X20(c)AT2311

Data sheet
3.40 (October 2024)

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 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

1.3 Order data

Order number	Short description	Figure
	Temperature measurement	
X20AT2311	X20 temperature input module, 2 resistance measurement inputs, PT100, resolution 0.001°C, 4-wire connections	
X20cAT2311	X20 temperature input module, coated, 2 resistance measurement inputs, Pt100, resolution 0.001°C, 4-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	
X20cBM11	X20 bus module, coated, 24 VDC keyed, internal I/O power supply connected through	
	Terminal blocks	
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed	

Table 1: X20AT2311, X20cAT2311 - Order data

1.4 Module description

The module is equipped with 2 inputs for PT100 4-line resistance temperature measurement.

- 2 inputs for resistance temperature measurement
- PT100 sensor
- Direct resistance measurement
- 4-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	X20AT2311	X20cAT2311
Short description		
I/O module	2 inputs for PT100 resistance temperature measurement	2 inputs for Pt100 resistance temperature measurement
General information		
B&R ID code	0xA4AA	0xF3B6
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	
Power consumption		
Bus	0.35 W	
Internal I/O	0.85 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	
DNV	Temperature: **B** (0 to 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)	
CCS	Yes	-
LR	ENV1	
KR	Yes	
ABS	Yes	
BV	**EC33B** Temperature: 5 - 55°C Vibration: 4 g EMC: Bridge and open deck	
KC	Yes	-
Resistance measurement temperature inputs		
Input	Resistance measurement with constant current supply for 4-wire connections	
Digital converter resolution	24-bit	
Filter time	Configurable between 1 ms and 400 ms	
Conversion time		
1000 Hz filter	1 ms for all inputs	
50 Hz filter	20 ms for all inputs	
Conversion procedure	Sigma-delta	
Output format	DINT or UDINT for resistance measurement	
Temperature measurement range	-200 to 850°C	
Resistance measurement range	0.5 to 390 Ω	
Temperature sensor resolution	1 LSB = 0.001°C	
Resistance measurement resolution	0.001 Ω	
Input filter	First-order low-pass filter / cutoff frequency 1050 Hz	
Sensor standard	EN 60751	
Insulation voltage between channel and bus	500 V_{eff}	
Insulation voltage between channel and channel	500 V_{eff}	
Linearization method	Internal	
Measurement current	1 mA	
Temperature sensor normalization	-200.0 to 850.0°C	
Reference	1568 Ω ±0.1%	
Permissible input signal	Short-term max. 28.8 V	
Max. error at 25°C [1]		
Gain	±0.0059% [2]	
Offset	±0.0015% [3]	

Table 2: X20AT2311, X20cAT2311 - Technical data

Technical description
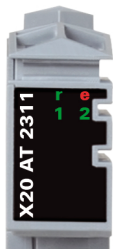
Order number	X20AT2311	X20cAT2311
Max. gain drift	±0.00065%/°C [2]	
Max. offset drift	±0.000025%/°C [3]	
Nonlinearity	<0.001% [3]	
Standardized range of values for resistance measurement	0.5 Ω to 390 Ω	
Temperature measurement monitoring		
Range undershoot	0x80000001	
Range overshoot	0x7FFFFFFF	
Open circuit	0x7FFFFFFF	
General fault	0x80000000	
Open inputs	0x7FFFFFFF	
Resistance measurement monitoring		
Range undershoot	0x80000001	
Range overshoot	0xFFFFFFFF	
Open circuit	0xFFFFFFFF	
General fault	0x80000000	
Electrical properties		
Electrical isolation	Channel isolated from channel and bus	
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	Up to 100%, 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.	Order 1x terminal block X20TB12 separately. Order 1x bus module X20cBM11 separately.
Pitch	12.5+0.2 mm	

Table 2: X20AT2311, X20cAT2311 - Technical data

1) To guarantee accuracy, dummy module ZF0000 must be connected to the left and right of module AT2311.
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
			Double flash	BOOT mode (during firmware update)[1]
			Blinking	Mode PREOPERATIONAL
			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 - 2	Green	Off	The input is switched off
			Blinking	Overflow, underflow or open line
			On	Analog/digital converter running, value OK

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

2.3 Pinout
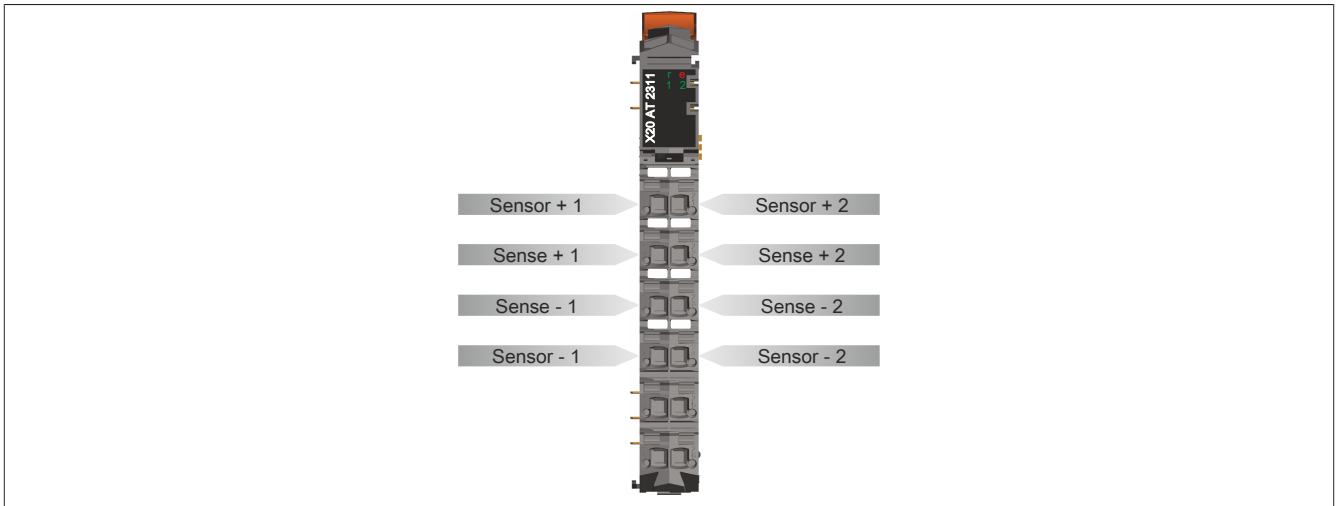
2.4 Connection example

To guarantee accuracy, a ZF dummy module must be connected to the left and right of the module.

2.5 Input circuit diagram

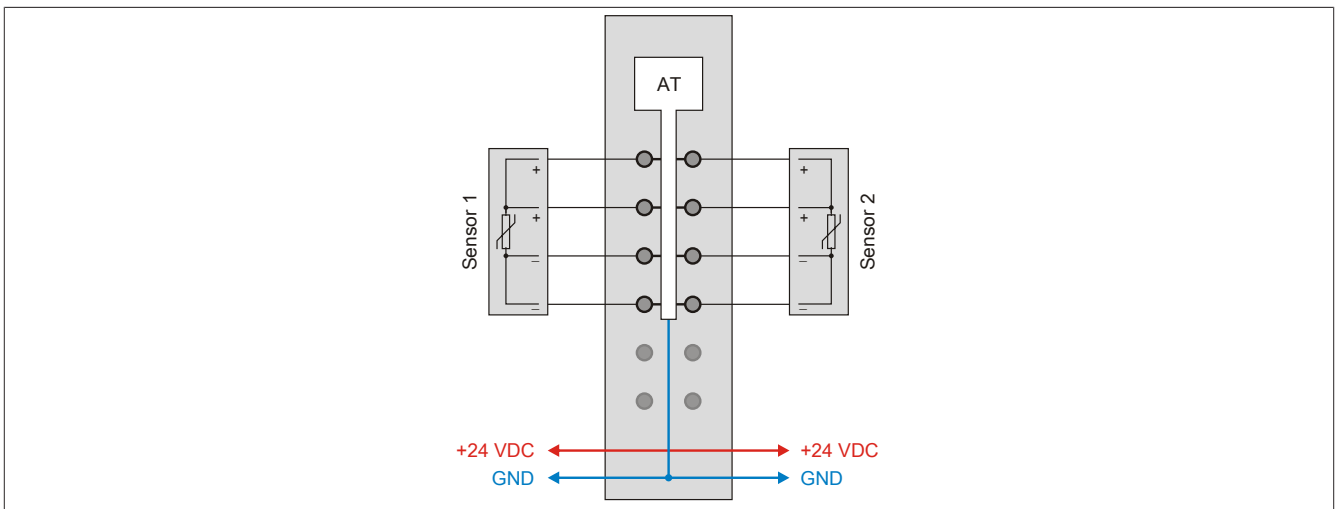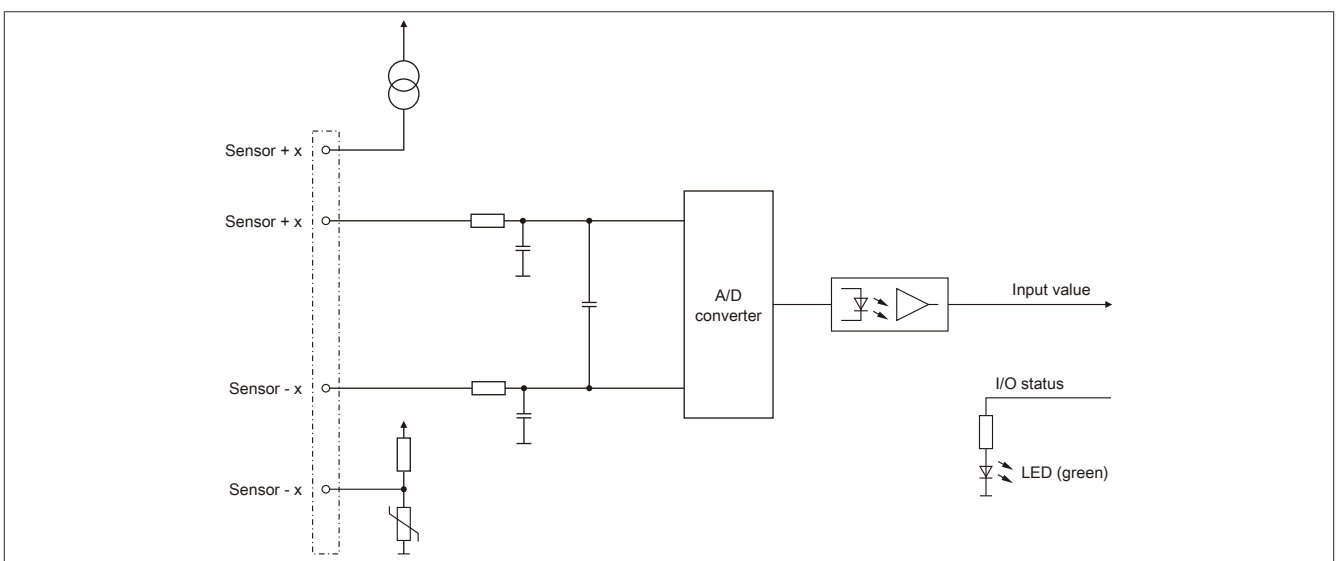# 3 Function description

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	Measurement range
Pt100 sensor type	-200.0 to 850.0°C
Resistance measurement	0.5 to 390 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, 0x80000000 is output.
- After switching the sensor type, 0x80000000 is output until the first conversion.
- If the input is not switched on, 0x80000000 is output.

Information:

The register is described in "Sensor type and channel disabling" on page 11.

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.

After an error, it takes about 15 filter times until a valid value is available again.

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

Information:

The register is described in "Status of the inputs" on page 12.

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 the filter time set in register .

Use of the channels	Conversion time
All channels regardless of configuration	1 x Filter time

4.2.2 Ratio of filter time to resolution

The following table shows the maximum frequency with which the specified resolution can be achieved.

Filter / Filter time	Resolution
5 Hz / 200 ms	0.001°C
50 Hz / 20 ms	0.01°C
1000 Hz / 1 ms	0.1°C

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						
2049	ConfigOutput01 (input filter)	USINT				•
2051	ConfigOutput02 (sensor type and channel disabling)	USINT				•
Communication						
2308	Temperature01	DINT	•			
	Resistor01	UDINT				
2316	Temperature02	DINT	•			
	Resistor02	UDINT				
2337	IOCycleCounter	USINT	•			
2345	StatusInput01	USINT	•			

5.3 Function model 254 - Bus controller

Register	Offset[1]	Name	Data type	Read		Write	
				Cyclic	**Acyclic**	**Cyclic**	**Acyclic**
Configuration							
2049	-	ConfigOutput01 (input filter)	USINT				•
2051	-	ConfigOutput02 (sensor type and channel disabling)	USINT				•
Communication							
0	0	Temperature01	DINT	•			
		Resistor01	UDINT				
4	4	Temperature02	DINT	•			
		Resistor02	UDINT				
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	20 ms
	4	60 Hz	16.7 ms
	5	100 Hz	10 ms
	6	500 Hz	2 ms
	7	1000 Hz	1 ms
	8	10 Hz (bus controller default setting)	100 ms
	9	5 Hz	200 ms
	10	2.5 Hz	400 ms

5.4.2 Sensor type and channel disabling

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.

Data type	Value	Bus controller default setting
USINT	See bit structure.	17

Bit structure:

Bit	Name	Value	Information
0 - 3	Channel 1	0000	Reserved
		0001	Sensor type Pt1000, resolution 1 mK (bus controller default setting)
		0010	Resistance measurement 0.5 Ω to 390 Ω, resolution 1 mΩ
		0011 to 0110	Reserved
		0111	Channel disabled
		1xxx	Reserved
4 - 7	Channel 2	0000	Reserved
		0001	Sensor type Pt1000, resolution 1 mK (bus controller default setting)
		0010	Resistance measurement 0.5 Ω to 390 Ω, resolution 1 mΩ
		0011 to 0110	Reserved
		0111	Channel disabled
		1xxx	Reserved

5.5 Communication

5.5.1 Analog measurement inputs

Name:
Temperature01 to Temperature02
Resistor01 to Resistor02

These registers contain the analog input values depending on the configured operating mode.

Name	Data type	Input signal	Digital value
Temperature01 to Temperature02	DINT	PT100 sensor type	-200000 to +850000 (for -200 to +850°C)
Resistor01 to Resistor02	UDINT	Resistance measurement 0.5 to 390 Ω	500 to 390000 (resolution 0.001 Ω)

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 8.

After an error, it takes about 15 filter times until a valid value is available again.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0 - 1	Channel 1	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit
2 - 3	Channel 2	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit
4 - 7	Reserved	0	

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
200 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 x Filter time