C-DIAS Temperature sensing module CAI 887

8 x temp. inputs 0 – 600°C
8 x digital outputs +24V

This analogue input module is used for the detection of temperatures in the range of 0 – 600°C by means of a NiCrNi (Typ K) temperature sensor.
In addition there are 8 digital +24V outputs (switched positive) available.

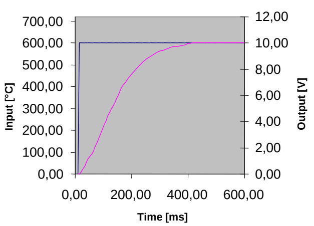
Technical data

Analogue channel specifications

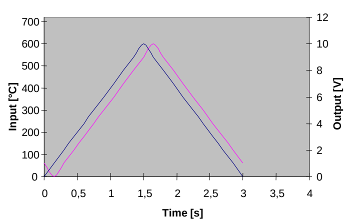
Number of channels	8	
Measuring range	0 – 600°C (0 – 24.902mV)	
Measured value	0 – 4000	Open input delivers 4095
Resolution	12 bit	
Transformation time per channel	≤14µs	
Suitable sensor type	NiCrNi (K) DIN 43710	
Input filter	0.5 s	Low pass class 3
Common-mode range	±10V	
Sensor type for comparison measuring point	KTY10-62	
Comparison measuring point	-20 to 80°C	
Precision of the analogue channel	±0.75% of the max. measured value *	

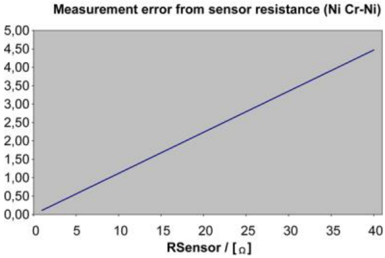
* when using the KTY10-62 terminal compensation sensor.

Response of the input filter 0-600 degree



Delay of the input filter 0-600 degree





Digital outputs

Number of outputs	8
Protection against short circuiting	Yes
Maximum permissible constant current / channel	70mA
Maximum total current	560mA
Voltage drop across the supply (output switched on)	≤1V
Residual current output (switched off)	≤0.2mA
Switch-on delay (RL=100Ω)	<0.6μs
Switch-off delay (RL=100Ω)	<4μs

Electrical requirements

Supply of the digital outputs (X6)	18 – 30V DC	
Current consumption supply of the digital outputs (X6)	Corresponds to the load on the digital outputs	
Supply of the C-DIAS Bus	+5V and +24V	
Current consumption on the C-DIAS bus (+5V supply)	Typically 15mA	Maximum 30mA
Current consumption on the C-DIAS bus (+24V supply)	Typically 50mA	Maximum 70mA

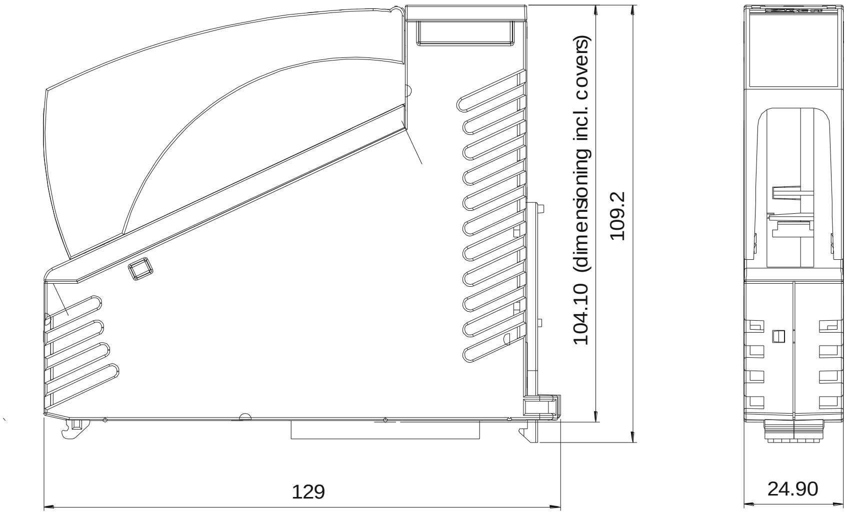
Miscellaneous

Article number	12-009-887
Hardware version	1.x
Standardization	UL (E247993)

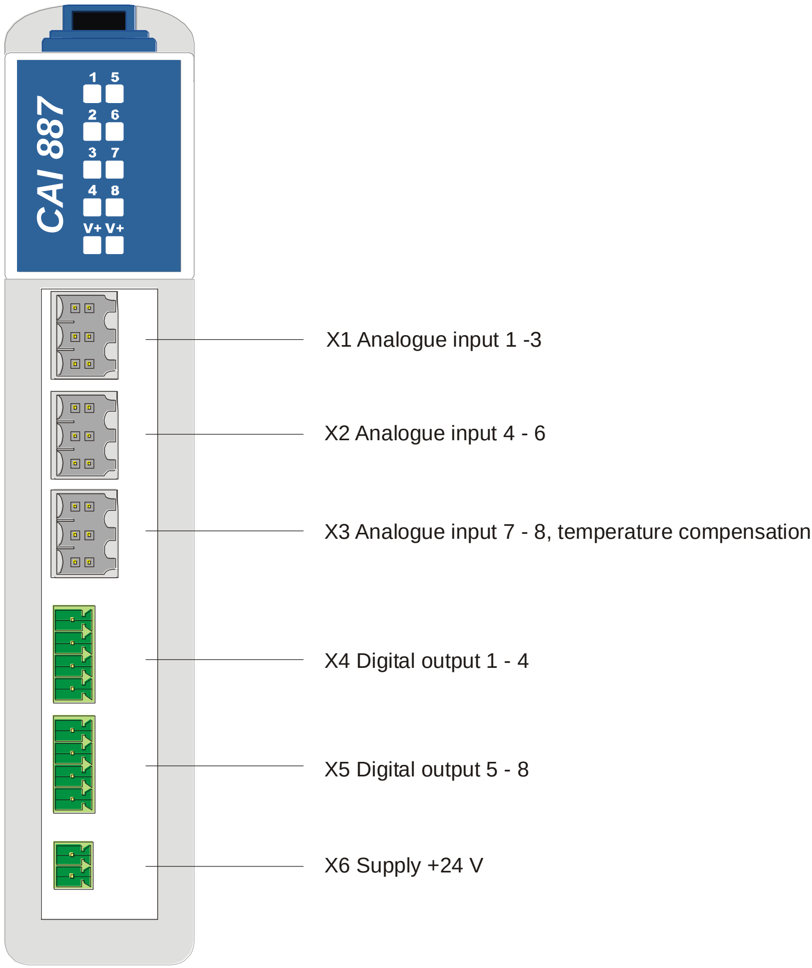
Environmental conditions

Storage temperature	-20 – +85°C	
Operating temperature	0 – +60°C	
Humidity	0 – 95%, without condensation	
EMV stability	In accordance with EN 61000-6-2 (industrial)	
Resistance to shocks	EN 60068-2-27	150m/s²
Protective system	EN 60529	IP 20

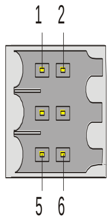
Mechanical dimensions



Connections

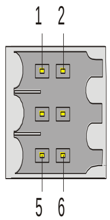


X1: Plug Temperature Input 1 - 3



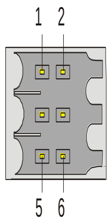
Pin	Assignment
1	Temperature Input 1-
2	Temperature Input 1+
3	Temperature Input 2-
4	Temperature Input 2+
5	Temperature Input 3-
6	Temperature Input 3+

X2: Plug Temperature Input 4 - 6



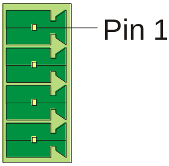
Pin	Assignment
1	Temperature Input 4-
2	Temperature Input 4+
3	Temperature Input 5-
4	Temperature Input 5+
5	Temperature Input 6-
6	Temperature Input 6+

X3: Plug Temperature Input 7 – 8, Temperature Compensation



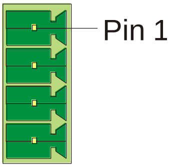
Pin	Assignment
1	Temperature Input 7-
2	Temperature Input 7+
3	Temperature Input 8-
4	Temperature Input 8+
5	Temperature Compensation -
6	Temperature Compensation +

X4: Plug digital output 1 - 4



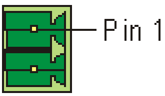
Pin	Function
1	Output 1
2	Output 2
3	Output 3
4	Output 4

X5: Plug digital output 5 - 8



Pin	Function
1	Output 5
2	Output 6
3	Output 7
4	Output 8

X6: Supply digital outputs



Pin	Function
1	+24V
2	GND

Useable connectors

X1-X3: 6-pole Weidmüller plug B2L/B2CF 3,5/6

X4-5: **Connector with spring clamp:**
Phoenix Contact: FK-MCP 1,5/ 4-ST-3,5

Connector with screw clamp technique:
Phoenix Contact: MC 1,5/ 4-ST-3,5

X6: **Connector with spring clamp:**
Phoenix Contact: FK-MCP 1,5/ 2-ST-3,5

Connector with screw clamp technique:
Phoenix Contact: MC 1,5/ 2-ST-3,5

The complete C-DIAS plug set CKL 043 with spring clamp is available from Sigmatek with the article number 12-600-043.

Wiring instructions

The signals detected from the analogue module are very small in comparison with the digital signals. In order to guarantee trouble free functioning it is essential to stick to a meticulous wiring arrangement.

- The 0V supply voltage connection must follow the shortest path the common 0V terminal.
- The connecting wires to the analogue inputs must be as short as possible and avoid lying in parallel to wires carrying digital signals.
- The signal carrying wires should be double or triple pole screened, or at least twisted together.

General comments on the comparison measuring point

Temperature measurement with thermocouples is based on the temperature dependent voltage (Seebeck effect), which arises at every connection made from two conductors of different metals (alloys).

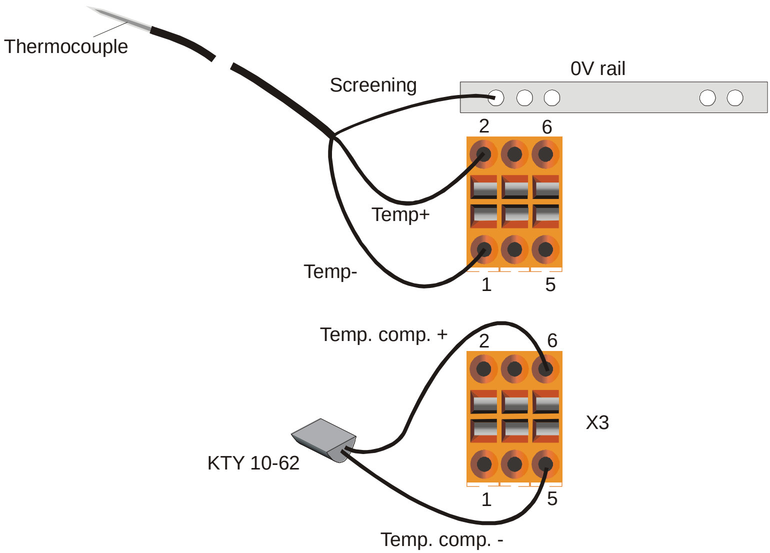
This voltage exists, therefore, not only at the point of measurement (where it is wanted) but also at the connection point between the thermocouple wires and copper (the connecting terminal). At this point the thermoelectric voltage is not desired, however it is unavoidable. (This voltage distorts the measured value by exactly the temperature of the terminal!)

An exact measurement is therefore only possible when the temperature of the terminal is measured and added to the measured voltage. All the switches necessary for this are integrated into the analogue card. The compensation is carried out directly by the electronics.

Thermocouples should, therefore, be lead directly (where necessary via compensating leads) to the connection socket on the analogue card.

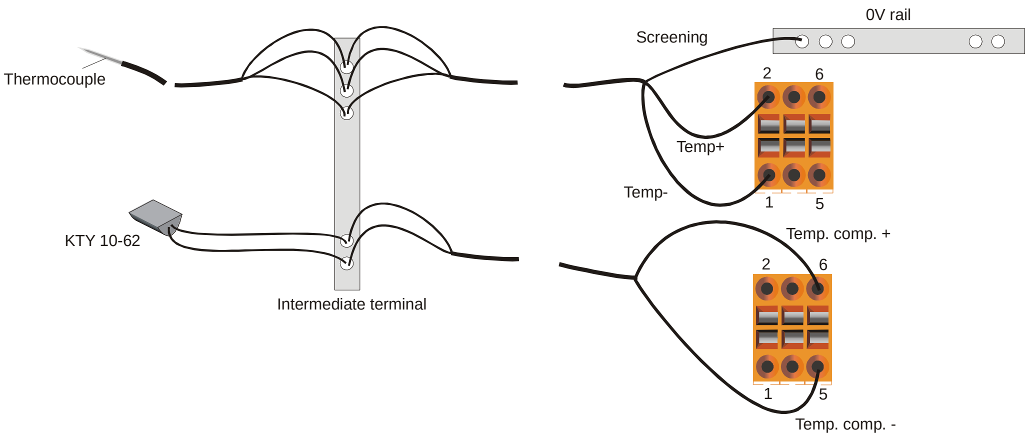
For thermocouple applications where the compensating lead is not led to the control, the comparison measurement must be carried out on the connecting terminal thermocouple (or compensating lead) and copper lead.

Direct connection of the thermocouples to the control



- If the sensor is electrically isolated, GND must be bridged with the temp- input to the terminal.
- With sensors that are not electrically isolated, a sufficiently sturdy earth lead must exist between the machine's earth and the 0V rail in the control box.
- The KTY 10-62 serves as the terminal voltage compensation.

Connection of the thermocouples via an intermediate terminal



- If the sensor is electrically isolated, GND must be bridged with the temp– input to the terminal.
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General comments on the digital outputs

All 8 outputs are supplied from a common +24V connection.

The cable cross-section of both the + 24V and the 0V supply has to be matched to the maximum output current being drawn from a group.

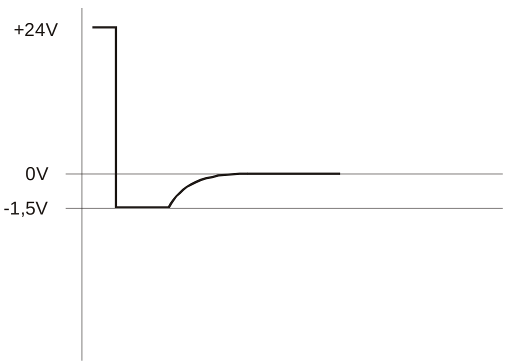
Caution!
If inductive loads are not protectively wired, when the load is disconnected high peak currents will flow through the 0V line, because the internal protective wiring directs the voltage peaks to 0V. With 0V cables, which are longer than permitted and too thin, this can lead to outputs on the module involved reacting in an undesired way.

Attention!
Si des charges inductives ne sont pas équipées d'un circuit de protection, au moment de la déconnection de la charge de forts courants s'écoulent à travers la ligne de 0V, car le circuit de protection interne dirige les pointes de tension vers 0V. Avec câbles 0V, d'une section trop faible et d'une longueur au-delà des spécifications, le module peut générer des signaux de sortie indésirables.

The outputs may be disconnected by disconnection of the +24V supply. The application of a voltage to an output, which exceeds the supply voltage by more than 0.7V, is not permitted.

All outputs are protectively wired to +24V internally. The disconnection of inductive loads is, as depicted in the diagram, limited to -1.5V. However, additional protective wiring to inductive loads is recommended (recovery diode), so that system malfunctioning through voltage peaks (inductive disturbance in analogue circuits) can be avoided.

Disconnection of inductive loads



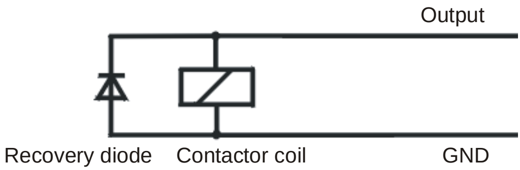
Wiring instructions for digital signals

The input filters, which suppress noise impulses, allow deployment in rough environmental conditions. In addition, to guarantee problem free operation, careful wiring is recommended.

Please pay attention to the following guidelines:

- Avoid laying the input cables parallel to the load circuits
- Protective wiring of all contactor coils (RC-networks or recovery diodes)
- Correct earthing

Connection of inductive loads



Status displays

LED no.	LED colour	Meaning
1	yellow	not used
2	yellow	not used
3	yellow	not used
4	yellow	not used
5	yellow	not used
6	yellow	not used
7	yellow	not used
8	yellow	not used
V+	red	not used
V+	red	not used

Addressing

Address	Access		Function
16#00	READ	WORD	Measured temperature value
16#02	READ	BYTE	Bit 0 : AD converter ready Bit 1 : EEPROM Data Output
16#06	READ	BYTE	Bit 0 : Surveillance +24V
16#00	WRITE	BYTE	Bit 0-2: Channel selection Temp. input 000 Channel 1 001 Channel 2 010 Channel 3 011 Channel 4 100 Channel 5 101 Channel 6 110 Channel 7 111 Channel 8 Bit 3 : 0 Bit 4 : 1 Bit 5 : 0 Bit 6 : 1 Bit 7 : 0
16#04	WRITE	BYTE	Transistor outputs 70mA, protected against short-circuiting Bit 0 : Output 1 Bit 1 : Output 2 Bit 2 : Output 3 Bit 3 : Output 4 Bit 4 : Output 5 Bit 5 : Output 6 Bit 6 : Output 7 Bit 7 : Output 8

For hardware matching, the matching values for offset, multiplier and divisor are determined at the factory. These values are saved in a serial EEPROM found in the module.

Data in EEPROM

Module data (organized byte-wise)

Address	Data	Description
$00	$xx	Check sum
$01	123	Identification
$02	5	Module group 5 = CAI
$03	9	Variant 9 = CAI887
$04	16	Number of channels
$05	$1x	Hardware version $10 = HW-V1.0, $11 = HW-V1.1, …
$10		Serial number

AI matching data (organized word-wise)

Address	Data	Description
$40	$xxxx	Check sum
$42	12345	Identification
$44	25	Length of the following data block in WORD
$46	$0808	Number of channels (8x TO and 8x AI)
$48	e.g. 0000	Offset for 0°C channel-1
$4A	e.g. 4000	Gain-Multiplicand channel-1
$4C	e.g. 4050	Gain-Divisor channel-1
$4E - $52	-	Matching values channel-2
$54 - $58	-	Matching values channel-3
$5A - $5E	-	Matching values channel-4
$60 - $64	-	Matching values channel-5
$66 - $6A	-	Matching values channel-6
$6C - $70	-	Matching values channel-7
$72 - $76	-	Matching values channel-8

Calculation of the analogue value read-in

e.g.: Offset 0000
Gain Multiplicand 4000
Gain Divisor 4050

Conversion formula for analogue inputs

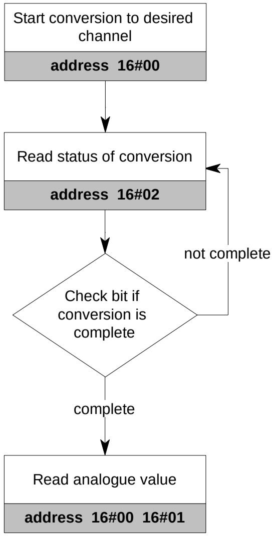
VALUE = (analogue input value + offset) * gain multiplicand / gain divisor

Example

e.g.: Value for 0°C: (0000+0000) * 4000 / 4050 =0000
Value for 600°C: (4050+0000) * 4000 / 4050 =4000

Operating diagram

Read-out of the analogue channel



Interpolation table for NiCrNi(k) temperature sensor DIN 43710

1/10 °C	BITS	mV
00000	0000	0,000
00310	200	1,245
00613	400	2,490
00913	600	3,735
01215	800	4,980
01522	1000	6,226
01833	1200	7,471
02145	1400	8,716
02453	1600	9,961
02758	1800	11,206
03058	2000	12,451
03358	2200	13,696
03655	2400	14,941
03951	2600	16,186
04245	2800	17,431
04539	3000	18,677
04831	3200	19,922
05124	3400	21,167
05416	3600	22,412
05708	3800	23,657
06000	4000	24,902