AI 031

S-DIAS AC Current Measuring Module

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Translation from German

S-DIAS AC Current Measuring Module AI 031

3 analog current inputs 0-5 A AC

The S-DIAS AI 031 AC current measuring module is used to measure current in low voltage networks. To decouple from the supply, an external transformer must be used, which converts the measured current to a maximum of 5 A AC.

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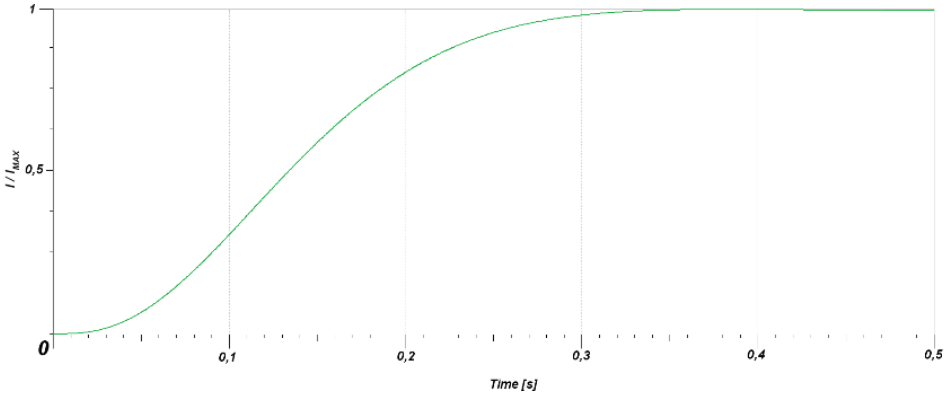
1 Technical Data

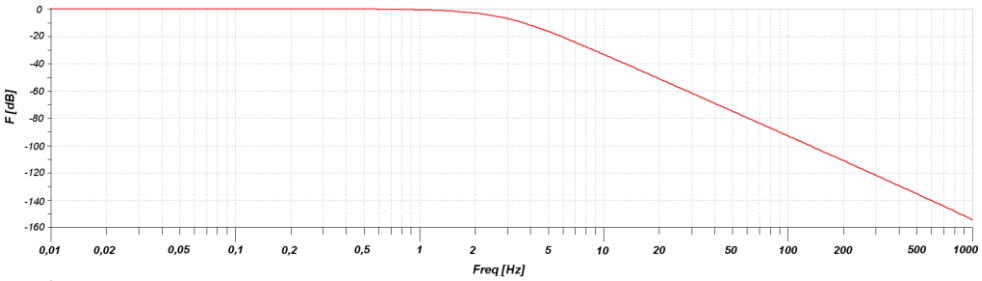
1.1 Analog Current Input Specifications

Number of channels	3	
Measurement range	0-5 A AC	
Measurement value	0-5000 digits	
Measuring process	average value	
Signal form	sine	
Frequency	47-63 Hz	
Resolution	12-bit (ca. 1.53 mA AC/digit)	
Conversion time per channel	1 ms	
Common mode range	±10 V	
Input filter hardware	typically 2 Hz	low pass 3rd order system
Resistive sensor	12 mΩ	
Measurement precision	±1 % of maximum measurement value	

1.1.1 Current Measurement Input Step Response



1.1.2 Current Measurement Input Amplitude Frequency Curve



1.2 Electrical Requirements

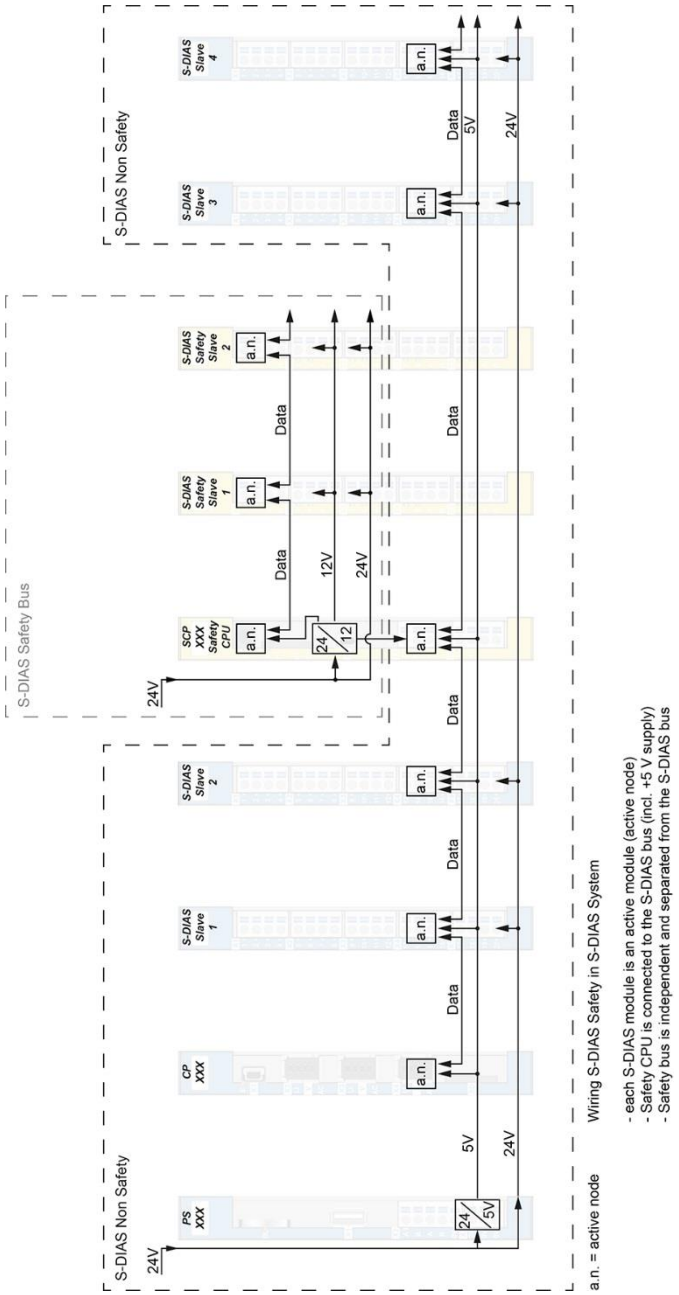
Voltage supply from S-DIAS bus	+5 V	
Current consumption on the S-DIAS bus (+5 V power supply)	typically 50 mA	maximum 55 mA
Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V power supply)	typically 40 mA	maximum 50 mA

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

Si ce module S-DIAS est connecté à un module d'alimentation S-DIAS suivi de plusieurs modules S-DIAS, le courant total des modules utilisés doit être déterminé et vérifié.
Le courant total de l'alimentation +24 V ne peut pas dépasser 1,6 A!
Le courant total de l'alimentation +5 V ne peut pas dépasser 1,6 A!
Le cahier des charges pour le courant peut être trouvé dans la documentation spécifique au module sous "Spécifications électriques".


S-DIAS Non Safety
S-DIAS Safety Bus
S-DIAS Non Safety
24V
PS XXX
CP XXX
S-DIAS Slave 1
S-DIAS Slave 2
SCP XXX Safety CPU
S-DIAS Safety Slave 1
S-DIAS Safety Slave 2
S-DIAS Slave 3
S-DIAS Slave 4
a.n.
Data
5V
12V
24V
24/5V
24/12
a.n. = active node
Wiring S-DIAS Safety in S-DIAS System
- each S-DIAS module is an active module (active node)
- Safety CPU is connected to the S-DIAS bus (incl. +5 V supply)
- Safety bus is independent and separated from the S-DIAS bus

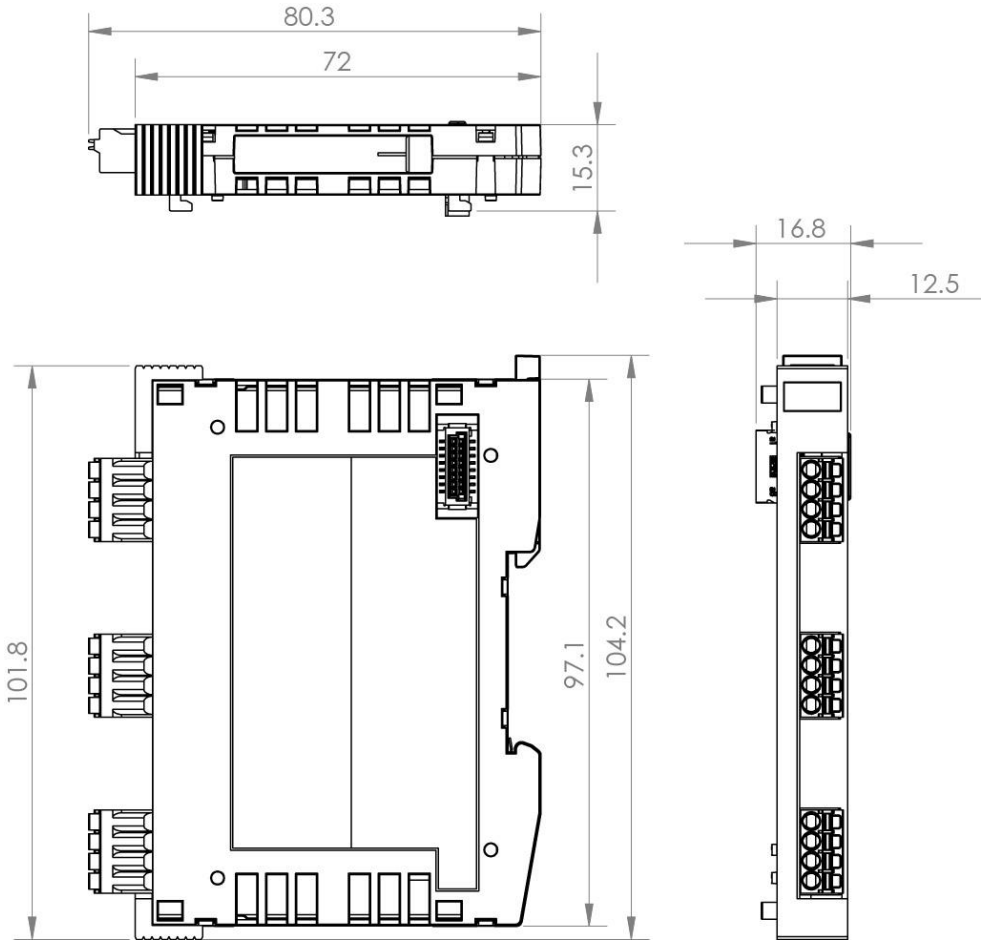
1.3 Miscellaneous

Article number	20-009-031
Hardware version	1.x
Standard	UL 508 (E247993)
Approvals	CE, $_{c}UL_{US}$

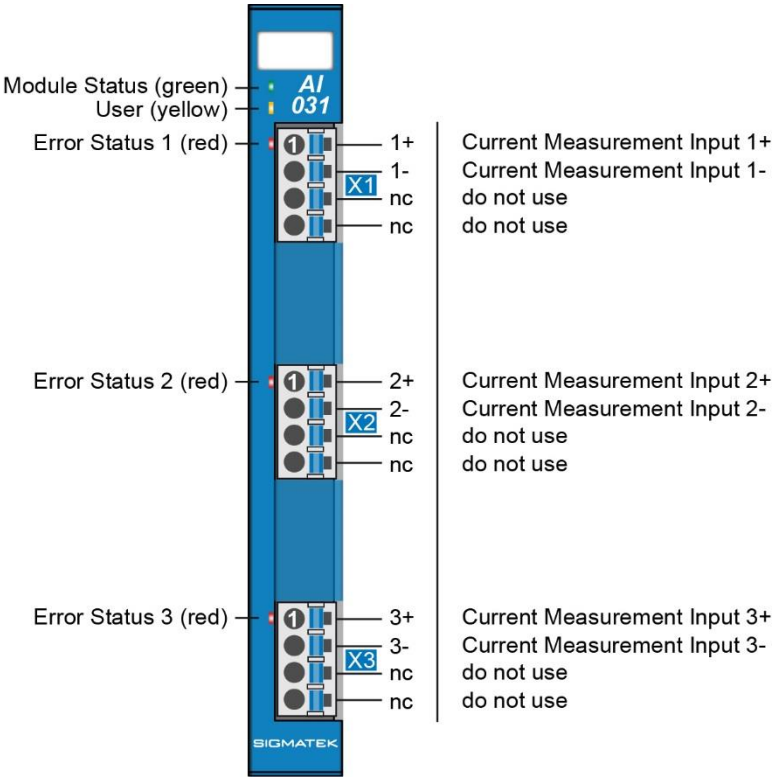
1.4 Environmental Conditions

Storage temperature	-20 ... +85 °C	
Environmental temperature	0 ... +60 °C	
Humidity	0-95 %, non-condensing	
Installation altitude above sea level	0-2000 m without derating > 2000 m with derating of the maximum environmental temperature by 0.5 °C per 100 m	
Operating conditions	pollution degree 2 Altitude up to 2000 m	
EMC resistance	in accordance with EN 61000-6-2:2007 (industrial area)	
EMC noise generation	in accordance with EN 61000-6-4 (industrial area)	
Vibration resistance	EN 60068-2-6	3.5 mm from 5-8.4 Hz 1 g from 8.4-150 Hz
Shock resistance	EN 60068-2-27	15 g
Protection type	EN 60529	IP20

2 Mechanical Dimensions



3 Connector Layout



3.1 Status LEDs

Module Status	green	ON	module active
		OFF	no supply available
		BLINKING (5 Hz)	no communication
User	yellow	ON	can be set from the application (e.g. the module LED can be set to blinking through the visualization so that the module is easily found in the control cabinet)
		OFF	
		BLINKING (2 Hz)	
		BLINKING (4 Hz)	
Error Status 1-3	red	BLINKING (5 Hz)	status 1-3: Over current channel 1 to channel 3 (I > 5 A AC)

3.2 Applicable Connectors

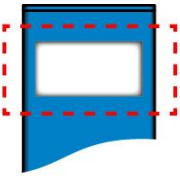
Connectors:
X1-X3: Connectors with spring terminals (included in delivery)
The spring terminals are suited for the connection of ultrasonically compacted (ultrasonically welded) stranded wire.

Connections:

Stripping length/sleeve length.	10 mm
Mating direction:	parallel to the conductor axis or circuit board
Conductor cross section rigid:	0.2-1.5 mm^2
Conductor cross section flexible:	0.2-1.5 mm^2
conductor cross section strands ultrasonically compacted:	0.2-1.5 mm^2
Conductor cross section AWG/kcmil:	24-16
Conductor cross section flexible with ferrule:	0.25-1.5 mm^2
Conductor cross section flexible with ferrule and plastic sleeve:	0.25-0.75 mm^2 (reason for reduction d2 of the ferrule)

d2 = max. 2.8 mm

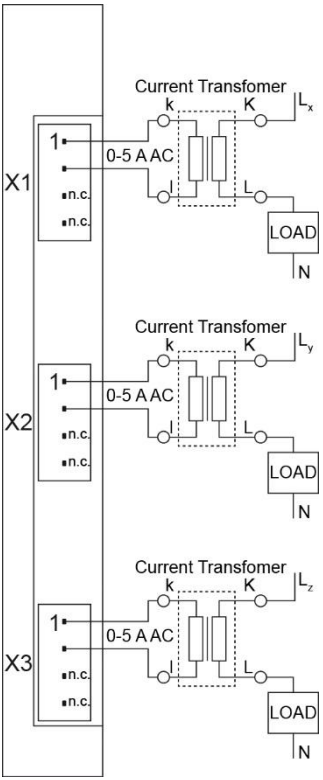
3.3 Label Field



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

4 Wiring

4.1 Wiring Example



4.2 Note

The signals recorded by the analog modules are very small, as compared to the digital signals. To ensure error-free operation, a careful wiring method must be followed:

- The DIN rail must have an adequate mass connection.
- The lines connected to the source of the analog signals must be as short as possible and parallel wiring to digital signal lines must be avoided.
- The signal lines must be shielded.
- The shielding must be connected to a shielding bus.
- Avoid parallel connections between input lines and load-bearing circuits.
- Protective circuits for all relays (RC networks or free-wheeling diodes).

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

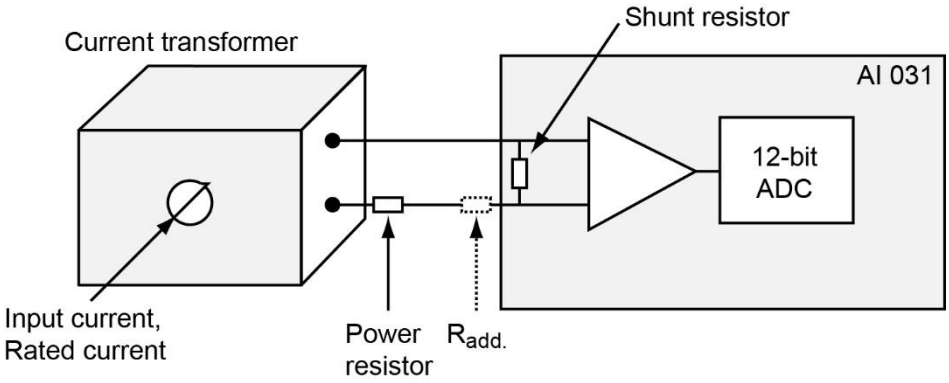
IMPORTANT:
The S-DIAS module CANNOT be connected/disconnected while voltage is applied!

5 Current Converter Guidelines

5.1 Considerations when Selecting the Current Transformer/Connection

In IEC600044-1, the precision of the current transformer is defined in the range of 25 % to 120 % of the nominal load. If the current transformer has less than 25 % of the nominal load, the maximum allowed error can be exceeded.

With an additional ohmic load (resistor in series), the measurement precision can be improved.



Shunt resistance = 0.012 Ω

Nominal load at ideal nominal current = circuit resistance + shunt resistance (+ possible R)

Example:

Current transformer with:
Secondary nominal current = 5 A_{rms}
Maximum rated power = 6 VA
Nominal load = 0,24 Ω (0.1 Ω Shunt + 0.228 Ω line)

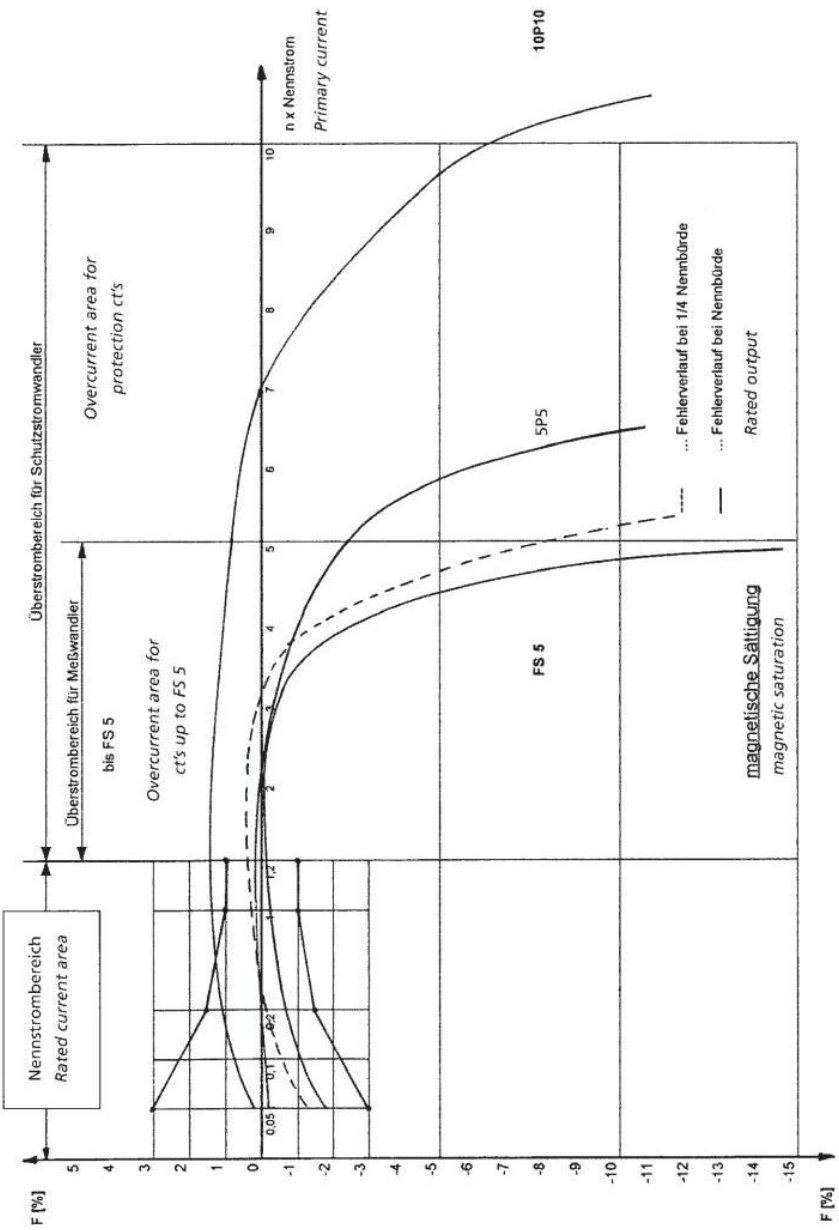
$$\text{Rated load} \quad \frac{\text{Rated power}}{\text{Secondary current}^2} = \frac{6\ \text{VA}}{5\ \text{A}^2} = 0.24\ \Omega$$

$$\text{Line resistance} \quad \frac{\text{2x wire length in m (outgoing and return line)}}{\text{56x wire cross section in mm}^2\text{ (copper)}}$$

$R_{\text{additional Resistance}}$ = rated load – line resistance – shunt resistance

$P_{\text{additional. Resistance}} = I_N^2 * R_{\text{additional Resistance}}$

5.2 Error Curve of Low-Voltage Current Transformers



5.3 Description of the Current Transformer Terminals

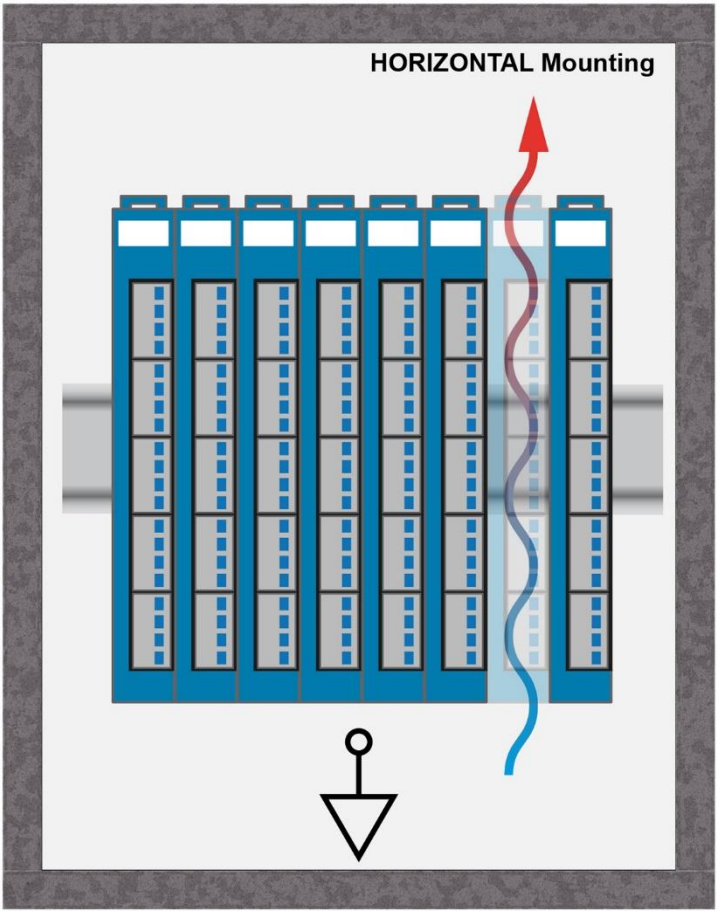
The terminals for all primary windings are labeled with ,,K-P1" and ,,L-P2", the terminals for all secondary windings are labeled with the corresponding lower case letters ,,k-s1" and ,,l-s2"

For current transformers with several secondary leads, the winding end ,,l" is then assigned an extra digit ,,l1", the leads are sequentially assigned the numbers ,,2", ,,3", etc. as the number of turns reduce. For differential transformers, with several independent primary windings, the individual windings before those identified with the capital letters ,,K" and ,,L" must be labeled with the capital letters ,,A", ,,B", ,,C", etc.

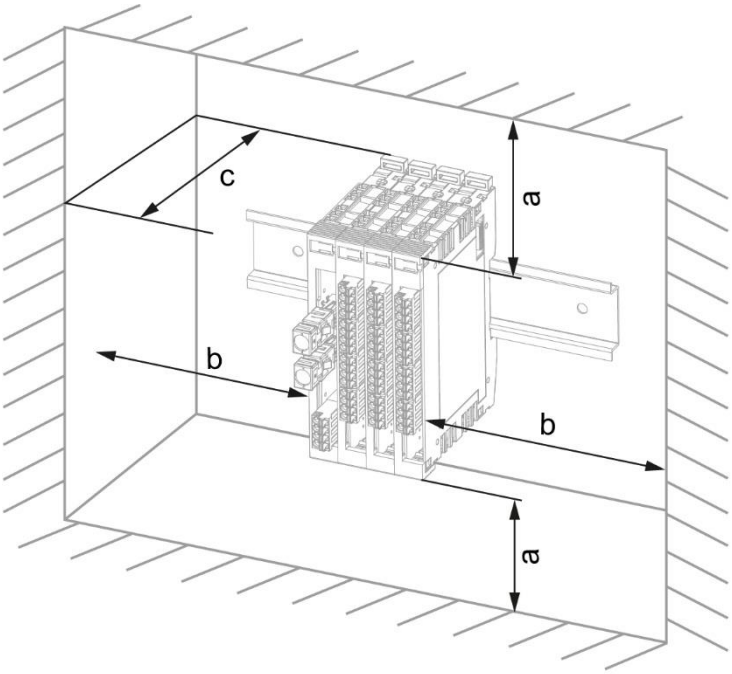
For example ,,AK" - ,,AL" for the highest primary circuit, ,,BK" - ,,BL" for the second primary circuit etc.; or the transformation or transformation ratio of the individual primary windings to one another must be specified.

6 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 ambient temperature is ensured.



Recommended minimum distances of the S-DIAS modules to the surrounding components or control cabinet wall:



a	b	c
30 mm (1.18″)	**30 mm** (1.18″)	**100 mm** (3.94″)

a, b, c … distances in mm (inches)

7 Addressing

Address (hex)	Size (bytes)	Access Type	Description
0000	**128**	**w**	**Cyclic Data for Firmware**
0000	2	w	-
0080	**128**	**r**	**Cyclic Data for the HW class**

0080	2	r	Status Bit 0 24 V DC not OK Indicates whether the supply voltage is OK. (0 = OK, 1 = not OK) Bit 1 not synchronized Indicates whether Sync messages were received from the client. At the latest, this bit is set after 127 ms if no Sync was received. This bit is reset after 2 equally long Sync intervals (= by 3rd Sync). (0 = OK, 1 = not OK) Bit 2 FLASH calibration data checksum error Indicates whether the FLASH data are stored correctly Check using CRC checksum. The check is run during the system start. (0 = OK, 1 = not OK) Bit 3 RAM calibration data checksum error Indicates whether the RAM data are stored correctly Check using CRC checksum. The check is run cyclically every 10 minutes (0 = OK, 1 = not OK) Bit 4 invalid calibration data Check whether the FW version is compatible with the configu-ration (version check). The check is run during the system start. (0 = OK, 1 = not OK) Bit 5 S-DIAS cyclic time not supported The S-DIAS bus time setting (in the master) is not supported by this module. (0 = OK, 1 = not OK) Bit 6 toggle bit (inverted by the FW with each write process) Inverted each cycle to indicate the change in the PDO data. The control can hereby detect whether the module is still operable 0 => 1 … Data are updated: OK 1 => 0 … Data are updated: OK 0 => 0 … Data are updated: not OK 1 => 1 … Data are updated: not OK

			Module-Specific: Bit 7-8 reserved (always 0) Other: Bit 9-11 reserved (always 0) Error information Bit 12-15 Error codes 00 …….. no errors 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	Analog input 3
0088	1	r	Cable break / short-circuit detection Bit 0 ... reserved (always 0) Bit 1 ... over current AI1 Bit 2 ... reserved (always 0) Bit 3 ... over current AI2 Bit 4 ... reserved (always 0) Bit 5 ... over current AI3 Bit 6-15 ... reserved
0100	**128**	**w**	**Firmware Configuration Data**
0100	2	w	Checksum over the entire configuration data
0102	2	w	Length of the configuration data
0104	1	w	Info (special cases 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	Message Counter

0180	128	r	HW Class Configuration Data
0180	2	r	Checksum over the entire configuration data
0182	2	r	Length of the configuration data
0184	2	r	Firmware version
0186	1	r	Message Counter
0187	1	r	Reserved

8 Supported Cycle Times

8.1 Cycle Times below 1 ms (in µs)

FW	50	100	125	200	250	500
V1.00					x	x

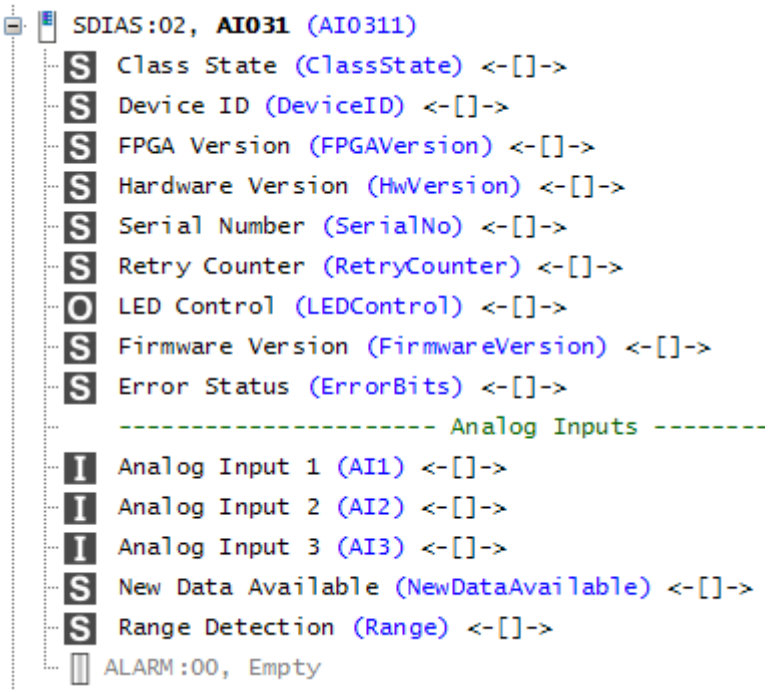
8.2 Cycle Times equal to or above 1 ms (in ms)

FW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
V1.00	x	x		x				x								x

FW	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
V1.00																x

9 Hardware Class AI031

Hardware Class AI031 for the S-DIAS AI 031 Analog Module



This hardware class is used to control the AI 031 hardware module. The module has 3 analog inputs with 0-5000 mA. More information on the hardware can be found in the module documentation.

9.1 Interfaces

9.1.1 General

Class state	State	This server shows the actual status of the hardware class.
Device ID	State	The device ID of the hardware module is shown in this server.
FPGA version	State	FPGA version of the module in 16#XY (e.g. 16#10 = version 1.0).
Hardware version	State	Hardware version of the module in format 16#XXYY (e.g. 16#0120 = Version 1.20)
Serial number	State	The serial number of the hardware module is shown in this server.
Retry counter	State	This increments if a SDIAS 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. The following status are possible: 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. The respective bits mean the following: Bit 1 not defined Bit 2 no Sync available Bit 3 FLASH data CRC error Bit 4 RAM data CRC error Bit 5 invalid EEProm version Bit 6 S-DIAS bus cycle time is not supported Bit 7 toggle bit Module specific: Bit 8-12 Error information bit 13-16: 00 no error occurred 01 peripheral could not be initialized 02 system clock could not be initialized 03-14 reserved 15 undefined error occurred

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. As initialization value (see Internal Properties).

9.1.2 Analog Inputs [1-3]

New Data Available	State	Shows whether new data are available for the analog inputs 1-3. 0 no new data available 1 new data available
Analog Input [1-3]	Input	Analog input 1-3, status query over read(). With open/shorted input the hardware class returns-2147483632.
AI[1-3] Minimal Value	Property	This value indicates the minimum value for the channel. If 0 mA is measured at the channel, this value is output in the software. With the settings in the clients AI[1-3]_Min Value and AI[1-3]_Max Value, the range of measurement values is defined. As initialization value (see Internal Properties).
AI[1-3] Maximal Value	Property	This value indicates the maximum value for the channel. If 5000 mA are measured at the channel, this value is output in the software. With the settings in the clients AI[1-3]_Min Value and AI[1-3]_Max Value, the range of measurement values is defined. As initialization value (see Internal Properties).

9.1.3 Cable Break Detection and Measurement Value Limits

Range Detection	State	Detection of the upper measurement limit (5125 mA): Bit 2: upper measurement limit violated at input AI1 Bit 4: upper measurement limit violated at input AI2 Bit 6: upper measurement limit violated at input AI3

9.1.4 Communication Interfaces

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

9.2 Internal Properties

9.2.1 Initialization Values

If clients are defined as "Initialization value", they must be defined by the 12th init pass or "_FirstScan" at the latest. After the init () method has been run 12 times, the values of these clients are read. Changing the values then is no longer allowed!

Documentation Changes

Change date	Affected page(s)	Chapter	Note
12.02.2018	3	1.1 Analog Current Input Specifications	Frequency
	4	1.1.2 Current Measurement Input Amplitude Frequency Curve	Diagram
	13	5 Current Converter Guidelines	Chapter added
15.11.2018	6	1.3 Miscellaneous	UL instead of UL in preparation
18.07.2019	22	8 Supported Cycle Times	Chapter added
08.09.2020	24	9 Hardware Class AI031	Chapter added
04.11.2020	17	6 Mounting	Expansion functional ground connection