AI 043

S-DIAS Analog Input Module

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Translation from German

S-DIAS ANALOG INPUT MODULE AI 043

with 4 resistance or temperature inputs

The S-DIAS AI 043 analog input module has four resistance inputs for 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 3-wire measuring technology. The analog inputs are galvanically separated from the S-DIAS bus.

Contents

1 Technical Data

1.1 Analog Resistance / Temperature Input Specifications

Number of channels	4
Measurement range	see the following measurement range table.
AD converter resolution	16-bit
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 system
Input filter	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 Range

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) An open input returns -2147483632 in the hardware class.

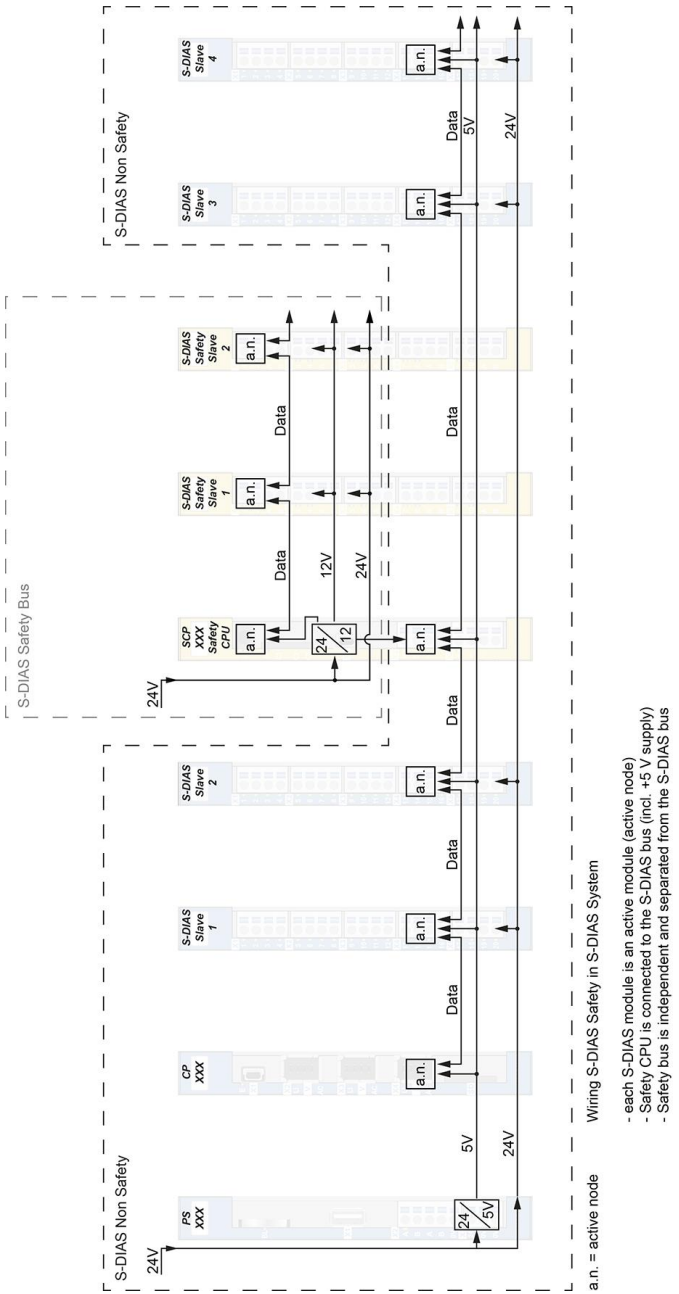
1.2.2 Measurement Range of Temperature Inputs

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	494.9-2233.3 Ω	-550 … +1500
KTY84-130 [2] KTY84-150 [2]	-40 … +300 °C	358.8-2623.0 Ω	-400 … +3000

[1] An open or shorted input returns -2147483632 in the hardware class.
[2] Sensor types are supported starting from Firmware version 1.10.

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
24V
PS XXX
CP XXX
S-DIAS Slave 1
S-DIAS Slave 2
a.n.
Data
5V
24V
24/5V
S-DIAS Safety Bus
SCP XXX Safety CPU
S-DIAS Safety Slave 1
S-DIAS Safety Slave 2
12V
24/12
S-DIAS Non Safety
S-DIAS Slave 3
S-DIAS Slave 4
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

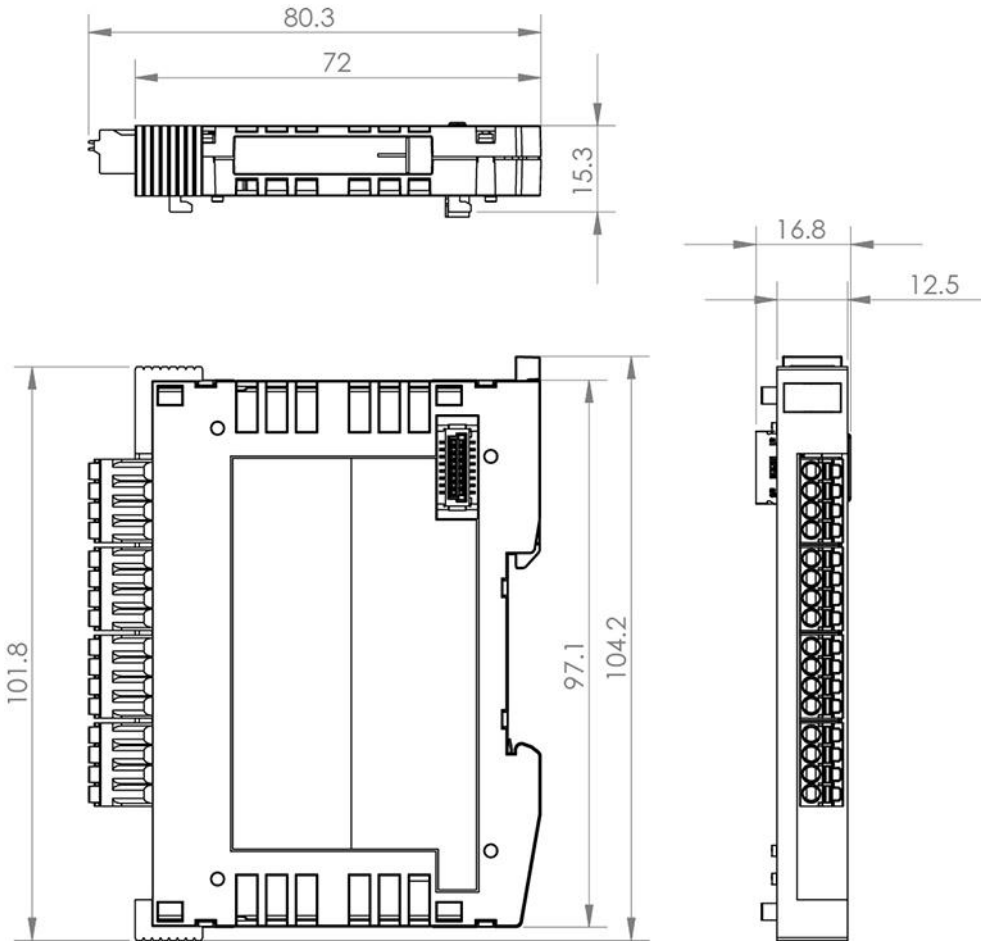
1.4 Miscellaneous

Article number	20-009-043
Hardware version	1.x
Standard	UL 508 (E247993)
Approbations	UL, cUL, CE

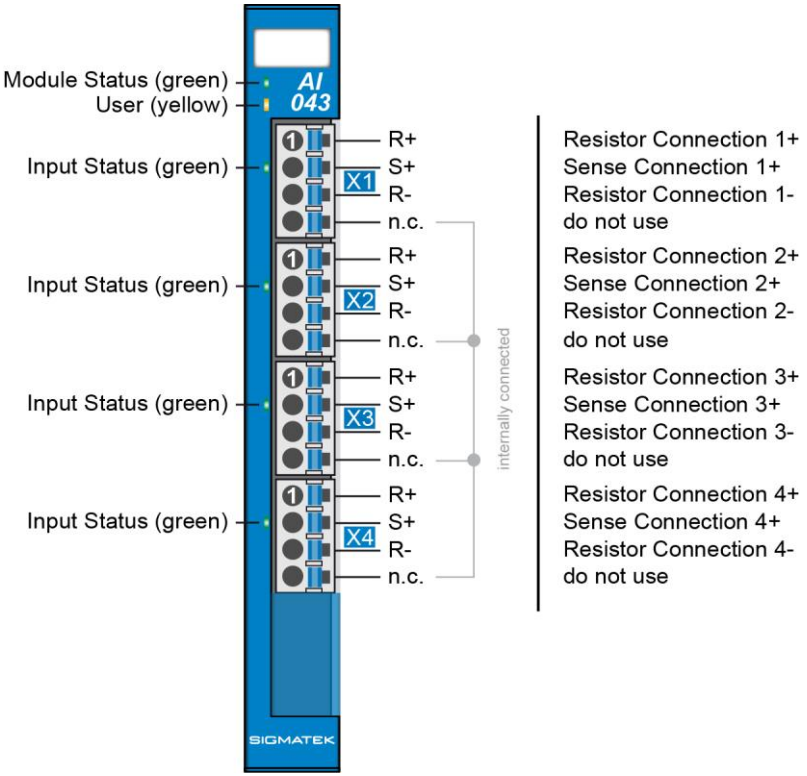
1.5 Environmental Conditions

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 altitude up to 2000 m	
EMC resistance	in accordance with 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 1g 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

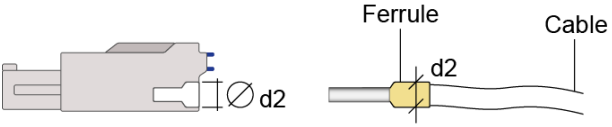
Module Status	green	ON	module active
		OFF	no supply available
		BLINKING (5 Hz)	no communication
User	yellow	ON	can be set from the application (e.g. the module LED can be set to blinking through the visualization so that the module is easily found in the control cabinet)
		OFF	
		BLINKING (2 Hz)	
		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 suitable connecting ultrasonically compacted (ultrasonically welded) strands.

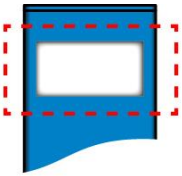
Connections:

Stripping length/Sleeve length:	10 mm
Mating direction:	parallel to the lead 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, 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

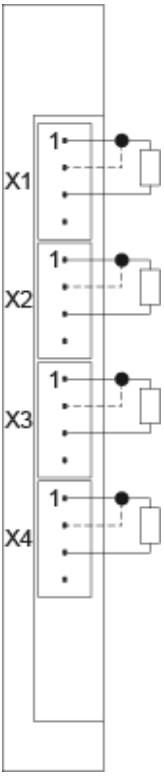
3.3 Label Field



Manufacturer	Weidmüller
Type	MF 10/5 CABUR MC NE WS
Weidmüller article number	1854510000
Compatible printer	Weidmüller
Type	Printjet Advanced 230V
Weidmüller article number	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 mass connection.
- 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 when possible!

Si possible la terre doit être connectée à l'armoire de commande!

IMPORTANT:
The S-DIAS module CANNOT be connected or disconnected while voltage is applied!

IMPORTANT:
Le module S-Dias NE PEUT PAS être inséré ou retiré sous tension.

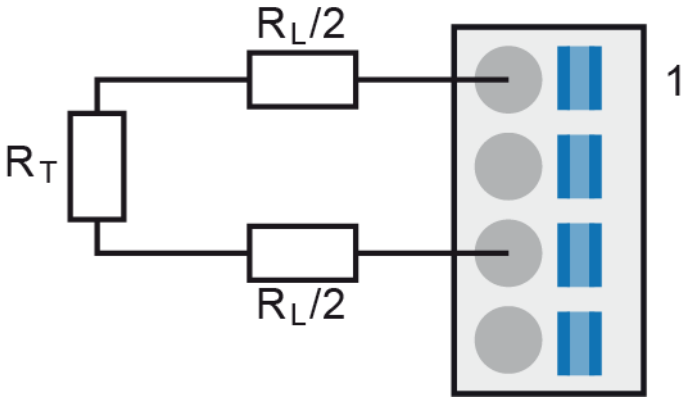
4.3 Connection Technology

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 cause a measurement error.

R_L ... resistance connection cable

R_T ... resistance measurement sensor

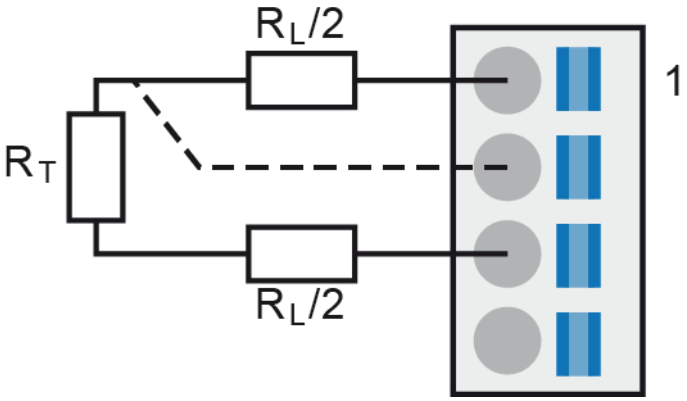


4.3.2 3-wire Measurement

With 3-wire measuring, the measurement error of the connector cable is compensated. Provided that the wires to and from the sensor are the same length and have the same cross section. Here, the voltage drop in the wire connected to the sensor is measured and in the calculation, subtracted from the measurement value twice so that only the voltage over sensor is measured and the resistance value thereby determined.

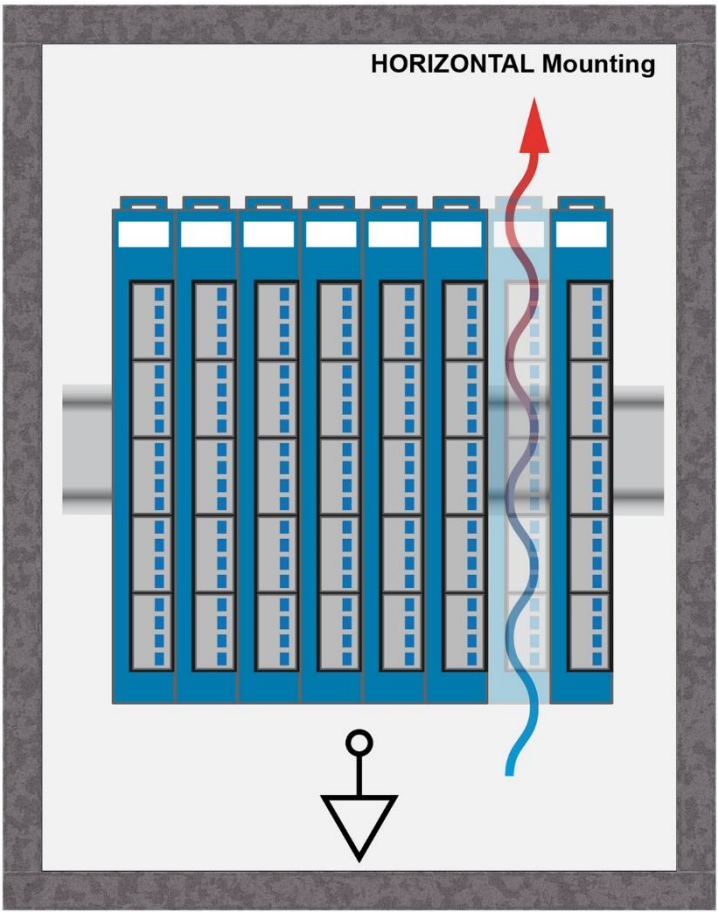
R_L ... resistance connection cable

R_T ... resistance measurement sensor

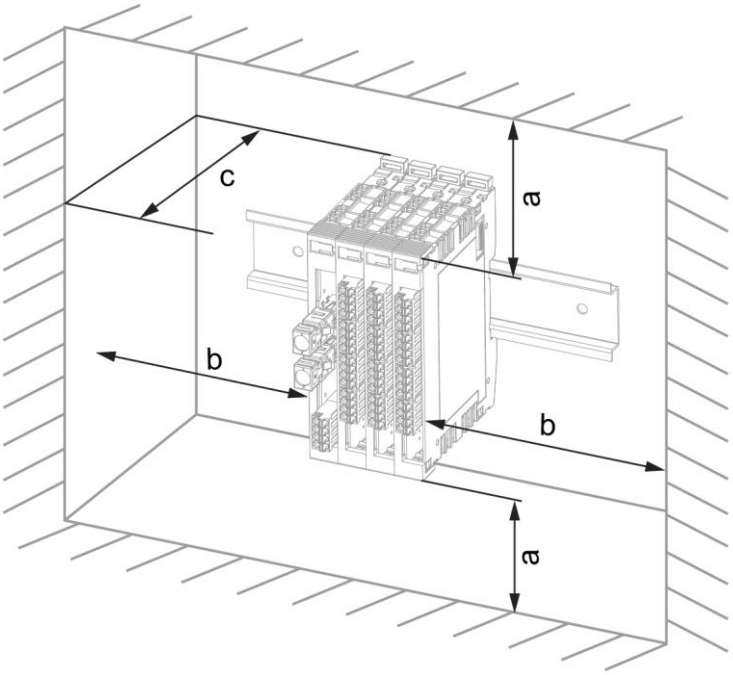


5 Mounting

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 wall 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	Analog input 3
0088	2	Analog input 4
008A	1	Cable break detection Bit 0 input AI1 Bit 1 input AI2 Bit 2 input AI3 Bit 3 input AI4

008B	1	Over range Bit 0 input AI1 Bit 1 input AI2 Bit 2 input AI3 Bit 3 input AI4 Under range Bit 4 input AI1 Bit 5 input AI2 Bit 6 input AI3 Bit 7 input AI4
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	Config AI3
010A	1	Config AI4
010B	1	Bit 0 = AI1: 0 → 2 wires, 1→ 3-wire measurement method Bit 1 = AI2: 0 → 2 wires, 1→ 3-wire measurement method Bit 2 = AI3: 0 → 2 wires, 1→ 3-wire measurement method Bit 3 = AI4: 0 → 2 wires, 1→ 3-wire measurement method

010C	2	Cutoff frequency low pass filter input 1 (0..100 Hz,1..50 Hz,2..25 Hz,3..10 Hz,4..0 Hz)
010E	2	Cutoff frequency low pass filter input 2 (0..100 Hz,1..50 Hz,2..25 Hz,3..10 Hz,4..0 Hz)
0110	2	Cutoff frequency low pass filter input 3 (0..100 Hz,1..50 Hz,2..25 Hz,3..10 Hz,4..0 Hz)
0112	2	Cutoff frequency low pass filter input 4 (0..100 Hz,1..50 Hz,2..25 Hz,3..10 Hz,4..0 Hz)
0114	1	Bit 0 = AI1: 0 → inactive, 1→ active Bit 1 = AI2: 0 → inactive, 1→ active Bit 2 = AI3: 0 → inactive, 1→ active Bit 3 = AI4: 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 below 1 ms (in µs)

FW	50	100	125	200	250	500
V1.60		x	x	x	x	x

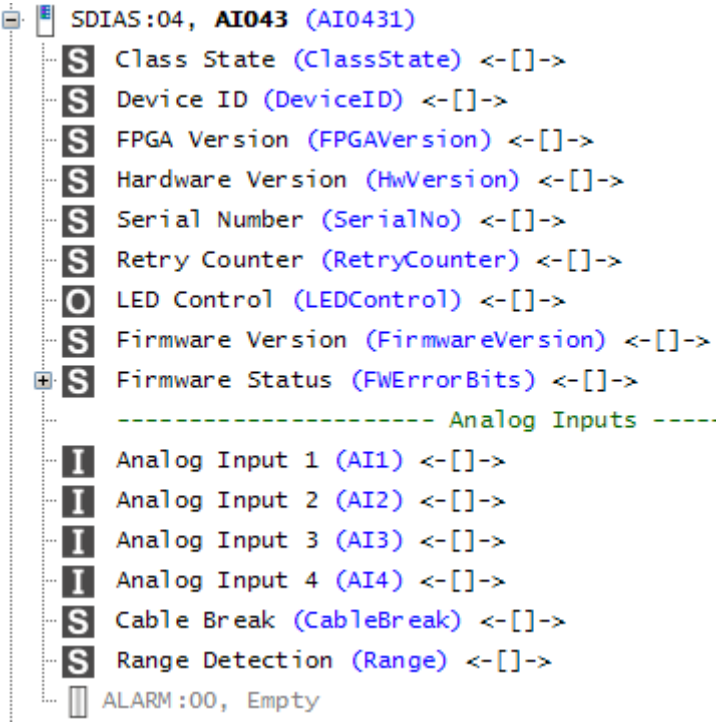
7.2 Cycle Times equal to or above 1 ms (in ms)

FW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
V1.60	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
V1.60	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

8 Hardware Class AI043

Hardware Class AI043 for the S-DIAS AI043 analog module



This hardware class is used to control the AI 043 hardware module. The module has 4 resistor inputs. More information on the hardware can be found in the module documentation.

8.1 General

Class State	State	This server shows the actual status of the hardware class.
Device ID	State	The device ID of the hardware module is shown in this server.
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. 0 LED off 1 LED on 2 blinks slowly 3 blinks rapidly
Required	Property	This client is active by default, which means that the S-DIAS hardware module at this position is mandatory for the system and can under no circumstances be disconnected or return an error. Otherwise, the entire hardware deactivated. If the hardware module is missing or removed, an S-DIAS error is triggered. If his client is initialized with 0, the hardware module located in this position is not mandatory. This means that it can be inserted or 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. 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

8.2 Analog Inputs 1-4

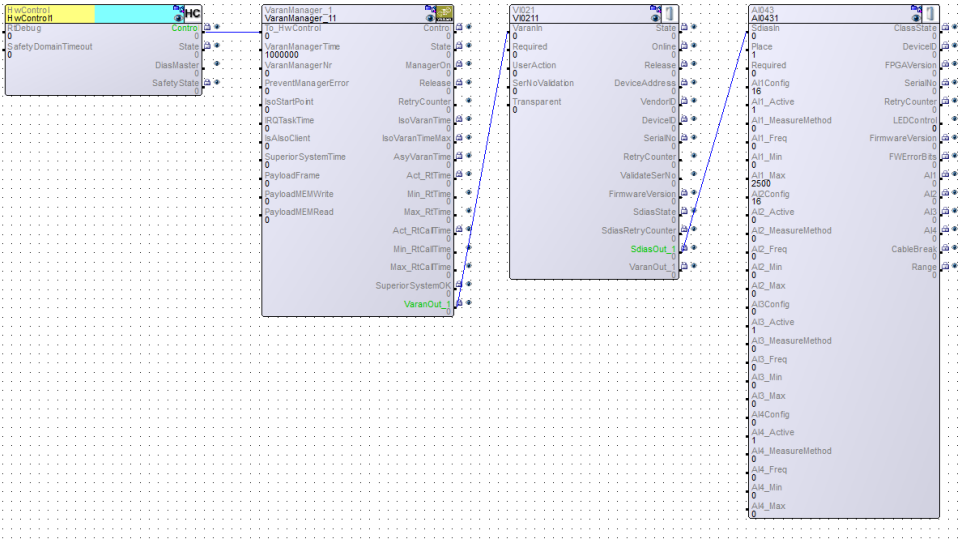
Analog Input [1-4]	Input	Analog input 1-4, status query over read(). Temperature values in 1/10 °C. Resistance values in 1/10 W, when no scaling is active. If AI[1-4]Config = 25 the temperature is then shown in 1/100°C. An open input returns -2147483632 in the hardware class.
Cable Break	State	Cable break detection Bit 0: cable break at input AI1 Bit 1: cable break at input AI2 Bit 2: cable break at input AI3 Bit 3: cable break at input AI4
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 the range was exceeded at input AI1 Bit 1: maximum value of the range was exceeded at input AI2 Bit 2: maximum value of the range was exceeded at input AI3 Bit 3: maximum value of the range was exceeded at input AI4 Bit 4: minimum value of the range was exceeded at input AI1 Bit 5: minimum value of the range was exceeded at input AI2 Bit 6: minimum value of the range was exceeded at input AI3 Bit 7: minimum value of the range was exceeded at input AI4
AI[1-4]Config	Property	The desired sensor type and its range are selected in this client. Possible values: 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[1-4] Channel Active	Property	In this client, the channel can be disabled/enabled. Possible values: 0 channel disabled (when channel is disabled, no error LED light) 1 channel enabled
AI[1-4] Measure Method	Property	In this client, the measuring method is set. Possible values: 0 2-wire measurement 1 3-wire measurement
AI[1-4] Cut Off Frequency	Property	In this client, the cutoff frequency for the software low pass filter is set. Value setting options are: 0 100 Hz 1 50 Hz 2 25 Hz 3 10 Hz 4 no filter 5 1 Hz
AI[1-4] Minimal 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[1-4] Maximal 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.

8.3 Communication Interfaces

ALARM	Downlink	With this downlink the corresponding alarm class can be placed via the hardware editor.

8.4 Example


HwControl
HwControlI
HC
IODebug
SafetyDomainTimeout
Control
State
DiasMaster
SafetyState
VaranManager_1
VaranManager_11
To_HwControl
VaranManagerTime
1000000
VaranManagerNr
PreventManagerError
IsoStartPoint
RQTaskTime
IsAlsoClient
SuperiorSystemTime
PayloadFrame
PayloadMEMWrite
PayloadMEMRead
Control
State
ManagerOn
Release
RetryCounter
IsoVaranTime
IsoVaranTimeMax
AsyVaranTime
Act_RtTime
Min_RtTime
Max_RtTime
Act_RtCallTime
Min_RtCallTime
Max_RtCallTime
SuperiorSystemOK
VaranOut_1
V0211
V0211
VaranIn
Required
UserAction
SerNoValidation
Transparent
State
Online
Release
DeviceAddress
VendorID
DeviceID
SerialNo
RetryCounter
ValidateSerNo
FirmwareVersion
SdiasState
SdiasRetryCounter
SdiasOut_1
VaranOut_1
AI043
AI0431
SdiasIn
Place
Required
AI1Config
16
AI1_Active
1
AI1_MeasureMethod
AI1_Freq
AI1_Min
AI1_Max
2500
AI2Config
16
AI2_Active
AI2_MeasureMethod
AI2_Freq
AI2_Min
AI2_Max
AI3Config
AI3_Active
1
AI3_MeasureMethod
AI3_Freq
AI3_Min
AI3_Max
AI4Config
AI4_Active
1
AI4_MeasureMethod
AI4_Freq
AI4_Min
AI4_Max
ClassState
DeviceID
FPGAVersion
SerialNo
RetryCounter
LEDControl
FirmwareVersion
FWErrorBits
AI1
AI2
AI3
AI4
CableBreak
Range

Documentation Changes

Change date	Affected page(s)	Chapter	Note
08.09.2014	6	1.4 Miscellaneous	UL standard added
22.01.2015	17	6.2 Detailed Address Mapping	Byte 0115 added
30.01.2015	11	4.2 note	Note regarding connecting/disconnecting the S-DIAS module under voltage.
26.03.2015	9	3.2 Applicable Connectors	Connections expanded
31.03.2015	5	1.2.2 Measurement range temperature input	KTY 10-62 added
20.05.2015	12 13	4.3.1 3-wire Measurement 4.3.2 3-wire Measurement	Graphic corrected Graphic corrected
01.07.2015	5	1.2.2 Measurement Range of Temperature Inputs	Pt200, NI100, NI1000, KTY10-62, KTY (-110, -120, -150), KTY81-121, KTY81-122: Resistance range changed KTY84-130 (1) und KTY84-150 (1) added
08.07.2015	5	1.3 Electrical Requirements	Changed Current consumption on the S-Dias bus
22.01.2016	6	1.3 Electrical Requirements	Graphics added
28.04.2016	16	5 Mounting	Graphics distances
30.05.2016	19	6 Adressing	Low pass filter inputs extended
27.03.2017	4 5	1.2.1 Measurement Range of Resistance Inputs 1.2.2 Measurement Range of Temperature Inputs	Added value for sensor break detection; table extended Added value for sensor break and short circuit detection; table extended
07.08.2017	9	3 Connector Layout	Graphic replaced (internally connected)
17.08.2017	7 10	1.5 Environmental Conditions 3.2 Applicable Connectors	Added operating conditions Added sleeve length Added info regarding ultrasonically welded strands

18.10.2017	12 18	3.3 Label Field 5 Mounting	Added chapter Graphic replaced
18.07.2019	22	7 Supported Cycle Times	Chapter added
08.09.2020		8 Hardware Class AI043	Chapter added
04.11.2020	17	5 Mounting	Expansion functional ground connection