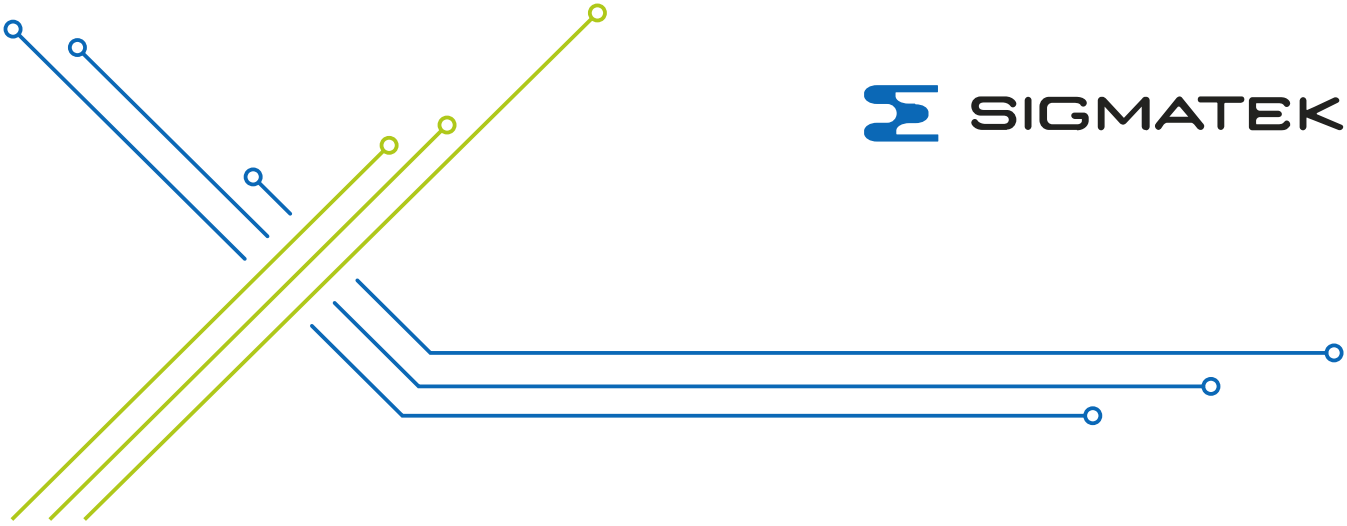
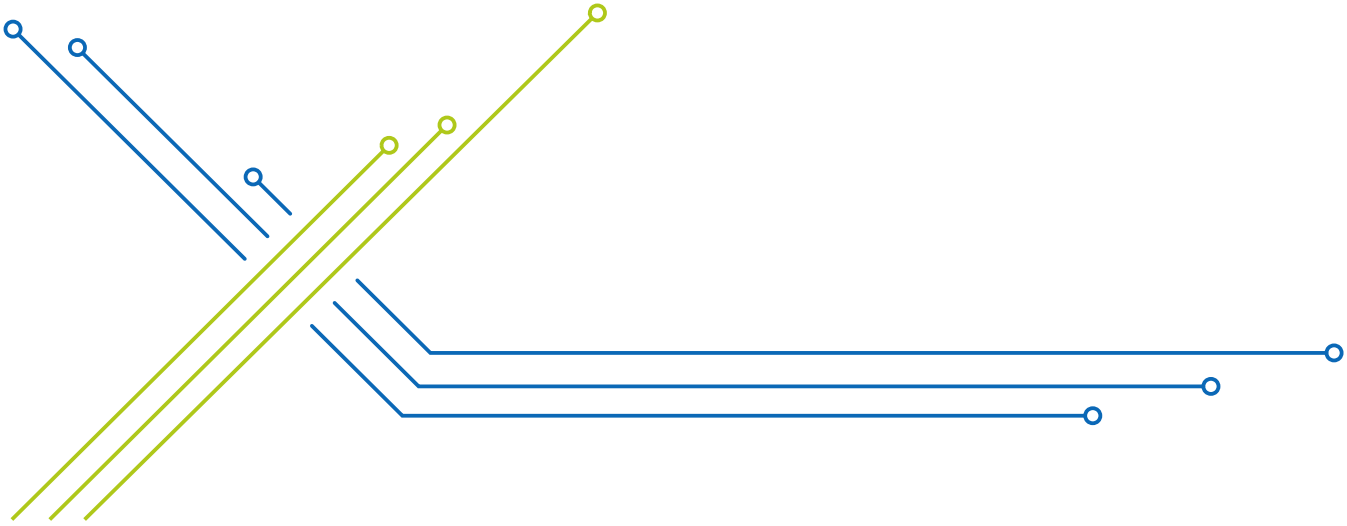


AI 088

S-DIAS Analog Input Module

INSTRUCTION MANUAL

Article number:	20-009-088-E
Date of creation:	08.08.2013
Version date:	14.01.2026



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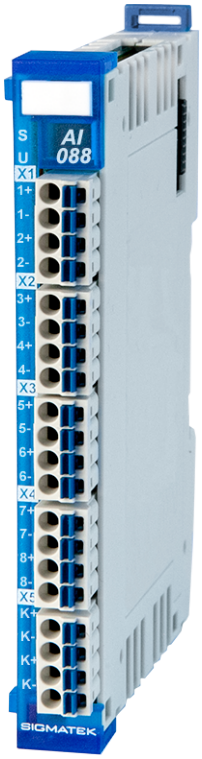
Translation of the Original Instructions

S-DIAS Analog Input Module AI 088



8 thermal element inputs

2 KTY temperature sensor inputs

1 KTY temperature sensor

The S-DIAS Analog Input ModuleAI 088 has eight thermal element inputs for all conventional thermal element types. Two inputs for KTY temperature sensors are also provided or starting with hardware version HW3.0 and firmware version FW2.0, additional temperature sensors for thermocouple compensation are integrated into the module.

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 AI 088

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

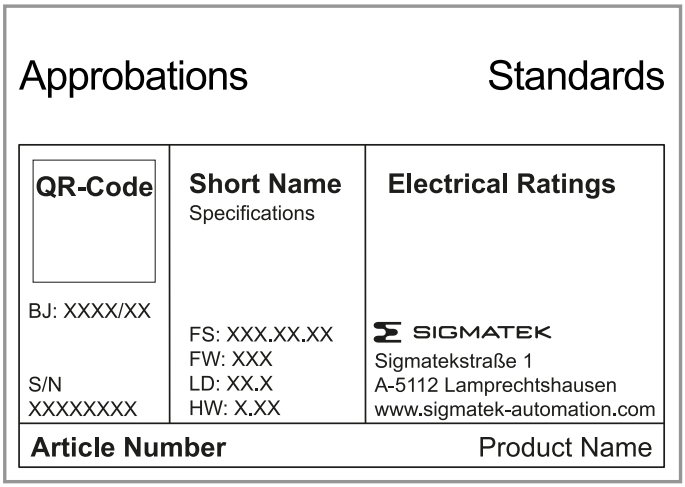
The product AI 088 conforms to the following European directives:

- 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.

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 Thermocouple Input Specifications

Number of channels	8	
Measurement range	see the following table for measuring ranges of thermocouples	
Resolution converter	16 bits	
Conversion time per channel	1 ms	
Common mode range	±10 V	
Input resistance	2 MΩ	
Cable break monitoring	yes	
Measuring current for cable break monitoring	typically 3 µA[1)]	
Overvoltage protection	265 V AC	
Input filter hardware	typically 2 Hz	low-pass 3rd order
Input filter software	50 Hz/60 Hz	
Measurement precision	±0.7 % of the maximum measurement value[2)]	

5.2 Temperature Inputs for Thermocoupling Compensation Specifications

Number of channels	2	
Sensor type	KTY10-62 or KTY11-62 (up to HW 3.40, no longer available) KTY11-62 replacement sensor (from HW 3.50)	
Measurement range	-20 ... +80 °C	
Measurement value	-200 ... +800	
	if the input is open/short-circuited, the hardware class returns -2147483632	
Resolution converter	16 bits	
Conversion time per channel	1 ms	
Sensor current	typically 0.3 mA at 25 °C	
Cable break monitoring	yes	
Short-circuit monitoring	yes	
Input filter hardware	typically 2 Hz	low-pass 3rd order
Measurement precision	±0.7 % of the maximum measured value	

1) The conductor resistance of the thermocouples causes a measurement error in connection with the measuring current for cable break monitoring.

2) Does not include the measurement error of the temperature measurement of the terminal point.

5.2.1 Measurement Range Voltage

Type	Voltage range	Measured value[1)]
1	0-40 mV	0-40000

5.2.2 Measuring Ranges Thermocouples

Type	Thermocouple	Measurement range	Measured value[2)]	Measurement error[3)]
J	Fe-CuNi	-10 … +690 °C (-0.501 ... 38.512 mV)	-100 ... 6900	0.0078 %/Ω
K	NiCr-Ni	-40 … +940 °C (-1.527 ... 38.918 mV)	-400 ... 9400	0.0077 %/Ω
T	Cu-CuNi	-40 … +400 °C (-1.475 ... 20.872 mV)	-400 ... 4000	0.0144 %/Ω
E	NiCr-CuNi	0 … +520 °C (0 ... 38.624 mV)	0 ... 5200	0.0078 %/Ω
N	NiCrSi-NiSi	-80 … +1080 °C (-1.972 ... 39.326 mV)	-800 ... 10800	0.0076 %/Ω
S	Pt10Rh-Pt	-50 … +1760 °C (-0.236 ... 18.609 mV)	-500 ... 17600	0.0161 %/Ω
R	Pt13Rh-Pt	-50 … +1760 °C (-0.226 ... 21.003 mV)	-500 ... 17600	0.0142 %/Ω
B	Pt30Rh-Pt6Rh	0 … +1820 °C (0 ... 13.820 mV)	0 ... 18200	0.0217 %/Ω
L	Fe-CuNi	0 … +680 °C (0 ... 38.487 mV)	0 ... 6800	0.0078 %/Ω
U	Cu-CuNi	0 … +590 °C (0 ... 33.606 mV)	0 ... 5900	0.0089 %/Ω

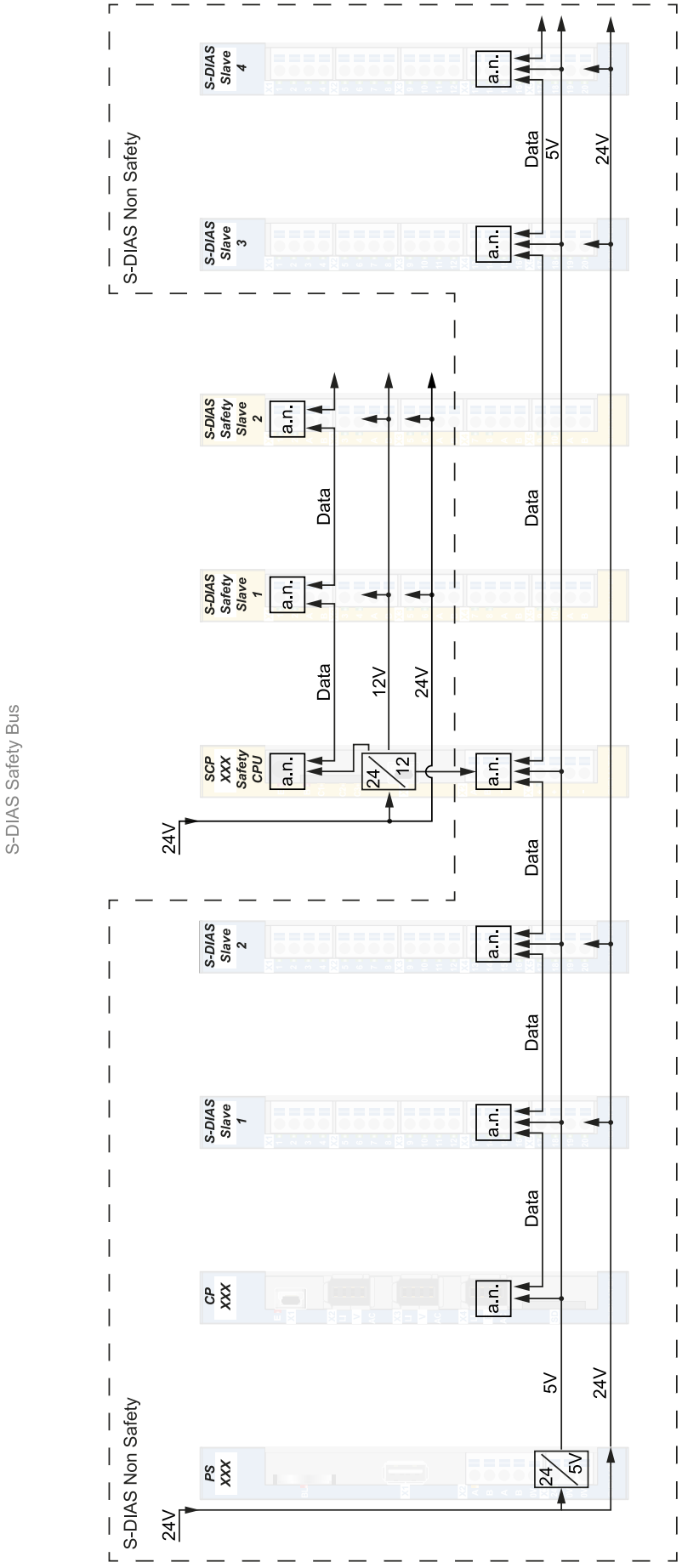
5.3 Electrical Requirements

Voltage supply from S-DIAS bus	+5 V	
Current consumption on the S-DIAS bus (+5 V supply)	typically 62 mA	maximum 68 mA
Voltage supply from S-DIAS bus	+24 V	
Current consumption on the S-DIAS bus (+24 V supply) HW1.x to HW3.10	typically 75 mA	maximum 90 mA
Current consumption on the S-DIAS bus (+24 V supply) Since HW3.30	typically 80 mA	maximum 102 mA

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".

1) When the input is open, the hardware class returns -2147483632.
2) When the input is open, the hardware class returns -2147483632.
3) Measurement error due to the lead resistance of the thermocouples, in relation to the measuring range.


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

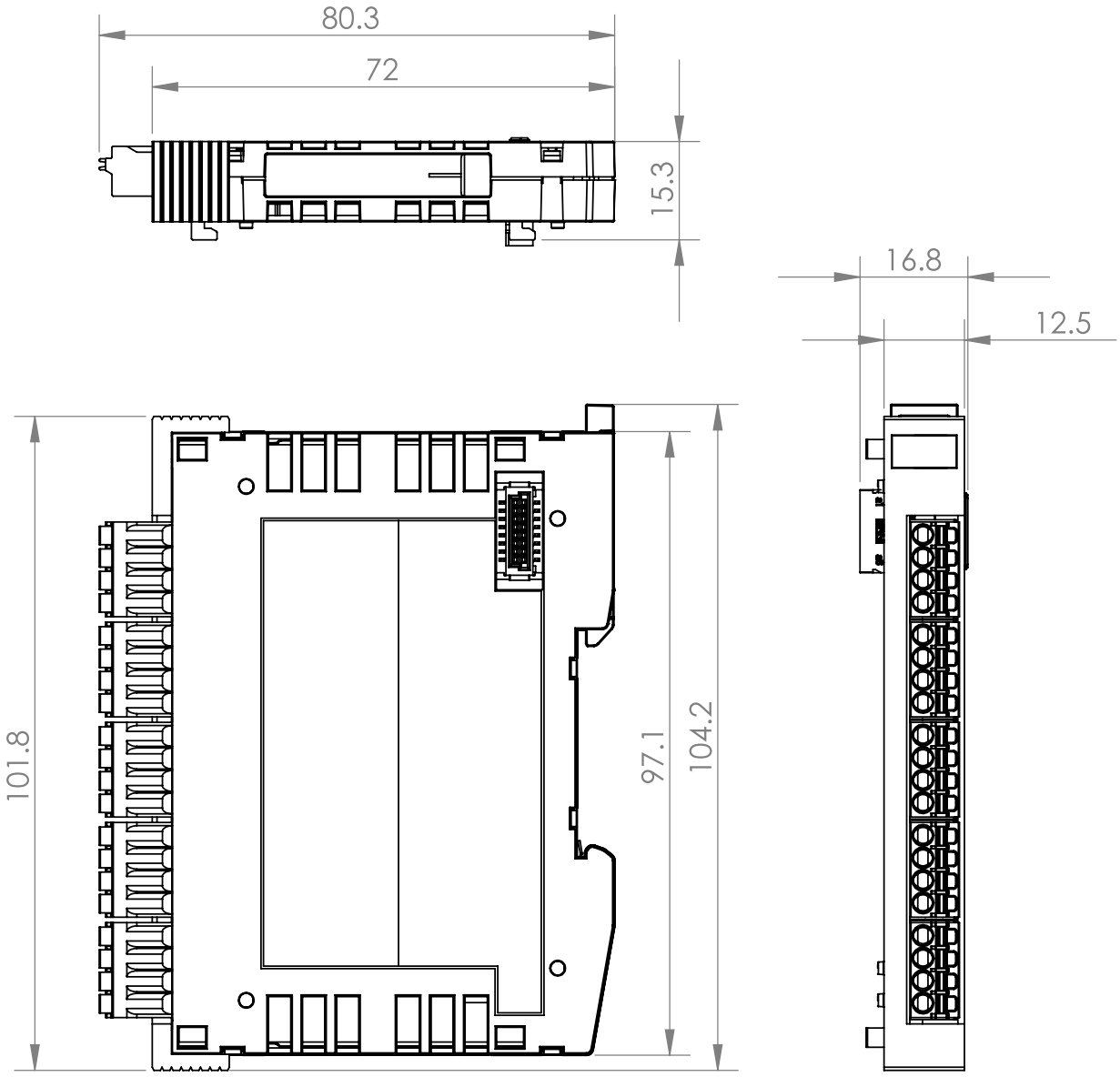
5.4 Miscellaneous

Article number	20-009-088	
Printed circuit board coating	no	
Approvals	CE	yes
	UL	cULus (E247993)
	Functional Safety	no
	UKCA	yes

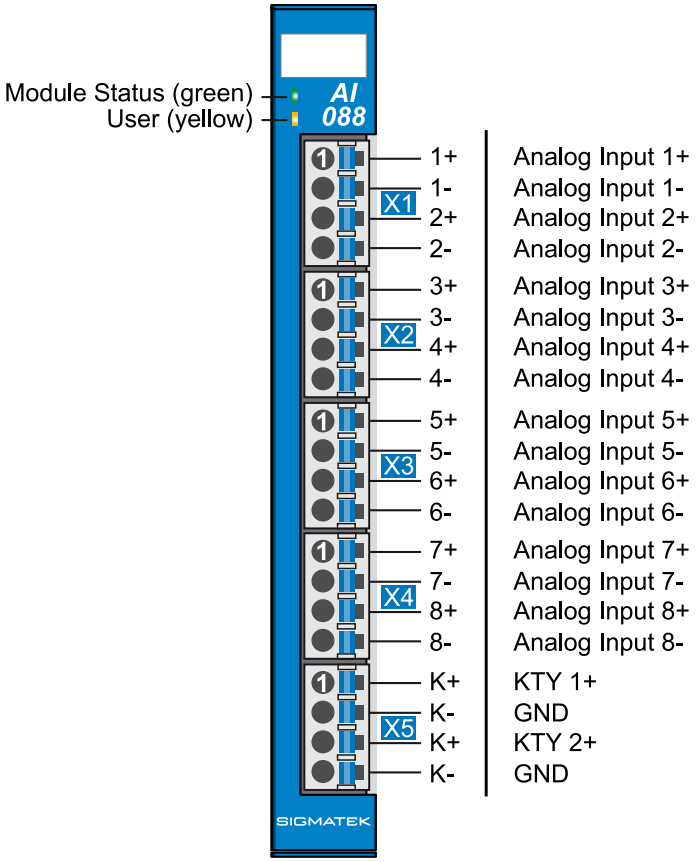
5.5 Environmental Conditions

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



The temperature sensors for the terminal point compensation (KTY1, KTY2 or from HW3.0 and from FW2.0 module-internal temperature sensors) can be set separately for each thermocouple input using software. If the KTY temperature inputs are not required for terminal point compensation, they can also be used as independent temperature inputs.

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)	

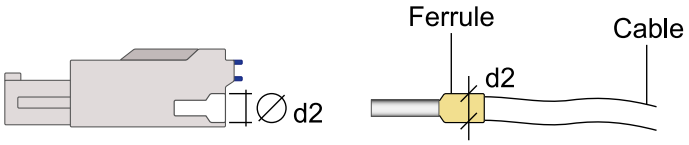
7.2 Applicable Connectors

X1-X4: Connectors with spring terminals gold-plated(included in delivery)
X5: Connectors with spring terminals tin-plated(included in delivery)

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

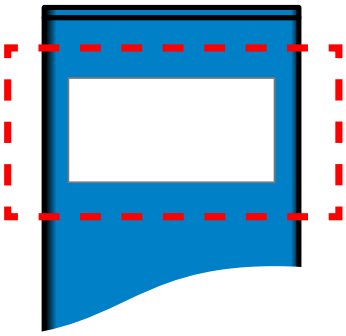
Connection capacity:

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

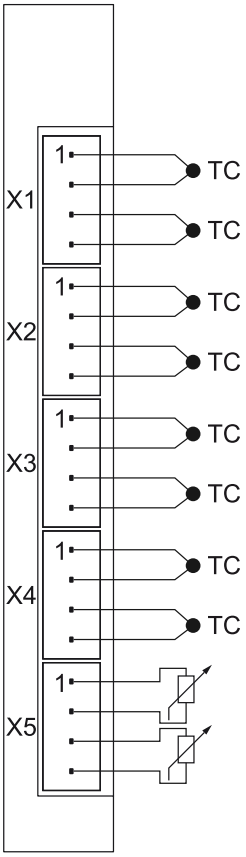
7.3 Label Field



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

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 following installation guidelines should be observed:

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

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 Measuring Temperature with Thermal Elements

Temperature measurement using thermocouples is based on the temperature-dependent voltage, which is generated through the combination of two conductors from different metals (alloys); this is called the Seebeck effect.

This voltage therefore exists not only at the measurement point (where it is desired), but also at the coupling between the thermal element conductors and the copper connection. The thermal voltage at this location is not desired, however, it is unavoidable. This voltage falsifies the measurement value by that of the temperature at the coupling!

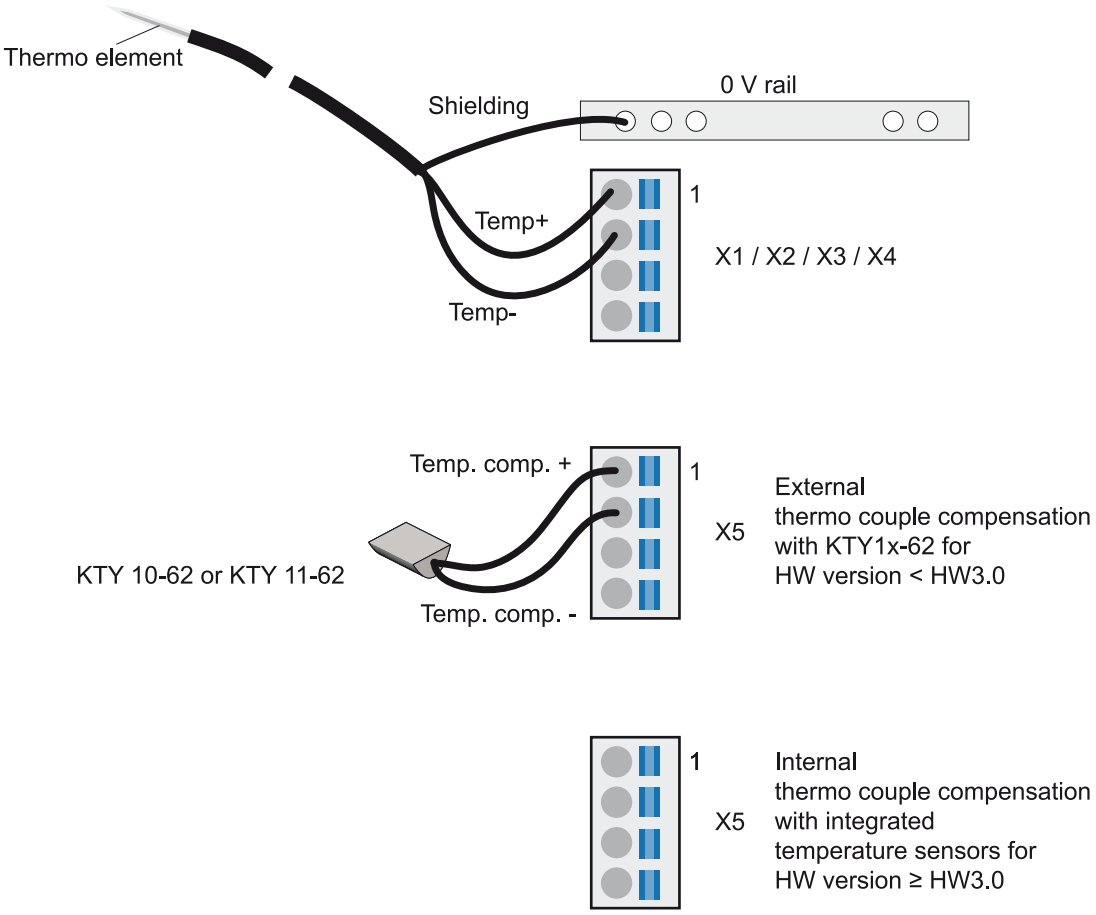
An exact measurement is therefore only possible if temperature of the coupling is measured, converted to the equivalent thermal voltage of the thermal element and added to the measured thermal voltage of the servo element and the temperature calculated therefrom. The calculation is performed in the module directly.

Thermal elements can be connected directly to the connector plug of the modules (over compensating circuits when possible). For thermocouple applications where the compensating circuit is not connected to the control, the comparison measurement must be made at the junction of the thermocouple (or compensating circuit) and copper conductor.

For reasons for precision, a remote coupling is recommended. Hereby, the KTY should be placed as close as possible to the coupling.

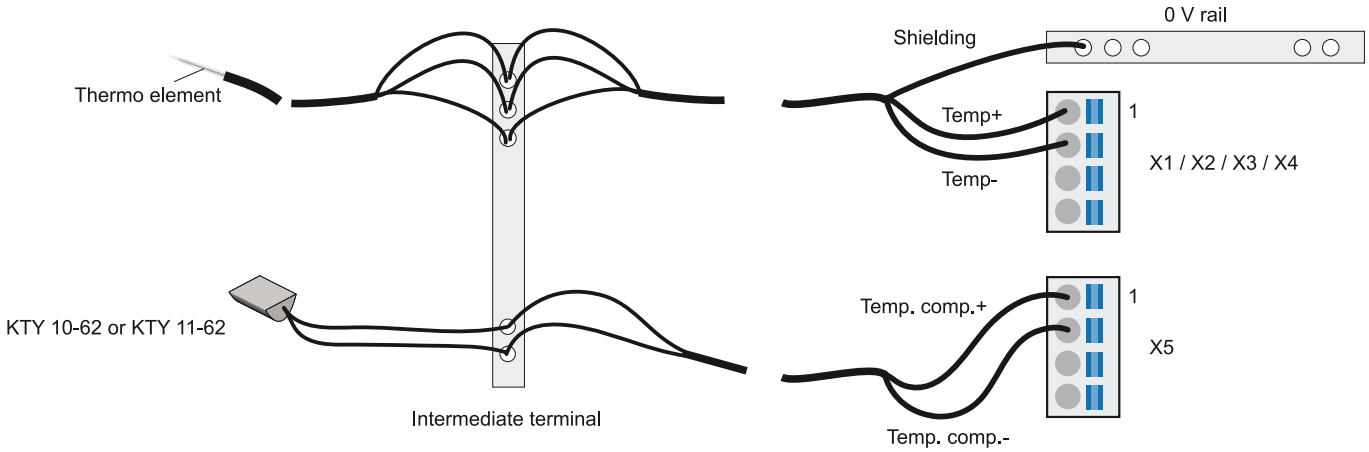
If the coupling is located directly on the module, the heat generated by the module and the warming of neighboring modules can lead to a greater measurement deviation than stated in the technical data.

8.4 Connecting the Thermoelement to the Control



- If the thermal element is galvanically separated, meaning not connected to earth, it is recommended that when using the thermal elements to measure the temperature in ceramic heating elements, the thermal element should be connected to the GND terminal of the control to prevent measuring signal errors caused by the voltage coupling.
- With a HW version < HW3.0, or firmware version < FW2.00, a KTY10-62 or KTY11-62 is used for thermocoupling compensation and in this case, measures the temperature directly from the S-DIAS connector X5.
- Starting with a hardware version ≥ HW3.0 and a firmware version ≥ FW2.00, the module has additional temperature sensors for thermo coupling compensation integrated. It is therefore recommended that the internal thermos coupling compensation be used when the thermal elements are connected directly to the control, so that the error can be reduced to ≤ ±2 °C via the compensation.

8.5 Connecting the Thermo Element over an Intermediate Coupling without Equalization Cable



- If the thermal element is galvanically separated, meaning not connected to earth, it is recommended that when using the thermal elements to measure the temperature in ceramic heating elements, the thermal element should be connected to the GND terminal of the control to prevent measuring signal errors caused by the voltage coupling.
- The KTY10-62/KTY11-62 or KTY11-62 replacement sensor is used for thermo couple compensation and in this case, measures the temperature directly on the intermediate coupling.

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.

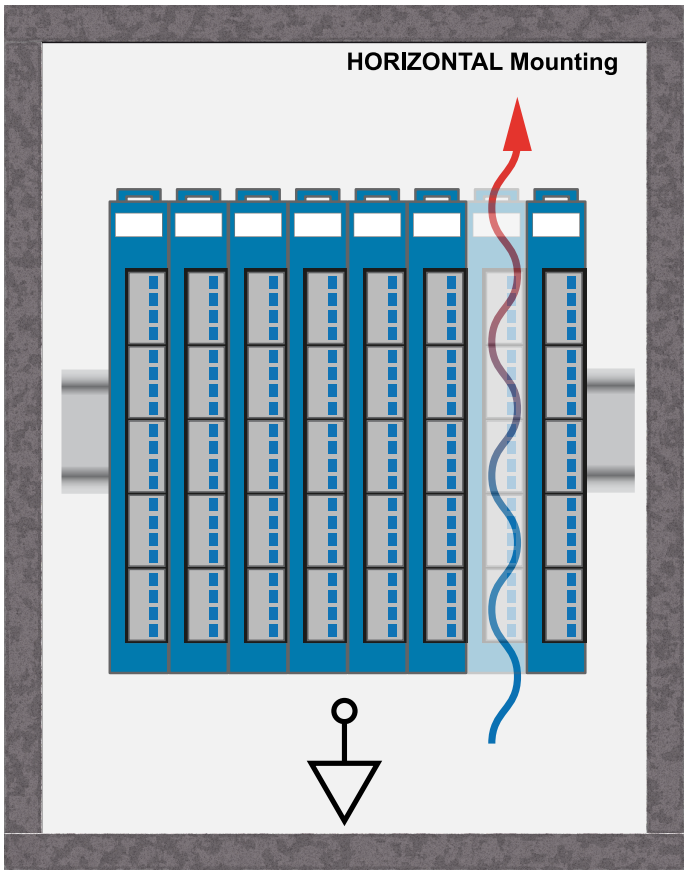
INFORMATION

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.

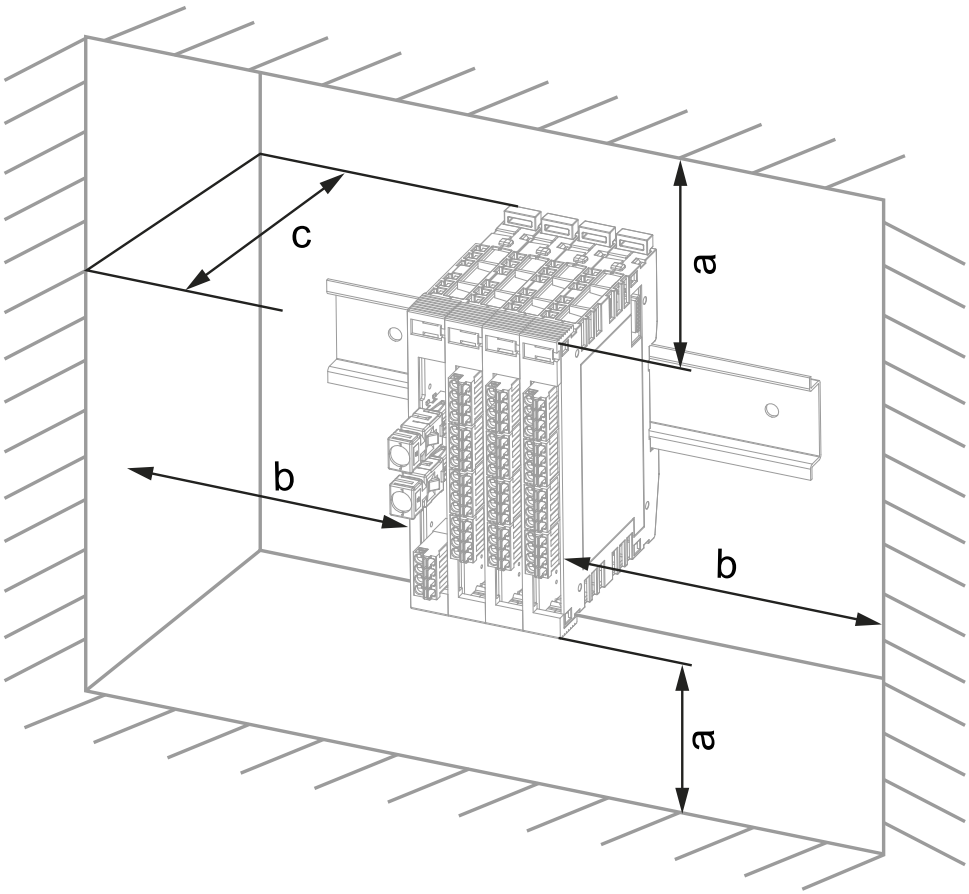
Damaged components can disrupt or damage the system.

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 Addressing

14.1 Address Mapping Overview (FW V1.00 to V1.10)

Address (hex)	Size (bytes)	Access type	Description	
0000	**128**	**w**	**Cyclical data to the firmware**	
0000	0	w	No data available	
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 checksum error
			Bit 3	RAM calibration data checksum error
			Bit 4	invalid calibration data
			Bit 5-15	reserved
0082	2	r	Temperature input 1	
0084	2	r	Temperature input 2	
0086	2	r	Temperature input 3	
0088	2	r	Temperature input 4	
008A	2	r	Temperature input 5	
008C	2	r	Temperature input 6	
008E	2	r	Temperature input 7	
0090	2	r	Temperature input 8	
0092	2	r	KTY temperature input 1	
0094	2	r	KTY temperature input 2	
0096	2	r	Cable break detection	
			Bit 0	cable break TMP_1
			Bit 1	cable break TMP_2
			……	
			Bit 7	cable break TMP_8
			Bit 8	cable break KTY_1
			Bit 9	cable break KTY_2 (external)
			Short-circuit detection	
			Bit 10	cable break KTY_1 (external)
			Bit 11	cable break KTY_2 (external)
			Bit 12-15	reserved
0100	**128**	**w**	**Configuration data to the firmware**	
0100	2	w	Checksum 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 (input values adjusted)
				1 = raw values are used and provided
			Bit 1-7	reserved
0105	1	w	reserved	
0106	1	w	Thermal element selection	
			Bit 3 ... 0	TMP 1
			Bit 7 ... 4	TMP 2
0107	1	w	Thermal element selection	
			Bit 3 ... 0	TMP 3
			Bit 7 ... 4	TMP 4
0108	1	w	Thermal element selection	
			Bit 3 ... 0	TMP 5
			Bit 7 ... 4	TMP 6
0109	1	w	Thermal element selection	
			Bit 3 ... 0	TMP 7
			Bit 7 ... 4	TMP 8
010A	1	w	Thermal element reference selection	
			Bit 0 .... TMP_1:	0 … KTY_1, 1 … KTY_2
			Bit 1 .... TMP_2:	0 … KTY_1, 1 … KTY_2
			……	
			Bit 7 .... TMP_8:	0 … KTY_1, 1 … KTY_2
0180	**128**	**r**	**Configuration data to the HW class**	
0180	2	r	Checksum over the entire configuration data	
0182	2	r	Length of the configuration data	
0184	2	r	Firmware version	

14.2 Address Mapping Overview (starting with FW V2.00)

Address (hex)	Size (bytes)	Access type	Description	
0000	**128**	**w**	**Cyclical data to the firmware**	
0000	0	w	No data available	
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 checksum error
			Bit 3	RAM calibration data checksum error
			Bit 4	invalid calibration data
			Bit 5	S-DIAS cyclic time not supported
			Bit 6-11	reserved
			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	Temperature input 1	
0084	2	r	Temperature input 2	
0086	2	r	Temperature input 3	
0088	2	r	Temperature input 4	
008A	2	r	Temperature input 5	
008C	2	r	Temperature input 6	
008E	2	r	Temperature input 7	
0090	2	r	Temperature input 8	
0092	2	r	KTY temperature input 1	
0094	2	r	KTY temperature input 2	

Address (hex)	Size (bytes)	Access type	Description	
0096	2	r	Bit 0	cable break TMP_1
			Bit 1	cable break TMP_2
			……	
			Bit 7	cable break TMP_8
			Bit 8	cable break KTY_1 (external)
			Bit 9	cable break KTY_2 (external)
			Cross-circuit detection	
			Bit 10	cable break KTY_1 (external)
			Bit 11	cable break KTY_2 (external)
			Bit 12-14	reserved
			Error information	
			Bit 15	overvoltage at one of the thermal inputs (TMP_1 to TMP_8)
0098	2	r	Internal KTY temperature input 1 (KTY_INT_1) (remains at "invalid-temperature" (= -30000) if the hardware does not support this feature)	
009A	2	r	Internal KTY temperature input 2 (KTY_INT_2) (remains at "invalid-temperature" (= -30000) if the hardware does not support this feature)	
0100	**128**	**w**	**Configuration data to the firmware**	
0100	2	w	Checksum over the entire configuration data	
0102	2	w	Length of the configuration data	
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	extended functionality
				0 .... additional features are deactivated (compatibility)
				1 .... additional features are activated. Contained therein, is the message counter function as well as testing the measurement range (if voltage mode is active in the thermal inputs). Additionally, the internal KTY sensors can thereby be used as a reference for the thermal inputs (address 0x010B).
			Bit 3-7	reserved
0105	1	w	Message counter (only used when bit 2 in the Info-Byte is set to address 0x0104)	
0106	1	w	Thermal element selection	
			Bit 3 …. 0	TMP_1
			Bit 7 …. 4	TMP_2

Address (hex)	Size (bytes)	Access type	Description	
0107	1	w	Thermal element selection	
			Bit 3 …. 0	TMP_3
			Bit 7 …. 4	TMP_4
0108	1	w	Thermal element selection	
			Bit 3 …. 0	TMP_5
			Bit 7 …. 4	TMP_6
0109	1	w	Thermal element selection	
			Bit 3 …. 0	TMP_7
			Bit 7 …. 4	TMP_8
010A	1	w	Thermal element reference selection	
			Bit 0 .... TMP_1:	0 … KTY_1, 1 … KTY_2
			Bit 1 .... TMP_2:	0 … KTY_1, 1 … KTY_2
			Bit 7 .... TMP_8:	0 … KTY_1, 1 … KTY_2
010B	1	w	Thermal element reference selection – internal/external (only when the new features (Bit 2 in the info-byte at address 0x0104) are activated)	
			Bit 0 .... TMP_1:	0 … KTY external, 1 … KTY internal
			Bit 1 .... TMP_2:	0 … KTY external, 1 … KTY internal
			……	
			Bit 7 .... TMP_8:	0 … KTY external, 1 … KTY internal
			Note: If “KTY external” is selected, the KTY input configured at address 0x010A is used. If “KTY internal” is selected, KTY_INT_1 is used for TMP_1 to TMP_4 and for TMP_5 to TMP_8, KTY_INT_2 is used.	
0180	**128**	**r**	**Configuration data to the HW class**	
0180	2	r	Checksum over the entire configuration data	
0182	2	r	Firmware version	
0184	2	r	Message counter (only used when bit 2 in the Info-Byte is set to address 0x0104)	
0186	1	r		
0187	1	r	reserved	

15 Supported Cycle Times

15.1 Cycle Times below 1 ms (in µs)

FW	50	100	125	200	250	500
V1.xx						
V2.00				x	x	x
V2.10				x	x	x
V2.20		x	x	x	x	x

x = supported

15.2 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
V1.xx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
V2.00	x	x		x				x								x
V2.10	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
V2.20	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

x = supported

FW	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
V1.xx	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
V2.00																x
V2.10	x	x	x	x												
V2.20	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

x = supported

Changes Chart

Change date	Affected page(s)	Chapter	Note
04.10.2013	4	1.4	Note
10.10.2013	4	1.3	Measurement range extended
23.10.2013	13	5.5 Environmental Conditions	Vibration resistance added
23.12.2013	15	7 Connector Layout	Changed image
	18	8.1 Wiring Example	Connection example added
11.02.2014	15	7 Connector Layout	Changed image
	16	7.2 Applicable Connectors	Connection capacity added
01.04.2014	13	5.4 Miscellaneous	UL added
	22	9 Assembly/Installation	Text updated
30.01.2015	19	8.2 Note	Added note concerning connecting the S-DIAS module while voltage is applied
18.03.2015	28	14.1 Address Mapping Overview (FW V1.00 to V1.10)	Address (hex) under standard mode (info register bit 0 = 0) changed from 0100 to 010A
26.03.2015	16	7.2 Applicable Connectors	Added connections
08.04.2015	10	5.1 Thermocouple Input Specifications	Common mode range changed, descriptions of input filter hardware and input filter software added
	11	5.2.1 Measurement Range Voltage	Table of measuring ranges for thermocouples extended and table of measuring ranges for voltage added
	10	5.2 Temperature Inputs for Thermocoupling Compensation Specifications	Description and technical data corrected
	19	8.2 Note	Chapter completely revised
09.07.2015	10	5.1 Thermocouple Input Specifications	Footnote added
	11	5.3 Electrical Requirements	Current consumption on the S-DIAS bus (+5 V supply) Value changed
	11	5.2.1 Measurement Range Voltage	Text changed
25.01.2016	11	5.3 Electrical Requirements	Graphics added
28.04.2016	22	9 Assembly/Installation	Graphics distances
31.10.2016	10	5.1 Thermocouple Input Specifications	Measuring current for cable break monitoring added
	11	5.2.1 Measurement Range Voltage	Measurement error column added

Change date	Affected page(s)	Chapter	Note
27.03.2017	11	5.2.1 Measurement Range Voltage	Value for sensor break detection added
	11	5.2.1 Measurement Range Voltage	
	10	5.2 Temperature Inputs for Thermocoupling Compensation Specifications	Value for sensor break and short-circuit detection added
17.08.2017	13	5.5 Environmental Conditions	Pollution degree
	16	7.2 Applicable Connectors	Sleeve length added Added info regarding ultrasonically welded strands
18.10.2017	17	7.3 Label Field	Chapter added
	22	9 Assembly/Installation	Graphic replaced
12.12.2017	1		Introduction text
	13	5.4 Miscellaneous	Hardware version
	15	7 Connector Layout	Addition extended
	19	8.3 Measuring Temperature with Thermal Elements	Remote clamping point removed
	20	8.4 Connecting the Thermoelement to the Control	new graphics and additions
	28	14.1 Address Mapping Overview (FW V1.00 to V1.10)	divided according to HW version
14.05.2019	33	15 Supported Cycle Times	Chapter added
15.07.2019	1		Temperature sensor KTY11-62 added
14.02.2020	33	15 Supported Cycle Times	FW 1.00 and FW 1.10 combined to FW 1.xx
03.04.2020	11	5.2.2 Measuring Ranges Thermocouples	Thermocouple values adjusted
08.09.2020		9 Hardware class AI 088	Chapter added
04.11.2020	22	9.2 Mounting	Expansion functional ground connection
21.09.2021	11	5.3 Electrical Requirements	Current consumption changed
08.04.2022	13	5.4 Miscellaneous	HW version
06.12.2022	13	5.4 Miscellaneous	UKCA conformity
26.07.2023		Document	General chapters added, design
14.01.2026		Einleitung	KTY11-62 Replacement sensor added
	10	5.2 Temperature Inputs for Thermocoupling Compensation Specifications	
	19	8.3 Measuring Temperature with Thermal Elements	

16 Hardware Class

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

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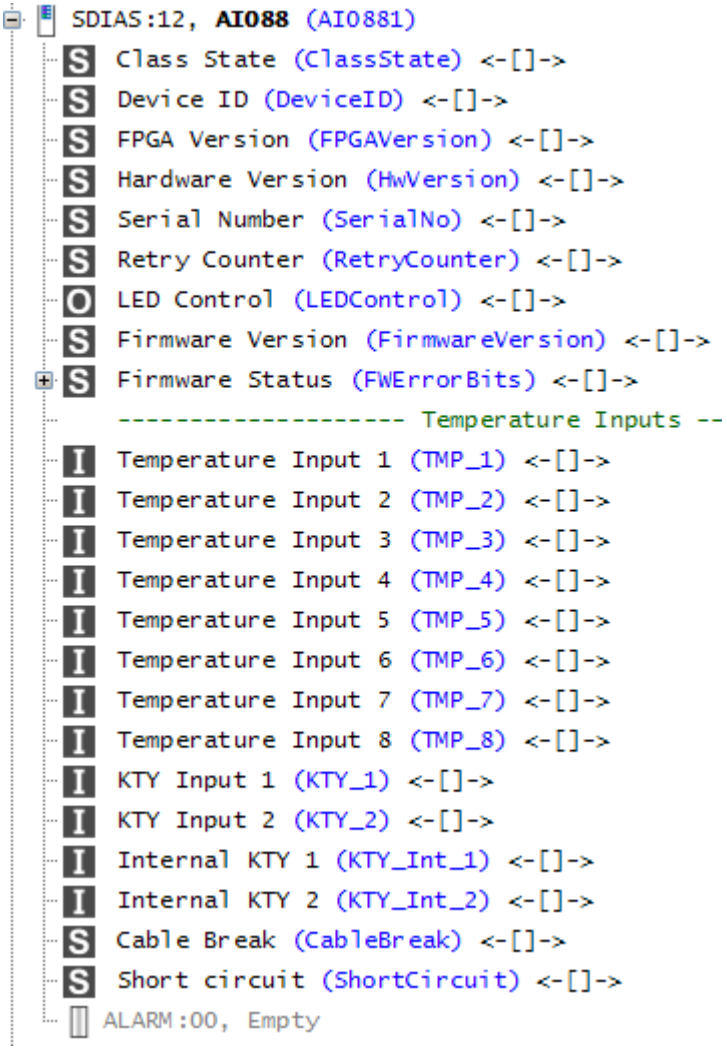
AI088

Hardware class AI088 for the S-DIAS analog input module AI 088



This hardware class is used to control the AI 088 hardware module. The thermal element input card has 8 thermal element inputs for all conventional thermal element types Two inputs for KTY temperature sensors for coupling compensation are provided. More information on the hardware can be found in the module documentation.

1 Interfaces

General

ClassState	State	This server shows the actual status of the hardware class.
DeviceID	State	Shows the device ID of the hardware module.
FPGAVersion	State	FPGA version of the module in 16#XY (e.g. 16#10 = version 1.0).
Hardware version	State	Hardware version of the module in format 16#XXYY (e.g. 16#0120 = Version 1.20)
Serial Number	State	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
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.
Firmware version	State	The firmware version of the hardware module is shown in this server.
Firmware Status	State	In this server, the status bits of the FW are shown. Bit 0 DC not OK Bit 1 no Sync available Bit 2 Flash Data CRC Error Bit 3 Ram Data CRC Error Bit 4 invalid EEProm version

Analog Inputs

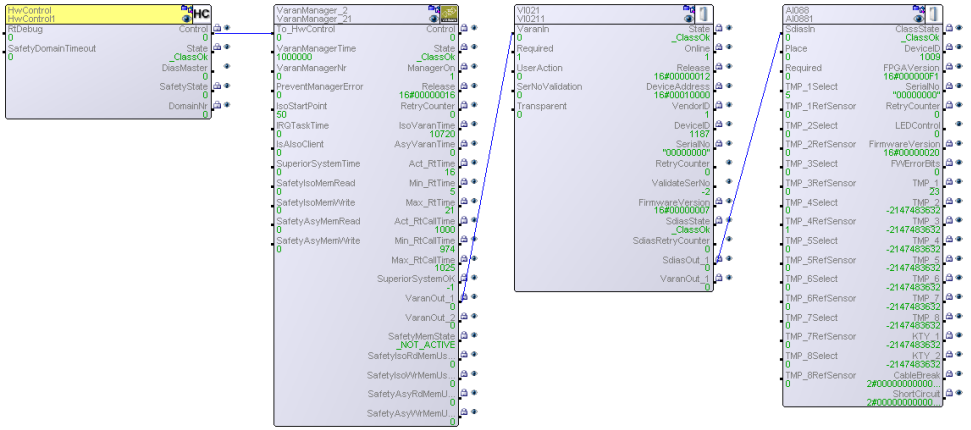
Temperature Input [1-8]	Input	Temperature input 1-8, status query over read() Temperature values in 1/10 °C. With open input the hardware class returns -2147483632.
Cable Break	State	Cable break detection Bit 0: cable break at temperature input TMP_1 Bit 1: cable break at temperature input TMP_2 Bit 2: cable break at temperature input TMP_3 Bit 3: cable break at temperature input TMP_4 Bit 4: cable break at temperature input TMP_5 Bit 5: cable break at temperature input TMP_6 Bit 6: cable break at temperature input TMP_7 Bit 7: cable break at temperature input TMP_8 Bit 8: cable break at temperature input KTY_1 Bit 9: cable break at temperature input KTY_2
Short Circuit	State	Short circuit detection: Bit 0: short circuit at temperature input KTY_1 Bit 1: short circuit at temperature input KTY_2
Thermocouple element select [1-8]	Property	Thermocouple selection for the temperature inputs 0: Type J (Fe-CuNi -10 … +690 °C) 1: Type K (NiCr-Ni -40 … +940 °C) 2: Type T (Cu-CuNi -40 … +400 °C) 3: Type E (NiCr-CuNi 0 … +520 °C) 4: Type N (NiCrSi-NiSi -80 … 1080 °C) 5: Type S (Pt10Rh-Pt -50 … 1760 °C) 6: Type R (Pt13Rh-Pt -50 … 1760 °C) 7: Type B (Pt30Rh-Pt6Rh 0 … +1820 °C)

		8 Type L (Fe-CuNi 0 … +680 °C) 9 Type U (Cu-CuNi 0 … +590 °C) 10 AnalogIn [µV]
Reference temperature sensor select [1-8]	Property	Selecting the reference temperature sensor. 0 KTY1 1 KTY2 1 Internal KTY
KTY Input [1-2]	Input	KTY temperature inputs, status query via read(). With open input, the hardware class returns -2147483632.
Internal KTY [1-2]	Input	Temperature value internal KTY (only available since hardware version 3.0) Internal KTY 1: for the inputs TMP_1 to TMP_4. Internal KTY 2: for the inputs TMP_5 to TMP_8. The temperature values are shown in 1/10 °C. If the hardware does not support internal KTY sensors or no internal KTY is used, -2147483632 is displayed.
Write Configuration Data	Output	With this server the configuration of the analog inputs can be changed at runtime. This feature is only available but FW version 2.20 or higher. 1 Writing the configuration data (via Write() method) 0 Writing of configuration data completed/not yet started -1 Feature is not available with the current firmware version -2 Error during writing the new configuration data to the firmware

Communication Interfaces

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

2 Example


HwControl
HwControl1
RtDebug
0
SafetyDomainTimeout
0
Control
0
State
_ClassOk
DiasMaster
0
SafetyState
0
DomainNr
0
VaranManager_2
VaranManager_21
To_HwControl
0
VaranManagerTime
1000000
VaranManagerNr
0
PreventManagerError
0
IsoStartPoint
50
IRQTaskTime
0
IsAlsoClient
0
SuperiorSystemTime
0
SafetyIsoMemRead
0
SafetyIsoMemWrite
0
SafetyAsyMemRead
0
SafetyAsyMemWrite
0
Control
0
State
_ClassOk
ManagerOn
1
Release
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RetryCounter
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IsoVaranTime
10720
AsyVaranTime
0
Act_RtTime
16
Min_RtTime
5
Max_RtTime
21
Act_RtCallTime
1000
Min_RtCallTime
974
Max_RtCallTime
1025
SuperiorSystemOK
-1
VaranOut_1
0
VaranOut_2
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SafetyMemState
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SafetyIsoRdMemUs...
0
SafetyIsoWrMemUs
0
SafetyAsyRdMemU...
0
SafetyAsyWrMemU...
0
VI021
VI0211
VaranIn
0
Required
1
UserAction
0
SerNoValidation
0
Transparent
0
State
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Online
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DeviceAddress
16#00010000
VendorID
1
DeviceID
1187
SerialNo
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RetryCounter
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ValidateSerNo
-2
FirmwareVersion
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SdiasState
_ClassOk
SdiasRetryCounter
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SdiasOut_1
0
VaranOut_1
0
AI088
AI0881
SdiasIn
0
Place
0
Required
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TMP_1Select
5
TMP_1RefSensor
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TMP_2Select
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TMP_2RefSensor
0
TMP_3Select
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TMP_3RefSensor
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TMP_4Select
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TMP_4RefSensor
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TMP_5Select
0
TMP_5RefSensor
0
TMP_6Select
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TMP_6RefSensor
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TMP_7Select
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RetryCounter
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LEDControl
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TMP_2
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TMP_3
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TMP_4
-2147483632
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TMP_6
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KTY_1
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KTY_2
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ShortCircuit
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