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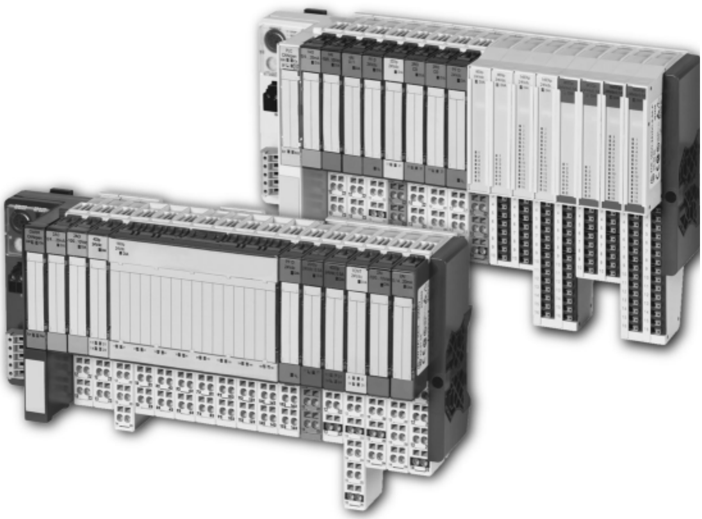
User Manual XI/ON

Analog I/O-Modules



EATON
Powering Business Worldwide

Manufacturer

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

Support

Region North America

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

Other regions

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

Original manual

The German version of this document is the original manual.

Translations of the original manual

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

Editorial department

Monika Jahn

Brand and product names

Copyright

Warning!
Dangerous electrical voltage!

Before commencing the installation

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

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

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About This Manual

Writing conventions

Abbreviations and symbols used in this manual have the following meanings:

Attention!
Warns of minor damage to property.

Caution!
Warns of major damage to property, and minor injuries.

Warning!
Warns of major damage to property, and death or major injuries.

→ Indicates interesting tips and additional information

1 The XI/ON Station

Dimensions

Dimensions of gateways, , end plate and end breacket

Table 1: Dimensions of gateways, , end plate and end breacket

Electronics module	W × L × H [mm]
XN standard gateway (XN-GW…)	50.6 x 114.75 x 74.4
XNE ECO gateway (XNE-GWBR-…)	33.5 x 129 x 75
End plate (XN-ABPL)	9.2 x 114.4 x 48.4
End bracket (XN-WEW-35/2-SW)	8 x 56 x 47

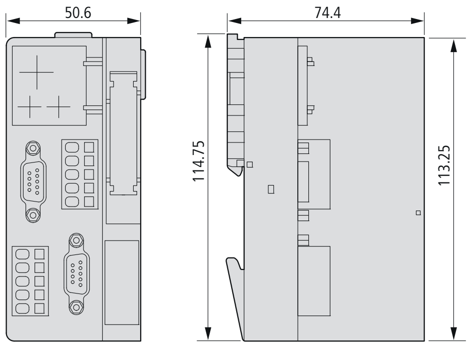


Figure 1: XN standard gateway (XN-GW…)

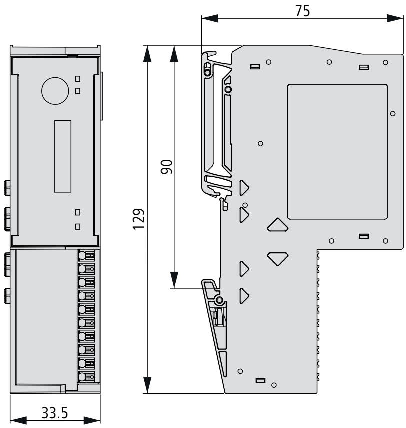


Figure 2: XNE ECO gateway (XNE-GWBR-…)

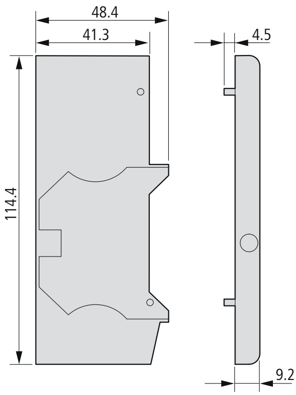


Figure 3: End plate (XN-ABPL)

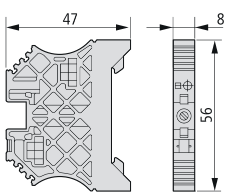


Figure 4: End bracket (XN-WEW-35/2-SW)

Dimensions of base and electronics modules

Table 2: Dimensions of electronics modules

Electronics module	W × L × H [mm]
XN standard electronics module:	
Slice design	12.6 x 74.1 x 55.4
Block design (XN-16…, XN-32…)	100.8 x 74.1 x 55.4
XNE ECO electronics module:	
XNE-8DI-24VDC-P XNE-8DO-24VDC-0.5A-P XNE-1SWIRE	13 x 129.5 x 74.5
XNE-16DI-24VDC-P XNE-16DO-24VDC-0.5A-P XNE-8AI-U/I-4PT/NI XNE-4AO-U/I XNE-2CNT-2PWM	13 x 161.5 x 74.5

Table 3: Dimensions of base modules

Base module	W × L × H [mm]
Slice design with:	
3 connection levels (XN-S3…, XN-P3…)	12.6 x 117.6 x 49.9
4 connection levels (XN-S4…, XN-P4…)	12.6 x 128.9 x 49.9
6 connection levels (XN-S6…)	12.6 x 154.5 x 49.9
Block design with:	
3 connection levels (XN-B3…)	100.8 x 117.6 x 49.9
4 connection levels (XN-B4…)	100.8 x 128.9 x 49.9
6 connection levels (XN-B6…)	100.8 x 154.5 x 49.9

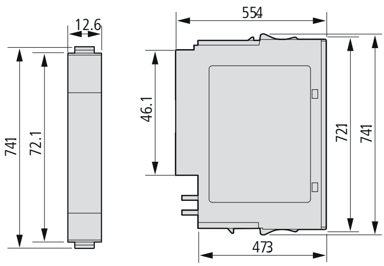


Figure 5: XN standard electonics module in slice design

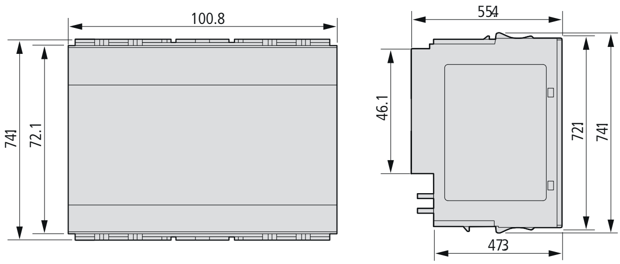


Figure 6: XN standard electonics module in block design

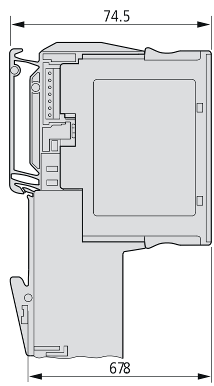


Figure 7: XN standard electonics module completed with a base module

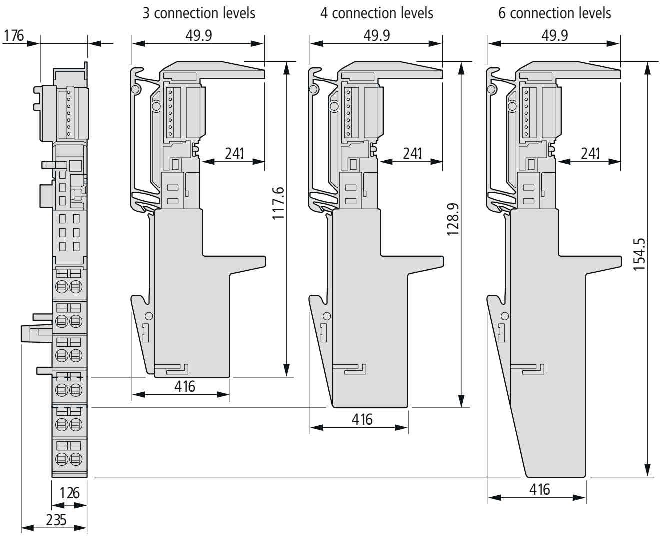


Figure 8: Base module in slice design with tension clamp connection (XN-SxT…, XN-PxT…)

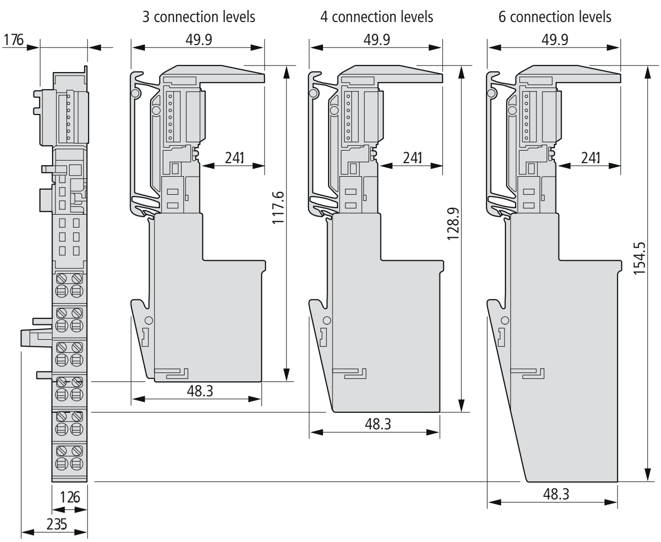


Figure 9: Base module in slice design with screw connection (XN-SxS…, XN-PxS…)

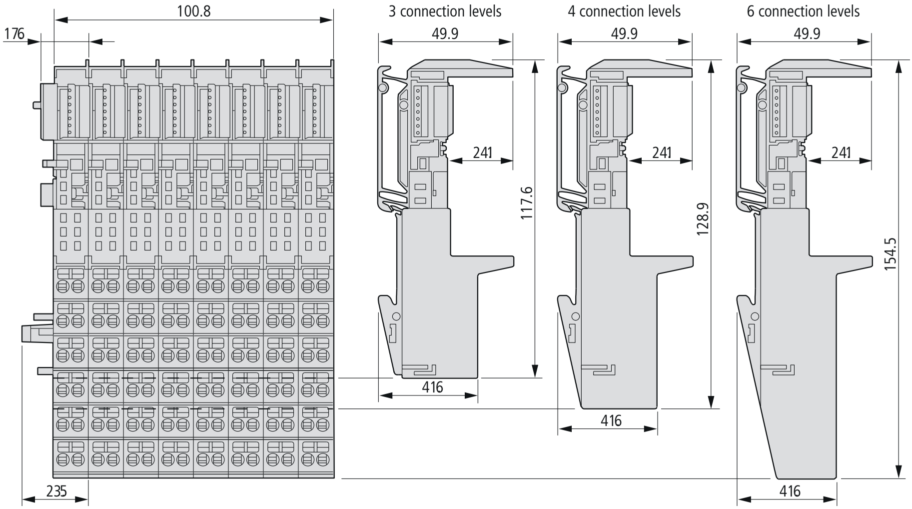


Figure 10: Base module in block design with tension clamp connection (XN-BxT…)

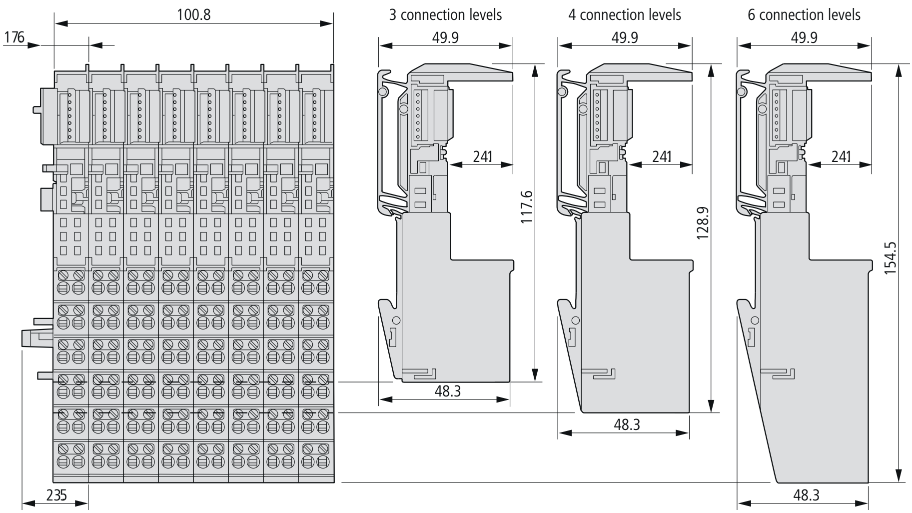


Figure 11: Base module in block design with screw connection (XN-BxS…)

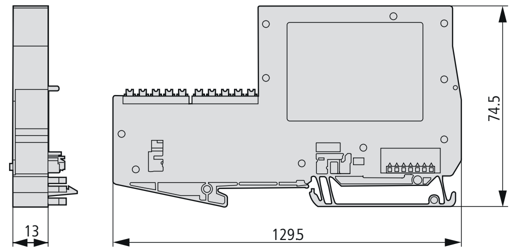


Figure 12: XNE ECO electonics module:
- XNE-8DI-24VDC-P
- XNE-8DO-24VDC-0.5A-P
- XNE-1SWIRE

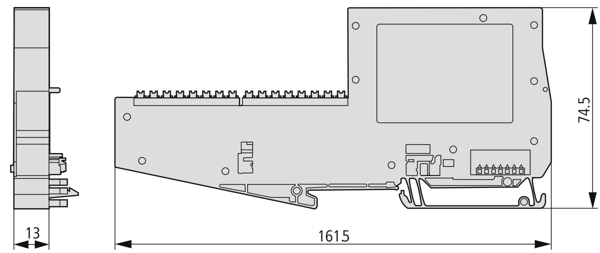


Figure 13: XNE ECO electonics module:
- XNE-16DI-24VDC-P
- XNE-16DO-24VDC-0.5A-P
- XNE-8AI-U/I-4PT/NI
- XNE-4AO-U/I
- XNE-2CNT-2PWM

Technical data for the XI/ON station

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

Table 4: Technical data for the XI/ON station

Designation	Value
Supply voltage/auxiliary supply	
Nominal value (provided for other modules)	24 V DC
Residual ripple	according to IEC/EN 61131-2
Electrical isolation (U_L to U_{SYS}/ U_L to field bus/U_{SYS} to field bus)	yes, via optocoupler
Environment/temperature	
Operating temperature, mounted horizontally	0…+55 °C
Operating temperature, mounted vertically	0…+55 °C
Storage temperature	-25…+85 °C
Relative humidity according to IEC/EN 60068-2-30	5…95 % (indoor), Level RH-2, no condensation (storage at 45 °C, no functional test)
Rating of XN standard enclosure[1)] for modules in slice design (max. possible power loss)	1.3 W
Rating of XN ECO enclosure[1)] for slice modules (max. possible power loss)	3 W
Rating of XN standard enclosure[1)] for block modules (max. possible power loss)	5 W
Corrosive gases	
SO_2	10 ppm (rel. humidity < 75 %, no condensation)
H_2S	1.0 ppm (rel. humidity < 75 %, no condensation)

Designation	Value
Vibration resistance	
10…57 Hz, constant amplitude 0.075 mm, 1 g	yes
57…150 Hz, constant acceleration 1 g	yes
Vibration type	Variable frequency runs at a rate of change of 1 octave/min
Vibration duration	20 variable frequency runs per coordinate axis
Shock resistance according to IEC/EN 60068-2-27	18 shocks, half-sine 15 g peak value/11 ms, for both +/- directions per spatial coordinate
Repeated shock resistance according to IEC/EN 60068-2-29	1000 shocks, half sine 25 g peak value/6 ms, for both +/- directions per spatial coordinate
Drop and topple	
Fall height (weight < 10 kg)	1.0 m
Fall height (weight 10…40 kg)	0.5 m
Test runs	7
Instrument with packaging, electronics boards electrically tested	
Electromagnetic compatibility (EMC) according to IEC/EN 61000-6-2 (industrial)	
Static electricity according to IEC/EN 61000-4-2	
Air discharge (direct)	8 kV
Relay discharge (indirect)	4 kV
Electromagnetic HF fields according to IEC/EN 61000-4-3	10 V/m
Conducted interference, induced by HF fields according to IEC/EN 61000-4-6	10 V

Designation	Value
Fast transients (burst) according to IEC/EN 61000-4-4	1 kV / 2 kV
Radiated interference according to IEC/EN 61000-6-4 (industrial)	according to IEC/CISPR 11 / EN 55011, Class A[1)]

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

1) XNE ECO enclosures are one-piece enclosures. The module electronics and the connection level cannot be separated.
XN standard enclosures are two-piece enclosures. The module electronics are located in a separate enclosure and must be inserted into a suitable base module. The vast majority of the XN standard electronics modules can be combined with different base module types.

Table 5: Approvals and tests for a XI/ON station

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

1) The approvals of newer XI/ON modules can still be pending
2) The operational life of the relay modules is not given in hours. The relevant factor for the operational life of relay modules is the number of switching operations.

Technical data for the terminals

Table 6: Technical data for the terminals

Designation	XN gateways, base modules	XNE gateways, XNE electronics modules
Protection class	IP20	IP20
Insulation stripping length	8.0…9.0 mm / 0.32…0.36 inch	8.0…9.0 mm / 0.32…0.36 inch
Max. wire range	0.5…2.5 mm^2 / 0.0008…0.0039 inch^2 / AWG 24…AWG 14	0.14…1.5 mm^2 / 0.0002…0.0023 inch^2 / AWG 24…AWG 16
Crimpable wire		
“e” solid core H 07V-U	0.5…2.5 mm^2 / 0.0008…0.0039 inch^2	0.25…1.5 mm^2 / 0.0004…0.0023 inch^2
“f” flexible core H 07V-K	0.5…1.5 mm^2 / 0.0008…0.0023 inch^2	0.25…1.5 mm^2 / 0.0004…0.0023 inch^2
“f” with ferrules **without** plastic collar according to DIN 46228-1 (ferrules crimped gas-tight)	0.5…1.5 mm^2 / 0.0008…0.0023 inch^2	0.25…1.5 mm^2 / 0.0004…0.0023 inch^2
“f” with ferrules **with** plastic collar according to DIN 46228-1 (ferrules crimped gas-tight)	0.5…1.5 mm^2 / 0.0008…0.0023 inch^2	0.25…0.75 mm^2 / 0.0004…0.0012 inch^2
Test finger according to IEC/EN 60947-1	A1	A1
Measurement data	according to VDE 0611 Part 1/8.92 / IEC/EN 60947-7-1	according to VDE 0611 Part 1/8.92 / IEC/EN 60947-7-1
Rated voltage	250 V	250 V
Rated current	17.5 A	17.5 A
Rated cross section	1.5 mm^2	1.5 mm^2
Rated surge voltage	4 kV	4 kV
Pollution degree	2	2
Connection method in TOP direction	Tension clamp connector or screw terminal	Push-in tension clamp terminals

Designations of the base modules

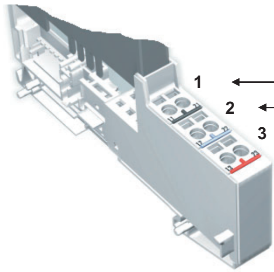


Figure 14: Example of a base module designation

Table 7: Abbreviations for base module designations

Identi-fier	Designation	Example
XN	Abbreviation for XI/ON	**XN**-B3S-SBB
B	Designation of base modules in block design (**Block**)	XN-**B**3S-SBB
S	Designation of base modules in slice design (**Slice**)	XN-**S**3T-SBB
P	Designation of base modules for feeding and bus refreshing modules (**Power**)	XN-**P**3T-SBB
3, 4, 6	Number of terminal rows.	XN-P**3**T-SBB
S	Designation of base modules with screw terminals (**Screw**)	XN-S3**S**-SBB
T	Designation of base modules with tension clamp connection (**Tension Clamp**)	XN-S3**T**-SBB
x	Optionally **S** or **T** in the designation of base modules with screw or tension clamp connections (**S**crew / **T**ension)	XN-S3**x**-SBB
S	Unbridged connections on the same connection level (level 1 in this case) in a base module, for connecting signals (**Single Connector**)	XN-S3T-**S**BB

Identi-fier	Designation	Example
B	Bridged connections on the same connection level in a base module, for voltage connections. (**Bridged Connector**)	XN-S3T-S**B**B
B	Supplement to the designation of base modules for bus refreshing modules that are used within a XI/ON station, but not for supplying the gateway. (**Bus Refreshing**)	XN-P4T-SBBC-**B**
C	Designation of a connection level that has a connection to a C-rail and can be used for a PE connection (only for specific base modules). (**Cross Connection**)	XN-S4T-SBB**C**
CJ	Base module for XN-2AI-THERMO-PI with integrated PT1000 for cold junction compensation. (**Cold Junction Compensation**)	XN-S4T-SBBS-**CJ**

Module designations and abbreviations

Table 8: Key to module designations

Identifier	Designation	Example
	Analog input and output modules	
AI	Analog input module	XN-1**AI**-U(-10/0…+10VDC)
AO	Analog output module	XN-1**AO**-I(0/4…20MA)
PT	Analog input module for connecting resistance thermometers with PT100, PT200, PT500 and PT1000 sensors with 2- and 3-wire measuring	XN-2AI-**PT**/NI-2/3
NI	Analog input module for connecting resistance thermometers with NI100 and NI1000 sensors with 2- and 3-wire measuring	XN-2AI-PT/**NI**-2/3
PI	Potentially isolated (analog modules for thermocouples)	XN-2AI-THERMO-**PI**
	Supply modules	
BR	Bus refreshing module	XN-**BR**-24VDC-D
PF	Power feeding module	XN-**PF**-24VDC-D
D	Diagnostics	XN-BR-24VDC-**D**
	Digital input and output modules	
DI	Digital input module	XN-2**DI**-24VDC-P
DO	Digital output module	XN-2**DO**-24VDC-2A-P
N	Negative switching (sourcing)	XN-2DI-24VDC-**N**
P	Positive switching	XN-2DI-24VDC-**P**
	Relay modules	
R	Relay module	XN-2DO-**R**-NC
CO	Change over	XN-2DO-R-**CO**
NC	Normally closed	XN-2DO-R-**NC**
NO	Normally open	XN-2DO-R-**NO**

Wiring of the XI/ON modules

The used method when wiring the XI/ON modules depends on the used connection engineering:

- The base modules use spring-finger contacts in the following versions:
  - Base modules using tension clamp connection technology (XN-…**T**-…)
  - Base modules using screw connection technology (XN-…**S**-…)
- The XNE ECO modules use direct push-in contacts:
  - Push-in tension clamp terminals

→ The XNE ECO modules can be easily combined with the base modules using tension clamp connection technology (XN-…**T**-…). A connection is **not** possible on base modules using screw connection technology (XN-…**S**-…).

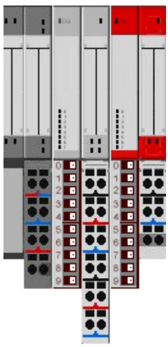


Figure 15: XNE ECO modules combined with tension clamp contact modules

Wiring of tension clamp connections

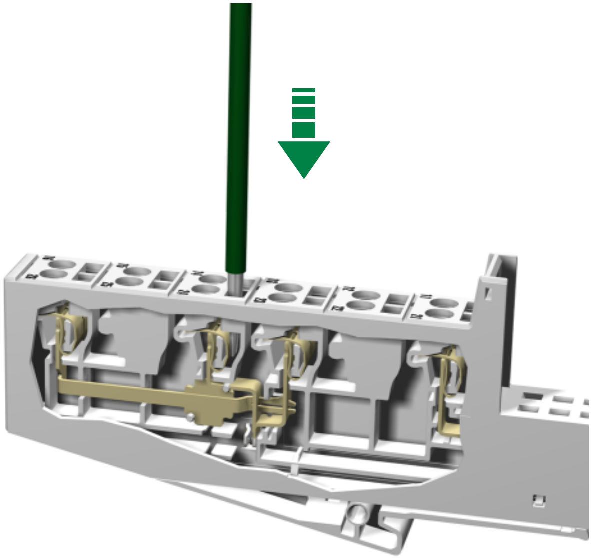


Figure 16: Tension clamp connections

Method:

▶ Insert a screwdriver into the rectangular opening located immediately above the connection level of the base module. When you feel a slight resistance, push the screwdriver into the opening until it comes up against a stop. This opens a tension clamp on the inside of the connection level.

▶ Insert the wiring into the round opening located directly below the rectangular opening, until the wire comes up against a stop.

▶ Remove the screwdriver; the tension clamp closes and secures the wire.

Wiring of screw connections

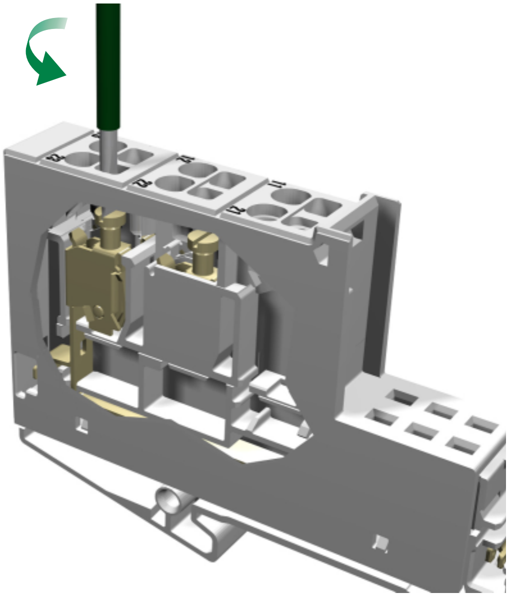


Figure 17: Screw connections

Method:

▶ Place the screwdriver in the rectangular opening of a connection level on the base module. Turn the screw counterclockwise as far as possible, without fully removing it.

▶ Insert the wire in to the round opening, located directly below the rectangular opening, until it comes up against a stop.

▶ Turn the screw clockwise until the wire is fully secured, and cannot be pulled out.

Handling the push-in tension clamp terminals of the XNE ECO modules

Insertion of the conductor

The conductor is simply pushed into the corresponding contact.

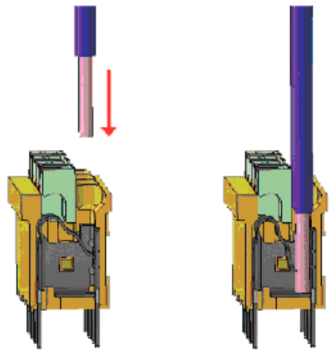


Figure 18: Insertion of the conductor

Removal of the conductor

The conductor can be removed from the corresponding contact by pressing the release mechanism, e.g. with a screw driver.

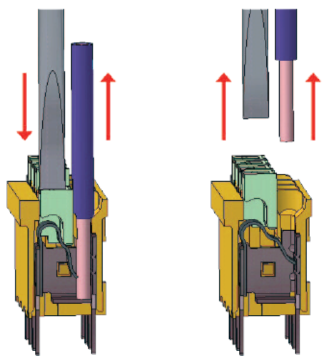


Figure 19: Removal of the conductor

The supply modules

A detailed description of these power supply modules can be found in the manual:

- User Manual XI/ON:
  Digital I/O modules, supply modules

Bus refreshing modules XN-BR-24VDC-D

The bus refreshing modules provide:

- 5 V DC for the internal XI/ON module bus and the neighbouring gateway.
- 24 V DC (permissible range according to IEC/EN 61131-2) as the supply for the module electronics and the field. This 24 V DC supply voltage is distributed throughout the XI/ON station as a separate cable.

This is electrically isolated from the neighbouring supply module on the left.

Attention!
If the XI/ON station contains a gateway without an integrated power supply unit (XN-GW-…), the first bus refreshing module must be fitted directly to the right of a gateway. This provides the 5 V DC power supply to the gateway when connected to a special base module.

Attention!
Only the base modules XN-P3x-SBB or XN-P4x-SBBC (as the first module to the right of the gateway) can be used to supply the gateway.

Power feeding modules XN-PF-24VDC-D and XN-PF-120/230VAC-D

The power feeding modules are used to supply the various XI/ON modules with the field voltage of 24 V DC (XN-PF-24VDC-D) or 120/230 V AC (XN-PF-120/230VAC-D). They are used when different potential groups need to be set up within a XI/ON station, or in the event that the supply would otherwise be inadequate for the rated current requirements of the XI/ON modules. They are electrically isolated from the adjacent supply group on the left.

Warning!
Power feeding modules cannot be used to provide the 5 V DC supply for XI/ON gateways.

The ash-grey cover of the base modules for power feeding modules make them clearly distinguishable from the base modules for the XI/ON I/O modules.

XN-PF-120/230VAC-D
The following modules can be supplied from a preceding XN-PF-120/230VAC-D:

- XN-2DI-120/230VAC
- XN-2DO-120/230VAC-0.5A

Caution!
Relay modules must **not** be supplied from a preceding XN-PF-120/230VAC-D!
The nominal voltage at the supply terminals is 24 V DC (≙ coil voltage)!
The relay modules can be externally loaded by up to 230 V AC (≙ contact voltage).

2 Analog Input Modules

General

Analog input modules (AI) process normalised electrical signals, convert them to digital values and transmit the corresponding measured value to the gateway via the internal module bus.

The electronics on the module bus of the analog input modules is isolated from the field level via optocouplers and is protected against reverse polarity.

Analog input modules are built in slice design. XN standard electronics modules are completed by base modules with tension clamp or screw connection. XNE ECO electronics modules do not require a base module.

Supported signal ranges
0…20 mA
4…20 mA
0…10 V DC
-10…+10 V DC

Connectable sensors
Platinum sensors (PT100, PT200, PT500, PT1000)
Nickel sensors (NI100, NI1000, NI1000TK5000)
Thermocouples (types B, E, J, K, N, R, S, T)

→ For the representation of current and voltage values with special operation modes (e.g. Extended Range and NE43) other equations and parameter settings must be applyed. Please read the subchapters «Value representation» of the corresponding module.

Representation of the analog values

16-bit or 12-bit representation

The analog values can be represented as either 16-bit or 12-bit values. The two's complement notation of the number allows both positive and negative values to be represented.

16-bit representation:
The 16-bit representation is implemented in **two's complement** notation. 2 bytes of process data are fully assigned.

12-bit representation:
The value is represented in **two's complement** notation for voltage measurement (output) and temperature measurement. The value is represented in **binary** format for current measurement (output) and resistance measurement. The 12-bit value is mapped **left-justified** in the process data so that it is compatible (e.g. with WIN bloc).
The diagnostics data is integrated in the process input data and is assigned to 4 bits (right-justified).
→ "Data structure with 12-bit representation" Page 235

The two's complement in the number circle

This figure shows a 5-digit binary code in the outer circle. The inner number circle shows the corresponding decimal value if this binary code is interpreted as a binary (positive) value) and as a two's complement value:

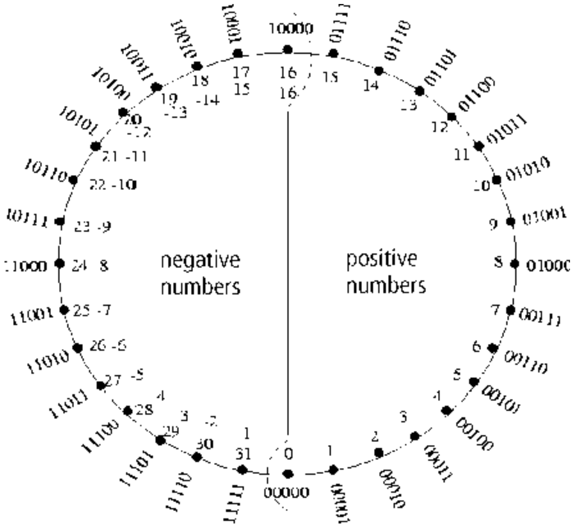


Figure 20: Binary code as binary number and as two's complement

Equations and graphs for 16-bit representation

Representation of current values in the range 0 mA…20 mA

To use the equation below, the hexadecimal or binary value must be converted to a decimal value.

The value range:

0…20 mA

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The hexadecimal/binary numerical value can be converted (using a pocket calculator) very easily to a decimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

Once the decimal value has been determined, the current values can be calculated with the following equation:

$$\text{current} = \frac{\text{dezimer value}}{1638.35}\ \text{mA} = 6.1 \times 10^{-4}\ \text{mA} \times \text{dezimer value}$$

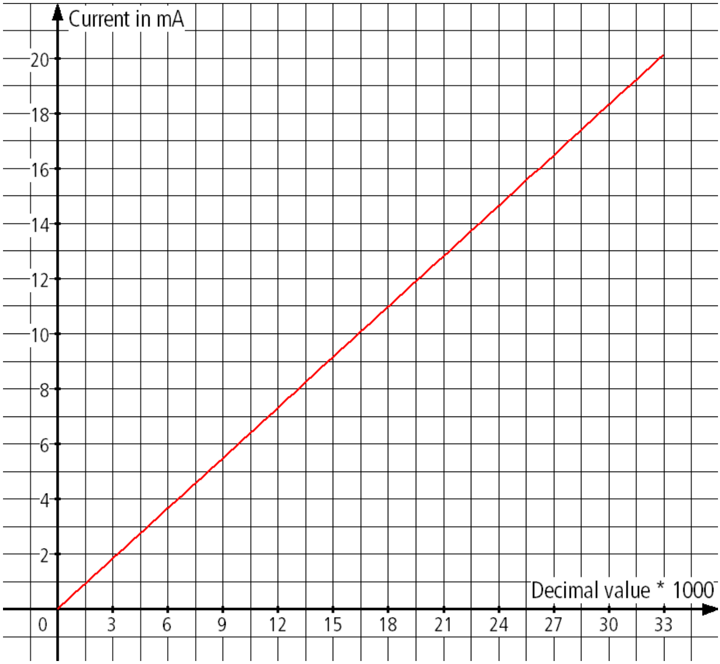


Figure 21: Representation of current values in relation to the decimal values in the coordinate system

Representation of current values in the range 4 mA…20 mA

To use the equation below, the hexadecimal or binary value must be converted to a decimal value.

The value range:

4…20 mA

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The hexadecimal/binary numerical value can be converted (using a pocket calculator) very simply to a decimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

Once the decimal value has been determined, the current values can be calculated with the following equation:

$$\text{current} = 4.88 \times 10^{-4}\ \text{mA} \times \text{dezimal value} + 4\ \text{mA}$$

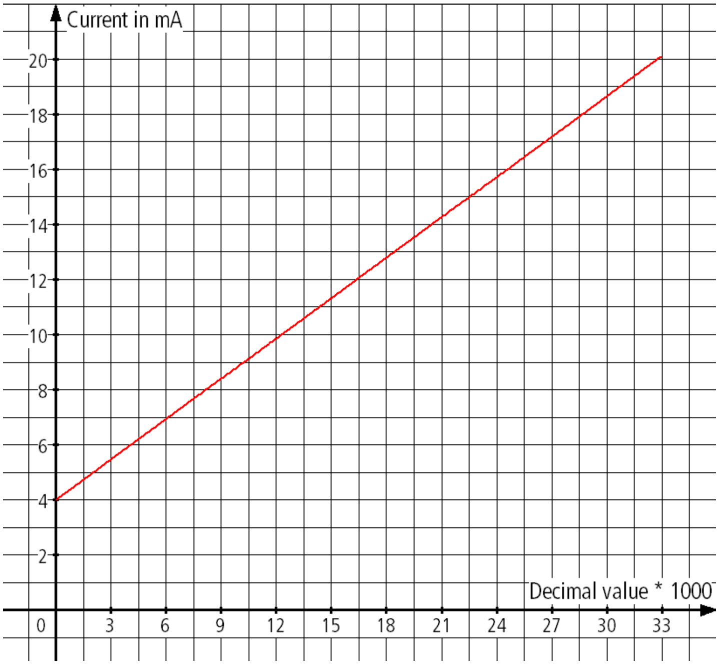


Figure 22: Representation of current values in relation to the decimal values in the coordinate system

Representation of temperature values and resistance values for the XN-2AI-PT/NI-2/3

To use the equations below, the hexadecimal or binary value must be converted to a decimal value.

The hexadecimal/binary numerical values for the negative number range cannot be converted (using a pocket calculator) easily to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 0000…$7FFF_{hex}$ represent **positive** numerical values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 16).

All numerical values in the range 8000…$FFFF_{hex}$ represent **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 16). The following examples shows the conversion to a decimal number:

→ "Example of the calculation of negative numerical values" Page 60

Once the decimal value has been determined, the **temperature values** can be calculated according to the parameters defined.

The following applies to the parameter setting of

- "PT100, -200..850’C"
- "NI100, -60..250’C"
- "PT200, -200..850’C"
- "PT500, -200..850’C"
- "PT1000, -200..850’C"
- "NI1000, -60..250’C"

$$\text{temperature} = 0.1\ °\text{C} \times \text{dezimal value}$$

The value range:

-200 °C…-0.1 °C

is mapped to the number range:

$F830_{hex}$…$FFFF_{hex}$ (decimal: -2000…-1).

The value range:

0…850 °C

is mapped to the number range:

0000_{hex}…2134_{hex} (decimal: 0…8500).

The following applies to the parameter setting of

- "PT100, -200..150’C"
- "NI100, -60..150’C"
- "PT200, -200..150’C"
- "PT500, -200..150’C"
- "PT1000, -200..150’C"
- "NI1000, -60..150’C"

$$\text{temperature} = 0.01\ {}^{\circ}\mathrm{C} \times \text{dezimal value}$$

The value range:

-200…-0.01 °C

is mapped to the number range:

B1E0$_{hex}$…FFFF$_{hex}$ (decimal: -20000 to -1).

The value range:

0…150 °C

is mapped to the number range:

0000$_{hex}$…3A98$_{hex}$ (decimal: 0…15000).

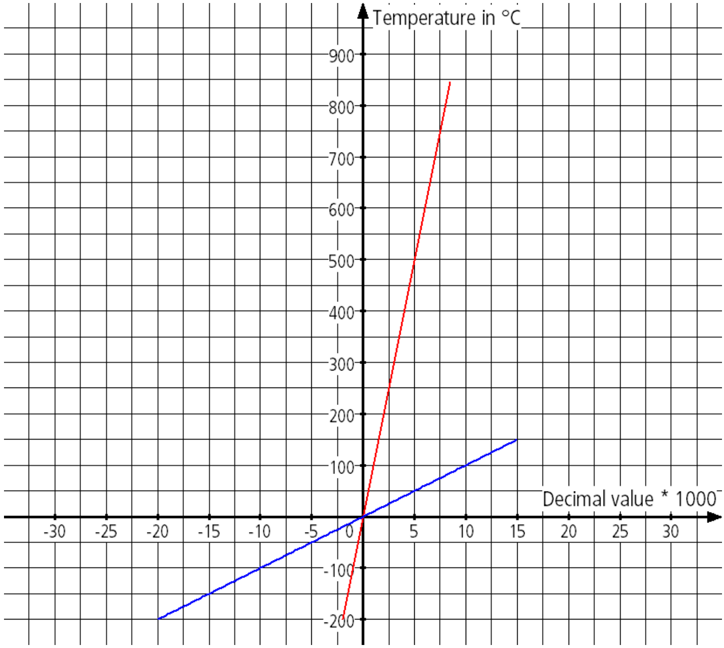


Figure 23: Representation of temperature values in relation to decimal values in the coordinate system
The **red** straight line (factor 0.1) applies with the following parameter setting:
"PT100, -200..850’C"
"NI100, -60..250’C"
"PT200, -200..850’C"
"PT500, -200..850’C"
"PT1000, -200..850’C"
"NI1000, -60..250’C"
The **blue** straight line (factor 0.01) applies with the following parameter setting:
"PT100, -200..150’C"
"NI100, -60..150’C"
"PT200, -200..150’C"
"PT500, -200..150’C"
"PT1000, -200..150’C"
"NI1000, -60..150’C"

The parameter setting for the measurement of **resistance values** only requires positive numerical values (hexadecimal/binary) for representation. The positive numerical values can be converted (with the pocket calculator) very easily to a decimal value.

The value range:

0…100 Ω; 0…200 Ω; 0…400 Ω; 0…1000 Ω

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

Once the decimal value has been determined, the resistance values can be calculated according to the parameters defined.

The following equations apply:

"Resistance, 0..100 Ohm" (yellow straight line):

$$\text{resistance} = 0.00305\ \Omega \times \text{dezimal value}$$

"Resistance, 0..200 Ohm" (red straight line):

$$\text{resistance} = 0.00610\ \Omega \times \text{dezimal value}$$

"Resistance, 0..400 Ohm" (blue straight line):

$$\text{resistance} = 0.01221\ \Omega \times \text{dezimal value}$$

"Resistance, 0..1000 Ohm" (green straight line):

$$\text{resistance} = 0.03052\ \Omega \times \text{dezimal value}$$

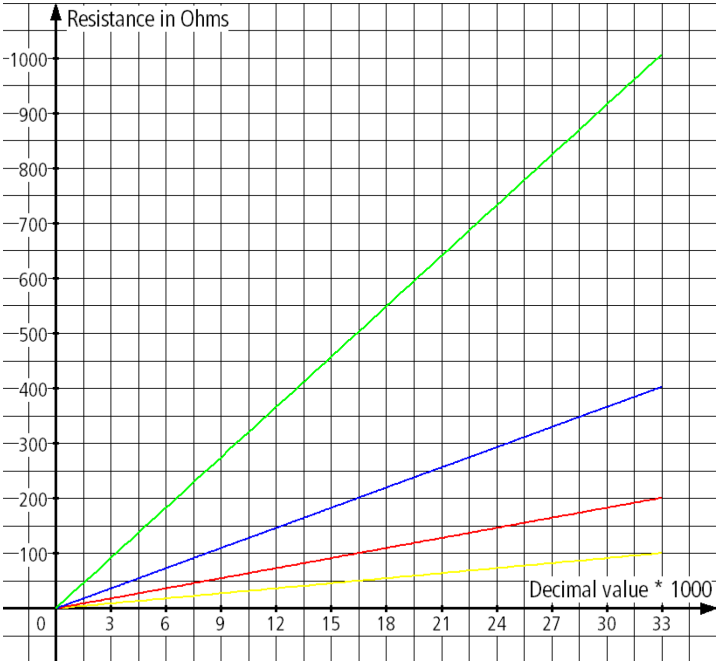


Figure 24: Representation of resistance values in relation to the decimal values in the coordinate system

Representation of temperature and voltage values for the XN-2AI-THERMO-PI

To use the equations below, the hexadecimal or binary value must be converted to a decimal value.

The hexadecimal/binary numerical values for the negative number range cannot be converted (using a pocket calculator) easily to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 0000…$7FFF_{hex}$ represent **positive** numerical values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 16).

All numerical values in the range 8000…$FFFF_{hex}$ represent **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 16). The conversion to a decimal value shows: → "Example of the calculation of negative numerical values" Page 60.

Once the decimal value has been determined, the **temperature values** and the **voltage values** can be calculated according to the parameters defined.

The following applies to the parameter setting of
"Type K, -270..1370'C"
"Type B, +100..1820'C"
"Type E, -270..1000'C"
"Type J, -210..1200'C"
"Type N, -270..1300'C"
"Type R, -50..1760'C"
"Type S, -50..1540'C"
"Type T, -270..400'C"

$$\text{temperature} = 0.1\ °\text{C} \times \text{dezimal value}$$

The value range:

-270…-0.1 °C

is mapped to the number range:

F574$_{hex}$…FFFF$_{hex}$ (decimal: -2700…-1)

The value range:

0…1820 °C

is mapped to the number range:

0000$_{hex}$…4718$_{hex}$ (decimal: 0…18200)

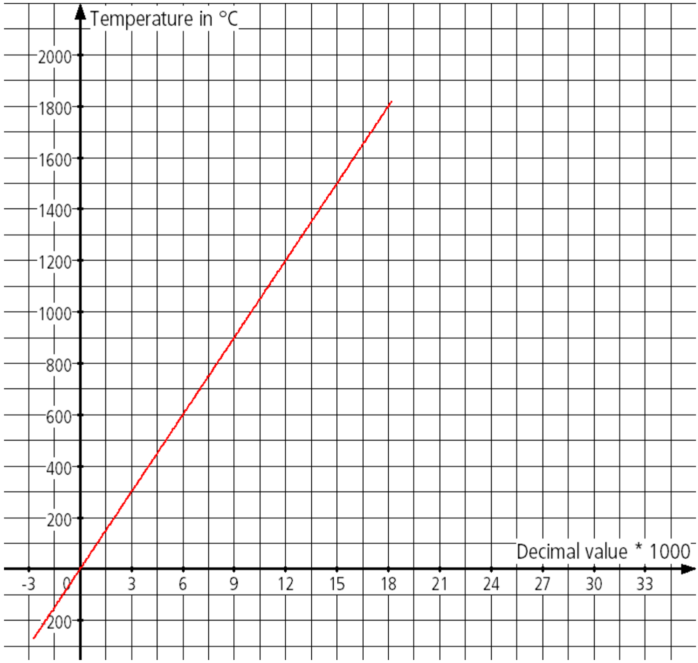


Figure 25: Representation of temperature values in relation to the decimal values in the coordinate system

The value range:

-50…-0.002 mV;
-100…-0.003 mV;
-500…-0.015 mV;
-1000…-0.031 mV

is mapped to the number range:

8000_{hex}…$FFFF_{hex}$ (decimal: -32768…-1)

The value range:

0…50 mV;
0…100 mV;
0…500 mV;
0…1000 mV;

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

The following applies to the parameter setting **"+/–50 mV"**:

$$\text{voltage} = 0.001526\text{ mV} \times \text{dezimal value}$$

The following applies to the parameter setting **"+/–100 mV"**:

$$\text{voltage} = 0.003052\text{ mV} \times \text{dezimal value}$$

The following applies to the parameter setting **"+/–500 mV"**:

$$\text{voltage} = 0.015259\text{ mV} \times \text{dezimal value}$$

The following applies to the parameter setting **"+/-1000 mV"**:

$$\text{voltage} = 0.030519\text{ mV} \times \text{dezimal value}$$

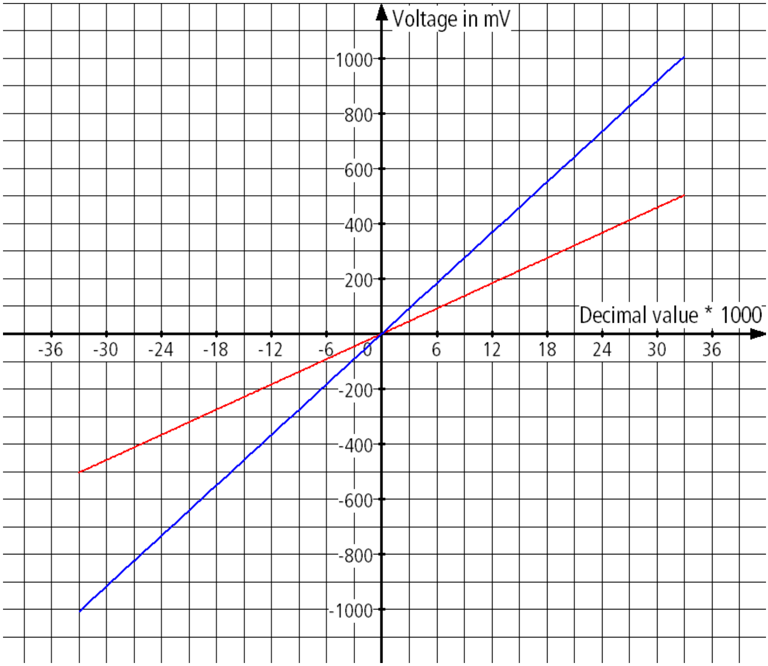


Figure 26: Representation of voltage values in relation to the decimal values in the coordinate system for the parameter setting "+/-500 mV" (red) and "+/-1000 mV" (blue)

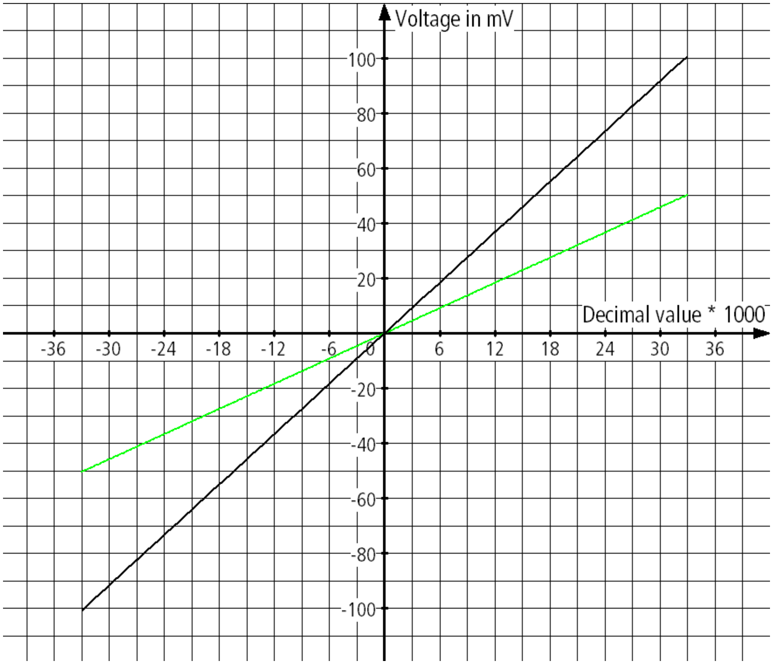


Figure 27: Representation of voltage values in relation to the decimal values in the coordinate system for the parameter setting "+/-50 mV" (green) and "+/-100 mV" (black)

Representation of the voltage values in the range 0 V DC…10 V DC

To use the equation below, the hexadecimal or binary value must be converted to a decimal value.

The hexadecimal/binary numerical value can be converted (using a pocket calculator) very simply to a decimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

The value range:

0…10 V DC

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

Once the decimal value has been determined, the voltage values can be calculated with the following equation:

$$\text{voltage} = 3.05185 \times 10^{-4}\,\text{V} \times \text{dezimal value}$$

Figure 28: Representation of voltage values in relation to the decimal values in the coordinate system

Representation of the voltage values in the range -10 V DC…10 V DC

To use the equation below, the hexadecimal or binary value must be converted to a decimal value.

The hexadecimal/binary numerical values for the negative number range cannot be simply converted (using a pocket calculator) to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 0000…$7FFF_{hex}$ represent **positive** numerical values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 16).

All numerical values in the range 8000…$FFFF_{hex}$ represent **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 16). The conversion to a decimal value shows: → "Example of the calculation of negative numerical values" Page 60.

The value range:

-10…-3.052 10^{-4} V DC

is mapped to the number range:

8000_{hex}…$FFFF_{hex}$ (decimal:-32768…-1)

The value range:

0…10 V DC

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

Once the decimal value has been determined, the voltage values can be calculated with the following equation:

$$\text{voltage} = 3.052 \times 10^{-4}\ \text{V} \times \text{dezimal value}$$

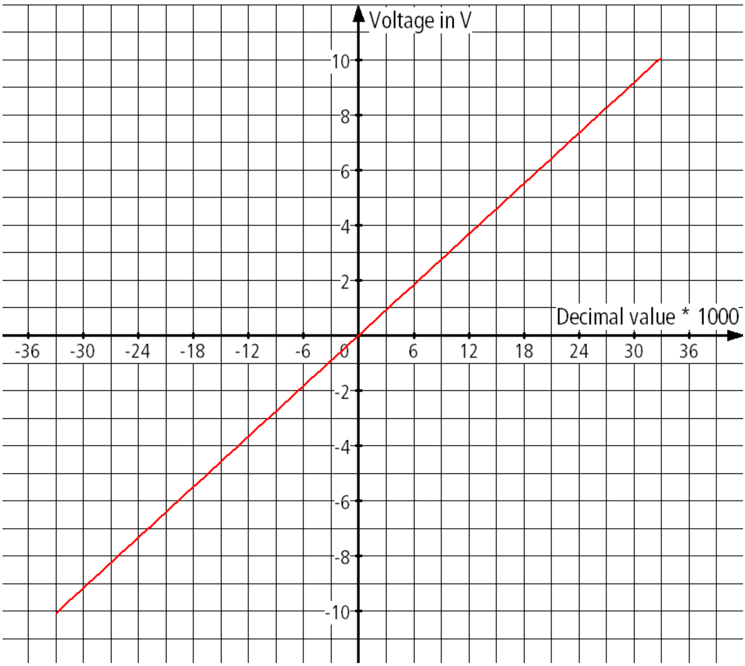


Figure 29: Representation of voltage values in relation to the decimal values in the coordinate system

Example of the calculation of negative numerical values

For the example the following parameter setting applies:
"PT100, -200..150’C"

The temperature is thus calculated with the factor 0.01 (→ Page 46).

The example shows the general procedure for calculating a negative decimal number from a hexadecimal or binary number coded as a two's complement value

The displayed hexadecimal value is **B344.**

The binary value for this is:

B344 ⇔ 1011.0011.0100.0100

Invert the binary number

1011.0011.0100.0100 ⇒ 0100.1100.1011.1011

Add a 1 to the inverted binary number:

0100.1100.1011.1011
0000.0000.0000.0001
0100.1100.1011.1100

Calculate the corresponding decimal value (with the pocket calculator):

0100.1100.1011.1100 ⇔ 19644

You have now calculated the negative decimal value and the required result is:

B344 ⇔ –19644

The temperature value can be calculated as follows:

$$\text{temperature} = 0.01\ °C \times \text{decimal value} = 0.01\ °C \times (-19644) = -196.44\ °C$$

Equations and graphs for 12-bit representation

Attention!
The 12-bit representation is “left-justified”. The number is transmitted with 16 bits! Bit 0…Bit 3 of the binary number, i.e. the last digit of the hexadecimal number, are the diagnostics bits.

Representation of the current values in the range 0…20 mA

To use the equation below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value.

The value range:

0…20 mA

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

The hexadecimal/binary value can be converted (with a pocket calculator) very easily to a decimal value.

Once the decimal value has been determined, the current values can be calculated with the following equation:

$$\text{current} = 4.88 \times 10^{-3}\ \text{mA} \times \text{dezimal value}$$

Figure 30: Representation of current values in relation to the decimal values in the coordinate system

Representation of the current values in the range 4…20 mA

To use the equation below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value.

The value range:

4…20 mA

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

The hexadecimal/binary value can be converted (with a pocket calculator) very easily to a decimal value.

Once the decimal value has been determined, the current values can be calculated with the following equation:

$$\text{current} = 3.91 \times 10^{-3}\ \text{mA} \times \text{dezimal value} + 4\ \text{mA}$$

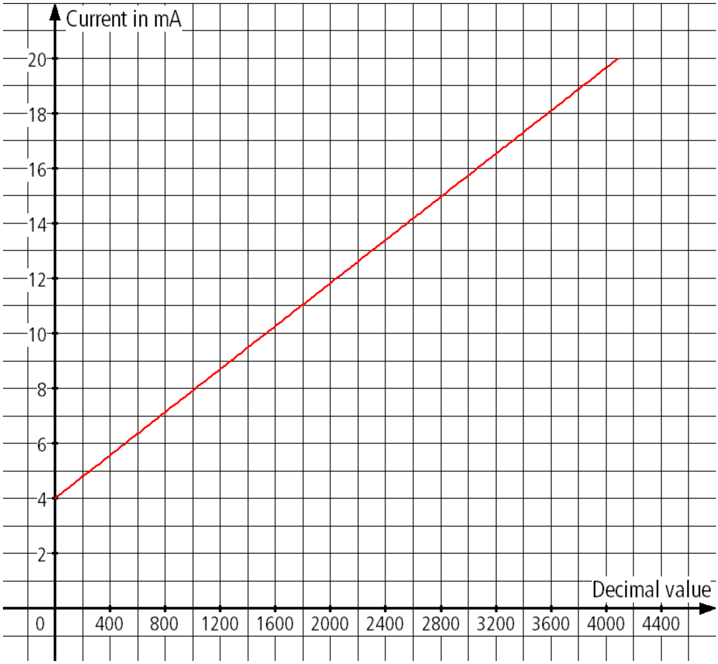


Figure 31: Representation of current values in relation to the decimal values in the coordinate system

Representation of temperature values and resistance values for the XN-2AI-PT/NI-2/3

To use the equations below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value (left-justified representation).

The hexadecimal/binary numerical values for the negative number range cannot be converted (using a pocket calculator) easily to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 000…$7FF_{hex}$ are **positive** values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 16).

All numerical value in the range 800…FFF_{hex} are **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 12).

The following example shows the conversion to a decimal number: → "Example of the calculation of negative numerical values" Page 60.

Only the three most significant hexadecimal digits, i.e. the 12 most significant binary digits, are used for the calculation!

Once the decimal value has been determined, the **temperature values** can be calculated according to the parameters defined.

The first equation is for the parameter setting:

- "PT100, -200..850'C"
- "NI100, -60..250'C"
- "PT200, -200..850'C"
- "PT500, -200..850'C"
- "PT1000, -200..850'C"
- "NI1000, -60..250'C"

$$\text{temperature} = 0.5\ ^\circ\text{C} \times \text{dezimal value}$$

The value range:

-200…-0.5 °C

is mapped to the number range:

$E70_{hex}$…FFF_{hex} (decimal: -400…-1)

The value range:

0…850 °C

is mapped to the number range:

000_{hex}…$6A4_{hex}$ (decimal: 0…1700)

The second equation is for the parameter setting:

- "PT100, -200..150’C"
- "NI100, -60..150’C"
- "PT200, -200..150’C"
- "PT500, -200..150’C"
- "PT1000, -200..150’C"
- "NI1000, -60..150’C"

$$\text{temperature} = 0.1\ °\text{C} \times \text{dezimal value}$$

The value range:

-200 °C…-0.1 °C

is mapped to the number range:

830_{hex}…FFF_{hex} (decimal: -2000…-1)

The value range:

0…150 °C

is mapped to the number range:

000_{hex}…$5DC_{hex}$ (decimal: 0…1500)

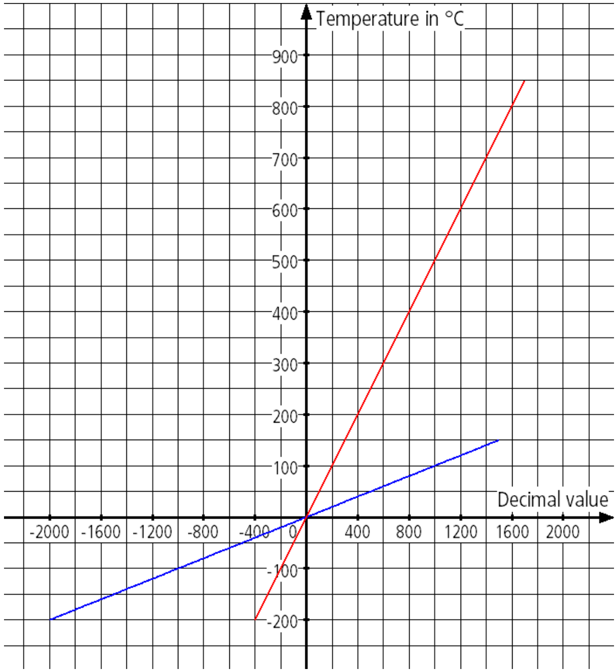


Figure 32: Representation of temperature values in relation to decimal values in the coordinate system
The **red** straight line applies with the following parameter setting:
"PT100, -200..850’C"
"NI100, -60..250’C"
"PT200, -200..850’C"
"PT500, -200..850’C"
"PT1000, -200..850’C"
"NI1000, -60..250’C"
The **blue** straight line applies with the following parameter setting:
"PT100, -200..150’C"
"NI100, -60..150’C"
"PT200, -200..150’C"
"PT500, -200..150’C"
"PT1000, -200..150’C"
"NI1000, -60..150’C"

The parameter setting for the measurement of **resistance values** only requires positive numerical values (hexadecimal/binary) for representation. The positive numerical values can be converted (with the pocket calculator) very easily to a decimal value.

Only the three most significant hexadecimal digits, i.e. 12 most significant binary digits, are used for the calculation!

Once the decimal value has been determined, the resistance values can be calculated according to the parameters defined.

The value range:

0…100 Ω;
0…200 Ω;
0…400 Ω;
0…1000 Ω;

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

The following equations apply:

"Resistance, 0..100 Ohm" (yellow straight line):

$$\text{resistance} = 0.02442\ \Omega \times \text{dezimal value}$$

"Resistance, 0..200 Ohm" (red straight line):

$$\text{resistance} = 0.04884\ \Omega \times \text{dezimal value}$$

"Resistance, 0..400 Ohm" (blue straight line):

$$\text{resistance} = 0.09768\ \Omega \times \text{dezimal value}$$

"Resistance, 0..1000 Ohm" (green straight line):

$$\text{resistance} = 0.24420\ \Omega \times \text{dezimal value}$$

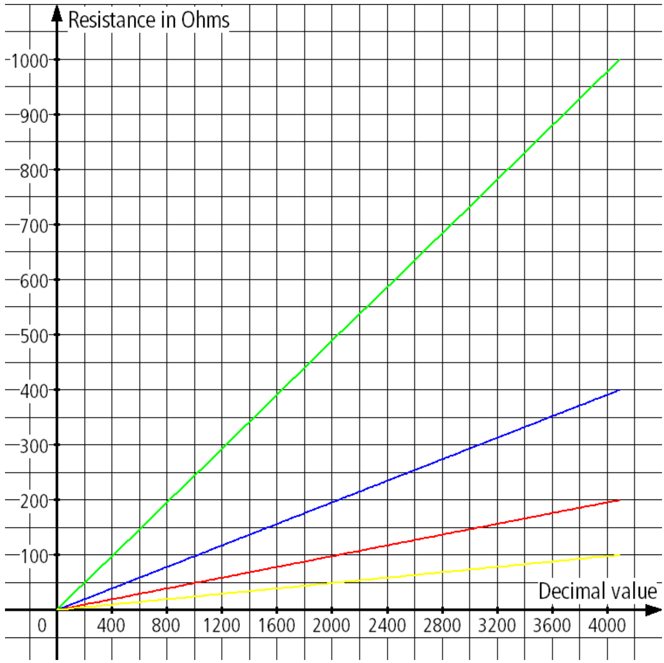


Figure 33: Representation of resistance values in relation to the decimal values in the coordinate system

Representation of temperature and voltage values for the XN-2AI-THERMO-PI

To use the equations below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value (left-justified representation).

The hexadecimal/binary numerical values for the negative number range cannot be converted (using a pocket calculator) easily to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 000…$7FF_{hex}$ are **positive** values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 16).

All numerical value in the range 800…FFF_{hex} are **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 12).

The following examples shows the conversion to a decimal number: → "Example of the calculation of negative numerical values" Page 60.

Only the three most significant hexadecimal digits, i.e. the 12 most significant binary digits, are used for the calculation!

Once the decimal value has been determined, the **temperature values** and the **voltage values** can be calculated according to the parameters defined.

The following applies to the parameter setting of
"Type K, -270..1370'C"
"Type B, +100..1820'C"
"Type E, -270..1000'C"
"Type J, -210..1200'C"
"Type N, -270..1300'C"
"Type R, -50..1760'C"
"Type S, -50..1540'C"
"Type T, -270..400'C"

$$\text{temperature} = 1\ °\text{C} \times \text{dezimal value}$$

The value range:

-270…1820 °C

is mapped to the number range:

$EF2_{hex}$…$71C_{hex}$ (decimal: -270…1820)

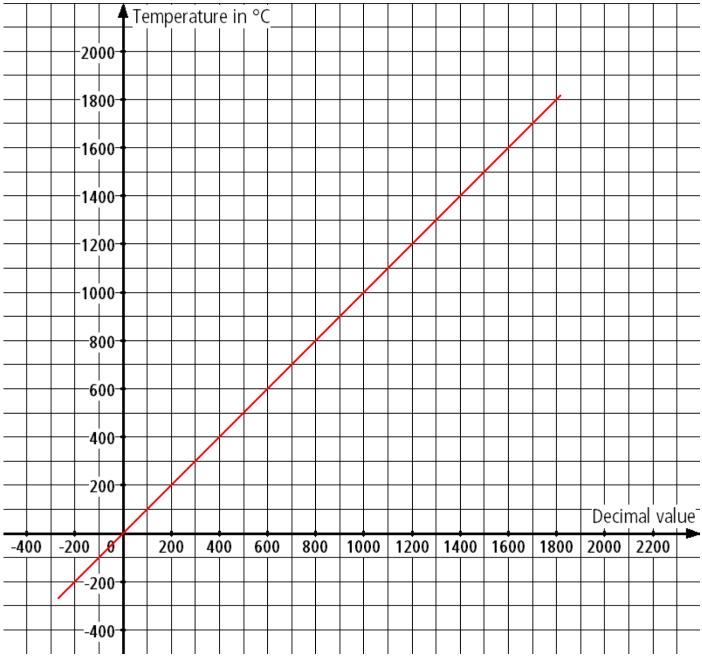


Figure 34: Representation of temperature values in relation to the decimal values in the coordinate system

The following applies to the parameter setting "+/-50 mV":

$$\text{voltage} = 0.02443\ \text{mV} \times \text{dezimal value}$$

The following applies to the parameter setting "+/-100 mV"

$$\text{voltage} = 0.04885\ \text{mV} \times \text{dezimal value}$$

The following applies to the parameter setting "+/-500 mV"

$$\text{voltage} = 0.24426\ \text{mV} \times \text{dezimal value}$$

The following applies to the parameter setting "+/-1000 mV"

$$\text{voltage} = 0.48852\ \text{mV} \times \text{dezimal value}$$

The value range:

-50…-0.024 mV;
-100…-0.049 mV;
-500…-0.244 mV;
-1000…-0.489 mV;

is mapped to the number range:

800_{hex}…FFF_{hex} (decimal: -2048…-1)

The value range:

0…50 mV;
0…100 mV;
0…500 mV;
0…1000 mV;

is mapped to the number range:

000_{hex}…$7FF_{hex}$ (decimal: 0…2047)

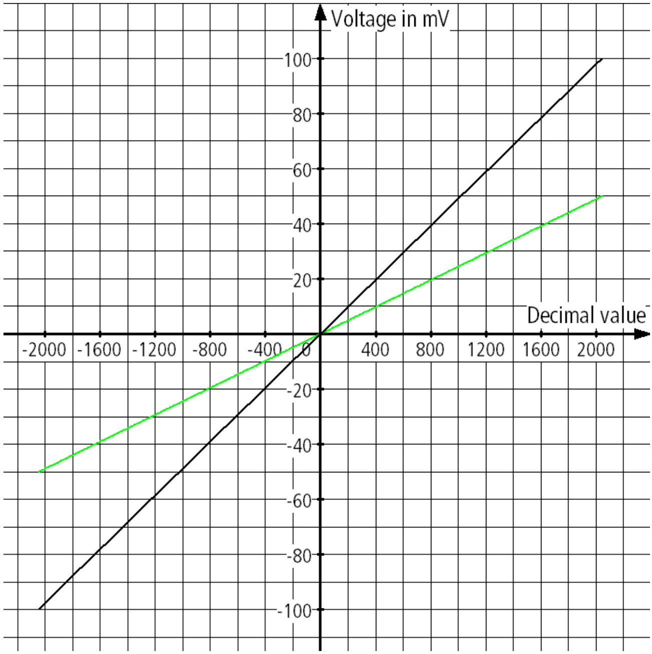


Figure 35: Representation of voltage values in relation to the decimal values in the coordinate system for the parameter setting "+/-50 mV" (green) and "+/-100 mV" (black)

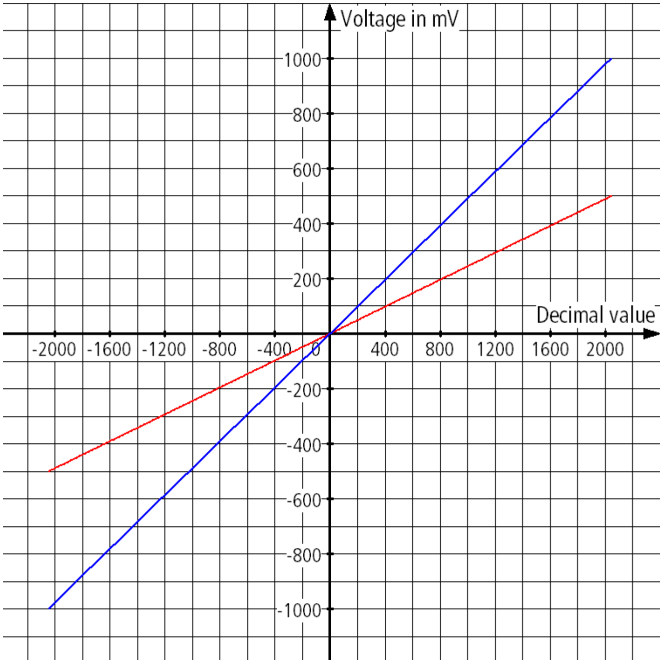


Figure 36: Representation of voltage values in relation to the decimal values in the coordinate system for the parameter setting "+/-500 mV" (red) and "+/-1000 mV" (blue)

Representation of the voltage values in the range 0 V DC…10 V DC

To use the equation below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value (left-justified representation).

The hexadecimal/binary numerical value can be converted (using a pocket calculator) very easily to a decimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 12-bit values.

Once the decimal value has been determined, the voltage values can be calculated with the following equation:

$$\text{voltage} = 0.002442\ \text{V} \times \text{dezimal value}$$

The value range:

0…10 V DC

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

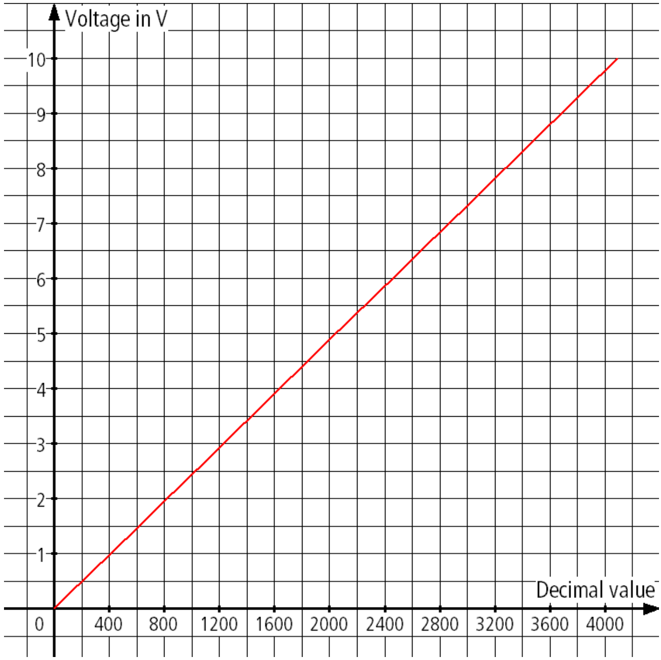


Figure 37: Representation of voltage values in relation to the decimal values in the coordinate system

Representation of the voltage values in the range -10 V DC…10 V DC

To use the equation below, the hexadecimal or binary value must be converted to a decimal value. The numerical value is represented by the three most significant digits of the hexadecimal value, i.e. the 12 most significant bits of the binary value (left-justified representation).

The hexadecimal/binary numerical values for the negative number range cannot be converted (using a pocket calculator) easily to a decimal value since the numbers are coded in the two's complement notation (→ Figure 20 Page 39).

All numerical values in the range 000…$7FF_{hex}$ are **positive** values in two's complement notation. Numbers in this range can be converted to a decimal value with a pocket calculator. This applies also to binary numbers with 0 as the most significant bit (bit 12).

All numerical value in the range 800…FFF_{hex} are **negative** values in two's complement notation. This applies also to binary numbers with 1 as the most significant bit (bit 12). The conversion to a decimal value shows: → "Example of the calculation of negative numerical values" Page 60.

Only the three most significant hexadecimal digits, i.e. the 12 most significant binary digits, are used for the calculation!

Once the decimal value has been determined, the voltage values can be calculated with the following equations:

Equations calculation:
For **positive** voltage values 0 V DC…10 V DC:

$$\text{voltage} = 0.004885\ \text{V} \times \text{dezimal value}$$

The value range:

0…10 V DC

is mapped to the number range:

000_{hex}…$7FF_{hex}$ (decimal: 0…2047)

For **negative** voltage values -10 V DC…10 V DC:

$$\text{voltage} = 0.004883\ \text{V} \times \text{dezimal value}$$

The value range:

-10…-0.0049 V DC

is mapped to the number range:

800_{hex}…FFF_{hex} (decimal: -2048…-1)

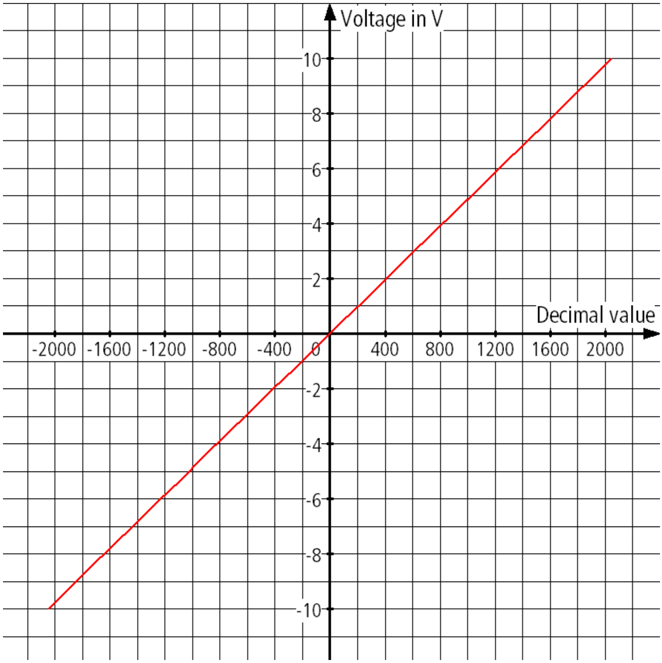


Figure 38: Representation of voltage values in relation to the decimal values in the coordinate system

LEDs

Errors from the I/O level are indicated on each module by means of the **DIA** collective LED. The corresponding diagnostics information is transmitted to the gateway as diagnostics bits.

If the **DIA** LED is permanently red, this indicates that the module bus communication for the analog input module has failed. At some analog input modules, in addition, this indicates that field voltage U_L is not present.

Shielding

Shielded signal cables are connected between the shield and base module via a two pole shield connector available as an accessory.

Module overview

	No. of channels
XN-1AI-I(0/4…20MA)	1
XN-2AI-I(0/4…20MA)	2
XN-1AI-U(-10/0…+10VDC)	1
XN-2AI-U(-10/0…+10VDC)	2
XN-2AI-PT/NI-2/3	2
XN-2AI-THERMO-PI	2
XN-4AI-U/I	4

XN-1AI-I(0/4…20MA)

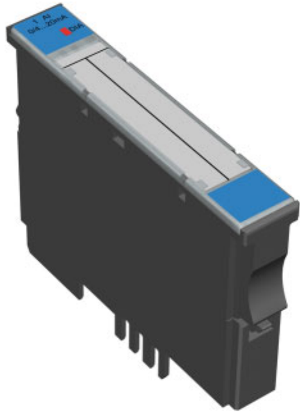


Figure 39: Analog input module, 1 analog input: 0…20 mA/4…20 mA

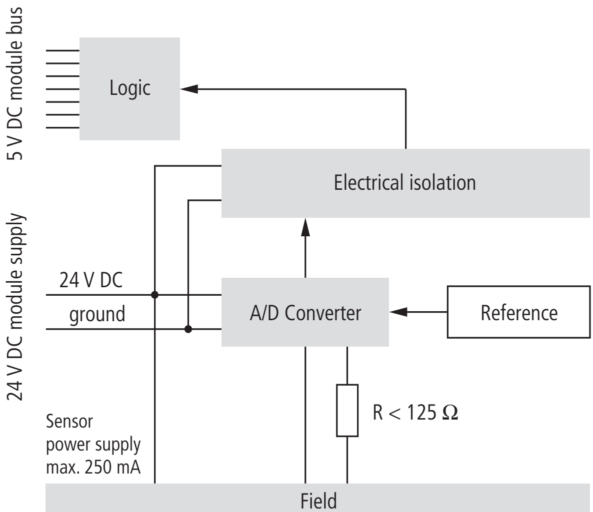


Figure 40: Block diagram

Technical data

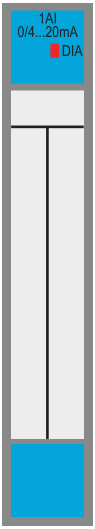
Table 9: XN-1AI-I(0/4…20MA)

Designation	Value
Measured variables	Current
Number of channels	1
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)2)]	≦ 50 mA
Nominal current consumption from module bus I_{MB} [2)]	≦ 41 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Sensor supply	Bridged with the supply terminals U_L and GND_L of the supply; not short-circuit-proof
Current measurement	
Measurement ranges	0…20 mA/4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire/4-wire + shield
Max. input current I_{max} (temporary – “measurement value range error” indicated already from 20.2 mA)	50 mA
Input resistance (burden) R_L	< 125 Ω
Cutoff frequency f_G	200 Hz
Offset error	< 0.1 %
Linearity (0.1…19.9 mA)	0.03 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.09 %
Temperature coefficient	≦ 300 ppm/ °C of limit value

Designation	Value
Representation of the converted input value	
Resolution of A/D converter	14 Bit Signed Integer
Measuring principle	Successive approximation
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostics messages



LED	Display	Meaning	Remedy
DIA	Red flashng, 0.5 Hz	Diagnostics present	–
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostics	–

The module features the following diagnostics data:

- Measurement value range error:
  Indication of overcurrent or undercurrent of 1 % of the set current range.
  - Current 0…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent is not detected.
  - Current 4…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent: I_{min} (I < 3.8 mA)
- Wire break:
  Indication of a wire break in the signal cable for operating mode 4…20 mA with a threshold of 3 mA.

Module parameters

Parameter name	Value
Diagnostic	release[1)]
	block
Value representation	Integer (15bit + sign)[1)]
	12bit (left-justified)
Current mode	0..20mA[1)]
	4..20mA

1) Standard parameter values

Base modules

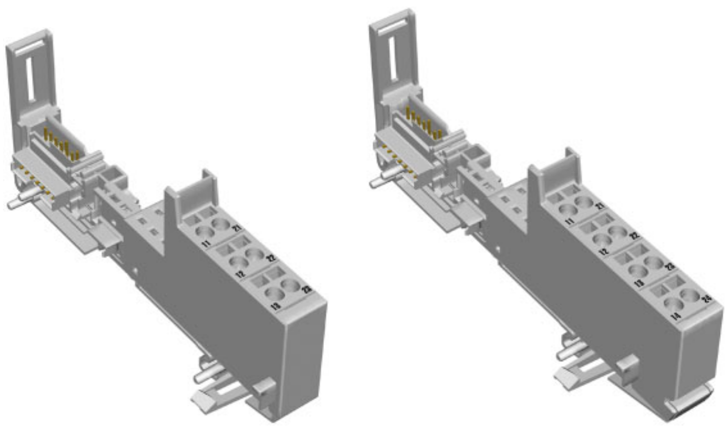


Figure 41: Base module XN-S3T-SBB (left) and XN-S4T-SBBS (right)

	Base modules
With tension clamp connection	XN-S3T-SBB XN-S4T-SBBS
With screw connection	XN-S3S-SBB XN-S4S-SBBS

Connection diagrams

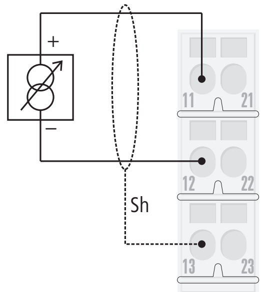


Figure 42: Connection diagram of XN-S3x-SBB analog sensor without sensor supply

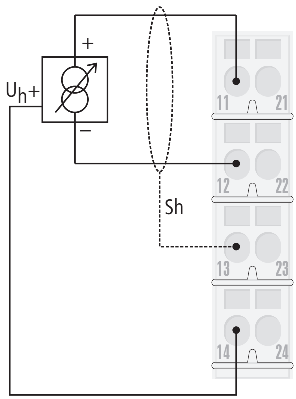


Figure 43: Connection diagram of XN-S4x-SBBS analog sensor with 1-wire sensor supply

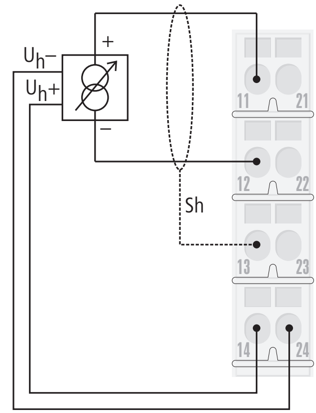


Figure 44: Connection diagram of XN-S4x-SBBS analog sensor with 2-wire sensor supply

→ "Technical data for the terminals" Page 26

XN-2AI-I(0/4...20MA)

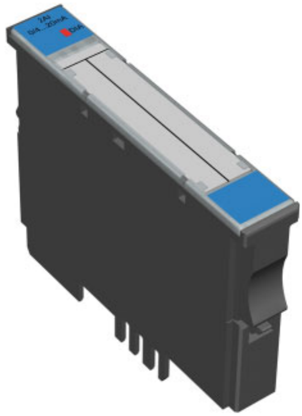


Figure 45: Analog input module,
2 analog inputs: 0...20 mA/4...20 mA

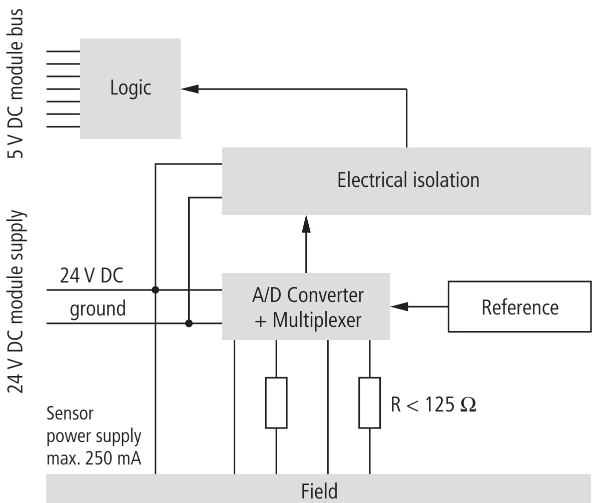


Figure 46: Block diagram

Technical data

Table 10: XN-2AI-I(0/4…20MA)

Designation	Value
Measured variables	Current
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L 1)2)	≦ 12 mA
Nominal current consumption from module bus I_{MB} 2)	≦ 35 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Sensor supply	≦ 250 mA; bridged with the supply terminals U_L and GND_L of the supply; not short-circuit-proof
Current measurement	
Measurement ranges	0…20 mA/4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire + shield
Max. input current I_{max} (temporary – “measurement value range error” indicated already from 20.2 mA)	50 mA
Input resistance (burden) R_L	< 125 Ω
Cutoff frequency f_G	50 Hz
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Temperature coefficient	≦ 300 ppm/ °C of limit value
Representation of the converted input value	
Resolution of A/D converter	16-bit
Measuring principle	Successive approximation

Designation	Value
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostics messages

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostic present	-
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	-

The module features the following diagnostics data per channel:

- Measurement value range error:
  Indication of overcurrent or undercurrent of 1 % of the set current range.
  - Current 0…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent is not detected.
  - Current 4…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent: I_{min} (I < 3.8 mA)
- Wire break:
  Indication of a wire break in the signal cable for operating mode 4…20 mA with a threshold of 3 mA.

→ With "12bit (left-justified)" measured value representation, the diagnostics data is transmitted with bits 0 to 3 of the process data of the relevant channel.

Module parameters (per channel)

Parameter name	Value
Channel Kx (x=1,2)	activate [1]
	deactivate
Diagnostic	release[1]
	block
Value representation	Integer (15bit + sign)[1]
	12bit (left-justified)
Current mode	0..20mA [1]
	4..20mA

1) Standard parameter value

Base modules

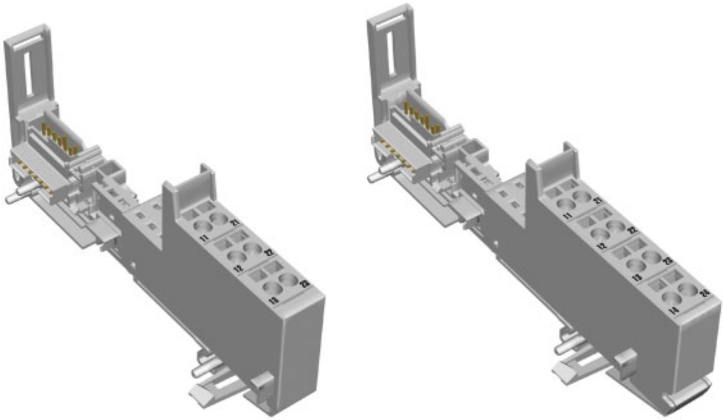


Figure 47: Base module XN-S3T-SBB (left) and XN-S4T-SBBS (right)

	Base modules
With tension clamp connection	XN-S3T-SBB XN-S4T-SBBS
With screw connection	XN-S3S-SBB XN-S4S-SBBS

Connection diagrams

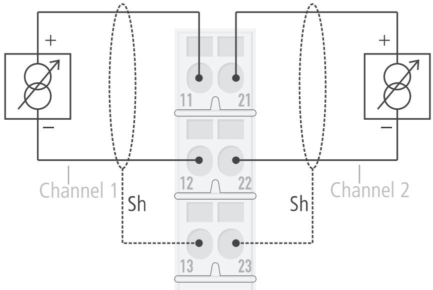


Figure 48: Connection diagram XN-S3x-SBB

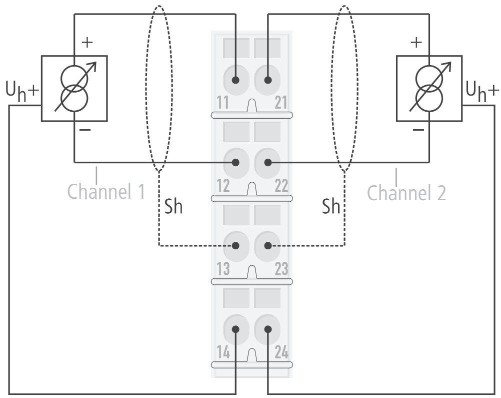


Figure 49: Connection diagram XN-S4x-SBBS

→ "Technical data for the terminals" Page 26

XN-1AI-U(-10/0…+10VDC)

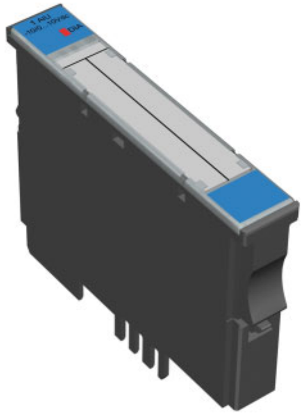


Figure 50: Analog input module, 1 analog input: -10…+10 V DC/0…+10 V DC

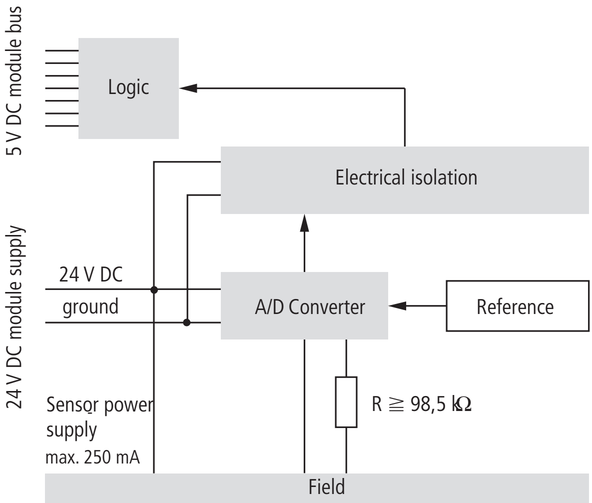


Figure 51: Block diagram

Technical data

Table 11: XN-1AI-U(-10/0…+10VDC)

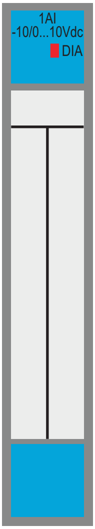
Designation	Value
Measured variables	Voltage
Number of channels	1
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L 1)2)	≦ 50 mA
Nominal current consumption from module bus I_{MB} 2)	≦ 41 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Sensor supply	Bridged with the supply terminals U_L and GND_L of the supply; not short-circuit-proof
Voltage measurement	
Measurement ranges	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire/4-wire + shield
Max. input voltage U_{max} (continuous - “measurement value range error” indicated already from 10.1 V DC)	35 V DC
Input resistance (burden) R_L	≧ 98.5 kΩ
Cutoff frequency f_G	200 Hz
Offset error	< 0.1 %
Linearity	0.03 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Temperature coefficient	≦ 300 ppm/ °C of limit value

Designation	Value
Representation of input value	
Resolution of A/D converter	14 Bit Signed Integer
Measuring principle	Successive approximation
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.

2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostics messages



LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostic present	–
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	–

The module features the following diagnostics data:

- Measurement value range error:
  Indication of overvoltage or undervoltage of 1 % of the set voltage range.
  - Voltage -10…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage: U_{min} (U < -10.1 V DC)
  - Voltage 0…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage: U_{min} (U < 0.1 V DC)

Module parameters

Parameter name	Value
Diagnostic	release[1)]
	block
Value representation	Integer (15bit + sign)[1)]
	12bit (left-justified)
Voltage mode	-10..+10V
	0..10V[1)]

1) Standard parameter value

Base modules

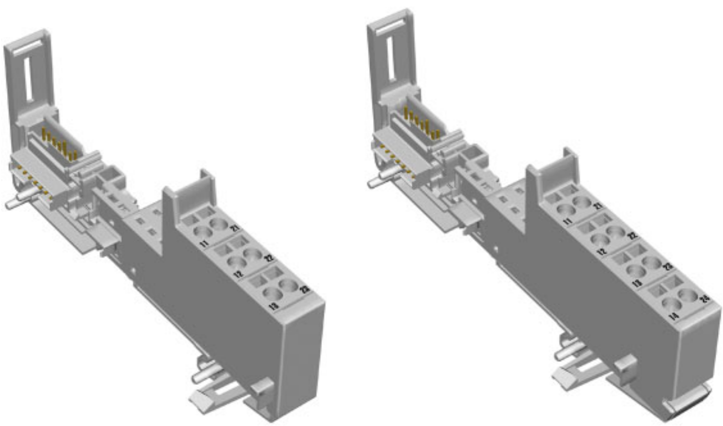


Figure 52: Base module XN-S3T-SBB (left) and XN-S4T-SBBS (right)

	Base modules
With tension clamp connection	XN-S3T-SBB XN-S4T-SBBS
With screw connection	XN-S3S-SBB XN-S4S-SBBS

Connection diagrams

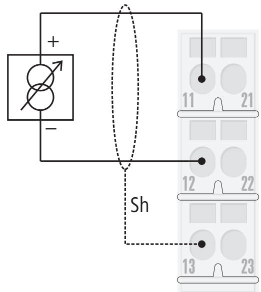


Figure 53: Connection diagram of XN-S3x-SBB analog sensor without sensor supply

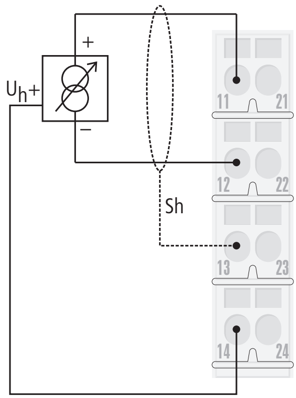


Figure 54: Connection diagram of XN-S4x-SBBS analog sensor with 1-wire sensor supply

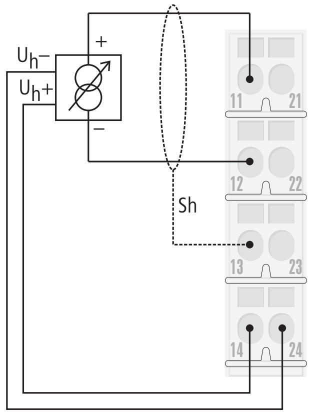


Figure 55: Connection diagram of XN-S4x-SBBS analog sensor with 2-wire sensor supply

→ “Technical data for the terminals” Page 26

XN-2AI-U(-10/0…+10VDC)

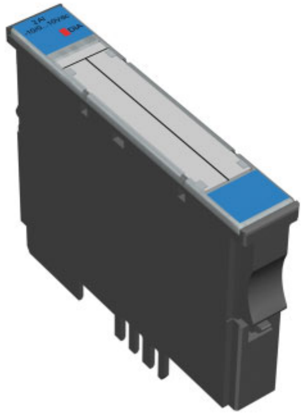


Figure 56: Analog input module, 2 analog inputs: -10…+10 V DC/0…+10 V DC

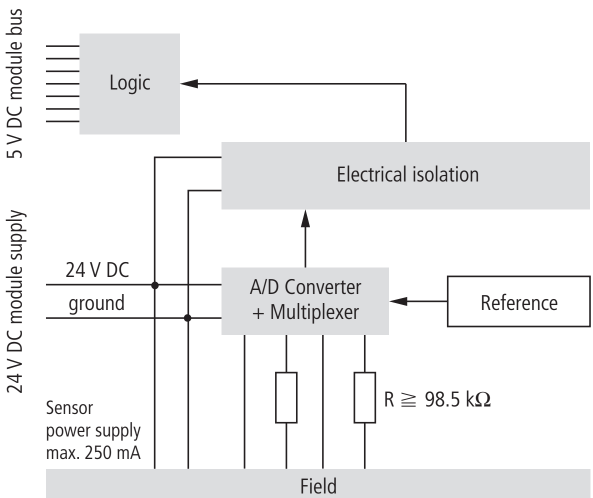


Figure 57: Block diagram

Technical data

Table 12: XN-2AI-U(-10/0…+10VDC)

Designation	Value
Measured variables	Voltage
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L 1)2)	≦ 12 mA
Nominal current consumption from module bus I_{MB} 2)	≦ 35 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Sensor supply	≦ 250 mA; bridged with the supply terminals U_L and GND_L of the supply; not short-circuit-proof
Voltage measurement	
Measurement ranges	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire + shield
Max. input voltage U_{max} (continuous - “measurement value range error” indicated already from 10.1 V DC)	35 V DC
Input resistance (burden) R_L	≧ 98.5 kΩ
Cutoff frequency f_G	50 Hz
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Temperature coefficient	≦ 150 ppm/ °C of limit value
Representation of input value	
Resolution of A/D converter	16-bit
Measuring principle	Delta Sigma

Designation	Value
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.

2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostic messages

LED	Display	Meaning	Remedy
DIA	Red, flashing, 0.5 Hz	Diagnostic present	-
	Red	Failure of module bus communication	Check whether more than twoadjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	-

The module features the following diagnostics data per channel:

- Measurement value range error:
  Indication of overvoltage or undervoltage of 1 % of the set voltage range.
  - Voltage -10…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage: U_{min} (U < -10.1 V DC)
  - Voltage 0…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage: U_{min} (U < 0.1 V DC)

→ With “12bit (left-justified)” measured value representation, the diagnostics data is transmitted with bits 0 to 3 of the process data of the relevant channel.

Module parameters (per channel)

Parameter name	Value
Channel Kx (x=1,2)	activate [1)]
	deactivate
Diagnostic	release[1)]
	block
Value representation	Integer (15bit + sign)[1)]
	12bit (left-justified)
Voltage mode	0..10V[1)]
	-10..+10V

1) Standard parameter value

Base modules

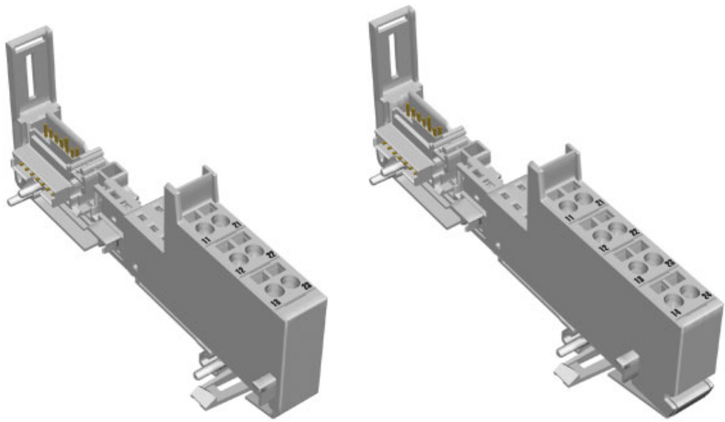


Figure 58: Base module XN-S3T-SBB (left) and XN-S4T-SBBS (right)

	Base modules
With tension clamp connection	XN-S3T-SBB XN-S4T-SBBS
With screw connection	XN-S3S-SBB XN-S4S-SBBS

Connection diagrams

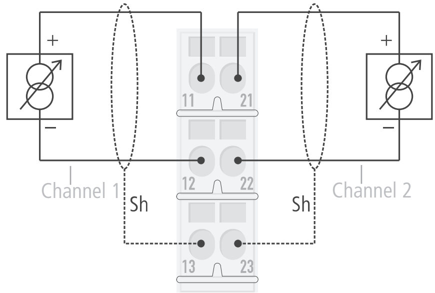


Figure 59: Connection diagram XN-S3x-SBB

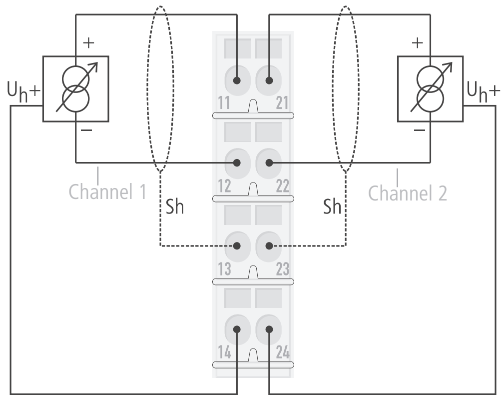


Figure 60: Connection diagram XN-S4x-SBBS

→ “Technical data for the terminals” Page 26

XN-2AI-PT/NI-2/3

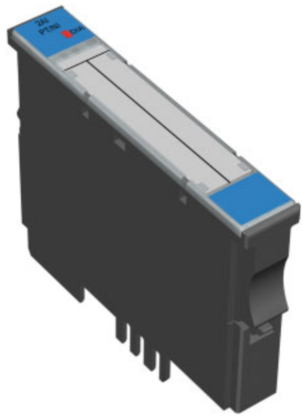


Figure 61: Analog input module,
2 analog inputs: PT/NI sensors

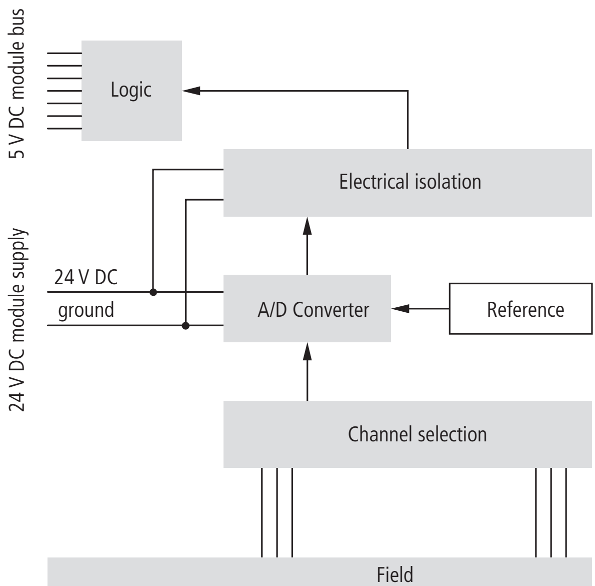


Figure 62: Block diagram

Technical data

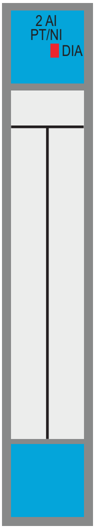
Table 13: XN-2AI-PT/NI-2/3

Designation	Value
Measured variables	Temperature (PT, NI), resistance R
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)2)]	≦ 30 mA
Nominal current consumption from module bus I_{MB} [2)]	≦ 45 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Temperature measurement	
Connectable sensors	PT100, PT200, PT500, PT1000 (IEC/EN 60751), NI100, NI1000 (DIN 43760)
Measurement ranges	Platinum sensors: -200…850 °C/-200…150 °C Nickel sensors: -60…250 °C/-60…150 °C
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire
Measurement current I_{mess}	< 1 mA
Destruction limit U_{max}	> 30 V DC
Offset error	≦ 0.1 %
Linearity	< 0.1 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Temperature coefficient	≦ 300 ppm/ °C of limit value

Designation	**Value**
R (resistance measurement)	
Measurement ranges	0…100 Ω, 0…200 Ω, 0…400 Ω, 0…1000 Ω
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire
Destruction limit U_{max}	> 30 V DC
Offset error	≦ 0.1 %
Linearity	< 0.1 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Temperature coefficient	≦ 300 ppm/ °C of limit value
Representation of input value	
Resolution of A/D converter	16-bit
Measuring principle	Delta Sigma
Cycle time	200 ms
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostic messages



LED	Display	Meaning	Remedy
DIA	Red flashing, 0.5 Hz	Diagnostic present	–
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	–

The module features the following diagnostics data per channel:

- Measurement value range error:
  - Unterflow diagnostics only in temperature measurements
  - Threshold: 1 % of the positive measurement range limit value
- Wire break
- Short-circuit (only in temperature measurements):
  - Threshold: 5 Ω (loop resistance)
  - With 3-wire measurements with PT100 sensors, no distinction is made between short-circuit and wire break at a temperature below -177 °C. In this case, the “Short-circuit” diagnostic signal is generated.

Module parameters (per channel)

Parameter name	Value
Measuring mode Kx (x=1,2)	2-wire[1)] 3-wire
Element Kx (x=1,2)	PT100, -200..850°C[1)] PT100, -200..150°C NI100, -60..250°C NI100, -60..150°C PT200, -200..850°C PT200, -200..150°C PT500, -200..850°C PT500, -200..150°C PT1000, -200..850°C PT1000, -200..150°C NI1000, -60..250°C NI1000, -60..150°C resistance, 0..100 Ohm resistance, 0..200 Ohm resistance, 0..400 Ohm resistance, 0..1000 Ohm
Channel Kx (x=1,2)	activate[1)] deactivate
Diagnostic Kx (x=1,2)	release[1)] block
Value representation Kx (x=1,2)	Integer (15bit + sign)[1)] 12bit (left-justified)
Mains suppression Kx (x=1,2)	50 Hz[1)] 60 Hz

1) Standard parameter value

Base modules

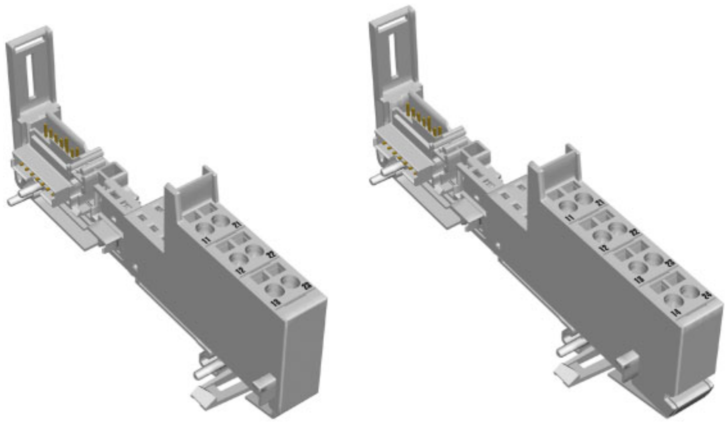


Figure 63: Base module XN-S3T-SBB (left) and XN-S4T-SBBS (right)

	Base modules
With tension clamp connection	XN-S3T-SBB (only 2-wire measuring possible) XN-S4T-SBBS (also 3-wire measuring possible)
With screw connection	XN-S3S-SBB (only 2-wire measuring possible) XN-S4S-SBBS (also 3-wire measuring possible)

Connection diagrams

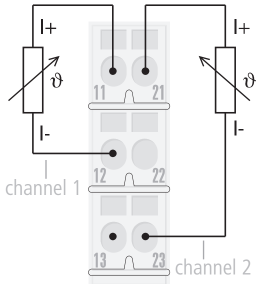


Figure 64: Wiring diagram XN-S3x-SBB (2-wire measuring)

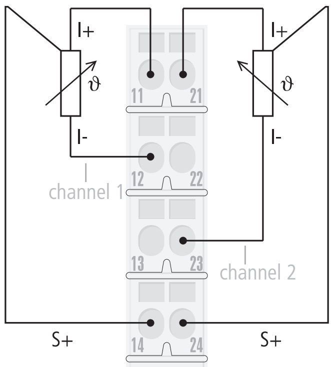


Figure 65: Wiring diagram XN-S4x-SBBS (3-wire measuring)

→ “Technical data for the terminals” Page 26

XN-2AI-THERMO-PI

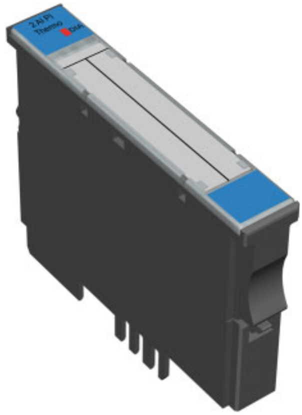


Figure 66: Analog input module,
2 analog inputs: thermocouples

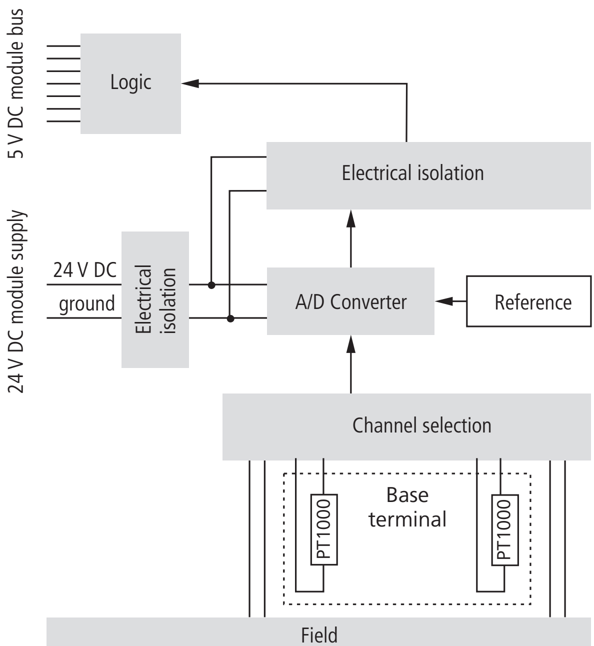


Figure 67: Block diagram

Technical data

Table 14: XN-2AI-THERMO-PI

Designation	Value
Measured variables	Temperature (Thermocouples)
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)2)]	≦ 30 mA
Nominal current consumption from module bus I_{MB} [2)]	≦ 45 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Insulation voltage (U_L to channels)	500 V_{rms}
Power loss	< 1 W
Temperature measurement	
Connectable sensors	Thermocouple type B, E, J, K, N, R, S, T according to IEC/EN 60584, Class 1, 2, 3
Measurement ranges	Type B: 100…1820 °C Type E: -270…1000 °C Type J: -210…1200 °C Type K: -270…1370 °C Type N: -270…1300 °C Type R: -50…1760 °C Type S: -50…1540 °C Type T: -270…400 °C
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire (cold-junction compensation in base module)
Destruction limit U_{max}	> 10 V DC
Basic error limit at 23 °C	The values are listed in the following table → Table 15, Page 122.
Repeatability	
Error due to cold junction compensation	

Designation	Value
Temperature coefficient	≦ 300 ppm/ °C of limit value
Cross talk attenuation	≧ 80 dB
Voltage measurement	
Measurement ranges	-50…50 mV -100…100 mV -50…500 mV -1000…1000 mV
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire
Max. input voltage U_{max}	10 V DC
Basic error limit at 23 °C	< 0.2 % (normally)
Repeatability (% of positive limit value)	0.05 %
Temperature coefficient	≦ 300 ppm/ °C of limit value
Cross talk attenuation	≧ 80 dB
Representation of input value	
Resolution of A/D converter	16-bit
Measuring principle	Delta Sigma
Cycle time	260 ms
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.

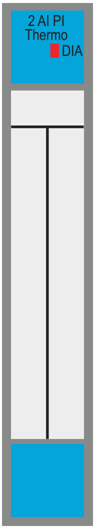
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Table 15: Basic error limits and repeatability in temperature measuement

Thermo-couple	**Temperature range [°C]**	**Basic error limit at 23 °C** (% of positive limit value)	**Repeatability** (% of positive limit value)	**Error due to cold junction compensatione[1)]** (% of positive limit value)
Type B	300…1820	0.2	0.05	0.11
Type E	-180…1000	0.2	0.05	0.20
Type J	-210…1200	0.2	0.05	0.17
Type K	-200…1370	0.2	0.05	0.15
Type N	-150…1300	0.2	0.05	0.16
Type R	-50…1760	0.2	0.05	0.12
Type S	-50…1540	0.2	0.05	0.13
Type T	-200…0 0…400	0.6 0.2	0.1 0.075	– 0.50

1) With negative measuring temperatures, a high deviation of the cold junction compensation should be expected.

Diagnostic messages



LED	Display	Meaning	Remedy
DIA	Red flashing, 0.5 Hz	Diagnostic present	–
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	–

The module features the following diagnostics data per channel:

- Measurement value range error:
  - Threshold: 1 % of the positive measurement range limit value
  - With type K, N and T sensors, the “Underflow” diagnostic signal is generated on temperatures below -271.6 °C.
- Wire break (only in temperature measurements)

Module parameters (per channel)

Parameter name	Value
Element Kx (x=1,2)	Type K, -270..1370°C[1)] Type B, +100…1820°C Type E, -270..1000°C Type J, -210..1200°C Type N, -270..1300°C Type R, -50..1760°C Type S, -50..1540°C Type T, -270..400°C +/-50 mV +/-100 mV +/-500 mV +/-1000 mV
Channel Kx (x=1,2)	activate[1)] deactivate
Diagnostic Kx (x=1,2)	release[1)] block
Value representation Kx (x=1,2)	Integer (15bit + sign)[1)] 12bit (left-justified)
Mains suppression Kx (x=1,2)	50 Hz[1)] 60 Hz

1) Standard parameter value

Base modules

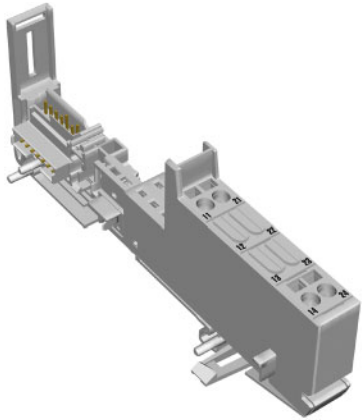


Figure 68: Base module XN-S4T-SBBS-CJ

	Base modules
With tension clamp connection	XN-S4T-SBBS-CJ
With screw connection	XN-S4S-SBBS-CJ

Connection diagram

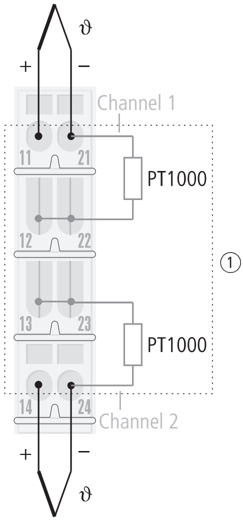


Figure 69: Connection diagram XN-S4x-SBBS-CJ

① Cold junction compensation in base module

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XN-4AI-U/I

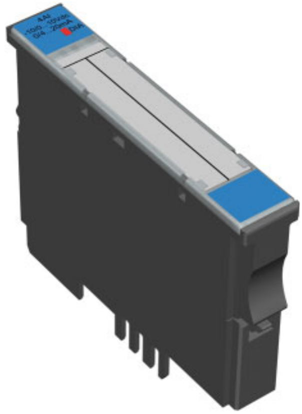


Figure 70: Analog input module, 4 analog inputs: voltage (-10…+10 V DC/0…+10 V DC) / current (0…20 mA/4…20 mA)

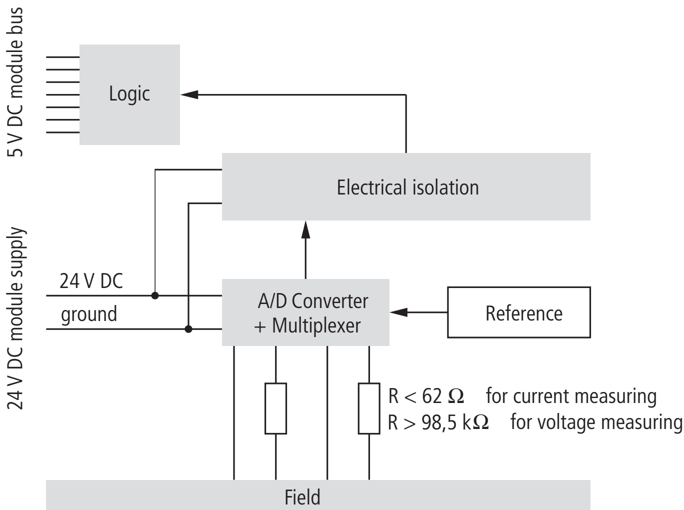


Figure 71: Block diagram

Technical data

Table 16: XN-4AI-U/I

Designation	Value
Measured variables	Voltage, current
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)2)]	≦ 50 mA
Nominal current consumption from module bus I_{MB} [2)]	≦ 20 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1 W
Voltage measurement	
Measurement ranges	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Max. input voltage U_{max} (continuous - “measurement value range error” indicated already from 10.1 V DC)	30 V DC
Input resistance (burden) R_L	≧ 98.5 kΩ[3)]
Cutoff frequency f_G	20 Hz
Basic error limit at 23 °C	< 0.3 %
Temperature coefficient	≦ 300 ppm/ °C of limit value
Current measurement[4)]	
Measurement ranges	0…20 mA/ 4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Max. input current I_{max} (temporary – “measurement value range error” indicated already from 20.2 mA)	50 mA[3)]
Input resistance (burden) R_L	< 62 Ω[3)]

Designation	Value
Cutoff frequency f_G	20 Hz
Basic error limit at 23 °C	< 0.3 %
Temperature coefficient	≦ 300 ppm/ °C of limit value
Representation of the converted input value	
Resolution of A/D converter	16-bit
Measuring principle	Delta Sigma
Measured value representation	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).
3)

→ The input resistance of the channel is changed automatically if the module is parameterised in the measuring range and is loaded with an impermissibly high current. Diagnostic messages are retained. In this case, the module switches from the parameterised current measuring to voltage measuring.

This function mostly protects the input channel from destruction due to an overload!

4)

→ The conditions for the “Current measuring” mode are relevant when the channel is enabled!

The channel is enabled by means of the “Channel Kx” parameter → “Module parameters (per channel)” Page 132.

Diagnostic messages

LED	Display	Meaning	Remedy
DIA	Red flashing, 0.5 Hz	Diagnostic present	-
	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed. Check the module supply via supply terminal U_L.
	OFF	No fault indication or diagnostic	-

The module features the following diagnostics data per channel:

- Measurement value range error:
  Indication of overvoltage or undervoltage of 1% of the set voltage range or indication of overcurrent or undercurrent of 1 % of the set current range.
  - Voltage -10…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage : U_{min} (U < -10.1 V DC)
  - Voltage 0…+10 V DC:
    - Overvoltage: U_{max} (U > 10.1 V DC)
    - Undervoltage : U_{min} (U < 0.1 V DC)
  - Current 0…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent is not detected.
  - Current 4…20 mA:
    - Overcurrent: I_{max} (I > 20.2 mA);
    - Undercurrent: I_{min} (I < 3.8 mA)
- Wire break:
  Indication of a wire break in the signal cable for operating mode 4…20 mA with a threshold of 3 mA.

→ With “12bit (left-justified)” measured value representation, the diagnostics data is transmitted with bits 0 to 3 of the process data of the relevant channel.

Module parameters (per channel)

Parameter name	Value
Operating mode	voltage[1]
	current
Channel Kx (x= 1…4)	activate[1]
	deactivate
Diagnostic	release[1]
	block
Value representation	Integer (15bit + sign)[1]
	12bit (left-justified)
Range	0..10V/0..20 mA[1]
	-10..+10V/4..20 mA

1) Standard parameter value

Base modules

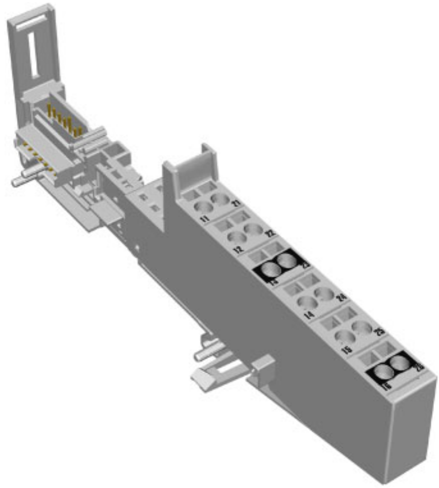


Figure 72: Base module XN-S6T-SBCSBC

	Base modules
With tension clamp connection	XN-S6T-SBCSBC
With screw connection	XN-S6S-SBCSBC

Connection diagram

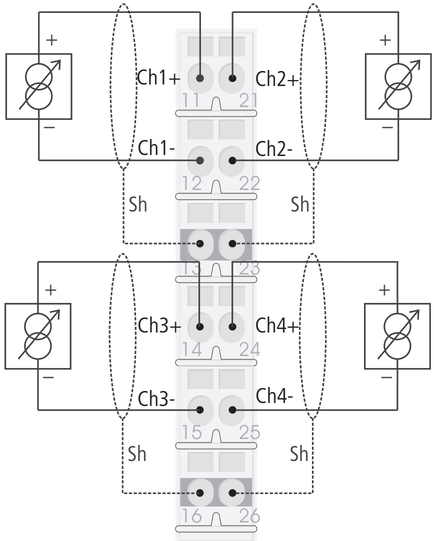


Figure 73: Connection diagram XN-S6x-SBCSBC

→ "Technical data for the terminals" Page 26

XNE-8AI-U/I-4PT/NI

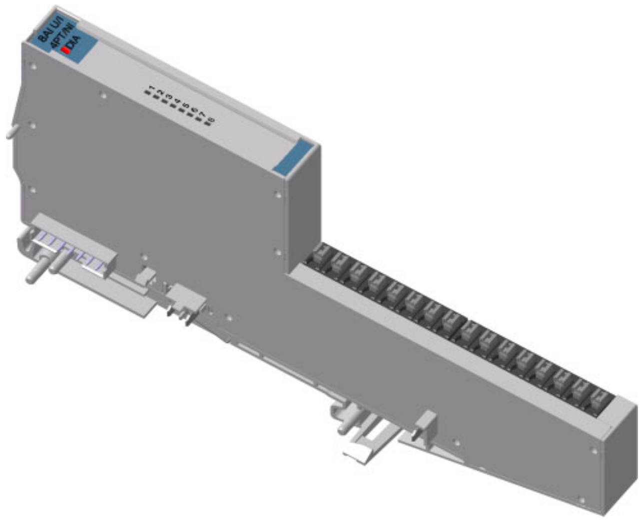


Figure 74: Analog input module (XNE ECO),
8 analog inputs:
- voltage (-10…+10 V DC/0…+10 V DC) /
- current (0…20 mA/4…20 mA)
or 4 analog inputs:
- PT/NI sensors

The analog input module is used to connect 8 analog encoders. Each channel can be parameterized in different current or respectively voltage ranges. Additionally, 2 analog channels at a time can be combined to a PT-/NI- or R-input with 2- or 3-wire technology.

The module thus provides a maximum number of 8 measurement inputs for voltage or current or 4 channels for 2- or 3-wire PT-/NI- or R-measurement. The function-setting is done via channel-oriented parameters.

The module thus provides electrical isolation between the field an the module bus connection.

The encoder supply has to be connected externally. A shield connection at the base module is not possible.

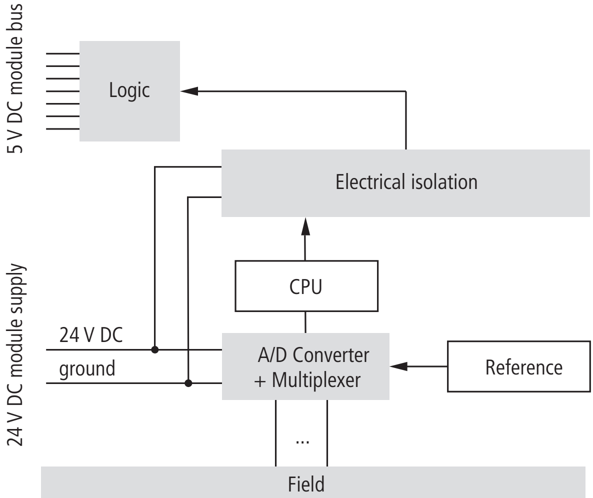


Figure 75: Block diagram

Technical data

Table 17: XNE-8AI-U/I-4PT/NI

Designation	Value
Measured variables	Voltage, current, temperature (PT, NI), resistance R
Number of channels	8 (U/I) / 4 (PT/NI/R)
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L 1)2)	normally 35 mA (without measurement signal)
Nominal current consumption from module bus I_{MB} 2)	≦ 30 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 1.5 W
Voltage measurement	
Measurement ranges	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified) Extended range, 16-bit/12-bit (left-justified) NE43, 16-bit/12-bit (left-justified)
Connection options	2-wire
Max. input voltage U_{max} 3)	± 20 V DC
Input resistance (burden) R_L	≧ 200 kΩ
Cutoff frequency f_G	1.5 Hz
Basic error limit at 23 °C 3)	< 0.2 %
Temperature coefficient	≦ 200 ppm/ °C of limit value
Current measurement	
Measurement ranges	0…20 mA/4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified) Extended range, 16-bit/12-bit (left-justified) NE43, 16-bit/12-bit (left-justified)
Connection options	2-wire

Designation	Value
Max. input current I_{max}	40 mA
Max. input voltage U_{max} 3)	< 17 V DC
Input resistance (burden) R_L	< 52 Ω
Cutoff frequency f_G	1.5 Hz
Basic error limit at 23 °C	< 0.2 %
Temperature coefficient	≦ 200 ppm/ °C of limit value
Temperature measurement	
Connectable sensors	PT100, PT200, PT500, PT1000 (all platinum sensors: IEC/EN 60751), NI100, NI1000 (DIN 43760), NI1000TK5000
Measurement ranges	Platinum sensors: -200…850 °C/-200…150 °C Nickel sensors: -60…250 °C/-60…150 °C
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire
Measurement current I_{mess}	< 0.5 mA (integral)
Destruction limit U_{max}	> 30 V DC
Cutoff frequency f_G	1.5 Hz
Basic error limit at 23 °C)	PT100, NI100: 0.35 % PT200, PT500, PT1000, NI1000, NI1000TK5000: 0.2 %
Temperature coefficient	≦ 200 ppm/ °C of limit value
R (resistance measurement)	
Measurement ranges	0…250 Ω, 0…400 Ω, 0…800 Ω, 0…2000 Ω, 0…4000 Ω
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire/3-wire
Destruction limit U_{max}	> 30 V DC
Cutoff frequency f_G	1.5 Hz
Basic error limit at 23 °C	< 0.2 %

Designation	Value
Temperature coefficient	≦ 200 ppm/ °C of limit value

1) The supply terminal (U_L) provides the current for the module electronics and for the analog sensor on the inputs. The overall current that is required for each module is the sum of all the individual currents.
2) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).
3)

→ If the maximum input voltage of a channel is overstepped, measurement errors at other channels may be caused!

Diagnostic messages

LED	Display	Meaning	Remedy
DIA	Red flashing, 0.5 Hz	Diagnostics pending	-
	Red	Module bus communication failure or field voltage U_L is not present	Check if more than two adjoining electronics modules have been pulled. Check the field voltage U_L.
	Off	No error messages or diagnostics	–
1…8	Green	Channel input active	
	Green flashing, 4 Hz	Overflow at channel	
	Green flashing, 0.5 Hz	Underflow at channel	
	Off	Channel inactive	

The module features the following diagnostics data per channel:

- Measurement value range error “Out of Range” (**OoR**):
  - The measured value overstepps or undercuts the limit of the nominal range (limit values according to parameterization).
- Wire break (**WB)**:
  - The measured value is in the range which is assumed that there is a wire break in the signal cable.
    - In temeperature messurements
    - In resistance measurements
    - In current measurements in the range of 4…20 mA

- Short-circuit (**SC**):
  - The measured value is in the range which is assumed that there is a short-circuit.
    - In temeperature messurements: Threshold: 5 Ω (loop resistance)
    - 3-wire measurements with PT100 sensors cannot differentiate between a short-circuit and a wire break at temperatures below -177 °C. In this case, the diagnostic "shortcircuit" is generated.
- Overflow / Underflow (**OUFL**):
  - The measured value exceeds the measurement range (limit values according to parameterization). The module cannot measure this value. The return value is the maximum or minimum value which can be measured.
- Hardware error (**HW Error**):
  - Exampels: CRC error, calibration errors…
  - The return value of the measured value is “0”.

→ The switching thresholds depend on the setting of the module parameter operation mode Kx. The switching thresholds can be found in the corresponding section from Page 146 on.

→ In the measurement ranges of current measurement, the module switches automatically to the voltage measurement after 300 ms if
I > 40.0 mA. For the 300 ms, a current of max. 500 mA is accepted. After this, a periodical switching to current measurement is done. If the current falls again to the permissible range, the module switches permanently back to current measurement. During this procedure, the transmitted value is always the measurement range end value.
Please consider the module’s maximum input voltage!

Module parameters (per channel)

The module provides 8 byte parameter data. One byte is assigned to each analog input channel.

→ Please read from Page 146 on. for detailed information about the parameter settings (Standard, Extended Range, NE43).

Table 18: Module parameters

Parameter	Settings
Operation mode Kx	voltage -10V..10V standard 1) voltage 0..10 V standard voltage -10V..10V NE43 voltage 0..10V NE43 voltage -10V..10V ext. range voltage 0..10V ext. range current 0..20mA standard current 4..20mA standard current 0..20mA NE43 current 4..20mA NE43 current 0..20mA ext. range current 4..20mA ext. range PT100, -200..850°C 2-wire 2) PT100, -200..150°C 2-wire PT200, -200..850°C 2-wire PT200, -200..150°C 2-wire PT500, -200..850°C 2-wire PT500, -200..150°C 2-wire PT1000, -200..850°C 2-wire PT1000, -200..150°C 2-wire PT100, -200..850°C 3-wire PT100, -200..150°C 3-wire PT200, -200..850°C 3-wire PT200, -200..150°C 3-wire PT500, -200..850°C 3-wire PT500, -200..150°C 3-wire PT1000, -200..850°C 3-wire PT1000, -200..150°C 3-wire

Parameter	Settings
Operation mode Kx	NI100, -60..250°C 2-wire[2)] NI100, -60..150°C 2-wire NI1000, -60..250°C 2-wire NI1000, -60..150°C 2-wire NI1000TK5000, -60..250°C 2-wire NI100, -60..250°C 3-wire NI100, -60..150°C 3-wire NI1000, -60..250°C 3-wire NI1000, -60..150°C 3-wire NI1000TK5000, -60..250°C 3-wire resistance, 0..250 Ohm[2)] resistance, 0..400 Ohm resistance, 0..800 Ohm resistance, 0..2000 Ohm resistance, 0..4000 Ohm deactivate
Value representation Kx	Integer (15bit + sign)[1)] 12bit (left-justified)
Diagnostics Kx	release[1)] block

1) Default settings
2) In PT-, NI- and resistance measurement, only the first of the used channel has too be parameterized (channel 1, 3, 5, 7). The parameterization of the second channel is ignored.

Connection diagram

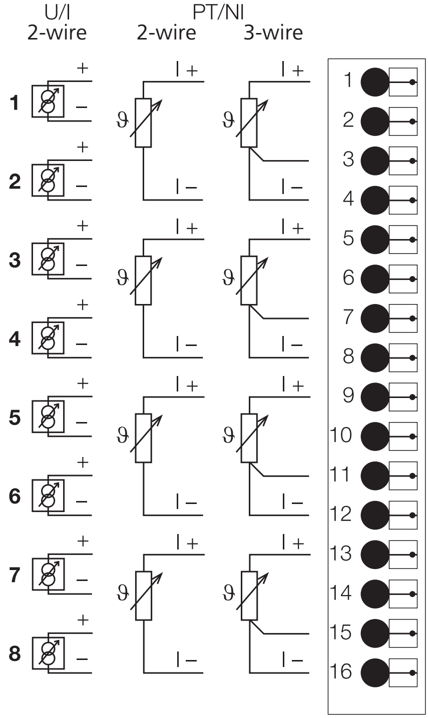


Figure 76: Connection options

→ "Technical data for the terminals" Page 26

Process input data

In case of parameterization with PT-/NI-/R-sensor, the measurement value can be found in the channel with the lower number of the used channels (K1, K3, K5, K7).

→ Open inputs or not used channels should **not** be parameterized in the measurement ranges of PT/NI or R measurement. This may cause minor measurement errors at adjacend channels.

Channel	B7 MSB	B6	B5	B4	B3	B2	B1	B0	B7	B6	B5	B4	B3	B2	B1	B0 LSB
1	Byte 1								Byte 0							
2	Byte 3								Byte 2							
3	Byte 5								Byte 4							
4	Byte 7								Byte 6							
5	Byte 9								Byte 8							
6	Byte 11								Byte 10							
7	Byte 13								Byte 12							
8	Byte 15								Byte 14							

Standard value representation for voltage / current

16-bit representation

-10…10 V	bipolar	diagnostic message	dec.	hex.
	voltage value U_M = (dec. value × 3.052 × 10^{-4}) V			
10.1000 V		if ↑ DIA "OoR" ON	32767	7FFF
10.0500 V		if ↓ DIA "OoR" OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.0003052 V			1	0001
0.000000 V			0	0000
-0.0003052 V			-1	FFFF
…			…	…
-5.0000 V			-16384	C000
…			…	…
-9.9997 V			-32767	8001
-10.0000 V			-32768	8000
-10.0500 V		if ↑ DIA "OoR" OFF	-32768	8000
-10.1000 V		if ↓ DIA "OoR" ON	-32768	8000

0…10 V	**unipolar**	**diagnostic message**	**dec.**	**hex.**
	voltage value U_M = (dec. value × 3.052 × 10^{-4}) V			
10.1000 V		if ↑ DIA “OoR” ON	32767	7FFF
10.0500 V		if ↓ DIA “OoR” OFF	32767	7FFF
10.0000 V	nominal range		32767	7FFF
9.9997 V			32766	7FFE
…			…	…
5.0002 V			16384	4000
…			…	…
0.0003052 V			1	0001
0.0000 V			0	0000
-0.0500 V		if ↑ DIA “OoR” OFF	0	0000
-0.1000 V		if ↓ DIA “OoR” ON	0	0000

0…20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
	current value I_M = (dec. value × 6.104 × 10^{-4}) mA			
20.2000 mA		if ↑ DIA “OoR” ON	32767	7FFF
20.1000 mA		if ↓ DIA “OoR” OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9994 mA			32766	7FFE
…			…	…
10.0003 mA			16384	4000
…			…	…
0.0006104 mA			1	0001
0.0000 mA			0	0000
-0.1 mA		if ↑ DIA “OoR” OFF	0	0000
-0.2 mA		if ↓ DIA “OoR” ON	0	0000

4…20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = ((dec. value × 4.883 × 10^{-4}) + 4) mA				
20.2000 mA		if ↑ DIA “OoR” ON	32767	7FFF
20.1000 mA		if ↓ DIA “OoR” OFF	32767	7FFF
20.0000 mA	nominal range		32767	7FFF
19.9995 mA			32766	7FFE
…			…	…
12.0002 mA			16384	4000
…			…	…
4.0004883 mA			1	0001
4.0000 mA			0	0000
3.7000 mA		if ↑ DIA “OoR” OFF	0	0000
3.6000 mA		if ↓ DIA “OoR” ON	0	0000
3.0000 mA		if ↑ DIA “WB” OFF	0	0000
2.9000 mA		if ↓ DIA “WB” ON	0	0000

12-bit representation (left-justified)

In the values representation „12-bit representation (left-justified)“, the diagnostic data are transmitted with bits 0 to 3 of the channel’s process data.

-10…10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 4.885 × 10^{-3}) V				
10.1000 V		if ↑ DIA “OoR” ON	2047 × 16	7FF×
10.0500 V		if ↓ DIA “OoR” OFF	2047 × 16	7FF×
10.0000 V	nominal range		2047 × 16	7FF×
9.9951 V			2046 × 16	7FE×
…			…	…
5.0024 V			1024 × 16	400×
…			…	…
0.004885 V			1 × 16	001×
0.0000 V			0	000×
-0.004883 V			-1 × 16	FFF×
…			…	…
-5.0000 V			-1024 × 16	C00×
…			…	…
-9.9951 V			-2047 × 16	801×
-10.0000 V			-2048 × 16	800×
-10.0500 V		if ↑ DIA “OoR” OFF	-2048 × 16	800×
-10.1000 V		if ↓ DIA “OoR” ON	-2048 × 16	800×

0…10 V	**unipolar**	**diagnostic message**	**dec.**	**hex.**
voltage value U_M = (dec. value / 16 × 2.442 × 10^{-3}) V				
10.1000 V		if ↑ DIA "OoR" ON	4095 × 16	FFF×
10.0500 V		if ↓ DIA "OoR" OFF	4095 × 16	FFF×
10.0000 V	nominal range		4095 × 16	FFF×
9.9976 V			4094 × 16	FFE×
…			…	…
5.0012 V			2048 × 16	800×
…			…	…
0.002442 V			1 × 16	001×
0.0000 V			0	000×
-0.0500 V		if ↑ DIA "OoR" OFF	0	000×
-0.1000 V		if ↓ DIA "OoR" ON	0	000×

0…20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = (dec. value / 16 × 4.884 × 10^{-3}) mA				
20.2000 mA		if ↑ DIA "OoR" ON	4095 × 16	FFF×
20.1000 mA		if ↓ DIA "OoR" OFF	4095 × 16	FFF×
20.0000 mA	nominal range		4095 × 16	FFF×
19.9951 mA			4094 × 16	FFE×
…			…	…
10.0024 mA			2048 × 16	800×
…			…	…
0.004884 mA			1 × 16	001×
0.0000 mA			0	000×
-0.1 mA		if ↑ DIA "OoR" OFF	0	000×
-0.2 mA		if ↓ DIA "OoR" ON	0	000×

4…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = ((dec. value / 16 × 3.907 × 10^{-3}) + 4) mA				
20.2000 mA		if ↑ DIA "OoR" ON	4095 × 16	FFF×
20.1000 mA		if ↓ DIA "OoR" OFF	4095 × 16	FFF×
20.0000 mA	nominal range		4095 × 16	FFF×
19.9961 mA			4094 × 16	FFE×
…			…	…
12.0020 mA			2048 × 16	800×
…			…	…
4.003907 mA			1 × 16	001×
4.0000 mA			0	000×
3.7000 mA		if ↑ DIA "OoR" OFF	0	000×
3.6000 mA		if ↓ DIA "OoR" ON	0	000×
3.0000 mA		if ↑ DIA "WB" OFF	0	000×
2.9000 mA		if ↓ DIA "WB" ON	0	000×

Extended Range value representation for voltage / current

16-bit representation

-10…10 V	bipolar	diagnostic message	dec.	hex.
	voltage value U_M = (dec. value × 3.617 × 10^{-4}) V			
≧ 11.8515 V	overflow		32767	7FFF
11.7593 V		if ↑ DIA "OoR" ON	32512	7F00
11.7589 V	out of range		32511	7EFF
11.6030 V		if ↓ DIA "OoR" OFF	32080	7D50
10.0004 V			27649	6C01
10.0000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.0003617 V			1	0001
0.0000 V			0	0000
-0.0003617 V			-1	FFFF
…			…	…
-5.0000 V			-13824	CA00
…			…	…
-10.0000 V			-27648	9400
-10.0004 V	out of range		-27649	93FF
-11.6030 V		if ↑ DIA "OoR" OFF	-32080	82B0
-11.7589 V			-32511	8100
-11.7593 V	underflow	if ↓ DIA "OoR" ON	-32512	80FF
≦ -11.8519 V			-32768	8000

0…10 V	bipolar	diagnostic message	dec.	hex.
	voltage value U_M = (dec. value × 3.617 × 10^{-4}) V			
≧ 11.8515 V	overflow		32767	7FFF
11.7593 V		if ↑ DIA "OoR" ON	32512	7F00
11.7589 V	out of range		32511	7EFF
11.6030 V		if ↓ DIA "OoR" OFF	32080	7D50
10.0004 V			27649	6C01
10.0000 V	nominal range		27648	6C00
…			…	…
5.0000 V			13824	3600
…			…	…
0.0003617 V			1	0001
0.0000 V			0	0000
-0.050 V	underflow	if ↑ DIA "OUFL" OFF	0	0000
-0.100 V		if ↓ DIA "OUFL" ON	0	0000

0…20 mA	bipolar	diagnostic message	dec.	hex.
	current value I_M = (dec. value × 7.234 × 10^{-4}) mA			
≧ 23.7030 mA	overflow		32767	7FFF
23.5185 mA		if ↑ DIA "OoR" ON	32512	7F00
23.5178 mA	out of range		32511	7EFF
23.2060 mA		if ↓ DIA "OoR" OFF	32080	7D50
20.0007 mA			27649	6C01
20.0000 mA	nominal range		27648	6C00
…			…	…
10.0000 mA			13824	3600
…			…	…
0.0007234 mA			1	0001
0.0000 mA			0	0000
-0.1 mA	underflow	if ↑ DIA "OUFL" OFF	0	0000
-0.2 mA		if ↓ DIA "OUFL" ON	0	0000

4…20 mA	**bipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = ((dec. value × 5.787 × 10^{-4}) + 4) mA				
≧ 22.9624 mA	overflow		32767	7FFF
22.8148 mA		if ↑ DIA "OoR" ON	32512	7F00
22.8142 mA	out of range		32511	7EFF
22.5648 mA		if ↓ DIA "OoR" OFF	32080	7D50
20.0006 mA			27649	6C01
20.0000 mA	nominal range		27648	6C00
…			…	…
12.0000 mA			13824	3600
…			…	…
4.0005787 mA			1	0001
4.0000 mA			0	0000
3.9994 mA	out of range		-1	FFFF
1.5567 mA		if ↑ DIA "OoR" OFF	-4222	EEBA
1.1852 mA			-4864	ED00
1.1846 mA	underflow	if ↓ DIA "OoR" ON	-4865	ECFF
≦ 0.0000 mA			-6912	E500

12-bit representation

The representation of the 12-bit values corresponds to that of the 16-bit values. Only the bits 0 to 3 are set to "0". Diagnostic data are **not** mapped to the process data.

-10…10 V	**bipolar**	**diagnostic message**	**dec.**	**hex.**
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≧ 11.8460 V	overflow		2047 × 16	7FF0
11.7592 V		if ↑ DIA “OoR” ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
11.6030 V		if ↓ DIA “OoR” OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.0000 V	nominal range		1728 × 16	6C00
…			…	…
5.0000 V			864 × 16	3600
…			…	…
0.0005787 V			1 × 16	0010
0.0000 V			0	0000
-0.0005787 V			-1 × 16	FFF0
…			…	…
-5.0000 V			-864 × 16	CA00
…			…	…
-10.0000 V			-1728 × 16	9400
-10.0058 V	out of range		-1729 × 16	93F0
-11.6030 V		if ↑ DIA “OoR” OFF	-2005 × 16	82B0
-11.7592 V			-2032 × 16	8100
-11.7650 V	underflow	if ↓ DIA “OoR” ON	-2033 × 16	80F0
≦ -11.8518 V			-2048 × 16	8000

0…10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value / 16 × 5.787 × 10^{-3}) V				
≧ 11.8460 V	overflow		2047 × 16	7FF0
11.7592 V		if ↑ DIA “OoR” ON	2032 × 16	7F00
11.7535 V	out of range		2031 × 16	7EF0
11.6030 V		if ↓ DIA “OoR” OFF	2005 × 16	7D50
10.0058 V			1729 × 16	6C10
10.0000 V	nominal range		1728 × 16	6C00
…			…	…
5.0000 V			864 × 16	3600
…			…	…
0.0005787 V			1 × 16	0010
0.0000 V			0	0000
-0.050 V	underflow	if ↑ DIA “OUFL” OFF	0	0000
-0.100 V		if ↓ DIA “OUFL” ON	0	0000

0…20 mA	bipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.01157) mA				
≧ 23.6921 mA	overflow		2047 × 16	7FF0
23.5185 mA		if ↑ DIA “OoR” ON	2032 × 16	7F00
23.5069 mA	out of range		2031 × 16	7EF0
23.2060 mA		if ↓ DIA “OoR” OFF	2005 × 16	7D50
20.0116 mA			1729 × 16	6C10
20.0000 mA	nominal range		1728 × 16	6C00
…			…	…
10.0000 mA			864 × 16	3600
…			…	…
0.01157 mA			1 × 16	0010
0.0000 mA			0	0000
-0.1 mA	underflow	if ↑ DIA “OUFL” OFF	0	0000
-0.2 mA		if ↓ DIA “OUFL” ON	0	0000

4…20 mA	**bipolar**	**diagnostic message**	**dec.**	**hex.**
current value I_M = ((dec. value / 16 × 9.259 × 10^{-3}) + 4) mA				
≧ 22.9537 mA	overflow		2047 × 16	7FF0
22.8148 mA		if ↑ DIA "OoR" ON	2032 × 16	7F00
22.8056 mA	out of range		2031 × 16	7EF0
22.5648 mA		if ↓ DIA "OoR" OFF	2005 × 16	7D50
20.0093 mA			1729 × 16	6C10
20.0000 mA	nominal range		1728 × 16	6C00
…			…	…
12.0000 mA			864 × 16	3600
…			…	…
4.009259 mA			1 × 16	0010
4.0000 mA			0	0000
3.9907 mA	out of range		-1 × 16	FFF0
1.2963 mA		if ↑ DIA "OoR" OFF	-292 × 16	EDC0
1.1851 mA			-304 × 16	ED00
1.1759 mA	underflow	if ↓ DIA "OoR" ON	-305 × 16	ECF0
≦ 0.000 mA			-432 × 16	E500

Value representation for process automation (NE43) for voltage /current

16-bit representation

The hexadecimal value transmitted by the module has to be interpreted as decimal value, which corresponds, if multiplied with a defined factor, to the analog value.

-10…10 V	bipolar	diagnostic message	dec.	hex.
		voltage value U_M = (dec. value × 0.001) V		
11.000 V	overflow	if ↑ DIA “OUFL” ON	11000	2AF8
10.999 V		if ↓ DIA “OUFL” OFF	10999	2AF7
10.501 V		if ↑ DIA “OoR” ON	10501	2905
10.500 V	out of range		10500	2904
10.250 V		if ↓ DIA “OoR” OFF	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
…			…	…
5.000 V			5000	1388
…			…	…
0.001 V			1	0001
0.000 V			0	0000
-0.001 V			-1	FFFF
…			…	…
-5.000 V			-5000	EC78
…			…	…
-10.000 V			-10000	D8F0
-10.001 V	out of range		-10001	D8EF
-10.250 V		if ↑ DIA “OoR” OFF	-10250	D7F6
-10.500 V			-10500	D6FC
-10.501 V	underflow	if ↓ DIA “OoR” ON	-10501	D6FB
-10.999 V		if ↑ DIA “OUFL” OFF	-10999	D509
-11.000 V		if ↓ DIA “OUFL” ON	-11000	D508

0…10 V	unipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
11.000 V	overflow	if ↑ DIA "OUFL" ON	11000	2AF8
10.999 V		if ↓ DIA "OUFL" OFF	10999	2AF7
10.501 V		if ↑ DIA "OoR" ON	10501	2905
10.500 V	out of range		10500	2904
10.250 V		if ↓ DIA "OoR" OFF	10250	280A
10.001 V			10001	2711
10.000 V	nominal range		10000	2710
…			…	…
5.000 V			5000	1388
…			…	…
0.001 V			1	0001
0.000 V			0	0000
-0.050 V	underflow	if ↑ DIA "OUFL" OFF	0	0000
-0.100 V		if ↓ DIA "OUFL" ON	0	0000

0…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
22.000 mA	overflow	if ↑ DIA "OUFL" ON	22000	55F0
21.999 mA		if ↓ DIA "OUFL" OFF	21999	55EF
21.001 mA		if ↑ DIA "OoR" ON	21001	5209
21.000 mA	out of range		21000	5208
20.500 mA		if ↓ DIA "OoR" OFF	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2712
…			…	…
0.001 mA			1	0001
0.000 mA			0	0000
-0.100 mA	underflow	if ↑ DIA "OUFL" OFF	0	0000
-0.200 mA		if ↓ DIA "OUFL" ON	0	0000

4…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value × 0.001) mA				
22.000 mA	overflow	if ↑ DIA “OUFL” ON	22000	55F0
21.999 mA		if ↓ DIA “OUFL” OFF	21999	55EF
21.001 mA		if ↑ DIA “OoR” ON	21001	5209
21.000 mA	out of range		21000	5208
20.500 mA		if ↓ DIA “OoR” OFF	20500	5014
20.001 mA			20001	4E21
20.000 mA	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.001 mA			4001	0FA1
4.000 mA			4000	0FA0
3.999 mA	out of range		3999	0F9F
3.800 mA		if ↑ DIA “OoR” OFF	3800	0ED8
3.600 mA			3600	0E10
3.599 mA	underflow	if ↓ DIA “OoR” ON	3599	0E0F
2.001 mA		if ↑ DIA “WB” OFF	2001	07D1
2.000 mA		if ↓ DIA “WB” ON	2000	07D0
0.000 mA			0000	0000

12-bit representation (left-justified)

The representation 12 bit (left-justified) in process automation corresponds to the 16 bit representation in which the lower 4 bits of the analog value are overwritten with diagnostic data.

<table>
<tr><th>-10…10 V</th><th>bipolar</th><th>diagnostic message</th><th>dec.</th><th>hex.</th></tr>
<tr><td colspan="5">voltage value U_M = (dec. value × 0.001) V</td></tr>
<tr><td>11.008 V</td><td rowspan="3">overflow</td><td>if ↑ DIA “OUFL” ON</td><td>11008</td><td>2B00</td></tr>
<tr><td>10.992 V</td><td>if ↓ DIA “OUFL” OFF</td><td>10992</td><td>2AF0</td></tr>
<tr><td>10.512 V</td><td>if ↑ DIA “OoR” ON</td><td>10512</td><td>2910</td></tr>
<tr><td>10.496 V</td><td rowspan="3">out of range</td><td></td><td>10496</td><td>2900</td></tr>
<tr><td>10.256 V</td><td>if ↓ DIA “OoR” OFF</td><td>10256</td><td>2810</td></tr>
<tr><td>10.016 V</td><td></td><td>10016</td><td>2720</td></tr>
<tr><td>10.000 V</td><td rowspan="11">nominal range</td><td rowspan="11"></td><td>10000</td><td>2710</td></tr>
<tr><td>…</td><td></td><td></td></tr>
<tr><td>4.992 V</td><td>4992</td><td>1380</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>0.016 V</td><td>16</td><td>0010</td></tr>
<tr><td>0.000 V</td><td>0</td><td>0000</td></tr>
<tr><td>-0.016 V</td><td>-16</td><td>FFF0</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>-4.992 V</td><td>-4992</td><td>EC80</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>-10.000 V</td><td>-10000</td><td>D8F0</td></tr>
<tr><td>-10.016 V</td><td rowspan="3">out of range</td><td></td><td>-10016</td><td>D8E0</td></tr>
<tr><td>-10.256 V</td><td>if ↑ DIA “OoR” OFF</td><td>-10256</td><td>D7F0</td></tr>
<tr><td>-10.496 V</td><td></td><td>-10496</td><td>D700</td></tr>
<tr><td>-10.512 V</td><td rowspan="3">underflow</td><td>if ↓ DIA “OoR” ON</td><td>-10512</td><td>D6F0</td></tr>
<tr><td>-10.992 V</td><td>if ↑ DIA “OUFL” OFF</td><td>-10992</td><td>D510</td></tr>
<tr><td>-11.008 V</td><td>if ↓ DIA “OUFL” ON</td><td>-11008</td><td>D500</td></tr>
</table>

0…10 V	bipolar	diagnostic message	dec.	hex.
voltage value U_M = (dec. value × 0.001) V				
11.008 V	overflow	if ↑ DIA “OUFL” ON	11008	2B00
10.992 V		if ↓ DIA “OUFL” OFF	10992	2AF0
10.512 V		if ↑ DIA “OoR” ON	10512	2910
10.496 V	out of range		10496	2900
10.256 V		if ↓ DIA “OoR” OFF	10256	2810
10.016 V			10016	2720
10.000 V	nominal range		10000	2710
…				
4.992 V			4992	1380
…			…	…
0.016 V			16	0010
0.000 V			0	0000
-0.050 V	underflow	if ↑ DIA “OUFL” OFF	0	0000
-0.100 V		if ↓ DIA “OUFL” ON	0	0000

0…20 mA	unipolar	diagnostic message	dec.	hex.
current value I_M = (dec. value / 16 × 0.001) mA				
22.000 mA	overflow	if ↑ DIA “OUFL” ON	22000	55F0
21.984 mA		if ↓ DIA “OUFL” OFF	21984	55E0
21.008 mA		if ↑ DIA “OoR” ON	21008	5210
20.992 mA	out of range		20992	5200
20.496 mA		if ↓ DIA “OoR” OFF	20496	5010
20.016 mA			20016	4E30
20.000 mA	nominal range		20000	4E20
…			…	…
10.000 mA			10000	2710
…			…	…
0.016 mA			16	0010
0.000 mA			0	0000
-0.100 mA	underflow	if ↑ DIA “OUFL” OFF	0	0000
-0.200 mA		if ↓ DIA “OUFL” ON	0	0000

4…20 mA	**unipolar**	**diagnostic message**	**dec.**	**hex.**
	current value I_M = (dec. value / 16 × 0.001) V			
22.000 mA	overflow	if ↑ DIA "OUFL" ON	22000	55F0
21.984 mA		if ↓ DIA "OUFL" OFF	21984	55E0
21.008 mA		if ↑ DIA "OoR" ON	21008	5210
20.992 mA	out of range		20992	5200
20.496 mA		if ↓ DIA "OoR" OFF	20496	5010
20.016 mA			20016	4E30
20.000 mA	nominal range		20000	4E20
…			…	…
12.000 mA			12000	2EE0
…			…	…
4.016 mA			4016	0FB0
4.000 mA			4000	0FA0
3.984 mA	out of range		3984	0F90
3.792 mA		if ↑ DIA "OoR" OFF	3792	0ED0
3.600 mA			3600	0E10
3.584 mA	underflow	if ↓ DIA "OoR" ON	3584	0E00
2.001 mA		if ↑ DIA "WB" OFF	2001	07D1
2.000 mA		if ↓ DIA "WB" ON	2000	07D0
0.000 mA			0000	0000

Standard value representation for PT-/ NI- and resistance measurement

Wire break and short circuit diagnosis in PT-/NI-measurement

- Wire break (WB):
  if resistance = respective end value of measurement range
- Short circuit (SC):
  resistance = loop resistance > 5 Ω

16-bit representation

	Measurement range, PT -200…850 °C PT100, PT200, PT500, PT1000 temperature T_M = (dec. value × 0.1) °C		transmitted value dec.	hex.
101.0 %	858.5 °C	if ↑ DIA “OoR” ON	8500	2134
100.5 %	854.2 °C	if ↓ DIA “OoR” OFF	8500	2134
100.0 %	850.0 °C	nominal range	8500	2134
…	…		…	…
	0.1 °C		1	0001
0.0 % .	0.0 °C		0	0000
	-0.1 °C		-1	FFFF
…				
-100.0 %	-200.0 °C		-2000	F830
-100.5 %	-201.0 °C	if ↑ DIA “OoR” OFF	-2000	F830
-101.0 %	-202.0 °C	if ↓ DIA “OoR” ON	-2000	F830

	Measurement range, PT -200…150 °C **PT100, PT200, PT500, PT1000** temperature T_M = (dec. value × 0.01) °C		**transmitted value** **dec.**	 **hex.**
101.0 %	151.50 °C	if ↑ DIA "OoR" ON	15000	3A98
100.5 %	150.80 °C	if ↓ DIA "OoR" OFF	15000	3A98
100.0 %	150.00 °C	nominal range	15000	3A98
…	…		…	…
	0.01 °C		1	0001
0.0 %	0.00 °C		0	0000
	-0.01 °C		-1	FFFF
…	…		…	…
-100.0 %	-200.00 °C		-20000	F830
-100.5 %	-201.00 °C	if ↑ DIA "OoR" OFF	-20000	F830
-101.0 %	-202.00 °C	if ↓ DIA "OoR" ON	-20000	F830

	Measurement range, NI -60…250 °C **NI100, NI1000, NI100TK5000** temperature T_M = (dec. value × 0.1) °C		**transmitted value** **dec.**	 **hex.**
101.0 %	252.5 °C	if ↑ DIA "OoR" ON	2500	09C4
100.5 %	251.2 °C	if ↓ DIA "OoR" OFF	2500	09C4
100.0 %	250.0 °C	nominal range	2500	09C4
…	…		…	…
	0.1 °C		1	0001
0.0 %	0.0 °C		0	0000
	-0.1 °C		-1	FFFF
…	…		…	…
-100.0 %	-60.0 °C		-600	FDA8
-100.5 %	-60.3 °C	if ↑ DIA "OoR" OFF	-600	FDA8
-101.0 %	-60.6 °C	if ↓ DIA "OoR" ON	-600	FDA8

	Measurement range, NI -60…150 °C NI100, NI1000 temperature T_M = (dec. value × 0.01) °C		**transmitted value** dec.	hex.
101.0 %	151.50 °C	if ↑ DIA “OoR” ON	15000	3A98
100.5 %	150.70 °C	if ↓ DIA “OoR” OFF	15000	3A98
100.0 %	150.00 °C	nominal range	15000	3A98
…	…		…	…
	0.01 °C		1	0001
0.0 %	0.00 °C		0	0000
	-0.01 °C		-1	FFFF
…	…		…	…
-100.0 %	-60.00 °C		-6000	E890
-100.5 %	-60.30 °C	if ↑ DIA “OoR” OFF	-6000	E890
-101.0 %	-60.60 °C	if ↓ DIA “OoR” ON	-6000	E890

	Measurement range, R 0…250 Ω resistance R_M = (dec. value × 0.00762963) Ω		**transmitted value** dec.	hex.
101.0 %	252.500 Ω	if ↑ DIA “OoR” ON	32767	7FFF
100.5 %	251.750 Ω	if ↓ DIA “OoR” OFF	32767	7FFF
100.0 %	250.000 Ω	nominal range	32767	7FFF
99.997 %	249.992 Ω		32766	7FFE
…	…		…	…
50.002 %	125.004 Ω		16384	4000
49.998 %	124.996 Ω		16383	3FFF
…	…		…	…
0.003 %	0.008 Ω		1	0001
0 %	0.000 Ω		0	0000

	Measurement range, R		transmitted value	
	0…400 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value × 0.012207) Ω			
101.0 %	404.000 Ω	if ↑ DIA "OoR" ON	32767	7FFF
100.5 %	402.000 Ω	if ↓ DIA "OoR" OFF	32767	7FFF
100.0 %	400.000 Ω	nominal range	32767	7FFF
99.997 %	399.988 Ω		32766	7FFE
…	…		…	…
50.002 %	200.006 Ω		16384	4000
49.998 %	199.994 Ω		16383	3FFF
…	…		…	…
0.003 %	0.012 Ω		1	0001
0 %	0.000 Ω		0	0000

	Measurement range, R		transmitted value	
	0…800 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value × 0.0244148) Ω			
101.0 %	808.000 Ω	if ↑ DIA "OoR" ON	32767	7FFF
100.5 %	804.000 Ω	if ↓ DIA "OoR" OFF	32767	7FFF
100.0 %	800.000 Ω	nominal range	32767	7FFF
99.997 %	799.976 Ω		32766	7FFE
…	…		…	…
50.002 %	400.012 Ω		16384	4000
49.998 %	399.988 Ω		16383	3FFF
…	…		…	…
0.003 %	0.024 Ω		1	0001
0 %	0.000 Ω		0	0000

	Measurement range, R 0…2000 Ω		transmitted value dec.	hex.
	resistance R_M = (dec. value × 0.061037) Ω			
101.0 %	2020.00 Ω	if ↑ DIA "OoR" ON	32767	7FFF
100.5 %	2010.00 Ω	if ↓ DIA "OoR" OFF	32767	7FFF
100.0 %	2000.00 Ω	nominal range	32767	7FFF
99.997 %	1999.94 Ω		32766	7FFE
…	…		…	…
50.002 %	1000.03 Ω		16384	4000
49.998 %	999.97 Ω		16383	3FFF
…	…		…	…
0.003 %	0.06 Ω		1	0001
0 %	0.00 Ω		0	0000

	Measurement range, R 0…4000 Ω		transmitted value dec.	hex.
	resistance R_M = (dec. value × 0.12207) Ω			
101.0 %	4040.00 Ω	if ↑ DIA "OoR" ON	32767	7FFF
100.5 %	4020.00 Ω	if ↓ DIA "OoR" OFF	32767	7FFF
100.0 %	4000.00 Ω	nominal range	32767	7FFF
99.997 %	3999.88 Ω		32766	7FFE
…	…		…	…
50.002 %	2000.06 Ω		16384	4000
49.998 %	1999.94 Ω		16383	3FFF
…	…		…	…
0.003 %	0.12 Ω		1	0001
0 %	0.00 Ω		0	0000

12-bit representation (left-justified)

	Measurement range, PT -200…850 °C **PT100, PT200, PT500, PT1000** temperature T_M = (dec. value / 16 × 0.5) °C		**transmitted value** **dec.**	 **hex.**
101.0 %	858.5 °C	if ↑ DIA “OoR” ON	1700 × 16	6A4x
100.5 %	854.2 °C	if ↓ DIA “OoR” OFF	1700 × 16	6A4×
100.0 %	850.0 °C	nominal range	1700 × 16	6A4×
…	…		…	…
	0.5 °C		1 × 16	001x
0.0 %	0.0 °C		0	000x
	-0.5 °C		-1 × 16	FFF×
…	…		…	…
-100.0 %	-200.0 °C		-400 × 16	E70x
-100.5 %	-201.0 °C	if ↑ DIA “OoR” OFF	-400 × 16	E70x
-101.0 %	-202.0 °C	if ↓ DIA “OoR” ON	-400 × 16	E70x

	Measurement range, PT -200…150 °C **PT100, PT200, PT500, PT1000** temperature T_M = (dec. value / 16 × 0.1) °C		**transmitted value** **dec.**	 **hex.**
101.0 %	151.5 °C	if ↑ DIA “OoR” ON	1500 × 16	5DC×
100.5 %	150.8 °C	if ↓ DIA “OoR” OFF	1500 × 16	5DC×
100.0 %	150.0 °C	nominal range	1500 × 16	5DC×
…	…		…	…
	0.1 °C		1	001x
0.0 %	0.0 °C		0	000x
	-0.1 °C		-1	FFF×
…	…		…	…
-100.0 %	-200.0 °C		-2000 × 16	830x
-100.5 %	-201.0 °C	if ↑ DIA “OoR” OFF	-2000 × 16	830x
-101.0 %	-202.0 °C	if ↓ DIA “OoR” ON	-2000 × 16	830x

	Measurement range, NI -60…250 °C NI100, NI1000, NI100TK5000 temperature T_M = (dec. value / 16 × 0.5) °C		**transmitted value dec.**	**hex.**
101.0 %	252.5 °C	if ↑ DIA "OoR" ON	500 × 16	1F4x
100.5 %	251.2 °C	if ↓ DIA "OoR" OFF	500 × 16	1F4x
100.0 %	250.0 °C	nominal range	500 × 16	1F4x
…	…		…	…
	0.5 °C		1 × 16	001x
0.0 %	0.0 °C		0	000x
	-0.5 °C		-1 × 16	FFF×
…	…		…	…
-100.0 %	-60.0 °C		-120 × 16	F88x
-100.5 %	-60.3 °C	if ↑ DIA "OoR" OFF	-120 × 16	F88x
-101.0 %	-60.6 °C	if ↓ DIA "OoR" ON	-120 × 16	F88x

	Measurement range, NI -60…150 °C NI100, NI1000 temperature T_M = (dec. value /16 × 0.1) °C		**transmitted value dec.**	**hex.**
101.0 %	151.5 °C	if ↑ DIA "OoR" ON	1500 ×16	5DC×
100.5 %	150.7 °C	if ↓ DIA "OoR" OFF	1500 ×16	5DC×
100.0 %	150.0 °C	nominal range	1500 ×16	5DC×
…	…		…	…
	0.1 °C		1 × 16	001x
0.0 %	0.0 °C		0	000x
	-0.1 °C		-1 × 16	FFF×
…	…		…	…
-100.0 %	-60.0 °C		-600 × 16	DA8x
-100.5 %	-60.3 °C	if ↑ DIA "OoR" OFF	-600 × 16	DA8x
-101.0 %	-60.6 °C	if ↓ DIA "OoR" ON	-600 × 16	DA8x

	Measurement range, R		transmitted value	
	0…250 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value / 16 × 0.06105) Ω			
101.0 %	252.500 Ω	if ↑ DIA "OoR" ON	4095 × 16	FFF×
100.5 %	251.750 Ω	if ↓ DIA "OoR" OFF	4095 × 16	FFF×
100.0 %	250.000 Ω	nominal range	4095 × 16	FFF×
99.976 %	249.939 Ω		4094 × 16	FFE×
…	…		…	…
50.012 %	125.030 Ω		2048 × 16	800x
49.988 %	124.969 Ω		2047 × 16	7FF×
…	…		…	…
0.024 %	0.061 Ω		1 × 16	001x
0 %	0.000 Ω		0 × 16	000x

	Measurement range, R		transmitted value	
	0…400 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value / 16 × 0.09768) Ω			
101.0 %	404.000 Ω	if ↑ DIA "OoR" ON	4095 × 16	FFF×
100.5 %	402.000 Ω	if ↓ DIA "OoR" OFF	4095 × 16	FFF×
100.0 %	400.000 Ω	nominal range	4095 × 16	FFF×
99.976 %	399.902 Ω		4094 × 16	FFE×
…	…		…	…
50.012 %	200.049 Ω		2048 × 16	800x
49.988 %	199.951 Ω		2047 × 16	7FF×
…	…		…	…
0.024 %	0.098 Ω		1 × 16	001x
0 %	0.000 Ω		0 × 16	000x

	Measurement range, R		transmitted value	
	0…800 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value / 16 × 0.19536) Ω			
101.0 %	808.000 Ω	if ↑ DIA "OoR" ON	4095 × 16	FFF×
100.5 %	804.000 Ω	if ↓ DIA "OoR" OFF	4095 × 16	FFF×
100.0 %	800.000 Ω	nominal range	4095 × 16	FFF×
99.976 %	799.805 Ω		4094 × 16	FFE×
…	…		…	…
50.012 %	400.098 Ω		2048 × 16	800x
49.988 %	399.902 Ω		2047 × 16	7FF×
…	…		…	…
0.024 %	0.195 Ω		1 × 16	001x
0 %	0.000 Ω		0 × 16	000x

	Measurement range, R		transmitted value	
	0…2000 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value/ 16 × 0.4884) Ω			
101.0 %	2020.00 Ω	if ↑ DIA "OoR" ON	4095 × 16	FFF×
100.5 %	2010.00 Ω	if ↓ DIA "OoR" OFF	4095 × 16	FFF×
100.0 %	2000.00 Ω	nominal range	4095 × 16	FFF×
99.976 %	1999.51 Ω		4094 × 16	FFE×
…	…		…	…
50.012 %	1000.24 Ω		2048 × 16	800x
49.988 %	999.76 Ω		2047 × 16	7FF×
…	…		…	…
0.024 %	0.49 Ω		1 × 16	001x
0 %	0.00 Ω		0 × 16	000x

	Measured value, R		**transmitted value**	
	0…4000 Ω		**dec.**	**hex.**
	resistance R_M = (dec. value / 16 × 0.9768) Ω			
101.0 %	4040.00 Ω	if ↑ DIA “OoR” ON	4095 × 16	FFF×
100.5 %	4020.00 Ω	if ↓ DIA “OoR” OFF	4095 × 16	FFF×
100.0 %	4000.00 Ω	nominal range	4095 × 16	FFF×
99.976 %	3999.02 Ω		4094 × 16	FFE×
…	…		…	…
50.012 %	2000.49 Ω		2048 × 16	800x
49.988 %	1999.51 Ω		2047 × 16	7FF×
…	…		…	…
0.024 %	0.98 Ω		1 × 16	001x
0 %	0.00 Ω		0 × 16	000x

3 Analog Output Modules

General

Analog output modules (AO) receive output values from the gateway via the internal module bus. The modules convert these values and transmit the appropriate signals per channel to the field level.

The electronics on the module bus of the analog output modules are isolated from the field level via optocouplers and are protected against reverse polarity.

The modules are short-circuit-proof.

Analog output modules are built in slice design. XN standard electronics modules are completed by base modules with tension clamp or screw connection. XNE ECO electronics modules do not require a base module.

Supported signal ranges
0…20 mA,
4…20 mA,
0…10 V DC,
-10…+10 V DC

Resolution of the analog value representation
The digitised analog values are represented in two's complement notation when both positive and negative values are processed. A parameter bit is used to set either 16-bit representation or left-justified 12-bit representation.

→ For the representation of current and voltage values with special operation modes (e.g. Extended Range and NE43) other equations and parameter settings must be applyed. Please read the subchapters «Value representation» of the corresponding module.

Equations and graphs for 16-bit representation

Representation of the current values in the range 0…20 mA

The decimal numerical values can be converted to the current values in the range 0 mA…20 mA using the following equation:

$$\text{decimal value} = 1638.35 \frac{1}{\text{mA}} \times \text{current}$$

The value range:

0…20 mA

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

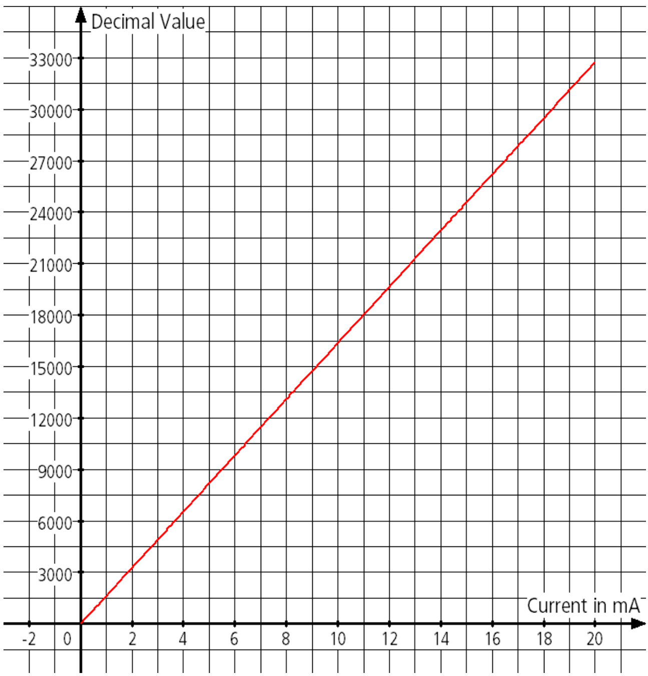


Figure 1: Representation of decimal values in relation to the current values in the coordinate system

The decimal numerical value can be converted (using a pocket calculator) very easily to a hexadecimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the current values in the range 4…20 mA

The decimal numerical values can be converted to the current values in the range 4 mA…20 mA using the following equation:

$$\text{decimal value} = 2047.9375 \frac{1}{\text{mA}} \times \text{current} - 8191.75$$

The value range:

4…20 mA

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

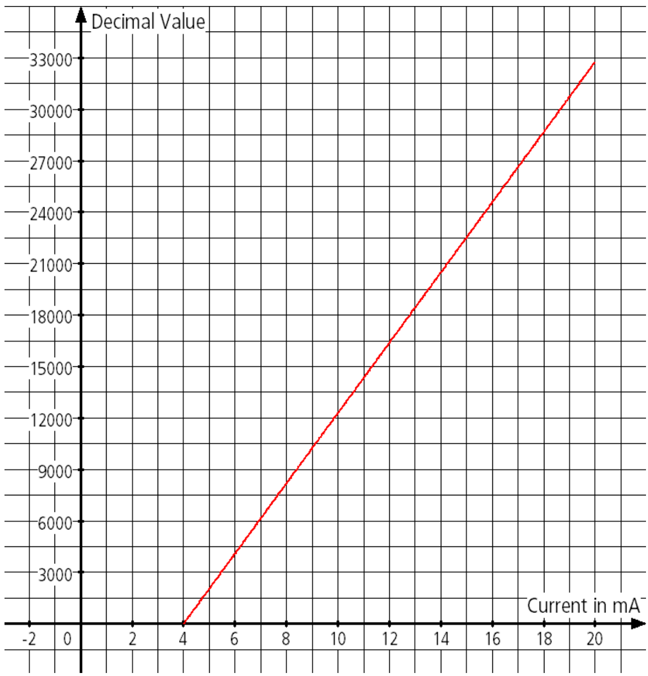


Figure 77: Representation of decimal values in relation to the current values in the coordinate system

The decimal numerical value can be converted (using a pocket calculator) very easily to a hexadecimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the voltage values in the range 0…10 V DC

The decimal numerical values can be converted to voltage values in the range 0 V DC…10 V DC using the following equation:

$$\text{decimal value} = 3276.7\,\frac{1}{V} \times \text{voltage}$$

The value range:

0…10 V DC

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

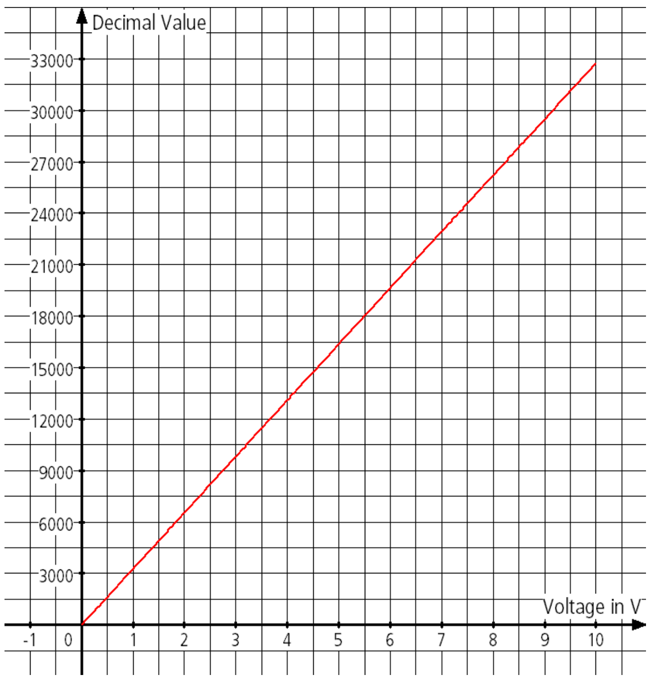


Figure 78: Representation of decimal values in relation to the voltage values in the coordinate system

The decimal numerical value can be converted (using a pocket calculator) very easily to a hexadecimal value since all the numbers are in the positive range of the two's complement (→ Figure 20 Page 39) of 16-bit values.

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the voltage values in the range -10 V DC…10 V DC

The decimal numerical values can be converted to the voltage values in the range -10 V DC…10 V DC using the following equations:
For **positive** voltage values 0 V DC…10 V DC:

$$\text{decimal value} = 3276.7\,\frac{1}{V} \times \text{voltage}$$

The value range:

0…10 V DC

is mapped to the number range:

0000_{hex}…$7FFF_{hex}$ (decimal: 0…32767)

For **negative** voltage values -10 V DC…0 V DC:

$$\text{decimal value} = 3276.8\,\frac{1}{V} \times \text{voltage}$$

The value range:

-10…-3.052 10^{-4} V DC

is mapped to the number range:

8000_{hex}…$FFFF_{hex}$ (decimal: -32768…-1)

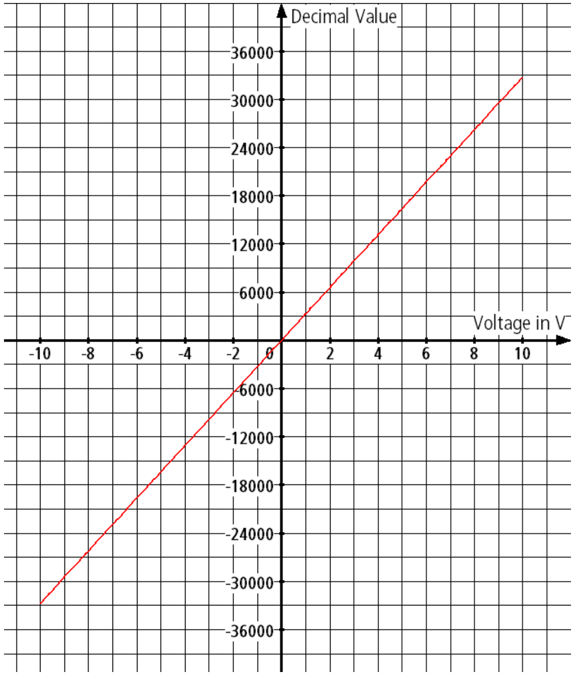


Figure 79: Representation of decimal values in relation to the voltage values in the coordinate system

Calculation of hexadecimal/binary values for negative decimal values

The decimal value can be converted (with a pocket calculator) very easily to a hexadecimal value for the positive range. The two's complement (→ Figure 20 Page 39) of the 16-bit values is the same as the binary values in the positive range.

The hexadecimal value for the negative range is slightly more complicated to calculate as the value must be coded in two's complement notation. The following example illustrates the procedure:

The 4-digit hexadecimal value for the voltage value **-6 V DC** is to be calculated.

Using the previously mentioned formula, the calculation is as follows:

$$\text{decimal value} = 3276.8\,\frac{1}{V} \times (-6\text{ V}) = -19660.8$$

Some pocket calculators convert negative decimal values directly to a hexadecimal value in two's complement notation.

If this is not possible, proceed as follows:

Convert the negative decimal value to a binary value:

$$|-19660.8| = 19660.8 \Leftrightarrow 100.1100.1100.1100$$

Place the binary value in 16 bits by adding preceding zeros as required.

$$100.1100.1100.1100 \Rightarrow 0100.1100.1100.1100$$

Invert the 16-digit binary value:

$$0100.1100.1100.1100 \Rightarrow 1011.0011.0011.0011$$

Add a 1 to the inverted binary value:

1011.0011.0011.0011
0000.0000.0000.0001
1011.0011.0011.0100

The number is now coded in two's complement notation and can be converted to a hexadecimal value. The conversion is very easy, as four digits of the binary value are always represented by one digit of the hexadecimal value.

$$1011.0011.0011.0100 \Rightarrow B334$$

The required result is:

$$-19660.8 \Rightarrow B334$$

Equations and graphs for 12-bit representation

Attention!
The 12-bit representation is "left-justified". The number is transmitted with 16 bits! Bit 0…Bit 3 of the binary number and the last digit of the hexadecimal number are always 0.

Representation of the current values in the range 0…20 mA

The decimal numerical values can be converted to the current values in the range 0 mA…20 mA using the following equation:

$$\text{decimal value} = 204.75 \frac{1}{\text{mA}} \times \text{current}$$

The value range:

0…20 mA

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

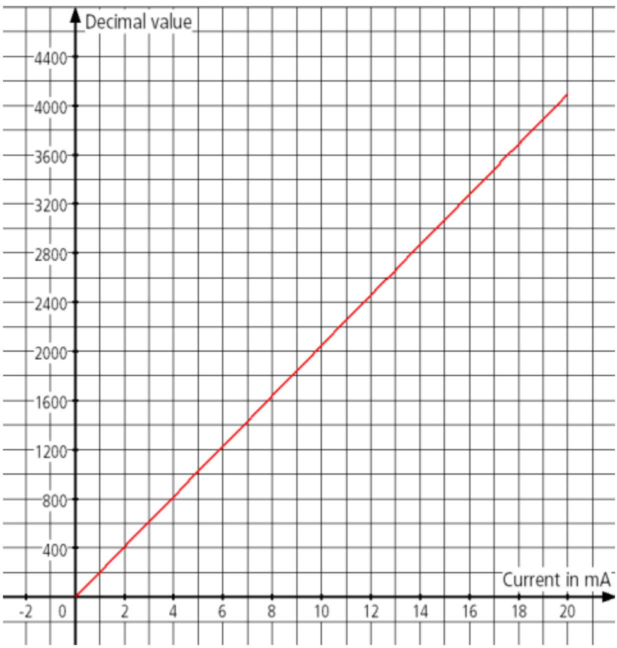


Figure 80: Representation of decimal values in relation to the current values in the coordinate system

The decimal value can be converted (with a pocket calculator) very easily to a hexadecimal value.

As the values have to be left-justified, do not forget to add a 0 to the three-digit hexadecimal value, i.e. to move the value by one digit to the left!

$XXX_{hex} \Rightarrow XXX0_{hex}$

In the same way, four zeros have to be added to the 12-digit binary value so that it is shifted four digits to the left.

$XXXX.XXXX.XXXX \Rightarrow XXXX.XXXX.XXXX.0000$

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the current values in the range 4 mA…20 mA

The decimal numerical values can be converted to the current values in the range 4 mA…20 mA using the following equation:

$$\text{decimal value} = 255.9375 \frac{1}{\text{mA}} \times \text{current} - 1023.75$$

The value range:

4…20 mA

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

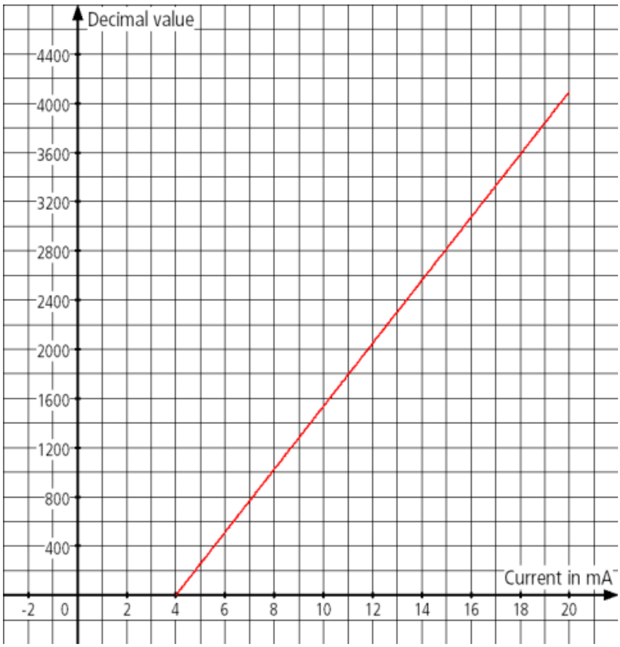


Figure 81: Representation of decimal values in relation to the current values in the coordinate system

The decimal value can be converted (with a pocket calculator) very easily to a hexadecimal value.

As the values have to be left-justified, do not forget to add a 0 to the three-digit hexadecimal value, i.e. to move the value by one digit to the left!

$XXX_{hex} \Rightarrow XXX0_{hex}$

In the same way, four zeros have to be added to the 12-digit binary value so that it is shifted four digits to the left.

XXXX.XXXX.XXXX ⇒ XXXX.XXXX.XXXX.0000

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the voltage values in the range 0…10 V DC

The decimal numerical values can be converted to voltage values in the range 0 V DC…10 V DC using the following equation:

$$\text{decimal value} = 409.5\,\frac{1}{V} \times \text{voltage}$$

The value range:

0…10 V DC

is mapped to the number range:

000_{hex}…FFF_{hex} (decimal: 0…4095)

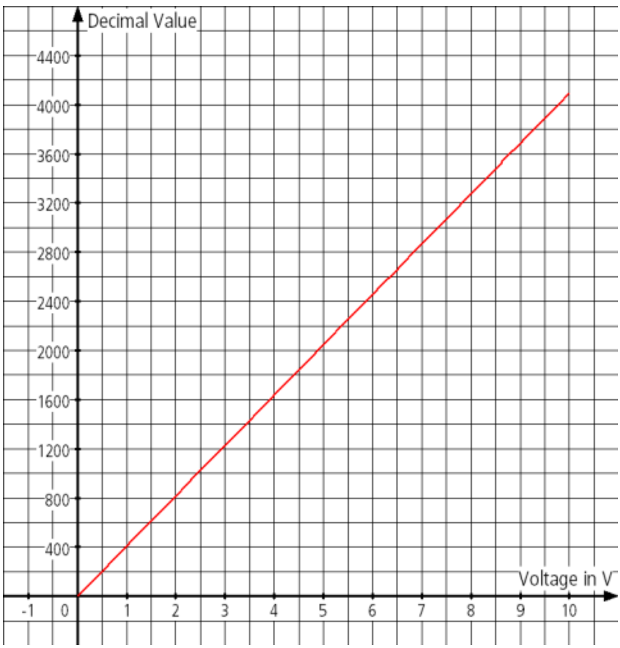


Figure 82: Representation of decimal values in relation to the voltage values in the coordinate system

The decimal value can be converted (with a pocket calculator) very easily to a hexadecimal value.

As the values have to be left-justified, do not forget to add a 0 to the three-digit hexadecimal value, i.e. to move the value by one digit to the left!

$XXX_{hex} \Rightarrow XXX0_{hex}$

In the same way, four zeros have to be added to the 12-digit binary value so that it is shifted four digits to the left.

XXXX.XXXX.XXXX ⇒ XXXX.XXXX.XXXX.0000

→ Make sure, the values which are to be transferred to the device, are in the valid number range.

Representation of the voltage values in the range -10 V DC…10 V DC

The decimal numerical values can be converted to the voltage values in the range -10 V DC…10 V DC using the following equations:
For **positive** voltage values 0 V DC…10 V DC:

$$\text{decimal value} = 204.7\,\frac{1}{V} \times \text{voltage}$$

The value range:

0…10 V DC

is mapped to the number range:

000_{hex}…$7FF_{hex}$ (decimal: 0…2047)

For **negative** voltage values -10 V DC…0 V DC:

$$\text{decimal value} = 204.8\,\frac{1}{V} \times \text{voltage}$$

The value range:

-10…-0.0049 V DC

is mapped to the number range:

800_{hex}…FFF_{hex} (decimal: -2048…-1)

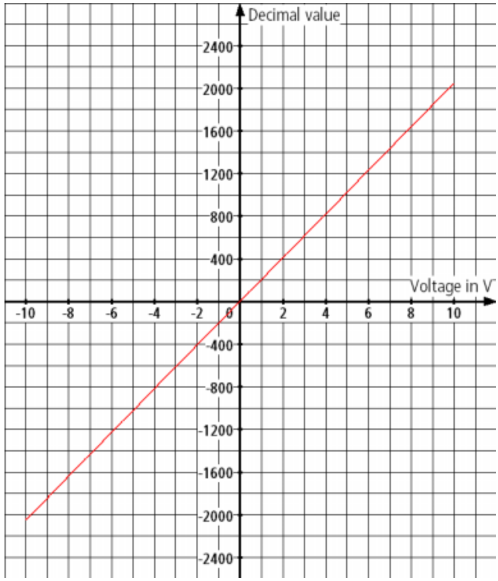


Figure 83: Representation of decimal values in relation to the voltage values in the coordinate system

The decimal value can be converted (with a pocket calculator) very easily to a hexadecimal value for the positive range. The two's complement (→ Figure 20 Page 39) of the 12-bit values is the same as the binary values in the positive range.

As the values have to be left-justified, do not forget to add a 0 to the three-digit hexadecimal value, i.e. to move the value by one digit to the left!

$XXX_{hex} \Rightarrow XXX0_{hex}$

In the same way, four zeros have to be added to the 12-digit binary value so that it is shifted four digits to the left.

XXXX.XXXX.XXXX ⇒ XXXX.XXXX.XXXX.0000

Calculation of hexadecimal/binary values for negative decimal values

The hexadecimal value for the negative range is slightly more complicated to calculate as the value must be coded in two's complement notation. The following example illustrates the procedure:

The 4-digit hexadecimal value for the voltage value **-6 V DC** is to be calculated.

Using the previously mentioned formula, the calculation is as follows:

$$\text{decimal value} = 204.8\frac{1}{V} \times (-6\ V) = -1228.8$$

Some pocket calculators convert negative decimal values directly to a hexadecimal value in two's complement notation.

If this is not possible, proceed as follows:

Convert the negative decimal value to a binary value:

$$|-1228.8| = 1228.8 \Leftrightarrow 100.1100.1100$$

Place the binary value in 12 bits by adding preceding zeros as required.

$$100.1100.1100 \Rightarrow 0100.1100.1100$$

Invert the 12-digit binary value:

$$0100.1100.1100 \Rightarrow 1011.0011.0011$$

Add a 1 to the inverted binary value:

1011.0011.0011
0000.0000.0001
1011.0011.0100

The number is now coded in two's complement notation and can be converted to a hexadecimal value. The conversion is very easy, as four digits of the binary value are always represented by one digit of the hexadecimal value.

1011.0011.0100 ⇒ B34

As the value is represented with 16 bits and is left-justified, a 0 has to be added to the hexadecimal value and four zeros to the binary value.

B34 ⇒ B340

1011.0011.0100 ⇒ 1011.0011.0100.0000

The required result is:

–1228.8 ⇒ B340

LEDs

Errors from the I/O level are indicated on each module by means of the **DIA** collective LED. The corresponding diagnostics information is transmitted to the gateway as diagnostics bits.

If the **DIA** LED is permanently red, this indicates that the module bus communication for the analog output module has failed. At some analog output modules, in addition, this indicates that field voltage U_L is not present.

Shielding

Shielded signal cables are connected between the shield and base module via a two pole shield connector available as an accessory.

Module overview

	No. of channels	Short-circuit proof
XN-1AO-I(0/4…20MA)	1	✓
XN-2AO-I(0/4…20MA)	1	✓
XN-2AO-U(-10/0…+10VDC)	2	✓

XN-1AO-I(0/4…20MA)

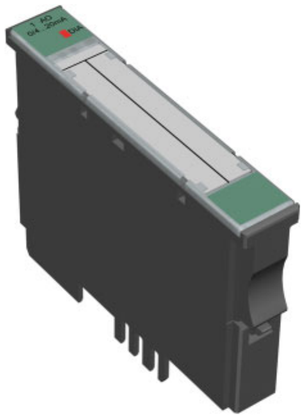


Figure 84: Analog output module, 1 analog output: 0…20 mA/4…20 mA

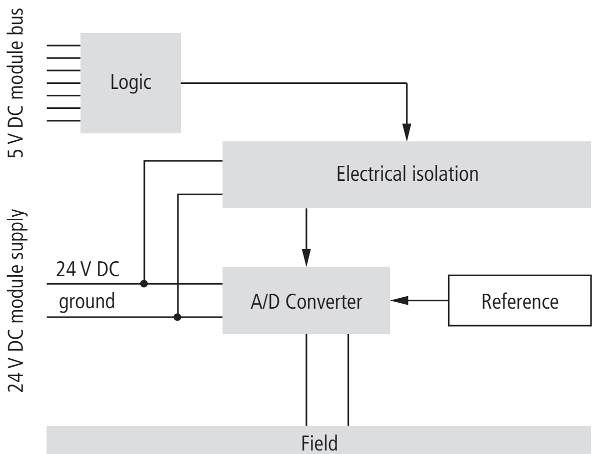


Figure 85: Block diagram

Technical data

Table 19: XN-1AO-I(0/4…20mA)

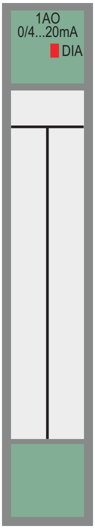
Designation	Value
Ouput values	Current
Number of channels	1
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)]	≦ 50 mA
Nominal current consumption from module bus I_{MB} [1)]	≦ 39 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	normally 1 W
Ouput value, current	
Ouput current	0…20 mA /4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Load resistance	
Resistive load	< 550 Ω
Inductive load	< 1 µH
Transmission frequency	< 200 Hz
Setting time (maximum)	
Resistive load	< 0.1 ms
Inductive load	< 0.5 ms
Capacitive load	< 0.5 ms
Accuracy of output value	
Offset error	≦ 0.1 %
Linearity	0.02 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %
Output ripple	0.02 %

Designation	Value
Temperature coefficient	≦ 300 ppm/ °C of limit value
Representation of output value	16-bit: • Two's complement notation 12-bit (left-justified): • Binary uncoded (only positive binary values)

1) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

→ Negative values are output automatically as 0 mA or 4 mA depending on the range set.

Diagnostic messages



LED	Display	Meaning	Remedy
DIA	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No error message	–

Module parameters

Parameter name	Value
Value representation	Integer (15bit + sign)[1]
	12bit (left-justified)
Current mode	0..20mA[1]
	4..20mA
Substitute value A1	The substitute value defined here will be output if one of the specific events occurs which are parameterized in the gateway.

1) Standard parameter values

Base modules

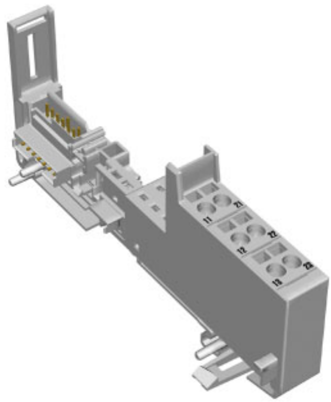


Figure 86: Base module XN-S3T-SBB

	Base modules
With tension clamp connection	XN-S3T-SBB
With screw connection	XN-S3S-SBB

Connection diagram

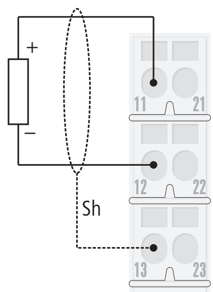


Figure 87: Connection diagram XN-S3x-SBB

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XN-2AO-I(0/4…20MA)

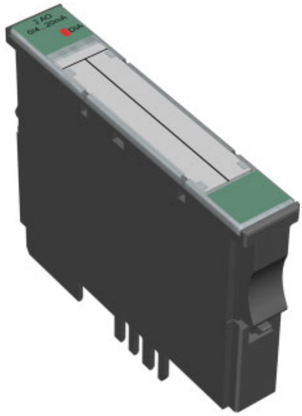


Figure 88: Analog output module,
2 analog outputs: 0…20 mA/4…20 mA

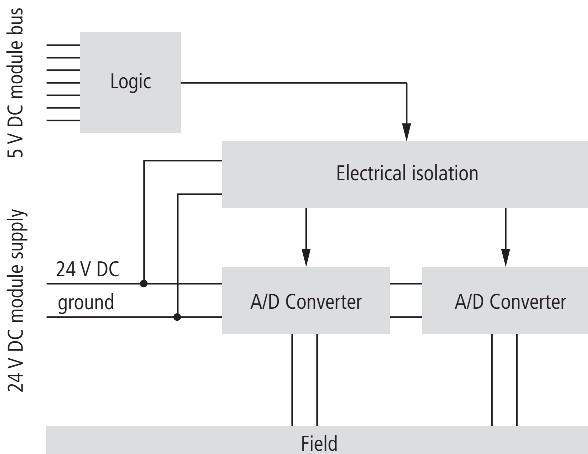


Figure 89: Block diagram

Technical data

Table 20: XN-2AO-I(0/4…20mA)

Designation	Value
Ouput values	Current
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)]	≦ 50 mA
Nominal current consumption from module bus I_{MB} [1)]	≦ 40 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	normally 1 W
Ouput value, current	
Ouput current	0…20 mA /4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Load resistance	
Resistive load	< 450 Ω
Inductive load	< 1 µH
Transmission frequency	< 200 Hz
Setting time (maximum)	
Resistive load	< 2 ms
Inductive load	< 2 ms
Capacitive load	–
Accuracy of output value	
Basic error limit at 23 °C	< 0.2 %
Temperature coefficient	≦ 300 ppm/ °C of limit value

Designation	Value
Representation of output value	16-bit: • Two's complement notation 12-bit (left-justified): • Binary uncoded (only positive binary values)

1) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

→ Negative values are output automatically as 0 mA or 4 mA depending on the range set.

Diagnostic messages

LED	Display	Meaning	Remedy
DIA	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No fault indication or diagnostic	-

Module parameters (per channel)

Parameter name	Value
Channel Kx (x=1,2)	activate 1)
	deactivate
Value representation	Integer (15bit + sign)1)
	12bit (left-justified)
Current mode	0..20mA 1)
	4..20mA
Substitute value Ax (x=1,2)	The substitute value defined here for the corresponding channel will be output if one of the specific events occurs which are parameterized in the gateway.

1) Standard parameter value

Base modules

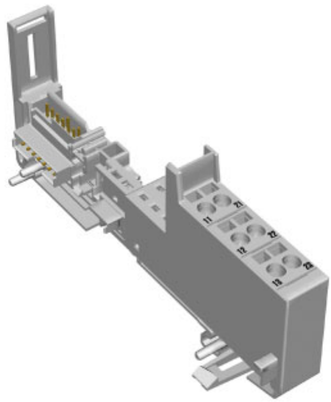


Figure 90: Base module XN-S3T-SBB

	Base modules
With tension clamp connection	XN-S3T-SBB
With screw connection	XN-S3S-SBB

Connection diagram

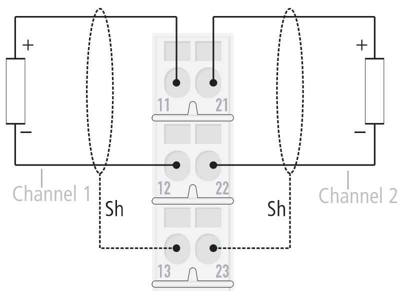


Figure 91: Connection diagram XN-S3x-SBB

→ "Technical data for the terminals" Page 26

XN-2AO-U (-10/0…+10VDC)

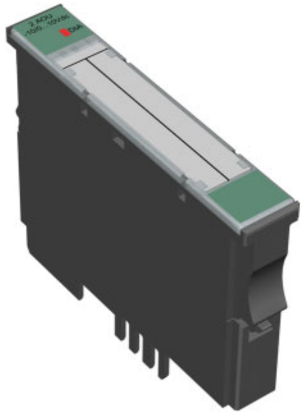


Figure 92: Analog output module, 2 analog outputs: -10…+10VDC/0…+10VDC

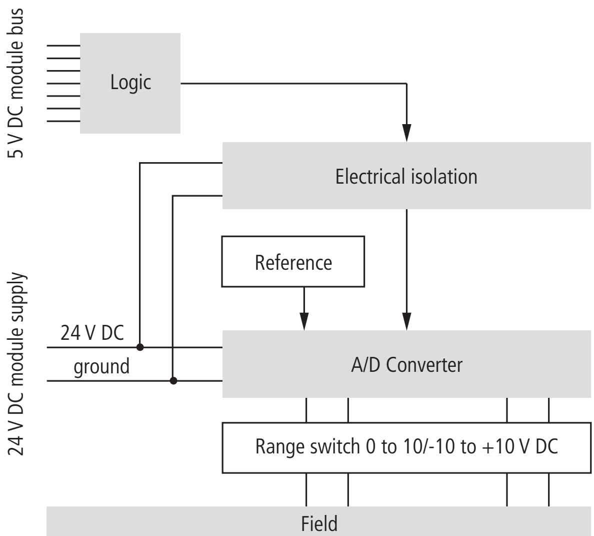


Figure 93: Block diagram

Technical data

Table 21: XN-2AO-U(-10/0…+10VDC)

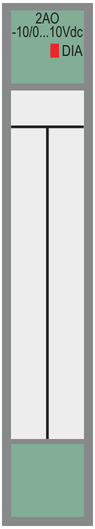
Designation	Value
Ouput values	Voltage
Number of channels	2
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)]	≦ 50 mA
Nominal current consumption from module bus I_{MB} [1)]	≦ 43 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	normally 1 W
Ouput value, voltage	
Ouput voltage	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Load resistance	
Resistive load	> 1000 Ω
Capacitive load	< 1 µF
Transmission frequency	< 100 Hz
Setting time (maximum)	
Resistive load	< 0.1 ms
Inductive load	< 0.5 ms
Capacitive load	< 0.5 ms
Short circuit current	≦ 40 mA
Accuracy of output value	
Offset error	≦ 0.1 %
Linearity	0.1 %
Basic error limit at 23 °C	< 0.2 %
Repeatability	0.05 %

Designation	Value
Temperature coefficient	≦ 300 ppm/ °C of limit value
Interference voltage suppression	
Common mode	> 90 dB
Normal mode	> 70 dB
Cross talk between channels	> -50 dB
Representation of output value	16-bit: • Two's complement notation 12-bit (left-justified): • Two's complement notation (also negative numerical values possible) • Binary uncoded (only positive binary values)

1) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

→ With a negative range from 0…10 V DC negative values are automatically output as 0 V DC.

Diagnostic messages



LED	Display	Meaning	Remedy
DIA	Red	Failure of module bus communication	Check whether more than two adjacent electronics modules have been removed.
	OFF	No error message	–

Module parameters

Parameter name	Value
Value representation	Integer (15bit + sign)[1)]
	12bit (left-justified)
Voltage mode	-10..+10 V
	0..10 V[1)]
Substitute value Ax (x=1,2)	The substitute value defined here for the corresponding channel will be output if one of the specific events occurs which are parameterized in the gateway.

1) Standard parameter values

Base modules

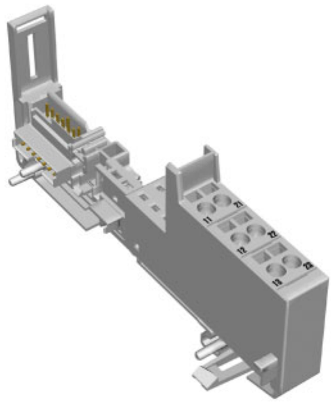


Figure 94: Base module XN-S3T-SBB

	Base modules
With tension clamp connection	XN-S3T-SBB
With screw connection	XN-S3S-SBB

Connection diagram

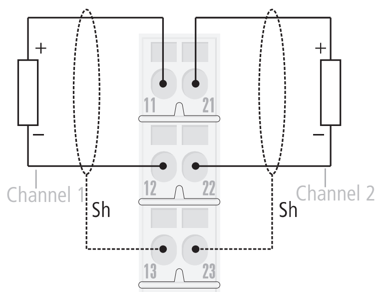


Figure 95: Connection diagram XN-S3x-SBB

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XNE-4AO-U/I

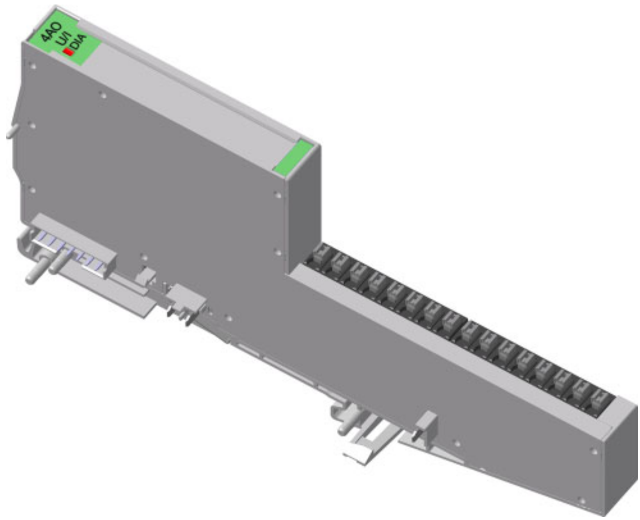

Figure 96: Analog output module (XNE ECO), 4 analog outputs: voltage (-10…+10VDC/0…+10VDC) / current (0…20 mA/4…20 mA)

This 4-channel analog output module provides 4 analog outputs for voltage or current.

The function-setting is done via channel-oriented parameters.

The module provides electrical isolation between the field an the module bus connection.

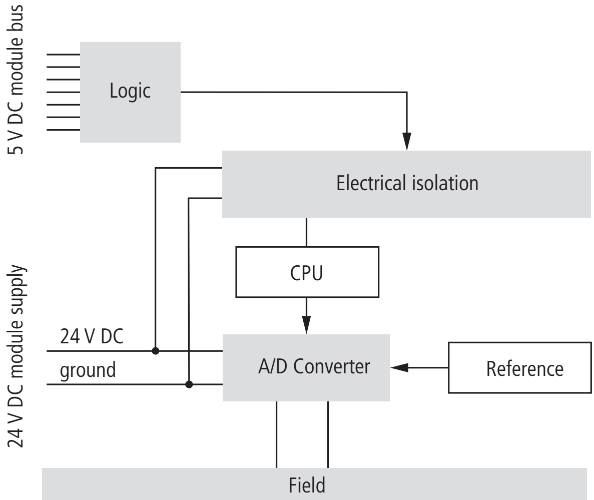

Figure 97: Block diagram

Technical data

Table 22: XNE-4AO-U/I

Designation	Value
Ouput values	Voltage, current
Number of channels	4
Nominal supply from supply terminal U_L (range)	24 V DC (18…30 V DC)
Nominal current consumption from supply terminal I_L [1)]	
without signal output	≦ 40 mA
with signal output	≦ 150 mA
Nominal current consumption from module bus I_{MB} [1)]	≦ 40 mA
Insulation voltage (channels to module bus)	500 V_{rms}
Power loss	< 3 W
Ouput value, voltage	
Ouput voltage	-10…10 V DC/ 0…10 V DC
Value representation	Standard, 16-bit/12-bit (left-justified) Extended range, 16-bit/12-bit (left-justified) NE43, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Load resistance	
Resistive load	> 1000 Ω
Capacitive load	< 1 µF
Transmission frequency	< 20 Hz
Setting time (maximum)	
Resistive load	< 1 ms
Inductive load	< 2 ms
Capacitive load	< 2 ms
Short circuit current	≦ 40 mA

Designation	Value
Accuracy of output value	
Basic error limit at 23 °C	< 0.2 %
Temperature coefficient	≦ 200 ppm/ °C of limit value
Ouput value, current	
Ouput current	0…20 mA /4…20 mA
Value representation	Standard, 16-bit/12-bit (left-justified) Extended range, 16-bit/12-bit (left-justified) NE43, 16-bit/12-bit (left-justified)
Connection options	2-wire + shield
Load resistance	
Resistive load	< 450 Ω
Inductive load	< 1 µH
Transmission frequency	< 20 Hz
Setting time (maximum)	
Resistive load	< 1 ms
Inductive load	< 2 ms
Capacitive load	< 2 ms
Short circuit current	≦ 40 mA
Accuracy of output value	
Basic error limit at 23 °C	< 0.2 %
Temperature coefficient	≦ 200 ppm/ °C of limit value

1) A part of the electronics of the XI/ON module is supplied from the module bus voltage (5 V DC), the rest from the supply terminal (U_L).

Diagnostic messages

LED	Display	Meaning	Remedy
DIA	Red	Module bus communication failure or field voltage U_L is not present	Check if more than two adjoining electronics modules have been pulled. Check the field voltage U_L.
	Off	No error messages or diagnostics	–

The module provides 1 byte of diagnostics data per channel:

- Output value range error “Out of Range” (**OoR**):
  - The set output value overstepps or undercuts the limit of the nominal range (limit values according to parameterization).
- Overflow / Underflow (**OUFL**):
  - The set output value exceeds the output range (limit values according to parameterization). The module cannot transmit this value. The output value is the maximum or minimum value which can be outputted.
- Hardware error (**HW Error**):
  - Exampels: CRC error, calibration errors…
  - The output value of the analog value is “0”.

→ The switching thresholds depend on the setting of the module parameter operation mode Kx. The switching thresholds can be found in the corresponding section from Page 221 on.

Module parameters (per channel)

The module provides 12 byte parameter data. Three bytes are assigned to each analog output channel.

→ Please read from Page 221 on for detailed information about the parameter settings (Standard, Extended Range, NE43).

Table 23: Module parameters

Parameter	Settings
Operation mode Kx	voltage -10V..10V standard[1)] voltage 0..10V standard voltage -10V..10V NE43 voltage 0..10V NE43 voltage -10V..10V ext. range voltage 0..10V ext. range current 0..20mA standard current 4..20mA standard current 0..20mA NE43 current 4..20mA NE43 current 0..20mA ext. range current 4..20mA ext. range deactivate
Value representation Kx	Integer (15bit + sign)[1)] 12bit (left-justified)
Diagnostics Kx	release[1)] block
Behaviour module bus error Ax	output substitute value[1)] hold current value

Parameter	Settings
Substitute value Ax	Substitute value = “0“ [1] The substitute value defined here for the corresponding channel will be output in the following cases: • if one of the specific events occurs which are parameterized in the gateway or • in the event of a module bus error: if the module parameter "behaviour module bus error Ax" is set to "output substitute value".

1) Default settings

Table 24: Min./max. values

Value representation/ ressolution	Rage	Min. value	Max. value
Standard/ 16 bit/ 12 bit	-10…10 V DC	-10 V DC	10 V DC
	0…10 V DC	0 V DC	10 V DC
	0…20 mA	0 mA	20 mA
	4…20 mA	4 mA	20 mA
Extended Range/ 16 bit/ 12 bit	-10…10 V DC	-11.76 V DC	11.76 V DC
	0…10 V DC	0 V DC	11.76 V DC
	0…20 mA	0 mA	23.52 mA
	4…20 mA	0 mA	22.81 mA
NE43 16 bit/ 12 bit	-10…10 V DC	-10.5 V DC	10.5 V DC
	0…10 V DC	0 V DC	10.5 V DC
	0…20 mA	0 mA	21 mA
	4…20 mA	3.6 mA	21 mA

Connection diagram

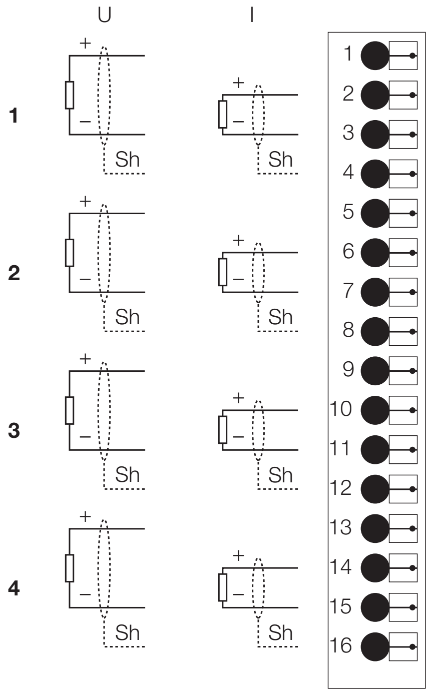

Figure 98: Connection options

→ Each single channel can be used for voltage output **or** for current output. Not used output terminals must be non-wired.

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Standard value representation

16-bit representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 3276.7 [1/V] × voltage value [V]				
100.000 %	32767	7FFF	nominal range	10.0000 V
99.997 %	32766	7FFE		9.9997 V
	…	…		…
50.002 %	16384	4000		5.0002 V
	…	…		…
0.003052 %	1	0001		0.0003052 V
0.000 %	0	0000		0.0000 V
-0.003052 %	-1	FFFF		-0.0003052 V
	…	…		…
-50.000 %	-16384	C000		-5.0000 V
	…	…		…
-99.997 %	-32767	8001		-9.9997 V
-100.000 %	-32768	8000		-10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value= 3276.7 [1/V] × voltage value [V]				
100.000 %	32767	7FFF	nominal range	10.0000 V
99.997 %	32766	7FFE		9.9997 V
	…	…		…
50.002 %	16384	4000		5.0002 V
	…	…		…
0.003052 %	1	0001		0.0003052 V
0.000 %	0	0000		0.0000 V
-0.003052 %	-1	FFFF	DIA “OoR” ON at FFFF to 8000	0.0000 V
	…	…		…
-50.000 %	-16384	C000		0.0000 V
	…	…		…
-99.997 %	-32767	8001		0.0000 V
-100.000 %	-32768	8000		0.0000 V

	dec.	hex.	unipolar	0…20 mA
dec. value= 1638.35 [1/mA] × current value [mA]				
100.000 %	32767	7FFF	nominal range	20.0000 mA
99.997 %	32766	7FFE		19.9994 mA
	…	…		…
50.002 %	16384	4000		10.0003 mA
	…	…		…
0.003052 %	1	0001		0.0006104 mA
0.000 %	0	0000		0.0000 mA
-0.003052 %	-1	FFFF	DIA “OoR” EIN at FFFF to 8000	0.0000 mA
	…	…		…
-50.000 %	-16384	C000		0.0000 mA
	…	…		…
-99.997 %	-32767	8001		0.0000 mA
-100.000 %	-32768	8000		0.0000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value= 2047.94 [1/mA] × (current value [mA] - 4 mA)				
100.000 %	32767	7FFF	nominal range	20.0000 mA
99.997 %	32766	7FFE		19.9995 mA
	…	…		…
50.002 %	16384	4000		12.0002 mA
	…	…		…
0.003052 %	1	0001		4.0004883 mA
0.000 %	0	0000		4.0000 mA
-0.003052 %	-1	FFFF	DIA “OoR” EIN bei FFFF to 8000	4.0000 mA
	…	…		…
-50.000 %	-16384	C000		4.0000 mA
	…	…		…
-99.997 %	-32767	8001		4.0000 mA
-100.000 %	-32768	8000		4.0000 mA

12-bit representation (left-justified)

	dec.	hex.	bipolar	-10…10 V
dec. value= 204.7 [1/V] × voltage value [V] × 16				
100.000 %	2047 × 16	7FF×	nominal range	10.0000 V
99.951 %	2046 × 16	7FEx		9.9951 V
	…	…		…
0.04885 %	1 × 16	001x		0.004885 V
0.000 %	0	000x		0.0000 V
-0.04883 %	-1 × 16	FFF×		-0.004883 V
	…	…		…
-99.951 %	-2047 × 16	801x		-9.9951 V
-100.000 %	-2048 × 16	800x		-10.0000 V

	dec.	hex.	unipolar	0…10 V
dec. value= 409.5 [1/V] × voltage value [V] × 16				
100.000 %	4095 × 16	FFF×	nominal range	10.0000 V
99.976 %	4094 × 16	FFEx		9.9976 V
	…	…		…
50.012%	2048 × 16	800x		5.0012 V
	…	…		…
0.02442 %	1 × 16	001x		0.002442 V
0.000 %	0	000x		0.0000 V

	dec.	hex.	unipolar	0…20 mA
dec. value= 204.75 [1/mA] × current value [mA] × 16				
100.000 %	4095 × 16	FFF×	nominal range	20.0000 mA
99.976 %	4094 × 16	FFEx		19.9951 mA
	…	…		…
50.012%	2048 × 16	800x		10.0024 mA
	…	…		…
0.02442 %	1 × 16	001x		0.004884 mA
0.000 %	0	000x		0.0000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value= (255.9 [1/mA] × (current value [mA] - 4 mA)) × 16				
100.000 %	4095 × 16	FFF×	nominal range	20.0000 mA
99.976 %	4094 × 16	FFEx		19.9961 mA
	…	…		…
50.012%	2048 × 16	800x		12.0020 mA
	…	…		…
0.02442 %	1 × 16	001x		4.003907 mA
0.000 %	0	000x		4.0000 mA

Extended Range value representation

16-bit representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.515 %	32767	7FFF	DIA "OoR" ON at 7F00 to 7FFF	11.8515 V
118.461 %	32752	7FF0		11.8461 V
117.593 %	32512	7F00		11.7593 V
117.589 %	32511	7EFF	out of range	11.7589 V
117.535 %	32496	7EF0		11.7535 V
100.058%	27664	6C10		10.0058 V
100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10.0000 V
0.05787 %	16	0010		5.787 µV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0 V
-0.003617 %	-1	FFFF		-361.7 µV
-0.05787 %	-16	FFF0		- 5.787 µV
-25.000 %	-6912	E500		-2.5 V
-100.000 %	-27648	9400		-10.0000 V
-100.004 %	-27649	93FF	out of range	-10.0004 V
-100.058 %	-27664	93F0		-10.0058 V
-117.593 %	-32512	8100		-11.7593 V
-117.596 %	-32513	80FF	DIA "OoR" ON at 80FF to 8000	-11.7596 V
-118.461 %	-32752	80F0		-11.8461 V
-118.519 %	-32768	800		-11.8519 V

	dec.	hex.	unipolar	0…10 V
dec. value= 2764.8 [1/V] × voltage value [V]				
118.515 %	32767	7FFF	DIA "OoR" ON at 7F00 to 7FFF	11.8515 V
118.461 %	32752	7FF0		11.8461 V
117.593 %	32512	7F00		11.7593 V
117.589 %	32511	7EFF	out of range	11.7589 V
117.535 %	32496	7EF0		11.7535 V
100.058%	27664	6C10		10.0058 V
100.004 %	27649	6C01		10.0004 V
100.000 %	27648	6C00	nominal range	10.0000 V
0.05787 %	16	0010		5.787 µV
0.003617 %	1	0001		361.7 µV
0.000 %	0	0000		0.00 V
-0.003617 %	-1	FFFF	DIA "OUFL" ON at FFFF to 8000	0.00 V
-0.05787 %	-16	FFF0		0.00 V
-25.000 %	-6912	E500		0.00 V
-100.000 %	-27648	9400		0.00 V
-100.004 %	-27649	93FF		0.00 V
-100.058 %	-27664	93F0		0.00 V
-117.593 %	-32512	8100		0.00 V
-117.596 %	-32513	80FF		0.00 V
-118.461 %	-32752	80F0		0.00 V
-118.519 %	-32768	8000		0.00 V

	dec.	**hex.**	**unipolar**	**0…20 mA**
dec. value= 1382.4 [1/mA] × current value [mA]				
118.515 %	32767	7FFF	DIA "OoR" ON at 7F00 to 7FFF	23.7030 mA
118.461 %	32752	7FF0		23.6921 mA
117.593 %	32512	7F00		23.5185 mA
117.589 %	32511	7EFF	out of range	23.5178 mA
117.535 %	32496	7EF0		23.5069 mA
100.058%	27664	6C10		20.0116 mA
100.004 %	27649	6C01		20.0007 mA
100.000 %	27648	6C00	nominal range	20.0000 mA
0.05787 %	16	0010		11.574 µA
0.003617 %	1	0001		0.7234 µA
0.000 %	0	0000		0.0000 mA
-0.003617 %	-1	FFFF	DIA "OUFL" ON at FFFF to 8000	0.0000 mA
-0.05787 %	-16	FFF0		0.0000 mA
-25.000 %	-6912	E500		0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
-100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

	dec.	hex.	unipolar	4…20 mA
dec. value= 1382.4 [1/mA] × current value [mA]				
118.515 %	32767	7FFF	DIA “OoR” ON at 7F00 to 7FFF	22.9624 mA
118.461 %	32752	7FF0		22.9537 mA
117.593 %	32512	7F00		22.8148 mA
117.589 %	32511	7EFF	out of range	22.8142 mA
117.535 %	32496	7EF0		22.8056 mA
100.058%	27664	6C10		20.0093 mA
100.004 %	27649	6C01		20.0006 mA
100.000 %	27648	6C00	nominal range	20.0000 mA
0.05787 %	16	0010		4.009259 mA
0.003617 %	1	0001		4.000579 mA
0.000 %	0	0000		4.0000 mA
-0.003617 %	-1	FFFF	out of range	3.9994 mA
-0.05787 %	-16	FFF0		3.9907 mA
-25.000 %	-6912	E500		0.0000 mA
-25.004 %	-6913	E4FF	DIA “OUFL” ON at E4FF to 8000	0.0000 mA
-100.000 %	-27648	9400		0.0000 mA
-100.004 %	-27649	93FF		0.0000 mA
-100.058 %	-27664	93F0		0.0000 mA
-117.593 %	-32512	8100		0.0000 mA
-117.596 %	-32513	80FF		0.0000 mA
-118.461 %	-32752	80F0		0.0000 mA
-118.519 %	-32768	8000		0.0000 mA

12-bit representation (left-justified)

The representation of the 12-bit values corresponds to that of the 16-bit values. Only the bits Bit 0 to 3 are set to "0".

Value representation for process automation (NE43)

16-bit representation

	dec.	hex.	bipolar	-10…10 V
dec. value= 1000 [1/V] × voltage value [V]				
327.67 %	32767	7FFF	DIA “OUFL” ON at 2AF9 to 7FFF	11.000 V
110. 01 %	11001	2AF9		11.000 V
110.00 %	11000	2AF8	DIA “OoR” ON at 2905 to 7FFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.00 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
0.01 %	1	0001		0.001 V
0.00 %	0	0000		0 V
-0.01 %	-1	FFFF		-0.001 V
-40.00 %	-4000	F060		-4.000 V
-100.00 %	-10000	D8F0		-10.000 V
-100.01 %	-10001	D8EF	out of range	-10.001 V
-105.00 %	-10500	D6FC		-10.500 V
-105.01 %	-10501	D6FB	DIA “OoR” ON at D6FB to 8000	-10.501 V
-110.00 %	-11000	D508		-11.000 V
-110.01 %	-11001	D507	DIA “OUFL” ON at D507 to 8000	-11.000 V
-327.68 %	-32768	8000		-11.000 V

	dec.	hex.	bipolar	0…10 V
dec. value= 1000 [1/V] × voltage value [V]				
655.35 %	65535	FFFF	DIA "OUFL" ON at 2AF9 to FFFF	11.000 V
110.01 %	11001	2AF9		11.000 V
110.00 %	11000	2AF8	DIA "OoR" ON at 2905 to FFFF	11.000 V
105.01 %	10501	2905		10.501 V
105.00 %	10500	2904	out of range	10.500 V
100.01 %	10001	2711		10.001 V
100.00 %	10000	2710	nominal range	10.000 V
40.00 %	4000	0FA0		4.000 V
20.00 %	2000	07D0		2.000 V
0.01 %	1	0001		0.001 V
0.00 %	0	0000		0 V

	dec.	hex.	unipolar	0…20 mA
dec. value= 1000 [1/mA] × current value [mA]				
327.675 %	65535	FFFF	DIA "OUFL" ON at 55F1 to FFFF	22.000 mA
110.050 %	22001	55F1		22.000 mA
110.000 %	22000	55F0	DIA "OoR" ON at 5209 to FFFF	22.000 mA
105.005 %	21001	5209		21.001 mA
105.000 %	21000	5208	out of range	21.000 mA
100.005 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
40.000 %	8000	1F40		8.000 mA
20.000 %	4000	0FA0		4.000 mA
0.010 %	2	0002		0.002 mA
0.005 %	1	0001		0.001 mA
0.000 %	0	0000		0.000 mA

	dec.	**hex.**	**unipolar**	**4…20 mA**
dec. value= 1000 [1/mA] × current value [mA]				
384.594 %	65535	FFFF	DIA “OUFL” ON at 55F1 to FFFF	22.000 mA
112.506 %	22001	55F1		22.001 mA
112.500 %	22000	55F0	DIA “OoR” ON at 5209 to FFFF	22.000 mA
106.256 %	21001	5209		21.001 mA
106.250 %	21000	5208	out of range	21.000 mA
100.006 %	20001	4E21		20.001 mA
100.000 %	20000	4E20	nominal range	20.000 mA
25.000 %	8000	1F40		8.000 mA
0.000 %	4000	0FA0		4.000 mA
-0.006 %	3999	0F9F	out of range	3.999 mA
-1.250 %	3800	0ED8		3.800 mA
-2.500 %	3600	0E10		3.600 mA
-2.506 %	3599	0E0F	DIA “OoR” ON at 0E0F to 0000	3.599 mA
-12.500 %	2000	07D0		2.000 mA
-12.506 %	1999	07CF		1.999 mA
-24.994 %	1	0001		0.001 mA
-25.000 %	0	0000		0.000 mA

12-bit representation (left-justified)
The representation of the 12-bit values corresponds to that of the 16-bit values. Only the bits Bit 0 to 3 are set to "0".

4 Integration in PROFIBUS-DP

General

The process data is transmitted byte-wise (8-bit) via PROFIBUS. The analog module types have 2 bytes of process data for each channel. The two process data bytes contain the measured value of the channel and define the voltage or current value of the channel.

The analog input modules supply process input data and the diagnostics data if the appropriate parameter is set (12-bit representation).

The analog output modules and relay modules only receive process output data.

→ You can find the latest GSD files on our home page (www.eaton-automation.com), under „DOWNLOADS“.

Process input data

Data structure with 16-bit representation

Table 25: Structure of the data bytes on the PROFIBUS-DP fieldbus

PDInp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Measured value							
Byte 1								

Table 26: Structure of the data bytes on the PROFIBUS-DP fieldbus, bitwise representation:

PDInp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8

Data structure with 12-bit representation

Table 27: Structure of the data bytes on the PROFIBUS-DP fieldbus

PDInp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Measured value[2)]				Diagnostics data[1)]			
Byte 1								

1) The diagnostics data varies according to module type and is represented by channel
2) The measured value is represented as a binary value if the set measured value range is positive. If the parameterised measured value range also allows negative values (-10 V DC…10 V DC), the measured value is coded as a two's complement value.

Table 28: Structure of the data bytes in the PROFIBUS-DP fieldbus, bitwise display - Example of diagnostics for the XN-2AI-PT/NI-2/3

PDInp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Bit 3	Bit 2	Bit 1	Bit 0	X	"Short-circuit"	Open circuit	"Measure-ment value range error"
Byte 1	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4

X = reserved

Process output data

Data structure with 16-bit representation

Table 29: Structure of the data bytes in the PROFIBUS-DP fieldbus

PDOutp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Output value							
Byte 1								

Table 30: Structure of the data bytes in the PROFIBUS-DP fieldbus, bitwise representation

PDOutp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8

Data structure with 12-bit representation

Table 31: Structure of the data bytes in the PROFIBUS-DP fieldbus

PDOutp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Output value[1)]				X	X	X	X
Byte 1								

X = reserved

1) The output value must be coded as a binary value if the parameterised output range is positive. If the parameterised output value range also allows negative values (-10 V DC…10 V DC), the output value must be coded as a two's complement value.

Table 32: Structure of the data bytes in the PROFIBUS-DP fieldbus, bitwise representation

PDOutp	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Bit 3	Bit 2	Bit 1	Bit 0	X	X	X	X
Byte 1	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4

X = reserved

Parameter data structure

The structure of the parameter data of the analog I/O module depends on the module type. The structure of the parameter data for each module type is shown further on in this section.

It must be remembered that all the modules that appear in the
Standard module representation
(e.g. "S-XN-2AO-U(-10/0..+10VDC)")
will occupy one parameter byte when project engineering with a software tool.

This parameter byte contains the number of all other parameter bytes of the module.

The response of the analog outputs in the event of an error (change of module, wrong module replaced, fieldbus error) can be defined through gateway parameters.

The description of these gateway parameters can be found in the manual:

- User Manual XI/ON:
  Gateways for PROFIBUS-DP

XN-1AI-I(0/4…20MA)

Table 33: Structure of the data byte (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	Diagnostic	Value representation	Current mode

X = reserved

→ “Meaning of the parameter data” Page 246

XN-2AI-I(0/4…20MA)

Table 34: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	Diagnostic	Value representation	Current mode
Byte 1	X	X	X	X	Channel K2	Diagnostic	Value representation	Current mode

X = reserved

→ “Meaning of the parameter data” Page 246

XN-1AI-U(-10/0…+10VDC)

Table 35: Structure of the data byte (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	Diagnostic	Value representation	Voltage mode

X = reserved

→ “Meaning of the parameter data” Page 246

XN-2AI-U(-10/0…+10VDC)

Table 36: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	Diagnostic	Value representation	Voltage mode
Byte 1	X	X	X	X	Channel K2	Diagnostic	Value representation	Voltage mode

X = reserved

→ “Meaning of the parameter data” Page 246

XN-2AI-PT/NI-2/3

Table 37: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	X	Meas. mode K1
Byte 1	Element K1				Channel K1	Diagnostic K1	Value representation K1	Mains suppression K1
Byte 2	X	X	X	X	X	X	X	Meas. mode K2
Byte 3	Element K2				Channel K2	Diagnostic K2	Value representation K2	Mains suppression K2

X = reserved

→ "Meaning of the parameter data" Page 246

XN-2AI-THERMO-PI

Table 38: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Element K1				Channel K1	Diagnostic K1	Value representation K1	Mains suppression K1
Byte 1	Element K2				Channel K2	Diagnostic K2	Value representation K2	Mains suppression K2

→ "Meaning of the parameter data" Page 246

XN-4AI-U/I

Table 39: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	Operating mode	Channel K1	Diagnostic	Value representation	Range
Byte 1	X	X	X	Operating mode	Channel K2	Diagnostic	Value representation	Range
Byte 2	X	X	X	Operating mode	Channel K3	Diagnostic	Value representation	Range
Byte 3	X	X	X	Operating mode	Channel K4	Diagnostic	Value representation	Range

X = reserved

→ "Meaning of the parameter data" Page 246

XNE-8AI-U/I-4PT/NI

Table 40: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Diagnostic K1	Value representation K1	Operating mode K1					
Byte 1	Diagnostic K2	Value representation K2	Operating mode K2					
Byte 2	Diagnostic K3	Value representation K3	Operating mode K3					
Byte 3	Diagnostic K4	Value representation K4	Operating mode K4					
Byte 4	Diagnostic K5	Value representation K5	Operating mode K5					
Byte 5	Diagnostic K6	Value representation K6	Operating mode K6					
Byte 6	Diagnostic K7	Value representation K7	Operating mode K7					
Byte 7	Diagnostic K8	Value representation K8	Operating mode K8					

→ "Meaning of the parameter data" Page 246

XN-1AO-I(0/4…20MA)

Table 41: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	Value representation	Current mode
Byte 1	Substitute value A1							
Byte 2								

X = reserved

→ "Meaning of the parameter data" Page 246

XN-2AO-I(0/4…20MA)

Table 42: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	X	Value representation	Current mode
Byte 1	Substitute value A1							
Byte 2								
Byte 3	X	X	X	X	Channel K2	X	Value representation	Current mode
Byte 4	Substitute value A2							
Byte 5								

X = reserved

→ "Meaning of the parameter data" Page 246

XN-2AO-U(-10/0…+10VDC)

Table 43: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	Value repre-sentation	Voltage mode
Byte 1	Substitute value A1							
Byte 2								
Byte 3	X	X	X	X	X	X	Value repre-sentation	Voltage mode
Byte 4	Substitute value A2							
Byte 5								

X = reserved

→ “Meaning of the parameter data” Page 246

XNE-4AO-U/I

Table 44: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Behaviour module bus error A1		Diagnostic K1	Value representation K1	Operating mode K1			
Byte 1	Substitute value A1							
Byte 2								
Byte 3	Behaviour module bus error A2		Diagnostic K2	Value representation K2	Operating mode K2			
Byte 4	Substitute value A2							
Byte 5								
Byte 6	Behaviour module bus error A3		Diagnostic K3	Value representation K3	Operating mode K3			
Byte 7	Substitute value A3							
Byte 8								
Byte 9	Behaviour module bus error A4		Diagnostic K4	Value representation K4	Operating mode K4			
Byte 10	Substitute value A4							
Byte 11								

→ “Meaning of the parameter data” Page 246

Meaning of the parameter data

The structure of the parameter bytes depends on the module and is described from Page 238 onwards. The following table contains an overview of the parameter descriptions for all analog XI/ON modules. The table is arranged in alphabetical order according to the parameter name.

Table 45: Meaning of the data bits (parameters):

Designation	Value 1):Default	Designation of the values/Value range	Description
behaviour module bus error Ax	00 1) 01 10 11	output substitute value 1) hold current value reserved reserved	This parameter defines what shall be used as substitute value.
channel Kx	0 1) 1	activate 1) deactivate	This parameter enables individual channels to be deactivated and reactivated selectively.
current mode	0 1) 1	0..20 mA 1) 4..20 mA	This parameter is used for setting the range for the current to be measured or the output current. The setting is carried out for each individual channel.
diagnostic, diagnostic Kx	0 1) 1	release 1) block	The fieldbus related separate diagnostic message can be activated or deactivated. The messages are always available if the diagnostic message is integrated with the 12-bit representation in the process input data. Parameters can be assigned to each channel with multiple channel modules.

Designation	Value 1):Default	Designation of the values/Value range	Description
element Kx	This parameter is used to set the variable to be measured and the measurement range. This setting is carried out for each individual channel.		
	XN-2AI-PT/NI-2/3:		
	0000[1)]	PT100, -200..850°C[1)]	
	0001	PT100, -200..150°C	
	0010	NI100, -60..250°C	
	0011	NI100, -60..150°C	
	0100	PT200, -200..850°C	
	0101	PT200, -200..150°C	
	0110	PT500, -200..850°C	
	0111	PT500, -200..150°C	
	1000	PT1000, -200..850°C	
	1001	PT1000, -200..150°C	
	1010	NI1000, -60..250°C	
	1011	NI1000, -60..150°C	
	1100	resistance, 0..100 Ohm	
	1101	resistance, 0..200 Ohm	
	1110	resistance, 0..400 Ohm	
	1111	resistance, 0..1000 Ohm	
	XN-2AI-THERMO-PI:		
	0000[1)]	Type K, -270..1370°C[1)]	
	0001	Type B, +100..1820°C	
	0010	Type E, -270..1000°C	
	0011	Type J, -210..1200°C	
	0100	Type N, -270..1300°C	
	0101	Type R, -50..1760°C	
	0110	Type S, -50..1540°C	
	0111	Type T, -270..400°C	
	1000	+/-50mV	
	1001	+/-100mV	
	1010	+/-500mV	
	1011	+/-1000mV	

Designation	Value 1):Default	Designation of the values/Value range	Description
mains suppression Kx	0[1)] 1	50 Hz[1)] 60 Hz	Interference caused by the frequency of the supply voltage is suppressed (in Germany the supply voltage is 50 Hz, in the USA 60 Hz). This setting is carried out for each individual channel.
measurement mode Kx	0[1)] 1	2-wire[1)] 3-wire	This parameter defines whether the measurement shall be carried out via 2-wire or 3-wire measuring (→ "Connection diagrams" Page 118). This setting is carried out for each individual channel.
operation mode, operation mode Kx	This parameter is used to set: • the variable to be measured, the measurement range and the value representation • or the output variable, the output value range and the value representation. The setting is carried out for each individual channel.		
	XN-4AI-U/I:		
	0[1)] 1	voltage[1)] current	
	XNE-8AI-U/I-4PT/NI:		
	000000[1)] 000001 000010 000011 000100 000101 000110 000111	voltage -10V..10V standard[1)] voltage 0..10 V standard voltage -10V..10V NE43 voltage 0..10V NE43 voltage -10V..10V ext. range voltage 0..10V ext. range reserved reserved	

Designation	Value 1):Default	Designation of the values/Value range	Description
operation mode, operation mode Kx	001000	current 0..20mA standard	
	001001	current 4..20mA standard	
	001010	current 0..20mA NE43	
	001011	current 4..20mA NE43	
	001100	current 0..20mA ext. range	
	001101	current 4..20mA ext. range	
	001110	reserved	
	001111	reserved	
	010000	PT100, -200..850°C 2-wire	
	010001	PT100, -200..150°C 2-wire	
	010010	PT200, -200..850°C 2-wire	
	010011	PT200, -200..150°C 2-wire	
	010100	PT500, -200..850°C 2-wire	
	010101	PT500, -200..150°C 2-wire	
	010110	PT1000, -200..850°C 2-wire	
	010111	PT1000, -200..150°C 2-wire	
	011000	PT100, -200..850°C 3-wire	
	011001	PT100, -200..150°C 3-wire	
	011010	PT200, -200..850°C 3-wire	
	011011	PT200, -200..150°C 3-wire	
	011100	PT500, -200..850°C 3-wire	
	011101	PT500, -200..150°C 3-wire	
	011110	PT1000, -200..850°C 3-wire	
	011111	PT1000, -200..150°C 3-wire	
	100000	NI100, -60..250°C 2-wire	
	100001	NI100, -60..150°C 2-wire	
	100010	NI1000, -60..250°C 2-wire	
	100011	NI1000, -60..150°C 2-wire	
	100100	NI1000TK5000, -60..250°C 2-wire	
	100101	reserved	
	100110	reserved	
	100111	reserved	
	101000	NI100, -60..250°C 3-wire	
	101001	NI100, -60..150°C 3-wire	
	101010	NI1000, -60..250°C 3-wire	
	101011	NI1000, -60..150°C 3-wire	
	101100	NI1000TK5000, -60..250°C 3-wire	
	101101	reserved	
	101110	reserved	
	101111	reserved	

Designation	Value 1):Default	Designation of the values/Value range	Description
operation mode, operation mode Kx	110000 110001 110010 110011 110100 110101 to 111110 111111	resistance, 0..250 Ohm resistance, 0..400 Ohm resistance, 0..800 Ohm resistance, 0..2000 Ohm resistance, 0..4000 Ohm reserved deactivate	
	XNE-4AO-U/I:		
	0000[1)] 0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111	voltage -10V..10V standard[1)] voltage 0..10V standard voltage -10V..10V NE43 voltage 0..10V NE43 voltage -10V..10V ext. range voltage 0..10V ext. range reserved reserved current 0..20mA standard current 4..20mA standard current 0..20mA NE43 current 4..20mA NE43 current 0..20mA ext. range current 4..20mA ext. range reserved deactivate	
range	0[1)] 1	0..10V/0..20 mA[1)] 10..+10V/4..20 mA	This parameter is used on the XN-4AI-U/I module for setting the current or voltage range. This module allows both current and voltage measuring. The relevance of the voltage or current range depends on the “operation mode” setting. This setting is carried out for each individual channel.

Designation	Value 1):Default	Designation of the values/Value range	Description
substitute value Ax	This parameter is used to define the substitute value to be output in the event of an errror. This setting is carried out for each individual channel.		
	XN-1AO-I(0/4…20MA), XN-2AO-I(0/4…20MA), XN-2AO-U(-10/0…+10VDC):		
	0[1)]		The substitute value defined here will be output if one of the specific events occurs which are parameterized in the gateway.
	XNE-4AO-U/I:		
	0[1)]		The substitute value defined here will be output in the following cases: • if one of the specific events occurs which are parameterized in the gateway or • in the event of a module bus error: if the module parameter "behaviour module bus error Ax" is set to "output substitute value".
value representation, value representation Kx	0[1)]	Integer (15bit + sign)[1)]	The value (current, voltage, resistance, temperature is represented with 16 bits.
	1	12bit (left-justified)	The value (current, voltage, resistance, temperature is represented with 12 bits. → "Representation of the analog values" Page 38

Designation	Value 1):Default	Designation of the values/Value range	Description
voltage mode	0 1) 1	0..10V 1) -10..+10V	This parameter is used for setting the range for the voltage to be measured or the output voltage. The setting is carried out for each individual channel.

Diagnostic

The analog input modules provide 1 byte of diagnostics data per channel:

Module	Chn.	Bit	Diagnostics
XN-1AI-I(0/4…20MA) XN-2AI-I(0/4…20MA)	n	0	Measurement value range error: Indication of overcurrent or undercurrent of 1 % of the set current range. • Current 0…20 mA: – Overcurrent: I_{max} (I > 20.2 mA); – Undercurrent is not detected. • Current 4…20 mA: – Overcurrent: I_{max} (I > 20.2 mA); – Undercurrent: I_{min} (I < 3.8 mA)
		1	Wire break: • Indication of a wire break in the signal cable for operating mode 4…20 mA with a threshold of 3 mA.
XN-1AI-U(-10/0…+10VDC) XN-2AI-U(-10/0…+10VDC)	n	0	Measurement value range error: Indication of overvoltage or undervoltage of 1% of the set voltage range. • Voltage -10…+10 V DC: – Overvoltage: U_{max} (U > 10.1 V DC) – Undervoltage: U_{min} (U < -10.1 V DC) • Voltage 0…+10 V DC: – Overvoltage: U_{max} (U > 10.1 V DC) – Undervoltage: U_{min} (U < 0.1 V DC)
XN-2AI-PT/NI-2/3	n	0	Measurement value range error: • Unterflow diagnostics only in temperature measurements • Threshold: 1 % of the positive measurement range limit value
		1	Wire break

Module	Chn.	Bit	Diagnostics
XN-2AI-PT/NI-2/3	n	2	Short-circuit (only in temperature measurements): • Threshold: 5 Ω (loop resistance) • With 3-wire measurements with PT100 sensors, no distinction is made between short-circuit and wire break at a temperature below -177 °C. In this case, the "Short-circuit" diagnostic signal is generated.
		3 to 7	reserved
XN-2AI-THERMO-PI	n	0	Measurement value range error: • Threshold: 1 % of the positive measurement range limit value • With type K, N and T sensors, the "Underflow" diagnostic signal is generated on temperatures below -271.6 °C.
		1	Wire break (only in temperature measurements)
		2 to 7	reserved
XN-4AI-U/I	n	0	Measurement value range error: Indication of overvoltage or undervoltage of 1% of the set voltage range or indication of overcurrent or undercurrent of 1 % of the set current range. • Voltage -10…+10 V DC: – Overvoltage: U_{max} (U > 10.1 V DC) – Undervoltage : U_{min} (U < -10.1 V DC) • Voltage 0…+10 V DC: – Overvoltage: U_{max} (U > 10.1 V DC) – Undervoltage : U_{min} (U < 0.1 V DC) • Current 0…20 mA: – Overcurrent: I_{max} (I > 20.2 mA); – Undercurrent is not detected. • Current 4…20 mA: – Overcurrent: I_{max} (I > 20.2 mA); – Undercurrent: I_{min} (I < 3.8 mA)

Module	Chn.	Bit	Diagnostics
XN-4AI-U/I	n	1	Wire break: • Indication of a wire brake in the signal cable for operating mode 4…20 mA with a threshold of 3 mA.
XNE-8AI-U/I-4PT/NI	n	0	Measurement value range error “Out of Range” (OoR)[1)]: • The measured value overstepps or undercuts the limit of the nominal range (limit values according to parameterization).
		1	Wire break (WB)[1)]: • The measured value is in the range which is assumed that there is a wire break in the signal cable. – In temeperature messurements – In resistance measurements – In current measurements in the range of 4…20 mA
		2	Short-circuit (SC): • The measured value is in the range which is assumed that there is a short-circuit. – In temeperature messurements: Threshold: 5 Ω (loop resistance) – 3-wire measurements with PT100 sensors cannot differentiate between a short-circuit and a wire break at temperatures below -177 °C. In this case, the diagnostic "shortcircuit" is generated.
		3	Overflow / Underflow (OUFL)[1)]: • The measured value exceeds the measurement range (limit values according to parameterization). The module cannot measure this value. The return value is the maximum or minimum value which can be measured.

Module	Chn.	Bit	Diagnostics
XNE-8AI-U/I-4PT/NI	n	7	Hardware error (HW Error): • Exampels: CRC error, calibration errors… • The return value of the measured value is “0”.
XNE-4AO-U/I	n	0	Output value range error “Out of Range” (OoR)[1]: • The set output value overstepps or undercuts the limit of the nominal range (limit values according to parameterization).
		3	Overflow / Underflow (OUFL)[1]: • The set output value exceeds the output range (limit values according to parameterization). The module cannot transmit this value. The output value is the maximum or minimum value which can be outputted.
		7	Hardware error (HW Error): • Exampels: CRC error, calibration errors… • The output value of the analog value is “0”.

1) The switching thresholds of the modules XNE-8AI-U/I-4PT/NI and XNE-4AO-U/I depend on the setting of the module parameter operation mode Kx. The switching thresholds can be found in the chapter of the corresponding module:
- For XNE-8AI-U/I-4PT/NI: from Page 146 on
- For XNE-4AO-U/I: from Page 221 on

5 Integration in CANopen

Process input data / process output data

The analog module types have 2 bytes of process data for each channel. These bytes contain the measured value of the channel (analog input) or the voltage or current value of the channel (analog output).

The analog input modules only provide process input data.

The analog output modules only receive process output data.

The process input and process output data is represented using the objects defined by the Device Profile for I/O Devices CiA DS-401.

→ You can find the latest EDS files on our home page (www.eaton-automation.com), under „DOWNLOADS“.

Objects for the process data

Overview

The objects represent the process input values for each analog input module and the process output values for each analog output channel of a XI/ON station.

Table 46: Objects for the process input and output data

Index (hex)	Page	Name
6401_{hex}		Read Analog Input 16 Bit
6411_{hex}		Write Analog Output 16 Bit

The **Index ($_{hex}$)** column describes the position of the entry in the object dictionary.

The following description of the objects uses the term "**Access",** indicating the possibility of accessing the entry.

These are as follows:

- rw (read/write):
  The writing and reading of the object via the service data is possible.
- ro (read only):
  The object can only be read.
- rwr (read/write/read):
  The writing and reading of the object via an SDO access is possible. A read PDO access is also possible if suitable PDO mapping has been configured for this object.
- rww (read/write/write):
  The writing and reading of the object via an SDO access is possible. A write PDO access is also possible if suitable PDO mapping has been configured for this object.

6401_{hex} Read Analog Input 16 Bit

The object represents the measured values for the analog input modules with 16 bits for each channel.

Attention!
The process data traffic for the analog input values is not started until the object 6423_{hex} is switched from the default setting FALSE to TRUE!

The representation of the different measured values as numerical values is described in detail from Page 38 onward for each value range.

Attention!
The possibility of 12-bit value representation (left-justified) is not useful for CANopen since all reference values (upper limit, lower limit) must be defined with 16 bits.

Table 47: Object 6401_{hex} Description

Features	**Sub-index**	**Description / Value**
Name		Read Analog Input 16 Bit
Object Code		ARRAY
PDO Mapping		Yes
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index $01…8E_{hex}$	Integer16
Access	Sub-index 00_{hex}	ro
	Sub-index $01…8E_{hex}$	ro
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index $01…8E_{hex}$	No

6411_{hex} Write Analog Output 16 Bit

The object represents the values for the analog output modules with 16 bits for each channel.

The representation of the current and voltage values as numerical values is described in detail from Page 176 onward for each value range.

Table 48: Object 6411_{hex} Description

Features	Sub-index	Description / Value
Name		Write Analog Output 16 Bit
Object Code		ARRAY
PDO Mapping		Yes
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index $01…8E_{hex}$	Integer16
Access	Sub-index 00_{hex}	ro
	Sub-index $01…8E_{hex}$	rww
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index $01…8E_{hex}$	00_{hex}

Objects for Interrupt behaviour

Objects 6421…6428_{hex} can be used to control the event-triggered transmission of the process input data. As well as these event-triggered control objects, the transmission frequency of the process input data is also controlled by means of objects 1800_{hex} to $181F_{hex}$. These objects are described in the manual:

- User Manual XI/ON: Gateways for CANopen

→ Remember that the object → "6423hex Analog Input Global Interrupt Enable" Page 265 must be used in order to enable the possibility of transmitting the process input data using an interrupt signal!

6421_{hex} Analog Input Interrupt Trigger Selection

The object defines which event is to trigger the transmitting of the analog input data (TPDOs) by means of an interrupt signal.

The triggering event is defined for each input channel using a corresponding sub-index of the object.

Table 49: Object 6421_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Trigger Selection
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index $01...8E_{hex}$	Unsigned8
Access	Sub-index 00_{hex}	ro
	Sub-index $01...8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index $01...8E_{hex}$	No

Table 50: Structure of sub-index 01_{hex} to $8E_{hex}$

Bit	Triggering event
0	1: **"Upper limit"**[1)] exceeded - the value at the input has exceeded the upper limit.
1	1: Input below **"lower limit"**[1)] - the value at the input is below the lower limit.
2	1: Input changed by more than **"delta"**[1)] - the value at the input has changed by a defined "Delta" value.
3	1: Input reduced by more than **"negative delta"**[1)] - the value at the input has reduced by a defined "Delta" value.
4	1: Input increased by more than **"positive delta"**[1)] - the value at the input has increased by a defined "Delta" value.
5…7	reserved

1) The upper/lower limit values and delta values are defined with the objects 6424_{hex}, 6425_{hex}, 6426_{hex}, 6427_{hex} and 6428_{hex}.

→ The transmitting of the analog input data (TPDOs) by means of an interrupt signal is triggered repeatedly with every change of the analog input value if the value stays above the upper limit or below the lower limit.

If another triggering event occurs at the same time (e.g. increase by "Delta value"), the repeated transmitting is aborted.

→ Several bits can be set simultaneously so that the transmitting of the input process data can be triggered by several events.

6422_{hex} Analog Input Interrupt Source

The object indicates if an analog input channel has fulfilled a condition for triggering an interrupt signal.

The conditions were defined with object 6421_{hex}.

If a condition for triggering an interrupt signal on a channel is fulfilled, the corresponding bit is set to 1. The corresponding bits for channels 0 to 31 are set in sub-index 01_{hex} and the bits for channels 32 to 63 in sub-index 02_{hex} etc.

The bits can be read using an SDO: The read operation causes the bits to be reset to 0.

Table 51: Object 6422_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Source
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…08_{hex}	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…08_{hex}	ro
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…08_{hex}	00_{hex}

6423_{hex} Analog Input Global Interrupt Enable

This object enables the option for generating an interrupt signal. If the value of this object is set from the default setting FALSE to TRUE, the transmitting of the analog input data (TPDOs) can be triggered by means of an interrupt signal.

Table 52: Object 6423_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Global Interrupt Enable
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Boolean
Access	Sub-index 00_{hex}	rw
XI/ON default value	Sub-index 00_{hex}	FALSE

6424_{hex} Analog Input Interrupt Upper Limit Integer

The object 6424_{hex} defines the value for an upper limit.

Values above this "upper limit" can be defined as the condition for generating an interrupt signal.

→ "6421hex Analog Input Interrupt Trigger Selection" Page 262

Table 53: Object 6424_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Upper Limit Integer
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Integer32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

6425_{hex} Analog Input Interrupt Lower Limit Integer

The object 6425_{hex} defines the value for a lower limit.

Values below this "lower limit" can be defined as the condition for generating an interrupt signal.

→ "6421hex Analog Input Interrupt Trigger Selection" Page 262

Table 54: Object 6425_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Lower Limit Integer
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Integer32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

6426_{hex} Analog Input Interrupt Delta Unsigned

The object 6426_{hex} defines a Delta value.

Values that deviate from the input value by this "Delta value" can be defined as the condition for generating an interrupt signal.

→ "6421hex Analog Input Interrupt Trigger Selection" Page 262

Table 55: Object 6426_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Delta Unsigned
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

6427_{hex} Analog Input Interrupt Negative Delta Unsigned

The object 6427_{hex} defines a Delta value.

Values **lesser than** the input value by this “Delta value” can be defined as the condition for generating an interrupt signal.

→ “6421hex Analog Input Interrupt Trigger Selection” Page 262

Table 56: Object 6427_{hex} Description

Features	**Sub-index**	**Description / Value**
Name		Analog Input Interrupt Negative Delta Unsigned
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

6428_{hex} Analog Input Interrupt Positive Delta Unsigned

The object 6428_{hex} defines a Delta value.

Values **greater than** the input value by this “Delta value” can be defined as the condition for generating an interrupt signal.

→ “6421hex Analog Input Interrupt Trigger Selection” Page 262

Table 57: Object 6428_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Input Interrupt Positive Delta Unsigned
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

Objects for the substitute output value in the event of an error

Overview

The objects define the substitute value and the substitute-value mode for each individual analog output channel of a XI/ON station. The substitute value is used in the event of a communication error or other unrecoverable error.

These values are not saved by the analog output modules in the integrated memory. If the bus-master or the gateway is replaced, the values will have to be updated.

6443_{hex} Analog Output Error Mode

It defines for each digital output channel whether or not the output should take on a substitute value in the event of an error. The sub-indexes of 01…$8E_{hex}$ define the mode of the analog output channels 1 to 142.
The following applies:

00_{hex}The output maintains its value if an error occurs.

01_{hex}The output is assigned a substitute value if an error occurs.

The substitute values for the analog output channels are defined with the object Analog Output Error State Object (6444_{hex}).

Table 58: Object 6443_{hex} Description

Features	**Sub-index**	**Description / Value**
Name		Analog Output Error Mode
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned8
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	01_{hex}

6444_{hex} Analog Output Error State

The substitute value is defined for each analog output channel. The substitute values are only taken into account in the event of an error if a 01_{hex} was entered for the relevant output channel in object Analog Output Error Mode Object (6443_{hex}). The sub-indexes of 01…$8E_{hex}$ define the value for the analog output channels 1 to 142.

Table 59: Object 6444_{hex} Description

Features	Sub-index	Description / Value
Name		Analog Output Error State
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Integer32
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	00_{hex}

→ The appropriate numerical values and number ranges for each input variable (current, voltage, temperature…) are given from Page 176.
The 12-bit representation is not available.

Objects for parameterisation

5420_{hex} Manu Spec Analog Input Range

The object Manu Spec Analogue Input Range defines the parameters of the analog input channels. Write accesses initiate a parameter update on the XI/ON module bus.

The parameter is stored retentively in the gateway and in the appropriate module, and is restored with every node reset.

The sub-indexes 01…$8E_{hex}$ define the parameters for the analog input channel 1 to 142.

Table 60: Object 5420_{hex} Description

Features	Sub-index	Description / Value
Name		Manu Spec Analogue Input Range
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned16
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	No

1) The default values are defined for every single parameter. This information is provided under → "Meaning of the parameter data" Page 246.

The structure of the 2 bytes of parameter data depends on the module concerned. A sub-index is assigned for each channel. The following explains the structure for each module type:

XN-1AI-I(0/4…20MA)

Table 61: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	Diagnostic[2)]	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

→ "Meaning of the parameter data" Page 246

XN-2AI-I(0/4…20MA)

Table 62: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	Diagnostic[2)]	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

Table 63: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K2	Diagnostic[2)]	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

→ “Meaning of the parameter data” Page 246

XN-1AI-U(-10/0...+10VDC)

Table 64: Structure of the data byte (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	Diagnostic[2)]	Value representation[1)]	Voltage mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

→ “Meaning of the parameter data” Page 246

XN-2AI-U(-10/0…+10VDC)

Table 65: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	Diagnostic[2)]	Value representation[1)]	Voltage mode
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

Table 66: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K2	Diagnostic[2)]	Value representation[1)]	Voltage mode
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

→ "Meaning of the parameter data" Page 246

XN-2AI-PT/NI-2/3

Table 67: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Element K1				Channel K1	Diagnostic K1[2)]	Value representation K1[1)]	Mains suppression K1
Byte 1	X	X	X	X	X	X	X	Meas. mode K1

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

X = reserved

Table 68: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Element K2				Channel K2	Diagnostic K2[2)]	Value representation K2[1)]	Mains suppression K2
Byte 1	X	X	X	X	X	X	X	Meas. mode K2

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

X = reserved

→ “Meaning of the parameter data” Page 246

XN-2AI-THERMO-PI

Table 69: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Element K1				Channel K1	Diagnostic K1 2)	Value representation K1 1)	Mains suppression K1
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

Table 70: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	Element K2				Channel K2	Diagnostic K2 2)	Value representation K2 1)	Mains suppression K2
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

→ "Meaning of the parameter data" Page 246

XN-4AI-U/I

Table 71: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	Operating mode	Channel K1	Diagnostic[2)]	Value representation[1)]	Range
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

Table 72: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	Operating mode	Channel K2	Diagnostic[2)]	Value representation[1)]	Range
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

Table 73: Structure of the data bytes (parameters) for the third channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	Operating mode	Channel K3	Diagnostic[2)]	Value representation[1)]	Range
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

X = reserved

Table 74: Structure of the data bytes (parameters) for the fourth channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	Operating mode	Channel K4	Diagnostic[2)]	Value representation[1)]	Range
Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

X = reserved

→ “Meaning of the parameter data” Page 246

XNE-8AI-U/I-4PT/NI

Table 75: Structure of the data bytes (parameters) for the first channel

		B7	B6	B5	B4	B3	B2	B1	B0
Channel n	Byte 0	Diagnostic Kx[2)]	Value representation Kx[1)]	Operating mode Kx					
	Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → “Emergencies” Page 290

X = reserved

→ “Meaning of the parameter data” Page 246

5440_{hex} Manu Spec Analog Output Range

The object Manu Spec Analogue Output Range defines the parameters of the analog output channels. Write accesses initiate a parameter update on the XI/ON module bus.

The parameter is stored retentively in the gateway and in the appropriate module, and is restored with every node reset.

The sub-indexes 01…$8E_{hex}$ define the parameters for the analog input channel 1 to 142.

Table 76: Object 5440_{hex} Description

Features	Sub-index	Description / Value
Name		Manu Spec Analogue Output Range
Object Code		ARRAY
PDO Mapping		No
Data Type	Sub-index 00_{hex}	Unsigned8
	Sub-index 01…$8E_{hex}$	Unsigned16
Access	Sub-index 00_{hex}	ro
	Sub-index 01…$8E_{hex}$	rw
XI/ON default value	Sub-index 00_{hex}	No
	Sub-index 01…$8E_{hex}$	No

The structure of the 2 bytes of parameter data depends on the module concerned. A sub-index is assigned for each channel. The following explains the structure for each module type:

XN-1AO-I(0/4…20MA)

Table 77: Structure of the data bytes (parameters)

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.

→ “Meaning of the parameter data” Page 246

XN-2AO-I(0/4…20MA)

Table 78: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K1	X	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.

Table 79: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	Channel K2	X	Value representation[1)]	Current mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.

→ “Meaning of the parameter data” Page 246

XN-2AO-U(-10/0…+10VDC)

Table 80: Structure of the data bytes (parameters) for the first channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	Value representation[1)]	Voltage mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.

Table 81: Structure of the data bytes (parameters) for the second channel

	B7	B6	B5	B4	B3	B2	B1	B0
Byte 0	X	X	X	X	X	X	Value representation[1)]	Voltage mode
Byte 1	X	X	X	X	X	X	X	X

X = reserved

1) The 12-bit representation is not available for CANopen.

→ “Meaning of the parameter data” Page 246

XNE-4AO-U/I

Table 82: Structure of the data bytes (parameters) for the first channel

		B7	B6	B5	B4	B3	B2	B1	B0
Channel n	Byte 0	X	X	Diagnostic Kx[2]	Value representation Kx[1]	Operating mode Kx			
	Byte 1	X	X	X	X	X	X	X	X

1) The 12-bit representation is not available for CANopen.
2) The diagnostics data is transmitted in the form of an Emergency telegram → "Emergencies" Page 290

X = reserved

→ "Meaning of the parameter data" Page 246

Object for the Device Profile and the I/O types

67FF$_{hex}$ Device Type DS401

The object 67FFh returns the type of the first device profile supported.

The object is assigned the value 000x0191$_{hex}$.

The Low word (0191$_{hex}$) specifies the Device Profile (to CiA DS-401: I/O modules).

The High word (000x$_{hex}$) specifies the I/O type(s) (see CiA DS-401).

Table 83: Object 67FF$_{hex}$ Description

Features	Sub-index	Description / Value
Name		Device Type DS401
Object Code		VAR
PDO Mapping		No
Data Type	Sub-index 00$_{hex}$	Unsigned32
Access	Sub-index 00$_{hex}$	ro
XI/ON default value	Sub-index 00$_{hex}$	No

Emergencies

The following CANopen Emergencies can be triggered by a XI/ON module of type analog output module:

Designation	Meaning	Byte 0/1 Error Code	Byte 2 Error Register	Byte 3 Additional information	Byte 4	Byte 5
XN-1AI-I(0/4…20MA); **XN-2AI-I(0/4…20MA)**						
Input current too high	The input current is outside of the permissible range[1].	2110_{hex}	Bit 1 = 1 (current error)	Module number	Channel number for the 2-channel modules	0
Input current too low	Open circuit or input current (for the measuring range 4…20 mA) too low. The threshold is 3 mA.	2130_{hex}	Bit 1 = 1 (current error)	Module number	Channel number for the 2-channel modules	0
XN-1AI-U(-10/0…+10VDC); **XN-2AI-U(-10/0…+10VDC)**						
AI U voltage out of range	The input voltage is outside of the permissible range[1].	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number for the 2-channel modules	0
XN-4AI-U/I						
Input current too high	The input current is outside of the permissible range[1].	2110_{hex}	Bit 1 = 1 (current error)	Module number	Channel number	0
Input current too low	Open circuit or input current (for the measuring range 4…20 mA) too low. The threshold is 3 mA.	2130_{hex}	Bit 1 = 1 (current error)	Module number	Channel number	0

Designa-tion	Meaning	Byte 0/1	Byte 2	Byte 3	Byte 4	Byte 5
		Error Code	Error Register	Additional information		
AI U voltage out of range	The input voltage is outside of the permissible range[1)].	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number	0
XN-2AI-PT/NI-2/3						
Output current too high	Current too high (threshold: approx. 5 Ω; only with temperature measuring ranges)	2310_{hex}	Bit 1 = 1 (current error)	Module number	Channel number	0
Output current out of range	The current is outside of the permissible range[1)].	2323_{hex}	Bit 1 = 1 (current error)	Module number	Channel number	0
Load dumps at outputs	Open circuit or current too low (threshold: positive converter limit value)	2330_{hex}	Bit 1 = 1 (current error)	Module number	Channel number	0
XN-2AI-THERMO-PI						
AI U voltage out of range	Open circuit or input voltage is outside of the permissible range.	3003_{hex}	Bit 2 = 1 (voltage error)	Module number	Channel number	0
XNE-8AI-U/I-4PT/NI; XNE-4AO-U/I						
Additional modules	Byte 5 contains the channel diagnostic byte. For furture information, → „Diagnostic messages“ page 140 and → „Diagnostic messages“ page 217.	7000_{hex}	Bit 7 = 1 (manu-facturer-specific error)	Module number	Channel number	Channel diag-nostic

1) The threshold for this error message is 1 % over the upper measuring range value or 1 % below the lower measuring range value.
Refer to the sections “Diagnostic messages” of the corresponding module type for information on the diagnostic options for each module type .

Bytes 6 and 7 of the Emergency Frame are not used, and therefore always 0.

6 Integration in DeviceNet

Analog Input Voltage Module Class (VSC106)

This class contains all the information and parameters of the analog input modules (voltage).

Table 84: Class Instance

Attribute No. dec.	hex	Attribute Name	Access	Type	Description
100	64_{hex}	CLASS REVISION	G	UINT	Contains the revision number for this class (Maj.-Rel. × 1000 + Min.-Rel.).
101	65_{hex}	MAX INSTANCE	G	USINT	Contains the number of the highest instance of an object created at this level in the class hierarchy.
102	66_{hex}	# OF INSTANCES	G	USINT	Contains the number of object instances created at this class level.
103	67_{hex}	MAX CLASS ATTR	G	USINT	Contains the number of the last class attribute that was implemented.

Table 85: Object Instances

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
100 (64_{hex})	MAX OBJECT ATTR	G	USINT	Contains the number of the last object attribute that was implemented.
101 (65_{hex})	MODULE PRESENT	G	BOOL	FALSE: XI/ON module is not inserted, vacant base module TRUE: XI/ON module is inserted
102 (66_{hex})	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module belonging to the module concerned (base module directly to the right of the gateway, = No. 1) corresponds to the instance number within the TERMINAL SLOT CLASS.
103 (67_{hex})	MODULE ID	G	DWORD	Contains the module ID.
104 (68_{hex})	MODULE ORDER NUMBER	G	UDINT	Contains the order number for the module, e.g. 225000.
105 (69_{hex})	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-1AI-U(-10/0..+10VDC).
106 ($6A_{hex}$)	MODULE REVISION	G	USINT	Contains the revision number of the module firmware.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
107 ($6B_{hex}$)	MODULE TYPE ID	G	ENUM USINT	Provides information on the module type: 0 (00_{hex}) unknown module type 1 (01_{hex}) digital I/O module 17 (11_{hex}) analog module I/O voltage 18 (12_{hex}) analog module I/O current (current/voltage) 19 (13_{hex}) analog module PT temperature 20 (14_{hex}) analog module thermo temperature 33 (21_{hex}) 16-bit counter module 34 (22_{hex}) 32-bit counter module 40 (28_{hex}) SSI module 49 (31_{hex}) Motor starter module as DOL or reversing starter 50 (32_{hex}) electronic motor starter 65 (41_{hex}) RS232 module 66 (42_{hex}) RS485/422 module 67 (43_{hex}) TTY module
108 ($6C_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Control interface of the XI/ON module. ARRAY OF: BYTE: control byte sequence
109 ($6D_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Message interface for the XI/ON module. ARRAY OF: BYTE: message byte sequence
110 ($6E_{hex}$)	MODULE REGISTERED INDEX	G	ENUM USINT	Contains the index number found in all module lists.
111 ($6F_{hex}$)	NUMBER OF SUPPORTED CHANNELS	G	USINT	Indicates the number of analog input channels supported by this module instance.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	PRODUCED DATA	G	INT	Contains the data of channels 1…8 transmitted from the analog input module. The calculation of the measured values for the numerical value of the analog voltage inputs has already been described fully: **16-bit representation** → "Representation of the voltage values in the range 0 V DC…10 V DC" Page 56 → "Representation of the voltage values in the range -10 V DC…10 V DC" Page 58 **12-bit representation:** → "Representation of the voltage values in the range 0 V DC…10 V DC" Page 78 → "Representation of the voltage values in the range -10 V DC…10 V DC" Page 80 The diagnostics data is integrated in the input data with 12-bit (left-justified) representation. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
120…127 (78…7F$_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data for channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit0: 0 = ok, 1 = Measurement value range error Bit1…7: reserved
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data for channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Voltage mode: 0 = 0…10 V 1 = -10…+10 V Bit1: Value representation: 0 = Integer (15bit + sign) 1 = 12bit (left-justified) → “Representation of the analog values” Page 38 Bit2:Diagnostic: 0 = release 1 = block Bit3…7: reserved

Analog Output Voltage Module Class (VSC107)

This class contains all the information and parameters of the analog output modules (voltage).

Table 86: Class Instance

Attribute No. dec.	hex.	Attribute Name	Access	Type	Description
100	64_{hex}	CLASS REVISION	G	UINT	Contains the revision number for this class (Maj.-Rel. × 1000 + Min.-Rel.).
101	65_{hex}	MAX INSTANCE	G	USINT	Contains the number of the highest instance of an object created at this level in the class hierarchy.
102	66_{hex}	# OF INSTANCES	G	USINT	Contains the number of object instances created at this class level.
103	67_{hex}	MAX CLASS ATTR	G	USINT	Contains the number of the last class attribute that was implemented.

Table 87: Object Instances

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
100 (64_{hex})	MAX OBJECT ATTR	G	USINT	Contains the number of the last object attribute that was implemented.
101 (65_{hex})	MODULE PRESENT	G	BOOL	FALSE: XI/ON module is not inserted, vacant base module TRUE: XI/ON module is inserted
102 (66_{hex})	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module belonging to the module concerned (base module directly to the right of the gateway = No. 1). Corresponds to the particular instance number within the TERMINAL SLOT CLASS.
103 (67_{hex})	MODULE ID	G	DWORD	Contains the module ID.
104 (68_{hex})	MODULE ORDER NUMBER	G	UDINT	Contains the order number for the module, e.g. 225000.
105 (69_{hex})	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-2AO-U(-10/0..+10VDC).
106 ($6A_{hex}$)	MODULE REVISION	G	USINT	Contains the revision number of the module firmware.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
107 ($6B_{hex}$)	MODULE TYPE ID	G	ENUM USINT	Provides information on the module type: 0 (00_{hex}) unknown module type 1 (01_{hex}) digital I/O module 17 (11_{hex}) analog module I/O voltage 18 (12_{hex}) analog module I/O current (current/voltage) 19 (13_{hex}) analog module PT temperature 20 (14_{hex}) analog module thermo temperature 33 (21_{hex}) 16-bit counter module 34 (22_{hex}) 32-bit counter module 40 (28_{hex}) SSI module 49 (31_{hex}) Motor starter module as DOL or reversing starter 50 (32_{hex}) electronic motor starter 65 (41_{hex}) RS232 module 66 (42_{hex}) RS485/422 module 67 (43_{hex}) TTY module
108 ($6C_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Control interface of the XI/ON module. ARRAY OF: BYTE: control byte sequence
109 ($6D_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Message interface for the XI/ON module. ARRAY OF: BYTE: message byte sequence
110 ($6E_{hex}$)	MODULE REGISTERED INDEX	G	ENUM USINT	Contains the index number found in all module lists.
111 ($6F_{hex}$)	NUMBER OF SUPPORTED CHANNELS	G	USINT	Indicates the number of analog output channels supported by this module instance.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	CONSUMED DATA	G/S	INT	Contains the data for the analog output channels no. 1…8. The calculation of the numerical values for the voltage values has already been described fully: **16-bit representation** → "Representation of the voltage values in the range 0…10 V DC" Page 180 → "Representation of the voltage values in the range -10 V DC…10 V DC" Page 182 **12-bit representation:** → "Representation of the voltage values in the range 0…10 V DC" Page 191 → "Representation of the voltage values in the range -10 V DC…10 V DC" Page 193 Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHAN-NELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.
120…127 (78…7F$_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data of channel 1…8 of the analog output module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHAN-NELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit 0…7: reserved

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data of channel 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Voltage mode: 0 = 0…10 V 1 = -10…+10 V Bit1: Value representation: 0 = Integer (15bit + sign) 1 = 12bit (left-justified) Bit2…7: reserved
136…143 (88…8F$_{hex}$)	FAULT VALUE PARAMETER DATA	G/S	INT	Contains the fault value definition of channels 1 to 8 of the analog output module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 136 contains the data for channel 1, attribute 143 for channel 8.

Analog Input Current Module Class (VSC108)

This class contains all the information and parameters of the analog input modules (current).

Class Instance

The class instance attributes of the analog input modules (current) are the same as those of the analog input modules (voltage).

Object Instances

The instances/attribute objects of the analog input modules (current) are the same as those of the analog input modules (voltage). Only the attributes concerning the measuring ranges of the module (current and voltage measurement) are different.

Table 88: Object Instances

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	PRODUCED DATA	G	INT	Contains the data of channels 1 to 8 transmitted from the analog input module. The calculation of the measured values for the numerical value of the analog current inputs has already been described fully: **16-bit representation** → "Representation of current values in the range 0 mA…20 mA" Page 40 → "Representation of current values in the range 4 mA…20 mA" Page 42 **12-bit representation** → "Representation of the current values in the range 0…20 mA" Page 62 → "Representation of the current values in the range 4…20 mA" Page 64 The diagnostics data is integrated in the input data with 12-bit (left-justified) representation. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
120…127 (78…7F$_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data of channels 1 to 8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit0: 0 = ok 1 = Measurement value range error Bit1: 0 = ok 1 = Open circuit; Only with measuring range: 4…20 mA Bit2…7: reserved

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Current mode: 0 = 0…20 mA 1 = 4…20 mA Bit1: Value representation: 0 = Integer (15bit + sign) 1 = 12bit (left-justified) Bit2: Diagnostic: 0 = release 1 = block Bit 3…7: reserved

Analog Output Current Module Class (VSC109)

This class contains all the information and parameters of the analog output modules (current).

Class Instance

The class instance attributes of the analog output modules (current) are the same as those of the analog output modules (voltage).

Object Instances

The instance/attribute object of the analog output modules (current) is the same as those of the analog output modules (voltage). Only the attributes to do with the measuring ranges of the module (current and voltage measurement) are different.

Table 89: Object Instances

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	CONSUMED DATA	G/S	INT	Contains the data for the analog output channels 1…8. The calculation of the numerical values for the current values has already been described fully: **16-bit representation** → "Representation of the current values in the range 0…20 mA" Page 176 → "Representation of the current values in the range 4…20 mA" Page 178 **12-bit representation** → "Representation of the current values in the range 0…20 mA" Page 187 → "Representation of the current values in the range 4 mA…20 mA" Page 189 Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.
120…127 (78…7F$_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data of channels 1…8 of the analog output module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit0…7:reserved

Attr. no. dec. (hex.)	Attribute Name	Access	Type	Description
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Current mode 0 = 0…20 mA 1 = 4…20 mA Bit1: Value representation 0 = Integer (15bit + sign) 1 = 12bit (left-justified) Bit2…7: reserved
112…119 (70…77$_{hex}$)	FAULT VALUE PARAMETER DATA	G/S	INT	Contains the fault value definition of channels 1…8 of the analog output module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 136 contains the data for channel 1, attribute 143 for channel 8.

Analog Input PT100/NI Module Class (VSC110)

This class contains all the information and parameters of the analog input modules for PT100/NI sensors.

Class Instance

The class instance attributes of the analog input modules are the same as those of the analog input modules (voltage).

Table 90: Object Instances

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
100 (64_{hex})	MAX OBJECT ATTR	G	USINT	Contains the number of the last object attribute that was implemented.
101 (65_{hex})	MODULE PRESENT	G	BOOL	FALSE: XI/ON module is not inserted, vacant base module TRUE: XI/ON module is inserted
102 (66_{hex})	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module belonging to the module concerned (base module directly to the right of the gateway = No. 1). Corresponds to the particular instance number within the TERMINAL SLOT CLASS.
103 (67_{hex})	MODULE ID	G	DWORD	Contains the module ID.
104 (68_{hex})	MODULE ORDER NUMBER	G	UDINT	Contains the order number for the module, e.g. 225000.
105 (69_{hex})	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-2AI-PT/NI-2/3.
106 ($6A_{hex}$)	MODULE REVISION	G	USINT	Contains the revision number of the module firmware.
107 ($6B_{hex}$)	MODULE TYPE ID	G	ENUM USINT	Describes the module type (digital, analog, counter …).

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
108 ($6C_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Control interface of the XI/ON module. ARRAY OF: BYTE: control byte sequence
109 ($6D_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Message interface for the XI/ON module. ARRAY OF: BYTE: message byte sequence
110 ($6E_{hex}$)	MODULE REGISTERED INDEX	G	ENUM USINT	Contains the index number found in all module lists.
111 ($6F_{hex}$)	NUMBER OF SUPPORTED CHANNELS	G	USINT	Indicates the number of analog input channels supported by this module instance.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	PRODUCED DATA	G	INT	Contains the data of channels 1…8 transmitted from the analog input module. The calculation of the measured values for the numerical value of the analog PT100/NI sensor inputs has already been described fully: **16-bit representation** → "Representation of temperature values and resistance values for the XN-2AI-PT/NI-2/3" Page 44 **12-bit representation** → "Representation of temperature values and resistance values for the XN-2AI-PT/NI-2/3" Page 66 The diagnostics data is integrated in the input data with 12-bit (left-justified) representation. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
120…127 (78…$7F_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit0: 0 = ok 1 = Measurement value range error Bit1: 0 = ok 1 = open circuit Bit2: 0 = ok 1 = short-circuit

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Mains suppression 0 = 50 Hz (50 Hz mains suppression) 1 = 60 Hz (60 Hz mains suppression) Bit1: Value representation: 0 = Integer (15bit + sign) 1 = 12bit (left-justified) Bit2: Diagnostic: 0 = release 1 = block Bit 3: Channel: 0 = activate channel 1 = deactivate channel Bit 4: Measuring mode: 0 = 2-wire 1 = 3-wire Bit 5…7: reserved

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
136…143 ($88…8F_{hex}$)	SENSOR PARAMETER DATA	G/S	ENUM USINT	Contains the sensor parameter data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 136 contains the data for channel 1, attribute 143 for channel 8. ENUM USINT: Element: 0: PT100, -200..850 °C 1: PT100, -200..150 °C 2: NI100, -60..250 °C 3: NI100, -60..150 °C 4: PT200, -200..850 °C 5: PT200, -200..150 °C 6: PT500, -200..850 °C 7: PT500, -200..150 °C 8: PT1000, -200..850 °C 9: PT1000, -200..150 °C 10: NI1000, -60..250 °C 11: NI1000, -60..150 °C 12: resistance: 0..100 Ω) 13: resistance: 0..200 Ω 14: resistance: 0..400 Ω 15: resistance: 0..1000 Ω 16…255: reserved

Analog Input THERMO Module Class (VSC111)

This class contains all the information and parameters of the analog input modules for thermocouples.

Class Instance

The class instance attributes of the analog input modules are the same as those of the analog input modules (voltage).

Table 91: Object Instances

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
100 (64_{hex})	MAX OBJECT ATTR	G	USINT	Contains the number of the last object attribute that was implemented.
101 (65_{hex})	MODULE PRESENT	G	BOOL	FALSE: XI/ON module is not inserted, vacant base module TRUE: XI/ON module is plugged in
102 (66_{hex})	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module belonging to the module concerned (base module directly to the right of the gateway = No. 1). Corresponds to the particular instance number within the TERMINAL SLOT CLASS.
103 (67_{hex})	MODULE ID	G	DWORD	Contains the module ID.
104 (68_{hex})	MODULE ORDER NUMBER	G	UDINT	Contains the order number for the module, e.g. 225000.
105 (69_{hex})	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-2AI-THERMO-PI.
106 ($6A_{hex}$)	MODULE REVISION	G	USINT	Contains the revision number of the module firmware.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
107 (6B$_{hex}$)	TYPE ID	G	ENUM USINT	Provides information on the module type: 0 (00$_{hex}$) unknown module type 1 (01$_{hex}$) digital I/O module 17 (11$_{hex}$) analog module I/O voltage 18 (12$_{hex}$) analog module I/O current (current/voltage) 19 (13$_{hex}$) analog module PT temperature 20 (14$_{hex}$) analog module thermo temperature 33 (21$_{hex}$) 16-bit counter module 34 (22$_{hex}$) 32-bit counter module 40 (28$_{hex}$) SSI module 49 (31$_{hex}$) Motor starter module as DOL or reversing starter 50 (32$_{hex}$) electronic motor starter 65 (41$_{hex}$) RS232 module 66 (42$_{hex}$) RS485/422 module 67 (43$_{hex}$) TTY module
108 (6C$_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Control interface of the XI/ON module. ARRAY OF: BYTE: control byte sequence
109 (6D$_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Message interface for the XI/ON module. ARRAY OF: BYTE: message byte sequence
110 (6E$_{hex}$)	MODULE REGISTERED INDEX	G	ENUM USINT	Contains the index number found in all module lists.
111 (6F$_{hex}$)	NUMBER OF SUPPORTED CHANNELS	G	USINT	Indicates the number of analog input channels supported by this module instance.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
112…119 (70…77$_{hex}$)	PRODUCED DATA	G	INT	Contains the data of channels 1…8 transmitted from the analog input module. The calculation of the measured values for the numerical value of the analog inputs of the XN-2AI-THERMO-PI has already been described fully: **16-bit representation** → "Representation of temperature and voltage values for the XN-2AI-THERMO-PI" Page 50 **12-bit representation** → "Representation of temperature and voltage values for the XN-2AI-THERMO-PI" Page 72 The diagnostics data is integrated in the input data with 12-bit (left-justified) representation. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 112 contains the data for channel 1, attribute 119 for channel 8.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
120…127 (78…7F$_{hex}$)	DIAG DATA	G	BYTE	Contains the diagnostics data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHAN-NELS. Attribute 120 contains the data for channel 1, attribute 127 for channel 8. BYTE diag: Bit0: 0 = ok 1 = Measurement value range error Bit1: 0 = ok 1 = open circuit

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
128…135 (80…87$_{hex}$)	MODE PARAMETER DATA	G/S	BYTE	Contains the parameter data for channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 128 contains the data for channel 1, attribute 135 for channel 8. BYTE mode: Bit0: Mains suppression: 0 = 50 Hz (50 Hz mains suppression) 1 = 60 Hz (60 Hz mains suppression) Bit1: Value representation: 0 = Integer (15bit + sign) 1 = 12bit (left-justified) Bit2: Diagnostic: 0 = release 1 = block Bit 3: Channel: 0 = activate channel 1 = deactivate channel Bit 4…7: reserved

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
136…143 (88…8F$_{hex}$)	SENSOR PARAMETER DATA	G/S	ENUM USINT	Contains the sensor parameter data of channels 1…8 of the analog input module. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 136 contains the data for channel 1, attribute 143 for channel 8. ENUM USINT Element: 0: Type K -270…1370 °C 1: Type B 100…1820 °C 2: Type E -270…1000 °C 3: Type J -210…1200 °C 4: Type N -270…1300 °C 5: Type R -50…1760 °C 6: Type S -50…1540 °C 7: Type T -270…400 °C 8: +/-50 mV 9: +/-100 mV 10: +/-500 mV 11: +/-1000 mV 12…255: reserved

Analog VERSATILE Module Class (VSC118)

This class contains all the information and parameters of analog modules with inputs and outputs. The inputs can be set for both current and voltage measurement. The outputs can be set as a current output and voltage output.

The XN-4AI-U/I is currently being commissioned with this class.

Class Instance

The class instance attributes of the analog input modules are the same as those of the analog input modules (voltage).

Table 92: Object Instances

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
100 (64$_{hex}$)	MAX OBJECT ATTR	G	USINT	Contains the number of the last object attribute that was implemented.
101 (65$_{hex}$)	MODULE PRESENT	G	BOOL	FALSE: XI/ON module is not inserted, vacant base module TRUE: XI/ON module is inserted
102 (66$_{hex}$)	TERMINAL SLOT NUMBER	G	USINT	The slot number of the base module belonging to the module concerned (base module directly to the right of the gateway = No. 1). Corresponds to the particular instance number within the TERMINAL SLOT CLASS.
103 (67$_{hex}$)	MODULE ID	G	DWORD	Contains the module ID.
104 (68$_{hex}$)	MODULE ORDER NUMBER	G	UDINT	Contains the order number for the module, e.g. 225000.
105 (69$_{hex}$)	MODULE ORDER NAME	G	SHORT_ STRING	Contains the module name, e.g. XN-2AO-U(-10/0..+10VDC).
106 (6A$_{hex}$)	MODULE REVISION	G	USINT	Contains the revision number of the module firmware.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
107 ($6B_{hex}$)	MODULE TYPE ID	G	ENUM USINT	Provides information on the module type: 0 (00_{hex}) unknown module type 1 (01_{hex}) digital I/O module 17 (11_{hex}) analog module I/O voltage 18 (12_{hex}) analog module I/O current (current/voltage) 19 (13_{hex}) analog module PT temperature 20 (14_{hex}) analog module thermo temperature 33 (21_{hex}) 16-bit counter module 34 (22_{hex}) 32-bit counter module 40 (28_{hex}) SSI module 49 (31_{hex}) Motor starter module as DOL or reversing starter 50 (32_{hex}) electronic motor starter 65 (41_{hex}) RS232 module 66 (42_{hex}) RS485/422 module 67 (43_{hex}) TTY module
108 ($6C_{hex}$)	MODULE COMMAND INTERFACE	G/S	ARRAY	Control interface of the XI/ON module. ARRAY OF: BYTE: control byte sequence
109 ($6D_{hex}$)	MODULE RESPONSE INTERFACE	G	ARRAY	Message interface for the XI/ON module. ARRAY OF: BYTE: message byte sequence
110 ($6E_{hex}$)	MODULE REGISTERED INDEX	G	ENUM USINT	Contains the index number found in all module lists.
111 ($6F_{hex}$)	INPUT CHANNEL COUNT	G	USINT	Indicates the number of analog input channels supported by this module instance.
112 (70_{hex})	OUTPUT CHANNEL COUNT	G	USINT	Indicates the number of analog output channels supported by this module instance.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
113…128 ($71…80_{hex}$)	INPUT UINT CHANNEL 1 to INPUT UINT CHANNEL 16	G/S	UINT	Contains the data of channel nos. 1 to 16 received by the analog input module. The calculation of the measured values for the numerical value of the analog voltage inputs and analog current inputs has already been described fully: **16-bit representation** → “Representation of the voltage values in the range 0 V DC…10 V DC” Page 56 → “Representation of the voltage values in the range -10 V DC…10 V DC” Page 58 → “Representation of current values in the range 0 mA…20 mA” Page 40 → “Representation of current values in the range 4 mA…20 mA” Page 42 **12-bit representation** (see next page)

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
				12-bit representation → “Representation of the voltage values in the range 0 V DC…10 V DC” Page 78 → “Representation of the voltage values in the range -10 V DC…10 V DC” Page 80 → “Representation of the current values in the range 0…20 mA” Page 62 → “Representation of the current values in the range 4…20 mA” Page 64 The diagnostics data is integrated in the input data with 12-bit (left-justified) representation. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 129 contains the data for channel 1, 144 for channel 16.
129…144 (81…90_{hex})	OUTPUT UINT CHANNEL 1 to OUTPUT UINT CHANNEL 16	G/S	UINT	Contains the data for the analog output channels no. 1…no. 16. Only those channels are supported that are defined in attribute 111, NUMBER OF SUPPORTED CHANNELS. Attribute 113 contains the data for channel 1, attribute 118 for channel 16.

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
145 (91_{hex})	RANGE ERROR	G	WORD	Maps the diagnostics data for "measurement value range error" of channels 1 to 16 of the analog input module to bits 0 to 15 of the WORD data type. The diagnostics are generated for an overcurrent or undercurrent of 1% the set current range. The undercurrent can only be detected on modules with a set current range of 4…20 mA. Overcurrent: max (I > 20.2 mA) Undercurrent: min (I < 3.8 mA) Diagnostic of an overvoltage or undervoltage of 1% of the set voltage range. Overvoltage: Umax (U > 10.1 V DC); Undervoltage: Umin (U < -10.1 V DC) for -10…+10 V DC Umin (U < -0.1 V DC) for 0…10 V DC Only those channels are supported that are defined in attributes 111 and 112, NUMBER OF SUPPORTED CHANNELS.
146 (92_{hex})	OPEN CIRCUIT ERROR	G	WORD	Maps the diagnostics data for "open circuit" of channels 1 to 16 of the analog input module to bits 0 to 15 of the WORD data type. The indication of an open circuit of the connection cable for operating mode "4…20 mA".

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
147 (93_{hex})	SHORT CIRCUIT ERROR	G	WORD	Maps the diagnostics data for "short-circuit" of channels 1 to 16 of the analog input module to bits 0 to 15 of the WORD data type. The XN-4AI-U/I does not generate this diagnostic type.
148 (94_{hex})	reserved			
149…164 ($94…A4_{hex}$)	PARAM FAULT VALUE UINT CHANNEL 1 to PARAM FAULT VALUE UINT CHANNEL 16	G/S	UINT	Defines the substitute values for the analog output channels 1…16 of a station. The substitute value is used in the event of a communication error or other unrecoverable error. Analog input channels do not use this attribute.
165…180 ($A5…B4_{hex}$)	PARAM OPERATING MODE CHANNEL 1 to PARAM OPERATING MODE CHANNEL 16	G/S	ENUM USINT	Each attribute of this group defines a parameter for a channel. Up to 16 channels can be parameterised. The rule is: 0: The channel is deactivated. 1: The channel is parameterised for the measuring range -10 V DC…10 V DC. 2: The channel is parameterised for the measuring range 0 V DC…10 V DC. 3: The channel is parameterised for the measuring range 0 mA…20 mA. 4: The channel is parameterised for the measuring range 4 mA…20 mA. 5…255: reserved

Attr. no. dec. (hex)	Attribute Name	Access	Type	Description
181…196 (B5… C4$_{hex}$)	PARAM DATA REPRESENTA-TION MODE CHANNEL 1 to PARAM DATA REPRESENTA-TION MODE CHANNEL 16	G/S	ENUM USINT	Each attribute of this group defines a parameter for a channel. Up to 16 channels can be parameterised. The rule is: 0: The default value is used for the representation of the channel values. 1: The channel values are represented with 16 bits in two's complement notation. 2: The channel values are represented with 12 bits. If the parameterised range of values also includes negative values, all values are represented in two's complement notation. If only positive values are set as permissible values, these are represented as uncoded binary values.
197 (C5$_{hex}$)	PARAM BLOCK DIAG-NOSTICS	G/S	WORD	Each bit of this WORD data type allows the individual activation/deactivation of diagnostics for each channel. Up to 16 channels can be parameterised: The messages are always available if the diagnostic message is integrated with the 12-bit representation in the process input data. 0: Diagnostic signalling is activated (default) 1:Diagnostic signalling is deactivated.

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