

# A0 046

## S-DIAS Analog Output Module

### Instruction Manual

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## **Translation of the Original Instructions**

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## S-DIAS Analog Output Module

**AO 046**

with 4 outputs (voltage/current switchable)

The S-DIAS AO 046 analog output module has four  $\pm 10.8$  V or 0-21.6 mA analog outputs with a resolution of 16 bits. The analog outputs are powered by an external +24 V supply. The analog output system is galvanically separated from the potential of the S-DIAS bus.



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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 AO 046

## 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 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 AO 046 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”.

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## 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 Output Voltage Specifications

Number of channels	4	
Output range	-10 ... +10 V	0 ... +10 V
Output value	-30,000 ... +30,000	0 ... +60,000
Output voltage over range	-10.8 ... +10.8 V	0 ... +10.8 V
Output value over range	-32,400 ... +32,400	0 ... +64,800
Resolution	16-bit (ca. 0.3 mV/LSB)	16-bit (ca. 0.15 mV/LSB)
Refresh time of all channels	minimum 100 $\mu$ s (corresponds to the S-DIAS cycle time)	
Output voltage capacity	maximum 2 mA	
Allowable capacitive load	maximum 100 nF	
Short circuit protection	yes	
Settling time	200 $\mu$ s typical for $C < 100$ nF (99.9 % of the end value)	
Galvanic isolation	yes (500 V) <sup>(1)</sup>	
Output precision	$\pm 0.04$ % of maximum output value	

### 5.2 Output Accuracy Analog Outputs Voltage

Basic accuracy incl. calibration error and noise 25 °C	0.015 %
Temperature drift	
20-40 °C	0.008 %
0-55 °C	0.015 %
Linearity	0.010 %
Crosstalk	< 0.001 %
Total error	
20-40 °C	$\pm 0.035$ % ( $\pm 3.5$ mV)
0-55 °C	$\pm 0.045$ % ( $\pm 4.5$ mV)

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

### 5.3 Analog Output Current Specifications

Number of channels	4	
Output range	0-20 mA	4-20 mA
Output value	0-60,000	12,000-60,000
Output voltage over range	0-21.6 mA	3.8-21.6 mA
Output value over range	0-64,800	11,400-64,800
Resolution current	16-bit (ca. 0.3 $\mu$ A/LSB)	
Refresh time of all channels	minimum 100 $\mu$ s (corresponds to the S-DIAS cycle time)	
Settling time	200 $\mu$ s typically for L < 0.5 mH at 50 $\Omega$ 200 $\mu$ s typically for L < 5 mH at 500 $\Omega$	
Load	maximum 500 $\Omega$	
Allowed output inductivity	maximum 0.5 mH at 50 $\Omega$ maximum 5 mH at 500 $\Omega$	
Cable break monitor	yes	
Galvanic isolation	yes (500 V) <sup>(1)</sup>	
Output precision	$\pm$ 0.17 % of maximum output value	

<sup>(1)</sup> The galvanic separation exists between the S-DIAS bus and combined analog outputs.

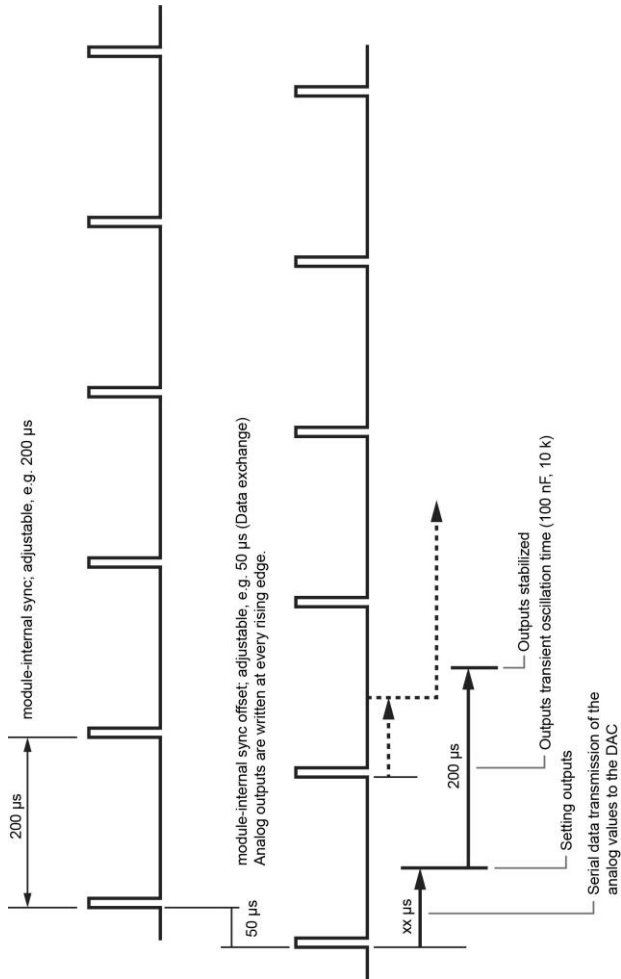
### 5.4 Output Accuracy Analog Outputs Current

Basic accuracy incl. calibration error and noise 25 °C	0.045 %
Temperature drift	
20-40 °C	0.028 %
0-55 °C	0.055 %
Linearity	0.035 %
Crosstalk	< 0.001 %
Total error	
20-40 °C	$\pm$ 0.140 % ( $\pm$ 28 $\mu$ A)
0-55 °C	$\pm$ 0.170 % ( $\pm$ 34 $\mu$ A)

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



### 5.5 Settling Time of the Analog Outputs



The diagram should display the settling time curve of the analog outputs. An internal module offset for the time of the S-DIAS Sync can be set. Starting from this time point, the constant write process from the S-DIAS bus in the direction of the digital-analog converter begins. At the end of this time, the new analog values of all channels are switched from the digital-analog converter to the converter output. From this point, the settling time of 200 µs starts in all channels. At the end of this time, all analog inputs are stabilized to the new output value.

## 5.6 Electrical Requirements

External +24 V supply	+18-30 V DC	
Current consumption of the +24 V supply without load on the analog outputs	typically 34 mA	maximum 44 mA
Current consumption of the +24 V supply with a load on the analog outputs per 20 mA	typically 92 mA	maximum 122 mA
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 22 mA	maximum 26 mA

### INFORMATION

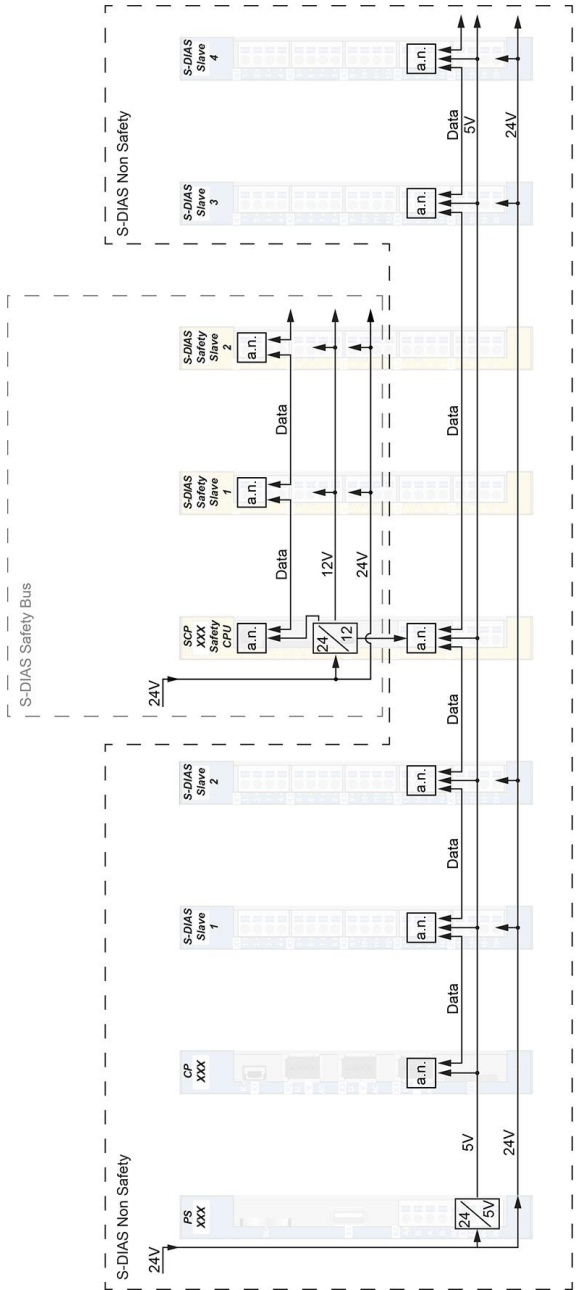


If this S-DIAS module is connected to an S-DIAS supply module with several S-DIAS modules, the total current of the modules used must be determined and checked.

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".



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

a.n. = active node

## 5.7 Voltage Monitoring External +24 V Supply

Supply voltage +24 V	query of the supply voltage with hysteresis: voltage > 18,0 V -> LED on, ExternVoltageOk=1 voltage < 16,0 V -> LED off, ExternVoltageOk=0 (DC OK-LED shines green)
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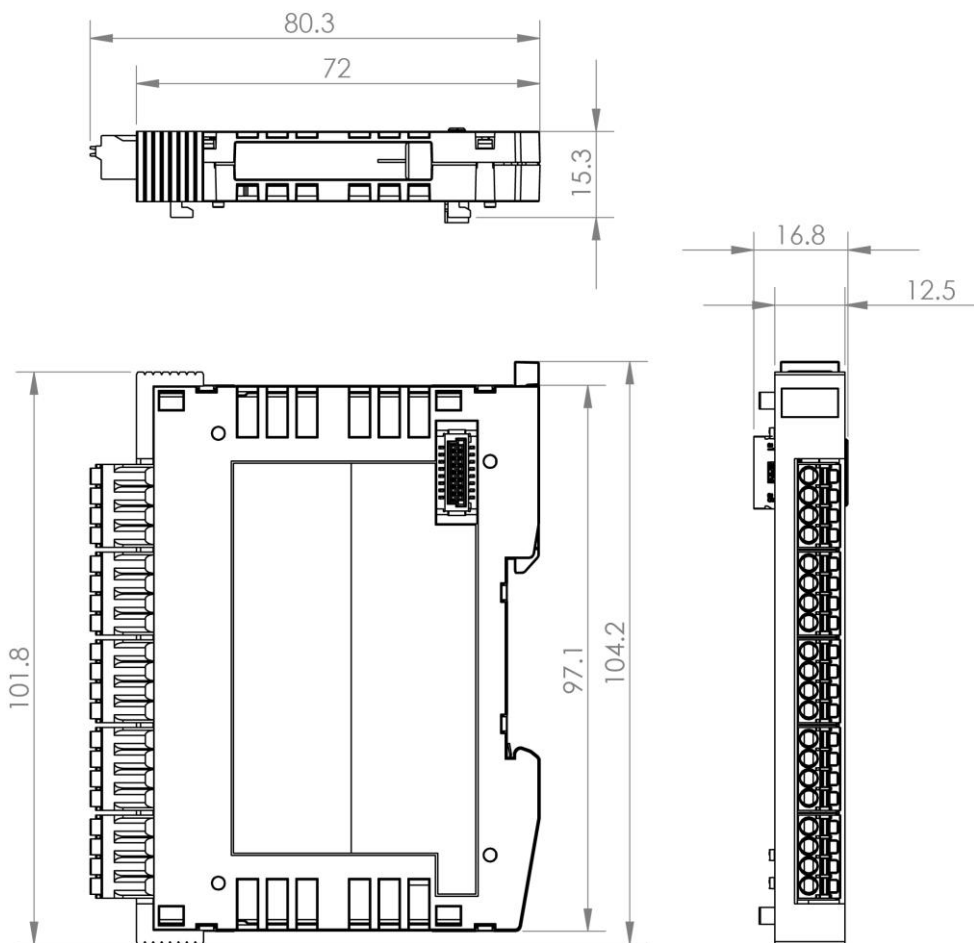
## 5.8 Miscellaneous

Article number	20-010-046
Standard	UL (in preparation)
Approbations	UKCA

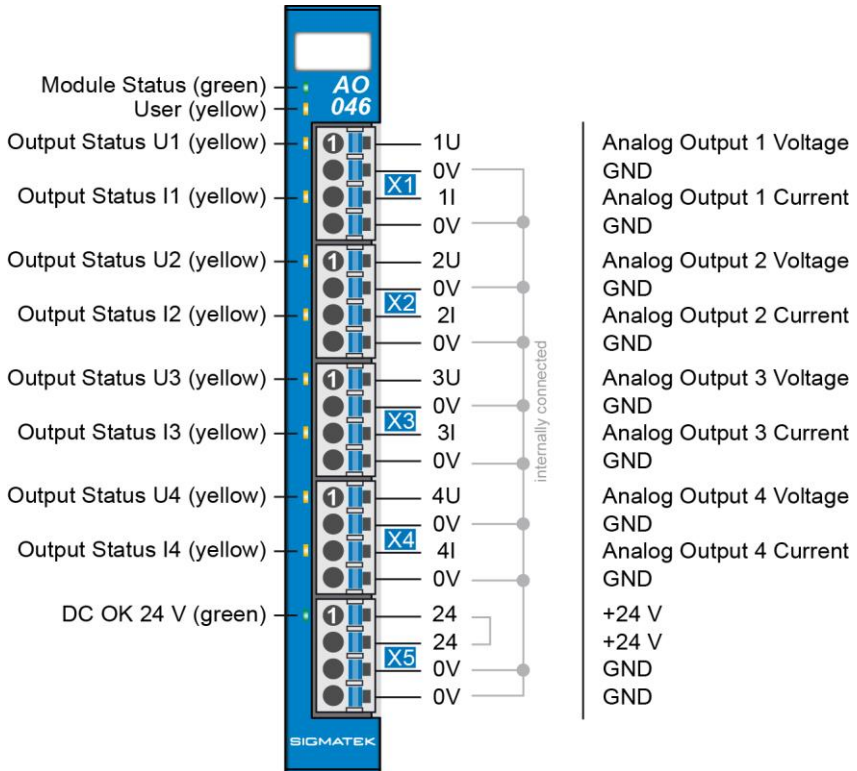
## 5.9 Environmental Conditions

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



Per channel, either voltage or current can be output only!

Between the channels, it possible to select between current and voltage as desired!

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)	
Output status Ux	yellow	ON	Analog output voltage active
		BLINKS	Analog output voltage error
		OFF	Analog output voltage inactive
Output status Ix	yellow	ON	Analog output current active
		BLINKS	Analog output current error
		OFF	Analog output current inactive
		USER	LED can be optionally controlled via the application
DC OK	green	ON	+24 V supply provided for analog output
		OFF	No supply voltage available

## 7.2 Applicable Connectors

### Connectors:

**X1, X2:** Connectors with spring terminals (included in delivery)

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

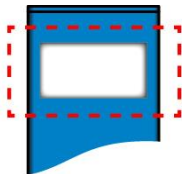
### Connections:

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 <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> (reason for reduction d2 of the ferrule)





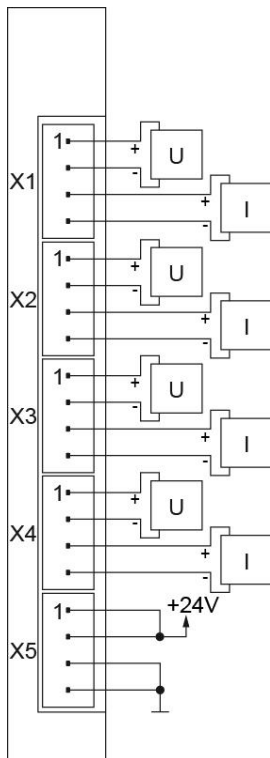
### 7.3 Label Field



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



Per channel, only voltage **or** current can be output!

## 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 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 signals must be as short as possible and parallel wiring to digital signal lines must be avoided.
- The signal lines must be shielded.
- The shielding must be connected to a shielding bus.
- 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!

## 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

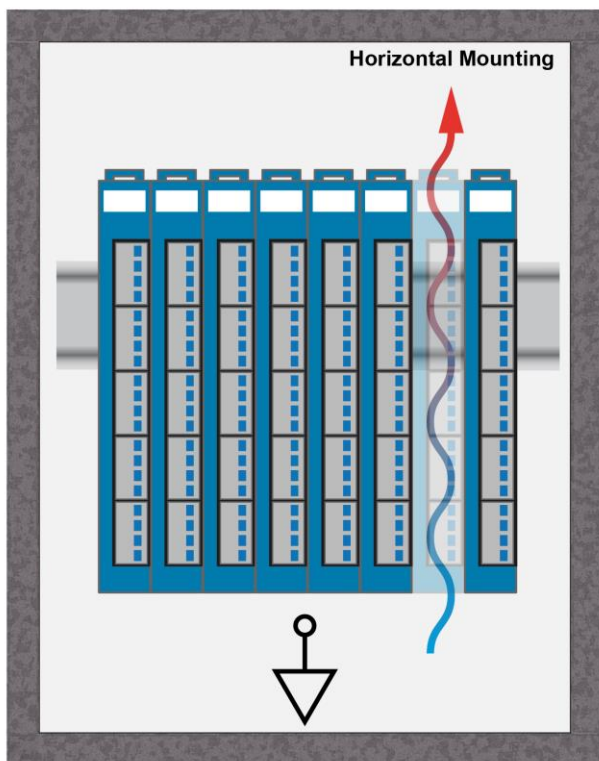


On receipt and before initial use, check the device for damage. If the device is damaged, contact our customer service and do not install the device in your system.

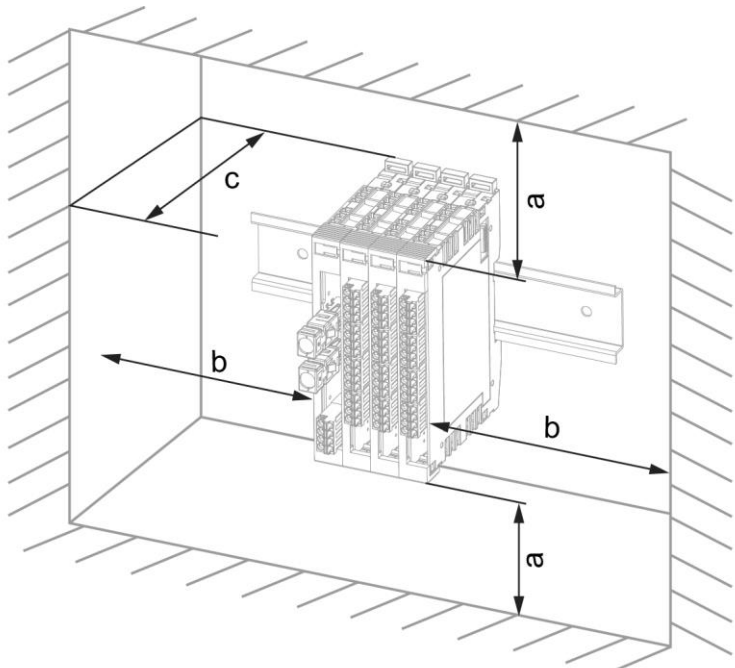
Damaged components can disrupt or damage the system.

## 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

Address (hex)	Size (bytes)	Access Type	Description	Reset value
000E	18	r/w	<b>PDO Write</b>	
000E	2	w16	LED Overwrite Register Bit 1...0: LED Channel 1 00 = off (HW status active, no SW overwrite) 01 = Enable SW Overwrite "0" 11 = Enable SW Overwrite "1" 10 = Reserved Bit 3...2: LED Channel 2 Bit 5...4: LED Channel 3 Bit 7...6: LED Channel 4 Bit 15..8: Reserved	0000
0010	2	w16	Analog output 1	0000
0012	2	w16	Analog output 2	0000
0014	2	w16	Analog output 3	0000
0016	2	w16	Analog output 4	0000
0018	2	w16	Offset time of the output in the output 1 cycle [1 µs]	0000
001A	2	w16	Offset time of the output in the output 2 cycle [1 µs]	0000
001C	2	w16	Offset time of the output in the output 3 cycle [1 µs]	0000
001E	2	w16	Offset time of the output in the output 4 cycle [1 µs]	0000
0020	16	r/w	Reserved	00

0030	2	r/w	PDO Read	
0030	2	r	Status Register Bit 0: edge limit analog output 1 Bit 1: edge limit analog output 2 Bit 2: edge limit analog output 3 Bit 3: edge limit analog output 4 Bit 4: temperature > 142 °C analog output 1 Bit 5: temperature > 142 °C analog output 2 Bit 6: temperature > 142 °C analog output 3 Bit 7: temperature > 142 °C analog output 4 Bit 8: over current analog output 1 (voltage) analog output 1 (current) voltage too high Bit 9: over current analog output 2 (voltage) analog output 2 (current) voltage too high Bit 10: over current analog output 3 (voltage) analog output 3 (current) voltage too high Bit 11: over current analog output 4 (voltage) analog output 4 (current) voltage too high Bit 12: calibration data could not be read Bit 13: calibration data invalid (CRC error) Bit 14: DC OK on DAC Bit 15: offset times must be corrected (deleted when read)	0000
0032	14	r/w	Reserved	00



0040	11	r/w	SDO	
0040	2	w64	Raw value output 1 (for PMB)	0000
0042	2		Raw value output 2 (for PMB)	0000
0044	2		Raw value output 3 (for PMB)	0000
0046	2		Raw value output 4 (for PMB) <sup>(1)</sup>	0000
0048	2	r/w16	DAC Control Bit 0: PMB mode Bit 1: enable offset time Bit 3...2: Reserved Bit 4: DAC SW reset analog output 1 Bit 5: DAC SW reset analog output 2 Bit 6: DAC SW reset analog output 3 Bit 7: DAC SW reset analog output 4 Bit 8: output 1 (0 = voltage, 1 = current) Bit 9: Output 2 (0 = voltage, 1 = current) Bit 10: output 1 (0 = voltage, 1 = current) Bit 11: output 1 (0 = voltage, 1 = current) Bit 12: mode output 1 0 = voltage -10 V to +10 V or 0 = current 0 mA to 24 mA 1 = voltage 0 V to +10 V or 1 = current 4 mA to 20 mA Bit 13: mode output 2 Bit 14: mode output 3 Bit 15: mode output 4	00F0
004A	1	w	Microblaze Control Bit 4...0: Reserved Bit 5: $\mu$ C Operational (read only) Bit 6: Reload configuration (1 = Tick to MicroBlaze, irq_config) Bit 7: MicroBlaze ( $\mu$ C) Reset (1 = MicroBlaze in Reset)	80
004B	693	r/w	Reserved	-
0300	256	r/w	Calibration for calibration data	-

<sup>(1)</sup> Note: If written to this register, the values are immediately sent to the DAC

## 11 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.

## 12 Storage

### INFORMATION



When not in use, store the operating panel according to the storage conditions. See chapter 11.

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

## 13 Maintenance

### INFORMATION



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

### 13.1 Service

This product was constructed for low-maintenance operation.

### 13.2 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 11 Transport/Storage.

## 14 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.



## 15 Hardware Class AO046

### Hardware Class AO046 For the S-DIAS AO046 analog output module

```

SDIAS:20, AO046 (A00461)
[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] Error Bits (ErrorBits) <-[]->
[S] Extern Voltage Ok (ExternVoltageOk) <-[]->
[S] Time Offset Error Bits (TimeOffsetErrorBits) <-[]->
----- Analog Output 1 -----
[O] Analog Output 1 (A01) <-[]->
[O] Time Offset Analog Output 1 (A01TimeOffset) <-[]->
[O] Set Led Analog Output 1 (A01SetLed) <-[]->
----- Analog Output 2 -----
[O] Analog Output 2 (A02) <-[]->
[O] Time Offset Analog Output 2 (A02TimeOffset) <-[]->
[O] Set Led Analog Output 2 (A02SetLed) <-[]->
----- Analog Output 3 -----
[O] Analog Output 3 (A03) <-[]->
[O] Time Offset Analog Output 3 (A03TimeOffset) <-[]->
[O] Set Led Analog Output 3 (A03SetLed) <-[]->
----- Analog Output 4 -----
[O] Analog Output 4 (A04) <-[]->
[O] Time Offset Analog Output 4 (A04TimeOffset) <-[]->
[O] Set Led Analog Output 4 (A04SetLed) <-[]->
[ALARM:00, Empty]

```

This hardware class is used to control the AO 046 hardware module. The module has 4 ( $\pm 10$  V, 0-10 V or 0-20 mA, 4-20 mA) analog outputs. More information on the hardware can be found in the module documentation.

## 15.1 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" data-bbox="380 486 991 619"> <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>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.								

## 15.2 Analog Outputs [1-4]

Analog Output [1-4]	Output	The analog output can be set with the write() method. Values are output depending on configuration. With the "Analog Output Config" 4-7, the output value can be overridden with the overrange settings. 8% for the voltage and +8%/-1% for the current output
Analog Output [1-4] Channel Active	Property	Here, the analog output can be activated/deactivated. Possible values: 0 channel deactivated 1 channel activated as initialization value
Analog Output [1-4] Config	Property	The desired analog output type and its range must be selected here as Init value. Possible values: 0 analog output -10 ... +10 V 1 analog output 0 ... +10 V 2 analog output 0 ... +20 mA 3 analog output +4 ... +20 mA Over range settings: Voltage $\pm 8\%$ , current $+8\%/-1\%$ 4 analog output -10.8 ... +10.8 V 5 analog output 0 ... +10.8 V 6 analog output 0 ... +21.6 mA 7 analog output +3.80 ... +21.6 mA
Analog Output [1-4] Minimum Value	Property	Minimum value of the output AO[1-4] as initialization value. If this value is written to the respective channel server, the minimum value is output on the module.
Analog Output [1-4] Maximum Value	Property	Maximum value of the output AO[1-4] as initialization value. If this value is written to the respective channel server, the maximum value is output on the module.
Analog Output [1-4] Set LED	Output	For setting the status LED. When an error occurs, the LED blinks. 0 HW status active 1 LED on 2 LED off

<b>Error Bits</b>	State	<p>In this server the error status bits are shown. The respective bits mean the following:</p> <table border="1"> <tr><td>Bit 1</td><td>Edge limitation output AO1</td></tr> <tr><td>Bit 2</td><td>Edge limitation output AO2</td></tr> <tr><td>Bit 3</td><td>Edge limitation output AO3</td></tr> <tr><td>Bit 4</td><td>Edge limitation output AO4</td></tr> <tr><td>Bit 5</td><td>Over temperature on output AO1</td></tr> <tr><td>Bit 6</td><td>Over temperature on output AO2</td></tr> <tr><td>Bit 7</td><td>Over temperature on output AO3</td></tr> <tr><td>Bit 8</td><td>Over temperature on output AO4</td></tr> <tr><td>Bit 9</td><td>Over current on output AO1</td></tr> <tr><td>Bit 10</td><td>Over current on output AO2</td></tr> <tr><td>Bit 11</td><td>Over current on output AO3</td></tr> <tr><td>Bit 12</td><td>Over current on output AO4</td></tr> <tr><td>Bit 13</td><td>Calibration data could not be read</td></tr> <tr><td>Bit 14</td><td>Calibration data invalid (CRC error)</td></tr> <tr><td>Bit 15</td><td>Supply voltage is not OK</td></tr> </table>	Bit 1	Edge limitation output AO1	Bit 2	Edge limitation output AO2	Bit 3	Edge limitation output AO3	Bit 4	Edge limitation output AO4	Bit 5	Over temperature on output AO1	Bit 6	Over temperature on output AO2	Bit 7	Over temperature on output AO3	Bit 8	Over temperature on output AO4	Bit 9	Over current on output AO1	Bit 10	Over current on output AO2	Bit 11	Over current on output AO3	Bit 12	Over current on output AO4	Bit 13	Calibration data could not be read	Bit 14	Calibration data invalid (CRC error)	Bit 15	Supply voltage is not OK
	Bit 1	Edge limitation output AO1																														
	Bit 2	Edge limitation output AO2																														
	Bit 3	Edge limitation output AO3																														
	Bit 4	Edge limitation output AO4																														
	Bit 5	Over temperature on output AO1																														
	Bit 6	Over temperature on output AO2																														
	Bit 7	Over temperature on output AO3																														
	Bit 8	Over temperature on output AO4																														
	Bit 9	Over current on output AO1																														
	Bit 10	Over current on output AO2																														
	Bit 11	Over current on output AO3																														
	Bit 12	Over current on output AO4																														
	Bit 13	Calibration data could not be read																														
	Bit 14	Calibration data invalid (CRC error)																														
Bit 15	Supply voltage is not OK																															
<b>External Voltage OK</b>	State	This server indicates whether the external module supply is OK.																														

### 15.3 Time Offset Mode

Analog Output Time Offset	Property	<p>This setting defines whether the time offset mode should be used for the analog outputs.</p> <p>0      time offset mode for analog outputs deactivated</p> <p>1      time offset mode for analog outputs activated</p> <p>as initialization value</p>
Analog Output [1-4] Time Offset	Output	<p>Time offset for the according analog input in <math>\mu\text{s}</math>. Valid limits: 10 <math>\mu\text{s}</math> to (cycle time - 10 <math>\mu\text{s}</math>) Example: 1 ms cycle time (bus time) ... Range: 10 <math>\mu\text{s}</math> to 990 <math>\mu\text{s}</math> Return value/status value:</p> <p>-1      feature is deactivated</p> <p>-2      defined value is outside the valid limits</p>
Time Offset Error Bits	State	<p>Bit 1 ... The defined time offsets were invalid and have been adjusted automatically. This can happen when the distance between two sample points is too small (&lt; 8 <math>\mu\text{s}</math>).</p>

### 15.4 Communication Interfaces

ALARM	Downlink	<p>With this downlink the corresponding alarm class can be placed via the hardware editor.</p>
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## 15.5 Internal Properties

The values for the analog output are transmitted as 16-bit value in a range of  $\pm 30,000$  resp. 0-60,000 increments.

To be able to use the full resolution of the DAC values for the minimum and maximum value settings are needed which allow 60,000 increments.

At  $\pm 10$  V this then is e.g.  $\pm 30,000$ .

If the overrange setting is used, on the analog output for the voltage  $\pm 8$  % and for the current  $+8$  %/ $-1$  % can be set.

e.g.: Analog output Config = 4, Analog output Min/Max Value =  $\pm 32,400$

Analog output 30.000 = 10 V      32,400 = 10.8 V

Analog output -30.000 = -10 V      -32,400 = -10.8 V

### 15.5.1 Time Offset Mode for Analog Outputs

This mode can define the time of writing data to the DAC in  $\mu\text{s}$  in relation to the SDIAS sync for each single analog output channel during runtime. The appropriate value must simply be written to one of the servers "AO[x]TimeOffset". This is then accepted by the firmware with the next SDIAS sync.

### 15.5.2 Limitations of this Mode

- The configuration of the new set points (as PDO) is valid in the next cycle.
- Set points are not available during 10  $\mu\text{s}$  after the sync. The hardware class does not allow any inputs less than 10  $\mu\text{s}$ .
- Set points are not available during 10  $\mu\text{s}$  before the sync. The hardware does not allow any inputs greater than this value.
- The difference between 2 set points must be at least 8  $\mu\text{s}$ . All other inputs are moved by the module to the appropriate area.

## Documentation Changes

Change date	Affected page(s)	Chapter	Note
23.06.2017	4	1.2 Analog Output Current Specifications	Values Ovrerrange changed
07.07.2017	10	3 Connector Layout	Internally connected added
26.07.2017	3	1.2 Output Accuracy Analog Outputs Voltage	Chapter new
	4	1.4 Output Accuracy Analog Outputs Current	Chapter new
	8	1.7 Voltage Monitoring External +24 V Supply	Chapter new
01.08.2017	8	1.7 Voltage Monitoring External +24 V Supply	Corrected voltage specifications
17.08.2017	8	1.9 Environmental Conditions	Added operating conditions
	12	3.2 Applicable Connectors	Added sleeve length Added info regarding ultrasonically welded strands
18.10.2017	13	3.3 Label Field	Added chapter
	17	5 Mounting	Graphic replaced
20.09.2018		3 Connector Layout	Note added
14.11.2019		7 Supported Cycle Times	Chapter added
28.02.2020	22	7 Supported Cycle Times	Text adapted
28.05.2020	22	7 Supported Cycle Times	Chapter removed
08.09.2020		7 Hardware Class AO046	Chapter added
04.11.2020	17	5 Mounting	Expansion functional ground connection
06.12.2022	9	1.8 Miscellaneous	UKCA conformity
26.07.2023		Document	General chapters added, design