X20AT4232

Data sheet
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Translation of the original documentation

Publishing information

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Disclaimer

Version history

B&R makes every effort to keep documents as current as possible. The most current versions are available for download on the B&R website (www.br-automation.com).

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
	Temperature measurement	
X20AT4232	X20 temperature input module, 4 resistance measurement inputs, NTC 10 kΩ, resolution 0.1°C, 2-wire connections	
	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: X20AT4232 - Order data

1.3 Module description

This module is equipped with 4 inputs for NTC resistance temperature measurement (10 kΩ at 25°C). In addition, this module can measure resistance from 0 to 200 kΩ.

- 4 inputs for resistance temperature measurement
- For NTC resistance type 10 kΩ
- Resistance measurement 0 to 200 kΩ
- Configurable measurement type per channel
- 2-wire measurement
- Configurable filter time

Functions:

- Sensor type and measurement range
- Monitoring the input signal

Sensor type and measurement range

The module can be used for both measurement sensor and resistance measurement. The measurement range varies depending on the operating mode set.

Monitoring the input signal

The input signal of the analog inputs is monitored against the upper and lower limit values as well as for open circuit.

2 Technical description

2.1 Technical data

Order number	X20AT4232
Short description	
I/O module	4 inputs for NTC (10 kΩ) resistance temperature measurement
General information	
B&R ID code	0xEA85
Status indicators	I/O function per channel, operating state, module status
Diagnostics	
Module run/error	Yes, using LED status indicator and software
Inputs	Yes, using LED status indicator and software
Cable specification	
Cable type	Shielded twisted pair cable
Line capacitance	Max. 1 nF
Power consumption	
Bus	0.01 W
Internal I/O	0.72 W
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
Resistance measurement temperature inputs	
Input	Resistance measurement with constant current supply for 2-wire connections
Digital converter resolution	16-bit
Filter time	Configurable between 16.7 and 66.7 ms
Conversion time	
1 channel	20 ms with 50 Hz filter
2 - 4 channels	40 ms per channel with 50 Hz filter
Conversion procedure	Sigma-delta
Output format	INT or UINT for resistance measurement
Sensor	
Sensor type	Configurable per channel
NTC10K type 1	Vishay: NTCLE100E3103GB0, $B_{25/85}$ = 3977
NTC10K type 2	Vishay: NTCLE413E2103F400L, $B_{25/85}$ = 3435
Temperature measurement range	-30 to 100°C for NTC with 10 kΩ [1]
Resistance measurement range	0 to 200 kΩ
Temperature sensor resolution	1 LSB = 0.1°C for NTC with 10 kΩ [1]
Resistance measurement resolution	5 Ω
Input filter	First-order low-pass filter / cutoff frequency 1.35 kHz
Insulation voltage between channel and bus	500 V_{eff}
Linearization method	Internal
Measurement current	9.1 µA ±1.5%
Reference	103,125 Ω ±0.1%
Permissible input signal	Short-term max. ±30 V
Max. error at 25°C	
Gain	±0.35% [2]
Offset	±0.004% [3]
Max. gain drift	±0.006%/°C [2]
Max. offset drift	±0.00009 %/°C [3]
Nonlinearity	<0.15% [3]
Standardized range of values for resistance measurement	0 to 200,000 Ω
Crosstalk between channels	<-70 dB
Temperature sensor normalization	
NTC10K type 1	-30.0 to 100.0°C
NTC10K type 2	-30.0 to 100.0°C

Table 2: X20AT4232 - Technical data

Order number	X20AT4232
Temperature measurement monitoring	
Range undershoot	0x8001
Range overshoot	0x7FFF
Open circuit	0x7FFF
General fault	0x8000
Open inputs	0x7FFF
Resistance measurement monitoring	
Range overshoot	0xFFFF
Open circuit	0xFFFF
General fault	0xFFFF
Open inputs	0xFFFF
Electrical properties	
Electrical isolation	Channel isolated from bus Channel 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: X20AT4232 - Technical data

1) Depends on the temperature sensor. The value applies when using Vishay NTCLE100E3103GB0 $B_{25/85}$ = 3977 and Vishay NTCLE413E2103F400L $B_{25/85}$ = 3435 sensors.
2) Based on the current measured resistance value.
3) Based on the entire resistance measurement range.

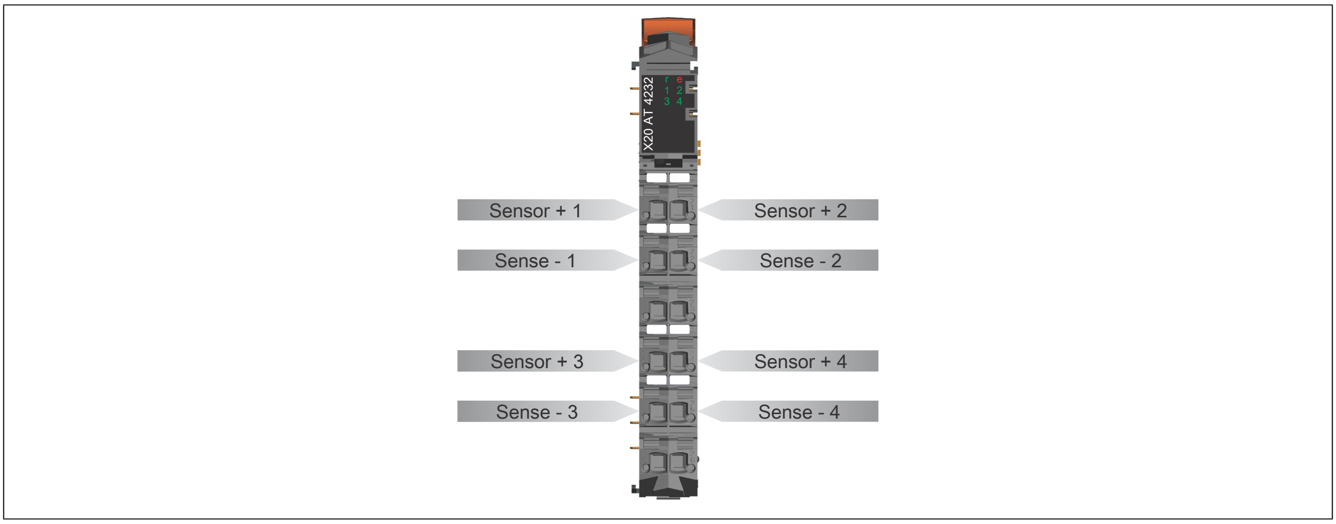
2.2 LED status indicators

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

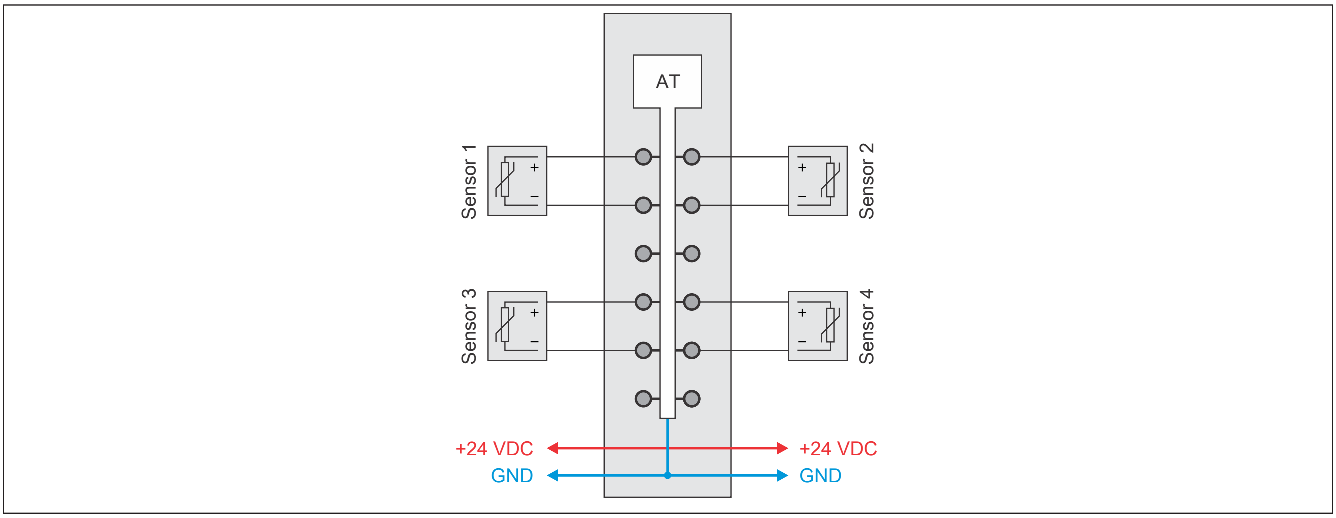
Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
			Single flash	Warning/Error on an I/O channel. Overflow or underflow of the analog inputs.
	e + r	Solid red / Single green flash		Invalid firmware
	1 - 4	Green	Off	The input is switched off
			Blinking	Overflow, underflow or open circuit
			On	Analog/digital converter running, value OK

2.3 Pinout

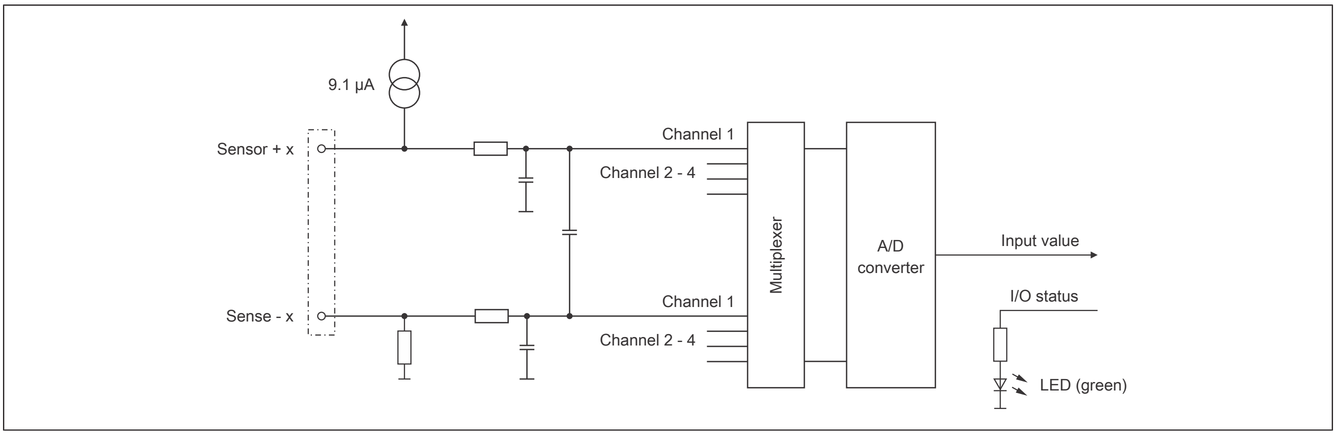
Channels that are not being used should be disabled.



2.4 Connection example



2.5 Input circuit diagram



3 Function description

3.1 Sensor type and measurement range

The module can be used for both measurement sensor and resistance measurement. The following measurement ranges result depending on the set operating mode:

Input signal	Digital value
Sensor type NTC10K type 1	-300 to 1000 (for -30.0 to 100.0°C)
Sensor type NTC10K type 2	-300 to 1000 (for -30.0 to 100.0°C)
Resistance measurement 0 to 200 kΩ	0 to 40000 (resolution 5 Ω)

In order for the user to always be supplied with a defined output value, the following must be taken into consideration:

- Up to the first conversion, 0x8000 is output.
- After switching the sensor type, 0x8000 is output until the first conversion.
- If the input is not switched on, 0xFFFF is output.

Information:

The register is described in "Sensor configuration" on page 10.

3.2 Monitoring the input signal

The module's inputs are monitored. A change in the monitoring status is actively transmitted as an error message.

Bit value	Information
00	No error
01	Lower limit value undershot
10	Upper limit value overshot
11	Open circuit

Limiting the analog value

In addition to the status information, the analog value is fixed to the values listed below by default in an error state.

Error state	Temperature measurement Digital value on error	Resistance measurement Digital value on error
Open circuit	32767 (0x7FFF)	65535 (0xFFFF)
Upper limit value overshot	32767 (0x7FFF)	65535 (0xFFFF)
Lower limit value undershot	-32767 (0x8001)	0 (0x0000)
Invalid value	-32768 (0x8000)[1)] 32767 (0x7FFF)[2)] 65535 (0xFFFF)[3)]	65535 (0xFFFF)

1) Default value or channel was disabled in the I/O configuration.
2) After switching off the channel during operation.
3) Value in function model 254 - Bus controller.

Information:

The register is described in "Status of the inputs" on page 11.

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.

4.2 Configuring the conversion cycle

The timing for acquiring measured values is controlled by the converter hardware. All switched-on inputs are converted during each conversion cycle and transferred halfway through the X2X Link cycle.

4.2.1 Conversion time

The conversion time for the channels depends on their use. For the formulas listed in the table, "n" corresponds to the number of channels that are switched on.

Use of the channels	Conversion time
1 channel	1 · Filter time
n channels with the same sensor type	n · (20 ms + Filter time)
n channels with different sensor types	n · (20 ms + 2 · Filter time)

4.2.2 Reduced update time

Any inputs that are not needed can be switched off, which reduces the I/O update time. Inputs can also be only switched off temporarily.

Calculating the time saved

The amount of time saved can be calculated with the following formula. And "n" corresponds to the number of inputs that are switched off.

$$\text{Time saved} = n \cdot (20\text{ ms} + \text{filter time})$$

Examples

Inputs are filtered using a 60 Hz filter.

	Example 1	Example 2	Example 3
Switched on inputs	1	1 and 3	1 to 4
Conversion time	16.7 ms	73.4 ms	146.8 ms

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 - Standard

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
16	ConfigOutput01 (Input filter)	USINT				•
18	ConfigOutput02 (Sensor configuration)	UINT				•
Communication						
0	Temperature01	INT	•			
	Resistor01	UINT				
2	Temperature02	INT	•			
	Resistor02	UINT				
4	Temperature03	INT	•			
	Resistor03	UINT				
6	Temperature04	INT	•			
	Resistor04	UINT				
28	IOCycleCounter	USINT	•			
30	StatusInput01	USINT	•			

5.3 Function model 254 - Bus controller

Register	Offset[1]	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Configuration							
16	-	ConfigOutput01 (Input filter)	USINT				•
18	-	ConfigOutput02 (Sensor configuration)	UINT				•
Communication							
0	0	Temperature01	INT	•			
	0	Resistor01	UINT				
2	2	Temperature02	INT	•			
	2	Resistor02	UINT				
4	4	Temperature03	INT	•			
	4	Resistor03	UINT				
6	6	Temperature04	INT	•			
	6	Resistor04	UINT				
28	-	IOCycleCounter	USINT		•		
30	-	StatusInput01	USINT		•		

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

5.4 Configuration

5.4.1 Input filter

Name:
ConfigOutput01

The filter time of all analog inputs is defined in this register.

Data type	Value	Filter	Filter time
USINT	0	15 Hz	66.7 ms
	1	25 Hz	40 ms
	2	30 Hz	33.3 ms
	3	50 Hz (bus controller default setting)	20 ms
	4	60 Hz	16.7 ms

5.4.2 Sensor configuration

Name:
ConfigOutput02

This register can be used to configure the sensor type for individual channels.

This module is designed for temperature and resistance measurement. The sensor type must be specified because of the different calibration values for temperature and resistance.

The default setting for all channels is ON. To save time, individual channels can be switched off (see "Reduced update time" on page 8).

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

Bit structure:

Bit	Name	Value	Information
0 - 3	Channel 1	0000	Sensor: NTC10K type 1 (bus controller default setting) [1]
		0001	Sensor: NTC10K type 2 [2]
		0010	Reserved
		0011	Reserved
		0100	Channel switched off
		0101	Resistance measurement 0 to 200 kΩ
		0110	Reserved
		0111	Channel switched off
		1000 - 1111	Reserved
...		...	
12 - 15	Channel 4	0000	Sensor: NTC10K type 1 (bus controller default setting) [1]
		0001	Sensor: NTC10K type 2 [2]
		0010	Reserved
		0011	Reserved
		0100	Channel switched off
		0101	Resistance measurement 0 to 200 kΩ
		0110	Reserved
		0111	Channel switched off
		1000 - 1111	Reserved

1) Sensor NTC10K type 1: Vishay NTCLE100E3103GB0, $B_{25/85}$ = 3977
2) Sensor NTC10K type 2: Vishay NTCLE413E2103F400L, $B_{25/85}$ = 3435

5.5 Communication

5.5.1 Analog inputs

The module outputs the converted analog values to the registers. Other ranges of values or data types result depending on resistance or temperature measurement.

Information:

Operating channels outside specifications can affect neighboring channels.

5.5.1.1 Input values of analog inputs

Name:
Temperature01 to Temperature04
Resistor01 to Resistor04

This register is used to indicate the analog input values depending on the configured operating mode.

Data type	Digital value	Input signal
INT	-300 to 1000 (for -30.0 to 100.0°C)	Sensor NTC10K type 1
	-300 to 1000 (for -30.0 to 100.0°C)	Sensor NTC10K type 2
UINT	0 to 40000 (resolution 5 Ω)	Resistance measurement 0 to 200 kΩ

5.5.2 I/O cycle counter

Name:
IOCycleCounter

The cyclic counter increases after all input data has been updated.

Data type	Values	Information
USINT	0 to 255	Repeating counter

5.5.3 Status of the inputs

Name:
StatusInput01

The module's inputs are monitored. A change in the monitoring status is actively issued as an error message and, in the event of an error, the analog value is fixed at defined values. For details, see "Monitoring the input signal" on page 7.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	Channel 1	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit
...		...	
6 - 7	Channel 4	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit

5.6 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
100 μs

5.7 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 input	Equal to the filter time
n inputs	n · (20 ms + filter time)