SIGMATEK

AI 047

S-DIAS Analog Input Module

Instruction Manual

Date of creation: 14.06.2017 | Version date: 26.07.2023 | Article number: 20-009-047-E

Publisher: SIGMATEK GmbH & Co KG
A-5112 Lamprechtshausen
Tel.: +43/6274/4321
Fax: +43/6274/4321-18
Email: office@sigmatek.at
WWW.SIGMATEK-AUTOMATION.COM

Translation of the Original Instructions

S-DIAS Analog Input Module AI 047

with 4 analog inputs 0-22 mA or 4-22 mA

The S-DIAS analog input module AI 047 has four analog inputs 0-22 mA or 4-22 mA with an 18-bit resolution. The voltage supply for the analog inputs are monitored for under voltage. The analog inputs are galvanically separated from the S-DIAS bus.

Contents

1 Introduction

1.1 Target Group/Purpose of this Operating Manual

This operating manual contains all information required for the operation of the product.

This operating manual is intended for:

- Project planners
- Technicians
- Commissioning engineers
- Machine operators
- Maintenance/test technicians

General knowledge of automation technology is required.

Further help and training information, as well as the appropriate accessories can be found on our website www.sigmatek-automation.com.

Our support team is happily available to answer your questions.
Please see our website for our hotline number and business hours.

1.2 Important Reference Documentation

This and additional documents can be downloaded from our website or obtained through support.

1.3 Contents of Delivery

1x AI 047

2 Basic Safety Directives

2.1 Symbols Used

The following symbols are used in the operator documentation for warning and danger messages, as well as informational notes:

DANGER

Danger indicates that death or serious injury **will occur**, if the specified measures are not taken.

⇨ To avoid death or serious injuries, observe all guidelines.

Danger indique une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

WARNING

Warning indicates that death or serious injury **can** occur, if the specified measures are not taken.

⇨ To avoid death or serious injuries, observe all guidelines.

Avertissement d'une situation dangereuse qui, faute de prendre les mesures adéquates, **entraînera** des blessures graves, voire mortelles.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

CAUTION

Caution indicates that moderate to slight injury **can** occur, if the specified measures are not taken.

⇨ To avoid moderate to slight injuries, observe all guidelines.

Attention indique une situation dangereuse qui, faute de prendre les mesures adéquates, **peut** entraîner des blessures assez graves ou légères.

⇨ Respectez toutes les consignes pour éviter des blessures graves, voire mortelles.

INFORMATION

Information

⇨ Provides important information on the product, handling or relevant sections of the documentation, which require attention.

2.2 Disclaimer

INFORMATION

The contents of this operating manual were prepared with the greatest care. However, deviations cannot be ruled out. This operating manual is regularly checked and required corrections are included in the subsequent versions. The machine manufacturer is responsible for the proper assembly, as well as device configuration. The machine operator is responsible for safe handling, as well as proper operation.

The current operating manual can be found on our website. If necessary, contact our support.

Subject to technical changes, which improve the performance of the devices. The following operating manual is purely a product description. It does not guarantee properties under the warranty.

Please thoroughly read the corresponding documents and this operating manual before handling a product.

SIGMATEK GmbH & Co KG is not liable for damages caused through, non-compliance with these instructions or applicable regulations.

2.3 General Safety Directives

The Safety Directives in the other sections of this operating manual must be observed. These instructions are visually emphasized by symbols.

INFORMATION

According to EU Directives, the operating manual is a component of a product.

This operating manual must therefore be accessible in the vicinity of the machine since it contains important instructions.

This operating manual should be included in the sale, rental or transfer of the product, or its online availability indicated.

Regarding the requirements for Safety and health connected to the use of machines, the manufacturer must perform a risk assessment in accordance with machine directives 2006/42/EG before introducing a machine to the market.

Operate the unit with devices and accessories approved by SIGMATEK only.

CAUTION

Handle the device with care and do not drop or let fall.

Prevent foreign bodies and fluids from entering the device.

The device must not be opened!

Manipulez l'appareil avec précaution et ne le laissez pas tomber.

Empêchez les corps étrangers et les liquides de pénétrer dans l'appareil.

L'appareil ne doit pas être ouvert!

If the device does not function as intended or has damage that could pose a danger, it must be replaced!

En cas de fonctionnement non conforme ou de dommages pouvant entraîner des risques, l'appareil doit être remplacé!

The module complies with EN 61131-2.

In combination with a facility, the system integrator must comply with EN 60204-1 standards.

For your own safety and that of others, compliance with the environmental conditions is essential.

Le module est conforme à la norme EN 61131-2.

En combinaison avec une équipement, l'intégrateur de système doit respecter la norme EN 60204-1.

Pour votre propre sécurité et celle des autres, le respect des conditions environnementales est essential.

2.4 Software/Training

The application is created with the software LASAL CLASS 2 and LASAL SCREEN Editor.

Training for the LASAL development environment, with which the product can be configured, is provided. Information on our training schedule can be found on our website.

3 Standards and Directives

3.1 Directives

The product was constructed in compliance with the following European Union directives and tested for conformity.

3.1.1 EU Conformity Declaration

EU Declaration of Conformity

The product AI 047 conforms to the following European directives:

- **2014/35/EU** Low-voltage Directive
- **2014/30/EU** Electromagnetic Compatibility (EMC Directive)
- **2011/65/EU** “Restricted use of certain hazardous substances in electrical and electronic equipment” (RoHS Directive)

The EU Conformity Declarations are provided on the SIGMATEK website. See Products/Downloads or use the search function and the keyword “EU Declaration of Conformity”.

4 Type Plate

Exemplary nameplate (symbol image)

HW: Hardware version
SW: Software version

5 Technical Data

5.1 Analog Input Specifications

Number of channels	4	
Measurement range (1)	0-22 mA	4-22 mA
Amplification	10	
Measurement value	0-220,000 (Mode: 19-bit signed value range) 0-27,500 (Mode: 16-bit signed value range)	40,000-220,000 (Mode: 19-bit signed value range) 5,000-27,500 (Mode: 16-bit signed value range)
Galvanic isolation	500 V (maximum isolation voltage)	
Input type	difference input	
A/D converter	18-bit SAR with simultaneous scanning	
Measurement range resolution	17-bit	
	ca. 0.17 µA/LSB	
Scan rate per channel	10 µs minimum	
Data memory depth per channel	512 Dwords (32 bits) 1024 words (16 bits)	
Calculation basis for number of values per channel (n)	n = S-DIAS cycle time / scan rate	
S-DIAS cyclic time	100 µs minimum	
Common mode range	±8 V	
Load	typically 45 Ω	
Cable break monitor	no	yes, can be set from 0-4 mA via software (default: 3 mA)
Input filter hardware (2)	10 kHz, low pass 3rd order (differential mode) 100 kHz, low pass 1st order (common mode)	
Input filter software (3)	configurable	
Maximum input current allowed	continuous 50 mA single pulse 1 s 0.12 A single pulse 40 ms 0.25 A single pulse 200 µs 0.75 A	

Total measurement precision Measurement method: Mode 2, sampling rate 50 µs	±0.060 % (20-40 °C) ±0.070 % (0-55 °C)
Status display	green LED

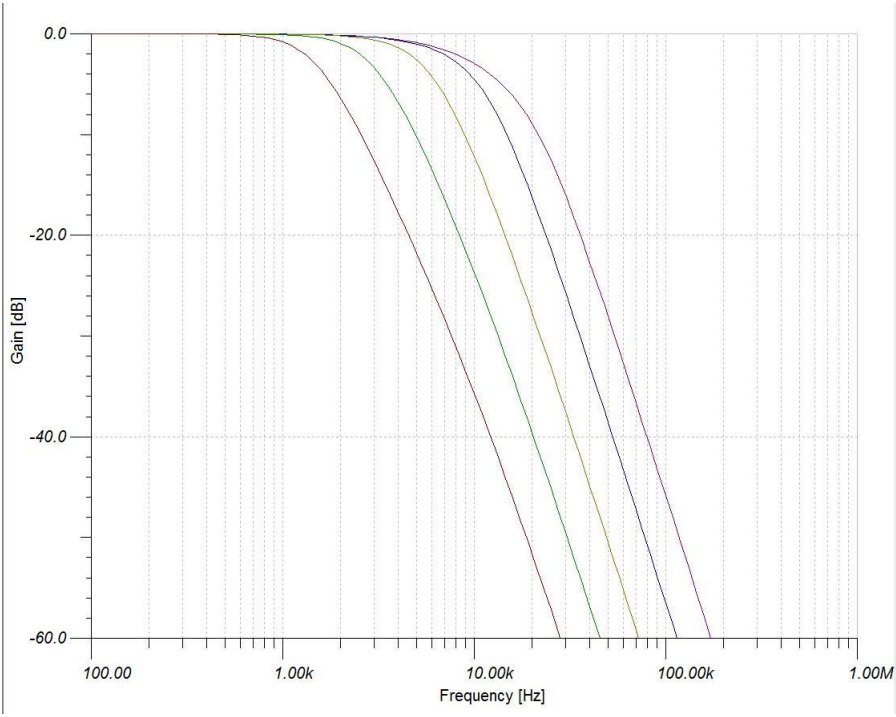
(1) If the upper or lower limit of a measurement range is exceeded, it will display a corresponding status bit.
(2) The filter parameters (frequency and order) for differential mode are depending on the scan rate in mode 2. An overview can be found in the table below. The frequency responses are shown in the diagrams below.
(3) This is a 1st order IIR filter, which has an adjustable frequency and can also be deactivated. **Caution!** The SW filter does not replace the HW filter! The SW filter only functions correctly when the Nyquist-Shannon theorem is observed.

5.2 Measuring Modes

Scan rate (µs)	**Mode 1** (1)	**Mode 2** (2)
	hardware frequency limit in kHz	hardware frequency limit in kHz
10	10	10
20	10	10
25	10	10
50	10	8
100	10	5
200	10	3
250	10	3
500	10	1.5
1000	10	1.5

(1) with oversampling in FPGA
(2) with oversampling in ADC (the integrated HW filter in the ADC changes depending on the defined sampling rate)

Typical frequency curves for the frequency limits 1.5 kHz (brown), 3 kHz (green), 5 kHz (yellow), 8 kHz (black) and 10 kHz (purple).



5.3 Measurement Precision

Accuracy incl. calibration error and noise Mode 2, sampling rate 50 µs 25 °C	0.028 %
Temperature drift 20-40 °C 0-55 °C	 0.007 % 0.032 %
Linearity	0.005 %
Crosstalk	0.003 %
Total error 20-40 °C 0-55 °C	 ±0.045 % (±9.9 µA) ±0.070 % (±15.4 µA)

Tolerances, which are caused be aging, are not taken into consideration. A calibration is necessary after 12 months at the latest.

5.4 Electrical Requirements

External voltage supply X5	18-30 V DC	
Current consumption X5 [1]	maximum 650 mA (maximum 500 mA for all sensor supplies) typically 60 mA (electronics)	
Voltage supply from S-DIAS bus	+5 V	
Current consumption on the S-DIAS bus (+5 V supply)	0	0
Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V supply)	typically 30 mA	maximum 35 mA

[1] The outgoing sensor supply for X1, X2, X3 and X4 are fed via X5. Using a PTC fuse, a common fuse is provided for the sensor supplies for a maximum of 500 mA
The specified values of the current consumption can change slightly in the design phase.

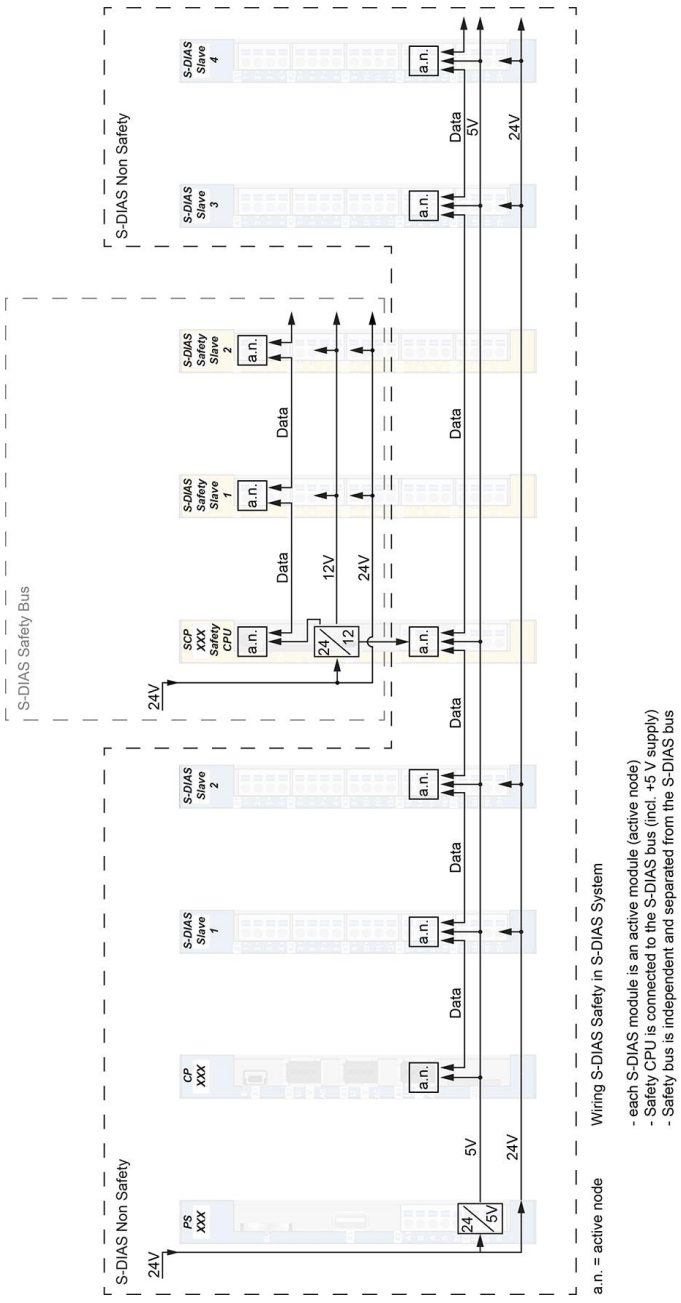
INFORMATION

If this S-DIAS module is connected to an S-DIAS supply module with several S-DIAS modules, the total current of the modules used must be determined and checked.

The total current of the +24 V supply cannot exceed 1.6 A!

The total current of the +5 V supply cannot exceed 1.6 A!

The specification for the current can be found in the module-specific technical documentation under "Electrical Requirements".


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

5.5 Voltage Monitor External +24 V Supply

Power supply +24 V	supply voltage > 18 V (DC OK-LED lights green)

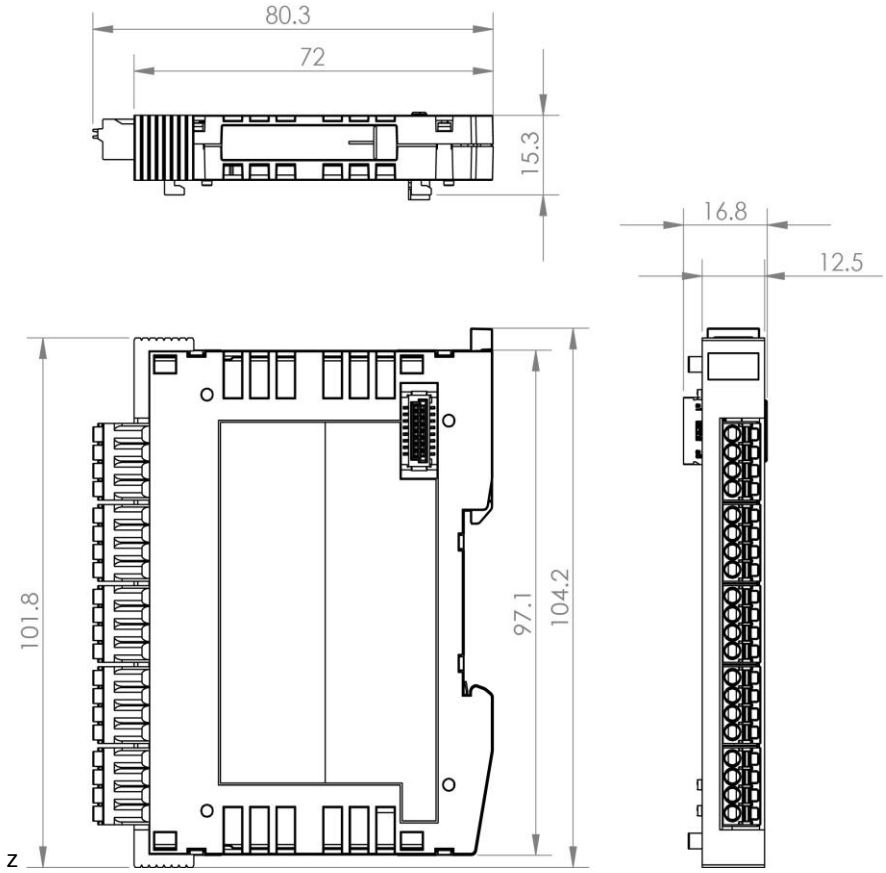
5.6 Miscellaneous

Article number	20-009-047
Standard	designed according to UL

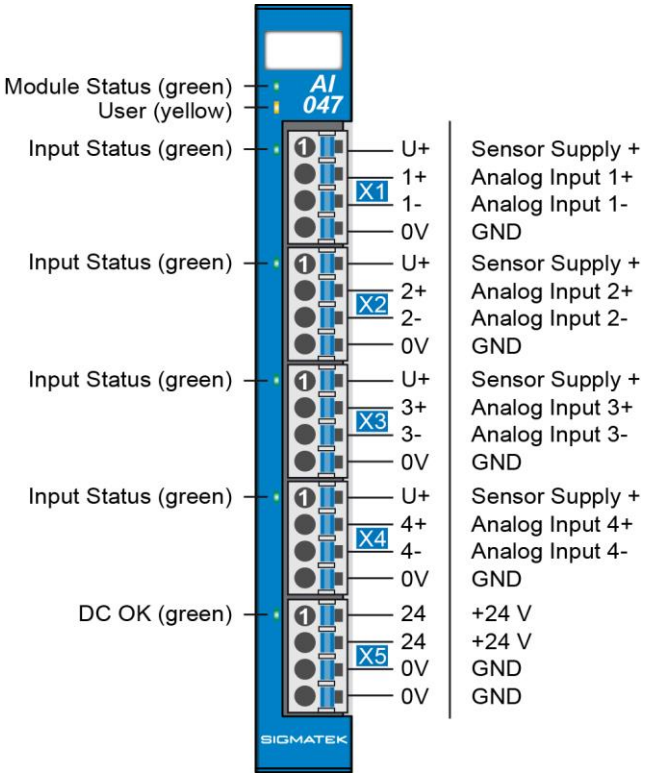
5.7 Environmental Conditions

Storage temperature	-20 ... +85 °C	
Environmental temperature	0 ... +55 °C	
Humidity	0-95 %, non-condensing	
Installation altitude above sea level	0-2000 m without derating > 2000 m up to a maximum of 5000 m with derating of the maximum environmental temperature by 0.5 °C per 100 m	
Operating conditions	Pollution degree 2	
EMC resistance	in accordance with EN 61000-6-2 (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

6 Mechanical Dimensions



7 Connector Layout



INFORMATION

The connections of the +24 V supply (X5: pin 1 and pin 2) or the GND supply (X5: pin 3 and pin 4) are internally bridged. To supply the module, only one connection to a +24 V pin (pin 1 or pin 2) and a GND pin (pin 3 or pin 4) is required. The bridged connections may be used for further looping of the +24 V supply and the GND supply. However, it must be taken into account that a total current of 6 A per connection is not exceeded by the forward looping!

7.1 Status LEDs

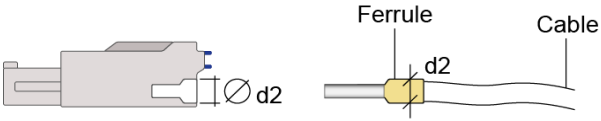
Module Status	green	ON	module active
		OFF	no supply available
		BLINKING (5 Hz)	no communication
User	yellow	ON	can be set from the application (e.g. the module LED can be set to blinking through the visualization so that the module is easily found in the control cabinet)
		OFF	
		BLINKING (2 Hz)	
		BLINKING (4 Hz)	
Input Status	green	ON	analog input active
		BLINKING (0.5 Hz)	analog input below measurement range
		BLINKING (4 Hz)	analog input above measurement range
		OFF	analog input inactive
		USER	LED can be optionally controlled via the application
DCOK	green	ON	+24 V supply for analog inputs available

7.2 Applicable Connectors

Connectors:
X1-X5: Connectors with spring terminals (included in delivery)
The spring terminals are suitable connecting ultrasonically compacted (ultrasonically welded) strands.

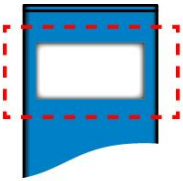
Connections:

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

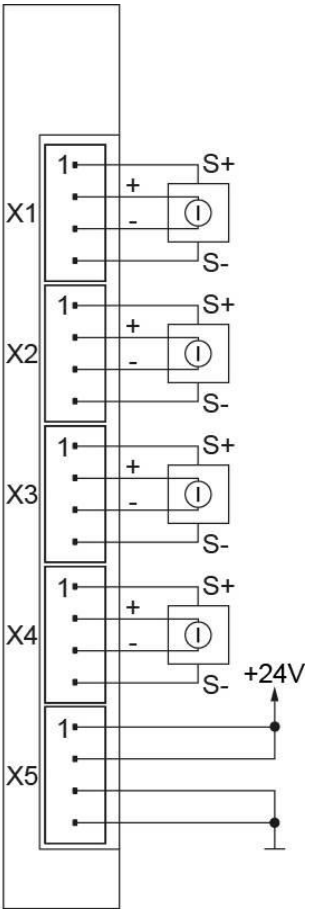
7.3 Label Field



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

8 Wiring

8.1 Wiring Example



8.2 Note

To ensure error-free operation, a careful wiring method must be followed:

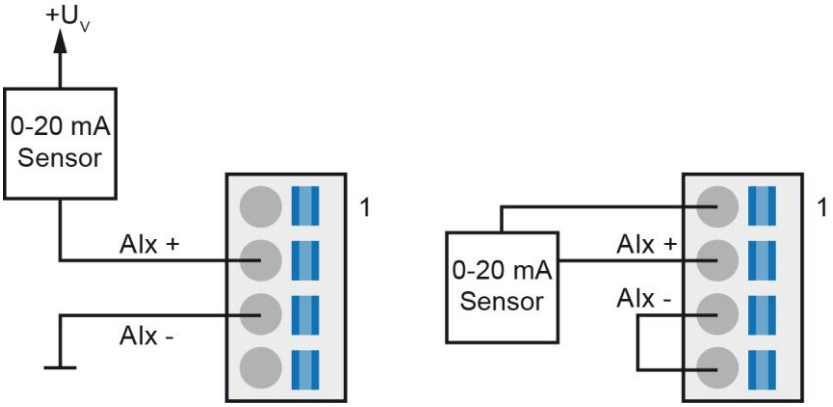
- The 0 V connection of the supply voltage must be connected with the 0 V collection point over the shortest route possible.
- The DIN rail must have an adequate mass connection.
- The lines connected to the source of the analog components must be as short as possible and parallel wiring to digital signal lines must be avoided.
- The signal lines must be shielded.
- The shielding must be connected to a shielding bus.
- Protective circuits for all relays (RC networks or free-wheeling diodes)
- Correct wiring to mass

INFORMATION

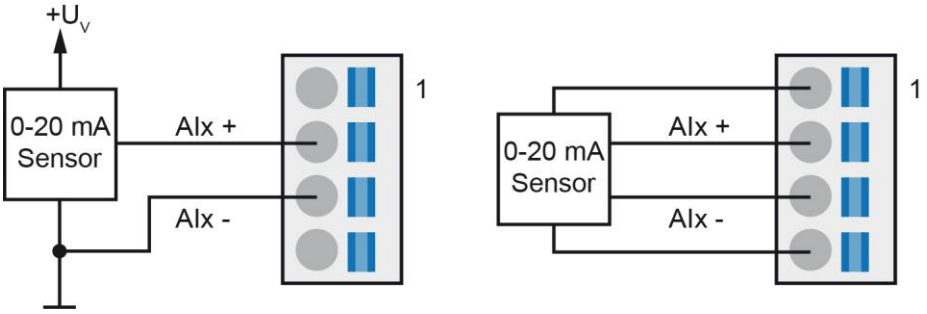
Connect the ground bus to the control cabinet.

The S-DIAS module CANNOT be connected/disconnected while voltage is applied!

8.3 Connection of a 2-wire Sensor



8.4 Connection of a 3-wire Sensor



9 Assembly/Installation

9.1 Check Contents of Delivery

Ensure that the contents of the delivery are complete and intact. See chapter Contents of Delivery.

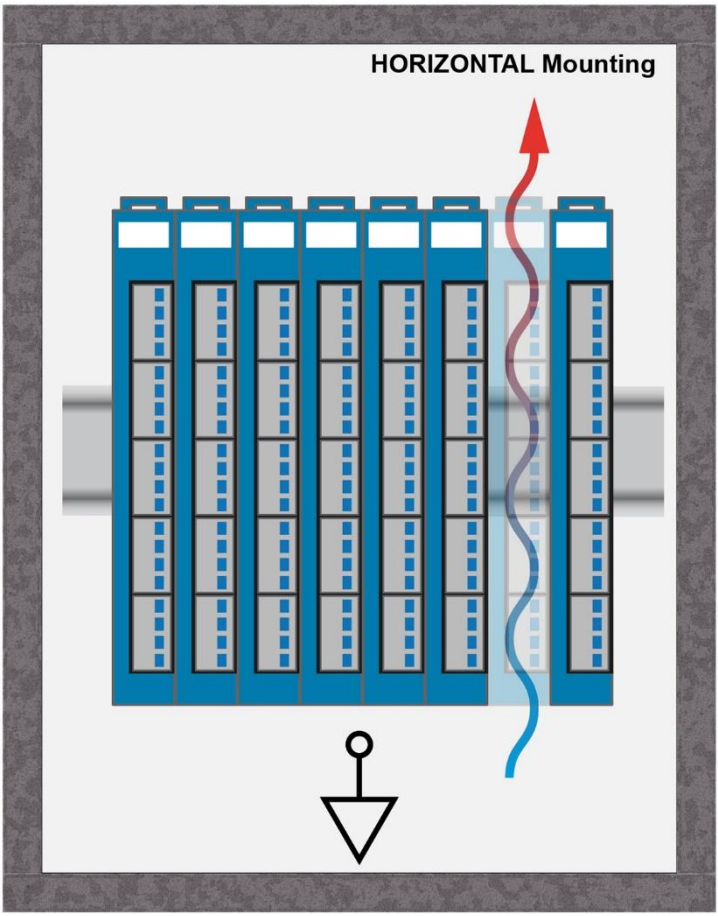
INFORMATION

On receipt and before initial use, check the device for damage. If the device is damaged, contact our customer service and do not install the device in your system.

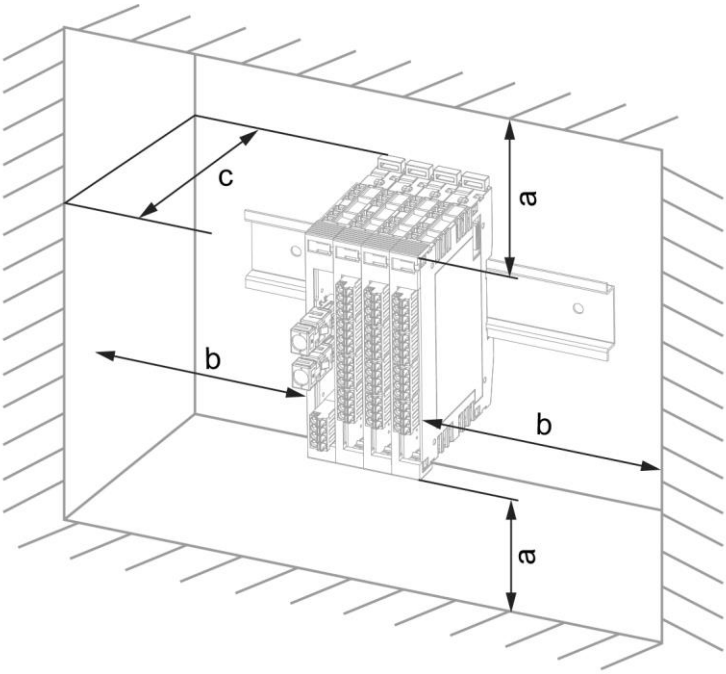
Damaged components can disrupt or damage the system.

9.2 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)

10 Configuration

To start, once the module is powered, the FPGA located in the microcontroller (MicroBlaze) is in Rest mode. If the reset for the MicroBlaze is deactivated via the "SDO control register", the microcontroller begins its configuration phase. As soon as this is complete, bit 3 Operational in the "Error/Status register" is set.

When a change is made in the SDO area, the settings are first assumed when bit 6 in the "SDO control register" is set. For the duration of the configuration phase, bit 3 Operational is inactive.

The data memory or each channel is filled with a defined number of values. The number of values in the data memory results from the configured S-DIAS cycle time and the scan rate. The values are written to the data memory in 16-bit mode as Word or in 19-bit mode, as Dword. In 16-bit mode, the number of bytes to read is reduced and therewith, the load on the S-DIAS bus. 16-bit/19-bit mode is set in the "SDO control register".

The data memory of each channel is filled when the respective channel is activated via the "PDO control register".

Using an alternating buffer, data consistency is ensured. The data memory is filled during an S-DIAS cycle and released at the end of the cycle. The values are then valid in the subsequent S-DIAS cycle for the duration of an S-DIAS cycle.

When setting the scan rate, FPGA oversampling and ADC oversampling, the required conversion time of the ADC and the transfer rated via SPI must be taken into consideration. From the resulting number of conversions, an average value is generated that is then written to the data memory. The following settings for the scan rate and oversampling are recommended:

10.1 FPGA Oversampling

Scan Rate	FPGA Oversampling	ADC Oversampling	Values within an S-DIAS Bus Cycle with 1 ms	Hardware Frequency Limit [kHz]
10	0 (1x)	0 (1x)	100	10
20	1 (2x)	0 (1x)	50	10
25	1 (2x)	0 (1x)	40	10
50	2 (4x)	0 (1x)	20	10
100	3 (8x)	0 (1x)	10	10
200	4 (16x)	0 (1x)	5	10
250	4 (16x)	0 (1x)	4	10
500	5 (32x)	0 (1x)	2	10
1000	6 (64x)	0 (1x)	1	10

10.2 ADC Oversampling

Scan Rate	FPGA Oversampling	ADC Oversampling	Values within an S-DIAS Bus Cycle with 1 ms	Hardware Frequency Limit [kHz]
10	0 (1x)	0 (1x)	100	22.0
20	0 (1x)	1 (2x)	50	22.0
25	0 (1x)	2 (4x)	40	18.5
50	0 (1x)	3 (8x)	20	11.9
100	0 (1x)	4 (16x)	10	6.0
200	0 (1x)	5 (32x)	5	3.0
250	0 (1x)	5 (32x)	4	3.0
500	0 (1x)	6 (64x)	2	1.5
1000	1 (2x)	6 (64x)	1	1.5

11 Addressing

Address (hex)	Size (bytes)	Access Type	Description	Reset value
0000	**532**	**r**	**PDO Read**	
0000	128	r16/32	Data memory channel 1 (16/32 bits) Data memory => if more than 128 bytes of data are available, the data is provided when rereading the next data. Unread data are no longer available in the next cycle. 16/32 bit => depending on the setting in the "control register", bit 0 of address 0x0229, the individual data sets are provided as Word or Dword (resolution is lower when read as word). All values are signed.	0000
0080	128	r16/32	Data memory channel 2 (16/32 bits)	0000
0100	128	r16/32	Data memory channel 3 (16/32 bits)	0000
0180	128	r16/32	Data memory channel 4 (16/32 bits)	0000
0200	2	r16	Data memory status register (Data memory is set to full when the current memory for the respective channel is full) Bit 0: Memory full channel 1 Bit 1: Memory full channel 2 Bit 2: Memory full channel 3 Bit 3: Memory full channel 4 (Data memory is set to empty when the current memory for the respective channel is empty) Bit 4: Memory empty channel 1 Bit 5: Memory empty channel 2 Bit 6: Memory empty channel 3 Bit 7: Memory empty channel 4 (If a memory area is read, although no data available, "Read on empty memory" is set) Bit 8: Read on empty memory channel 1 Bit 9: Read on empty memory channel 2 Bit 10: Read on empty memory channel 3 Bit 11: Read on empty memory channel 4 Bit 12: DC 24 V not ok latched Bit 13: DC 24 V ok Bit 14-15: Reserved	00
0202	1	r	Hardware status latch register (bytes are reset after reading) Bit 0: channel 1 lower limit Bit 1: channel 2 lower limit Bit 2: channel 3 lower limit Bit 3: channel 4 lower limit Bit 4: channel 1 upper limit Bit 5: channel 2 upper limit Bit 6: channel 3 upper limit Bit 7: channel 4 upper limit	00

0203	1	r	Reserved	00
0204	4	r32	Binary data channel 1 (18-bit signed)	00000000
0208	4	r32	Binary data channel 2 (18-bit signed)	00000000
020C	4	r32	Binary data channel 3 (18-bit signed)	00000000
0210	4	r32	Binary data channel 4 (18-bit signed)	00000000
0214	**2**	**w**	**PDO Write**	
0214	1	w	PDO control register Bit 0: Channel 1 enable (1 = channel enabled) Bit 1: Enable channel 2 Bit 2: Enable channel 3 Bit 3: Enable channel 4 Bit 4: Reserved Bit 5: Start synchronous ADC (1 = active) Bit 6-7: Reserved	00
0215	1	w	LED Overwrite Register Bit 0-1: LED channel 1 00 = off (HW status active, no SW overwrite) 01 = Enable SW Overwrite "0" 11 = Enable SW Overwrite "1" 10 = Reserved Bit 2-3: LED channel 2 Bit 4-5: LED channel 3 Bit 6-7: LED channel 4	00
0216	**234**	**r/w**	**SDO**	
0216	2	r w16	Scan rate (µs) The shortest scan rate is defined with 10 µs	000A
0218	1	r/w	Reserved	00
0219	1	r/w	FPGA Oversampling Bit 0-2: Oversampling via FPGA Number of samples = 2^Oversampling Bit 3-7: reserved	00
021A	2	r/w	IIR filter frequency limit channel 1 [Hz] 0 = off, min. 10 Hz	0000
021C	2	r/w	IIR filter frequency limit channel 2 [Hz] 0 = off, min. 10 Hz	0000
021E	2	r/w	IIR filter frequency limit channel 3 [Hz] 0 = off, min. 10 Hz	0000
0220	2	r/w	IIR filter frequency limit channel 4 [Hz] 0 = off, min. 10 Hz	0000

0222	1	r/w	IO Expander Register [1] Bit 2-0: ADC oversampling (value 7 is not supported) Bit 3: ADC reset **For current, 10x amplification is automatically selected and cannot be changed (register value is ignored). For voltage, 1x or 10x can be selected.** Bit 4: Current / voltage amplification channel 1 (0 = 1x, 1 = 10x application) Bit 5: Current / voltage amplification channel 2 Bit 6: Current / voltage amplification channel 3 Bit 7: Current / voltage amplification channel 4	08
0223	1	r/w	Enable lower threshold value of current card (4-20 mA mode) Bit 0: Enable channel (1 = threshold value detection active) Bit 1: Enable channel 2 Bit 2: Enable channel 3 Bit 3: Enable channel 4 Bit 4-7: Reserved	00
0224	4	r/w	Lower threshold value cable break (for current card only) Bit 0-18: Lower threshold value (signed) Bit 19-31: Reserved	00000000
0228	1	r	Error/status register Bit 0: Calibration data could not be read Bit 1: Calibration data (CRC error) Bit 2: IIR filter calculation error (OR gated) Bit 3: Operational (1 = active) Bit 4: Current or voltage measurement (1 = current, 0 = voltage) Detection via Pin wiring / placement variant, filtered Bit 5-7: Reserved	00
0229	1	r/w	SDO control register Bit 0: Value range in data memory 0 = 32-bit access 1 = 19-bit value 1 = 16-bit access 1 = 19-bit value of bits 18...3 Bit 1-5: Reserved Bit 6: Reload configuration (when written as "1") Bit 7: MicroBlaze (µC) Reset (1 = MicroBlaze in Reset)	80
022A	1	r	IIR filter error (latched) Bit 0: Channel 1 overflow Bit 1: Channel 2 overflow Bit 2: Channel 3 overflow Bit 3: Channel 4 overflow Bit 4-7: Reserved	00
022B	213	-	Reserved	-
0300	**48**	**r/w**	**DPRAM (used for buffering calibration data) Amplification 1x**	

0300	4	r/w	Calibration data channel 1 offset	0..0
0304	4	r/w	Calibration data channel 1 multiplier	0..0
0308	4	r/w	Calibration data channel 1 divisor	0..0
030C	4	r/w	Calibration data channel 2 offset	0..0
0310	4	r/w	Calibration data channel 2 multiplier	0..0
0314	4	r/w	Calibration data channel 2 divisor	0..0
0318	4	r/w	Calibration data channel 3 offset	0..0
031C	4	r/w	Calibration data channel 3 multiplier	0..0
0320	4	r/w	Calibration data channel 3 divisor	0..0
0324	4	r/w	Calibration data channel 4 offset	0..0
0328	4	r/w	Calibration data channel 4 multiplier	0..0
032C	4	r/w	Calibration data channel 4 divisor	0..0
0330	**48**	**r/w**	**DPRAM (used for buffering calibration data) Amplification 10x**	
0330	4	r/w	Calibration data channel 1 offset	0..0
0334	4	r/w	Calibration data channel 1 multiplier	0..0
0338	4	r/w	Calibration data channel 1 divisor	0..0
033C	4	r/w	Calibration data channel 2 offset	0..0
0340	4	r/w	Calibration data channel 2 multiplier	0..0
0344	4	r/w	Calibration data channel 2 divisor	0..0
0348	4	r/w	Calibration data channel 3 offset	0..0
034C	4	r/w	Calibration data channel 3 multiplier	0..0
0350	4	r/w	Calibration data channel 3 divisor	0..0
0354	4	r/w	Calibration data channel 4 offset	0..0
0358	4	r/w	Calibration data channel 4 multiplier	0..0
035C	4	r/w	Calibration data channel 4 divisor	0..0

(1) Note: each time the IO Expander Register is written, an access is run and it is updated in the hardware

12 Supported Cycle Times

12.1 Cycle Times Below 1 ms (in µs)

50	100	125	200	250	500
x	x	x	x	x	x

x= supported

12.2 Cycle Times Equal to or Higher than 1 ms (in ms)

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

x= supported

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

x= supported

13 Transport/Storage

INFORMATION

This device contains sensitive electronics. During transport and storage, high mechanical stress must therefore be avoided.

For storage and transport, the same values for humidity and vibration as for operation must be maintained!

Temperature and humidity fluctuations may occur during transport. Ensure that no moisture condenses in or on the device, by allowing the device to acclimate to the room temperature while turned off.

When sent, the device should be transported in the original packaging if possible. Otherwise, packaging should be selected that sufficiently protects the product from external mechanical influences. Such as cardboard filled with air cushioning.

14 Storage

INFORMATION

When not in use, store the operating panel according to the storage conditions. See chapter 13.

During storage, ensure that all protective covers (if available) are placed correctly, so that no contamination, foreign bodies or fluids enter the device.

15 Maintenance

INFORMATION

During maintenance as well as servicing, observe the safety instructions from chapter 2 Basic Safety Directives.

15.1 Service

This product was constructed for low-maintenance operation.

15.2 Repair

INFORMATION

In the event of a defect/repair, send the device with a detailed error description to the address listed at the beginning of this document.

For transport conditions, see chapter 13 Transport/Storage.

16 Disposal

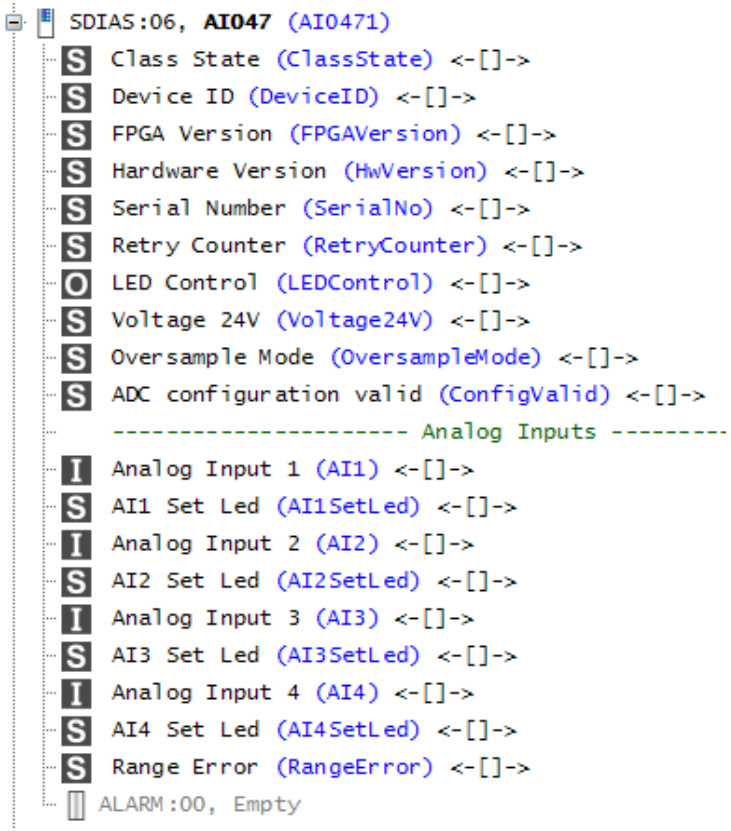
INFORMATION

Should you need to dispose of the device, the national regulations for disposal must be followed.

The device appliance must not be disposed of as household waste.

17 Hardware Class AI047

Hardware Class AI047 For the S-DIAS AI047 analog module



This hardware class is used to control the AI 047 hardware module. The module has four analog inputs with 2048 bytes memory each. The measurement values of each analog input are written into the corresponding measurement value memory. More information on the hardware can be found in the module documentation.

17.1 General

ClassState	State	This server shows the actual status of the hardware class.
DeviceID	State	The device ID of the hardware module is shown in this server.
FPGAVersion	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
Voltage 24 V	State	Shows whether the 24 V supply is OK. 0 not OK 1 OK
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.

17.2 Analog Inputs [1-4]

Config Valid	State	Shows whether the configuration of analog input 1-4 is valid. 1 – configuration is valid 0 – configuration is written -1 – configuration is not valid
AI[1-4] Analog Input	Input	Analog input. Here, the first value of the according measurement value memory is displayed. The displayed value depends on MaxValue and MinValue. With open/shorted input the hardware class returns -2147483632 (0x8000 0010).
AI[1-4]Channel Config	Property	Analog input [1-4] settings: 0 – AI[1-4] is used as analog input (range: 0 to 22 mA) 16 bit: 0-27,500 maximum resolution corresponds to 0-22 mA 18 bit: 0-220,000 maximum resolution corresponds to 0-22 mA 1 – AI[1-4] is used as analog input (range: 4 to 22 mA) 16 bit: 5,000-27,500 maximum resolution corresponds to 4-22 mA 18 bit: 40,000-220,000 maximum resolution corresponds to 4-22 mA 2 – AI[1-4] is deactivated as initialization value
AI[1-4] Maximum Value	Property	To set the upper scale range. Default values are: 18 bit: 220,000 corresponds to 22 mA 16 bit: 27,500 corresponds to 22 mA as initialization value
AI[1-4] Minimum Value	Property	To set the lower scale range. Default values are: AIx Channel Config = 0 16 bit: 0 corresponds to 0 mA 18 bit: 0 corresponds to 0 mA AIx Channel Config = 1 16 bit: 5,000 corresponds to 4 mA 18 bit: 40,000 corresponds to 4 mA as initialization value
AI[1-4] IIR Filter Grenzfrequenz	Property	This client sets the filter frequency limit of the software low pass filter. 0 – off (default) 1 – 10 kHz 2 – 5 kHz 3 – 1000 Hz (1 kHz) 4 – 500 Hz 5 – 100 Hz 6 – 50 Hz 7 – 25 Hz 8 – 10 Hz as initialization value
AI[1-4] LED Overwrite	Output	For activating the status LED. 0 – HW status active 1 – LED on 2 – LED off

<table>
<tr><td>Oversample Mode</td><td>Output</td><td>For setting the oversampling mode.
0 FPGA oversampling
1 ADC oversampling</td></tr>
<tr><td>Samples Per Ms</td><td>Property</td><td>For setting the samples to be sent per cycle and analog input. As initialization value
The shortest conversion time for the ADC is 10 µs. This results in a maximum of 100 values, which can sent in one millisecond when only one analog input is activated.
0 1 Sample per ms (1 ms conversion time)
FPGA OVS … 64
ADC OVS … 64 + FPGA OVS … 2
1 2 Samples per ms (500 µs conversion time)
FPGA OVS … 32
ADC OVS … 64
2 4 Samples per ms (250 µs conversion time)
FPGA OVS … 16
ADC OVS … 32
3 5 Samples per ms (200 µs conversion time)
FPGA OVS … 16
ADC OVS … 32
4 10 Samples per ms (100 µs conversion time)
FPGA OVS … 8
ADC OVS … 16
5 20 Samples per ms (50 µs conversion time)
FPGA OVS … 4
ADC OVS … 8
6 40 Samples per ms (25 µs conversion time)
FPGA OVS …2
ADC OVS …4
7 50 Samples per ms (20 µs conversion time)
FPGA OVS …2
ADC OVS … 2
8 100 Samples per ms (10 µs conversion time)
FPGA OVS … 1
ADC OVS … 1
as initialization value</td></tr>
<tr><td>Values Size</td><td>Property</td><td>For setting the size of a value.
0 16 bit mode (2 byte value)
1 18 bit mode (4 byte value) (default)
as initialization value</td></tr>
</table>

17.3 Cable Break Detection and Measurement Value Limits

<table>
<tr><td>Range Error</td><td>State</td><td>Shows, whether on the the analog input 1-4 a cable break or over current occurred. An error is also shown by the LED on each single analog input.

Detection lower measurement limit (cable break detection):<table><tr><td>Bit 0</td><td>channel 1 lower limit</td></tr><tr><td>Bit 1</td><td>channel 2 lower limit</td></tr><tr><td>Bit 2</td><td>channel 3 lower limit</td></tr><tr><td>Bit 3</td><td>channel 4 lower limit</td></tr></table>
Detection upper measurement limit:<table><tr><td>Bit 4</td><td>channel 1 upper limit</td></tr><tr><td>Bit 5</td><td>channel 2 upper limit</td></tr><tr><td>Bit 6</td><td>channel 3 upper limit</td></tr><tr><td>Bit 7</td><td>channel 4 upper limit</td></tr></table></td></tr>
<tr><td>Low Range Limit</td><td>Property</td><td>This client sets the lower limit for the cable break detection in the 4-20 mA mode.
Value range: 0-4000 [µA] (3000 default value = 3 mA)
as initialization value</td></tr>
</table>

17.4 Communication Interfaces

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

17.5 Global Methods

The following method can be called with the server ClassState.

17.5.1 GetData

This function is used to copy data from the measurement value memory.

Transfer parameters	Type	Description
usChannelNr	USINT	Indicates analog input, from which the data should be read.
uiDataLength	UINT	Indicates the required data length in bytes. Per measurement value 2 bytes in the 16-bit mode and 4 bytes in the 18-bit mode are needed.
pBufferData	^void	Pointer to the buffer, where the data of the measurement value memory should be copied to.
pDataCounter	^UDINT	If the pointer is valid and there are no errors in the method, the current data counter is written to its contents to indicate whether there is new data.
Return parameters	**Type**	**Description**
dRetCode	DINT	0 data were copied -1 selected analog input is inactive -2 selected analog input is not available -3 data length is not valid -4 data of the analog input are not valid

17.6 Internal Properties

The shortest conversion time of the ADC is 10 microseconds. In one millisecond, a maximum of 100 values can be thereby converted. If all 4 analog inputs are active, then 400 measurement values per millisecond are processed.

Operation of the module with a bus cycle time below 1 ms is only supported for certain samples per ms:

Bus cycle time samples/ms	50 µs	100 µs	125 µs	200 µ	250 µs	55 µs	≥ 1 ms
1	✓	✓	✓	✓	✓	✓	✓
2	✓	✓	✓	✗	✓	✓	✓
4	✓	✗	✓	✗	✓	✓	✓
5	✓	✓	✗	✓	✗	✗	✓
10	✓	✓	✗	✓	✗	✓	✓
20	✓	✓	✗	✓	✓	✓	✓
40	✓	✓	✓	✓	✓	✓	✓
50	✗	✓	✗	✓	✗	✓	✓
100	✓	✓	✗	✓	✓	✓	✓

✓ supported
✗ not supported

17.6.1 Example: Exceeding the Maximum Memory Size

As the maximum memory size is 2048 bytes, is the 18-bit mode a maximum of 512 measurement values can be recorded.
So with a setting of 100 values per millisecond in the 18-bit mode, the bus cycle time must not be higher than 5 milliseconds. Otherwise the measurement value memory overflows.
With a bus cycle time of 6 milliseconds and activation of only one channel, the following calculation is true:
100 samples * 4 bytes (18-bit) = 400 bytes per channel
400 bytes * 6 milliseconds = 2400 bytes
This configuration is not allowed, as only 2048 bytes read memory are available.

17.6.2 Example: Exceeding the Available Read Memory of the SDIAS Manager

When increasing the bus cycle time also the read memory need increases. A maximum of 6143 bytes read memory can be used,
With a bus cycle time of 4 milliseconds and activation of all 4 channels in the 18-bit mode, the following calculation is true:
100 samples per channel * 4 bytes (18-bit) = 400 bytes per channel
400 bytes per channel * 4 = 1600 bytes with four channels
1600 bytes * 4 milliseconds = 6400 bytes
This configuration is not allowed, as only 6143 bytes read memory are available.

Documentation Changes

Change date	Affected page(s)	Chapter	Note
28.06.2017	5	1.3 Measurement Precision	Info warm up phase deleted Accuracy incl. Calibration error and noise
10.07.2017	3	1.1 Analog Input Specifications	Scan rate, data memory depth per channel, calculation basis, number of values per channel (n) added
	17	6 Configuration	Chapter added
	20	7 Addressing	reworked
14.07.2017	7	1.3 Measurement Precision	Total error added
20.07.2017	3, 4	1.1 Analog Input Specifications	Input filter hardware and footnote 2 changed
	6	1.2 Measuring Modes	Diagram added
10.08.2017			All notes about internal jumper deleted
17.08.2017	9	1.7 Environmental Conditions	Added operating conditions
	13	3.2 Applicable Connectors	Added sleeve length Added info regarding ultrasonically welded strands
11.10.2017	4	1.1 Analog Input Specifications	Total measurement precision changed to ±0.060 %
	6	1.3 Measurement Precision	0-55 °C changed to 0.032 %
18.10.2017	15	3.3 Label Field	Added chapter
	19	5 Mounting	Graphic replaced
03.11.2017	18	4.3 Connection of a 2-wire Sensor 4.4 Connection of a 3-wire Sensor	Chapter added
14.02.2018	1		resolution instead of converter resolution
20.09.2018		3 Connector Layout	Note added
14.11.2019		8 Supported Cycle Times	Chapter added
28.02.2020	27	8 Supported Cycle Times	Text adapted
08.09.2020		9 Hardware Class AI047	Chapter added
04.11.2020	19	5 Mounting	Expansion functional ground connection

26.07.2023		Document	General chapters added, design