X20AI2237

Data sheet
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Translation of the original documentation

Publishing information

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Disclaimer

1 General information

1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual

1.2 Order data

Order number	Short description	Figure
	Analog input modules	
X20AI2237	X20 analog input module, 2 inputs, ±10 V, 16-bit converter resolution, single-channel galvanically isolated and with own sensor power supply, NetTime function	
	Required accessories	
	Bus modules	
X20BM11	X20 bus module, 24 VDC keyed, internal I/O power supply connected through	
X20BM15	X20 bus module, with node number switch, 24 VDC keyed, internal I/O power supply connected through	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20AI2237 - Order data

1.3 Module description

The module is equipped with 2 voltage measurement inputs with 16-bit digital converter resolution and a very fast sampling rate.

Each voltage measurement input is equipped with its own sensor power supply. The two channels with the associated sensor power supplies are galvanically isolated from each other.

Functions:

- Analog inputs
- Scaling
- Input filter
- Monitoring the input signal
- NetTime Technology

Scaling

The input value of the analog inputs of ±10 V is mapped in either ±32767 or ±10000 steps depending on the scaling.

Input filter

An input filter can be configured for each individual analog input.

Monitoring the input signal

The input signal is monitored against the upper and lower limit values as well as for open circuit. In addition to the status information, user-defined limit values can be defined as well as replacement values that are output if the limit values are overshot or undershot.

NetTime timestamp of the measurement

Not only is the measured value important for many applications, but also the exact time when the measurement takes place. The module is equipped with a NetTime timestamp function for this that supplies a timestamp for the recorded measurement with microsecond accuracy.

2 Technical description

2.1 Technical data

Order number	X20AI2237
Short description	
I/O module	2 analog inputs ±10 V
General information	
B&R ID code	0xC9C4
Status indicators	I/O function per channel, operating state, module status, sensor power supply per channel
Diagnostics	
Module run/error	Yes, using LED status indicator and software
Inputs	Yes, using LED status indicator and software
Sensor power supply	Yes, using LED status indicator and software
Power consumption	
Bus	0.05 W
Internal I/O	1.05 W (Rev. ≥D0), 1.15 W (Rev. <D0) [1]
Additional power dissipation caused by actuators (resistive) [W]	-
Certifications	
CE	Yes
UKCA	Yes
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X
UL	cULus E115267 Industrial control equipment
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5
Analog inputs	
Input	±10 V
Input type	Differential input
Digital converter resolution	±15-bit
Data output rate	10000 samples per second
Output format	
Data type	INT
Voltage	INT 0x8001 - 0x7FFF / 1 LSB = 0x0001 = 305.176 µV
Input impedance in signal range	20 MΩ
Input protection	Up to 30 VDC, reverse polarity protection
Open-circuit detection	Yes, using software
Permissible input signal	Max. ±30 V
Output of digital value during overload	Configurable
Conversion procedure	SAR
Input filter	Fourth-order low-pass filter / Cutoff frequency 10 kHz
Max. error	
Gain	0.013% [2]
Offset	0.0035% [3]
Max. gain drift	<0.0008%/°C [2]
Max. offset drift	<0.0025%/°C [3]
Common-mode rejection	
DC	84 dB
Up to 60 Hz	84 dB
Up to 10 kHz	82 dB
Common-mode range	±14 V
Nonlinearity	<0.003% [3]
Test voltage	
Channel - Channel	1000 VAC
Channel - Bus	1000 VAC
Channel - Ground	1000 VAC
Bus - Ground	800 VAC
Sensor power supply	
Power consumption	0.75 W per channel
Nominal voltage	25 V ±2%
Nominal output current	Max. 30 mA
Short-circuit proof	Yes, continuous

Table 2: X20AI2237 - Technical data

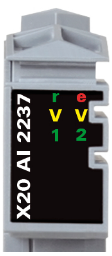
Order number	X20AI2237
Max. voltage ripple	
Up to 100 kHz	≤2.2 mV
Up to 1 MHz	≤22 mV
Higher	≤100 mV
Short-circuit current	
Typical	<50 mA
Maximum	60 mA
Behavior on short circuit	Current limiting
Electrical properties	
Electrical isolation	Channel isolated from channel and bus Sensor power supply isolated from sensor power supply Sensor power supply not isolated from channel
Operating conditions	
Mounting orientation	
Horizontal	Yes
Vertical	Yes
Installation elevation above sea level	
0 to 2000 m	No limitation
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
Degree of protection per EN 60529	IP20
Ambient conditions	
Temperature	
Operation	
Horizontal mounting orientation	-25 to 60°C
Vertical mounting orientation	-25 to 50°C
Derating	-
Storage	-40 to 85°C
Transport	-40 to 85°C
Relative humidity	
Operation	5 to 95%, non-condensing
Storage	5 to 95%, non-condensing
Transport	5 to 95%, non-condensing
Mechanical properties	
Note	Order 1x terminal block X20TB12 separately. Order 1x bus module X20BM11 separately.
Pitch	$12.5^{+0.2}$ mm

Table 2: X20AI2237 - Technical data

1) To reduce power dissipation, B&R recommends bridging unused inputs.
2) Based on the current measured value.
3) Based on the 20 V measurement range.

2.2 LED status indicators

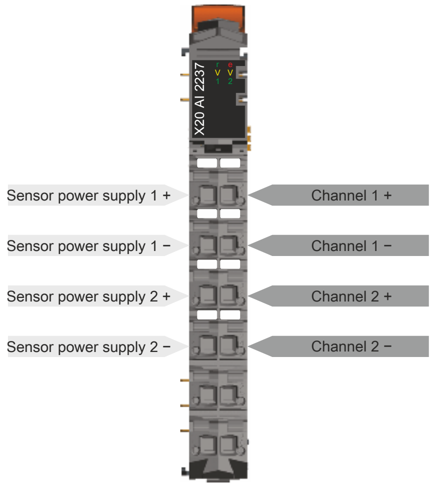
For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 system user's manual.

Figure	LED	Color	Status	Description
	**Operating state**			
	r	Green	Off	No power to module
			Single flash	UNLINK mode
			Double flash	BOOT mode (during firmware update)[1]
			Blinking quickly	SYNC mode
			Blinking slowly	PREOPERATIONAL mode
			On	RUN mode
	Module status			
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
	Sensor supply			
	V	Yellow	Off	Module supply not connected or overload
			On	Sensor supply in its normal operating range
	Analog input			
	1 - 2	Green	Off	Indicates one of the following cases: • No power to module • Channel disabled • Open line
			Single flash	Input signal overflow or underflow
			On	Analog/digital converter running, value OK

1) Depending on the configuration, a firmware update can take up to several minutes.

2.3 Pinout

Shielded twisted pair cables should be used to minimize coupling disturbances. Use either one cable for each channel or a multiple twisted pair cable for both channels.

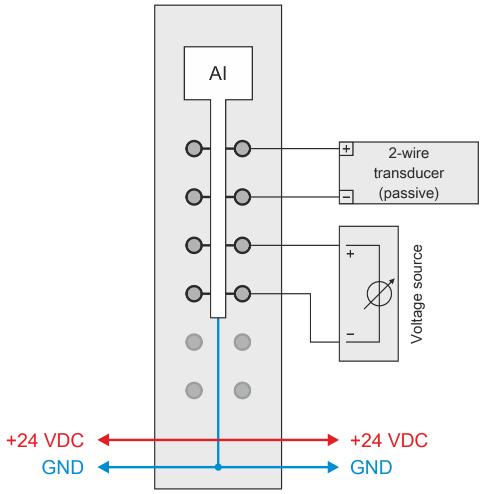


2.4 Connection examples

2-wire connections

A 2-wire connection can be implemented as follows:

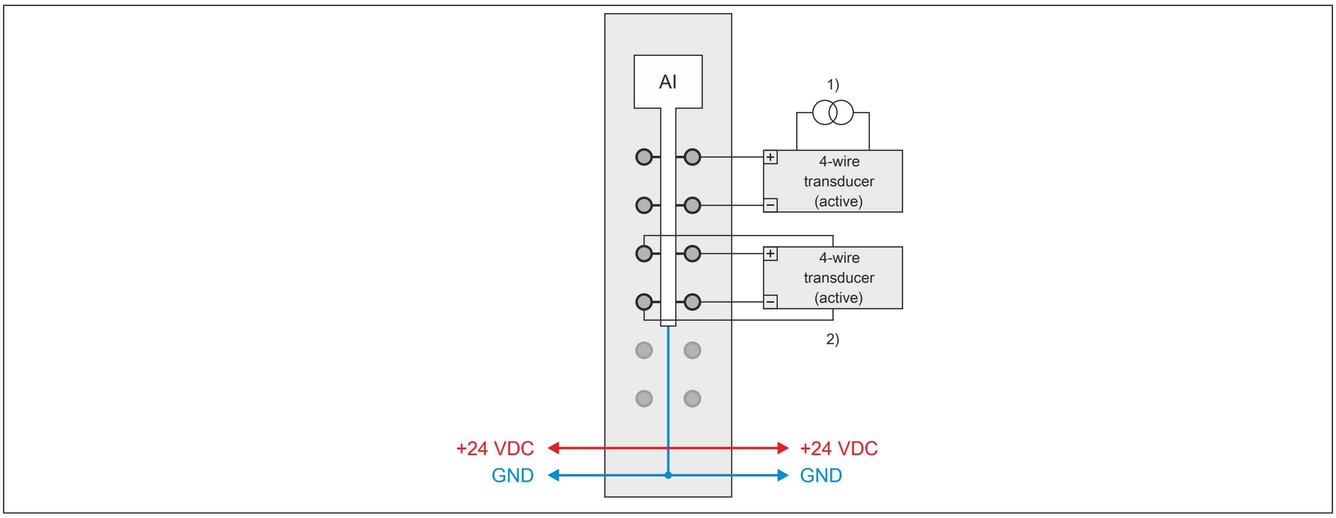
- 2-wire transducer
- Active voltage source



4-wire connections

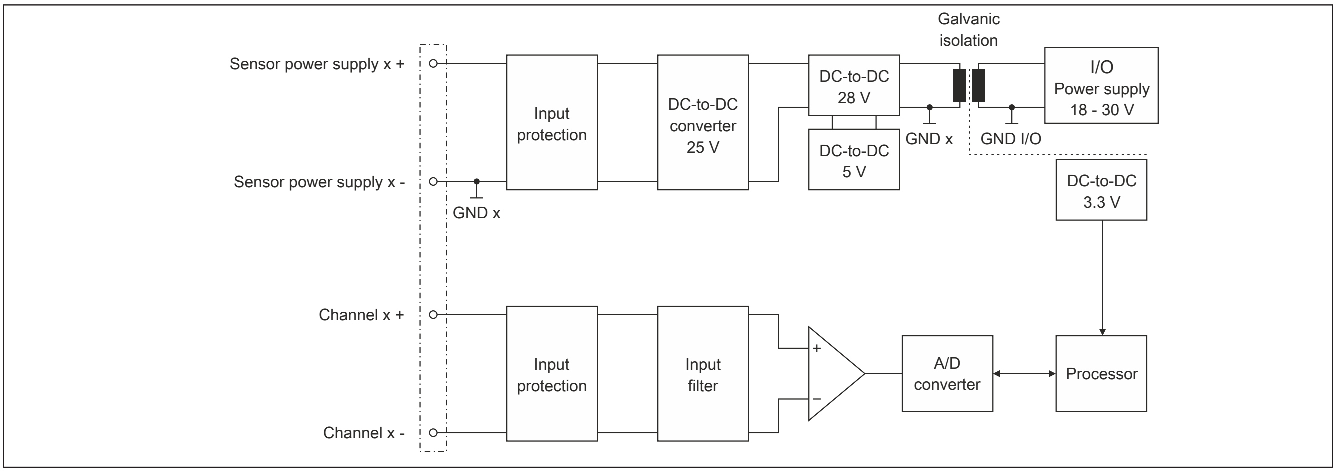
A 4-wire connection can be implemented as follows:

- 4-wire transducer with external supply
- 4-wire transducer supplied by the module



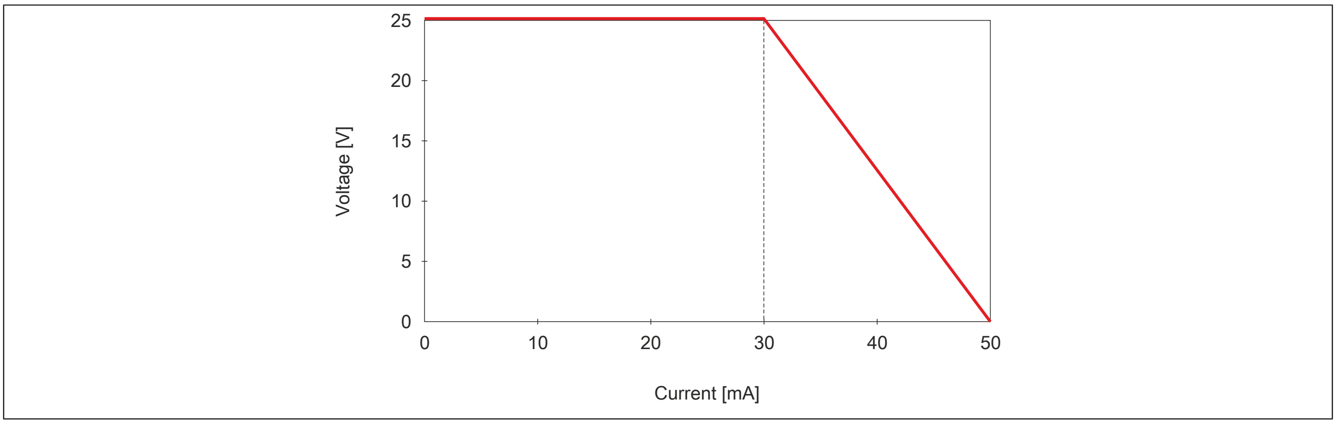
1) With external power supply.
2) With internal power supply. The internal power supply is only permitted to be loaded with max. 30 mA.

2.5 Input circuit diagram



2.6 Behavior in the event of short circuit

In the event of a short circuit, the output current for the sensor supply is limited according to the following diagram.



3 Function description

3.1 Analog inputs

The module provides the user with 2 galvanically isolated channels. An electrical voltage signal in the range ±10 V can be read per channel, and the signal transmitter can be supplied with 24 VDC.

The specification of the voltage applied can be retrieved via 2 different registers. The unassessed measured value contains the scaled transducer value. The assessed measured value also takes into account the limit value settings and configured replacement value strategy.

Each channel is enabled individually and configured and operated independently of the other. The user must first set the scaling of the input value and select a replacement value strategy. Depending on the application requirements, the user can also specify user-defined limit values and define an input filter.

Information:

The registers are described in "Analog signal - Communication" on page 23.

3.1.1 Scaling

The module's A/D converter works with a resolution of 16 bits (±15 bits). The input value of ±10 V can therefore be mapped using ±32767 steps. For easier implementation, the user can select subsequent scaling to ±10000 levels. The conversion value corresponds to the applied voltage in mV and, with a resolution of more than 14 bits (±13 bits), is still sufficiently accurate for the many technical applications.

Information:

The register is described in "Channel parameters" on page 21.

3.1.2 Input filter

Analog input signals can experience brief disturbances caused by external factors (EMC). The A/D converters high sampling rate allows you to filter out these types of signal peaks without hindering the application processes.

Information:

The register is described in "Configuring filters" on page 20.

3.1.2.1 Filter level

A filter can be defined to prevent large input steps. This filter is used to bring the input value closer to the actual analog value over a period of several bus cycles.
Filtering takes place after any input ramp limiting has been carried out.

Formula for calculating the input value:

$$\text{Value}_{\text{New}} = \text{Value}_{\text{Old}} - \frac{\text{Value}_{\text{Old}}}{\text{Filter level}} + \frac{\text{Input value}}{\text{Filter level}}$$

Adjustable filter levels:

Value	Filter level
0	Filter switched off
1	Filter level 2
2	Filter level 4
3	Filter level 8

Value	Filter level
4	Filter level 16
5	Filter level 32
6	Filter level 64
7	Filter level 128

The following examples show the functionality of the filter based on an input step and a disturbance.

Example 1

The input value jumps from 8000 to 16000. The diagram shows the calculated value with the following settings:

Input ramp limiting = 0

Filter level = 2 or 4

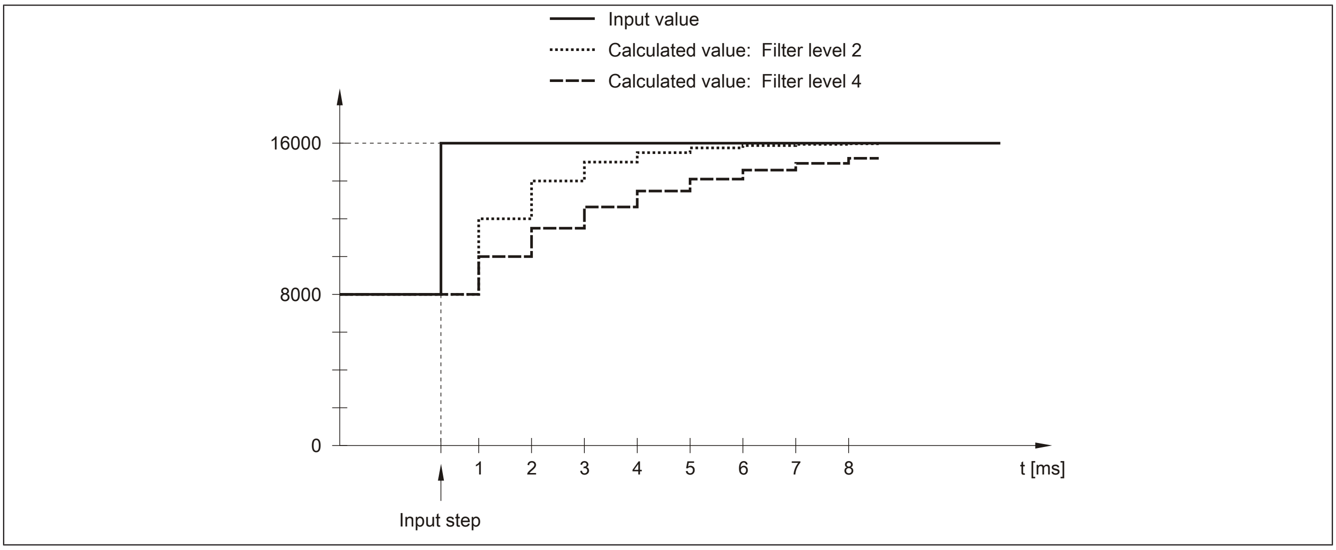


Figure 1: Calculated value during input step

Example 2

A disturbance interferes with the input value. The diagram shows the calculated value with the following settings:

Input ramp limiting = 0

Filter level = 2 or 4

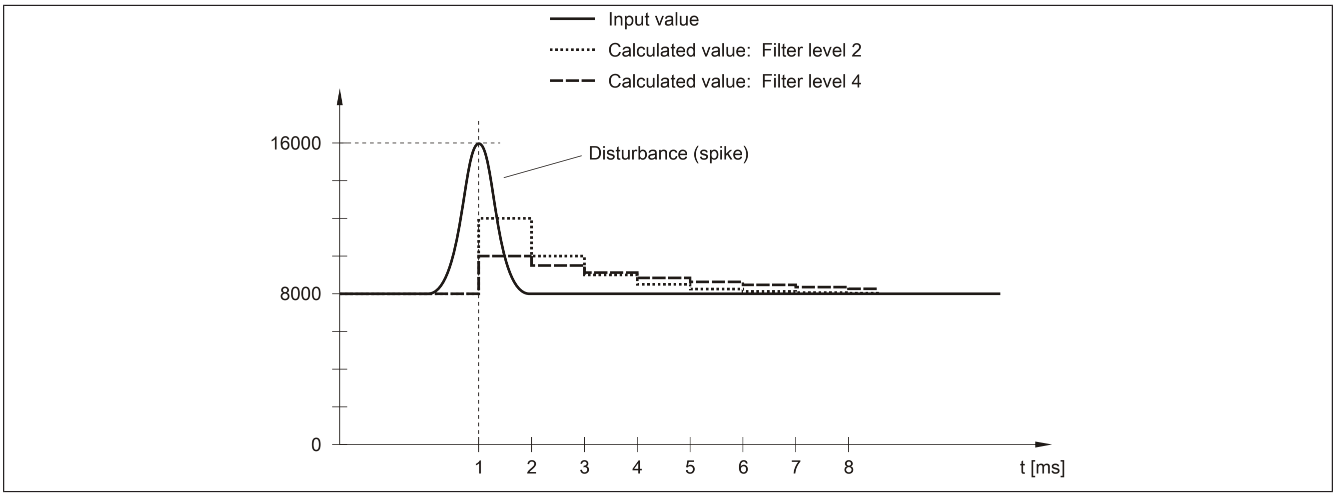


Figure 2: Calculated value during disturbance

3.1.2.2 Input ramp limiting

Input ramp limiting can only be performed in conjunction with filtering. Input ramp limiting is performed before filtering.

The difference of the input value change is checked for exceeding the specified limit. In the event of overshoot, the tracked input value is equal to the old value ± the limit value.

Configurable limit values:

Value	Limit value
0	The input value is used without limitation.
1	0x3FFF = 16383
2	0x1FFF = 8191
3	0x0FFF = 4095
4	0x07FF = 2047
5	0x03FF = 1023
6	0x01FF = 511
7	0x00FF = 255

Input ramp limiting is well suited for suppressing disturbances (spikes). The following examples show the functionality of input ramp limiting based on an input step and a disturbance.

Example 1

The input value jumps from 8000 to 17000. The diagram shows the tracked input value with the following settings:

Input ramp limiting = 4 = 0x07FF = 2047

Filter level = 2

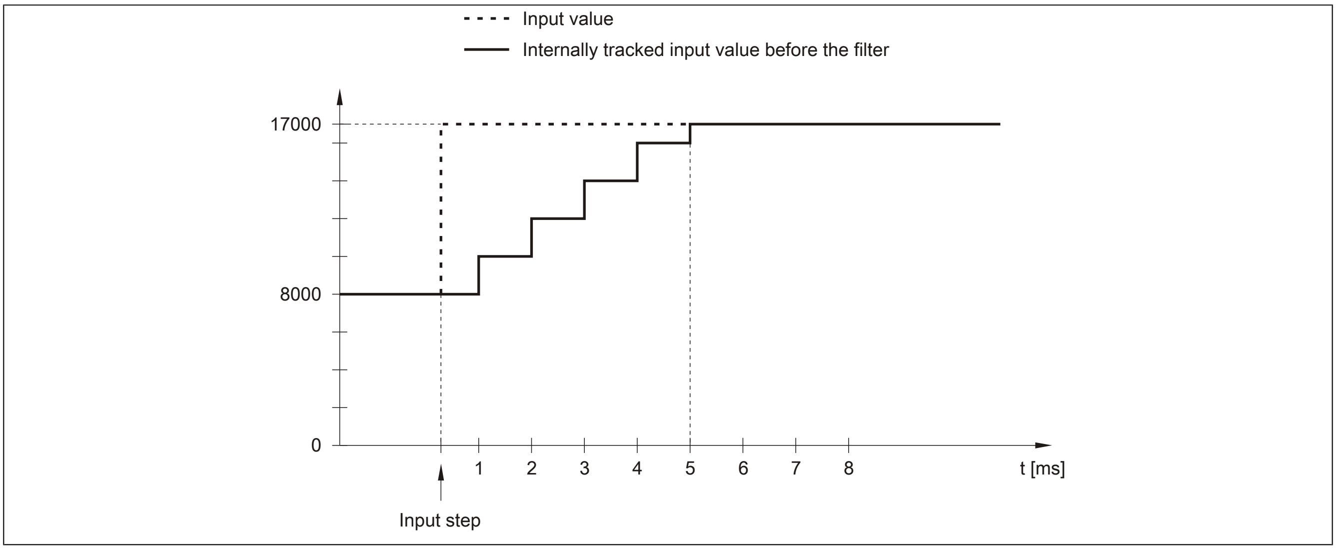


Figure 3: Tracked input value for input step

Example 2

A disturbance interferes with the input value. The diagram shows the tracked input value with the following settings:

Input ramp limiting = 4 = 0x07FF = 2047

Filter level = 2

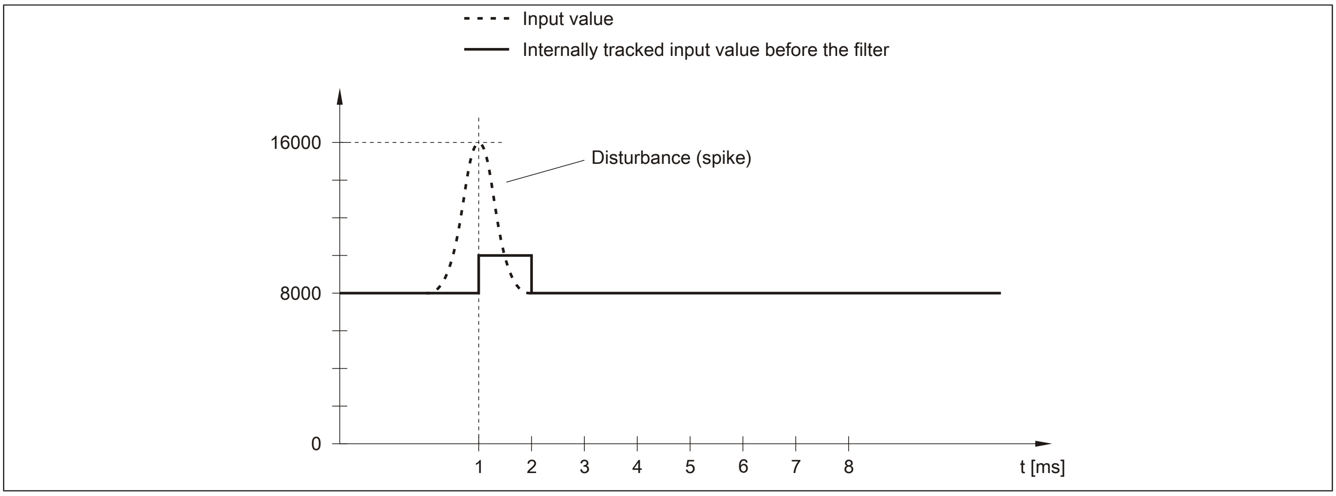


Figure 4: Tracked input value for disturbance

3.2 Monitoring the input signal

The input signal is monitored against the upper and lower limit values as well as for open circuit. The status of the power supply can also be read out. Some error information is delayed according to the previously set condition.

Limit value (default)	Voltage signal ±10 V	
Upper maximum limit value	+10 V	+32767 or 10000
Lower minimum limit value	-10 V	-32767 or -10000

Packed status information

Setting "Format status information" in Automation Studio makes it possible to specify whether the status information is transferred as USINT or bit by bit.

The following values are monitored:

Name	Value	Information
UnderflowAnalogInput	0	No error
Depending on the configuration, the error state of the signal undershoot is mapped here. [1]	1	Lower limit value undershot
OverflowAnalogInput	0	No error
Depending on the configuration, the error state of the signal overshoot is mapped here. [1]	1	Upper limit value overshot
OpenLineAnalogInput	0	No error
This error indicates an open circuit.	1	Open circuit detected
SumErrorAnalogInput	0	No error
This error information is derived from the status of the individual errors and is only enabled after a configurable delay time [ms]. Linking this error information in the application makes it possible to hide temporary overshoots or undershoots of the temperature value, for example.	1	Composite error detected
SensorErrorAnalogInput	0	Sensor voltage OK
This error information is derived from the status of the individual errors and is only enabled after a configurable delay time [ms]. Linking this error information in the application makes it possible to hide temporary overshoots or undershoots of the temperature value, for example.	1	Sensor load too high
IoSuppErrorAnalogInput	0	I/O power supply OK
This error is enabled immediately after a supply voltage undershoot (<20 VDC) is detected.	1	I/O power supply error detected

1) This error information is only enabled after a configurable delay as a multiple of the conversion cycles.

Information:

The register is described in "Status of the inputs" on page 24.

3.2.1 Limit and replacement values

3.2.1.1 Limit value monitoring

In addition to the qualitative assessment of the input, the module is also equipped with the function of adjusting the permissible range of values to the requirements of the application. In addition, the permissible upper and lower limits can be further limited. In this case, the set replacement value strategy is applied sooner.

If user-specific limit values are used, a hysteresis range should also be defined. This configures how far the limit value must be overshot in order to trigger a reaction.

3.2.1.2 Replacement value strategy

To ensure the quality of the read-in value, the detected voltage is assessed. If a logically impermissible voltage value or open circuit is detected, for example, limit value monitoring is triggered.

The reaction to this is determined by the user via the replacement value strategy. With option "Replace with static value", the user defines two values for the overshoot or undershoot that are used to replace the converted value in the event of a limit value violation. With the alternative "Keep last valid value", the last value deemed good is retained. The assessment takes more time, however. Depending on the defined preparation interval, the current read-in value is delayed.

Information:

The registers are described in "Configuring the limit values" on page 22.

3.2.1.3 Receiving the measured value

If the last valid measured value should be kept when violating the limit value, then PreparationInterval must be defined. The measured values continue to be acquired and converted according to the configured I/O update time. They are then checked and discarded if they do not meet the specifications. When an error does not occur, therefore, the measured value acquired 2 preparation intervals ago is constantly output.

Functionality:
Depending on the configured input filter, measured values are continuously converted and stored in the measured value memory. The current content of the measured value memory is checked within the set interval time. If a permissible value is present, the content of the temporary memory is transferred to the output memory and the content of the measured value memory is transferred to the temporary memory.
If the check results in an impermissible value, the content of the measured value memory is discarded. The copy direction between the output memory and temporary memory is reversed, and the next-to-last valid value is still output.

Information:

With the "Hold last valid value" configuration, the delay from measurement to the output of the value is at least twice the time of the preparation interval. In the worst case, however, it can also take twice the interval time plus the configured conversion cycle of the A/D converter.

	"Application" Value being measured (analog)
↓	Condition: - Conversion interval (A/D converter) elapsed
	"Measured value memory" Measured value (digital)
↓	Condition: - PreparationInterval elapsed - Measured value permissible
	"Buffer" Last valid value
↓	Condition: - PreparationInterval elapsed - Measured value permissible
	"Output memory" Next-to-last valid/ displayed value

Information:

The register is described in "Preparation time for the measured values" on page 23.

3.3 NetTime Technology

NetTime refers to the ability to precisely synchronize and transfer system times between individual components of the controller or network (controller, I/O modules, X2X Link, POWERLINK, etc.).

This allows the moment that events occur to be determined system-wide with microsecond precision. Upcoming events can also be executed precisely at a specified moment.

NetTime
TECHNOLOGY

3.3.1 Time information

Various time information is available in the controller or on the network:

- System time (on the PLC, Automation PC, etc.)
- X2X Link time (for each X2X Link network)
- POWERLINK time (for each POWERLINK network)
- Time data points of I/O modules

The NetTime is based on 32-bit counters, which are increased with microsecond resolution. The sign of the time information changes after 35 min, 47 s, 483 ms and 648 µs; an overflow occurs after 71 min, 34 s, 967 ms and 296 µs.

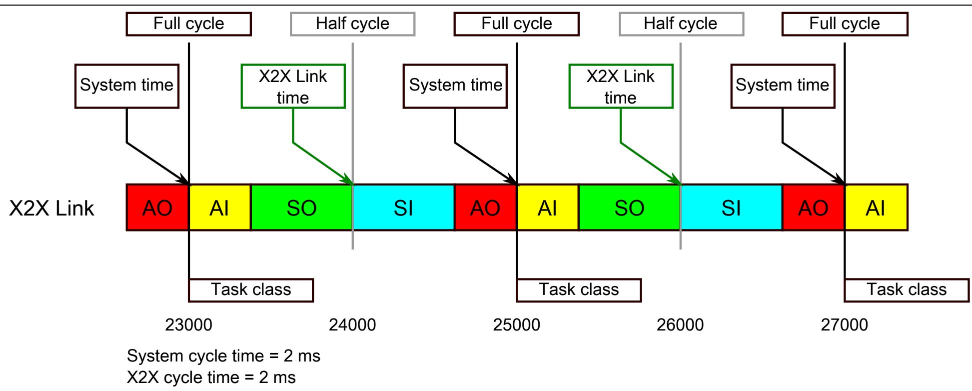
The initialization of the times is based on the system time during the startup of the X2X Link, the I/O modules or the POWERLINK interface.

Current time information in the application can also be determined via library AsIOTime.

3.3.1.1 Controller data points

The NetTime I/O data points of the controller are latched to each system clock and made available.

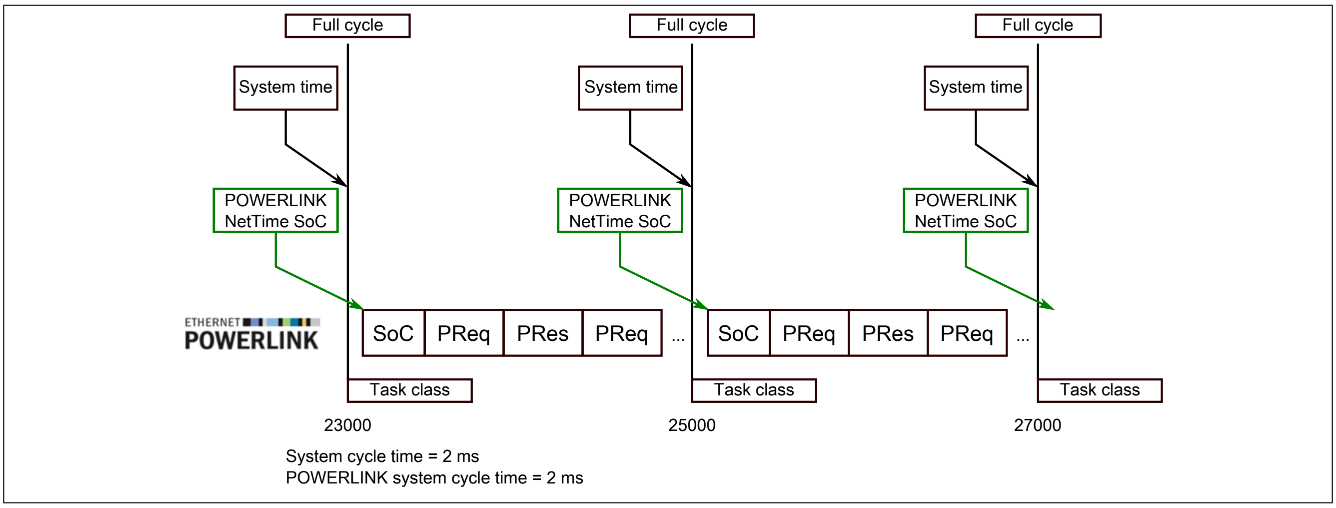
3.3.1.2 X2X Link - Reference time point



The reference time point on the X2X Link network is always calculated at the half cycle of the X2X Link cycle. This results in a difference between the system time and the X2X Link reference time point when the reference time is read out.

In the example above, this results in a difference of 1 ms, i.e. if the system time and X2X Link reference time are compared at time 25000 in the task, then the system time returns the value 25000 and the X2X Link reference time returns the value 24000.

3.3.1.3 POWERLINK - Reference time point

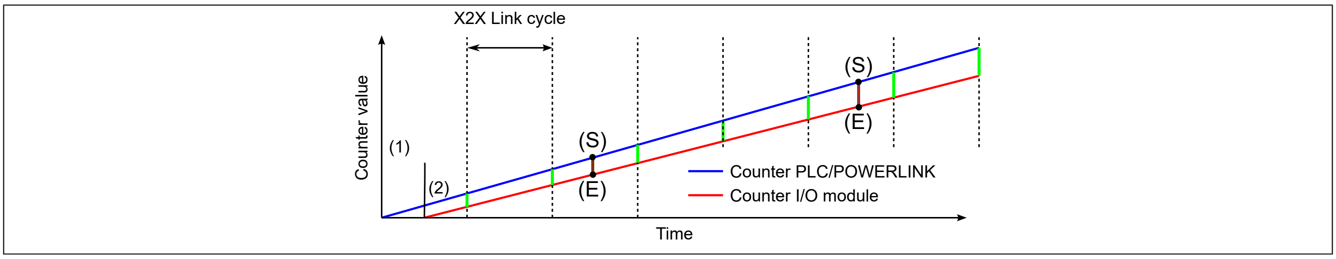


The POWERLINK reference time point is always calculated at the start of cycle (SoC) of the POWERLINK network. The SoC starts 20 µs after the system clock due to the system. This results in the following difference between the system time and the POWERLINK reference time:

POWERLINK reference time = System time - POWERLINK cycle time + 20 µs

In the example above, this means a difference of 1980 µs, i.e. if the system time and POWERLINK reference time are compared at time 25000 in the task, then the system time returns the value 25000 and the POWERLINK reference time returns the value 23020.

3.3.1.4 Synchronization of system time/POWERLINK time and I/O module



At startup, the internal counters for the controller/POWERLINK (1) and the I/O module (2) start at different times and increase the values with microsecond resolution.

At the beginning of each X2X Link cycle, the controller or POWERLINK network sends time information to the I/O module. The I/O module compares this time information with the module's internal time and forms a difference (green line) between the two times and stores it.

When a NetTime event (E) occurs, the internal module time is read out and corrected with the stored difference value (brown line). This means that the exact system moment (S) of an event can always be determined, even if the counters are not absolutely synchronous.

Note

The deviation from the clock signal is strongly exaggerated in the picture as a red line.

3.3.2 Timestamp functions

NetTime-capable modules provide various timestamp functions depending on the scope of functions. If a timestamp event occurs, the module immediately saves the current NetTime. After the respective data is transferred to the controller, including this precise moment, the controller can then evaluate the data using its own NetTime (or system time), if necessary.
For details, see the respective module documentation.

3.3.2.1 Time-based inputs

NetTime Technology can be used to determine the exact moment of a rising edge at an input. The rising and falling edges can also be detected and the duration between 2 events can be determined.

Information:

The determined moment always lies in the past.

3.3.2.2 Time-based outputs

NetTime Technology can be used to specify the exact moment of a rising edge on an output. The rising and falling edges can also be specified and a pulse pattern generated from them.

Information:

The specified time must always be in the future, and the set X2X Link cycle time must be taken into account for the definition of the moment.

3.3.2.3 Time-based measurements

NetTime Technology can be used to determine the exact moment of a measurement that has taken place. Both the starting and end moment of the measurement can be transmitted.

4 Commissioning

4.1 Using the module on the bus controller

Function model 254 "Bus controller" is used by default only by non-configurable bus controllers. All other bus controllers can use other registers and functions depending on the fieldbus used.

For detailed information, see section "Additional information - Using I/O modules on the bus controller" in the X20 user's manual (version 3.50 or later).

4.1.1 CAN I/O bus controller

The module occupies 1 analog logical slot on CAN I/O.

5 Register description

5.1 General data points

In addition to the registers described in the register description, the module has additional general data points. These are not module-specific but contain general information such as serial number and hardware variant.

General data points are described in section "Additional information - General data points" in the X20 System user's manual.

5.2 Function model 0 - default

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Analog input - Configuration						
390 434	AnalogFilter01 AnalogFilter02	UINT				•
386 430	AnalogMode01 AnalogMode02	UINT				•
402 446	UpperLimit01 UpperLimit02	INT				•
398 442	LowerLimit01 LowerLimit02	INT				•
406 450	Hysteres01 Hysteres02	INT				•
414 458	ReplacementUpper01 ReplacementUpper02	INT				•
410 454	ReplacementLower01 ReplacementLower02	INT				•
426 470	PreparationInterval01 PreparationInterval02	UINT				•
418 462	ErrorDelay01 ErrorDelay02	UINT				•
422 466	SumErrorDelay01 SumErrorDelay02	UINT				•
Analog input - Communication						
0 2	AnalogInput01 (limited) AnalogInput02 (limited)	INT	•			
258 262	AnalogInput01 (original value) AnalogInput02 (original value)	INT	•			
284 292	AnalogSampletime01 (32-bit) AnalogSampletime02 (32-bit)	DINT	•			
282 290	AnalogSampletime01 (16-bit) AnalogSampletime02 (16-bit)	INT	•			
273 275	AnalogStatus01 AnalogStatus02	USINT	•			
	UnderflowAnalogInput01 or 02	Bit 0				
	OverflowAnalogInput01 or 02	Bit 1				
	OpenLineAnalogInput01 or 02	Bit 2				
	SumErrorAnalogInput01 or 02	Bit 4				
	SensorErrorAnalogInput01 or 02	Bit 6				
	IoSuppErrorAnalogInput01 or 02	Bit 7				

5.3 Function model 254 - Bus controller

Register	Offset[1]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Analog input - Configuration							
390 434	- -	AnalogFilter01 AnalogFilter02	UINT				•
386 430	- -	AnalogMode01 AnalogMode02	UINT				•
402 446	- -	UpperLimit01 UpperLimit02	INT				•
398 442	- -	LowerLimit01 LowerLimit02	INT				•
406 450	- -	Hysteres01 Hysteres02	INT				•
414 458	- -	ReplacementUpper01 ReplacementUpper02	INT				•
410 454	- -	ReplacementLower01 ReplacementLower02	INT				•
426 470	- -	PreparationInterval01 PreparationInterval02	UINT				•
418 462	- -	ErrorDelay01 ErrorDelay02	UINT				•
422 466	- -	SumErrorDelay01 SumErrorDelay02	UINT				•
Analog input - Communication							
0 2	0 2	AnalogInput01 AnalogInput02	INT	•			
273 275	- -	AnalogStatus01 AnalogStatus02	USINT		•		
		UnderflowAnalogInput01 or 02	Bit 0				
		OverflowAnalogInput01 or 02	Bit 1				
		OpenLineAnalogInput01 or 02	Bit 2				
		SumErrorAnalogInput01 or 02	Bit 4				
		SensorErrorAnalogInput01 or 02	Bit 6				
		IoSuppErrorAnalogInput01 or 02	Bit 7				

1) The offset specifies the position of the register within the CAN object.

5.4 Analog signal - Configuration

5.4.1 Configuring filters

Name:
AnalogFilter01 to AnalogFilter02

This register is used to define the filter level and input ramp limitation of the input filter.

Data type	Value	Bus controller default setting
UINT	See bit structure.	0

Bit structure:

Bit	Description	Value	Information
0 - 2	Defines the filter level	000	Filter disabled (bus controller default setting)
		001	Filter level 2
		010	Filter level 4
		011	Filter level 8
		100	Filter level 16
		101	Filter level 32
		110	Filter level 64
		111	Filter level 128
3	Reserved	0	
4 - 6	Defines input ramp limiting	000	The input value is applied without limitation (bus controller default setting)
		001	Limit value = 0x3FFF (16383)
		010	Limit value = 0x1FFF (8191)
		011	Limit value = 0x0FFF (4095)
		100	Limit value = 0x07FF (2047)
		101	Limit value = 0x03FF (1023)
		110	Limit value = 0x01FF (511)
		111	Limit value = 0x00FF (255)
7	Reserved	0	

5.4.2 Channel parameters

Name:
AnalogMode01 to AnalogMode02

These registers are used to specify the operating parameters that the module uses for the associated channel. Each channel must be enabled individually and can be configured and operated independently of the other.

Information:

Different limit values must be configured for any display normalizing that needs to take place.

Data type	Value	Bus controller default setting
UINT	See bit structure.	15

Bit structure:

Bit	Name	Value	Information
0	Channel (on/off)	0	Disabled
		1	Enabled (bus controller default setting)
1	Limit exceeded	0	Disabled
		1	Enabled (bus controller default setting)
2	Lower limit violation	0	Disabled
		1	Enabled (bus controller default setting)
3	Reserved	0	
4	Replacement value strategy	0	Replace with static value
		1	Retain last valid value
5	Scaling of the measured value	0	±32767 (resolution: 16-bit)
		1	±10000 (resolution: >14-bit)
6 - 15	Reserved	0	

5.4.3 Delaying error messages

Name:
ErrorDelay01 to ErrorDelay02

This register describes the number of consecutive conversion operations for which an error must be pending until the corresponding single error status bit is set. The delay acts on underflow, overflow and open circuit errors. This delay can be used to hide short-term deviations of the measured value, for example.

Data type	Value	Information
UINT	0 to 65535	Bus controller default setting: 2

5.4.4 Time for composite error bit

Name:
SumErrorDelay01 to SumErrorDelay02

This register can be used to set the minimum time in milliseconds that an error must be present in order to set the sum error bit.

Data type	Value	Information
UINT	0 to 65535	In 0.1 ms steps Bus controller default setting: 4000

5.5 Configuring the limit values

5.5.1 Lower limit value

Name:
LowerLimit01 to LowerLimit02

If the value range needs to be restricted further, this register can be used to enter new user-specific lower limit values.

Data type	Value	Information
INT	-32767 to 32767	Bus controller default setting: -32767
	-10000 to 10000	

Information:

The defined limit values must take the configured scaling into consideration.

5.5.2 Upper limit value

Name:
UpperLimit01 to UpperLimit02

If the value range needs to be restricted further, this register can be used to enter new user-specific upper limit values.

Data type	Value	Information
INT	-32767 to 32767	Bus controller default setting: 32767
	-10000 to 10000	

Information:

The defined limit values must take the configured scaling into consideration.

5.5.3 Lower replacement value

Name:
ReplacementLower01 to ReplacementLower02

These registers are used to specify the lower static values that are displayed instead of the current measured value when a limit value is violated.

Data type	Value	Information
INT	-32767 to 32767	Bus controller default setting: -32767

5.5.4 Upper replacement value

Name:
ReplacementUpper01 to ReplacementUpper02

These registers are used to specify the upper static values that are displayed instead of the current measured value when a limit value is violated.

Data type	Value	Information
INT	-32767 to 32767	Bus controller default setting: 32767

5.5.5 Hysteresis

Name:
Hysteres01 to Hysteres02

These registers are used to configure how far the limit value must be overshot in order to trigger a reaction. The error state is cleared when the converted input value exceeds the agreed limit again by at least the value of the hysteresis in the allowed direction.

Data type	Value	Information
INT	-32767 to 32767	Bus controller default setting: 100
	-10000 to 10000	

Information:

The hysteresis value must take the scaling into consideration.

5.5.6 Preparation time for the measured values

Name:
PreparationInterval01 to PreparationInterval02

If the last valid measured value should be retained in the event of a limit value violation, the preparation interval must be defined. For details, see "Receiving the measured value" on page 14.

Data type	Value	Information
UINT	0 to 65535	In 0.1 ms steps Bus controller default setting: 0

5.6 Analog signal - Communication

5.6.1 Analog input values - Original values

Name:
AnalogInput01 to AnalogInput02

These registers are used to indicate the actual input values after standardization.

Data type	Value
INT	-32767 to 32767
	-10000 to 10000

5.6.2 Analog input values - Limited

Name:
AnalogInput01 to AnalogInput02

These registers are used to indicate the actual input values after standardization. In addition, the settings for limit value monitoring and replacement value strategy are applied to this register.

Data type	Value
INT	-32767 to 32767
	-10000 to 10000

5.6.3 Sample time

Name:
Sampletime01 to Sampletime02

These registers return the timestamp for when the module reads the current channel mapping. The values are provided as signed 2-byte or 4-byte values.

For additional information about NetTime and timestamps, see "NetTime Technology" on page 15.

Data type	Values [µs]	Information
INT	-32,768 to 32767	NetTime timestamp of the current input value
DINT	-2,147,483,648 to 2,147,483,647	NetTime timestamp of the current input value

5.6.4 Status of the inputs

Name:
AnalogStatus01 to AnalogStatus02
UnderflowAnalogInput01 to UnderflowAnalogInput02
OverflowAnalogInput01 to OverflowAnalogInput02
OpenLineAnalogInput01 to OpenLineAnalogInput02
SumErrorAnalogInput01 to SumErrorAnalogInput02
SensorErrorAnalogInput01 to SensorErrorAnalogInput02
IoSuppErrorAnalogInput01 to IoSuppErrorAnalogInput02

Regardless of the configured replacement value strategy, the current error state of the module channels is indicated in this register.

Data type	Value
USINT	See bit structure.

Bit structure:

Bit	Name	Value	Information
0	UnderflowAnalogInput01 or 02	0	No error
		1	Below lower limit value
1	OverflowAnalogInput01 or 02	0	No error
		1	Above upper limit value
2	OpenLineAnalogInput01 or 02	0	No error
		1	Open line detected
3	Reserved	0	
4	SumErrorAnalogInput01 or 02	0	No error
		1	Composite error detected
5	Reserved	0	
6	SensorErrorAnalogInput01 or 02	0	Sensor voltage OK
		1	Sensor load too high
7	IoSuppErrorAnalogInput01 or 02	0	I/O power supply OK
		1	I/O power supply error detected

5.7 Minimum cycle time

The minimum cycle time specifies how far the bus cycle can be reduced without communication errors occurring. It is important to note that very fast cycles reduce the idle time available for handling monitoring, diagnostics and acyclic commands.

Minimum cycle time
200 µs

5.8 Minimum I/O update time

The minimum I/O update time specifies how far the bus cycle can be reduced so that an I/O update is performed in each cycle.

Minimum I/O update time
1 ms