22.3 AT4222

22.3.1 General information

The AT4222 module is equipped with four inputs for PT100/PT1000 resistance temperature measurement.

- 4 inputs for resistance temperature measurement
- For PT100 and PT1000
- Sensor type can be be set for each channel
- Direct resistance measurement as well
- 2 or 3 wire connection can be configured for each module
- Filter time can be configured

22.3.2 Order data

Model number	Short description	Figure
	Temperature module	
X20AT4222	X20 temperature input module, 4 resistance measurement inputs, PT100, PT1000, resolution 0.1 K, 3-wire connections	
	Required accessories	
X20TB12	X20 terminal block, 12-pin, 24 V coded	
X20BM11	X20 bus module, 24 V coded, internal I/O supply is interconnected	

Table 529: AT4222 - Order data

22.3.3 Technical data

Product ID	AT4222
Short description	
I/O module	4 inputs for PT100 or PT1000 resistance temperature measurement
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 2 - 4 channels	 20 ms at 50 Hz filter 40 ms per channel with 50 Hz filter
Output format	INT or UINT for resistance measurement
Maximum error at 25°C Gain Offset	 0.037%, based on the current resistance value 0.0015%, based on the entire resistance range
Sensor PT100 PT1000	Can be set per channel -200°C to +850°C -200°C to +850°C
Resistance measurement range	0.1 Ω to 4500 Ω / 0.05 Ω to 2250 Ω
General information	
Status indicators	I/O function per channel, operating state, module status
Diagnostics Module run/error Inputs	 Yes, with status LED and software status Yes, with status LED and software status
Electrical isolation Channel - Bus Channel - Channel	 Yes No
Power consumption Bus I/O internal	 0.01 W 1.1 W
Certification	CE, C-UL-US, GOST-R
Operating conditions	
Operating temperature Horizontal installation Vertical installation	 0°C to +55°C 0°C to +50°C
Relative humidity	5 to 95%, non-condensing
Mounting orientation	Horizontal or vertical
Installation at altitudes above sea level 0 - 2000 m >2000 m	 No derating Reduction of ambient temperature by 0.5°C per 100 m
Protection type	IP20

Table 530: AT4222 - Technical data

Product ID	AT4222
Storage and transport conditions	
Temperature	-25°C to +70°C
Relative humidity	5 to 95%, non-condensing
Mechanical characteristics	
Spacing	12.5 $^{+0.2}$ mm
Comment	Order terminal block 1x X20TB12 separately Order bus module 1x X20BM11 separately

Table 530: AT4222 - Technical data (cont.)

22.3.4 Additional technical data

Product ID	AT4222
Temperature inputs - Resistance measurement	
Sensor standard	IEC/EN 60751
Temperature sensor resolution PT100 PT1000	 1 LSB = 0.1°C 1 LSB = 0.1°C
Resistance measurement resolution G = 1 G = 2	 0.1 Ω 0.05 Ω
Temperature sensor standardization PT100 PT1000	 -200.0°C to +850.0°C -200.0°C to +850.0°C
Standardized value range for resistance measurement G = 1 G = 2	 0.1 Ω to 4500.0 Ω 0.05 Ω to 2250.0 Ω
Temperature measurement monitoring Open inputs Wire break Below lower range limit Above upper range limit General error	 $7FFF $7FFF $8001 $7FFF $8000
Resistance measurement monitoring Open inputs Wire break Above upper range limit General error	 $FFFF $FFFF $FFFF $FFFF
Conversion method	pSigma Delta
Linearization method	Internal
Reference	4530 Ω ±0.1%
Measuring current	250 µA ±1.25%
Permitted input signal	Short-term max. ±30 V
Input filter	Low pass 1st order / cut-off frequency 500 Hz
Maximum gain drift	0.004%/°C, based on the current resistance measurement

Table 531: AT4322 - Additional technical data

Product ID	AT4222
Maximum offset drift	0.00015%/°C, based on the entire resistance measurement range
Common-mode rejection DC 50 Hz	 >95 dB >80 dB
Synchronized zone	>0.7 V
Cross-talk between channels	>93 dB
Non-linearity	<0.0010%, based on the entire resistance range
Isolation voltage betw. channel and bus	500 V_{eff}
General information	
B&R ID code	$1BA7

Table 531: AT4322 - Additional technical data (cont.)

22.3.5 Status LEDs

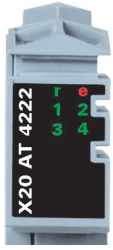
Figure	LED	Color	Status	Description
	r	Green	Off	Module supply not connected
			Single flash	Reset mode
			Blinking	Preoperational mode
			On	RUN mode
	e	Red	Off	Module supply not connected or everything is OK
			On	Error or reset state
			Single flash	Warning/error for an I/O channel. Overflow or underflow of the analog inputs.
	e + r	Steady red / single green flash		Invalid firmware
	1 - 4	Green	Off	The input is switched off
			Blinking	Overflow, underflow or broken connection
			On	The analog/digital converter is running, value is OK

Table 532: AT4222 - Status indicators

22.3.6 Pin assignments

Channels that are not being used should be deactivated.

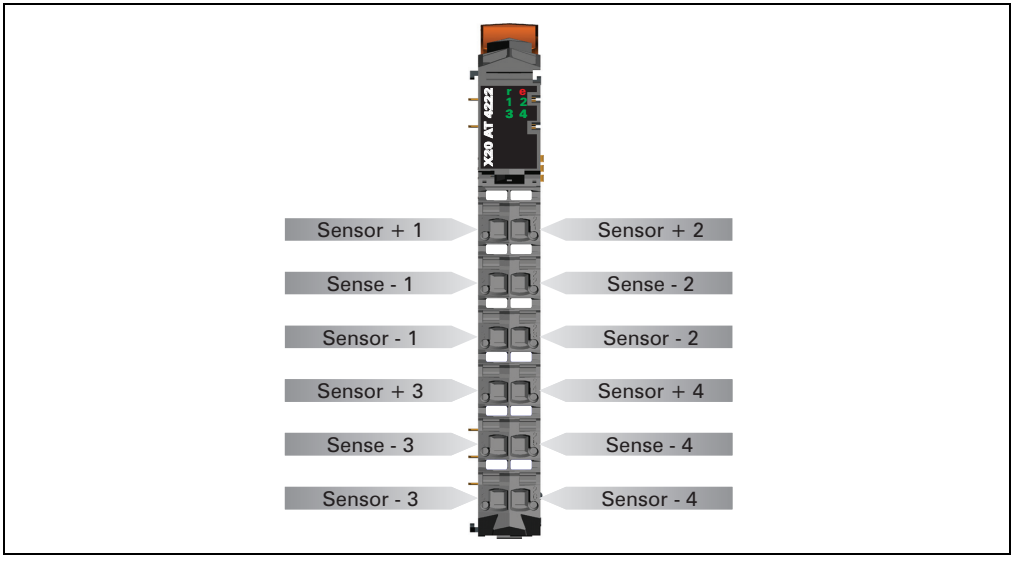


Figure 399: AT4222 - Pin assignments

22.3.7 Connection example

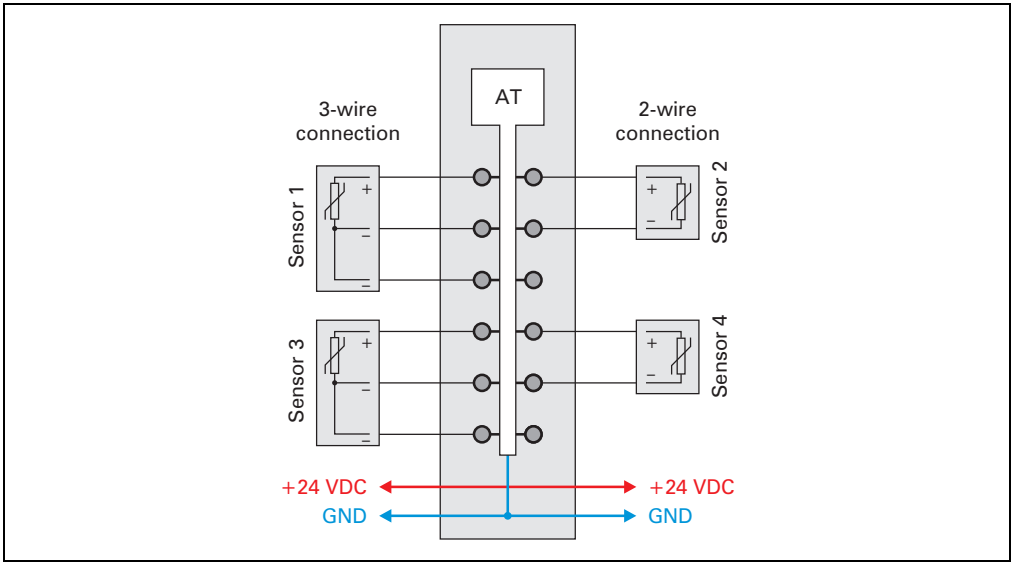


Figure 400: AT4222 - Connection example

22.3.8 Input circuit diagram

2-line connection

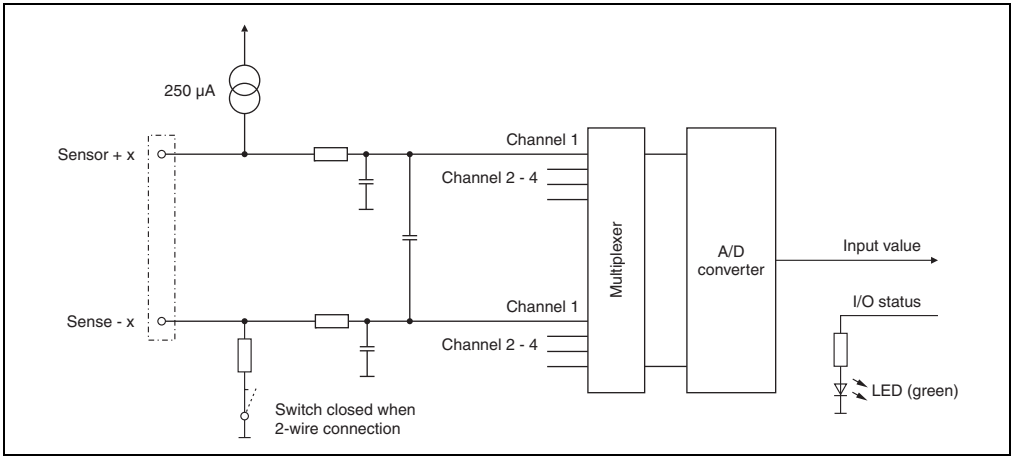


Figure 401: AT4222 - Input circuit diagram - 2-wire connection

3-line connection

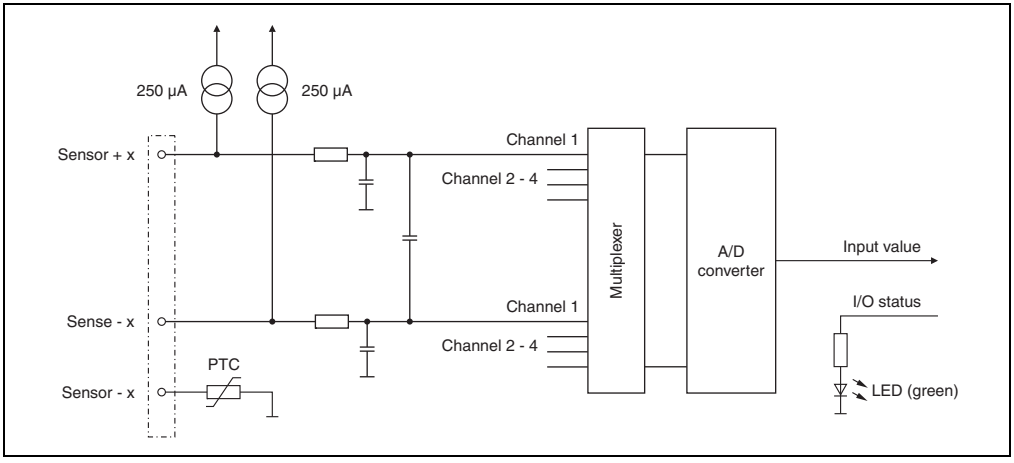


Figure 402: AT4222 - Input circuit diagram - 3-wire connection

22.3.9 Analog inputs

The converted analog values are output by the module in the registers. Different resistance or temperature measurements will result in different value ranges and data types.

22.3.10 Timing setting

The timing setting for data acquisition is made using the converter hardware. All switched on inputs are converted during each conversion cycle.

22.3.11 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	$1 \cdot FilterTime$
n channels with the same sensor type	$n \cdot (20ms + FilterTime)$
n channels with different sensor types	$n \cdot (20ms + 2 \cdot FilterTime)$

22.3.12 Reduced refresh time

If an input is not necessary, it can be switched off, thereby reducing the refresh time. Inputs can also be only temporarily switched off.

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.

$$TimeSaved = n \cdot (20ms + FilterTime)$$

Examples

The inputs are filtered using a 60 Hz filter.

	Example 1	Example 2	Example 3
Switched on inputs	1	1, 3	1 - 4
Conversion time	16.7 ms	73.4 ms	146.8 ms

22.3.13 Input filter

The filter time for all analog inputs is defined using the input filter parameter.

Value	Filter	Filter time	Digital converter resolution
0	15 Hz	66.7 ms	16-bit
1	25 Hz	40 ms	16-bit
2	30 Hz	33.3 ms	16-bit
3	50 Hz	20 ms	16-bit
4	60 Hz	16.7 ms	16-bit
5	100 Hz	10 ms	16-bit
6	500 Hz	2 ms	16-bit
7	1000 Hz	1 ms	16-bit

22.3.14 Sensor type and channel deactivation

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

The default setting for all channels is ON. To save time, individual channels can be switched off (see section 22.3.12 "Reduced refresh time" on page 864).

Code	Input signal
0	Reserved
1	Reserved
2	Sensor type PT100
3	Sensor type PT1000
4	Reserved
5	Resistance measurement 0.1 Ω to 4500 Ω
6	Resistance measurement 0.05 Ω to 2250 Ω
7	Channel turned off

22.3.15 Input status

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

Code	Channel x
0	No error
1	Below lower limit value
2	Above upper limit value
3	Wire break

22.3.16 "StatusInput01" register

Bit	Description
0 - 1	Channel 1: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break
2 - 3	Channel 2: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break
4 - 5	Channel 3: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break
6 - 7	Channel 4: 00 ... No error 01 ... Below lower limit value 10 ... Above upper limit value 11 ... Wire break

In addition to the status info, the error type also sets the analog value to the following values:

Error type	Temperature measurement Digital value for error	Resistance measurement Digital value for error
Wire break	+32767 ($7FFF)	65535 ($FFFF)
Above upper limit value	+32767 ($7FFF)	65535 ($FFFF)
Below lower limit value	-32767 ($8001)	0 ($0000)
Invalid value	-32768 ($8000)	65535 ($FFFF)

22.3.17 IOCyclicCounter

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

22.3.18 B&R ID code

Code for module identification ($1BA7).

22.3.19 Minimum cycle time

The minimum cycle time is the minimum time needed for the bus cycle to be shut down without a communication error or malfunction occurring. It should be noted that very fast cycles reduce the idle time needed for handling monitoring, diagnostics and acyclic commands.

Minimum cycle time	
In each operating mode	100 µs

22.3.20 Minimum I/O update time

The minimum I/O update time refers to the minimum time it takes for the bus cycle to shut down, so that in each cycle an I/O update takes place.

Minimum I/O update time	
1 input	Equal to the filter time
n inputs	$n \cdot (20ms + FilterTime)$