

Chapter 6 Analog input modules

Overview

This chapter contains a description of the construction and the operation of the VIPA analog input modules.

Below follows a description of:

- A system overview of the analog input modules
- Properties
- Constructions
- Interfacing and schematic diagram
- Technical data

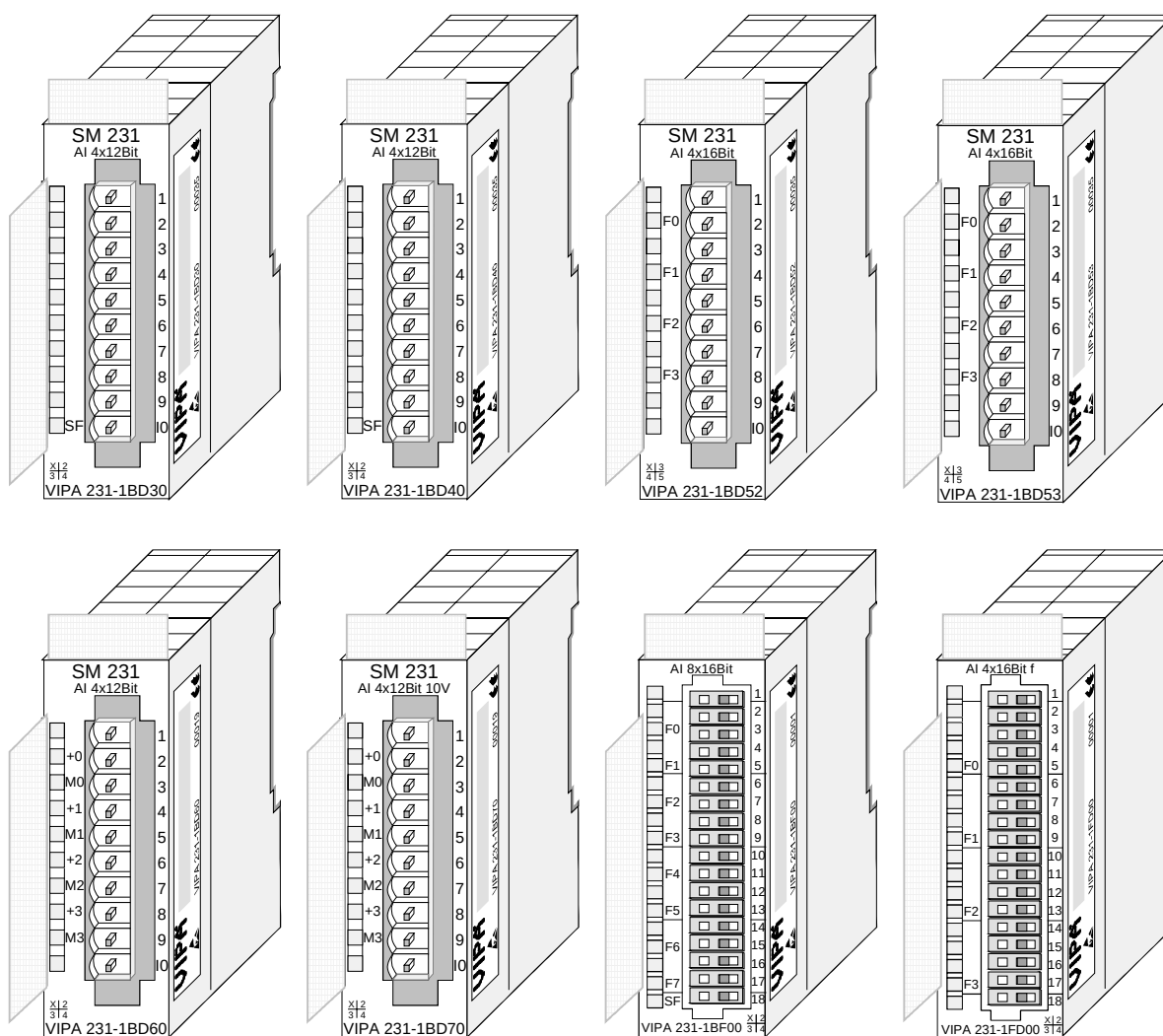
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System overview

Input modules SM 231

Here follows a summary of the analog input modules that are currently available from VIPA:



Order data input modules

Type	Order number	Page
AI4x12Bit $\pm 10V$ - ECO,	VIPA 231-1BD30	6-6
AI4x12Bit 4...20mA, $\pm 20mA$ - ECO	VIPA 231-1BD40	6-11
AI4x16Bit, Multiinput	VIPA 231-1BD52	6-16
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AI4x12Bit, 4 ... 20mA, isolated	VIPA 231-1BD60	6-39
AI4x12Bit, $\pm 10V$, isolated	VIPA 231-1BD70	6-42
AI8x16Bit	VIPA 231-1BF00	6-45
AI4x16Bit f	VIPA 231-1FD00	6-55

General

Cabling for analog signals

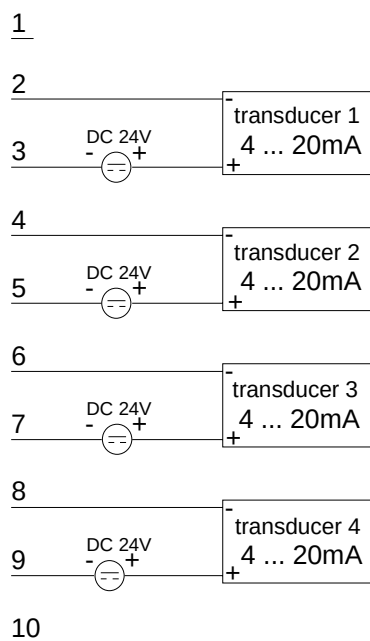
You must only use screened cable when you are connecting analog signals. These cables reduce the effect of electrical interference. The screen of the analog signal cable should be grounded at both ends. When there are potential differences between the cable ends, there may flow a current will to equalize the potential difference. This current could interfere with the analog signals. Under these circumstances it is advisable to ground the screen of the signal cable at one end only.

Connecting current sensor

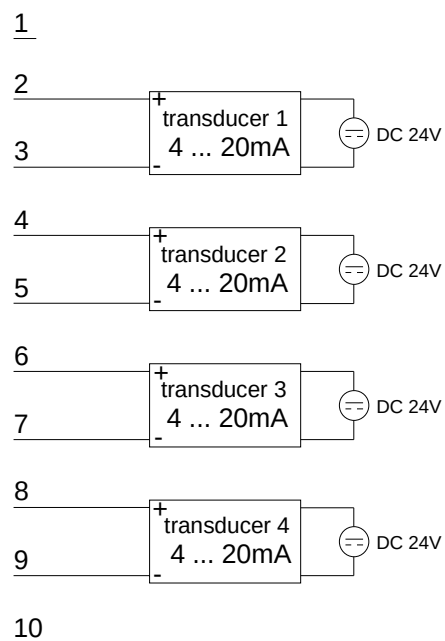
Our analog input modules provide a large number of input configurations for 2- and 4wire transducers.

Please remember that sensors require an external power supply. You have to connect an external power supply in line with any 2wire sensor. The following diagram explains the connection of 2- and 4wire sensors:

2wire interfacing



4wire interfacing



Note!

Please ensure that you connect the sensors with the correct polarity! Unused inputs should be short circuited by placing a link between the positive pole and the common ground for the channel.

Parameterization and diagnosis during runtime

By using the SFCs 55, 56 and 57 you may change the parameters of the analog modules during runtime via the CPU 21x.

For diagnosis evaluation during runtime, you may use the SFCs 51 and 59. They allow you to request detailed diagnosis information and to react to it.

Numeric notation in S5 from Siemens

In S5 format, the input data are stored in one word. The word consists of the binary value and the information bits.

Please regard only the Siemens S7 format (two's complement) is supported by the Siemens SIMATIC manager for decimal representation. When the Siemens S5 format is used the decimal values are incorrectly represented.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range overrun Bit 1: error bit (set at internal error) Bit 2: activity bit (always 0) Bit 7 ... 3: binary measured value
1	Bit 6 ... 0: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V (two's complement)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	E000
0V	0	0000
5V	8192	2000
10V	16384	4000

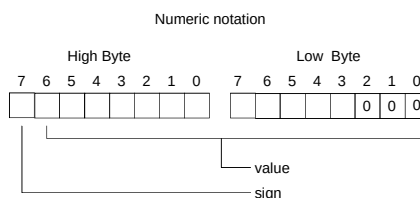
Formulas for the calculation:

$$Value = 16384 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{16384}$$

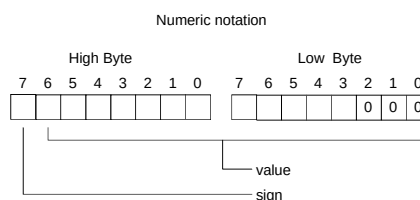
U: voltage, Value: Decimal value

+/- 10V (value and sign)

Voltage	Decimal	Hex
-10V	-16384	C000
-5V	-8192	A000
0V	0	0000
5V	8192	2000
10V	16384	4000

**4...20mA (value and sign)**

Current	Decimal	Hex
4mA	0	0000
12mA	8192	2000
20mA	16384	4000

**+/- 20mA (two's complement)**

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	E000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

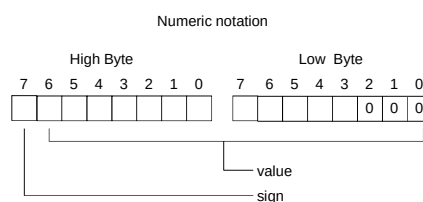
Formula for the calculation:

$$Value = 16384 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{16384}$$

I: Current, Value: Decimal value

+/- 20mA (value and sign)

Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000



Numeric notation in S7 from Siemens

Analog values are represented as a two's complement value.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 7 ... 0: binary measured value
1	Bit 6 ... 0: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

0...10V

Voltage	Decimal	Hex
0V	0	0000
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	13824	3600
5V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{27648} + 1$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4...20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

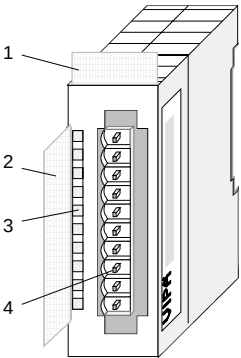
$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

231-1BD30 - AI 4x12Bit ±10V - ECO

Order data	AI 4x12Bit, ±10V	VIPA 231-1BD30
Description	The module has 4 inputs that you may configure individually. This module requires a total of 8Byte of the process image for the input data (2Byte per channel). DC/DC converters provide electrical isolation for the channels of the module with respect to the backplane bus.	
Properties	• 4 inputs, channels isolated from the backplane bus • the different channels are individually configurable and may be turned off • Suitable for transducers with ±10V outputs • LED leave end overdrive region or leave end underdrive region or wrong parameterization	

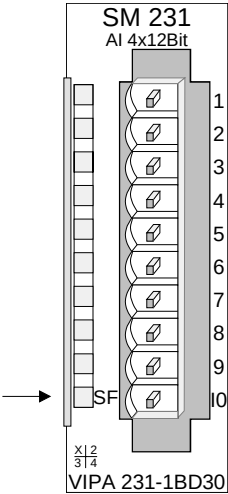
Construction



- [1] Label for the name of the module
- [2] Label for the bit address with description
- [3] LED status indicator
- [4] Edge connector

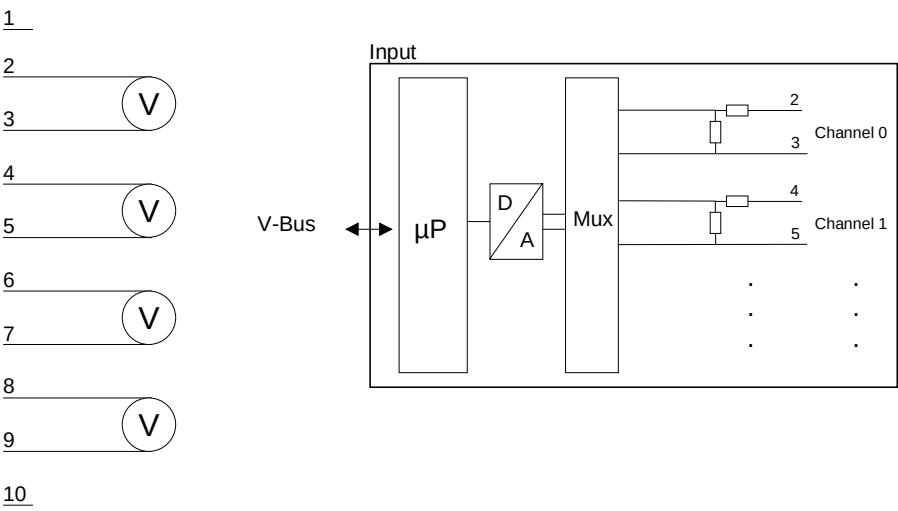
Pin assignment

LED	Description	Pin	Assignment
SF	LED (red) Sum error at: - Leave end of overdrive region or end of underdrive region - wrong parameterization	1	
		2	pos. connection Channel 0
		3	Channel 0 common
		4	pos. connection Channel 1
		5	Channel 1 common
		6	pos. connection Channel 2
		7	Channel 2 common
		8	pos. connection Channel 3
		9	Channel 3 common
		10	



Wiring and
schematic
diagram

Wiring diagram Schematic diagram



Attention!
Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Measurement data
acquisition

During a measurement the data is stored in the data input area.
The following figure shows the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Parameter data

Every channel is individual parameterizeable. For the parameterization, 10Byte parameterization data are available. The parameterization data are stored permanently and remain also in off mode. By using the SFC 55 "WR_PARM" you may alter the parameterization in the module during runtime. The time needed until the new parameterization is valid can last up to 60ms. During this time, the measuring value output is 7FFFh.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0, 1	reserved	00h
2	Function-no. channel 0	28h
3	Function-no. channel 1	28h
4	Function-no. channel 2	28h
5	Function-no. channel 3	28h
6..9	reserved	00h

Function-no. assignment

For each channel here the function-no. of your measuring function can be set. Please see the according table.

The function-no. 00h does not influence the function-no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation
00h	Does not affect permanently stored configuration data	
28h	Voltage $\pm 10V$ Siemens S7 format	$\pm 11.76V$ / 11.76V = max. value before over range (32511) -10...10V = nominal range (-27648...27648) -11.76V = min. value before under range (-32512) two's complement
2Bh	Voltage $\pm 10V$ Siemens S5 format	$\pm 12.50V$ / 12.50V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.50V = min. value before under range (-20480) value and sign
3Bh	Voltage $\pm 10V$ Siemens S5 format	$\pm 12.50V$ / 12.50V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.50V = min. value before under range (-20480) two's complement
FFh	Channel not active (turned off)	

**Note!**

The module is preset to the range " $\pm 10V$ voltage" in S7 format from Siemens.

Technical data

Module specific Data	VIPA 231-1BD30	
Number of inputs	4	
Length of cable: shielded	200m	
Voltages, Currents, Potentials		
Isolation		
- channels / backplane bus	yes	
- between channels	no	
Permitted potential difference		
- between the inputs (U_{CM})	DC 2V	
- between the inputs and $M_{INTERN}(U_{ISO})$	DC 75V / AC 60V	
Isolation tested with	DC 500V	
Current consumption		
- from the backplane bus	120mA	
Dissipation power of the module	0.6W	
Analog value generation		
Measuring principle	SAR (Successive approximation)	
programmable	yes	
conversion time/resolution (per channel)		
- Basic conversion time (ms)	n x 2ms	
- Resolution (Bit) incl. overrange	13Bit	
Noise suppression, limits of error		
Noise suppression for $f=n \times (f_1 \pm 1\%)$ (f_1 =interference frequency, $n=1,2,\dots$)	f=50Hz...400Hz	
Common-mode interference ($U_{CM} < 2V$)	> 80dB	
Crosstalk between the inputs	> 50dB	
Operational limit (in the entire temperature range, with reference to the input range)		
Voltage input	Measuring range	Tolerance
	$\pm 10V$	$\pm 0.2\%$
Basic error (operational limit at 25°C, referred to input range)		
Voltage input	Measuring range	Tolerance
	$\pm 10V$	$\pm 0.1\%$
Temperature error (with reference to the input range)	$\pm 0.005\%/K$	
Linearity error (with reference to the input range)	$\pm 0.02\%$	
Repeatability (in steady state at 25°C, with reference to the input range)	$\pm 0.05\%$	
Diagnostics	no	
Diagnostic interrupt	none	
Sum error	red SF LED	

n= Number of channels

continued ...

... continue technical data

Data for selecting a sensor		
	Input range	Input resistance
Voltage	$\pm 10V$	100k Ω
Maximum input voltage for voltage input (destruction limit)	max. 30V	
Connection of the sensor		
for measuring voltage	possible	
Permissible environment conditions		
Operating temperature	0°C...+60°C	
Transport and storage temperature	-25°C...+70°C	
relative humidity	95% without condensation	
Vibration/Shock resistance	acc. IEC 68000-2-6/IEC 68000-2-27	
EMC resistance ESD/Burst	acc. IEC 61000-4-2 / IEC 61000-4-2 / IEC 61000-4-4 (to level 3)	
Project engineering		
Input data	8Byte (1 Word per channel)	
Output data	-	
Parameter data	10Byte	
Diagnostics data	-	
Dimensions and Weight		
Dimensions (WxHxD in mm)	25.4x76x88mm	
Weight	ca. 80g	

231-1BD40 - AI 4x12Bit 4...20mA, ± 20 mA - ECO

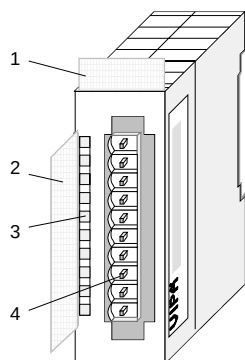
Order data AI 4x12Bit, 4...20mA, ± 20 mA VIPA 231-1BD40

Description The module has 4 inputs that you may configure individually. This module requires a total of 8Byte of the process image for the input data (2Byte per channel).

DC/DC converters are employed to provide electrical isolation for the channels of the module with respect to the backplane bus.

- Properties**
- 4 inputs, channels isolated from the backplane bus
 - the different channels are individually configurable and may be turned off
 - Suitable for transducers with 4...20mA , ± 20 mA outputs
 - LED leave end overdrive region or leave end underdrive region or wrong parameterization

Construction

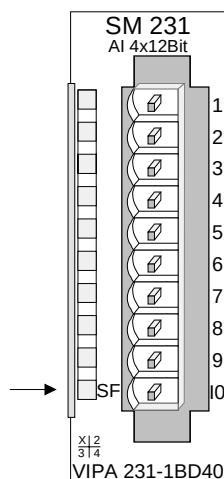


- [1] Label for the name of the module
- [2] Label for the bit address with description
- [3] LED status indicator
- [4] Edge connector

Status indicator pin assignment

LED Description

- SF LED (red)
Sum error at:
- Leave end of overdrive region or leave end of underdrive region
 - or wrong parameterization

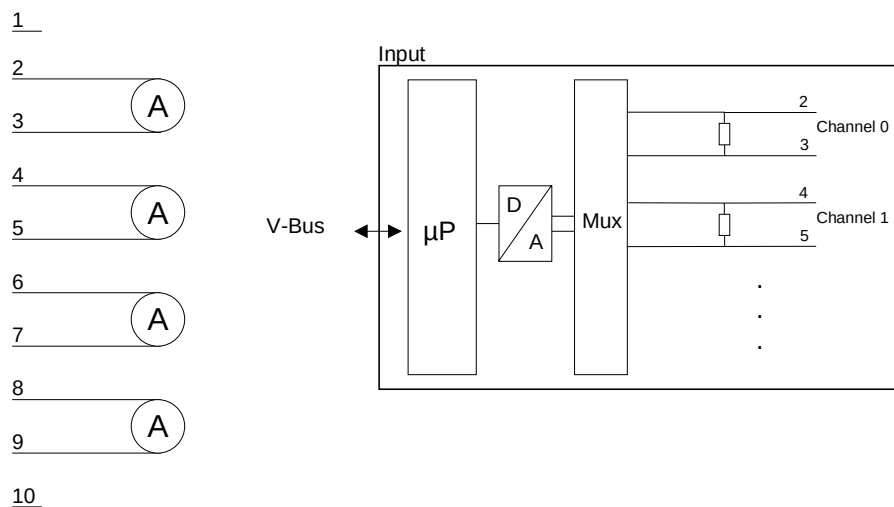


Pin Assignment

- | | |
|----|-----------------------|
| 1 | |
| 2 | pos. connection Ch. 0 |
| 3 | Channel 0 common |
| 4 | pos. connection Ch.1 |
| 5 | Channel 1 common |
| 6 | pos. connection Ch.2 |
| 7 | Channel 2 common |
| 8 | pos. connection Ch.3 |
| 9 | Channel 3 common |
| 10 | |

Wiring and schematic diagram

Wiring diagram Schematic diagram



Attention!

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

Measurement data acquisition

During a measurement the data is stored in the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Parameter data

Every channel is individual parameterizeable. For the parameterization, 10Byte parameterization data are available. The parameterization data are stored permanently and remain also in off mode. By using the SFC 55 "WR_PARM" you may alter the parameterization in the module during runtime. The time needed until the new parameterization is valid can last up to 60ms. During this time, the measuring value output is 7FFFh.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0, 1	reserved	00h
2	Function-no. channel 0	2Ch
3	Function-no. channel 1	2Ch
4	Function-no. channel 2	2Ch
5	Function-no. channel 3	2Ch
6..9	reserved	00h

**Function-no.
assignment**

For each channel here the function-no. of your measuring function can be set. Please see the according table.

The function-no. 00h does not influence the function-no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation
00h	Does not affect permanently stored configuration data	
2Ch	Current $\pm 20\text{mA}$ Siemens S7 format	$\pm 23.52\text{mA}$ / 23.52mA = max. value before over range (32511) -20...20mA = rated value (-27648...27648) -23.52mA = min. value before under range (-32512) two's complement
2Dh	Current 4...20mA Siemens S7 format	1.185 .. +22.81mA / 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 1.185 mA = min. value before under range (-4864) two's complement
2Eh	Current 4...20mA Siemens S5 format	0.8 .. +24.00mA / 24.00mA = max. value before over range (20480) 4 .. 20mA = rated range (0...16384) 0.8mA = min. value before under range (-3277) value and sign
2Fh	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 25.00\text{mA}$ / 25.00mA = max. value before over range (20480) -20...20mA = rated value (-16384...16384) -25.00mA = min. value before under range (-20480) value and sign
39h	Current 4...20mA Siemens S5 format	0.8 .. +24.00mA / 24.00mA = max. value before over range (20480) 4 .. 20mA = rated range (0...16384) 0.8mA = min. value before under range (-3277) value and sign
3Ah	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 25.00\text{mA}$ / 25.00mA = max. value before over range (20480) -20...20mA = nominal range (-16384...16384) -25.00mA = min. value before under range (-20480) two's complement
FFh	Channel not active (turned off)	

**Note!**

The module is preset to the range " $\pm 20\text{mA}$ current" in S7-format from Siemens.

Technical data

Module specific Data	VIPA 231-1BD40	
Number of inputs	4	
Length of cable: shielded	200m	
Voltages, Currents, Potentials		
Isolation		
- channels / backplane bus	yes	
- between channels	no	
Permitted potential difference		
- between the inputs (U_{CM})	DC 2V	
- between the inputs and $M_{INTERN}(U_{ISO})$	DC 75V / AC 60V	
Isolation tested with	DC 500V	
Current consumption		
- from the backplane bus	120mA	
Dissipation power of the module	0.6W	
Analog value generation		
Measuring principle	SAR (Successive approximation)	
programmable	yes	
conversion time/resolution (per channel)		
- Basic conversion time (ms)	n x 2ms	
- Resolution (Bit) incl. overrange	13Bit	
Noise suppression, limits of error		
Noise suppression for $f=n \times (f_1 \pm 1\%)$ (f_1 =interference frequency, $n=1,2,\dots$)	$f=50\text{Hz} \dots 400\text{Hz}$	
Common-mode interference ($U_{CM} < 2\text{V}$)	> 80dB	
Crosstalk between the inputs	> 50dB	
Operational limit (in the entire temperature range, with reference to the input range)		
Current input	Measuring range	Tolerance
	$\pm 20\text{mA}$	$\pm 0.2\%$
	4...20mA	$\pm 0.5\%$
Basic error (operational limit at 25°C, referred to input range)		
Current input	Measuring range	Tolerance
	$\pm 20\text{mA}$	$\pm 0.1\%$
	4...20mA	$\pm 0.2\%$
Temperature error (with reference to the input range)	$\pm 0.005\%/K$	
Linearity error (with reference to the input range)	$\pm 0.02\%$	
Repeatability (in steady state at 25°C, with reference to the input range)	$\pm 0.05\%$	
Diagnostics	no	
Diagnostic interrupt	none	
Sum error	red SF LED	

n= Number of channels

continued ...

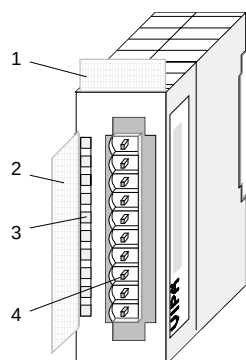
... continue technical data

Data for selecting a sensor		
	Input range	Input resistance
Current	$\pm 20\text{mA}$	60Ω
	4...20mA	60Ω
Maximum input current for current input (destruction limit)	40mA	
Connection of the sensor		
for measuring current		
as 2wire transmitter	possible, with external supply	
as 4wire transmitter	possible	
Permissible environment conditions		
Operating temperature	$0^{\circ}\text{C} \dots +60^{\circ}\text{C}$	
Transport and storage temperature	$-25^{\circ}\text{C} \dots +70^{\circ}\text{C}$	
relative humidity	95% without condensation	
Vibration/Shock resistance	acc. IEC 68000-2-6/IEC 68000-2-27	
EMC resistance ESD/Burst	acc. IEC 61000-4-2 / IEC 61000-4-2 / IEC 61000-4-4 (to level 3)	
Project engineering		
Input data	8Byte (1 Word per channel)	
Output data	-	
Parameter data	10Byte	
Diagnostics data	-	
Dimensions and Weight		
Dimensions (WxHxD in mm)	25.4x76x88mm	
Weight	ca. 80g	

231-1BD52 - AI 4x16Bit, multiinput

Order data	AI 4x16Bit multiinput	VIPA 231-1BD52
Description	The module has got 4 inputs that you may configure individually. The module requires a total of 8 input data bytes in the process image (2Byte per channel). Isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.	
Properties	- the different channels are individually configurable and may be turned off - the common signal inputs of the channels are not isolated from each other and the permitted potential difference is up to 5V - LED for cable break and over current in sensor circuits - diagnostic function	

Construction



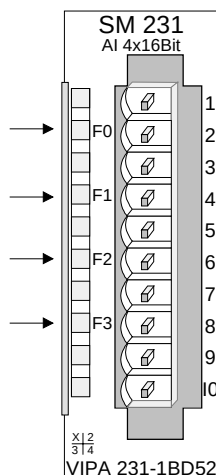
- [1] Label for module description
- [2] Label for the bit address with description
- [3] LED status indicator
- [4] Edge connector

Status indicators pin assignment

LED Description

F0 ... F3 LED (red):
turned on when an open circuit exists on the 4...20mA sensor circuits

blinks when the current > 40mA at all current sensor circuits



Pin Assignment

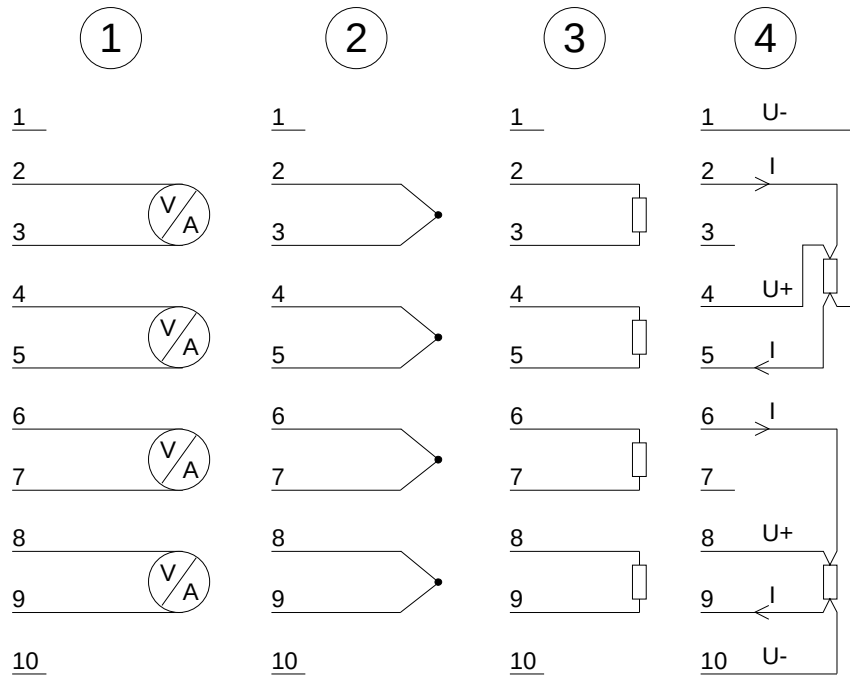
1	For 4wire systems channel 0
2	+ channel 0
3	Channel 0 common
4	+ channel 1
5	Channel 1 common
6	+ channel 2
7	Channel 2 common
8	+ channel 3
9	Channel 3 common
10	For 4wire systems channel 2

Wiring diagrams

The following illustration shows the connection options for the different measuring ranges. The assignment to the measuring ranges is to find in the column "Conn." of the table "Function-no. assignment" on the next pages.

**Note!**

Please note that the module 231-1BD52 was developed from the VIPA 231-1BD50. The measuring function no longer starts at 00h but it is offset by one to 01h.

**Attention!**

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

The following circumstances may cause damages at the analog module:

- The external supply of the input (current/voltage) must not be present as long as the backplane bus of the CPU is still without current supply!
- Parameterization and connection of the input must be congruent!
- You must not apply a voltage >15V to the input!

**Function-no.
assignment**

The assignment of a function-no. to a certain channel happens during parameterization. The function-no. 00h does not influence the function-no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance	Conn.
00h	Does not affect permanently stored configuration data			
01h	Pt100 in 2wire mode	-200 .. +850°C / in units of 1/10°C, two's complement	¹⁾²⁾³⁾ ±1°C	(3)
02h	Pt1000 in 2wire mode	-200 .. +500°C / in units of 1/10°C, two's complement	¹⁾²⁾³⁾ ±1°C	(3)
03h	NI100 in 2wire mode	-50 .. +250°C / in units of 1/10°C, two's complement	¹⁾²⁾³⁾ ±1°C	(3)
04h	NI1000 in 2wire mode	-50 .. +250°C / in units of 1/10°C, two's complement	¹⁾²⁾³⁾ ±1°C	(3)
05h	Resistance measurement 60Ohm 2wire	- / 60Ω= final value (32767)	¹⁾²⁾³⁾ ±0.2% of final value	(3)
06h	Resistance measurement 600Ohm 2wire	- / 600Ω = final value (32767)	¹⁾²⁾³⁾ ±0.1% of final value	(3)
07h	Resistance measurement 3000Ohm 2wire	- / 3000Ω = final value (32767)	¹⁾²⁾³⁾ ±0.1% of final value	(3)
08h	Resistance measurement 6000Ohm 2wire	- / 6000Ω = final value (32767)	¹⁾²⁾³⁾ ±0.1% of final value	(3)
09h	Pt100 via 4wire connection	-200 .. +850°C / in units of 1/10°C, two's complement	¹⁾²⁾ ±0.5°C	(4)
0Ah	Pt1000 via 4wire connection	-200 .. +500°C / in units of 1/10°C, two's complement	¹⁾²⁾ ±0.5°C	(4)
0Bh	NI100 via 4wire connection	-50 .. +250°C / in units of 1/10°C, two's complement	¹⁾²⁾ ±0.5°C	(4)
0Ch	NI1000 via 4wire connection	-50 .. +250°C / in units of 1/10°C, two's complement	¹⁾²⁾ ±0.5°C	(4)
0Dh	Resistance measurement 60Ohm 4wire	- / 60Ω= final value (32767)	¹⁾²⁾ ±0.1% of final value	(4)
0Eh	Resistance measurement 600Ohm 4wire	- / 600Ω= final value (32767)	¹⁾²⁾ ±0.05% of final value	(4)
0Fh	Resistance measurement 3000Ohm 4wire	- / 3000Ω = final value (32767)	¹⁾²⁾ ±0.05% of final value	(4)
10h	Thermocouple type J , externally compensated	-210 °C .. 850 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±1°C	(2)

continued ...

... continue

No.	Function	Measurement range / representation	Tolerance	Conn.
11h	Thermocouple type K, externally compensated	-270 °C .. 1200 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±1.5°C	(2)
12h	Thermocouple type N, externally compensated	-200 °C .. 1300 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±1.5°C	(2)
13h	Thermocouple type R, externally compensated	-50 °C .. 1760 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±4°C	(2)
14h	Thermocouple type T, externally compensated	-270 °C .. 400 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±1.5°C	(2)
15h	Thermocouple type S, externally compensated	-50 °C .. 1760 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±5°C	(2)
18h	Thermocouple type J, internally compensated	-210 °C .. 850 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±1.5°C	(2)
19h	Thermocouple type K, internally compensated	-270 °C .. 1200 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±2°C	(2)
1Ah	Thermocouple type N, internally compensated	-200 °C .. 1300 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±2°C	(2)
1Bh	Thermocouple type R, internally compensated	-50 °C .. 1760 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±5°C	(2)
1Ch	Thermocouple type T, internally compensated	-270 °C .. 400 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±2°C	(2)
1Dh	Thermocouple type S, internally compensated	-50 °C .. 1760 °C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±5°C	(2)
27h	Voltage 0...50mV Siemens S7 format	0...50mV / 59.25mV = max. range before over range (32767) 0...50mV = nominal value (0...27648) two's complement	¹⁾ ±0.1% of final value	(1)
28h	Voltage ±10V Siemens S7 format	±11.85V / 11.85V = max. value before over range (32767) -10...10V = nominal range (-27648...27648) -11.85V = min. value before under range (-32767) two's complement	¹⁾ ±0.05% of final value	(1)
29h	Voltage ±4V Siemens S7 format	±4.74V / 4.74V = max. value before over range (32767) -4...4V = rated range (-27648...27648) -4.74V = min. value before under range (-32767) two's complement	¹⁾ ±0.05% of final value	(1)
2Ah	Voltage ±400mV Siemens S7 format	±474mV / 474mV = max. value before over range (32767) -400...400mV = rated range (-27648...27648) -474mV = min. value before under range (-32767) two's complement	¹⁾ ±0.1% of final value	(1)
2Bh	Voltage ±10V Siemens S5 format	±11.85V / 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480) value and sign	¹⁾ ±0.2% of final value	(1)

continued ...

... continue

No.	Function	Measurement range / representation	Tolerance	Conn.
2Ch	Current $\pm 20\text{mA}$ Siemens S7 format	$\pm 23.70\text{mA}$ / 23.70mA = max. value before over range (32767) -20...20mA = rated value (-27648...27648) -23.70mA = min. value before under range (-32767) two's complement	¹⁾ $\pm 0.05\%$ of final value	(1)
2Dh	Current 4...20mA Siemens S7 format	1.185 .. +22.96mA / 22.96mA = max. value before over range (32767) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-5530) two's complement	¹⁾ $\pm 0.05\%$ of final value	(1)
2Eh	Current 4...20mA Siemens S5 format	1.185 .. +22.96mA / 22.96mA = max. value before over range (20480) 20mA = rated range (0...16384) 0mA = min. value before under range (-4096) value and sign	¹⁾ $\pm 0.2\%$ of final value	(1)
2Fh	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 23.70\text{mA}$ / 23.70mA = max. value before over range (19456) -20...20mA = rated value (-16384...16384) -23.70mA = min. value before under range (-19456) value and sign	¹⁾ $\pm 0.05\%$ of final value	(1)
32h	Resistance measurement 6000Ohm 4wire	- / 6000 Ω = final value (32767)	¹⁾²⁾ $\pm 0.05\%$ of final value	(4)
33h	Resistance measurement 6000Ohm 4wire	- / 6000 Ω = final value (6000)	¹⁾²⁾ $\pm 0.05\%$ of final value	(4)
35h	Resistance measurement 600Ohm 2wire	- / 60 Ω = final value (6000)	¹⁾²⁾³⁾ $\pm 0.2\%$ of final value	(3)
36h	Resistance measurement 600Ohm 2wire	- / 600 Ω = final value (6000)	¹⁾²⁾³⁾ $\pm 0.1\%$ of final value	(3)
37h	Resistance measurement 3000Ohm 2wire	- / 3000 Ω = final value (30000)	¹⁾²⁾³⁾ $\pm 0.1\%$ of final value	(3)
38h	Resistance measurement 6000Ohm 2wire	- / 6000 Ω = final value (6000)	¹⁾²⁾³⁾ $\pm 0.1\%$ of final value	(3)
⁶⁾ 3Ah	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 23.70\text{mA}$ / 23.70mA = max. value before over range (19456) -20...20mA = nominal range (-16384...16384) -23.70mA = min. value before under range (-19456) two's complement	¹⁾ $\pm 0.05\%$ of final value	(1)
⁶⁾ 3Bh	Voltage $\pm 10\text{V}$ Siemens S5 format	$\pm 11.85\text{V}$ / 12.5V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.5V = min. value before under range (-20480) two's complement	¹⁾ $\pm 0.2\%$ of final value	(1)
3Dh	Resistance measurement 600Ohm 4wire	- / 60 Ω = final value (6000)	¹⁾²⁾ $\pm 0.1\%$ of final value	(4)

continued ...

... continue

No.	Function	Measurement range / representation	Tolerance	Conn.
3Eh	Resistance measurement 6000Ohm 4wire	- / 6000Ω = final value (6000)	¹⁾²⁾ ±0.05% of final value	(4)
3Fh	Resistance measurement 30000Ohm 4wire	- / 30000Ω = final value (30000)	¹⁾²⁾ ±0.05% of final value	(4)
57h	Voltage 0...50mV	0...50mV / 59.25mV = max. value before over range (5925) 0...50mV = rated range (0...5000) two's complement	¹⁾ ±0.1% of final value	(1)
58h	Voltage ±10V	±11.85V / 11.85V = max. value before over range (11850) -10...10V = rated range (-10000...10000) -11.85V = min. value before under range (-11850) two's complement	¹⁾ ±0.05% of final value	(1)
59h	Voltage ±4V	±4.74V / 4.74V = max. value before over range (4740) -4...4V = rated range (-4000...4000) -4.74V = min. value before under range (-4740) two's complement	¹⁾ ±0.05% of final value	(1)
5Ah	Voltage ±400mV	±474mV / 474mV = max. value before over range (4740) -400...400mV = rated range (-4000...4000) -474mV = min. value before under range (-4740) two's complement	¹⁾ ±0.1% of final value	(1)
5Ch	Current ±20mA	±23.70mA / 23.70mA = max. value before over range (23700) -20...20mA = rated value (-20000...20000) -23.70mA = min. value before under range (-23700) two's complement	¹⁾ ±0.05% of final value	(1)
5Dh	Current 4...20mA	1.185 .. +22.96mA / 22.96mA = max. value before over range (18960) 4...20mA = rated range (0...16000) 0mA = min. value before under range (-4000) two's complement	¹⁾ ±0.05% of final value	(1)
FFh	Channel not active (turned off)			

¹⁾ measured at an environmental temperature of 25°C, velocity of 15 conversions/s

²⁾ excluding errors caused by transducer inaccuracies

³⁾ excluding errors caused by contact resistance and line resistance

⁴⁾ the compensation of the neutralization must be implemented externally

⁵⁾ the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these must be extended by means of Thermocouple extension cables

⁶⁾ starting from hardware release 11

**Note!**

The module is preset to the range "±10V voltage" at S7 format.

Measurement data acquisition

During a measurement the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figure shows the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

**Note!**

Only channels 0 and 2 are used in 4wire systems.

Parameter data

Every channel is individual parameterizeable. 10Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 5 ... 0: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	reserved	00h
2	Function-no. channel 0 (see table)	2Dh
3	Function-no. channel 1 (see table)	2Dh
4	Function-no. channel 2 (see table)	2Dh
5	Function-no. channel 3 (see table)	2Dh
6	Option byte channel 0	00h
7	Option byte channel 1	00h
8	Option byte channel 2	00h
9	Option byte channel 3	00h

Parameters

Diagnostic alarm

The diagnostic alarm is enabled by means of Bit 6 of Byte 0. In this case an error a 4Byte diagnostic message will be issued to the master system.

Function-no.

Here you have to enter the function number of your measurement function for every channel. The allocation of the function number to a measurement function is available from the table above.

Option byte

Here you may specify the conversion rate. In addition selection and envelope functions have been implemented.



Note!

Please note that the resolution is reduced when conversion rate is increased due to the shorter integration time.

The format of the data transfer remains the same. The only difference is that the lower set of bits (LSBs) lose significance for the analog value.

Structure of the option byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	Option byte: Bit 3 ... 0: rate*		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123 conversions/s	14	
	0100 168 conversions/s	12	
	0101 202 conversions/s	10	
	0110 3.7 conversions/s	16	
	0111 7.5 conversions/s	16	
	Bit 5 ... 6: Selection function		
	00 deactivated		
	01 use 2 of 3 values		
	10 use 4 of 6 values		
	Bit 7 ... 6: Envelope function		
	00 deactivated		
	01 envelope ± 8		
	10 envelope ±16		

*) These specifications apply to 1channel operation. For multi-channel operations, the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Diagnostic data

As soon as you activated the alarm release in Byte 0 of the parameter area, 4 diagnostic Bytes with fixed content are transferred to the superordinated system in case of an error. Please note that analog modules only use the first two bytes for diagnostic purposes. The remaining two byte are not used. The structure of the diagnostic bytes is as follows:

Diagnostic data:

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: constant 0 Bit 2: external error Bit 3: channel error present Bit 7 ... 4: reserved	-
1	Bit 3 ... 0: class of module 0101 analog module Bit 4: channel information available Bit 7 ... 5: reserved	-
2 ... 3	not assigned	-

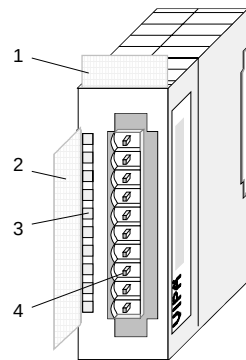
Technical data

Electrical data	VIPA 231-1BD52
Number of inputs	4 differential inputs
Input resistance	> 2M Ω (voltage range) < 50 Ω (current range)
measuring range	
- Thermocouple	Type J, K, N, R, S, T
- Resistance thermometer	Pt100, Pt1000, NI100, NI1000
- Resistance measuring	60 Ω , 600 Ω , 3k Ω
- Voltage measuring	0...50mV, 0...10V, ± 4 mV, ± 4 V, ± 10 V
- Current measuring	4...20mA, ± 20 mA
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	500Vrms (field voltage - backplane bus)
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	10Byte
Diagnostic data	4Byte
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x88mm
Weight	100g

231-1BD53 - AI 4x16Bit, multiinput

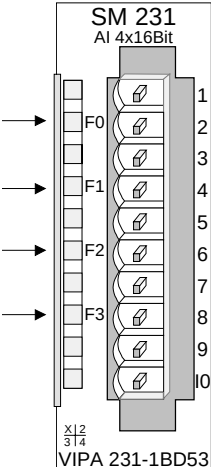
Order data	AI 4x16Bit multiinput	VIPA 231-1BD53
Description	The module has 4 inputs that you may configure individually. The module requires a total of 8 input data bytes in the periphery area (2Byte per channel). Isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.	
Properties	• the different channels are individually configurable and may be turned off • the common signal inputs of the channels are not isolated from each other and the permitted potential difference is up to 5V • diagnostic function	

Construction



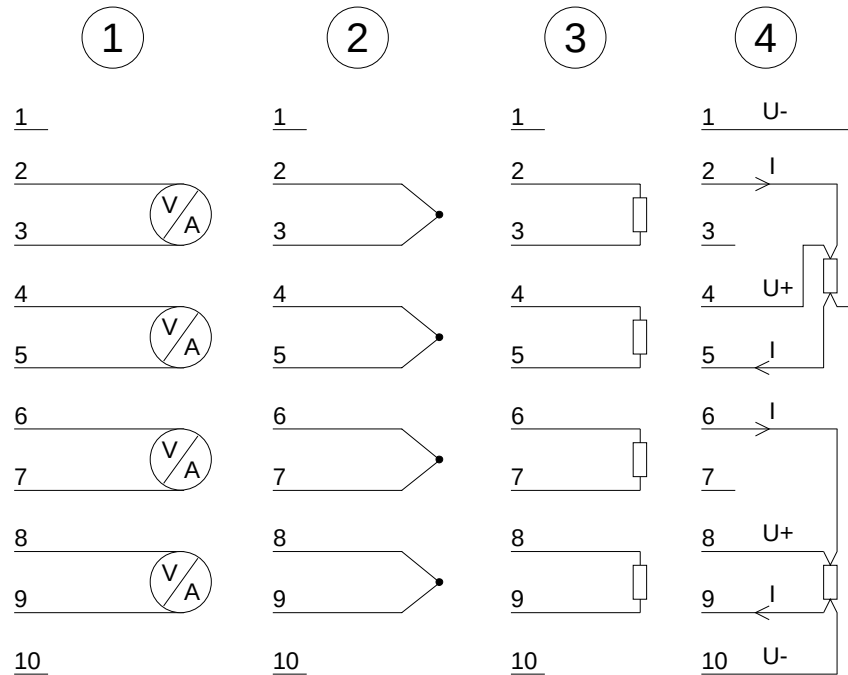
- [1] Label for module description
- [2] Label for the bit address with description
- [3] LEDs
- [4] Edge connector

Status indicators pin assignment

LED	Description	Pin	Assignment
F0 ... F3	LED (red): turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened		1 For 4wire systems channel 0 2 + channel 0 3 Channel 0 common 4 + channel 1 5 Channel 1 common 6 + channel 2 7 Channel 2 common 8 + channel 3 9 Channel 3 common 10 For 4wire systems channel 2

Wiring diagrams

The following illustration shows the connection options for the different measuring ranges. The assignment to the measuring ranges is to find in the column "Conn." of the table "Function-no. assignment" on the next pages.

**Attention!**

Temporarily not used inputs have to be connected with the concerning ground at activated channel. When deactivating unused channels by means of FFh, this is not required.

The following circumstances may cause damages at the analog module:

- The external supply of the input (current/voltage) must not be present as long as the backplane bus of the CPU is still without current supply!
- Parameterization and connection of the input must be congruent!
- You must not apply a voltage >15V to the input!

**Function-no.
assignment**

The assignment of a function-no. to a certain channel happens during parameterization. The function-no. 00h does not influence the function-no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Conn.
00h	Does not affect permanently stored configuration data		
01h	Pt100 in 2wire mode	-200°C ... +850°C / in units of 1/10°C, two's complement	(3)
02h	Pt1000 in 2wire mode	-200°C ... +850°C / in units of 1/10°C, two's complement	(3)
03h	NI100 in 2wire mode	-60°C ... +250°C / in units of 1/10°C, two's complement	(3)
04h	NI1000 in 2wire mode	-60°C ... +250°C / in units of 1/10°C, two's complement	(3)
05h	Resistance measurement 600Ohm 2wire	- / 60Ω = final value (32767)	(3)
06h	Resistance measurement 6000Ohm 2wire	- / 600Ω = final value (32767)	(3)
07h	Resistance measurement 30000Ohm 2wire	- / 3000Ω = final value (32767)	(3)
08h	Resistance measurement 60000Ohm 2wire	- / 6000Ω = final value (32767)	(3)
09h	Pt100 via 4wire connection	-200°C ... +850°C / in units of 1/10°C, two's complement	(4)
0Ah	Pt1000 via 4wire connection	-200°C ... +850°C / in units of 1/10°C, two's complement	(4)
0Bh	NI100 via 4wire connection	-60°C ... +250°C / in units of 1/10°C, two's complement	(4)
0Ch	NI1000 via 4wire connection	-60°C ... +250°C / in units of 1/10°C, two's complement	(4)
0Dh	Resistance measurement 600Ohm 4wire	- / 60Ω = final value (32767)	(4)
0Eh	Resistance measurement 6000Ohm 4wire	- / 600Ω = final value (32767)	(4)
0Fh	Resistance measurement 30000Ohm 4wire	- / 3000Ω = final value (32767)	(4)
10h	Thermocouple type J, ¹⁾ externally compensated	-210°C ... 1200 °C / in units of 1/10°C, two's complement	(2)

continued ...

... continue

No.	Function	Measurement range / representation	Conn.
11h	Thermocouple type K, ¹⁾ externally compensated	-270°C .. +1372°C / in units of 1/10°C, two's complement	(2)
12h	Thermocouple type N, ¹⁾ externally compensated	-270°C .. +1300°C / in units of 1/10°C, two's complement	(2)
13h	Thermocouple type R, ¹⁾ externally compensated	-50°C .. +1769°C / in units of 1/10°C, two's complement	(2)
14h	Thermocouple type T, ¹⁾ externally compensated	-270°C .. +400°C / in units of 1/10°C, two's complement	(2)
15h	Thermocouple type S, ¹⁾ externally compensated	-50°C .. +1769°C / in units of 1/10°C, two's complement	(2)
16h	Thermocouple type E, ¹⁾ externally compensated	-270°C .. +1000°C / in units of 1/10°C, two's complement	(2)
18h	Thermocouple type J, ²⁾ internally compensated	-210°C .. +1200°C / in units of 1/10°C, two's complement	(2)
19h	Thermocouple type K, ²⁾ internally compensated	-270°C .. +1372°C / in units of 1/10°C, two's complement	(2)
1Ah	Thermocouple type N, ²⁾ internally compensated	-270°C .. +1300°C / in units of 1/10°C, two's complement	(2)
1Bh	Thermocouple type R, ²⁾ internally compensated	-50°C .. +1769°C / in units of 1/10°C, two's complement	(2)
1Ch	Thermocouple type T, ²⁾ internally compensated	-270°C .. +400°C / in units of 1/10°C, two's complement	(2)
1Dh	Thermocouple type S, ²⁾ internally compensated	-50°C .. +1769°C / in units of 1/10°C, two's complement	(2)
1Eh	Thermocouple type E, ²⁾ internally compensated	-270°C .. +1000°C / in units of 1/10°C, two's complement	(2)
27h	Voltage ±50mV Siemens S7 format	±58.79mV / 58.79mV = max. value before over range (32511) -50...50mV = nominal range (-27648...27648) -58.79mV = min. value before under range (-32512) two's complement	(1)
28h	Voltage ±10V Siemens S7 format	±11.76V / 11.76V = max. value before over range (32511) -10...10V = nominal range (-27648...27648) -11.76V = min. value before under range (-32512) two's complement	(1)
29h	Voltage ±4V Siemens S7 format	±4.70V / 4.70V = max. value before over range (32511) -4...4V = rated range (-27648...27648) -4.70V = min. value before under range (-32512) two's complement	(1)
2Ah	Voltage ±400mV Siemens S7 format	±470mV / 470mV = max. value before over range (32511) -400...400mV = rated range (-27648...27648) -470mV = min. value before under range (-32512) two's complement	(1)
2Bh	Voltage ±10V Siemens S5 format	±12.50V / 12.50V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.50V = min. value before under range (-20480) value and sign	(1)

continued ...

... continue

No.	Function	Measurement range / representation	Conn.
2Ch	Current $\pm 20\text{mA}$ Siemens S7 format	$\pm 23.52\text{mA}$ / 23.52mA = max. value before over range (32511) -20...20mA = rated value (-27648...27648) -23.52mA = min. value before under range (-32512) two's complement	(1)
2Dh	Current 4...20mA Siemens S7 format	1.185 .. +22.81mA / 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 1.185 mA = min. value before under range (-4864) two's complement	(1)
2Eh	Current 4...20mA Siemens S5 format	0.8 .. +24.00mA / 24.00mA = max. value before over range (20480) 4 .. 20mA = rated range (0...16384) 0.8mA = min. value before under range (-3277) value and sign	(1)
2Fh	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 25.00\text{mA}$ / 25.00mA = max. value before over range (20480) -20...20mA = rated value (-16384...16384) -25.00mA = min. value before under range (-20480) value and sign	(1)
32h	Resistance measurement 6000 Ω 4wire	- / 6000 Ω = final value (32767)	(4)
33h	Resistance measurement 6000 Ω 4wire	- / 6000 Ω = final value (6000)	(4)
35h	Resistance measurement 60 Ω 2wire	- / 60 Ω = final value (6000)	(3)
36h	Resistance measurement 600 Ω 2wire	- / 600 Ω = final value (6000)	(3)
37h	Resistance measurement 3000 Ω 2wire	- / 3000 Ω = final value (30000)	(3)
38h	Resistance measurement 6000 Ω 2wire	- / 6000 Ω = final value (6000)	(3)
3Ah	Current $\pm 20\text{mA}$ Siemens S5 format	$\pm 25.00\text{mA}$ / 25.00mA = max. value before over range (20480) -20...20mA = nominal range (-16384...16384) -25.00mA = min. value before under range (-20480) two's complement	(1)
3Bh	Voltage $\pm 10\text{V}$ Siemens S5 format	$\pm 12.50\text{V}$ / 12.50V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.50V = min. value before under range (-20480) two's complement	(1)
3Dh	Resistance measurement 60 Ω 4wire	- / 60 Ω = final value (6000)	(4)
3Eh	Resistance measurement 600 Ω 4wire	- / 600 Ω = final value (6000)	(4)
3Fh	Resistance measurement 3000 Ω 4wire	- / 3000 Ω = final value (30000)	(4)

continued ...

... continue

No.	Function	Measurement range / representation	Conn.
57h	Voltage $\pm 50\text{mV}$	$\pm 58.79\text{mV}$ / 58.79mV = max. value before over range (5879) -50...50mV = rated range (-5000...5000) -58.79V = min. value before under range (-5879) two's complement	(1)
58h	Voltage $\pm 10\text{V}$	$\pm 11.76\text{V}$ / 11.76V = max. value before over range (11760) -10...10V = rated range (-10000...10000) -11.76V = min. value before under range (-11760) two's complement	(1)
59h	Voltage $\pm 4\text{V}$	$\pm 4.70\text{V}$ / 4.70V = max. value before over range (4700) -4...4V = rated range (-4000...4000) -4.70V = min. value before under range (-4700) two's complement	(1)
5Ah	Voltage $\pm 400\text{mV}$	$\pm 470\text{mV}$ / 470mV = max. value before over range (4700) -400...400mV = rated range (-4000...4000) -470mV = min. value before under range (-4700) two's complement	(1)
5Ch	Current $\pm 20\text{mA}$	$\pm 23.51\text{mA}$ / 23.51mA = max. value before over range (23510) -20...20mA = rated value (-20000...20000) -23.51mA = min. value before under range (-23510) two's complement	(1)
5Dh	Current 4...20mA	1.185 .. +22.81mA / 22.81mA = max. value before over range (18810) 4...20mA = rated range (0...16000) 1.185mA = min. value before under range (-2815) two's complement	(1)
62h	Cu50 2wire	-50°C ... +150°C / in units of 1/10°C, two's complement	(3)
6Ah	Cu50 4wire	-50°C ... +150°C / in units of 1/10°C, two's complement	(4)
FFh	Channel not active (turned off)		

¹⁾ the compensation of the neutralization must be implemented externally

²⁾ the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these must be extended by means of thermo element extension cables

**Note!**

The module is preset to the range " $\pm 10\text{V}$ voltage" at S7 format.

Measurement data acquisition

During a measurement the data is stored in the data input area.
The following figure shows the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

**Note!**

Only channels 0 and 2 are used in 4wire systems.

Diagnosis at wire break with Thermocouples always active

When using Thermocouples the diagnosis for wire break is always active. If a diagnosis alarm is parameterized, the module initializes a diagnosis at wire break for the corresponding channel.

Parameter data

Every channel is individual parameterizeable. For the parameterization, 10Byte parameterization data are available. The parameterization data are stored permanently and remain also in off mode. By using the SFC 55 "WR_PARM" you may alter the parameterization in the module during runtime. The time needed until the new parameterization is valid can last up to 60ms. During this time, the measuring value output is 7FFFh.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	diagnostic: Bit 5 ... 0: reserved Bit 6: diagnostic alarm 0: deactivated 1: activated Bit 7: reserved	00h
1	Bit 7 ... 0: reserved	00h
2	Function-no. channel 0	28h
3	Function-no. channel 1	28h
4	Function-no. channel 2	28h
5	Function-no. channel 3	28h
6	Option-Byte channel 0	00h
7	Option-Byte channel 1	00h
8	Option-Byte channel 2	00h
9	Option-Byte channel 3	00h

Parameters*Diagnostic alarm*

With the help of Bit 6 of Byte 0, you may release the diagnostic alarm. In case of an error, the *record set 0* with a size of 4Byte is transferred to the superordinated system.

More detailed information is to find below under "Diagnostic data".

Function-no.

Here you set the function-no. of your measuring function for every channel. Please see the according table above.

Option-Byte

Here you may set the transducer velocity for every input channel. Please regard that a higher transducer velocity causes a lower resolution because of the lower integration time.

The data transfer format remains unchanged. Only the lower Bits (LSBs) are not longer relevant for the analog value.

Structure Option-Byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 7	Bit 3 ... 0: Velocity per channel*		00h
	0000 15 conversions/s	16	
	0001 30 conversions/s	16	
	0010 60 conversions/s	15	
	0011 120 conversions/s	14	
	0100 170 conversions/s	12	
	0101 200 conversions/s	10	
	0110 3,7 conversions/s	16	
	0111 7,5 conversions/s	16	
	Bit 5 ... 4: Mean value evaluation		
	00 deactivated		
	01 use 2 of 3 values		
	10 use 4 of 6 values		
	11 deactivated		
	Bit 7 ... 6: Envelope function		
	00 deactivated		
	01 envelope ± 8		
	10 envelope ± 16		
	11 deactivated		

*) These specifications apply to 1channel operation. For multi-channel operations, the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Mean value evaluation

Mean value function 2 of 3 values:

After every measuring, the module evaluates the mean value of the last 3 binary values. The value most different from the mean value is deleted and another mean value evaluated from the remaining 2 values. This value is monitored.

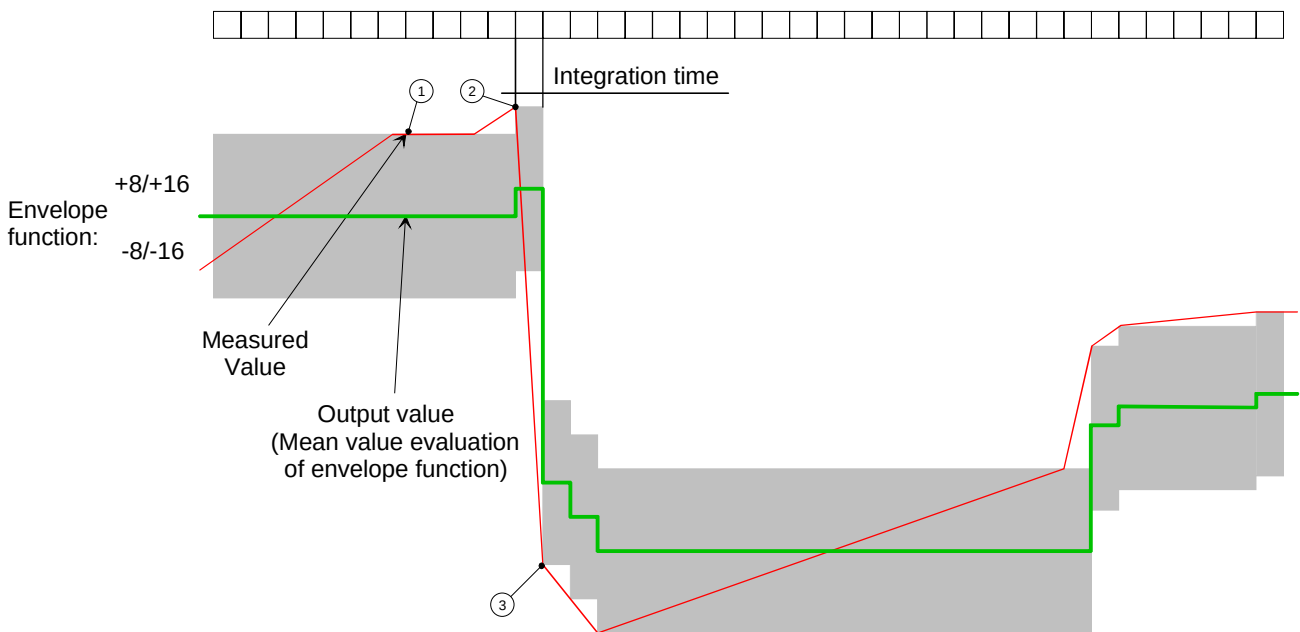
Mean value function 4 of 6 values:

After every measuring, the module evaluates the mean value of the last 6 binary values. The 2 values most different from the mean value are deleted and another mean value evaluated from the remaining 4 values. This value is monitored.

Envelope function

The output valued is "wrapped" with an envelope. If the measured value over- res. underruns the envelope, the envelope migrates accordingly. The output value is the mean value of the envelope.

The following sample illustrates this:



- ① Measuring value within envelope → no envelope shift, Output is mean value of the current envelope upper and lower limit.
- ② Measuring value oversteps the envelope → Envelope shift up for the difference between "old" envelope upper limit and measuring range, output value is the mean value of the "new" envelope upper and lower limit.
- ③ Measuring value shortfalls the envelope → Envelope shift down for the difference between "old" envelope lower limit and measuring range, output value is the mean value of the "new" envelope upper and lower limit.

Diagnostic data

The diagnostic data uses 12Byte and are stored in the record sets 0 and 1 of the system data area.

When you enable the diagnostic alarm in Byte 0 of the parameter area, modules will transfer *record set 0* to the superordinated system when an error is detected.

Record set 0 has a predefined content and a length of 4Byte. The content of the record set may be read in plain text via the diagnostic window of the CPU.

For extended diagnosis during runtime, you may evaluate the 12Byte wide *record set 1* via the SFCs 51 and 59.

Evaluate diagnosis

At present diagnosis, the CPU interrupts the user application and branches into the OB 82. This OB gives you detailed diagnostic data via the SFCs 51 and 59 when programmed correctly.

After having processed the OB 82, the user application processing is continued. Until leaving the OB 82, the data remain consistent.

Record set 0

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present Bit 6 ... 4: reserved Bit 7: Wrong parameters in the module	00h
1	Bit 3 ... 0: Module class 0101 Analog module Bit 4: Channel information present Bit 7 ... 5: reserved	15h
2	reserved	00h
3	reserved	00h

Record set 1

The *record set 1* contains the 4Byte of record set 0 and additional 8Byte channel specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	Content record set 0 (see page before)	-
4	Bit 6 ... 0: Channel type 70h: Digital input 71h: Analog input 72h: Digital output 73h: Analog output 74h: Analog in-/output Bit 7: reserved	74h
5	Bit 7 ... 0: Number of diagnostic bits of the module per channel	08h
6	Bit 7 ... 0: Number of identical channels of a module	04h
7	Bit 0: Channel error Channel 0 Bit 1: Channel error Channel 1 Bit 2: Channel error Channel 2 Bit 3: Channel error Channel 3 Bit 7 ... 4: reserved	00h
8	Bit 0: Wire break Channel 0 (only at Thermocouples) Bit 1: Parameterization error Channel 0 Bit 2: Measuring range underflow Channel 0 Bit 3: Measuring range overflow Channel 0 Bit 7 ... 4: reserved	00h
9	Bit 0: Wire break Channel 1 (only at Thermocouples) Bit 1: Parameterization error Channel 1 Bit 2: Measuring range underflow Channel 1 Bit 3: Measuring range overflow Channel 1 Bit 7 ... 4: reserved	00h
10	Bit 0: Wire break Channel 2 (only at Thermocouples) Bit 1: Parameterization error Channel 2 Bit 2: Measuring range underflow Channel 2 Bit 3: Measuring range overflow Channel 2 Bit 7 ... 4: reserved	00h
11	Bit 0: Wire break Channel 3 (only at Thermocouples) Bit 1: Parameterization error Channel 3 Bit 2: Measuring range underflow Channel 3 Bit 3: Measuring range overflow Channel 3 Bit 7 ... 4: reserved	00h

Technical data

Electrical Data	VIPA 231-1BD53							
Number of inputs	4							
- at 4wire resistance-type sensor	2							
Length of cable (shielded)	200m							
Voltages, Currents, Potentials								
Constant current for resistance-type sensor	1.25mA							
Isolation								
- channel / backplane bus	yes							
- between the channels	no							
Permitted potential difference								
- between the inputs (U_{CM})	DC 5V							
- between inputs and $M_{INTERNAL}$ (U_{ISO})	DC 75V/AC 60V							
Isolation proofed with	DC 500V							
Current consumption								
- via backplane bus	280mA							
Power dissipation of the module	1.4W							
Analog value generation	Calculation time/Resolution (per channel)							
Measuring principle	Sigma-Delta							
parameterizable	yes							
Conversion rate (Hz)	200	170	120	60	30	15	7.5	3.7
Integration time (ms)	5	6	8	17	33	67	133	270
Basic conversion time (ms)	7	8	10	19	35	69	135	272
- Additional conversion time for open-circuit monitoring (ms)	135	135	135	135	135	135	135	135
- Service time per cycle (only by thermocouple) (ms)	10	10	10	10	10	10	10	10
Resolution (Bit) incl. overrange	10	12	14	15	16	16	16	16
Noise suppression for frequency f1 (Hz)	no					50 and 60Hz		
Basic execution time of the module, in ms (all channels enabled)	28	32	40	76	140	276	540	1088
Averaging	2 of 3 or 4 of 6							
Envelope function	± 8 or ± 16							
Suppression of interference, Limits of error								
Noise suppression for $f=n \times (f1 \pm 1\%)$ ($f1$ =interference frequency, $n=1,2,\dots$)								
Common-mode interference ($U_{CM} < 5V$)	> 80dB							
Series-mode noise (peak value of noise < nominal value of input range)	> 80dB							
Crosstalk between the inputs	> 50dB							

continued ...

... continue

Operational limit (only valid to 120W/s) (in the entire temperature range, with reference to the input range)		
At voltage input	Measuring range	Tolerance
	$\pm 50\text{mV}$	$\pm 0.6\%$
	$\pm 400\text{mV}$, $\pm 4\text{mV}$, $\pm 10\text{V}$	$\pm 0.3\%$
At current input	$\pm 20\text{mA}$	$\pm 0.3\%$
	0...20mA	$\pm 0.6\%$
	4...20mA	$\pm 0.8\%$
Resistance	0...60 Ω	$\pm 0.8\%$
	0...600 Ω , 0...3k Ω , 0...6k Ω	$\pm 0.4\%$
Resistance thermometer	Pt100, Pt1000	$\pm 0.4\%$
	Ni100, Ni1000	$\pm 1.0\%$
	Cu50	$\pm 1.4\%$
Thermocouple	Type J, K, N, R, S, E, T	$\pm 1.5\%$
Basic error limit (only valid to 120W/s) (during temperature is 25°C, referring to input range)		
Voltage input	Measuring range	Tolerance
	$\pm 50\text{mV}$	$\pm 0.4\%$
	$\pm 400\text{mV}$, $\pm 4\text{V}$, $\pm 10\text{V}$	$\pm 0.2\%$
Current input	$\pm 20\text{mA}$	$\pm 0.2\%$
	0...20mA	$\pm 0.4\%$
	4...20mA	$\pm 0.5\%$
Resistance	0...60 Ω	$\pm 0.4\%$
	0...600 Ω , 0...3k Ω , 0...6k Ω	$\pm 0.2\%$
Resistance thermometer	Pt100, Pt1000	$\pm 0.2\%$
	Ni100, Ni1000	$\pm 0.5\%$
	Cu50	$\pm 0.7\%$
Thermocouple	Type J, K, N, R, S, E, T	$\pm 1.0\%$
Temperature error (with reference to the input range) measuring current		$\pm 0.005\%/K$ $\pm 0.015\%/K$
Linearity error (with reference to the input range)		$\pm 0.02\%$
Repeatability (in steady state at 25°C referred to the input range)		$\pm 0.05\%$
Temperature error of internal compensation		$\pm 1.5\%$
States, Interrupts, Diagnosis		
Diagnostic interrupt	parameterizable	
Diagnosis functions	red SF LED (per channel)	
- Sum error monitor	possible	
- Diagnostic information read-out		

continued ...

... continue

Data for selecting a sensor	
Voltage ±50mV, ±400mV, ±4V, ±10V	20MΩ
Current ±20mA, 0...20mA, 4...20mA	50Ω
Resistors 0...60Ω, 0...600Ω, 0...3kΩ, 0...6kΩ	20MΩ
Resistance thermometer Pt100, Pt1000, Ni100, Ni1000, Cu50	20MΩ
Thermocouple Type J, K, N, R, S, E, T	20MΩ
Maximum input voltage for voltage input (destruction limit)	25V
Maximum input current for current input (destruction limit)	30mA
Connection of the sensor For measuring voltage For measuring current as 2wire transmitter as 4wire transmitter For measuring resistance with 2conductor connection with 4conductor connection	possible possible with external power supply possible possible possible
Characteristic linearization parameterizable for RTD Thermocouple	yes Pt100, Pt1000, Ni100, Ni1000, Cu50 Typ J, K, N, R, S, E, T
Temperature compensation parameterizable internal temperature compensation external temperature compensation with comparison point (0°C)	yes possible possible
Unit for temperature measurement	°C
Parameter data	
Input data Parameter data Diagnostic data	8Byte (1 Word per channel) 10Byte 12Byte
Dimensions and weight	
Dimensions (WxHxD) in mm Weight	25.4x76x88mm 80g

231-1BD60 - AI 4x12Bit, 4 ... 20mA, isolated

Order data

AI 4x12Bit, 4...20mA, isolated

VIPA 231-1BD60

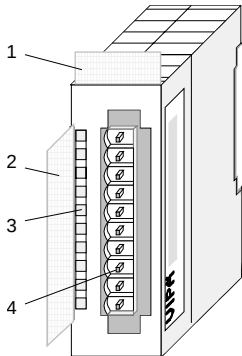
Description

The module has 4 inputs that are permanently configured to measure current signals (4 ... 20mA). This module requires a total of 8Byte of the process image for the input data (2Byte per channel).

The measured values are returned in S5 format from Siemens. DC/DC converters and isolation amplifiers are employed to provide electrical isolation for the channels of the module with respect to the backplane bus and between the different channels.

- Properties
- 4 inputs, channels isolated from the backplane bus and from each other (galvanic isolation of the channels by means of isolation amplifiers)
 - Permanently configured for current measurements
 - No parameterization required
 - Suitable for transducers with 4 ... 20mA outputs
 - LEDs to indicate wire break

Construction



[1] Label for the name of the module

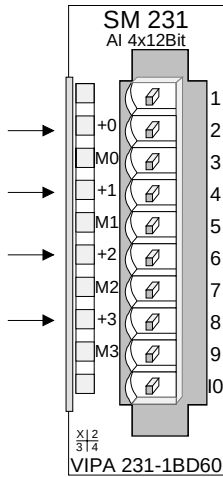
[2] Label for the bit address with description

[3] LED status indicator

[4] Edge connector

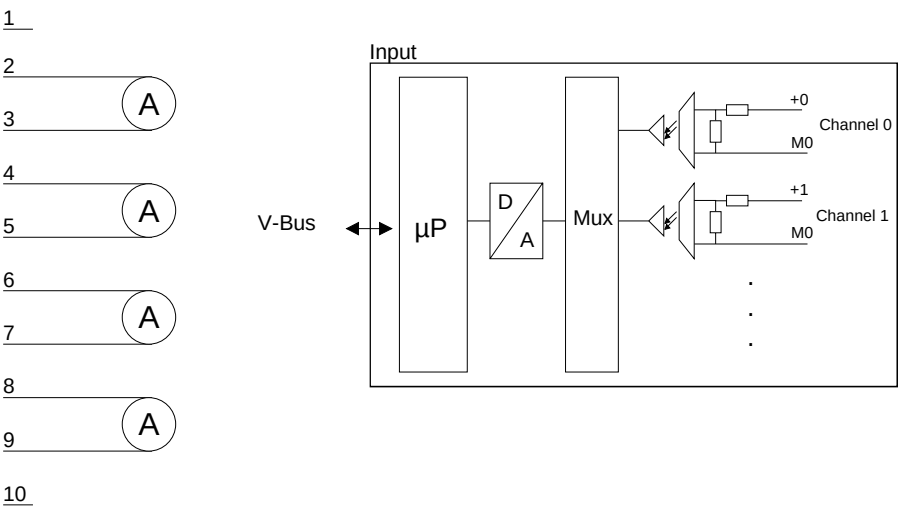
Status indicator
pin assignment

LED	Description	Pin	Assignment
+0 ... +3	LED (red)	1	
	wire break detection	2	pos. connection Ch. 0
	These LEDs is turned on when the transducer is disconnected.	3	Channel 0 common
		4	pos. connection Ch.1
		5	Channel 1 common
		6	pos. connection Ch.2
		7	Channel 2 common
		8	pos. connection Ch.3
		9	Channel 3 common
		10	



Wiring and schematic diagram

Wiring diagram Schematic diagram



Wire break recognition

The wire break recognition is always active. In case of a wire break res. when no encoder is connected, the LED of the according channel is turned on. The module has no diagnostic ability.

Numeric notation

Input data in Siemens S5 format is stored in a word. The word contains the binary value and information bits:

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range exceeded Bit 1: error bit (set at internal error) Bit 2: activity bit (always 0) Bit 7 ... 3: binary measured value (see table below)
1	Bit 6 ... 0: binary measured value (see table below) Bit 7: sign 0 positive 1 negative

The following table shows the allocation of binary values to the respective measured values.

**Numeric notation
in Siemens
S5 format**

Measured value in mA	Units	Binary measured value	T	E	Ü	Range
24.0	2560	0 1 0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	overdrive region
20.016	2049	0 1 0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
20.0	2048	0 1 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	nominal range
19.98	2047	0 0 1 1 1 1 1 1 1 1 1 1 1 1	0	0	0	
12.0	1024	0 0 1 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
8.0	512	0 0 0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	
6.0	256	0 0 0 0 1 0 0 0 0 0 0 0 0 0	0	0	0	
5.0	128	0 0 0 0 0 1 0 0 0 0 0 0 0 0	0	0	0	
4.016	2	0 0 0 0 0 0 0 0 0 0 0 0 0 1 0	0	0	0	
4.008	1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
4	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
3.984	-2	1 1 1 1 1 1 1 1 1 1 1 1 1 1 0	0	0	0	Underdrive region
3.0	-128	1 1 1 1 1 1 0 0 0 0 0 0 0 0	0	0	0	
2.0	-256	1 1 1 1 1 0 0 0 0 0 0 0 0 0	0	0	0	
1.0	-384	1 1 1 1 0 1 0 0 0 0 0 0 0 0	0	0	0	
0.0	-512	1 1 1 1 0 0 0 0 0 0 0 0 0 0	0	0	0	

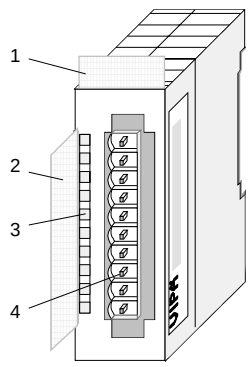
Technical data

Electrical data	VIPA 231-1BD60
Number of inputs	4 individually isolated
Current measuring range	4 ... 20mA
Input filter time delay	3ms
Input resistance	20Ω
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	yes, every channel separately, isolation tested at 500Vrms
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	-
Diagnostic data	-
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x88mm
Weight	120g

231-1BD70 - AI 4x12Bit, ±10V, isolated

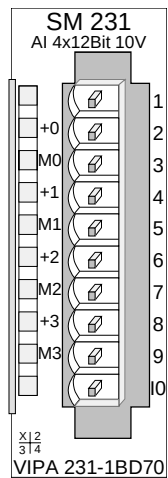
Order data	AI 4x12Bit, ±10V, isolated	VIPA 231-1BD70
Description	The module has 4 inputs that are permanently configured to measure voltage signals (±10V). This module requires a total of 8Byte of the process image for the input data (2Byte per channel). The measured values are returned in S5 format from Siemens. DC/DC converters and isolation amplifiers are employed to provide electrical isolation for the channels of the module with respect to the backplane bus and between the different channels.	
Properties	• 4 inputs, channels isolated from the backplane bus and from each other (Galvanic isolation of the channels by means of isolation amplifiers) • Permanently configured for voltage measurements • No parameterization required • Suitable for transducers with ±10V outputs	

Construction



- [1] Label for the name of the module
- [2] Label for the bit address with description
- [3]
- [4] Edge connector

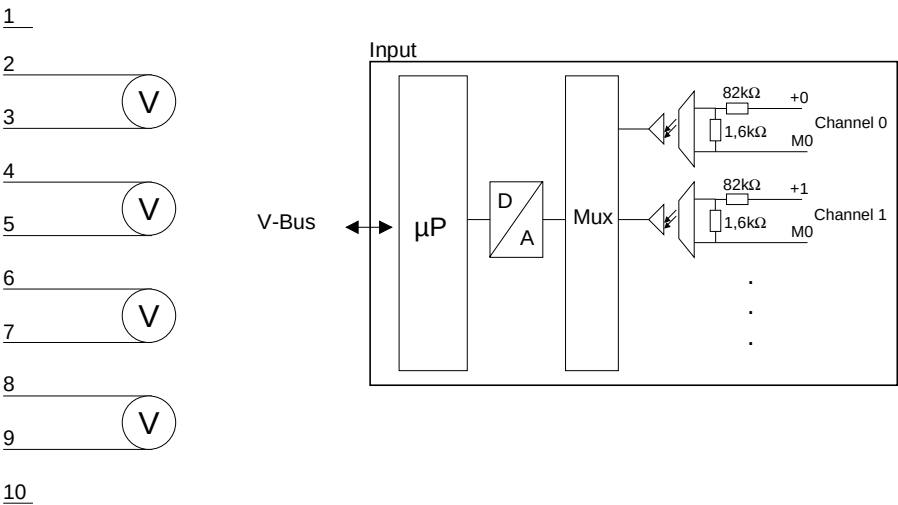
Pin assignment



Pin	Assignment
1	
2	pos. connection Channel 0
3	Channel 0 common
4	pos. connection Channel 1
5	Channel 1 common
6	pos. connection Channel 2
7	Channel 2 common
8	pos. connection Channel 3
9	Channel 3 common
10	

Wiring and schematic diagram

Wiring diagram Schematic diagram



Numeric notation

Input data in Siemens S5 format is stored in a word. The word contains the binary value and information bits:

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: overflow bit 0: value within measuring range 1: measuring range exceeded Bit 1: error bit (set at internal error) Bit 2: activity bit (always 0) Bit 7 ... 3: binary measured value (see table below)
1	Bit 6 ... 0: binary measured value (see table below) Bit 7: sign 0 positive 1 negative

The following table shows the allocation of binary values to the respective measured values.

**Numeric notation
in Siemens
S5 format**

Measured value in V	Units	Binary measured value	T	E	Ü	Range
12.5	2560	0 1 0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	overdrive region
10.005	2049	0 1 0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
10.0	2048	0 1 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	nominal range
5	1024	0 0 1 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
2.5	512	0 0 0 1 0 0 0 0 0 0 0 0 0 0	0	0	0	
1.25	256	0 0 0 0 1 0 0 0 0 0 0 0 0 0	0	0	0	
0.625	128	0 0 0 0 0 1 0 0 0 0 0 0 0 0	0	0	0	
0.005	1	0 0 0 0 0 0 0 0 0 0 0 0 0 1	0	0	0	
0	0	0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
-0.005	-1	1 1 1 1 1 1 1 1 1 1 1 1 1 1	0	0	0	
-0.625	-128	1 1 1 1 1 1 0 0 0 0 0 0 0 0	0	0	0	
-1.25	-256	1 1 1 1 1 0 0 0 0 0 0 0 0 0	0	0	0	
-2.5	-512	1 1 1 1 0 0 0 0 0 0 0 0 0 0	0	0	0	
-5	-1024	1 1 1 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
-10.0	-2048	1 1 0 0 0 0 0 0 0 0 0 0 0 0	0	0	0	
-10.005	-2049	1 0 1 1 1 1 1 1 1 1 1 1 1 1	0	0	0	Underdrive region
-12	-2560	1 0 1 1 0 0 0 0 0 0 0 0 0 0	0	0	0	

Technical data

Electrical data	VIPA 231-1BD70
Number of inputs	4 individually isolated
Voltage measuring range	±10V
Input filter time delay	3ms
Input resistance	83.5kΩ
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	yes, every channel separately, isolation tested at 500Vrms
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	-
Diagnostic data	-
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x88mm
Weight	120g

231-1BF00 - AI 8x16Bit

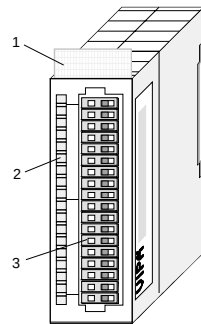
Order data AI 8x16Bit VIPA 231-1BF00

Description The analog input module transfers analog signals from the process into digital signals for the internal processing.
As transducer you may connect thermo couplers type J, K, T and resistance thermometer Pt100.
The modules has 8 inputs that you may configure in groups of two channels individually.

Properties

- 8 analog inputs
- wire break detection
- resolution 15Bit + sign

Construction



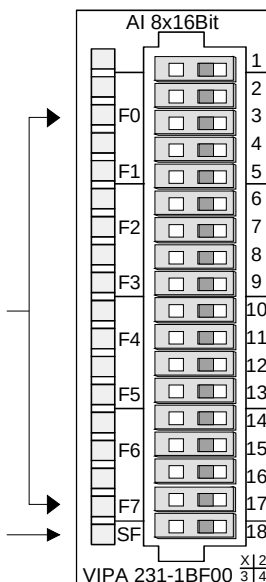
- [1] Label for the name of the module
- [2] LED status indicator
- [3] Edge connector

Status indicator pin assignment

LED	Description
-----	-------------

F0...F7	LED (red): error for each channel
---------	--------------------------------------

SF	LED (red): sum error
----	-------------------------



Pin	Assignment
-----	------------

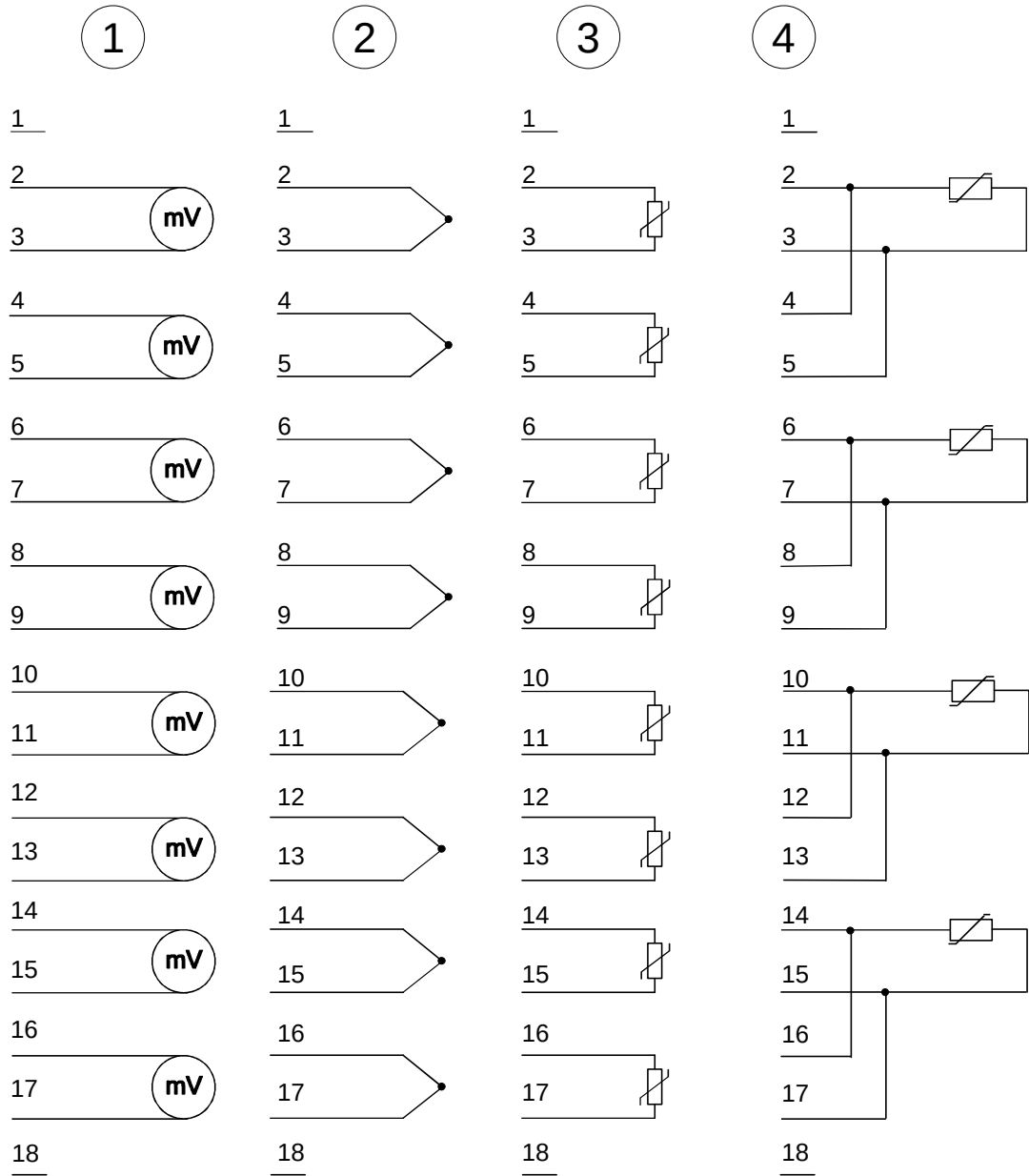
1	not connected
2	pos. connection Ch.0
3	Channel 0 common
4	pos. connection Ch.1
5	Channel 1 common
6	pos. connection Ch.2
7	Channel 2 common
8	pos. connection Ch.3
9	Channel 3 common
10	pos. connection Ch.4
11	Channel 4 common
12	pos. connection Ch.5
13	Channel 5 common
14	pos. connection Ch.6
15	Channel 6 common
16	pos. connection Ch.7
17	Channel 7 common
18	not connected



Note!

Unused inputs on activated channels have to be connected to the respective ground. This is not necessary when the unused channels are turned off by means of FFh.

Connection
diagram



**Function-no.
assignment**

The assignment of a function-no. to a certain channel happens during parameterization. The function-no. 00h does not influence the function-no. stored in the permanent parameterization data. Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance ref. to nominal range	Conn.
00h	Does not affect permanently stored configuration data			
01h	RTD Pt100 in 2wire mode	-200 .. +850°C / in units of 1/10°C, two's complement	¹⁾²⁾³⁾ ±0.15%	(3)
61h	RTD Pt100 in 2wire mode	-328 .. 1562°F in units of 1/10°F, two's complement	¹⁾²⁾³⁾ ±0.15%	(3)
09h	RTD Pt100 via 4wire connection	-200 .. +850°C / in units of 1/10°C, two's complement	¹⁾²⁾ ±0.15%	(4)
69h	RTD Pt100 via 4wire connection	-328 .. 1562°F in units of 1/10°F, two's complement	¹⁾²⁾ ±0.15%	(4)
10h	Thermocouple type J, externally compensated	0 °C .. 1000°C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±0.1%	(2)
40h	Thermocouple type J, externally compensated	32 .. 1832°F in units of 1/10°F, two's complement	¹⁾²⁾⁴⁾ ±0.1%	(2)
11h	Thermocouple type K, externally compensated	0 °C .. 1300°C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ ±0.1%	(2)
41h	Thermocouple type K, externally compensated	32 .. 2372°F in units of 1/10°F, two's complement	¹⁾²⁾⁴⁾ ±0.1%	(2)
14h	Thermocouple type T, externally compensated	-200 °C .. +400°C / in units of 1/10°C, two's complement	¹⁾²⁾⁴⁾ -200...-60.1 ±0.5% -60...400 ±0.2%	(2)
44h	Thermocouple type T, externally compensated	-328 .. 752°F in units of 1/10°F, two's complement	¹⁾²⁾⁴⁾ -328...-76,1 ±0.5% -76...752 ±0.2%	(2)
18h	Thermocouple type J, internally compensated	0 °C .. 1000°C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±1.0%	(2)
48h	Thermocouple type J, internally compensated	32 .. 1832°F in units of 1/10°F, two's complement	¹⁾²⁾⁵⁾ ±1.0%	(2)
19h	Thermocouple type K, internally compensated	0 °C .. 1300°C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±1.0%	(2)
49h	Thermocouple type K, internally compensated	32 .. 2372°F in units of 1/10°F, two's complement	¹⁾²⁾⁵⁾ ±1.0%	(2)
1Ch	Thermocouple type T, internally compensated	-200 °C .. +400°C / in units of 1/10°C, two's complement	¹⁾²⁾⁵⁾ ±2.0%	(2)
4Ch	Thermocouple type T, internally compensated	-328 .. 752°F in units of 1/10°F, two's complement	¹⁾²⁾⁵⁾ ±2.0%	(2)
26h	Voltage 0...60mV	0...60mV = nominal range (0-27648)	¹⁾ ±0.1%	(1)
56h	Voltage 0...60mV	0...60mV = nominal range (0-6000) in units of 1/100mV	¹⁾ ±0.1%	(1)
FFh	Channel not active (off)			

¹⁾ measured at an ambient temperature of 25°C, velocity of 15 conversions/s

²⁾ excluding errors caused by transducer inaccuracies

³⁾ excluding errors caused by contact resistance and line resistance

⁴⁾ the compensation of the neutralization has to be implemented externally

⁵⁾ the compensation for the neutralization is implemented internally by including the temperature of the front plug. The thermal conductors have to be connected directly to the front plug, and where necessary these have to be extended by means of Thermocouple extension cables.

Measurement data acquisition

During a measurement, the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figures show the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3
8	High-Byte channel 4
9	Low-Byte channel 4
10	High-Byte channel 5
11	Low-Byte channel 5
12	High-Byte channel 6
13	Low-Byte channel 6
14	High-Byte channel 7
15	Low-Byte channel 7

**Note!**

Only channels 0, 2, 4 and 6 are used in 4wire systems.

Parameter data

You may configure the channels in groups of two individually. 10Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 0: 0: wire break recognition channel 0/1 off 1: wire break recognition channel 0/1 on Bit 1: 0: wire break recognition channel 2/3 off 1: wire break recognition channel 2/3 on Bit 2: 0: wire break recognition channel 4/5 off 1: wire break recognition channel 4/5 on Bit 3: 0: wire break recognition channel 6/7 off 1: wire break recognition channel 6/7 on Bit 4, 5: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	0Fh
1	reserved	00h
2	Function-no. channel 0/1 (see table)	26h
3	Function-no. channel 2/3 (see table)	26h
4	Function-no. channel 4/5 (see table)	26h
5	Function-no. channel 6/7 (see table)	26h
6	Option Byte channel 0/1	00h
7	Option Byte channel 2/3	00h
8	Option Byte channel 4/5	00h
9	Option Byte channel 6/7	00h

Parameters*Diagnostic alarm*

The diagnostic alarm is enabled by means of Bit 6 of Byte 0. In this case an error a 4Byte diagnostic message will be issued to the master system.

Function-no.

Here you have to enter the function number of your measurement function for 2 channels. The allocation of the function number to a measurement function is available from the table above.

Option-Byte

Here you may specify for 2 channels the conversion rate.

**Note!**

Please note that the resolution is reduced when conversion rate is increased due to the shorter integration time.

The format of the data transfer remains the same. The only difference is that the lower set of bits (LSBs) lose significance for the analog value.

Structure of the option byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	Option byte: Bit 3 ... 0: rate* 0000 15 conversions/s 0001 30.1 conversions/s 0010 60 conversions/s 0011 123.2 conversions/s 0100 168.9 conversions/s 0101 202.3 conversions/s 0110 3.76 conversions/s 0111 7.51 conversions/s Bit 7 ... 4: reserved		00h

*) These specifications apply to 1channel operation. For multi-channel operations the conversion rate per channel can be calculated by dividing the specified conversion rate by the number of active channels.

Diagnostic data

The diagnostic data have a size of 12Byte and are stored in the record sets 0 and 1 of the system data area.

As soon as you activated the alarm release in Byte 0 of the parameter area, in case of an error *record set 0* is transferred to the superordinated system.

Record set 0 has a fixed content and a length of 4Byte. The contents of *record set 0* may be monitored in plain text via the diagnosis window of the CPU.

For extended diagnostic purposes during runtime, you may evaluate the *record set 1* with a size of 12Byte via the SFCs 51 and 59.

Evaluate diagnosis

At a diagnostic task the CPU interrupts the user application and branches into OB 82. With according programming, you may request in this OB with the SFCs 51 and 59 detailed diagnostic information and react on it.

After execution of the OB 82, the processing of the user application is continued. The diagnostic data remains consistent until leaving the OB 82.

Record set 0

Byte 0 to 3:

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: error in module Bit 1: reserved Bit 2: external error Bit 3: channel error Bit 6 ... 4: reserved Bit 7: wrong parameter in module	00h
1	Bit 3 ... 0: module class 0101 analog module Bit 4: channel information present Bit 7 ... 6: reserved	15h
2	not used	00h
3	Bit 5 ... 0: reserved Bit 6: missing (lost) process alarm (see process alarm) Bit 7: reserved	00h

Record set 1*Byte 0 to 11:*

Record set 1 contains the 4Byte of record set 0 and 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	content of record set 0 (see page above)	-
4	Bit 6 ... 0: channel type 70h: digital input 71h: analog input 72h: digital output 73h: analog output Bit 7: reserved	71h
5	Bit 7 ... 0: number of diagnostic output bits per channel	04h
6	Bit 7 ... 0: number of similar channels of a module	08h
7	Bit 0: Channel error channel 0 Bit 1: Channel error channel 1 Bit 2: Channel error channel 2 Bit 3: Channel error channel 3 Bit 4: Channel error channel 4 Bit 5: Channel error channel 5 Bit 6: Channel error channel 6 Bit 7: Channel error channel 7	00h
8	Bit 0: Wire break channel 0 Bit 1: Parameterization error channel 0 Bit 2: Measuring range underflow channel 0 Bit 3: Measuring range overflow channel 0 Bit 4: Wire break channel 1 Bit 5: Parameterization error channel 1 Bit 6: Measuring range underflow channel 1 Bit 7: Measuring range overflow channel 1	00h
9	Bit 0: Wire break channel 2 Bit 1: Parameterization error channel 2 Bit 2: Measuring range underflow channel 2 Bit 3: Measuring range overflow channel 2 Bit 4: Wire break channel 3 Bit 5: Parameterization error channel 3 Bit 6: Measuring range underflow channel 3 Bit 7: Measuring range overflow channel 3	00h

continued ...

... continue

Byte	Bit 7 ... Bit 0	Default
10	Bit 0: Wire break channel 4 Bit 1: Parameterization error channel 4 Bit 2: Measuring range underflow channel 4 Bit 3: Measuring range overflow channel 4 Bit 4: Wire break channel 5 Bit 5: Parameterization error channel 5 Bit 6: Measuring range underflow channel 5 Bit 7: Measuring range overflow channel 5	00h
11	Bit 0: Wire break channel 6 Bit 1: Parameterization error channel 6 Bit 2: Measuring range underflow channel 6 Bit 3: Measuring range overflow channel 6 Bit 4: Wire break channel 7 Bit 5: Parameterization error channel 7 Bit 6: Measuring range underflow channel 7 Bit 7: Measuring range overflow channel 7	00h

Technical data

Electrical data	VIPA 231-1BF00
Number of inputs	8
Input resistance	> 2MΩ
measuring range	
- Thermocouple	Type J, K, T
- Resistance thermometer	Pt100
- Voltage measuring	0...60mV
Power supply	5V via backplane bus
Current consumption	280mA via backplane bus
Isolation	500Vrms (field voltage - backplane bus)
Dissipation power	typ. 1.3W
Status indicators	via LEDs on the front
Programming specifications	
Input data	16Byte (1 word per channel)
Output data	-
Parameter data	10Byte
Diagnostic data	12Byte
Process alarm data	-
Dimensions and weight	
Dimensions (WxHxD)	25.4x76x88mm
Weight	120g

231-1FD00 - AI 4x16Bit f

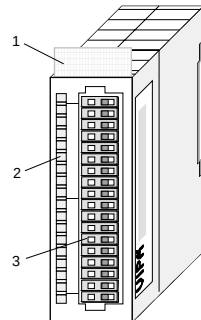
Order data AI 4x16Bit f VIPA 231-1FD00

Description The module has 4 fast (f=fast) inputs that you may configure individually. The module requires a total of 8 input data bytes in the process image (2Byte per channel).

Isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

- Properties**
- Using all 4 channels, the cycle time is < 1ms
 - the different channels are individually configurable and can be turned off
 - LED for signaling wire break in current loop operation
 - Diagnostic function
 - Resolution 16Bit

Construction



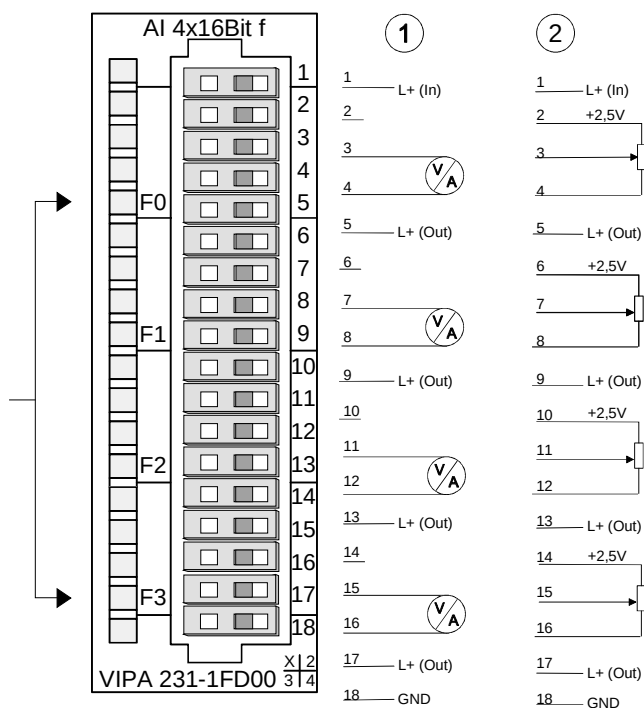
- [1] Label for the name of the module
- [2] LED status indicator
- [3] Edge connector

Status indicator pin assignment

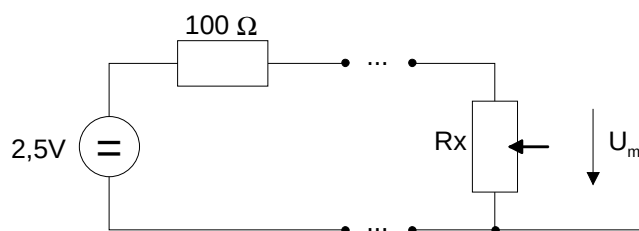
LED Description

F0 ... F3 LED (red):
is on if the measured current
value exceeds the range
4...20mA (cable break or
overload).

Wiring diagram



The internal resistance R_i of the 2.5V voltage source is 100Ω . For a connection of a voltage divider the following equivalent circuit is valid:



Note!

Unused inputs on activated channels have to be connected to the respective ground. This is not necessary when the unused channels are turned off by means of FFh.

**Function-no.
allocation**

The assignment of a function-no. to a certain channel happens during parameterization. The function-no. 00h does not influence the function-no. stored in the permanent parameterization data.

Assigning FFh deactivates the according channel.

No.	Function	Measurement range / representation	Tolerance	Conn.
00h	Does not affect permanently stored configuration data			
28h	Voltage $\pm 10V$ Siemens S7 format (Default)	-10V ... -9.9V (-27648 ... -27371) ¹⁾ -9.9 ... 9.9 (-27370 ... 27370) -10...10V = rated range (-27648...27648) 9.9 ... 10V (27371 ... 27648) ¹⁾	0.2% of final value	(1), (2)
29h	Voltage $\pm 4V$ Siemens S7 format	$\pm 4.70V$ / 4.70V = max. value before over range (32511) -4...4V = rated range (-27648...27648) -4.70V = min. value before under range (-32512) two's complement	0.2% of final value	(1), (2)
2Ah	Voltage $\pm 400mV$ Siemens S7 format	$\pm 470mV$ / 470mV = max. value before over range (32511) -400...400mV = rated range (-27648...27648) -470mV = min. value before under range (-32512) two's complement	0.4% of final value	(1)
2Ch	Current $\pm 20mA$ Siemens S7 format	$\pm 23.51mA$ / 23.51mA = max. value before over range (32511) -20...20mA = rated range (-27648...27648) -23.51mA = min. value before under range (-32512) two's complement	0.2% of final value	(1)
2Dh	Current 4...20mA Siemens S7 format	1.185 .. +22.81mA / 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 1.18mA = min. value before under range (-4864) two's complement	0.5% of final value	(1)
58h	Voltage $\pm 10V$	-10 ... -9.9V (-10000 ... -9901) ¹⁾ -9,9 ... 9.9V (-9900 ... 9900) -10...10V = rated range (-10000...10000) 9.9 ... 10V (9901 ... 10000) ¹⁾	0.2% of final value	(1), (2)
59h	Voltage $\pm 4V$	$\pm 4.95V$ / 4,95V = max. value before over range (4950) -4...4V = rated range (-4000...4000) -4.95V = min. value before under range (-4950) two's complement	0.2% of final value	(1), (2)
5Ah	Voltage $\pm 400mV$	$\pm 495mV$ / 495mV = max. value before over range (4950) -400...400mV = rated range (-4000...4000) -495mV = min. value before under range (-4950) two's complement	0.4% of final value	(1)
5Ch	Current $\pm 20mA$	$\pm 25mA$ / 25mA = max. value before over range (25000) -20...20mA = rated range (-20000...20000) -25mA = min. value before under range (-25000) two's complement	0.2% of final value	(1)
5Dh	Current 4...20mA	0.8 .. +24.00mA / 24.00mA = End over range (20000) 4...20mA = rated range (0...16000) 0.8mA = min. value before under range (-3200) two's complement	0.5% of final value	(1)
FFh	Channel not active (turned off)			

1) depends on calibration factor and is not guaranteed.

**Note!**

The module is preset to the range "±10V voltage" in S7 format from Siemens.

**Numeric notation
in S7 from
Siemens**

Analog values are represented as a two's complement value.

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 7 ... 0: binary measured value
1	Bit 6 ... 0: binary measured value Bit 7: sign 0 positive 1 negative

+/- 10V

Voltage	Decimal	Hex
-10V	-27648	9400
-5V	-13824	CA00
0V	0	0
5V	13824	3600
10V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{10}, \quad U = Value \cdot \frac{10}{27648}$$

U: voltage, Value: decimal value

+/-4V

Voltage	Decimal	Hex
-4V	-27648	9400
0V	0	0
4V	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{4}, \quad U = Value \cdot \frac{4}{27648}$$

U: voltage, Value: decimal value

+/-400mV

Voltage	Decimal	Hex
-400mV	-27648	9400
0V	0	0
400mV	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{U}{400}, \quad U = Value \cdot \frac{400}{27648}$$

U: voltage, Value: decimal value

4....20mA

Current	Decimal	Hex
4mA	0	0
12mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I - 4}{16}, \quad I = Value \cdot \frac{16}{27648} + 4$$

I: current, Value: decimal value

+/- 20mA

Current	Decimal	Hex
-20mA	-27648	9400
-10mA	-13824	CA00
0mA	0	0
10mA	13824	3600
20mA	27648	6C00

Formulas for the calculation:

$$Value = 27648 \cdot \frac{I}{20}, \quad I = Value \cdot \frac{20}{27648}$$

I: current, Value: decimal value

Measurement data acquisition

During a measurement the data is stored in the data input area. The table above shows the allocation of the data to a measured value as well as the respective tolerance.

The following figures show the structure of the data input area:

Data input area:

Byte	Bit 7 ... Bit 0
0	High-Byte channel 0
1	Low-Byte channel 0
2	High-Byte channel 1
3	Low-Byte channel 1
4	High-Byte channel 2
5	Low-Byte channel 2
6	High-Byte channel 3
7	Low-Byte channel 3

Parameter data

You may configure every channel individually. 32Byte are available for the configuration data. Configuration parameters are stored in permanent memory and they will be retained even if power is turned off.

The following table show the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic alarm byte: Bit 5 ... 0: reserved Bit 6: 0: diagnostic alarm inhibited 1: diagnostic alarm enabled Bit 7: reserved	00h
1	Limit value monitoring: Bit 0: limit value monitoring channel 0 Bit 1: limit value monitoring channel 1 Bit 2: limit value monitoring channel 2 Bit 3: limit value monitoring channel 3 Bit 7 ... 4: reserved	00h
2	Function-no. channel 0 (see table)	28h
3	Function-no. channel 1 (see table)	28h
4	Function-no. channel 2 (see table)	28h
5	Function-no. channel 3 (see table)	28h
6-9	reserved	00h

continued ...

... continue

Byte	Bit 7 ... Bit 0	Default
10	Bit 2 ... 0: mean value 000: disabled 001: mean value over 2 values 010: mean value over 4 values 011: mean value over 8 values 100: mean value over 16 values 101, 011, 111: disabled Bit 7 ... 3: reserved	00h
11-15	reserved	00h
16	channel 0, upper limit, High-Byte	7Fh
17	channel 0, upper limit, Low-Byte	FFh
18	channel 0, lower limit, High-Byte	80h
19	channel 0, lower limit, Low-Byte	00h
20	channel 1, upper limit, High-Byte	7Fh
21	channel 1, upper limit, Low-Byte	FFh
22	channel 1, lower limit, High-Byte	80h
23	channel 1, lower limit, Low-Byte	00h
24	channel 2, upper limit, High-Byte	7Fh
25	channel 2, upper limit, Low-Byte	FFh
26	channel 2, lower limit, High-Byte	80h
27	channel 2, lower limit, Low-Byte	00h
28	channel 3, upper limit, High-Byte	7Fh
29	channel 3, upper limit, Low-Byte	FFh
30	channel 3, lower limit, High-Byte	80h
31	channel 3, lower limit, Low-Byte	00h

Diagnostic data

The diagnostic data have a size of 12Byte and are stored in the record sets 0 and 1 of the system data area.

As soon as you activated the alarm release in Byte 0 of the parameter area, in case of an error *record set 0* is transferred to the superordinated system.

Record set 0 has a fixed content and a length of 4Byte. The contents of *record set 0* may be monitored in plain text via the diagnosis window of the CPU.

For extended diagnostic purposes during runtime, you may evaluate the *record set 1* with a size of 12Byte via the SFCs 51 and 59.

Evaluate diagnosis

At a diagnostic task the CPU interrupts the user application and branches into OB 82. With according programming, you may request in this OB with the SFCs 51 and 59 detailed diagnostic information and react on it.

After execution of the OB 82, the processing of the user application is continued. The diagnostic data remains consistent until leaving the OB 82.

Record set 0

Byte 0 to 3:

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: error in module Bit 1: reserved Bit 2: external error Bit 3: channel error Bit 6 ... 4: reserved Bit 7: wrong parameter in module	00h
1	Bit 3 ... 0: module class 0101 analog module Bit 4: channel information present Bit 7 ... 5: reserved	15h
2	not used	00h
3	Bit 5 ... 0: reserved Bit 6: missing (lost) process alarm (see process alarm) Bit 7: reserved	00h

Record set 1*Byte 0 to 11:*

Record set 1 contains the 4Byte of record set 0 and 8Byte module specific diagnostic data.

The diagnostic bytes have the following assignment:

Record set 1 (Byte 0 to 11):

Byte	Bit 7 ... Bit 0	Default
0 ... 3	content of record set 0 (see page above)	-
4	Bit 6 ... 0: channel type 70h: digital input 71h: analog input 72h: digital output 73h: analog output Bit 7: reserved	71h
5	Bit 7 ... 0: number of diagnostic output bits per channel	04h
6	Bit 7 ... 0: number of similar channels of a module	04h
7	Bit 0: channel error channel 0 Bit 1: channel error channel 1 Bit 2: channel error channel 2 Bit 3: channel error channel 3 Bit 7 ... 4: reserved	00h
8	Bit 0: reserved Bit 1: parameterization error channel 0 Bit 4 ... 2: reserved Bit 5: parameterization error channel 1 Bit 6, 7: reserved	00h
9	Bit 0: reserved Bit 1: parameterization error channel 2 Bit 4 ... 2: reserved Bit 5: parameterization error channel 3 Bit 6, 7: reserved	00h
10 ... 11	reserved	00h

Process alarm

The upper and the lower limit value is parameterizable for every channel. Please regard during parameterization that you have to enable the limit value monitoring in parameter byte 1.

If the signal is beyond the defined operation range, a process alarm is initialized. In the CPU, the process alarm block (OB 40) is called.

The 4Byte of process alarm additional information are used as follows:

Process alarm additional information

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: upper limit exceeded channel 0 Bit 1: upper limit exceeded channel 1 Bit 2: upper limit exceeded channel 2 Bit 3: upper limit exceeded channel 3 Bit 7 ... 4: reserved	00h
1	Bit 0: lower limit underrun channel 0 Bit 1: lower limit underrun channel 1 Bit 2: lower limit underrun channel 2 Bit 3: lower limit underrun channel 3 Bit 7 ... 4: reserved	00h
2	reserved	00h
3	reserved	00h

**Note!**

When a process alarm has not yet been acknowledged by the CPU and a new process alarm of the same type occurs at this channel, a diagnostic alarm is initialized, containing the information "Process alarm missing/lost" (diagnostic data Byte 3).

Technical data

Electrical data	VIPA 231-1FD00
Number of inputs	4 differential inputs
Cycle time (all channels)	< 1ms
measuring range	
- Voltage measuring	$\pm 400\text{mV}$, $\pm 4\text{V}$, $\pm 10\text{V}$
- Current measuring	4...20mA, $\pm 20\text{mA}$
Input resistance	> $2\text{M}\Omega$ (voltage range) < 57Ω (current range)
Power supply	5V via backplane bus
Current consumption	300mA via backplane bus
Isolation	500Vrms (field voltage - backplane bus)
Status indicators	via LEDs on the front
Programming specifications	
Input data	8Byte (1 word per channel)
Output data	-
Parameter data	32Byte
Diagnostic data	12Byte
Process alarm data	4Byte
Dimensions and weight	
Dimensions (WxHxD)	25.4 x 76 x 88mm
Weight	100g