

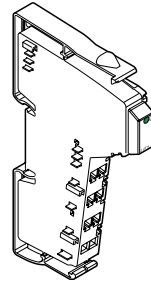
# VARIO UTH 2

## I/O Extension Module With Two Analog Input Channels for Measuring Temperature

User Manual

02/2003

57220001



This data sheet is only valid in association with the documents of the used fieldbus coupler

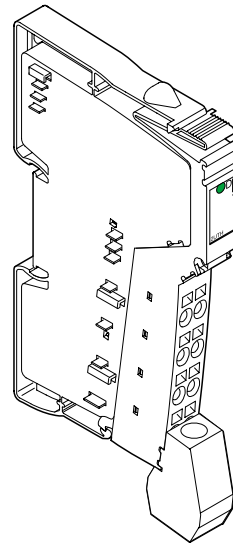
## Function

With this terminal you can measure signals from standard thermocouples.

13 different thermocouple types (according to DIN EN 60584-1 and DIN 43710) and a linear voltage input of - 15 mV to +85 mV are supported.

## Features

- Two differential inputs for thermocouples or linear voltage; one input for an external cold junction PT 1000 or Ni 1000
- Configuration of the channels via fieldbus
- Internal detection of the cold junction temperature (can be configured)
- Absolute or differential temperature measurement (can be configured)
- PT 1000 sensor close to the connection terminals of the thermocouple inputs for the internal detection of the cold junction temperature
- Measured values can be represented in three different formats



5722A013

Figure 1 VARIO UTH 2 terminal with the connector plugged in



All modules will be delivered including connectors and labeling fields

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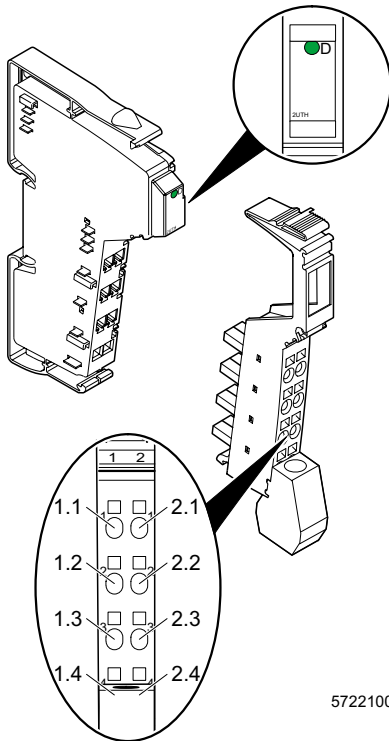
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Figure 2 VARIO UTH 2 terminal with the appropriate connector

**Local Diagnostic and Status Indicators**

Des.	Color	Meaning
D	Green	Bus diagnostics

**Terminal Assignment**

Terminal Points	Signal	Assignment
1.1, 2.1		Not used
1.2	TC+	Thermocouple (plus input) channel 2
2.2	TC-	Thermocouple (minus input) channel 2
1.3	TC+	Thermocouple (plus input) channel 1
2.3	TC-	Thermocouple (minus input) channel 1
1.4, 2.4	Shield	Shield connection (channels 1 and 2)

## Installation Instruction

High current flowing through the voltage jumpers  $U_M$  and  $U_S$  leads to a temperature rise of the voltage jumpers and the inside of the terminal. Note the following instruction to keep the current flowing through the voltage jumpers of the analog terminals as low as possible:



All of the analog terminals need a separate main circuit!

If this is not possible in your application and if you are using analog terminals in a main circuit together with other terminals, make sure you are placing the analog terminals after all the other terminals at the end of the main circuit.

Note with the VARIO UTH 2 terminal that any current flowing through the voltage jumpers falsifies the temperature of the internal cold junction. Therefore, position this terminal after **all** of the other terminals to keep the current flowing through **all** voltage jumpers as low as possible.

# Internal Circuit Diagram

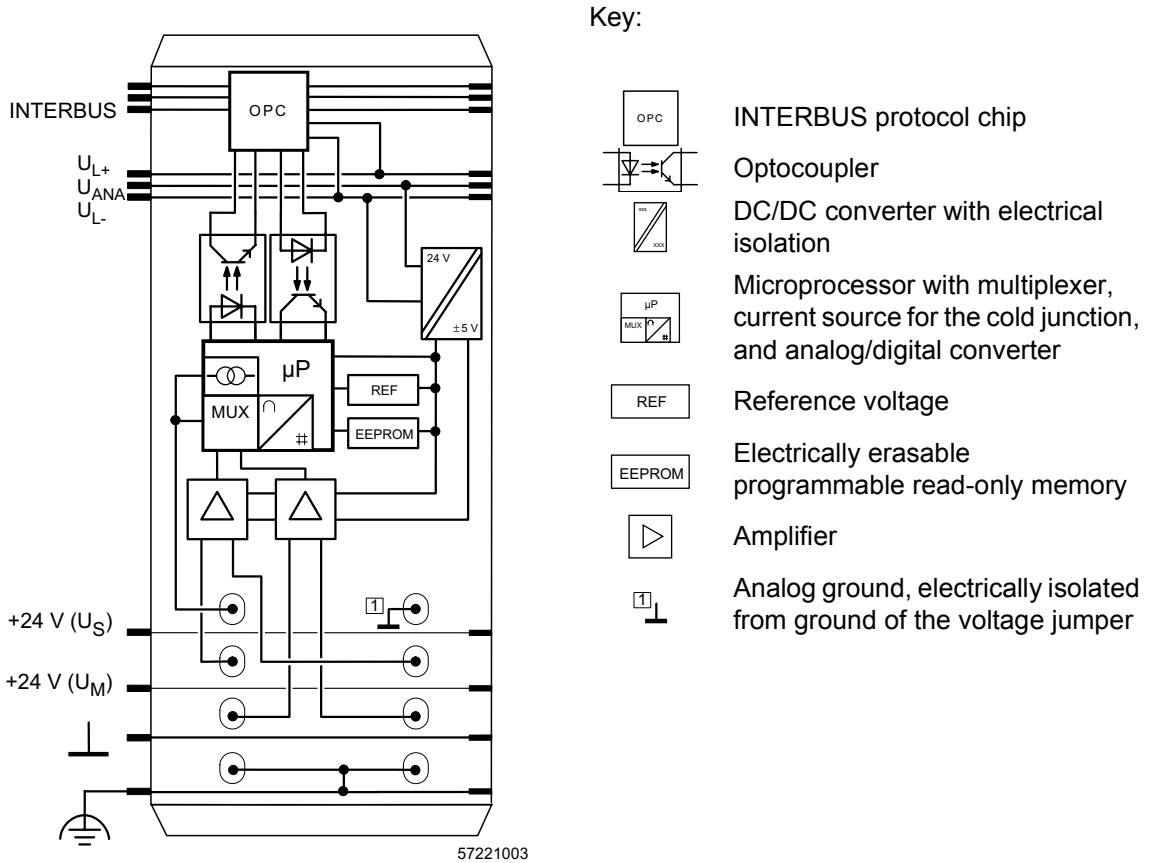


Figure 3 Internal wiring of the terminal points

## Electrical Isolation

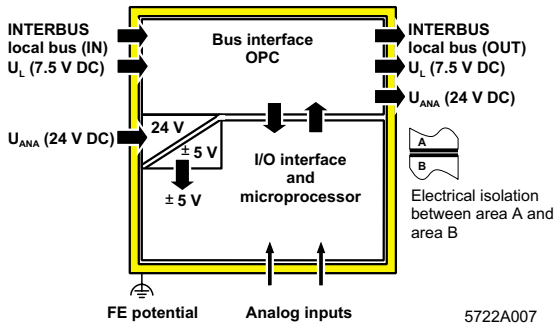


Figure 4 Electrical isolation of the function areas

## Connection Notes

### Connection of the Thermocouples



**Always** connect thermocouples using shielded, twisted-pair cables.  
Use encapsulated thermocouples (ungrounded junction) only!

### Connection of the Shield



The connection of the shield is shown in the examples (Figure 5 to Figure 7).

Connect the shield only at the the Inline terminal above the shield connector clamp. This prevents the creation of PE loops that could occur if both ends of the shield are connected to PE (protective earth ground). The clamp connects the shield directly to FE (functional earth ground) on the terminal side. Additional wiring is not necessary.

Insulate the shield at the sensor.

## Connection Examples



When connecting the shield at the terminal you must insulate the shield on the sensor side (shown in Figure 5 and Figure 6 [gray area]).

Use a connector with shield connection when installing the sensors. Figure 5 and Figure 6 shows the connection schematically (without shield connector).

### Absolute Temperature Measurement

### Differential Temperature Measurement

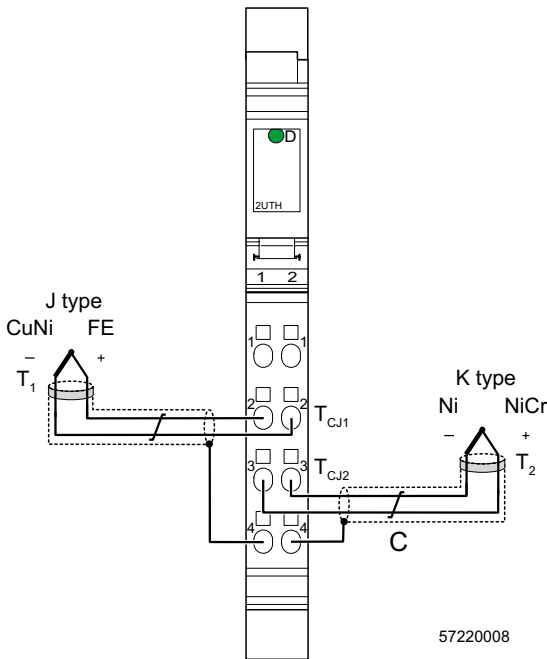


Figure 5 Absolute temperature measurement on two channels

With absolute temperature measurement the measuring temperature of  $T_1$  or  $T_2$  is detected through cold junction compensation ( $T_{CJ1}$ ,  $T_{CJ2}$ ).

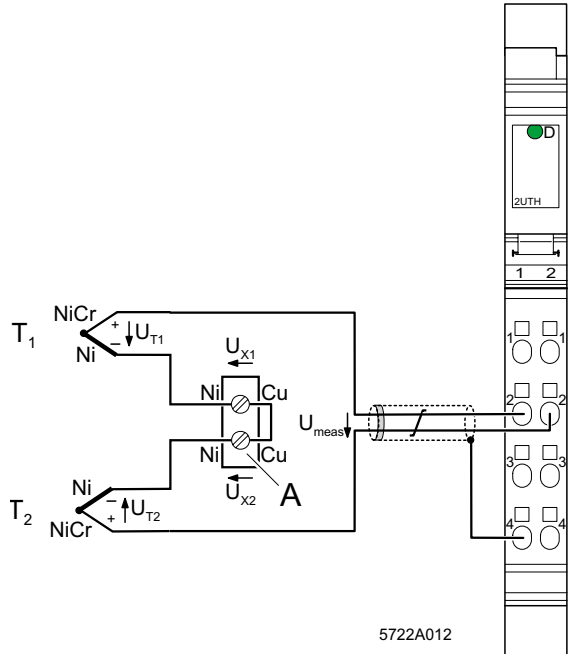


Figure 6 Differential temperature measurement with two thermocouples (K type)

$$U_{\text{meas}} = U_{T1} - U_{X1} + U_{X2} - U_{T2} = U_{T1} - U_{T2}$$

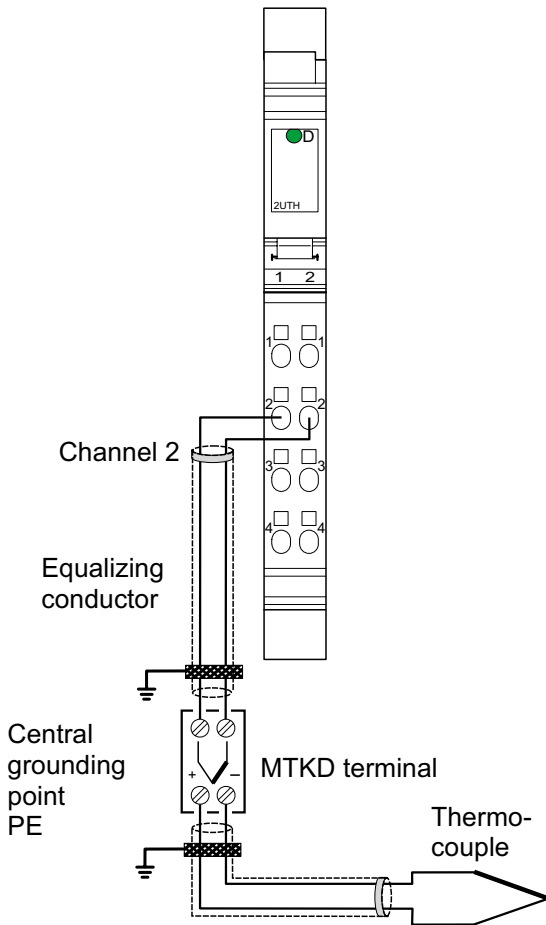
If the two terminal points (A) have the same temperature level the absolute values of  $U_{X1}$  and  $U_{X2}$  are identical. Both voltages cancel each other out. What remains is the difference between  $U_{T1}$  and  $U_{T2}$ .

**Extension of the Equalizing Conductor**



When connecting the shield at a central ground position you must insulate the shield on the opposite side (shown in Figure 7 [gray area]).

Use a connector with shield connection when installing the sensors. Figure 7 shows the connection schematically (without shield connector).



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Figure 7 Extension of the equalizing conductor using thermal element terminal blocks



## Programming Data

ID code	7F <sub>hex</sub> (127 <sub>dec</sub> )
Length code	02 <sub>hex</sub>
Process data channel	32 bits
Input address area	4 bytes
Output address area	4 bytes
Parameter channel (PCP)	0 bytes
Register length (bus)	4 bytes

## Process Data Words

### Output Data Words for the Configuration of the Terminal (see page 10)

"Word-bit" view	Word	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
"Byte-bit" view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Channel 1	Assignment	1	0	0	0	0	0	0	CJ	Reso- lution	Format	Sensor type					
Channel 2	Assignment	1	0	0	0	0	0	0	CJ	Reso- lution	Format	Sensor type					

### Assignment of the Terminal Points to the Input Data Word

"Word-bit" view	Word	Word x															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
"Byte-bit" view	Byte	Byte 0								Byte 1							
	Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Channel 2	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Channel 1	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

### OUT Process Data Output Words

You can configure the channels of the terminal with the two process data output words. The following configurations are possible for every channel independent of the other channel:

- Selection of a sensor type
- Setting the resolution
- Switchover of the formats of the measuring value representation
- Selection of the cold junction

The configuration setting is not saved. It must be transmitted in each fieldbus cycle.

After applying voltage (Power Up) to the Inline station, the message “Measured value invalid” (error code 8004<sub>hex</sub>) appears in the process data input words.

After 1 s (maximum) the preset configuration is accepted and the first measured value is available. If you change the configuration the corresponding channel is re-initialized. The message “Measured value invalid” (error code E8004<sub>hex</sub>) appears in the process data output words for 100 ms (maximum).

Default:

Sensor type:	TC type K
Resolution:	0.1°C (1μV)
Output format:	Format 1 (IB standard)
Cold junction:	Internal

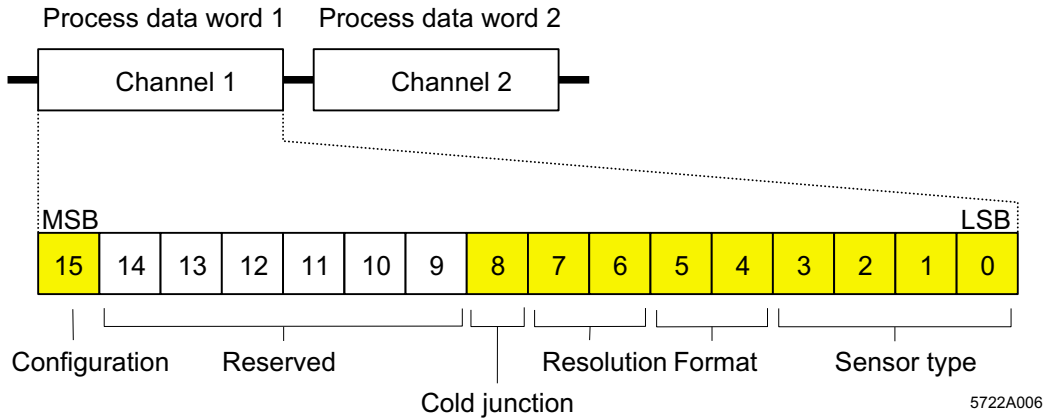


Figure 8 Process data output words



Set all reserved bits to 0.

One process data output word is available for the configuration of each channel.

You must set bit 15 of the corresponding output word to 1 to configure the terminal. If bit 15 = 0 the preset configuration is active.

Bit 15:

Code		Configuration
Dec.	Bin.	
0	0	Default
1	1	Configuration data

Bit 8:

Code		Cold Junction Compensation
Dec.	Bin.	
0	0	Internal
1	1	None

Bit 7 and bit 6:

Code		Resolution (refers to format 1 [IB standard])
Dec.	Bin.	
0	00	0.1°C (1 µV)
1	01	1°C (10 µV)
2	10	0.1°F
3	11	1°F

Bit 5 and bit 4:

Code		Format
Dec.	Bin.	
0	00	<b>Format 1: IB standard 15 bits + sign bit with extended diagnostics</b>
1	01	Format 2: 12 bits + sign bit + 3 diagnostic bits
2	10	Format 3: 15 bits + sign bit
3	11	Reserved

Bit 3 to bit 0:

Code		Sensor Type
Dec.	Bin.	
0	0000	<b>TC type K</b>
1	0001	TC type J
2	0010	TC type E
3	0011	TC type R
4	0100	TC type S
5	0101	TC type T
6	0110	TC type B
7	0111	TC type N

Code		Sensor Type
Dec.	Bin.	
8	1000	TC type U
9	1001	TC type L
10	1010	TC type C
11	1011	TC type W
12	1100	TC type HK
13	1101	Cold Junction (CJ)
14	1110	U: voltage (-15 mV to +85 mV)
15	1111	Reserved



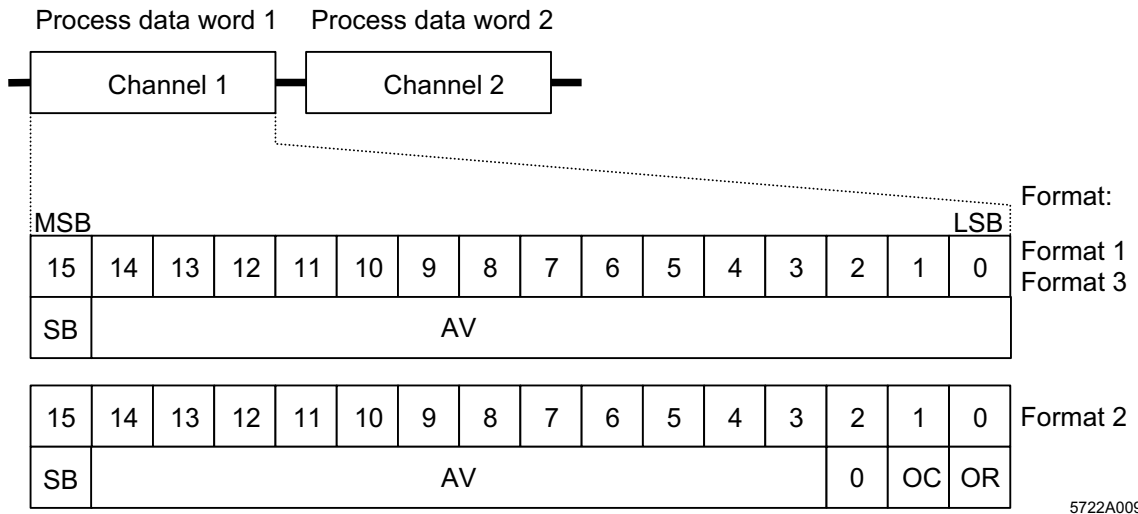
Use the IB standard format for the representation of the measured values of sensor type 14 (linear voltage).



When selecting the cold junction sensor type, the temperature of the cold junction (terminal temperature) is indicated in the input data word. The configured channel is not evaluated in the measuring cycle so that the update time for the terminal is reduced.

**Process Data Input Words**

The measured values are transmitted, per channel, through the process data input words to the controller board or the computer.



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Figure 9 Sequence of the process data input words and display of the bits of the first process data word in different formats

- SB Sign bit
- AV Analog value
- 0 Reserved
- OC Open circuit
- OR Over range

The process data format 1 (IB standard) supports extended diagnostics. The following error codes are possible:

Code (Hex)	Error
8001	Over range
8002	Open circuit
8004	Measured value invalid/no valid measured value available
8008	Cold junction defective
8010	Configuration invalid
8040	Terminal defective
8080	Under range



Sensor Type (Bit 3 to 0)		TC and CJ Sensor (0 to 13)	Linear Voltage (14)
Resolution (Bit 7 and 6)		$01_{\text{bin}} / 11_{\text{bin}}$	$01_{\text{bin}}$
Process Data <sub>hex</sub> (= Analog Value <sub>hex</sub> )	Analog Value <sub>dec</sub>	$1^{\circ}\text{C} / 1^{\circ}\text{F}$ ( $^{\circ}\text{C}$ ) / ( $^{\circ}\text{F}$ )	$10 \mu\text{V}$ ( $\mu\text{V}$ )
8002		<i>Open circuit</i>	–
8001		<i>Over range</i>	> 85000
2134	8500	–	85000
03E8	1000	1000	10000
0001	1	1	10
0000	0	0	0
FFFF	-1	-1	-10
FF9C	-100	-100	-1000
FA24	-1500	–	-15000
8080		<i>Under range</i>	< -15000



If the measured value is higher than the process data representation, the error code “Overrange or Underrange” is indicated.

The error message “Open circuit” is only indicated in TC operating mode.

**Format 2**

The measured value is represented in bits 14 to 3. The remaining 4 bits are: sign bit and error bit.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SB	AV											0	OC	OR	

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Figure 11 Measured value representation in format 2 (12 bits)

SB	Sign bit	OC	Open circuit
AV	Analog value	OR	Over range
0	Reserved		



## Typical Analog Values Depending on the Resolution

Sensor Type (Bit 3 to 0)		TC and CJ Sensor (0 to 13)	
Resolution (Bit 7 and 6)		00 <sub>bin</sub> / 10 <sub>bin</sub>	01 <sub>bin</sub> / 11 <sub>bin</sub>
Process Data <sub>hex</sub> (= Analog Value <sub>hex</sub> )	Analog Value <sub>dec</sub>	0.1°C / 0.1°F (°C) / (°F)	1°C / 1°F (°C) / (°F)
xxxx xxxx xxxx xxx1 <sub>bin</sub>		<i>Over range</i> (AV = positive final value from the table on page 21)	
2710	10000	1000	–
03E8	1000	100	1000
0008	8	0.8	8
0000	0	0	0
FFF8	-8	-0.8	-8
FC18	-1000	-100	–
xxxx xxxx xxxx xxx1 <sub>bin</sub>		<i>Under range</i> (AV = negative final value from the table on page 21)	
xxxx xxxx xxxx xxx1 <sub>bin</sub>		<i>Open circuit</i> (AV = negative final value from the table on page 21)	

AV Analog value X Can have the values 0 or 1

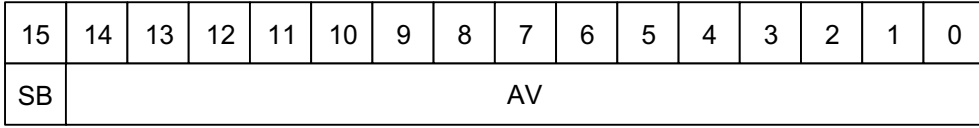


If the measured value is higher than the representation area of the process data, bit 0 is set to 1.

With an open circuit, bit 1 is set to 1.

**Format 3**

The measured value is represented in bits 14 to 0. An additional bit (bit 15) is available as a sign bit.



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Figure 12 Measured value representation in format 3 (15 bits)

SB      Sign bit    AV      Analog value

## Typical Analog Values Depending on the Resolution

Sensor Type (Bit 3 to 0)		TC and CJ Sensor (0 to 13)
Resolution (Bit 7 and 6)		$00_{bin} / 10_{bin}$
Process Data <sub>hex</sub> (= Analog Value <sub>hex</sub> )	Analog Value <sub>dec</sub>	$0.1^{\circ}\text{C} / 0.1^{\circ}\text{F}$ ( $^{\circ}\text{C}$ ) / ( $^{\circ}\text{F}$ )
<i>Upper limit value* +1 LSB</i>		<i>Over range</i>
7D00	32000	–
2710	10000	1000.0
000A	10	1
0001	1	0.1
0000	0	0
FFFF	-1	-0.1
FC18	-1000	-100.0
B500	-19200	–
<i>Lower limit value* -1 LSB</i>		<i>Under range</i>
<i>Lower limit value* -2 LSB</i>		<i>Open circuit</i>

Sensor Type (Bit 3 to 0)		TC and CJ Sensor (0 to 13)
Resolution (Bit 7 and 6)		$01_{bin} / 11_{bin}$
Process Data <sub>hex</sub> (= Analog Value <sub>hex</sub> )	Analog Value <sub>dec</sub>	$1^{\circ}\text{C} / 1^{\circ}\text{F}$ ( $^{\circ}\text{C}$ ) / ( $^{\circ}\text{F}$ )
<i>Upper limit value* +1 LSB</i>		<i>Over range</i>
6400	25600	–
03E8	1000	1000
0001	1	1
0000	0	0
FFFF	-1	-1
FF9C	-100	-100
ED40	-4800	–
<i>Lower limit value* -1 LSB</i>		<i>Under range</i>
<i>Lower limit value* -2 LSB</i>		<i>Open circuit</i>

\* For the limit values refer to the table on page 21

## Measuring Ranges

### Measuring Ranges Depending on the Resolution (Format 1 [IB Standard] and Format 3)

Resolution (Bit 7 and 6)	Thermocouples	Linear Voltage Sensor
00	-273°C to +3276.8°C Resolution: 0.1°C	-15 mV to +32.7768 mV Resolution: 1 µV
01	-273°C to +32768°C Resolution: 1.0°C	-15 mV to +85 mV Resolution: 10 µV
10	-459°F to +3276.8°F Resolution: 0.1°F	
11	-459°F to +32768°F Resolution: 1.0°F	

### Measuring Ranges Depending on the Resolution (Format 2)

Resolution (Bit 7 and 6)	Thermocouples
00	-272.8°C to +3276.0°C Resolution: 0.8°C
01	-272°C to +32760°C Resolution: 8°C
10	-459.2°F to +3276°F Resolution: 0.8°F
11	-456°F to +32760°F Resolution: 8°F

Temperature values can be converted from °C to °F with this formula:

$$T [^{\circ}\text{F}] = T [^{\circ}\text{C}] \times \frac{9}{5} + 32$$

With:

- T [°F]    Temperature in degrees Fahrenheit
- T [°C]    Temperature in degrees Celsius

## Input Measuring Ranges

No.	Input	Sensor Type	Standard	Measuring Range (Supported Software)	
				Lower Limit	Upper Limit
1	Thermocouples	B	EN 60584-1	+50°C +122°F	+1820°C +3308°F
2		E		-270°C -454°F	+1000°C +1832°F
3		J		-210°C -346°F	+1200°C +2192°F
4		K		-270°C -454°F	+1372°C +2501°F
5		N		-270°C -454°F	+1300°C +2372°F
6		R		-50°C -58°F	+1768°C +3214°F
7		S		-50°C -58°F	+1768°C +3214°F
8		T		-270°C -454°F	+400°C +752°F
9		C		-18°C 0°F	+2316°C +4200°F
10		W		-18°C 0°F	+2316°C +4200°F
11		HK		-200°C -328°F	+800°C +1472°F
12		L	DIN 43710	-200°C -328°F	+900°C +1652°F
13		U		-200°C -328°F	+600°C +1112°F
14	Internal cold junction	PT1000	DIN IEC 60751	-200°C	+850°C
15	Voltage input	Linear voltage signal		-15 mV	+85 mV



With underrange or overrange of the indicated limits in format 1 "IB Standard" the error message "Overrange" is generated.

## Tolerances

Tolerances at an Ambient Temperature of  $T_A = +25^\circ\text{C}$

No.	Input	Sensor Type	Measuring Range for the Tolerance Indication*	Relative Error	Absolute Error	Relative Error, Maximum	Absolute Error, Maximum
1	Thermo-couples	B	+500°C to +1820°C* +932°F to +3308°F	±0.23%	±4.20 K	±0.92%	±16.7 K
2		E	-226°C to +1000°C* -374.8°F to +1832°F	±0.04%	±0.4 K	±0.15%	±1.6 K
3		J	-210°C to +1200°C -346°F to +2192°F	±0.04%	±0.5 K	±0.15%	±1.9 K
4		K	-200°C to +1372°C* -328°F to +2501°F	±0.04%	±0.6 K	±0.17%	±2.4 K
5		N	-200°C to +1300°C* -328°F to +2372°F	±0.07%	±1.0 K	±0.29%	±3.7 K
6		R	-50°C to +1768°C -508°F to +3214°F	±0.14%	±2.5 K	±0.57%	±10.0 K
7		S	-50°C to +1768°C -58°F to +3214°F	±0.14%	±2.5 K	±0.57%	±10.0 K
8		T	-270°C to +400°C -454°F to +752°F	±0.16%	±0.7 K	±0.63%	±2.5 K
9		C	-18°C to +2316°C 0°F to +4200°F	±0.07%	±1.7 K	±0.29%	±6.7 K
10		W	-18°C to +2316°C 0°F to +4200°F	±0.09%	±2.1 K	±0.36%	±8.4 K
11		HK	-200°C to +800°C -328°F to 1472°F	±0.05%	±0.4 K	±0.18%	±1.5 K
12		L	-200°C to +900°C -328°F to +1652°F	±0.05%	±0.5 K	±0.21%	±1.9 K
13		U	-200°C to +600°C -328°F to +1112°F	±0.11%	±0.7 K	±0.42%	±2.5 K
14	Internal reference junction	PT 1000	-25°C to +85°C	±0.04%	±0.3 K	±0.22%	±1.9 K
15	Voltage input	Linear signals	-15 mV to +85 mV	±0.03%	±25 µV	±0.12%	±100 µV



All percentage data refers to the corresponding final value of the measuring range.

\* Below the indicated range, more errors are expected because of the low sensitivity of the sensor elements.

The tolerance values of the TC sensors refer to a differential temperature measurement without cold junction compensation. The tolerances of the sensor element and the cold junction (see table on page 25) must also be considered.

Tolerances at an Ambient Temperature of  $T_A = -25^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$ 

No.	Input	Sensor Type	Measuring Range for the Tolerance Indication*	Relative Error	Absolute Error	Relative Error, Maximum	Absolute Error, Maximum
1	Thermo-couples	B	+500°C to +1820°C* +932°F to +3308°F	±0.55%	±10.0 K	±1.37%	±25.0 K
2		E	-226°C to +1000°C* -374.8°F to +1832°F	±0.09%	±0.9 K	±0.23%	±2.3 K
3		J	-210°C to +1200°C -346°F to +2192°F	±0.09%	±1.1 K	±0.23%	±2.8 K
4		K	-200°C to +1372°C* -328°F to +2501°F	±0.10%	±1.4 K	±0.26%	±3.6 K
5		N	-200°C to +1300°C* -328°F to +2372°F	±0.17%	±2.2 K	±0.43%	±5.6 K
6		R	-50°C to +1768°C -58°F to +3214°F	±0.34%	±6.0 K	±0.85%	±15.0 K
7		S	-50°C to +1768°C -58°F to +3214°F	±0.34%	±6.0 K	±0.85%	±15.0 K
8		T	-270°C to +400°C -454°F to +752°F	±0.38%	±1.5 K	±0.95%	±3.8 K
9		C	-18°C to +2316°C 0°F to +4200°F	±0.17%	±4.0 K	±0.43%	±10.0 K
10		W	-18°C to +2316°C 0°F to +4200°F	±0.22%	±5.0 K	±0.54%	±12.5 K
11		HK	-200°C to +800°C -328°F to 1472°F	±0.11%	±0.9 K	±0.28%	±2.2 K
12		L	-200°C to +900°C -328°F to +1652°F	±0.12%	±1.1 K	±0.31%	±2.8 K
13		U	-200°C to +600°C -328°F to +1112°F	±0.25%	±1.5 K	±0.63%	±3.8 K
14	Internal cold junction	PT 1000	-25°C to +85°C	±0.05%	±0.4 K	±0.24%	±2.0 K
15	Voltage input	Linear signals	-15 mV to +85 mV	±0.07%	±60 µV	±0.18%	±150 µV





All percentage data refers to the corresponding final value of the measuring range.

\* Below the indicated range, more errors are expected because of the low sensitivity of the sensor elements.

The tolerance values of the TC sensors refer to a differential temperature measurement without cold junction compensation. The tolerances of the sensor element and the cold junction (see table on page 25) must also be considered.

### Temperature Response

No.	Input	Sensor Type	Measuring Range for the Tolerances	Typical Drift	Maximum Drift
15	Voltage input	Linear signals	-15 mV to +85 mV	15 ppm/K	35 ppm/K

### Tolerances of the Internal Cold Junction

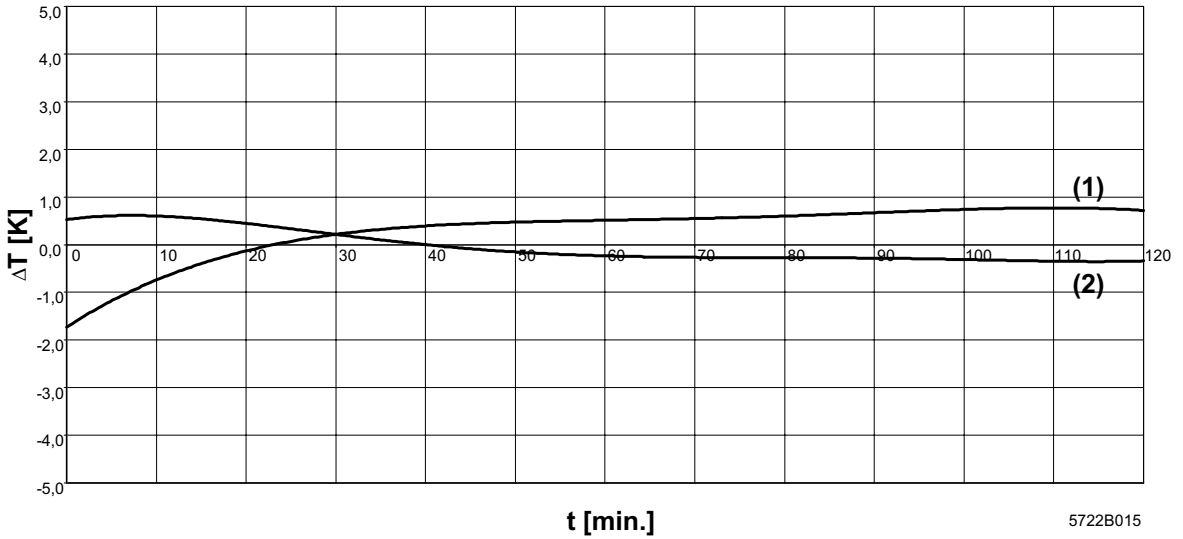
Operation at an ambient temperature of  $T_A = -25^\circ\text{C}$  to  $+55^\circ\text{C}$  ( $-13^\circ\text{F}$  to  $131^\circ\text{F}$ )

No.	Error Type	Typical	Maximum
1	Sensore tolerance PT 1000 ( $T_A = 25^\circ\text{C}$ [ $77^\circ\text{F}$ ])	$\pm 0.2$ K	$\pm 0.43$ K
2	Error caused by temperature distribution (channel 1 and channel 2)	–	–
3	Linearity error because of linearization	$\pm 0.01$ K	$\pm 0.01$ K
4	<b>Total error of the cold junction at <math>T_A = 25^\circ\text{C}</math> (<math>77^\circ\text{F}</math>)</b>	<b><math>\pm 0.3</math> K</b>	<b><math>\pm 1.9</math> K</b>
5	<b>Total error of the cold junction at <math>T_A = -25^\circ\text{C}</math> to <math>+55^\circ\text{C}</math> (<math>-13^\circ\text{F}</math> to <math>131^\circ\text{F}</math>)</b>	<b><math>\pm 0.4</math> K</b>	<b><math>\pm 2.0</math> K</b>



After applying the supply voltage, the warm up time lasts approximately 30 minutes. Directly after startup the tolerances of the cold junction can be increased by the typical tolerance.

The curve that represents the transient response is shown in Figure 13.



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Figure 13 Transient reaction of the VARIO UTH 2 terminal

t [min.] Time after switching power on (in minutes)

ΔT [K] Temperature deviation from the measured value in Kelvin (absolute error)  
 The total system error shown in Figure 13 at absolute temperature measurement consists of sensor tolerance, device error, and cold junction error.

(1) Curve for channel 1

(2) Curve for channel 2

## Tolerances Because of Linearization

No.	Input	Sensor Type	Standard	Measuring Range (Software Supported)	Maximum Error Because of Sensor Linearization
1	Thermocouples	B	EN 60584-1	+50°C to +1820°C +122°F to +3308°F	±0.05 K
2		E		-270°C to +1000°C -454°F to +1832°F	±0.05 K
3		J		-210°C to +1200°C -346°F to +2192°F	±0.05 K
4		K		-270°C to +1372°C -454°F to +2501°F	±0.05 K
5		N		-270°C to +1300°C -454°F to +2372°F	±0.05 K
6		R		-50°C to +1768°C -58°F to +3214°F	±0.05 K
7		S		-50°C to +1768°C -58°F to +3214°F	±0.05 K
8		T		-270°C to +400°C -454°F to +752°F	±0.05 K
9		C		-18°C to +2316°C 0°F to +4200°F	±0.1 K
10		W		-18°C to +2316°C 0°F to +4200°F	±0.1 K
11		HK		-200°C to +800°C -328°F to 1472°F	±0.1 K
12		L	DIN 43710	-200°C to +900°C -328°F to 1652°F	±0.05 K
13		U		-200°C to 600°C -328°F to 1112°F	±0.05 K
14	Internal cold junction	PT 1000		-200°C to +850°C -328°F to +1562°F	±0.01 K
15	Voltage input	Linear signals		–	–

**Additional Tolerances Influenced by EMI (Electromagnetic Interference)**

Type of Electromagnetic Interference	Typical, Relative Deviation of the Measuring Range Final Value	Criterion
Electromagnetic fields according to IEC 61000-4-3; EN 61000-4-3; field strength 10 V/m	Channel 1: $\pm 9.6\%$ Channel 2: $\pm 5.0\%$	A
Conducted interference (0.15 MHz to 80 MHz) according to IEC 61000-4-6; EN 61000-4-6, Class 3 (10 V)	Channel 1: $\pm 4.2\%$ Channel 2: $\pm 2.5\%$	A
Fast transients according to IEC 61000-4-4; EN 61000-4-4; 2 kV; Class 3	–	B
Surge voltage according to IEC 61000-4-5; EN 61000-4-5	–	B
Electrostatic discharge (ESD) according to IEC 61000-4-2; EN 61000-4-2 (6 kV contact / 6 kV air discharge)	–	B



Additional tolerances can occur with EMI. The values refer to default operation (TC type K with cold junction compensation).

**Process Data Update Time**



(Module response time for outputting the required channel address with the corresponding measured value)

Action	Time	Number of local bus Cycles
Refreshing the measured value in the process data keeping the process data output word (e.g., PD-OUT = $0000_{hex}$ )	< 30 ms	= time/cycle time



The time includes the response time of the electronics module up to the point at which valid values are available in the process data output words.

## Technical Data

General	
Housing dimensions (width x height x depth)	12.2 mm x 120 mm x 71.5 mm (0.480 in. x 4.724 in. x 2.795 in.)
Weight	46 g (without connector)
Operating mode	Process data operation with 2 words
Connection type of the sensors	2-wire technology
Permissible temperature (operation)	-25°C to +55°C (-13°F to +131°F)
Permissible temperature (storage/transport)	-25°C to +85°C (-13°F to +185°F)
Permissible humidity (operation)	75% on average, 85% occasionally (no condensation)
 Ranging from -25°C to +55°C (-13°F to +131°F) appropriate measures against increased humidity (> 85%) must be taken.	
Permissible humidity (storage/transport)	75% on average, 85% occasionally (no condensation)
 For a short period, slight condensation may appear on the housing if, for example, the terminal is brought into a closed room from a vehicle.	
Permissible air pressure (operation)	80 kPa to 106 kPa (up to 2000 m [6562 ft.] above sea level)
Permissible air pressure (storage/transport)	70 kPa to 106 kPa (up to 3000 m [9843 ft.] above sea level)
Degree of protection	IP 20 according to IEC 60529
Class of protection	Class 3 according to VDE 0106, IEC 60536

Interface	
local bus interface	Data routing

Power Consumption	
Communications power $U_L$	7.5 V
Current consumption from $U_L$	43 mA, typical
I/O supply voltage $U_{ANA}$	24 V DC
Current consumption from $U_{ANA}$	11 mA, typical
Total power consumption	590 mW, typical

**Supply of the Module Electronics and I/O Through Bus Terminal / Power Terminal**

Connection method	Potential routing
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**Analog Inputs**

Number	2 inputs for thermocouples or linear voltage
Connection of the signals	2-wire, shielded equalizing conductor for TC with encapsulated sensors
Cable length	Shorter than 30 m (94.425 ft.) with shielded cables
Sensor types that can be used	B, C, E, J, K, L, N, R, S, T, U, W, HK
Standards for characteristic curves	DIN EN 60584-1: 1995 (B, E, J, K, N, R, S, T) EN 43710 (U, L)
Voltage input range	-15 mV to +85 mV
Temperature measuring unit	Celsius, Fahrenheit, or $\mu$ V scale
Temperature measuring range	See table on page 21
Resolution in the process data word (quantization)	Configurable, see table on page 11
Resolution of the measured values	See table on page 20
Measured value representation	In the formats Format 1 (IB standard) (15 bits with sign bit) Format 2 (12 bits with sign bit) Format 3 (15 bits with sign bit)
Conversion method of the analog/digital converter	Successive approximation
Conversion time of the analog/digital converter	120 $\mu$ s, typical
Process data update	30 ms for both channels, maximum
Limit frequency of the analog filter	48 Hz

**Safety Devices**

Surge voltage resistant up to $\pm 40$ V	TC channels: Terminations 1.2 and 2.2; 1.3 and 2.3
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**Electrical Isolation**

For the electrical isolation between logic level and I/O area it is necessary to provide the bus terminal supply  $U_{BK}$  and the I/O supply ( $U_M/U_S$ ) from separate power supplies. Interconnection of power supply units in the 24 V range is not allowed!

**Common potentials**

24 V main supply  $U_M$ , 24 V segment voltage  $U_S$ , and GND have the same potential. FE (functional earth ground) is a separate potential area.

**Separate system potentials consisting of bus terminal/power terminal and analog I/O terminal**

- Test distance	- Test voltage
5 V supply incoming remote bus / 7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min
5 V supply outgoing remote bus / 7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min
7.5 V supply (bus logic) / 24 V supply (I/O)	500 V AC, 50 Hz, 1 min
7.5 V supply (bus logic) / 24 V analog supply (analog I/O)	500 V AC, 50 Hz, 1 min
24 V supply (I/O) / functional earth ground	500 V AC, 50 Hz, 1 min
24 V analog supply (analog I/O) / functional earth ground	500 V AC, 50 Hz, 1 min

**Error Messages to the Higher-Level Control or Computer System**

Failure of the internal voltage supply	Yes
Failure or dropping of communications power $U_L$	Yes, I/O error message to the bus terminal
I/O error/user error	Yes, error message through the process data input words

## Ordering Data

Description	Order Designation	Order No.
Terminal with 2 analog input channels for the connection of thermocouples with connector and labeling field	VARIO UTH 2	KSVC-103-00421

PMA Prozess- und Maschinen-Automation  
GmbH  
Miramstrasse 87  
34123 Kassel  
Germany



+49 - (0)561 505 - 1307



+49 - (0)561 505 - 1710



[www.pma-online.de](http://www.pma-online.de)