

X20(c)AT4222

1 General information

The module is equipped with 4 inputs for PT100/PT1000 resistance temperature measurement.

- 4 inputs for resistance temperature measurement
- For PT100 and PT1000
- Configurable sensor type per channel
- Direct resistance measurement
- Configurable 2- or 3- wire connections per module
- Configurable filter time

2 Coated modules

Coated modules are X20 modules with a protective coating for the electronics component. This coating protects X20c modules from condensation and corrosive gases.

The modules' electronics are fully compatible with the corresponding X20 modules.

For simplification purposes, only images and module IDs of uncoated modules are used in this data sheet.

The coating has been certified according to the following standards:

- Condensation: BMW GS 95011-4, 2x 1 cycle
- Corrosive gas: EN 60068-2-60, Method 4, exposure 21 days



3 Order data


Model number	Short description	Figure
	Temperature measurement	
X20AT4222	X20 temperature input module, 4 inputs for resistance measurement, PT100, PT1000, resolution 0.1°C, 3-wire connections	
X20cAT4222	X20 temperature input module, coated, 4 inputs for resistance measurement, PT100, PT1000, resolution 0.1°C, 3-wire connections	
	Required accessories	
	Bus modules	
X20BM11	X20 bus module, 24 VDC keyed, internal I/O supply continuous	
X20cBM11	X20 bus module, coated, 24 VDC keyed, internal I/O supply continuous	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20AT4222, X20cAT4222 - Order data

4 Technical data

Model number	X20AT4222	X20cAT4222
Short description		
I/O module	4 inputs for PT100 or PT1000 resistance temperature measurement	
General information		
B&R ID code	0x1BA7	0xE215
Status indicators	I/O function per channel, operating state, module status	
Diagnosics		
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	1.1 W	
Additional power dissipation caused by the actuators (resistive) [W]	-	
Electrical isolation		
Channel - Bus	Yes	
Channel - Channel	No	
Certification		
CE	Yes	
KC	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 FTZÚ 09 ATEX 0083X	
DNV GL	Temperature: B (0 - 55°C) Humidity: B (up to 100%) Vibration: B (4g) EMC: B (Bridge and open deck)	
LR	ENV1	-
GOST-R	Yes	
Temperature inputs resistance measurement		
Input	Resistance measurement with constant current supply for 2- or 3-wire connections	
Digital converter resolution	16-bit	
Filter time	Configurable between 1 ms 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	
PT100	-200 to 850°C	
PT1000	-200 to 850°C	
Resistance measurement range	0.1 to 4500 Ω / 0.05 to 2250 Ω	
Input filter	1st-order low pass / cutoff frequency 500 Hz	
Sensor standard	EN 60751	
Common-mode range	>0.7 V	
Isolation voltage between channel and bus	500 V _{eff}	
Linearization method	Internal	
Measuring current	250 μA ±1.25%	
Reference	4530 Ω ±0.1%	
Permitted input signal	Short-term max. ±30 V	
Max. error at 25°C		
Gain	0.037% ¹⁾	
Offset	0.0015% ²⁾	
Max. gain drift	0.004 %/°C ¹⁾	
Max. offset drift	0.00015 %/°C ²⁾	
Nonlinearity	<0.001% ²⁾	
Crosstalk between channels	<-93 dB	
Temperature sensor resolution		
PT100	1 LSB = 0.1°C	
PT1000	1 LSB = 0.1°C	
Resistance measurement resolution		
G = 1	0.1 Ω	
G = 2	0.05 Ω	

Table 2: X20AT4222, X20cAT4222 - Technical data


Model number	X20AT4222	X20cAT4222
Common-mode rejection		
50 Hz		>80 dB
DC		>95 dB
Standardized value range for resistance measurement		
G = 1		0.1 to 4500 Ω
G = 2		0.05 to 2250 Ω
Temperature sensor normalization		
PT100		-200.0 to 850.0°C
PT1000		-200.0 to 850.0°C
Temperature measurement monitoring		
Range exceeded (neg.)		0x8001
Above upper range limit		0x7FFF
Open circuit		0x7FFF
General error		0x8000
Open inputs		0x7FFF
Resistance measurement monitoring		
Above upper range limit		0xFFFF
Open circuit		0xFFFF
General error		0xFFFF
Open inputs		0xFFFF
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
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	Up to 100%, condensing
Storage	5 to 95%, non-condensing	
Transport	5 to 95%, non-condensing	
Mechanical characteristics		
Note	Order 1x X20TB12 terminal block separately Order 1x X20BM11 bus module separately	Order 1x X20TB12 terminal block separately Order 1x X20cBM11 bus module separately
Spacing	12.5 ^{+0.2} mm	

Table 2: X20AT4222, X20cAT4222 - Technical data

- 1) Based on the current resistance value.
- 2) Based on the entire resistance measurement range.

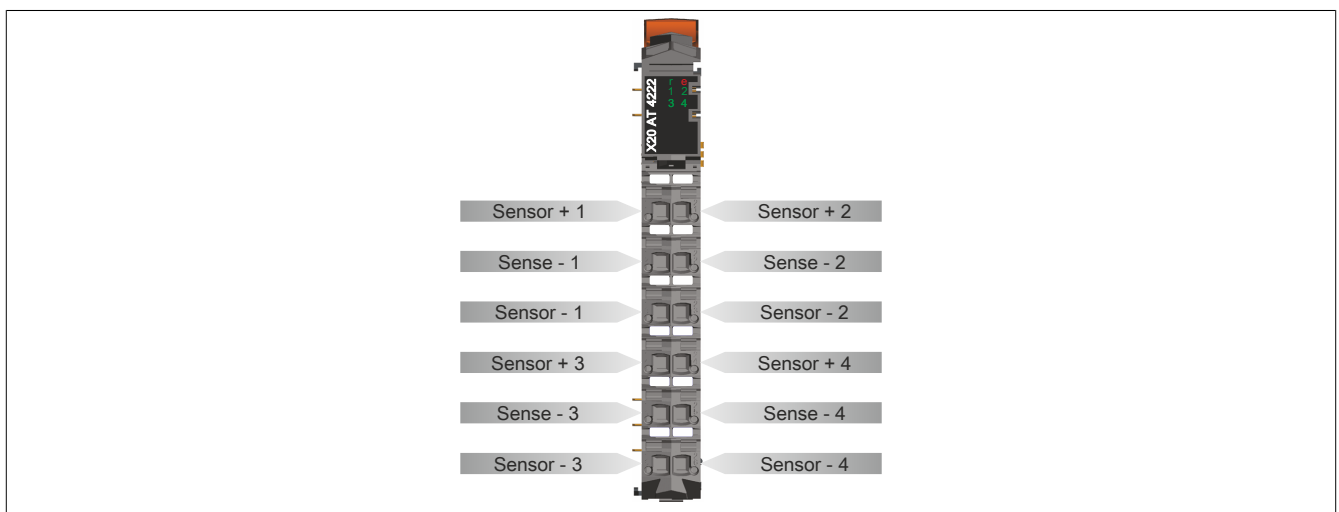
5 LED status indicators

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

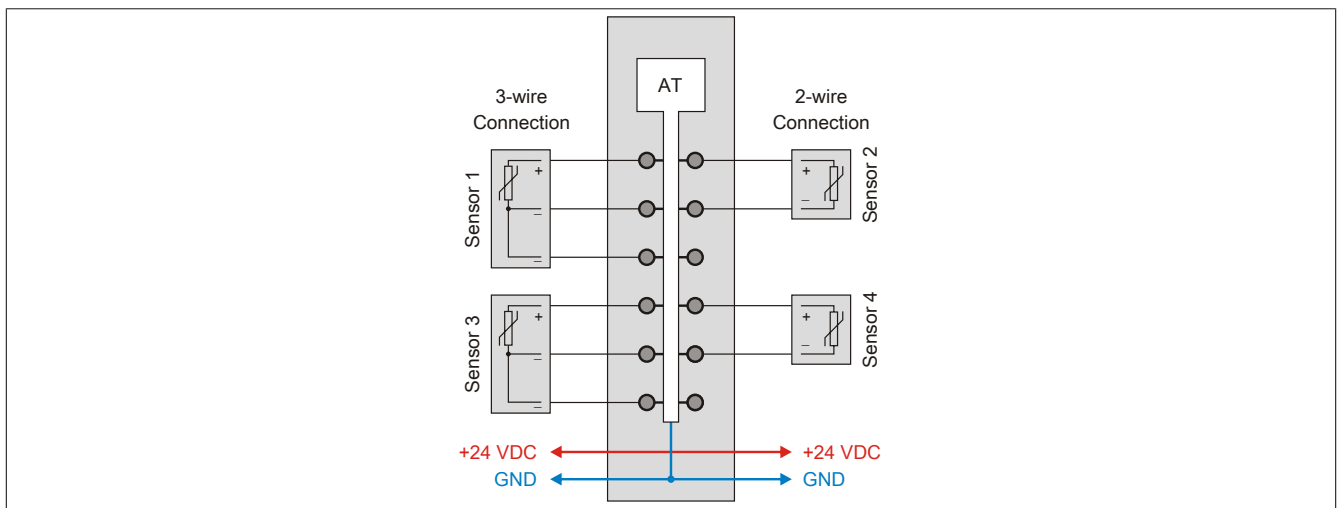
Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	RESET mode
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			On	Error or reset status
			Single flash	Warning/Error on an I/O channel. Overflow or underflow of the analog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

6 Pinout

Channels that are not being used should be disabled.

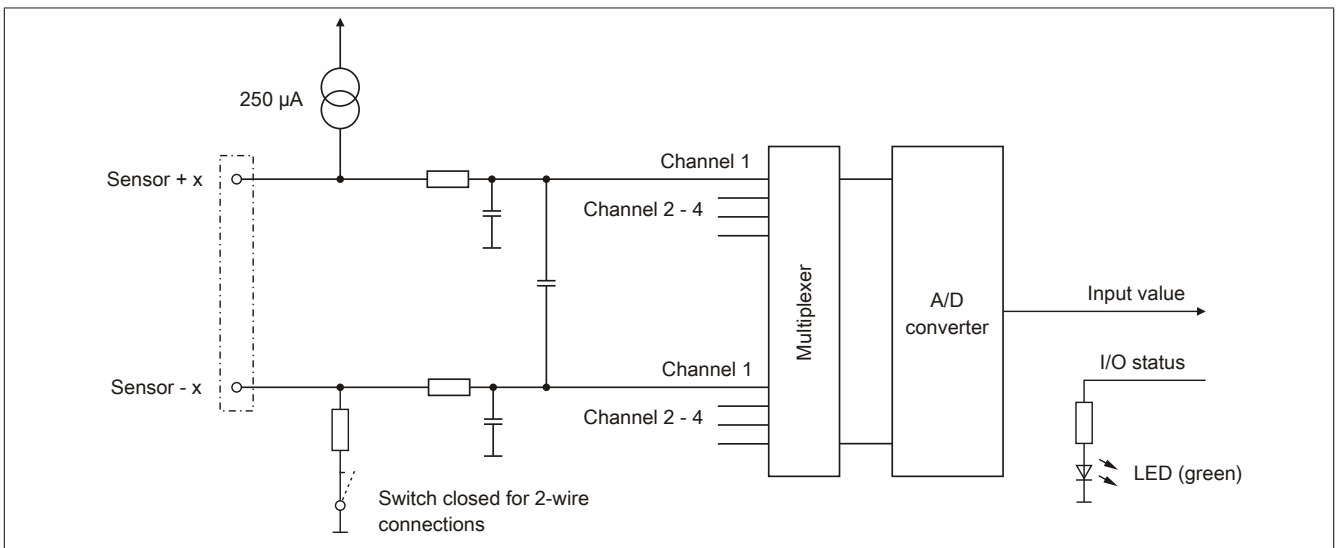


7 Connection example

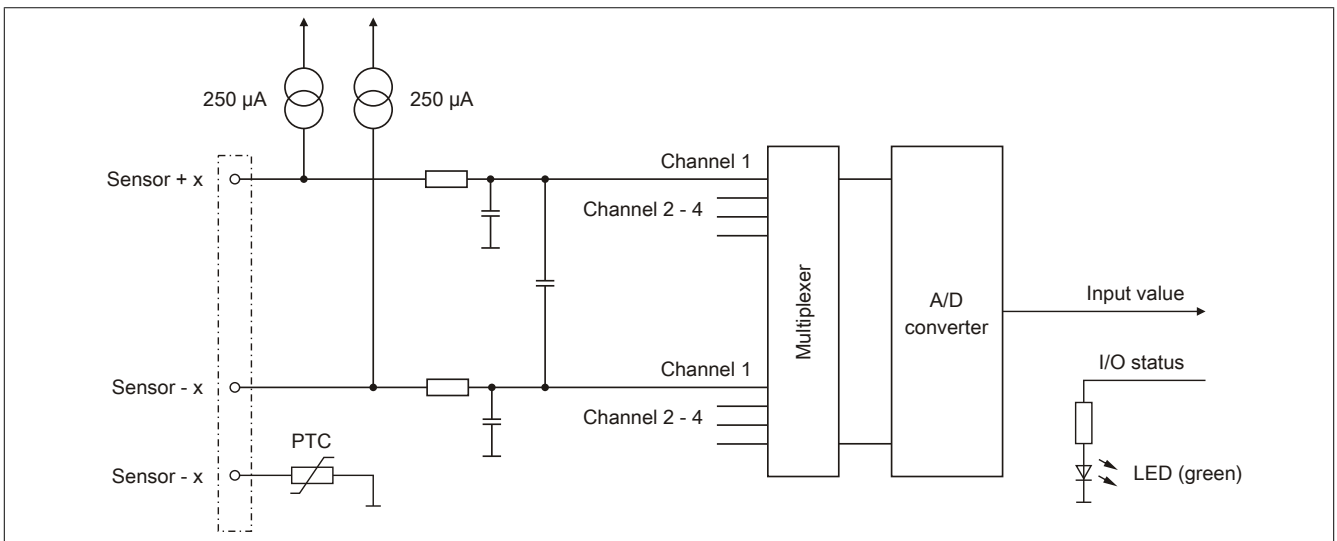


8 Input circuit diagram

2-wire connections



3-wire connections



9 Register description

9.1 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.

9.2 Function model 0 - "3-wire connections" and function model 1 - "2-wire connections"

For this module, the connection type is selected using function models 0 and 1.

Function model	Connection type
0	3-wire connections (standard)
1	2-wire connections

The registers used are identical for both function models:

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
Configuration						
16	ConfigOutput01	USINT				•
18	ConfigOutput02	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	•			

9.3 Function model 254 - Bus controller

Register	Offset ¹⁾	Name	Data type	Read		Write	
				Cyclic	Acyclic	Cyclic	Acyclic
Configuration							
16	-	ConfigOutput01	USINT				•
18	-	ConfigOutput02	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.

9.3.1 CAN I/O bus controller

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

9.4 General information

9.4.1 Analog inputs

This module stores converted analog values in the registers. Different resistance or temperature measurements will result in different value ranges and data types.

Information:

Operating channels outside the specification can have an effect on neighboring channels.

9.4.2 Timing

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

9.4.3 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.

Channel uses	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)

9.4.4 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

9.5 Configuration

9.5.1 Input filter

Name:

ConfigOutput01

This register can be used to configure the filter time for all analog inputs.

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	20 ms
	4	60 Hz	16.7 ms
	5	100 Hz	10 ms
	6	500 Hz	2 ms
	7	1000 Hz	1 ms

9.5.2 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](#)").

Data type	Value
UINT	See bit structure.

Bit structure:

Bit	Name	Value	Information
0 - 3	Channel 1	0000 - 0001	Reserved
		0010	PT100 sensor type
		0011	PT1000 sensor type
		0100	Reserved
		0101	Resistance measurement 0.1 to 4500 Ω
		0110	Resistance measurement 0.05 to 2250 Ω
		1111	Channel disabled
...
12 - 15	Channel 4	0000 - 0001	Reserved
		0010	PT100 sensor type
		0011	PT1000 sensor type
		0100	Reserved
		0101	Resistance measurement 0.1 to 4500 Ω
		0110	Resistance measurement 0.05 to 2250 Ω
		1111	Channel disabled

9.6 Communication

9.6.1 Analog input values

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	-2000 to 8500 (for -200.0 to 850.0°C)	PT100 sensor type
	-2000 to 8500 (for -200.0 to 850.0°C)	PT1000 sensor type
UINT	1 to 45000 (resolution 0.1 Ω)	Resistance measurement 0.1 to 4500 Ω
	1 to 45000 (resolution 0.05 Ω)	Resistance measurement 0.05 to 2250 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, 0x8000 is output.

9.6.2 I/O cycle counter

Name:

IOCycleCounter

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

Data type	Value	Information
USINT	0 to 255	Repeating counter

9.6.3 Status of the inputs

Name:

StatusInput01

The module's inputs are monitored. A change in the monitoring status generates an error message.

Data type	Value
USINT	See bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	Channel 1	00	No error
		01	Below lower limit value
		10	Above upper limit value
		11	Open circuit
...
6 - 7	Channel 4	00	No error
		01	Below lower limit value
		10	Above upper limit value
		11	Open circuit

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.

Error status	Temperature measurement Digital value for error	Resistance measurement Digital value for error
Open circuit	32767 (0x7FFF)	65535 (0xFFFF)
Above upper limit value	32767 (0x7FFF)	65535 (0xFFFF)
Below lower limit value	-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.

9.7 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	
100 μ s	

9.8 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 input	Equal to the filter time
n inputs	$n \cdot (20 \text{ ms} + \text{filter time})$