

# AM 442

## S-DIAS Analog Mixed Module

### Instruction Manual

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## **Translation of the Original Instructions**

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## S-DIAS Analog Mixed Module

## AM 442

**with 4 current inputs**

**4 current outputs**

The S-DIAS AM 442 analog mixed module has four current inputs, 0-20 mA and 4-20 mA respectively, each with a 16-bit resolution as well as two current outputs, 0-20 mA and 4-20 mA respectively, with a 12-bit resolution. The voltage supply for the current inputs and outputs are monitored for under voltage.



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# 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](http://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 442

## 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

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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.

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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.

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**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 essentiel.

## 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



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#### EU Declaration of Conformity

The product AM 442 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



HW: X.XX  
 SW: XX.XX.XXX  
 Safety Version: SXX.XX.XX

Serial No.

SIGMATEK GMBH & CO KG  
 Sigmatekstrasse 1 A-5112 LAMPRECHTSHAUSEN

Article Number

Product Name Short Name

### Exemplary nameplate (symbol image)



HW: 1.00  
 SW: 01.00.000  
 Safety Version: S01.00.00

12345678

SIGMATEK GMBH & CO KG  
 Sigmatekstrasse 1 A-5112 LAMPRECHTSHAUSEN

12-246-133-3

Handbediengerät Wireless HGW 1033-3

HW: Hardware version

SW: Software version

## 5 Technical Data

### 5.1 Analog Input Specifications

Number of channels	4	
Measurement range	0-20 mA	4-20 mA
Measurement value	0-20.000	4.000-20.000 An open or shorted input returns -2147483632 in the hardware class.  Note: starting from FW V1.10 the lower limit can be set to a value of 0-4000µA valid for all input channels.
Input type	Differential input	
Current resolution	16-bit (ca. 0.3 µA/LSB)	
Conversion time for all channels	1 ms	
Common mode range	±10 V	
Load	typically 50 Ω	
Input filter hardware	typically 1 kHz, low pass 3 <sup>rd</sup> order system	
Input filter software	configurable	
Maximum input current allowed	continuous	30 mA
	single pulse 1s	0.12 A
	single pulse 40 ms	0.25 A
	single pulse 200 µs	0.75 A
Cable break monitor	no	yes
Short circuit monitor	no	yes
Basic precision incl. calibration error, linearity and noise at 25 °C	±0.30 % of maximum measurement value	
Temperature drift 0-60 °C	±0.20 % of maximum measurement value	
Total measurement precision (0-60 °C)	±0.50 % of maximum measurement value	

## 5.2 Analog Output Specifications

Number of channels	4	
Output range	0-20 mA	4-20 mA
Output value	0-20.000	4.000-20.000
Current resolution	12-bit (ca. 5 $\mu$ A/LSB)	
Refresh time for all channels	1 ms	
Settling time	50 $\mu$ s + load * capacitive load (63 % of the end value) 100 $\mu$ s + 2*load * capacitive load (86 % of the end value) 250 $\mu$ s + 5*load * capacitive load (99 % of the end value)	
Load	maximum 500 $\Omega$	
Allowable output capacity	1 $\mu$ F at 50 $\Omega$ load	
Cable break monitor	no	
Basic precision incl. calibration error, linearity and noise at 25 °C	$\pm$ 0.30 % of maximum output value	
Temperature drift 0-60 °C	$\pm$ 0.20 % of maximum output value	
Total output precision (0-60 °C)	$\pm$ 0.50 % of maximum output value	

## 5.3 Analog In and Output Voltage Supply Specifications

External supply	+18-30 V
Current consumption	maximum 90 mA

## 5.4 Voltage Monitor External +24 V Supply

+ 24 V supply voltage	supply voltage > 18 V (DC OK-LED lights green)
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## 5.5 Electrical Requirements

External +24 V supply	+18-30 V DC	
Current consumption of the +24 V supply without load on the analog outputs	typically 27 mA at +18 V typically 24 mA at +24 V typically 23 mA at +13 V	maximum 31 mA at +18 V maximum 28 mA at +24 V maximum 27 mA at +30 V
Current consumption of the +24 V supply without load on the analog outputs Starting with HW1.50 (AM 442-E)	typically 27 mA at +18 V typically 25 mA at +24 V typically 23 mA at +13 V	maximum 31 mA at +18 V maximum 30 mA at +24 V maximum 27 mA at +30 V
Current consumption of the +24 V supply with maximum load on the analog outputs	typically 99 mA at +18 V typically 78 mA at +24 V typically 66 mA at +30 V	maximum 110 mA at +18 V maximum 87 mA at +24 V maximum 73 mA at +30 V
Voltage supply from S-DIAS bus	+5 V	
Current consumption on the S-DIAS bus (+5 V supply)	typically 55 mA	maximum 62 mA

### 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 documentation under "Electrical Requirements".



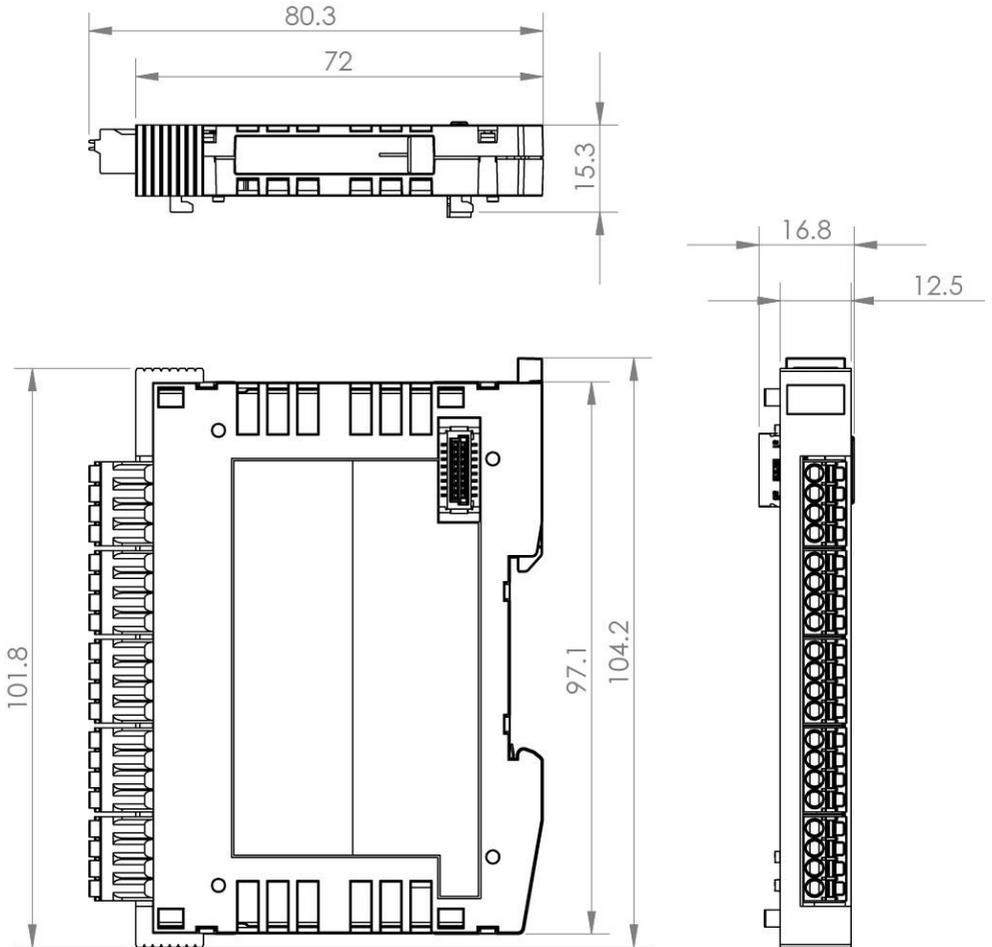
## 5.6 Miscellaneous

Article number	20-017-442
Standard	UL 508 (E247993)
Approbations	UL, cUL, CE

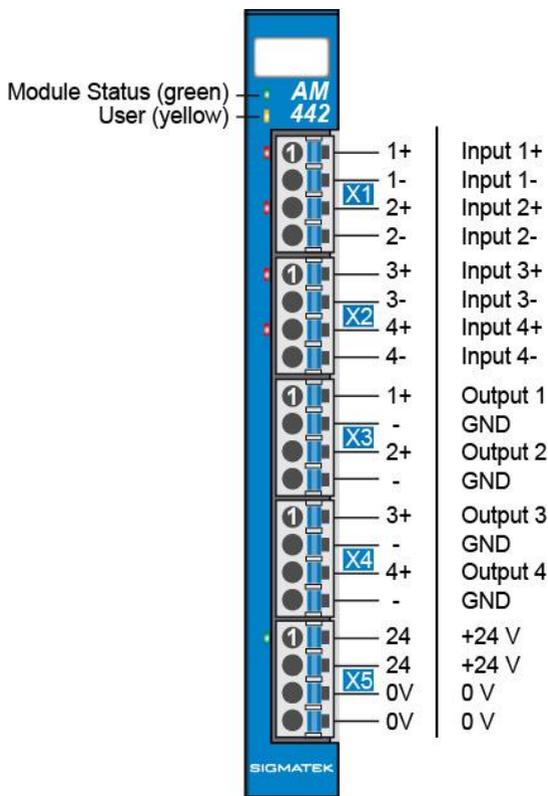
## 5.7 Environmental Conditions

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	
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 1g 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)	
Inputs 1-4	red	ON	minimum current exceeded/cable break
		BLINKING (2 Hz)	maximum current exceeded
DCOK 24 V	green	ON	+24 V supply for analog in and outputs available

## 7.2 Applicable Connectors

### Connectors:

**X1-X5:** Connectors with spring terminals (included in delivery)

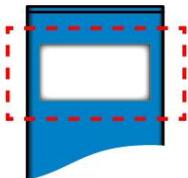
The spring terminals are suitable connecting ultrasonically compacted (ultrasonically welded) strands.

### Connections:

Stripping length/Sleeve length:	10 mm
Plug-in direction:	parallel to conductor axis or to PCB
Conductor cross section, rigid:	0.2-1.5 mm <sup>2</sup>
Conductor cross section, flexible:	0.2-1.5 mm <sup>2</sup>
Conductor cross section, ultrasonically compacted:	0.2-1.5 mm <sup>2</sup>
Conductor cross section AWG/kcmil:	24-16
Conductor cross section flexible, with ferrule without plastic sleeve:	0.25-1.5 mm <sup>2</sup>
Conductor cross section flexible, with ferrule with plastic sleeve:	0.25-0.75 mm <sup>2</sup> (ground for reducing d2 of the ferrule)



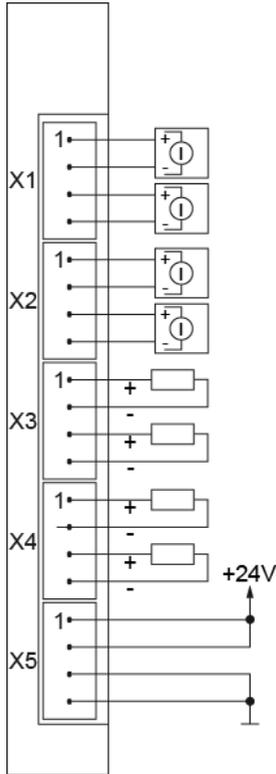
### 7.3 Label Field



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

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 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.
- Avoid parallel connections between input lines and load-bearing circuits.
- Protective circuits for all relays (RC networks or free-wheeling diodes).

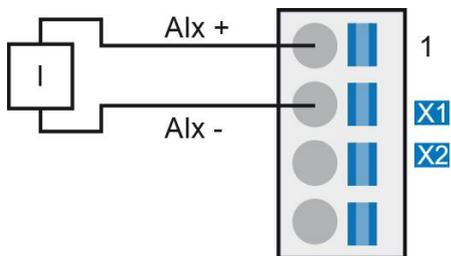
### INFORMATION



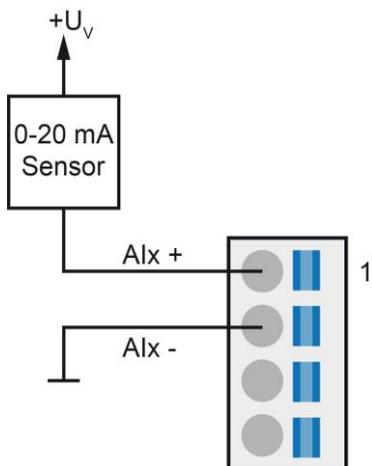
Connect the ground bus to the control cabinet.

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

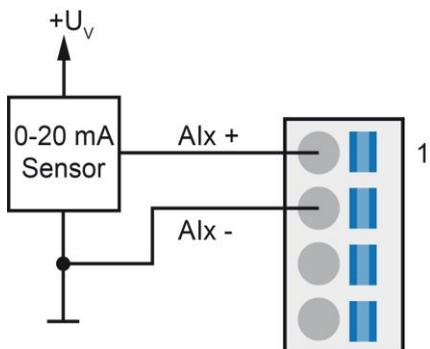
### 8.3 Signal Source Connection



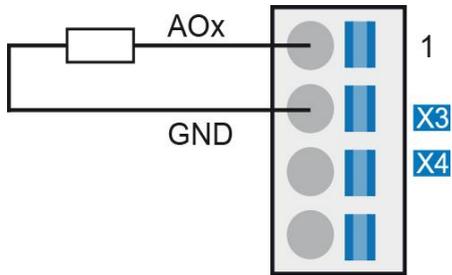
#### 8.3.1 Connection of a 2-wire Sensor



#### 8.3.2 Connection of a 3-wire Sensor



### 8.4 Load Connection



## 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

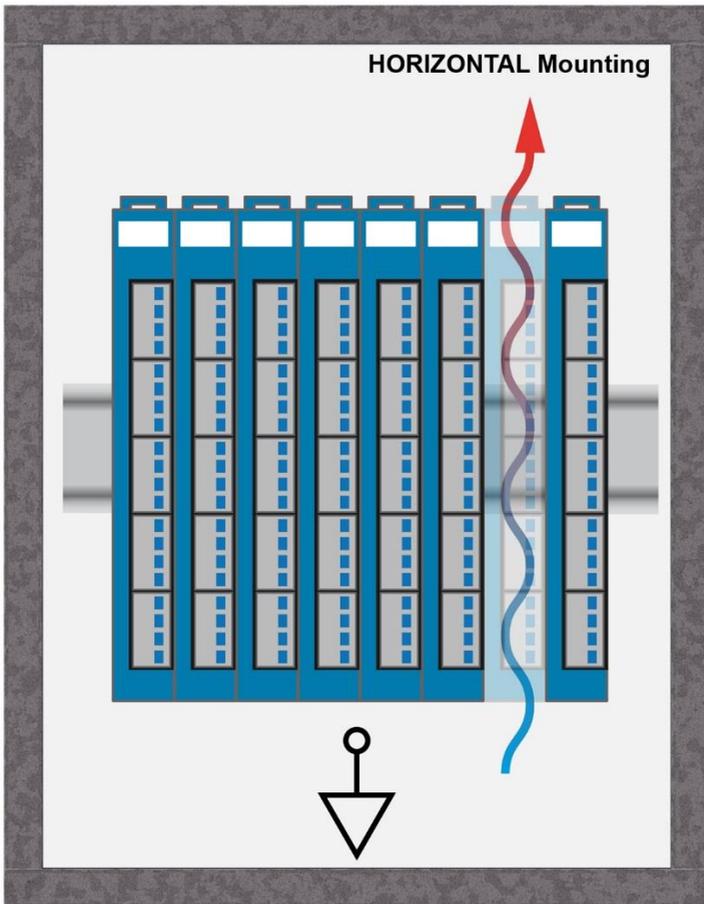


On receipt and before initial use, check the device for damage. If the device is damaged, contact our customer service and do not install the device in your system.

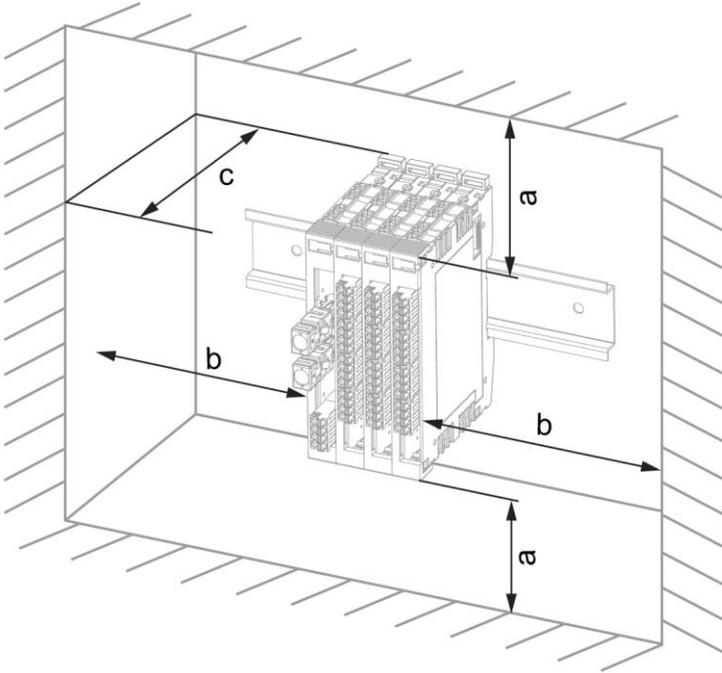
Damaged components can disrupt or damage the system.

## 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:



<b>a</b>	<b>b</b>	<b>c</b>
<b>30 mm (1.18")</b>	<b>30 mm (1.18")</b>	<b>100 mm (3.94")</b>

a, b, c ... distances in mm (inches)

## 10 Addressing

### 10.1 Address Mapping Overview

Address (hex)	Size (bytes)	Description
<b>Cyclic Data for Firmware (mem – address range)</b>		
0000	2	Analog output value 1: 0-20 mA (0-20000)
0002	2	Analog output value 2: 0-20 mA (0-20000)
0004	2	Analog output value 3: 0-20 mA (0-20000)
4000	2	Analog output value 4: 0-20 mA (0-20000)
<b>Cyclic Data for the HW Class (mem – address range)</b>		
0080	2	Status Bit 0 reserved Bit 1 no sync Bit 2 FLASH data CRC error Bit 3 RAM data CRC error Bit 4 unsafe FLASH data Bit 5 SYNC time is not supported Bit 6 configuration is invalid
0082	2	Analog input 1- 0-20 mA (0-20000)
0084	2	Analog input 2- 0-20 mA (0-20000)
0086	2	Analog input 3- 0-20 mA (0-20000)
0088	2	Analog input 4- 0-20 mA (0-20000)
008A	2	Module status Bit 0 AI1: value below minimum Bit 1 AI2: value below minimum Bit 2 AI3: value below minimum Bit 3 AI4: value below minimum Bit 4 AI1: value above maximum Bit 5 AI2: value above maximum Bit 6 AI3: value above maximum Bit 7 AI4: value above maximum Bit 8-14 not used Bit 15 DC_OK
<b>CFG for the Firmware (mem – address area)</b>		
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	1	Reserve
<b>Standard mode (info register bit 0 = 0)</b>		
0106	1	AI configuration Bit 0-1 AI1 Cfg 0: 0-20mA 1: 4-20mA (starting from FW V1.10 the lower limit corresponds to the value in 0x112 in $\mu\text{A}$ ) 2: analog value = raw value 3: input deactivated Bit 2-3 AI2 Cfg Bit 4-5 AI3 Cfg Bit 6-7 AI4 Cfg
0107	1	AO configuration Bit 0-1 AO1 Cfg 0: 0-20mA 1: 4-20mA 2: raw value output 3: output disabled Bit 2-3 AO2 Cfg Bit 4-5 AO3 Cfg Bit 6-7 AO4 Cfg
0108	2	Cutoff frequency low pass filter input 1
010A	2	Cutoff frequency low pass filter input 2
010C	2	Cutoff frequency low pass filter input 3
010E	2	Cutoff frequency low pass filter input 4
0110	1	Message counter
0111	1	reserved byte for 2-byte alignment
0112	2	Variable lower limit for cable break detection 0-4000 $\mu\text{A}$ (from FW V1.10)
<b>CFG/version for HW class (mem – address area)</b>		
0180	2	CRC16
0182	2	data length
0184	2	Firmware version
0186	2	CRC of the Firmware configuration
0188	1	message Counter of the configuration

0189	1	reserved byte for 2-byte alignment
<b>SDO access (mem – address range)</b>		
0300	128	SDO Request
0380	128	SDO Response

## 11 Supported Cycle Times

### 11.1 Cycle Times below 1 ms (in $\mu\text{s}$ )

FW	50	100	125	200	250	500
V1.10			x	x		

### 11.2 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
V1.10	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
V1.10	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

## 12 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.

## 13 Storage

### INFORMATION



When not in use, store the operating panel according to the storage conditions. See chapter 12.

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

## 14 Maintenance

### INFORMATION



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

### 14.1 Service

This product was constructed for low-maintenance operation.

### 14.2 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 12 Transport/Storage.

## 15 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.



## 16 Hardware Class AM442

### Hardware Class AM442 for the S-DIAS AM442 Analog Module

```
SDIAS:18, AM442 (AM4421)
[S] Class State (ClassState) <-[]->
[S] Device ID (DeviceID) <-[]->
[S] FPGA Version (FPGAVersion) <-[]->
[S] Hardware Version (HwVersion) <-[]->
[S] Serial Number (SerialNo) <-[]->
[S] Retry Counter (RetryCounter) <-[]->
[O] LED Control (LEDControl) <-[]->
[S] Firmware Version (FirmwareVersion) <-[]->
[S] Error Status (ErrorBits) <-[]->
[S] Reference Voltage OK (RefVoltageOK) <-[]->
----- Analog Inputs -----
[I] Analog Input 1 (AI1) <-[]->
[I] Analog Input 2 (AI2) <-[]->
[I] Analog Input 3 (AI3) <-[]->
[I] Analog Input 4 (AI4) <-[]->
[S] Range detection (Range) <-[]->
----- Analog Outputs -----
[O] Analog Output 1 (AO1) <-[]->
[O] Analog Output 2 (AO2) <-[]->
[O] Analog Output 3 (AO3) <-[]->
[O] Analog Output 4 (AO4) <-[]->
[ ] ALARM:00, Empty
```

This hardware class is used to control the AM 442 hardware module. The module has 4 analog inputs, 0-20 mA or 4-20 mA and 4 analog outputs 0-20 mA or 4-20 mA. More information on the hardware can be found in the module documentation.

## 16.1 General

<b>Class State</b>	State	This server shows the actual status of the hardware class.										
<b>Device ID</b>	State	The device ID of the hardware module is shown in this server.										
<b>FPGA Version</b>	State	FPGA version of the module in 16#XY (e.g. 16#10 = version 1.0).										
<b>Hardware Version</b>	State	Hardware version of the module in format 16#XXYY (e.g. 16#0120 = Version 1.20)										
<b>Serial Number</b>	State	The serial number of the hardware module is shown in this server.										
<b>Retry Counter</b>	State	This server increments when a transfer fails.										
<b>LED Control</b>	Output	<p>With this server, the application LED of the S-DIAS module can be activated to find the module in the network more quickly. The following statuses are possible:</p> <table border="1"> <tr> <td>0</td> <td>LED off</td> </tr> <tr> <td>1</td> <td>LED on</td> </tr> <tr> <td>2</td> <td>blinks slowly</td> </tr> <tr> <td>3</td> <td>blinks rapidly</td> </tr> </table>	0	LED off	1	LED on	2	blinks slowly	3	blinks rapidly		
0	LED off											
1	LED on											
2	blinks slowly											
3	blinks rapidly											
<b>Firmware Version</b>	State	The Firmware version of the hardware module is shown in this server.										
<b>Error Status</b>	State	<p>In this server, the status bits of the FW are shown. The respective bits mean the following:</p> <table border="1"> <tr> <td>Bit 0</td> <td>Not defined</td> </tr> <tr> <td>Bit 1</td> <td>No Sync available</td> </tr> <tr> <td>Bit 2</td> <td>Flash Data CRC Error</td> </tr> <tr> <td>Bit 3</td> <td>Ram Data CRC Error</td> </tr> <tr> <td>Bit 4</td> <td>Invalid EEPROM version</td> </tr> </table>	Bit 0	Not defined	Bit 1	No Sync available	Bit 2	Flash Data CRC Error	Bit 3	Ram Data CRC Error	Bit 4	Invalid EEPROM version
Bit 0	Not defined											
Bit 1	No Sync available											
Bit 2	Flash Data CRC Error											
Bit 3	Ram Data CRC Error											
Bit 4	Invalid EEPROM version											
<b>Reference Voltage OK</b>	State	The reference voltage for sever value 0 is too low.										
<b>Required</b>	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.										

## 16.2 Analog Inputs and Outputs

AI[1-4] Config	Property	Analog input [1-4] settings: <table border="1" data-bbox="381 236 992 336"> <tbody> <tr> <td>0</td> <td>AI[1-4] used as analog input (range: 0-20 mA)</td> </tr> <tr> <td>1</td> <td>AI[1-4] used as analog input (range: 4-20 mA)</td> </tr> <tr> <td>3</td> <td>AI[1-4] disabled.</td> </tr> </tbody> </table> as an initialization value	0	AI[1-4] used as analog input (range: 0-20 mA)	1	AI[1-4] used as analog input (range: 4-20 mA)	3	AI[1-4] disabled.								
0	AI[1-4] used as analog input (range: 0-20 mA)															
1	AI[1-4] used as analog input (range: 4-20 mA)															
3	AI[1-4] disabled.															
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: <table border="1" data-bbox="381 405 992 632"> <tbody> <tr> <td>0</td> <td>1000 Hz</td> </tr> <tr> <td>1</td> <td>500 Hz</td> </tr> <tr> <td>2</td> <td>250 Hz</td> </tr> <tr> <td>3</td> <td>100 Hz</td> </tr> <tr> <td>4</td> <td>50 Hz</td> </tr> <tr> <td>5</td> <td>25 Hz</td> </tr> <tr> <td>6</td> <td>10 Hz</td> </tr> </tbody> </table> as an initialization value	0	1000 Hz	1	500 Hz	2	250 Hz	3	100 Hz	4	50 Hz	5	25 Hz	6	10 Hz
0	1000 Hz															
1	500 Hz															
2	250 Hz															
3	100 Hz															
4	50 Hz															
5	25 Hz															
6	10 Hz															
AI[1-4] minimal value	Property	This value indicates the minimum value for the channel. If 0 mA is measured at the channel (0 mA .. AI[1-4]_Config = 0.4 mA .. AI[1-4]_Config = 1), this value is output in the software. The range of the measurement values are defined by the setting in the clients I[1-4]_Min and AI[1-4]_Max. as an initialization value														
AI[1-4] maximal value	Property	This value indicates the maximum value for the channel. If +20 mA 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[1-4]_Min and AI[1-4]_Max. as an initialization value														
AO[1-4] Config	Property	Analog input [1-4] settings: <table border="1" data-bbox="381 922 992 1018"> <tbody> <tr> <td>0</td> <td>AO[1-4] used as analog output (range: 0-20 mA)</td> </tr> <tr> <td>1</td> <td>AO[1-4] used as analog output (range: 4-20 mA)</td> </tr> <tr> <td>3</td> <td>AO[1-4] disabled.</td> </tr> </tbody> </table> as an initialization value	0	AO[1-4] used as analog output (range: 0-20 mA)	1	AO[1-4] used as analog output (range: 4-20 mA)	3	AO[1-4] disabled.								
0	AO[1-4] used as analog output (range: 0-20 mA)															
1	AO[1-4] used as analog output (range: 4-20 mA)															
3	AO[1-4] disabled.															
AO[1-4] minimal value	Property	Minimum output value AO[1-4]. If this value is written to the respective channel server, the module outputs (0 mA .. AO[1-4]_Config = 0,4 mA .. AO[1-4]_Config = 1). as an initialization value														
AO[1-4] maximal value	Property	Maximum output value AO[1-4]. If this value is written to the respective channel server, the module outputs 20 mA. as an initialization value														
Analog Input [1-4]	Input	Analog input 1-4, status query over read(). An open or shorted input returns -2147483632 in the hardware class. Note: starting from FW V1.10 the lower limit can be set to a value of 0-4000µA valid for all input channels.														
Analog Output [1-4]	Output	Analog output [1-4].														

### 16.3 Cable Break Detection and Measurement Values

<b>Range Detection</b>	State	<p>Detection lower measurement limit (cable break detection)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Bit 0</td> <td>cable break at input AI1</td> </tr> <tr> <td>Bit 1</td> <td>cable break at input AI2</td> </tr> <tr> <td>Bit 2</td> <td>cable break at input AI3</td> </tr> <tr> <td>Bit 3</td> <td>cable break at input AI4</td> </tr> </table> <p>0-20 mA mode: The limit for the lower measurement range is &lt; -0,25 mA.</p> <p>4-20 mA mode: Firmware ≥ 1.10: The limit for the cable break detection can be set in the property "Limit for low rangedetection". Default value = 3 mA Firmware &lt; 1.10: The limit is fixly set to &lt; 3.75 mA.</p> <p>Detection upper measurement limit:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 10%;">Bit 0</td> <td>upper measurement range exceeded at input AI1</td> </tr> <tr> <td>Bit 1</td> <td>upper measurement range exceeded at input AI2</td> </tr> <tr> <td>Bit 2</td> <td>upper measurement range exceeded at input AI3</td> </tr> <tr> <td>Bit 3</td> <td>upper measurement range exceeded at input AI4</td> </tr> </table> <p>Firmware ≥ 1.10: The upper measurement value limit is &gt; 20.25 mA. Firmware &lt; 1.10: No detection of upper measurement limit.</p>	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	Bit 0	upper measurement range exceeded at input AI1	Bit 1	upper measurement range exceeded at input AI2	Bit 2	upper measurement range exceeded at input AI3	Bit 3	upper measurement range exceeded at input AI4
	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																	
Bit 0	upper measurement range exceeded at input AI1																	
Bit 1	upper measurement range exceeded at input AI2																	
Bit 2	upper measurement range exceeded at input AI3																	
Bit 3	upper measurement range exceeded at input AI4																	
<b>Limit for low range detection</b>	Property	<p>Configurable limit for the detection of the lower measurement limit (cable break detection). Value range 0-4000 [µA]. (3000 default value = 3 mA) =&gt; effective with using firmware version ≥ 1.10. =&gt; with firmware versions &lt; 1.10 the value is &lt; 3.75 mA.</p>																

### 16.4 Communication Interfaces

<b>ALARM</b>	Downlink	With this downlink the corresponding alarm class can be placed via the hardware editor.
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## Documentation Changes

Change date	Affected page(s)	Chapter	Note
26.03.2015	8	3.2 Applicable Connectors	Added connections
10.06.2015	1		2-bit to 12-bit corrected
09.07.2015	4	1.5 Electrical Requirements	Changed electrical requirements
21.01.2016	5	1.6 Miscellaneous	Standard changed
18.02.2016	4	1.5 Electrical Requirements	Graphic added
09.03.2016	3	1.1 Analog Input Specifications	Input type added
15.04.2016	14	4.3 Signal Source Connection 4.4 Load Connection	Graphics changed
28.04.2016	14	5 Mounting	Graphics distances
11.05.2016	16	6 Addressing	Bit added
11.01.2017	3	1.2 Analog Output Specifications	Wording of analog precision
27.03.2017	3	1.1 Analog Input Specifications	Added value for cable break and short circuit monitoring
17.08.2017	7	1.7 Environmental Conditions	Added operating conditions
	10	3.2 Applicable Connectors	Added sleeve length Added info regarding ultrasonically welded strands
18.10.2017	12	3.3 Label Field	Added chapter
	17	5 Mounting	Graphic replaced
03.11.2017	16	4.4 Connection of a 2-wire Sensor 4.5 Connection of a 3-wire Sensor	Chapter added
20.03.2018	4	1.1 Analog Input Specifications	Measurement and output precision specified in detail
	5	1.2 Analog Output Specifications	
20.09.2018		3 Connector Layout	Note added
14.11.2019		7 Supported Cycle Times	Chapter added

29.07.2020	4 20	1.1 Analog Input Specifications 6.1 Address Mapping Overview	Measurement value specified more precisely At 0106 1: something added + 0112 new inserted
08.09.2020		8 Hardware Class AM442	Chapter added
04.11.2020	17	5 Mounting	Expansion functional ground connection
01.12.2021	6	1.5 Electrical Requirements	Current consumption changed (AM 442-E)
26.07.2023		Document	General chapters added, design
22.11.2023	13	5.1 Analog Input Specifications	Maximum input current allowed added