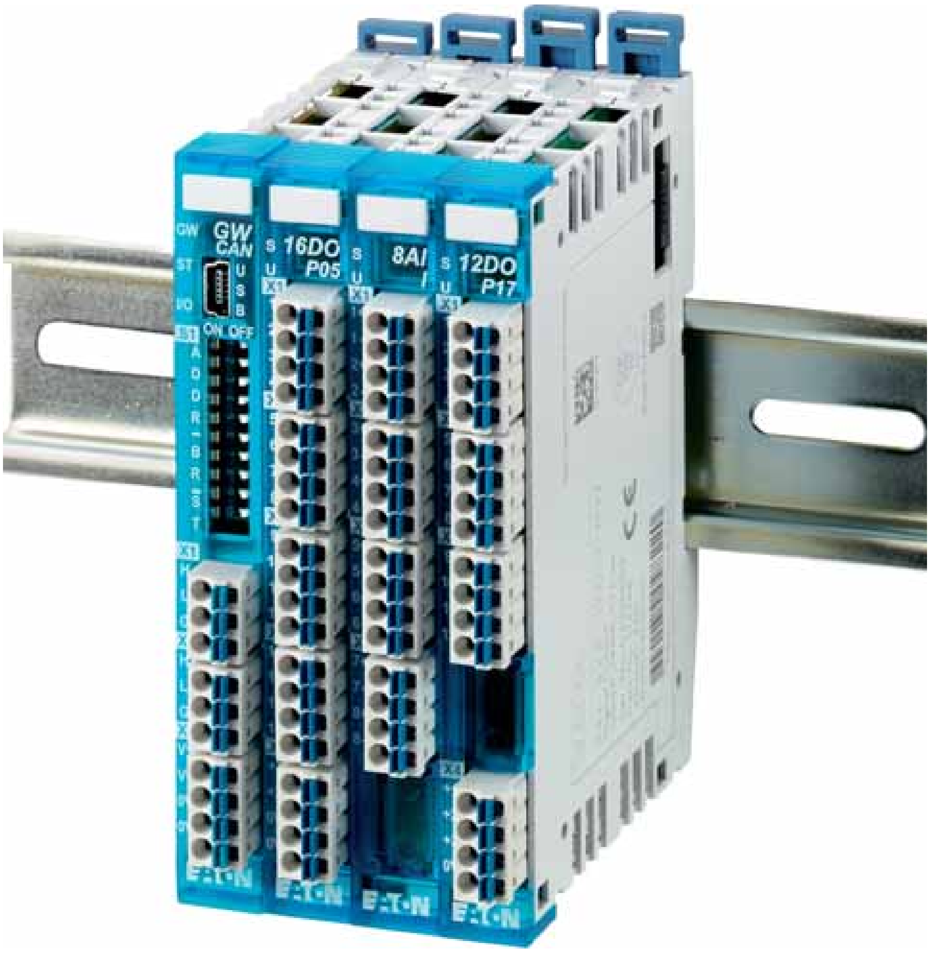
XN300 slice modules

Digital I/O modules
Analog I/O modules
Technology modules
Power distribution



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Original operating manual
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original operating manual.

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5th edition 2024, publication date 02/24
See revision protocol in the „About this manual“ chapter

Authors: Thomas Hettwer

Danger!
Dangerous electrical voltage!

Before starting with the installation

- De-energize the device
- Secure against retriggering
- Verify isolation from the supply
- Ground and short-circuit
- Cover or enclose any neighboring live parts.
- Follow the mounting instructions (AWA/IL) for the device.
- Only suitably qualified personnel in accordance with EN 50 110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- 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 to the equipotential bonding. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed in such a way that inductive and capacitive interference will not have a negative impact on 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 cable or wire breakage on the signal side will not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 V supply. Only use power supply units complying with IEC 60364-4-41 or HD 384.4.41 S2 (VDE 0100 Part 410).
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the specifications, otherwise this may result in malfunction and hazardous states.
- Emergency stop devices complying with IEC/EN 60204-1 must remain functional in all of the automation devices' operating modes. Unlatching the emergency stop devices must not result in an automatic restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state; desktop devices and portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restarting of programs interrupted after a voltage dip or outage. This should not result in 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.).

Contents

0 About this manual

This manual describes the installation, commissioning and programming of the XN300 slice modules.

The XN300 slice modules are an integral part of the XN300 system, as is the gateways with designation XN-312-GW-….

Support center

The latest version of this manual can be found in other languages on the Internet by visiting our Support Center at:

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By entering the search keyword "XN300" into the quick search or by entering the document designation, e.g. "MN050002".

0.1 List of revisions

The following significant amendments have been introduced since previous issues:

Publication date	Page	Keyword	New	Changes
02/16	165	Use of 3 kΩ potentiometer → Section "23.3.1 Potentiometer measurements"	✓	
	167	Technical data for reference outputs → Section "23.5 Technical data for reference outputs"		✓
	264	The following chapter was revised → Chapter 34 "DC motor driver module XN-322-1DCD-B35"		✓
06/16	150	Additional value representation parameters → Chapter 22 "Analog input module XN-322-4AI-PTNI"		✓
	40	→ Chapter 7 "Digital input module XN-322-8DI-PD"	✓	
	45	→ Chapter 8 "Digital input module XN-322-16DI-PD"	✓	
	71	→ Chapter 12 "Digital input module XN-322-20DI-ND"	✓	
	77	→ Chapter 13 "Relay output module XN-322-4DO-RNO"	✓	
	92	→ Chapter 15 "Digital output module XN-322-8DO-P05"	✓	
	114	→ Chapter 18 "Digital input/output module XN-322-8DIO-PD05"	✓	
	121	→ Chapter 19 "Digital input/output module XN-322-16DIO-PD05"	✓	
	129	→ Chapter 20 "XN-322-16DIO-PC05 digital input/output module"	✓	
	213	→ Chapter 29 "Analog input/output module ±10 V XN-322-4AIO-U2"	✓	
	233	→ Chapter 31 "XN-322-4AIO-I analog input/output module"	✓	
	243	→ Chapter 32 "XN-322-8AIO-I analog input/output module"	✓	
04/2023	28	→ Section "2.6 Conditions for marine approval"	✓	
	189	→ Chapter 26 "Analog input module XN-322-10AI-TEKT"		
	330	→ Section "39.2 Shipping approvals for XN300 system devices"	✓	
	191	→ Section "26.2.1 Temperature measurements using thermocouples"	✓	
	Additional value of 1 Hz added to low-pass cutoff frequency in the "Filters" section for the following slice modules:		✓	
	239	XN-322-4AIO-I		
	218	XN-322-4AIO-U2		
	167	XN-322-7AI-U2PT		
	176	XN-322-8AI-I		
	249	XN-322-8AIO-I		
	228	XN-322-8AIO-U2		
	157	XN-322-4AI-PTNI		
	339	→ Section "39.5 Further reading and links"	✓	
02/24	140	→ Chapter 21 "Multi-I/O module XN-322-16MIO-DIOAI"	✓	
	85	→ Chapter 14 "Relay output module XN-322-5DO-RCO"	✓	
	180	→ Chapter 25 "Analog input module XN-322-8AI-PTKT"	✓	
	305	→ Chapter 37 "Pulse width module XN-322-2PWM"	✓	
	200	→ Chapter 27 "Analog output module XN-322-4AO-UI"	✓	
	311	→ Chapter 38 "XN-322-2SI-RS serial interface specialty module"	✓	

0.2 Additional Documentation

Please follow the safety instructions in the "Product Cyber Security Guideline for XN300 Slice Modules", MZ050024EN and observe "End User License Agreement XN300 Slice Modules“, MZ050025EN.

0.3 Target group

This manual is intended for automation technicians and engineers.

Extensive knowledge of how to work with the field bus being used will make it easier to understand the contents of this manual.

A specialist knowledge of electrical engineering is needed for commissioning and programming.

0.4 Legal disclaimer

All information in this operator manual was provided by us to the best of our knowledge and belief and in accordance with the current state-of-the-art. However, this does not exclude the possibility of inaccuracies so that we cannot accept any liability for the accuracy and completeness of the information. In particular, this information does not guarantee any particular properties.

The devices described here must only be set up and operated as specified in this manual and in the installation instructions provided with the device. Installation, commissioning, operation, maintenance and refitting of the devices must only be carried out by qualified persons. The devices must only be used in the areas recommended and only in conjunction with third-party devices and components that have been approved by us. Only use is technically faultless condition is permitted. Fault-free and safe operation of the system requires proper transport, storage, installation and commissioning as well as careful operation and maintenance. If the following safety instructions are not observed, particularly with regard to commissioning and maintenance of the devices by insufficiently qualified personnel and/or in the event of improper use of the devices, any hazards caused by the devices cannot be excluded. We assume no liability for any injury or damages incurred.

0.5 Device designations and abbreviations

- COB-ID - Communication OBject IDentifier
- DIP - Dual Inline Package
- EDS - Electronic Data Sheet
- PDO - Process Data Objects
- RPDO - Receive Process Data Objects
- SDO - Service Data Objects
- SSI - Synchronous Serial Interface
- TPDO - Transmit Process Data Objects
- XN300 - Device series, including the XN-312-GW-… gateways and XN-322 slice modules

Following designations XSOFT-CODESYS are used:

- Module - System bus module
- Station - Coordinator
- Station address - Address of the field bus module

0.6 Writing conventions

Symbols used in this manual have the following meanings:

DANGER
Warns of hazardous situations that result in serious injury or death.

CAUTION
Warns of the possibility of hazardous situations that could result in slight injury or even death.

NOTICE
Warns about the possibility of material damage.

→ Indicates useful tips.

▶ Indicates instructions to be followed.

For greater clarity, the name of the current chapter and the name of the current section are shown at the top of each page.

1 XN300 slice modules

1.1 Proper use

XN300 slice modules include both digital and analog input and output modules, as well as various technology modules with counting, weighing, and motor drive functionalities. These modules can be joined together without the use of tools in order to form a system block. All XN300 system slice modules communicate through the system bus and are part of the XN300 system.The XN-322 I/O slices can be combined with XN-312 gateways to form a remote I/O block for connecting to a higher-level PLC via standard communication methods. In addition the XN-322... slices can be assembled locally on the XControl PLC series to build a modular control unit.

The system bus is not designed for transmitting safety-relevant signals and must not be used as a replacement for controllers such as burner, crane, and two-hand safety controllers.

Power supply and signal terminals must be protected against accidental contact and covered.

The XN300 system may only be operated if it has been correctly fitted and connected by qualified electrical specialists. The installation must comply with regulations for electromagnetic compatibility (EMC).

DANGER

Commissioning the XN300 slice modules and switching them on must not result in any hazards being posed by the devices being driven, e.g., unexpected motor startups and equipment becoming unexpectedly energized.

1.2 Overview of functions

XN300 slice modules include a variety of I/O modules, as well as specialty modules.

1.3 List of I/O slice module devices

All I/O slice modules can be operated on the XN-312-GW-... gateways and the XControl PLC range. In order to ensure that you will be able to fully commission all I/O slice modules and functions, make sure that the gateway operating system is up-to-date. The latest updates for the gateway operating system can be downloaded from the Software Download Center.

The I/O slice modules need to be locked in place together with the gateway or PLC in order to form a system block. For a detailed description of how the respective gateway works, please refer to the relevant manual:

"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN
"Modular PLCs XControl: XC-104-… XC-204-… XC-303-…", MN050005EN

Please note that all the object names in the
"Supported objects" chapters are specified in the form of hexadecimal values.

Power Distribution

- XN-322-4PS-20, power supply, 4 x 24VDC/2A,kf
- XN-322-18PD-M, power distribution,18 channels, GND
- XN-322-18PD-P, power distribution,18 channels, VCC

Digital I/O modules

- XN-322-8DI-PD, digital input card, 8 digital inputs 24 V DC each, pulse-switching, 5.0 ms
- XN-322-16DI-PD, digital input card, 16 digital inputs 24 V DC each, pulse-switching, 5.0 ms
- XN-322-20DI-PD, digital, 20 inputs, P, 24VDC, 5.0ms
- XN-322-20DI-PF, digital, 20 inputs, P, 24VDC, 0.5ms
- XN-322-20DI-PCNT, digital, 20 inputs, P, 24VDC, 2/4 CNT, 25kHz
- XN-322-20DI-ND, digital input card, 20 digital inputs 24 V DC each, negative switching, 5.0 ms
- XN-322-4DO-RNO, digital relay module, 4 digital relay outputs, N/O
- XN-322-5DO-RCO, relay module
- XN-322-8DO-P05, digital output module, 8 digital outputs short-circuit proof 24 V DC/0.5 A each, pulse-switching
- XN-322-12DO-P17, digital, 12 outputs, P, 24VDC, 1.7A, kf
- XN-322-16DO-P05, digital,16 outputs, P, 24VDC, 0.5A, kf
- XN-322-8DIO-PD05, digital I/O module, 4 digital inputs and 4 digital outputs 24 V DC each, pulse-switching
- XN-322-16DIO-PD05, digital I/O module, 8 digital inputs and 8 digital outputs 24 V DC each, pulse-switching
- XN-322-16DIO-PC05, digital I/O module, 8 digital inputs and 8 digital outputs 24 V DC each, pulse-switching, counter
- XN-322-16MIO-DIOAI, multi I/O module, 6 digital inputs and 8 digital outputs, 2 analog inputs (-10/0 - 10V, 0/4-20mA)

Analog I/O modules

- XN-322-4AI-PTNI, analog, 4 inputs, PT/NI/KTY/R, 2/3 wire
- XN-322-7AI-U2PT, analog, 6 inputs, +/-10V,1 PT/KTY,Uref

- XN-322-8AI-I, analog, 8 inputs, 0/4-20mA
- XN-322-8AI-PTKT, analog, 8 inputs, PT1000/KTY/Resistance
- XN-322-10AI-TEKT, analog, 8 inputs, thermocouple, 2 KTY
- XN-322-4AO-UI, analog, 4 outputs, +/-10.8V, 0-20mA
- XN-322-8AO-U2, analog, 8 outputs, +/-10V
- XN-322-4AIO-U2, analog, 4 outputs, +/-10V
- XN-322-8AIO-U2, analog, 4 inputs/4 outputs, +/-10V,Uref
- XN-322-4AIO-I, digital I/O module, 2 analog inputs and 2 analog outputs, 0/4 to 20 mA
- XN-322-8AIO-I, digital I/O module, 4 analog inputs and 4 analog outputs, 0/4 to 20 mA

Technology modules

- XN-322-2DMS-WM, weigh module, 2DMS, 24Bit
- XN-322-1DCD-B35, DC motor driver,12-30V, brushed, 3.5A
- XN-322-1CNT-8DIO, counter,1 CNT,125kHz, 16Bit, 4 DO, 4 DI
- XN-322-2SSI, serial, 2 SSI, RS422, 32Bit
- XN-322-2PWM, pulse width module
- XN-322-2SI-RS, serial module

1.4 Catalog number selection XN300

XN - 3 2 2 - x xx - x x x

Auxiliary function
- 20 = 2.0 A
- 8DIO = 8 Digital I/O
- B35 = Brush 3.5A
- I1 = Range 0…20 mA
- I = Range 0/4…20 mA
- RCO = Relay Normally Closed
- RNO = Relay Normally Open
- RS = Recommended Standard
- P = Power
- P05 = Positive 0.5
- P05S = Positive 0.5 > separated
- P17 Positive 1.7 A=
- PCNT = Positive Counter
- PD = Positive Delay
- PF = Positive Fast
- PFS = Positive Fast Separated
- PTKT = PT and KT sensors
- PTNI = PT and NI sensors
- TEKT = Thermo-Element with KTY cold junction compensation
- UI = Range -10.8 to +10.8 V or 0 to 21.6 mA.
- U2 = Range -10…+10VDC
- U2PT = Range -10…+10VDC with PT
- WM = Weigh Module
- UMS = interface converter (Switch)

Type of input/output
- AI = analog inputs
- AO = analog outputs
- CNT = counter
- DCD = Current regulator
- DI = digital inputs
- DO = digital Outputs
- DIOAI = multi I/O and analog input
- DMS = weigh module
- ETH = Ethernet
- MIO = Multiple digital inputs and outputs
- SI = serial interface
- PWM = pulse width modulation

Number of inputs/outputs (+ expansion)

Product code 322

Product family XN

2 Installation

> **DANGER OF ELECTRIC SHOCK!**
> All installation work must be carried out with the entire installation in a de-energized state.
> Always follow the safety rules:
> • De-energize and isolate the system.
> • Verify isolation from the supply.
> • Secure against restart.
> • Short-circuit and ground.
> • Cover adjacent live parts.

2.1 Mounting the XN300 slice modules

Install the XN300 slice modules in a control panel, service distribution board, or enclosure so that the power supply and terminal connections cannot be touched directly during operation. Mount the XN300 slice modules on an EN/IEC 60715 DIN-rail.

The DIN-rail must establish a conductive connection to the control panel's back plate. The individual modules need to be mounted side by side on the DIN-rail and then secured in place by closing the locking elements. Please note that all the devices must be installed in a horizontal position (module designation on top).

In order to ensure that the maximum operating ambient temperature will not be exceeded, make sure that there is enough clearance between the system block's vents and any neighboring components, as well as between the vents and the control panel's back plate.

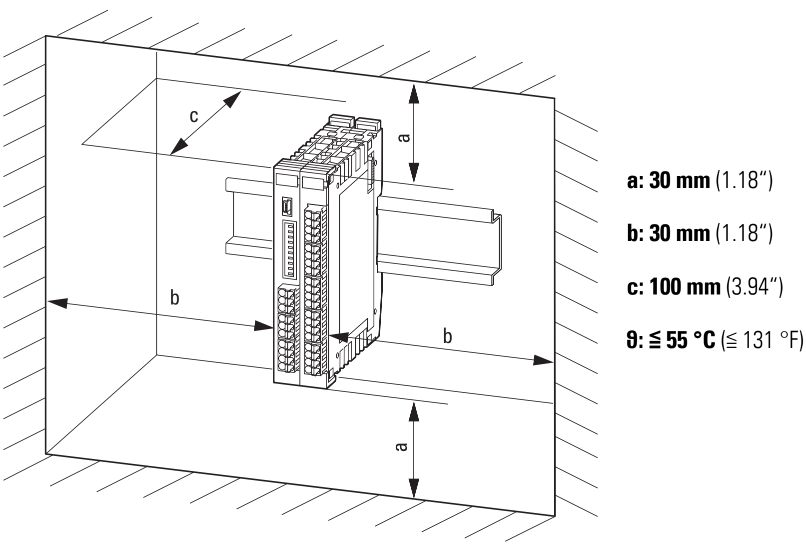


Figure 1: The XN300 slice modules must be installed in a horizontal position

To mount the system on the DIN-rail, join the XN 300 slice modules and the gateway to form a system block and then snap the entire system block onto the DIN-rail.
To mount the system block, follow the steps below:

- ▶ The gateway must be the first element on the left in the system block.
- ▶ Disengage the side locking tabs on the XN300 slice modules by pulling on the front cover (blue). Make sure that all locking tabs (blue) are in the front so that they will engage the new slice. (the front cover stay-put function is intended to make the process easier).

→ The gateway's front cover is non-detachable and cannot be removed.

- ▶ Attach an XN300 slice module from the right in such a way that the locking tabs engage the guide.

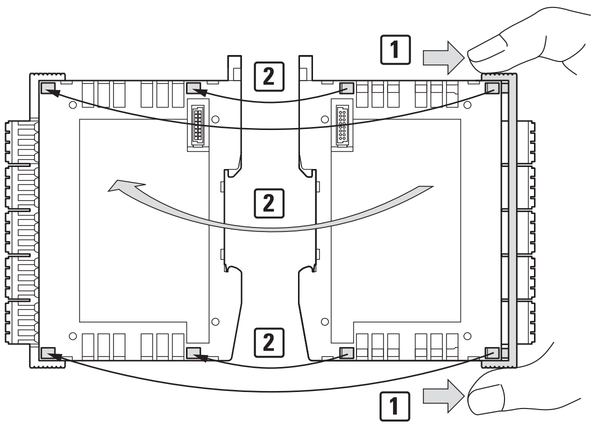


Figure 2: Joining the gateway and an XN300 slice module to form a system block

- ▶ Grab the front cover from the top and bottom and push it back towards the XN300 slice module so that the slice modules lock solidly into place with each other.

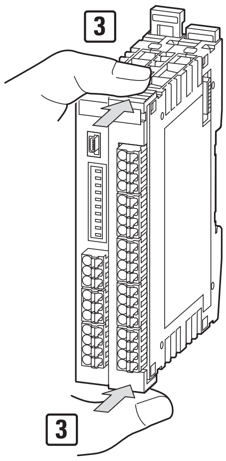


Figure 3: Locking the system block in place

- ▶ Repeat these steps until all the XN300 slice modules form a system block together with the gateway.
- ▶ Pull the locking elements at the back of the gateway and the XN300 slice modules upwards. You can use a screwdriver to do this.

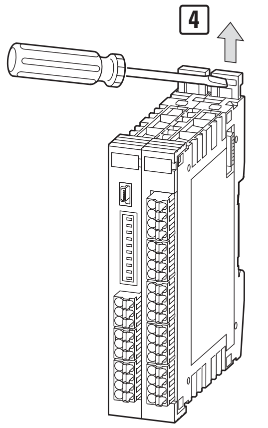


Figure 4: Securing the system block on the DIN-rail

- ▶ Tilt the system block forward and place it against the DIN-rail's bottom edge in an inclined position.

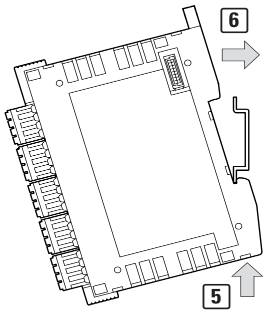


Figure 5: Placing the system block against the bottom edge of the DIN-rail

- ▶ Push the system block over the DIN-rail's top edge.
- ▶ Push the locking elements on the back of all XN300 slice modules downwards in order to secure the modules. You can use a screwdriver to do this.

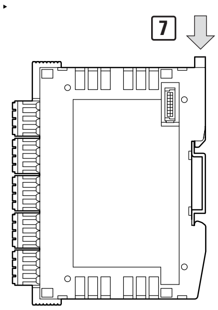


Figure 6: Locking the system block into place on the DIN-rail

- ▶ Check to make sure that the system block is solidly mounted.

2.2 Removing the XN300 slice modules

To remove the XN300 slice modules, follow the steps below:

▶ Slide the locking elements on the back of all XN300 slice modules upwards. You can use a screwdriver to do this.

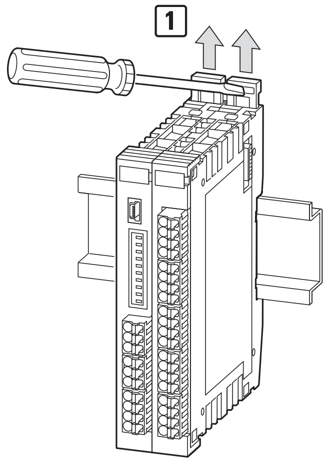


Figure 7: Disengaging the system block

▶ Tilt the system block forward, then pull the block, from its bottom edge, away from the DIN-rail.

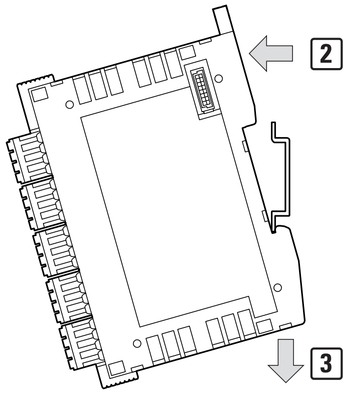


Figure 8: Placing the system block against the bottom edge of the DIN-rail

▶ Disengage the locking tabs between the slice modules by pulling on the front cover (blue). The front cover's stay-put function will indicate that the locking tabs have been disengaged.

→ The gateway's front cover is non-detachable and cannot be removed.

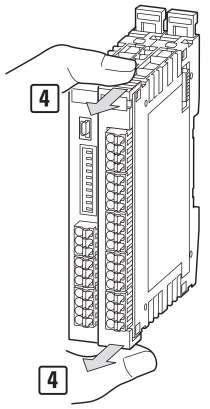


Figure 9: Disengaging the front cover

▶ Once the locking tabs have been disengaged, you can separate the slice modules from each other.

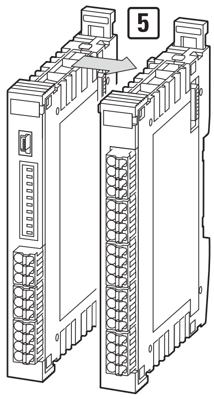


Figure 10: Separating the XN300 slice modules from the system block

2.3 Connection terminals

Plug connector

X1 – Xn: The required plug connectors with push-in spring-cage terminals are included as standard with every XN300 slice module. To use them, the conductor simply needs to be slid into the appropriate contact.

In order to release the conductor, simply press on the release mechanism, e.g., with a screwdriver, to pull out the conductor from the corresponding contact.

Table 1 Connection specifications

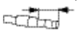
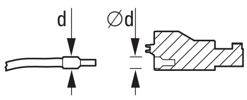
Cable cross-sectional areas			XN-322-…	XN-322-4DO-RNO XN-322-5DO-RCO
10 mm (0.39") 	solid	mm²	0.2 – 1.5	0.2 – 2.5
10 mm (0.39") 	flexible with uninsulated ferrule	mm²	0.2 – 1.5	0.25 – 2.5
10 mm (0.39") 	flexible with insulated ferrule	mm²	0.2 – 0.75	0.25 – 2.5
	Ferrule d	mm	≤ 2.8	≤ 3.8
	AWG		24 – 16	24 – 12
	Strip length	mm	10	10

Table 2 Technical data for plug connectors XN-322-…

Technical data as per IEC/DIN/VDE	Unit	solid	Flexible	Flexible
Insulating material group	–	I		
Overvoltage category/pollution degree	–/–	III/3	III/2	II/2
Device Voltage Rating	V	160	200	400
Rated surge voltage	kV	2.5	2.5	2.5
Rated operational current/cross-sectional area	A/mm²	6/1.5		

Table 3 Technical data for plug connectors XN-322-4DO-RNO

Technical data as per IEC/DIN/VDE	Unit	solid	Flex-ible	Flex-ible
Insulating material group	–	I		
Overvoltage category/pollution degree	–/–	III/3	III/2	II/2
Device Voltage Rating	V	320	320	630
Rated surge voltage	kV	4	4	4
Rated operational current/cross-sectional area	A/mm²	12/2.5		

2.4 Connecting the power supply

DANGER
In safety-relevant applications, the power supply used to power the XN300 system must be a PELV power supply unit.

The system bus communication channel on the XN300 slice modules is powered with the 5 V on the system bus.

Power is delivered either through the XControl modular PLC being used or through the gateway.

CAUTION
Make sure not to exceed the maximum total current for all the XN300 slice modules.

The total current for the +5 V power supply must not exceed the current delivered by the XControl modular PLC or the gateway!
The total current for the +24 V power supply must not exceed the current delivered by the XControl modular PLC or the gateway!

To find out the maximum I_{BP_5V} current drawn per XN300 slice module, please refer to the table in the appendix in → Section "39.4.4 Current draw per XN300 slice module on the 5 V system bus", page 335.

For information on the delivered current, please refer to → Section "39.4.3 Delivery of power on the system bus", page 334.

In addition, the system bus provides a 24 VDC supply voltage used to internally power the XN300 slice modules.

To find out the maximum I_{BP_24V} current drawn per XN300 slice module, please refer to the table in the appendix in → Section "39.4.5 Current draw per XN300 slice module on the 24 V system bus", page 337.

Modules with high power consumption levels, however, will also need an additional power supply.

The following XN300 slice modules require an external 24 VDC power supply as well:

- XN-322-8DO-P05
- XN-322-12DO-P17
- XN-322-16DO-P05
- XN-322-8DIO-PD05
- XN-322-16DIO-PD05
- XN-322-16DIO-PC05
- XN-322-8AO-U2
- XN-322-4AIO-I
- XN-322-8AIO-I
- XN-322-1DCD-B35
- XN-322-1CNT-8DIO
- XN-322-16MIO-DIOAI
- XN-322-2PWM
- XN-322-4AO-UI

External 24 VDC voltages can be distributed using an XN-322-4PS-20 power distribution module or XN322-18PD-P and XN-322-18PD-M field potential distributor modules:
→ Chapter 4 “Power supply XN-322-4PS-20”, page 32,
→ Chapter 6 “Power distribution +24 V XN-322-18PD-P”, page 37,
→ Chapter 5 “Power distribution 0 V XN-322-18PD-M”, page 34.

You can use the XN300-Assist software program for assistance with engineering and commissioning.

2.5 Potential relationship between the components

All XN300 slice modules feature a contact point that is used to establish a functional earth connection to the DIN-rail. Moreover, all power supply earth connections are connected to the functional earth. Finally, the CANopen field bus interface or EtherCAT interface and the XN300 system are galvanically isolated from each other.

Common

- 0V
- ⏚

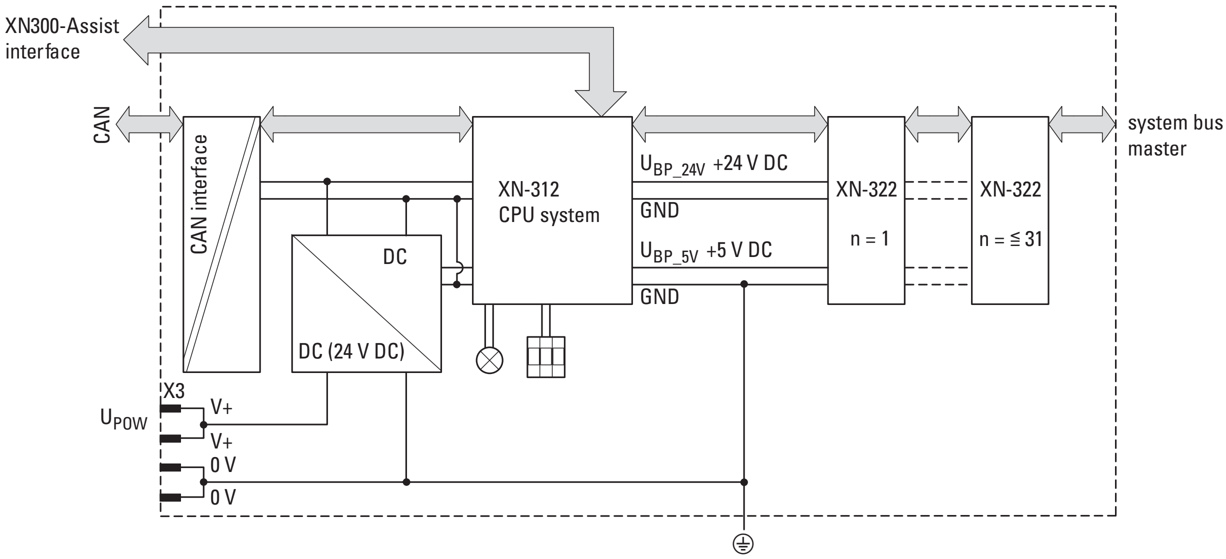


Figure 11: Function principle of XN300 system

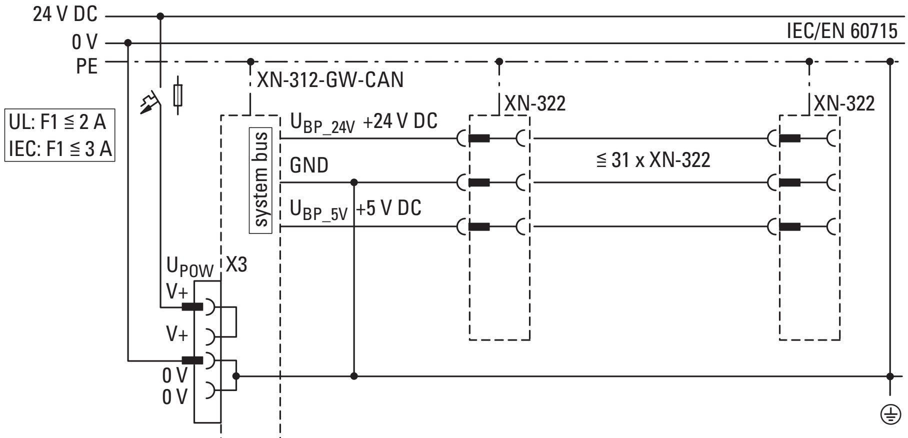


Figure 12: Gateway in XN300 system

2.6 Conditions for marine approval

The following DNV GL rules for shipping classification in accordance with DNVGL-CG-0339 type approvals must be observed:

1. Complete and proper installation and commissioning in accordance with DNV GL rules and Eaton requirements and specifications.
2. Installation of radio interference suppression filters for the 24 V DC supply.

2.6.1 Radio interference suppression filter for the 24 V DC supply

Additional interference filters must be installed for the power supply in order to comply with EMC Class B requirements. Make sure to integrate an interference filter into the wiring. Depending on the output, the following filters can be used:

- XT-FIL-1 radio interference suppression filter for 24 V DC supply up to 2.2 A (Eaton article no. 285316)

or

- XT-FIL-2 radio interference suppression filter for 24 V DC supply up to 12 A (Eaton article no. 118980)

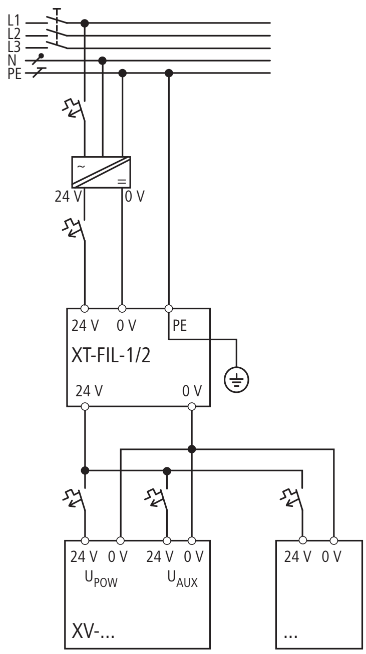


Figure 13: Engineering example for integration of radio interference suppression filters

2.6.2 Screening the communication cables used

In order to ensure that signals are transmitted without noise so as to comply with EMC B requirements, the communication cables used must be screened.

Use screened cables or screen the cables yourself with a ferrite ring such as:

- Würth STAR-RING snap-together ferrite, split ferrite core, 30 x 20 x 20 mm, for cables with a diameter of 8 mm
- Würth STAR-GAP snap-together ferrite, split ferrite core, 31.5 x 35 x 28.3 mm, for cables with a diameter of 13 mm

▶ Make sure to properly place the ferrite ring on the communication cable at a location close to the connection side (max. distance of 20 cm from the external device plug) on the touch display.

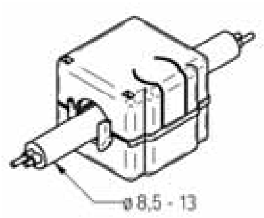


Figure 14: Screening with snap-together ferrite ring

3 Commissioning

XN300 slice modules are commissioned in the corresponding system block with the gateway. For a detailed explanation on how to commission the gateway, please refer to the "Commissioning" chapter in following manuals:

"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN
"Modular PLCs XControl: XC-104-… XC-204-… XC-303-…", MN050005EN

3.1 General commissioning instructions

The signals received by analog modules are very small in comparison to digital signals. In order to ensure that these modules work properly, it is absolutely necessary to route all cables carefully:

- The DIN-rail must have a proper earth connection
- The cables used to connect to the analog signal sources must be as short as possible and must not be routed parallel to digital signal cables.
- Analog signal cables must be screened.
- The screening must be terminated at a screening bus.
- Do not route the input cables parallel to load circuits.
- Suppressor circuit for all contactor coils (RC suppressors or flyback diodes)

→ If possible, connect the earth bus to the control panel earth bus!

3.2 Wiring in accordance with EMC requirements

Undesired faults can occur on the field bus and the analog inputs due to electromagnetic interference. This can be minimized beforehand by the implementation of suitable EMC measures. These include:

- EMC-conformant system configuration,
- Routing all analog input and field bus cables in a way that meets EMC requirements
- Measures designed to reduce potential differences
- The correct installation of the field bus system (cable, connection of the bus connectors, etc.),
- Using shielding

for DIN-rail

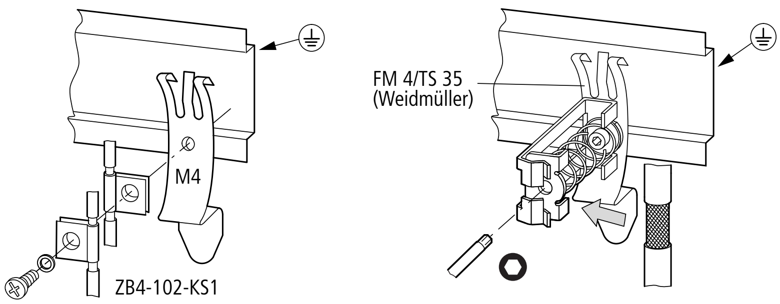


Figure 15: Field bus shielded by using a shield

XN300 slice modules feature a functional earth connection point at the back.

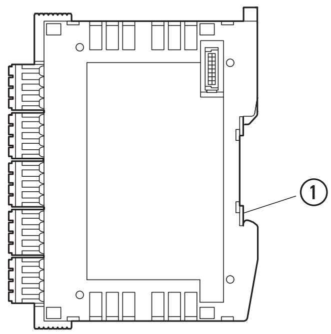


Figure 16: XN300 slice module side view

① Functional earth

3.3 LED indicators

Status LEDs are used to indicate the status of all XN300 slice modules. These LEDs have various colors in order to make it possible to easily determine which function they represent:

- Green: input
- Yellow: output
- Red: fault

4 Power supply XN-322-4PS-20

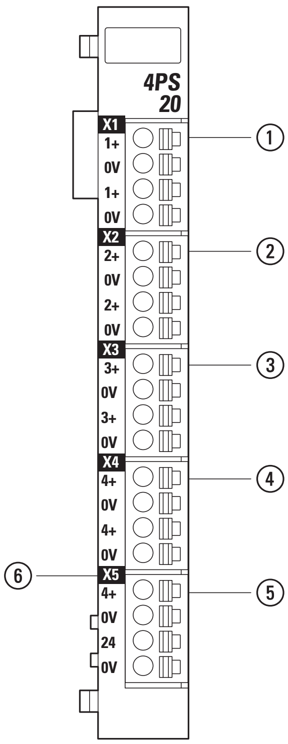
Power supply modules can be used to distribute the field supply voltage for XN300 slice modules.

The targeted use of power supply modules makes it possible to ensure that all slice modules will be properly powered and fused as required for the application in question by segmenting the power supply into sections.

XN-322-4PS-20 modules are powered via connector X5 using the 24 and 0 V pins. The slice modules then distribute this power to nine +24 VDC-Out power outputs, each with its own GND output.

The power outputs are grouped and short-circuit proof, with each group being able to deliver up to 2 A.

4.1 Status LED signals and pin assignment



① X1
- 1+ 24 VDC-Out 1, power supply group 1
- 0 V GND 1, power supply group 1
- 1+ 24 VDC-Out 2, power supply group 1
- 0 V GND 2, power supply group 1

② X2
- 2+ 24 VDC-Out 3, power supply group 2
- 0 V GND 3, power supply group 2
- 2+ 24 VDC-Out 4, power supply group 2
- 0 V GND 4, power supply group 2

③ X3
- 3+ 24 VDC-Out 5, power supply group 3
- 0 V GND 5, power supply group 3
- 3+ 24 VDC-Out 6, power supply group 3
- 0 V GND 6, power supply group 3

④ X4
- 4+ 24 VDC-Out 7, power supply group 4
- 0 V GND 7, power supply group 4
- 4+ 24 VDC-Out 8, power supply group 4
- 0 V GND 8, power supply group 4

⑤ X5
- 4+ 24 VDC-Out 9, power supply group 4
- 0 V GND 9, power supply group 4
- 24 VDC U_{e24} input
- 0 V GND input

⑥ 24 VDC OK LED

Figure 17: LED signals and pin assignment for XN-322-4PS-20

Status LEDs

Module status (24 VDC OK)	Green	ON	24 VDC OK Power supply group voltage ≧ 18 VDC
		OFF	No power

4.2 Wiring topic

Each power supply module can be used to power up to nine XN300 slice modules.

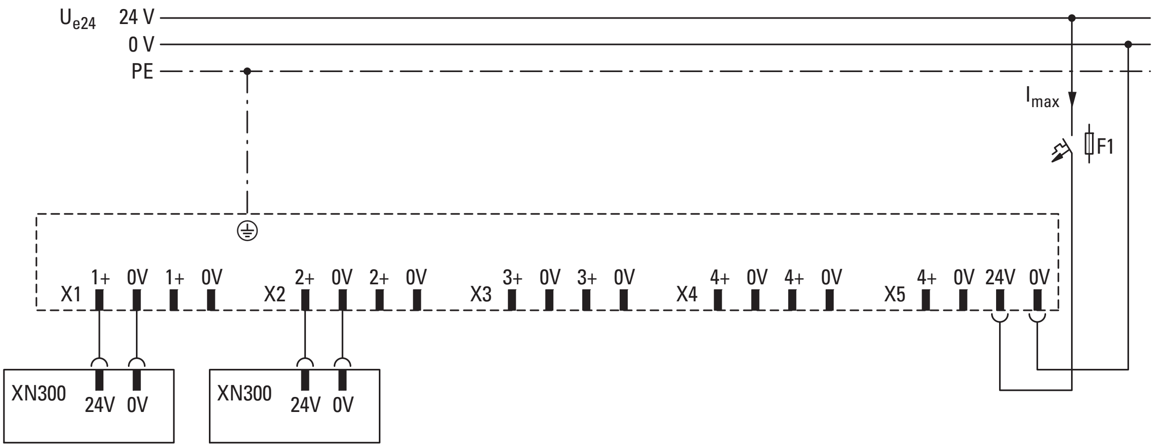


Figure 18: Wiring example using connectors X1 to X5 with a total of nine XN300 slice modules

4.3 Technical specifications

4.3.1 +24 V power supply modules

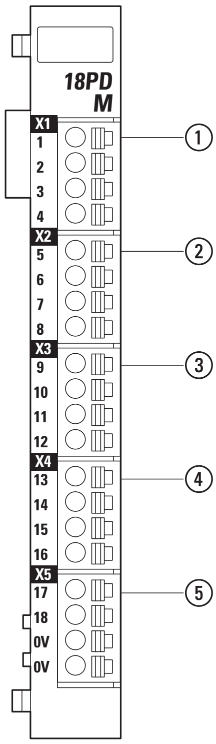
Number of +24 VDC power supply outputs	9 (distributed among 4 power supply groups)
Short-circuit proof	Yes
Maximum permissible continuous load current / power supply connection	2 A
Maximum permissible continuous load current / power supply group	2 A
Maximum total current / module	6 A
Potential isolation	none

5 Power distribution 0 V XN-322-18PD-M

XN-322-18PD-M modules are passive XN300 field potential distribution slice modules. They provide an output potential of 0 V for a total of 18 pins. This means that this 0 V potential can be tapped without the need for additional terminal strips.

XN-322-18PD-M modules are normally used together with XN-322-18PD-P modules in order to ensure that XN300 slice modules can be segmented into groups that can be fused and switched as such. When used together with digital slice modules, these modules make it possible to use two-wire and three-wire connection configurations.

5.1 Pin assignment



① X1
- 1 GND output 1
- 2 GND output 2
- 3 GND output 3
- 4 GND output 4

② X2
- 5 GND output 5
- 6 GND output 6
- 7 GND output 7
- 8 GND output 8

③ X3
- 9 GND output 9
- 10 GND output 10
- 11 GND output 11
- 12 GND output 12

④ X4
- 13 GND output 13
- 14 GND output 14
- 15 GND output 15
- 16 GND output 16

⑤ X5
- 17 GND output 17
- 18 GND output 18
- 0 V GND input
- 0 V GND input

Figure 19: LED signals and pin assignment for XN-322-18PD-M

5.2 Wiring topic

> *NOTICE*
> Connect both of the device's 0 V terminals to the power supply's 0 V!

In order to reduce the contact current flowing through the plug connector, the two 0 V input pins on the module need to be connected to the power supply's 0 V.

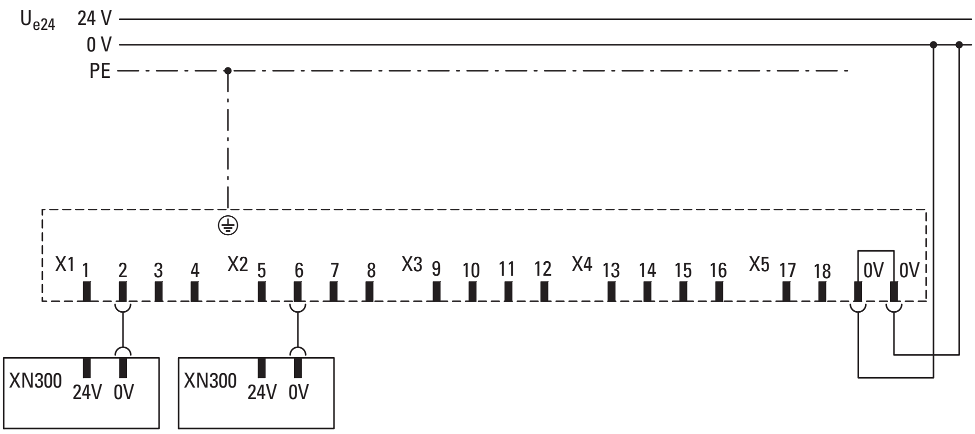


Figure 20: Wiring example

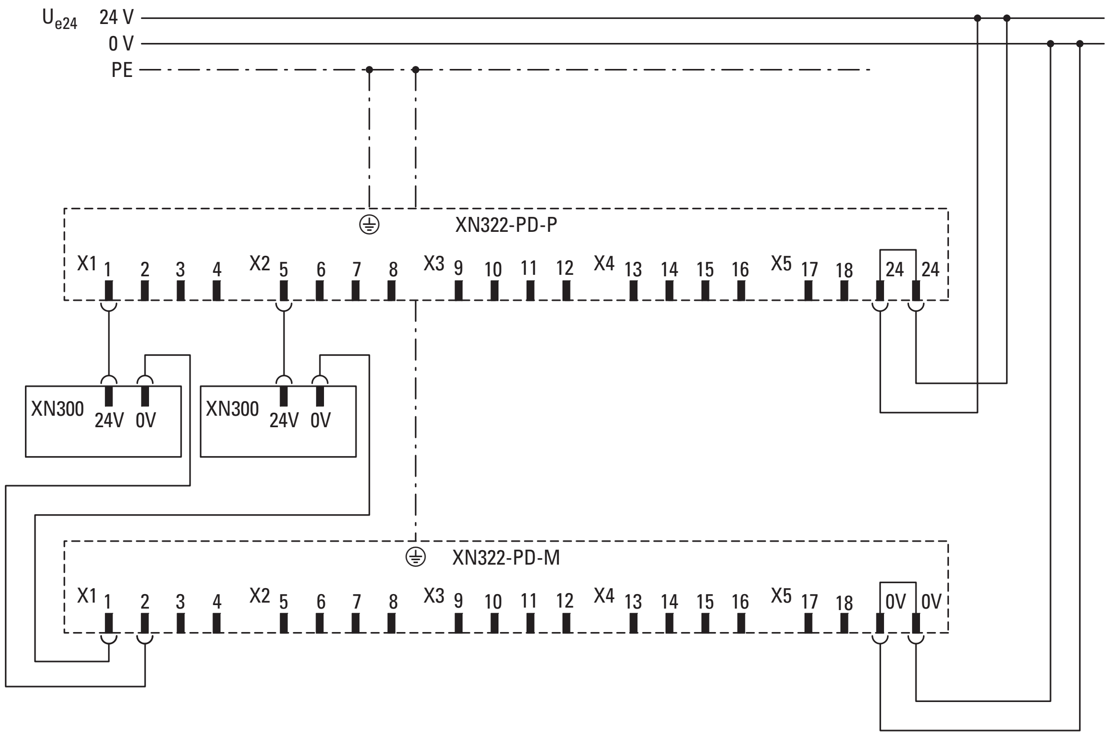


Figure 21: XN-322-18PD-M and XN-322-18PD-P wiring example showing how to power slice modules

5.3 Technical specifications

5.3.1 0 V distribution

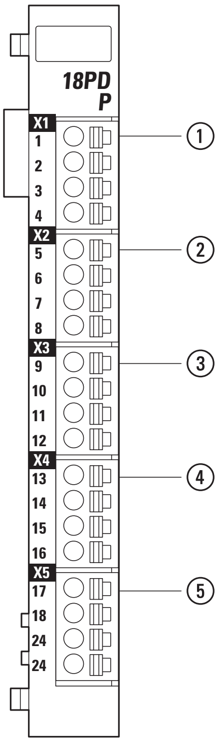
Number of 0 V potentials	2
Short-circuit proof	no
Internal fusing	no
Maximum permissible continuous load current / connection	8A
Maximum total current	16 A (The maximum current of 8 A per connection must not be exceeded at the inputs or outputs!)

6 Power distribution +24 V XN-322-18PD-P

XN-322-18PD-P modules are passive XN300 field potential distribution slice modules. They provide an output potential of 24 VDC for a total of 18 pins. This means that this voltage can be tapped without the need for additional terminal strips.

XN-322-18PD-P modules are normally used together with XN-322-18PD-M modules in order to ensure that XN300 slice modules can be segmented into groups that can be fused and switched as such. When used together with digital slice modules, these modules make it possible to use two-wire and three-wire connection configurations.

6.1 Pin assignment



1. X1
   - 1 24VDC output 1
   - 2 24VDC output 2
   - 3 24VDC output 3
   - 4 24VDC output 4
2. X2
   - 5 24VDC output 5
   - 6 24VDC output 6
   - 7 24VDC output 7
   - 8 24VDC output 8
3. X3
   - 9 24VDC output 9
   - 10 24VDC output 10
   - 11 24VDC output 11
   - 12 24VDC output 12
4. X4
   - 13 24VDC output 13
   - 14 24VDC output 14
   - 15 24VDC output 15
   - 16 24VDC output 16
5. X5
   - 17 24VDC output 17
   - 18 24VDC output 18
   - 24 24VDC power supply
   - 24 24VDC power supply

Figure 22: LED signals and pin assignment for XN-322-18PD-P

6.2 Wiring topic

NOTICE

Connect both of the device's 24 V terminals to the power supply's 24 V!

In order to reduce the contact current flowing through the plug connector, the two 24 input pins on the module need to be connected to the power supply's 24 V.

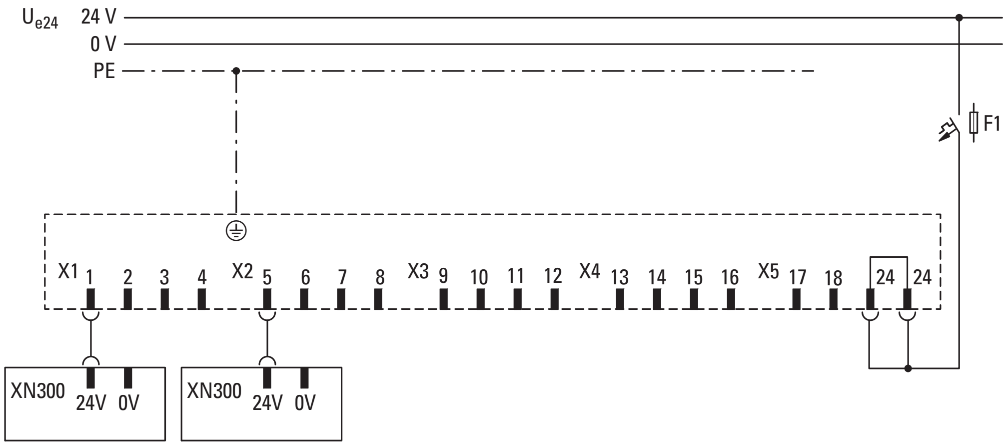


Figure 23: Wiring example

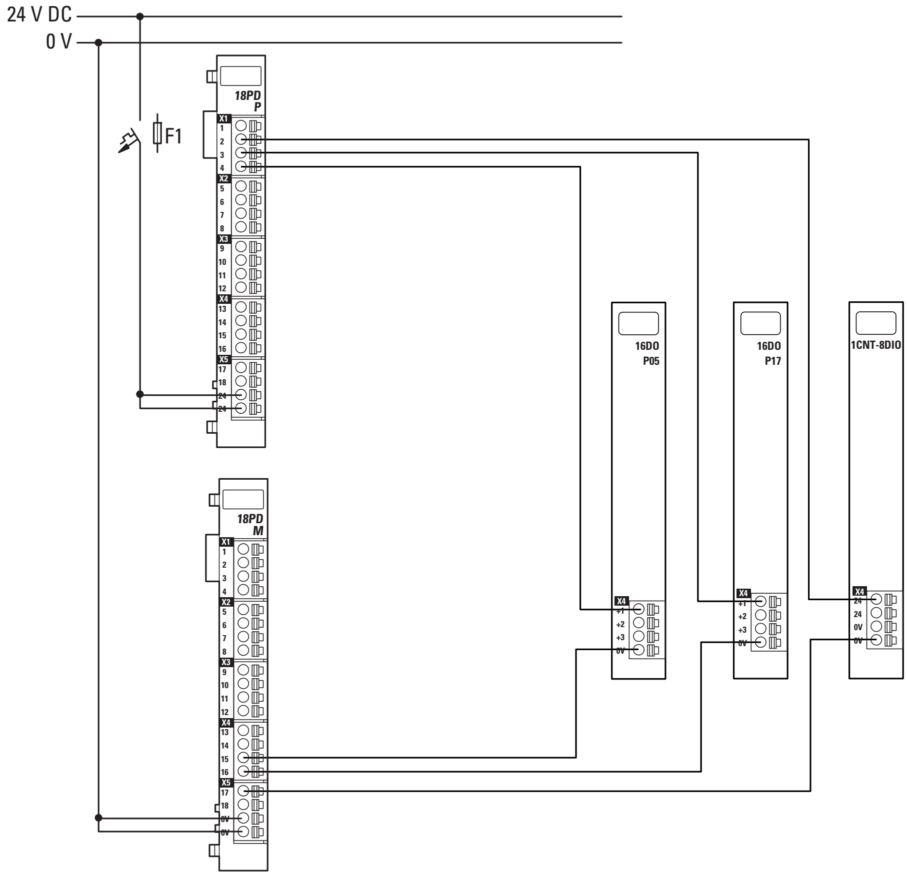


Figure 24: XN-322-18PD-P and XN-322-18PD-M wiring example showing how to power slice modules

6.3 Technical specifications

6.3.1 +24 V distribution

Number of +24 V outputs	2
Short-circuit proof	no
Internal fusing	no
Maximum permissible continuous load current per pin	8 A
Maximum total current	16 A (The maximum current of 8 A per pin must not be exceeded at the inputs or outputs!)

7 Digital input module XN-322-8DI-PD

XN-322-8DI-PD digital input module has 8 inputs, for a +24 V signal level, that can be used to read the logical low and logical high levels, i.e., 0 and 1. These modules feature an internal input filter designed to suppress glitches on the corresponding signal cables.

7.1 Status LEDs

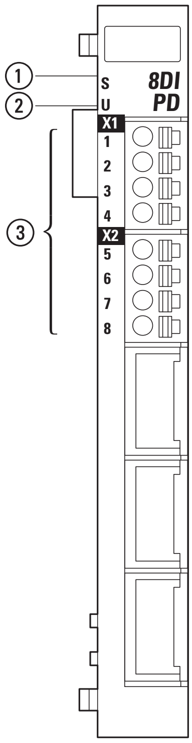


Figure 25: LED signals and pin assignment for XN-322-8DI-PD

1. Module status LED
2. User LED
3. Status LEDs for inputs 1 to 8

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 ... Input 8	Green	ON	Input ON
		OFF	Input OFF

7.2 Pin assignment

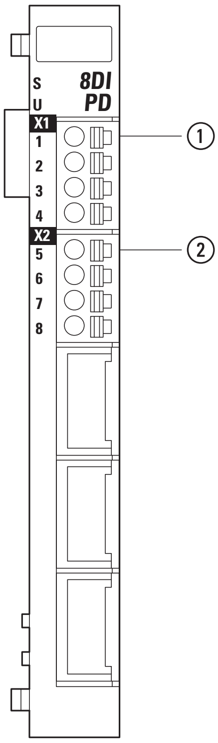


Figure 26: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

7.3 Digital input wiring

The digital input, as defined in the EN 61131-2 type 1 with a 5-ms input delay, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

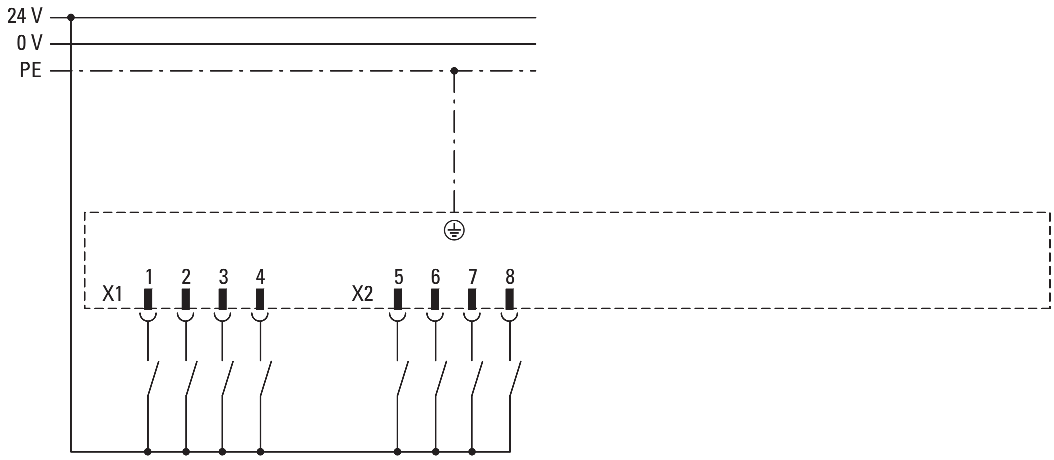


Figure 27: Input wiring

7.4 Technical data for digital inputs

Designation		
Number of channels	8	
	61131-2 Type1	
Input voltage U_E	24 Vdc	maximum 30 VDC
Signal level	LOW: $0 < U_E < +8$ V	HIGH: $+14 \text{ V} < U_E < +30$ V
Switching threshold	normally +11 VDC	
Input current at U_E=24Vdc	normally 3.7 mA	
Input delay	normally 5 ms	

7.5 Memory layout

→ For product-specific standard CANopen or EtherCAT objects, please refer to the manual for the respective gateway: "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description				Lokale I/O address (HEX)
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID				–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x3150	0x6000 SUB x	0x6xx0 SUB 01	1	Input1_8	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
0x4001	–	0x9xx0 SUB 08	max.10	CAN:SerialNumber EC:Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	9xx0 SUB 0A	Max. 25	ProductName				–

8 Digital input module XN-322-16DI-PD

XN-322-16DI-PD digital input modules have 16 inputs, for a +24 V signal level, that can be used to read the logical low and logical high levels, i.e., 0 and 1. The modules feature input filters designed to suppress glitches on the corresponding signal cables.

8.1 Status LEDs

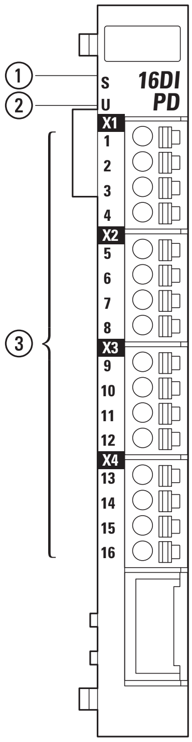


Figure 28: LED signals and pin assignment for XN-322-16DI-PD

① Module status LED
② User LED
③ Status LEDs for inputs 1 to 16

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 ... Input 16	Green	ON	Input ON
		OFF	Input OFF

8.2 Pin assignment

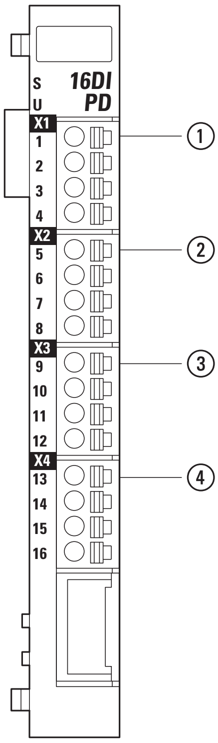


Figure 29: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

③ X3
- 9 digital input 9
- 10 digital input 10
- 11 digital input 11
- 12 digital input 12

④ X4
- 13 digital input 13
- 14 digital input 14
- 15 digital input 15
- 16 digital input 16

8.3 Digital input wiring

The digital input, as defined in the EN 61131-2 type 1 with a 5-ms input delay, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

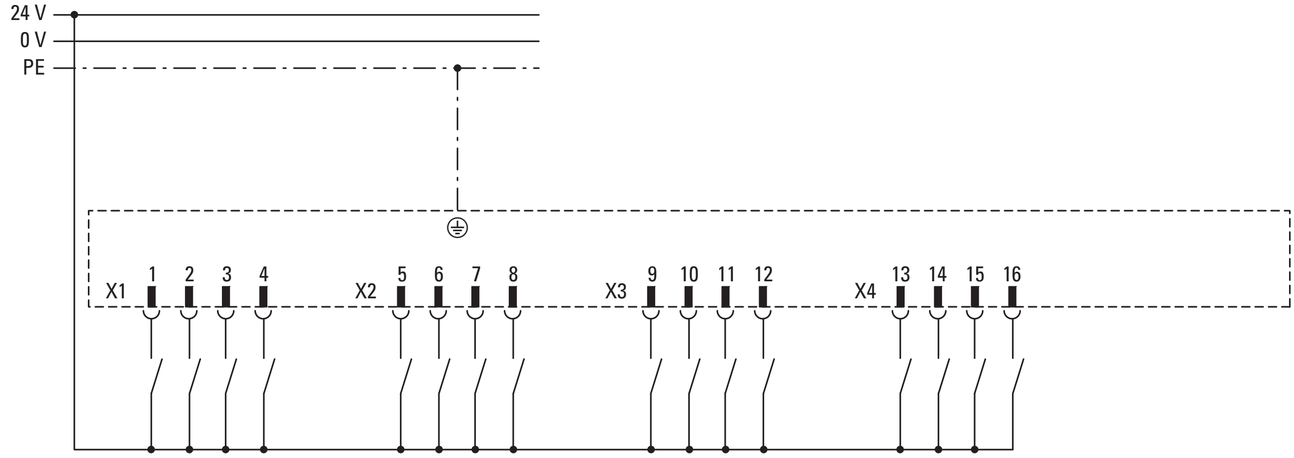


Figure 30: Input wiring

8.4 Technical data for digital inputs

Designation		
Number of channels	16	
	61131-2 Type1	
Input voltage UE	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 < UE < +8 V	HIGH: +14 V < UE < +30 V
Switching threshold	normally +11 VDC	
Input current at UE=24Vdc	normally 3.7 mA	
Input delay	normally 5 ms	

8.5 Memory layout

→ For product-specific standard CANopen or EtherCAT objects, please refer to the manual for the respective gateway: "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID				–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x3140	0x6000 SUB x	0x6xx0 SUB 01	2	Input1_16 Digital input register	Byte 0	Bit 0	Input 1	0x000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
	0x6000 SUB x+1	0x6xx0 SUB 02			Byte 1	Bit 0	Input 9	
						Bit 1	Input 10	
						Bit 2	Input 11	
						Bit 3	Input 12	
						Bit 4	Input 13	
						Bit 5	Input 14	
						Bit 6	Input 15	
						Bit 7	Input 16	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description		Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber		–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl		–
0x400C	–	–	Max. 25	ProductName		–

9 Digital input module XN-322-20DI-PD

XN-322-20DI-PD digital input modules have 20 inputs, for a +24 V signal level, that can be used to read the logical low and logical high levels, i.e., 0 and 1. These modules feature an internal input filter designed to suppress glitches on the corresponding signal cables.

9.1 Status LEDs

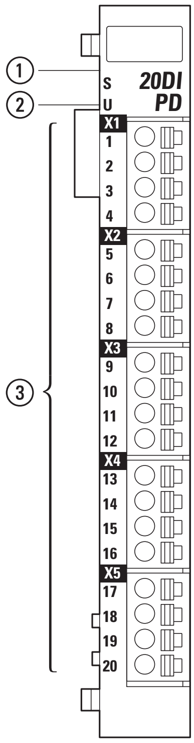


Figure 31: LED signals and pin assignment for XN-322-20DI-PD

① Module status LED
② User LED
③ Status LEDs for inputs 1 to 20

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 … Input 20	Green	ON	Input ON
		OFF	Input OFF

9.2 Pin assignment

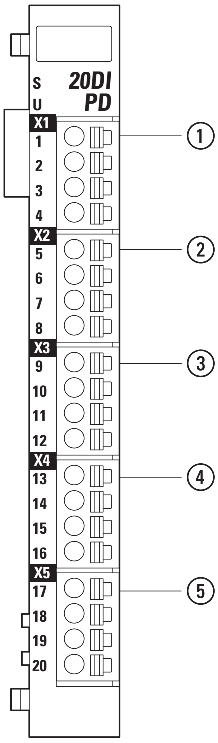


Figure 32: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

③ X3
- 9 digital input 9
- 10 digital input 10
- 11 digital input 11
- 12 digital input 12

④ X4
- 13 digital input 13
- 14 digital input 14
- 15 digital input 15
- 16 digital input 16

⑤ X5
- 17 digital input 17
- 18 digital input 18
- 19 digital input 19
- 20 digital input 20

9.3 Digital input wiring

The digital input, as defined in the EN 61131-2 type 1 with a 5-ms input delay, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

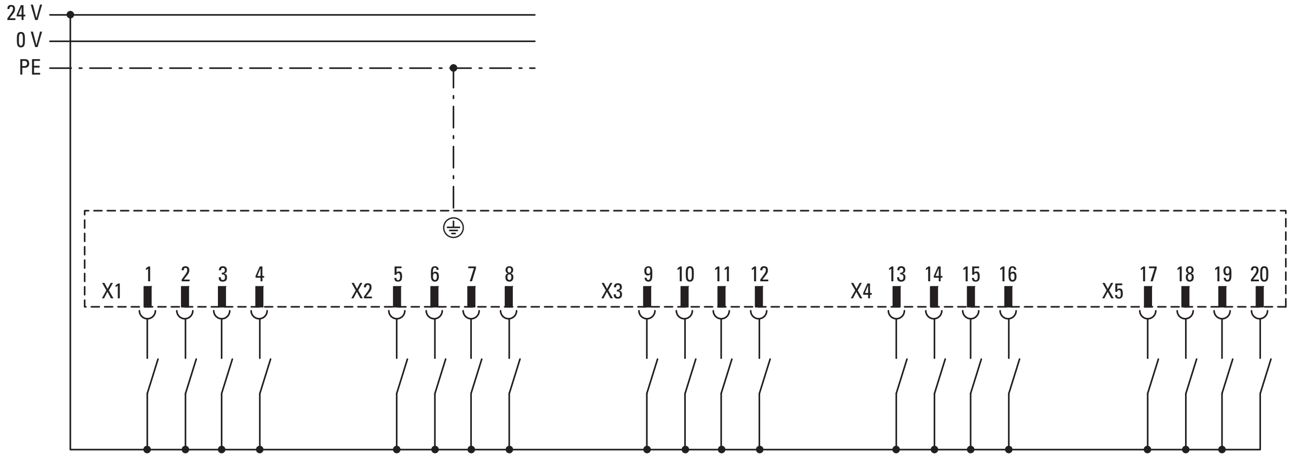


Figure 33: Input wiring

9.4 Technical data for digital inputs

Designation		
Number of channels	20	
	61131-2 Type1	
Input voltage UE	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 < UE < +8 V	HIGH: +14 V < UE < +30 V
Switching threshold	normally +11 VDC	
Input current at UE=24Vdc	normally 3.7 mA	
Input delay	normally 5 ms	

9.5 Memory layout

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState	–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	–
–	–	0x9xx0 SUB 03	4	FPGAVersion	–
–	–	0x9xx0 SUB 04	4	DeviceType	–
–	–	0x9xx0 SUB 05	4	VendorID	–
–	–	0x9xx0 SUB 06	4	ProductCode	–
–	–	0x9xx0 SUB 07	4	Revision	–
–	–	0x9xx0 SUB 09	4	HWVersion	–
–	–	0x9xx0 SUB 0A	4	FWVersion	–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3010	0x6000 SUB x	0x6xx0 SUB 01	4	Input1_20	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
	0x6000 SUB x+1	0x6xx0 SUB 02			Byte 1	Bit 0	Input 9	0x0001
						Bit 1	Input 10	
						Bit 2	Input 11	
						Bit 3	Input 12	
						Bit 4	Input 13	
						Bit 5	Input 14	
						Bit 6	Input 15	
						Bit 7	Input 16	
	0x6000 SUB x+2	0x6xx0 SUB 03			Byte 2	Bit 0	Input 17	0x0002
						Bit 1	Input 18	
						Bit 2	Input 19	
						Bit 3	Input 20	
						Bit 4	-	
						Bit 5	-	
						Bit 6	-	
						Bit 7	-	
	0x6000 SUB x+3	0x6xx0 SUB 04			Byte 3	Bit 0	-	–
						Bit 1	-	
						Bit 2	-	
						Bit 3	-	
						Bit 4	-	
						Bit 5	-	
						Bit 6	-	
						Bit 7	-	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber	–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl	–
0x400C	–	–	Max. 25	ProductName	–

10 Digital input module XN-322-20DI-PF

XN-322-20DI-PF digital input modules have 20 inputs, for a +24 V level, that can be used to read the logical low and logical high signal levels, i.e., 0 and 1. The modules feature input filters designed to suppress glitches on the corresponding signal cables.

10.1 Status LEDs

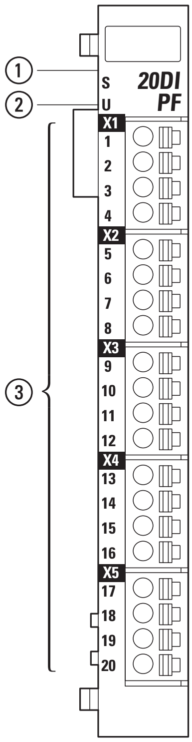


Figure 34: LED signals and pin assignment for XN-322-20DI-PF

1. Module status LED
2. User LED
3. Status LEDs for inputs 1 to 20

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 … Status input 20	Green	ON	Input ON
		OFF	Input OFF

10.2 Pin assignment

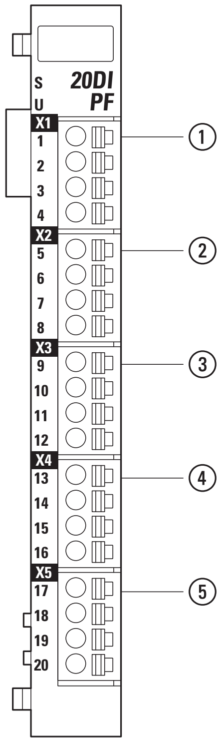


Figure 35: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

③ X3
- 9 digital input 9
- 10 digital input 10
- 11 digital input 11
- 12 digital input 12

④ X4
- 13 digital input 13
- 14 digital input 14
- 15 digital input 15
- 16 digital input 16

⑤ X5
- 17 digital input 17
- 18 digital input 18
- 19 digital input 19
- 20 digital input 20

10.3 Digital input wiring

The digital input, which conforms to EN 61131-2 type 1, is suitable for connecting electronic sensors. It is used to convert a signal with two possible states into a one-bit binary number.

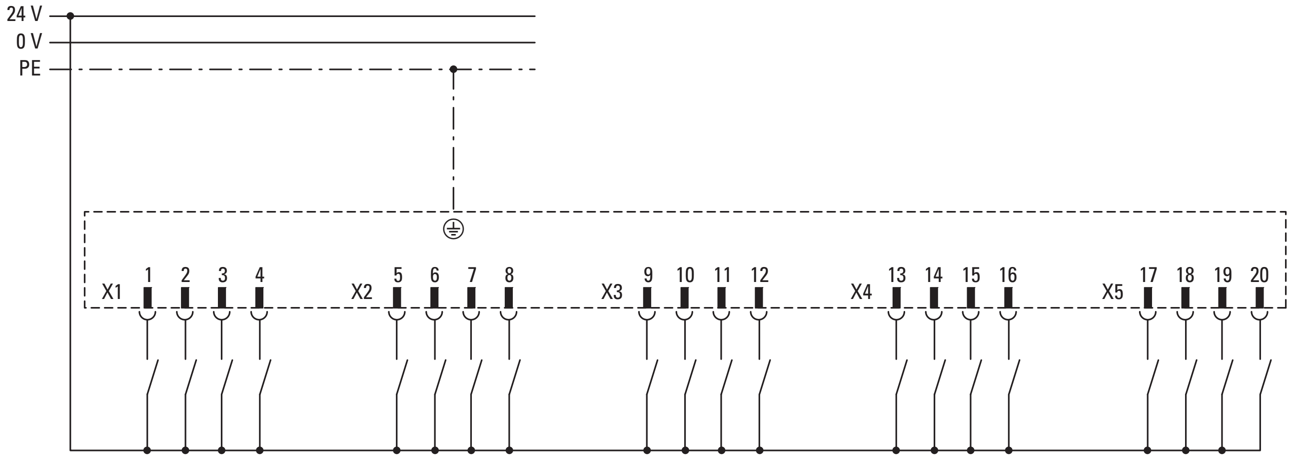


Figure 36: Input wiring

10.4 Technical data for digital inputs

Designation		
Number of channels	20	
	61131-2 Type1	
Input voltage UE	24 Vdc	maximum 30 VDC
Signal level	LOW: $0 < U_e < +8$ V	HIGH: $+14$ V $< U_e < +30$ V
Switching threshold	normally +11 VDC	
Input current at UE=24Vdc	normally 3.7 mA	
Input delay	normally 0.5 ms	

10.5 Memory layout

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description		Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState		–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number	–
–	–	0x9xx0 SUB 03	4	FPGAVersion		–
–	–	0x9xx0 SUB 04	4	DeviceType		–
–	–	0x9xx0 SUB 05	4	VendorID		–
–	–	0x9xx0 SUB 06	4	ProductCode		–
–	–	0x9xx0 SUB 07	4	Revision		–
–	–	0x9xx0 SUB 09	4	HWVersion		–
–	–	0x9xx0 SUB 0A	4	FWVersion		–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0X3030	0x6000 SUB x	0x6xx0 SUB 01	4	Input1_20	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
	0x6000 SUB x+1	0x6xx0 SUB 02			Byte 1	Bit 0	Input 9	0x0001
						Bit 1	Input 10	
						Bit 2	Input 11	
						Bit 3	Input 12	
						Bit 4	Input 13	
						Bit 5	Input 14	
						Bit 6	Input 15	
						Bit 7	Input 16	
	0x6000 SUB x+2	0x6xx0 SUB 03			Byte 2	Bit 0	Input 17	0x0002
						Bit 1	Input 18	
						Bit 2	Input 19	
						Bit 3	Input 20	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	
	0x6000 SUB x+3	0x6xx0 SUB 04			Byte 3	Bit 0	–	–
						Bit 1	–	
						Bit 2	–	
						Bit 3	–	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description		Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber		–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl		–
0x400C	–	–	Max. 25	ProductName		–

11 XN-322-20DI-PCNT digital input module with counter

XN-322-20DI-PCNT digital input modules have 20 inputs, for a +24 V level, that can be used to read the logical low and logical high signal levels, i.e., 0 and 1. The modules feature input filters designed to suppress glitches on the corresponding signal cables. In addition, digital inputs 1 – 4 feature a counter function that, when used, makes internal module registers be incremented every time there is an input pulse.

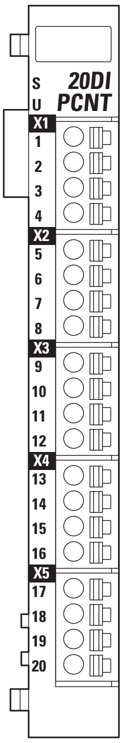


Figure 37: Device view XN-322-20DI-PCNT

11.1 Status LEDs

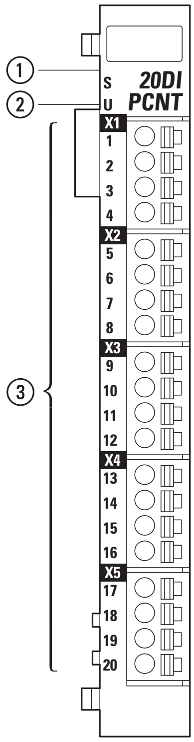


Figure 38: LED signals and pin assignment

1. Module status LED
2. User LED
3. Status LEDs for inputs 1 to 20

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 – 20	Green	ON	Input ON
		OFF	Input OFF

11.2 Pin assignment

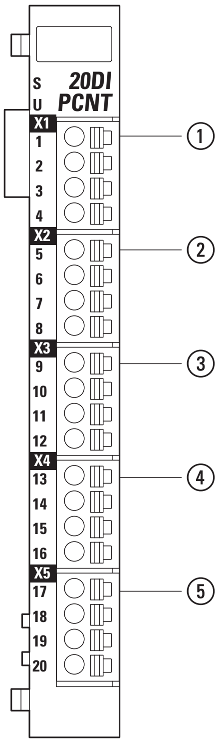


Figure 39: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

③ X3
- 9 digital input 9
- 10 digital input 10
- 11 digital input 11
- 12 digital input 12

④ X4
- 13 digital input 13
- 14 digital input 14
- 15 digital input 15
- 16 digital input 16

⑤ X5
- 17 digital input 17
- 18 digital input 18
- 19 digital input 19
- 20 digital input 20

11.3 Wiring topic

There are 20 digital inputs wired to each of the connectors from X1 to X5 connectors.

11.3.1 Wiring up the digital inputs

The digital input, which conforms to EN 61131-2 type 1, is particularly suitable for connecting electronic sensors. It is used to convert a signal with two possible states into a one-bit binary number.

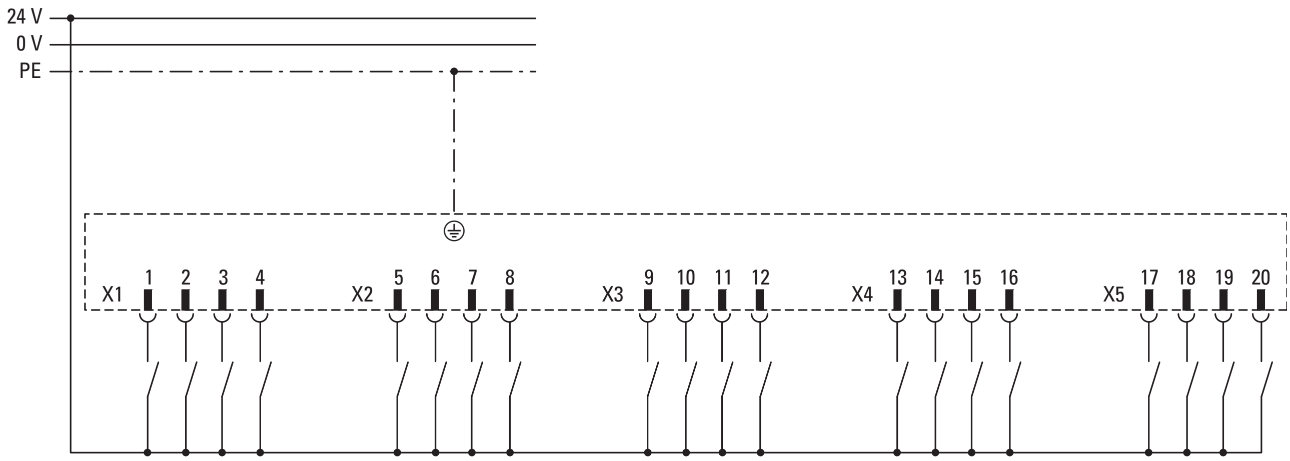


Figure 40: Input wiring

11.3.2 Wiring the counter functions for inputs 1 to 4

Inputs 1…4 are connected downstream of internal module counter registers that can be used to directly count signal pulses at these inputs.

The following modes are available:

- Counter mode (simple counting): The 8-bit counter register for an input will be incremented every time there is a rising signal pulse at that input. Objects 0x3023 to 0x3026 are the corresponding 8-bit counter registers.
- Incremental encoder mode: Counts by interpreting the signals from two inputs using AB quadrature mode with X4 encoding and incrementing a 16-bit counter register. Objects 0x3027 to 0x3028 are the corresponding 16-bit counter registers.

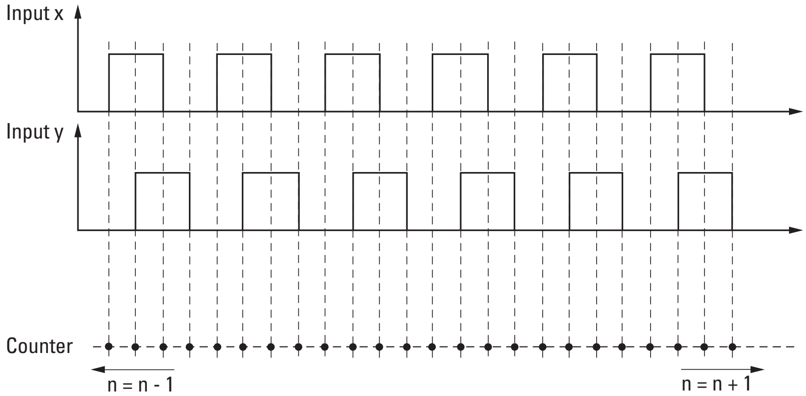


Figure 41: Timing diagram showing how the signals at the XN-322-20DI-PCNT module's inputs are used for counting when using AB quadrature mode with X4 encoding

11.3.3 Configuring inputs 1 to 4

Counter mode register object 0x4020 can be used to configure the function for inputs 1 to 4 and, accordingly, select the operating mode you want to use.

In addition, any writing command to counter mode register object 0x4020 will reset counter registers 0x3023 through 0x3028 to 0x00.

The following functions are available:

Data bit	Designation	Description
0	Input 1/2	0 = Counter Mode 1 = Incremental Encoder Mode
1	Input 3/4	0 = Counter Mode 1 = Incremental Encoder Mode
2 – 7		reserved

Please refer to Application examples on 339.

11.4 Technical data for digital inputs

Designation		
Number of channels	20	
	61131-2 Type1	
Input voltage U_e	24 Vdc	maximum 30 VDC
Signal level	LOW: $0 < U_e < +8$ V	HIGH: $+14\ V < U_e < +30$ V
Switching threshold	normally +11 VDC	
Input current at UE=24VDC	normally 3.7 mA	
Input delay		
Inputs 1 to 4	normally 10 µs	
Inputs 5 to 20	normally 500 µs	
Max. input frequency at inputs 1 to 4 when using X1 encoding	25 kHz	
Max. input frequency at inputs 1 to 4 when using X4 encoding	100 kHz	

11.5 Memory layout

→ For product specific CANopen or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	**Default CAN Mapping**	**EtherCAT Object Index**	**Size (byte)**	**Local I/O description**				**Local I/O addresses**
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID		Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3020	0x6000 SUB x	0x6xx0 SUB 01	3	Input1_8	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
0x3021	0x6000 SUB x+1	0x6xx0 SUB 02		Input9_16	Byte 1	Bit 0	Input 9	0x0001
						Bit 1	Input 10	
						Bit 2	Input 11	
						Bit 3	Input 12	
						Bit 4	Input 13	
						Bit 5	Input 14	
						Bit 6	Input 15	
						Bit 7	Input 16	
0x3022	0x6000 SUB x+2	0x6xx0 SUB 03		Input17_20	Byte 2	Bit 0	Input 17	0x0002
						Bit 1	Input 18	
						Bit 2	Input 19	
						Bit 3	Input 20	
						Bit 4	-	
						Bit 5	-	
						Bit 6	-	
						Bit 7	-	
0x3023		0x6xx4 SUB 01	1	Counter1		Counter 1 Register[1)]		0x0004
0x3024		0x6xx4 SUB 02	1	Counter2		Counter 2 Register[1)]		0x0005
0x3025		0x6xx4 SUB 03	1	Counter3		Counter 3 Register[1)]		0x0006
0x3026		0x6xx4 SUB 04	1	Counter4		Counter 4 Register[1)]		0x0007
0x3027		0x6xx4 SUB 01	2	Incremental Encoder1		Incremental encoder 1 Register[2)]		0x0004
0x3028		0x6xx4 SUB 03	2	Incremental Encoder2		Incremental encoder 2 Register[2)]		0x0006
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x4020		0x8xx4 SUB 01	1	CounterModeRegister Selecting the operating mode		Bit 0, Input 1 – 2	0 = Counter Mode	0x0003
							1 = Incremental Encoder Mode	
						Bit 1, Input 3 – 4	0 = Counter Mode	
							1 = Incremental Encoder Mode	

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

→ Make sure to only use the data relevant to the selected operating mode. Registers for operating modes that are not selected will contain invalid values. The operating mode can be selected using the counter mode register.

12 Digital input module XN-322-20DI-ND

The XN-322-20DI-ND digital input module features 20 inputs that are pulled up to +24 V with a pull-up resistor and relay a logic level of "0" at this voltage. If an input is pulled down to GND, a signal state of "1" will be relayed for that input instead. The modules feature input filters designed to suppress glitches on the corresponding signal cables.

12.1 Status LEDs

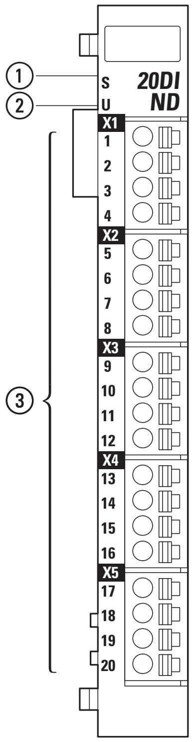


Figure 42: LED signals and pin assignment for XN-322-20DI-ND

① Module status LED
② User LED
③ Status LEDs for inputs 1 to 20

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 ... Input 20	Green	ON	Input ON
		OFF	Input OFF

12.2 Pin assignment

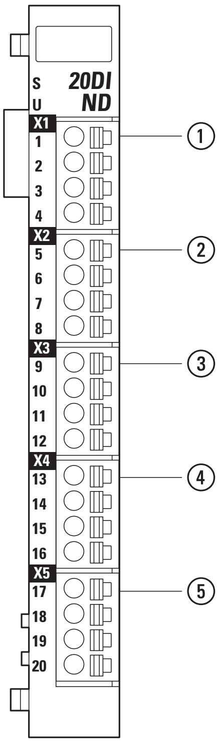


Figure 43: Pin assignment

① X1
- 1 digital input 1
- 2 digital input 2
- 3 digital input 3
- 4 digital input 4

② X2
- 5 digital input 5
- 6 digital input 6
- 7 digital input 7
- 8 digital input 8

③ X3
- 9 digital input 9
- 10 digital input 10
- 11 digital input 11
- 12 digital input 12

④ X4
- 13 digital input 13
- 14 digital input 14
- 15 digital input 15
- 16 digital input 16

⑤ X5
- 17 digital input 17
- 18 digital input 18
- 19 digital input 19
- 20 digital input 20

12.3 Digital input wiring

When not switched, each digital input will deliver a LOW signal. When an input is connected to ground, its logic signal level will switch to HIGH instead.

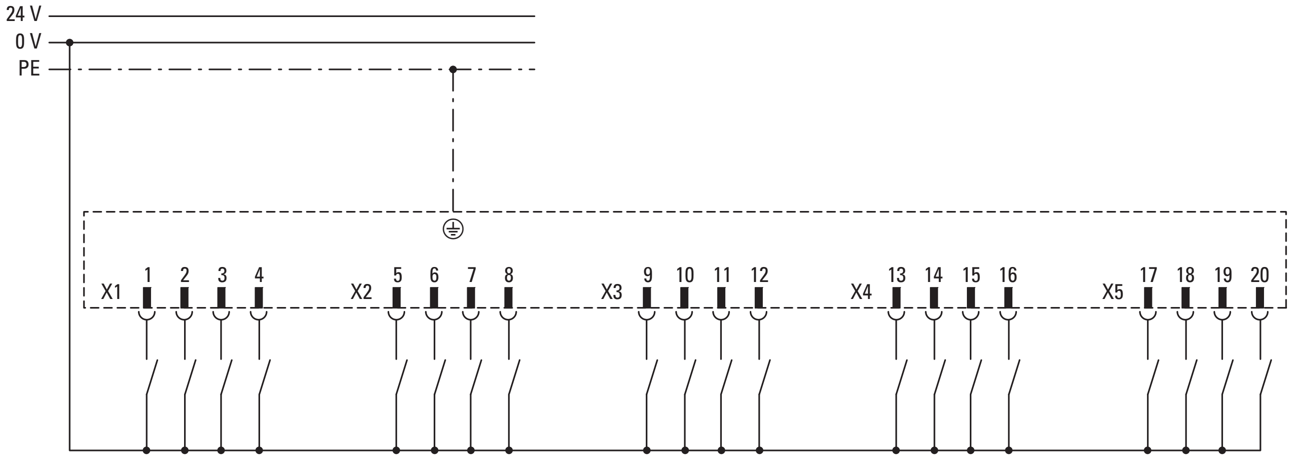


Figure 44: Input wiring

12.4 Technical data for digital inputs

Designation			
Number of channels that switch when connected to GND	20		
Input voltage UE_LOW	minimum 15 VDC	24 Vdc	maximum 30 VDC
Input current at IE_LOW	-1.0 mA		0 mA
Input voltage UE_HIGH	0 Vdc		5 Vdc
Input current at IE_LOW	-4.0 mA	-3.0 mA	-2.0 mA
Switching threshold	normally +7 VDC		
Input delay	normally 5 ms		

12.5 Memory layout

→ For product specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number			–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3130	0x6000 SUB x	0x6xx0 SUB 01	4	Input1_20	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
	0x6000 SUB x+1	0x6xx0 SUB 02			Byte 1	Bit 0	Input 9	0x0001
						Bit 1	Input 10	
						Bit 2	Input 11	
						Bit 3	Input 12	
						Bit 4	Input 13	
						Bit 5	Input 14	
						Bit 6	Input 15	
						Bit 7	Input 16	
	0x6000 SUB x+2	0x6xx0 SUB 03			Byte 3	Bit 0	Input 17	0x0002
						Bit 1	Input 18	
						Bit 2	Input 19	
						Bit 3	Input 20	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	
	0x6000 SUB x+3	0x6xx0 SUB 04			Byte 4	Bit 0	–	–
						Bit 1	–	
						Bit 2	–	
						Bit 3	–	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber	–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl	–
0x400C	–	–	Max. 25	ProductName	–

13 Relay output module XN-322-4DO-RNO

The XN-322-4DO-RNO is an XN300 slice module with 4 relay outputs. Each relay output features a normally open contact (NO) with a switching power of 230 VAC/6 A / 24 VDC/6 A.

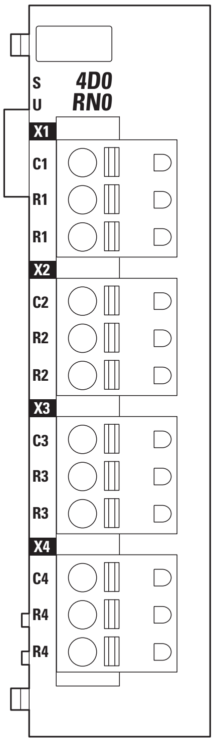


Figure 45: Device view XN-322-4DO-RNO

13.1 Status LEDs

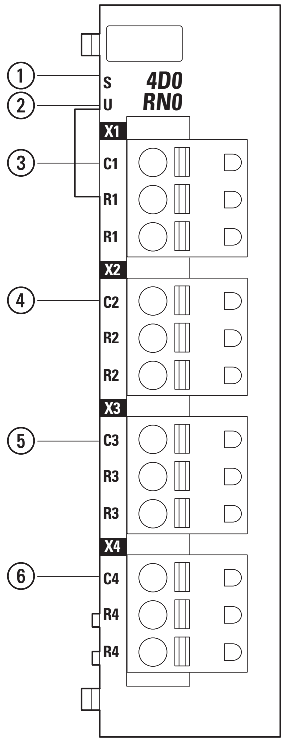


Figure 46: LED signals and pin assignment

1. Module status LED
2. User LED
3. Output 1 status LED
4. Output 2 status LED
5. Output 3 status LED
6. Output 4 status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Output status	yellow	ON	Relay contact closed
		OFF	Relay contact open

13.2 Pin assignment

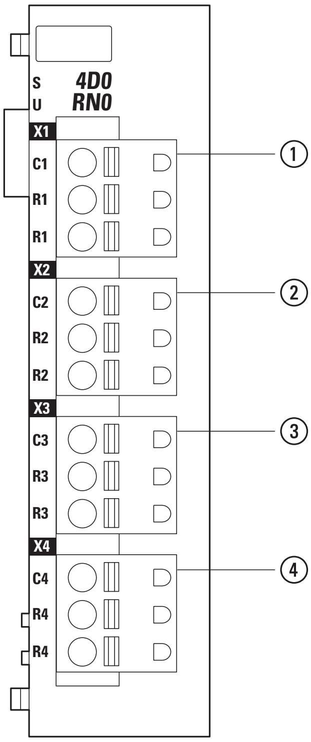


Figure 47: Pin assignment

① X1
- C1 NO
- R1 common contact
- R1 common contact

② X2
- C2 NO
- R2 common contact
- R2 common contact

③ X3
- C3 NO
- R3 common contact
- R3 common contact

④ X4
- C4 NO
- R4 common contact
- R4 common contact

13.3 Wiring topic

A digital output is wired to each of the four X1 to X4 connectors.

13.3.1 Wiring the relay output

The EN 60947-5-1 relay output has the properties specified in EN 61131-2.

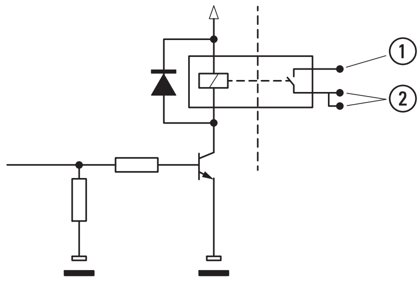


Figure 48: Internal logic for relay output

① NO relay contact

② Common contact

> *NOTICE*
> In order for the relay coil to pick up correctly, the relay output module needs a minimum supply voltage.

The power supply module (the gateway or PLC, for example) must provide a minimum supply voltage to the relay output module. This voltage depends on the ambient temperature, as shown in the table below:

Ambient air temperature [°C]	Supply voltage [V]
-25,…+30	18
+40	18.7
+50	19.4
+60	20.0

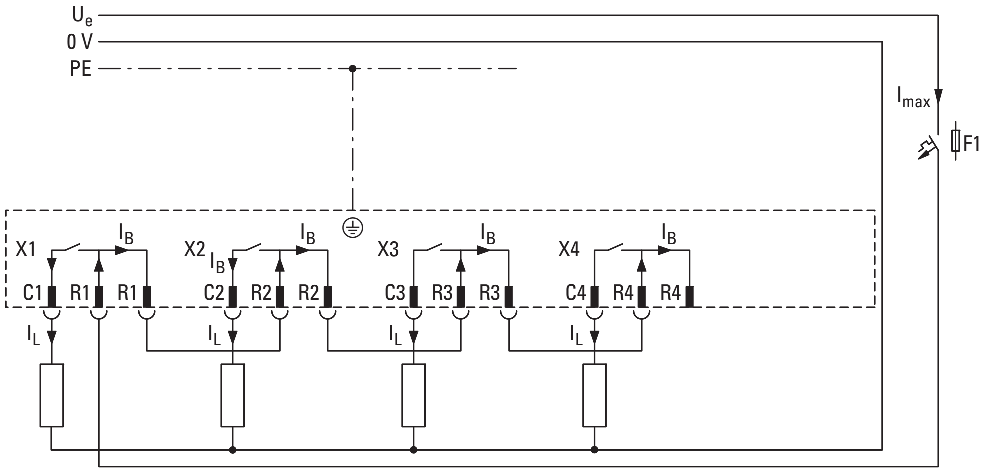


Figure 49: Wiring diagram with U_e looped through

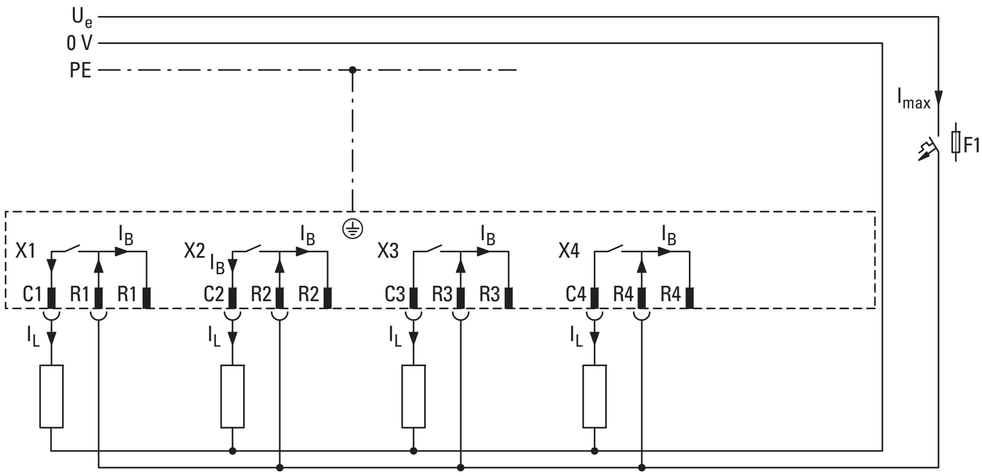


Figure 50: Wiring diagram with U_e at all four connection terminals for total currents > 10 A

13.3.2 Suppressor circuit for inductive loads

NOTICE

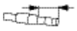
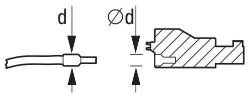
When switching inductive loads, a snubber must be added at the load in order to prevent EMI.

13.4 Technical data relay outputs

Number of relay outputs	4	
Function	Normally open	
Rated operating voltage U_e	24 V DC	230 V AC
maximum rated operating voltage	30 V DC	250 V AC
Continuous current per channel I_c	6 A DC	6 A AC
Simultaneity of all outputs	100 %	
Continuous current per connector contact	max. 10 A DC	max. 10 A AC
Current-carrying capacity of common contact link I_B	max. 10 A DC	max. 10 A AC
On-delay/off-delay	≤ 10 ms/≤ 10 ms	
Switching Frequency		
Mechanical switching operations	10×10^6	
Resistive load / lamp load	2 Hz	
Inductive	0.5 Hz	
Switching frequency as per IEC 61810 (8A, 250VAC, cosφ=1, 85°C)	100×10^3	
Making capacity		
AC-15, 250 V AC, 3 A (600 S/h)	300000 switching operations	
DC-13, L/R ≤ 150ms, 24 V DC, 1 A (500 S/h)	200000 switching operations	
Breaking capacity		
AC-15, 250 V AC, 3 A (600 S/h)	300000 switching operations	
DC-13, L/R ≤ 150ms, 24 V DC, 1 A (500 S/h)	200000 switching operations	
Filament bulb load		
1000 W at 230/240 V AC	25000 switching operations	
500 W at 115/120 V AC	25000 switching operations	
Fluorescent lamp load of 10 x 58 W with 230/240 VAC (with ballast, without compensation, with compensation)	25000 switching operations	
Insulation test voltage		
Contact-to-contact	1500 V	
Coil-to-contact	1500 V	
Material	AgSnO2	

13.5 Connection terminals

Table 4 XN-322-4DO-RNO connection specifications

Cable cross-sectional areas			XN-322-4DO-RNO
10 mm (0.39“) 	solid	mm^2	0.2 – 2.5
10 mm (0.39“) 	flexible with uninsulated ferrule	mm^2	0.25 – 2.5
10 mm (0.39“) 	flexible with insulated ferrule	mm^2	0.25 – 2.5
	Ferrule d	mm	≤ 3.8
	AWG		24 – 12
	Strip length	mm	10

13.6 Memory layout

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN-312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Lokale I/O address
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2120	0x6200 SUB x	0x7xx0 SUB 01	1	Output1_4	Bit 0	Relay output 1	0x0000
					Bit 1	Relay output 2	
					Bit 2	Relay output 3	
					Bit 3	Relay output 4	
					Bit 4	–	
					Bit 5	–	
					Bit 6	–	
					Bit 7	–	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–

14 Relay output module XN-322-5DO-RCO

The XN-322-5DO-RCO module is an XN300 slice module featuring five relay outputs that can be switched as changeover outputs. Each relay output features a changeover contact with a switching power of 115 VAC/6 A and 24 VDC/6 A.

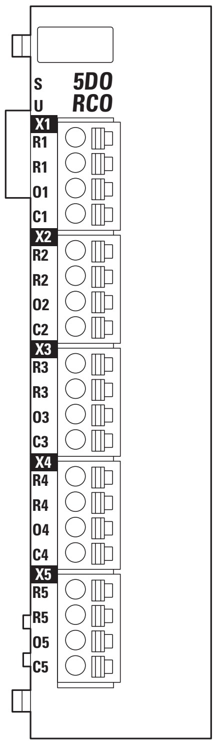


Figure 51: Device view XN-322-5DO-RCO

14.1 Status LEDs

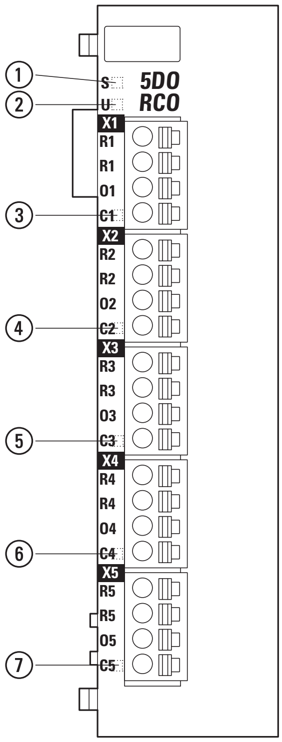


Figure 52: LED layout

1. Module status LED
2. User LED
3. Output 1 status LED
4. Output 2 status LED
5. Output 3 status LED
6. Output 4 status LED
7. Output 5 status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	
CO output status	yellow	ON	Relay active; Ox contact close; Cx contact open
		OFF	Relay inactive; Ox contact open; Cx contact close

14.2 Pin assignment

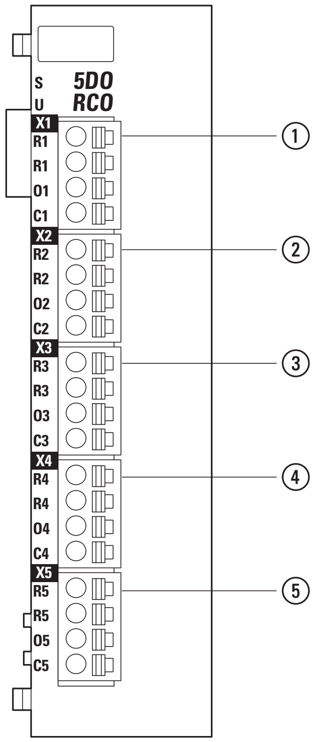


Figure 53: Pin assignment

① X1
- R1 common contact
- R1 common contact
- O1 normally close contact
- C1 normally open contact

② X2
- R2 common contact
- R2 common contact
- O2 normally close contact
- C2 normally open contact

③ X3
- R3 common contact
- R3 common contact
- O3 normally close contact
- C3 normally open contact

④ X4
- R4 common contact
- R4 common contact
- O4 normally close contact
- C4 normally open contact

⑤ X5
- R5 common contact
- R5 common contact
- O5 normally close contact
- C5 normally open contact

14.3 Wiring topic

A relay output is wired to each of the five X1 to X5 connectors.

14.3.1 Wiring the relay output

The EN 60947-5-1 relay output has the properties specified in EN 61131-2.

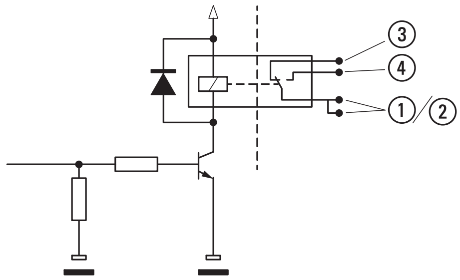


Figure 54: Internal logic for relay output

1 / 2 Common contact
3 Normally close contact
4 Normally open contact

NOTICE

In order for the relay coil to pick up correctly, the relay output module needs a minimum supply voltage.

The power supply module (the gateway or PLC, for example) must provide a minimum supply voltage to the relay output module. This voltage depends on the ambient temperature, as shown in the table below:

Ambient air temperature [°C]	Supply voltage [V]
-25,…+30	18
+40	18.7
+50	19.4
+60	20.0

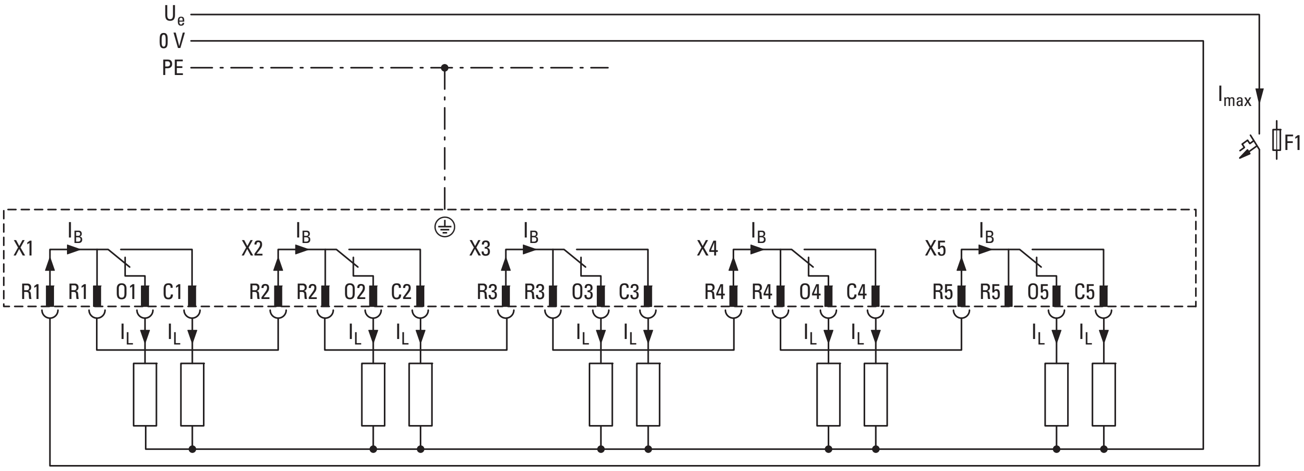


Figure 55: Wiring diagram with U_e looped through

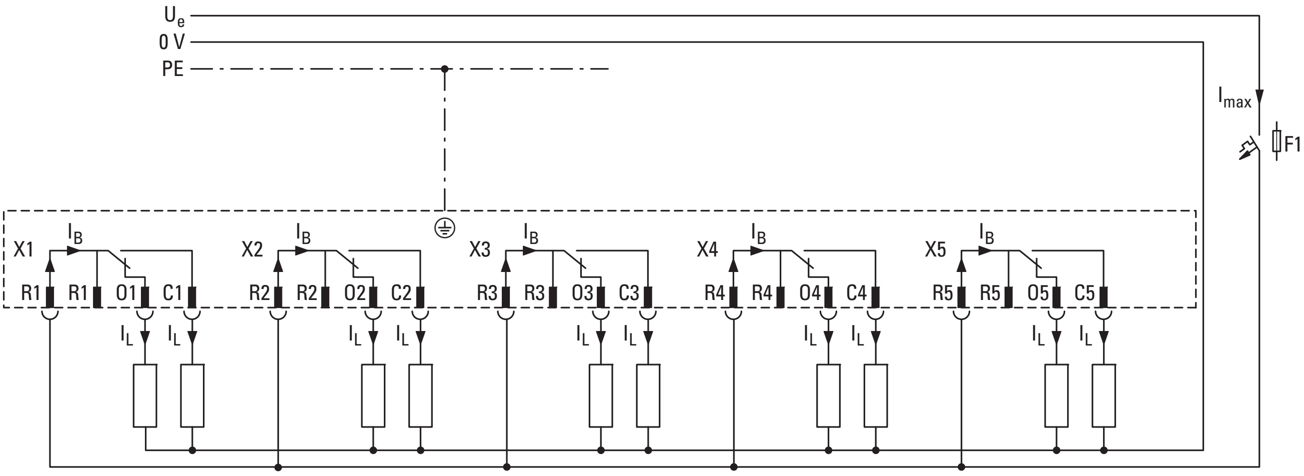


Figure 56: Wiring diagram with U_e at all five connection terminals for total currents > 10 A

14.3.2 Suppressor circuit for inductive loads

NOTICE

When switching inductive loads, a snubber must be added at the load in order to prevent EMI. RC suppressors have proven to be particularly effective for this purpose as a result of their dynamic response. In contrast, the use of varistors is not always adequate.

14.4 Technical data relay outputs

Number of relay outputs	5	
Function	Changeover contact	
Rated operating voltage U_e	24 V DC	115 V AC
maximum rated operating voltage	30 V DC	115 V AC
Continuous current per channel I_c	6 A DC	6 A AC
Switch-on and switch-off delay	≤ 10 ms	
Simultaneity of all outputs	100 %	

14.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	Ether-CAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x21D0	0x6200	0x7xx0 SUB 01	1	Output 1_5 Digital output register	Bit 0	Relay output 1	0x0000
					Bit 1	Relay output 2	
					Bit 2	Relay output 3	
					Bit 3	Relay output 4	
					Bit 4	Relay output 5	
					Bit 5-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber	–		–
0x4004	–	0x8xx1 SUB 01 (EC: SUB 01)	1	UserLEDControl	–		–
0x400C	–	–	Max. 25	ProductName	–		–

15 Digital output module XN-322-8DO-P05

XN-322-8DO-P05 digital output modules feature 8 short-circuit proof digital outputs (+24 V / 0.5 A) and one supply voltage. The supply voltage is monitored for undervoltage.

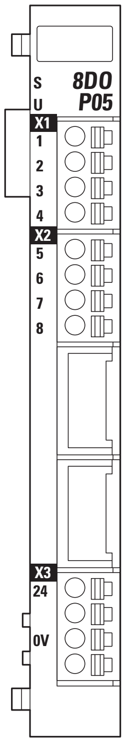


Figure 57: Device view XN-322-8DO-P05

15.1 Pin assignment and status LED signals

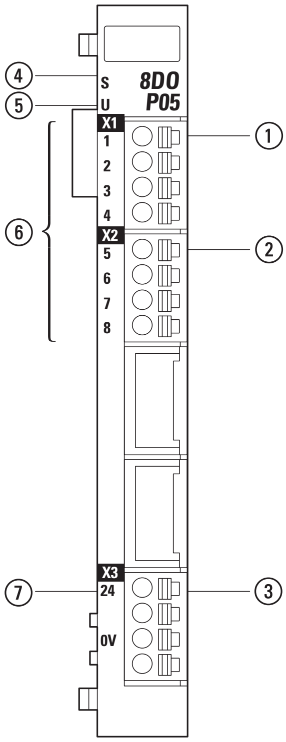


Figure 58: Pin assignment and status LED signals

① X1
- 1 digital output 1
- 2 digital output 2
- 3 digital output 3
- 4 digital output 4

② X2
- 5 digital output 5
- 6 digital output 6
- 7 digital output 7
- 8 digital output 8

③ X3
- 24power supply +24VDC
- –
- 0V GND
- –

④ Module status LED
⑤ User status LED
⑥ Output n status LED
⑦ Power status LED for digital outputs

Table 5 Status LED signals

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status of output n n = 1 to 8	yellow	ON	Output is "ON"
		OFF	Output is "OFF"
Power status for digital outputs	Green	ON	The digital outputs are being powered with 24 VDC
		OFF	The outputs are not being powered properly (under-voltage) or the system is not being powered at all. If the system is not being powered at all, the module status LED will be OFF.

15.1.1 Wiring topic

Four digital outputs can be wired to the X1 connector and another four digital outputs can be wired to the X2 connector.

15.1.2 Connecting the power supply

The cross-sectional area of the +24 V cables used to supply power must be sized for the maximum total current drawn by all the outputs.

It is impermissible to apply a voltage, at any output, that exceeds the supply voltage by more than 0.7 V.

15.1.3 Connecting EN 61131-2 short-circuit proof digital outputs

The outputs are able to drive twice their rated operational current briefly when driving loads with higher inrush currents.

15.1.4 Wiring digital outputs

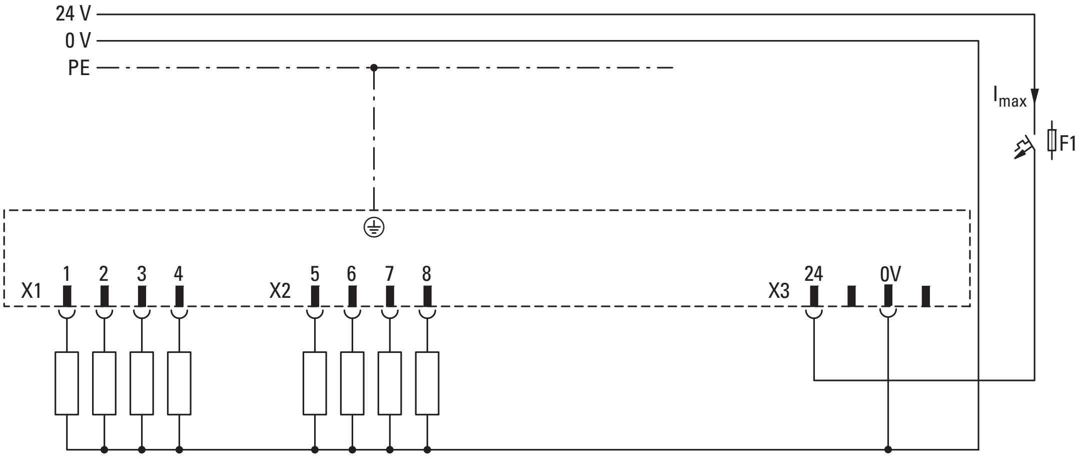


Figure 59: Wiring example

15.1.5 Suppressor circuit for inductive loads

High induced voltages may be produced when inductive loads are switched off. Because of this, the transistor outputs have internal suppressor circuits to +24 V.

As shown in the diagram below, the voltage when switching off inductive loads is limited to -29 V. In order to prevent system malfunctions caused by voltage peaks (e.g., coupling on analog cables), it is recommended to use a suppressor circuit (RC suppressors or flyback diodes) directly on inductive loads.

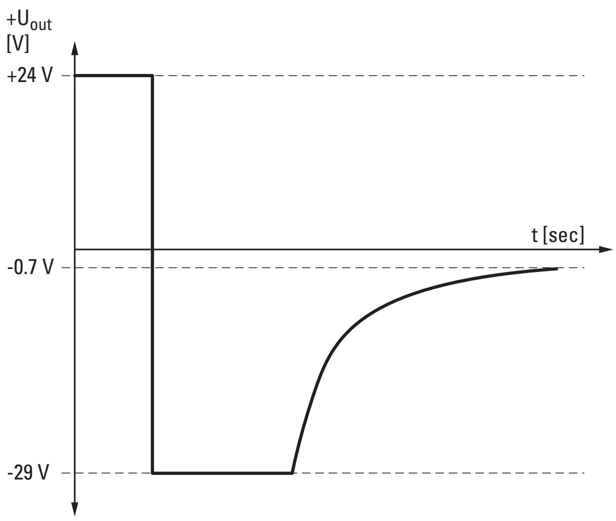


Figure 60: Voltage limiting when switching off inductive loads

15.2 Technical data for digital outputs

Quantity	8
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X3, pin on connector 24)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Residual ripple	≤ 5 %
Maximum permissible total current per power supply group, with eight channels each, when using a duty factor of 100%	4A
Protection against polarity reversal	no
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Output current per channel	0.5 A
„0“ signal	
Output voltage	< 0.1 VDC
Max. output current per channel	≤ 10 µA
Switching-on delay	< 100 µs
Switch off delay	< 100 µs
Maximum permissible total current for all channels when using a duty factor of 100%	4A
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

15.3 Memory layout

→ For product specific CANopen or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN312-GW-CAN", MN050003EN, "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2190	0x6200 SUB x	0x7xx0 SUB 01	1	Output1_8	Bit 0	Output 1	0x0000
					Bit 1	Output 2	
					Bit 2	Output 3	
					Bit 3	Output 4	
					Bit 4	Output 5	
					Bit 5	Output 6	
					Bit 6	Output 7	
					Bit 7	Output 8	
0x3190	–	0x6xxF SUB 01	2	CAN: InputVoltageState EC: VoltageOK	Bit 0	1: State 24 VDC OK	0x0000
					Bit 1-15	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–

16 Digital output module XN-322-12DO-P17

XN-322-12DO-P17 digital output modules feature 12 short-circuit proof digital outputs that are organized into three groups. The supply voltage for each group is monitored for undervoltage.

In accordance with the safety requirements set forth by the Institute for Occupational Safety and Health of the German Social Accident Insurance (IFA), the outputs' primary side (+5 V) is isolated from the secondary side (+24 V) with optocouplers (as required for class 3, pollution degree 2).

In addition, optocouplers are used in the monitoring circuit for the supply voltage for each channel group in order to isolate the 24 V on the primary side from the 24 V on the secondary side.

0 V / GND potentials and ⏚ are connected to each other.

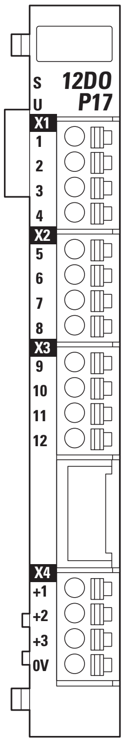


Figure 61: Device view XN-322-12DO-P17

16.1 Status LEDs

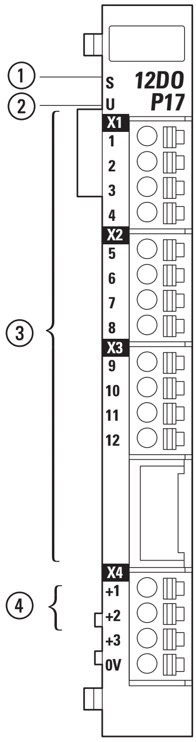


Figure 62: LED signals and pin assignment

① Module status LED
② User status LED
③ Status LEDs for outputs DO1 to DO12
④ Status LEDs for 24V1 to 24V3

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status of output n n = 1 to 12	yellow	ON	Output is "ON"
		OFF	Output is "OFF"
Status LED for group n n = 1 to 3	Green	ON	Supply voltage OK
		OFF	Supply voltage not OK (undervoltage)

16.2 Pin assignment

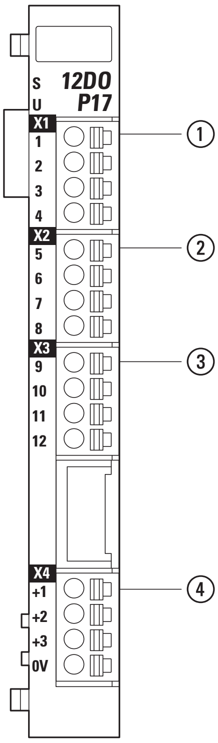


Figure 63: Pin assignment

① X1
- 1 group 1 digital output 1
- 2 group 1 digital output 2
- 3 group 1 digital output 3
- 4 group 1 digital output 4

② X2
- 5 group 2 digital output 5
- 6 group 2 digital output 6
- 7 group 2 digital output 7
- 8 group 2 digital output 8

③ X3
- 9 group 3 digital output 9
- 10 group 3 digital output 10
- 11 group 3 digital output 11
- 12 group 3 digital output 12

④ X4
- +1 power supply, group 1 +24VDC
- +2 power supply, group 2 +24VDC
- +3 power supply, group 3 +24VDC
- –0V GND

16.3 Wiring topic

Four digital outputs can be wired to each of the connectors X1, X2 and X3.

16.3.1 Connecting the power supply

The cross-sectional area of the +24 V cables used to supply power must be sized for the maximum output current drawn by each group.

It is impermissible to apply a voltage, at any output, that exceeds the supply voltage by more than 0.7 V.

16.3.2 Connecting EN 61131-2 short-circuit proof digital outputs

The outputs are able to drive twice their rated operational current briefly when driving loads with higher inrush currents.

The outputs can be switched off by groups by using the corresponding group power supplies.

16.3.3 Wiring digital outputs

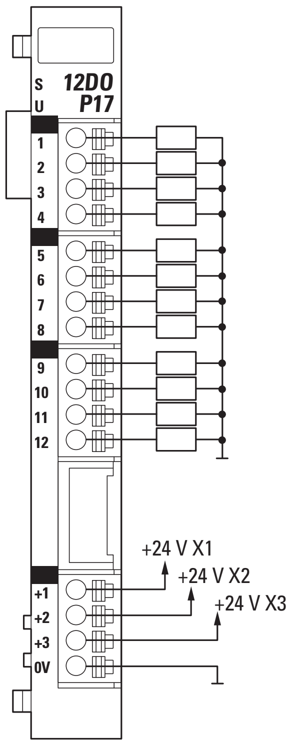


Figure 64: Wiring example

16.3.4 Suppressor circuit for inductive loads

Induced voltages may be produced when inductive loads are switched off. Accordingly, the transistor outputs have internal suppressor circuits to +24 V in order to protect the XN300 slice module.

As shown in the diagram below, the voltage when switching off inductive loads is limited to -12 V. In order to prevent system malfunctions caused by voltage peaks (e.g., coupling on analog cables), it is recommended to use a suppressor circuit (RC suppressors or flyback diodes) directly on inductive loads.d

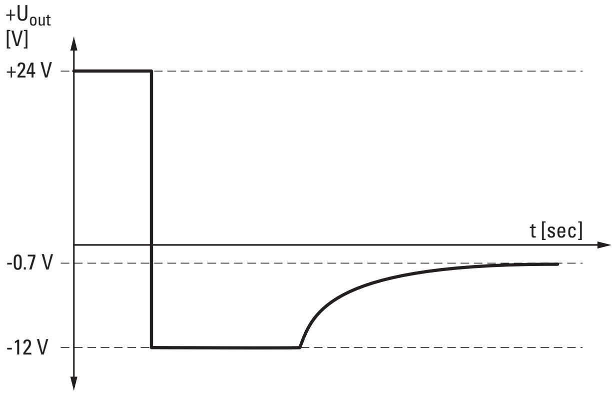


Figure 65: Voltage limiting when switching off inductive loads

16.4 Technical data for digital outputs

Quantity	12
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	3 (clamp positions +1/+2/+3)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Residual ripple	≤ 5 %
Maximum permissible total current per power supply group, with four channels each, when using a duty factor of 100%	3.4A
Maximum permissible total current for all channels when using a duty factor of 100%	10.2A
Protection against polarity reversal	no
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Max. Output current per channel	1.7 A
„0“ signal	
Output voltage	< 0.1 VDC
Max. output current per channel	≤ 100 µA
Switching-on delay	< 200 µs
Switch off delay	< 200 µs
Maximum breaking energy of outputs (inductive load)	0.64 Joule/channel 1.95 joules / power supply group

16.5 Memory layout

→ For product specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2040	0x6200 SUB x	0x7xx0 SUB 01	2	Output1_12	Bit 0	Output 1	0x0000
					Bit 1	Output 2	
					Bit 2	Output 3	
					Bit 3	Output 4	
					Bit 4	Output 5	
					Bit 5	Output 6	
					Bit 6	Output 7	
					Bit 7	Output 8	
	0x6200 SUB x+1	0x7xx0 SUB 01			Bit 8	Output 9	
					Bit 9	Output 10	
					Bit 10	Output 11	
					Bit 11	Output 12	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x3040	–	0x6xxF SUB 01	2	InputVoltageState	Bit 0	DC 24V Output 1…4 OK	0x0002
					Bit 1	DC 24V Output 5…8 OK	
					Bit 2	DC 24V Output 9…12 OK	
					Bit 3-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–

17 Digital output module XN-322-16DO-P05

XN-322-16DO-P05 digital output modules feature 16 short-circuit proof digital outputs (+24 V / 0.5 A) and two supply voltages, with each of these voltages powering eight outputs. The supply voltage for each group is monitored for undervoltage.

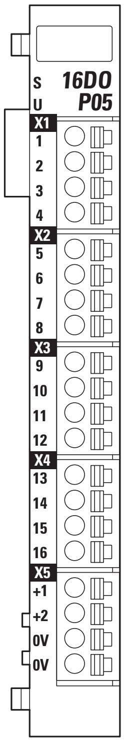


Figure 66: Device view XN-322-16DO-P05

17.1 Pin assignment and status LED signals

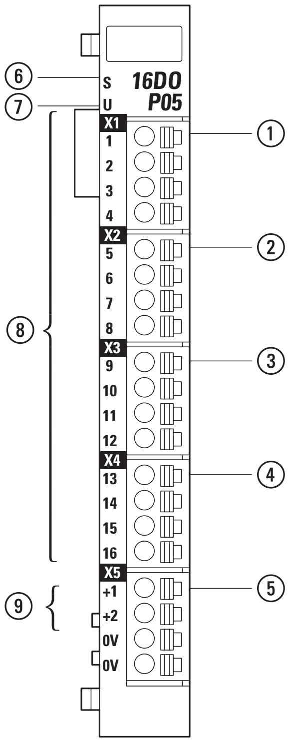


Figure 67: Pin assignment and status LED signals

① X1
- 1 group 1 digital output 1
- 2 group 1 digital output 2
- 3 group 1 digital output 3
- 4 group 1 digital output 4

② X2
- 5 group 1 digital output 5
- 6 group 1 digital output 6
- 7 group 1 digital output 7
- 8 group 1 digital output 8

③ X3
- 9 group 2 digital output 9
- 10 group 2 digital output 10
- 11 group 2 digital output 11
- 12 group 2 digital output 12

④ X4
- 13 group 2 digital output 13
- 14 group 2 digital output 14
- 15 group 2 digital output 15
- 16 group 2 digital output 16
-

⑤ X5
- +1 power supply, group 1 +24VDC
- +2 power supply, group 2 +24VDC
- 0V GND
- 0V GND

⑥ Module status LED
⑦ User status LED
⑧ Output status LED
⑨ Power status LEDs for group 1 and group 2

Table 6 Status LED signals

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status of output n n = 1 to 16	yellow	ON	Output is "ON"
		OFF	Output is "OFF"
Power status of group n n = 1 to 2	Green	ON	Group n is being powered with 24 VDC
		OFF	Group n is not being powered properly (undervoltage) or the system is not being powered at all. If the system is not being powered at all, the module status LED will be OFF.

17.1.1 Wiring topic

Four digital outputs can be wired to each of the four X1 to X4 connectors.

17.1.2 Connecting the power supply

The cross-sectional area of the +24 V cables used to supply power must be sized for the maximum output current drawn by each group.

It is impermissible to apply a voltage, at any output, that exceeds the supply voltage by more than 0.7 V.

The two 0 V pins on connector X5 are internally connected to each other.

17.1.3 Connecting EN 61131-2 short-circuit proof digital outputs

The outputs are able to drive twice their rated operational current briefly when driving loads with higher inrush currents.

The outputs can be fused and switched off externally by groups by using the corresponding group power supplies.

17.1.4 Wiring digital outputs

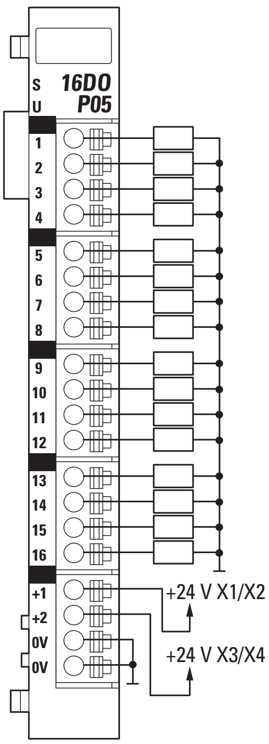


Figure 68: Wiring example

17.1.5 Suppressor circuit for inductive loads

High induced voltages may be produced when inductive loads are switched off.   Because of this, the transistor outputs have internal suppressor circuits to +24 V.

As shown in the diagram below, the voltage when switching off inductive loads is limited to -29 V. In order to prevent system malfunctions caused by voltage peaks (e.g., coupling on analog cables), it is recommended to use a suppressor circuit (RC suppressors or flyback diodes) directly on inductive loads.

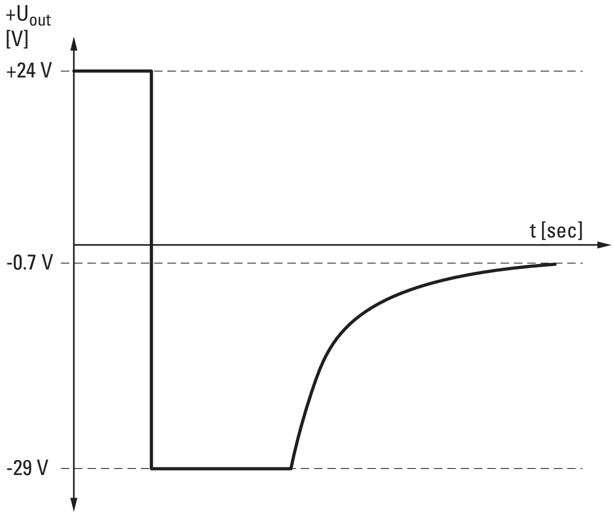


Figure 69: Voltage limiting when switching off inductive loads

17.2 Technical data for digital outputs

Quantity	16
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	2 (clamp positions +1/+2)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Residual ripple	≤ 5 %
Maximum permissible total current for all channels when using a duty factor of 100%	8A
Protection against polarity reversal	no
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Output current per channel	0.5 A
„0“ signal	
Output voltage	< 0.1 VDC
Max. output current per channel	≤ 100 μA
Switching-on delay	< 100 μs
Switch off delay	< 100 μs
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

17.3 Memory layout

→ For product specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2050	0x6200 SUB x		2	Digital output register	Bit 0	Output 1	0x0000
					Bit 1	Output 2	
					Bit 2	Output 3	
					Bit 3	Output 4	
					Bit 4	Output 5	
					Bit 5	Output 6	
					Bit 6	Output 7	
					Bit 7	Output 8	
	0x6200 SUB x+1				Bit 8	Output 9	
					Bit 9	Output 10	
					Bit 10	Output 11	
					Bit 11	Output 12	
					Bit 12	Output 13	
					Bit 13	Output 14	
					Bit 14	Output 15	
					Bit 15	Output 16	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x3050	0x3050		1	InputVoltageState	Bit 0	1: DC 24V Output 1..8 OK	0x0002
					Bit 1	1: DC 24V Output 9..16 OK	
					Bit 2-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–

18 Digital input/output module XN-322-8DIO-PD05

The XN-322-8DIO-PD05 digital input/output module has 4 inputs, for a +24 V signal level, that can be used to read the logic 0 and logic 1 levels. In addition, the module features 4 short-circuit proof digital outputs (+24 V / 0.5 A). The supply voltage for the digital outputs will be monitored for undervoltage. Finally, the module features input filters designed to suppress glitches on the corresponding input cables.

18.1 Status LEDs

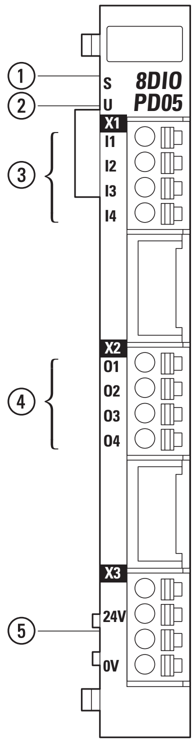


Figure 70: XN-322-8DIO-PD05 LEDs

① Module status LED
② User LED
③ Status LEDs for inputs 1 to 4
④ Status LEDs for outputs 1 to 4
⑤ Power status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 … Input 4	Green	ON	Input ON
		OFF	Input OFF
Output 1 status … Output 4	yellow	ON	Output ON
		OFF	Output OFF
Status Supply voltage	Green	ON	Supply voltage OK
		OFF	Supply voltage faulty

18.2 Pin assignment

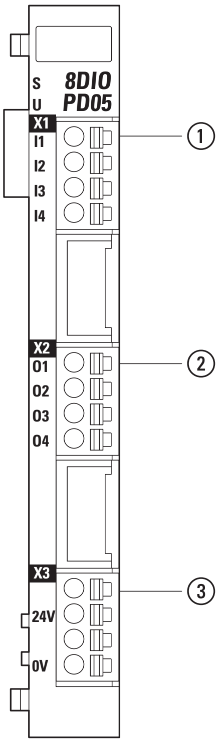


Figure 71: Pin assignment

① X1
- I1 digital input 1
- I2 digital input 2
- I3 digital input 3
- I4 digital input 4

② X2
- O1 digital output 1
- O2 digital output 2
- O3 digital output 3
- O4 digital output 4

③ X3
- –
- 24 Supply voltage 24VDC
- –
- 0V GND

18.3 Digital input wiring

Four digital inputs can be wired to connector X1 and four digital outputs can be wired to connector X2.

The digital input, as defined in the EN 61131-2 type 1 with a 5-ms input delay, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

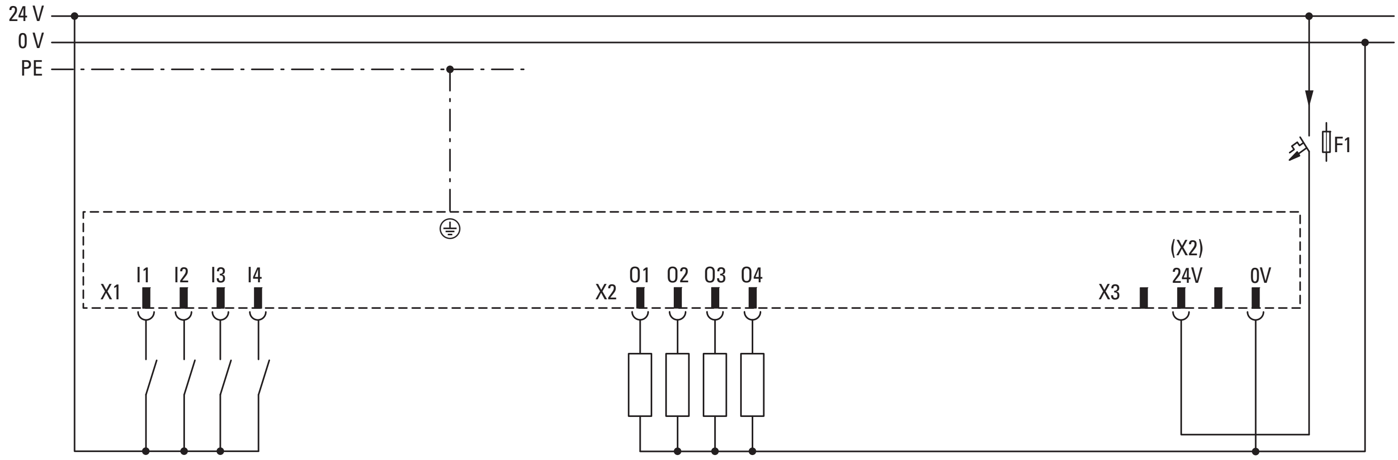


Figure 72: Wiring inputs to X1 and outputs to X2

18.4 Technical data

18.4.1 Digital inputs

Designation		
Number of channels	4	
	61131-2 Type1	
Input voltage U_E	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 < U_E < +8 V	HIGH: +14 V < U_E < +30 V
Switching threshold	normally +11 VDC	
Input current at U_E=24Vdc	normally 3.7 mA	
Input delay	normally 5 ms	

18.4.2 Digital outputs

Quantity	4
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X3, pin on connector 24)
Rated operating voltage U_e	24 Vdc
Admissible range	18 – 30 VDC
Maximum permissible total current when using a duty factor of 100%	2A
Protection against polarity reversal	no
Voltage monitoring	Yes
Output characteristic data	
„1“ signal	
Output voltage	(U_e - 1V) < U_a < U_e
Output current per channel	0.5 A
„0“ signal	
Output voltage	0V
Max. output current per channel	≤ 10 μA
Switching-on delay	< 100 μs
Switch off delay	< 150 μs
Maximum permissible total current for all channels when using a duty factor of 100%	2A
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

18.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number			–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x3180	0x6000 SUB x	0x6xx0 SUB 01	1	Input1_4	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	
0x2180	0x6200 SUB x	0x7xx0 SUB 01	1	Output1_4	Byte 0	Bit 0	Output 1	0x0000
						Bit 1	Output 2	
						Bit 2	Output 3	
						Bit 3	Output 4	
						Bit 4	–	
						Bit 5	–	
						Bit 6	–	
						Bit 7	–	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3181	–	0x6xxF SUB 01	1	InputVoltageState	Byte 0	Bit 0	1: 24VDC ok at 01…04	0x0001
						Bit 1-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–

19 Digital input/output module XN-322-16DIO-PD05

The XN-322-16DIO-PD05 digital input/output module has 8 inputs, for a +24 V signal level, that can be used to read the logic 0 and logic 1 levels.
In addition, the module features 8 short-circuit proof digital outputs (+24 V / 0.5 A) assigned to a single power supply group. The supply voltage for this group will be monitored for undervoltage. Finally, the module features input filters designed to suppress glitches on the corresponding input cables.

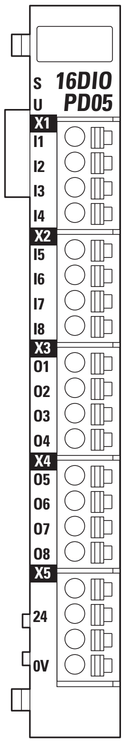


Figure 73: XN-322-16DIO-PD05 front view

19.1 Status LEDs

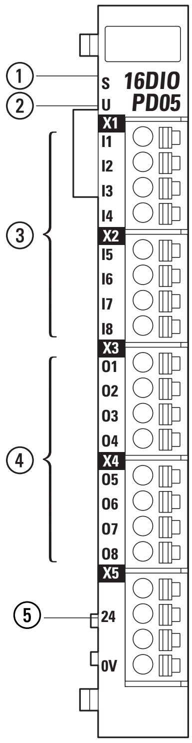


Figure 74: XN-322-16DIO-PD05 LEDs

1. Module status LED
2. User LED
3. Status LEDs for inputs 1 to 8
4. Status LEDs for outputs 1 to 8
5. Power status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 ... Input 8	Green	ON	Input ON
		OFF	Input OFF
Output 1 status ... Output 8	yellow	ON	Output ON
		OFF	Output OFF
Status Supply voltage	Green	ON	Supply voltage OK
		OFF	Supply voltage faulty

19.2 Pin assignment

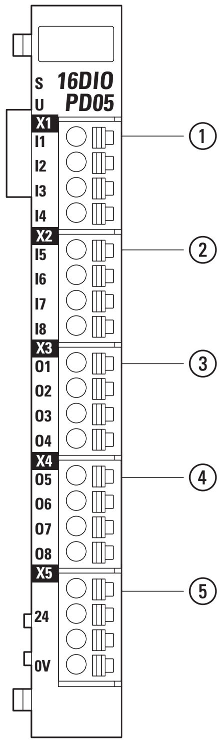


Figure 75: Pin assignment

① X1
- I1 digital input 1
- I2 digital input 2
- I3 digital input 3
- I4 digital input 4

① X2
- I5 digital input 5
- I6 digital input 6
- I7 digital input 7
- I8 digital input 8

② X3
- O1 digital output 1
- O2 digital output 2
- O3 digital output 3
- O4 digital output 4

③ X4
- O5 digital output 5
- O6 digital output 6
- O7 digital output 7
- O8 digital output 8
-

④ X5
- –
- 24 Supply voltage 24VDC
- –
- 0V GND

19.3 Wiring

Four digital inputs can be wired to each of the two X1 and X2 connectors, while four digital outputs can be wired to each of the two X3 and X4 connectors.

19.3.1 Digital inputs

Four digital inputs can be wired to the X1 connector and another four digital inputs can be wired to the X2 connector.

The digital input, as defined in the EN 61131-2 type 1 with a 5 ms input delay, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

19.3.2 Connecting the power supply

The cross-sectional area of the +24 V cable used to supply power at X5 must be sized for the maximum total current drawn by all the outputs.

It is impermissible to apply a voltage, at any output, that exceeds the supply voltage by more than 0.7 V.

19.3.3 Connecting EN 61131-2 short-circuit proof digital outputs

Four digital outputs can be wired to the X3 connector and another four digital outputs can be wired to the X4 connector.

The outputs are able to drive twice their rated operational current briefly when driving loads with higher inrush currents.

19.3.4 Suppressor circuit for inductive loads

High induced voltages may be produced when inductive loads are switched off. Because of this, the transistor outputs have internal suppressor circuits to +24 V.

As shown in the diagram below, the voltage when switching off inductive loads is limited to -29 V. In order to prevent system malfunctions caused by voltage peaks (e.g., coupling on analog cables), it is recommended to use a suppressor circuit (RC suppressors or flyback diodes) directly on inductive loads.

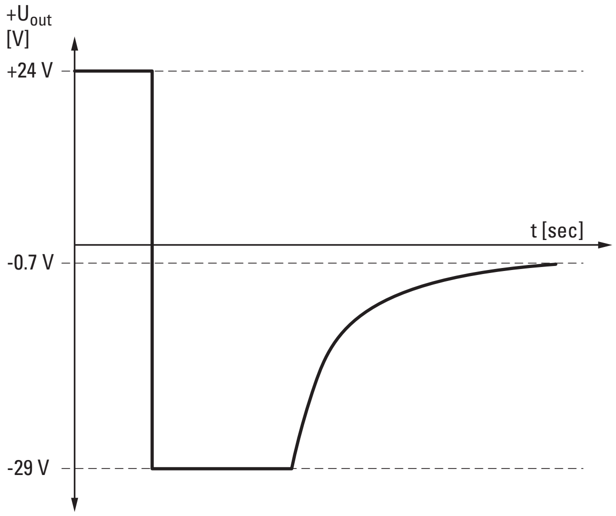


Figure 76: Voltage limiting when switching off inductive loads

19.3.5 Wiring example

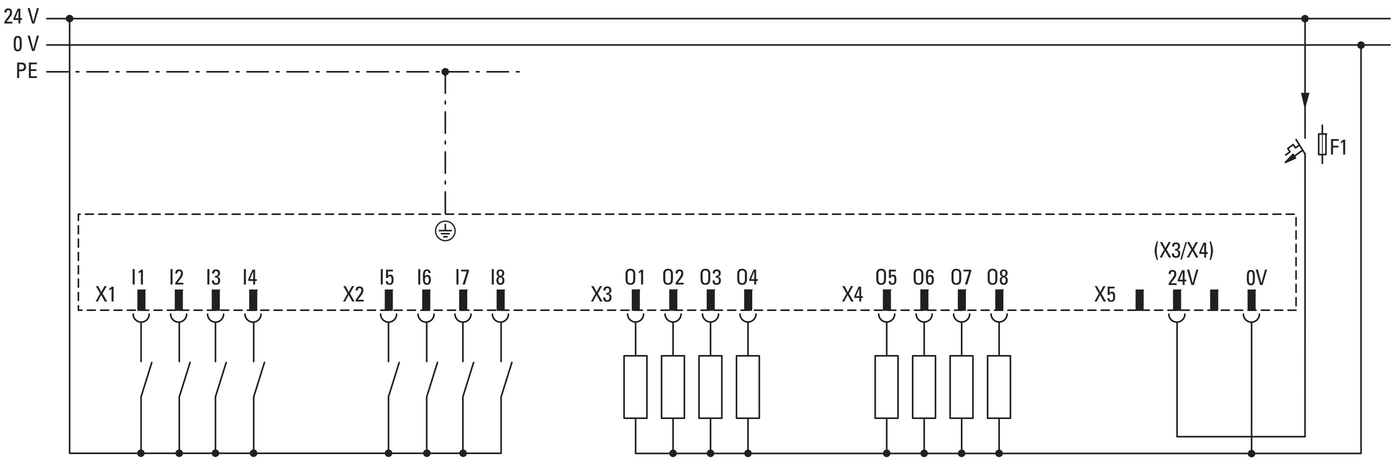


Figure 77: Wiring example showing how to connect inputs to X1/X2 and outputs to X3/X4

19.4 Technical data

19.4.1 Digital inputs

Designation		
Number of channels	8	
	61131-2 Type1	
Input voltage U_E	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 < U_E < +8 V	HIGH: +14 V < U_E < +30 V
Switching threshold	normally +11 VDC	
Input current at U_E = 24 VDC	normally 3.7 mA	
Input delay	normally 5 ms	

19.4.2 Digital outputs

Quantity	8
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X5, pin on connector 24)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Maximum permissible total current for all output channels when using a duty factor of 100%	4A
Protection against polarity reversal	no
Voltage monitoring	Yes
Output characteristic data	
„1“ signal	
Output voltage	(U_e - 1V) < U_a < U_e
Output current per channel	0.5 A
„0“ signal	
Output voltage	< 1 VDC
Max. output current per channel	≤ 10 µA
Switching-on delay	< 100 µs
Switch off delay	< 150 µs
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

19.5 Memory layout

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number			–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x3160	0x6000 SUB x	0x6xx0 SUB 01	1	Input1_8	Byte 0	Bit 0	Input 1	0x0000
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	Input 7	
						Bit 7	Input 8	
0x2160	0x6200 SUB x	0x7xx0 SUB 01	1	Output1_8	Byte 0	Bit 0	Output 1	0x0000
						Bit 1	Output 2	
						Bit 2	Output 3	
						Bit 3	Output 4	
						Bit 4	Output 5	
						Bit 5	Output 6	
						Bit 6	Output 7	
						Bit 7	Output 8	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3161		0x6xxF SUB 01	1	InputVoltageState	Byte 0	Bit 0	1: 24VDC ok at O1…O8	0x0001
						Bit 1-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–

20 XN-322-16DIO-PC05 digital input/output module

The XN-322-16DIO-PC05 digital input/output module has 8 inputs, for a +24 V signal level, that can be used to read the logic 0 and logic 1 levels.
In addition, the module features 8 short-circuit proof digital outputs (+24 V / 0.5 A) assigned to a single power supply group. The supply voltage for this group will be monitored for undervoltage. The module features input filters designed to suppress glitches on the corresponding input cables. Finally, digital inputs 1 to 4 feature a counter function that, when used, makes an internal module register be incremented every time there is an input pulse. Input pulses increment an internal module register.

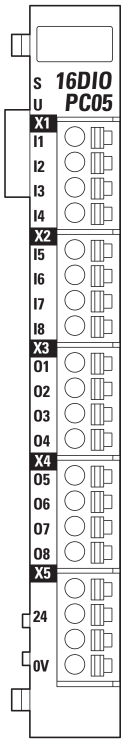


Figure 78: XN-322-16DIO-PC05 front view

20.1 Status LEDs

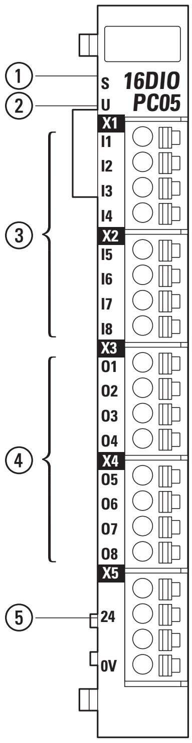


Figure 79: XN-322-16DIO-PC05 LEDs

1. Module status LED
2. User LED
3. Status LEDs for inputs 1 to 8
4. Status LEDs for outputs 1 to 8
5. Power status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input 1 ... Input 8	Green	ON	Input ON
		OFF	Input OFF
Output 1 status ... Output 8	yellow	ON	Output ON
		OFF	Output OFF
Status Supply voltage	Green	ON	Supply voltage OK
		OFF	Supply voltage faulty

20.2 Pin assignment

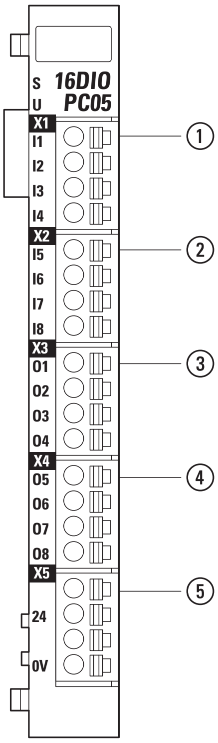


Figure 80: Pin assignment

1. X1
   - I1 digital input 1
   - I2 digital input 2
   - I3 digital input 3
   - I4 digital input 4
2. X2
   - I5 digital input 5
   - I6 digital input 6
   - I7 digital input 7
   - I8 digital input 8
3. X3
   - O1 digital output 1
   - O2 digital output 2
   - O3 digital output 3
   - O4 digital output 4
4. X4
   - O5 digital output 5
   - O6 digital output 6
   - O7 digital output 7
   - O8 digital output 8
   -
5. X5
   - –
   - 24 Supply voltage 24VDC
   - –
   - 0V GND

20.3 Wiring

Four digital inputs can be wired to each of the two X1 and X2 connectors, while four digital outputs can be wired to each of the two X3 and X4 connectors.

20.3.1 Digital inputs

The digital input, as defined in the EN 61131-2 type 1 with an input delay of 1 µs for input 1-4 and 5 ms for input 5-8, is particularly suitable for connecting electronic switching devices, including relay contacts, pushbuttons, switches, etc. It is used to convert a signal with two possible states into a one-bit binary number.

20.3.2 Counter functions for inputs 1…4

Internal module counter registers are connected internally to digital inputs 1 to 4. These counter registers make it possible to count signal pulses at the inputs.

The PLC program must manage any register overflows at the counter registers (the program's cycle times and maximum counter frequency must be taken into account).

The following counter functions can be configured:

- Counter mode (simple counting): The 8-bit counter register for an input will be incremented every time there is a rising signal pulse at that input. Objects 0x3172 to 0x3175 are the corresponding 8-bit counter registers.
- Incremental encoder mode: Counts by interpreting the signals from two inputs using X4 encoding and incrementing a 16-bit counter register. Objects 0x3176 to 0x3177 are the corresponding 16-bit counter registers.
- PWM time measuring mode: This mode supports time measurements at inputs 1 to 4.
  The "high time" for an input will be the time that passes between the rising and falling edges of a signal at that input. When a rising signal edge is detected, a counter will start being incremented every µs. Then, when the corresponding falling signal edge is detected, the counter value will be recorded in the corresponding 16 bit PwmHighTime(x) count register. Once the value is transferred to PwmHighTime(x), the counter will be reset. "High times" will be recorded in objects 0x3178, 0x317A, 0x317C, 0x317E.
  Period t_p will be the time that passes between the rising edges of the signal at the digital input. When the first rising signal edge is detected, a counter will start being incremented every µs. Then, when the second rising signal edge is detected, the counter value will be recorded in the corresponding 16 bit PwmPeriodTime(x) counter register. Once the value is transferred to PwmPeriodTime(x), the counter will be reset. "Period times" will be recorded in objects 0x3179, 0x317B, 0x317D, 0x317F.

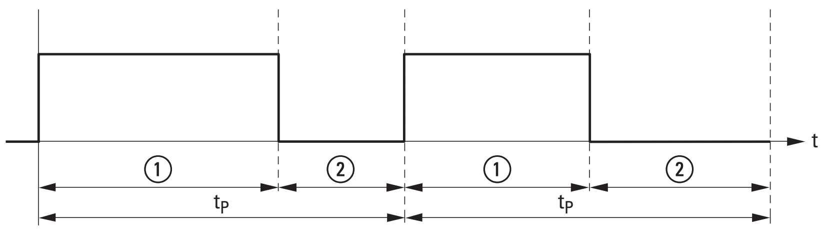


Figure 81: PWM signal measurement

① High Time
② Low Time

20.3.3 Configuring inputs 1 to 4

Counter mode register object 0x4170 can be used to configure the function for inputs 1 to 4 and, accordingly, select the operating mode you want to use.

In addition, any writing command to counter mode register object 0x4170 will reset count registers 0x3172 through 0x3177 to 0x00.

The following functions are available:

Data bit B1	B0	Designation	Description
0	0	Input 1/2	Counter Mode Every time there is a rising edge at input n, the value in the register for counter n will be incremented by one. When there is a counter overflow, the value will jump from 16#FF to 16#00.
0	1		Incremental Encoder Mode Input 1(3) and input 2(4) will be used as an incremental encoder with AB quadrature mode and X4 encoding.
1	1		PWM Time Measuring Mode (High-Time in µs, Period Time in µs)
Data bit B3	**B2**	**Designation**	**Description**
0	0	Input 3/4	Counter Mode
0	1		Incremental Encoder Mode
1	1		PWM Time Measuring Mode

Please refer to „Application examples“.

20.3.4 Connecting the power supply

The cross-sectional area of the +24 V cable used to supply power at X5 must be sized for the maximum total current drawn by all the outputs.

It is impermissible to apply a voltage, at any output, that exceeds the supply voltage by more than 0.7 V.

20.3.5 Connecting EN 61131-2 short-circuit proof digital outputs

Four digital outputs can be wired to the X3 connector and another four digital outputs can be wired to the X4 connector. The outputs are able to drive twice their rated operational current briefly when driving loads with higher inrush currents.

Large currents may be produced when inductive loads are switched off. Because of this, digital outputs should be protected with a suppressor circuit.

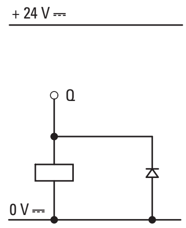


Figure 82: Example of a suppressor circuit

> *NOTICE*
> When switching inductive loads, a snubber must be added at the load in order to prevent EMI.

20.3.6 Wiring example

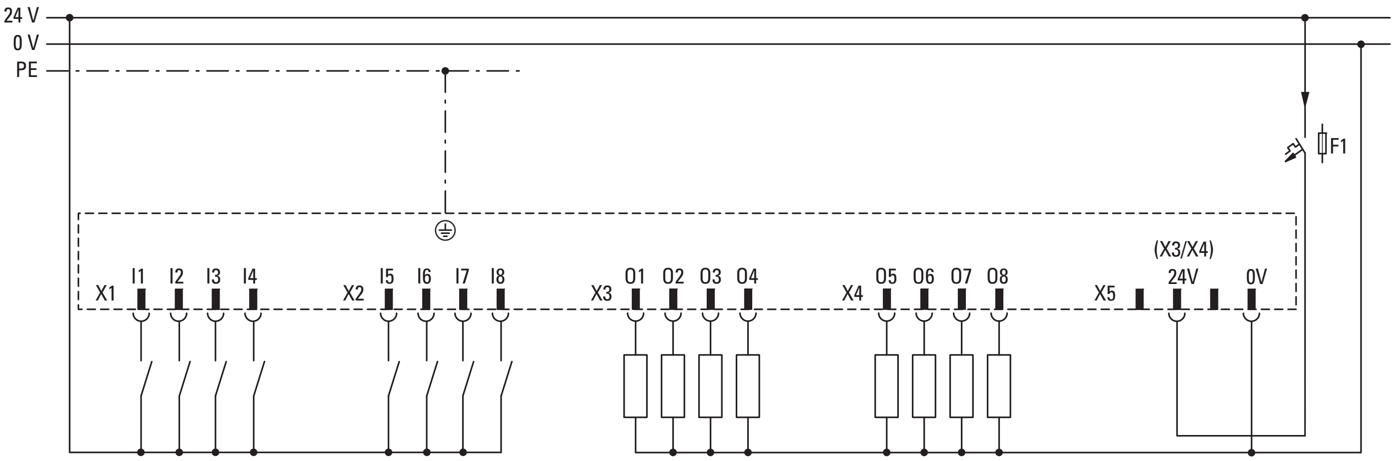


Figure 83: Wiring example showing how to connect inputs to X1/X2 and outputs to X3/X4

20.4 Technical data

20.4.1 Digital inputs

Designation		
Number of channels	8	
	61131-2 Type1	
Input voltage U_E	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 < U_E < +8 V	HIGH: +14 V < U_E < +30 V
Switching threshold	normally +11 VDC	
Input current at U_E=24Vdc	normally 3.7 mA	
Typical input delay		
Input 1-4	1 µs	
Input 5-8	5 ms	
Input frequency for inputs 1-4	Max. 25 kHz	
Counter frequency for inputs 1-4	Max. 25 kHz for event counting Max. 100 kHz for X4 encoding	
PWM time measurement for inputs 1-4	Measures the time between edge changes in µsec.	

20.4.2 Digital outputs

Quantity	8
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X5, pin on connector 24)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Maximum permissible total current for all output channels when using a duty factor of 100%	4A
Protection against polarity reversal	no
Voltage monitoring	Yes
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Output current per channel	0.5 A
„0“ signal	
Output voltage	< 1 VDC
Max. output current per channel	≤ 10 µA
Switching-on delay	< 100 µs
Switch off delay	< 150 µs
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

20.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway "CANopen Gateway XN-312-GW-CAN", MN050003EN "EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Byte	Bit			Local I/O addresse s
–	–	0x9xx0 SUB 01	4	ModuleState					–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID		Module ID number			–
–	–	0x9xx0 SUB 03	4	FPGAVersion					–
–	–	0x9xx0 SUB 04	4	DeviceType					–
–	–	0x9xx0 SUB 05	4	VendorID					–
–	–	0x9xx0 SUB 06	4	ProductCode					–
–	–	0x9xx0 SUB 07	4	Revision					–
–	–	0x9xx0 SUB 09	4	HWVersion					–
–	–	0x9xx0 SUB 0A	4	FWVersion					–
0x3170	0x6000 SUB x	0x6xx0 SUB 01	1	Input1_8	Byte 0	Bit 0	Input 1		0x0004
						Bit 1	Input 2		
						Bit 2	Input 3		
						Bit 3	Input 4		
						Bit 4	Input 5		
						Bit 5	Input 6		
						Bit 6	Input 7		
						Bit 7	Input 8		

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

3) If the inputs are configured for PWM mode in the counter mode register. Resolution: 1 μs.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Byte	Bit			Local I/O addresses
0x2170	0x6200 SUB x	0x7xx0 SUB 01	1	Output1_8	Byte 0	Bit 0	Output 1		0x0004
						Bit 1	Output 2		
						Bit 2	Output 3		
						Bit 3	Output 4		
						Bit 4	Output 5		
						Bit 5	Output 6		
						Bit 6	Output 7		
						Bit 7	Output 8		
0x3171	–	0x6xxF SUB 01	1	InputVoltageState	Byte 1	Bit 0	1: 24VDC ok at 01…08		0x0005
						Bit 1-7	–		
0x3172	–	0x6xx4 SUB 05	1	Counter1	8-bit counter for input 1 1)			CNT1	0x0006
0x3173	–	0x6xx4 SUB 05	1	Counter2	8-bit counter for input 2 1)			CNT2	0x0007
0x3174	–	0x6xx4 SUB 06	1	Counter3	8-bit counter for input 3 1)			CNT3	0x0008
0x3175	–	0x6xx4 SUB 06	1	Counter4	8-bit counter for input 4 1)			CNT4	0x0009
0x3176	–	0x6xx4 SUB 05	2	IncrementalEncoder1	Incremental Encoder 1 Register 2)			ENC1	0x0006
0x3177	–	0x6xx4 SUB 06	2	IncrementalEncoder2	Incremental Encoder 2 Register 2)			ENC2	0x0008
0x3178	–	0x6xx5 SUB 01	2	PwmHighTime1	PWM time measurement for input 1 (resolution 1µs) 3)			PWMHT1	0x000A
0x3179	–	0x6xx5 SUB 05	2	PwmPeriod1	PWM period time counter for input 1 3)			PWMPT1	0x000E
0x317A	–	0x6xx5 SUB 02	2	PwmHighTime2	PWM high time counter for input 2 3)			PWMHT2	0x0008
0x317B	–	0x6xx5 SUB 06	2	PwmPeriod2	PWM period time counter for input 2 3)			PWMPT2	0x0010
0x317C	–	0x6xx5 SUB 03	2	PwmHighTime3	PWM high time counter for input 3 3)			PWMHT3	0x000C
0x317D	–	0x6xx5 SUB 7	2	PwmPeriod3	PWM period time counter for input 3 3)			PWMPT3	0x0012
0x317E	–	0x6xx5 SUB 04	2	PwmHighTime4	PWM high time counter for input 4 3)			PWMHT4	0x000C
0x317F	–	0x6xx4 SUB 08	2	PwmPeriod4	PWM period time counter for input 4 3)			PWMPT4	0x0014

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

3) If the inputs are configured for PWM mode in the counter mode register. Resolution: 1 µs.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Byte	Bit	Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4170		0x8xx4 SUB 01	1	CounterModeRegister1 Note: Writing to this register will reset all counter values to 0x00!	Bit 0 / 1 Input 1-2	00: Counter - Mode	–
						01: Encoder - Mode	
						10: Timestamp mode (reserved)	
						11: PWM time measurement	
					Bit 2 / 31 Input 3-4	00: Counter - Mode	
						01: Encoder - Mode	

1) If the inputs are configured for counter mode in the counter mode register.

2) If the inputs are configured for incremental encoder mode in the counter mode register.

3) If the inputs are configured for PWM mode in the counter mode register. Resolution: 1 μs.

→ Make sure to only use the data relevant to the selected operating mode. Registers for operating modes that are not selected will contain invalid values. The operating mode can be selected using the counter mode register.

21 Multi-I/O module XN-322-16MIO-DIOAI

The XN-322-16MIO-DIOAI multi-I/O module features six digital inputs (+24 V / 3.5 mA) for reading logic levels "0" and "1" with an input delay of 0.5 ms and eight short-circuit proof digital outputs (+24 V / 0.5 A). The module also supports back-reading the state of a digital output by writing this state to a corresponding memory address.

The supply voltage for the digital outputs will be monitored for undervoltage.

In addition, the module features a differential analog input for voltage (-10/0V...+10V) and another differential analog input for current (0/4mA...20mA).

Both analog inputs have a resolution of 16 bits.

21.1 Status LEDs

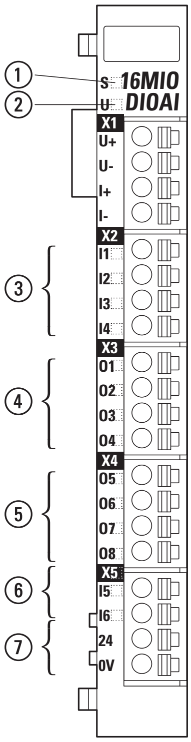
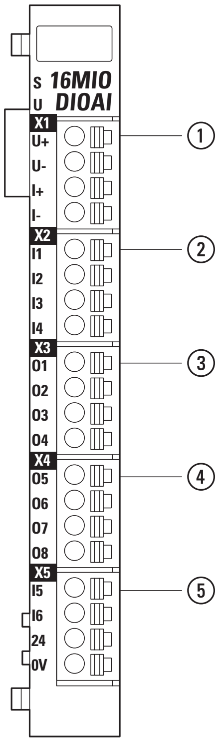


Figure 84: XN-322-16MIO-DIOAI LEDs

① Module status LED
② User LED
③ Status LEDs for inputs I1 to I4
④ Status LEDs for outputs O1 to O4
⑤ Status LEDs for outputs O5 to O8
⑥ Status LEDs for inputs I5 to I6
⑦ Supply voltage status LEDs for outputs O1 to O8

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	
Status input 1 ... Input 6	Green	ON	Input ON
		OFF	Input OFF
Output 1 status ... Output 8	yellow	ON	Output ON
		OFF	Output OFF
Supply voltage status for outputs O1 to O8	Green	ON	Supply voltage OK
		OFF	Supply voltage faulty

21.2 Pin assignment



① X1
- U+ analog input for differential voltage V+
- U- analog input for differential voltage V-
- I+ analog input for I+ differential current
- I- analog input for I- differential current

② X2
- I1 digital input 1
- I2 digital input 2
- I3 digital input 3
- I4 digital input 4

③ X3
- O1 digital output 1
- O2 digital output 2
- O3 digital output 3
- O4 digital output 4

④ X4
- O5 digital output 5
- O6 digital output 6
- O7 digital output 7
- O8 digital output 8

⑤ X5
- I5 digital input 5
- I6 digital input 6
- 24 V supply voltage for outputs O1 to O8
- 0V GND

Figure 85: Pin assignment

21.3 Wiring for digital and analog inputs and outputs

Digital inputs can be wired to connector X2 and X5 and digital outputs can be wired to connector X3 and X4.

The digital input, as defined in the EN 61131-2 type 1 with a 0.5 ms input delay, is particularly suitable for connecting electronic switching devices, sensors and switches, etc. It is used to convert a signal with two possible states into a one-bit binary value.

The eight short-circuit proof digital outputs are provided on connectors X3 and X4 with +24 V/0.5 A.

On connector X1 the U+ and U- signals of the analog input can be wired to an analog output signal. A differential measurement will be carried out without connecting either input cable to ground (GND). The signal being measured must fall within the input's permissible common mode range. Please refer to → Table 7, page 144.

An additional I+/I- analog input can be wired on connector X1. A measuring range of 4–20 mA with open wire monitoring is supported, as is a measuring range of 0–20 mA without open wire monitoring.
The current input channel uses a differential voltage measurement at an internal module resistor with a resistance of 50 Ω.
It must be ensured that the input signal's voltage level falls within the permissible common mode range.Please refer to → Table 8, page 145.

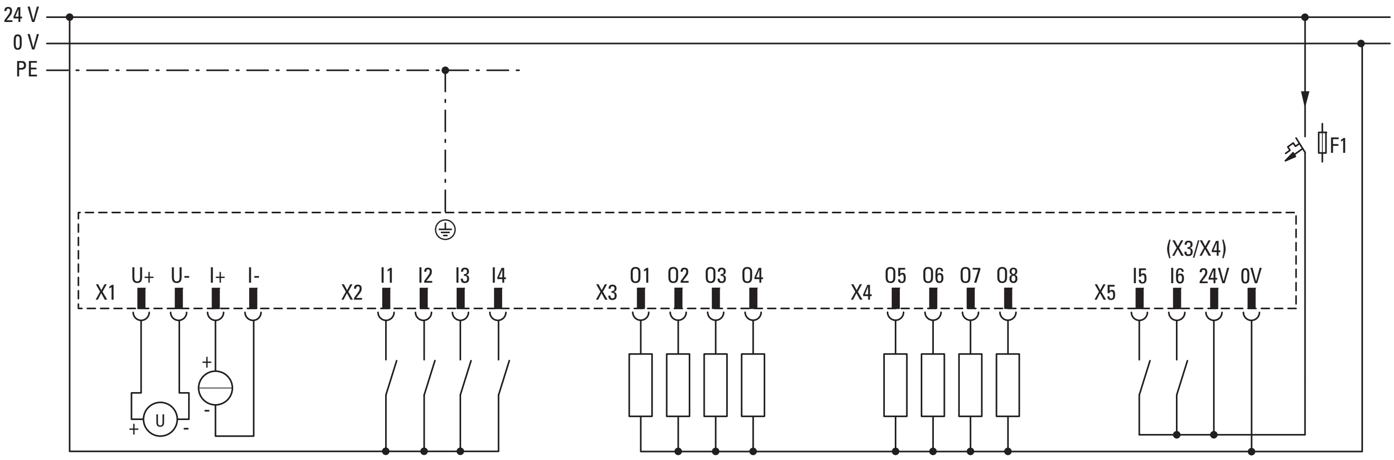


Figure 86: Wiring of inputs and outputs

21.4 Technical data

21.4.1 Voltage measurement analog input

Table 7 Technical data for analog inputs

Analog inputs	1	
Measuring range	-10…+10 V	0 V …+10 V
Measured value	-30,000…+30,000	0 … +30,000
D-A converter	16 Bit	
Resolution min.	0.3 mV / LSB	
Conversion time per channel	15.26 µs	
Common-mode range	± 12 V	
Input resistance	normally 660 kΩ	
Open wire monitoring	Yes	
Input filters		
Hardware	Typically: 1 kHz (third-order low-pass filter)	
Software (parameterizable)	parameterizable	
Measuring accuracy		
Cumulative error ± 10V	±0.2% of full scale value	
Total potentiometer error	±0.3% of full scale value	

21.4.2 Filtering:

The low-pass cutoff frequency can be configured for the voltage input channel by using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0 x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

21.4.3 Current measurement analog input

Table 8 Technical data for analog inputs

Channels	Value	
Number of channels	1	
Measuring range	0…20mA	4…20mA
Measured value	0…60,000	12,000…60,000
A-D converter	16 Bit	
Resolution	0.3 µA / LSB	
Conversion time per channel	15.26 µs	
Common-mode range	± 10 V	
Input resistance	50 Ω	
Input filters		
Hardware	typically 1 kHz (third-order low-pass filter)	
Software (parameterizable)	Configurable first-order low-pass filter	
Measuring accuracy		
Cumulative error	±0.5% of full scale value	

21.4.4 Digital inputs

Designation		
Number of channels	6	
	61131-2 Type1	
Input voltage U_E	24 Vdc	maximum 30 VDC
Signal level	LOW: 0 V < U_E < +5 V	HIGH: +15 V < U_E < +30 V
Switching threshold	normally +11 VDC	
Input current at U_E=24V DC	normally 3.7 mA	
Input delay	normally 0.5 ms	

21.4.5 Digital outputs

Quantity	8
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X5, pin on connector 24)
Rated operating voltage U_e	24 Vdc
Admissible range	18 – 30 VDC
Maximum permissible total current when using a duty factor of 100%	4A
Protection against polarity reversal	no
Voltage monitoring	Yes
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Output current per channel	0.5 A
„0“ signal	
Output voltage	0V
Max. output current per channel	≤ 10 µA
Switching-on delay	< 100 µs
Configuration can be read back	Yes
Signal level when reading	LOW: 0 V < UE < +8 V HIGH: +14 V < UE < +30 V
Switch off delay	< 150 µs
Maximum permissible total current for all channels when using a duty factor of 100%	4A
Maximum breaking energy of outputs (inductive load)	1 Joule/channel

21.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID			Module Identification Number	–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x21C0	0x6200 SUB x	0x7xx0 SUB01	1	Output1_8 Digital output register (write)	Byte 0	Bit 0	Output 1	0x0003
						Bit 1	Output 2	
						Bit 2	Output 3	
						Bit 3	Output 4	
						Bit 4	Output 5	
						Bit 5	Output 6	
						Bit 6	Output 7	
						Bit 7	Output 8	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x31C0	0x6000 SUB x	0x6xx0 SUB 01	1	Input1_8 Digital input register (read)	Byte 0	Bit 0	Input 1	0x0002
						Bit 1	Input 2	
						Bit 2	Input 3	
						Bit 3	Input 4	
						Bit 4	Input 5	
						Bit 5	Input 6	
						Bit 6	0: Diagnostics for reading back OK	
						Bit 7	DC 24V ok	
0x31C1	0x6000 SUB x	0x6xx0 SUB 02	1	OutputState1_8	Byte 0	Reading digital outputs Output1_8		0x0003
						Bit 0	Read status for output 1	
						Bit 1	Read status for output 2	
						Bit 2	Read status for output 3	
						Bit 3	Read status for output 4	
						Bit 4	Read status for output 5	
						Bit 5	Read status for output 6	
						Bit 6	Read status for output 7	
						Bit 7	Read status for output 8	
0x31C2	0x6401 SUB x	0x6xx1 SUB 01	2	InputChannel1	Word 1	Bit 0…15	Analogue input, voltage → Table 7	0x0006
0x31C3	0x6401 SUB x	0x6xx1 SUB 02	2	InputChannel2	Word 1	Bit 0…15	Analog input Current → Table 8	0x0008
0x31C4	–	0x6xxD SUB 01	1	ModuleDiag Module diagnostics	Byte 0	Status Information System bus		
						Bit 0	24VDC not ok	0x0004
						Bit 1	No SYNC signal	
						Bit 2	FLASH-CRC error	
						Bit 3	RAM-CRC error	
						Bit 4	Invalid calibration	
						Bit 5	Unsupported system bus cycle time	
						Bit 6-7	reserved	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x31C5	–	0x6xxA SUB 01	1	CableBreakDiag Open wire diagnostics	Byte 0	Bit 0	1: Cable break input U+/ U-	0x000A
						Bit 1	Diagnostics possible only in 4 to 20 mA measurement range: 1: Cable break input I+/I-	
						Bit 2-4	reserved	
						Bit 5	Measuring range exceeded	
						Bit 6-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x51C0	–	0x8xx6 SUB 01	1	InputChannelMode Used to select the measurement range		Bit 0	0: -10… +10 V (default) 1: 0…10 V	0x0106
						Bit 1	0: 0…20 mA (default) 1: 4…20 mA	
						Bit 2-7	reserved	
0x51C1	–	0x8xx9 SUB 01	2	FilterConfigChannel1 Cutoff frequency setting for low-pass filter for current input channel 2			Used to specify the cutoff frequency as a decimal value in Hz.	0x0107
0x51C2	–	0x8xx9 SUB 02	2	FilterConfigChannel2 Cutoff frequency setting for low-pass filter for current input channel 2			Used to specify the cutoff frequency as a decimal value in Hz.	0x0109
0x51C3	–	0x8xxA SUB 01	2	CableBreakLimit Limit for open wire detection for AI2, possible only in 0 to 20 mA measurement range mode			Used to specify the limit as a decimal value in µA 0…4000 (default 3600)	0x010B

22 Analog input module XN-322-4AI-PTNI

XN-322-4AI-PTNI modules are XN300 slice modules with 4 analog input channels used to measure temperatures with Pt100, Pt200, Pt500, Pt1000, Ni100, Ni100, or KTY sensors or resistance values within various measuring ranges. These modules support two-wire and three-wire connections. Every channel can be individually configured.

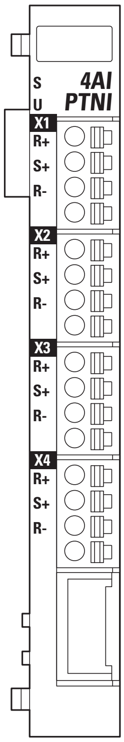


Figure 87: Device view XN-322-4AI-PTNI

22.1 Status LEDs

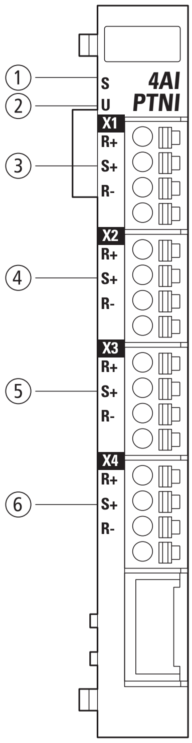


Figure 88: LED signals and pin assignment

① Module status LED
② User LED
③ Input 1 status LED
④ Input 2 status LED
⑤ Input 3 status LED
⑥ Input 4 status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status input	yellow	ON	Input enabled
		FLASHES (0.5 Hz)	Measuring range fallen below
		FLASHES (4 Hz)	Measuring range exceeded or cable breakage
		OFF	Input disabled

22.2 Pin assignment

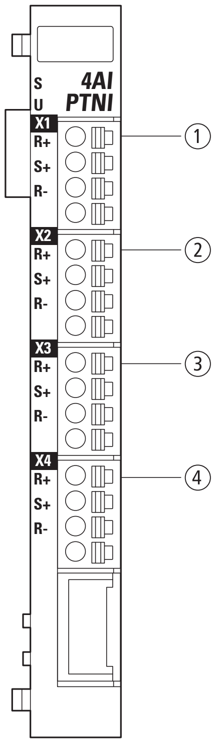


Figure 89: Pin assignment

① X1
- R+ Resistor 1+
- S+ Sense 1+
- R- Resistor 1-
- – not used

② X2
- R+ Resistor 2+
- S+ Sense 2+
- R- Resistor 2-
- – not used

③ X3
- R+ Resistor 3+
- S+ Sense 3+
- R- Resistor 3-
- – not used

④ X4
- R+ Resistor 4+
- S+ Sense 4+
- R- Resistor 4-
- – not used

22.3 Wiring topic

One analog input can be wired to each of the four X1 to X4 connectors. Both 2-wire and 3-wire configurations are supported.

22.3.1 Two-wire connection

When using a 2-wire configuration, the resistance value between pins 1 and 3 will be measured and interpreted as a temperature reading. The cable resistance will affect the reading in the form of an error. The advantage of using this type of configuration is the fact that it requires a small number of connection cables.

R_L = Cable resistance of connection cable

R_T = Resistance of temperature sensor

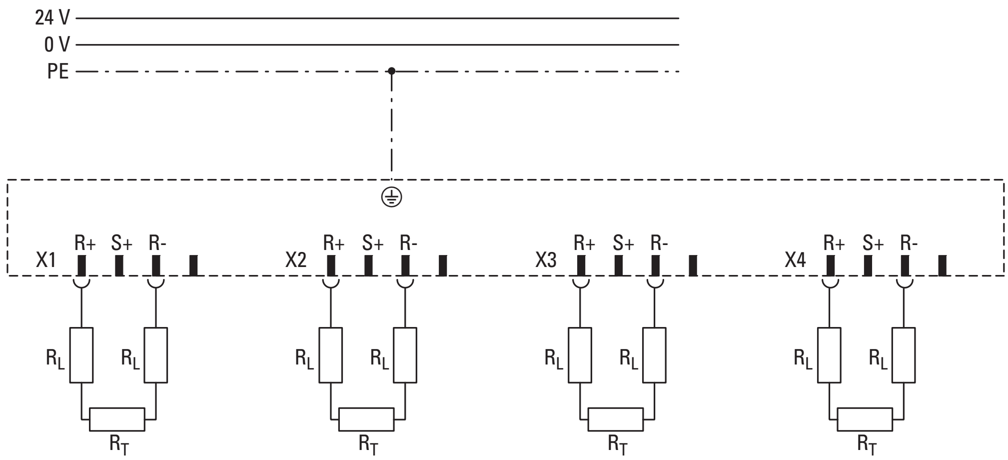


Figure 90: Wiring diagram for two-wire connections; X1, X2, X3, and/or X4 can be used with this type of configuration

22.3.2 Three-wire connection

When using a three-wire connection, the resistance value between pins 1 and 3 and between pins 1 and 2 is measured. In this type of configuration, the cable resistance will not affect the measurement, provided all cable lengths are identical.

$R_L \leq 200\ \Omega$ = Cable resistance of connection cable

R_T = Resistance of temperature sensor

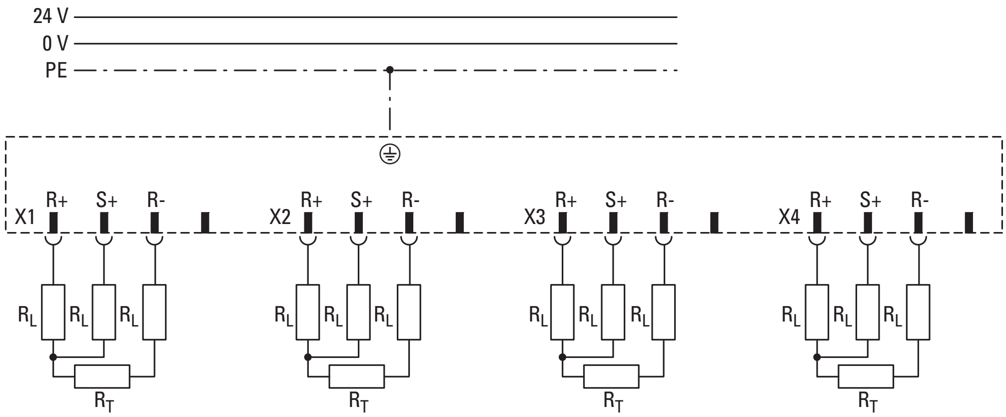


Figure 91: Wiring diagram for three-wire connections; X1, X2, X3, and/or X4 can be used with this type of configuration

22.4 Technical specifications

22.4.1 Specifications for analog resistance / temperature inputs

Number of analog input channels	4
A-D converter resolution	16 bits
Configurable parameters	Pt100, Pt200, Pt500, Pt1000, NI100, NI1000, KTY11-62, KTY81-110, KTY81-120, KTY81-150, KTY81-121, KTY81-122 KTY84-130, KT84-150
Typical measuring current	< 300 µA
Reading update	4 ms
Input resistance	> 10 MΩ
Input filter	
Built-in	10 kHz, second-order low-pass filter
parameterizable	Yes
Cumulative error	±0.3% of full scale value
Sensor connection cable resistance	max. 100 Ω
Isolation	
Input vs. Backplane	500 V_{eff}
status display	LEDs green, yellow

22.4.2 Measuring ranges for resistance inputs

The values are represented as a decimal value in ohms with one decimal place (in 1 / 10 ohm).

Catalog Number	**Resistance range**
1	0 ... 250 Ω
2	0 ... 500 Ω
3	0 ... 1000 Ω
4	0 ... 2500 Ω
5	0 ... 5000 Ω

22.4.3 Measuring ranges for temperature inputs

The values will be represented as a decimal value in °C with one or two decimal places (in 1 / 10 °C or 1 / 100 °C). The measurement range can be configured with SDOs 0x5070 to 0x5073.

SDO value for sensor type	Catalog Number	Temperature range	Resistance range	Resolution in °C
0	Pt100	-200…+150 °C	18.5…157.3 Ω	1/10
1	Pt100	-200…+850 °C	18.5 …390.5 Ω	1/10
2	Pt200	-200…+150 °C	39.0…314 Ω	1/10
3	Pt200	-200…+850 °C	39.0…780 Ω	1/10
4	Pt500	-200…+150 °C	92.6…786.6 Ω	1/10
5	Pt500	-200…+850 °C	92.6…1952.4 Ω	1/10
6	Pt1000	-200…+150 °C	185.2…1573.3 Ω	1/10
7	Pt1000	-200…+850 °C	185.2…3904.8 Ω	1/10
8	NI100	-60…+150 °C	69.5…198.7 Ω	1/10
9	NI100	-60…+250 °C	69.5…290.1 Ω	1/10
10	NI1000	-60…+150 °C	743.0…1987.0 Ω	1/10
11	NI1000	-60…+250 °C	743.0…2800.0 Ω	1/10
12	Potentiometer	0	250	1/10
13	Potentiometer	0	500	1/10
14	Potentiometer	0	1000	1/10
15	Potentiometer	0	2500	1/10
16	Potentiometer	0	5000	1/10
17	KTY11-62	-50…+150 °C	1035.9…4575.3 Ω	1/10
18 19	KTY81-110 KTY81-120	-55…+150 °C	450.0 … 2211.0 Ω	1/10
20	KTY81-121	-55…+150 °C	485.0 … 2189.0 Ω	1/10
21	KTY81-122	-55…+150 °C	495.0 … 2233.0 Ω	1/10
22	KTY81-150	-55…+150 °C	450.0 … 2211.0 Ω	1/10
23	KTY84-130	-40…+300 °C	359.0 … 2624.0 Ω	1/10
24	KTY84-150	-40…+300 °C	359.0 … 2624.0 Ω	1/10
25	Pt100	-200…+150 °C	18.5…157.3 Ω	1/100

22.5 Diagnostics

If the reading falls within the permissible measuring range and both the range and channel diagnostics read "FALSE," the valid reading will be shown.

If the measuring range is exceeded or fallen below, but the reading still falls within the limits for range diagnostics, the fact that the permissible measuring range has been exceeded/fallen below will be indicated by setting the range diagnostics' (measuring range diagnostics) status to "TRUE". In this case, the open wire diagnostics will remain "FALSE", and a reading will be shown.

If the reading exceeds or falls below the limits for range diagnostics, the device will be unable to perform a measurement, just like in the event of an cable break. In this case, the cable break diagnostics will signal the fault by having their status set to "TRUE", while the range diagnostics will keep a status of "FALSE". When this occurs, a value of "-30000" will be shown as the reading.

If a channel is disabled, there will not be any measurements, and the open wire diagnostics will indicate this with the "TRUE" status.

→ Range and open wire diagnostics must be taken into account in order to ensure that the reading shown is being interpreted correctly.

22.6 Filtering:

The low-pass cutoff frequency can be configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

Values from 0 to 100 are allowed.

0: No filter. A value of 1 to 100 corresponds to 1 to 100 Hz

Example: 50 Hz low-pass cutoff frequency; register value: 50_{dec} / 32_{hex}

The following values are allowed:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0x0032
100 Hz	0x0064

22.7 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT ObjectIndex	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID		Module ID number	–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x3070		0x6xxD SUB 01	UINT	ModuleDiag	Bit 0	reserved	0x0080
					Bit 1	No SYNC	
					Bit 2	FLASH data CRC error	
					Bit 3	RAM data CRC error	
					Bit 4	Unsafe FLASH data	
					Bit 5-15	reserved	
0x3071	0x6401	0x6xx1 SUB 01	INT	InputChannel1			0x0082
0x3072	0x6401	0x6xx1 SUB 02	INT	InputChannel2			0x0084
0x3073	0x6401	0x6xx1 SUB 03	INT	InputChannel3			0x0086
0x3074	0x6401	0x6xx1 SUB 04	INT	InputChannel4			0x0088
0x3075	–	0x6xxA SUB 01	USINT	WireBreakDiag	Bit 0	1: Communication error channel AI1	0x008A
					Bit 1	1: Communication error channel AI2	
					Bit 2	1: Communication error channel AI3	
					Bit 3	1: Communication error channelAI4	
					Bit 4-15	reserved	

CAN Object Index	Default CAN Mapping	EtherCAT ObjectIndex	Size (byte)	Local I/O description			Local I/O addresses
0x3076		0x6xx2 SUB 01	USINT	RangeDiag	Bit 0	1: Range overflow channel AI1	0x008B
					Bit 1	1: Range underflow channel AI2	
					Bit 2	1: Range overflow channel AI3	
					Bit 3	1: ange underflow channel AI4	
					Bit 4	1: Range overflow channel AI1	
					Bit 5	1: ange underflow channel AI2	
					Bit 6	1: Range overflow channel AI3	
					Bit 7	1: ange underflow channel AI4	
0x3077	0x6401	–	INT	NativeDataAI1			–
0x3078	0x6401	–	INT	NativeDataAI2			–
0x3079	0x6401	–	INT	NativeDataAI3			–
0x307A	0x6401	–	INT	NativeDataAI4			–
0x307B	0x6401	–	INT	NativeDataAI5			–
0x307C	0x6401	–	INT	NativeDataAI6			–
0x307D	0x6401	–	INT	NativeDataAI7			–
0x307E	0x6401	–	INT	NativeDataAI8			–
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber	–		–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl	–		–
0x400C	–	–	Max. 25	ProductName	–		–
0x4070	–	–	2	FirmwareVersion	–		–

CAN Object Index	Default CAN Mapping	EtherCAT ObjectIndex	Size (byte)	Local I/O description				Local I/O addresses
0x5070		0x8xx6 SUB 01	USINT	SensorSelectionAI1	0:	Pt100	-200 …+150°C	0x0107
					1:	Pt100	-200 … +850°C	
0x5071		0x8xx6# SUB 02	USINT	SensorSelectionAI2	2:	Pt200	-200 … +150°C	0x0108
					3:	Pt200	-200 … +850°C	
0x5072		0x8xx6 SUB 03	USINT	SensorSelectionAI3	4:	Pt500	-200 … +150°C	0x0109
					5:	Pt500	-200 … +850°C	
0x5073		0x8xx6 SUB 04	USINT	SensorSelectionAI4	6:	Pt1000	-200 … +150°C	0x010A
					7:	Pt1000	-200 … +850°C	
					8:	NI100	-60 … +150°C	
					9:	NI100	-60 … +250°C	
					10:	NI1000	-60 … +150°C	
					11:	NI1000	-60 … +250°C	
					12:	R	0 … 250 Ω	
					13:	R	0 … 500 Ω	
					14:	R	0 … 1000 Ω	
					15:	R	0 …2500 Ω	
					16:	R	0 … 5000 Ω	
					17:	KTY11-62	-50 … +150°C	
					18:	KTY81-110	-55 … +150°C	
					19:	KTY81-120	-55 … +150°C	
					20:	KTY81-121	-55 … +150°C	
					21:	KTY81-122	-55 …+150°C	
					22:	KTY81-150	-55 …+150°C	
					23	KTY84-130	-40 …+300°C	
					24	KTY84-150	-40 …+300°C	
					25	Pt100	-200 …+150°C	
					26-255	reserved		
0x5074		0x8xxC SUB 02	USINT	ChannelMeasuring-Configuration	Bit 0	1: MeasuringConfig_AI1_As_3Wire		0x010B
					Bit 1	1: MeasuringConfig_AI2_As_3Wire		
					Bit 2	1: MeasuringConfig_AI3_As_3Wire		
					Bit 3	1: MeasuringConfig_AI4_As_3Wire		
					Bit 4-15	reserved		

CAN Object Index	Default CAN Mapping	EtherCAT ObjectIndex	Size (byte)	Local I/O description			Local I/O addresses
0x5075		0x8xx9 SUB 01	UINT	FilterConfigChannel 1	Used to specify the cutoff frequency as a decimal value in Hz.		0x010C
0x5076		0x8xx9 SUB 02	UINT	FilterConfigChannel 2			0x010E
0x5077		0x8xx9 SUB 03	UINT	FilterConfigChannel 3			0x0110
0x5078		0x8xx9 SUB 04	UINT	FilterConfigChannel 4			0x0112
0x5079		0x8xxC SUB 01	USINT	ChannelActivation	Bit 0	1: AI1_active	0x0114
					Bit 1	1: AI2_active	
					Bit 2	1: AI3_active	
					Bit 3	1: AI4_active	
					Bit 4-15	reserved	

23 Analog input module XN-322-7AI-U2PT

XN-322-7AI-U2PT modules are XN300 slice modules with 7 analog input channels. Out of the seven analog inputs, six are used to measure an analog input signal of ±10 V, with the option of configuring the first channel as a temperature input (KTY, Pt1000) instead. The final, seventh analog channel is used to measure temperatures with sensors (KTY, Pt1000).

A reference voltage source with 10 V / 15 mA and 6 outputs makes it possible to directly power potentiometers in order to read their position using the analog voltage inputs.

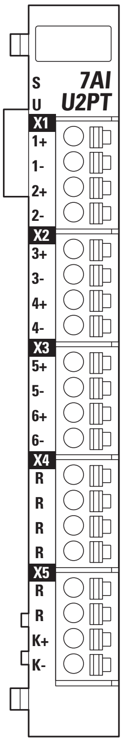


Figure 92: Device view XN-322-7AI-U2PT

23.1 Status LEDs

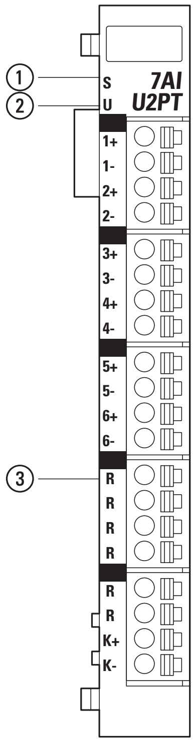


Figure 93: LED signals and pin assignment

1. Module status LED
2. User LED
3. Reference fault LED

Module Status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Error Reference	red	ON	10 V reference overload
		FLASHES (20Hz)	Overload GND; For channels configured to use measurements relative to ground.
		OFF	No Error

23.2 Pin assignment

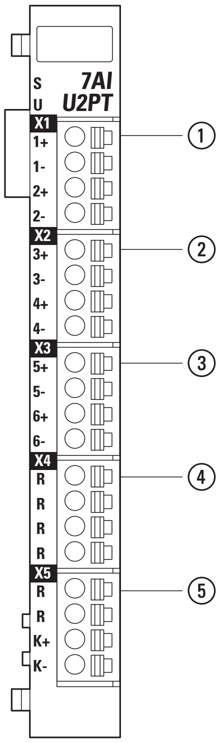


Figure 94: Pin assignment

① X1
- 1+ analog input 1+(KTY+)
- 1- analog input 1- /AGND(KTY-)
- 2+ analog input 2+
- 2- analog input 2-/AGND

② X2
- 3+ analog input 3+
- 3- analog input 3-/AGND
- 4+analog input 4+
- 4- analog input 4-/AGND

③ X3
- 3+ analog input 3+
- 3- analog input 3-/AGND
- SH analog input 4+
- SH analog input 4-/AGND

④ X4
- R reference output
- R reference output
- R reference output
- R reference

⑤ X5
- R reference
- R reference
- K+ KTY+ analog input
- K- KTY- analog input

23.3 Wiring topic

23.3.1 Potentiometer measurements

When using potentiometer measurements, the potentiometer is powered using the reference voltage and AIx is connected to GND by configuring the corresponding parameters. The potentiometer's position can then be interpreted as a % by measuring the analog voltage at the potentiometer's wiper.

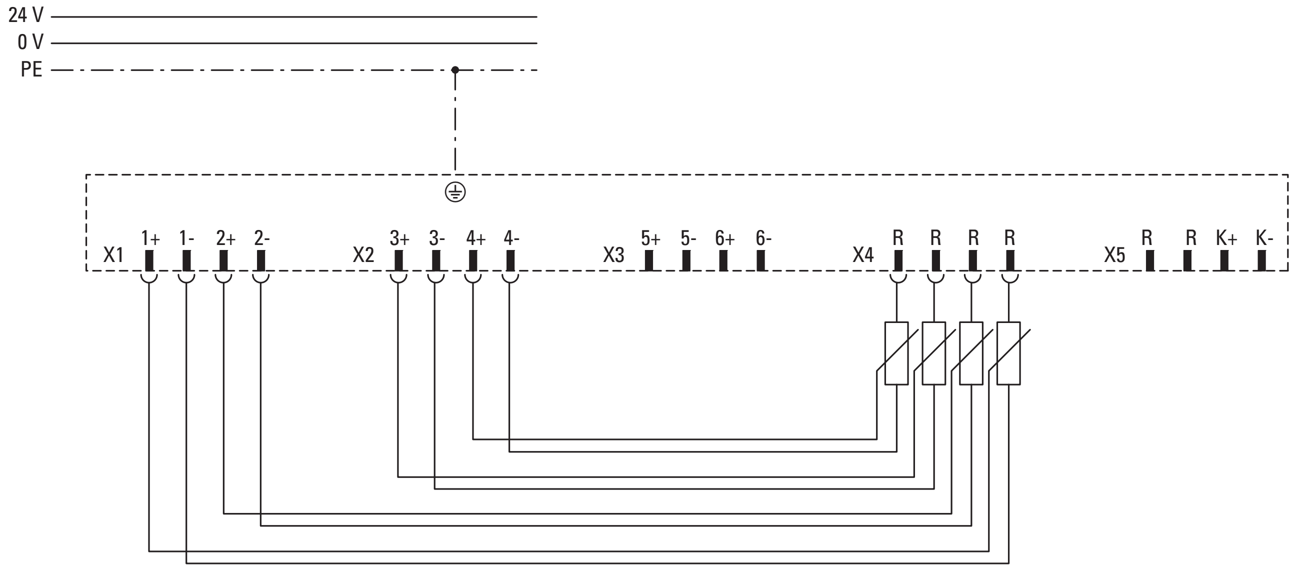


Figure 95: Potentiometer measurement at AI1, AI2, AI3 and/or AI4

23.3.2 Measurements using sensors / temperature inputs

In order to measure a sensor's output voltage via an analog input, a differential voltage measurement is carried out without connecting either input cable to earth (GND). The signal being measured must fall within the input's permissible common mode range.

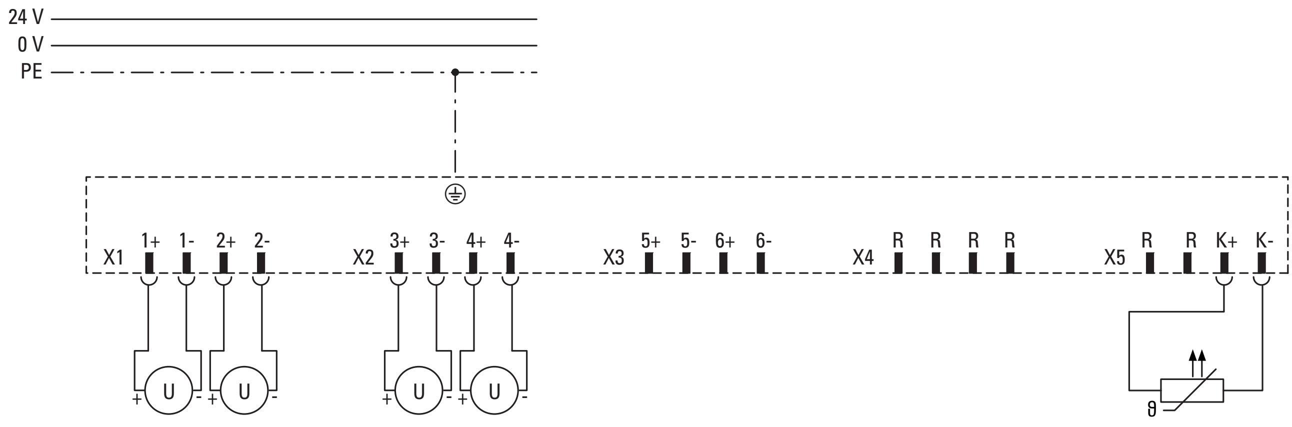


Figure 96: Connecting analog inputs for measuring a sensor at AI1, AI2, AI3, and/or AI4; temperature measurement for KTY10 at X5

23.4 Technical data for inputs

Number of analog input channels	7	
Analog inputs	6 voltage inputs ±10 V (of which channel 1 can be configured to work as a KTY, Pt1000 input instead)	
KTY, Pt1000 - inputs	1	
Analog inputs	6	
Measuring range	-10V … +10V	0 – 100% (potentiometer)
Measured value	-10,000…10,000	0 … 10,000
D-A converter	16 bits	
Resolution	0,3 mV / LSB	
Conversion time per channel	1 ms	
Common-mode range	± 12 V	
Input resistance	> 10 MΩ	
Open wire monitoring	Yes	
Input filters		
Hardware	Typically: 1 kHz (third-order low-pass filter)	
Software (parameterizable)	parameterizable	
Measuring accuracy		
Cumulative error ± 10V	±0.3% of full scale value	
Total potentiometer error	±0.35% of full scale value	
KTY, Pt1000 inputs	1 (parameterizable Pt1000/KTY10)	
	Pt1000	KTY10
	-25 … +850 °C	-50 … +150 °C
	502.4 – 3904.8 Ω	1035.9 – 4575.3 Ω
D-A converter	16 bits	
Resolution	0.1 °C	
Conversion time per channel	1 ms	
Input resistance	33 kΩ	
Open wire monitoring	Yes	
Input filters		
Hardware	Typically: 1 kHz (third-order low-pass filter)	
Software	10 Hz	
Measuring accuracy		
Basic error limit	±0.5% of full scale value	

23.5 Technical data for reference outputs

	Device version	
	1.00 or higher	3.01 or higher
Number of channels	1	
Connection points per channel	6	
Reference voltage	+10 V	
Permissible load per potentiometer input		
Max. permissible output current	≤ 2.50 mA	≤ 4.17 mA
Potentiometer	≥ 4 kΩ	≥ 2.4 kΩ
Maximum operating temperature	0…60 °C	0…55 °C
Maximum permissible capacitive load	100 nF	
Short-circuit proof	Yes, maximum 1 minute	
Cumulative error as a percentage of full scale value	±0.3 %	

23.6 Measurement ranges

Input 1				Value representation
1	U	-10…+10 V		Represented as a decimal value in mV
	Pt1000	-125…+850 °C	502.4…3904.8 Ω	Represented as a decimal value in ohms with one decimal place (in 1/10 ohm)
	KTY10	-50…+150 °C	1035.9…4575.3 Ω	
2-6	U	-10…+10V	-10000…10000	Represented as a decimal value in mV
7	Pt1000	-125…+850 °C	502.4…3904.8 Ω	Represented as a decimal value in °C with one decimal place (in 1/10 °C)
	KTY10	-50…+150 °C	1035.9…4575.3 Ω	

23.7 Filtering:

The low-pass cutoff frequency can be configured for each voltage input channel by using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

The following settings are valid:

Table 9 Configurable low-pass filter.

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0 x0032

Low-pass cut-off frequency	Register value
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

23.8 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN objects	EtherCAT Object Index	Size (byte)	Local I/O description			Lokale I/O address
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x3080		0x6xxD SUB 01	2	ModuleDiag	Bit 0	reserved	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	
0x3081	0x6401	0x6xx1 SUB 01	2	InputChannel1 (U/KTY/Pt1000)			0x0082
0x3082	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084
0x3083	0x6401	0x6xx1 SUB 03	2	InputChannel3			0x0086
0x3084	0x6401	0x6xx1 SUB 04	2	InputChannel4			0x0088
0x3085	0x6401	0x6xx1 SUB 05	2	InputChannel5			0x008A
0x3086	0x6401	0x6xx1 SUB 06	2	InputChannel6			0x008C

CAN Object Index	Default CAN objects	EtherCAT Object Index	Size (byte)	Local I/O description			Lokale I/O address
0x3087	0x6401	0x6xx1 SUB 07	2	InputChannel7			0x008E
0x3088	–	0x6xxA SUB 01	2	WireBreakDiag	Bit 0	1: Cable break input AI1	2
					Bit 1	1: Cable break input AI2	
					Bit 2	1: Cable break input AI3	
					Bit 3	1: Cable break input AI4	
					Bit 4	1: Cable break input AI5	
					Bit 5	1: Cable break input AI6	
					Bit 6	1: Cable break input AI7	
					Bit 7	1: Short-circuit at input AI1 when configured as KTY/ Pt1000	
					Bit 8	1: Short-circuit input AI7	
					Bit 9	1: Reference undervoltage	
					Bit10	1:Reference overcurrent	
					Bit 11-15	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4080	–	–	2	FirmwareVersion			–

CAN Object Index	Default CAN objects	EtherCAT Object Index	Size (byte)	Local I/O description				Lokale I/O address
0x5080	–	0x8xx6 SUB 01	2	ChannelMeasuringConfig Parameter definition channel	Measured value 1 (AI1)	Bit 0	0: Analog measurement ± 10V	0x0106
							1: Temperature measurement	
						Bit 1	0: KTY10 Sensor	
							1: Pt1000 Sensor	
						Bit 2	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 2 (AI2)	Bit 3	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 3 (AI3)	Bit 4	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 4 (AI4)	Bit 5	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 5 (AI5)	Bit 6	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 6 (AI6)	Bit 7	0: Differential measurement	
							1: Measurement relative to ground	
					Measured value 7 (AI7)	Bit 8	0: KTY10 Sensor	
							1: Pt1000 Sensor	
					–	Bit 9-15	reserved	
0x5081	–	0x8xx9 SUB 01	2	FilterConfigChannel1		Used to specify the cutoff frequency as a decimal value in Hz.		0x0108
0x5082	–	0x8xx9 SUB 02	2	FilterConfigChannel2				0x010A
0x5083	–	0x8xx9 SUB 03	2	FilterConfigChannel3				0x010C
0x5084	–	0x8xx9 SUB 04	2	FilterConfigChannel4				0x010E
0x5085	–	0x8xx9 SUB 05	2	FilterConfigChannel5				0x0110
0x5086	–	0x8xx9 SUB 06	2	FilterConfigChannel6				0x0112

24 Analog input module XN-322-8AI-I

XN-322-8AI-I modules are XN300 slice modules with 8 analog input channels used to measure current input signals within a measuring range of 0 – 20 mA or 4 – 20 mA.

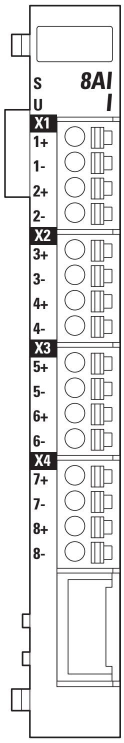


Figure 97: Device view XN-322-8AI-I

24.1 Status LEDs

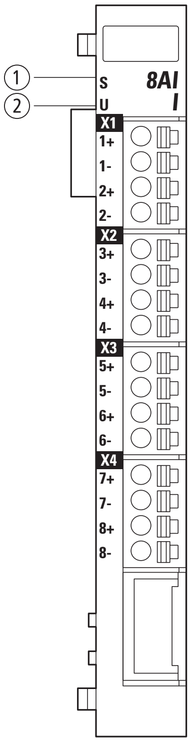


Figure 98: LED signals and pin assignment

① Module status LED

② User status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	

24.2 Pin assignment

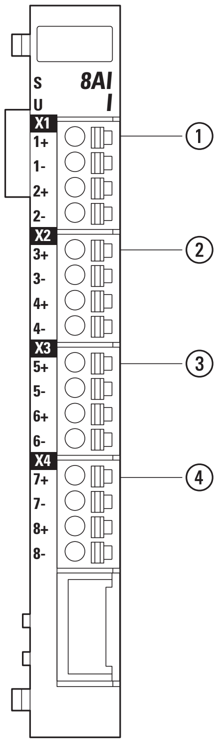


Figure 99: Pin assignment

① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+analog input 2+
- 2- analog input 2-

② X2
- 3+ analog input 3+
- 3- analog input 3-
- 4+ analog input 4+
- 4- analog input 4-

③ X3
- 5+ analog input 5+
- 5- analog input 5-
- 6+ analog input 6+
- 6- analog input 6-

④ X4
- 7+ analog input 7+
- 7- analog input 7-
- 8+ analog input 8+
- 8- analog input 8-

24.3 Wiring topic

Two analog inputs can be wired to each of the four X1 to X4 connectors.

A measuring range of 4–20 mA with open wire monitoring is supported, as is a measuring range of 0–20 mA without open wire monitoring.

The current input channels use a differential voltage measurement at an internal module resistor with a resistance of 50 Ω.

It must be ensured that the input signals' voltage levels fall within the permissible common mode range.

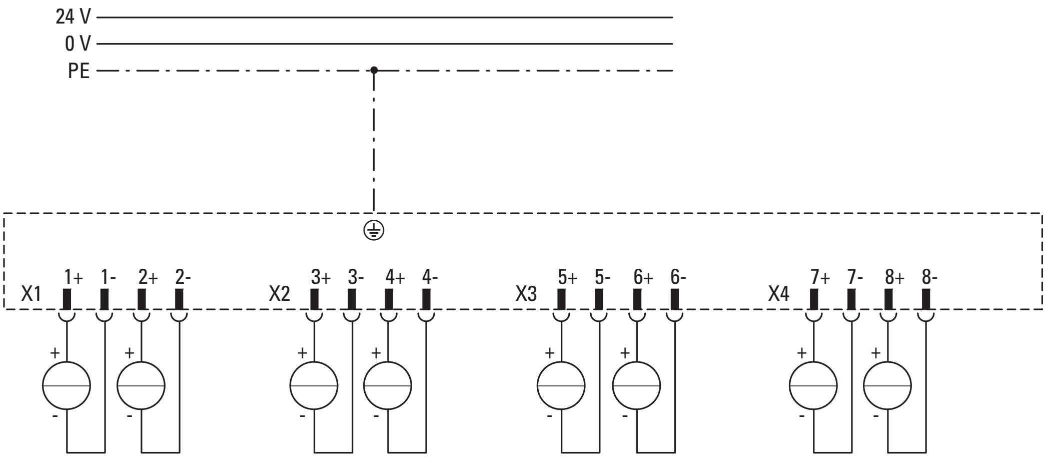


Figure 100: Connecting example for signal current sources

24.4 Technical specifications

24.4.1 Channels

Channels	Value	
Number of channels	8 analog input channels	
Measuring range	0…20mA	4…20mA
Measured value	0…20000	4000…20000
A-D converter	16 bits	
Resolution	0.3 µA / LSB	
Conversion time per channel	1 ms	
Common-mode range	± 10 V	
Input resistance	50 Ω	
Input filters		
Hardware	Typically: 1 kHz (third-order low-pass filter)	
Software (parameterizable)	parameterizable	
Measuring accuracy		
Cumulative error	±0.5% of full scale value	

24.4.2 Measurement ranges

Current in mA	Value representation in µA	
0 …20 mA	0000 20000	Represented as a decimal value
4 … 20 mA	4000 20000	

24.4.3 Diagnostics

Open wires will only be detected with diagnostics when using the 4 – 20 mA measuring range. When using the 0 – 20 mA measuring range, the open wire detection diagnostics will always read "FALSE."

→ Range and channel diagnostics must be taken into account in order to ensure that the reading shown is being interpreted correctly.

Diagnostics	Measuring range in mA	
	0 – 20	**4 – 20**
Cable break	–	< 4 mA (diagnostics)
Under Range	–	0 … 4 mA
Display value	Measured value	
Over Range	20 …21 20…20.25 (firmware version 4.03 and higher)	
over current	> 21	
Display value	> 21 (no reading)	

24.4.4 Filtering:

The low-pass cutoff frequency can be configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

24.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x3090	0x6401	0x6xxD SUB 01	2	ModuleDiag	Bit 0	reserved	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	
0x3091	0x6401	0x6xx1 SUB 01	2	InputChannel1			0x0082
0x3092	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084
0x3093	0x6401	0x6xx1 SUB 03	2	InputChannel3			0x0086
0x3094	0x6401	0x6xx1 SUB 04	2	InputChannel4			0x0088
0x3095	0x6401	0x6xx1 SUB 05	2	InputChannel5			0x008A
0x3096	0x6401	0x6xx1 SUB 06	2	InputChannel6			0x008C

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x3097	0x6401	0x6xx1 SUB 07	2	InputChannel7			0x008E
0x3098	0x6401	0x6xx1 SUB 08	2	InputChannel8			0x0090
0x3099	–	0x6xxA SUB 01	2	WireBreakDiag	Bit 0	1: Cable break input AI1	0x0092
					Bit 1	1: Cable break input AI2	
					Bit 2	1: Cable break input AI3	
					Bit 3	1: Cable break input AI4	
					Bit 4	1: Cable break input AI5	
					Bit 5	1: Cable break input AI6	
					Bit 6	1: Cable break input AI7	
					Bit 7	1: Cable break input AI8	
					Bit 8-15	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4080	–	–	2	FirmwareVersion			–
0x5090		0x8xx6 SUB 01	2	ChannelMeasuring-Config Measuring range parameter configuration	Bit 0 (AI1)	0: measurement range 0…20mA	0x0106
						1: measurement range 4…20mA	
					Bit 1 (AI2)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 2 (AI3)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 3 (AI4)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 4 (AI5)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 5 (AI6)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 6 (AI7)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 7 (AI8)	0: measurement range 0…20mA	
						1: measurement range 4…20mA	
					Bit 8-15	reserved	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description		Local I/O addresses
0x5091		0x8xx9 SUB 01	2	FilterConfigChannel1	Used to specify the cutoff frequency as a decimal value in Hz.	0x0108
0x5092		0x8xx9 SUB 02	2	FilterConfigChannel2		0x010A
0x5093		0x8xx9 SUB 03	2	FilterConfigChannel3		0x010C
0x5094		0x8xx9 SUB 04	2	FilterConfigChannel4		0x010E
0x5095		0x8xx9 SUB 05	2	FilterConfigChannel5		0x0110
0x5096		0x8xx9 SUB 06	2	FilterConfigChannel6		0x0112
0x5097		0x8xx9 SUB 07	2	FilterConfigChannel7		0x0114
0x5098		0x8xx9 SUB 08	2	FilterConfigChannel8		0x0116

25 Analog input module XN-322-8AI-PTKT

The XN-322-8AI-PTKT module is an XN300 slice module with eight analog input channels used to measure temperatures with Pt1000 and KTY sensors or resistance values within a fixed resistance range. These modules support two-wire connections. Every channel can be individually configured.

25.1 Status LEDs

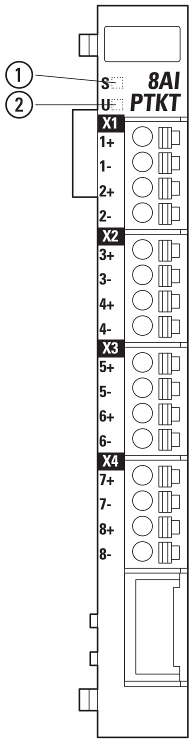


Figure 101: LED signals and pin assignment

① Module status LED

② User LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	

25.2 Pin assignment

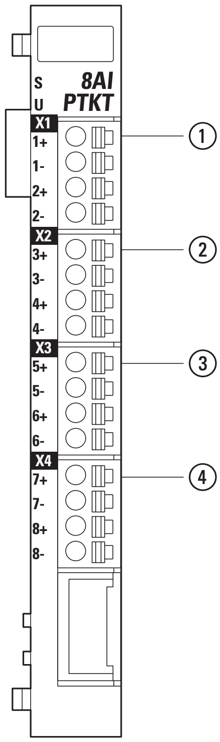


Figure 102: Pin assignment

① X1
- Analog input 1+
- Analog input 1-
- Analog input 2+
- Analog input 2-

② X2
- Analog input 3+
- Analog input 3-
- Analog input 4+
- Analog input 4-

③ X3
- Analog input 5+
- Analog input 5-
- Analog input 6+
- Analog input 6-

④ X4
- Analog input 7+
- Analog input 7-
- Analog input 8+
- Analog input 8-

25.3 Wiring topic

Two analog inputs can be wired to each of the four X1 to X4 connectors. Two-wire configuration is supported.

When using a 2-wire configuration, the resistance value between pins 1+ and 1- will be measured and interpreted as a temperature reading. The cable resistance will affect the reading in the form of an error. The advantage of using this type of configuration is the fact that it requires a small number of connection cables.

R_T = Resistance of temperature sensor

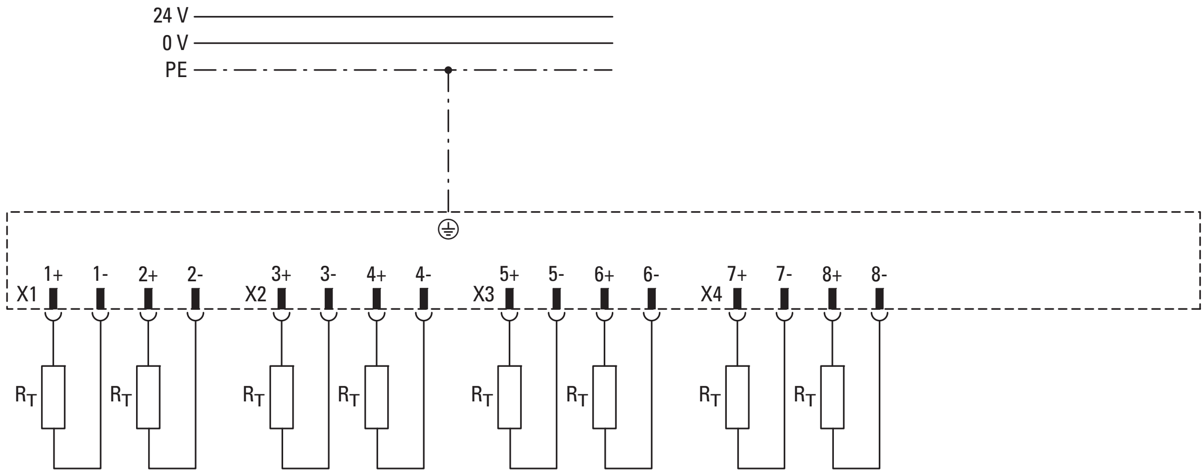


Figure 103: Wiring diagram for two-wire connection for eight analog inputs

25.4 Technical specifications

25.4.1 Specifications for analog resistance / temperature inputs

Number of analog input channels	8
A-D converter resolution	16 bits
Resolution	0.1 °C / LSB or 0.1Ω / LSB
Configurable parameters	Pt1000, KTY10-62, KTY11-62, KTY81-110, KTY81-120, KTY81-150, KTY81-121, KTY81-122
Typical measuring current	< 330 µA
Reading update	1 ms
Input resistance	> 30 kΩ
Input filter	
Built-in	1 kHz, third-order low-pass filter
parameterizable	Yes; refer to → Table , page 185
Cumulative error	±0.75% of full scale value
status display	LEDs green, yellow

25.4.2 Measuring ranges for temperature inputs

The values will be represented as a decimal value in °C with one or two decimal places in 1/10 °C. When the resistance type is selected, the value will be shown as a decimal value in 1/10 Ω. The measurement range can be configured, e.g., with SDOs 0x5210 to 0x5217 for CANopen, please refer to → Section “25.7 Memory layout”, page 186.

SDO value for sensor type	Catalog Number	Temperature range	Resistance range	Resolution in °C
0	Pt1000	-50…+150 °C	803.1…1573.3 Ω	1/10
8	Pt1000 extended (FW ≥ 01.20)	-150…+850 °C	397.2…3904.8 Ω	1/10
1	KTY10-62 KTY11-62	-50…+150 °C	1035.9…4575.3 Ω	1/10
2	KTY81-110 KTY81-120 KTY81-150	-55…+150 °C	490.0 … 2211.0 Ω	1/10
3	KTY81-121	-55…+150 °C	485.0 … 2189.1 Ω	1/10
4	KTY81-122	-55…+150 °C	494.9 … 2233.0 Ω	1/10
6	Resistance	–	350…4600 Ω	–

25.5 Diagnostics

If the reading falls within the permissible measuring range and both the range and channel diagnostics read "FALSE," the valid reading will be shown.

If the measuring range is exceeded or fallen below, but the reading still falls within the limits for range diagnostics, the fact that the permissible measuring range has been exceeded/fallen below will be indicated by setting the range diagnostics' (measuring range diagnostics) status to "TRUE." In this case, the open wire diagnostics will remain "FALSE," and a reading will be shown.

If the reading exceeds or falls below the limits for range diagnostics, the device will be unable to perform a measurement, just like in the event of an open wire. In this case, the open wire diagnostics will signal the fault by having their status set to "TRUE," while the range diagnostics will keep a status of "FALSE." When this occurs, a value of "-30000" will be shown as the reading.

If a channel is disabled, there will not be any measurements, and the open wire diagnostics will indicate this with the "TRUE" status.

→ Range and open wire diagnostics must be taken into account in order to ensure that the reading shown is being interpreted correctly.

25.6 Filtering:

The low-pass cutoff frequency can be configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

Values from 0 to 100 are allowed.

0: No filter. A value of 1 to 100 corresponds to 1 to 100 Hz

Example: 50 Hz low-pass cutoff frequency; register value: 50_{dec} / 32_{hex}

The following values are allowed:

Table 10 Configurable low-pass filter.

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

25.7 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID			–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x3210	–	–	1	CAN: ModuleDiag Module diagnostics	Bit 0	reserved	0x0080
					Bit 1	Not synchronized	
					Bit 2	FLASH data CRC error	
					Bit 3	RAM data CRC error	
					Bit 4	Invalid FLASH data	
					Bit 5-7	reserved	
0x3211	0x6401 SUB 01	0x6xx1 SUB 01	2	InputChannel1		Analog Input 1	0x0082
0x3212	0x6401 SUB 02	0x6xx1 SUB 02	2	InputChannel2		Analog Input 2	0x0084
0x3213	0x6401 SUB 03	0x6xx1 SUB 03	2	InputChannel3		Analog Input 3	0x0086
0x3214	0x6401 SUB 04	0x6xx1 SUB 04	2	InputChannel4		Analog Input 4	0x0088
0x3215	0x6401 SUB 05	0x6xx1 SUB 05	2	InputChannel5		Analog Input 5	0x008A
0x3216	0x6401 SUB 06	0x6xx1 SUB 06	2	InputChannel6		Analog Input 6	0x008C

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3217	0x6401 SUB 07	0x6xx1 SUB 07	2	InputChannel7		Analog Input 7		0x008E
0x3218	0x6401 SUB 08	0x6xx1 SUB 08	2	InputChannel8		Analog Input 8		0x0090
0x3219	–	0x6xxA SUB 01	1	CableBreakDetection	Bit 0	1: Cable break Analog input 1		0x0092
					Bit 1	1: Cable break Analog input 2		
					Bit 2	1: Cable break Analog input 3		
					Bit 3	1: Cable break Analog input 4		
					Bit 4	1: Cable break Analog input 5		
					Bit 5	1: Cable break Analog input 6		
					Bit 6	1: Cable break Analog input 7		
					Bit 7	1: Cable break Analog input 8		
0x4001	–	0x9xx0 SUB 08	max.10	CAN:SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
					Value	Configuration InputConfig1-8		
0x5210	–	0x8xx6 SUB 01	1	InputConfig1	0:	Pt1000	-50 … +150°C	0x0106
0x5211	–	0x8xx6 SUB 02	1	InputConfig2	1:	KTY10-62	-50 … +150°C	0x0107
0x5212	–	0x8xx6 SUB 03	1	InputConfig3	2:	KTY81-110	-55 … +150°C	0x0108
0x5213	–	0x8xx6 SUB 04	1	InputConfig4	3:	KTY81-121	-55 … +150°C	0x0108
0x5214	–	0x8xx6 SUB 05	1	InputConfig5	4:	KTY81-122	-55 … +150°C	0x010A
0x5215	–	0x8xx6 SUB 06	1	InputConfig6	5:	KTY84-1x0	-40 …+300°C	0x010B
0x5216	–	0x8xx6 SUB 07	1	InputConfig7	6:	R	350 …4600 Ω	0x010C
0x5217	–	0x8xx6 SUB 08	1	InputConfig8	7:	Pt100	-150 …+850°C	0x010D
					$\text{Value}_{\text{dec}}$	Used to specify the cutoff frequency for the LowPassChan1-8 channels as a decimal value in Hz.		
0x5218	–	0x8xx9 SUB 01	2	LowPassChan1	0	Filter off	0x0000	0x010E
0x5219	–	0x8xx9 SUB 02	2	LowPassChan2	10	1 Hz	0x000A	0x0110
0x521A	–	0x8xx9 SUB 03	2	LowPassChan3	25	25 Hz	0x0019	0x0112

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x521B	–	0x8xx9 SUB 04	2	LowPassChan4	50	50 Hz	0x0032	0x0114
0x521C	–	0x8xx9 SUB 05	2	LowPassChan5	100	100 Hz	0x0064	0x0116
0x521D	–	0x8xx9 SUB 06	2	LowPassChan6				0x0118
0x521E	–	0x8xx9 SUB 07	2	LowPassChan7				0x011A
0x521F	–	0x8xx9 SUB 08	2	LowPassChan8				0x011C

26 Analog input module XN-322-10AI-TEKT

XN-322-10AI-TEKT modules are XN300 slice modules with 10 analog input channels. 8 of these input channels can be used to measure temperatures with thermocouples, while the other 2 channels can be used with KTY sensors for cold-junction compensation purposes. A KTY sensor is included as standard on the bottom of the device.

The module supports all common thermocouple types for its temperature measurements.

On hardware version 3.03 and higher, two internal KTY(i) temperature sensors are installed in the slice module in order to provide cold-junction compensation. (The hardware version is printed on the side of the slice module).

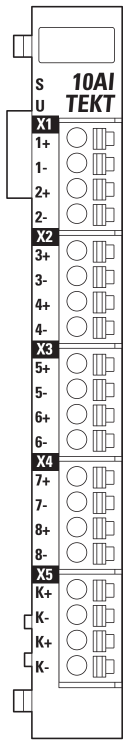
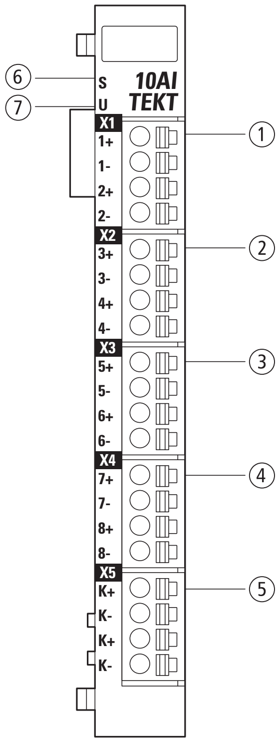


Figure 104: Device view XN-322-10AI-TEKT

26.1 Pin assignment and status LEDs



① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+ analog input 2
- 2- analog input 2-

② X2
- 3+ analog input 3+
- 3- analog input 3-
- 4+ analog input 4+
- 4- analog input 4-

③ X3
- 5+ analog input 5+
- 5- analog input 5-
- 6+ analog input 6+
- 6- analog input 6-

④ X4
- 7+ analog input 7+
- 7- analog input 7-
- 8+ analog input 8+
- 8- analog input 8-

⑤ X5
- K+ analog input KTY 1+
- K- analog input GND
- K+ analog input KTY 2+
- K- analog input GND

⑥ Module status LED

⑦ User LED

Figure 105: LED signals and pin assignment

Table 11 Status LED table

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	

26.2 Wiring topic

Two analog inputs can be wired to each of the connectors X1 to X5.

- ▶ Remove the KTY sensor included as standard from the bottom of the device.
- ▶ Insert the thermocouple's positive pin into one of the + pins, e.g., "1+".
- ▶ Insert the thermocouple's negative pin into one of the - pins, e.g., "1-".
- ▶ If external cold junction compensation is used, the KTY sensor must be placed at the reference junction and wired to one of the two measuring inputs KTY1, KTY2. When parameterizing the device, each thermal measuring input can be assigned a KTY measuring input for cold junction compensation.
  The reference point is the place where the transition of the thermocouple lines to the supply line takes place.

26.2.1 Temperature measurements using thermocouples

Measuring temperatures with thermocouples takes advantage of the ability of cables made of different alloys to produce a voltage at their point of contact (junction) as a result of their electrochemical properties.
The magnitude of this voltage will be small, non-linear, and extremely dependent on temperature, making this method ideal for measuring temperatures across a wide temperature range. The module will adjust for the corresponding non-linearity, representing values in °C / 10 (with one decimal place).

The term "cold-junction compensation" refers to the action of correcting the value measured with the thermocouple by removing the error resulting from the corresponding pin. The reason this is necessary is that when a thermocouple's individual lead is connected to the module connector's copper, this will create a "parasitic" thermocouple, resulting in measuring errors and requiring additional correction on behalf of the module.

Internal cold-junction compensation

On hardware version 3.03 and higher, internal temperature sensors for cold-junction compensation are available. When thermo-wires are connected directly on the module, It is recommended to select internal cold junction compensation, since this will minimize the measurement error.

External cold-junction compensation

If external cold-junction compensation is selected and the wires of the thermocouples are not directly connected to the module, the inputs KTY1 and KTY2 are used to detect the temperature at the junction of the thermocouple cable and the copper wire. Nornmally compensation doses are used for this purpose..

If the thermocouples are wired directly to the module, it is advisable to wire the external KTY sensor directly to the module as well. This will ensure that the temperature measured has a value that depends on the module's outside and inside temperatures and reflects the temperature at the thermocouple connector's pin. In fact, the conditions at the pin will be comparable, provided there are no localized temperature differences (X5 vs. X1). If this type of temperature difference exists, as is the case when a system has specific sides warm up in a localized manner during operation, it will affect the measurement in the form of an error.

In order to isolate the measurement from the system assembly's local conditions, as well as to compensate for large distances, it is possible to use wheatstone bridge compensation circuits in which the thermocouples are wired in a thermally stable environment, as is the measurement of the cold junction temperature with the KTY sensor.

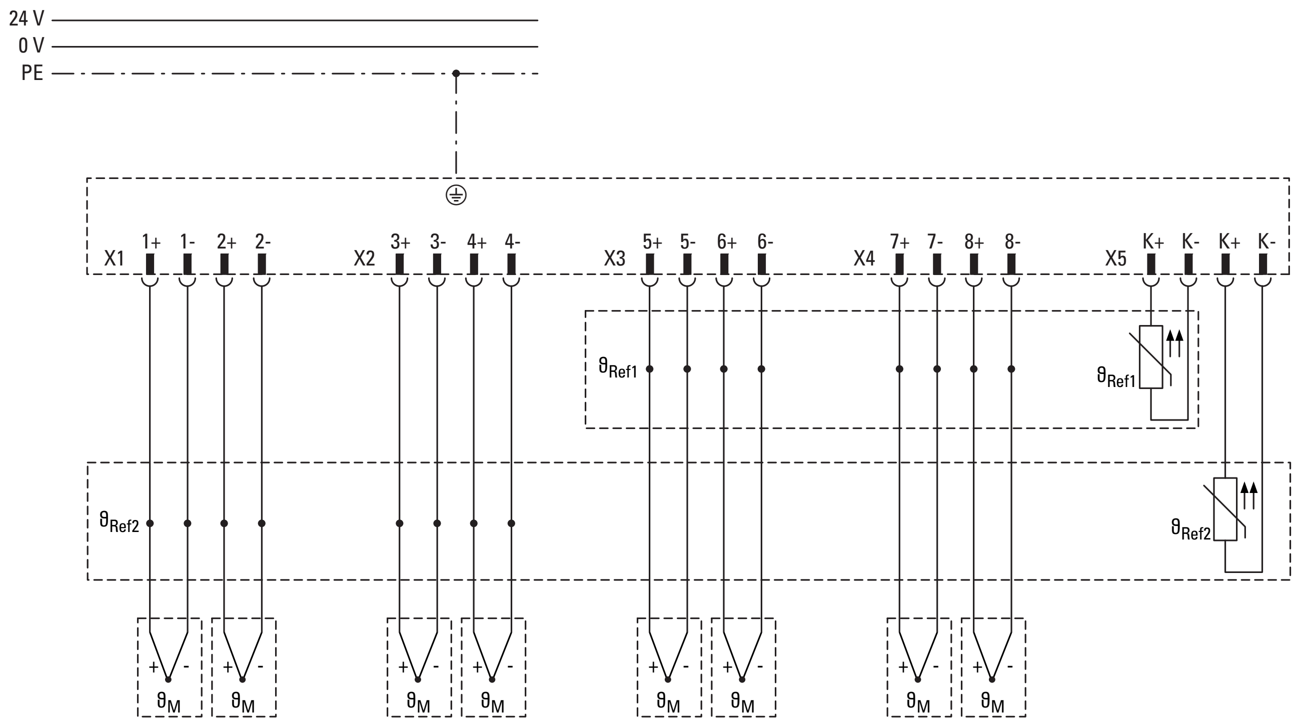


Figure 106: Wiring example with 4 thermocouples on an external KTY sensor; the ϑ_M measuring points and the ϑ_{Ref1} and ϑ_{Ref2} reference junctions are clearly shown

26.2.2 Technical data for thermocouple inputs

Table 12 Technical data for thermocouple inputs

Number of analog input channels	10
Inputs, thermocouple	8
Inputs KTY	2
Inputs, thermocouple	
D-A converter resolution	16 bits
Conversion time per channel	1 ms
Common-mode range	±2 V
Table 13 Input resistance	2 MΩ
Configurable parameters	thermocouples J, K, T, E, N, S, R, B, L, U
Open wire monitoring	Yes
Input filters	
Hardware	Typically: 2 Hz; third-order low-pass filter
Measuring accuracy	
Cumulative error	±0.7% of full scale value
KTY inputs for cold-junction compensation	
D-A converter resolution	16 bits
Conversion time per channel	1 ms
Sensor current	normally 0.3mA at 25°C
Open wire monitoring	Yes
Input filters	
Hardware	normally 2 Hz; third-order low-pass
Measuring accuracy	
Cumulative error	±0.7% of full scale value

26.2.3 Measurement ranges

The readings are represented as a decimal value in °C with one decimal place (in 1 / 10 °C)

Table 14 Measurement ranges and measurement errors

Catalog Number	Thermocouple	Measuring range [°C]	Measuring range [mV]	Measured value1) [1/10°C]	Measurement error2) [%/Ω]	Resistance
J	Fe-CuNi	-10 … +690 °C	-0.501…38,512	-100…+6900	0.0078	
K	NiCr-Ni	-40…+940 °C	-1,527…38,918	-400…+9400	0.0077	
T	Cu-CuNi	-40…+400 °C	-1,475…20,872	-400…4+000	0.0144	
E	NiCr-CuNi	0…+520 °C	0…38,624	0…+5200	0.0078	
N	NiCrSi-NiSi	-80… +1080 °C	-1,972…+39,326	-800…+10800	0.0076	
S	Pt10Rh-Pt	-50…+1760 °C	-0.236…+18,609	-500…+17600	0.0161	
R	Pt13Rh-Pt	-50… +1760 °C	-0.226…+21,003	-500…+17600	0.0142	
B	Pt30Rh-Pt6Rh	0… +1820 °C	0…+13,820	0…+18200	0.0217	
L	Fe-CuNi	0…+680 °C	0…+38,487	0…+6800	0.0078	
U	Cu-CuNi	0…+590 °C	0…+33,606	0…+5900	0.0089	
KTY10	–	-20 °C… +80 °C				1367…2980 Ω

1) If the input is open, the hardware class will deliver a value of -2147483632

2) Measurement error resulting from the thermocouples' cable resistance relative to the measurement range

26.2.4 How measurement errors are calculated

Aside from the length of the corresponding input wiring, a thermocouple's loop resistance depends on the cross-sectional area of said input wiring and on the material being used.

Say you have a type K thermocouple with a cross-sectional area of 0.22 mm^2 and a loop resistance of 4.5 Ω / m (the loop resistance can be found in the data sheet for the thermocouple being used).

In order to calculate the measurement error, you would use the following formula:

As per table → Table 14, the measurement error for type K = 0.0077 % / Ω.

$$\text{Measurement error}_{[940°C]} = 0.0077 \frac{1}{\Omega} * 4.5 \frac{\Omega}{m} * 940\ °C = 0.33 \frac{°C}{m}$$

Relative to a measurement range with 940 °C, you would get a measurement error of 0.33 °C/m.

The error can be reduced by using a thermocouple with a larger cross-sectional area.

26.2.5 How the total tolerance for analog inputs is calculated

In order to illustrate how the analog inputs' tolerance is calculated, we will be using the same type K thermocouple as an example.

Example showing the formula for total error, error for cold-junction compensation

Refer to → Table 12 Measurement accuracy for total error: ±0.7% of maximum reading

$$\text{Cumulative error}_{[940°C]} = \pm 0.7\,\% * 940\,°C * \frac{40\text{ mV}}{38.9\text{ mV}} = \pm 6.8\,°C$$

0.7%: Measurement accuracy relative to the maximum reading of 40 mV for the module's entire ambient temperature range of 0 to 60 °C
940 °C: Specified measurement range for type K thermocouple
38.9 mV: Thermal voltage of type K thermocouple relative to 940 °C
40 mV: Specified measurement range

This does not include the additional measurement error caused by the thermocouple's connection resistance or the thermocouple's own measurement error as a function of the thermocouple class.

When using the internal cold-junction compensation function, a cold-junction compensation error of ±2 °C is additionally added.

I.e., the total internal module accuracy for a thermocouple measurement with a type K thermocouple comes up to ±8.8 °C for the module's entire ambient temperature range of 0 to 60 °C.

26.3 Memory layout

Cold-junction compensation can be implemented by using the KTY channels. To do this, the parameters must be configured in such a way as to assign a KTY channel to each measuring channel for compensation purposes.

Measuring ranges are configured using a single byte for the two channels in each Xn connector. For example: The measuring range for 1+ and 2+ is configured using object 0x50A0, where the high nibble is used to configure 1+ and the low nibble is used to configure 2+.

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Switching contact	Bit	Description	Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState				–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID		Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion				–
–	–	0x9xx0 SUB 04	4	DeviceType				–
–	–	0x9xx0 SUB 05	4	VendorID				–
–	–	0x9xx0 SUB 06	4	ProductCode				–
–	–	0x9xx0 SUB 07	4	Revision				–
–	–	0x9xx0 SUB 09	4	HWVersion				–
–	–	0x9xx0 SUB 0A	4	FWVersion				–
0x30A0	0x6401	0x6xxD SUB 01	2	ModuleDiag		Bit 0	reserved	0x0080
						Bit 1	No SYNC signal	
						Bit 2	FLASH-CRC error	
						Bit 3	RAM-CRC error	
						Bit 4	Flash memory error	
						Bit 5-15	reserved	
0x30A1	0x6401	0x6xx1 SUB 01	2	InputChannel1	AI1			0x0082
0x30A2	0x6401	0x6xx1 SUB 02	2	InputChannel2	AI2			0x0084

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Switching contact	Bit	Description	Local I/O addresses
0x30A3	0x6401	0x6xx1 SUB 03	2	InputChannel3	AI3			0x0086
0x30A4	0x6401	0x6xx1 SUB 04	2	InputChannel4	AI4			0x0088
0x30A5	0x6401	0x6xx1 SUB 05	2	InputChannel5	AI5			0x008A
0x30A6	0x6401	0x6xx1 SUB 06	2	InputChannel6	AI6			0x008C
0x30A7	0x6401	0x6xx1 SUB 07	2	InputChannel7	AI7			0x008E
0x30A8	0x6401	0x6xx1 SUB 08	2	InputChannel8	AI8			0x0090
0x30A9	0x6401	0x6xx1 SUB 09	2	CAN: ReferenceInput1 EC: InputKTY1 Reference input KTY 1 for cold-junction compensation	KTY1			0x0092
0x30AA	0x6401	0x6xx1 SUB 0A	2	CAN: ReferenceInput2 EC: InputKTY2 Reference input KTY 2 for cold-junction compensation	KTY2			0x0094
0x30AB	–	0x6xxA SUB 01	2	WireBreakDiag	AI1	Bit 0	0= OK 1 = Cable break	0x0096
					AI2	Bit 1		
					AI3	Bit 2		
					AI4	Bit 3		
					AI5	Bit 4		
					AI6	Bit 5		
					AI7	Bit 6		
					AI8	Bit 7		
					KTY1	Bit 8		
					KTY2	Bit 9		
					KTY1	Bit 10	0 = OK 1 = Short-circuit	
					KTY2	Bit 11		
						Bit 12-15	reserved	
0x30AC	–	–	2	IntRefInput1 Temperature reading KTY1(i) The 0x30AC object contains ten times the temperature measured by the internal KTY1(i) temperature sensor at the cold junction. When internal temperature compensation is selected, the software will automatically take into account the value in object 0x30AC.				–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Switching contact	Bit	Description	Local I/O addresses
0x30AD	–	–	2	IntRefInput2 Temperature reading KTY2(i) The 0x30AD object contains ten times the temperature measured by the internal KTY2(i) temperature sensor at the cold junction. When internal temperature compensation is selected, the software will automatically take into account the value in object 0x30AC.				–
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x4080	–	–	2	FirmwareVersion				–
0x50A0	–	0x8xx6 SUB 01	1	SensorTypeSelectChannel1_2	AI1	Bit 0-3	→ Table 15, page 199	0x0106
					AI2	Bit 4-7		
0x50A1	–	–	1	SensorTypeSelectChannel3_4	AI3	Bit 0-3	→ Table 15, page 199	0x0107
					AI4	Bit 4-7		
0x50A2	–	–	1	SensorTypeSelectChannel5_6	AI5	Bit 0-3	→ Table 15, page 199	0x0108
					AI6	Bit 4-7		
0x50A3	–	–	1	SensorTypeSelectChannel7_8	AI7	Bit 0-3	→ Table 15, page 199	0x0109
					AI8	Bit 4-7		
0x50A4	–	–	1	ReferenceInputSelect Used to assign a external cold-junction compensation channel (One of the two KTY sensors is assigned to analog input AIn for cold-junction compensation purposes concerning the temperature readings)	AI1	Bit 0	0 = KTY 1 1 = KTY 2	0x010A
					AI2	Bit 1	0 = KTY 1 1 = KTY 2	
					AI3	Bit 2	0 = KTY 1 1 = KTY 2	
					AI4	Bit 3	0 = KTY 1 1 = KTY 2	
					AI5	Bit 4	0 = KTY 1 1 = KTY 2	
					AI6	Bit 5	0 = KTY 1 1 = KTY 2	
					AI7	Bit 6	0 = KTY 1 1 = KTY 2	
					AI8	Bit 7	0 = KTY 1 1 = KTY 2	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Switching contact	Bit	Description	Local I/O addresses
0x50A4	–	–	1	ReferenceInputSelectIntExt Used to select whether internal or external cold-junction compensation will be used for the respective input. (One of the two KTY sensors is assigned to analog input AIn for cold-junction compensation purposes concerning the temperature readings)	AI1	Bit 0	0 = KTY external 1 = KTY 1(i) internal	0x010B
					AI2	Bit 1	0 = KTY external 1 = KTY 1(i) internal	
					AI3	Bit 2	0 = KTY external 1 = KTY 1(i) internal	
					AI4	Bit 3	0 = KTY external 1 = KTY 1(i) internal	
					AI5	Bit 4	0 = KTY external 1 = KTY 2 internal	
					AI6	Bit 5	0 = KTY external 1 = KTY 2(i) internal	
					AI7	Bit 6	0 = KTY external 1 = KTY 2(i) internal	
					AI8	Bit 7	0 = KTY external 1 = KTY 2(i) internal	

In the registers used to select a sensor, the low nibble (bits 0-3) is used to configure the lower channel (channel 1, 3, 5, 7), while the high nibble (bits 4-7) is used to configure the upper channel (channel 2, 4, 6, 8).

Table 15 Sensor selection list

Hexadecimal value Bit 0-3 Bit 4-7	Catalog Number	Measuring range
0_{hex}	J	-10 … +690 °C
1_{hex}	K	-40…+940 °C
2_{hex}	T	-40…+400 °C
3_{hex}	E	0…+520 °C
4_{hex}	N	-80… +1080 °C
5_{hex}	S	-50…+1760 °C
6_{hex}	R	-50… +1760 °C
7_{hex}	B	0… +1820 °C
8_{hex}	L	0…+680 °C
9_{hex}	U	0…+590 °C
A-F_{hex}	reserved	

27 Analog output module XN-322-4AO-UI

The XN-322-4AO-UI module is an XN300 slice module with four analog output channels. Each can be used to output a voltage signal within a range of -10.8 V to +10.8 V or a current signal in the range of 0mA...21.6mA with a resolution of 16Bit.

These reference analog output module features various module diagnostics and is performing a pecision for voltage output of +/- 0.04% and for current output of +/- 0,17%.

The analog outputs are powered via an external +24 V power supply.

The analog output system is galvanically isolated from the system bus potential.

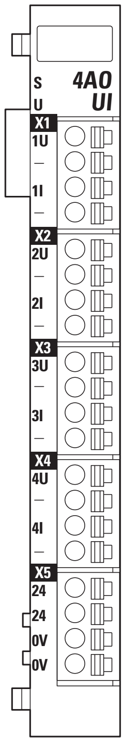
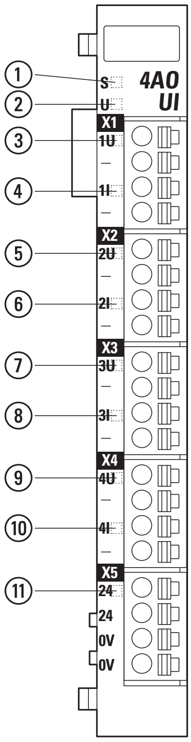


Figure 107: Device view XN-322-4AO-UI

27.1 Status LEDs

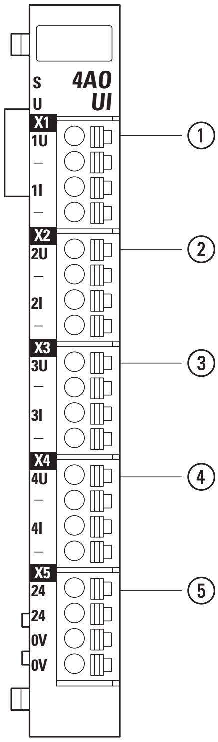


1. Module status LED
2. User LED
3. Analog voltage output 1 status LED
4. Analog current output 1 status LED
5. Analog voltage output 2 status LED
6. Analog current output 2 status LED
7. Analog voltage output 3 status LED
8. Analog current output 3 status LED
9. Analog voltage output 4 status LED
10. Analog current output 4 status LED
11. Supply voltage OK status LED

Figure 108: Display

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	
Analog Output Status 1…4 Voltage	yellow	ON	Voltage present at analog output
		OFF	No voltage at analog output
		Flashes	There is a voltage fault
Analog Output Status 1…4 Current	yellow	ON	Current present at analog output
		OFF	No current at analog output
		Flashes	There is a current fault
Status Specifications for connection to supply voltage	Green	ON	Supply voltage OK
		OFF	No supply voltage for analog outputs

27.2 Pin assignment



① X1
- 1U analog output, 1 voltage
- - GND
- 1I analog output, 1 current
- - GND

② X2
- 2U analog output, 2 voltage
- - GND
- 2I analog output, 2 current
- - GND

③ X3
- 3U analog output, 3 voltage
- - GND
- 3I analog output, 3 current
- - GND

④ X4
- 4U analog output, 4 voltage
- - GND
- 4I analog output, 4 current
- - GND

⑤ X5
- 24 supply voltage U_{e24} 24VDC
- 24 supply voltage U_{e24} 24VDC
- 0 V GND input
- 0 V GND input

Figure 109: Pin assignment

The 24 VDC terminals on X5 are internally connected to each other. All GND terminals, as well as 0 V on X5, are internally connected to each other.

27.3 Wiring topic

One analog outputs can be wired to each of the four X1 to X4 connectors.

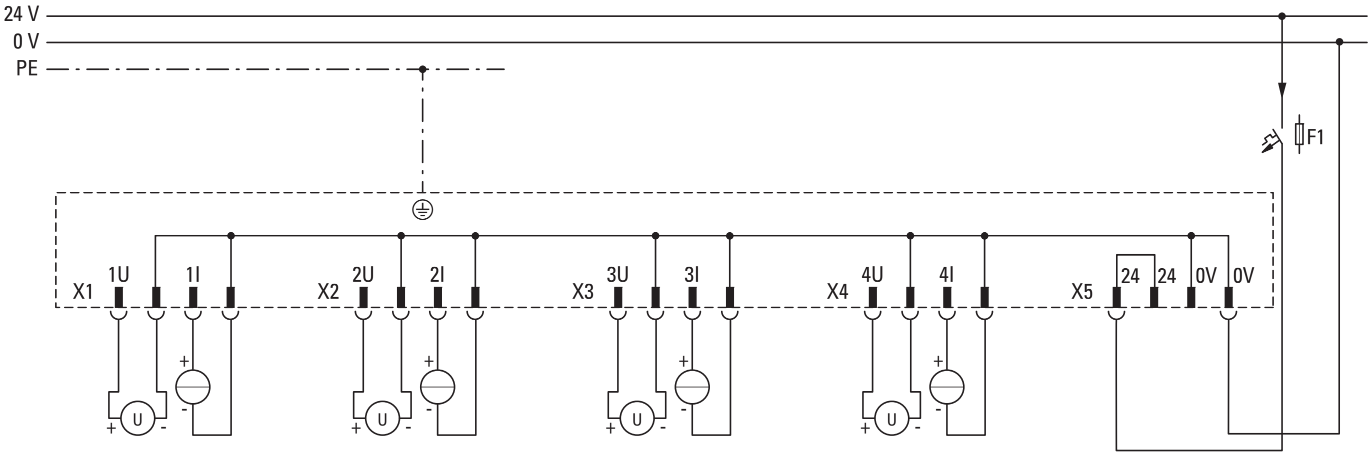


Figure 110: Connection diagram for analog outputs

The PLC configuration tool can be used to define whether the outputs will be used as analog voltage outputs or as analog current outputs – please refer to → Section “ OutputChannelConfig”, page 206.

27.4 Technical data for analog voltage outputs

Number of analog channels		4	
Measuring range	V	-10 … +10	0 … +10
Measured value		-30,000 … +30,000	0… +60,000
Over Range Measuring range	V	-10 ,8… +10.8	0 … +10,8
Over Range Measured value		-32,400… +32,400	0… +64,800
D-A converter		16 Bit	
Resolution	mV/LSB	0.3	0.15
Internal module refresh time	µs	100	
Maximum output current per channel	mA	2	
Max. capacitive load	nF	100	
Short circuit protection		yes (max. 1 minute)	
Accuracy			
Cumulative error	%	± 0.04	

27.5 Technical data for analog current outputs

Number of analog channels		4
Measuring range	mA	0 …20
Measured value		0…60,000
Over Range Measuring range	mA	0… 21.6
Over Range Measured value		0… 64,800
D-A converter		16 Bit
Resolution	mV/LSB	0.3
Internal module refresh time	µs	100
Maximum load	Ω	500
Maximum inductive load	mH	0.5 at 50 Ω 5 at 500 Ω
Accuracy		
Cumulative error	%	± 0.17

27.6 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description		Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState		–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number	–
–	–	0x9xx0 SUB 03	4	FPGAVersion		–
–	–	0x9xx0 SUB 04	4	DeviceType		–
–	–	0x9xx0 SUB 05	4	VendorID		–
–	–	0x9xx0 SUB 06	4	ProductCode		–
–	–	0x9xx0 SUB 07	4	Revision		–
–	–	0x9xx0 SUB 09	4	HWVersion		–
–	–	0x9xx0 SUB 0A	4	FWVersion		–
0x21E0	0x6411	0x7xx1 SUB 01	2	OutputChannel1	Analog Output1	0x0010
0x21E1	0x6411	0x7xx1 SUB 02	2	OutputChannel2	Analog Output2	0x0012
0x21E2	0x6411	0x7xx1 SUB 03	2	OutputChannel3	Analog Output3	0x0014
0x21E3	0x6411	0x7xx1 SUB 04	2	OutputChannel4	Analog Output4	0x0016

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x31E0	–	0x6xxD SUB 01	2	Status register Modules Diagnostics	Bit 0	Edge limiting for analog output 1	0x0030
					Bit 1	Edge limiting for analog output 2	
					Bit 2	Edge limiting for analog output 3	
					Bit 3	Edge limiting for analog output 4	
					Bit 4	Temperature > 142 °C, analog output 1	
					Bit 5	Temperature > 142 °C, analog output 2	
					Bit 6	Temperature > 142 °C, analog output 3	
					Bit 7	Temperature > 142 °C, analog output 4	
					Bit 8	Overcurrent at analog output 1 (voltage) Excessive voltage at analog output 1 (current)	
					Bit 9	Overcurrent at analog output 2 (voltage) Excessive voltage at analog output 2 (current)	
					Bit 10	Overcurrent at analog output 3 (voltage) Excessive voltage at analog output 3 (current)	
					Bit 11	Overcurrent at analog output 4 (voltage) Excessive voltage at analog output 4 (current)	
					Bit 12	Unable to read calibration data	
					Bit 13	Invalid calibration data (CRC error)	
					Bit 14	DC OK on DAC	
					Bit 15	Offset times had to be corrected	
0x4001	–	0x9xx0 SUB 08	max.10	CAN:SerialNumber EC:Serialnumber			–
0x4004	–	0x8001 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x41E0	–	0x8xx6 SUB 01	4	OutputChannelConfig	0: deactivated 1: -10 V to +10 V voltage outputs 2: 0 to 10 V voltage outputs 3: 0 to 20 mA current outputs		0x0048

28 Analog output module XN-322-8AO-U2

XN-322-8AO-U2 modules are XN300 slice modules with 8 analog output channels that can be used to output a voltage signal within a range of -10 to 10 V.

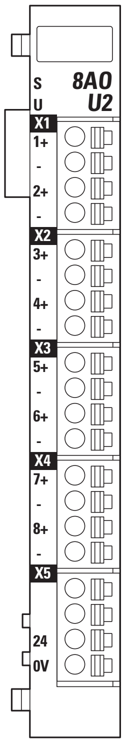


Figure 111: Device view XN-322-8AO-U2

28.1 Status LEDs

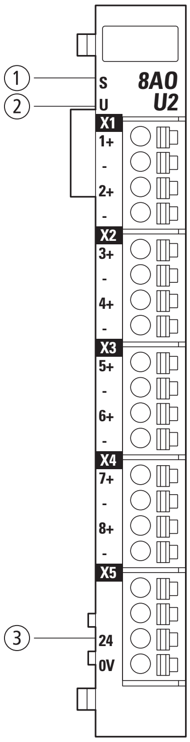


Figure 112: LED signals and pin assignment

① Module status LED
② User LED
③ Supply voltage status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Status Specifications for connection to supply voltage	Green	ON	Faulty supply voltage
		OFF	Supply voltage OK

28.2 Pin assignment

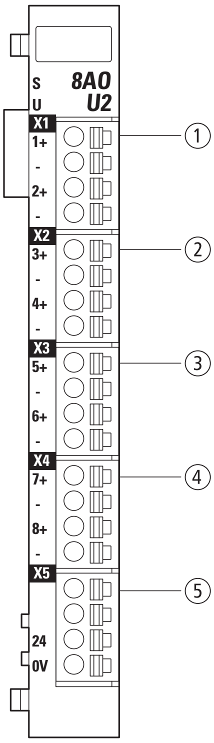


Figure 113: Pin assignment

① X1
- 1+ analog output 1
- \- GND
- 2+ analog output 2
- \- GND 1-

② X2
- 3+ analog output 3
- \- GND 1+
- 4+ analog output 4
- \- GND 1-

③ X3
- 5+ analog output 5
- \- GND
- 6+ analog output 6
- \- GND

④ X4
- 7+ analog output 7
- \- GND
- 8+ analog output 8
- \- GND

⑤ X5
- nc
- nc
- 24VDC power supply U_{e24}
- GND supply

28.3 Wiring topic

Two analog outputs can be wired to each of the four X1 to X4 connectors.

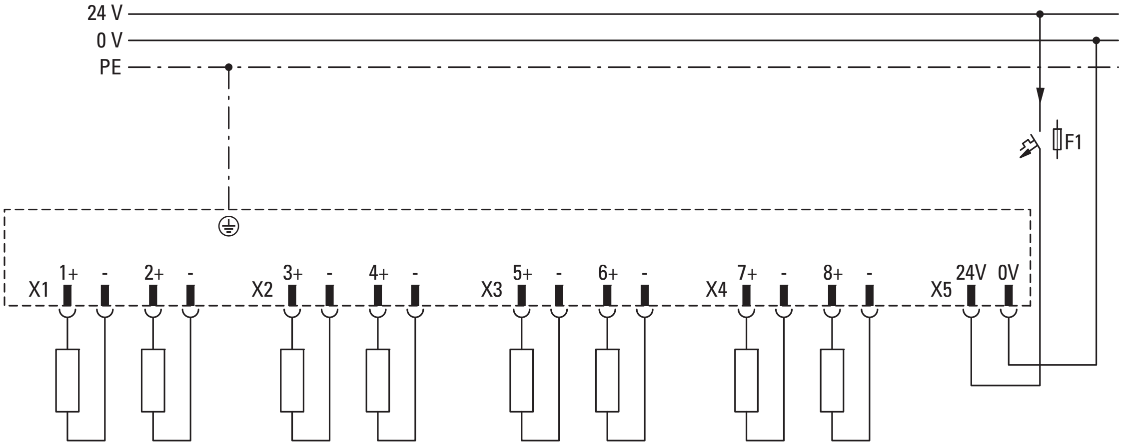


Figure 114: Connection diagram for analog outputs

28.4 Technical data for analog outputs

Number of analog channels		8
Measuring range	V	-10 … +10
Measured value	m V	-10,000 … +10,000
D-A converter		12 Bit
Resolution	mV/LSB	5
Internal module refresh time	ms	1
Min. load resistance	kΩ	> 5
Max. capacitive load	nF	100
Short circuit protection		yes (max. 1 minute)
Accuracy		
Cumulative error	%	± 0.5

28.5 Memory layout

→ For product-specific CANopen- or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x20D0	0x6411	0x7xx1 SUB 01	2	Analog output value 1 (AO1)			0x0000
0x20D1	0x6411	0x7xx1 SUB 02	2	Analog output value 2 (AO2)			0x0002
0x20D2	0x6411	0x7xx1 SUB 03	2	Analog output value 3 (AO3)			0x0004
0x20D3	0x6411	0x7xx1 SUB 04	2	Analog output value 4 (AO4)			0x0006
0x20D4	0x6411	0x7xx1 SUB 05	2	Analog output value 5 (AO5)			0x0008
0x20D5	0x6411	0x7xx1 SUB 06	2	Analog output value 6 (AO6)			0x000A
0x20D6	0x6411	0x7xx1 SUB 07	2	Analog output value 7 (AO7)			0x000C
0x20D7	0x6411	0x7xx1 SUB 08	2	Analog output value 8 (AO8)			0x000E

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x30D0	0x6401	0x6xxD SUB 01	2	Modules Diagnostics	Bit 0	24 VDC supply voltage faulty	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4080	–		2	FirmwareVersion			–

29 Analog input/output module ±10 V XN-322-4AIO-U2

The XN-322-8AIO-U2 is an XN300 slice module that features two analog input channels that can be used to measure a voltage input signal within a range of -10 to 10 V, two analog output channels that can be used to output a voltage signal within a range of -10 to 10 V, and a reference voltage source with 10 V/10 mA and 2 pins that makes it possible to directly power potentiometers in order to read their position using the aforementioned analog voltage inputs.

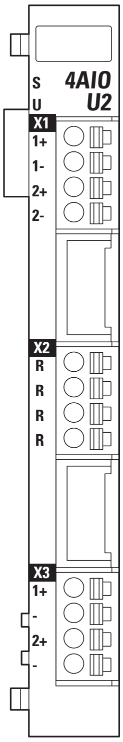


Figure 115: Device view XN-322-4AIO-U2

29.1 Status LEDs

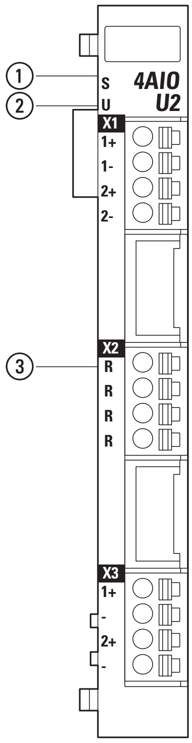


Figure 116: LED signals and pin assignment

① Module status LED
② User LED
③ Reference fault LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Error Reference	red	ON	10 V reference overload
		FLASHES (20Hz)	Overload GND Evaluated if AIx is configured to be connected to GND (ground reference).
		OFF	No Error

29.2 Pin assignment

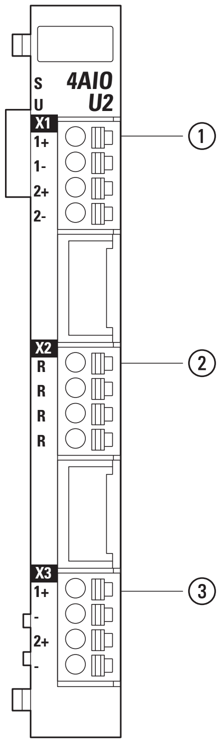


Figure 117: Pin assignment

① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+ analog input 2+
- 2- analog input 2-

② X2
- R reference +10 V
- R reference +10 V
- R reference +10 V
- R reference +10 V

③ X3
- 1+ analog output 1+
- - GND
- 2+ analog output 2+
- - GND

29.3 Wiring topic

Two analog inputs are wired to connector X1, and two analog outputs are wired to connector X3.

29.3.1 Analog output wiring

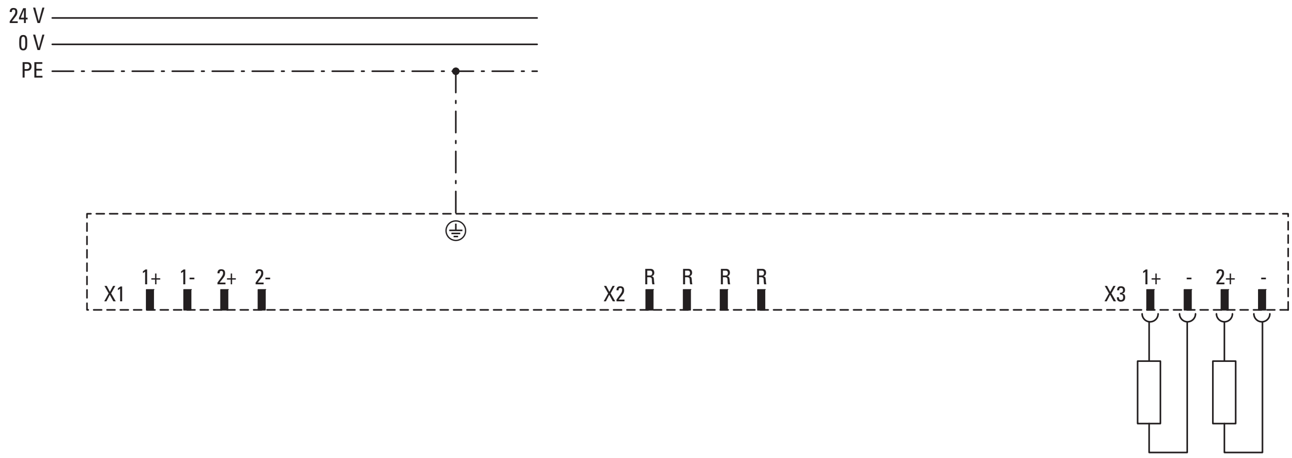


Figure 118: Analog outputs connection

29.3.2 Potentiometer measurements

When using potentiometer measurements, the potentiometer is powered using the reference voltage and AIx is directly connected to GND by configuring the corresponding parameters. These parameters can be configured using object 0x51A0.

The potentiometer's position can then be interpreted as a percentage by measuring the analog voltage at the potentiometer's wiper contact..

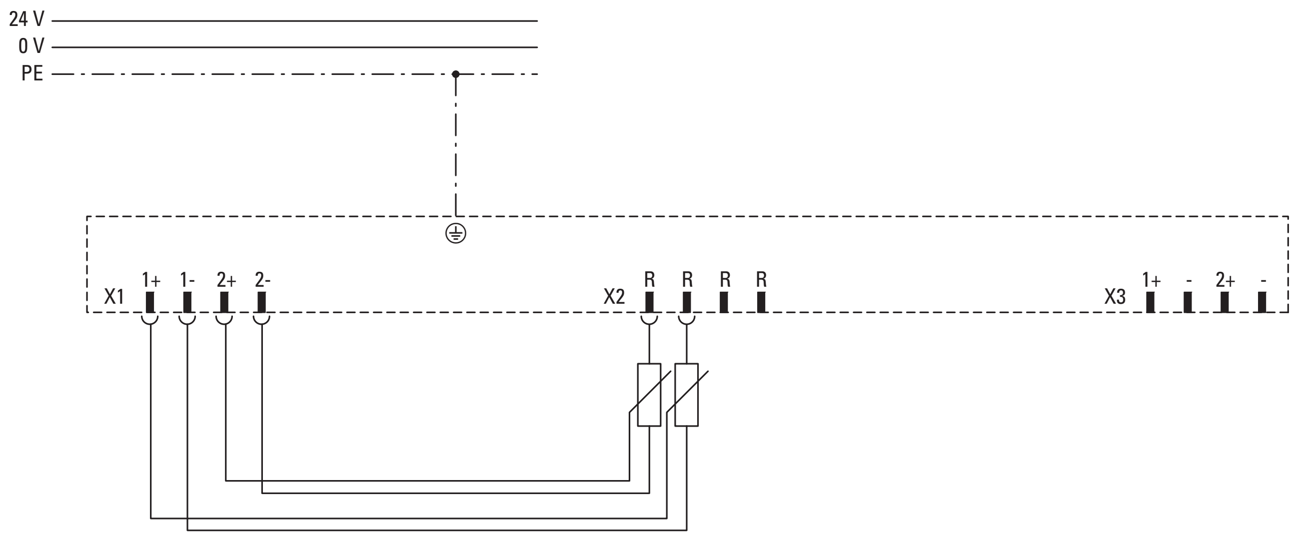


Figure 119: Potentiometer measurement wiring

29.3.3 Measurements using sensors

In order to measure a sensor's output voltage via an analog input, a differential voltage measurement is carried out without connecting either input cable to ground (GND). The signal being measured must fall within the input's permissible common mode range.

Voltage measurement for floating voltage sources

When using a non-floating voltage source (a voltage source with reference to GND), the input must be configured as a differential analog input by means of software. The corresponding parameter can be configured using object 0x51A0. In order to avoid errors in measurement caused by compensating currents, there must not be any connection between analog input AI and GND when it comes to the analog input.

Voltage measurement for non-floating voltage sources

When using a floating voltage source (a voltage source without reference to GND), the input must be configured as a GND ground reference by means of software or an external reference to GND must be established.
The corresponding parameter can be configured using object 0x51A0. The GND reference will prevent the measurement signal from moving out of the permissible measurement range.

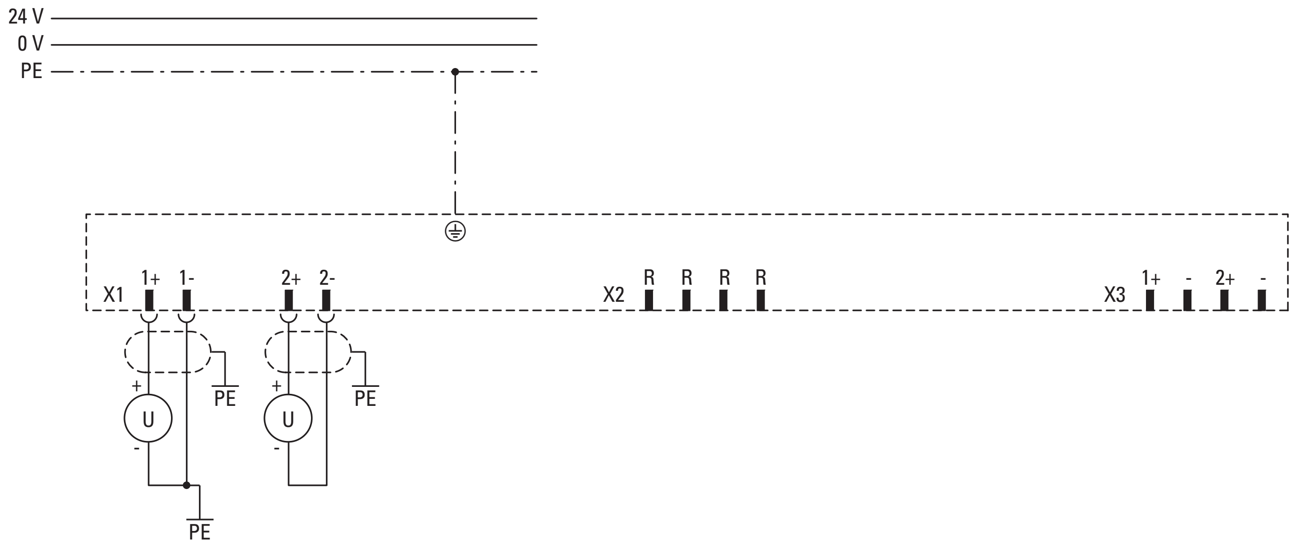


Figure 120: Wiring analog inputs in order to measure one non-floating voltage source (1+/1-) and one floating voltage source (2+/2-)

29.4 Diagnostics

Cable break diagnostics will only be run for the analog inputs. The R voltage reference outputs will be individually monitored for overcurrent, short-circuits, and an excessively high total current. Object 0x31A3 delivers the diagnostics – please refer to manual:
"CANopen Gateway XN-312-GW-CAN", MN050003EN

29.5 Filtering:

The low-pass cutoff frequency can be individually configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

Example: 50 Hz low-pass cutoff frequency; register value: 50_{dec} / 32_{hex}

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

29.6 Technical specifications

29.6.1 Analog inputs ±10 V / 0…100%

Number of channels		2	
Measurement type		Differential input	Potentiometer input
Measuring range	V	-10 V ...+10 V	0 …100 % (potentiometer)
Measurement display		-10,000 ... +10,000	0 ... 10,000
D-A converter	Bit	16	
Resolution		0,3 mV / LSB	
Conversion time per channel	ms	1	
Common-mode range	V	±12	
Input resistance	MΩ	> 10	
Open wire monitoring		Yes	
Input filters			
Hardware		Typically: 1 kHz, third-order low-pass filter	
Software, parameterizable		parameterizable	
Cumulative error as a percentage of full scale value	%	±0.3	±0.35

29.6.2 Analog outputs ±10 V

Number of channels		2
Measuring range	V	-10 …+10
Measurement display		-10,000 ...+10,000
D-A converter	Bit	12
Resolution		approx. 5 mV / LSB
Internal module refresh time	μs	≥ 250
Minimum load resistance	kΩ	> 5
Maximum capacitive load	nF	100
Short-circuit proof		yes (max. 1 minute)
Settling time (typical) for		
63% of end value	μs	50
86% of end value	μs	100
99% of end value	μs	250
Cumulative error as a percentage of full scale value	%	± 0.5

29.6.3 Reference output +10V

Number of channels		1
Connection points per channel		4
Reference voltage	V	+10
Permissible load per potentiometer input		
Current	mA	≤ 4.17
Potentiometer	kΩ	≥ 2.4
Maximum capacitive load	nF	100
Short-circuit proof		yes (max. 1 minute)
Cumulative error as a percentage of full scale value	%	±0.5

29.7 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x21A0	0x6411	0x7xx1 SUB 01	2	OutputChannel1			0x0004
0x21A1	0x6411	0x7xx1 SUB 02	2	OutputChannel2			0x0006
0x30A0		0x6xxD SUB 01	2	ModuleDiag	Bit 0	24 VDC supply voltage faulty	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	
0x31A1	0x6401	0x6xx1 SUB 01	2	InputChannel1			0x0082
0x31A2	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x31A3	–	0x6xxA SUB 01	2	WireBreakDiag		Bit 0	1: Cable break input AI1	0x008A
						Bit 1	1: Cable break input AI2	
						Bit 2	reserved	
						Bit 3	reserved	
						Bit 4	1: Reference Low Voltage	
						Bit 5	1: Reference Overcurrent	
						Bit 6-15	reserved	
0x4001	–	0x9xx0 SUB08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x4080	–		2	FirmwareVersion				–
0x51A0		0x8xx6 SUB 01	2	AnalogInputSelection Parameter definition channel	Measured value 1 (AI1)	Bit 0 (AI1)	0: Differential measurement	0x0106
							1: AI1- grounded measurement	
					Measured value 2 (AI2)	Bit 1 (AI2)	0: Differential measurement	
							1: AI2- grounded measurement	
					–	Bit 2-15	reserved	
0x50A1		0x8xx9 SUB 01	2	FilterConfigChannel1 Setting for AI1 input filter			Used to specify the cutoff frequency as a decimal value in Hz.	0x0108
0x50A2		0x8xx9 SUB 02	2	FilterConfigChannel2 Setting for AI2 input filter				0x010A

30 Analog input/output module ±10 V XN-322-8AIO-U2

The XN-322-8AIO-U2 is an XN300 slice module that features four analog input channels that can be used to measure a voltage input signal within a range of -10 to 10 V, four analog output channels that can be used to output a voltage signal within a range of -10 to 10 V, and a reference voltage source with 10 V / 10 mA and 4 pins that makes it possible to directly power potentiometers in order to read their position using the aforementioned analog voltage inputs.

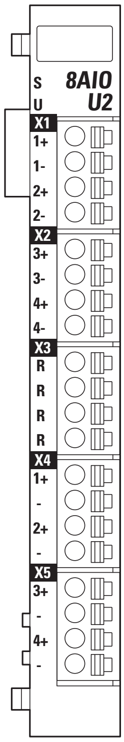


Figure 121: Device view XN-322-8AIO-U2

30.1 Status LEDs

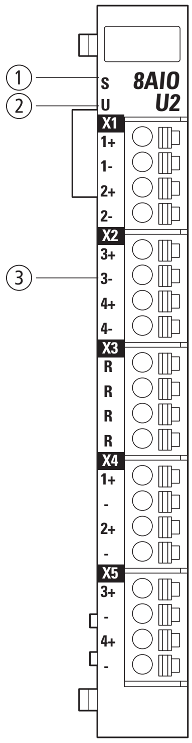


Figure 122: LED signals and pin assignment

① Module status LED
② User LED
③ Reference fault LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Error Reference	red	ON	10 V reference overload
		FLASHES (20Hz)	Overload GND Evaluated if AIx is configured to be connected to GND (ground reference).
		OFF	No Error

30.2 Pin assignment

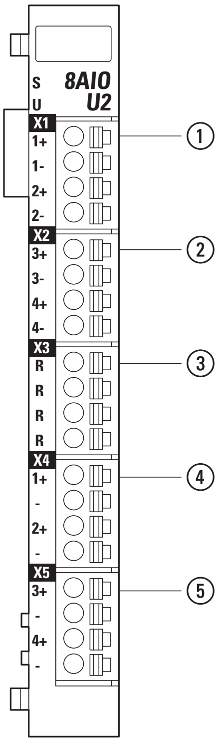


Figure 123: Pin assignment

① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+analog input 2+
- 2- analog input 2-

② X2
- 3+ analog input 3+
- 3- analog input 3-
- 4+ analog input 4+
- 4- analog input 4-

③ X3
- R reference +10 V
- R reference +10 V
- R reference +10 V
- R reference +10 V

④ X4
- 1+ analog output 1+
- – GND
- 2+ analog output 2+
- – GND

⑤ X5
- 3+ analog output 3+
- – GND
- 4+ analog output 4+
- – GND

30.3 Wiring topic

Two analog inputs / outputs are wired to each of the four connectors.

30.3.1 Analog output wiring

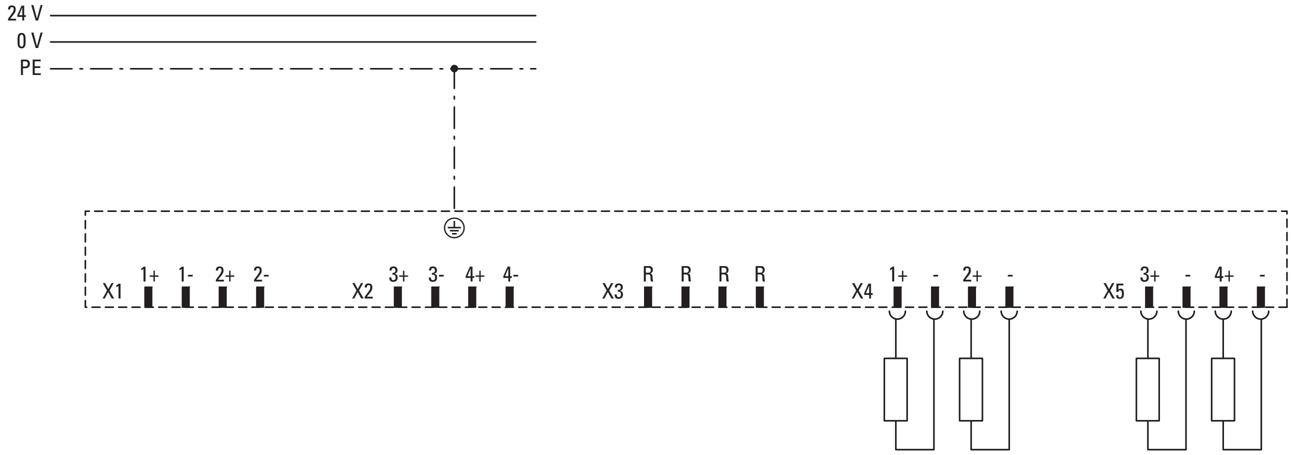


Figure 124: Analog outputs connection

30.3.2 Potentiometer measurements

When using potentiometer measurements, the potentiometer is powered using the reference voltage and AIx is directly connected to GND by configuring the corresponding parameters. The potentiometer's position can then be interpreted as a % by measuring the analog voltage at the potentiometer's wiper contact.

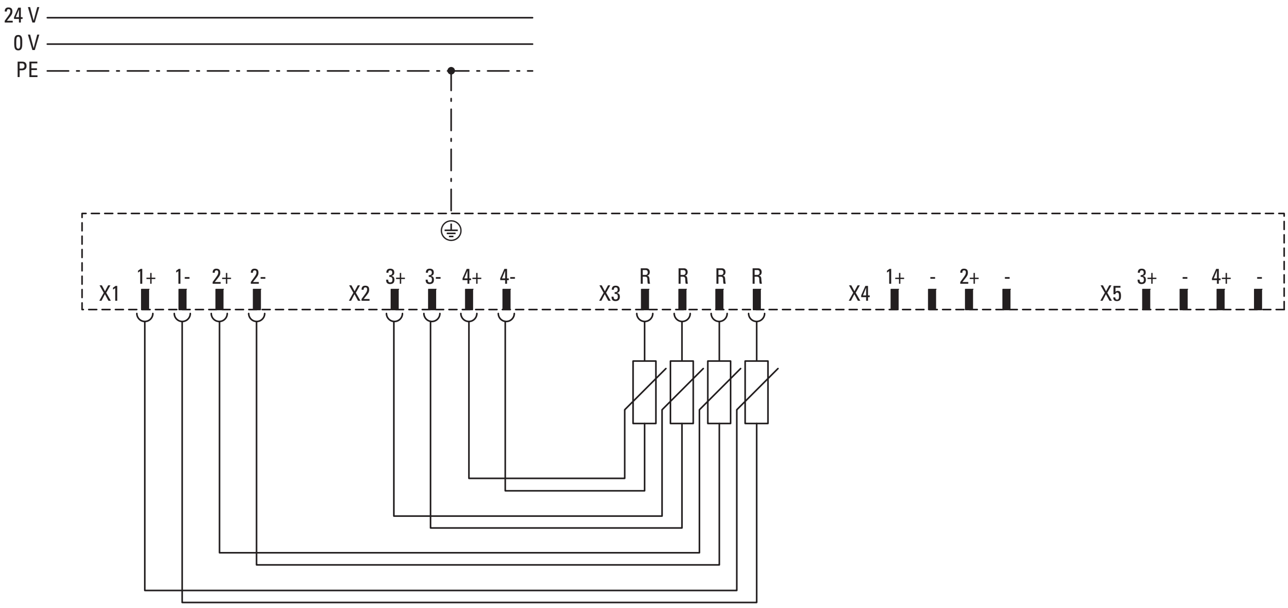


Figure 125: Potentiometer measurement wiring

30.3.3 Measurements using sensors

In order to measure a sensor's output voltage via an analog input, a differential voltage measurement is carried out without connecting either input cable to ground (GND). The signal being measured must fall within the input's permissible common mode range.

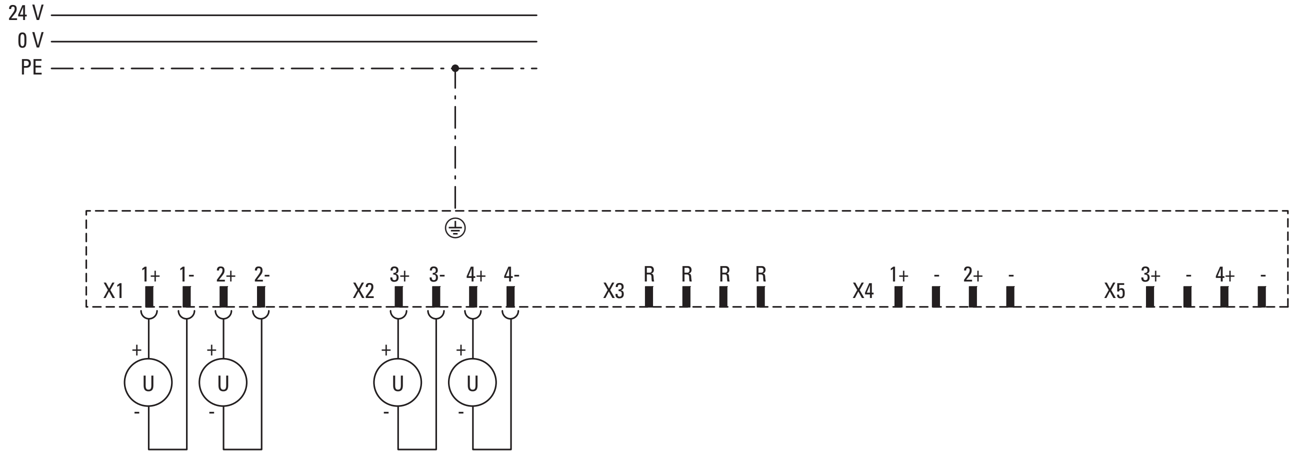


Figure 126: Wiring for analog inputs in order to measure a sensor

30.4 Diagnostics

Cable break diagnostics will only be run for the analog inputs. The R voltage reference outputs will be individually monitored for overcurrent, short-circuits, and an excessively high total current. Object 0x30B5 delivers the diagnostics – please refer to manual:
"CANopen Gateway XN-312-GW-CAN", MN050003EN.

30.5 Filtering:

The low-pass cutoff frequency can be configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

Example: 50 Hz low-pass cutoff frequency; register value: 50_{dec} / 32_{hex}

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0 x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

30.6 Technical specifications

30.6.1 Analog inputs ±10 V/0 – 100%

Number of channels		4	
Measurement type		Differential input	Potentiometer input
Measuring range	V	-10 V ...+10 V	0 …100 % (potentiometer)
Measurement display		-10,000 ... +10,000	0 ... 10,000
A-D converter	Bit	16	
Resolution		0,3 mV / LSB	
Conversion time per channel	ms	1	
Common-mode range	V	±12	
Input resistance	MΩ	> 10	
Open wire monitoring		Yes	
Input filters			
Hardware		Typically: 1 kHz, third-order low-pass filter	
Software, parameterizable		parameterizable	
Cumulative error as a percentage of full scale value	%	±0.3	±0.35

30.6.2 Analog outputs ±10 V

Number of channels		4
Measuring range	V	-10 …+10
Measurement display		-10,000 ...+10,000
A-D converter	Bit	12
Resolution		approx. 5 mV / LSB
Internal module refresh time	µs	≥ 250
Minimum load resistance	kΩ	> 5
Maximum capacitive load	nF	100
Short-circuit proof		yes (max. 1 minute)
Cumulative error as a percentage of full scale value	%	± 0.5

30.6.3 Reference output +10V

		Device version	
		1.00 or higher	**3.01 or higher**
Number of channels		1	
Connection points per channel		4	
Reference voltage	V	+10	
Permissible load per potentiometer input			
Current	mA	≤ 2.50 mA	≤ 4.17 mA
Potentiometer	kΩ	≥ 4 kΩ	≥ 2.4 kΩ
Maximum operating temperature	°C	0…60 °C	0…55 °C
Maximum capacitive load	nF	100	
Short-circuit proof		yes (max. 1 minute)	
Cumulative error as a percentage of full scale value	%	±0.5	

30.7 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x20B0	0x6411	0x7xx1 SUB 01	2	OutputChannel1			0x0000
0x20B1	0x6411	0x7xx1 SUB 02	2	OutputChannel2			0x0002
0x20B2	0x6411	0x7xx1 SUB 03	2	OutputChannel3			0x0004
0x20B3	0x6411	0x7xx1 SUB 04	2	OutputChannel4			0x0006
0x30B0		0x6xxD SUB 01	2	ModulDiag	Bit 0	24 VDC supply voltage faulty	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	
0x30B1	0x6401	0x6xx1 SUB 01	2	InputChannel1			0x0082
0x30B2	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x30B3	0x6401	0x6xx1 SUB 03	2	InputChannel3				0x0086
0x30B4	0x6401	0x6xx1 SUB 04	2	InputChannel4				0x0088
0x30B5	–	0x6xxA SUB 01	2	WireBreakDiag		Bit 0	1: Cable break input AI1	0x008A
						Bit 1	1: Cable break input AI2	
						Bit 2	1: Cable break input AI3	
						Bit 3	1: Cable break input AI4	
						Bit 4	1: Reference Low Voltage	
						Bit 5	1: Reference Overcur-rent	
						Bit 6-15	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: Serial-Number EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x4080	–	–	2	FirmwareVersion				–
0x50B0		0x8xx6 SUB 01	2	AnalogInputSe-lection Parameter defini-tion channel	Measure d value 1 (AI1)	Bit 0 (AI1)	0: Differential measurement 1: AI1- grounded measurement	0x0106
					Measure d value 2 (AI2)	Bit 1 (AI2)	0: Differential measurement 1: AI2- grounded measurement	
					Measure d value 3 (AI3)	Bit 2 (AI3)	0: Differential measurement 1: AI3- grounded measurement	
					Measure d value 4 (AI4)	Bit 3 (AI4)	0: Differential measurement 1: AI4- grounded measurement	
					–	Bit 4-15	reserved	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x50B1		0x8xx9 SUB 01	2	FilterConfigChannel1		Used to specify the cutoff frequency as a decimal value in Hz.	0x0108
0x50B2		0x8xx9 SUB 02	2	FilterConfigChannel2			0x010A
0x50B3		0x8xx9 SUB 03	2	FilterConfigChannel3			0x010C
0x50B4		0x8xx9 SUB 04	2	FilterConfigChannel4			0x010E
0x800C		0x8xxC SUB 01	1	FullRes16Bit Resolution analog input value	Bit 0	0:1 mV 1:0.3 mV	
					Bit 1-7	reserved	

31 XN-322-4AIO-I analog input/output module

The XN-322-4AIO-I is an XN300 slice module with two analog input channels used to measure current input signals within a measuring range of 0 – 20 mA or 4 – 20 mA. In addition, it features two analog output channels with an output range of 0 – 20 mA. The power supply for the current inputs and outputs will be monitored for undervoltage.

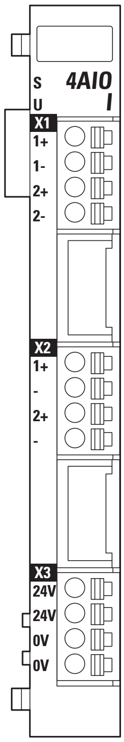


Figure 127: XN-322-4AIO-I device view

31.1 Status LED signals

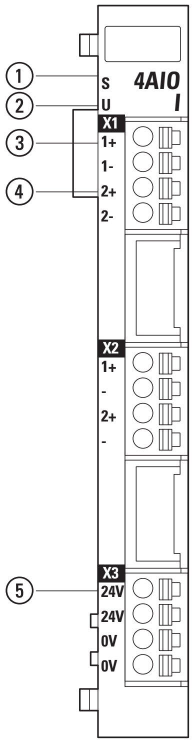


Figure 128: LED signals and pin assignment

1. Module status LED
2. User status LED
3. Cable break LED indicator for analog input 1
4. Cable break LED indicator for analog input 2
5. Supply voltage status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Analog input status	red	ON	Minimum current (4 mA) fallen below / cable break
		FLASH (2 Hz)	Maximum current exceeded
Status Supply voltage	Green	ON	Supply voltage for analog inputs and outputs OK
		OFF	Supply voltage for inputs and outputs faulty

31.2 Pin assignment

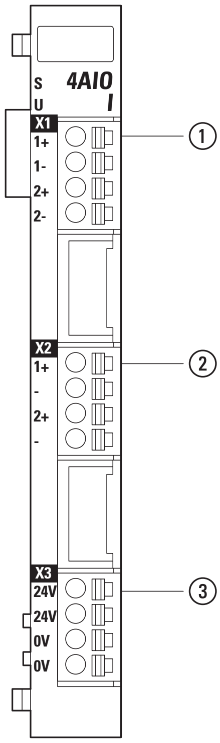


Figure 129: Pin assignment

① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+analog input 2+
- 2- analog input 2-

② X2
- 1+ analog output 1+
- - GND
- 2+ analog output 2+
- - GND

③ X3
- 24V supply voltage +24VDC
- 24V supply voltage +24VDC
- 0V GND
- 0V GND

31.3 Wiring topic

Two analog inputs can be wired to connector X1. A measuring range of 4 – 20 mA with open wire monitoring is supported, as is a measuring range of 0 – 20 mA without open wire monitoring.

The current input channels use a differential voltage measurement at an internal module resistor with a resistance of 50 Ω.

It must be ensured that the input signals' voltage levels fall within the permissible common mode range.

Two analog outputs for a burden resistance of less than 500 Ω can be wired to connector X2.

$0 < R_{burden} < 500\ \Omega$

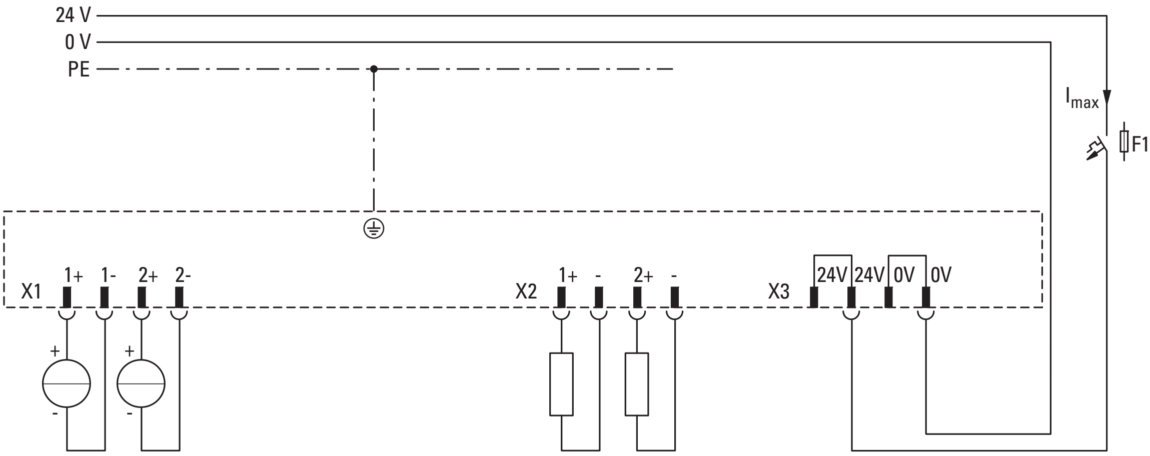


Figure 130: Connecting example showing signal current sources at X1 and burden current sources at X2

31.4 Technical specifications

31.4.1 Analog inputs

Channels	Value
Number of channels	2 analog input channels
Measuring range	0…20 mA
Measured value	0…20000
D-A converter	16 Bit
Resolution	0.3 µA/ LSB
Conversion time per channel	1 ms
Common-mode range	± 10 V
Input resistance	50 Ω
Input filters	
Hardware	typically 1 kHz (third-order low-pass filter)
Software (parameterizable)	parameterizable
Open wire monitoring	Yes
Measuring accuracy	
Total error limit	±0.5% of full scale value

31.4.2 Analog outputs

Channels	Value	
Number of channels	2 analog output channels	
Measuring range	0…20 mA	4…20 mA
Measured value	0…20000	4000…20000
D-A converter	12 Bit	
Resolution	5 µA / LSB	
Conversion time per channel	1 ms	
Load resistance (burden)	$0 < R_{burden} < 500\ \Omega$	
Max. permissible output capacitance	1 µF with 50 Ω burden	
Open wire monitoring	No	
Settling time (typical) for		
63% of end value	$50\ \mu s + R_{burden} \cdot R_{L\ capacitive}$	
86% of end value	$100\ \mu s + 2 \cdot R_{burden} \cdot R_{L\ capacitive}$	
99% of end value	$250\ \mu s + 5 \cdot R_{burden} \cdot R_{L\ capacitive}$	
Measuring accuracy		
Total error limit	±0.5% of full scale value	

31.4.3 External power supply

The 24 VDC power supply is used to power the analog inputs and outputs.

Channels	Value
Number of supply voltages	1 (X3, pin on connector 24V)
Supply voltage +24 V	18…30 VDC
Voltage monitoring Supply voltage OK status LED	U > 18 VDC
Maximum power acceptance	70 mA

31.4.4 Measurement ranges

Current in mA	Value representation in µA	
0 …20 mA	0000…20000	Represented as a decimal value
4 … 20 mA	4000…20000	

31.4.5 Diagnostics

When it comes to the analog inputs, cable breaks will only be detected with diagnostics when using the 4 – 20 mA measuring range. When using the 0 – 20 mA measuring range, the open wire detection diagnostics will always read "FALSE."

→ Range and channel diagnostics must be taken into account in order to ensure that the reading shown is being interpreted correctly.

Diagnostics	Measuring range in mA	
	0 – 20	4 – 20
Cable break	–	< 4 mA (diagnostics)
Under Range	–	0 … 4 mA
Display value	Measured value	
Over Range	20 …21 mA	
over current	> 21 mA	
Display value	> 21 (no reading)	

31.4.6 Filtering

The low-pass cutoff frequency can be individually configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0 x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

31.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x21B0	0x6411	0x7xx1 SUB 01	2	OutputChannel1			0x0000
0x21B1	0x6411	0x7xx1 SUB 02	2	OutputChannel2			0x0002
0x31B0	–	0x6xxD SUB 01	2	ModuleDiag	Bit 0	reserved	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5	Invalid configuration	
					Bit 6-15	reserved	
0x31B1	0x6401	0x6xx1 SUB 01	2	InputChannel1			0x0082
0x31B2	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x31B3		0x6xx2 SUB 01	2	ChannelDiag	Bit 0	1: Cable break input AI1	0x008A
					Bit 1	1: Cable break input AI2	
					Bit 2	reserved	
					Bit 3	reserved	
					Bit 4	1: Overcurrent at input AI1	
					Bit 5	1: Overcurrent at input AI2	
					Bit 6-14	reserved	
					Bit 15	Supply voltage +24 V OK	
0x31B4			1	InputVoltageState	Bit 0-6	reserved	
					Bit 7	0: +24 VDC missing 1: +24 VDC OK at Analog input +1, 2+ Analog output +1, 2+	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4080	–	–	2	FirmwareVersion			–
0x51B0		0x8xx6 SUB 01	1	InputChannelConfig Input measuring range configuration	AI 1		0x0106
					Bit 0 Bit 1		
					0 0	Measurement range 0…20mA	
					0 1	Measurement range 4…20mA	
					1 0	–	
					1 1	Input disabled	
					AI 2		
					Bit 2 Bit 3		
					0 0	Measurement range 0…20mA	
					0 1	Measurement range 4…20mA	
					1 0	–	
					1 1	Input disabled	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x51B1		0x8xx6 SUB 01	1	OutputChannelConfig Output measuring range configuration	AO1			0x0017
					Bit 0	Bit 1		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
					AO2			
					Bit 2	Bit 3		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
0x51B2		0x8xx9 SUB 01	2	FilterConfigChannel1 AI1 cutoff frequency configuration			Used to specify the cutoff frequency as a decimal value in Hz.	0x0108
0x5092		0x8xx9 SUB 02	2	FilterConfigChannel2 AI2 cutoff frequency configuration				0x010A

32 XN-322-8AIO-I analog input/output module

The XN-322-8AIO-I is an XN300 slice module with four analog input channels used to measure current input signals within a measuring range of 0 – 20 mA or 4 – 20 mA. In addition, it features four analog output channels with an output range of 0 – 20 mA or 4 – 20 mA. The power supply for the current inputs and outputs will be monitored for undervoltage.

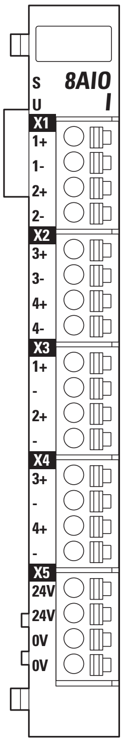


Figure 131: XN-322-8AIO-I device view

32.1 Status LED signals

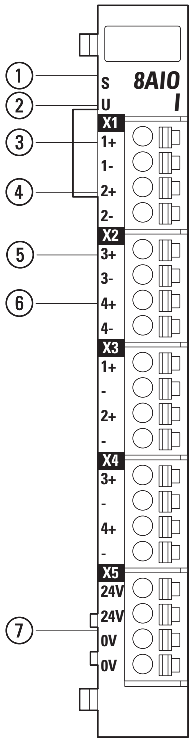


Figure 132: LED signals and pin assignment

① Module status LED
② User status LED
③ Cable break LED indicator for analog input 1
④ Cable break LED indicator for analog input 2
⑤ Cable break LED indicator for analog input 3
⑥ Cable break LED indicator for analog input 4
⑦ Supply voltage status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Analog input status	red	ON	Minimum current (4 mA) fallen below / cable break
		FLASH (2 Hz)	Maximum current exceeded
Status Supply voltage	Green	ON	Supply voltage for analog inputs and outputs OK
		OFF	Supply voltage for inputs and outputs faulty

32.2 Pin assignment

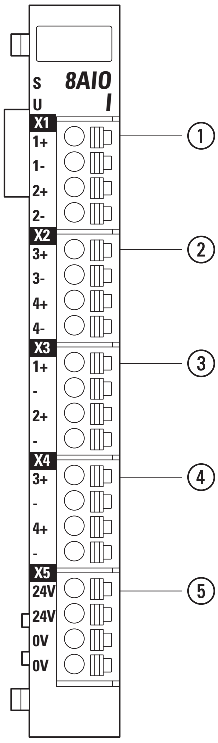


Figure 133: Pin assignment

① X1
- 1+ analog input 1+
- 1- analog input 1-
- 2+analog input 2+
- 2- analog input 2-

② X2
- 3+ analog input 3+
- 3- analog input 3-
- 4+analog input 4+
- 4- analog input 4-

③ X3
- 1+ analog output 1+
- \- GND
- 2+ analog output 2+
- \- GND

④ X4
- 3+ analog output 3+
- \- GND
- 4+ analog output 4+
- \- GND

⑤ X5
- 24V supply voltage +24VDC
- 24V supply voltage +24VDC
- 0V GND
- 0V GND

32.3 Wiring topic

Two analog inputs can be wired to each of the two X1 and X2 connectors. A measuring range of 4 – 20 mA with cable break monitoring is supported, as is a measuring range of 0 – 20 mA without cable break monitoring.

The current input channels use a differential voltage measurement at an internal module resistor with a resistance of 50 Ω.

It must be ensured that the input signals' voltage levels fall within the permissible common mode range.

Two analog outputs for a burden resistance of less than 500 Ω can be wired to each of the connectors X3 and X4.

$0 < R_{burden} < 500\ \Omega$

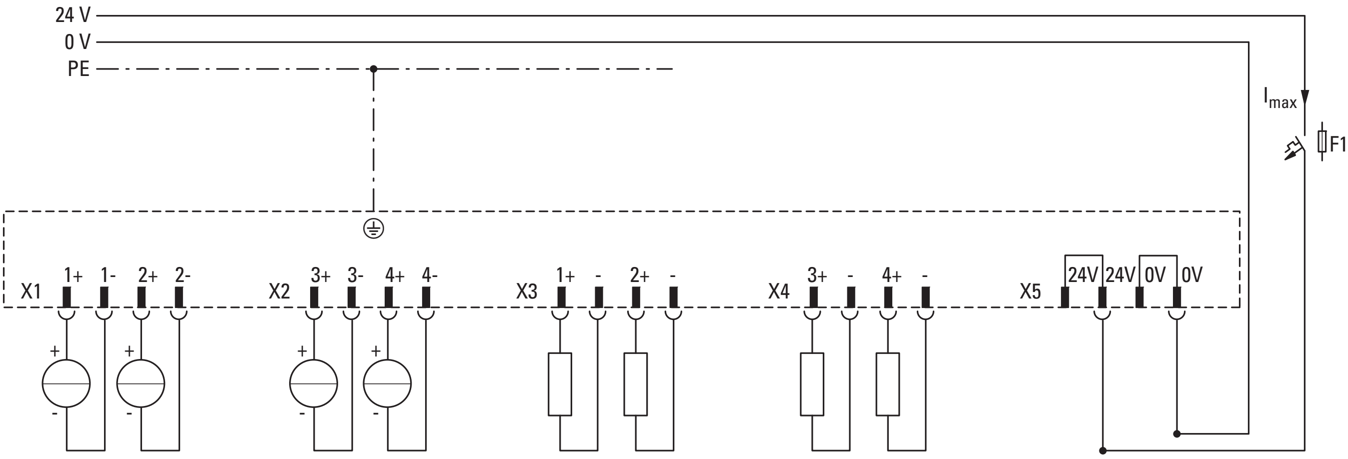


Figure 134: Connecting example showing signal current sources at X1, X2 and burden current sources at X3, X4

32.4 Technical specifications

32.4.1 Analog inputs

Channels	Value	
Number of channels	4 analog input channels	
Measuring range	0…20 mA	4…20 mA
Measured value	0…20000	4000…20000
D-A converter	16 Bit	
Resolution	0.3 μA/ LSB	
Conversion time per channel	1 ms	
Common-mode range	± 10 V	
Input resistance	50 Ω	
Input filters		
Hardware	typically 1 kHz (third-order low-pass filter)	
Software (parameterizable)	parameterizable	
Open wire monitoring	Yes	
Measuring accuracy		
Total error limit	±0.5% of full scale value	

32.4.2 Analog outputs

Channels	Value
Number of channels	4 analog output channels
Measuring range	0…20 mA
Measured value	0…20000
D-A converter	12 Bit
Resolution	5 μA / LSB
Conversion time per channel	1 ms
Load resistance (burden)	$0 < R_{burden} < 500\ \Omega$
Max. permissible output capacitance	1 μF with 50 Ω burden
Open wire monitoring	No
Settling time (typical) for	
63% of end value	$50\ \mu s + R_{burden} \cdot R_{L\ capacitive}$
86% of end value	$100\ \mu s + 2 \cdot R_{burden} \cdot R_{L\ capacitive}$
99% of end value	$250\ \mu s + 5 \cdot R_{burden} \cdot R_{L\ capacitive}$
Measuring accuracy	
Total error limit	±0.5% of full scale value

32.4.3 External power supply

The 24 VDC power supply is used to power the analog inputs and outputs.

Channels	Value
Number of supply voltages	1 (X5, pin on connector 24V)
Supply voltage +24 V	18…30 VDC
Voltage monitoring Supply voltage OK status LED	U > 18 VDC
Maximum power acceptance	70 mA

32.4.4 Measurement ranges

Current in mA	Value representation in µA	
0 …20 mA	0000 20000	Represented as a decimal value
4 … 20 mA	4000 20000	

32.4.5 Diagnostics

When it comes to the analog inputs, cable breaks will only be detected with diagnostics when using the 4 – 20 mA measuring range. When using the 0 – 20 mA measuring range, the open wire detection diagnostics will always read "FALSE."

→ Range and channel diagnostics must be taken into account in order to ensure that the reading shown is being interpreted correctly.

Diagnostics	Measuring range in mA	
	0 – 20	4 – 20
Cable break	–	< 4 mA (diagnostics)
Under Range	–	0 … 4 mA
Display value	Measured value	
Over Range	20 …21 mA	
over current	> 21 mA	
Display value	> 21 (no reading)	

32.4.6 Filtering:

The low-pass cutoff frequency can be individually configured for each input channel using the appropriate register. This cutoff frequency is specified in Hz without any decimal places.

The following settings are valid:

Low-pass cut-off frequency	Register value
Filter disabled (default)	0x0000
1 Hz	0x0001
10 Hz	0x000A
25 Hz	0x0019
50 Hz	0x0032
100 Hz	0x0064
250 Hz	0x00FA
500 Hz	0x01F4
1000 Hz	0x03E8

32.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x21C0	0x6411	0x7xx1 SUB 01	2	OutputChannel1			0x0000
0x21C1	0x6411	0x7xx1 SUB 02	2	OutputChannel2			0x0002
0x21C2	0x6411	0x7xx1 SUB 03	2	OutputChannel3			0x0004
0x21C3	0x6411	0x7xx1 SUB 04	2	OutputChannel4			0x0006
0x30C0	–	0x6xxD SUB 01	2	ModuleDiag	Bit 0	reserved	0x0080
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5	Invalid configuration	
					Bit 6-15	reserved	
0x30C1	0x6401	0x6xx1 SUB 01	2	InputChannel1			0x0082
0x30C2	0x6401	0x6xx1 SUB 02	2	InputChannel2			0x0084

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x30C3	0x6401	0x6xx1 SUB 03	2	InputChannel3			0x0086
0x30C4	0x6401	0x6xx1 SUB 04	2	InputChannel4			0x0088
0x30C5		0x6xxA SUB 01	2	ChannelDiag Channel status for inputs	Bit 0	1: Cable break input AI1	0x008A
					Bit 1	1: Cable break input AI2	
					Bit 2	1: Cable break input AI3	
					Bit 3	1: Cable break input AI4	
					Bit 4	1: Overcurrent at input AI1	
					Bit 5	1: Overcurrent at input AI2	
					Bit 6	1: Overcurrent at input AI3	
					Bit 7	1: Overcurrent at input AI4	
					Bit 8-14	reserved	
					Bit 15	Supply voltage +24 V OK	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4080	–	–	2	FirmwareVersion			–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x50C0	–	0x8xx6 SUB 01	1	InputChannelConfig Input measuring range configuration	AI 1			0x0106
					Bit 1	Bit 0		
					0	0	Measurement range 0…20mA	
					0	1	Measurement range 4…20mA	
					1	0	–	
					1	1	Input disabled	
					AI 2			
					Bit 3	Bit 2		
					0	0	Measurement range 0…20mA	
					0	1	Measurement range 4…20mA	
					1	0	–	
					1	1	Input disabled	
					AI 3			
					Bit 5	Bit 4		
					0	0	Measurement range 0…20mA	
					0	1	Measurement range 4…20mA	
					1	0	–	
					1	1	Input disabled	
					AI 4			
					Bit 7	Bit 6		
					0	0	Measurement range 0…20mA	
					0	1	Measurement range 4…20mA	
					1	0	–	
					1	1	Input disabled	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x50C1	–	0x8xx6 SUB 03	1	OutputChannelConfig Output measuring range configuration	AO1			0x0107
					Bit 1	Bit 0		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
					AO2			
					Bit 3	Bit 2		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
					AO3			
					Bit 5	Bit 4		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
					AO4			
					Bit 7	Bit 6		
					0	0	Measurement range 0…20mA	
					0	1	–	
					1	0	–	
					1	1	Output disabled	
0x50C2	–	0x8xx9 SUB 01	2	FilterConfigChannel1			Used to specify the cutoff frequency as a decimal value in Hz. Permissible values: 10 to 1000 Hz Filter disabled (default)	0x0108
0x50C3	–	0x8xx9 SUB 02	2	FilterConfigChannel2				0x010A
0x50C4	–	0x8xx9 SUB 03	2	FilterConfigChannel3				0x010C
0x50C5	–	0x8xx9 SUB 04	2	FilterConfigChannel4				0x010E

33 Analog weigh module XN-322-2DMS-WM

The XN-322-2DMS-WM module features two analog input channels for Wheatstone bridges (strain gauges) and load cells. This means that the module can be used for uncalibrated measurements in weighing applications with the use of Wheatstone bridges in a four-wire or six-wire configuration. In addition, it provides the required reference voltage for the bridge.

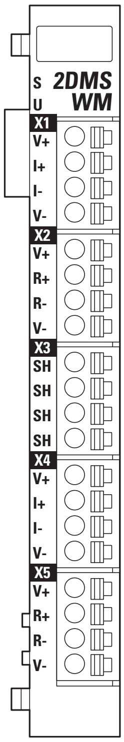


Figure 135: Device view XN-322-2DMS-WM

33.1 Status LEDs

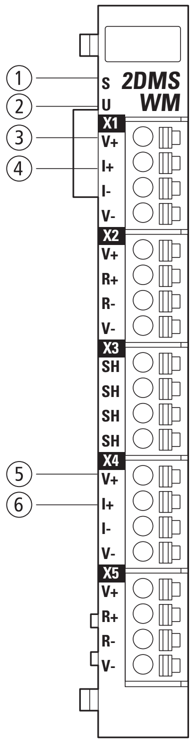


Figure 136: LED signals and pin assignment

① Module status LED
② User LED
③ AI1 input error LED
④ AI1 input status LED
⑤ AI2 input error LED
⑥ AI2 input status LED

Module Status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Input AI1/AI2	Green	FLASHES (3 Hz)	A-D conversion running
		OFF	A-D conversion not running
Error AI1/AI2	red	ON	Open sensor, overload or short-circuit in the power supply for the Wheatstone bridge
		OFF	No Error

33.2 Pin assignment

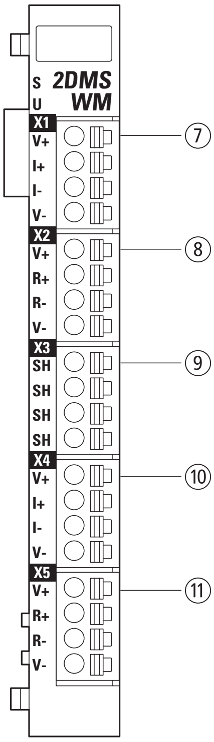


Figure 137: Pin assignment

1 X1
- V+ Reference output 1+
- I+ Input 1+
- I- Input 1-
- V- Reference output 1-

2 X2
- V+ Reference output 1+
- R+ Reference input 1+
- R- Reference input 1-
- V- Reference output 1-

3 X3
- SH Shielding GND
- SH Shielding GND
- SH Shielding GND
- SH Shielding GND

4 X4
- V+ Reference output 2+
- I+ Input 2+
- I- Input 2-
- V- Reference output 2-

5 X5
- V+ Reference output 2+
- R+ Reference input 2+
- R- Reference input 2-
- V- Reference output 2-

33.3 Wiring topic

The module supports the use of two Wheatstone bridges. These bridges need to be wired with a four-wire or six-wire configuration.

33.3.1 Four-wire connection

When using a four-wire connection, only X1 or X4 is wired to the Wheatstone bridge. This means that the Wheatstone bridge will be powered via V+ / V- and that the corresponding readings will be acquired via I+ / I-.

Reference output V+ and reference input R+, as well as V- and R-, need to be connected to each other at X2 and X5.

The advantage of using this configuration is the fact that only a small number of connection cables are required. However, using this operating mode also means that the cable resistances will affect the measurement in the form of an error.

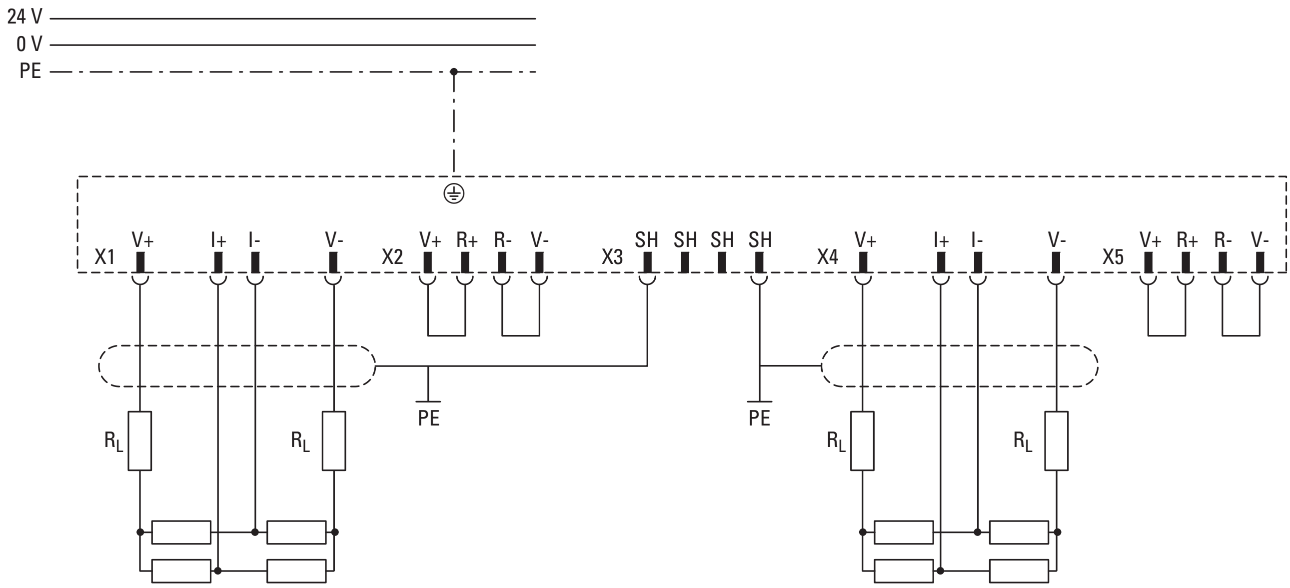


Figure 138: Wiring diagram for four-wire connection using AI1 and AI2

33.3.2 Six-wire connection

When using a six-wire connection, the voltage drop at the cable extending from the module to the Wheatstone bridge is measured via R+ and R- and taken into account in the measurement.

This means that when this operating mode is used, the cable resistance will not affect the measurement in the form of an error.

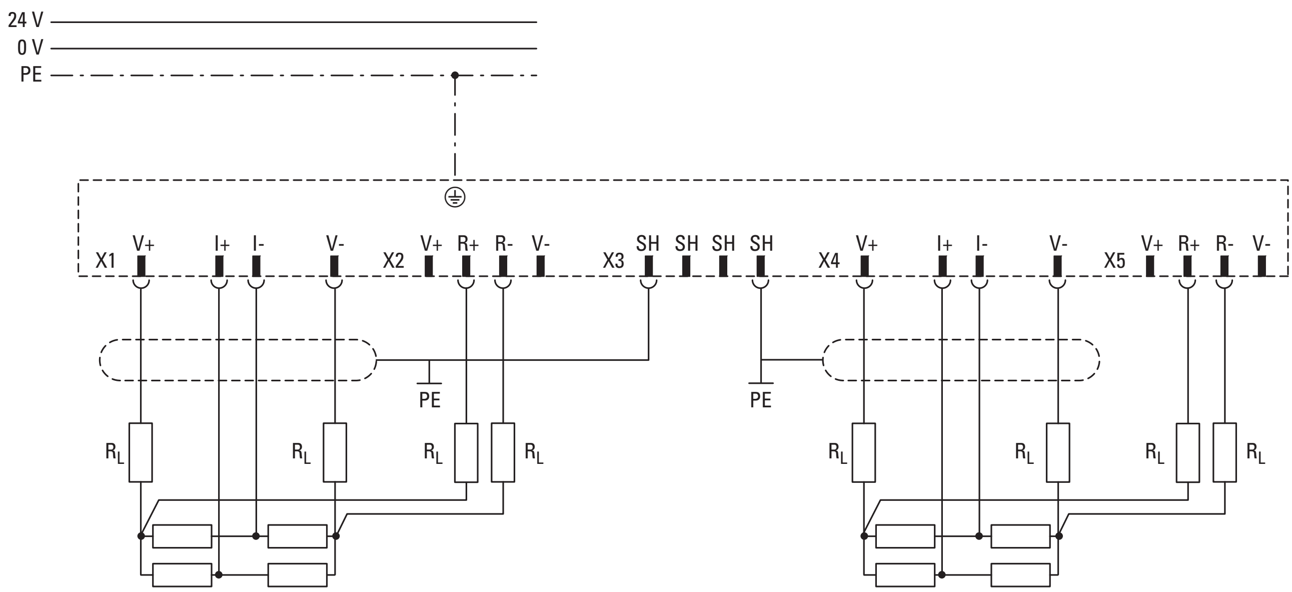


Figure 139: Wiring diagram for six-wire configuration using AI1 and AI2

33.4 Sensors

Weigh module XN-322-2DMS-WM is compatible with strain gauge load cells with the following load cell characteristic values: 0.25 mV / V; 0.5 mV / V; 1 mV / V; 2 mV / V; 16 mV / V with a supply voltage of 5 V and a working resistance of 150 Ω to 5000 Ω.

Load cell characteristic values [mV/V]	Measurement ranges [mV]
0.25	± 1.875
0.5	± 3.75
1	± 7.5
2	± 15
16	± 120

33.5 Filter settings

The reading's accuracy and stability will depend on how the filter is configured. If the filter has a high cutoff frequency, so that the goal is to have a short refresh time for the reading, the resolution will be lower. If the filter has a low cutoff frequency, resulting in a long refresh time, the measured value will be more accurate and the transmission frequency (bus load) will be lower.

The refresh frequency can be calculated by using the formula below. The cutoff frequency must be configured in CAN object 5060 → Section " 0x5060", page 262.

$$f_{ADC} = \frac{f_{CLK}}{(\sin c\ x \cdot 1024 \cdot \mathrm{AIxFilterDepth}}$$

f_{ADC}: ADC data rate
f_{CLK} : 4.92 MHz
AIxFilterDepth :ADC filter depth

$$t_{SETTLE} = \frac{2}{f_{ADC}} = \frac{2 \cdot (\sin c\ x \cdot 1024 \cdot \mathrm{AIxFilterDepth})}{f_{CLK}}$$

t_{SETTLE}: Conversion time
f_{ADC}: ADC data rate
f_{CLK} : 4.92 MHz
AIxFilterDepth : ADC filter depth

For a cutoff frequency of 3 dB, this yields:

$$f_{3dB} = 0.24 \cdot f_{ADC} = \frac{0.24 \cdot f_{CLK}}{(\sin c\ x \cdot 1024 \cdot \mathrm{AIxFilterDepth})}$$

f_{ADC}: ADC data rate
f_{CLK}: 4.92 MHz
AIxFilterDepth: ADC filter depth

For: sinc x = sinc 4, AIxFilterDepth = 5

$$t_{SETTLE} = \frac{2}{f_{ADC}} = \frac{2 \cdot (4 \cdot 1024 \cdot 5)}{4920000\ \mathrm{Hz}} = 0.0083\mathrm{s}$$

Conversion time = 8.3 ms

$$f_{3dB} = 0.24 \cdot f_{ADC} = \frac{0.24 \cdot 4920000\ \mathrm{Hz}}{4 \cdot 1024 \cdot 5}$$

3dB limit frequency = 57.66 Hz

33.6 Calibrating the force transducer

1. The ADC's gain must be adjusted as required by the specifications in the transducer's data sheet. The way it is set should ensure that the transducer range being used takes advantage of the ADC's value range to the greatest extent possible without exceeding it.
2. The transducer's zero point (tare) is calibrated with the minimum load on the sensor and mode = 6 (configuration of cutoff frequency for AIx, bits 11-13). This defines the initial value for the scale.
3. The transducer's full-scale calibration is carried out with the maximum load on the sensor and mode = 7 (configuration of cutoff frequency for AIx, bits 11-13). This defines the final value for the scale. The final value for the scale can only be calibrated to a value between 50% and 100% of the positive measuring range.

Please refer to „Application examples“.

33.7 Specific technical data for the module

Number of channels	**2 Wheatstone bridges**				
D-A converter	24 Bit				
Supply voltage for Wheatstone bridges	+5V				
Load cell characteristic values	0.25mV/V	0.5mV/V	1mV/V	2mV/V	16mV/V
Measurement ranges1)	± 1.875mV	± 3.75mV	± 7.5mV	± 15mV	± 120mV
Measured value	± 8388608_{dez} = $\pm 800000_{hex}$, zero value =800000_{hex}				
Configurable parameters					
Filter value	2	…	5	…	1023
Filter Type	Sinc4	…	Sinc4	…	Sinc4
Limit frequency (–3 db)	144 Hz	…	57.7 Hz	…	0.282 Hz
Conversion time	4 ms	…	9 ms	…	1702 ms
Noise-free resolution2)	15.5 Bit	…	16 Bit	…	20 Bit
Open sensor detection	Yes				
Working resistance per channel	150 Ω - 5000 Ω				
Measuring accuracy3)	±0.0031% noise for filter word 2				
Temperature drift	± 0.001% /°C				
Can be calibrated	no				

1) The measuring ranges are sized for load cell overstretching of 50%
2) Typical values with active sinc filter and measuring range of 2 mV/V
3) A system calibration with the sensor, in which the minimum and maximum values are calibrated, is required in order for the measuring accuracy value to be met. The minimum value must be calibrated first, followed by the maximum value. The maximum value can only be calibrated to a value between 50% and 100% of the positive measuring range.

33.8 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x3060	–	0x6xxD SUB 01	2	ModuleDiag (Error bits 7 and 8 will be set to "zero" the moment the set gain matches the stored values. The application must ensure that the correct GAIN (and filter type and filter depth) is set. If the gain changes, the calibration must be repeated.)	Bit 0	reserved	0x0080
					Bit 1	no SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	FLASH memory error	
					Bit 5	Bridge 1 DC not OK	
					Bit 6	Bridge 2 DC not OK	
					Bit 7	Offset ADC 1 invalid	
					Bit 8	Offset ADC 2 invalid	
					Bit 9	Filter ADC 1 not ready	
					Bit 10	Filter ADC 2 not ready	
					Bit 11…15	reserved	
0x3061	0x6401	0x6xx1 SUB 01	4	InputChannel1 Current measured value of channel (if AI1ConfigValid and the Ready bit in AI1ADCState are set)		Measured value 1 (AI1) DWORD	0x0082

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x3062	0x6401	0x6xx1 SUB 02	4	InputChannel2 Current measured value of channel (if AI2ConfigValid and the Ready bit in AI2ADCState are set)			Measured value 2 (AI2) DWORD	0x0086
0x3063	–	0x6xxA SUB 01	2	ADCDiag Diagnostic ADC Controller	Byte 0	ADC AI1		0x008A
						Bit 0…4	reserved	
						Bit 5	Faulty reference voltage	
						Bit 6	ADC measuring range error	
						Bit 7	Conversion in progress	
		0x6xxA SUB 02			Byte 1	ADC AI2		0x008B
						Bit 0…4	reserved	
						Bit 5	Faulty reference voltage	
						Bit 6	ADC measuring range error	
						Bit 7	Conversion in progress	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber				–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl				–
0x400C	–	–	Max. 25	ProductName				–
0x4080	–	–	2	FirmwareVersion				–
0x5060	–	0x8xx6 SUB 01	2	MeasuringConfigChannel1 Measuring configuration for channel 1 (AI1)	Bit 0-9	Filter depth of ADC 1–1023 (Default = 2)		0x0106
					Bit 10	0: SINC4 filter (Default) 1: SINC3 filter		
					Bit 11-13	Resize mode		
						0 = Continuous conversion mode (default)		
						6 = System zero-scale calibration		
						7 = System full-scale calibration		
					Bit 14, 15	reserved		

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x5061	–	0x8xx6 SUB 02	2	RangeConfigChannel1 Measuring range configuration for channel 1 (AI1)	Bit 0-2	GAIN	0x0108
						0: GAIN 1 (± 120mV)	
						1: reserved	
						2: reserved	
						3: GAIN 8 (± 15mV) (default)	
						4: GAIN 16 (± 7.5mV)	
						5: GAIN 32 (± 3.75mV)	
						6: GAIN 64 (± 1.875mV)	
					Bit 3-15	reserved	
0x5062	–	0x8xx6 SUB 03	2	MeasuringConfigChannel2 Measuring configuration for channel 2 (AI2)	Bit 0-9	Filter depth of ADC 1–1023 (Default = 2)	0x010A
					Bit 10	0: SINC4 filter (Default), 1: SINC3 filter	
					Bit 11-13	Resize mode	
						0: Continuous conversion mode (default)	
						6: System zero-scale calibration	
						7: System full-scale calibration	
					Bit 14, 15	reserved	
0x5063	–	0x8xx6 SUB 04	2	RangeConfigChannel2 Measuring range configuration for channel 2 (AI2)	Bit 0-2	GAIN	0x010C
						0: GAIN 1 (± 120mV)	
						1: reserved	
						2: reserved	
						3: GAIN 8 (± 15mV) (default)	
						4: GAIN 16 (± 7.5mV)	
						5: GAIN 32 (± 3.75mV)	
						6: GAIN 64 (± 1.875mV)	
					Bit 3-15	reserved	
0x5064	–	0x8xx6 SUB 05	4	ZeroScaleChannel1		Scale start value for zero point calibration for channel 1	0x010E
0x5065	–	0x8xx6 SUB 06	4	FullScaleChannel1		Scale end value for zero point calibration for channel 1	0x0112
0x5066	–	0x8xx6 SUB 07	4	ZeroScaleChannel2		Scale start value for zero point calibration for channel 1	0x0116
0x5067	–	0x8xx6 SUB 08	4	FullScaleChannel2		Scale end value for zero point calibration for channel 2	0x011A

34 DC motor driver module XN-322-1DCD-B35

The XN-322-1DCD-B35 features a DC motor driver that can be used to run a brushed motor, as well as two current outputs that can be used to drive two external LEDs. These current outputs have rated operational currents of 20 mA and 350 mA.

The power control module can be used to run a DC motor with supply voltages of 12 – 30 V and a maximum motor current of 3.5 A. It can also accommodate higher inrush currents briefly. The output power is controlled with a PWM output, and the operating direction can be defined with the polarity of the switched output driver stage. Accordingly, the output power must be controlled using duty cycles.

In addition, these DC motor driver modules provide up-to-date operating data on the motor so that the information can be used for further analysis or display if necessary.

- Motor driver temperature
- Current motor current
- Motor status
- Let-through energy
- Diagnostics information

In order to integrate the motor into a speed control system, it is recommended to provide a speed feedback signal by using a rotary encoder on the motor together with an XN-322-1CNT-8DIO or XN-322-20DI-PCNT module. This will make it possible to determine the motor's speed, operating direction, and covered distance (angle of rotation).

The LED drivers can be programmed in such a way that the corresponding LEDs will signal the information obtained by the module. For example, a motor's speed or load can be represented by different LED brightness levels.

34.1 Status LEDs

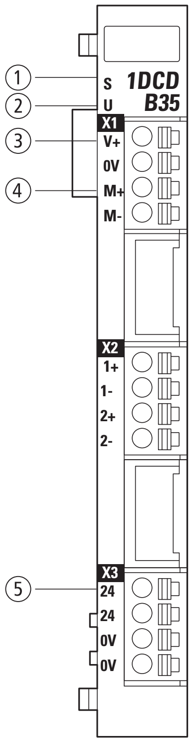


Figure 140: XN-322-1DCD-B35 LEDs

1. Module status LED
2. User status LED
3. Motor power supply status LED
4. Motor status LED
5. Module power supply status LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Motor power supply status	red	ON	Faulty motor power supply
		OFF	Motor power supply OK
Motor Status	Green	ON	Motor enable signal active
		OFF	Motor enable signal not active
Module power supply status	red	ON	Faulty module power supply
		OFF	Module power supply OK

34.2 Pin assignment

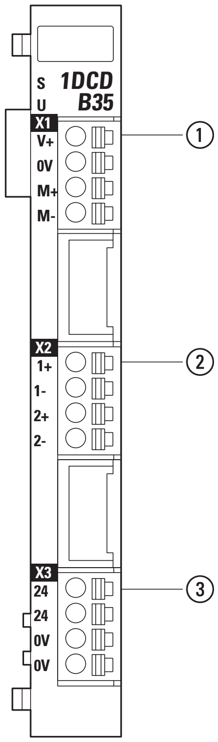


Figure 141: Pin assignment XN-322-1DCD-B35

① X1

- V+ Motor+ power supply
- 0V GND
- M+ Motor +
- M- Motor -

② X2

- 1+ LED 1 +
- 1- LED 1 -
- 2+ LED 2 +
- 2- LED 2-

③ X3

- 24 +24VDC
- 24 +24VDC
- 0V GND
- 0V GND

34.3 Wiring topic

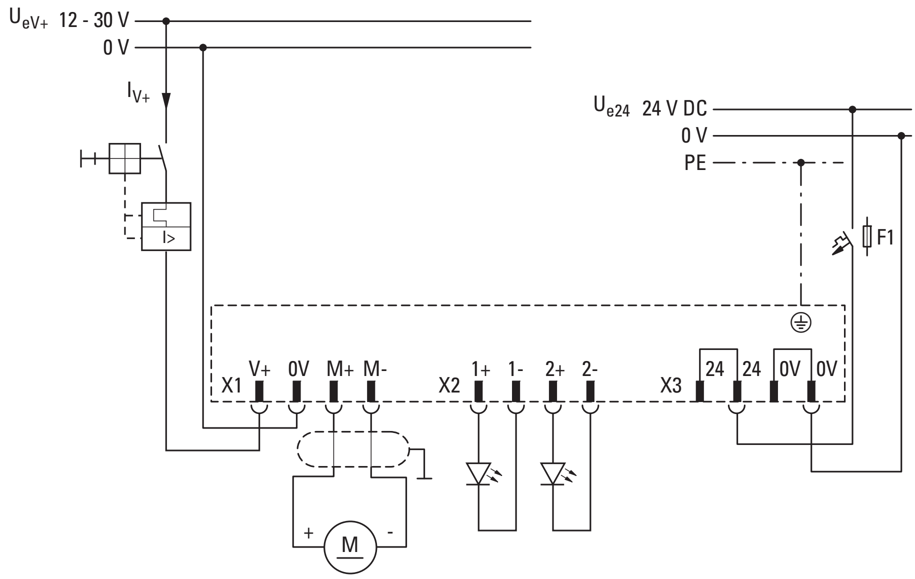


Figure 142: Diagram version 2: Wiring example for XN-322-1DCD-B35

The connection to PE is established with a DIN-rail contact at the bottom of the module.

34.3.1 Connecting the power supply for the module

The module and the LED drivers are powered through connection terminal X3. The two GND pins and the two 24 pins are internally linked.

34.3.2 Motor connection

> *NOTICE*
> The rated uninterrupted current must not exceed 3.5 A.

The connection cables for the motor power supply need to be connected to connector X1 with the output voltage for the motor.

The module can be used to control the motor's speed, output, and operating direction. To make sure you use the right operating direction, make sure to connect the motor with the right polarity.

34.3.3 Connecting LEDs

The LEDs are driven with a PWM controlled current source.

→ Please make sure to use the right polarity when connecting the LEDs.

34.3.4 How the XN-322-1DCD-B35 works

XN-322-1DCD-B35 slice modules can be used to run a brushed DC motor with a rated operational current of up to 3.5 and an operational voltage of up to 30 VDC. The motor can be driven in the following way:

- pulse width modulation

When using pulse width modulation, the manipulated variable is controlled by using variable pulse widths while keeping a constant period duration. The manipulated variable in this case is the power delivered to the motor.

The duration of the 4 steps, i.e., the sequence time, is specified in registers 0x32E0 to 0x20E3 with 11 bits. Meanwhile, the period duration is defined, relative to the internal clock frequency of 32 MHz, in register 0x20E4 with 16 bits.

Generating the output signal for the motor drive

The PWM output sequence for driving the motor is transmitted to the XN300 module with four subsequences using four objects, 0x20E0 to 0x20E3. These subsequences are grouped together in a fixed order in order to make up the output sequence, with each of the subsequences containing the following information:

- Operating direction: Definition of operating direction by activating the output driver.
- Time reference:
  - Relative: The sequence time's starting point will be the end of the previous sequence.
  - Absolute: The sequence time's starting point will be the start of the period. The duration of previous sequences must be taken into account.
- Sequence time: The sequence time, relative to the internal clock frequency of 32 MHz, is defined in an 11-bit register. (min: 29_{hex} (1.3 µs), max: (63.9 µs))

If the defined period duration is shorter than the time defined with the sequences, the sequence will be interrupted and restarted at the end of the period duration.

The operating direction is defined with the states of bits 12 to 15 in the sequence register.

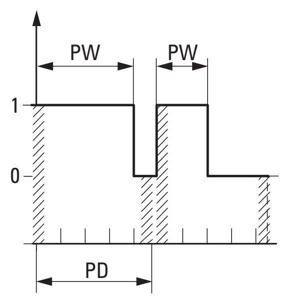


Figure 143: Pulses at output terminal X1, pin M+ module output

PD: Period duration

Each period must start with the Motor Off state. As a general rule, sequence times 1 to 4 only describe the time response when there is an edge transition from LOW to HIGH. If a period duration that is shorter than the LOW sequence time is selected, the motor will stop. Period durations that are longer than the start time for the HIGH sequence will control the motor power, with the state remaining for the rest of the period duration.

Enable

The enable signal is activated with motor control object 0x20E7, bit 0. The output sequence will not be applied at the M+ / M- motor output until this enable signal is active. Once the enable signal has been activated, the relevant parameters will change directly as required for the output signal for the motor, M+, M-.

Defining the period duration

The period duration is determined based on the time value stored in object 0x20E4 and the system clock frequency (32 MHz).

$$\text{Period duration} = \frac{\text{Time value register entry (16-bit)}}{\text{System clock frequency}}$$

In turn, the period duration is used to determine the fundamental frequency.

$$\text{Fundamental frequency} = \frac{1}{\text{Period duration}}$$

Defining the motor's operating direction

> **CAUTION**
> There should be no state changes in the motor's operating direction within an output sequence.
> In order to reduce motor overload and the mechanical load on the motor, start by decelerating the motor's speed to "zero," then change the operating direction, and finally increase the speed back to the setpoint.

The motor's operating direction can be defined for each subsequence in objects 0x20E0 – 0x20E3 using bits 12 – 15. A state of "1" means: switch closed. T These switches are implemented inside the device with the use of transistors.

Permitted switching combinations for the sequence setting	Bit 12-15 $Value_{hex}$	Bit 15	Bit 14	Bit 13	Bit 12
Motor Off	0_{hex}	0	0	0	0
Operating direction right	6_{hex}	0	1	1	0
Operating direction left	9_{hex}	1	0	0	1
Motor armature short-circuit	C_{hex}	1	1	0	0

> **CAUTION**
> When changing the motor's operating direction, make sure to keep the motor switched off for a minimum period of 5 µs by using an armature short-circuit sequence. Otherwise, an impermissible I^2dt energy flux may be produced, resulting in the XN300 slice module overheating.

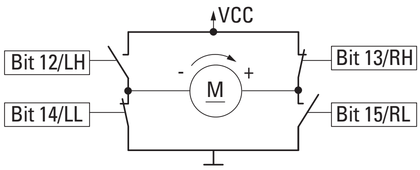


Figure 144:	Block diagram for a clockwise motor operating direction

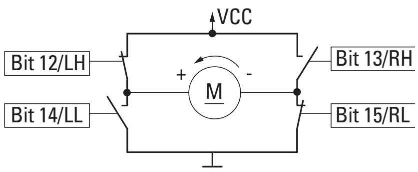


Figure 145:	Block diagram for a counterclockwise motor operating direction

Motor armature short-circuit

If bits 14 and 15 are set at the same time, the motor will be short-circuited to ground. At this point, the motor will brake, as it will be working as a short-circuited generator.

> **CAUTION**
> Use external mechanisms to make sure that the motor will be in a safe state after stopping.

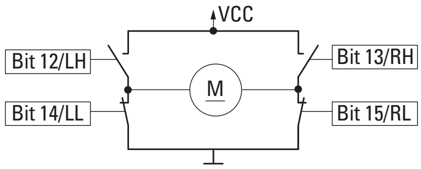


Figure 146: Block diagram showing a motor armature short-circuit

Motor Off

If all bits are set to 0, the motor will not receive any pulses and will not have a connection to ground. If there is any motor power, it will not be possible for this power to be discharged to ground.

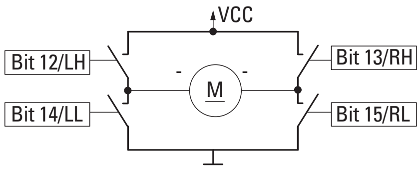


Figure 147: Block diagram showing open motor

Short-circuit fault message

If bit 12 and bit 14, or bit 13 and bit 15, were to be set at the same time (left_high and left_low), this would result in a short-circuit. The device will interpret this state as incorrect input and switch the motor off.

If the motor is switched off due to erroneous sequence input, this will be signaled with a fault message. It will not be possible to switch the motor back on until this error message is cleared with the acknowledgment bit.

Defining the sequence time

Bits 0 to 10 in registers 0x20E0 to 0x20E3 are used to store a time value. Dividing this time value by the system clock frequency (32 MHz) yields the sequence time.

$$\text{Sequence time} = \frac{\text{Time value register entry (bits 0-10)}}{\text{System clock frequency}}$$

Relative or absolute counting

Tc (Time control), i.e., bit 11, defines whether the time value for the subsequences will be counted as a relative or absolute value. It is possible to use both counting methods at different points within the output sequence. However, doing so is not recommended.

Bit 11 = 0: The pulse width is relative and is counted starting from the end of the last sequence. The period always starts with sequence 1.

Bit 11 = 1: The pulse width is absolute and is counted starting when the period begins. This means that the time specified for a sequence must be longer than the time specified for the previous sequence.

Relative pulse width

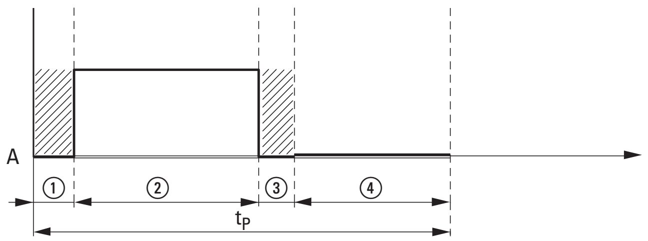


Figure 148: Four subsequences with pulses when using relative counting

1. Subsequence 1, e.g. Motor off
2. Subsequence 2, e.g. Operating direction right
3. Subsequence 3, e.g. Motor off
4. Subsequence 4, e.g. Armature short-circuit

Absolute pulse width

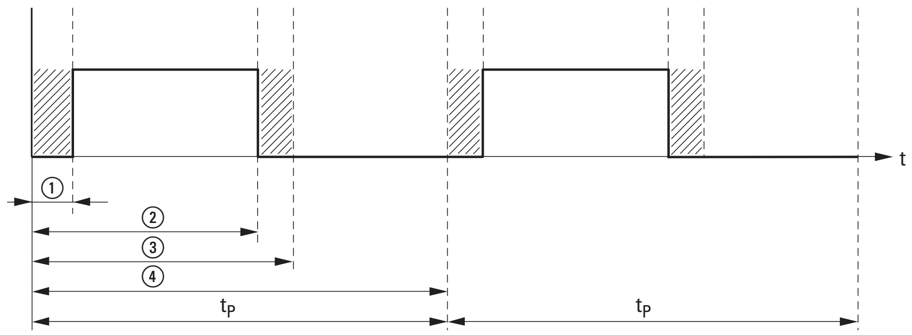


Figure 149: Four subsequences with pulses when using absolute counting

1. Subsequence 1, e.g. Motor off
2. Subsequence 2, e.g. Operating direction right
3. Subsequence 3, e.g. Motor off
4. Subsequence 4, e.g. Armature short-circuit

Keep the ratio of the period duration to the sequence time in mind

> *NOTICE*
>
> Select period duration t_p in line with the output sequence:
> $t_p = t_{OutputSequence} = t_{OutputSequence1} + ... + t_{OutputSequence4}$
> Failure to do so may result in undesired XN300 slice module states.

Output signal when the period duration is set correctly

$t_P = t_{OutputSequence}$

Period duration t_P will be equal to the time that the output sequence lasts.

The following scenarios must be avoided:

Output signal with interrupted sequence

$t_P < t_{OutputSequence}$

If period duration t_P is shorter than the output sequence, the state at the motor output will be truncated when the period duration ends, and the period will start again with subsequence 1. This means that subsequence 4 will not be completed.

Output signal with subsequence 4 state held

$t_P > t_{OutputSequence}$ If defined period duration t_P is longer than the output sequence, the last state (subsequence 4) at the motor output will be maintained until the period ends. This means that subsequence 4 will be unintentionally extended.

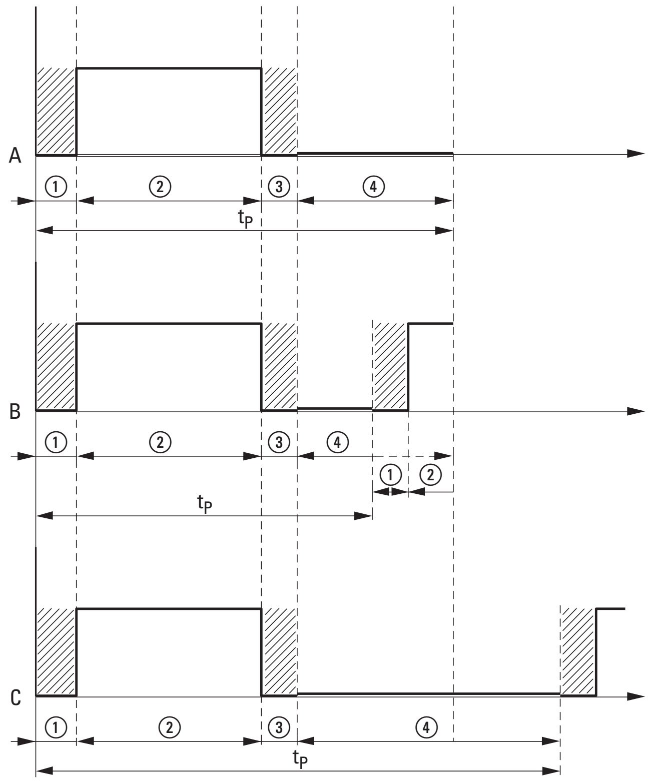


Figure 150: Output signal

A: When the period duration is set correctly
B: with interrupted sequence
C: with subsequence 4 state held

Clockwise operation example

System clock frequency: 32 MHz

Period duration register entry: 1120_{dec}

Period duration: 1120_{dec}/32 MHz = 35 µs

TC = relative

Motor	Subsequence values, hex	Pulse width	Motor state				TC	Binary time value					Time Value	
			15	14	13	12	11	10	9	8	7 6 5 4	3 2 1 0	dec	hex
Off	$00A0_{hex}$	≈ 5 µs	0	0	0	0	0	0	0	0	1 0 1 0	0 0 0 0	160_{dec}	$A0_{hex}$
Right	6140_{hex}	10 µs	0	1	1	0	0	0	0	1	0 1 0 0	0 0 0 0	320_{dec}	140_{hex}
Off	$00A0_{hex}$	≈ 5 µs	0	0	0	0	0	0	0	0	1 0 1 0	0 0 0 0	160_{dec}	$A0_{hex}$
Armature short-circuit	$C1E0_{hex}$	15 µs	1	1	0	0	0	0	0	1	1 1 1 0	0 0 0 0	480_{dec}	$1E0_{hex}$

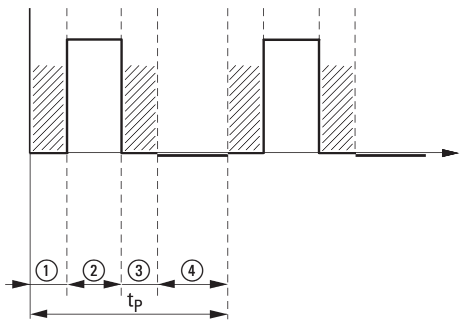


Figure 151: Output signal with clockwise operation

① Motor Off
② Clockwise motor operating direction
③ Motor Off
④ Motor armature short-circuit

Counterclockwise operation example

System clock frequency: 32 MHz

Period duration register entry: 1120_{dec}

Period duration: 1120_{dec}/32 MHz = 35 µs

TC = relative

Motor	Subse-quence values, hex	Pulse width	Motor state					TC	Binary time value					Time Value	
			hex	15	14	13	12	11	10	9	8	7 6 5 4	3 2 1 0	dec	hex
Off	$00A0_{hex}$	≈ 5 µs	0	0	0	0	0	0	0	0	0	1 0 1 0	0 0 0 0	160_{dec}	$A0_{hex}$
Left	9140_{hex}	10 µs	9	1	0	0	1	0	0	0	1	0 1 0 0	0 0 0 0	320_{dec}	140_{hex}
Off	$00A0_{hex}$	≈ 5 µs	0	0	0	0	0	0	0	0	0	1 0 1 0	0 0 0 0	160_{dec}	$A0_{hex}$
Armature short-circuit	$C1E0_{hex}$	15 µs	c	1	1	0	0	0	0	0	1	1 1 1 0	0 0 0 0	480_{dec}	$1E0_{hex}$

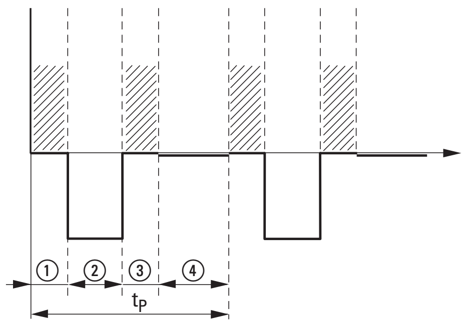


Figure 152: Pulse-width modulated signal at module output M+ for the counterclockwise motor operating direction example

1. Subsequence 1: Motor off, $00A0_{hex}$
2. Subsequence 2: Motor operating direction left, 9140_{hex}
3. Subsequence 3: Motor off, $00A0_{hex}$
4. Subsequence 1: Motor armature short-circuit, $C1E0_{hex}$

Example with a change in operating direction

System clock frequency: 32 MHz

Period duration register entry: 1120_{dec}

Period duration: 1120_{dec}/32 MHz = 35 µs

TC = relative

Subsequence values, hex	Pulse width		Motor state				TC	Binary time value											Time Value	
		hex	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	dec	hex
$00A0_{hex}$	≈ 5 µs		0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	160_{dec}	$A0_{hex}$
6140_{hex}	10 µs		0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	320_{dec}	140_{hex}
$00A0_{hex}$	≈ 5 µs		0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	160_{dec}	$A0_{hex}$
$C1E0_{hex}$	15 µs		1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	480_{dec}	$1E0_{hex}$
$00A0_{hex}$	≈ 5 µs		0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	160_{dec}	$A0_{hex}$
9140_{hex}	10 µs		1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	320_{dec}	140_{hex}
$00A0_{hex}$	≈ 5 µs		0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	160_{dec}	$A0_{hex}$
$C1E0_{hex}$	15 µs		1	1	0	0	0	0	0	1	1	1	1	0	0	0	0	0	480_{dec}	$1E0_{hex}$

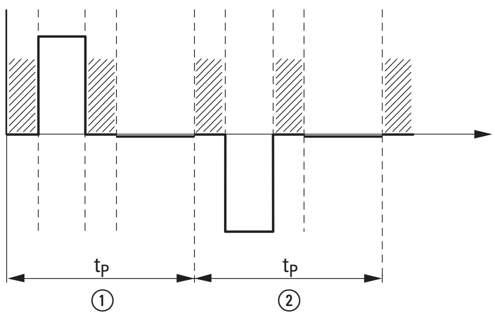


Figure 153: Pulse-width modulated signal at module output M+ for the operating direction change example

① Forward

② Counter-clockwise

34.4 Technical data

34.4.1 DC motor driver

Qty.	1
Specifications for connection to supply voltage	12 – 30 VDC
Rated operational current I_N	0 – 3.5 A
Operating mode	S3 / 50% (50% intermittent duty) with a maximum duty factor of 1.5 min
Load peak inrush current	Maximum I^2t-value = 16A^2s
Current Metering	10 Bit
Short-circuit proof	No
status display	1x LED (green)

The rated uninterrupted current for the motor should not exceed the specified value of 3.5 A continuously.
This also applies to the motor's deceleration and startup when the motor is repeatedly switched off and on.
The maximum let-through energy during motor startup is defined by integral $\int I^2dt$. The I^2T value is the integral of the square of the current over a specified period of time. It is also a measurement of the maximum energy that the load output can deliver.

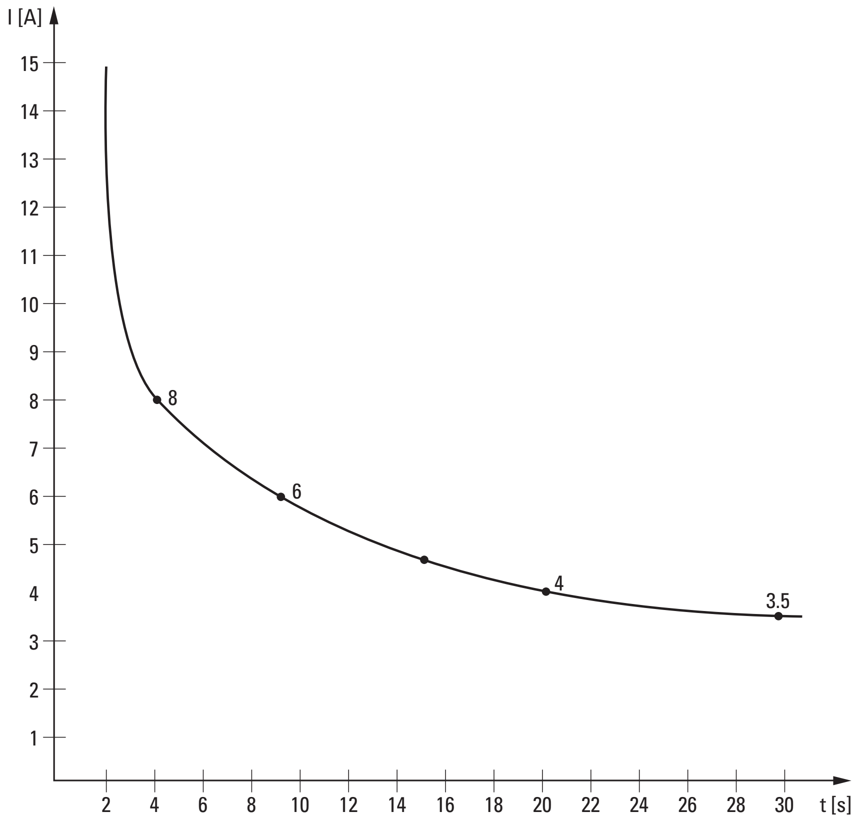


Figure 154: Permissible current curve during motor startup and continuous motor operation for the XN300 slice module as a function of time

34.4.2 LED drivers

Each of the LED drivers is a PWM controlled current source.

Number of PWM channels for LED drivers	2
LED 1	
Current	0 – 20 mA
Resolution	8 bits
LED 2 (Power LED)	
Current	0 – 350 mA
Resolution	8 bits

34.5 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description Refer to → Figure 144, page 270 to → Figure 146, page 271,			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x20E0		0x7xxB SUB 01	2	WRSeq1 Write sequence time 1 data	Bit 0-10	Value / system clock	0x0000
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x20E1		0x7xxB SUB 02	2	WRSeq2 Write sequence time 2 data	Bit 0-10	Value / system clock	0x0002
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description Refer to → Figure 144, page 270 to → Figure 146, page 271,			Local I/O addresses
0x20E2		0x7xxB SUB 03	2	WRSeq3 Write sequence time 3 data	Bit 0-10	Value / system clock	0x0004
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x20E3		0x7xxB SUB 04	2	WRSeq4 Write sequence time 4 data	Bit 0-10	Value / system clock	0x0006
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x20E4		0x7xxA SUB 01	2	WRPeriodDurationSeq		Period duration for one run through sequences 1 to 4.	0x0008
0x20E5		0x7xx4 SUB 01	1	TonLED1		Duty factor for the LED 1 PWM output (20 mA)	0x000A
0x20E6		0x7xx4 SUB 02	1	TonLED2		Duty factor for the LED 2 PWM output (350 mA)	0x000B
0x20E7		0x7xxA SUB 02	2	MotorControl Tabs	Bit 0	Activate sequence output	0x000C
					Bit 1	Resets the sequence definition error status (acknowledgment)	
					Bit 2-9	reserved	
					Bit 10	Internal overtemperature - activate shut-down	
					Bit 11	Reset status - internal overtemperature (acknowledgement)	
					Bit 12	Activate shutdown for when I^2t limit is exceeded	
					Bit 13	I^2t limit exceeded; reset status (acknowl-edgment)	
					Bit 14	Activate LED1	
					Bit 15	Activate LED2	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description Refer to → Figure 144, page 270 to → Figure 146, page 271,			Local I/O addresses
0x30E0 (Read)		–	2	RDSeq1 1 IN sequence time data	Bit 0-10	Value / system clock	0x0000
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x30E1 (Read)		–	2	RDSeq2 2 IN sequence time data	Bit 0-10	Value / system clock	0x0002
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x30E2 (Read)		–	2	RDSeq3 3 IN sequence time data	Bit 0-10	Value / system clock	0x0004
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x30E3 (Read)		–	2	RDSeq4 4 IN sequence time data	Bit 0-10	Value / system clock	0x0006
					Bit 11	0: Relative time base 1: Absolute time base	
					Bit 12	Motor polarity – left high	
					Bit 13	Motor polarity – right high	
					Bit 14	Motor polarity – left low	
					Bit 15	Motor polarity – right low	
0x30E4 (Read)		–	2	RDPeriodDurationSeq	Period duration for one run through sequences 1 to 4.		0x0008
0x30E5		0x6xx1 SUB 01	2	DCDTempK	Motor driver temperature in 1/16 °C Temperature = Object value · 10/16		0x000A
0x30E6		0x6xx1 SUB 02	2	DCMotorCurrent	Current motor power consumption in mA; the sign indicates the operating direction.		0x000C

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description Refer to → Figure 144, page 270 to → Figure 146, page 271,			Local I/O addresses
0x30E7		0x6xxA SUB 01	2	DCMotorDiag Motor diagnostics register (stored system diagnostics, excl. bit 10 and bit 12)	Bit 0	reserved	0x000E
					Bit 1	Invalid setting in sequence (requires reset)	
					Bit 2	Absolute timeout error (the absolute time values must increase with each sequence)	
					Bit 3-9	reserved	
					Bit 10	Internal overtemperature has shut down sequence (T >95 °C) (reset required if internal overtemperature shutdown is activated)	
					Bit 11	reserved	
					Bit 12	I²t limit exceeded, resulting in shutdown (reset required if internal overtemperature shutdown is activated)	
					Bit 13	reserved	
					Bit 14	reserved	
					Bit 15	reserved	
0x30E8		0x6xxA SUB 02	2	DCMotorStatus Motor Status Register	Bit 0	Sequence output active	0x0010
					Bit 1-4	reserved	
					Bit 5	DC of module supply OK	
					Bit 6	DC of motor supply OK	
					Bit 7-9	reserved	
					Bit 10	Internal overtemperature (T > 95 °C)	
					Bit 11	reserved	
					Bit 12	I²t limit value exceeded	
					Bit 13	reserved	
					Bit 14	reserved	
					Bit 15	reserved	
0x30E9		0x6xx1 SUB 03	4	DCMotorI2T I²t – value	Bit 0-20	Current motor I²t value	0x0012
					Bit 21-31	reserved	
30EA	–	–	2	ModuleDiag (Error bits 7 and 8 will be set to "zero" the moment the set gain matches the stored values. The application must ensure that the correct GAIN (and filter type and filter depth) is set. If the gain changes, the calibration must be repeated.)	Bit 0	Internal 24 VDC malfunctioning	0x0016
					Bit 1	No SYNC signal	
					Bit 2	FLASH-CRC error	
					Bit 3	RAM-CRC error	
					Bit 4	Flash memory error	
					Bit 5-15	reserved	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O Description Refer to → Figure 144, page 270 to → Figure 146, page 271,		Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber		–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl		–
0x400C	–	–	Max. 25	ProductName		–
0x4080	–	–	2	FirmwareVersion		–
40E1		0x9xxA SUB 01	2	PreScaleLED1 LED 1 PWM prescaler	PWM prescaler register for LED 1 (20 mA). Reduces the 50 MHz input clock frequency to 5.55 MHz. 5.55 MHz/256 (8-bit resolution) = Approx. 20 kHz PWM frequency. (Default =0x0009)	0x0018
40E2		0x9xxA SUB 02	2	PreScaleLED2 LED 2 PWM prescaler	PWM prescaler register for LED 2 (350 mA). Reduces the 50 MHz input clock frequency to 900kHz. 900 kHz/256 (8-bit resolution) = Approx. 3.5 kHz PWM frequency. (Default =0x0037)	0x001A
40E3		0x9xxA SUB 03	1	PDLED1 LED 1 PWM period duration	PWM period duration for LED 1 (20 mA). (Maximum value of PWM counter; default: 0xFF)	0x001C
40E4		0x9xxA SUB 04	1	PDLED2 LED 2 PWM period duration	PWM period duration for LED 2 (350 mA). (Maximum value of PWM counter; default: 0xFF)	0x001D
40E5		0x8xxA SUB 02	4	DCMotorI2TLimit I^2t – switch off threshold (Default 0x0000 0400)	Bit 0-20: I^2t - switch off threshold Bit 21-31: reserved	0x0020

35 Counter module XN-322-1CNT-8DIO

The XN-322-1CNT-8DIO module features an incremental encoder input (either TTL or RS-422), as well as a 5 VDC output for powering it. In addition, the device also features four digital outputs (24 VDC/2 A) and four digital inputs (24 VDC). With the configurable latch function, the inputs can be used to store the current count in a special register.

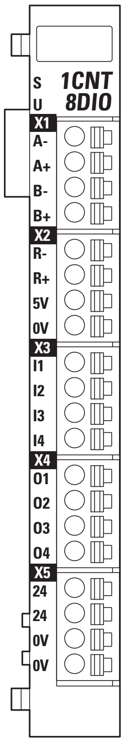
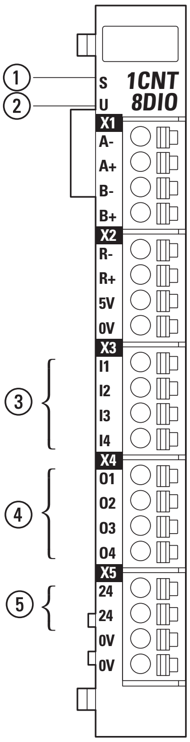


Figure 155: Device overview XN-322-1CNT-8DIO

35.1 Status LEDs

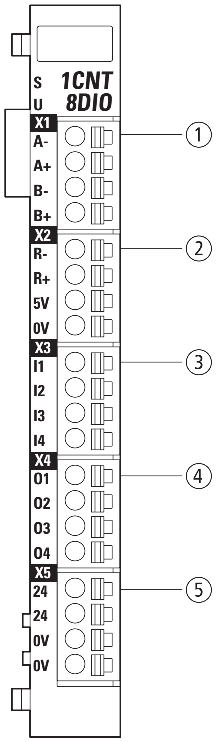


1. Module status LED
2. User LED
3. Input status LED
4. Output status LED
5. +24 V error status LED

Figure 156: LED signals and pin assignment

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
Input status	Green	ON	Input ON
		OFF	Input OFF
Output status	yellow	ON	Output ON
		OFF	Output OFF
Status Error +24V	red	ON	Supply voltage +24V OK
		OFF	Faulty +24 V supply voltage (undervoltage) or the system is not being powered at all. If the system is not being powered at all, the module status LED will be OFF.

35.2 Pin assignment



① X1
- A- RS422 incremental encoder signal (A-)
- A+ RS422/TTL incremental encoder signal (A+)
- B- RS422 incremental encoder signal (B-)
- B+ RS422/TTL incremental encoder signal (B+)

② X2
- R- RS422 incremental encoder signal (R-)
- R+ RS422/TLL incremental encoder signal (R+)
- 5 V +5 V encoder power supply
- 0 GND

③ X3
- I1 digital input 1
- I2 digital input 2
- I3 digital input 3
- I4 digital input 4

④ X4
- O1 digital output 1
- O2 digital output 2
- O3 digital output 3
- O4 digital output 4

⑤ X5
- 24 +24V Supply digital outputs
- 24 +24V Supply incremental encoder U_{e24}
- 0V GND
- 0V GND

Figure 157: Pin assignment

35.3 Input and output wiring

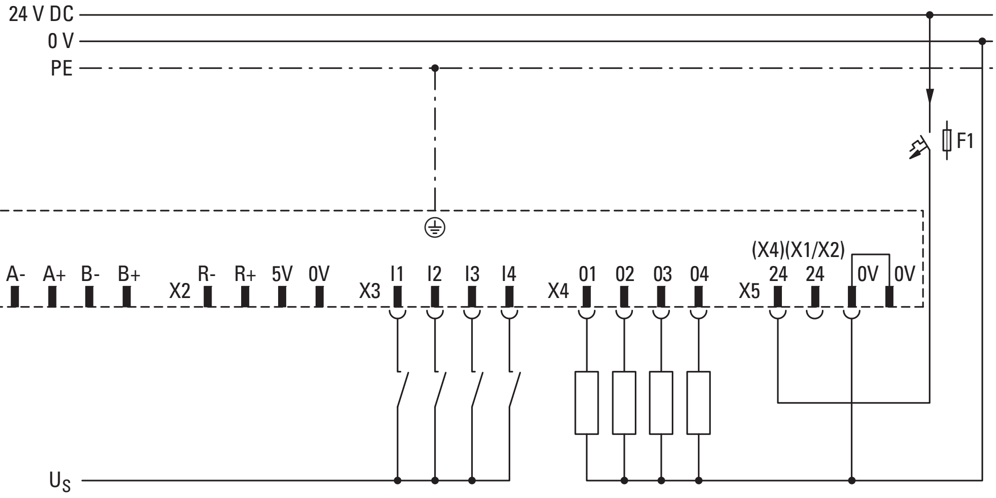


Figure 158: Wiring example for digital outputs and 4 digital inputs

35.3.1 RS422 mode wiring

→ Check to make sure that the encoder is suitable for operation with this module. To do this, compare the technical data for the encoder with the specifications for the XN300 slice module.

To run the counter module in RS422 mode, follow the steps below:

- ▶ Power the XN300 slice module with 24 VDC by connecting the power supply to the 24V incremental encoder supply and GND pins on terminal X5 (+24 V (X1/X2)).
- ▶ Connect the XN300 slice module's 5 V and 0 V pins to the incremental encoder's positive and negative potentials.
- ▶ Connect the incremental encoder's A, $\overline{A}$, B, $\overline{B}$, R, $\overline{R}$ output signals to the corresponding pins on the XN300 slice module.
- ▶ Use the control software to configure the device so that it runs in RS422 mode.

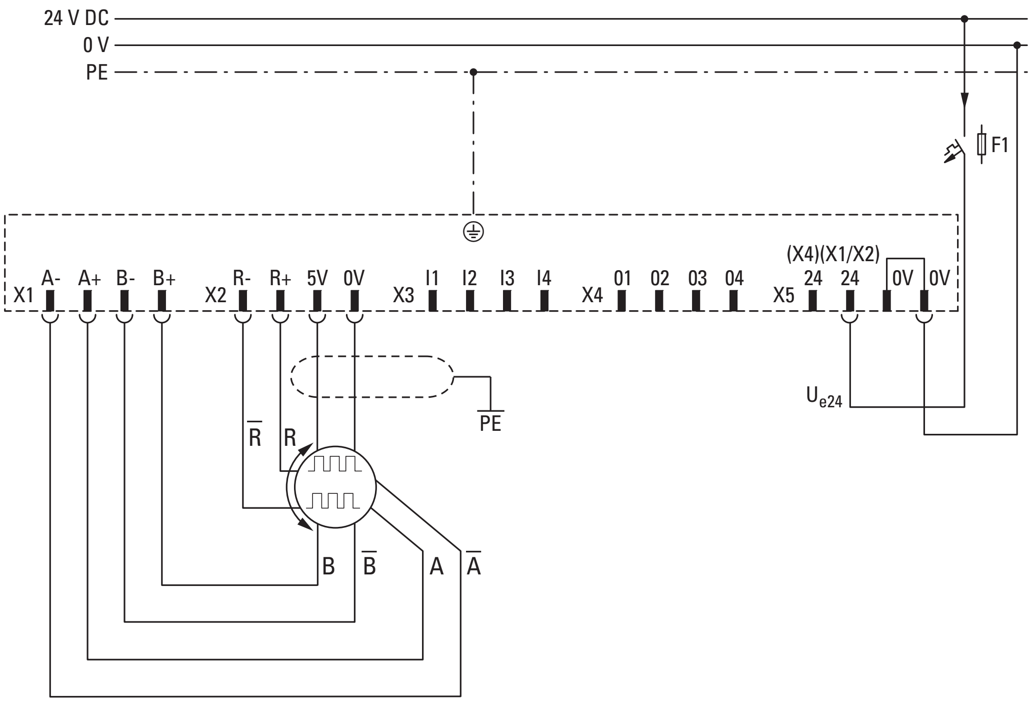


Figure 159: Wiring example for XN-322-1CNT-8DIO counter module in RS422 mode

35.3.2 TTL mode wiring

→ Check to make sure that the encoder is suitable for operation with this module. To do this, compare the technical data for the encoder with the specifications for the XN300 slice module.

To run the counter module in TTL mode, follow the steps below:

- ▶ Power the XN300 slice module with 24 VDC by connecting the power supply to the 24V incremental encoder supply and GND pins on terminal X5 (+24 V (X1/X2)).
- ▶ Connect the XN300 slice module's 5 V and 0 V pins to the incremental encoder's positive and negative potentials.
- ▶ Connect the incremental encoder's A, B, R output signals to the corresponding pins on the module.
- ▶ Use the control software to configure the device so that it runs in TTL mode.

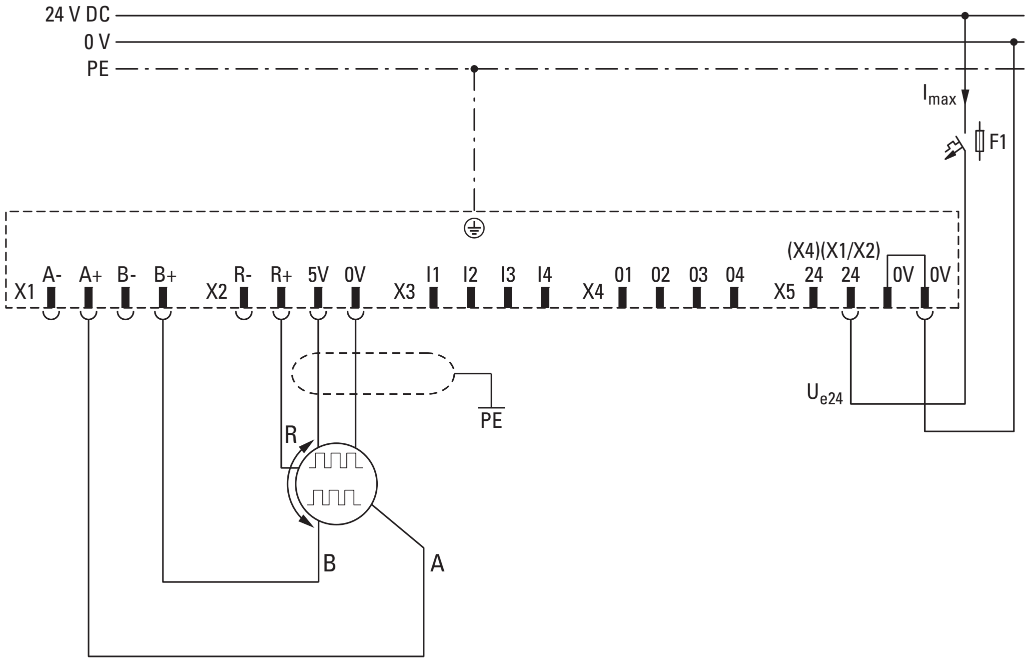


Figure 160: Wiring example for XN-322-1CNT-8DIO counter module in TTL mode

35.4 How the counter module works

In AB quadrature mode, the phase shift of the input signals at pins A and B is used to determine pulses and directions. To do this, signals A and B are evaluated for rising and falling edges. The device can be configured for X1, X2, or X4 encoding as necessary.

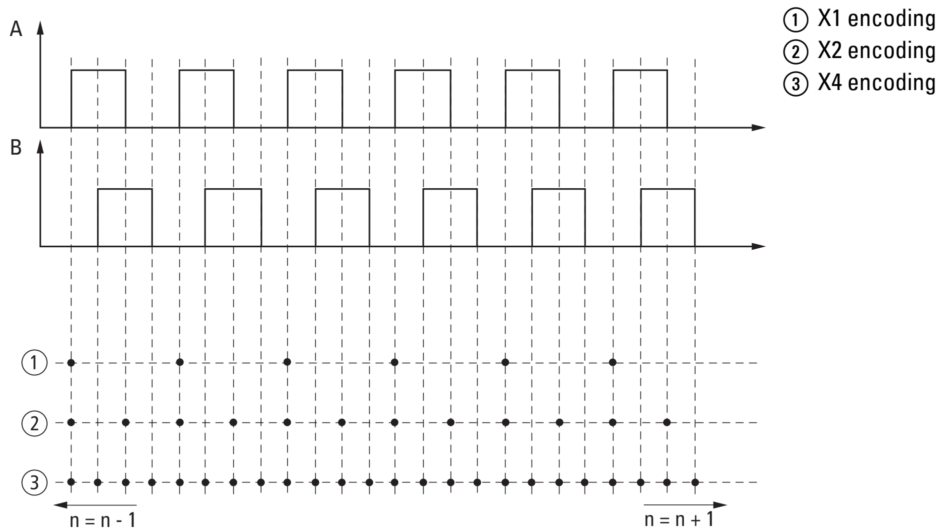


Figure 161: Signal diagram for counter module

The dots represent the points at which the count changes. If the signal sequence is followed in the direction the arrow is pointing (towards the right), this corresponds to a positive counting direction. If it is followed against it, this corresponds to a negative counting direction.

Please refer to Application examples → Chapter 39 "Appendix", page 330.

35.5 Technical specifications

35.5.1 Incremental encoder inputs

Designation	
Qty.	1
Input signal	
Incremental encoder signal RS422	A+, A-, B+, B-, R+, R- RS422 level (120 Ω termination)
Incremental encoder signal TTL(	A+, B+, R+) TTL level (1200 Ω Pull-Up)
Max. input frequency	125 kHz
Maximum counter frequency for X4 encoding	500 kHz
Signal analysis	X1, X2, X4 encoding
Encoder power supply	+5Vdc / 0.2A short-circuit proof

35.5.2 Digital inputs

Designation		
Number of channels	4	
	61131-2 Type1	
Input voltage U_E	30 Vdc	maximum 30 VDC
Signal level	LOW: $0 < U_e < +8$ V	HIGH: $+14 \text{ V} < U_e < +30$ V
Switching threshold	normally +11 VDC	
Input current at U_E=24Vdc	normally 3.7 mA	
Input delay	normally 5 ms	

35.5.3 Digital outputs

Quantity	4
Short-circuit proof as per EN 61131-2	Yes
Power supply for digital outputs	
Number of supply voltages	1 (X4, pin on connector 24)
Rated operating voltage U_e	24 Vdc
admissible range	18 – 30 VDC
Residual ripple	≤ 5 %
Maximum permissible total current for all output channels when using a duty factor of 100%	6A
Protection against polarity reversal	no
Output characteristic data	
„1“ signal	
Output voltage	$(U_e - 1V) < U_a < U_e$
Output current per channel	2A
Maximum breaking energy of an output when there is an inductive load	0.65 Joule
„0“ signal	
Output voltage	< 0.1 VDC
Max. output current per channel	≤ 100 µA
Residual current when the output has a state of "0"	≤ 12 µA
Switching-on delay	< 200 µs
Switch off delay	< 200 µs
Maximum breaking energy for all outputs when there is an inductive load	1.95 Joule/channel

35.6 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Description	bits	Status Bit n+1	Status Bit n	What the state means	Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState						–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number					–
–	–	0x9xx0 SUB 03	4	FPGAVersion						–
–	–	0x9xx0 SUB 04	4	DeviceType						–
–	–	0x9xx0 SUB 05	4	VendorID						–
–	–	0x9xx0 SUB 06	4	ProductCode						–
–	–	0x9xx0 SUB 07	4	Revision						–
–	–	0x9xx0 SUB 09	4	HWVersion						–
–	–	0x9xx0 SUB 0A	4	FWVersion						–
0x20F0		0x7xx0 SUB 01	1	Output1_4 Digital output register		Bit 0	Output 1			0x0003
						Bit 1	Output 2			
						Bit 2	Output 3			
						Bit 3	Output 4			
						Bit 4-7	reserved			
0x30F0		0x6xx0 SUB 01	1	Input1_4 Digital input register		Bit 0	Input 1			0x0003
						Bit 1	Input 2			
						Bit 2	Input 3			
						Bit 3	Input 4			
						Bit 4-7	reserved			

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Description	bits	Status Bit n+1	Status Bit n	What the state means	Local I/O addresses
0x30F1	–	0x6xx4 SUB 01	4	IdleTime	Pause time, measured by counting internal clock signals in this 32-bit counter register. The register contains the number of pulses, from an internal time reference, counted between the last two counter value increments (rising edges on signal A). The register value with the counted pulses is refreshed with a rising edge on A or when the maximum value is reached. Accordingly, this register makes it possible to represent count pulses per time unit for the frequency or speed measurement. The direction (sign) is determined based on the evaluation of the signal sequence when in AB quadrature mode.					0x0004
0x30F2	–	0x6xx4 SUB 02	2	CounterValue	Counter value (16-bite incremental encoder counter value) The counter resolves edges into numbers of pulses and directions. X1, X2 and X4 encoding are available.					0x0008
0x30F3	–	0x6xx4 SUB 03	2	LatchValue	Stored counter value (stored 16-bit incremental encoder counter value) This register contains the counter value stored by a latch pulse. The input that triggers this action must be configured accordingly.					0x000A
0x30F4	–	0x6xx4 SUB 04	1	EncoderStatus Incremental encoder status register		Bit 0-3			reserved	0x000C
						Bit 4			Zero position	
						Bit 5			reserved	
						Bit 6 (State +24V X4)			24 VDC OK on supply to outputs	
						Bit 7 (State +24V X1/X2)			24 VDC OK on supply to incremental encoder	
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber						–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl						–
0x400C	–	–	Max. 25	ProductName						–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Description	bits	Status Bit n+1	Status Bit n	What the state means	Local I/O addresses
0x40F0	–	0x8xxA SUB 01	1	LatchConfig Used to configure the latch function for the digital inputs Note: If multiple inputs are configured for the latch function, their signals will be OR'd.			Bit n+1	Bit n		0x0000
					Input 1	Bit 1-0	0	0	Latch function disabled	
							0	1	Latch on rising edge	
							1	0	Latch on falling edge	
							1	1	Latch on rising and falling edges	
					Input 2	Bit 3-2	0	0	Latch function disabled	
							0	1	Latch on rising edge	
							1	0	Latch on falling edge	
							1	1	Latch on rising and falling edges	
					Input 3	Bit 5-4	0	0	Latch function disabled	
							0	1	Latch on rising edge	
							1	0	Latch on falling edge	
							1	1	Latch on rising and falling edges	
					Input 4	Bit 7-6	0	0	Latch function disabled	
							0	1	Latch on rising edge	
							1	0	Latch on falling edge	
							1	1	Latch on rising and falling edges	
0x40F1	–	0x8xxA SUB 03	1	EncoderConfig Used to configure the input so that it matches the sensor output		Bit 0			0: TTL Sensor Output 1: RS422 Sensor Output	0x0002
						Bit 1- 7			reserved	
0x40F2 (WRITE)	–	0x8xx4 SUB 01	4	MaxIdleTime	Max. waiting time value (count range for the waiting time register (max. 31-bit)) This register uses the register width to define the maximum value for the waiting time. When the maximum value is reached, a motor stop is identified, for example.					0x0010
0x40F3	–	0x8xx4 SUB 02	1	IdleClock	Cycle prescaler for determining the waiting time Prescaler periods = Cycle [Hz] * Measuring time [sec]					0x0016

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description	Description	bits	Status Bit n+1	Status Bit n	What the state means	Local I/O addresses
0x40F4 (READ)	–	0x9xx1 SUB 01	1	SystemClock	Pulse frequency (System Clock) Pulse frequency in MHz					0x0017
0x40F5	–	–	2	CounterValueSDO	Counter value as acyclical access (16-bit incremental encoder counter value)					0x0018
0x40F6	–	0x8xxA SUB 02	1	SignalConfig Incremental encoder configuration register		Bit 0 -1	reserved			0x001A
						Bit 2	Inverted logic for R zero-position evaluation			
						Bit 3	Inverted logic for B phase evaluation			
						Bit 5-4	Bit n+1	Bit n	Signal analysis	
							0	0	Off	
							0	1	X1 encoding	
							1	0	X2 encoding	
							1	1	X4 encoding	
						Bit 6 -7	reserved			
0x40F7	–	0x6xxA SUB 01	1	EncoderStatusSDO Incremental encoder status register (acyclical access)		Bit 0 -3	reserved			0x001B
						Bit 4	Zero position present			
						Bit 5	Zero position has been crossed; Bit 5 will be automatically reset after the register is read.			
						Bit 6-7	reserved			
0x40F8	–	0x6xx4 SUB 03	2	LatchValueSDO	Stored counter value as acyclical access (stored 16-bit incremental encoder counter value) This register contains the counter value stored by a latch pulse. The input that triggers this action must be configured accordingly.					0x001C

36 Interface module XN-322-2SSI

The XN-322-2SSI SSI interface module can be used to read data from up to two absolute encoders and provide it to the PLC. The interface is designed for SSI encoders, e.g., absolute linear encoders, that support natural binary or Gray code.

→ Check to make sure that the encoder is suitable for operation with this XN300 slice module. To do this, compare the technical data for both devices.

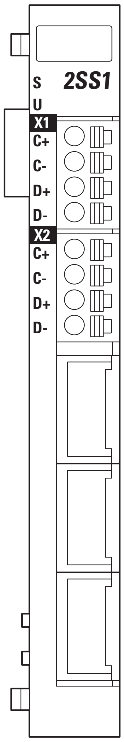


Figure 162: Device view XN-322-2SSI

36.1 Status LEDs

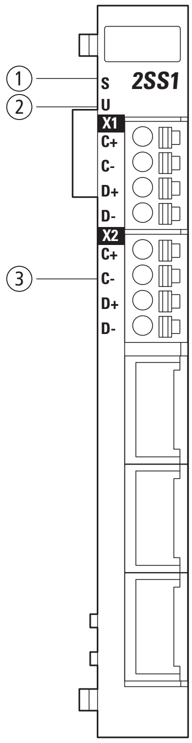


Figure 163: XN-322-2SSI LEDs

1. Module status LED
2. User status LED
3. SSI encoder LED

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
Status User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASH (200 ms ON, 1000 ms OFF)	
		FLASH (1000 ms ON, 200 ms OFF)	
SSI encoder status	Green	ON	There is communication with the SSI encoder
		OFF	No communication with the SSI encoder

36.2 Pin assignment

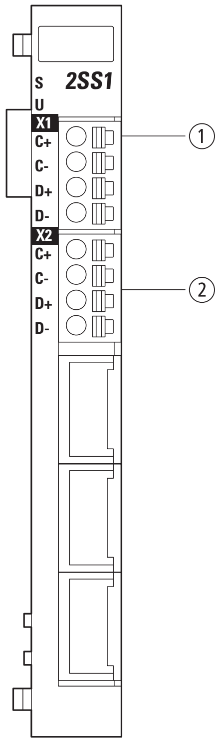


Figure 164: Pin assignment XN-322-2SSI

① X1
- C+ encoder 1
- C- encoder 1
- D+ encoder 1
- D- encoder 1

② X2
- C+ encoder 2
- C- encoder 2
- D+ encoder 2
- D- encoder 2

36.3 Wiring topic

SSI encoders can be run in two different modes:

- Binary Mode
- Gray Decoder Mode

36.3.1 Binary Mode

When using binary mode, Gray code decoding must be turned off (it is turned off by default). This mode can also be used when the encoder delivers Gray code data that includes unencoded extra bits, i.e., as using automatic decoding in this case would yield an incorrect final result. In this latter case, decoding must be carried out in the PLC program. The encoder's deserialized data stream will be mapped to the channel's relevant data register as a 32-bit value.

36.3.2 Gray Decoder Mode

For encoders delivering Gray code data, the result will be automatically decoded (Gray code decoding ON) and provided as a 32-bit value in the channel's corresponding data register. Additional bits in the encoder's data stream must be taken into account in this mode. Automatic decoding will result in incorrect decoding if there are additional bits that are not encoded and that are transmitted before the encoded measurement data in the serial data stream. In this case, using binary mode is recommended. If the additional bits that have not been encoded instead come after the measurement data in the encoder's serial data stream, decoding will only result in the additional bits being corrupted.

36.3.3 Terminal type

The current reading is continuously written to a shift register in the sensor. If a data value needs to be read, the device will output a clock signal on the clock line. With this clock signal, the device will then read the data from the encoder's shift register. Absolute encoders provide their absolute data with additional control information in the shift register if applicable.

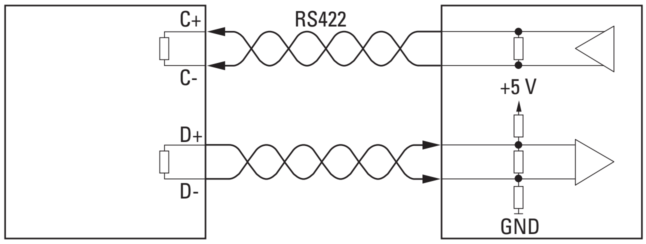


Figure 165: Look

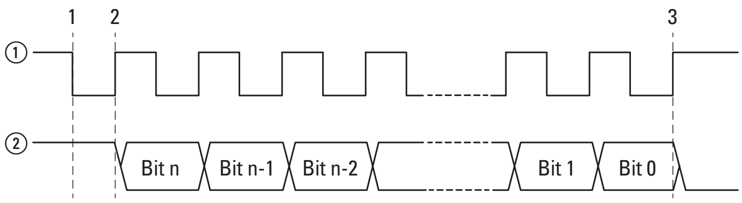


Figure 166: Look

① Clock
② Data

36.3.4 Wiring example

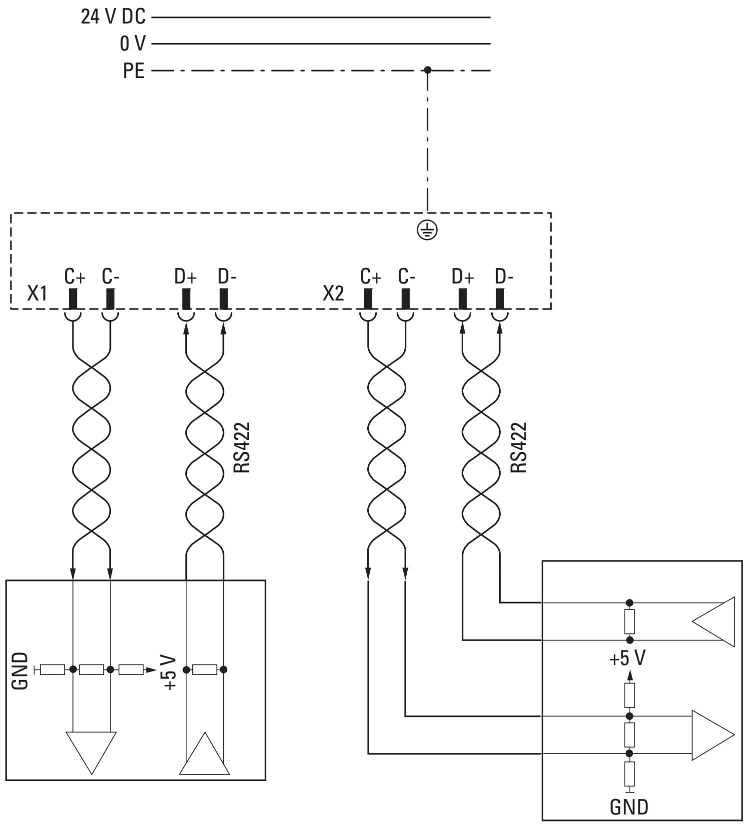


Figure 167: Wiring example XN-322-2SSI

36.4 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2100		0x7xx9 SUB 01	1	StartReadCycle Starts read cycle	Bit 0	Start Read Channel 1	0x0004
					Bit 1	Start Read Channel 2	
					Bit 2-7	reserved	
0x3100		–	1	ReadCycleState			
0x3101		0x8xxA SUB 01	1	ModuleDiag Channel status data for channel 1 and channel 2	Bit 0	Channel 1 „started“	0x0007
					Bit 1	Channel 1 „busy“	
					Bit 2	Channel 1 „toggle“	
					Bit 3	Channel 1 SSI Error/ Invalid Z-Position	
					Bit 4	Channel 2 „started“	
					Bit 5	Channel 2 „busy“	
					Bit 6	Channel 2 „toggle“	
					Bit 7	Channel 2 SSI Error/ Invalid Z-Position	
0x3102		0x8xxA SUB 02	4	InputChannel1	Bit 0-31	SSI Input Data	0x0008
0x3103		0x8xxA SUB 03	4	InputChannel2	Bit 0-31	SSI Input Data	0x000C

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x4001	–	0x9xx0 SUB 08	max.10	CAN: SerialNumber EC: Serialnumber			–
0x4004	–	0x8xx1 SUB 01	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4100		0x8xxA SUB 01	1	ConfigurationRegisterChannel1 Configuration registers channel 1 (Default 0x20)	Bit 0-5	SSI Shift Register ; Length: 1-32 Bit Bit 5 4 3 2 1 0 0 0 0 0 0 0 reserved 0 0 0 0 1 1 1-bit register 0 0 0 0 1 0 2-bit register . . . 0 1 1 1 1 1 31-bit register 1 0 0 0 0 0 32-bit register 1 0 0 0 0 1 reserved . . . reserved 1 1 1 1 1 1 reserved	0x0000
					Bit 6	Read mode: 0: Single Read 1: Double Read	
					Bit 7	reserved	
0x4101		0x8xxA SUB 02	1	StateRegisterChannel1 Channel 1 status and control register	Bit 0.1	SSI Shift Register Frequency 00 = 125 kHz 01 = 250 kHz 10 = 500 kHz 11 = 1 MHz	0x0001
					Bit 2	0: Binary Data 1: Gray Code Decoding	
					Bit 3	SSI busy (1= busy) (read only)	
					Bit 4	Reserved	
					Bit 5	Error Clear (1 = clear error) (write)	
					Bit 6	Start with Sync (1= enable)	
					Bit 7	Continuous Sensor Read (1= enable)	

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x4102		0x8xxA SUB 03	1	ConfigurationRegisterChannel2 Configuration registers channel 2 (Default 0x20)	Bit 0-5	SSI Shift Register ; Length: 1-32 Bit Bit 5 4 3 2 1 0 0 0 0 0 0 0 reserved 0 0 0 0 1 1 1-bit register 0 0 0 0 1 0 2-bit register … 0 1 1 1 1 1 31-bit register 1 0 0 0 0 0 32-bit register 1 0 0 0 0 1 reserved … reserved 1 1 1 1 1 1 reserved	0x0002
					Bit 6	Read mode: 0: Single Read 1: Double Read	
					Bit 7	reserved	
0x4103		0x8xxA SUB 04	1	StateRegisterChannel2 Channel 2 status and control register	Bit 0.1	SSI Shift Register Frequency 00 = 125 kHz 01 = 250 kHz 10 = 500 kHz 11 = 1 MHz	0x0003
					Bit 2	0: Binary Data 1: Gray Code Decoding	
					Bit 3	SSI busy (1= busy) (read only)	
					Bit 4	Reserved	
					Bit 5	Error Clear (1 = clear error) (write)	
					Bit 6	Start with Sync (1= enable)	
					Bit 7	Continuous Sensor Read (1= enable)	

37 Pulse width module XN-322-2PWM

The XN-322-2PWM module features two outputs (P1 and P2) on terminal X1 for pulse width modulation (PWM) that can be used to switch +24 V with an adjustable frequency in order to drive inductive loads such as solenoid valves, proportional valves, etc.

The two PWM outputs are powered via terminal X1 with a 24 V supply voltage and 0 V. The supply voltage is monitored for undervoltage.

The XN-322-2PWM module can be configured with two parameters. The pulse width is used to specify the length of the pulse duration within a period and can be adjusted in increments of 0.5 µs with software.

Meanwhile, the PWM frequency can be adjusted as a period in increments of 0.5 µs between 30.5 Hz and 20 kHz – please refer to → Section "Figure 172: Signal Pulse width modulation", page 308

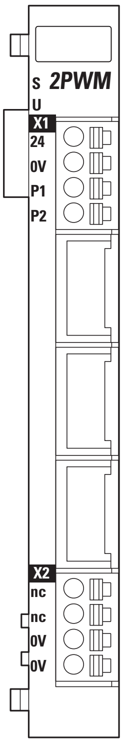


Figure 168: Device view XN-322-2PWM

37.1 Status LEDs

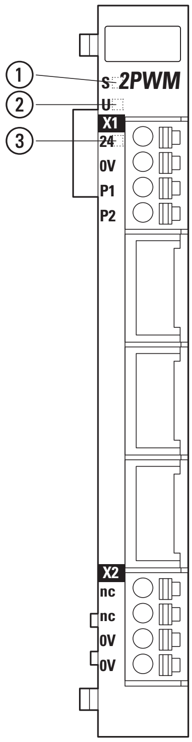
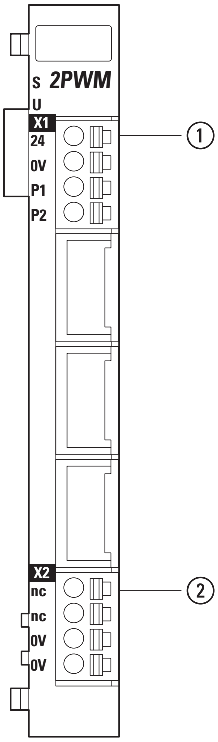


Figure 169: LED signals and pin assignment

① Module status LED
② User LED
③ P1 and P2 POW supply voltage LED

Module Status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	
POW P1/P2	Green	ON	Supply voltage for PWM outputs present
		OFF	Supply voltage <18 V for the PWM outputs

37.2 Pin assignment



1. X1
   - 24 V POW supply voltage for P1 and P2
   - 0 V for PWM outputs P1 and P2
   - P1 output PWM 1
   - P2 output PWM 2
2. X2
   - not wired
   - not wired
   - 0V GND
   - 0V GND

Figure 170: Pin assignment

37.3 Wiring topic

The module can be used to drive two valves or other inductive loads with PWM.

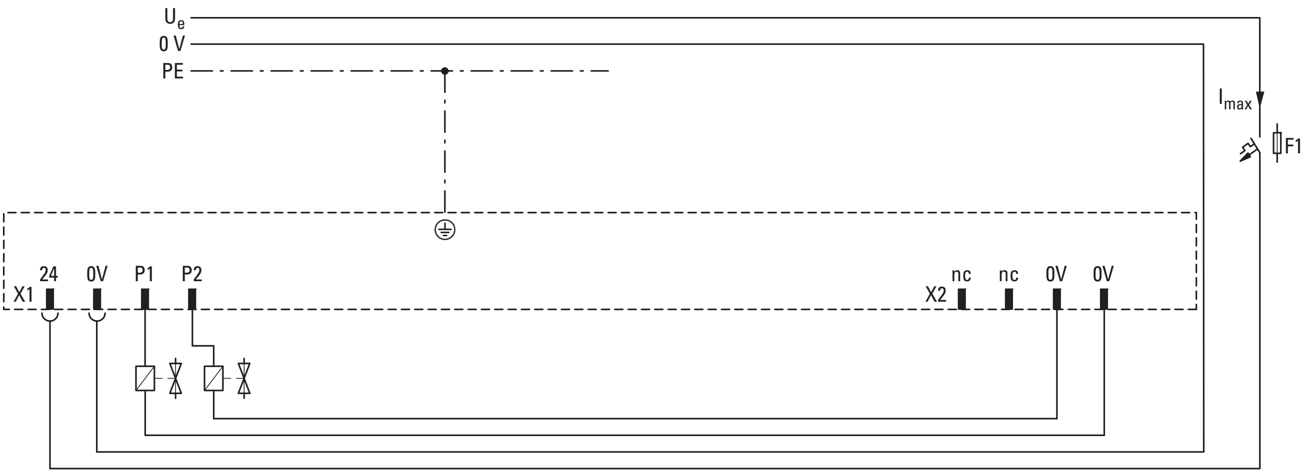


Figure 171: Wiring diagram with wiring for P1 and P2

37.4 Settings

The minimum switching granularity t_S is 500 ns. The minimum period duration T_{Period} is 100*500 ns = 50 µs. This yields a maximum frequency of 20 kHz.

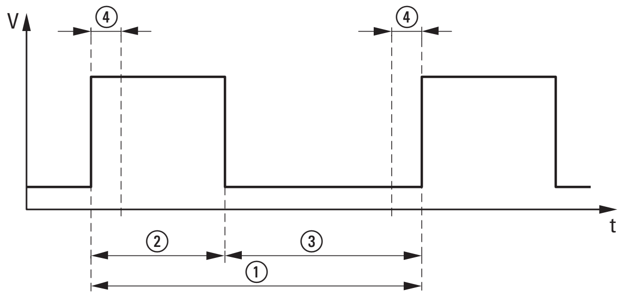


Figure 172: Signal Pulse width modulation

① $50\ \mu s \leq T_{Period} \leq 32787\ \mu s$
② $t_{Impulse} \geq 1.5\ \mu s$
③ $t_{Pause} \geq 3\ \mu s$
④ Minimum period / "off" duration = 4.5 µs

With 0, the signal is completely OFF.

$$f = \frac{1}{T}$$

f: frequency
T : period duration

37.5 Technical data for the PWM module

Number of channels	**2**
Power supply P1, P2	+24 V +18 V…+30 V
System bus supply voltage	+5 V
System bus current draw	normally 50 mA
Short-circuit proof	Yes
Maximum current per channel	1.5 A at 45°C 1 A at 55°C
Configurable parameters	
PWM frequency	Adjustable in increments of 0.5 µs via software
Minimum frequency	30.5 Hz
Maximum frequency	20 kHz
Pulse width	settable in increments of 0.5 µs

37.6 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway:
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
–	–	0x9xx0 SUB 01	4	ModuleState			–
0x1027	–	0x9xx0 SUB 02	CAN:2 EC:4	CAN: ModuleID EC: DeviceID	Module ID number		–
–	–	0x9xx0 SUB 03	4	FPGAVersion			–
–	–	0x9xx0 SUB 04	4	DeviceType			–
–	–	0x9xx0 SUB 05	4	VendorID			–
–	–	0x9xx0 SUB 06	4	ProductCode			–
–	–	0x9xx0 SUB 07	4	Revision			–
–	–	0x9xx0 SUB 09	4	HWVersion			–
–	–	0x9xx0 SUB 0A	4	FWVersion			–
0x2220	0x6411 SUB 01	0x7xx4 SUB 01	2	Pwm1TurnOnTime P1 pulse duration, adjustable in increments of 500 ns, please refer to 2 → Figure 172	Bit 0-15	0: PWM not activated; in the event of a periphery reset, all bits are set to a value of 0.	0x0000
0x2221	0x6411 SUB 02	0x7xx4 SUB 02	2	Pwm2TurnOnTime P2 pulse duration, adjustable in increments of 500 ns refer to 2 → Figure 172	Bit 0-15	0: PWM not activated; in the event of a periphery reset, all bits are set to a value of 0.	0x0002
0x3220	–	0x6xxA SUB 01	1	Status register	Bit 0	1: Current high (7 A)	0x0010
					Bit 1	1: Overcurrent (14 A); a periphery reset will be triggered	
					Bit 2	1: DC ok Supply voltage for outputs P1/P2 ok	
					Bit 3	1: Periphery reset	
					Bit 4	1: Voltage for output stage too high; a periphery reset will be triggered	
					Bit 5-7	reserved	
0x4001	–	0x9xx0 SUB 08	max.10	CAN:SerialNumber ECSerialnumber			–

CAN Object Index	Default CAN Mapping	EtherCAT Object Index	Size (byte)	Local I/O description			Local I/O addresses
0x4004	–	–	1	UserLEDControl			–
0x400C	–	–	Max. 25	ProductName			–
0x4220	–	0x7xx4 SUB 01	2	Pwm1Period refer to 1 → Figure 172	Bit 0-15	Used to select the period duration for channel 1-2; Default: 0; This default value must be set to a valid period duration. The period duration can be set to a value between 50 and 32767 μs in increments of 500 ns	0x0004
0x4221	–	0x7xx4 SUB 01	2	Pwm2Period refer to 1 → Figure 172	Bit 0-15		0x0006

38 XN-322-2SI-RS serial interface specialty module

The XN-322-2SI-RS module is an XN300 slice module with an RS-232 interface and an RS-485 interface.

The RS-232 interface on connector X1 supports transmission rates from 4,8 kbaud up to 115,2 kbaud and can be run with or without RTS and CTS handshake signals.

Connectors X2 and X3 can be used to access the RS-485 interface. The signals connected in parallel are intended for forwarding the RS-485 signal. In addition, the termination for the interface (120 Ω termination resistor) and 1 kΩ spread resistors can be activated in the configuration. The RS-485 interface is overvoltage-proof up to 15 V and can be run with transmission rates from 4.8 kbaud up to 115.2 kbaud.

An external power supply is not required.

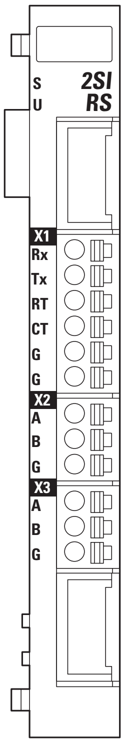


Figure 173: Device view XN-322-2SI-RS

38.1 Status LEDs

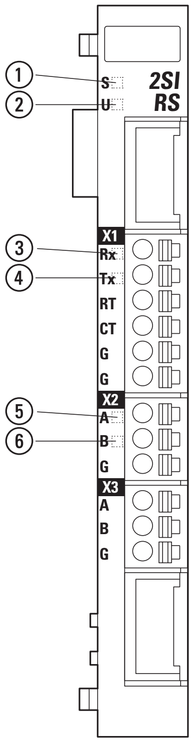


Figure 174: Display

1. Module status LED
2. User LED
3. RS-232 RxD1 Read LED
4. RS-232 TxD1 Transmit LED
5. RS-485 Rx Read LED
6. RS-485 Tx Transmit LED

Table 16 Status LED table

Module status	Green	ON	System OK
		OFF	No power
		FLASHES (5 Hz)	No communications
User	yellow	ON	The user can set the LED signals as necessary. (For example, the visualization interface can be used to set the module's LED to flash so that it is easier to find the module inside the control panel.)
		OFF	
		FLASHES (2 Hz)	
		FLASHES (4 Hz)	
RS232 Rx1)	Green	Flashes	Data is being received
RS232 Tx1)	yellow	Flashes	Data is being transferred
RS485 Rx	Green	Flashes	Data is being received
RS485 Tx	yellow	Flashes	Data is being transferred

1) Only the first RS-232 interface has RX/Tx LEDs in case two of these interfaces are configured

38.2 Pin assignment

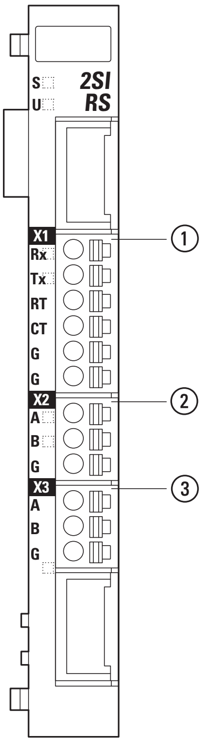


Figure 175: Pin assignment

1. X1
   - Rx RS-232 RxD1 Read
   - Tx RS-232 TxD1 Transmit
   - RT RS232 RTS1 Ready to send/ oder: TxD2 Transmit D2
   - CT RS232 CTS1 Clear to send / oder: RxD2 Read D2
   - G RS232 GND
2. X2
   - A RS485 A
   - B RS485 A
   - G RS485 GND
3. X3
   - A RS485 A
   - B RS485 A
   - G RS232 GND

38.3 Wiring topic

One or two RS-232 interfaces can be wired to connector X1.

X2 and X3 are internally connected to each other and can be wired as a single RS-485 interface.

Shielded twisted pair cables must be used when wiring data cables.

The XN-322-2SI-RS XN300 slice module features two spread resistors and a termination resistor that can be activated through the software.

External spread and termination resistors can be used. If you do this, make sure not to activate the internal resistors with the application anymore.

Maximum number of RS485 participants: 32 nodes

Maximum length: 500 m; the cable length is the complete length, including all stubs.

38.3.1 RS485 interface

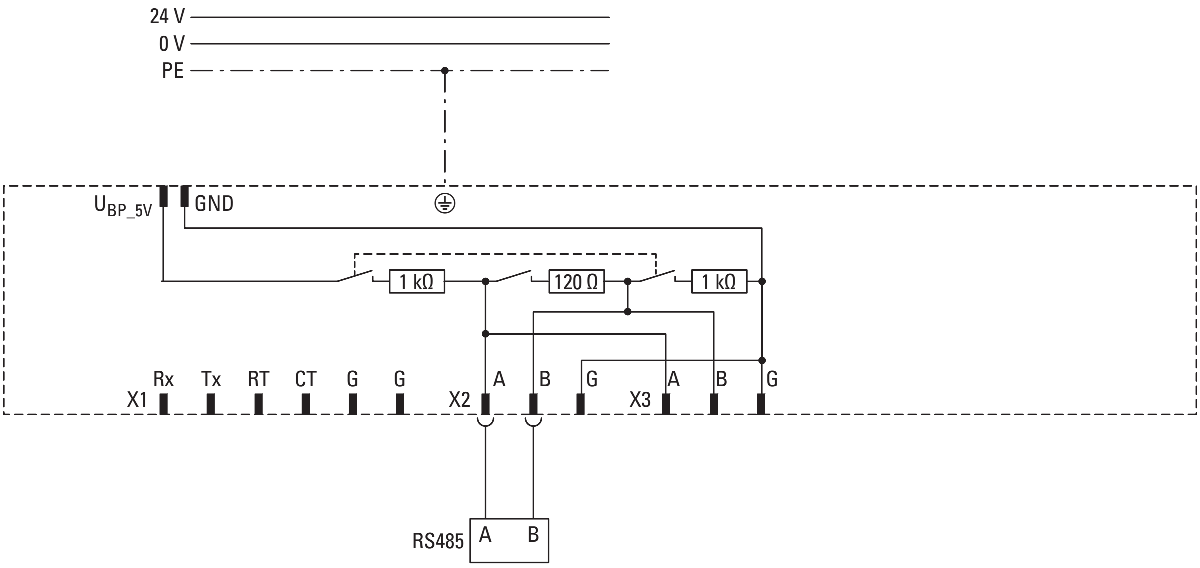


Figure 176: Wiring for an RS-485 interface with the internal termination resistor

38.3.2 RS232 interface

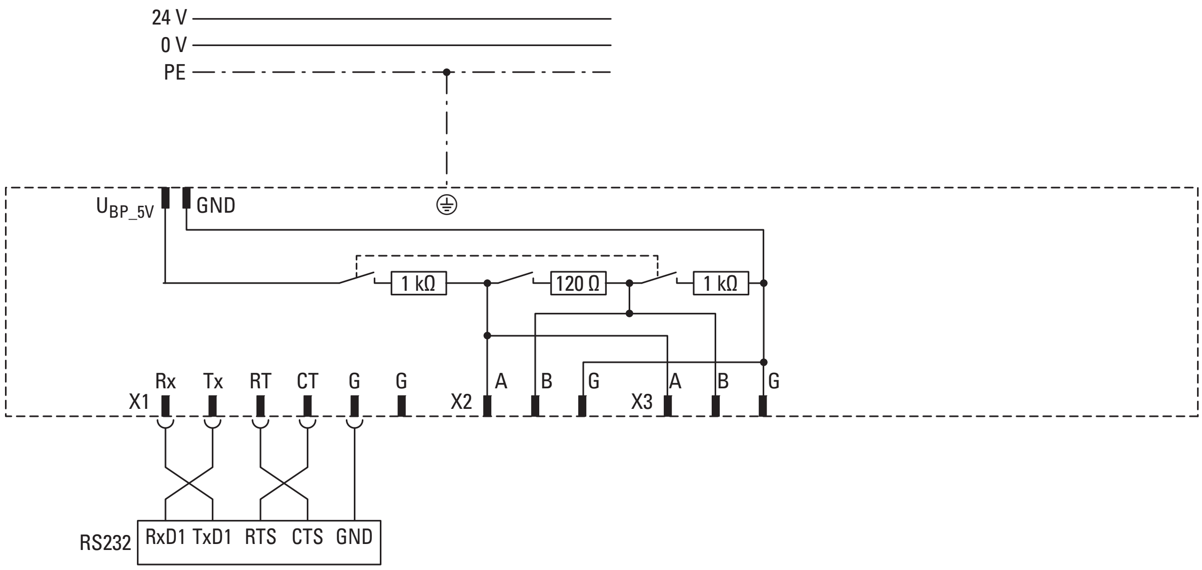


Figure 177: Wiring for an RS-232 interface

38.4 Technical data for the serial interfaces

Table 17 Technical data for the serial interfaces

Interfaces	One RS-232 with handshake or two RS-232 without handshake can be configured through software	
RS232	in baud	
Data transfer rates	4800 9600 19200 38400 57600 62500 115200 Additional baud rates are possible for CANopen communications with DivisorLatch 0x4201.	
Overvoltage capability	RxD terminal contact TxD terminal contact	± 30 V ± 15 V
Node	≤ 2	
Max. cable length[1)]	15 m	
RS485	4800 9600 19200 38400 57600 62500 115200 Additional baud rates are possible for CANopen communications with DivisorLatch 0x4203.	
Overvoltage capability	A/B terminal contact	-9…± 14 V
Spread resistor	1 kΩ between U_{BP_5V} and the common potential of X2/A, X3/A; 1 kΩ between GND and the common potential of X2/B, X3/B; each one can be activated internally	
Bus termination resistor	120 Ω; can be activated internally	
Node	≤ 32	
Max. cable length[1)]	500 m	
Short-circuit proof	Yes	
Status LEDs	Yes	
Send buffer	240 byte	
Receive buffer	784 byte	

1) ISO 8482: The cable length is the complete length, including the stubs

38.5 Library with function blocks for running XN-322-2SI-RS

Data transmission between the XN322-2SI-RS and the XControl modular PLC or the XN-312 gateways is supported by the EA_XN322_2SI_RS.library. This library contains general data types,
structures, and enumeration definitions, functions, and function blocks for running the XN-322-2SI-RS.

The library itself contains additional information regarding the available functions and how they are used.

For more information on how this library can be integrated, please refer to the "Libraries, function blocks, and functions" section of manual MN050005, "XControl modular PLCs."

38.6 Memory layout

→ For product-specific CANopen or EtherCAT objects please refer to the manual for the respective gateway
"CANopen Gateway XN-312-GW-CAN", MN050003EN
"EtherCAT Gateway XN-312-GW-EC", MN050010EN.

38.6.1 CANopen objects

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x1027	–	2	CAN: ModuleID	Module ID number			–
0x3200	–	2	Status232 Setting up the RS232 interface via „Modem Status Register“ and „Line Status Register“	Byte 0 Modem Status-Register	Bit 0	1:Delta Clear to Send Signal received	0x0180
					Bit 1	1: Delta Data Set Ready	
					Bit 2	1: Trailing Edge Ring Indicator	
					Bit 3	1: Delta Data Carrier Detect	
					Bit 4	1: Clear to Send	
					Bit 5	1: Data Set Ready	
					Bit 6	1: Ring Indicator	
					Bit 7	1: Data Carrier Detect	
				Byte 1 Line Status Register	Bit 0	1: Transmitter Holding Register Empty	
					Bit 1	1: Rx Parity Error	
					Bit 2	1: Rx Framing Error	
					Bit 3	1: Break Condition receivedBit	
					Bit 4	1: Tx Busy	
					Bit 5	1: Receive Buffer Overflow	
					Bit 6-7	reserved	

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x3201	–	2	ControlRb232 Reading back parameter Control232	Bit 0	1: Data Terminal Ready		0x0182
				Bit 1	1: Request to Send aktiv		
				Bit 2	Mode/de	(fix) 0: RS232 mode	
				Bit 3	reserved		
				Bit 4	reserved		
				Bit 5	Echo	1: disable(default)	
				Bit 6	reserved		
				Bit 7	reserved		
				Bit 8-9	Bit 8-9 00 01 10 11	Data word length 0: 5Bit 1: 6Bit 2: 7Bit 3: 8Bit	
				Bit 10	Number of stop bits 0: 1:	1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
				Bit 11	Parity Enable	0: No parity 1: Parity	
				Bit 12	Even Parity Select	0: Odd 1: Even	
				Bit 13	reserved		
				Bit 14	Set Break	1: Receive Buffer Overflow	
				Bit 15	reserved		
0x3202	–	1	ReceiveCount232	Number of bytes in receive buffer			0x0184
0x3203	–	1	TransmitCount232	Number of bytes in send buffer			0x0185

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x3204	–	2	Status485	Byte 0 Modem Status-Register	Bit 0	1: Delta Clear to Send	0x0280
					Bit 1	1: Delta Data Set Ready	
					Bit 2	1: Trailing Edge Ring Indicator	
					Bit 3	1: Delta Data Carrier Detect	
					Bit 4	1: Clear to Send	
					Bit 5	1: Data Set Ready	
					Bit 6	1: Ring Indicator	
					Bit 7	1: Data Carrier Detect	
				Byte 1 Line Status Register	Bit 0	1: Transmitter Holding Register Empty	
					Bit 1	1: Rx Parity Error	
					Bit 2	1:Rx Framing Error	
					Bit 3	1: Break Condition received	
					Bit 4	1: Rx Busy	
					Bit 5	1: Rx Receive Buffer Overflow	
					Bit 6-7	reserved	

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x3205	–	2	ControlRb485 Reading back Status485	Byte 0 Modem Control-Register	Bit 0	Data Terminal Ready	0x0282
					Bit 1	Request to Send	
					Bit 2	(fix) 1: RS485 mode	
					Bit 3	reserved	
					Bit 4	reserved	
					Bit 5	1: Echo disable (default)	
					Bit 6	reserved	
					Bit 7	reserved	
				Byte 1 Line Control Register	Bit 0-1 00 01 10 11	Data word length 0: 5 Bit 1: 6 Bit 2: 7 Bit 3: 8 Bit	
					Bit 2 Number of stop bits 0: 1:	1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
					Bit 3	Parity Enable 0: No parity 1: Parity	
					Bit 4	Even Parity Select 0: Odd 1: Even	
					Bit 5	reserved	
					Bit 6	Set Break	
					Bit 7	reserved	
0x3206	–	1	ReceiveCount485	Byte counter for Rx-FiFo for RS-485			0x0284
0x3207	–	1	TransmitCount485	Number of bytes in TX send buffer			0x0285

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x3208	–	1	ModuleStatus		Bit 0-3	HW-Indentify	0x0380
					Bit 4	DC OK 24V	
					Bit 5	Comparator input U > 50V	
					Bit 6	reserved	
					Bit 7	Resistor Status Internal termina-tion resistor ("1" = active)	
0x4001	–	max.10	CAN:SerialNumber				–
0x4004	–	1	UserLEDControl				–
0x400C	–	Max. 25	ProductName				–

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x4200	–	2	Control232 Setting up the RS232 interface	Byte 0 Modem Control Register	Bit 0	1: Data Terminal Ready	0x0100
					Bit 1	1: Request to Send	
					Bit 2	Mode/de. (fix) 0: RS 232 mode,	
					Bit 3	reserved	
					Bit 4	reserved	
					Bit 5	1: Echo disabled (default)	
					Bit 6	reserved	
					Bit 7	reserved	
				Byte 1 Line Control Register	Bit 0-1 00 01 10 11	Data word length 0: 5 Bit 1: 6 Bit 2: 7 Bit 3: 8 Bit	
					Bit 2 Number of stop bits 0: 1:	1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
					Bit 3	Parity Enable 0: No parity 1: Parity	
					Bit 4	Even Parity Select 0: Odd 1: Even	
					Bit 5	reserved	
					Bit 6	1: Set Break	
					Bit 7	reserved	
0x4201	–	2	DivisorLatch232 Baud rate setting examples [in kbaud] 0xC0C0: 4800 0xC060: 9600 0xC030: 19200 0xC180: 38400 0xC010: 57600 0xC008: 115200	Bit 0-13	clock divider	Freq/(16*baud rate)	0x0102
				Bit 14-15	input frequency select	00: 1.8432 MHz 01: 1 MHz 10: 7.3728 MHz 11: 14.7456 MHz	

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x4202	–	2	Control485	Byte 0 Modem Control-Register	Bit 0	1: Data Terminal Ready	0x0200
					Bit 1	1: Request to Send	
					Bit 2	Mode/de. (fix) 0: RS 485 mode,	
					Bit 3	reserved	
					Bit 4	reserved	
					Bit 5	1: Echo disabled (default)	
					Bit 6	reserved	
					Bit 7	reserved	
				Byte 1 Line Control Register	Bit 0-1 00 01 10 11	Data word length 0: 5 Bit 1: 6 Bit 2: 7 Bit 3: 8 Bit	
					Bit 2 Number of stop bits 0: 1:	1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
					Bit 3	Parity Enable 0: No parity 1: Parity	
					Bit 4	Even Parity Select 0: Odd 1: Even	
					Bit 5	reserved	
					Bit 6	1: Set Break	
					Bit 7	reserved	

CAN Object Index	Default CAN Mapping	Size (byte)	Local I/O description				Local I/O addresses
0x4203	–	2	DivisorLatch485 Baud rate setting examples [in kbaud] 0xC0C0: 4800 0xC060: 9600 0xC030: 19200 0xC180: 38400 0xC010: 57600 0xC008: 115200	Bit 0-13	clock divider	Freq/(16*baud rate)	0x0202
				Bit 14-15	input frequency select	00: 1.8432 MHz 01: 1 MHz 10: 7.3728 MHz 11: 14.7456 MHz	
0x4204	–	1	SetPhysics485	Bit 0	RS485 Termination Resistor	1: active, no read back	0x0380
				Bit 1	RS-485 spread resistor	1: active, no read back	
				Bit 2-5	reserved		
				Bit 6	Resistors activation (Pull-Up/Down)	1: active, no read back	
				Bit 7	reserved		
0x4205	–	max. 120	TransmitBuffer232 Maximum register size of 120 bytes	The memory contents will be written to Tx-FiFo			–
0x4206	–	max. 120	ReceiveBuffer232 Maximum register size of 120 bytes	The data will be read from Rx-FiFo and written to the register.			–
0x4207	–	max. 120	TransmitBuffer485 Maximum register size of 120 bytes	Memory contents will be written to RS-485 Tx-FiFo			–
0x4208	–	max. 120	ReceiveBuffer485 Maximum register size of 120 bytes	The data will be read from RS-485 Rx-FiFo and written to the register.			–

38.6.2 Memory layout for EtherCAT objects

EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x9xx0 SUB 01	4	ModuleState				–
0x9xx0 SUB 02	EC:4	EC: DeviceID	Module ID number			–
0x9xx0 SUB 03	4	FPGAVersion				–
0x9xx0 SUB 04	4	DeviceType				–
0x9xx0 SUB 05	4	VendorID				–
0x9xx0 SUB 06	4	ProductCode				–
0x9xx0 SUB 07	4	Revision				–
0x9xx0 SUB 09	4	HWVersion				–
0x9xx0 SUB 0A	4	FWVersion				–
0x6xx0 SUB 01	2	RS232	RTS	Bit 0	1: Request to send signal is set (read-back)	0x182
0x6xx0 SUB 02	2	RS232	CTS	Bit 4	1: Clear to send signal received	0x180
0x6xxA SUB 01	2	Status232 Setting up the RS232 interface via „Modem Status Register“ and „Line Status Register“	Byte 1 Line Status Register	Bit 0	1: Transmitter Holding Register Empty	0x0180
				Bit 1	1: Rx Parity Error	
				Bit 2	1: Rx Framing Error	
				Bit 3	1: Break Condition receivedBit	
				Bit 4	1: Tx Busy	
				Bit 5	1: Receive Buffer Overflow	
				Bit 6-7	reserved	
0x6xx9 SUB 01	2	VoltageOK		Bit 0	1: State 24 VDC OK	–
				Bit 1-15	reserved	
0x6xxA SUB 02	1	TransmitCount232	Number of bytes in send buffer			0x0185
0x7xx0 SUB 1	2	SetRTS232	Bit 0		1: Set Request to send	–

EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x6xxA SUB 03	2	Status485	Byte 1 Line Status Register	Bit 0	1: Transmitter Holding Register Empty	0x0280
				Bit 1	1: Rx Parity Error	
				Bit 2	1:Rx Framing Error	
				Bit 3	1: Break Condition received	
				Bit 4	1: Rx Busy	
				Bit 5	1: Rx Receive Buffer Overflow	
				Bit 6-7	reserved	
0x6xxA SUB 04	1	TransmitCount485	Number of bytes in TX send buffer			0x0285
0x9xx0 SUB 08	max.10	SerialNumber				–
0x8xx1 SUB 01	1	UserLEDControl				–
0x8xxA SUB 01	2	Control232 Setting up the RS232 interface	Byte 0 Modem Status-Register	Bit 0	Enable Interface	0x0100
				Bit 1-7	reserved	
0x8xxA SUB 03			Byte 1 Line Status Register	Bit 0-1 00 01 10 11	Data word length 0: 5 Bit 1: 6 Bit 2: 7 Bit 3: 8 Bit	
0x8xxA SUB 05				Bit 2 0: 1:	Number of stop bits 1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
0x8xxA SUB 04				Bit 3	0: No parity	
				Bit 4	1: Even parity	
				Bit 5	1: Odd parity	
				Bit 6	1: MARK	
				Bit 7	1: SPACE	

EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x8xxA SUB 02	4	Baud rate232	Bit 0-15	0xC0C0	4800 kBaud	0x0102
				0xC060	9600 kBaud	
				0xC030	19200 kBaud	
				0xC180	38400 kBaud	
				0xC010	57600 kBaud	
				0xC008	115200 kBaud	
0x8xxA SUB 07	2	Control485	Byte 0 Modem Status-Register	Bit 0	Enable Interface	0x0200
				Bit 1-7	reserved	
0x8xxA SUB 09			Byte 1 Line Status Register	Bit 0-1 00 01 10 11	Data word length 0: 5Bit 1: 6Bit 2: 7Bit 3: 8Bit	
0x8xxA SUB 11				Bit 2 0: 1:	Number of stop bits 1 stop bit, 1.5 stop bits for 5-bit data word length 2 stop bits for 6-bit, 7-bit, 8-bit data word length	
0x8xxA SUB 10				Bit 3	0: No parity	
				Bit 4	1: Even parity	
				Bit 5	2: Odd parity	
				Bit 6	3: MARK	
				Bit 7	4: SPACE	

EtherCAT Object Index	Size (byte)	Local I/O description				Local I/O addresses
0x8xxA SUB 08	2	Baud rate485	Bit 0-15	0xC0C0	4800 kBaud	0x0202
				0xC060	9600 kBaud	
				0xC030	19200 kBaud	
				0xC180	38400 kBaud	
				0xC010	57600 kBaud	
				0xC008	115200 kBaud	
0x8xxB SUB 01	1	SetPhysics485	Bit 0	RS485 Termi-nation Resistor	1: active, no read back	0x0380
0x8xxB SUB 02			Bit 1	RS-485 spread resistor	1: active, no read back	

39 Appendix

39.1 Approvals and national approvals for XN300 system devices

XN300 system devices are approved for use in several countries and regions.

Product standards	• IEC/EN; • UL 508 (INDUSTRIAL CONTROL EQUIPMENT); • CE-mark
UL File No.	XN-312-…, XN-322--…: E135462, XN322-1DCD-B35: E172143
NA Certification	cULus
Protection Style	IEC: IP20

39.2 Shipping approvals for XN300 system devices

The XN-312-GW-CAN gateway, as well as nearly every XN300 slice module, has been approved for ships.

XN300	**BV** **(Bureau Veritas)**	**DNV GL** **(DET NORSKE VERITAS)** **(Germanischer Lloyd)**	**LR** **(Lloyds Register of Shipping)**
Certificate number:	–	TAA00001E9	–

39.3 Dimensions

All XN300 slice modules have the exact same dimensions, except for the XN322-4DO-RNO and XN-322-5DO-RCO relay modules.

Dimensions		XN322-…	XN322-4DO-RNO XN-322-5DO-RCO
Dimensions W x H x D	mm	16.8 x 104.2 x 80.3	29.3 x 104.7 x 89.2
	in	0.66 x 4.10 x 3.16	1.15 x 4.12 x 3.51
Mounting		Snapped onto IEC/EN 60715 DIN-rail	Snapped onto IEC/EN 60715 DIN-rail
Mounting position		Horizontal	Horizontal

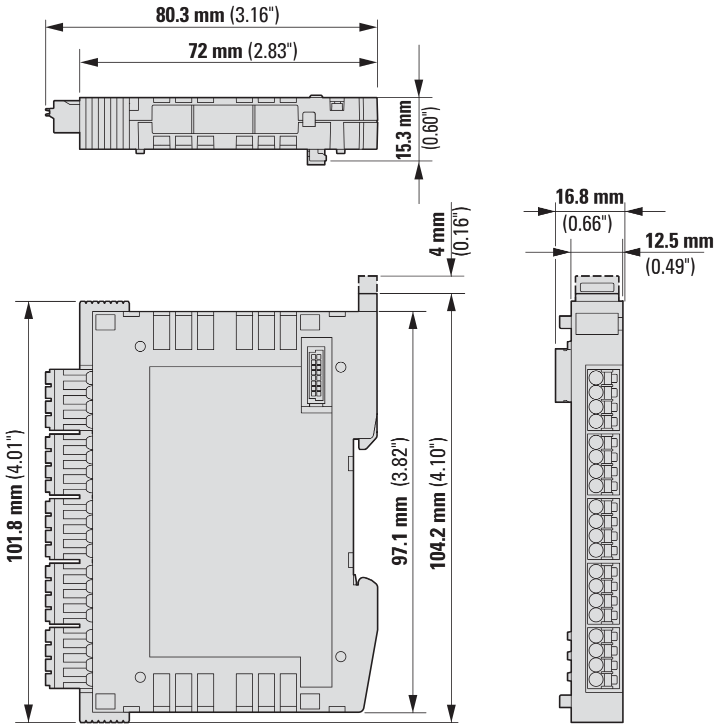


Figure 178: XN300 slice modules dimensions

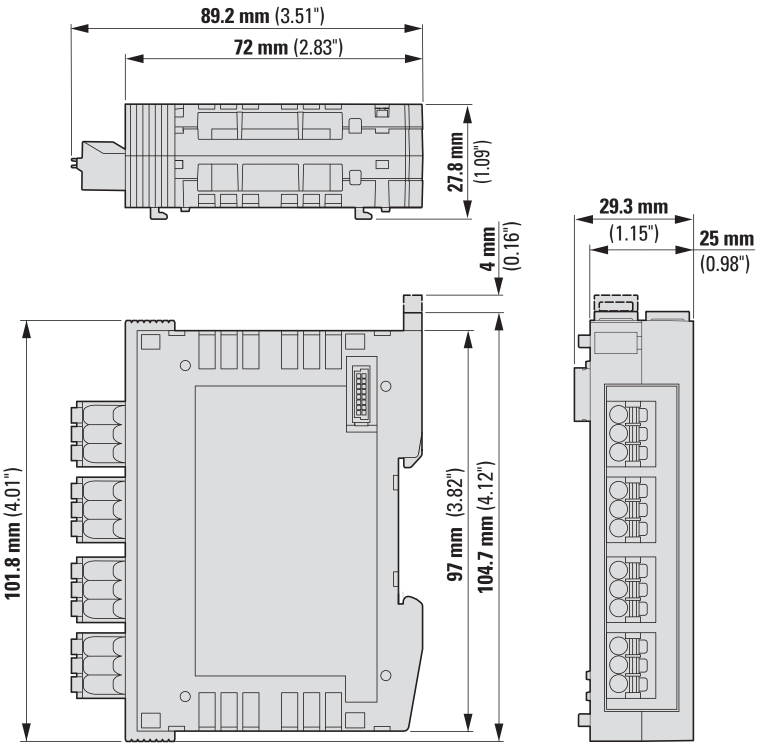


Figure 179: XN322-4DO-RNO, XN-322-5DO-RCO relay module dimension

39.4 Technical specifications

For specific technical data, please consult the chapter for the specific XN300 slice module you want, e.g., technical data for the XN322-1DCD-B35 motor driver can be found in → Section "34.4 Technical data", page 277.

39.4.1 Ambient conditions

Storage temperature	-20 to +85 °C -40 up to +85 °C (XN-322-4DO-RNO, XN-322-5DO-RCO)	
Operating temperature	0 to +60 °C XN-322-4PS-20 XN-322-18PD-M XN-322-18PD-P XN-322-8DI-PD XN-322-16DI-PD XN-322-20DI-PCNT XN-322-20DI-ND XN-322-8DO-P05 XN-322-16DO-P05 XN-322-8DIO-PD05 XN-322-16DIO-PD05 XN-322-16DIO-PC05 XN-322-4AI-PTNI, XN-322-7AI-U2PT XN-322-8AI-I XN-322-10AI-TEKT XN-322-8AO-U2 XN-322-4AIO-U2 with potentiometer ≥ 2.4 kΩ XN-322-8AIO-U2 XN-322-4AIO-I XN-322-8AIO-I XN-322-2DMS-WM XN-322-1CNT-8DIO XN-322-2SSI XN-322-16MIO-DIOAI XN-322-8AI-PTKT	0 to +55 °C XN-322-20DI-PD XN-322-20DI-PF XN-322-12DO-P17 XN-322-1DCD-B35 XN-322-7AI-U2PT with potentiometer from 2.4…3.9 kΩ XN-322-8AIO-U2 with potentiometer from 2.4…3.9 kΩ XN-322-4AIO-U2 with potentiometer < 2.4 kΩ XN-322-2PWM XN-322-4AO-UI XN-322-2SI-RS
	-25 to +60 °C XN-322-4DO-RNO XN-322-5DO-RCO	
Humidity	0 – 95 %, non-condensing	
EMC interference immunity	As per EN 61000-6-2 (industrial environment)	
EMC emitted interference	As per EN 61000-6-4 (industrial environment)	
Vibration resistance	EN 60068-2-6	3.5 mm of 5 Hz - 8.4 Hz 1 g of 8.4 Hz - 150 Hz
Mechanical shock resistance	EN 60068-2-27	15 g
Protection Style	EN 60529	IP20

39.4.2 Power Supply

$U_{Backplane\ 24V}$ supply voltage			
Specifications for connection to supply voltage	U_e	V	18 –30 VDC
Residual ripple of input voltage		%	≦ 5
Protection against polarity reversal			No
Overload proof			Yes
$U_{Backplane\ 5V}$ supply voltage			
Rated operating voltage	U_e	V	5

39.4.3 Delivery of power on the system bus

Power is delivered on the system bus either through an XControl modular PLC or through a gateway – please refer to → Section “Figure 11: Function principle of XN300 system”, page 27 for more information.

Table 18 Backplane Current Supply $I_{BP\_5V\_CSmax}$

Article number.	**Part No**	**$I_{BP\_5V\_CSmax}$ [A]**
178782	XN-312-GW-CAN	1.6
178785	XN-312-GW-EC	1.6
	XC-104-C10-000	0.4
	XC-204-C10-000	0.8
	XC-204-C11-003	0.8
	XC-204-C21-001	0.8
	XC-204-C20-002	0.8
191082	XC-303-C11-000	1.6
191081	XC-303-C21-001	1.6
191080	XC-303-C32-002	1.6

39.4.4 Current draw per XN300 slice module on the 5 V system bus

Table 19 Maximum current draw IBP_5V

Article number	XN300 slice module	Max. current draw I_{BP_5V} [mA]
183172	XN-322-8DI-PD	40 1)
		V4.04: 56
183173	XN-322-16DI-PD	40 1)
		V4.04: 56
178786	XN-322-20DI-PD	50 1)
		V4.04: 56
178768	XN-322-20DI-PF	50 1)
		V4.04: 56
178767	XN-322-20DI-PCNT	45
183174	XN-322-20DI-ND	50
178779	XN-322-4DO-RNO	48
183175	XN-322-8DO-P05	45
178788	XN-322-12DO-P17	50
178787	XN-322-16DO-P05	50 1)
		V4.07: 67
183178	XN-322-8DIO-PD05	50
183179	XN-322-16DIO-PD05	50
183180	XN-322-16DIO-PC05	55
178772	XN-322-4AI-PTNI	0
178789	XN-322-7AI-U2PT	55
179288	XN-322-8AI-I	55
178792	XN-322-10AI-TEKT	68
178790	XN-322-8AO-U2	60
183181	XN-322-4AIO-U2	55
178791	XN-322-8AIO-U2	55
183182	XN-322-4AIO-I	62
178771	XN-322-8AIO-I	62
178793	XN-322-2DMS-WM	55
178794	XN-322-1DCD-B35	80
178795	XN-322-1CNT-8DIO	50
178773	XN-322-2SSI	0
EP-401004	XN-322-16MIO-DIOAI	65
EP-400999	XN-322-5DO-RCO	50
EP-401002	XN-322-8AI-PTKT	0

1) Applies to all versions that are not explicitly specified.

EP-401003	XN-322-2PWM	65
EP-401001	XN-322-4AO-UI	0
Y7-183170	XN-322-2SI-RS	70

1) Applies to all versions that are not explicitly specified.

39.4.5 Current draw per XN300 slice module on the 24 V system bus

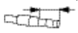
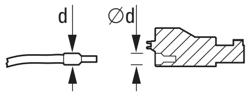
Table 20 Maximum current draw I_{BP_24V}

Article number	XN300 slice module	Max. current draw I_{BP_24V} [mA]
183172	XN-322-8DI-PD	0
183173	XN-322-16DI-PD	0
178786	XN-322-20DI-PD	0
178768	XN-322-20DI-PF	0
178767	XN-322-20DI-PCNT	0
183174	XN-322-20DI-ND	0
178779	XN-322-4DO-RNO	50
183175	XN-322-8DO-P05	0
178788	XN-322-12DO-P17	0
178787	XN-322-16DO-P05	0
183178	XN-322-8DIO-PD05	0
183179	XN-322-16DIO-PD05	0
183180	XN-322-16DIO-PC05	0
178772	XN-322-4AI-PTNI	0
178789	XN-322-7AI-U2PT	60
179288	XN-322-8AI-I	35
178792	XN-322-10AI-TEKT	90
178790	XN-322-8AO-U2	45
183181	XN-322-4AIO-U2	32
178791	XN-322-8AIO-U2	60
183182	XN-322-4AIO-I	0
178771	XN-322-8AIO-I	0
178793	XN-322-2DMS-WM	45
178794	XN-322-1DCD-B35	20
178795	XN-322-1CNT-8DIO	0
178773	XN-322-2SSI	40
EP-401004	XN-322-16MIO-DIOAI	25
EP-400999	XN-322-5DO-RCO	77
EP-401002	XN-322-8AI-PTKT	24
EP-401003	XN-322-2PWM	0
EP-401001	XN-322-4AO-UI	26
Y7-183170	XN-322-2SI-RS	15

1) Applies to all versions that are not explicitly specified.

39.4.6 Cable cross-sections

Table 21 Connection specifications

Cable cross-sectional areas			**XN-322-…**	**XN-322-4DO-RNO**
10 mm (0.39") 	solid	mm^2	0.2 – 1.5	0.2 – 2.5
10 mm (0.39") 	flexible with uninsulated ferrule	mm^2	0.2 – 1.5	0.25 – 2.5
10 mm (0.39") 	flexible with insulated ferrule	mm^2	0.2 – 0.75	0.25 – 2.5
	Ferrule d	mm	≤ 2.8	≤ 3.8
	AWG		24 – 16	24 – 12
	Strip length	mm	10	10

39.5 Further reading and links

For more information on additional devices and modules, please visit the following links.

Product information

For up-to-date information, please consult the product page on the Internet

eaton.com/xn300

Download Center — Documentation

You can find the documents on the Download Center - Documentation page by entering the document name.

eaton.com/documentation

File type	Title	Designation
Mounting instruction	XN-312-GW-CAN	IL050017ZU
Mounting instruction	XC-303-…	IL050018ZU
Mounting instruction	XControl, XC-104-…, XC-204-…	IL050031ZU
Manual	XN-312-GW-CAN	MN050003
Manual	XN-312-GW-EC	MN050010
Manual	XN300 slice modules	MN050002
Manual	Modular PLCs XControl: XC-104-…, XC-204-…, XC-303-…	MN050005

Download Center — Software

The XSOFT-CODESYS-2 and XSOFT-CODESYS-3 software described in this manual, as well as updates for the XN-312-… operating system, EDS files, application examples, and the XN300-Assist engineering tool, are available on the Internet from the Eaton Download Center — Software page:

eaton.com/software

Category	Title	Designation
Software	XSOFT-CODESYS-2	XSOFT-CODESYS Vx.x.x SPx
Software	XSOFT-CODESYS-3	
Firmware Updates	XN300	XN-312-GW-CAN FW Vx.xx
Firmware Updates	XC300	Included in: XSOFT-CODESYS Vx.x.x SPx
Tools	XN300-Assist	XN300-Assist Vx.xx
Application examples	XC300	XC300 Application examples CODESYS V3 for slice modules XN-322-20DI-PCNT XN-322-1CNT-8DIO, XN-322-1DCD-B35 XN-322-2SSI XN-322-2DMS-WM

39.6 Definitions for short-circuit proof outputs (in accordance with IEC/EN 61131-2)

The following applies to outputs that the manufacturer declares to be short-circuit proof:

- The output must continue to work with all output currents that are higher than I_e max. but less than two times the rated operational current I_e. Moreover, the output must be able to withstand temporary overloads. The manufacturer must provide specifics regarding temporary overload scenarios.
- The protective device must trip for all foreseeable output currents that are more than 20 times the rated value. After the protective device is reset or replaced, the PLC system must continue to work normally.
- It may be necessary to repair or replace the module after the presence of output currents within a range of 2 to 20 times or temporary overloads that exceed the limits specified by the manufacturer (see first bullet point).
- No fire or electric shock hazards must arise when there is an overload of two times I_e for 5 min. The highest temperature rise in the I/O insulation must not exceed the values specified in 4.4.2. immediately after each overload.

Alphabetical index

Eaton is an intelligent power management company dedicated to protecting the environment and improving the quality of life for people everywhere. We make products for the data center, utility, industrial, commercial, machine building, residential, aerospace and mobility markets. We are guided by our commitment to do business right, to operate sustainably and to help our customers manage power – today and well into the future.
By capitalizing on the global growth trends of electrification and digitalization, we're accelerating the planet's transition to renewable energy sources, helping to solve the world's most urgent power management challenges, and building a more sustainable society for people today and generations to come.
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Eaton Industries GmbH
Hein-Moeller-Str. 7–11
D-53115 Bonn

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