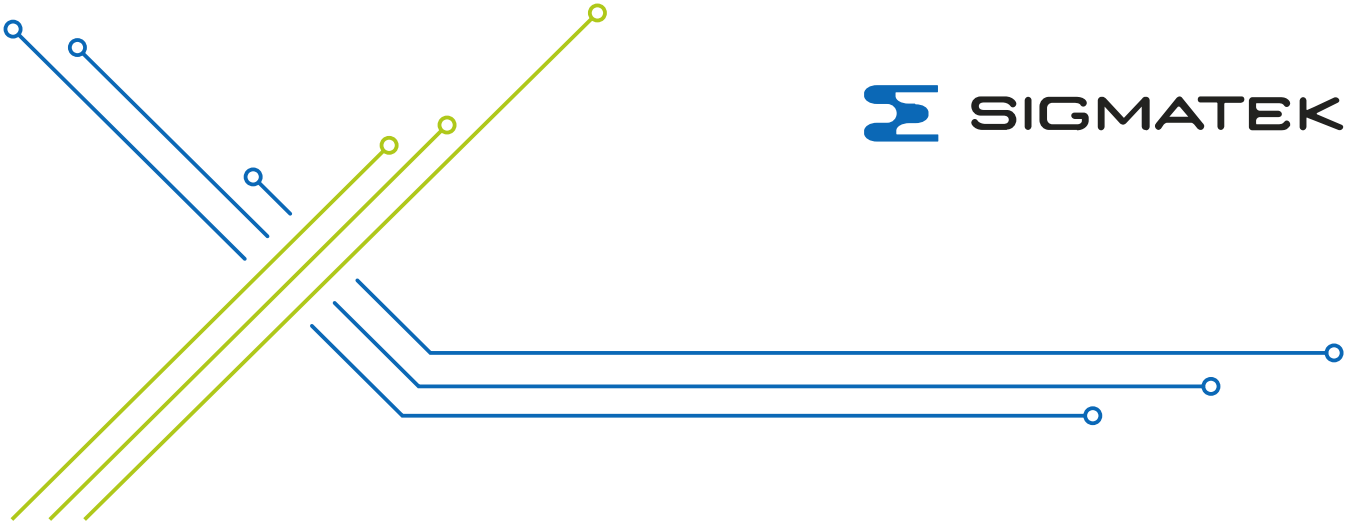
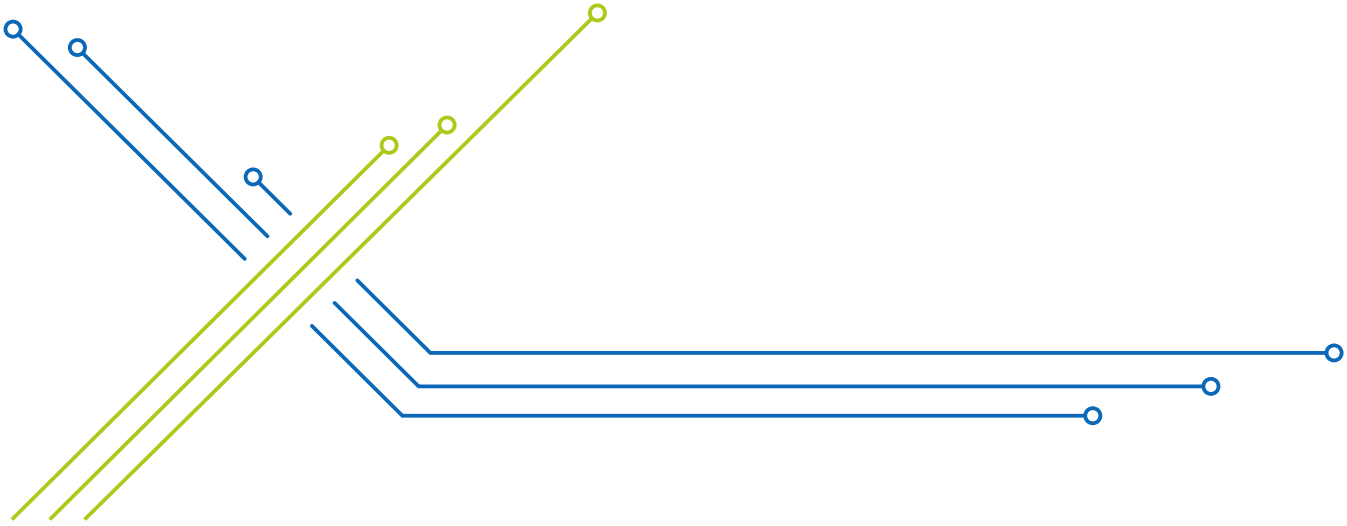


AM 221

S-DIAS Analog Mixed Module ±10 V

INSTRUCTION MANUAL

Article number:	20-017-221-E
Date of creation:	19.05.2014
Version date:	26.01.2026



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 Mixed Module ±10 V AM 221

2 analog outputs

2 analog inputs or potentiometer inputs

1 reference output

The S-DIAS Analog Mixed Module ±10 V AM 221 has two ±10 V analog outputs with a resolution of 12 bits and two ±10 V analog inputs or 0-100 % potentiometer inputs with a 16-bit resolution. For the potentiometer inputs a +10 V reference is provided that can be loaded with a maximum of 8.3 mA.

Table of 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 AM 221

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 particular attention.

2.2 Disclaimer

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.

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.

INFORMATION

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 !

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

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 Declaration of Conformity

EU Declaration of Conformity

The product AM 221 conforms to the following European directives:

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

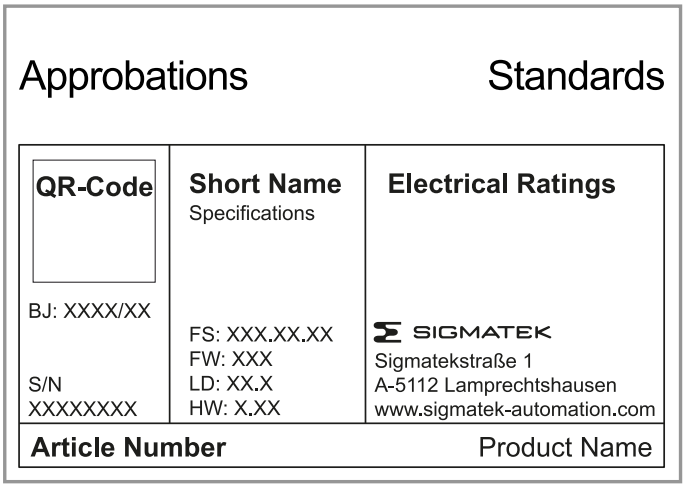
The EU Conformity Declarations are provided on the SIGMATEK website. They can be found in the download area of the respective product.

3.2 Safety-Relevant Parameters

Calculation basis	IEC 61709 SN 29500 EN ISO 13849 EN IEC 62061
Conditions	+60 °C
Number of hour per year	8760
MTBF	217 years
$MTTF_D$	435 years
PFH based on $MTTF_D$ = 100 y according to table K1 Annex K EN13849	> $1.14 * 10^{-6}$
The MTBF is a calculated value that represents the probability of failure and should not be confused with the product service life.	
Safety classification according to EN ISO 13849	
Category	1
Performance level	C
Safety classification according to EN IEC 62061	
Security integrity level	SIL 1

4 Type Plate

The type plate provides information about the product's features. The type plate shown here is only an example.



HW: Hardware version
FS: Safety version number
FW: Firmware version
LD: Logic device version
QR-Code: Serial number

5 Technical Data

5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification

Number of channels	2	
Input type	differential input	potentiometer input
Measurement range	-10 … +10 V	0-100 %
Measurement value	-10,000 ... +10,000 or -30,000 … +30,000 (with full range)	0-10,000 or 0-30,000 (with full range)
	if the input is open, the firmware supplies the positive maximum value and a status bit to signal the cable break (the HW class thus shows the value -2147483632)	
Resolution	16 bits (ca. 0.3 mV/LSB)	
Conversion time for all channels	FW version 01.00 – 01.20: 500 µs	
	FW version ≥ 02.00: depending on the selected timing	
	speed mode: 200 µs	
	time offset mode: corresponds to the S-DIAS cycle time	
Common mode range	±12 V	
Input resistance	> 10 MΩ	
Cable break monitoring	yes	
Input filter hardware	typically 1 kHz, 3rd order low pass	
Input filter software	configurable, low pass 1st order	
Measurement precision	±0.3 % of the maximum measured value	±0.35 % of the maximum measured value

5.2 Reference Output Specifications

Number of channels	1
Reference voltage	+10 V
Permissible output current	maximum 5.0 mA (< HW version 2.5)
	maximum 8.3 mA (≥ HW version 2.5)
Permissible load per potentiometer input	≤ 2.50 mA (< HW version 2.5)
	≤ 4.17 mA (≥ HW version 2.5)
	≥ 4.0 kΩ (< HW version 2.5)
	≥ 2.4 kΩ (≥ HW version 2.5)
Short-circuit protection	yes
Accuracy	±0.5 %

5.3 Analog Outputs ±10 V Specifications

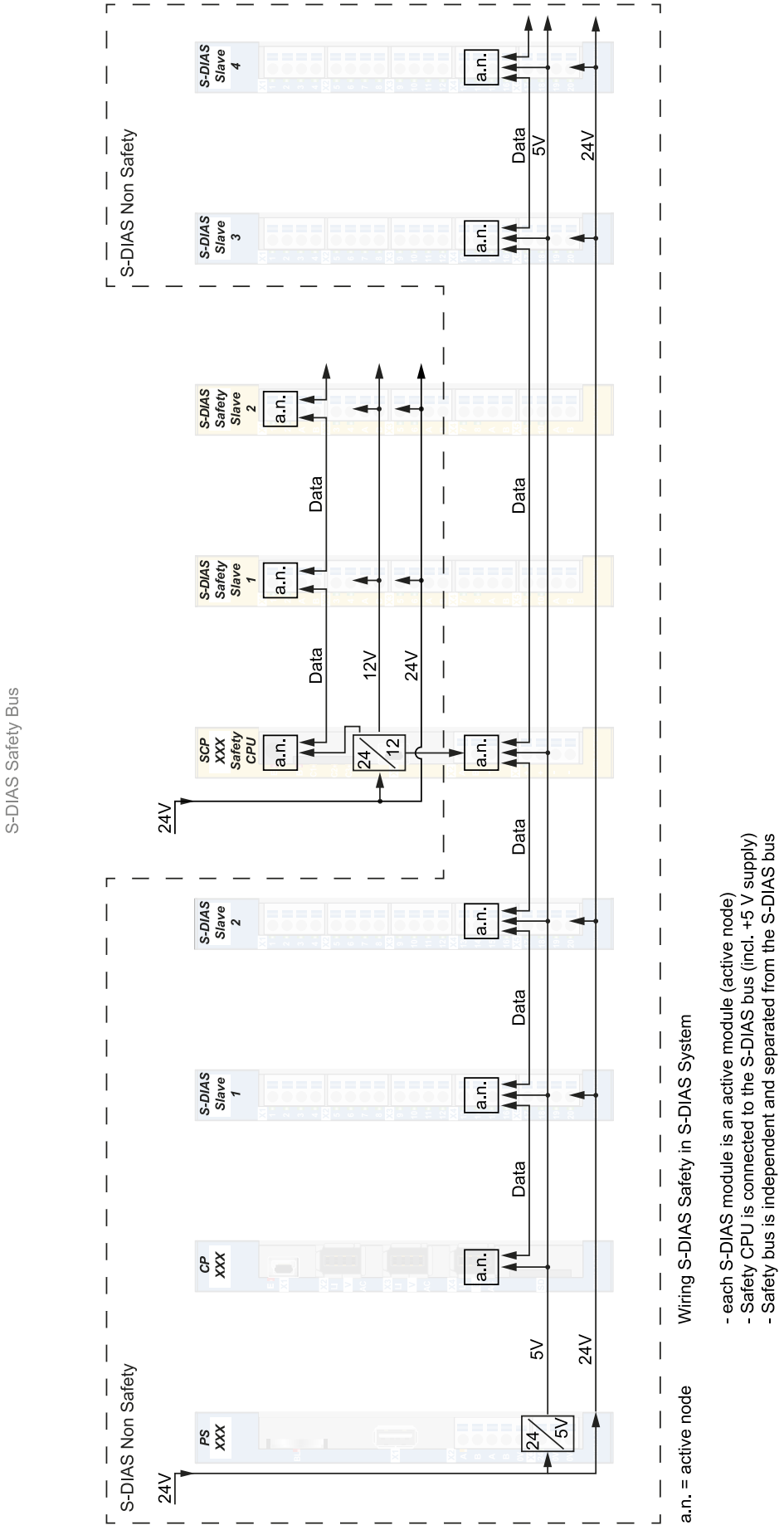
Number of channels	2
Output range	-10 … +10 V
Output value	-10,000 ... +10,000
Resolution	12 bits (ca. 5 mV/LSB)
Refresh time of all channels	≥ 500 µs (corresponds to the S-DIAS cycle time)
Load capacity of the output voltage	> 5 KΩ
Permissible capacitive load	maximum 100 nF
Short-circuit protection	yes (1 min.)
Settling time	50 µs (63 % of the end value)
	100 µs (86 % of the end value)
	250 µs (99 % of the end value)
Output accuracy	±0.5 % of the maximum output value

5.4 Electrical Requirements

Voltage supply from S-DIAS bus	+5 V	
Current consumption on the S-DIAS bus (+5 V supply)	typically 50 mA	maximum 55 mA
Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V supply)	typically 32 mA (without load on the reference output and the analog outputs)	maximum 40 mA (without load on the reference output and the analog outputs)
	typically 40 mA (with load of the reference output with 4x 4 kΩ and maximum load of the analog outputs)	maximum 55 mA (with load of the reference output with 4x 4 kΩ and maximum load of the analog outputs)
	typically 45 mA (with load of the reference output with 4x 2k4 kΩ and maximum load of the analog outputs)	maximum 60 mA (with load of the reference output with 4x 2k4 kΩ and maximum load of the analog outputs)
Short-circuit of the analog outputs	typically 30 mA additional per channel on +24 V supply	

INFORMATION

If this S-DIAS module is used on an S-DIAS supply module with several S-DIAS modules, the total currents of the S-DIAS modules used must be determined and checked.
The total current of the +24 V supply must not exceed 1.6 A!
The total current of the +5 V supply must not exceed 1.6 A!
The power consumption information can be found in the module-specific technical documentation under "Electrical Requirements".


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

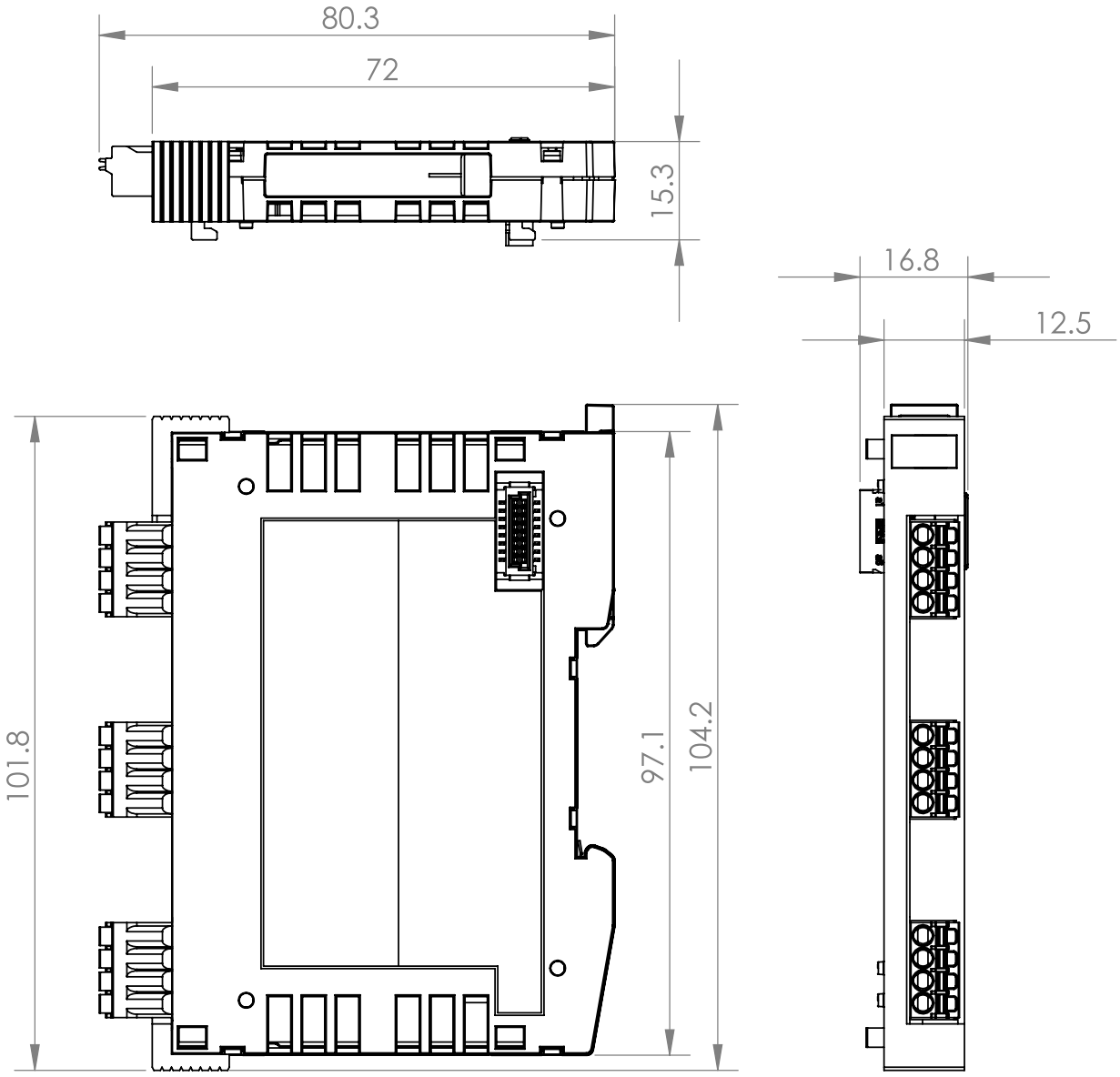
5.5 Miscellaneous

Article number	20-017-221	
Printed circuit board coating	no	
Approvals	CE	yes
	UL	cULus (E247993)
	Functional Safety	no
	UKCA	yes

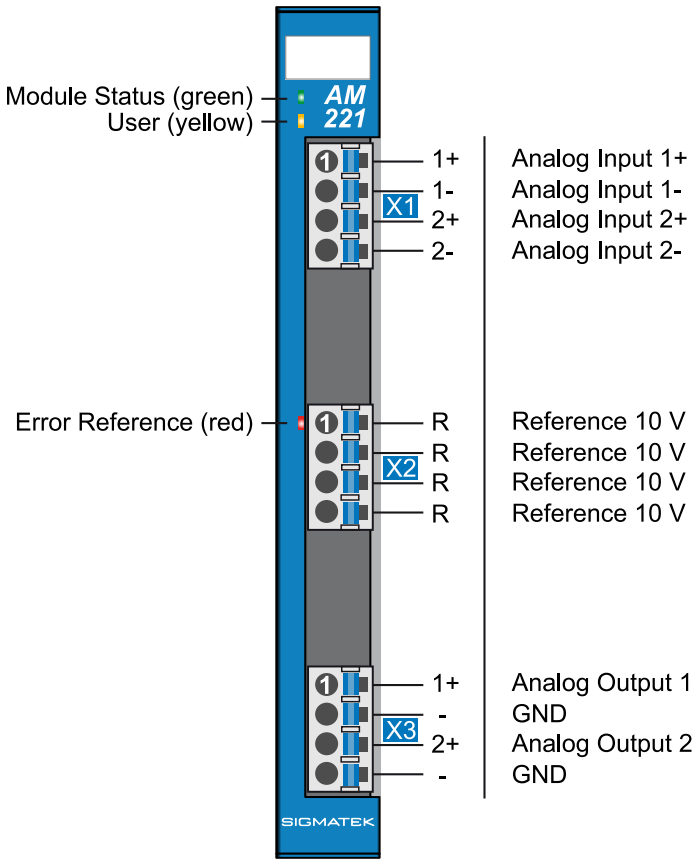
5.6 Environmental Conditions

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 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	
Noise emission	≤ 70 dB	
EMC resistance	EN 61000-6-2 (industrial area)	
EMC noise generation	EN 61000-6-4 (industrial area)	
Vibration resistance	EN 60068-2-6	3.5 mm von 5-8.4 Hz 1 g von 8.4-150 Hz
Shock resistance	EN 60068-2-27	15 g (147.15 m/s²)
Protection type	EN 60529/NEMA 250	IP20/Type1

6 Mechanical Dimensions



7 Connector Layout



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)	
Error reference	red	ON	10 V reference overload
		OFF	no errors
		BLINKING (20 Hz)	GND overload if AIx is switched to GND by software!

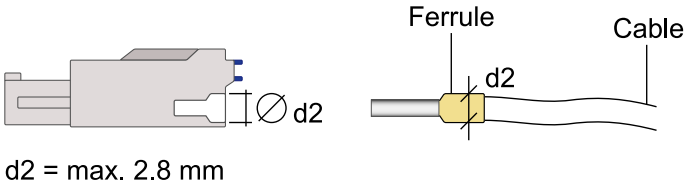
7.2 Applicable Connectors

X1-X3: Connectors with spring terminals (included in delivery)

The spring terminals are suited for the connection of ultrasonically compacted (ultrasonically welded) stranded wire.

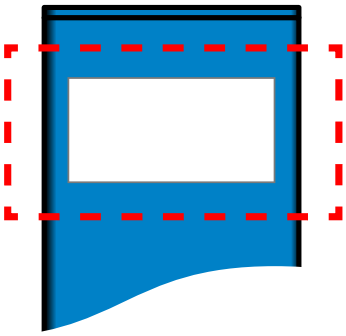
Connection capacity:

Stripping length/sleeve length	10 mm
Mating direction	parallel to the conductor axis or circuit board
Conductor cross section rigid	0.2-1.5 mm²
Conductor cross section flexible	0.2-1.5 mm²
Conductor cross section, ultrasonically compacted	0.2-1.5 mm²
Conductor cross section AWG/kcmil	24-16
Conductor cross section flexible with ferrule without plastic sleeve	0.25-1.5 mm²
Conductor cross section flexible with ferrule with plastic sleeve	0.25-0.75 mm² (reason for reduction d2 of the ferrule)



d2 = max. 2.8 mm

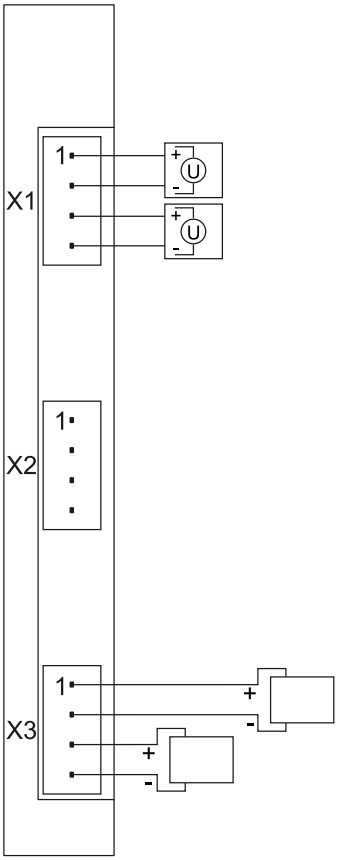
7.3 Label Field



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

8 Wiring

8.1 Wiring Example



8.2 Note

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

The following installation guidelines should be observed:

- Protective circuits for all relays (RC networks or free-wheeling diodes)
- 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.
- Correct wiring to ground

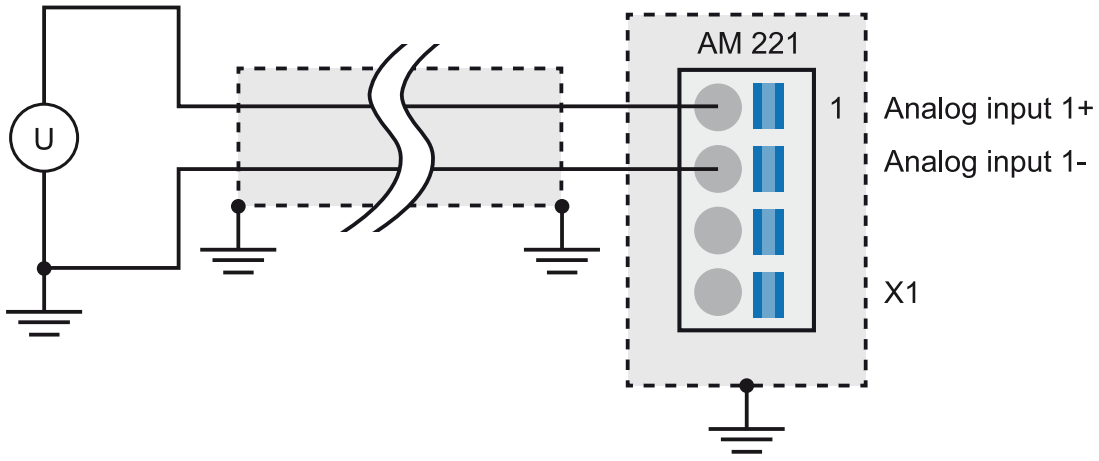
INFORMATION

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

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

8.3 Connection Variants

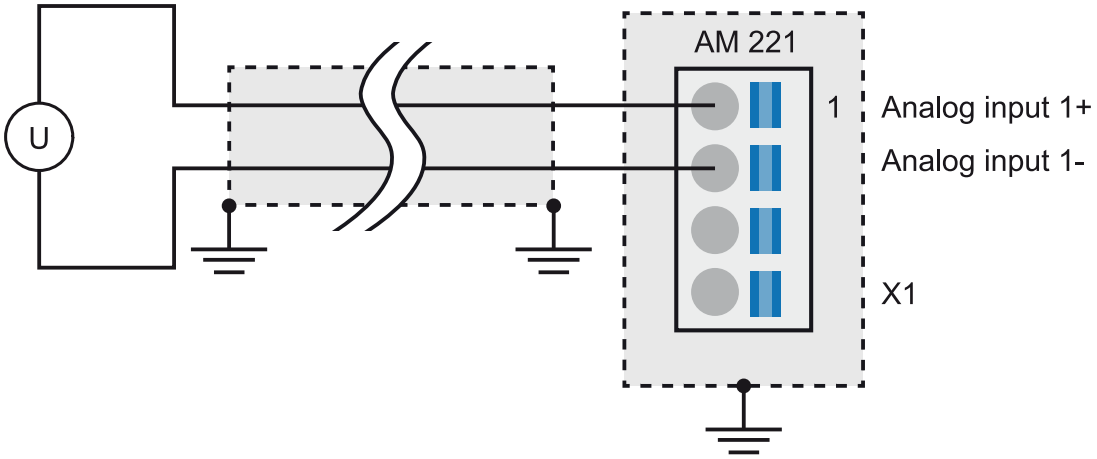
8.3.1 Voltage Measurement of Non Potential-free Voltage Sources



Wiring diagram 1

When using a non-potential-free voltage source (voltage source with connection to earth or GND), the input must be configured as a differential analog input via software. The analog input must not be connected to AGND, GND or earth. Otherwise, equalizing currents and measurement errors may occur.

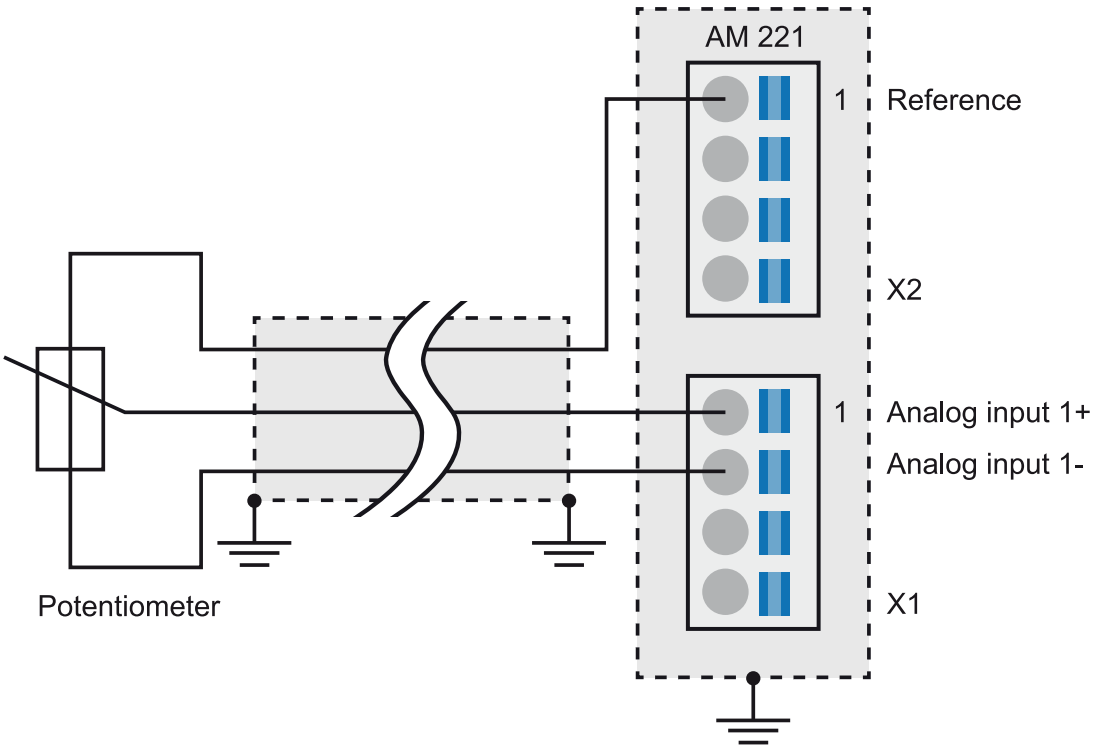
8.3.2 Voltage Measurement of Potential-free Voltage Sources



Wiring diagram 2

When using a potential-free voltage source (voltage source without connection to earth or GND), either the input must be configured by software as an "input with earth reference" so that the analog input 1- connection is switched internally to AGND or the input must be configured by software as a differential analog input and the earth reference of the analog signal must be established externally.

8.3.3 8.3.3 Voltage Measurement with a Potentiometer

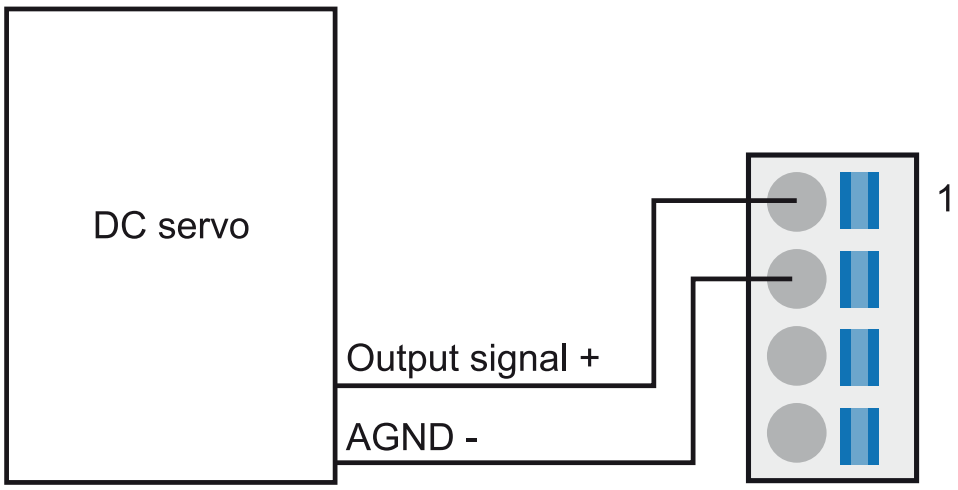


Wiring diagram 3

The analog inputs can also be used to connect a potentiometer. In this case, the input must be configured as an "input with ground reference" via software. This switches the analog input 1- connection internally to AGND. The reference connection provided for this purpose must be used to supply the potentiometer.

8.3.4 Connection of the analog outputs

Application examples: Axis control for DC servo, AC drive



9 Assembly/Installation

9.1 Check Contents of Delivery

Ensure that the contents of the delivery are complete and intact. See chapter 1.3 Contents of Delivery.

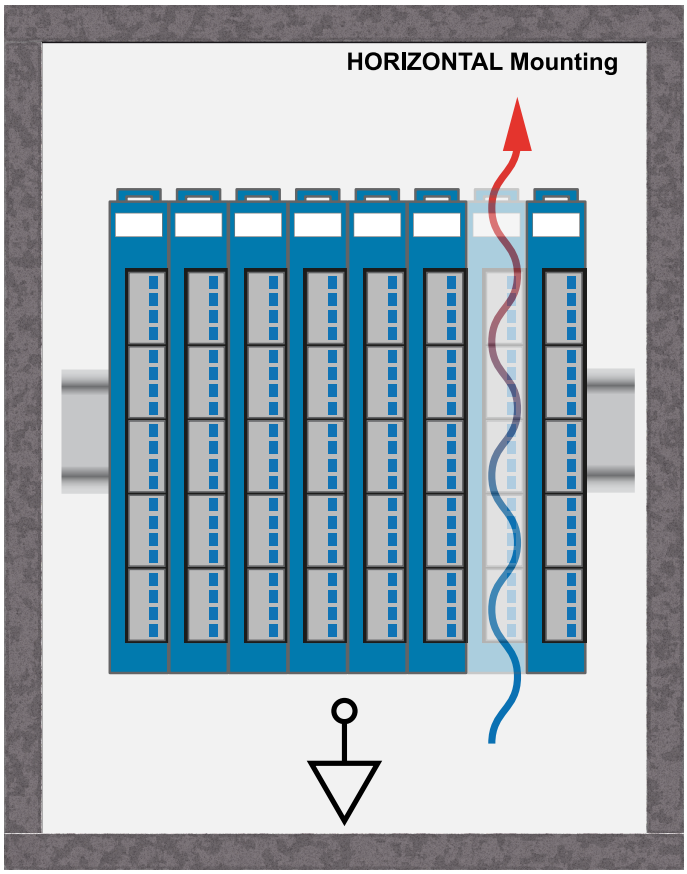
INFORMATION

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.

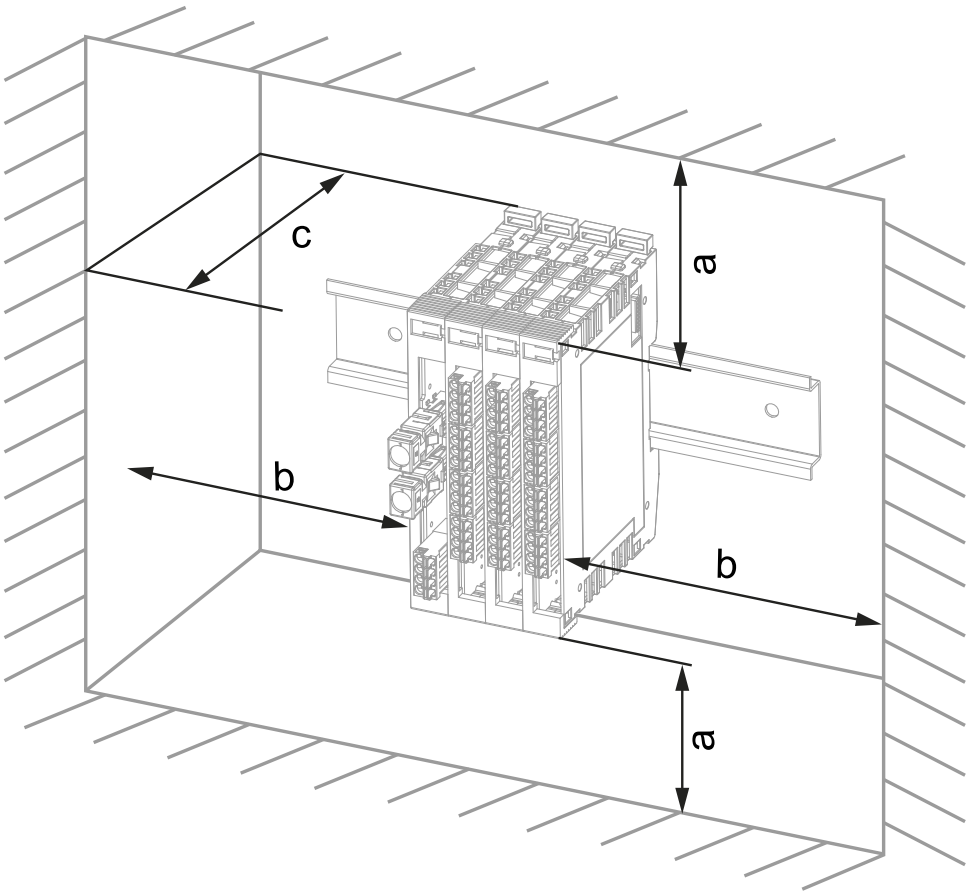
Damaged components can disrupt or damage the system.

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 rai is made via the grounding lug 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 to ensure proper function up to the maximum operating temperature.



Recommended minimum distances between the S-DIAS modules and 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 Transport/Storage

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.

11 Storage

When not in use, store the device according to the storage conditions. See chapter 10 Transport/Storage.

INFORMATION

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

12 Maintenance

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

12.1 Service

This product was constructed for low-maintenance operation.

12.2 Repair

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 10 Transport/Storage.

13 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.

14 Expanded Timing Modes (FW version ≥ V02.00)

The AM 221 can operate the analog inputs in either speed mode (highest possible scan rate) or in time-offset mode (measuring active only once per cycle at a defined time). This can be configured via bit 3 in the Info byte of the configuration data (address 0x0104).

The analog outputs on the contrary, are always operated in time offset mode. By default however, predefined time offsets (at the start of a cycle) are used for this purpose. By setting bit 4 in the info byte of the configuration data (address 0x0104), the time offsets can also be predefined for the analog outputs of the HW class.

Thereby, it is important to note that the time offsets for the analog outputs can only be exactly stopped when the analog inputs are also operated in the same operating mode, since they are assigned to the analog outputs. If the analog inputs should be operated in speed mode, the actual time point of the defined analog value output can deviate up to 200 µs.

14.1 Speed Mode

The speed mode is available for the analog inputs only. In this mode, the analog inputs are scanned as fast as possible and filtered to achieve the highest possible sampling rate. The time point of the individual measurements cannot be defined since measuring is continuous and is therewith performed several times per S-DIAS cycle.

The analog outputs are activated during the sections of free time between measurements of the analog inputs. A constant sampling rage is thereby guaranteed.

14.2 Time Offset Mode

The time-offset mode is basically used for the analog outputs, since they must be written only once per S-DIAS cycle. However, it also available for the analog inputs (the appropriate bit must be set in the info byte of the configuration data).

In the time offset mode, the analog in- and outputs (depending on the configuration of both or only the outputs) are measured only once per cycle (the duration of a cycle corresponds to the S-DIAS cycle time). The measurement or output time can be defined in µs as an offset to the S-DIAS Sync (cycle start point).

The time for the analog inputs are thereby predefined by the hardware class directly (in the cyclic data for the firmware, one time offset can be set per channel).

In the analog outputs, predefined time offsets configured so they correspond to the earliest time possible are used by default.

If however, bit 4 in the info byte of the configuration file (address 0x0104) is set, the time offsets in the cyclic data provided by the HW class are used. Here, it is important to note that deviations can occur, if the analog inputs are operated in speed mode.

The settable values (time offsets) are subject to the following limits:

- **Minimum time offset value:** Since the firmware must process the incoming cyclic data immediately after the
  S-DIAS sync, only offset values of **130 µs** and higher can be used.
- **Maximum time offset value:** Since cyclic data for the HW class must be written at the end of an S-DIAS cycle, only offset values up a maximum **cycle time below 160 µs** can be used.
- **Interval between time offsets:** Since it is not possible to measure or set multiple analog inputs simultaneously, the interval between offsets must be at least **20 µs**.
- **Correction within the firmware:** If offset values beyond the limits are set or too close together, these are corrected (shifted) by the firmware where possible. To signal the correction or incorrect values to the HW class, the appropriate status bit is set (bit 7 of 8 in the cyclic data for the HW class to address 0x000A).

15 Addressing

15.1 Firmware – HW Class Addressing (FW Version V01.00 – V01.20)

The address assignment specified here relates to FW versions 01.00, 01.10 and 01.20.

F0r FW version ≥ 02.00, see 15.2 Firmware – HW Class Addressing (FW Version ≥ 02.00)

Address (hex)	Size (bytes)	Access type	Description	
0000	**128**	**w**	**Cyclical data to the firmware**	
0000	2	w	reserved	
0002	2	w	reserved	
0004	2	w	Analog output 1	
0006	2	w	Analog output 2	
0080	**128**	**r**	**Cyclical data to the HW class**	
0080	2	r	Status	
			Bit 0	24 V DC not OK
			Bit 1	not synchronized
			Bit 2	FLASH calibration data CRC error
			Bit 3	RAM calibration data CRC error
			Bit 4	invalid calibration data
			Bit 5-15	reserved
0082	2	r	Analog input 1	
0084	2	r	Analog input 2	
0086	2	r	reserved	
0088	2	r	reserved	
008A	2	r	Cable break detection	
			Bit 0	cable break AI1
			Bit 1	cable break AI2
			Bit 2-3	reserved
008A	2	r	Modul status	
			Bit 4	reference voltage
				0 ... reference voltage OK
				1 ... reference voltage too low
			Bit 5	AI overload (at least 1 analog input is overloaded)
			Bit 6-15	reserved
0100	**128**	**w**	**Firmware Configuration Data**	
0100	2	w	CRC16 over the entire configuration data	
0102	2	w	Length of the configuration data	

Address (hex)	Size (bytes)	Access type	Description	
0104	1	w	Info (special purpose or status bits)	
			Bit 0	raw value mode
				0 ... normal mode (in and output values compared)
				1 ... raw values are used and provided
			Bit 1-7	reserved
0105	1	w	reserved	
0106	2	w	Configuration of the analog inputs	
			Bit 0	analog input 1
				0 … differential analog input
				1 ... analog input with reference to mass
			Bit 1	analog input 2
				0 … differential analog input
				1 ... analog input with reference to mass
			Bit 2-15	reserved
0108	2	w	Frequency limit low pass filter in Hz analog input 1 (with a frequency limit setting of 0 Hz, the software low pass filter is deactivated; compliance with the sampling theorem must be ensured)	
010A	2	w	Frequency limit low pass filter in Hz analog input 2 (Note, see address 0x0108)	
010C	2	w	reserved	
010E	2	w	reserved	
0180	**128**	**r**	**HW Class Configuration Data**	
0180	2	r	CRC16 over the entire configuration data	
0182	2	r	Length of the configuration data	
0184	2	r	Firmware version	

15.2 Firmware – HW Class Addressing (FW Version ≥ 02.00)

The address allocation defined here applies to the FW version ≥ V02.00.

For older FW versions see 15.1 Firmware – HW Class Addressing (FW Version V01.00 – V01.20)

Address (hex)	Size (bytes)	Access type	Description	
0000	**128**	**w**	**Cyclical data to the firmware**	
0000	2	w	reserved	
0002	2	w	reserved	
0004	2	w	Analog output 1	
0006	2	w	Analog output 2	
0008	2	w	AI 1 – Time offset from Sync in µs(the time offsets are automatically adjusted, see 14.2 Time Offset Mode)	
000A	2	w	AI 2 – Time offset from Sync in µs(Note, see address 0x0008)	
000C	2	w	reserved	
000E	2	w	reserved	
0010	2	w	reserved	
0012	2	w	reserved	
0014	2	w	AO 1 – Time offset from Sync in µs(the time offsets are adjusted automatically, see 14.2 Time Offset Mode; if the analog inputs are operated in speed mode, the analog value output can deviate up to 200 µs)	
0016	2	w	AO 2 – Time offset from Sync in µs(Note, see address 0x0014)	
0080	**128**	**r**	**Cyclical data to the HW class**	
0080	2	r	Status	
			Bit 0	24 V DC not OK
			Bit 1	not synchronized
			Bit 2	FLASH calibration data CRC error
			Bit 3	RAM calibration data CRC error
			Bit 4	invalid calibration data
			Bit 5	S-DIAS cycle time not supported
			Bit 6-11	reserved
0080	2	r	Error information	
			Bit 12-15	Error codes
				00 = no error occurred
				01 = periphery could not be initialized
				02 = system clock could not be initialized
				03-14 = reserved
				15 = undefined error occurred
0082	2	r	Analog input 1	
0084	2	r	Analog input 2	
0086	2	r	reserved	

Address (hex)	Size (bytes)	Access type	Description	
0088	2	r	reserved	
008A	2	r	Cable break detection and measurement range testing	
			Bit 0	cable break AI1 (also corresponds to AI1 overrange when the new features (bit 2 at address 0x0104) are activated)
			Bit 1	cable break AI2 (also corresponds to AI2 overrange when the new features (bit 2 at address 0x0104) are activated)
			Bit 2-3	reserved
			Modul status	
			Bit 4	reference voltage
				0 ... reference voltage OK
				1 ... reference voltage too low
			Bit 5	AI overload (at least 1 analog input is overloaded)
			Bit 6	24 V DC not OK
008A	2	r	Time offset information	
			Bit 7	Time offset must be corrected (interval was too short or is beyond the limit)
			Bit 8	Time offsets exceed the allowed limits and cannot be corrected (the defined time offsets are invalid or became invalid by shifting the offsets within the firmware)
			Expanded measurement range testing	
			Bit 9	AI1 underrange (only when the new features (Bit 2 in the info byte at address 0x0104) are activated)
			Bit 10	AI2 underrange (only when the new features (Bit 2 in the info byte at address 0x0104) are activated)
			Bit 11-15	reserved
0100	**128**	**w**	**Firmware Configuration Data**	
0100	2	w	CRC16 over the entire configuration data	
0102	2	w	Length of the configuration data	

Address (hex)	Size (bytes)	Access type	Description	
0104	1	w	Info (special purpose or status bits)	
			Bit 0	raw value mode
				0 ... normal mode (in and output values compared)
				1 ... raw values are used and provided
			Bit 1	reserved
			Bit 2	Expanded functionality
				0 … additional features are deactivated (compatibility)
				1 … additional features are activated. Included therein is the use of the message counter, as well as testing the measurement range for all analog inputs and the connected under- and overrange bits at address 0x008A.
0104	1	w	Bit 3	ADC - timing mode
				0 ... speed mode (the ADC is read over a measurement timer as fast as possible)
				1 ... time offset mode (the analog inputs are sampled with the predefined time offsets of the HW class)
			Bit 4	Configurable DAC time offsets
				0 … predefined offsets are used for the time point of the analog value output (at the beginning of the S-DIAS cycle)
				1 … the time offsets set by the HW class are used for the analog value outputs
			Bit 5	Full 16-bit resolution (full range mode)
				0 ... full range mode is deactivated (the voltage values are provided in a range from -10000 mV to +10000 mV)
				1 ... full range mode is activated (the resolution of the values is increased by a factor of 3, whereby the voltages are provided in a range from -30000 to +30000 units the measurement range remains unchanged)
			Bit 6	Module version (to distinguish the hardware, only required when time offsets are used to deactivate the unavailable in- and outputs)
				AM 221
				AM 441
			Bit 7	reserved
0105	1	w	Message Counter (only used when bit 2 in the Info-Byte is set at address 0x0104)	

Address (hex)	Size (bytes)	Access type	Description	
0106	2	w	Configuration of the analog inputs	
			Bit 0	analog input 1
				differential analog input
				analog input with reference to mass
			Bit 1	analog input 2
				differential analog input
				analog input with reference to mass
			Bit 2-15	reserved
0108	2	w	Frequency limit low pass filter in Hz analog input 1(with a frequency limit setting of 0 Hz, the software low pass filter is deactivated; compliance with the sampling theorem must be ensured)	
010A	2	w	Frequency limit low pass filter in Hz analog input 2(Note, see address 0x0108)	
010C	2	w	reserved	
010E	2	w	reserved	
0180	128	r	HW Class Configuration Data	
0180	**2**	**r**	CRC16 over the entire configuration data	
0182	2	r	Length of the configuration data	
0184	2	r	Firmware version	
0186	1	r	Message Counter (only used when bit 2 in the Info-Byte is set at address 0x0104)	
0187	1	r	reserved	

16 Supported Cycle Times

16.1 Cycle Times below 1 ms (in µs)

FW	50	100	125	200	250	500
< V3.00						x
≥ V3.00						x

16.2 Cycle Times equal to or higher than 1 ms (in ms)

FW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
< V3.00		x	x													
≥ V3.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

FW	1	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
< V3.00																
≥ V3.00	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Changes Chart

Change date	Affected page(s)	Chapter	Note
05.06.2014	10	5.2 Reference Output Specifications	Permissible output current changed/Permissible load per potentiometer input added
30.01.2015	19	8.2 Note	Added note concerning connecting the S-DIAS module while voltage is applied
26.03.2015	16	7.2 Applicable Connectors	Added connections
08.04.2015	19	8.3 Connection Variants	Chapter revised
27.07.2015	10	5.2 Reference Output Specifications	Permissible output current and permissible load per potentiometer input extended
	11	5.4 Electrical Requirements	Current consumption on the S-DIAS bus (+24 V supply) changed
29.09.2015	10	5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification	Differential inputs adjusted
	19	8.3.1 Voltage Measurement of Non Potential-free Voltage Sources	Voltage measurement of non-floating voltage sources-differential inputs adapted
	20	8.3.2 Voltage Measurement of Potential-free Voltage Sources	Voltage measurement of potential-free voltage sources-differential inputs adapted
20.01.2016	13	5.5 Miscellaneous	Standard changed
25.01.2016	11	5.4 Electrical Requirements	Graphics added
09.03.2016	10	5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification	Input type changed
22.04.2016	30	15.1 Firmware – HW Class Addressing (FW Version V01.00 – V01.20)	Address 0000 changed to 0002
			Address 0002 changed to 0006
28.04.2016	22	9 Assembly/Installation	Graphics distances
17.05.2016	10	5.2 Reference Output Specifications	Short-circuit protection (1 min.) deleted
11.01.2017	11	5.3 Analog Outputs ±10 V Specifications	Formulation of analog accuracy
27.03.2017	10	5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification	Value for sensor break detection added
11.07.2017	10	5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification	Information on measured value and conversion time corrected
	11	5.3 Analog Outputs ±10 V Specifications	Corrected refresh time specification
	30	15 Addressing	Mapping corrected (firmware dependency)
19.07.2017	10	5.1 Analog Inputs ±10 V or Potentiometer Inputs 0-100 % Specification	Conversion time of ALL channels 500 µs
	11	5.3 Analog Outputs ±10 V Specifications	Refresh time of all channels
17.08.2017	13	5.6 Environmental Conditions	Pollution degree
	16	7.2 Applicable Connectors	Sleeve length added

Change date	Affected page(s)	Chapter	Note
			Added info regarding ultrasonically welded strands
18.10.2017	17	7.3 Label Field	Chapter added
	22	9 Assembly/Installation	Graphic replaced
16.04.2019	8	3.2 Safety-Relevant Parameters	Chapter added
13.08.2020		Entire document	FW version 02.00 adapted to FW version ≥ 02.00
08.09.2020		9 Hardware class AM 221	Chapter added
04.11.2020	22	9.2 Mounting	Expansion functional ground connection
06.12.2022	13	5.5 Miscellaneous	UKCA conformity
20.02.2023	36	16 Supported Cycle Times	Chapter added
26.07.2023		Document	General chapters added, design
26.01.2026	30	15.1 Firmware – HW Class Addressing (FW Version V01.00 – V01.20)	AO 1and AO 2 correctly assigned

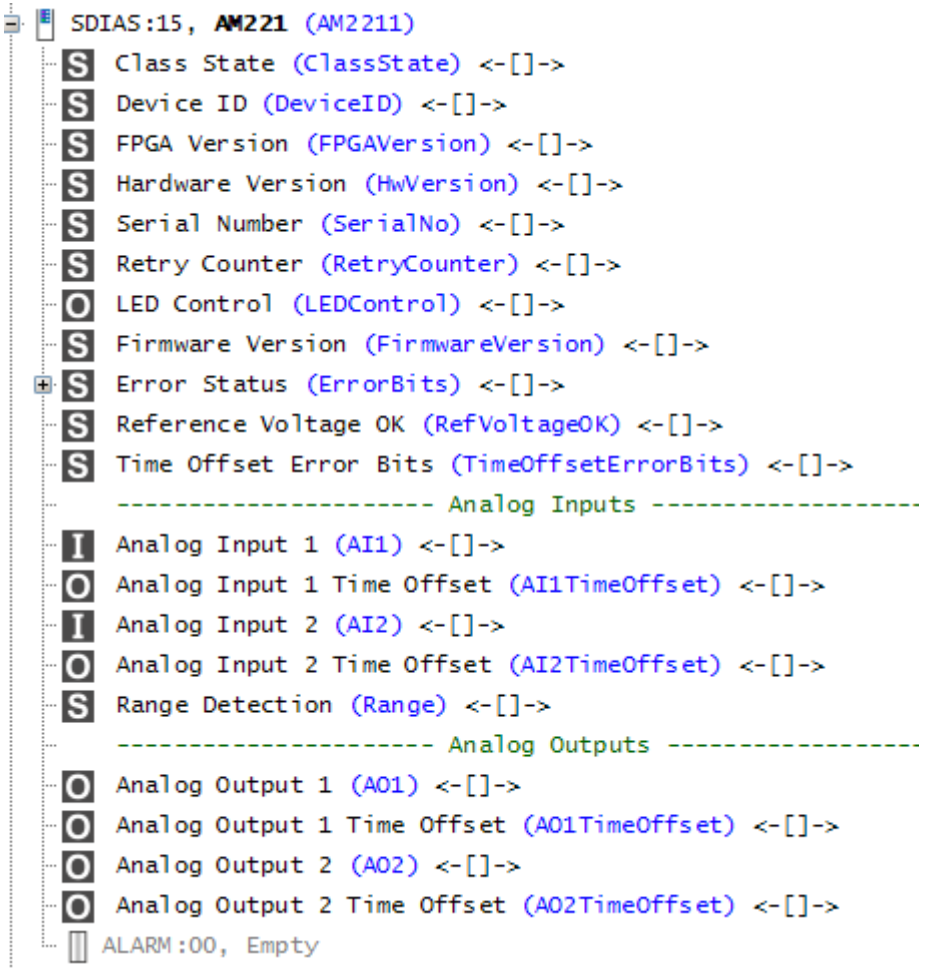
17 Hardware Class

The HW classes are used to configure the module under LASAL CLASS and this document is available in the LASAL CLASS help.

Table of Contents

AM221

Hardware class AM221 for the S-DIAS analog module AM 221



This hardware class is used to control the AM 221 hardware module. The module has 2 analog inputs (±10 V) and 2 analog outputs (±10 V). More information on the hardware can be found in the module documentation.

1.1 Interfaces

General

Class State	State	This server shows the actual status of the hardware class.
Device ID	State	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	Shows the serial number of the hardware module.
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
Firmware Version	State	The firmware version of the hardware module is shown in this server.
Error Status	State	In this server, the status bits of the FW are shown. Bit 1 Supply +24 V on S-DIAS bus not OK Bit 2 No Sync available Bit 3 Flash Data CRC Error Bit 4 Ram Data CRC Error Bit 5 Invalid EEProm version Bit 6 Bus time not supported Bit 17 Cable break at input AI1 Bit 18 Cable break at input AI2 Bit 22 Voltage too low Bit 23 Supply +24 V on S-DIAS bus not OK Bit 26 Lower measuring range AI1 was violated Bit 27 Lower measuring range AI2 was violated
Reference Voltage OK	State	The reference voltage for sever value 0 is too low.

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.

Analog Inputs and Outputs

AI[1-2] Config	Property	0 AI[1-2] used as analog input (range: -10 ... +10 V) 1 AI[1-2] used as analog input with reference to mass (range: -10 ... +10 V)
AI[1-2] cut off frequency	Property	In this client, the cutoff frequency for the software low pass filter is set. 0 1000 Hz 1 500 Hz 2 250 Hz 3 100 Hz 4 50 Hz 5 25 Hz 6 10 Hz Available since FW version 3.10 9 off Values higher than 10 are directly transferred to the firmware and are set. e.g. 125 ... 125 Hz. Valid range: 10-1000. If the time-offset mode for the analog inputs is activated and the set frequency would violate Shannon's sampling theorem, it is automatically adjusted by the hardware class. The new calculated frequency is then written to the respective client. Additionally a log message is displayed.
AI[1-2] minimal value	Property	This value indicates the minimum value for the channel. If -10 V is measured at the channel, this value is output in the software. The range of the measurement values are defined by the setting in the clients I[1-2]_Min and AI[1-2]_Max.
AI[1-2] maximal value	Property	This value indicates the maximum value for the channel. If +10 V is measured at the channel, this value is output in the software. The range of the measurement values are defined by the setting in the clients I[1-2]_Min and AI[1-2]_Max.
AO[1-2] minimal value	Property	Minimum output value AO[1-2]. If this value is written to the respective channel server, the module outputs -10 V. Must be different than the maximum value of the output.
AO[1-2] maximal value	Property	Maximum output value AO[1-2]. If this value is written to the respective channel server, the module outputs +10 V. Must be different than the minimum value of the output.

Analog Input [1-2]	Input	Analog input 1-2, status query over read(). An open input returns -2147483632 in the hardware class.
Analog Output [1-2]	Output	Analog output [1-2].
Full Resolution 16Bit	Property	This value specifies whether the full resolution (16 instead of 15 bit) should be used for the analog inputs. Supported only from FW version 2.00. 0 -10/+10 V 1 mV LSB 1 -10/+10 V 0.3 mV LSB
Range detection	State	Detection upper measuring limit (cable break detection). Bit 1 Cable break at input AI1 Bit 2 Cable break at input AI2 The limit for cable break detection is > 10,25 V. Detection upper measuring limit (available with FW version 2.00 or higher). Bit 5 Lower measuring range violated at input AI1 Bit 6 Lower measuring range violated at input AI2 The upper measuring value limit is < -10,25 V.

Time Offset Mode

Available since firmware version ≥ 2.00

Activate Time Offset Analog In	Property	This setting defines, whether the time offset mode for the analog inputs should be used. 0 Time offset mode for analog inputs deactivated 1 Time offset mode for analog inputs activated If 1 is set and the firmware of the module does not support this mode, the Class State is set to _ClientNotReady and a log message is output. as initialization value
Activate Time Offset Analog Out	Property	This setting defines, whether the time offset mode for the analog outputs should be used. 0 Time offset mode for analog outputs deactivated 1 Time offset mode for analog outputs activated If 1 is set and the firmware of the module does not support this mode, the Class State is set to _ClientNotReady and a log message is output. as initialization value
Analog Input [1-2] Time Offset	Output	Time offset for the according analog input in µs. Valid limits: 105 µs to (cycle time - 197 µs). Example: 1 ms cycle time (bus time) ... Range: 105 µs to 803 µs Input value/status value: -1 Feature is not supported by the current firmware. (Available for FW version ≥ 2.00 or higher) -2 Defined value is outside the valid limits

Analog Output [1-2] Time Offset	Output	Time offset for the according analog output in µs. Valid limits: 105 µs to (cycle time - 197 µs). Example: 1 ms cycle time (bus time) ... Range: 105 µs to 803 µs Input value/status value: -1 Feature is not supported by the current firmware. (Available for FW version ≥ 2.00 or higher) -2 Defined value is outside the valid limits
Time Offset Error Bits	State	Bit 1 The defined time offsets were invalid and have automatically been adjusted by the firmware. This can happen, if the difference between two time offsets is too small (lower than 20 µs). Bit 2 The defined time offsets were invalid and could not be adjusted automatically by the firmware. This can happen, if the time offsets are defined too narrow, e.g. several time offsets are exactly at 105 µs before the sync.

Time Offset Mode for Analog Inputs

This mode allows to define the conversion time for each single analog input channel in µs in relation to the SDIAS sync during runtime. For this, the according value must be written to one of the servers “AI[x]TimeOffset”. This is accepted by the firmware with the next SDIAS sync.

Time Offset Mode for Analog Outputs

This mode allows to define the conversion time for each single analog output channel in µs in relation to the SDIAS sync during runtime. For this, the according value must be written to one of the servers “AO[x]TimeOffset”. This is accepted by the firmware with the next SDIAS sync.

Limitations of this Mode

- The configuration of new time offsets is not accepted by the firmware before the next cycle.
- Offsets are only valid 105 µs after the sync. All lower inputs are not accepted by the hardware class.
- Offsets are only valid up to 197 µs before the sync. All higher inputs are not accepted by the hardware class.
- The difference between two time offsets must be at least 20 µs. All other inputs are moved into the according range by the firmware. Then, the according status bit is set.

Communication Interfaces

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