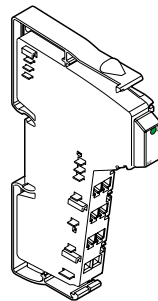


# VARIO AI 2/SF



## I/O Extension Module With Two Analog Input Channels



User Manual

02/2003

5564A001



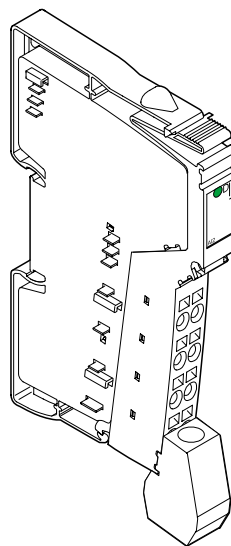
This data sheet is only valid in association with the documents of the used fieldbus coupler

## Function

This terminal is used to measure analog voltage or current signals. It is designed for use within an VARIO station.

## Features

- Two analog single-ended signal inputs for the connection of either voltage or current signals
- Connection of 2- and 3-wire sensors
- Three current measuring ranges:  
0 mA to 20 mA,  $\pm 20$  mA, 4 mA to 20 mA
- Two voltage measuring ranges:  
0 V to 10 V,  $\pm 10$  V
- Configuration of the independent channels through the field-bus
- Measured values can be represented in four different formats
- Resolution independent of the representation format and the measuring range
- Process data update of both channels in 1.5 ms, maximum
- Diagnostic indicators



5564A010

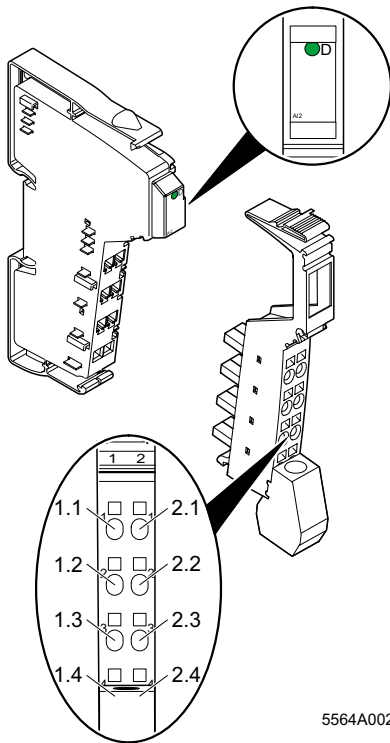
Figure 1 VARIO AI 2/SF terminal with the connector plugged in



All modules will be delivered including connectors and labeling fields

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5564A002

Figure 2 VARIO AI 2/SF terminal with an appropriate connector

### Local Diagnostic and Status Indicators

Des.	Color	Meaning
D	Green	Bus diagnostics

### Terminal Assignment

Terminal Points	Signal	Assignment
1.1	+U1	Voltage input channel 1
2.1	+U2	Voltage input channel 2
1.2	+I1	Current input channel 1
2.2	+I2	Current input channel 2
1.3	-1	Return for channel 1 (common for current and voltage)
2.3	-2	Return for channel 2 (common for current and voltage)
1.4, 2.4	Shield	Shield connection

## Installation Instruction

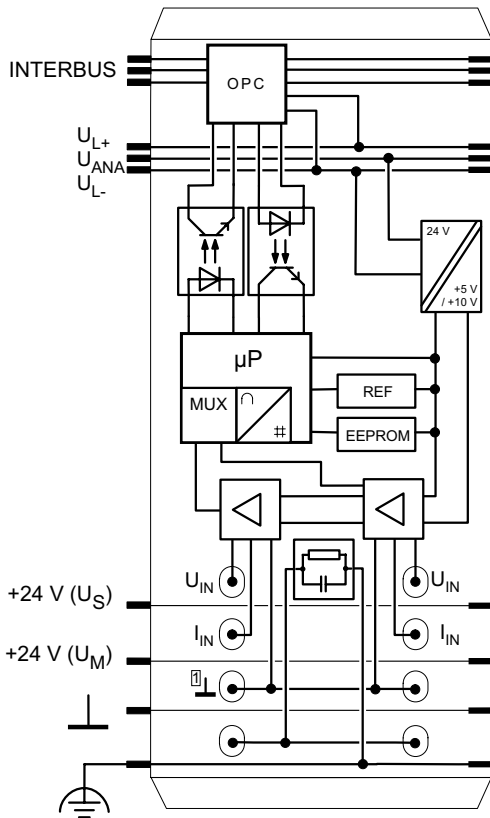
High current flowing through the potential jumpers  $U_M$  and  $U_S$  raises the temperature of the potential jumpers and at the inside of the terminal. Note the following instruction to keep the current flowing through the potential jumpers of the analog terminals as low as possible:



All of the analog terminals need a separate main circuit!

If this is not possible in your application and if you use analog terminals in a main circuit together with other terminals, place the analog terminals behind all the other terminals at the end of the main circuit.

# Internal Circuit Diagram



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**Key:**









-  INTERBUS protocol chip
-  Optocoupler
-  DC/DC converter with electrical isolation
-  Microprocessor with multiplexer and analog/digital converter
-  Reference voltage
-  Electrically erasable programmable read-only memory
-  Amplifier
-  Coupling network

Figure 3 Internal wiring of the terminal points

## Electrical Isolation

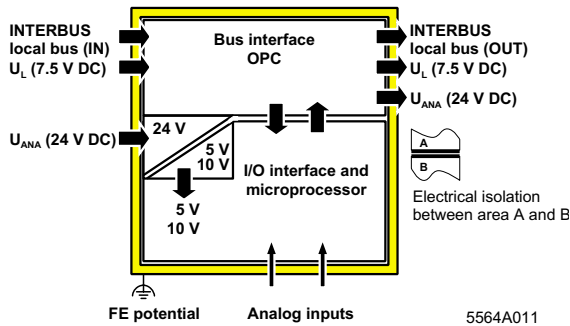


Figure 4 Electrical isolation of the function areas

## Connection



Do not connect voltages above  $\pm 5\text{ V}$  to a current input. This damages the module electronics as the permissible maximum current of  $\pm 100\text{ mA}$  is exceeded.



**Always** connect sensors using shielded, twisted-pair cables.

Connect the shielding of the terminal above the shield connector clamp. With the clamp, the shield is connected with a high-resistance and capacitance to FE on the module side. Additional wiring is not necessary.

Connect the shielding of the sensor with PE potential.

## Connection Examples



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

### Connection of Active Sensors

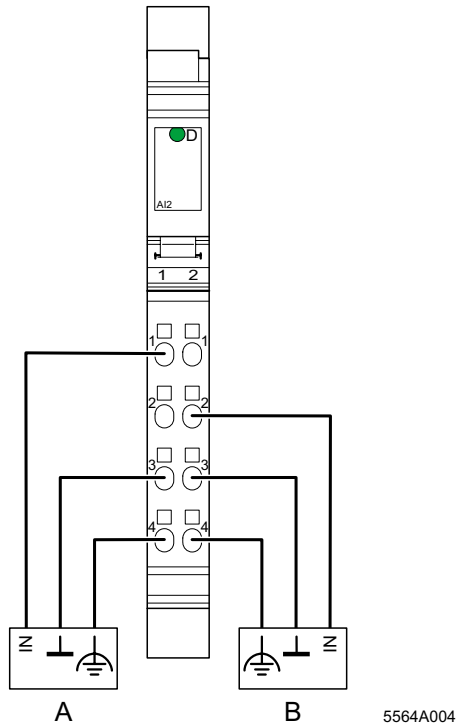


Figure 5 Connection of active sensors with 2-wire technology with shield connection

- A Active sensor with voltage output (channel 1)
- B Active sensor with current output (channel 2)

### Connection of Passive Sensors

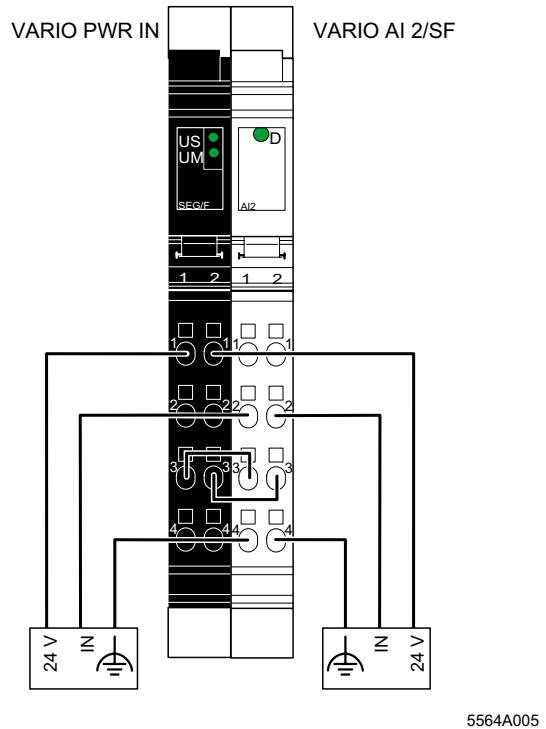


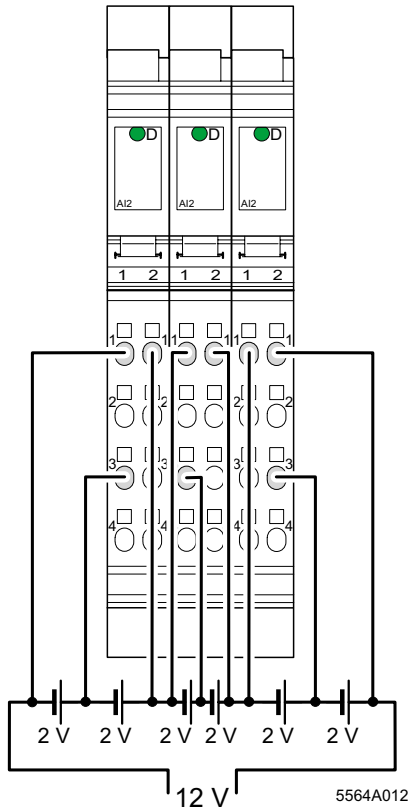
Figure 6 Connection of two passive sensors with 2-wire technology with shield connection

Figure 6 shows the passive sensor supply. The sensors are supplied through a preconnected segment terminal with a fuse. The sensors can also be supplied from an external power supply.

## Connection for Battery Monitoring



Both reference inputs (minus inputs) of each VARIO AI 2/SF terminal are connected with each other. If signal sources are connected in series, wrong connections can lead to a short circuit of individual signal sources.



Because of the single-ended inputs, the following connections are necessary:

- Connect the reference input of a terminal between two voltage sources.
- Channel 1 measures with opposite polarity the first voltage source. The measured value must be adapted in the control system to the polarity.

Channel 2 measures with correct polarity the second voltage source.

Configure the terminal to bipolar ( $\pm 10$  V).

Figure 7 Connection for battery monitoring

## Programming Data

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



## Process Data Words

### Process Data Output Word for the Configuration of the Terminal (compare page 11)

"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	Filter	0	0	Format	Measuring range					
Channel 2	Assignment	1	0	0	0	0	0	Filter	0	0	Format	Measuring range					

### Assignment of the Terminal Points to the Process Data Input Words (compare page 12)

"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	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		Terminal point 1.1: Voltage input Terminal point 1.2: Current input															
	Signal reference	Terminal point 1.3															
	Shield (FE)	Terminal point 1.4															
Channel 2	Signal	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
		Terminal point 2.1: Voltage input Terminal point 2.2: Current input															
	Signal reference	Terminal point 2.3															
	Shield	Terminal point 2.4															

## Process Data Output Words

With the two process data output words you can configure each channel of the terminal independently. The following configurations are possible:

- Selecting a measuring range according to the input signal
- Switching off averaging function
- Switchover of the formats of the measuring value representation

The configuration setting is not saved. It must be transmitted in each communication 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 input words for 100 ms (maximum).

Default:

Measuring range:	0 to 10 V
Averaging:	Switched on
Output format:	IL format



You cannot change the signal input type through the process data output words. Current or voltage measurement is selected by applying the measured signal to the current or voltage input.

In addition, select the corresponding measuring range through the process data output words.



Do not simultaneously apply current and voltage signals to an input channel as you will not receive valid measured values.

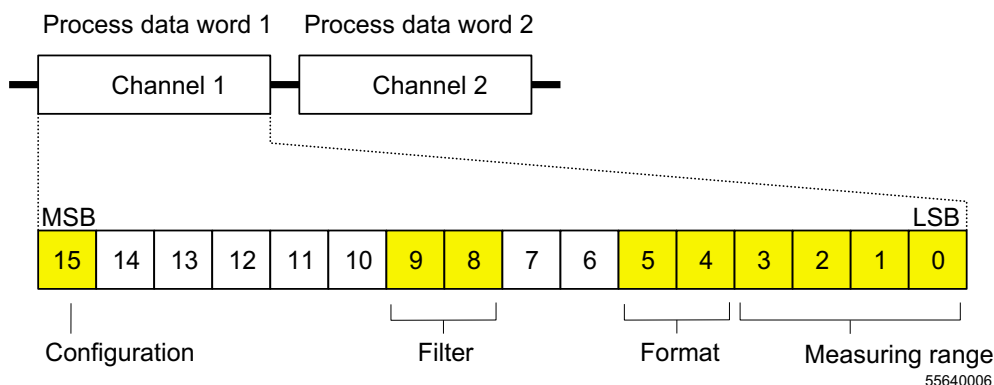


Figure 8    Process data output words

MSB    Most Significant Bit

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 9 and bit 8:

Code	Filter
00	16-fold average (default)
01	No filter
10, 11	Reserved

LSB    Least Significant Bit

Bit 15:

Code	Configuration
0	Default
1	Configuration data

Bit 5 and bit 4:

Code	Format
00	IB IL (15 bits) (default)
01	IB ST (12 bits)
10	IB RT (15 bits)
11	Standardized representation

Bit 3 to bit 0:

Code	Measuring Range (Voltage)
0000	0 V to 10 V (default)
0001	±10 V
0010 to 0111	Reserved

Code	Measuring Range (Current)
1000	0 mA to 20 mA
1001	±20 mA
1010	4 mA to 20 mA
1011 to 1111	Reserved



Set all reserved bits to 0.

**Process Data Input Words**

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

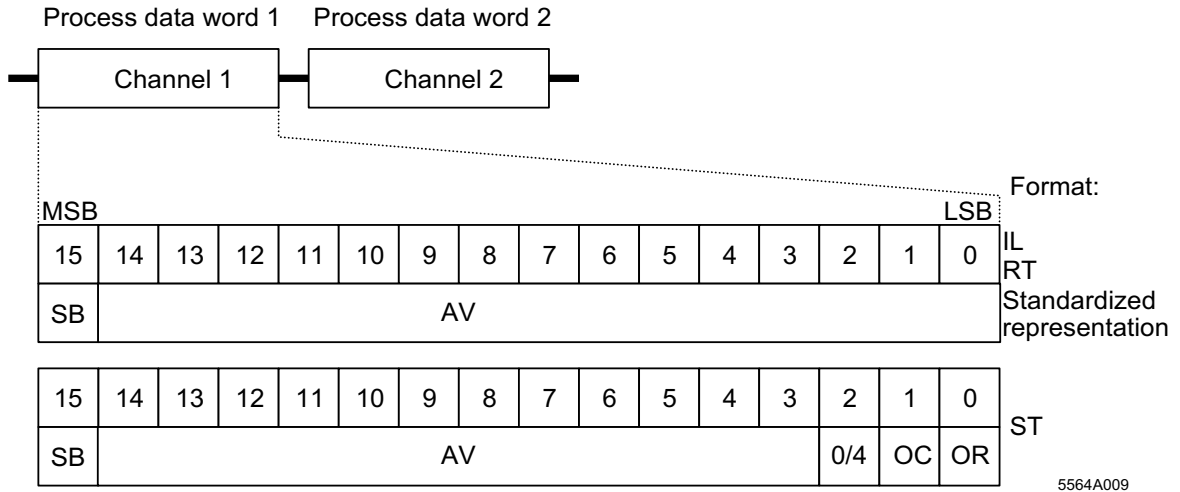


Figure 9 Sequence of the process data input words in the INTERBUS ring and representation of the bits of the first process data word in different formats

- |     |                            |     |                       |
|-----|----------------------------|-----|-----------------------|
| SB  | Sign bit                   | OC  | Open circuit          |
| AV  | Analog value               | OR  | Over range            |
| 0/4 | Measuring range 4 to 20 mA |     |                       |
| MSB | Most Significant Bit       | LSB | Least Significant Bit |

The process data formats "IB IL" and "Standardized representation" support 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
8010	Configuration invalid
8040	Terminal defective
8080	Under range



Measuring range -20 mA to +20 mA / -10 V to +10 V

Input Data Word (Two's Complement)		-20 mA to +20 mA $I_{\text{Input}}$	-10 V to +10 V $U_{\text{Input}}$
hex	dec	mA	V
8001	Over range	> +21.6746	> +10.837
7F00	32512	+21.6746	+10.837
7530	30000	+20.0	+10.0
0001	1	+0.66667 $\mu\text{A}$	+333.33 $\mu\text{V}$
0000	-1	0	0
FFFF	0	-0.66667 $\mu\text{A}$	-333.33 $\mu\text{V}$
8AD0	-30000	-20.0	-10.0
8100	-32000	-21.6746	-10.837
8080	Under range	<-21.6746	<-10.837

Measuring range 4 mA to 20 mA

Input Data Word (Two's Complement)		4 mA to 20 mA $I_{\text{Input}}$
hex	dec	mA
8001	Over range	> +21.339733
7F00	32512	+21.339733
7530	30000	+20.0
0001	1	+4.00053333
0000	0	+4.0 to 3.2
8002	Open circuit	<+3.2

**“IB ST” Format**

The measured value is represented in bits 14 to 3. The remaining 4 bits are: sign bit, measuring range, open circuit, and overrange.

This format corresponds to the data format used on INTERBUS ST modules.

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

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Figure 11 Measured value representation in “IB ST” format (12 bits)

- |     |                            |    |              |
|-----|----------------------------|----|--------------|
| SB  | Sign bit                   | OC | Open circuit |
| AV  | Analog value               | OR | Over range   |
| 0/4 | Measuring range 4 to 20 mA |    |              |

**Significant Measured Values**

Measuring range 0 mA to 20 mA / 0 V to 10 V

Input Data Word (Two's Complement)	0 mA to 20 mA $I_{Input}$	0 V to 10 V $U_{Input}$
hex	mA	V
7FF9	>21.5	>10.75
7FF8	20.0 to 21.5	10.00 to 10.75
7FF8	19.9951	9.9975
4000	10.0	5.0
0008	0.0048828	0.002441
0000	0	0



Measuring range -20 mA to +20 mA / -10 V to +10 V

Input Data Word (Two's Complement)	-20 mA to +20 mA $I_{\text{Input}}$	-10 V to +10 V $U_{\text{Input}}$
hex	mA	V
7FF9	>21.5	>10.75
7FF8	20.0 to 21.5	10.00 to 10.75
7FF8	19.9951	9.9975
0008	0.0048828	0.002441
0000	0	0
FFF8	-0.0048828	-0.002441
8000	-20.0 to -21.5	-10.00 to -10.75
8001	<-21.5	<-10.75

Measuring range 4 mA to 20 mA

Input Data Word (Two's Complement)	4 mA to 20 mA $I_{\text{Input}}$
hex	mA
7FFD	>21.5
7FFC	20.0 to 21.5
7FFC	19.9961
000C	4.003906
0004	3.2 to 4.0
0006	< 3.2



Measuring range -20 mA to +20 mA / -10 V to +10 V

Input Data Word (Two's Complement)	-20 mA to +20 mA $I_{\text{Input}}$	-10 V to +10 V $U_{\text{Input}}$
hex	mA	V
7FFF	$\geq +19.999389$	$\geq +9.999939$
7FF7	+19.998779	+9.99939
4000	+10.0	+5.0
0001	+0.61035 $\mu\text{A}$	+305.0 $\mu\text{V}$
0000	0	0
FFFF	-0.61035 $\mu\text{A}$	-305.0 $\mu\text{V}$
8001	-19.999389	-9.99939
8000	$\leq -20.0$	$\leq -10.0$

Measuring range 4 mA to 20 mA

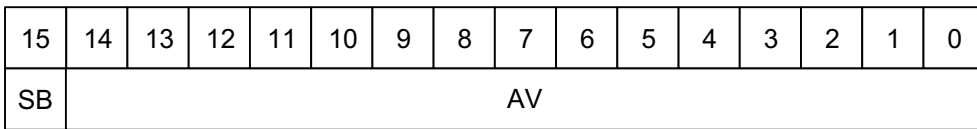
Input Data Word (Two's Complement)	4 mA to 20 mA $I_{\text{Input}}$
hex	mA
7FFF	$\geq 19.9995116$
7FFE	19.9990232
4000	12.0
0001	0.4884 $\mu\text{A}$
0000	4.0
0000	3.2 to 4.0
7FFF	< 3.2

**“Standardized Representation” Format**

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

In this format, data on the measuring range is standardized and represented in such a way that it indicates the corresponding value without conversion. In this format one bit has the value of 1 mV or 1 µA.

This format supports extended diagnostics. Values > 8000<sub>hex</sub> indicate an error. The error codes are listed on page 13.



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Figure 13 Measured value representation in “Standardized representation” format (15 bits)

SB Sign bit AV Analog value

**Significant Measured Values**



Because of the representation standardization not all of the possible codes are used. In addition, some codes are used for diagnostic functions. Therefore, the resolution is not 15 bits but exactly 13.287713 bits.

Measuring range 0 V to 10 V

Input Data Word (Two's Complement)		0 V to 10 V $U_{\text{Input}}$
hex	dec	V
8001	Over range	> +10.837
2A55	10837	+10.837
2710	10000	+10.0
0001	1	+0.001
0000	0	≤ 0

Measuring range 0 mA to 20 mA

Input Data Word (Two's Complement)		0 mA to 20 mA $I_{\text{Input}}$
hex	dec	mA
8001	Over range	> +21.674
54AA	21674	+21.674
4E20	20000	+20.0
0001	1	+0.001
0000	0	≤ 0

Measuring range -10 V to +10 V

Input Data Word (Two's Complement)		-10 V to +10 V $U_{\text{Input}}$
hex	dec	V
8001	Over range	> +10.837
2A55	10837	+10.837
2710	10000	+10.0
0001	1	+0.001
0000	0	0
FFFF	-1	-0.001
D8F0	-10000	-10.0
D5A6	-10837	-10.837
8080	Under range	< -10.837

Measuring range -20 mA to +20 mA

Input Data Word (Two's Complement)		-20 mA to +20 mA $I_{\text{Input}}$
hex	dec	mA
8001	Over range	> +21.674
54AA	21674	+21.674
4E20	20000	+20.0
0001	1	+0.001
0000	0	0
FFFF	-1	-0.001
B1E0	-20000	-20.0
A656	-21674	-21.674
8080	Under range	< -21.674

Measuring range 4 mA to 20 mA

Input Data Word (Two's Complement)		4 mA to 20 mA $I_{Input}$
hex	dec	mA
8001	Over range	> 21.339
43BB	17339	21.339
3E80	16000	20.0
0001	1	4.001
0000	0	4.0 to 3.2
8002	Open circuit	< 3.2

**Example**

Measured value representation in different data formats.



Measuring range: 0 mA to 20 mA

Measured value: 10 mA

Input data word

Format	HEX Value	DEC Value	Measured Value
IB IL	3A98	15 000	10 mA
IB ST	4000	16 384	10 mA
IB RT	4000	16 384	10 mA
Standardized representation	2710	10 000	10 mA

## 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	47 g (without connector)
Operating mode	Process data operation with 2 words
Connection type of the sensors	2- and 3-wire technology
Power supply of the sensors	With an external power supply or with an additional segment terminal (VARIO PWR IN)
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
 Permissible humidity (storage/transport)	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 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

### Deviations From Common Technical Data

#### Noise Immunity Test According to EN 50082-2

Electrostatic discharge (ESD) according to IEC 61000-4-2	Criterion B 6 kV contact discharge 6 kV air discharge
--	---

Mechanical Demands	
Shock test according to IEC 60068-2-27	15g load for 11 ms, half sinusoidal wave, three shocks in each space direction and orientation 25g load for 6 ms, half sinusoidal wave, three shocks in each space direction and orientation


Interface	
local bus interface	Data routing

Power Consumption	
Communications power $U_L$	7.5 V
Current consumption from $U_L$	Approximately 45 mA, typical
I/O supply voltage $U_{ANA}$	24 V DC
Current consumption of $U_{ANA}$	Approximately 12 mA, typical
Total power consumption	Approximately 625 mW, typical

Supply of the Module Electronics and I/O Through Bus Terminal/Power Terminal	
Connection method	Potential routing

Analog Inputs				
Number		2 analog single-ended inputs		
Signals/resolution in the process data word (quantization)				
Voltage	0 to 10 V	0 to 10.837 V	(Format IB IL)	0.333 mV/LSB
		0 to 10.000 V	(Format IB ST)	2.441 mV/LSB
		0 to 10.000 V	(Format IB RT)	0.305 mV/LSB
		0 to 10.837 V	(Standardized repres.)	1.000 mV/LSB
	±10 V	±10.837 V	(Format IB IL)	0.333 mV/LSB
		±10.000 V	(Format IB ST)	2.441 mV/LSB
		±10.000 V	(Format IB RT)	0.305 mV/LSB
		±10.837 V	(Standardized repres.)	1.000 mV/LSB
Current	0 to 20 mA	0 to 21.6746 mA	(Format IB IL)	0.6666 µA/LSB
		0 to 20.000 mA	(Format IB ST)	4.8828 µA/LSB
		0 to 20.000 mA	(Format IB RT)	0.6105 µA/LSB
		0 to 21.6746 mA	(Standardized repres.)	1.000 µA/LSB



Analog Inputs (continued)			
±20 mA	±21.6746 mA	(Format IB IL)	0.6666 µA/LSB
	±20.000 mA	(Format IB ST)	4.8828 µA/LSB
	±20.000 mA	(Format IB RT)	0.6105 µA/LSB
	±21.6746 mA	(Standardized repres.)	1.000 µA/LSB
4 mA to 20 mA	4 to 21.339 mA	(Format IB IL)	0.533 µA/LSB
	4 to 20.000 mA	(Format IB ST)	3.906 µA/LSB
	4 to 20.000 mA	(Format IB RT)	0.4884 µA/LSB
	4 to 21.339 mA	(Standardized repres.)	1.000 µA/LSB
Measuring value representation		In the formats	
		IB IL	(15 bits with sign bit)
		IB ST	(12 bits with sign bit)
		IB RT	(15 bits with sign bit)
		Standardized repres.	(15 bits with sign bit)
 For the measured value representation in the formats “IB IL” and “Standardized representation” observe the information on page 14 and page 20.			
Mean value generation		Over 16 measured values (can be switched off)	
Conversion time of the A/D converter		Approximately 120 µs	

Analog Input Stages	
<b>Voltage inputs</b>	
Input resistance	> 220 kΩ
Limit frequency (-3 dB) of the input filter	40 Hz
Process data update of both channels	< 1.5 ms
Behavior upon sensor failure	Goes to 0 V
Maximum permissible voltage between analog voltage inputs and analog reference potential	±32 V
Common mode rejection (CMR)	90 dB, minimum
Reference: Voltage input signal, valid for permissible DC common-mode voltage range	110 dB, typical
Permissible DC common-mode voltage for CMR	40 V between voltage input and FE

<b>Analog Input Stages (continued)</b>	
<b>Current inputs</b>	
Input resistance	50 $\Omega$ (shunt)
Limit frequency (-3 dB) of the input filter	40 Hz
Process data update of both channels	< 1.5 ms
Behavior upon sensor failure	Goes to 0 mA / 4 mA
Maximum permissible voltage between analog current inputs and analog reference potential	$\pm 5$ V (corresponding with 100 mA across the sensor resistances)
Common mode rejection (CMR)	90 dB, minimum
Reference: Current input signal, valid for permissible DC common-mode voltage range	110 dB, typical
Permissible DC common-mode voltage for CMR	40 V between current input and FE
Permissible current, maximum	$\pm 100$ mA

<b>Tolerance and Temperature Response of the Voltage Inputs (The error indications refer to the measuring range final value of 10 V.)</b>		
	<b>Typical</b>	<b>Maximum</b>
<b>Error at 23°C (73.4°F)</b>		
Offset error	$\pm 0.03\%$	$\pm 0.06\%$
Gain error	$\pm 0.05\%$	$\pm 0.10\%$
Differential non-linearity	$\pm 0.10\%$	$\pm 0.20\%$
<b>Total error of the voltage inputs at 23°C (73.4°F) Offset error + gain error + linearity error</b>	$\pm 0.15\%$	$\pm 0.30\%$
<b>Temperature response at -25°C to +55°C (-13°F to +131°F)</b>		
Offset drift $T_{KVO}$	$\pm 6$ ppm/K	$\pm 12$ ppm/K
Gain drift $T_{KG}$	$\pm 30$ ppm/K	$\pm 50$ ppm/K
Total voltage drift $T_{Ktot} = T_{KVO} + T_{KG}$	$\pm 36$ ppm/K	$\pm 62$ ppm/K
<b>Total error of the voltage inputs (-25°C [-13°F] to +55°C [+131°F]) Offset error + gain error + linearity error + drift error</b>	$\pm 0.30\%$	$\pm 0.50\%$

<b>Tolerance and Temperature Response of the Current Inputs (The error indications refer to the measuring range final value of 20 mA.)</b>		
	<b>Typical</b>	<b>Maximum</b>
<b>Error at 23°C (73.4°F)</b>		
Offset error	±0.03%	±0.06%
Gain error	±0.10%	±0.10%
Differential non-linearity	±0.10%	±0.30%
<b>Total error of the current inputs at 23°C (73.4°F) Offset error + gain error + linearity error</b>	±0.20%	±0.40%
<b>Temperature response at -25°C to +55°C (-13°F to +131°F)</b>		
Offset drift $T_{KIO}$	±6 ppm/K	±12 ppm/K
Gain drift $T_{KG}$	±30 ppm/K	±50 ppm/K
Total drift $T_{Ktot} = T_{KIO} + T_{KG}$	±36 ppm/K	±62 ppm/K
<b>Total error of the current inputs (-25°C [-13°F] to +55°C [+131°F]) offset error + gain error + linearity error + drift error</b>	±0.35%	±0.60%

<b>Additional Tolerances Influenced by Electromagnetic Fields</b>				
<b>Type of electromagnetic interference</b>	<b>Typical deviation of the measuring range final value (voltage input)</b>		<b>Typical deviation of the measuring range final value (current input)</b>	
	<b>Relative</b>	<b>Absolute</b>	<b>Relative</b>	<b>Absolute</b>
Electromagnetic fields; field strength 10 V/m according to IEC 61000-4-3	< ±2%	< ±200 mV	< ±2%	< ±400 µA
Conducted interference Class 3 (test voltage 10 V) according to IEC 61000-4-6	< ±1%	< ±100 mV	< ±1%	< ±100 µA
Fast transients 4 kV supply, 2 kV input according to IEC 61000-4-4	< ±1%	< ±100 mV	< ±1%	< ±100 µA

<b>Safety Devices</b>	
Surge voltage	Suppressor diodes in the analog inputs

**Electrical Isolation**



To provide electrical isolation between the logic level and the I/O area it is necessary to supply the bus terminal and the sensors using a power terminal from separate power supplies. Interconnection of power supply units in the 24 V range is not allowed! (For detailed information refer to the user manual.)

**Common potentials**

24 V main power, 24 V segment voltage, 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 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 $U_{ANA}$ / I/O	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logic) / 24 V supply $U_{ANA}$ / functional earth ground	500 V AC, 50 Hz, 1 min.
I/O / functional earth ground	500 V AC, 50 Hz, 1 min.

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

Breakdown of the internal voltage supply	Yes
I/O error/user error	Yes, error message through the process data input words

**Ordering Data**

Description	Order Designation	Order No.
Terminal with two analog input channels with connectors and labeling fields	VARIO AI 2/SF	KSVC-103-00121





CD Automation srl  
Via Picasso 34/36  
20025 Legnano (MI)  
Italy



+39 - (0331) 577479



+39 - (0331) 579479



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