are required for a data length of 8 bits, in order to represent a total of 64 bits. A data length of 1 bit requires 64 sub-indices for a total of 64 bits.

Object 1600_{hex} to 1603_{hex} (RPDO1 to RPDO4) references by default the values for the first 64 digital output channels and the values for the first 12 analog output channels. This requires the values to be represented with the object 6200_{hex} (digital values) and the object 6411_{hex} (analog values).

Table 66: Object 1600_{hex} to $161F_{hex}$ Description

Features	Sub-index	Description / Value
Name		Receive PDO Mapping Parameters
Object Code		RECORD
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index 40_{hex}	Unsigned32
Function		
1600_{hex} to 1603_{hex}	→ Table 67, Page 151	
1604_{hex} to $161F_{hex}$	Sub-index 00_{hex}	Number of entries (depending on the data length)
	Sub-index 01_{hex}	1st Mapped Application Object
	Sub-index 02_{hex}	2nd Mapped Application Object
	Sub-index 03_{hex}	3rd Mapped Application Object
	...	...
	Sub-index 40_{hex}	64th Mapped Application Object
Access	Sub-index 00_{hex}	rw
	Sub-index 01_{hex} to Sub-index 08_{hex}	rw
XI/ON default value		
1600_{hex} to 1603_{hex}	→ Table 67, Page 151	
1604_{hex} to $161F_{hex}$	Sub-index 00_{hex} to Sub-index 40_{hex}	No

→ The number of mapping objects, which are automatically generated by the gateway during start-up, depends on the actual physical structure of the XI/ON station.

Table 67: Set default values for objects 1600_{hex} to 1603_{hex}

Object	Sub-index	XI/ON default value	Description	for
1600_{hex}	01_{hex}	6200 0108_{hex}	1st Mapping Object (digital output)	RPDO1
	02_{hex}	6200 0208_{hex}	2nd Mapping Object (digital output)	
	03_{hex}	6200 0308_{hex}	3rd Mapping Object (digital output)	
	04_{hex}	6200 0408_{hex}	4th Mapping Object (digital output)	
	05_{hex}	6200 0508_{hex}	5th Mapping Object (digital output)	
	06_{hex}	6200 0608_{hex}	6th Mapping Object (digital output)	
	07_{hex}	6200 0708_{hex}	7th Mapping Object (digital output)	
	08_{hex}	6200 0808_{hex}	8th Mapping Object (digital output)	
1601_{hex}	01_{hex}	6411 0110_{hex}	1st Mapping Object (analog output)	RPDO2
	02_{hex}	6411 0210_{hex}	2nd Mapping Object (analog output)	
	03_{hex}	6411 0310_{hex}	3rd Mapping Object (analog output)	
	04_{hex}	6411 0410_{hex}	4th Mapping Object (analog output)	

Object	Sub-index	XI/ON default value	Description	for
1602_{hex}	01_{hex}	6411 0510_{hex}	1st Mapping Object (analog output)	RPDO3
	02_{hex}	6411 0610_{hex}	2nd Mapping Object (analog output)	
	03_{hex}	6411 0710_{hex}	3rd Mapping Object (analog output)	
	04_{hex}	6411 0810_{hex}	4th Mapping Object (analog output)	
1603_{hex}	01_{hex}	6411 0910_{hex}	1st Mapping Object (analog output)	RPDO4
	02_{hex}	6411 $0A10_{hex}$	2nd Mapping Object (analog output)	
	03_{hex}	6411 $0B10_{hex}$	3rd Mapping Object (analog output)	
	04_{hex}	6411 $0C10_{hex}$	4th Mapping Object (analog output)	

The following structure is used for the parameters of the sub-indices 01_{hex} to 40_{hex}:

Table 68: Structure of the PDO mapping entries

msb		lsb
Object-index (16 bit)	Sub-index (8 bit)	Object length (8 bit)

→ Observe the instructions given in Chapter "Procedure for altering PDO mappings", Page 109 for changing the number of mapping entries.

Transfer of process input data

The objects 1800_{hex} to $181F_{hex}$ define together with objects $1A00_{hex}$ to $1A1F_{hex}$ which output data with which priority and with which transmission type are to be transferred with the TPDO transfer.

The object 1800_{hex} defines the priority, the Inhibit Time, the maximum interval (Event Time) between two transmissions and the transmission type for the TPDO**1**. The object $1A00_{hex}$ states the object index, sub-index and the data length for the data to be transferred with TPDO**1**.

The object 1801_{hex} together with object $1A01_{hex}$ provides this information accordingly for the TPDO**2** etc.

The priority of the data is defined by the identifier/COB-ID.

The values are already entered by default for objects 1800_{hex} to 1803_{hex} and $1A00_{hex}$ to $1A03_{hex}$.

A station with up to 64 digital inputs and 12 analog inputs therefore transfers the process input data automatically via TPDOs.

Objects 1800_{hex} to $181F_{hex}$ Transmit PDO Parameters

The objects 1800_{hex} to $181F_{hex}$ define the priority, the Inhibit Time, the maximum interval (Event Time) between two transmissions and the transmission type for TPDO1 to TPDO32.

The priority is defined with the identifier/COB-ID (→ Chapter "Identifier for the standard objects", Page 77) via the sub-index 01_{hex}. The remaining content can be defined as invalid/valid with the most significant bit of sub-index 01_{hex}. The corresponding most significant hexadecimal number is then >8.

The transmission type is defined with the sub-index 02_{hex}. Possible transmission types are shown in Table 65, Page 148.

The minimum inhibit time is defined with the sub-index 03_{hex}.

The maximum interval (Event Time) between two transmissions is defined with sub-index 05_{hex}.

Which data content is to be transferred with the RPDO1 to RPDO32 is defined with the objects $1A00_{hex}$ to $1A1F_{hex}$.

Table 69: Object 1800_{hex} to $181F_{hex}$ Description

Features	Sub-index	Description / Value
Name		Transmit PDO Communication Parameters
Object Code		RECORD
PDO Mapping		No
Parameter name	Sub-index 00_{hex}	Number of Entries
	Sub-index 01_{hex}	COB-ID (→ Chapter "Identifier for the standard objects", Page 77)
	Sub-index 02_{hex}	Transmission Type (→ Table 72, Page 158)
	Sub-index 03_{hex}	Inhibit Time (→ Chapter "The minimum inhibit time", Page 158)
	Sub-index 04_{hex}	Reserved
	Sub-index 05_{hex}	Event Time (→ Chapter "The maximum interval (Event Time) between two transmissions", Page 158)
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex}	Unsigned32
	Sub-index 02_{hex}	Unsigned8
	Sub-index 03_{hex}	Unsigned16
	Sub-index 04_{hex}	Unsigned8
	Sub-index 05_{hex}	Unsigned16
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to 05_{hex}	rw

Features	Sub-index	Description / Value
XI/ON default value	Sub-index 00_{hex}	5
	Sub-index 01_{hex}	• Index 1800_{hex}: $0000\ 0180_{hex}$ + Node-ID • Index 1801_{hex}: $0000\ 0280_{hex}$ + Node-ID • Index 1802_{hex}: $0000\ 0380_{hex}$ + Node-ID • Index 1803_{hex}: $0000\ 0480_{hex}$ + Node-ID • Index 1804_{hex} to $181F_{hex}$: Invalid
	Sub-index 02_{hex}	255
	Sub-index 03_{hex} to 05_{hex}	0000_{hex}

The COB-ID:

Sub-index 01_{hex} shows the following structure:

Table 70: Structure of the COB-ID entry (Sub-index 01_{hex})

	msb				lsb
Bits	31	30	29	28 to 11	10 to 0
11-bit ID	0 / 1	0 / 1	0	00 0000 0000 0000 0000	11-bit Identifier
29-bit ID	0 / 1	0 / 1	1	29-bit Identifier	

Table 71: Description of the COB-ID entry (Sub-index 01_{hex})

Bit number	Value	Meaning
31 (msb)	0	PDO exists / is valid
	1	PDO does not exist / is invalid
30	0	RTR is possible with this PDO
	1	RTR is not possible with this PDO
29	0	11-bit ID (CAN 2.0A) (standard application)
	1	29-bit ID (CAN 2.0B)
28 to 11	0	If Bit 29=0 (standard application)
	X	If Bit 29=1: Bits 28 to 11 of the COB-ID
10 to 0 (lsb)	X	Bit 10 to 0 of the COB-ID

Transmission type:

Sub-index 02_{hex} can assume the following structure:

Table 72: Description of transmission type

Transmission type	PDO transmission				
	cyclic	acyclic	synchronous	asynchronous	only with RTR
0		X	X		
1	X		X		
2 to 252	reserved				
253				X	X
254	reserved				
255				X	

The minimum inhibit time
The Inhibit Time is defined as the time between two transmissions so that high-priority messages to do not constantly load the bus.
The Inhibit Time is defined with sub-index 03_{hex} as the multiple of 100 µs. However, since the time resolution of the system clock in the XI/ON-CANopen gateway is 1 ms, Inhibit Time values below 10 × 100 µs have no effect.

The maximum interval (Event Time) between two transmissions
Sub-index 05_{hex} defines the maximum interval after which a TPDO will be transmitted, even though no event has occurred. The expiry of the interval set for the Event Time is detected as an event. If any other event occurs, the Event Time is reset and restarted.
The value of the object is interpreted as a multiple of 1 ms.

Objects $1A00_{hex}$ to $1A1F_{hex}$ Transmit PDO Mapping Parameters

The objects $1A00_{hex}$ to $1A1F_{hex}$ state which data content is to be transferred with the TPDO1 to TPDO32. The data content itself (in this case: process input data) is represented with product-specific, mappable objects.

→ Chapter "Mappable objects", Page 107.

The process input data for the digital channels are entered, for example, in the objects 6000_{hex}, 6020_{hex} etc.

These objects are described in the respective user manuals.

The entry in the sub-index 01_{hex} to 40_{hex} of the objects $1A00_{hex}$ to $1A1F_{hex}$ comprises the object number, the sub-index and the length of the data content which is to be transferred with the respective TPDO.

A TPDO can transfer up to 8 bytes (64 bits).

The number of sub-indices depends on the data length and must be calculated and entered by the user for larger projects (see below).

8 sub-indices are required for a data length of 8 bits in order to represent a total of 64 bits. A data length of 1 bit requires 64 sub-indices for a total of 64 bits.

Object $1A00_{hex}$ to $1A03_{hex}$ (TPDO1 to TPDO4) references by default the values for the first 64 digital input channels and the values for the first 12 analog input channels. This requires the values to be represented with the object 6000_{hex} (digital values) and the object 6401_{hex} (analog values).

Table 73: Object $1A00_{hex}$ to $1A1F_{hex}$ Description

Features	Sub-index	Description / Value
Name		Transmit PDO Mapping Parameters
Object Code		RECORD
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index 40_{hex}	Unsigned32
Function		
$1A00_{hex}$ to $1A03_{hex}$	→ Table 74, Page 161	
$1A03_{hex}$ to $1A1F_{hex}$	Sub-index 00_{hex}	Number of entries (depending on the data length)
	Sub-index 01_{hex}	1st Mapped Application Object
	Sub-index 02_{hex}	2nd Mapped Application Object
	Sub-index 03_{hex}	3rd Mapped Application Object
	...	...
	Sub-index 40_{hex}	64th Mapped Application Object
Access	Sub-index 00_{hex}	rw
	Sub-index 01_{hex} to Sub-index 08_{hex}	rw
XI/ON default value		
$1A00_{hex}$ to $1A03_{hex}$	→ Table 74, Page 161	
$1A04_{hex}$ to $1A1F_{hex}$	Sub-index 00_{hex} to Sub-index 40_{hex}	No

→ The number of mapping objects, which are automatically generated by the gateway during start-up, depends on the actual physical structure of the XI/ON station.

Table 74: Set default values for objects $1A00_{hex}$ to $1A03_{hex}$

Object	Sub-index	XI/ON default value	Description	for
$1A00_{hex}$	01_{hex}	6000 0108_{hex}	1st Mapping Object (digital input)	TPDO1
	02_{hex}	6000 0208_{hex}	2nd Mapping Object (digital input)	
	03_{hex}	6000 0308_{hex}	3rd Mapping Object (digital input)	
	04_{hex}	6000 0408_{hex}	4th Mapping Object (digital input)	
	05_{hex}	6000 0508_{hex}	5th Mapping Object (digital input)	
	06_{hex}	6000 0608_{hex}	6th Mapping Object (digital input)	
	07_{hex}	6000 0708_{hex}	7th Mapping Object (digital input)	
	08_{hex}	6000 0808_{hex}	8th Mapping Object (digital input)	
$1A01_{hex}$	01_{hex}	6401 0110_{hex}	1st Mapping Object (analog input)	TPDO2
	02_{hex}	6401 0210_{hex}	2nd Mapping Object (analog input)	
	03_{hex}	6401 0310_{hex}	3rd Mapping Object (analog input)	
	04_{hex}	6401 0410_{hex}	4th Mapping Object (analog input)	

Object	Sub-index	XI/ON default value	Description	for
$1A02_{hex}$	01_{hex}	6401 0510_{hex}	1st Mapping Object (analog input)	TPDO3
	02_{hex}	6401 0610_{hex}	2nd Mapping Object (analog input)	
	03 h	6401 0710_{hex}	3rd Mapping Object (analog input)	
	04_{hex}	6401 0810_{hex}	4th Mapping Object (analog input)	
$1A03_{hex}$	01_{hex}	6401 0910_{hex}	1st Mapping Object (analog input)	TPDO4
	02_{hex}	6401 $0A10_{hex}$	2nd Mapping Object (analog input)	
	03_{hex}	6401 $0B10_{hex}$	3rd Mapping Object (analog input)	
	04_{hex}	6401 $0C10_{hex}$	4th Mapping Object (analog input)	

The following structure is used for the parameters of the sub-indices 01_{hex} to 40_{hex}:

Table 75: Structure of the PDO mapping entries

msb		lsb
Object-index (16 bit)	Sub-index (8 bit)	Object length (8 bit)

→ To change the number of mapping entries follow the instructions in the section "Procedure for altering PDO mappings" in this chapter.

Network management

The objects $1F80_{hex}$ to $1F83_{hex}$ are only relevant if the XI/ON station is required to perform the functions of a network management master. The definition: "The XI/ON station is the NMT master" is executed via bit 0 of object $1F80_{hex}$.

Object $1F80_{hex}$ NMT Startup

The object $1F80_{hex}$ describes the startup behavior of XI/ON in the NMT (network management).

Table 76: Object $1F80_{hex}$ Description

Features	Sub-index	Description / Value
Name		NMT StartUp
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned32
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	No

Table 77: Structure of the entry

Bit	Value	Meaning
0	0	The XI/ON station is not the NMT master. All other bits are ignored. The objects in the network list are ignored.
	1	The XI/ON station is the NMT master.
1	0	Only the explicitly selected slaves are started.
	1	After the boot-up the service "NMT Start Remote Node All Nodes" is executed.
2	0	XI/ON switches automatically to "Operational" status.
	1	XI/ON does not switch automatically to "Operational" status. The status change is defined by the respective application.
3	0	The start of the slave is permitted.
	1	The start of the slave is not permitted.
4	0	An error event of an obligatory slave treats the slave individually.
	1	An error event of an obligatory slave initiates an NMT Reset All Nodes (see "Object $1F81_{hex}$", bit 3).
5 to 31		Reserve; set to 0

Object $1F81_{hex}$ Slave Assignment

The object $1F81_{hex}$ describes as per CiA DSP-302 all slaves that are connected to the NMT master. It contains the information on error control parameters and on actions that were triggered by error events. All other parameters for a slave are only valid if this slave is described in object $1F81_{hex}$.

→ The object $1F81_{hex}$ is only valid if the XI/ON is defined as the NMT master (see object $1F80_{hex}$, bit 0).

Table 78: Object $1F81_{hex}$ Description

Features	Sub-index	Description / Value
Name		Slave Assignment
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	Unsigned32
Function	Sub-index 00_{hex}	Supported number of slaves
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	Entry for slave with Node-ID 1 to 127 (→ Table 79, Page 166)
Access	Sub-index 00_{hex} to Sub-index $7F_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	127
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	No

→ Each sub-index corresponds to the slave with the particular Node-ID. The sub-index with the Node-ID of the NMT master is ignored.

Table 79: Structure of the entry

Byte	Bit	Value	Meaning
0	0	0	The node with this ID is not a slave.
		1	The node with this ID is a slave. After configuration, the node will be put into the "Operational" state.
	1	0	An error event or other event detection by a slave during boot-up leads to the notification of the application.
		1	An error event or other event detection by a slave during boot-up leads to the notification of the application and to automatic start of Error Control Services.
	2	0	An error event or other event detection by a slave during boot-up does not lead to the automatic configuration and starting of the slave.
		1	An error event or other event detection by a slave during boot-up leads to the starting of "Start Boot Slaves".
	3	0	Optional slave: the network can also be started if this node is not connected.
		1	Obligatory slave: the network will not be started if this node is not connected during the slave boot-up.
	4	0	The slave can be reset by the "NMT Reset Communication" command, depending on its state.
		1	The NMT master does not have to send an "NMT Reset Communication" command for this slave, if the slave is in the "Operational" state.
	5	0	Verification of the application software version is not required for this node.
		1	Verification of the application software version is required for this node.
	6	0	Automatic update of the application software (download) is not permitted.
		1	Automatic update of the application software (download) is permitted.
	7		Reserve; set to 0
1			8-Bit value for the Retry Factor
2 to 3			16-bit value for the Guard Time

Object $1F82_{hex}$ Request NMT

The object $1F82_{hex}$ describes as per CiA DSP-302 all slaves that can send requests to the Network Management (NMT).

Table 80: Object $1F82_{hex}$ Description

Features	Sub-index	Description / Value
Name		Request NMT
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index 80_{hex}	Unsigned8
Function	Sub-index 00_{hex}	Supported number of slaves
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	Request NMT Service for slave with Node-ID 1 to 127 (→ Table 81, Page 168)
	Sub-index 80_{hex}	Request NMT Service for all slaves
Access	Sub-index 00_{hex}	ro
	Sub-index 00_{hex} to Sub-index $7F_{hex}$	rw
	Sub-index 80_{hex}	wo
XI/ON default value	Sub-index 00_{hex}	127
	Sub-index 01_{hex} to Sub-index 80_{hex}	No

For a write access to this object, the value corresponds to the status of the node to which the request is directed. For read access, the object contains the present status of the node.

Table 81: Value ranges

Status	Value on write access	Value on read access
Stopped	4	4
Operational	5	5
Reset Node	6	–
Reset Communication	7	–
PreOperational	127	127
Unknown	–	0
Node missing	–	1

Object $1F83_{hex}$ Request Guarding

The object $1F83_{hex}$ describes as per CiA DSP-302 all slaves that can be monitored by the Network Management (NMT).

→ The object $1F83_{hex}$ is only valid if the XI/ON is configured as the NMT master (see object $1F80_{hex}$, Bit 0).

Table 82: Object $1F83_{hex}$ Description

Features	Sub-index	Description / Value
Name		Request Guarding
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index 80_{hex}	Unsigned8
Function	Sub-index 00_{hex}	Supported number of slaves
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	Request Guarding for slaves with the Node-ID 1 to 127 (→ Table 81, Page 168)
	Sub-index 80_{hex}	Request Start/Stop Guarding for all slaves
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to Sub-index $7F_{hex}$	rw
	Sub-index 80_{hex}	wo
XI/ON default value	Sub-index 00_{hex}	128
	Sub-index 01_{hex} to Sub-index 80_{hex}	No
Value	Sub-index 01_{hex} to Sub-index $7F_{hex}$	0 = Slave being monitored at present 1 = Slave not being monitored at present

Manufacturer-specific objects

The following table provides an overview of the manufacturer-specific entries in the Object Dictionary:

Table 83: Overview of the manufacturer-specific Object Dictionary entries

Index (hex)	Object	Name	Type
2000_{hex}	VAR	Serial No.	Unsigned32
2010_{hex}	ARRAY	Behavior Modifiers	Unsigned32

The column **Index (hex)** describes the position of the entry in the Object Dictionary.
The **Object** column shows a symbolic name for the entry.
The **Name** column shows a simple function description of the entry.
The **Type** column indicates the data type of the entry.

Objects 3000_{hex} to 3097_{hex}

Objects 3000_{hex} to 3097_{hex} enable direct access to the internal module bus of the XI/ON station. These objects are generally not used, since access is made through the objects of the Device Profile.



Attention!
If these objects are utilized by the user, then the user must ensure that all the relevant conditions are fulfilled for trouble-free, faultless operation of the XI/ON station in the CANopen network.

Eaton Support is always willing to assist you in the use of these objects!

Object 2000_{hex} Serial Number

The object 2000_{hex} corresponds to the Sub-index 04_{hex} of object 1018_{hex} and contains the serial number of the XI/ON gateway that is used.

→ We recommend using object 1018_{hex}, sub-index 04_{hex} for the serial number.

Object 2010_{hex} Behaviour Modifiers

The object 2010_{hex} is used for a temporary (volatile) modification to the module behavior.

Table 84: Object 2010_{hex} Description

Features	Sub-index	Description / Value
Name		Behaviour Modifiers
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01_{hex} to Sub-index 03_{hex}	Unsigned32
Function	Sub-index 00_{hex}	No. of entries
	Sub-index 01_{hex}	Hard Reset Modifier
	Sub-index 02_{hex}	Save Ref Reset Modifier
	Sub-index 03_{hex}	Save Current Reset Modifier
Access	Sub-index 00_{hex}	ro
	Sub-index 01_{hex} to Sub-index 03_{hex}	rw
XI/ON default value	Sub-index 01_{hex} to Sub-index 03_{hex}	No

Sub-index 01_{hex}:

The Hard Reset Modifier determines in the event of a Reset Node command, whether a normal, fast or a hard processor reset is carried out which requires several seconds.

For the write operation, the transferred value is interpreted as a string in the Unsigned32 format:

Table 85: Preselect Hard Reset (Processor Reset)

msb			**lsb**
t	s	r	h
74_{hex}	73_{hex}	72_{hex}	68_{hex}

Table 86: Preselect normal reset

msb			**lsb**
t	s	r	s
74_{hex}	73_{hex}	72_{hex}	73_{hex}

After the next Reset Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

Sub-index 02_{hex}:

The Index "Save Ref Reset Modifier"determines that, in the event of a Reset Node command, the XI/ON Reference Module List (Objects 3080_{hex} and 3081_{hex}) will be saved in non-volatile memory and then followed by a hard processor reset. This hardware reset is necessary, because changes to the XI/ON Reference Module List cannot be dynamically accepted in the CANopen I/O image. If the module list is altered, all the CANopen parameters will be reset to the default values.

For writing, the value that is transferred in Unsigned32 format will be interpreted as a string:

Table 87: Save and Hardware Reset selection

msb			**lsb**
v	a	s	r
76_{hex}	61_{hex}	73_{hex}	72_{hex}

Table 88: Preselect normal reset

msb			**lsb**
t	s	r	s
74_{hex}	73_{hex}	72_{hex}	73_{hex}

After the next Reset Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

Sub-index 03_{hex}:

The Index "Save Current Reset Modifier"determines that, in the event of a Reset Node command, the current XI/ON Reference Module List (Objects 3090_{hex} and 3091_{hex}) will be saved in non-volatile memory, and then followed by a hard processor reset. This hardware reset is necessary, because changes to the XI/ON Reference Module List cannot be dynamically accepted in the CANopen I/O image. If the module list is altered, all the CANopen parameters will be reset to the default values.

For the write operation, the transferred value is interpreted as a string in the Unsigned32 format:

Table 89: Save and Hardware Reset selection

msb			**lsb**
v	a	s	c
76_{hex}	61_{hex}	73_{hex}	63_{hex}

Table 90: Preselect normal reset

msb			**lsb**
t	s	r	s
74_{hex}	73_{hex}	72_{hex}	73_{hex}

After the next Reset Node or the next "Reset Communication" command, the operating mode will in all cases be reset to "normal Reset Node".

Object 2400_{hex} System Voltages

The object System Voltages allows the reading of up to 4 system voltages from the gateway. At present, the XN-GWBR-CANopen supports reading of U_{SYS} to sub-index 1. Sub-indices 2...4 return the constant 0.

Object description	
INDEX	2400_{hex}
Name	System Voltages
Object Code	ARRAY
No of Elements	4
Data Type	Unsigned16
Access	ro
Default Value	No
PDO Mapping	Yes

Diagnostic messages

The XI/ON-CANopen gateway and various XI/ON modules can generate diagnostics messages that can trigger an Emergency Frame.

The gateway transmits the following diagnostics:

- Checking the status of the XI/ON station
- Checking the communication via the internal module bus
- Checking the communication to PROFIBUS-DP
- Checking the status of the gateway

Diagnostics messages are indicated in two different ways:

- via the individual LEDs:
  - XN standard gateways:
    → Chapter "Diagnostics LED indications", Page 40
  - XNE ECO gateways:
    → Chapter "Diagnostic messages via LEDs", Page 61
- via a CANopen configuration tool (software):
  → Chapter "Diagnostics messages via software", Page 176

Diagnostics messages via software

The diagnostics messages of the XI/ON-CANopen gateway and the XI/ON modules can be displayed using a CANopen configuration tool.

An example of diagnostics messages using a CANopen configuration tool can be found in Chapter 3, Section "Example of a ProCANopen diagnostics message".

Description of the gateway diagnostics

Table 91: Diagnostics for XI/ON-CANopen gateway

Diagnostics	Error Code	Designation as per CiA DS-301 / DS-401	Meaning
Error Reset / No Error	0000_{hex}	-	Error Reset
Mains voltage too high[1)]	3110_{hex}	Mains voltage too high	System voltage too high
Mains voltage too low[1)]	3120_{hex}	Mains voltage too low	System voltage too low
Field voltage too low[1)]	3320_{hex}	Output voltage too low	Field voltage too low
Deviating I/O configuration	$707A_{hex}$	Additional modules	I/O module list, adaptable change, e.g. module removed
I/O configuration error	$707D_{hex}$	Additional modules	I/O module list, incompatible change
Deviating I/O configuration - module expansion	$707E_{hex}$	Additional modules	I/O module list, expanded
Deviating I/O configuration - module removed	707Fh	Additional modules	1 module removed from I/O module list
CAN Warning level reached	8100_{hex}	Communication	CAN communication faulty (at least one of the error counters for the CAN controller of the XI/ON-CANopen gateway has reached the value 96)
CAN Transmit Timeout	8100_{hex}	Communication	The XI/ON-CANopen gateway was not able to transmit a frame within the specified time.

Diagnostics	Error Code	Designation as per CiA DS-301 / DS-401	Meaning
Life Guard Error or Heartbeat Error	8130_{hex}	Life guard error or heartbeat error	The XI/ON-CANopen gateway has detected an error in the CANopen Guarding or Heartbeat Protocol, e.g. a timeout.
Left CAN-BusOff	8140_{hex}	Recovered from Bus-Off	The system has left the CAN-Bus Off state, i.e. the CAN controller for the XI/ON-CANopen gateway has moved out of this serious fault condition.
I/O**assistant** Force Mode active	9009_{hex}	External Error	Force Mode activated (I/O**assistant**), i.e. the outputs of the XI/ON station are currently not under the control of CANopen

1) Only at XN-GWBR-CANopen and XNE-GWBR-CANopen

Description of the supply module diagnostics

Table 92: Diagnostics for XI/ON modules (per channel)

Module / Diagnostics	Error Code	Designation as per CiA DS-301 / DS-401	Meaning
XN-BR-24VDC-D			
Module bus voltage warning	3120_{hex}	Mains voltage too low	System voltage too low
Field voltage missing	3320_{hex}	Output voltage too low	Field voltage too low
XN-PF-24VDC-D			
Field voltage missing	3320_{hex}	Output voltage too low	Field voltage too low
XN-PF-120/230VAC-D			
Field voltage missing	3320_{hex}	Output voltage too low	Field voltage too low

Maximum topology

A bus line must have at least two nodes (stations). These could be, for example, a PLC or a PC with a CANopen compliant plug-in card, and a XI/ON gateway. The connection of a XI/ON station to the CANopen network can only be made through the XI/ON gateway.

Incoming and outgoing cables are connected through SUBD plug/socket connectors or through direct wiring. Each XI/ON gateway behaves as an active node, and thus has a Node-ID assigned.

Maximum system configuration of a CANopen bus line

A CANopen bus line can have a maximum of 110 nodes. This maximum number must not be exceeded.

The way to set the Node-ID depends on the gateway type:

- On the stadard gateways, the Node-ID is set through the two rotary encoding switches (→ Chapter "Node-ID setting", Page 35). Adjustable addresses (Node-IDs):
  – XN-GW-CANopen: 1 to 127
  – XN-GWBR-CANopen: 1 to 99
- On the XNE ECO gateways, the Node-ID is set through DIP switches (→ Chapter "Setting the Node-ID", Page 56). Adjustable addresses (Node-IDs):
  – XNE-GWBR-CANopen: 1 to 63

It is not possible to assign Node-IDs directly via the bus.

→ Within a XI/ON station with the XNE ECO gateway XNE-GWBR-CANopen, the maximum number of modules is limited. Please note Chapter "Maximum station extension", Page 64.

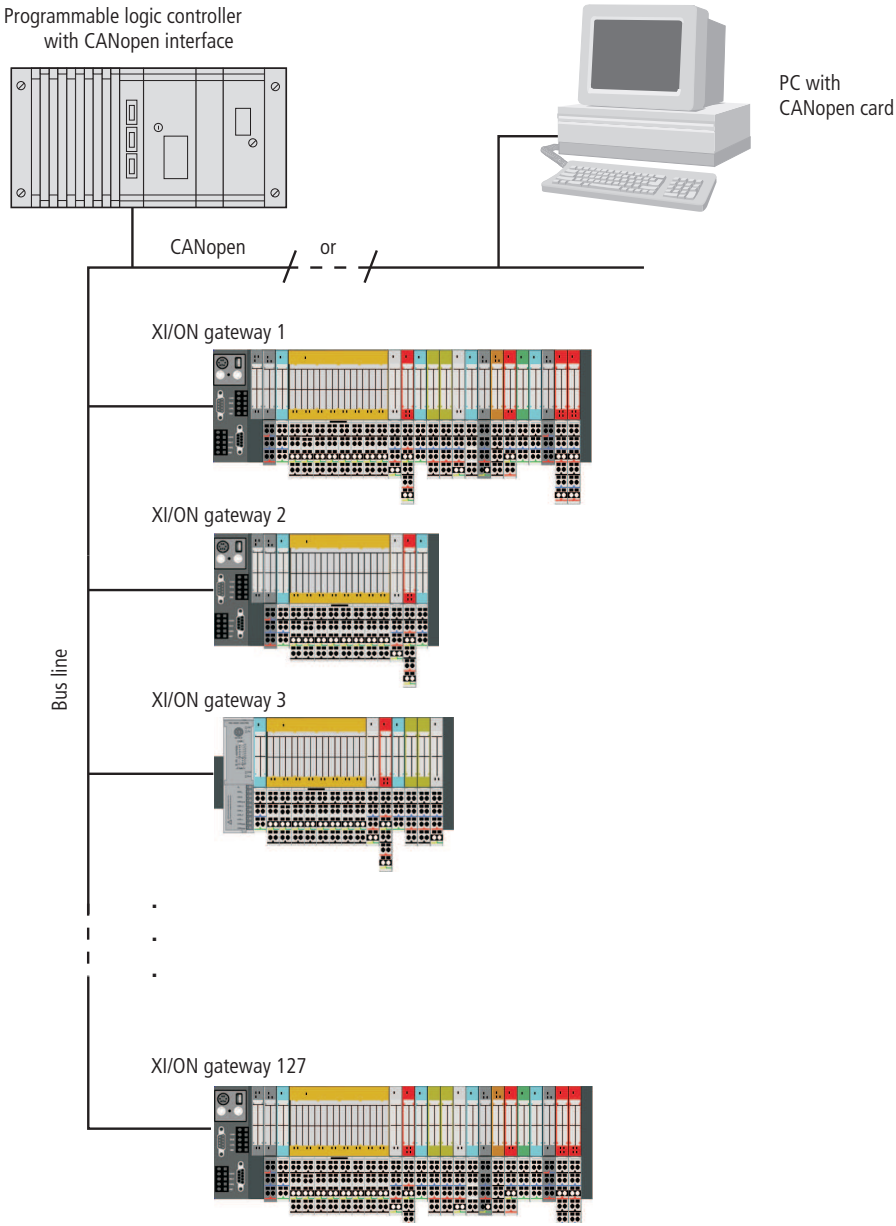


Figure 31: Max. system configuration of a CANopen bus line

Maximum bus length

The maximum bus length for CANopen depends on the transmission rate that is used. The following table shows an overview of the possible transmission rates and the corresponding maximum cable lengths:

Table 93: Maximum cable lengths

Bit transfer rate (Kbit/s)	Maximum cable length (m)
10	1000
20	1000
50	1000
100	650
125	500
250	250
500	100
800	50
1000	25

For bus lengths of 1000 m or more, it may be necessary to insert repeaters.

Mixed operation with other types of station

In addition to the XI/ON gateways, other stations (e.g. other station types and modules from the WIN bloc series, or third-party devices that comply with the CANopen profile family) can also be integrated into the field bus system, so that mixed operation is possible. The CANopen system is thus extremely flexible, and can be applied even in the most difficult industrial environments.

6 Coupling with automation equipment

Commissioning the XI/ON station with MXpro

Connection of programming PC, PLC and CAN-XI/ON station

To commission a Eaton PLC (e.g. XV200/MK2) with the MXpro software, the PLC must be connected with the programming PC. The Eaton PLC is connected via a CAN cable with the CAN gateway of the XI/ON station.

Starting MXpro and creating a new project

▶After launching MXpro, open a new project by choosing < File I New >.

▶Select the PLC type of your application in the Target Settings window.



▶Confirm the displayed information on the PLC with "OK".

– This will take you to the "Programming" area.

▶Leave the area "New POU" via "Cancel" in order to then follow the configuration of the XI/ON station.

Integrating the CAN master

Complete the following steps to enable communication via CANopen:

▶To configure the XI/ON station click the Resources tab.

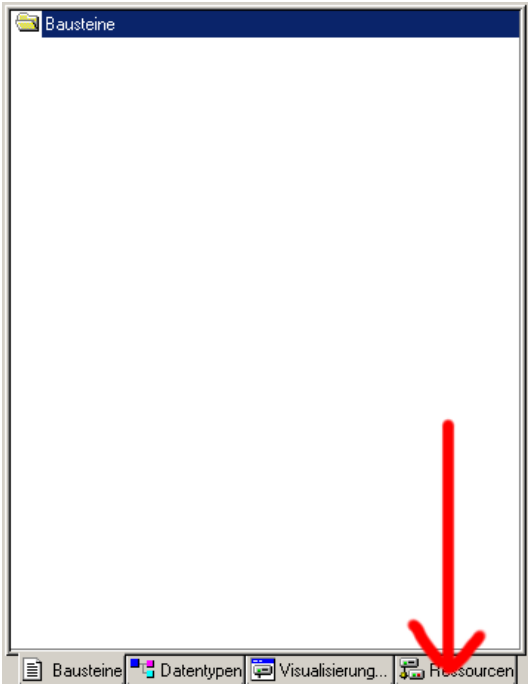


Figure 32: Selecting Configuration mode

▶Choose the PLC Configuration element from the configuration tree.

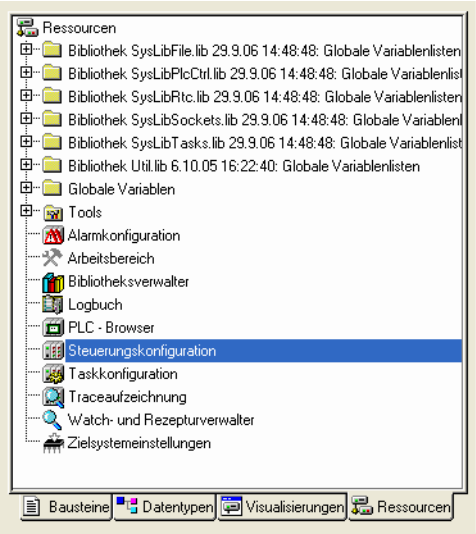
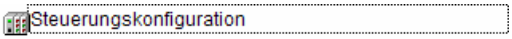


Figure 33: Selecting PLC configuration

▶Right click PLC Configuration.



▶Then choose:
<Append Subelement I CANMaster>.
– The appropriate CAN master you have selected is added to the PLC configuration.
– The right field shows the tab for parameterizing the CAN master.

▶Check the settings on the CAN Parameters tab:

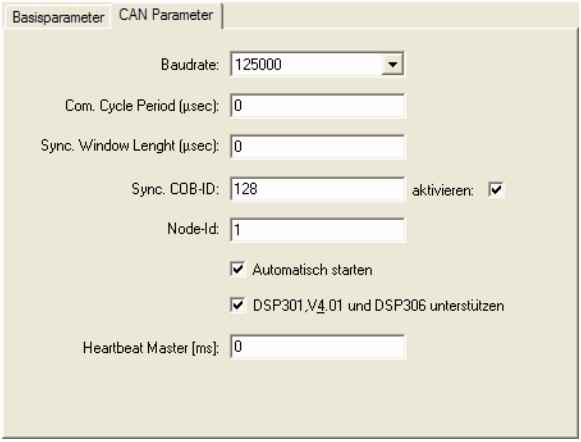


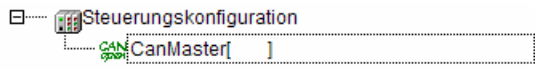
Figure 34: CAN parameters of the CAN master

- The baud rate setting of the master must be the same as that of the slave (in this case: XN-GWBR-CANopen).
- The maximum bus length determines which is the most suitable transfer rate (→ Chapter "Maximum bus length", Page 183).
- The setting for the transfer rate of the XN-GWBR-CANopen is made using DIP switches (→ Chapter "Setting the bit transfer rate via DIP switches", Page 33).
- The next three entry fields are used to activate a Synchronisation message.
  - The "Node ID" of the master must be between 1 and 127 must only be assigned once in the entire network.
  - The selected "Automatic startup" option ensures that the CAN bus is initialized and started automatically. Without this function activated, the CAN bus must be started in the project.
  - The Support DSP301,V4.01 and DSP306 option enables the clock rate for the Heartbeat function to be set.

→ Refer to the MXpro documentation for further information.

Integrating the CAN slave

▶In order to add the CAN slave (in this case: XN-GWBR-CANopen) to your configuration, right-click the "CanMaster[xxx]" element:



▶Then select:
<Append Subelement>.
– The list shows all configurable slaves:

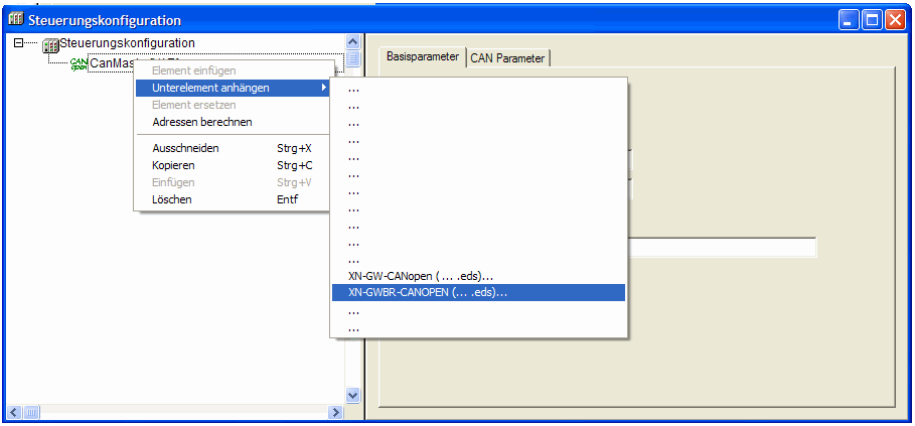


Figure 35: Add CAN slave

▶Select the appropriate CAN slave.
– The selected CAN slave is added to the PLC configuration.

▶Update your MXpro version if your product is not shown.
– Updates can be obtained from our website (www.eaton-automation.com), under "DOWNLOADS".

Configuration of the XI/ON gateway
The right field shows the tab for parameterizing the CAN slave.

▶Check the settings on the CAN Parameters tab:
- The "Node ID" of the slave:
  - is set with the rotary encoding switches on the housing,
  - must be set between 1 and 127.
  - and must only be assigned once in the entire network.

→ Compare the Node ID set with the rotary encoding switches and the Node ID on the tab!

Adjust the Node-ID if necessary!

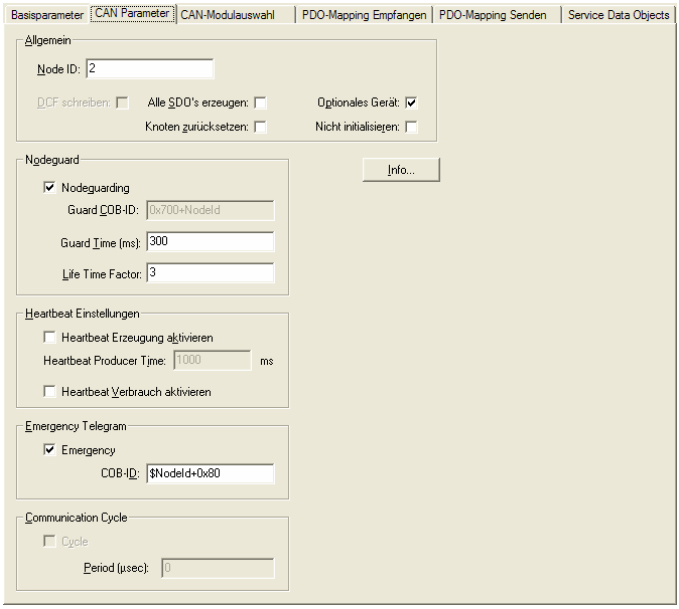


Figure 36: CAN parameters of the CAN slave (in this case: XN-GWBR-CANopen)

→ Refer to the MXpro documentation for further information.

Configuration of the XI/ON modules

▶To configure the XI/ON station click the CAN Module Selection tab.

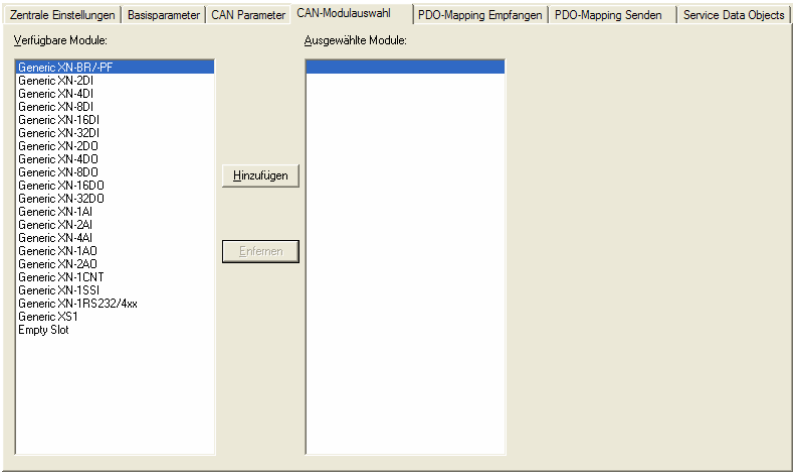


Figure 37: CAN module selection of the CAN slave (in this case: XN-GWBR-CANopen)

– This tab has two windows:
  – The left-hand window contains a list of available module types.
  – The right-hand window contains a list of the module types of your station.

▶To configure a XI/ON module, select the module type in the left-hand window and then click: <Add>.

→ You can add other XI/ON modules at any position:

▶In the left-hand window select the module type and in the right-hand window the required position.

▶Click <Add>.

– The selected XI/ON module is positioned directly **in front of** the selected module.

Inactive process data objects

Some process data objects are not activated automatically. These objects can only take part in process data exchange if they are enabled manually (→ Chapter "Activation of the default PDOs / manual "enabling" of process data", Page 196).

The inactive process data objects are reported every time the configuration is changed.

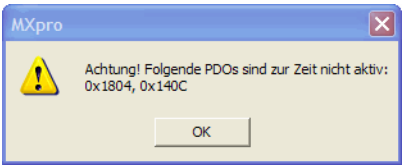


Figure 38: Indication of inactive PDOs

You can activate these inactive objects immediately after the first message or after the entire configuration has been completed.

Mapping immediately after the first message simplifies the assignment of the inactive object to the module type.

The process data objects are updated automatically if the equipment of the XI/ON station meets the following criteria:

- Maximum of **64** digital input channels
- Maximum of **64** digital output channels
- Maximum of **12** analog input channels
- Maximum of **12** analog output channels
- No technology module

This default "mapping" and activation of the process data conforms with the CiA DS-301 Communication Profile.

→ Chapter "Default PDOs and PDO mappings", Page 101.

→ If the XI/ON station is fitted with more input and output channels than listed above or contains technology modules, the process data objects must be enabled manually (→ Chapter "Activation of the default PDOs / manual "enabling" of process data", Page 196).

Activation of the default PDOs / manual "enabling" of process data

The manual "enabling" of process data is only necessary if the station size described in the previous chapter is exceeded.

The process data objects are activated via the "Receive PDO Mapping" and "Send PDO Mapping" tabs:

▶In the right-hand window select the appropriate PDO and then choose:
<Properties>
– This will open the following window.

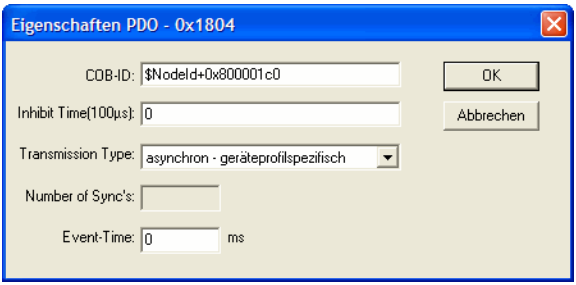


Figure 39: PDO properties (Send PDO mapping)

▶In the "COB-ID" field reset the most significant bit of the identifier.
– Modification example:
"$NodeId+0x800001c0" →
"$NodeId+0x000001c0"

→ Refer to the following documentation for further information.
- Manual on the PLC programming environment MXpro
- System description CiA Draft Standard DSP301

Integrating the libraries for CANopen communication

After the CAN master is added and the program is compiled for the first time, all the libraries required for CANopen communication are added automatically.

If this does not occur, add the required libraries manually using the Library Manager:

▶On the Resources tab select the Library Manager element on the configuration tree.

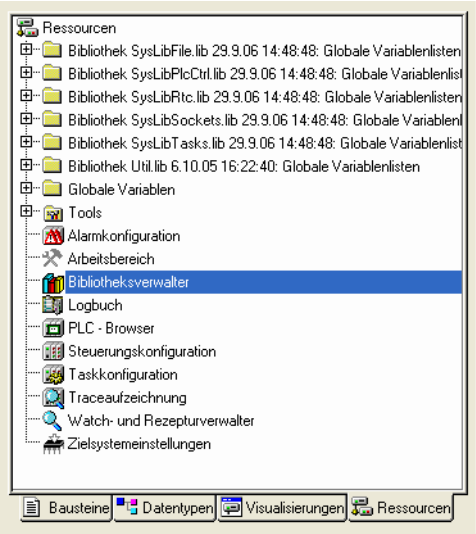


Figure 40: Selecting the Library Manager

→ Refer to the relevant PLC documentation for further information.

Index

A
address setting 56
Approvals 16, 50

B
baud rate 58
Bus 43
Bus lengths
Maximum 183
bus terminating resistor 59

C
CANopen
Network Management messages 69
Process Data Objects (PDOs) 69
Service Data Objects (SDOs) 69
COB-ID 77
communication bytes 64
Configuration button 38

D
Degree of protection 16, 50
Diagnostics 177
DIP switches 56
Direct wiring
CANopen 180

E
Electromagnetic compatibility 14
Electronic data sheet 72
Emergency Frame 83
Err 42

F
Fieldbus connection
Direct wiring 24
Open style connector 28
SUB-D socket 22

G
GW 40

I
Indication elements 176
IOs 41

L
LED
Bus 43
Err 42
GW 40
IOs 41

M
Maximum bus length 183
Mixed operation 184

N
Node-ID 35, 77
NODE-ID setting 56

O
Operating life 16, 50

P
PDO Mapping 109
Pin assignment 28
Process Data Object (PDO) 96
Process Data Objects (PDOs) 69

R
Repeater 183
Rotary encoding switch
Decimal 37
Hexadecimal 36
Rotary hex encoding switch 36

S
Service Data Object (SDO) 91
Service interface 31, 54
SUB-D plug 180
SUB-D socket 180
Supply voltage 13, 18
supply voltage 52

T
tension clamp terminals 53
Terminating resistor 22
Topology 180
Transfer rate 183
Transmission Type 97