

X20AI8321

1 General information

The module is equipped with 8 inputs with 12-bit digital converter resolution. It is possible to select between the two current ranges 0 to 20 mA and 4 to 20 mA.

- 8 analog inputs, 0 to 20 mA or 4 to 20 mA
- 12-bit digital converter resolution

2 Order data


Model number	Short description	Figure
	Analog inputs	
X20AI8321	X20 analog input module, 8 inputs, 0 to 20 mA, 12-bit converter resolution	
	Required accessories	
	Bus modules	
X20BM11	X20 bus module, 24 VDC keyed, internal I/O supply continuous	
X20BM15	X20 bus module, with node number switch, 24 VDC keyed, internal I/O supply continuous	
	Terminal blocks	
X20TB1F	X20 terminal block, 16-pin, 24 VDC keyed	

Table 1: X20AI8321 - Order data

3 Technical data

Model number	X20AI8321
Short description	
I/O module	8 analog inputs 0 to 20 mA / 4 to 20 mA
General information	
B&R ID code	0xD831
Status indicators	I/O function per channel, operating state, module status
Diagnostics	
Module run/error	Yes, using status LED and software
Inputs	Yes, using status LED and software
Power consumption	
Bus	0.01 W
Internal I/O	1.37 W (Rev. ≥ D0), 1.24 W (Rev. < D0)
Additional power dissipation caused by the actuators (resistive) [W]	-
Electrical isolation	
Channel - Bus	Yes
Channel - Channel	No
Certification	
CE	Yes
UL	cULus E115267 Industrial control equipment
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta = 0 - Max. 60°C FTZÜ 09 ATEX 0083X
DNV GL	Temperature: B (0 - 55°C) Humidity: B (up to 100%) Vibration: B (4 g) EMC: B (Bridge and open deck)
LR	ENV1
GOST-R	Yes
Analog inputs	
Input	0 to 20 mA/4 to 20 mA
Input type	Differential input
Digital converter resolution	12-bit
Conversion time	1 ms for all inputs
Output format	
Data type	INT
Current	INT 0x0000 - 0x7FFF / 1 LSB = 0x0008 = 4.883 µA
Load	<300 Ω
Input protection	Protection against wiring with supply voltage
Reverse polarity protection	Yes
Permitted input signal	Max. ±50 mA
Output of the digital value during overload	Configurable
Conversion procedure	SAR
Input filter	3rd-order low pass / cutoff frequency 1 kHz
Max. error at 25°C	
Gain	0.08% ¹⁾
Offset	0.03% ²⁾
Max. gain drift	0.009 %/°C ¹⁾
Max. offset drift	0.005 %/°C ²⁾
Common-mode rejection	
DC	70 dB
50 Hz	70 dB
Common-mode range	±12 V
Crosstalk between channels	-70 dB
Nonlinearity	<0.05% ²⁾
Isolation voltage between channel and bus	500 VDC, 1 min
Operating conditions	
Mounting orientation	
Horizontal	Yes
Vertical	Yes
Installation at elevations above sea level	
0 to 2000 m	No limitations
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
EN 60529 protection	IP20

Table 2: X20AI8321 - Technical data

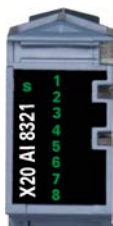
Model number	X20AI8321
Environmental conditions	
Temperature	
Operation	
Horizontal installation	-25 to 60°C
Vertical installation	-25 to 50°C
Derating	-
Storage	-40 to 85°C
Transport	-40 to 85°C
Relative humidity	
Operation	5 to 95%, non-condensing
Storage	5 to 95%, non-condensing
Transport	5 to 95%, non-condensing
Mechanical characteristics	
Note	Order 1x X20TB1F terminal block separately Order 1x X20BM11 bus module separately
Spacing	12.5 ^{+0.2} mm

Table 2: X20AI8321 - Technical data

- 1) Based on the current measured value.
2) Based on the 20 mA measurement range.

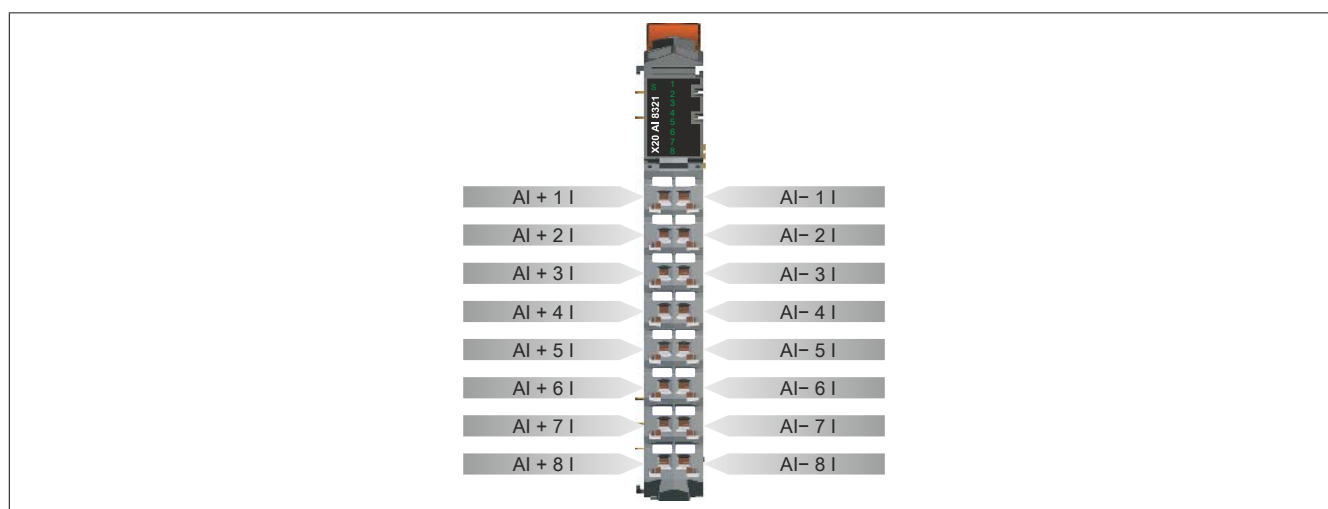
4 LED status indicators

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

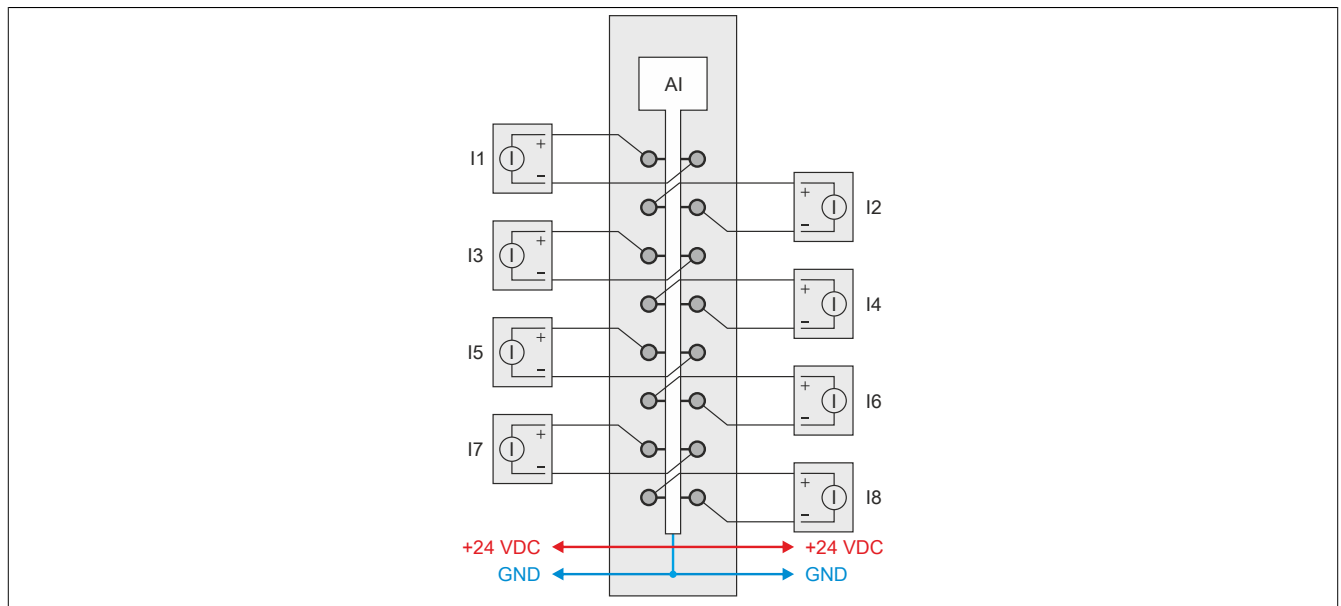
Figure	LED	Color	Status	Description
	S	Green	Off	No power to module
			Single flash	UNLINK mode
			Double flash	BOOT mode (during firmware update) ¹⁾
			Blinking quickly	SYNC mode
			Blinking slowly	PREOPERATIONAL mode
			On	RUN mode
	1 - 8	Red	Off	No power to module or everything OK
			On	Error or reset status
		Green	Off	No power to module
			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.

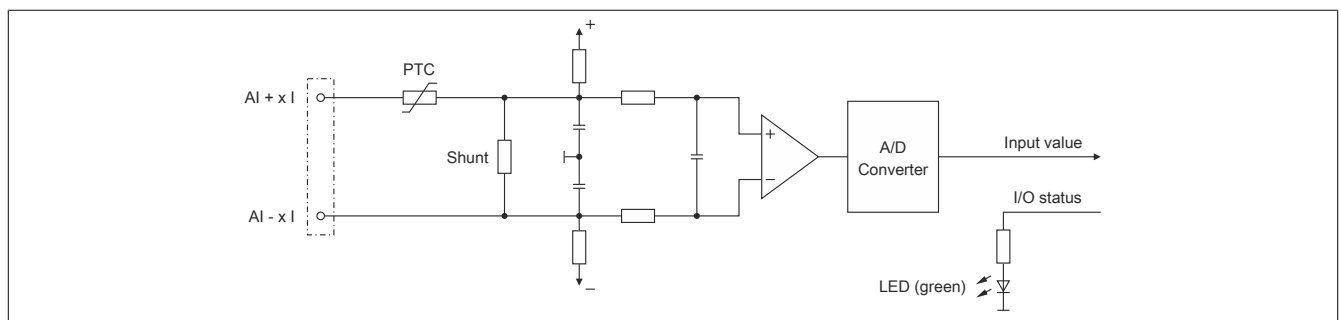
5 Pinout



6 Connection example



7 Input circuit diagram



8 Register description

8.1 General data points

In addition to the registers listed in the register description, the module also has other more general data points. These registers are not specific to the module but contain general information such as serial number and hardware version.

These general data points are listed in section "Additional information - General data points" of the X20 system user's manual.

8.2 Function model 0 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Non-cyclic	Cyclic	Non-cyclic
Analog signal - Configuration						
16	ConfigOutput01 (Input filter)	USINT				•
18	ConfigOutput02 (Channel type)	UINT				•
20	ConfigOutput03 (Lower limit value)	INT				•
22	ConfigOutput04 (Upper limit value)	INT				•
Analog signal - Communication						
Index * 2 - 2	AnalogInput0N (Index N = 1 to 8)	INT	•			
30	StatusInput01	USINT	•			
31	StatusInput02	USINT	•			

8.3 Function model 254 - Bus controller

Register	Offset ¹⁾	Name	Data type	Read		Write	
				Cyclic	Non-cyclic	Cyclic	Non-cyclic
Analog signal - Configuration							
16	-	ConfigOutput01 (Input filter)	USINT				•
18	-	ConfigOutput02 (Channel type)	UINT				•
20	-	ConfigOutput03 (Lower limit value)	INT				•
22	-	ConfigOutput04 (Upper limit value)	INT				•
Analog signal - Communication							
Index * 2 - 2	Index * 2 - 2	AnalogInput0N (Index N = 1 to 8)	INT	•			
30	-	StatusInput01	USINT		•		
31	-	StatusInput02	USINT		•		

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

8.3.1 CAN I/O bus controller

The module occupies 2 analog logical slots on CAN I/O.

8.4 Analog inputs

Input signals are converted asynchronously in a 1 ms interval.

8.5 Analog input values

Name:

AnalogInput01 to AnalogInput08

The analog input values are mapped to this register.

Data type	Value	Input signal:
INT	0 to 32767	Current signal 0 to 20 mA or 4 to 20 mA

8.6 Input filter

This module is equipped with a configurable input filter.

Information:

The filter sampling time is fixed at 1 ms and is acyclic to the X2X cycle.

8.6.1 Input ramp limitation

Input ramp limitation can only take place when a filter is used; the input ramp is limited before filtering takes place.

The amount the input value changes is checked to make sure that specified limits are not exceeded. If the values are exceeded, the adjusted input value is equal to the old value \pm 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 limitation is well suited for suppressing disturbances (spikes). The following examples show the function of the input ramp limitation based on an input jump and a disturbance.

Example 1

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

Input ramp limitation = 4 = 0x07FF = 2047

Filter level = 2

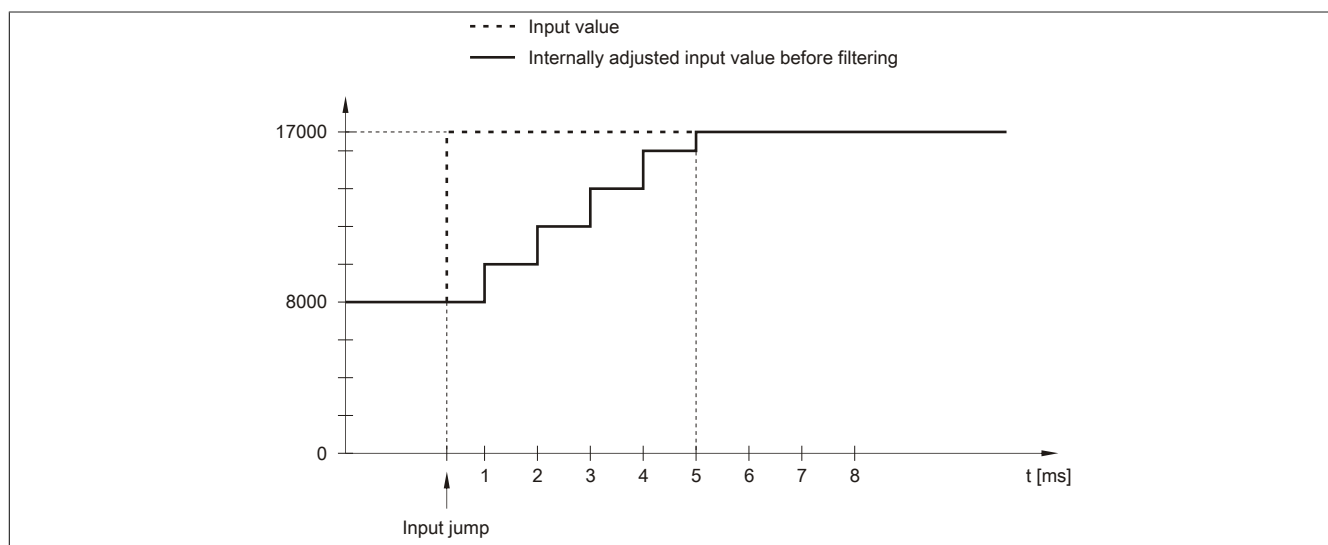


Figure 1: Adjusted input value for input jump

Example 2

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

Input ramp limitation = 4 = 0x07FF = 2047

Filter level = 2

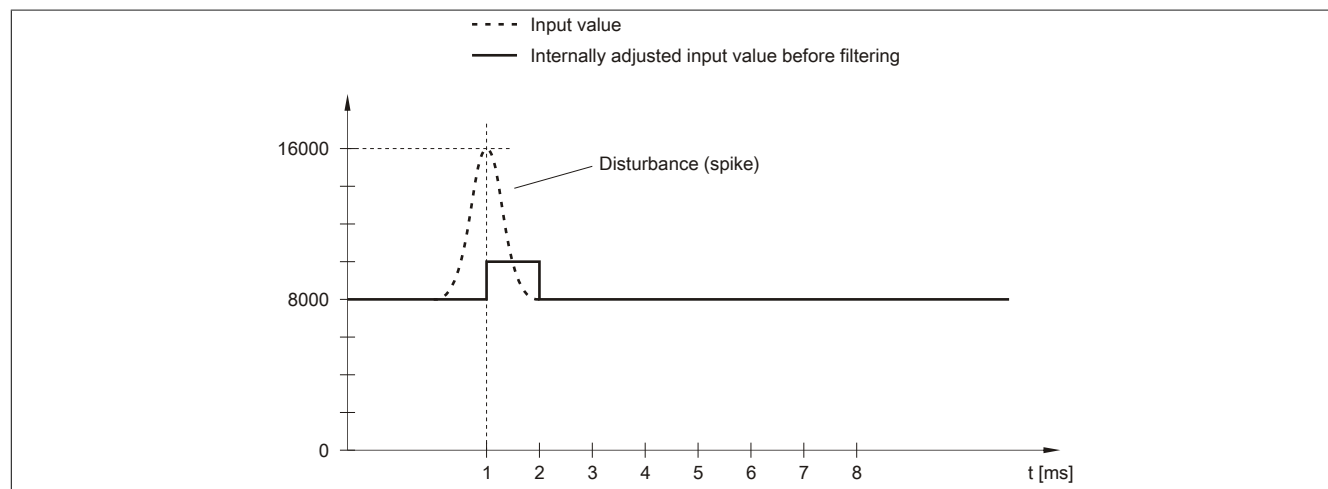


Figure 2: Adjusted input value for disturbance

8.6.2 Filter level

A filter can be defined to prevent large input jumps. This filter is used to bring the input value closer to the actual analog value over a period of several milliseconds.

Filtering takes place after input ramp limitation.

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

The following examples show how filtering works in the event of an input jump or disturbance.

Example 1

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

Input ramp limitation = 0

Filter level = 2 or 4

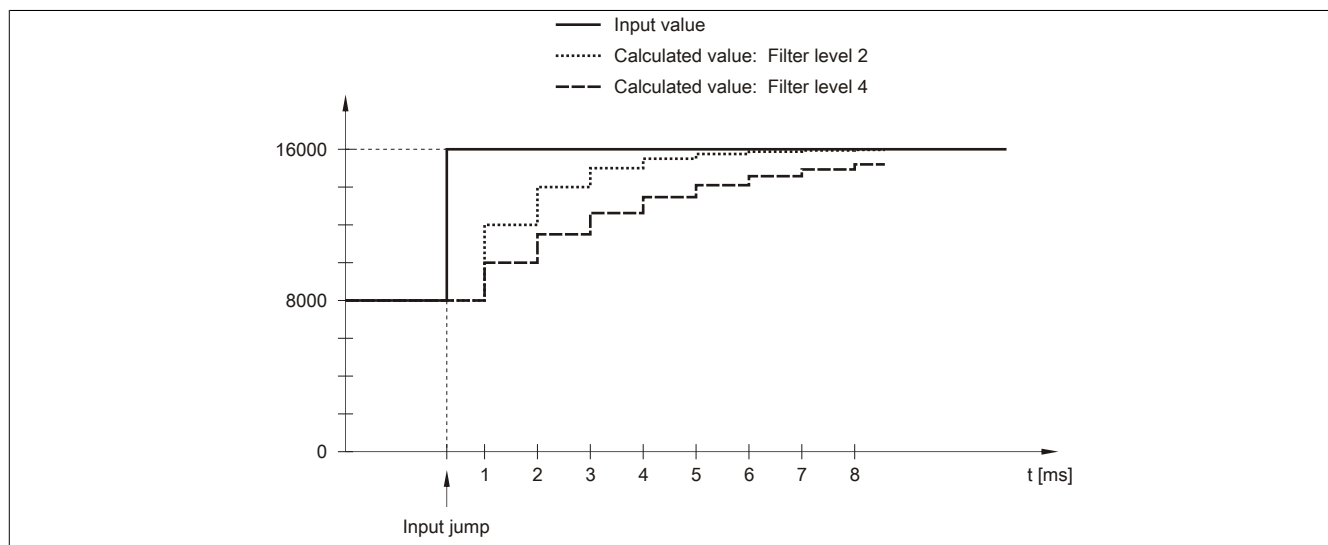


Figure 3: Calculated value during input jump

Example 2

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

Input ramp limitation = 0

Filter level = 2 or 4

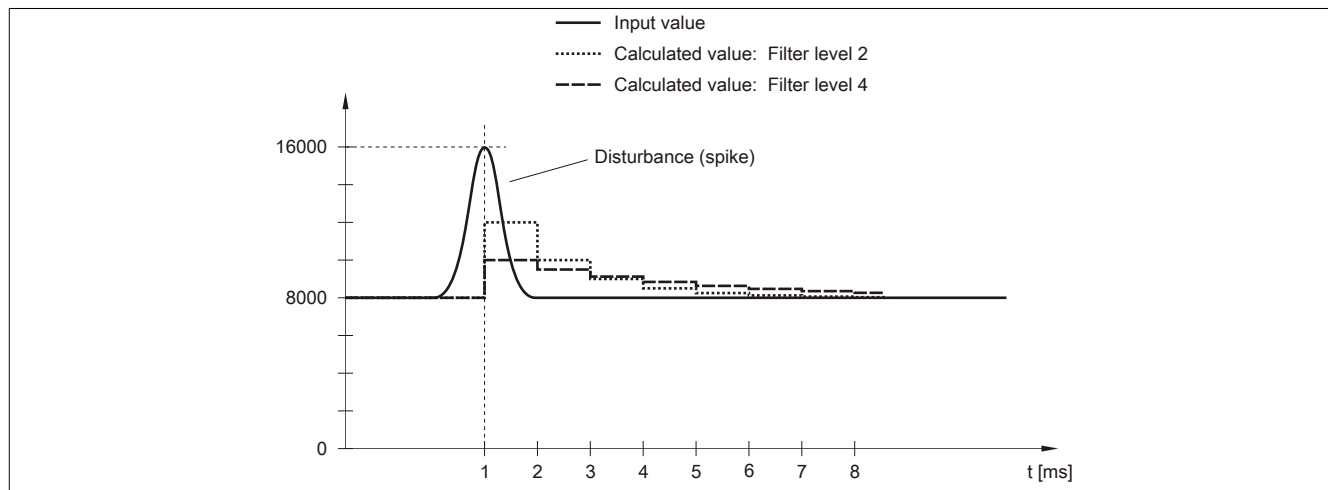


Figure 4: Calculated value during disturbance

8.7 Configuring the input filter

Name:

ConfigOutput01

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

Data type	Value
UINT	See bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 2	Defines the filter level	000	Filter switched off
		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 the input ramp limitation	000	The input value is used without limitation
		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 - 15	Reserved	0	

8.8 Channel type

Name:

ConfigOutput02

This register can be used to set the range of the current signal. This is determined by how they are configured. The following input signals can be set:

- 0 to 20 mA current signal
- 4 to 20 mA current signal

Data type	Values
USINT	See bit structure.

Bit structure:

Bit	Description	Value	Information
0	Channel 1: Current measurement range	0	0 to 20 mA current signal
		1	4 to 20 mA current signal
...		...	
7	Channel 8: Current measurement range	0	0 to 20 mA current signal
		1	4 to 20 mA current signal

8.9 Lower limit value

Name:

ConfigOutput03

This register can be used to configure the lower limit for analog values. If the analog value goes below the limit value, it is frozen at this value and the corresponding error status bit is set.

Data type	Value
INT	-32768 to 32767

Information:

- When configured as 0 to 20 mA, this value should be set to 0.
- When configured as 4 to 20 mA, this value can be set to -8192 (corresponds to 0 mA) in order to display values <4 mA.

Keep in mind that this setting applies to all channels!

8.10 Upper limit value

Name:

ConfigOutput04

This register can be used to configure the upper limit for analog values. If the analog value goes above the limit value, it is frozen at this value and the corresponding error status bit is set.

Data type	Value
INT	-32768 to 32767

Information:

The default value of 32767 corresponds to the maximum default value at 20 mA.

Keep in mind that this setting applies to all channels!

8.11 Input status

Name:

StatusInput01 to StatusInput02

This register is used to monitor the module inputs. A change in the monitoring status generates an error message.

Data type	Values
USINT	See bit structure.

Bit structure:

StatusInput01 monitors Channels 1 to 4

StatusInput02 monitors Channels 5 to 8

Bit	Description	Value	Information
0 - 1	Channel 1 or 5	00	No error
		01	Lower limit value exceeded
		10	Upper limit value exceeded
...		...	
6 - 7	Channel 4 or 8	00	No error
		01	Lower limit value exceeded
		10	Upper limit value exceeded

Limiting the analog value

In addition to the status information, the analog value is set to the values listed below by default when an error occurs. The analog value is limited to the new values if the limit values were changed.

Error status	Digital value for error (default values)	
	0 to 20 mA	4 to 20 mA
Upper limit value exceeded	+32767 (0x7FFF)	
Lower limit value exceeded	0	-8191 (0xE001)

8.12 Minimum cycle time

The minimum cycle time defines how far the bus cycle can be reduced without communication errors occurring. Note that very fast cycles decrease the idle time available for handling monitoring, diagnostics and acyclic commands.

Minimum cycle time
150 µs

8.13 Minimum I/O update time

The minimum I/O update time defines how far the bus cycle can be reduced while still allowing an I/O update to take place in each cycle.

Minimum I/O update time
1 ms