SIGMATEK

AI 023

S-DIAS Analog Input Module

Operating Manual

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Translation from German

S-DIAS Analog Input Module AI 023

with 2 resistance or temperature inputs

The AI 023 S-DIAS analog input module has two resistance inputs with five settable measurement ranges from 0-250 Ω, 0-500 Ω, 0-1000 Ω, 0-2500 Ω and 0-5000 Ω. Supported temperature sensors include PT100, PT1000, NI100, NI1000 and various KTY sensors. The module allows a connection with 2 or 4-wire measuring technology. The analog inputs are galvanically separated from the S-DIAS bus.

Contents

1 Technical Data

1.1 Analog Input Specifications Resistance/Temperature

Number of channels	2
Measurement range	see the following measurement range table.
AD converter resolution	16 bits
typical current measurement	< 0.3 ms
Conversion time for all channels	4 ms
Input resistance	> 10 MΩ
Input filter hardware	10 kHz, low pass 2nd order
Input filter software	configurable
Measurement precision	±0.3 % of maximum measurement value
Resistance sensor connector cable	< 100 Ω
Galvanic separation of analog inputs to the S-DIAS bus.	yes (560 V)
Status display	green LEDs

1.2 Measurement Ranges

1.2.1 Measurement Range of Resistance Inputs

Type	Resistance range	Measurement value (1)
1	0-250 Ω	0-2500
2	0-500 Ω	0-5000
3	0-1000 Ω	0-10000
4	0-2500 Ω	0-25000
5	0-5000 Ω	0-50000

(1) With an open input, the hardware class returns -2147483632.

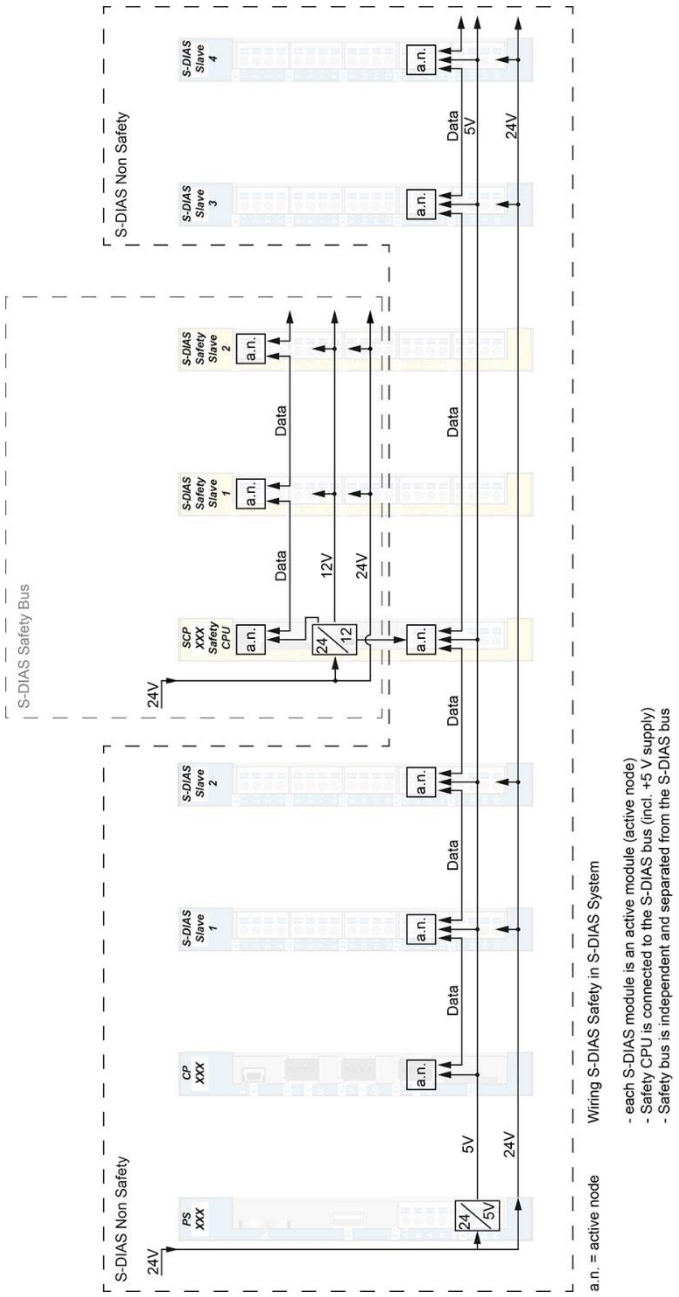
1.2.2 Measurement Range of Temperature Inputs

Type	Temperature range	Resistance range	Measurement value [1]
Pt100	-200 ... +150°C	18.5-157.3 Ω	-2000 … +1500
Pt100	-200 ... +850°C	18.5-390.5 Ω	-2000 ... +8500
Pt200	-200 ... +150°C	37.0-314.6 Ω	-2000 ... +1500
Pt200	-200 ... +850°C	37.0-781.0 Ω	-2000 ... +8500
Pt500	-200 ... +150°C	92.6-786.6 Ω	-2000 ... +1500
Pt500	-200 ... +850°C	92.6-1952.4 Ω	-2000 ... +8500
Pt1000	-200 ... +150°C	185.2-1573.3 Ω	-2000 ... +1500
Pt1000	-200 ... +850°C	185.2-3904.8 Ω	-2000 ... +8500
NI100	-60 ... +150°C	69.5-198.6 Ω	-600 ... +1500
NI100	-60 ... +250°C	69.5-289.2 Ω	-600 ... +2500
NI1000	-60 ... +150°C	695.2-1986.3 Ω	-600 ... +1500
NI1000	-60 ... +250°C	695.2-2891.6 Ω	-600 ... +2500
KTY10-62 KTY11-62	-50 ... +150°C	1035.9-4575.3 Ω	-500 … +1500
KTY81-110 KTY81-120 KTY81-150	-55 ... +150°C	490.0-2211.0 Ω	-550 … +1500
KTY81-121	-55 ... +150°C	485.1-2189.1 Ω	-550 … +1500
KTY81-122	-55 ... +150°C	494.9-2233.0 Ω	-550 … +1500
KTY84-130) KTY84-150	-40 ... +300 °C	358.8-2623.0 Ω	-400 … +3000

[1] With an open or shorted input, the hardware class returns -2147483632

1.3 Electrical Requirements

Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V power supply)	typically 46 mA at +18 V typically 37 mA at +24 V typically 32 mA at +30 V	maximum 50 mA at +18 V maximum 41 mA at +24 V maximum 36 mA at +30 V


S-DIAS Non Safety
S-DIAS Safety Bus
S-DIAS Non Safety
24V
PS XXX
CP XXX
S-DIAS Slave 1
S-DIAS Slave 2
SCP XXX Safety CPU
S-DIAS Safety Slave 1
S-DIAS Safety Slave 2
S-DIAS Slave 3
S-DIAS Slave 4
a.n.
Data
5V
12V
24V
24/5V
24/12
a.n. = active node
Wiring S-DIAS Safety in S-DIAS System
- each S-DIAS module is an active module (active node)
- Safety CPU is connected to the S-DIAS bus (incl. +5 V supply)
- Safety bus is independent and separated from the S-DIAS bus

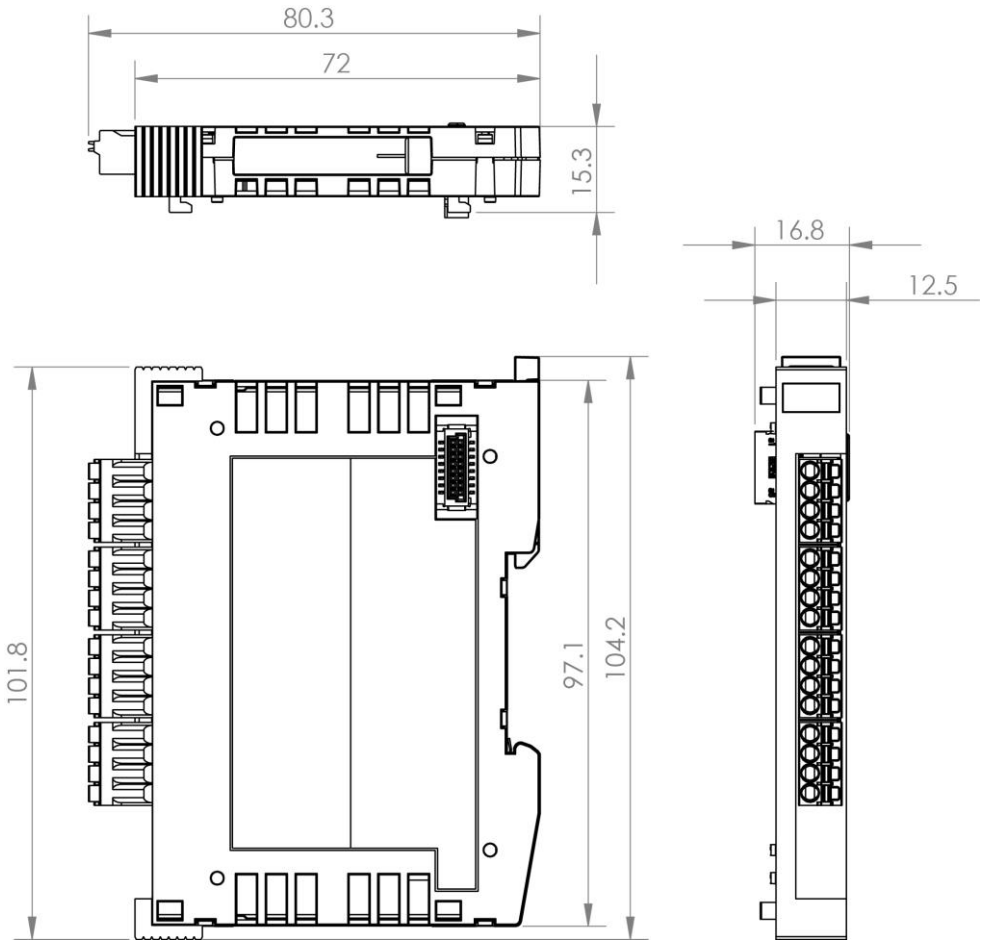
1.4 Miscellaneous

Article number	20-009-023
Hardware version	1.x
Standard	designed according to UL
Approvals	CE

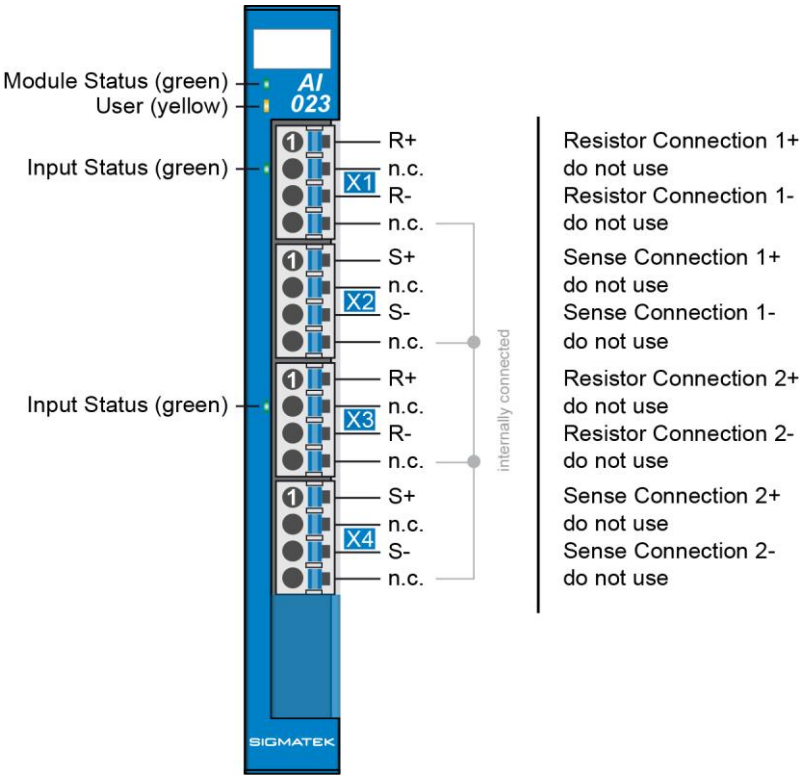
1.5 Environmental Conditions

Storage temperature	-20 ... +85°C	
Environmental temperature	0 ... +60°C	
Humidity	0-95 %, non-condensing	
Installation altitude above sea level	0-2000 m without Derating > 2000 m with derating of the maximum environmental temperature by 0.5 °C per 100 m	
Operating conditions	pollution degree 2	
EMC resistance	according to EN 61000-6-2:2007 (industrial area)	
EMC noise generation	in accordance with EN 61000-6-4 (industrial area)	
Vibration resistance	EN 60068-2-6	3.5 mm from 5-8.4 Hz 1 g from 8.4-150 Hz
Shock resistance	EN 60068-2-27	15 g
Protection type	EN 60529	IP20

2 Mechanical Dimensions



3 Connector Layout



3.1 Status LEDs

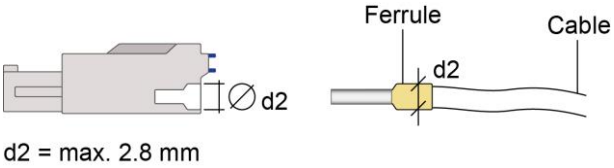
Module Status	green	ON	module active
		OFF	no supply available
		BLINKING (5 Hz)	no communication
User	yellow	ON	can be set from the application (e.g. the module LED can be set to blinking through the visualization, so that it is easily found in the control cabinet)
		OFF	
		BLINKING (2 Hz)	
		BLINKING (4 Hz)	
Input Status	green	ON	input x activated
		OFF	input x deactivated
		BLINKING (0.5 Hz)	input x below measurement range
		BLINKING (4 Hz)	input x above measurement range / sensor break

3.2 Applicable Connectors

Connectors:
X1-X4: Connectors with spring terminals (included in delivery)
The spring terminals are suited for the connection of ultrasonically compacted (ultrasonically welded) stranded wire.

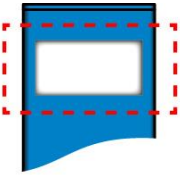
Connections:

Stripping length/sleeve length:	10 mm
Mating direction:	parallel to the conductor axis or circuit board
Conductor cross section rigid:	0.2-1.5 mm^2
Conductor cross section flexible:	0.2-1.5 mm^2
Conductor cross-section strands ultrasonically compacted:	0.2-1.5 mm^2
Conductor cross section AWG/kcmil:	24-16
Conductor cross section flexible with ferrule without plastic sleeve:	0.25-1.5 mm^2
Conductor cross section flexible with ferrule with plastic sleeve:	0.25-0.75 mm^2 (reason for reduction d2 of the ferrule)



d2 = max. 2.8 mm

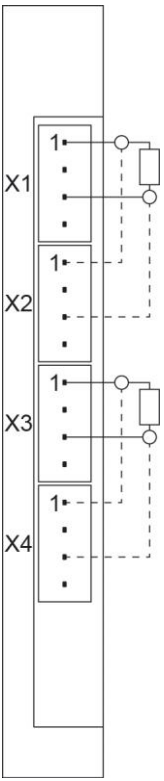
3.3 Label Field



Manufacturer	Weidmüller
Type	MF 10/5 CABUR MC NE WS
Article number Weidmüller	1854510000
Compatible printer	Weidmüller
Type	Printjet Advanced 230V
Article number Weidmüller	1324380000

4 Wiring

4.1 Wiring Example



4.2 Note

The signals recorded by the analog modules are very small, as compared to the digital signals. To ensure error-free operation, a careful wiring method must be followed:

- The DIN rail must have an adequate connection to mass.
- The lines connected to the source of the analog signals must be as short as possible and parallel wiring to digital signal lines must be avoided.
- The signal lines must be shielded.
- The shielding must be connected to a shielding bus.
- Avoid parallel connections between input lines and load-bearing circuits.
- Protective circuits for all relays (RC networks or free-wheeling diodes).

The ground bus should be connected to the control cabinet if possible!

IMPORTANT:
The S-DIAS module cannot be connected/disconnected while voltage is applied!

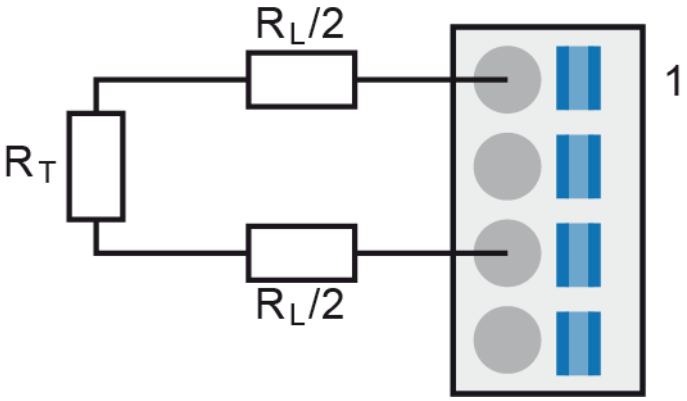
4.3 Connection Technology

4.3.1 2-wire Measurement

The 2-wire measurement provides the advantage of simple wiring. Short connector cables are recommended. With 2-wire measuring however, the resistance of the connector cables causes a measurement error.

R_L ... Resistance sensor connector cable

R_T ... resistance measurement sensor



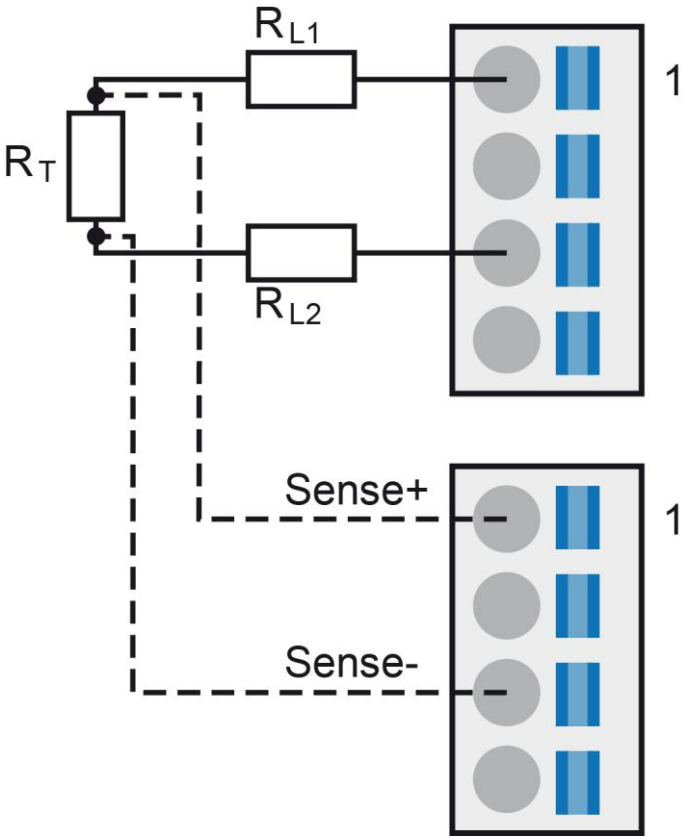
4.3.2 4-wire Measurement

With 4-wire measuring, symmetrical as well as asymmetrical resistances of the connection lines and connector transition resistances are monitored and properly compensated. This is achieved via recording the measurement current and measuring the voltage over the additional sensor lines of the measurement sensor. From these two values, the resistance value of the measurement sensor is determined internally.

RL1- Resistance sensor connector cable 1

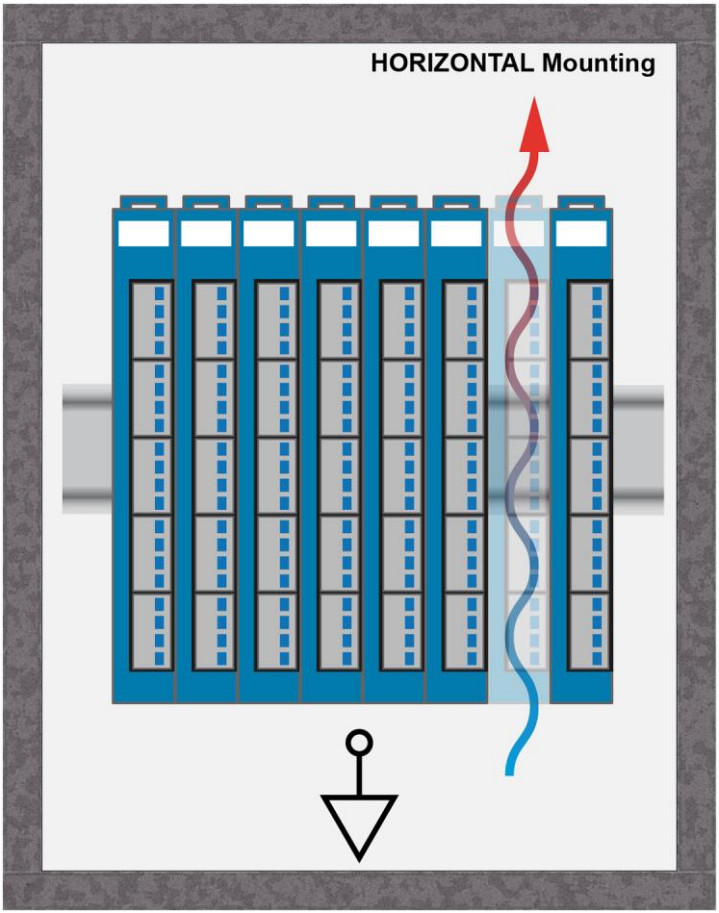
RL2- Resistance sensor connector cable 2

R_T ... Resistance measurement sensor

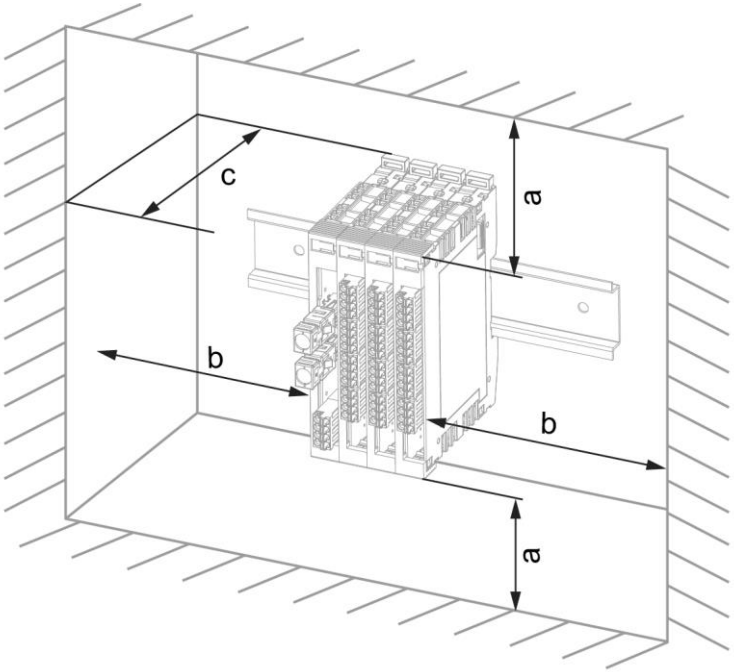


5 Mounting

The S-DIAS modules are designed for installation into the control cabinet. To mount the modules, a DIN-rail is required. The DIN rail must establish a conductive connection with the back panel of the control cabinet. The individual S-DIAS modules are mounted on the DIN rail as a block and secured with latches. The functional ground connection from the module to the DIN rail is made via the grounding clamp on the back of the S-DIAS modules. The modules must be mounted horizontally (module label up) with sufficient clearance between the ventilation slots of the S-DIAS module blocks and nearby components and/or the control cabinet wall. This is necessary for optimal cooling and air circulation, so that proper function up to the maximum operating temperature is ensured.



Recommended minimum distances of the S-DIAS modules to the surrounding components or control cabinet wall:



a	b	c
30 mm (1.18″)	**30 mm** (1.18″)	**100 mm** (3.94″)

a, b, c … distances in mm (inches)

6 Addressing

6.1 Address Mapping Overview

Address (hex)	Size (bytes)	Description
0000	128	Cyclic Data for Firmware
0080	128	Cyclic Data for the HW class
0100	128	CFG for the Firmware
0180	128	CFG/version for the HW class
0300	128	SDO Request
0380	128	SDO Response

6.2 Detailed Address Mapping

Cyclic Data for Firmware (memory address range)		
0000	0	-
Cyclic Data for the HW Class (memory address range)		
0080	2	Status Bit 0 tbd Bit 1 no sync Bit 2 FLASH data CRC error Bit 3 RAM data CRC error Bit 4 non-safe FLASH data
0082	2	Analog input 1
0084	2	Analog input 2
0086	2	Reserved
0088	2	Reserved

008A	1	cable break detection Bit 0 input AI1 Bit 1 input AI2
008B	1	Over range Bit 0 input AI1 Bit 1 input AI2 Under range Bit 4 input AI1 Bit 5 input AI2
008C	2	Raw value analog input 1
008E	2	Raw value analog input 2
0090	2	Raw value analog input 3
0092	2	Raw value analog input 4
0094	2	Raw value analog input 5
0096	2	Raw value analog input 6
0098	2	Raw value analog input 7
009A	2	Raw value analog input 8
CFG for the Firmware (memory address range)		
0100	2	CRC16
0102	2	data length
0104	1	Info (special purpose or status bits) Bit 0 free Bit 1 boot loader/update request
0105	2	Reserved
	Standard mode (info register bit 0 = 0)	
0107	1	Config (type and measurement range 0-19) AI1
0108	1	Config AI2
0109	1	Reserved

010A	1	Reserved
010B	1	Bit 0 = AI1: 0 → 2 wires, 1→ 4-wire measurement method Bit 1 = AI2: 0 → 2 wires, 1→ 4-wire measurement method
010C	2	cutoff frequency low pass filter input 1
010E	2	cutoff frequency low pass filter input 2
0110	2	Reserved
0112	2	Reserved
0114	1	Bit 0 = AI1: 0 → inactive, 1→ active Bit 1 = AI2: 0 → inactive, 1→ active
0115	1	Message Counter
CFG/version for the HW class (memory address range)		
0180	2	CRC16
0182	2	Data length
0184	2	Firmware version
SDO access (memory address range)		
0300	128	SDO request
0380	128	SDO response

7 Supported Cycle Times

7.1 Cycle Times Under 1 ms (in µs)

FW	50	100	125	200	250	500
V1.00		x	x	x	x	x

7.2 Cycle Times Above or Equal to 1 ms (in ms)

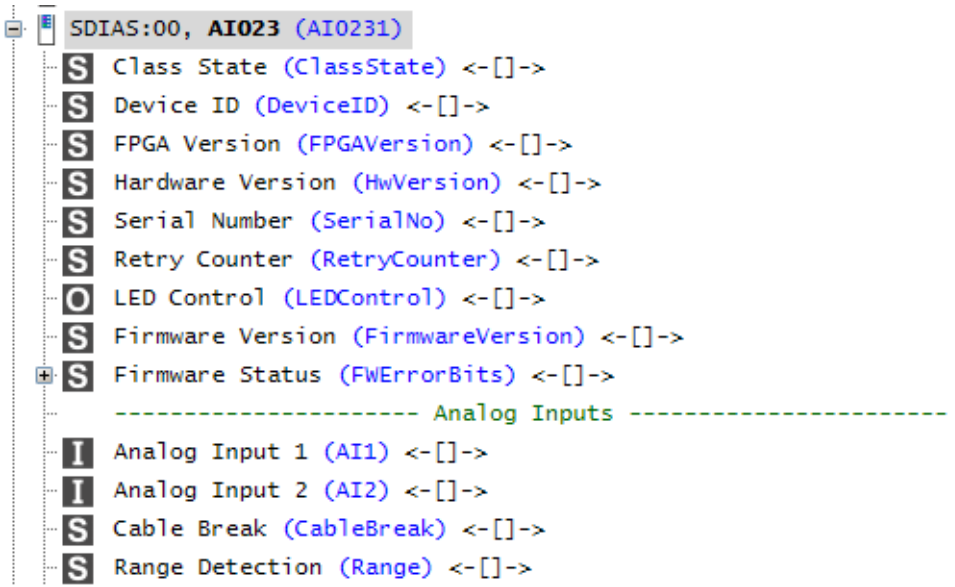
FW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
V1.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

FW	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
V1.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

8 Hardware Class AI023

Hardware class AI023 for the S-DIAS analog module AI 023

This hardware class is used to control the AI023 hardware module. The module has 2 resistance inputs. More information on the hardware can be found in the module documentation.



8.1 Interfaces

8.1.1 General

Class State	State	This server shows the actual status of the hardware class.
Device ID	State	This server shows the device ID of the hardware module.
FPGA Version	State	FPGA version of the module in 16#XY (e.g. 16#10 = version 1.0).
Hardware Version	State	Hardware version of the module in format 16#XXYY (e.g. 16#0120 = version 1.20)
Serial Number	State	The serial number of the hardware module is shown in this server.
Retry Counter	State	This server increments when a transfer fails.
LED Control	Output	With this server, the application LED of the S-DIAS module can be activated to find the module in the network more quickly. The following status are possible: 0 LED off 1 LED on 2 blinks slowly 3 blinks fast
Required	Property	This client is activated by default, i.e. this S-DIAS hardware module at this position is absolutely necessary for the system and may under no circumstances be missing, disconnected or deliver an error, otherwise the entire hardware is switched off. If the hardware module is missing, it returns an error or if it is removed, this triggers an S-DIAS error. If this client is initialized with 0, this hardware module is not mandatory at the position. This means that it can be removed at any time. However, which components identified as "not required" should be selected with regard to the safety of the system.
firmware version	State	The firmware version of the hardware module is shown in this server.
Firmware Status	State	In this server, the status bits of the FW are shown. The respective bits mean the following: Bit 0 DC not OK Bit 1 no Sync available Bit 2 flash Data CRC Error Bit 3 RAM Data CRC Error Bit 4 Invalid EEProm version

8.1.2 Analog Inputs [1-2]

Analog Input [1-4]	Input	Analog input 1-2, status query over read(). Temperature values in 1/10 °C. Resistance values in 1/10 W, when no scaling is active. If AI[1-2]Config = 25 the temperature is then shown in 1/100 °C. The hardware class returns -2147483632 with an open input.
Cable Break	State	Cable break detection: Bit 0 Wire-break at the input AI1 Bit 1 Wire-break at the input AI2
Range Detection	State	In this server, whether the value at an input exceeded the upper or lower limit is shown. Bit 0 Maximum value of range was exceeded at input AI1 Bit 1 Maximum value of range was exceeded at input AI2 Bit 4 Minimum value of the range was exceeded at input AI1 Bit 5 Minimum value of the range was exceeded at input AI2
AI[1-2]Config	Property	The desired sensor type and its range are selected in this client. 0 PT100 (Range: -200 ... +150 °C) 1 PT100 (Range: -200 ... +850 °C) 2 PT200 (Range: -200 ... +150 °C) 3 PT200 (Range: -200 ... +850 °C) 4 PT500 (Range: -200 ... +150 °C) 5 PT500 (Range: -200 ... +850 °C) 6 PT1000 (Range: -200 ... +150 °C) 7 PT1000 (Range: -200 ... +850 °C) 8 NI100 (Range: -60 ... +150 °C) 9 NI100 (Range: -60 ... +250 °C) 10 NI1000 (Range: -60 ... +150 °C) 11 NI1000 (Range: -60 ... +250 °C) 12 Potentiometer (Range: 0-250 Ω) 13 Potentiometer (Range: 0-500 Ω) 14 Potentiometer (Range: 0-1000 Ω) 15 Potentiometer (Range: 0-2500 Ω) 16 Potentiometer (Range: 0-5000 Ω) 17 KTY11-62 (Range: -50 ... +150 °C) 18 KTY81-110 (Range: -55 ... +150 °C) 19 KTY81-120 (Range: -55 ... +150 °C) 20 KTY81-121 (Range: -55 ... +150 °C) 21 KTY81-122 (Range: -55 ... +150 °C) 22 KTY81-150 (Range: -55 ... +150 °C) 23 KTY84-130 (Range: -40 ... +300 °C) 24 KTY84-150 (Range: -40 ... +300 °C) 25 PT100 (Range: -200 ... +150) resolution in 1/100 °C

AI[1-2] Channel Active	Property	The channel can be deactivated/activated at this client. 0 Channel deactivated (when channel is deactivated, no error LED lights) 1 Channel activated
AI[1-2] Measure Method	Property	In this client, the measuring method is set. 0 2-wire measurement 1 4-wire measurement
AI[1-2] Cut Off Frequency	Property	In this client, the cutoff frequency for the software low pass filter is set. 0 100 Hz 1 50 Hz 2 25 Hz 3 10 Hz 4 no filter 5 1 Hz
AI[1-2] minimum value	Property	This value indicates the minimum scaling value for the channel. Affects resistance measurements with potentiometer only (set with AI_Config 12 – 16). If both AI_Min and AI_Max are both set to 0, scaling is disabled.
AI[1-2] maximum value	Property	This value indicates the maximum scaling value for the channel. Affects resistance measurements with potentiometer only (set with AI_Config 12 – 16). If both AI_Min and AI_Max are both set to 0, scaling is disabled.

Documentation Changes

Change date	Affected page(s)	Chapter	Note
08.09.2020	22	8 Hardware Class AI023	Chapter added
04.11.2020	16	5 Mounting	Expansion functional ground connection