VIPA System 200V

SM-AIO | Manual

HB97E_SM-AIO | Rev. 12/32

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Note

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CE Conformity

Hereby, VIPA GmbH declares that the products and systems are in compliance with the essential requirements and other relevant provisions of the following directives:

- 2004/108/EC Electromagnetic Compatibility Directive
- 2006/95/EC Low Voltage Directive

Conformity is indicated by the CE marking affixed to the product.

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Contents

About this manual

This manual describes the analog signal modules (SM) and the Combination module 238-2BC00 of the System 200V from VIPA. In addition to the product summary it contains detailed descriptions of the different modules. You are provided with information on the connection and the utilization of the System 200V SM modules.

Overview

Chapter 1: Assembly and installation guidelines

The focus of this chapter is on the introduction of the VIPA System 200V. Here you will find the information required to assemble and wire a controller system consisting of System 200V components.

Besides the dimensions the general technical data of System 200V will be found.

Chapter 2: Analog input modules

This chapter contains a description of the construction and the operating of the VIPA digital input modules.

Chapter 3: Analog output modules

This chapter contains a description of the construction and the operation of the VIPA digital output modules.

Chapter 4: Analog input/output modules

This chapter contains a description of the construction and the operation of the VIPA digital input/output modules.

Chapter 5: 238-2BC00 - Combination module

In this chapter follows the description of the Combination module SM 238C that includes a digital in-/output module with counter function and an analog in-/output module.

Objective and contents

This manual describes the analog signal modules (SM) and the combination module 238-2BC00 of the System 200V. It contains a description of the construction, project implementation and the technical data.

Target audience

The manual is targeted at users who have a background in automation technology.

Structure of the manual

The manual consists of chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document

The following guides are available in the manual:

- an overall table of contents at the beginning of the manual
- an overview of the topics for every chapter

Availability

The manual is available in:

- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings

Important passages in the text are highlighted by following icons and headings:

Danger!
Immediate or likely danger.
Personal injury is possible.

Attention!
Damages to property is likely if these warnings are not heeded.

Note!
Supplementary information and useful tips.

Safety information

Applications conforming with specifications

The System 200V is constructed and produced for:

- all VIPA System 200V components
- communication and process control
- general control and automation applications
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

Danger!

This device is not certified for applications in

- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the

- project design department
- installation department
- commissioning
- operation

The following conditions must be met before using or commissioning the components described in this manual:

- Modification to the process control system should only be carried out when the system has been disconnected from power!
- Installation and modifications only by properly trained personnel
- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal

National rules and regulations apply to the disposal of the unit!

Chapter 1 Basics and Assembly

Overview

The focus of this chapter is on the introduction of the VIPA System 200V. Here you will find the information required to assemble and wire a controller system consisting of System 200V components.

Besides the dimensions the general technical data of System 200V will be found.

Contents

Safety Information for Users

Handling of electrostatic sensitive modules

VIPA modules make use of highly integrated components in MOS-Technology. These components are extremely sensitive to over-voltages that can occur during electrostatic discharges.

The following symbol is attached to modules that can be destroyed by electrostatic discharges.

The Symbol is located on the module, the module rack or on packing material and it indicates the presence of electrostatic sensitive equipment.

It is possible that electrostatic sensitive equipment is destroyed by energies and voltages that are far less than the human threshold of perception. These voltages can occur where persons do not discharge themselves before handling electrostatic sensitive modules and they can damage components thereby, causing the module to become inoperable or unusable.

Modules that have been damaged by electrostatic discharges can fail after a temperature change, mechanical shock or changes in the electrical load.

Only the consequent implementation of protection devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatic sensitive modules.

Shipping of electrostatic sensitive modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

When you are conducting measurements on electrostatic sensitive modules you should take the following precautions:

- Floating instruments must be discharged before use.
- Instruments must be grounded.

Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

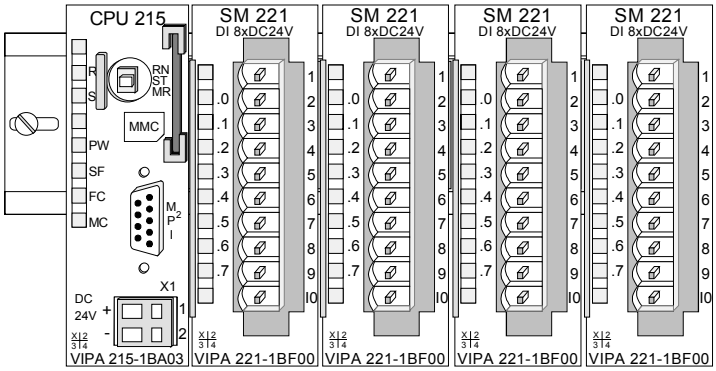
Attention!

Personnel and instruments should be grounded when working on electrostatic sensitive modules.

System conception

Overview

The System 200V is a modular automation system for assembly on a 35mm profile rail. By means of the peripheral modules with 4, 8 and 16 channels this system may properly be adapted matching to your automation tasks.

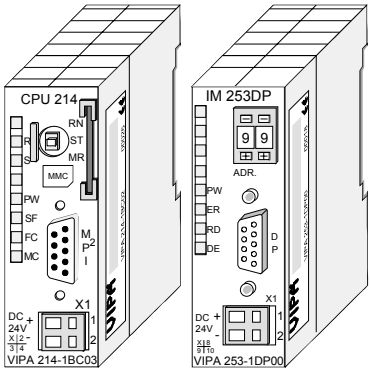


Components

The System 200V consists of the following components:

- *Head modules* like CPU and bus coupler
- *Periphery modules* like I/O, function und communication modules
- *Power supplies*
- *Extension modules*

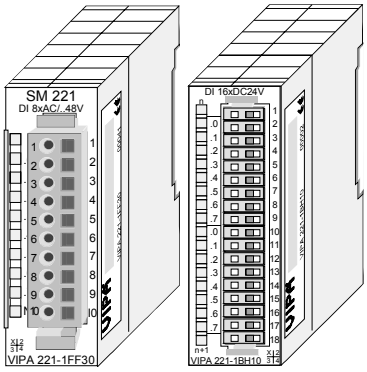
Head modules



With a head module CPU respectively bus interface and DC 24V power supply are integrated to one casing.

Via the integrated power supply the CPU respectively bus interface is power supplied as well as the electronic of the connected periphery modules.

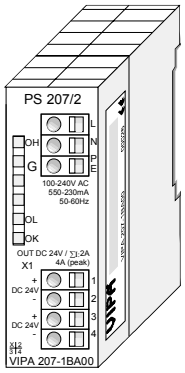
Periphery modules



The modules are direct installed on a 35mm profile rail and connected to the head module by a bus connector, which was mounted on the profile rail before.

Most of the periphery modules are equipped with a 10pin respectively 18pin connector. This connector provides the electrical interface for the signaling and supplies lines of the modules.

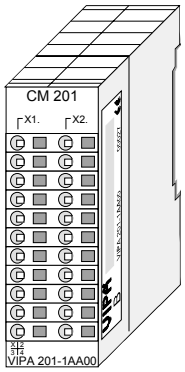
Power supplies



With the System 200V the DC 24V power supply can take place either externally or via a particularly for this developed power supply.

The power supply may be mounted on the profile rail together with the System 200V modules. It has no connector to the backplane bus.

Expansion modules



The expansion modules are complementary modules providing 2- or 3wire connection facilities.

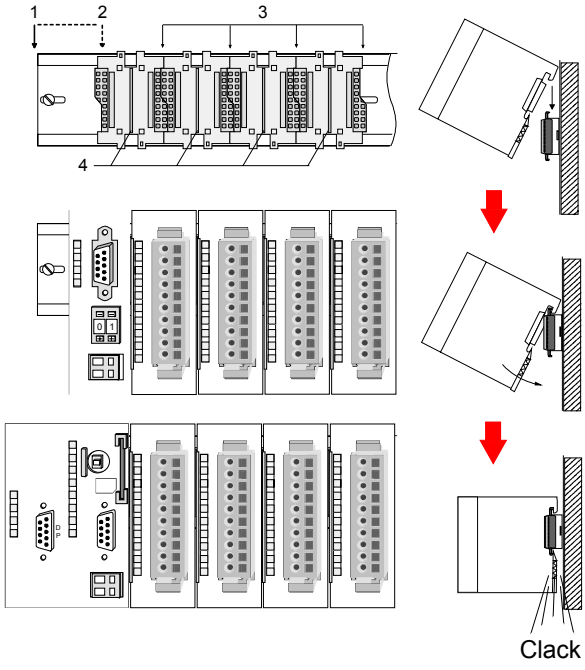
The modules are not connected to the backplane bus.

Structure/ dimensions

- Profile rail 35mm
- Dimensions of the basic enclosure:
  1tier width: (HxWxD) in mm: 76x25.4x74 in inches: 3x1x3
  2tier width: (HxWxD) in mm: 76x50.8x74 in inches: 3x2x3

Installation

Please note that you can only install header modules, like the CPU, the PC and couplers at slot 1 or 1 and 2 (for double width modules).



[1]	Head module (double width)
[2]	Head module (single width)
[3]	Periphery module
[4]	Guide rails

Note

A maximum of 32 modules can be connected at the back plane bus. Take attention that here the **maximum sum current** of **3.5A** is not exceeded.

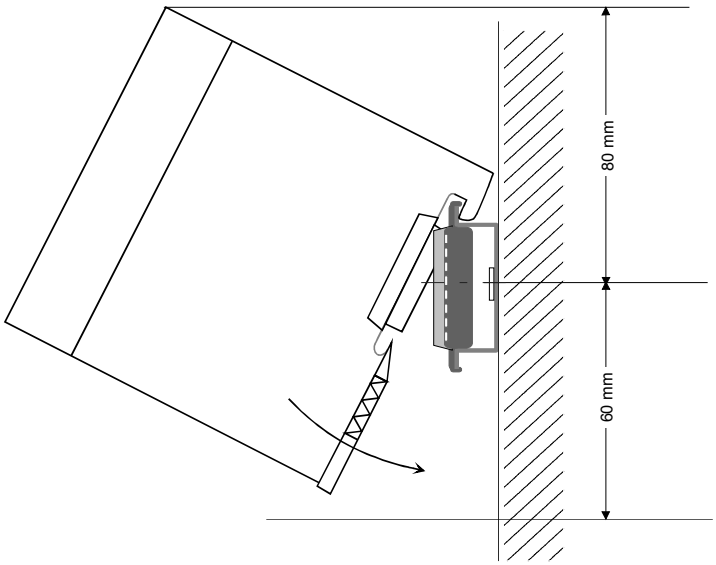
Please install modules with a high current consumption directly beside the header module.

Dimensions

Dimensions Basic enclosure

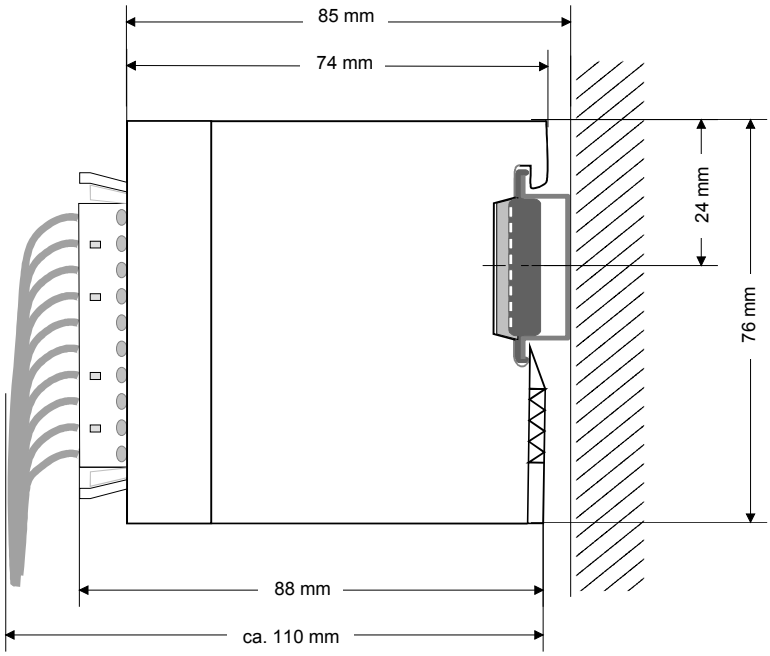
1tier width (HxWxD) in mm: 76 x 25.4 x 74
2tier width (HxWxD) in mm: 76 x 50.8 x 74

Installation dimensions

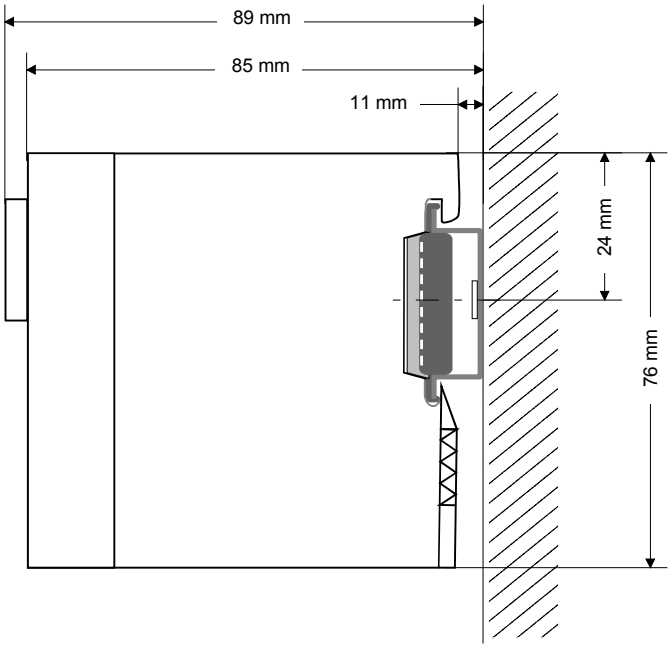


Installed and wired dimensions

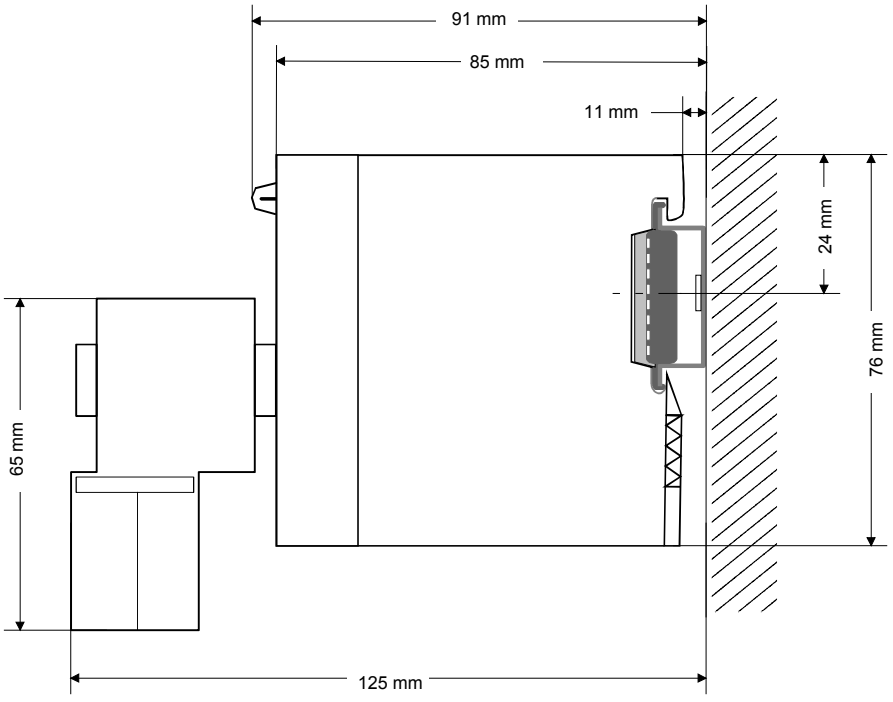
In- / Output modules



Function modules/
Extension modules



CPUs (here with
EasyConn from
VIPA)



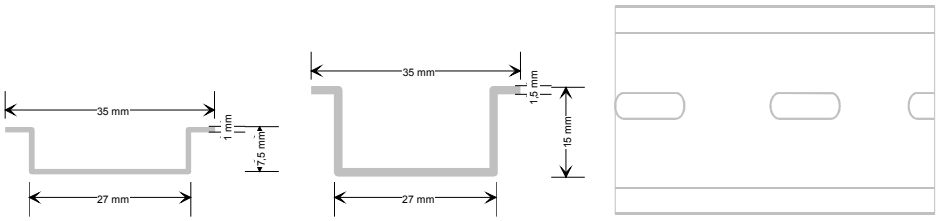
Installation

General

The modules are each installed on a 35mm profile rail and connected via a bus connector. Before installing the module the bus connector is to be placed on the profile rail before.

Profile rail

For installation the following 35mm profile rails may be used:

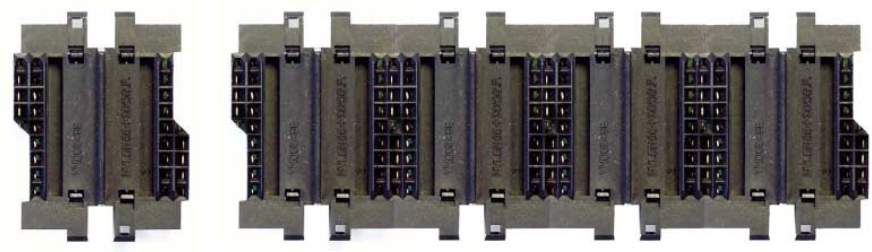


Order number	Label	Description
290-1AF00	35mm profile rail	Length 2000mm, height 15mm
290-1AF30	35mm profile rail	Length 530mm, height 15mm

Bus connector

System 200V modules communicate via a backplane bus connector. The backplane bus connector is isolated and available from VIPA in of 1-, 2-, 4- or 8tier width.

The following figure shows a 1tier connector and a 4tier connector bus:



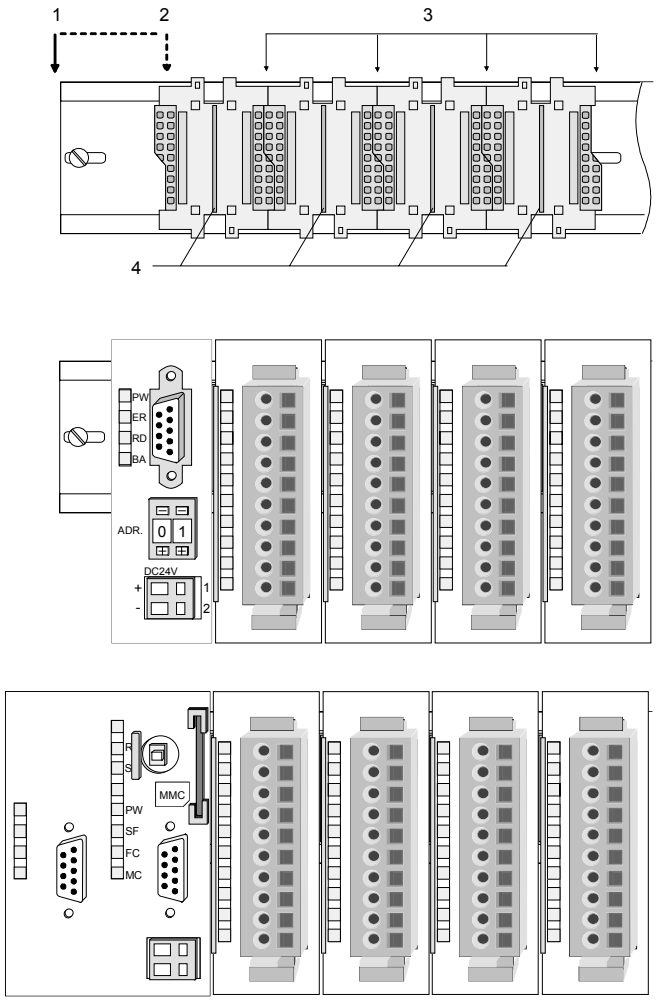
The bus connector is to be placed on the profile rail until it clips in its place and the bus connections look out from the profile rail.

Order number	Label	Description
290-0AA10	Bus connector	1tier
290-0AA20	Bus connector	2tier
290-0AA40	Bus connector	4tier
290-0AA80	Bus connector	8tier

Installation on a profile rail

The following figure shows the installation of a 4tier width bus connector in a profile rail and the slots for the modules.

The different slots are defined by guide rails.



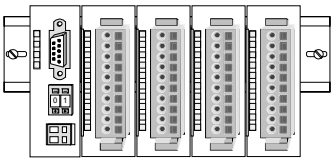
[1] Header module (double width)
[2] Header module (single width)
[3] Peripheral module
[4] Guide rails

Assembly regarding the current consumption

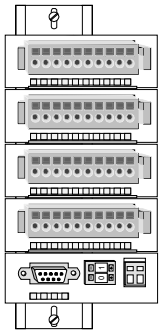
- Use bus connectors as long as possible.
- Sort the modules with a high current consumption right beside the header module. In the service area of www.vipa.com a list of current consumption of every System 200V module can be found.

Assembly possibilities

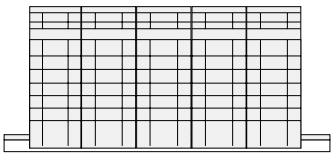
hoizontal assembly



vertical assembly



lying assembly

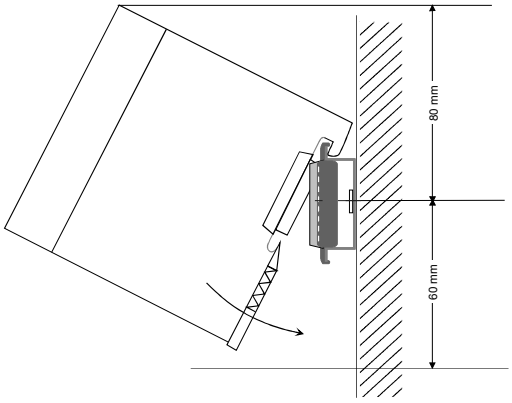


Please regard the allowed environmental temperatures:

- horizontal assembly: from 0 to 60°C
- vertical assembly: from 0 to 40°C
- lying assembly: from 0 to 40°C

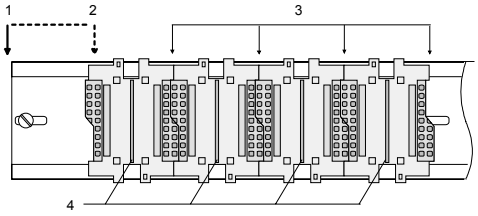
The horizontal assembly always starts at the left side with a header module, then you install the peripheral modules beside to the right.

You may install up to 32 peripheral modules.



Please follow these rules during the assembly!

- Turn off the power supply before you install or remove any modules!
- Make sure that a clearance of at least 60mm exists above and 80mm below the middle of the profile rail.



- Every row must be completed from left to right and it has to start with a header module.

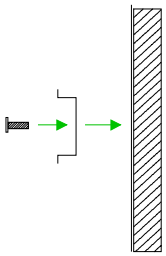
[1] Header module (double width)
[2] Header module (single width)
[3] Peripheral modules
[4] Guide rails

- Modules are to be installed side by side. Gaps are not permitted between the modules since this would interrupt the backplane bus.
- A module is only installed properly and connected electrically when it has clicked into place with an audible click.
- Slots after the last module may remain unoccupied.

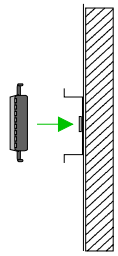
Note!

A maximum of 32 modules can be connected at the back plane bus. Take attention that here the maximum **sum current** of **3.5A** is not exceeded.

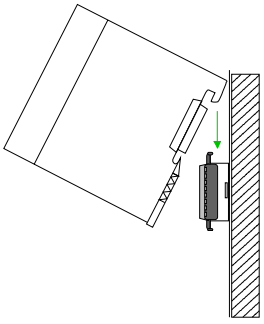
Assembly procedure



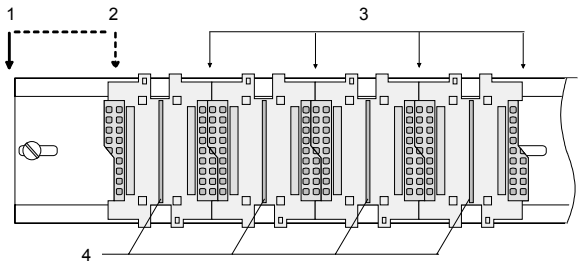
- Install the profile rail. Make sure that a clearance of at least 60mm exists above and 80mm below the middle of the profile rail.



- Press the bus connector into the profile rail until it clips securely into place and the bus-connectors look out from the profile rail. This provides the basis for the installation of your modules.



- Start at the outer left location with the installation of your header module and install the peripheral modules to the right of this.

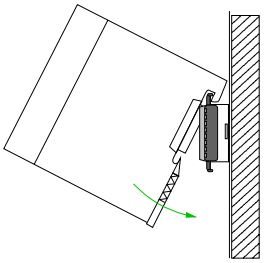


[1] Header module (double width)

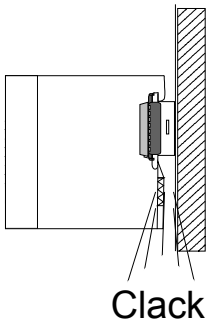
[2] Header module (single width)

[3] Peripheral module

[4] Guide rails



- Insert the module that you are installing into the profile rail at an angle of 45 degrees from the top and rotate the module into place until it clicks into the profile rail with an audible click. The proper connection to the backplane bus can only be guaranteed when the module has properly clicked into place.

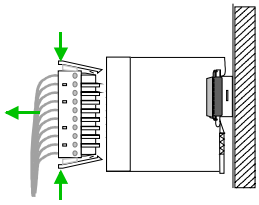


Attention!

Power must be turned off before modules are installed or removed!

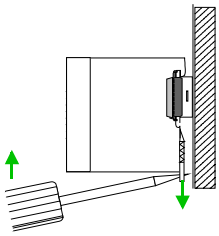
Demounting and module exchange

1



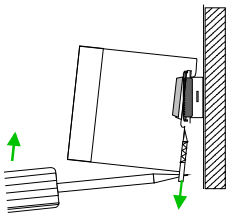
- Remove if exists the wiring to the module, by pressing both locking lever on the connector and pulling the connector.

2



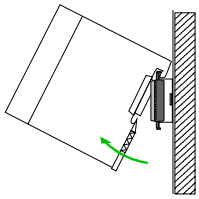
- The casing of the module has a spring loaded clip at the bottom by which the module can be removed.

3



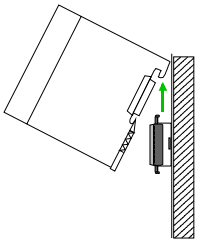
- The clip is unlocked by pressing the screwdriver in an upward direction.

4



- Withdraw the module with a slight rotation to the top.

5



Attention!

Power must be turned off before modules are installed or removed!

Please regard that the backplane bus is interrupted at the point where the module was removed!

Wiring

Overview

Most peripheral modules are equipped with a 10pole or a 18pole connector. This connector provides the electrical interface for the signaling and supply lines of the modules.

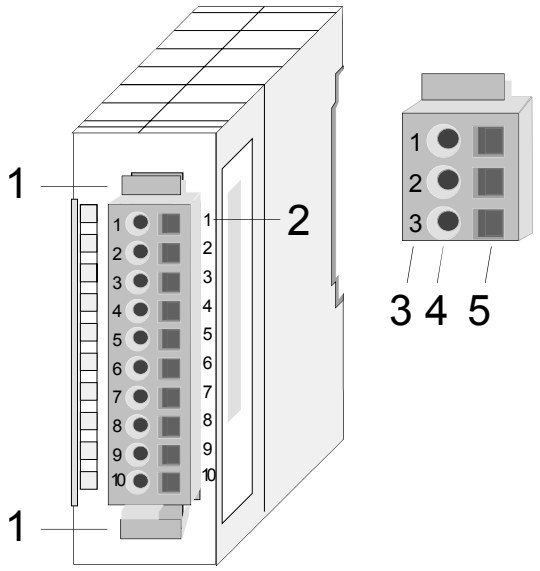
The modules carry spring-clip connectors for interconnections and wiring.

The spring-clip connector technology simplifies the wiring requirements for signaling and power cables.

In contrast to screw terminal connections, spring-clip wiring is vibration proof. The assignment of the terminals is contained in the description of the respective modules.

You may connect conductors with a diameter from 0.08mm^2 up to 2.5mm^2 (max. 1.5mm^2 for 18pole connectors).

The following figure shows a module with a 10pole connector.



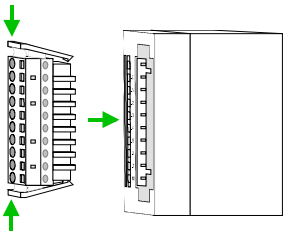
[1] Locking lever
[2] Pin no. at the module
[3] Pin no. at the connector
[4] Wiring port
[5] Opening for screwdriver

Note!

The spring-clip is destroyed if you push the screwdriver into the wire port!

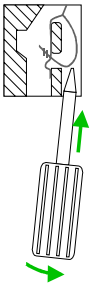
Make sure that you only insert the screwdriver into the square hole of the connector!

Wiring procedure

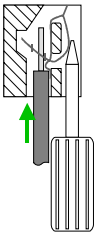


- Install the connector on the module until it locks with an audible click. For this purpose you press the two clips together as shown.
  The connector is now in a permanent position and can easily be wired.

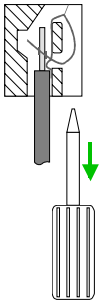
The following section shows the wiring procedure from top view.



- Insert a screwdriver at an angel into the square opening as shown.
- Press and hold the screwdriver in the opposite direction to open the contact spring.



- Insert the stripped end of the wire into the round opening. You can use wires with a diameter of 0.08mm^2 to 2.5mm^2
  (1.5mm^2 for 18pole connectors).



- By removing the screwdriver the wire is connected safely with the plug connector via a spring.

Note!

Wire the power supply connections first followed by the signal cables (inputs and outputs).

Installation guidelines

General

The installation guidelines contain information about the interference free deployment of System 200V systems. There is the description of the ways, interference may occur in your control, how you can make sure the electromagnetic digestibility (EMC), and how you manage the isolation.

What means EMC?

Electromagnetic digestibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interferenced res. without interferencing the environment.

All System 200V components are developed for the deployment in hard industrial environments and fulfill high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.

Possible interference causes

Electromagnetic interferences may interfere your control via different ways:

- Fields
- I/O signal conductors
- Bus system
- Current supply
- Protected earth conductor

Depending on the spreading medium (lead bound or lead free) and the distance to the interference cause, interferences to your control occur by means of different coupling mechanisms.

One differs:

- galvanic coupling
- capacitive coupling
- inductive coupling
- radiant coupling

Basic rules for EMC

In the most times it is enough to take care of some elementary rules to guarantee the EMC. Please regard the following basic rules when installing your PLC.

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - Install a central connection between the ground and the protected earth conductor system.
  - Connect all inactive metal extensive and impedance-low.
  - Please try not to use aluminum parts. Aluminum is easily oxidizing and is therefore less suitable for grounding.
- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal res. data lines in separate channels or bundles.
  - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).
- Proof the correct fixing of the lead isolation.
  - Data lines must be laid isolated.
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favorable.
  - Lay the line isolation extensively on an isolation/protected earth conductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metalized plug cases for isolated data lines.
- In special use cases you should appoint special EMC actions.
  - Wire all inductivities with erase links.
  - Please consider luminescent lamps can influence signal lines.
- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC is a protection and functionality activity.
  - Connect installation parts and cabinets with the System 200V in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If potential differences between installation parts and cabinets occur, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

Electrical, magnetically and electromagnetic interference fields are weakened by means of an isolation, one talks of absorption.

Via the isolation rail, that is connected conductive with the rack, interference currents are shunt via cable isolation to the ground. Hereby you have to make sure, that the connection to the protected earth conductor is impedance-low, because otherwise the interference currents may appear as interference cause.

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.
- Normally you should always lay the isolation of cables on both sides. Only by means of the both-sided connection of the isolation you achieve high quality interference suppression in the higher frequency area.

  Only as exception you may also lay the isolation one-sided. Then you only achieve the absorption of the lower frequencies. A one-sided isolation connection may be convenient, if:
  - the conduction of a potential compensating line is not possible
  - analog signals (some mV res. µA) are transferred
  - foil isolations (static isolations) are used.
- With data lines always use metallic or metalized plugs for serial couplings. Fix the isolation of the data line at the plug rack. Do not lay the isolation on the PIN 1 of the plug bar!
- At stationary operation it is convenient to strip the insulated cable interruption free and lay it on the isolation/protected earth conductor line.
- To fix the isolation tangles use cable clamps out of metal. The clamps must clasp the isolation extensively and have well contact.
- Lay the isolation on an isolation rail directly after the entry of the cable in the cabinet. Lead the isolation further on to the System 200V module and **don't** lay it on there again!

Please regard at installation!

At potential differences between the grounding points, there may be a compensation current via the isolation connected at both sides.

Remedy: Potential compensation line.

General data

Structure/ dimensions

- Profile rail 35mm
- Peripheral modules with recessed labelling
- Dimensions of the basic enclosure:
  1tier width: (HxWxD) in mm: 76x25.4x74 in inches: 3x1x3
  2tier width: (HxWxD) in mm: 76x50.8x74 in inches: 3x2x3

Reliability

- Wiring by means of spring pressure connections (CageClamps) at the front-facing connector, core cross-section 0.08 ... 2.5mm^2 or 1.5 mm^2 (18pole plug)
- Complete isolation of the wiring when modules are exchanged
- Every module is isolated from the backplane bus
- ESD/Burst acc. IEC 61000-4-2 / IEC 61000-4-4 (to level 3)
- Shock resistance acc. IEC 60068-2-6 / IEC 60068-2-27 (1G/12G)
- Class of protection IP20

Environmental conditions

- Operating temperature: 0 ... +60°C
- Storage temperature: -25 ... +70°C
- Relative humidity: 5 ... 95% without condensation
- Ventilation by means of a fan is not required

Chapter 2 Analog input modules

Overview

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

Contents

General

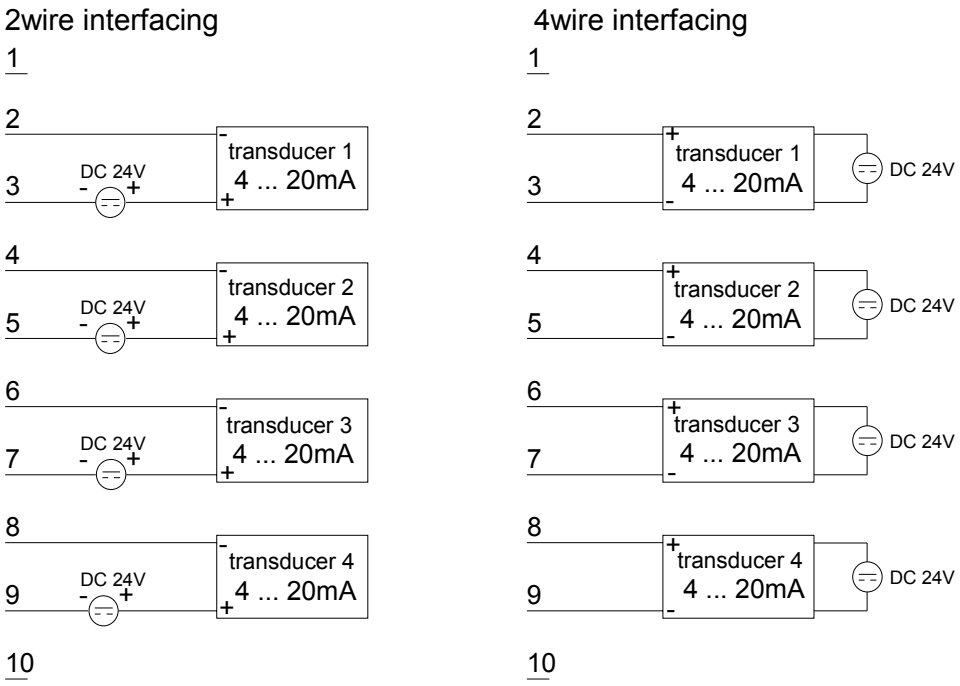
Cabling for analog signals

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:



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

+/- 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)

Strom	Dezimal	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

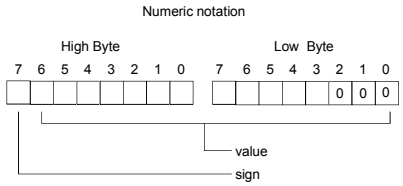
+/- 20mA (value and sign)

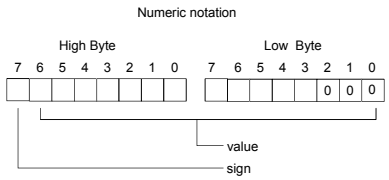
Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

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

U: voltage, Value: Decimal value

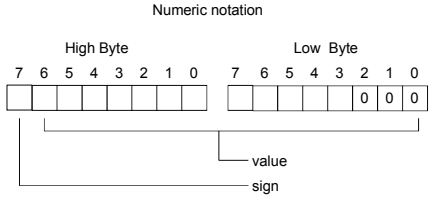




Formula for the calculation:

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

I: Current, Value: Decimal value



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

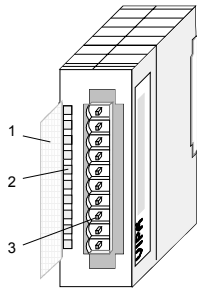
Description The module has 4 inputs that you may configure individually. This module requires a total of 8byte of the process image for the input data (2byte per channel).

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

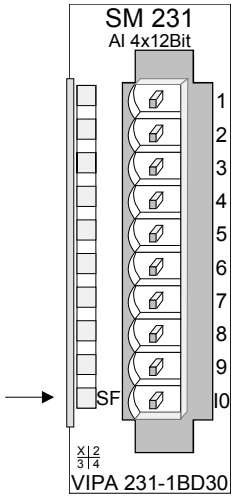


[1] Label for the bit address with description
[2] LED status indicator
[3] Edge connector

Status indicator

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

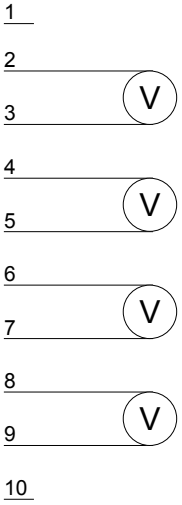
pin assignment



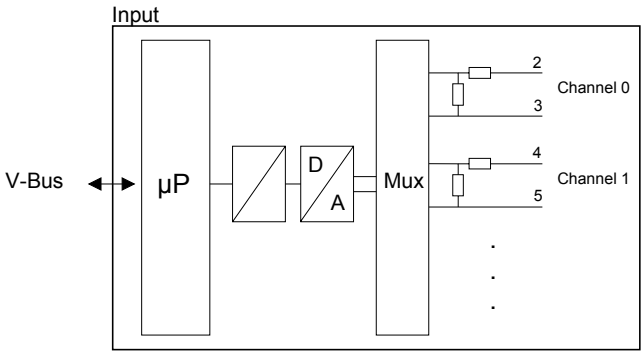
Pin	Assignment
1	
2	pos. connection Channel 0
3	Channel 0 common
4	pos. connection Channel 1
5	Channel 1 common
6	pos. connection Channel 2
7	Channel 2 common
8	pos. connection Channel 3
9	Channel 3 common
10	

Wiring and schematic diagram

Wiring diagram



Schematic diagram



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 parameterizable. 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 ±10V Siemens S7 format (two's complement)	±11.76V **/** 11.76V= max. value before over range (32511) -10...10V= nominal range (-27648...27648) -11.76V= min. value before under range (-32512)
2Bh	Voltage ±10V Siemens S5 format (value and sign)	±12.50V **/** 12.50V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.50V = min. value before under range (-20480)
3Bh	Voltage ±10V Siemens S5 format (two's complement)	±12.50V / 12.50V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.50V = min. value before under range (-20480)
FFh	Channel not active (turned off)	

Note!

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

Technical data

Order number	**231-1BD30**
Type	SM 231, ECO
Current consumption/power loss	
Current consumption from backplane bus	120 mA
Power loss	0.6 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	-10 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Basic error limit voltage ranges with SFU	+/-0.1%
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	13
Measurement principle	successive approximation
Basic conversion time	2 ms / channel
Noise suppression for frequency	f=50 Hz...400 Hz
Initial data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	none
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	-
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 2 V

Order number	**231-1BD30**
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	12
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

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

Order data

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

Description

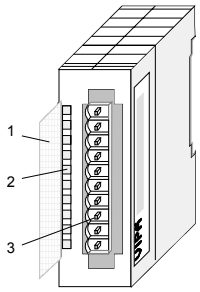
The module has 4 inputs that you may configure individually. This module requires a total of 8byte of the process image for the input data (2byte per channel).

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, ±20mA outputs
- LED leave end overdrive region or leave end underdrive region or wrong parameterization

Construction

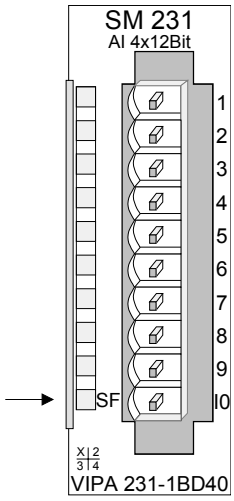


[1] Label for the bit address with description
[2] LED status indicator
[3] Edge connector

Status indicator

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

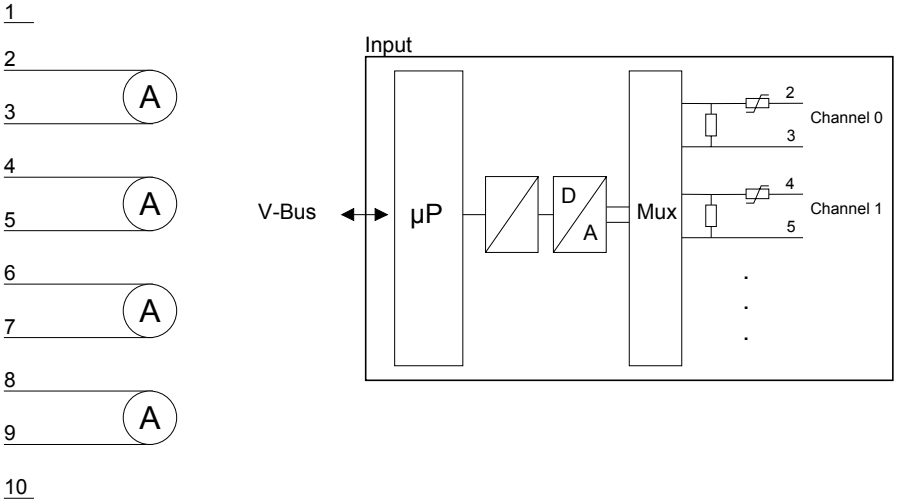
pin assignment



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 parameterizable. 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 ±20mA Siemens S7 format (two's complement)	±23.52mA **/** 23.52mA = max. value before over range (32511) -20...20mA = rated value (-27648...27648) -23.52mA = min. value before under range (-32512)
2Dh	Current 4...20mA Siemens S7 format (two's complement)	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)
2Eh	Current 4...20mA Siemens S5 format (value and sign)	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)
2Fh	Current ±20mA Siemens S5 format (value and sign)	±25.00mA / 25.00mA = max. value before over range (20480) -20...20mA = rated value (-16384...16384) -25.00mA = min. value before under range (-20480)
39h	Current 4...20mA Siemens S5 format (two's complement)	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)
3Ah	Current ±20mA Siemens S5 format (two's complement)	±25.00mA / 25.00mA = max. value before over range (20480) -20...20mA = nominal range (-16384...16384) -25.00mA = min. value before under range (-20480)
FFh	Channel not active (turned off)	

Note!

The module is preset to the range "±20mA current" in S7-format from Siemens.

Technical data

Order number	**231-1BD40**
Type	SM 231, ECO
Current consumption/power loss	
Current consumption from backplane bus	120 mA
Power loss	0.6 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	110 Ω
Input current ranges	-20 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2% ... +/-0.5%
Basic error limit current ranges with SFU	+/-0.1% ... +/-0.2%
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	13
Measurement principle	successive approximation
Basic conversion time	2 ms / channel
Noise suppression for frequency	f=50 Hz...400 Hz
Initial data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	none
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	-
Max. potential difference between circuits	-

Order number	231-1BD40
Max. potential difference between inputs (Ucm)	DC 2 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	12
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

231-1BD53 - AI 4x16Bit, multiinput

Order data AI 4x16Bit multiinput VIPA 231-1BD53

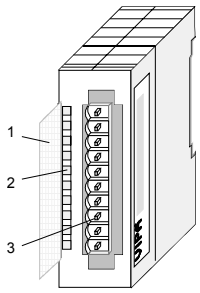
Description The module has 4 inputs that you may configure individually. The module requires a total of 8 input data bytes in the periphery area (2byte per channel).

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

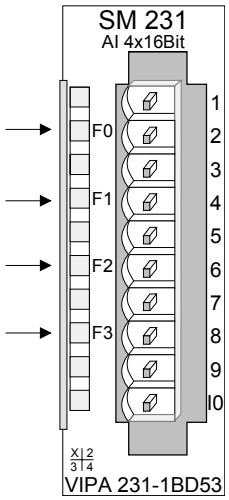
Construction



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

Status indicators pin assignment

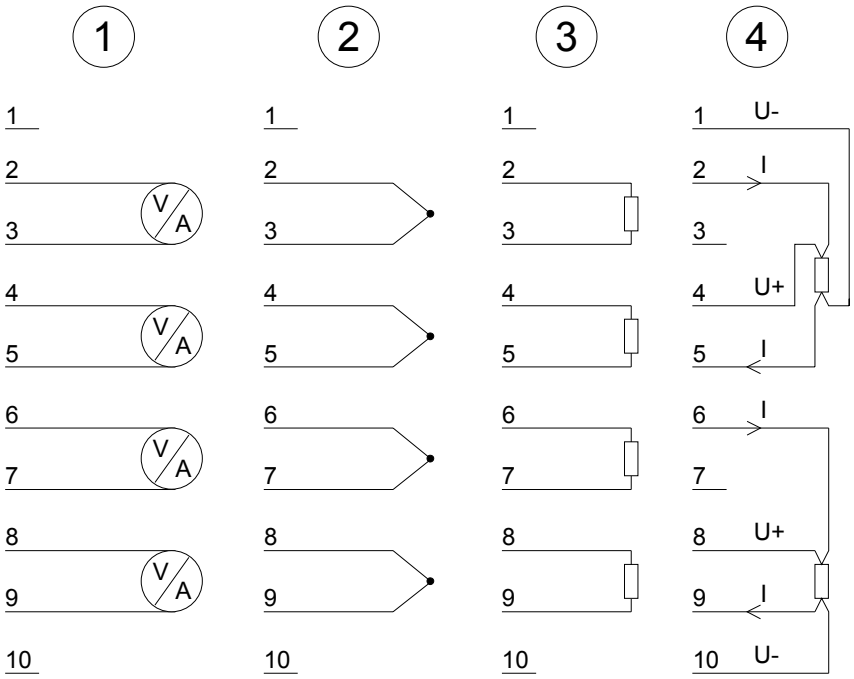
LED	Description
F0 ... F3	LED (red): turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened



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.



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 60Ohm 2wire	- **/** 60Ω= final value (32767)	(3)
06h	Resistance measurement 600Ohm 2wire	- **/** 600Ω = final value (32767)	(3)
07h	Resistance measurement 3000Ohm 2wire	- **/** 3000Ω = final value (32767)	(3)
08h	Resistance measurement 6000Ohm 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 60Ohm 4wire	- **/** 60Ω= final value (32767)	(4)
0Eh	Resistance measurement 600Ohm 4wire	- **/** 600Ω= final value (32767)	(4)
0Fh	Resistance measurement 3000Ohm 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)
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)

continued ...

… continue

No.	Function	Measurement range / representation	Conn.
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 (two's complement)	±58.79mV **/** 58.79mV = max. value before over range (32511) -50...50mV= nominal range (-27648...27648) -58.79mV = min. value before under range (-32512)	(1)
28h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V **/** 11.76V= max. value before over range (32511) -10...10V= nominal range (-27648...27648) -11.76V= min. value before under range (-32512)	(1)
29h	Voltage ±4V Siemens S7 format (two's complement)	±4.70V **/** 4.70V = max. value before over range (32511) -4...4V = rated range (-27648...27648) -4.70V = min. value before under range (-32512)	(1)
2Ah	Voltage ±400mV Siemens S7 format (two's complement)	±470mV **/** 470mV = max. value before over range (32511) -400...400mV = rated range (-27648...27648) -470mV = min. value before under range (-32512)	(1)
2Bh	Voltage ±10V Siemens S5 format (value and sign)	±12.50V **/** 12.50V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.50V = min. value before under range (-20480)	(1)
2Ch	Current ±20mA Siemens S7 format (two's complement)	±23.52mA **/** 23.52mA = max. value before over range (32511) -20...20mA = rated value (-27648...27648) -23.52mA = min. value before under range (-32512)	(1)
2Dh	Current 4...20mA Siemens S7 format (two's complement)	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)	(1)
2Eh	Current 4...20mA Siemens S5 format (value and sign)	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)	(1)
2Fh	Current ±20mA Siemens S5 format (value and sign)	±25.00mA / 25.00mA = max. value before over range (20480) -20...20mA = rated value (-16384...16384) -25.00mA = min. value before under range (-20480)	(1)

continued ...

… continue

No.	Function	Measurement range / representation	Conn.
32h	Resistance measurement 6000Ω 4wire	- / 6000Ω= final value (32767)	(4)
33h	Resistance measurement 6000Ω 4wire	- / 6000Ω= final value (6000)	(4)
35h	Resistance measurement 60Ω 2wire	- / 60Ω= final value (6000)	(3)
36h	Resistance measurement 600Ω 2wire	- / 600Ω = final value (6000)	(3)
37h	Resistance measurement 3000Ω 2wire	- / 3000Ω = final value (30000)	(3)
38h	Resistance measurement 6000Ω 2wire	- / 6000Ω = final value (6000)	(3)
3Ah	Current ±20mA Siemens S5 format two's complement	±25.00mA / 25.00mA = max. value before over range (20480) -20...20mA = nominal range (-16384...16384) -25.00mA = min. value before under range (-20480)	(1)
3Bh	Voltage ±10V Siemens S5 format two's complement	±12.50V / 12.50V = max. value before over range (20480) -10...10V = nominal range (-16384...16384) -12.50V = min. value before under range (-20480)	(1)
3Dh	Resistance measurement 60Ω 4wire	- ***I*** 60Ω= final value (6000)	(4)
3Eh	Resistance measurement 600Ω 4wire	- ***I*** 600Ω= final value (6000)	(4)
3Fh	Resistance measurement 3000Ω 4wire	- ***I*** 3000Ω = final value (30000)	(4)
57h	Voltage ±50mV two's complement	±58.79mV ***I*** 58.79mV = max. value before over range (5879) -50...50mV = rated range (-5000...5000) -58.79V = min. value before under range (-5879)	(1)
58h	Voltage ±10V two's complement	±11.76V ***I*** 11.76V = max. value before over range (11760) -10...10V = rated range (-10000...10000) -11.76V = min. value before under range (-11760)	(1)
59h	Voltage ±4V two's complement	±4.70V ***I*** 4.70V = max. value before over range (4700) -4...4V = rated range (-4000...4000) -4.70V = min. value before under range (-4700)	(1)
5Ah	Voltage ±400mV two's complement	±470mV ***I*** 470mV = max. value before over range (4700) -400...400mV = rated range (-4000...4000) -470mV = min. value before under range (-4700)	(1)
5Ch	Current ±20mA two's complement	±23.51mA ***I*** 23.51mA = max. value before over range (23510) -20...20mA = rated value (-20000...20000) -23.51mA = min. value before under range (-23510)	(1)
5Dh	Current 4...20mA two's complement	1.185 .. +22.81mA ***I*** 22.81mA = max. value before over range (18810) 4...20mA = rated range (0...16000) 1.185mA = min. value before under range (-2815)	(1)
62h	Cu50 2wire	-50°C ... +150°C ***I*** in units of 1/10°C, two's complement	(3)
6Ah	Cu50 4wire	-50°C ... +150°C ***I*** in units of 1/10°C, two's complement	(4)

continued ...

… continue

No.	Function	Measurement range / representation	Conn.
91h	PTC KTY81-110 [3] 990-1010Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
92h	PTC KTY81-120 [3] 980-1020Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
93h	PTC KTY81-121 [3] 980-1000Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
94h	PTC KTY81-122 [3] 1000-1020Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
95h	PTC KTY81-150 [3] 950-1050Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
96h	PTC KTY81-151 [3] 950-1000Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
97h	PTC KTY81-152 [3] 1000-1050Ω Two-wire connection	200°C = max. value before over range (2000) -55 ... 150°C = nominal range (-550... 1500) -100°C = min. value before under range (-1000) Values in 0.1°C	(3)
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

[3] This function is available starting with firmware version 143 of the module.

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 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 parameterizable. 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 interrupt 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 interrupt

With the help of bit 6 of byte 0, you may release the diagnostic interrupt. 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.

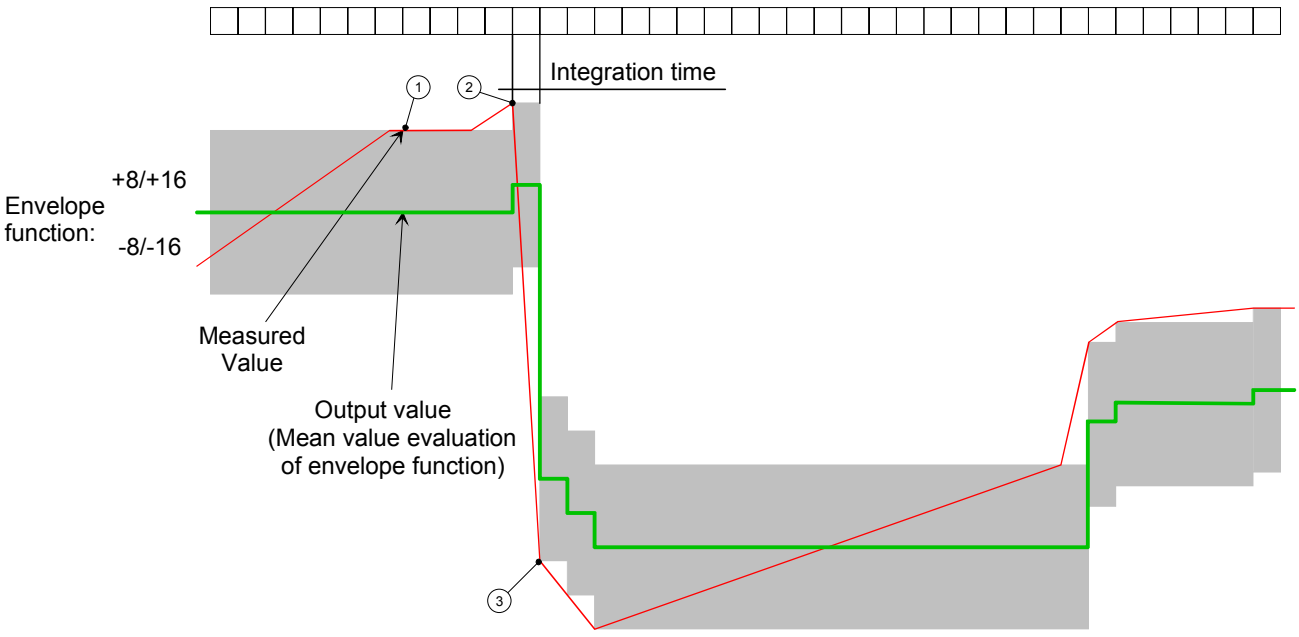
Mean value function 4 of 6 values:

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 interrupt 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

Order number	231-1BD53
Type	SM 231
Current consumption/power loss	
Current consumption from backplane bus	280 mA
Power loss	1.4 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	✓
Min. input resistance (voltage range)	20 MΩ
Input voltage ranges	-50 mV ... +50 mV -400 mV ... +400 mV -4 V ... +4 V -10 V ... +10 V
Operational limit of voltage ranges	+/-0.3% ... +/-0.6%
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.4%
Current inputs	✓
Max. input resistance (current range)	85 Ω
Input current ranges	-20 mA ... +20 mA 0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.8%
Basic error limit current ranges with SFU	+/-0.2% ... +/-0.5%
Resistance inputs	✓
Resistance ranges	0 ... 60 Ohm 0 ... 600 Ohm 0 ... 3000 Ohm 0 ... 6000 Ohm
Operational limit of resistor ranges	+/-0.4% ... +/-0.8%
Basic error limit	+/-0.2% ... +/-0.4%
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100, Pt1000 KTY81-152 Ni100, Ni1000 Cu50 KTY81-110 KTY81-120 KTY81-121 KTY81-122 KTY81-150 KTY81-151
Operational limit of resistance thermometer ranges	+/-0.4% ... +/-1.4%
Basic error limit thermoresistor ranges	+/-0.2% ... +/-0.7%
Thermocouple inputs	✓
Thermocouple ranges	type J type K type N type R type S type E type T
Operational limit of thermocouple ranges	+/-1.5%
Basic error limit thermoelement ranges	+/-1.0%
Programmable temperature compensation	✓
External temperature compensation	✓
Internal temperature compensation	✓

Order number	**231-1BD53**
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	7 ms ... 272 ms
Noise suppression for frequency	none
Initial data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	none
Group error display	none
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	-
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 4 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	12
Diagnostic bytes	12
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	100 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

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

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

Description

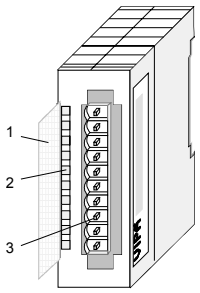
The module has 4 inputs that are permanently configured to measure current signals (4 ... 20mA). This module requires a total of 8byte of the process image for the input data (2byte per channel).

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

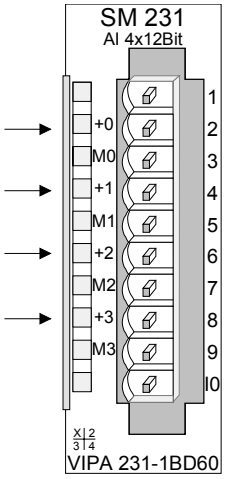


[1] Label for the bit address with description
[2] LED status indicator
[3] Edge connector

Status indicator

LED	Description
+0 ... +3	LED (red) wire break detection These LEDs is turned on when the transducer is disconnected.

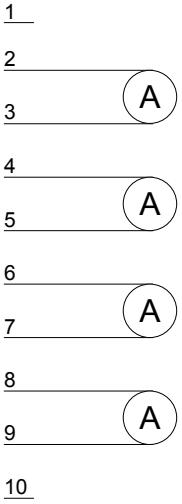
pin assignment

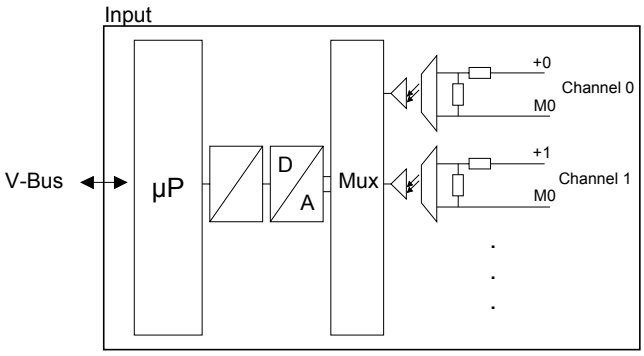


Pin	Assignment
1	
2	pos. connection Ch. 0
3	Channel 0 common
4	pos. connection Ch.1
5	Channel 1 common
6	pos. connection Ch.2
7	Channel 2 common
8	pos. connection Ch.3
9	Channel 3 common
10	

Wiring and schematic diagram

Wiring diagram **Schematic diagram**





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 S5 format

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

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: **Overflow** bit (**O**) 0: value within measuring range 1: measuring range exceeded Bit 1: **Error** bit (**E**: set at internal error) Bit 2: **Activity** bit (**A**: 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

Representation of analog values

Analog values are exclusively processed in a binary format. For this the analog module transforms every process signal into a digital value and transfers this as word.

Resolution	Analog value															
	byte 1								byte 0							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	SG	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
12bit + sign	**SG**	**Measuring value**												**A**	**E**	**O**

Measuring value

The here listed formulas allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range and vice versa.

Measuring range	Current (I)	Decimal (D)	Hex	Range	Formulas for calculation
4 ... 20mA Siemens S5 format	24.00mA	2560	0A00h	overrange	$D = 2048 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{2048} + 4$
	20mA	2048	0800h	nominal range	
	12mA	1024	0400h		
	4mA	0	0000h		
	0mA	-512	FE00h	underrange	

Technical data

Order number	**231-1BD60**
Type	SM 231
Current consumption/power loss	
Current consumption from backplane bus	280 mA
Power loss	1.4 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	20 Ω
Input current ranges	+4 mA ... +20 mA
Operational limit of current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-

Order number	**231-1BD60**
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	-
Noise suppression for frequency	-
Initial data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	none
Group error display	none
Channel error display	red LED per channel
Isolation	
Between channels	✓
Between channels of groups to	1
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	DC 75 V/ AC 60 V
Max. potential difference between inputs (Ucm)	DC 75 V/ AC 60 V
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	3
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

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

Order data

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

Description

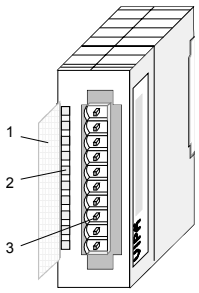
The module has 4 inputs that are permanently configured to measure voltage signals (±10V). This module requires a total of 8byte of the process image for the input data (2byte per channel).

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

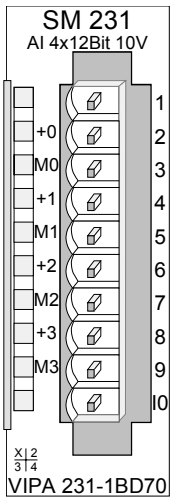
- 4 inputs, channels isolated from the backplane bus and from each other (Galvanic isolation of the channels by means of isolation amplifiers)
- Permanently configured for voltage measurements
- No parameterization required
- Suitable for transducers with ±10V outputs

Construction



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

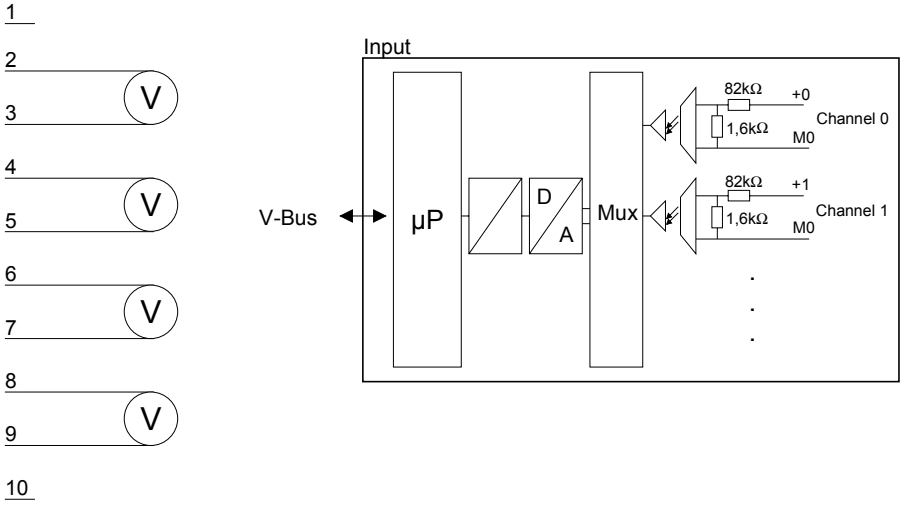
Pin assignment



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 S5 format

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

Numeric notation:

Byte	Bit 7 ... Bit 0
0	Bit 0: **Overflow** bit (**O**) 0: value within measuring range 1: measuring range exceeded Bit 1: **Error** bit (**F**: set at internal error) Bit 2: **Activity** bit (**A**: 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

Representation of analog values

Analog values are exclusively processed in a binary format. For this the analog module transforms every process signal into a digital value and transfers this as word.

Resolution	Analog value															
	byte 1								byte 0							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	SG	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
12bit + sign	**SG**	**Measuring value**												**A**	**E**	**O**

Measuring value

The here listed formulas allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range and vice versa.

Measuring range	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S5 format	12,5	2560	0A00h	overrange	$D = 2048 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{2048}$
	10V	2048	0800h	nominal range	
	5V	1024	0400h		
	0V	0	0000h		
	-5V	-1024	FC00h		
	-10V	-2048	F800h		
	-12,5	-2560	F600h	underrange	

Technical data

Order number	**231-1BD70**
Type	SM 231
Current consumption/power loss	
Current consumption from backplane bus	280 mA
Power loss	1.4 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	✓
Min. input resistance (voltage range)	83 kΩ
Input voltage ranges	-10 V ... +10 V
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	-
Noise suppression for frequency	-
Initial data size	8 Byte

Order number	**231-1BD70**
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	none
Group error display	none
Channel error display	none
Isolation	
Between channels	✓
Between channels of groups to	1
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	DC 75 V/ AC 60 V
Max. potential difference between inputs (Ucm)	DC 75 V/ AC 60 V
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	3
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

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.

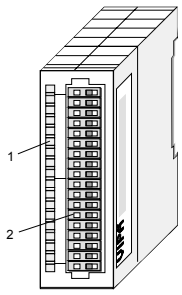
As transducer you may connect thermo couplers type J, K, T and resistance thermometer Pt100.

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

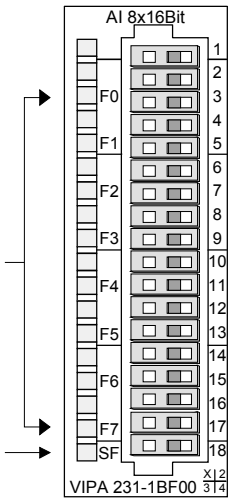
Construction



[1] LED status indicator
[2] Edge connector

Status indicator
pin assignment

LED	Description
F0...F7	LED (red): error for each channel
SF	LED (red): sum error



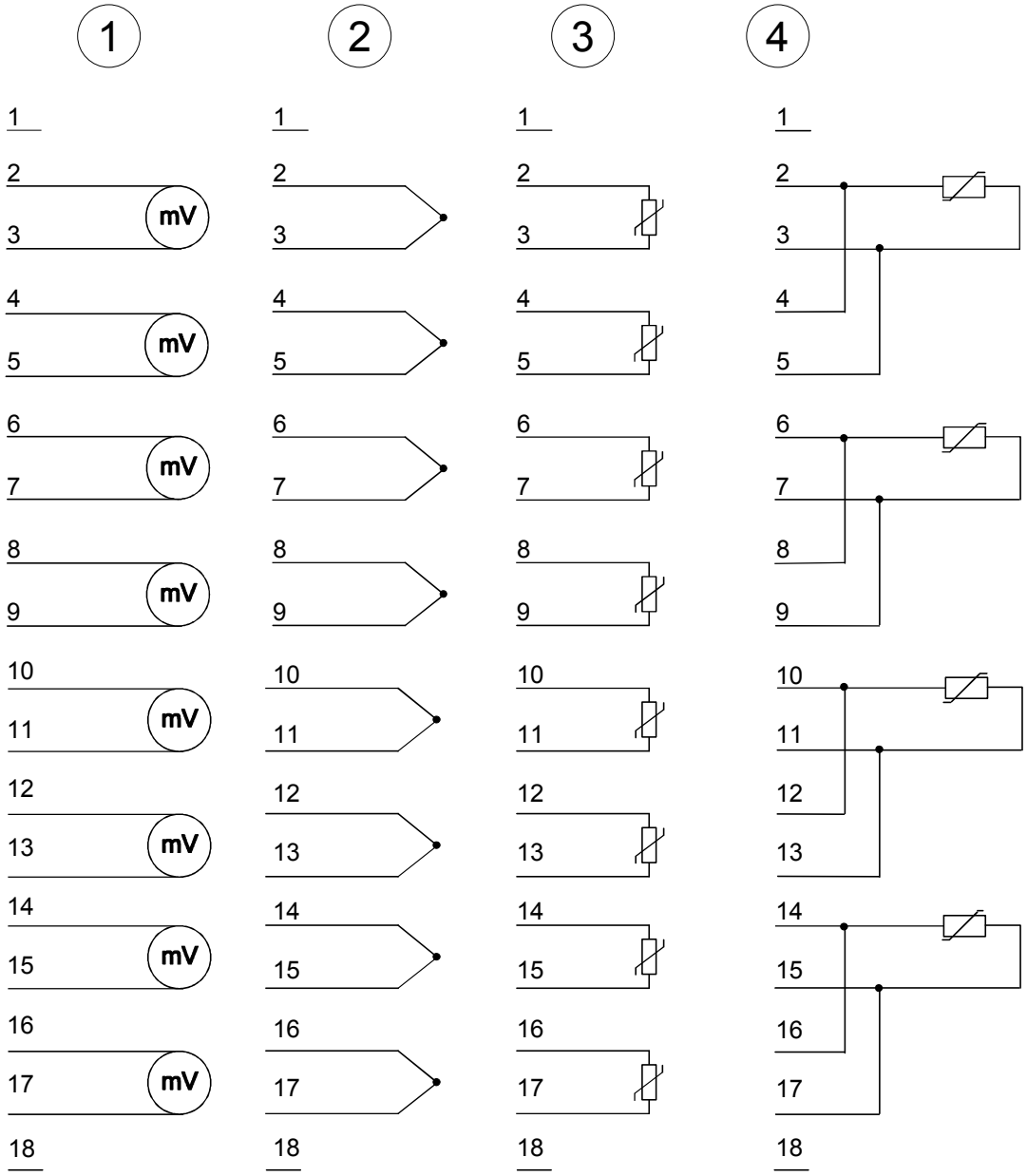
Pin	Assignment
1	not connected
2	pos. connection Ch.0
3	Channel 0 common
4	pos. connection Ch.1
5	Channel 1 common
6	pos. connection Ch.2
7	Channel 2 common
8	pos. connection Ch.3
9	Channel 3 common
10	pos. connection Ch.4
11	Channel 4 common
12	pos. connection Ch.5
13	Channel 5 common
14	pos. connection 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 shows the structure of the parameter area:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Diagnostic interrupt 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 interrupt inhibited 1: diagnostic interrupt 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 interrupt

The diagnostic interrupt 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) loose significance for the analog value.

Structure of the option byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	Option byte:		00h
	Bit 3 ... 0: rate *		
	0000 15 conversions/s	16	
	0001 30.1 conversions/s	16	
	0010 60 conversions/s	15	
	0011 123.2 conversions/s	14	
	0100 168.9 conversions/s	12	
	0101 202.3 conversions/s	10	
	0110 3.76 conversions/s	16	
	0111 7.51 conversions/s	16	
	Bit 7 ... 4: reserved		

*) 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

Order number	**231-1BF00**
Type	SM 231
Current consumption/power loss	
Current consumption from backplane bus	280 mA
Power loss	1.4 W
Technical data analog inputs	
Number of inputs	8
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	✓
Min. input resistance (voltage range)	2 MΩ
Input voltage ranges	0 mV ... +60 mV
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	+/-0.1%
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	±0.15% (2-wire) ±0.15% (4-wire)
Thermocouple inputs	✓
Thermocouple ranges	type J

Order number	231-1BF00
	type K type T
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	±0.1% (Compensation external) ±1.0% (internal)
Programmable temperature compensation	✓
External temperature compensation	✓
Internal temperature compensation	✓
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	6.75 ms ... 268 ms
Noise suppression for frequency	50 Hz and 60 Hz
Initial data size	16 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	none
Group error display	red SF LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	-
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 15 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 15 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	16
Output bytes	0
Parameter bytes	12
Diagnostic bytes	12
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

231-1FD00 - AI 4x16Bit f

Order data AI 4x16Bit f VIPA 231-1FD00

Description

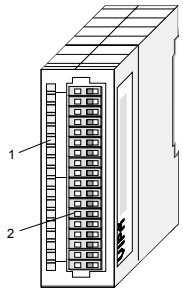
The module has 4 fast (f=fast) inputs that you may configure individually. The module requires a total of 8 input data bytes in the process image (2byte per channel).

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

Properties

- Using each 4 channels, the cycle time is ca. 0.8ms
- Different channels are individually configurable and may be turned off
- LED for signaling wire break in current loop operation
- Diagnostic function
- Resolution 16Bit
- Easy to connect 2-wire current sensors via splitting the front power supply
- Potentiometer are supplied via internal reference power supply

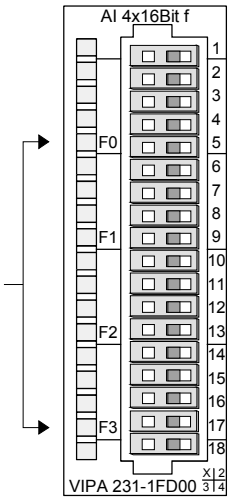
Construction



[1] LED status indicator
[2] 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).



Pin	Assignment
1	L+ (In)
2	+2.5V
3	pos. connection channel 0
4	neg. connection channel 0
5	L+ (Out)
6	+2.5V
7	pos. connection channel 1
8	neg. connection channel 1
9	L+ (Out)
10	+2.5V
11	pos. connection channel 2
12	neg. connection channel 2
13	L+ (Out)
14	+2.5V
15	pos. connection channel 3
16	neg. connection channel 3
17	L+ (Out)
18	GND

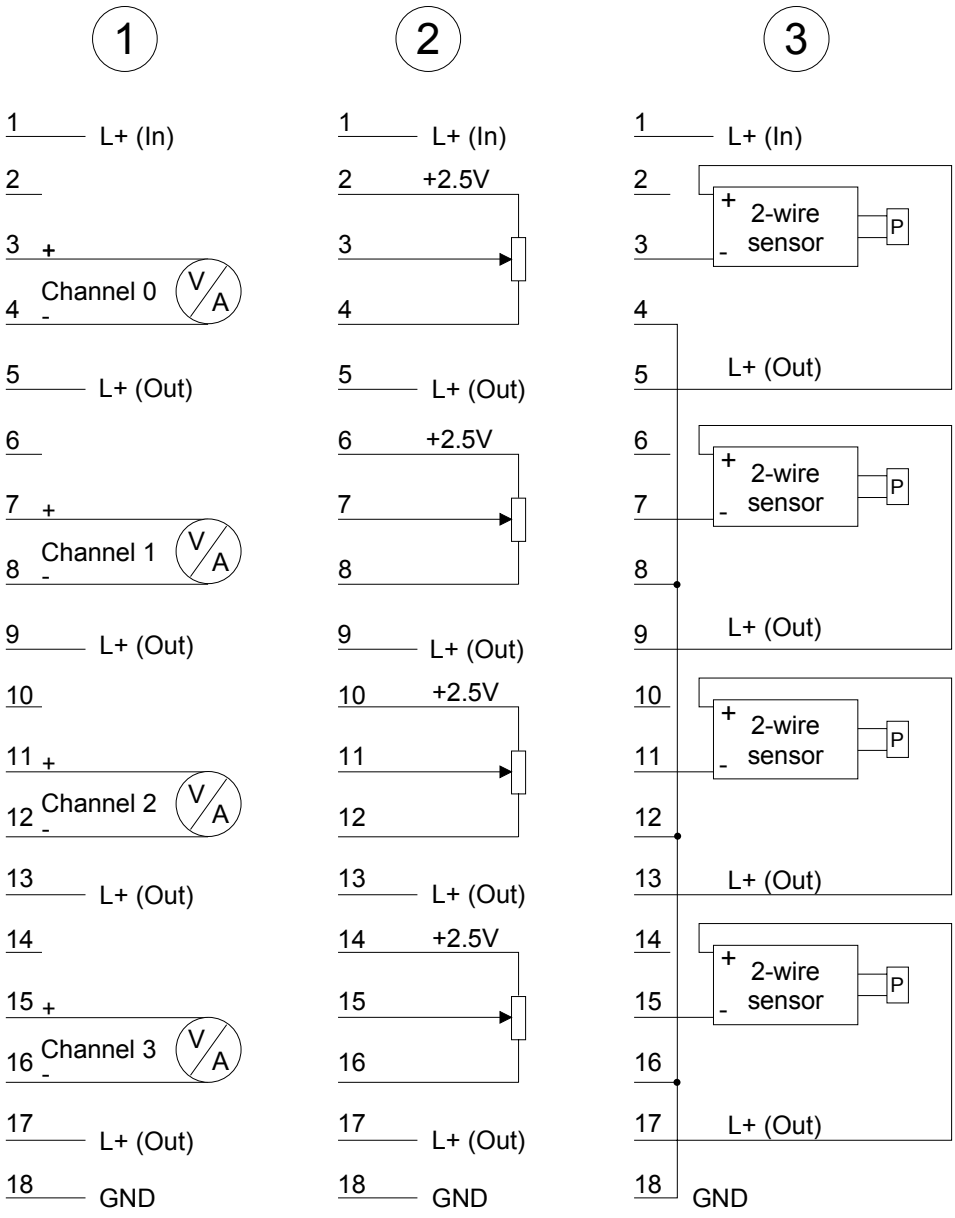
Note!

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.

The following circumstances may cause damages at the analog module:

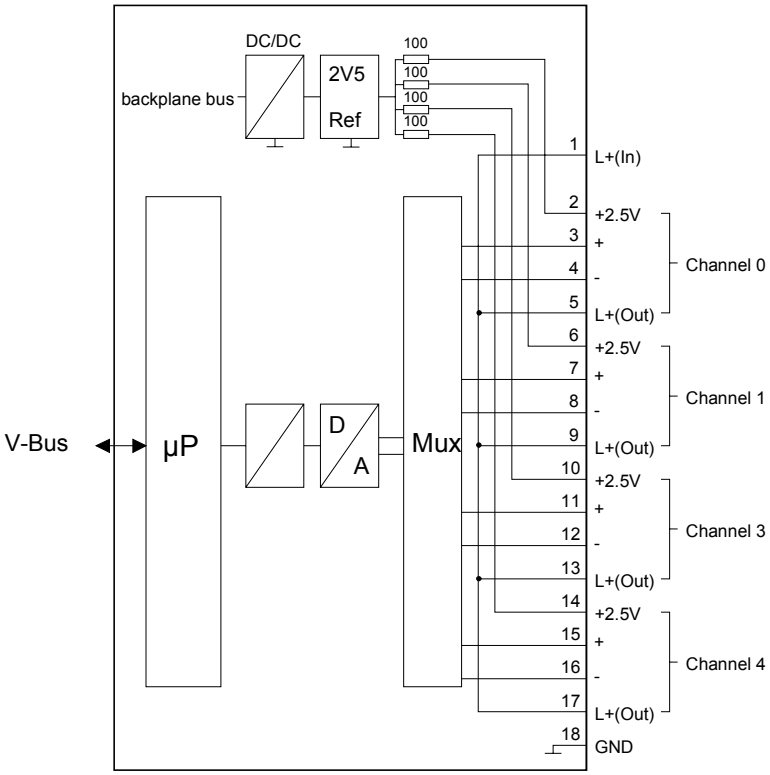
- The module must always first be power supplied via backplane bus before connecting the external power supply (current/voltage) to the front connector.
- Parameterization and connection of the input must always be congruent!
- You must not apply a voltage >15V to the input!

Wiring diagram

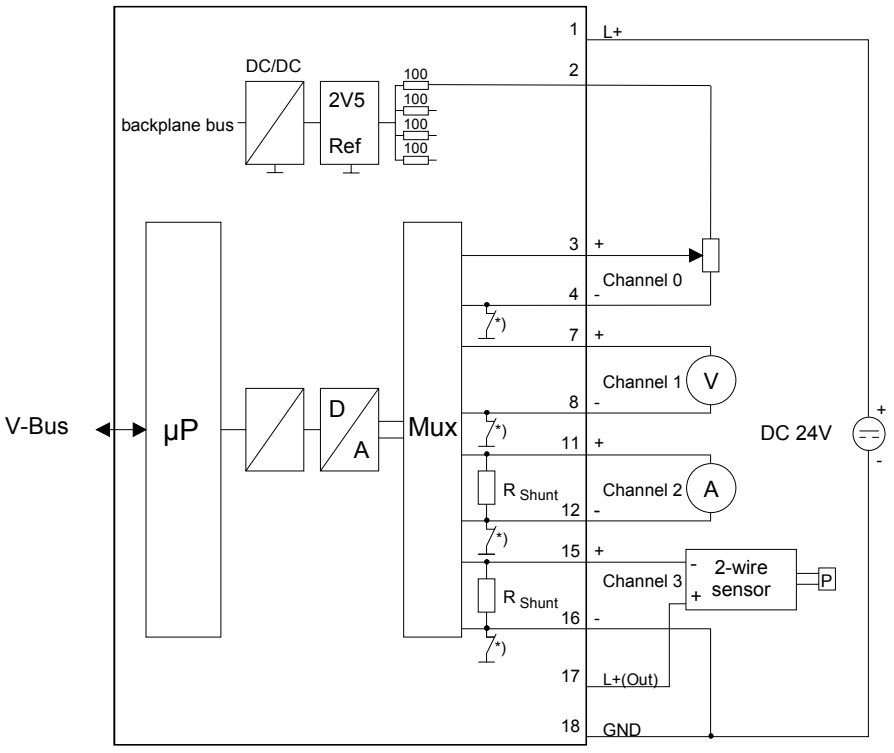


Schematic diagrams

Overview



Connection variants



*) During measuring the connection to ground is closed.

Attention!

If you connect one or more external differential sources (e.g. current shunts), a further connection to GND (Pin 18) is not allowed! This may damage the module!

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	Connection
00h	Does not affect permanently stored configuration data		
28h	Default value Voltage ±10V Siemens S7 format (two's complement)	±10V 9.9 ... 10V (27371 ... 27648) [1)] -9.9...9.9V= rated range (-27370... 27370) -10V ... -9.9V (-27648 ... -27371) [1)]	(1), (2)
29h	Voltage ±4V Siemens S7 format (two's complement)	±4.70V **/** 4.70V = max. value before over range (32511) -4...4V = rated range (-27648...27648) -4.70V = min. value before under range (-32512)	(1), (2)
2Ah	Voltage ±400mV Siemens S7 format (two's complement)	±470mV **/** 470mV = max. value before over range (32511) -400...400mV = rated range(-27648...27648) -470mV = min. value before under range (-32512)	(1)
2Ch	Current ±20mA Siemens S7 format (two's complement)	±23.51mA **/** 23.51mA = max. value before over range (32511) -20...20mA = rated range (-27648...27648) -23.51mA = min. value before under range (-32512)	(1), (3)
2Dh	Current 4...20mA Siemens S7 format (two's complement)	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)	(1), (3)
58h	Voltage ±10V (two's complement)	±10V 9.9 ... 10V (9901 ... 10000) [1)] -9.9 ... 9.9V rated range (-9900 ... 9900) -10 ... -9.9V (-10000 ... -9901) [1)]	(1), (2)
59h	Voltage ±4V (two's complement)	±4.95V **/** 4,95V = max. value before over range (4950) -4...4V = rated range (-4000...4000) -4.95V = min. value before under range (-4950)	(1), (2)
5Ah	Voltage ±400mV (two's complement)	±495mV **/** 495mV = max. value before over range (4950) -400...400mV = rated range (-4000...4000) -495mV = min. value before under range (-4950)	(1)
5Ch	Current ±20mA (two's complement)	±25mA **/** 25mA = max. value before over range (25000) -20...20mA = rated range (-20000...20000) -25mA = min. value before under range(-25000)	(1), (3)
5Dh	Current 4...20mA (two's complement)	0.8 .. +24.00mA **/** 24.00mA = End over range (20000) 4...20mA = rated range (0...16000) 0.8mA = min. value before under range (-3200)	(1), (3)
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 shows 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 interrupt inhibited 1: diagnostic interrupt 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 interrupt is initialized, containing the information "Process alarm missing/lost" (diagnostic data byte 3).

Technical data

Order number	231-1FD00
Type	SM 231
Current consumption/power loss	
Current consumption from backplane bus	300 mA
Power loss	1.5 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Voltage inputs	✓
Min. input resistance (voltage range)	10 MΩ
Input voltage ranges	-400 mV ... +400 mV -4 V ... +4 V -10 V ... +10 V
Operational limit of voltage ranges	+/-0.2% ... +/-0.4%
Basic error limit voltage ranges with SFU	+/-0.1% ... +/-0.3%
Current inputs	✓
Max. input resistance (current range)	57 Ω
Input current ranges	+4 mA ... +20 mA -20 mA ... +20 mA
Operational limit of current ranges	+/-0.2% ... +/-0.5%
Basic error limit current ranges with SFU	+/-0.1% ... +/-0.3%
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	0.2 ms/channel
Noise suppression for frequency	-
Initial data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	none
Group error display	none
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓

Order number	**231-1FD00**
Between channels and power supply	-
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 2 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	0
Parameter bytes	34
Diagnostic bytes	12
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	90 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

Chapter 3 Analog output modules

Overview

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

Contents

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. In situations with different electrical potentials, it is possible that a current will flow 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 loads and actuators

You can use the analog output modules to supply loads and actors with current or voltage.

Note!

Please take always care of the correct polarity when connecting actuators!

Please leave the output clamps of not used channels disconnected and set the *output type* of the channel to "deactivated" in the hardware configurator from Siemens.

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.

Analog value

Analog value representation

The analog values are only processed by the CPU in binary representation. Hereby the process signals are transformed into digital format in the analog module and passed on to the CPU as word variable.

The digitized analog value is the same for input and output values at the same nominal range.

The resolution depends on the used module as follows:

	Analog value															
	High byte								Low byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Resolution	SG	Analog value (word)														
12bit + Sign	SG	Relevant output value												X	X	X
11bit + Sign	SG	Relevant output value											X	X	X	X
10bit + Sign	SG	Relevant output value										X	X	X	X	X

* The least significant irrelevant bits of the output value are marked by "X".

Sign bit (SG)

The algebraic sign bit is represented by Bit 15. Here it is essential:

Bit 15 = "0" → positive value

Bit 15 = "1" → negative value

Conversion within the Siemens S5-format

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.

Within the Siemens S5 format a value may be converted between decimal and output value by means of the following formulas.

+/- 10V

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

0...10V

Voltage	Decimal	Hex
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

1...5V

Voltage	Decimal	Hex
1V	0	0
3V	8192	2000
5V	16384	4000

Formulas for the calculation:

$$Value = 16384 \cdot \frac{U-1}{4}, \quad U = Value \cdot \frac{4}{16384} + 1$$

U: voltage, Value: decimal value

4....20mA

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

Formulas for the calculation:

$$Value = 16384 \cdot \frac{I-4}{16}, \quad I = Value \cdot \frac{16}{16384} + 4$$

I: current, Value: decimal value

+/- 20mA

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

Formulas for the calculation:

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

I: current, Value: decimal value

0...20mA

Current	Decimal	Hex
0mA	0	0
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

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

I: current, Value: decimal value

Conversion within the Siemens S7-format

Within the Siemens S7 format a value may be converted between decimal and output value by means of the following formulas.

+/- 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

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

0...20mA

Current	Decimal	Hex
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

232-1BD30 - AO 4x12Bit ±10V, 0 ... 10V - ECO

Order data AO 4x12Bit, ±10V, 0 ... 10V VIPA 232-1BD30

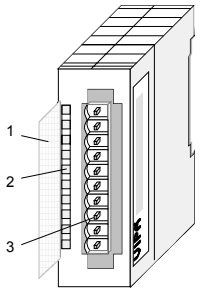
Description This module provides 4 outputs that can be configured individually. The module occupies a total of 8byte of output data (2byte per channel) in the process image. These values have to be defined as left justified two's complement entries.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC optocouplers. The module requires an external supply of DC 24V.

Properties

- 4 outputs with common ground
- Outputs with individually configurable functions
- Suitable for connection to actuators requiring ±10V or 0 … 10V inputs

Construction

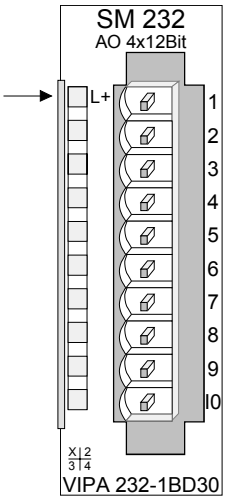


[1] Label for the bit address with description
[2] LED status indicator
[3] Edge connector

Status indicator

LED	Description
L+	LED (green) supply voltage is on

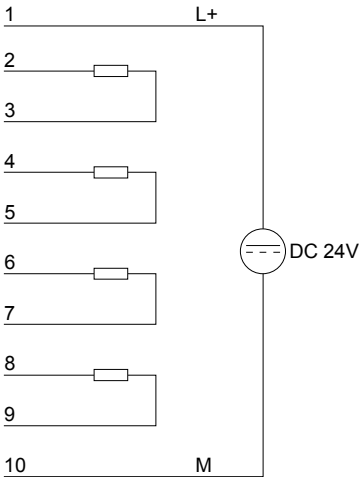
pin assignment



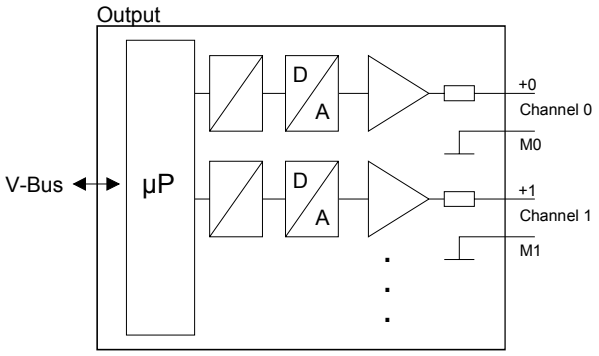
Pin	Assignment
1	DC 24V supply voltage
2	+ Channel 0
3	Channel 0 common
4	+ Channel 1
5	Channel 1 common
6	+ Channel 2
7	Channel 2 common
8	+ Channel 3
9	Channel 3 common
10	Supply voltage common

Wiring and schematic diagram

Wiring diagram



Schematic diagram



Data output

The value of the output data is entered into the data output area. For every channel you may configure the relationship between the output value and the respective voltage value by means of a function-no.

The following table shows the structure of the data output area:

Data output 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!

When new values are transferred from the CPU to the module, the module needs one cycle to update all outputs abbr. if the analog values change within this cycle, these are at least available at the concerning outputs at the end of the next following cycle.

Parameter data

6byte of parameter data are available for the configuration data. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

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	09h
3	Function-no. channel 1	09h
4	Function-no. channel 2	09h
5	Function-no. channel 3	09h

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	Output range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5 format (two's complement)	±12.5V 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480)
05h	Voltage 0...10V Siemens S5 format (two's complement)	0...12.5V 12.5V = max. value before over range (20480) 0...10V = rated range (0...16384) no under range available
09h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V 11.76V= max. value before over range (32511) -10V...10V = rated range (-27648...27648) -11.76 = min. value before under range (-32512)
0Dh	Voltage 0...10V Siemens S7 format (two's complement)	0...11.76V 11.76V = max. value before over range (32511) 0...10V = rated range (0...27648) no under range available
FFh	Channel not active (turned off)	

Note!

- The module is preset to the range "±10V voltage" in S7-format from Siemens.
- When cross over or underdrive range all modes return the value 0.

Technical data

Order number	**232-1BD30**
Type	SM 232, ECO
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	2.7 W
Technical data analog outputs	
Number of outputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	100 mA
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Output voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.4%
Basic error limit voltage ranges with SFU	+/-0.2%
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges with SFU	-
Settling time for ohmic load	1.5 ms
Settling time for capacitive load	3 ms
Settling time for inductive load	-
Resolution in bit	12
Conversion time	0.7 ms / all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	green LED
Group error display	none
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	-
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	-
Max. potential difference between Mintern and outputs	-

Order number	232-1BD30
Insulation tested with	DC 500 V
Datasizes	
Input bytes	0
Output bytes	8
Parameter bytes	8
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	80 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

232-1BD40 - AO 4x12Bit, 0/4...20mA - ECO

Order data AO 4x12Bit, 0...20mA, 4 ... 20mA VIPA 232-1BD40

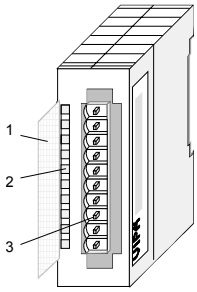
Description This module provides 4 outputs that can be configured individually. The module occupies a total of 8byte of output data (2byte per channel) in the process image. These values have to be defined as left justified two's complement entries.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC optocouplers. The module requires an external supply of DC 24V.

Properties

- 4 outputs with common ground
- Outputs with individually configurable functions
- Suitable for actuators with 0 ... 20mA or 4 ... 20mA input

Construction

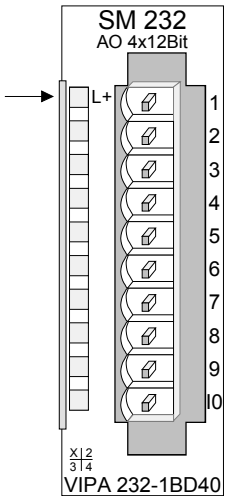


[1] Label for the bit address with description
[2] LED status indicator
[3] Edge connector

Status indicator

LED	Description
L+	LED (green) supply voltage is on

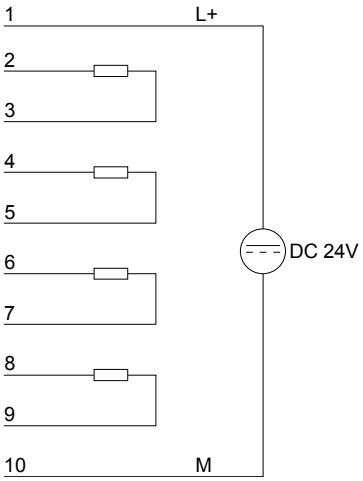
pin assignment



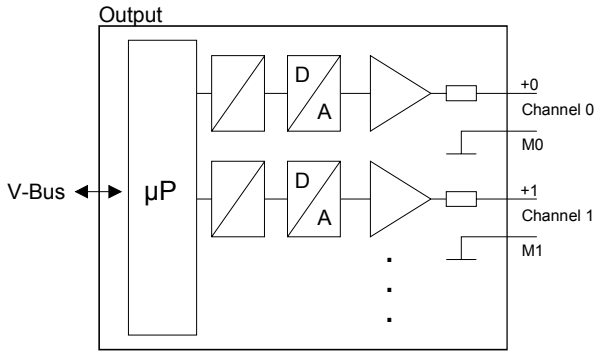
Pin	Assignment
1	DC 24V supply voltage
2	+ Channel 0
3	Channel 0 common
4	+ Channel 1
5	Channel 1 common
6	+ Channel 2
7	Channel 2 common
8	+ Channel 3
9	Channel 3 common
10	Supply voltage common

Wiring and schematic diagram

Wiring diagram



Schematic diagram



Data output

The value of the output data is entered into the data output area. For every channel you may configure the relationship between the output value and the respective current value by means of a function-no.

The following table shows the structure of the data output area:

Data output 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!

When new values are transferred from the CPU to the module, the module needs one cycle to update all outputs abbr. if the analog values change within this cycle, these are at least available at the concerning outputs at the end of the next following cycle.

Parameter data

6Byte of parameter data are available for the configuration data. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

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	0Eh
3	Function-no. channel 1	0Eh
4	Function-no. channel 2	0Eh
5	Function-no. channel 3	0Eh

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	Output range
00h	Does not affect permanently stored configuration data	
04h	Current 4...20mA Siemens S5 format (two's complement)	0...24mA 24mA = max. value before over range (20480) 4...20mA = rated range (0...16384) 0mA = min. value before under range (-4096)
06h	Current 0...20mA Siemens S5 format (two's complement)	0...25mA 25mA = max. value before over range (20480) 0...20mA = rated range (0...16384) no under range available
0Ch	Current 4...20mA Siemens S7 format (two's complement)	0...22.81mA 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-6912)
0Eh	Current 0...20mA Siemens S7 format (two's complement)	0...23.52mA 23.52mA = max. value before over range (32511) 0...20mA = rated range (0...27648) no under range available
FFh	Channel not active (turned off)	

Note!

- The module is preset to the range "0...20mA" in S7-format from Siemens.
- When cross over or underdrive range all modes return the value 0.

Technical data

Order number	**232-1BD40**
Type	SM 232, ECO
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	1.5 W
Technical data analog outputs	
Number of outputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	50 mA
Voltage output short-circuit protection	-
Voltage outputs	-
Min. load resistance (voltage range)	-
Max. capacitive load (current range)	-
Output voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current outputs	✓
Max. in load resistance (current range)	350 Ω
Max. inductive load (current range)	10 mH
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.4%
Basic error limit current ranges with SFU	+/-0.2%
Settling time for ohmic load	0.03 ms
Settling time for capacitive load	-
Settling time for inductive load	1.5 ms
Resolution in bit	12
Conversion time	0.7 ms / all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	no
Diagnostics information read-out	none
Supply voltage display	green LED
Group error display	none
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	-
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	-
Max. potential difference between Mintern and outputs	-

Order number	**232-1BD40**
Insulation tested with	DC 500 V
Datasizes	
Input bytes	0
Output bytes	8
Parameter bytes	8
Diagnostic bytes	0
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	80 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

232-1BD51 - AO 4x12Bit, multioutput

Order data

AO 4x12Bit multioutput VIPA 232-1BD51

Please be aware that this Module cannot be operated on a Profibus DP slave with revision level 4 or less. In this case please use our (spare-part) Module with order-no.: VIPA 232-1BD50 which has the identical function.

Description

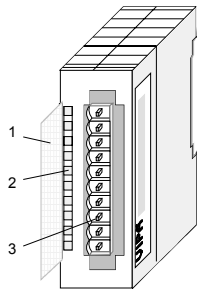
This module provides 4 outputs that can be configured individually. The module occupies a total of 8byte of output data (2byte per channel) in the process image. These values have to be defined as left justified two's complement entries.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers. The module requires an external supply of DC 24V.

Properties

- 4 outputs with common ground
- Outputs with individually configurable functions
- Suitable for connection to actuators requiring ±10V, 1 ... 5V, 0 … 10V, ±20mA, 4 … 20mA or 0 ... 20mA inputs
- Diagnostic LED and diagnostic function

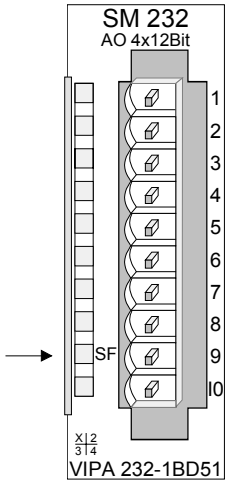
Construction



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

Status indicator

LED	Description
SF	Diagnostic LED (red) turned on by: - a short circuit is detected at the control voltage output - an open circuit is detected on the current output line - wrong parameter at module - the module does not receive supply voltage

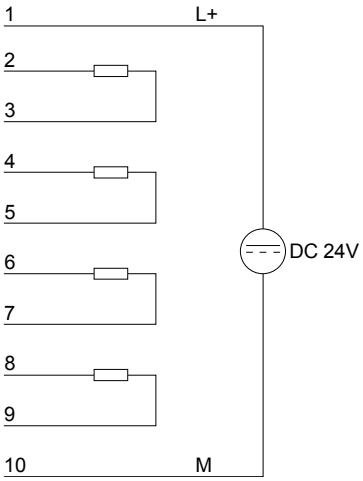


pin assignment

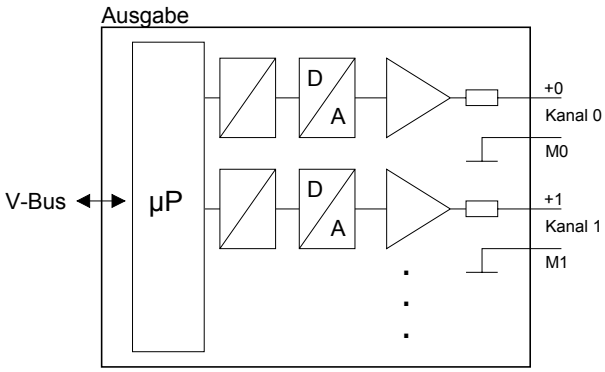
Pin	Assignment
1	DC 24V supply voltage
2	+ Channel 0
3	Channel 0 common
4	+ Channel 1
5	Channel 1 common
6	+ Channel 2
7	Channel 2 common
8	+ Channel 3
9	Channel 3 common
10	Supply voltage common

Wiring and schematic diagram

Wiring diagram



Schematic diagram



Attention!

Switching off and on the load nominal voltage (L+) could lead to wrong values on the output for ca. 80ms!

Data output

The value of the output data is entered into the data output area. For every channel you may configure the relationship between the output value and the respective current or voltage by means of a function-no..

The following table shows the structure of the data output area:

Data output 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!

When new values are transferred from the CPU to the module, the module needs one cycle to update all outputs abbr. if the analog values change within this cycle, these are at least available at the concerning outputs at the end of the next following cycle.

Parameter data

6Byte of parameter data are available for the configuration data. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0
0	Diagnostic interrupt byte: Bit 5 ... 0: reserved Bit 6: 0: diagnostic interrupt inhibited 1: diagnostic interrupt enabled Bit 7: reserved
1	reserved
2	Function-no. channel 0
3	Function-no. channel 1
4	Function-no. channel 2
5	Function-no. channel 3

Parameter

Diagnostic interrupt

You can enable diagnostic interrupts by means of bit 6 of byte 0. When an error occurs 4 diagnostic bytes are transmitted to the master system.

Function-no.

Here you enter the function-no. of the output function for every channel. The relationship between the function number and the output functions is available from the function-no. allocation table.

Diagnostic data

When you enable alarms in byte 0 of the parameter area, modules will transfer 4 diagnostic bytes with pre-defined contents to your master in case of an error. Please note that analog modules only use the first two bytes for diagnostic purposes. The remaining bytes are not used.

The structure of the diagnostic bytes is as follows:

Diagnostic data:

Byte	Bit 7 ... Bit 0
0	Bit 0: Module malfunction Bit 1: reserved Bit 2: External error Bit 3: Channel error present (wire break/short circuit) Bit 6 ... 4: reserved Bit 7: Wrong parameter at module
1	Bit 3 ... 0: class of module 0101 analog module Bit 4: channel information available Bit 7 ... 5: reserved
2	not assigned
3	not assigned

Function-no. allocation

The assignment of a function-no. to a certain channel happens during parameterization.

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5 format (two's complement)	±12.5V 12.5V = max. value before over range (20480) -10...10V = rated range (-16384...16384) -12.5V = min. value before under range (-20480)
02h	Voltage 1...5V Siemens S5 format (two's complement)	0...6V 6V = max. value before over range (20480) 1...5V = rated range (0...16384) 0V = min. value before under range (-4096)
05h	Voltage 0...10V Siemens S5 format (two's complement)	0...12.5V 12.5V = max. value before over range (20480) 0...10V = rated range (0...16384) no under range available
09h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V 11.76V= max. value before over range (32511) -10V...10V = rated range (-27648...27648) -11.76 = min. value before under range (-32512)
0Ah	Voltage 1...5V Siemens S7 format (two's complement)	0...5.704V 5.704V = max. value before over range (32511) 1...5V = rated range (0...27648) 0V = min. value before under range (-6912)
0Dh	Voltage 0...10V Siemens S7 format (two's complement)	0...11.76V 11.76V = max. value before over range (32511) 0...10V = rated range (0...27648) no under range available
03h	Current ±20mA Siemens S5 format (two's complement)	±25mA 25mA = max. value before over range (20480) -20...20mA = rated range (-16384...16384) -25mA = min. value before under range (-20480)
04h	Current 4...20mA Siemens S5 format (two's complement)	0...24mA 24mA = max. value before over range (20480) 4...20mA = rated range (0...16384) 0mA = min. value before under range (-4096)
06h	Current 0...20mA Siemens S5 format (two's complement)	0...25mA 25mA = max. value before over range (20480) 0...20mA = rated range (0...16384) no under range available
0Bh	Current ±20mA Siemens S7 format (two's complement)	±23.52mA 23.52mA = max. value before over range (32511) -20...20mA = rated range (-27648...27648) -23.52mA = min. value before under range (-32512)
0Ch	Current 4...20mA Siemens S7 format (two's complement)	0...22.81mA 22.81mA = max. value before over range (32511) 4...20mA = rated range (0...27648) 0mA = min. value before under range (-6912)
0Eh	Current 0...20mA Siemens S7 format (two's complement)	0...23.52mA 23.52mA = max. value before over range (32511) 0...20mA = rated range (0...27648) no under range available
FFh	Channel not active (turned off)	

Note!

The module is preset to the range "±10V voltage" in Siemens S7-format. When cross over or underdrive range all modes return the value 0.

Technical data

Order number	232-1BD51
Type	SM 232
Current consumption/power loss	
Current consumption from backplane bus	75 mA
Power loss	1.8 W
Technical data analog outputs	
Number of outputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	60 mA
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	1 kΩ
Max. capacitive load (current range)	1 µF
Output voltage ranges	-10 V ... +10 V +1 V ... +5 V 0 V ... +10 V
Operational limit of voltage ranges	see below
Basic error limit voltage ranges	see below
Current outputs	✓
Max. in load resistance (current range)	500 Ω
Max. inductive load (current range)	10 mH
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA -20 mA ... +20 mA
Operational limit of current ranges	see below
Basic error limit current ranges	see below
Settling time for ohmic load	0.05 ms
Settling time for capacitive load	0.5 ms
Settling time for inductive load	0.1 ms
Resolution in bit	12
Conversion time	0.45 ms / channel
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	none
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	-
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and	-

Order number	**232-1BD51**
Mintern (Uiso)	
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	0
Output bytes	8
Parameter bytes	8
Diagnostic bytes	4
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	100 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

Suppression of interference, limits of error output channels		
Operational limit (in the entire temperature range, referring to output range)		
	Measuring range	Tolerance
Voltage output	1 … 5V	±0.8%[1]
	0 … 10V	±0.6%[1]
	±10V	±0.4%[1]
Current output	4 … 20mA	±0.8%[2]
	0 … 20mA	±0.6%[2]
	±20mA	±0.3%[2]
Basic error limit (during temperature is 25°C, referring to output range)		
	Measuring range	Tolerance
Voltage output	1 … 5V	±0.4%[1]
	0 … 10V	±0.3%[1]
	±10V	±0.2%[1]
Current output	4 … 20mA	±0.5%[2]
	0 … 20mA	±0.4%[2]
	±20mA	±0.2%[2]

[1] The error limits are measured with a load of R=1GΩ. For voltage output the output impedance is 30Ω.

[2] The error limits are measured with a load of R=10Ω.

Chapter 4 Analog input/output modules

Overview

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

Content

General

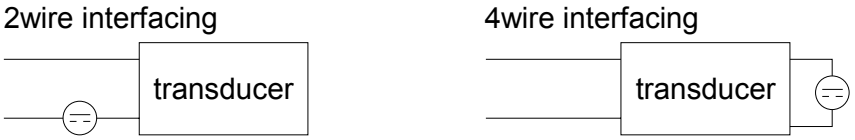
Cabling for analog signals

You must only use screened twisted-pair cable for analog signals. These cables reduce the effect of electrical interference. The screen of the analog signal cable should be grounded at both ends. In situations where the cable ends are at different electrical potentials, it is possible that a current will flow 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 sensors

Our analog modules provide a large number of configuration options suitable for 2wire and 4wire transducers. Please remember that transducers require an external power source. You have to connect an external power supply in line with any 2wire transducer.

The following diagram explains the connection of 2- and 4wire transducers:



Connecting loads and actuators

Due to the fact that actuators also require a source of external power, they may also be connected with 2 or 4wires. Where control signals are supplied to 2wire actuators a power supply has to be connected in series with the control cable. 4wire actuators need an external power source.

Note!

Please ensure that you connect actuators to the correct polarity!

Unused output terminals must not be connected!

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.

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!

234-1BD50 - AI 2/AO 2x12Bit - Multiin-/output

Order data AI 2/AO 2x12Bit Multiin-/output VIPA 234-1BD50

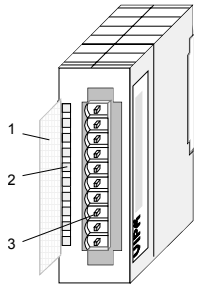
Description This module has 2 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 4byte of input and 4byte of output data.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers. The module requires an external supply of DC 24V.

Properties

- 2 inputs and 2 outputs with common ground
- In-/Outputs with individually configurable functions
- Suitable for encoder res. actuators with in- res. output ranges of: ±10V, 1...5V, 0...10V, ±20mA, 0...20mA or 4...20mA
- Diagnostic LED

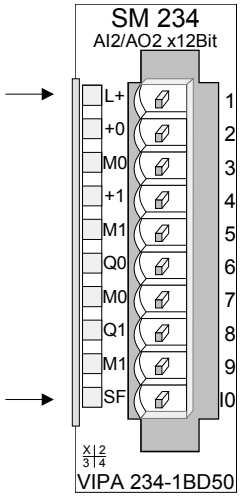
Construction



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

Status indicator
Pin assignment

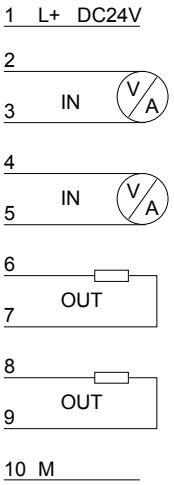
LED	Description
L+	LED (yellow) Supply voltage present
SF	Sum error LED (red) turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened



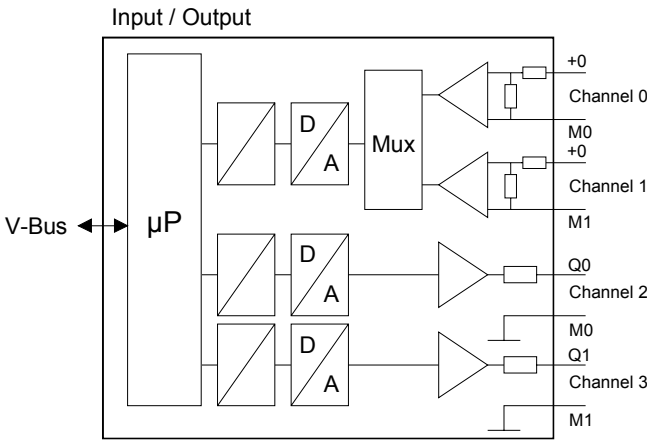
Pin	Assignment
1	DC 24V supply voltage
2	pos. connection Ch.0
3	Ground Channel 0
4	pos. connection Ch.1
5	Ground Channel 1
6	pos. connection Ch.2
7	Ground Channel 2
8	pos. connection Ch.3
9	Ground Channel 3
10	Supply voltage Ground

Circuit and schematic diagram

Circuit diagram



Schematic diagram



Attention!

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!

Data input/ data output range

Data input range:

During the measuring, the measuring values are stored in the data input area with the following assignment.:

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

Note!

At 3wire res. 4wire measuring, only channel 0 is used.

Data output range:

For output of the data you set a value in the data output area. The functionality can be set by means of function-no. for each channel.

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

Parameter data

12byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition and diagnostic interrupt: Bit 0: Wire break recognition channel 0 0: deactivated 1: activated Bit 1: Wire break recognition channel 1 0: deactivated 1: activated Bit 5 ... 2: reserved Bit 6: 0: diagnostic interrupt inhibited 1: diagnostic interrupt enabled Bit 7: reserved	00h
1	reserved Bit 0: reserved Bit 1: reserved Bit 2: CPU-Stop reaction for channel 2 0: Set replacement value channel 2*) 1: Store last value channel 2 Bit 3: CPU-Stop reaction for channel 3 0: Set replacement value channel 3 1: Store last value channel 3 Bit 7 ... 4: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	09h
5	Function-no. channel 3 (see table input ranges)	09h
6	Meas. cycle channel 0	00h
7	Meas. cycle channel 1	00h
8	High-Byte replacement value channel 2	00h
9	Low-Byte replacement value channel 2	00h
10	High-Byte replacement value channel 3	00h
11	Low-Byte replacement value channel 3	00h

*) If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):
E500h for the S7 format from Siemens and F000h for the S5 format from Siemens.

Parameter

Wire break recognition

The bits 0 and 1 of byte 0 allow you to activate the wire break recognition for the input channels. The wire break recognition is only available for the current measuring range of 4...20mA. A wire break is recognized when the current input during current measuring sinks under 1.18mA.

A wire break at activated wire break recognition causes an entry in the diagnosis area. This is shown via the SF-LED.

If additionally a diagnostic interrupt is activated, a diagnosis message is sent to the superordinated system.

Diagnostic interrupt

With the help of bit 6 of byte 0, you may release the diagnostic interrupt. 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".

CPU-Stop reaction and replacement value

With Bit 2 and 3 of byte 1 and byte 8 ... 11 you may set the reaction of the module at CPU-Stop for every output channel.

Via Byte 8 ... 11 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting Bit 2 res. 3, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function-no.

Here you set the function-no. of your measuring res. output function for every channel. Please see the according table next page.

Meas. cycle

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 Meas. cycle 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 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 7 ... 4: reserved		

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.

By entering FFh you may deactivate the concerning channel.

The following tables list all functions that are supported by the depending channel.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

Input range (channel 0, channel 1)

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
3Bh	Voltage ±10V Siemens S5 format (two's complement)	±12.5V **/** 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480)
2Bh	Voltage ±10V Siemens S5 format (value and sign)	±12.5V **/** 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480)
72h	Voltage 1...5V Siemens S5 format (value and sign)	0...6V 6V = End overdrive region (20480) 1...5V = nominal range (0...16384) 0V = End underdrive region (-4096)
75h	Voltage 0...10V Siemens S5 format (value and sign)	0...12.5V 12.5V = End overdrive region (20480) 0...10V = nominal range (0...16384) no underdrive region available
28h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V **/** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512)
7Ah	Voltage 1...5V Siemens S7 format (two's complement)	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912)

continued ...

... continue function-no. input range (channel 0, channel 1)

No.	Function	Measuring range / representation
7Dh	Voltage 0...10V Siemens S7 format (two's complement)	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
3Ah	Current ±20mA Siemens S5 format (two's complement)	±25.0mA **/** 25.0mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25.0mA = End underdrive region (-20480)
2Fh	Current ±20mA Siemens S5 format (value and sign)	±25.0mA **/** 25.0mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25.0mA = End underdrive region (-20480)
2Eh	Current 4...20mA Siemens S5 format (value and sign)	0.8...+24.0mA **/** 24.0mA = End overdrive region(20480) 4 ... 20mA = nominal range (0...16384) 0.8mA = End underdrive region (-3277)
76h	Current 0...20mA Siemens S5 format (value and sign)	0...25mA 25mA = End overdrive region (20480) 0...20mA = nominal range (0...16384) no underdrive region available
2Ch	Current ±20mA Siemens S7 format (two's complement)	±23.51mA **/** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512)
2Dh	Current 4...20mA Siemens S7 format (two's complement)	1.185...+22.81mA **/** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864)
7Eh	Current 0...20mA Siemens S7 format (two's complement)	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Note!

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

Output range (Channel 2, Channel 3)

No.	Function	Output or input range
00h	Does not affect permanently stored configuration data	
01h	Voltage ±10V Siemens S5 format (two's complement)	±12.5V 12.5V = End overdrive region (20480) -10...10V = nominal range (-16384...16384) -12.5V = End underdrive region (-20480)
02h	Voltage 1...5V Siemens S5 format (two's complement)	0...6V 6V = End overdrive region (20480) 1...5V = nominal range (0...16384) 0V = End underdrive region (-4096)
05h	Voltage 0...10V Siemens S5 format (two's complement)	0...12.5V 12.5V = End overdrive region (20480) 0...10V = nominal range (0...16384) no underdrive region available
09h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512)
0Ah	Voltage 1...5V Siemens S7 format (two's complement)	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912)
0Dh	Voltage 0...10V Siemens S7 format (two's complement)	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
03h	Current ±20mA Siemens S5 format (two's complement)	±25.0mA 25mA = End overdrive region (20480) -20...20mA = nominal range (-16384...16384) -25mA = End underdrive region (20480)
04h	Current 4...20mA Siemens S5 format (two's complement)	0...24mA 24mA = End overdrive region (20480) 4...20mA = nominal range (0...16384) 0mA = End underdrive region (-4096)
06h	Current 0...20mA Siemens S5 format (two's complement)	0...25mA 25mA = End overdrive region (20480) 0...20mA = nominal range (0...16384) no underdrive region available
0Bh	Current ±20mA Siemens S7 format (two's complement)	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512)
0Ch	Current 4...20mA Siemens S7 format (two's complement)	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912)
0Eh	Current 0...20mA Siemens S7 format (two's complement)	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Note!

Leaving the defined range, the output is 0V res. 0A!

Numeric notation in Siemens S5 format

In Siemens S5 format, input data is saved into a 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 exceeded Bit 1: error bit (set by internal errors) 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

+/- 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)

Strom	Dezimal	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

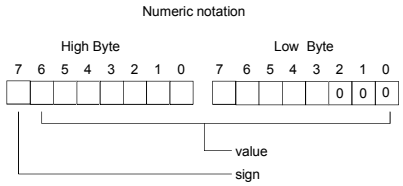
+/- 20mA (value and sign)

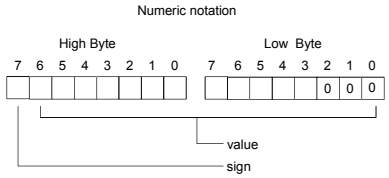
Current	Decimal	Hex
-20mA	-16384	C000
-10mA	-8192	A000
0mA	0	0000
10mA	8192	2000
20mA	16384	4000

Formulas for the calculation:

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

U: voltage, Value: Decimal value

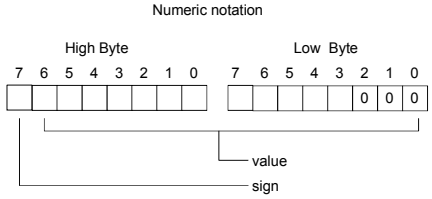




Formula for the calculation:

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

I: Current, Value: Decimal value



Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

Numeric representation:

Byte	Bit 7 ... Bit 0
0	Bit 7 ... 0: binary measured vale
1	Bit 6 ... 0: binary measured vale 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

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 interrupt 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

Byte 0 to 3:

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 4: external supply voltage is missing Bit 5,6: 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

Byte 0 to 11:

The *record set 1* contains the 4byte of record set 0 and additional 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 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 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 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 at current output res. short circuit at voltage output Channel 2 Bit 1: Parameterization error Channel 2 Bit 7 ... 2: reserved	00h
11	Bit 0: Wire break at current output res. short circuit at voltage output Channel 3 Bit 1: Parameterization error Channel 3 Bit 7 ... 2: reserved	00h

Technical data

Order number	234-1BD50
Type	SM 234
Current consumption/power loss	
Current consumption from backplane bus	100 mA
Power loss	2.9 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	70 mA
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	+1 V ... +5 V 0 V ... +10 V -10 V ... +10 V
Operational limit of voltage ranges	-
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.6%
Current inputs	✓
Max. input resistance (current range)	50 Ω
Input current ranges	+4 mA ... +20 mA 0 mA ... +20 mA -20 mA ... +20 mA
Operational limit of current ranges	-
Basic error limit current ranges with SFU	+/-0.3% ... +/-0.8%
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Basic error limit	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	6.75 ms - 268 ms
Noise suppression for frequency	50 Hz and 60 Hz
Initial data size	4 Byte
Technical data analog outputs	
Number of outputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	70 mA
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	1 kΩ
Max. capacitive load (current range)	1 µF
Output voltage ranges	-10 V ... +10 V +1 V ... +5 V 0 V ... +10 V
Operational limit of voltage ranges	-

Order number	**234-1BD50**
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.6%
Current outputs	✓
Max. in load resistance (current range)	500 Ω
Max. inductive load (current range)	10 mH
Output current ranges	-20 mA ... +20 mA +4 mA ... +20 mA 0 mA ... +20 mA
Operational limit of current ranges	-
Basic error limit current ranges with SFU	+/-0.3% ... +/-0.8%
Settling time for ohmic load	0.05 ms
Settling time for capacitive load	0.5 ms
Settling time for inductive load	0.1 ms
Resolution in bit	12
Conversion time	2.5 ms/all channels
Substitute value can be applied	yes
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	-
Max. potential difference between Mana and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	-
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	4
Output bytes	4
Parameter bytes	14
Diagnostic bytes	12
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	110 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

234-1BD60 - AI 4/AO 2x12Bit - Multiin-/output

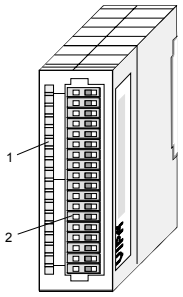
Order data AI 4/AO 2x12Bit Multiin-/output VIPA 234-1BD60

Description This module has 4 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 8byte of input and 4byte of output data in the periphery area. Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and optocouplers.

Properties

- 4inputs and 2 outputs with common ground
- In-/Outputs with individually configurable functions
- Channel 0 to 2 suitable for encoder with input ranges of:
  voltage ±10V, 1 ... 5V, 0 ... 10V, ±4V, ±400mV
  current ±20mA, 4...20mA or 0 ... 20mA
- Channel 3 suitable for encoder with input ranges of:
  Pt100, Pt1000, NI100, NI1000 and
  resistant measuring 600Ω, 3000Ω
- Channel 4 to 5 Suitable for actuators with output ranges of:
  ±10V, 1 ... 5V, 0 ... 10V, ±20mA, 0 ... 20mA or 4 ... 20mA

Construction

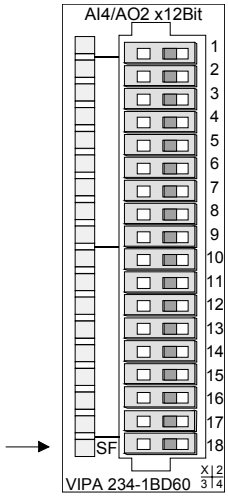


[1] Label for the name of the module
[2] LED status indicator
[3] Edge connector

Status indicator

LED	Description
SF	Sum error LED (red) turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened

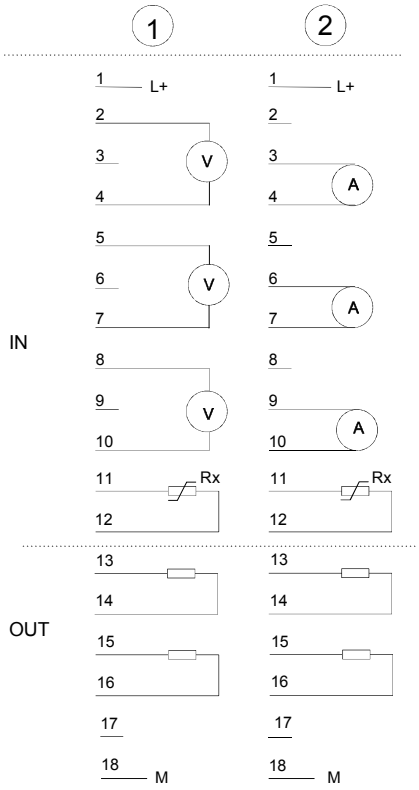
Pin assignment



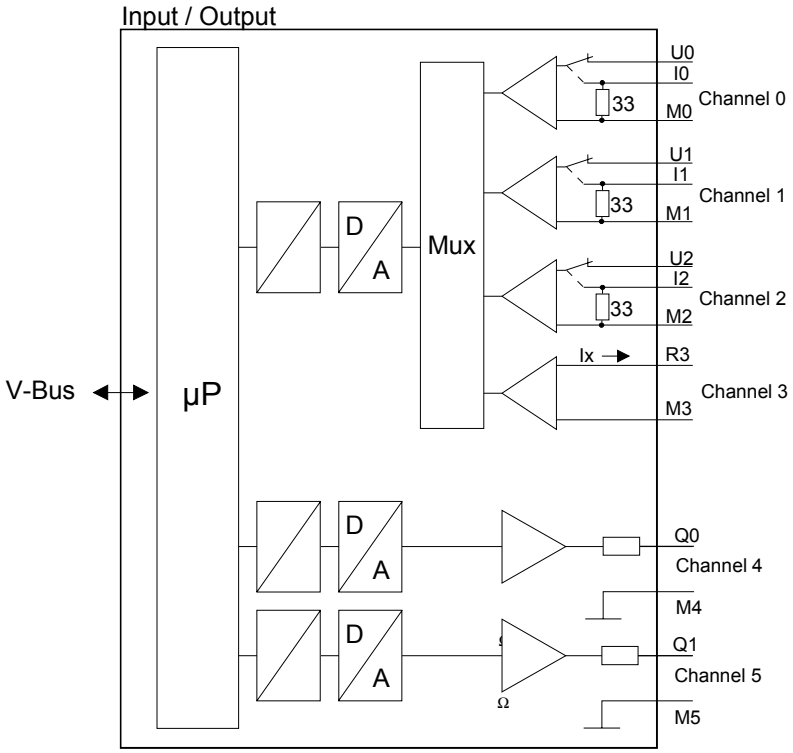
Pin	Assignment
1	DC 24V supply voltage
2	Voltage measuring channel 0
3	Current measuring channel 0
4	Ground channel 0
5	Voltage measuring channel 1
6	Current measuring channel 1
7	Ground channel 1
8	Voltage measuring channel 2
9	Current measuring channel 2
10	Ground channel 2
11	Measuring channel 3 (Pt, Ni, R)
12	Ground 3
13	Q0 output channel 4
14	M4 output channel 4
15	Q1 output channel 5
16	M5 output channel 5
17	reserved
18	Ground Supply voltage

Circuit and schematic diagram

Circuit diagram



Schematic diagram



Attention!

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!

Data input/ data output range

Data input range:

During the measuring, the measuring values are stored in the data input area with the following assignment.:

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

Data output range:

For output of the data you set a value in the data output area.

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

Parameter data

16byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off. 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 50ms. During this time, the measuring value output is 7FFFFh.

The following table shows the structure of the parameter data:

Parameter area:

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition channel 0 Bit 0: 0 = deactivated 1 = activated Wire break recognition channel 1 Bit 1: 0 = deactivated 1 = activated Wire break recognition channel 2 Bit 2: 0 = deactivated 1 = activated Wire break recognition channel 3 Bit 3: 0 = deactivated 1 = activated Bit 4, 5: reserved Diagnostic interrupt Bit 6: 0 = diagnostic interrupt inhibited 1 = diagnostic interrupt enabled Bit 7: reserved	00h
1	Bit 3 … 0: reserved CPU-Stop reaction for channel 4 Bit 4: 0 = Set replacement value *) 1 = Store last value CPU-Stop reaction for channel 5 Bit 5: 0 = Set replacement value *) 1 = Store last value Bit 6, 7: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	28h
5	Function-no. channel 3 (see table input ranges)	01h
6	Option-Byte channel 0 (see table next page)	00h
7	Option-Byte channel 1 (see table next page)	00h
8	Option-Byte channel 2 (see table next page)	00h
9	Option-Byte channel 3 (see table next page)	00h
10	Function-no. channel 4 (see table output ranges)	09h
11	Function-no. channel 5 (see table output ranges)	09h
12	High-Byte replacement value channel 4	00h
13	Low-Byte replacement value channel 4	00h
14	High-Byte replacement value channel 5	00h
15	Low-Byte replacement value channel 5	00h

*) If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):
E500h for the S7 format from Siemens.

Parameter

Wire break recognition

Via the bits 0 and 3 of byte 0, the wire break recognition is activated for the input channels. The wire break recognition is only available for the current measuring range of 4...20mA and at (thermo) resistance measuring. A wire break is recognized when the current input during current measuring sinks under 1.18mA res. when the resistance at (thermo) resistance measuring reaches infinite. This causes an entry in the diagnosis area and is shown via the SF-LED.

If a diagnostic interrupt is activated, a diagnosis message is sent to the super-ordinated system.

Diagnostic interrupt

With the help of bit 6 of byte 0, you may release the diagnostic interrupt. In case of an error like e.g. wire break, the superordinated system receives *record 0* (4byte). For an extended diagnosis you may then call *record 1* (12byte). More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With bit 4 and 5 of byte 1 and byte 12 ... 15 you may set the reaction of the module at CPU-Stop for every output channel.

Via byte 12 ... 15 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting bit 4 res. 5, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function-no.

Here you set the function-no. of your measuring res. output function for every channel. Please see the according table next page.

Meas. cycle

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 Meas. cycle Byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	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 7 ... 4: reserved		

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.

By entering FFh you may deactivate the concerning channel.

The following tables list all functions that are supported by the depending channel.

You may find the connection type mentioned under "connection" at the "circuit diagram" above.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

Input range (channel 0 … 2)

No.	Function	Measuring range / representation	Connection
00h	Does not affect permanently stored configuration data.		
7Dh	Voltage 0 … 10V Siemens S7 format (two's complement)	-1.76 … 11.76V **/** 11.76V= End overdrive region (32511) 0...10V= nominal range (0...27648) -1.76V= End underdrive region (-4864)	(1)
7Ah	Voltage 1 … 5V Siemens S7 format (two's complement)	0.3 … 5.70V **/** 5.70V= End overdrive region (32511) 1...5V= nominal range (0...27648) 0.30V= End underdrive region (-4864)	(1)
28h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V **/** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512)	(1)
29h	Voltage ±4V Siemens S7 format (two's complement)	±4.70V **/** 4.70V= End overdrive region (32511) -4...4V= nominal range (-27648...27648) -4.70V= End underdrive region (-32512)	(1)
2Ah	Voltage ±400mV Siemens S7 format (two's complement)	±470mV **/** 470mV= End overdrive region (32511) -400...400mV= nominal range (-27648...27648) -470mV= End underdrive region (-32512)	(1)
7EH	Current 0 … 20mA Siemens S7 format (two's complement)	-3.51 … 23.51mA **/** 23.51mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) -3.51mA = End underdrive region (-4864)	(2)
2Ch	Current ±20mA Siemens S7 format (two's complement)	±23.51mA **/** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512)	(2)
2Dh	Current 4...20mA Siemens S7 format (two's complement)	1.185...+22.81mA **/** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864)	(2)
FFh	Channel not active (turned off)		

Input range (channel 3)

No.	Function	Measuring range / representation	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)
02h	Pt1000 in 2wire mode	-200 .. +500°C **/** in units of 1/10°C, two's complement	(1, 2)
03h	NI100 in 2wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
04h	NI1000 in 2wire mode	-50 .. +250°C **/** in units of 1/10°C, two's complement	(1, 2)
06h	Resistance measurement 600Ohm 2wire	- **/** 600Ω = Limit value (32767)	(1, 2)
07h	Resistance measurement 3000Ohm 2wire	- **/** 3000Ω = Limit value (32767)	(1, 2)
FFh	Channel not active (turned off)		

Output range (channel 4, channel 5)

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
09h	Voltage ±10V Siemens S7 format (two's complement)	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512)
0Ah	Voltage 1...5V Siemens S7 format (two's complement)	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912)
0Dh	Voltage 0...10V Siemens S7 format (two's complement)	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
0Bh	Current ±20mA Siemens S7 format (two's complement)	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512)
0Ch	Current 4...20mA Siemens S7 format (two's complement)	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912)
0Eh	Current 0...20mA Siemens S7 format (two's complement)	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Note!

When exceeding the predefined range, 0V res. 0A is shown as value!

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

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

0....20mA

Current	Decimal	Hex
0mA	0	0
12mA	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

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

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 interrupt 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

Byte 0 to 3:

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 4: external supply voltage is missing Bit 5, 6: 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

Byte 0 to 11:

The *record set 1* contains the 4byte of record set 0 and additional 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 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	04h
6	Bit 7 ... 0: Number of identical channels of a module	06h
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, 7: reserved	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
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 4 Bit 1: Parameterization error Channel 4 Bit 2, 3: reserved Bit 4: Wire break at current output res. short circuit at voltage output Channel 5 Bit 5: Parameterization error Channel 5 Bit 6, 7: reserved	00h
11	reserved	00h

Technical data

Order number	234-1BD60
Type	SM 234
Current consumption/power loss	
Current consumption from backplane bus	100 mA
Power loss	2.9 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	70 mA
Voltage inputs	✓
Max. input resistance (voltage range)	120 kΩ
Input voltage ranges	+1 V ... +5 V 0 V ... +10 V -10 V ... +10 V -400 mV ... +400 mV -4 V ... +4 V
Operational limit of voltage ranges	+/-0.3% ... +/-0.7%
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.5%
Current inputs	✓
Min. input resistance (current range)	90 Ω
Input current ranges	+4 mA ... +20 mA 0 mA ... +20 mA -20 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.8%
Basic error limit current ranges with SFU	+/-0.2% ... +/-0.5%
Resistance inputs	✓
Resistance ranges	0 ... 600 Ohm 0 ... 3000 Ohm
Operational limit of resistor ranges	+/-0.4%
Basic error limit	+/-0.2%
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100 Pt1000 Ni100 Ni1000
Operational limit of resistance thermometer ranges	+/-0.4% ... +/-1.0%
Basic error limit thermoresistor ranges	+/-0.2% ... +/-0.5%
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	7 ms - 272 ms
Noise suppression for frequency	50 Hz and 60 Hz
Initial data size	4 Byte
Technical data analog outputs	
Number of outputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without	70 mA

Order number	**234-1BD60**
load)	
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	1 kΩ
Max. capacitive load (current range)	1 µF
Output voltage ranges	-10 V ... +10 V +1 V ... +5 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.4% ... +/-0.8%
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.4%
Current outputs	✓
Max. in load resistance (current range)	500 Ω
Max. inductive load (current range)	10 mH
Output current ranges	-20 mA ... +20 mA +4 mA ... +20 mA 0 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.8%
Basic error limit current ranges with SFU	+/-0.2% ... +/-0.5%
Settling time for ohmic load	0.3 ms
Settling time for capacitive load	1 ms
Settling time for inductive load	0.5 ms
Resolution in bit	12
Conversion time	1.5 ms/channel
Substitute value can be applied	yes
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	none
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	none
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 4 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8
Output bytes	4
Parameter bytes	18
Diagnostic bytes	12
Housing	

Order number	234-1BD60
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	25.4 x 76 x 88 mm
Weight	100 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

Chapter 5 238-2BC00 - Combination module

Overview

In this chapter follows the description of the combination module SM 238C that includes a digital in-/output module with counter function and an analog in-/output module.

Contents

Overview

General

The combination module includes a digital in-/output module with counter function and an analog in-/output module.

The following components are integrated:

- Analog input: 3xU/I, 1xPT100x12Bit
- Analog output: AO 2x12Bit COM
- Digital input: 16(12)xDC24V with parameterizable counter functions
- Digital output: 0(4)xDC24V 1A
- Counter: max. 3 counter with the operating modes: endless, single or periodic counting.

Security hints for deploying I/O channels!

Please regard that the voltage applied to an output channel must be ≤ the voltage supply applied to L+.

Due to the parallel connection of in- and output channel, a set output channel may be supplied via an applied input signal. Thus, a set output remains active even at power-off of the voltage supply with the applied input signal.

Non-observance may cause module demolition.

Project engineering

The combination module can only be used together with a CPU 21x or with the DP-V1 PROFIBUS coupler (253-xDP01)! Here the max. number of modules is limited to 2.

The operation at a other bus coupler is not permitted.

The necessary GSD files can be found at the "service" area under www.vipa.com.

The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required.

After installation of the GSD the combination module can be found at the hardware catalog at:

Additional Field devices > *I/O* > *VIPA_System_200V* >...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

For the module has a digital and an analog part, you have to configure for each one component during the hardware configuration.

Counter

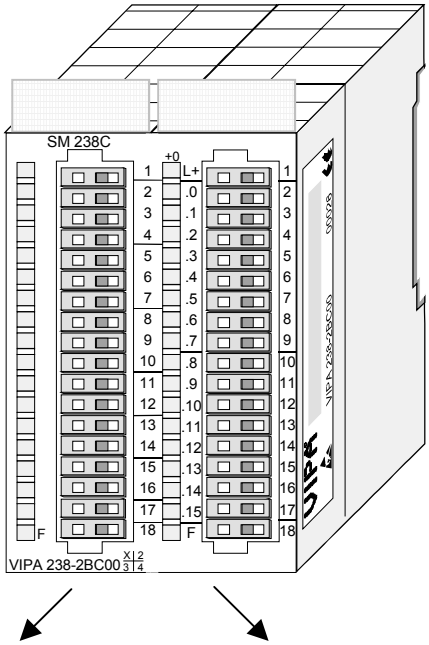
The control of the counter happens via digital input channels. For the counter you may configure alarms that influence one digital output channel per counter.

Ordering data

DI 16xDC24V / AI 4/AO 2x12Bit Combination module	VIPA 238-2BC00

In-/Output part

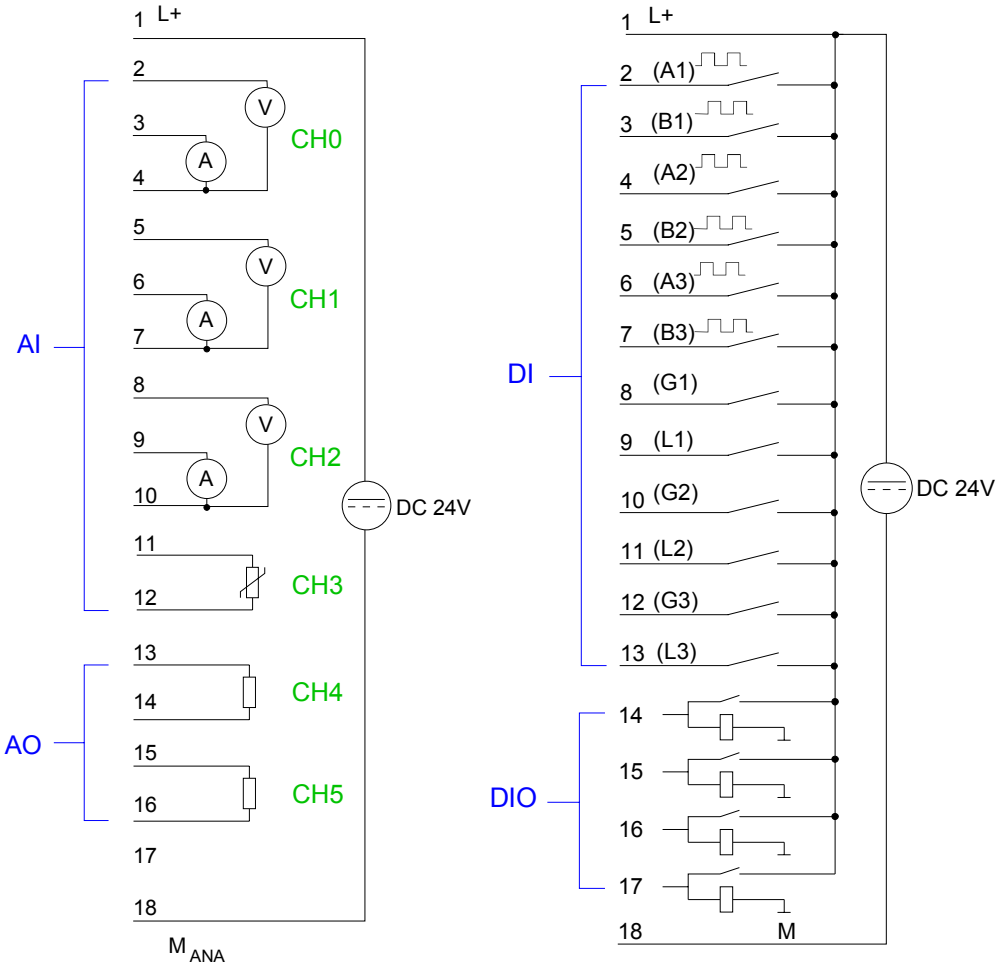
Structure



Pin assignment

Analog part

Digital part



Analog part

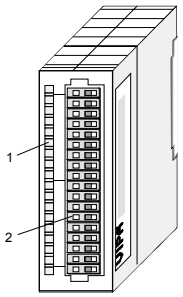
Properties

The analog part has 4 analog inputs and 2 analog outputs that may be configured individually. The module occupies a total of 8byte of input and 4byte of output data.

Galvanic isolation between the channels on the module and the backplane bus is provided by means of DC/DC converters and opto couplers.

- 4inputs and 2 outputs with common ground
- In-/Outputs with individually configurable functions
- Channel 0 to 2 suitable for encoder with input ranges of:
  voltage ±10V, 1 ... 5V, 0 ... 10V, ±4V, ±400mV
  current ±20mA, 4...20mA, 0 ... 20mA
- Channel 3 suitable for encoder with input ranges of:
  Pt100, Pt1000, NI100, NI1000
  resistant measuring 600Ω, 3000Ω
- Channel 4 to 5 Suitable for actuators with output ranges of:
  ±10V, 1 ... 5V, 0 ... 10V, ±20mA, 0 ... 20mA or 4 ... 20mA

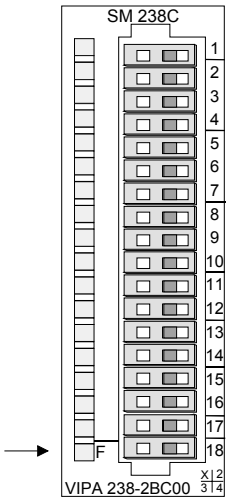
Construction



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

Status indicator
Pin assignment

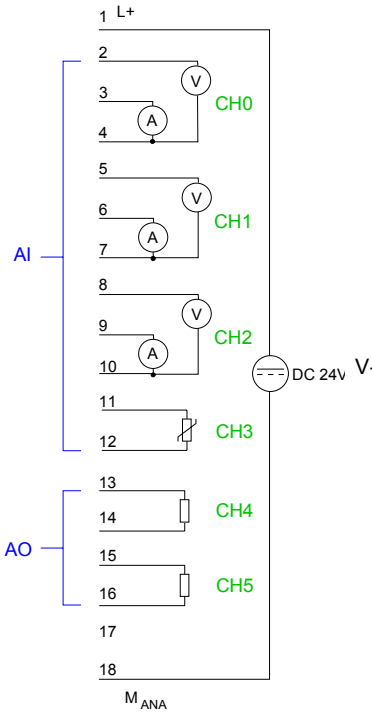
LED	Description
F	Sum error LED (red) turned on as soon as an channel error is detected res. an entry in the diagnostic bytes happened



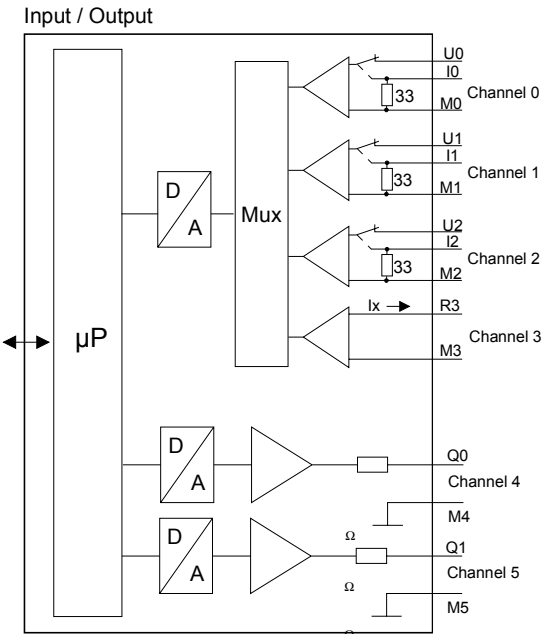
Pin	Assignment
1	DC 24V supply voltage
2	Voltage measuring channel 0
3	Current measuring channel 0
4	Ground channel 0
5	Voltage measuring Ch. 1
6	Current measuring Ch. 1
7	Ground channel 1
8	Voltage measuring channel 2
9	Current measuring channel 2
10	Ground channel 2
11	Measuring channel 3 (Pt, Ni, R)
12	Ground 3
13	Q0 output channel 4
14	M4 output channel 4
15	Q1 output channel 5
16	M5 output channel 5
18	Ground Supply voltage

Circuit and schematic diagram

Circuit 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.

Numeric notation in Siemens S7 format

The analog values are represented in two's complement format.

Depending on the parameterized transformation speed the lowest value bits of the measuring value are irrelevant. With increasing sampling rate, the resolution decreases.

The following table lists the resolution in dependence of the sampling rate.

	Analog value															
	High-Byte								Low-Byte							
Bit number	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Resolution	sign	Measuring value														
15 Bit + sign	sign	Relevant output value (at 3.7 ... 30Hz)														
14 Bit + sign	sign	Relevant output value (at 60Hz)														X*
13 Bit + sign	sign	Relevant output value (at 120Hz)													X	X
11 Bit + sign	sign	Relevant output value (at 170Hz)											X	X	X	X
9 Bit + sign	sign	Relevant output value (at 200Hz)									X	X	X	X	X	X

* The lowest value irrelevant bits of the output value are marked with "X".

Algebraic sign bit (sign)

Bit 15 serves as algebraic sign bit. Here is:
Bit 15 = "0" → positive value
Bit 15 = "1" → negative value

Digital/Analog conversion

In the following all measuring ranges are listed that are supported by the analog part.

The here listed formulas allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range and vice versa.

+/- 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	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

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

0....20mA

Current	Decimal	Hex
0mA	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

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

Analog part - Project engineering

Access to the analog part

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required which can be found at the "service" area on www.vipa.com.

After installation of the GSD file the combination module can be found at the hardware catalog at:

Additional Field devices > *I/O* > *VIPA_System_200V* > ...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

Please take care that you always configure both module parts in the sequence shown above

Data input/ data output range

For data input 8bytes and for data output 4bytes are available with the following assignment:

Data input range:

During the measuring, the measuring values are stored in the 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

Data output range:

For output of the data you set a value in the data output area.

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

Behavior at errors

As soon as a measuring value exceeds the overdrive res. underdrive region, the following value is returned:

Measuring value > Overdrive region: 32767 (7FFFh)

Measuring value < Underdrive region: -32768 (8000h)

When exceeding the predefined range the analog output is set to 0V res. 0A!

Parameter data

16byte of parameter data are available for the configuration. These parameters are stored in non-volatile memory and are available after the unit has been powered off.

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 50ms. During this time, the measuring value output is 7FFFFh.

The following table shows the structure of the parameter data:

Parameter area Record set 0

Byte	Bit 7 ... Bit 0	Default
0	Wire break recognition channel 0 Bit 0: 0 = deactivated 1 = activated Wire break recognition channel 1 Bit 1: 0 = deactivated 1 = activated Wire break recognition channel 2 Bit 2: 0 = deactivated 1 = activated Wire break recognition channel 3 Bit 3: 0 = deactivated 1 = activated Bit 4, 5: reserved Diagnostic interrupt Bit 6: 0 = diagnostic interrupt inhibited 1 = diagnostic interrupt enabled Bit 7: reserved	00h
1	Bit 3 … 0: reserved CPU-Stop reaction for channel 4 Bit 4: 0 = Set replacement value *) 1 = Store last value CPU-Stop reaction for channel 5 Bit 5: 0 = Set replacement value *) 1 = Store last value Bit 7 ... 6: reserved	00h
2	Function-no. channel 0 (see table input ranges)	28h
3	Function-no. channel 1 (see table input ranges)	28h
4	Function-no. channel 2 (see table input ranges)	28h
5	Function-no. channel 3 (see table input ranges)	01h
6	Option-Byte channel 0 (see table next page)	00h
7	Option-Byte channel 1 (see table next page)	00h
8	Option-Byte channel 2 (see table next page)	00h
9	Option-Byte channel 3 (see table next page)	00h
10	Function-no. channel 4 (see table output ranges)	09h
11	Function-no. channel 5 (see table output ranges)	09h
12	High-Byte replacement value channel 4	00h
13	Low-Byte replacement value channel 4	00h
14	High-Byte replacement value channel 5	00h
15	Low-Byte replacement value channel 5	00h

*) If you want to get 0A res. 0V as output value at CPU-STOP, you have to set the following replacement values at current output (4...20mA) res. voltage output (1...5V):

E500h for the S7-format from Siemens.

Parameters

Wire break recognition

Via the bits 0 and 3 of byte 0, the wire break recognition is activated for the input channels. The wire break recognition is only available for the current measuring range of 4...20mA and at (thermo) resistance measuring. A wire break is recognized when the current input during current measuring sinks under 1.18mA res. when the resistance at (thermo) resistance measuring reaches infinite. This causes an entry in the diagnostic area and is shown via the SF-LED.

If a diagnostic interrupt is activated, a diagnostic message is sent to the superordinated system.

Diagnostic interrupt

With the help of bit 6 of byte 0, you may release the diagnostic alarm. In case of an error like e.g. wire break, the superordinated system receives *record 0* (4byte). For an extended diagnostic you may then call *record 1* (12byte). More detailed information is to find below under "Diagnostic data".

CPU-Stop reaction and replacement value

With bit 4 and 5 of byte 1 and byte 12 ... 15 you may set the reaction of the module at CPU-Stop for every output channel.

Via byte 12 ... 15 you predefine a replacement value for the output channel as soon as the CPU switches to Stop.

By setting bit 4 res. 5, the last output value remains in the output at CPU-Stop. A reset sets the replacement value.

Function No.

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

Meas. cycle

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 Meas. cycle Byte:

Byte	Bit 7 ... Bit 0	Resolution	Default
6 ... 9	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 7 ... 4: reserved		

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.

By entering FFh you may deactivate the concerning channel.

The following tables list all functions that are supported by the depending channel.

You may find the corresponding connection type at the "circuit diagram" above.

Note!

When exceeding the overdrive region, the value 7FFFh (32767) is thrown, at underrun of the underdrive region the value is 8000h (-32768).

Input range (channel 0 … 2)

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
7Dh	Voltage 0 … 10V Siemens S7-format	-1.76 … 11.76V ***I*** 11.76V= End overdrive region (32511) 0...10V= nominal range (0...27648) -1.76V= End underdrive region (-4864) two's complement
7Ah	Voltage 1 … 5V Siemens S7-format	0.3 … 5.70V ***I*** 5.70V= End overdrive region (32511) 1...5V= nominal range (0...27648) 0.30V= End underdrive region (-4804) two's complement
28h	Voltage ±10V Siemens S7-format	±11.76V ***I*** 11.76V= End overdrive region (32511) -10...10V= nominal range (-27648...27648) -11.76V= End underdrive region (-32512) two's complement
29h	Voltage ±4V Siemens S7-format	±4.70V ***I*** 4.70V= End overdrive region (32511) -4...4V= nominal range (-27648...27648) -4.70V= End underdrive region (-32512) two's complement
2Ah	Voltage ±400mV Siemens S7-format	±470mV ***I*** 470mV= End overdrive region (32511) -400...400mV= nominal range (-27648...27648) -470mV= End underdrive region (-32512) two's complement

continued ...

... continue function-no. input range (channel 0…2)

7EH	Current 0 … 20mA Siemens S7-format	-3.51 … 23.51mA ***I*** 23.51mA = End overdrive region (32511) 0...20mA = nominal range (-27648...27648) -3.51mA = End underdrive region (-4864) two's complement
2Ch	Current ±20mA Siemens S7-format	±23.51mA ***I*** 23.51mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.51mA = End underdrive region (-32512) two's complement
2Dh	Current 4...20mA Siemens S7-format	1.185...+22.81mA ***I*** 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 1.18mA = End underdrive region (-4864) two's complement
FFh	Channel not active (turned off)	

Input range (channel 3)

No.	Function	Measuring range / representation
00h	Does not affect permanently stored configuration data.	
01h	Pt100 in 2wire mode	-200 .. +850°C ***I*** in units of 1/10°C, two's complement
02h	Pt1000 in 2wire mode	-200 .. +500°C ***I*** in units of 1/10°C, two's complement
03h	NI100 in 2wire mode	-50 .. +250°C ***I*** in units of 1/10°C, two's complement
04h	NI1000 in 2wire mode	-50 .. +250°C ***I*** in units of 1/10°C, two's complement
06h	Resistance measurement 600Ohm 2wire	- ***I*** 600Ω = Limit value (32767)
07h	Resistance measurement 3000Ohm 2wire	- ***I*** 3000Ω = Limit value (32767)
FFh	Channel not active (turned off)	

Output range (Channel 4, Ch. 5)

No.	Function	Output range
00h	Does not affect permanently stored configuration data	
09h	Voltage ±10V Siemens S7-format	±11.76V 11.76V= End overdrive region (32511) -10V...10V = nominal range (-27648...27648) -11.76 = End underdrive region (-32512) two's complement
0Ah	Voltage 1...5V Siemens S7-format	0...5.704V 5.704V = End overdrive region (32511) 1...5V = nominal range (0...27648) 0V = End underdrive region (-6912) two's complement
0Dh	Voltage 0...10V Siemens S7-format	0...11.76V 11.76V= End overdrive region (32511) 0...10V = nominal range (0...27648) no underdrive region available
0Bh	Current ±20mA Siemens S7-format	±23.52mA 23.52mA = End overdrive region (32511) -20...20mA = nominal range (-27648...27648) -23.52mA = End underdrive region (-32512) two's complement
0Ch	Current 4...20mA Siemens S7-format	0...22.81mA 22.81mA = End overdrive region (32511) 4...20mA = nominal range (0...27648) 0mA = End underdrive region (-6912) two's complement
0Eh	Current 0...20mA Siemens S7-format	0...23.52mA 23.52mA = End overdrive region (32511) 0...20mA = nominal range (0...27648) no underdrive region available
FFh	Channel not active (turned off)	

Note!
When exceeding the predefined range, 0V res. 0A is shown as value!

Analog part - Alarm and diagnostic

Diagnostic functions

As soon as you've activated the diagnostic alarm release in the parameterization, the following events can release a diagnostic alarm:

- Wire break
- Parameterization error
- Measuring range overflow
- Measuring range underflow

At accumulated diagnostic the CPU interrupts the user application and branches to the OB82 for diagnostic (incoming). This OB allows you with an according programming to monitor detailed diagnostic information via the SFCs 51 and 59 and to react to it. After the execution of the OB82 the user application processing is continued. The diagnostic data is consistent until leaving the OB82.

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

In the following the record sets for diagnostic (incoming) and diagnostic (going) are specified:

Record set 0
Diagnostic (incoming)

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 4: external supply voltage is missing Bit 5,6: 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 0
Diagnostic (going)

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

Record set 0 (Byte 0 to 3:)

Byte	Bit 7 ... Bit 0	Default
0	00h (fix)	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
Addition diagnostic (incoming)

The record set 1 contains the 4byte of record set 0 and additional 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 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	Number of diagnostic bits per channel	04h
6	Number of identical channels of a module	06h
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 7 ... 6: reserved	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
10	Bit 0: Wire break at current output res. short circuit at voltage output Channel 4 Bit 1: Parameterization error Channel 4 Bit 2,3: reserved Bit 4: Wire break at current output res. short circuit at voltage output Channel 5 Bit 5: Parameterization error Channel 5 Bit 6,7: reserved	00h
11	reserved	00h

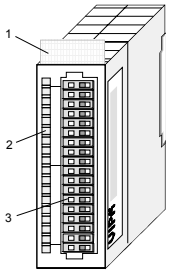
Digital part

Properties

The digital input part accepts binary control signals from the process and provides an electrically isolated interface to the central bus system. It has 16 channels that indicate the respective status by means of LEDs. Additionally, the first 12 inputs may control 3 counter.

- 16 inputs, isolated from the backplane bus whereof 4 inputs are switchable as outputs
- 3 configurable counter (continuously, once and periodically) parameterizable via the first 12 inputs / 3 counter outputs
- Status indicator for each channel by means of an LED

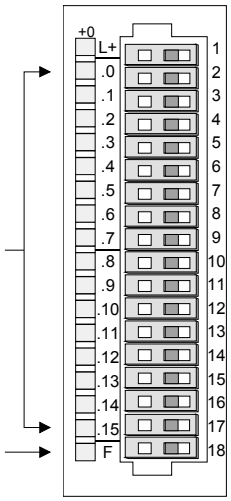
Construction



[1] Label for module description
[2] LED status indicator
[3] Edge connector

Status indicator
Pin assignment

LED	Description
L+	LED (green) Supply voltage available
.0...15	LEDs (green) I.0 up to I.15 when the input signal is "1" or the output is active the respective LED is turned on
F	LED (red) Overload, overheat or short circuit error

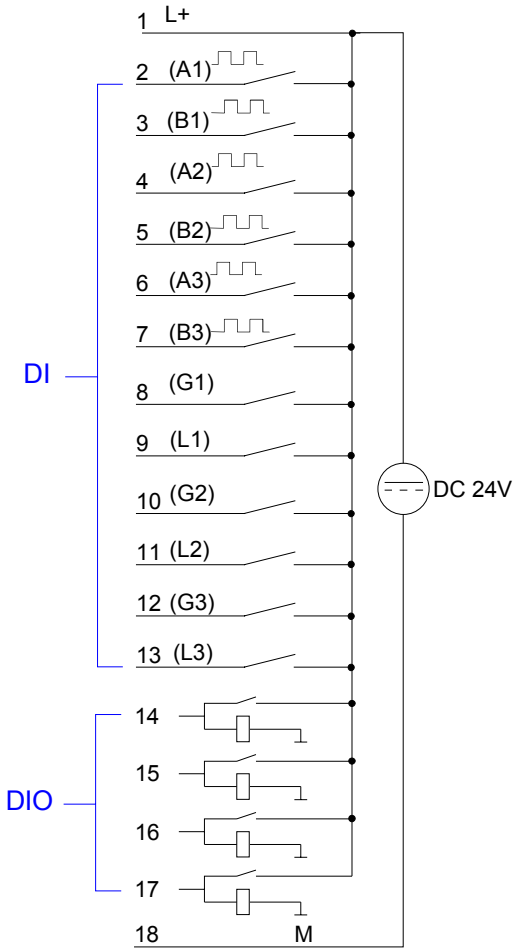


Pin	Assignment Counter activated	Counter deactivated
1	Power supply DC 24V	
2	Input Counter (A1)	I.0 (byte 3.0)*
3	Input Counter (B1)	I.1 (byte 3.1)
4	Input Counter (A2)	I.2 (byte 7.0)
5	Input Counter (B2)	I.3 (byte 7.1)
6	Input Counter (A3)	I.4 (byte 11.0)
7	Input Counter (B3)	I.5 (byte 11.1)
8	Input Counter Gate 1	I.6 (byte 12.0)
9	Input Counter Latch 1	I.7 (byte 12.4)
10	Input Counter Gate 2	I.8 (byte 12.1)
11	Input Counter Latch 2	I.9 (byte 12.5)
12	Input Counter Gate 3	I.10 (byte 12.2)
13	Input Counter Latch 3	I.11 (byte 12.6)
14	I/Q.12 Counter out 1 (byte 12.0) / Input (byte 15.0)	
15	I/Q.13 Counter out 2 (byte 12.1) / Input (byte 15.1)	
16	I/Q.14 Counter out 3 (byte 12.2) / Input (byte 15.2)	
17	I/Q.15 Output (byte 12.3) /	Input (byte 15.3)
18	Ground	

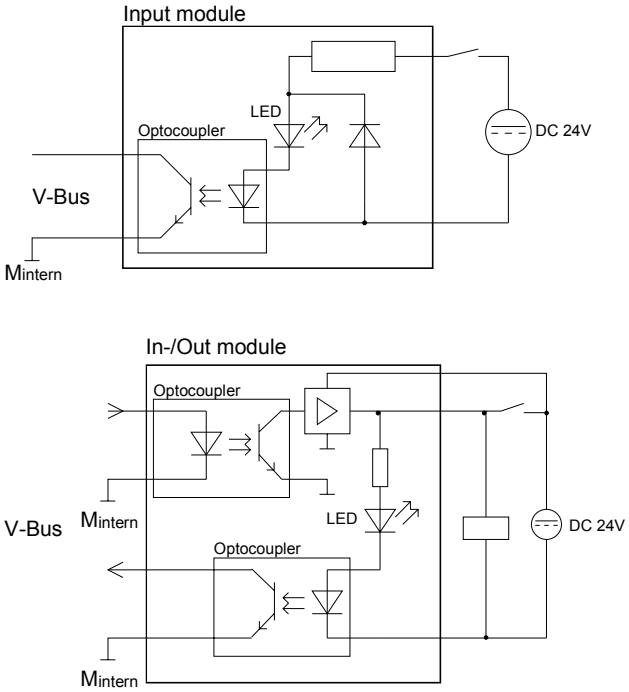
*) The byte data refer to the offset of the base address of the module.

Wiring and schematic diagram

Wiring diagram



Schematic diagram



Security hints for deploying I/O channels!

Please regard that the voltage applied to an output channel must be ≤ the voltage supply applied to L+.

Due to the parallel connection of in- and output channel, a set output channel may be supplied via an applied input signal. Thus, a set output remains active even at power-off of the voltage supply with the applied input signal.

Non-observance may cause module demolition.

Digital part - Counter - Fast introduction

Include GSD

The combination module can only be used together with a CPU 21x or with the DP-V1 Profibus coupler (253-xDP01)! The project engineering takes place in the Siemens SIMATIC manager. For this the import of the corresponding GSD file is required which can be found at the "service" area under www.vipa.com.

After installation of the GSD file the combination module can be found at the hardware catalog at:

Additional Field devices > *I/O* > *VIPA_System_200V* > ...

as 2 modules:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

Please take care that you always configure both module parts in the sequence shown above

The combination module has 3 parameterizable integrated counter that are controlled via the input channels. During the counter process, the counter signal is registered and evaluated. Operating mode and additional functions are set via the parameterization.

Counter preset and parameterization

By placing both module parts within hardware configuration the counter parameters can be set with the "238-2BC00 (2/2) Counter" properties.

The digital part has to be provided with 60Byte *parameter* data. Here you define among others:

- Alarm behavior
- Assignment I/O
- Counter operating mode res. behavior
- Start value for load value, end value and comparison value register

You may alter the parameters during runtime by using the SFC 55, 56, 57 and 58, except of the parameters in record set 0. Here you have to send the wanted parameters to the counter by means of the user application using the according SFC and sending the data as record set.

Control counter by commands

The controlling of the counters happens by the output image. Here the respective counter can be controlled by commands and the software gate can be (re-)set.

After transmitting a command, the respective counter confirms the successful processing of the command by setting the corresponding handshake bit. To enable the respective counter to accept a new command, you have to transmit the command 00h to the counter. After writing the command 00h, the handshake bit assigned to this counter will be reset. The counter is released for a new command.

Counter start/stop

The counter is controlled via the internal gate (I-gate). The I-gate is the result of logic operation of hardware- (HW) and Software-gate (SW), where the HW-gate evaluation may be deactivated via the parameterization.

HW-gate: Input at $Gate_x$-input at module

SW-gate: Open (activate): Output image byte 12, set bit 4 ... 6 depending on counter

Close (deactivate): Output image byte 12, reset bit 4 ... 6 depending on counter

The following states influence the gates:

SW-gate	HW-gate	influences I-gate
0	0	0
1	0	0
0	1	0
1	1	1
0	deactivated	0
1	deactivated	1

Access to counter values via input image

The module sends back a 16byte input image that is mapped into the memory area of the CPU. Here the current values and states of the counter can be found among others.

Counter inputs (connections)

For every counter, the following inputs are available:

Pulse/A (A_x)

Pulse input for counter signal res. line A of an encoder. Here you may connect encoders with 1-, 2- or 4-thread evaluation.

Direction/B (B_x)

Here you connect the direction signal res. line B of the encoder.

You may invert the direction signal by parameterization.

Latch (L_x)

A positive edge at the digital input „Latch“ stores the recent internal counter value.

HW Gate (G_x)

You start the counter via the digital input „Hardware gate“.

Counter output

Every counter has an assigned output channel. You may set the following behavior for the according output channel via the parameterization:

- No comparison: Output is not called
- Counter value ≥ comparison value: Output is set
- Counter value ≤ comparison value: Output is set
- Pulse at comparison value: Set output for a configurable pulse duration

Digital part - Counter - Project engineering

Overview

By including the appropriate GSD into your hardware configurator the module is available via the hardware catalog.

Please take care that you always configure both module parts in the sequence:

238-2BC00 (1/2) AI4/AO2*12Bit

238-2BC00 (2/2) Counter

You may employ a max. of 2 combination modules at one system!

Parameterization

The parameterization happens in the hardware configurator. Here 60Byte parameter data are transferred:

Byte	Record set	Description
0 ... 2	0	Basic parameter (Alarm behavior, assignment I/O)
3 ... 21	81h (129)	Counter parameter counter 1
22 ... 40	82h (130)	Counter parameter counter 2
41 ... 59	83h (131)	Counter parameter counter 3

By using SFC 55, 56 and 57 you may alter the parameterization in the module during runtime. On this occasion 60byte parameter data are stored at record set 0, 81h, 82h and 83h.

Basic parameter
Record set 0

The basic parameters allow you to control the alarm behavior of the digital part and the assignment of the I/O channels that can be accessed by the according counter as output.

Byte	Description
0	Alarm generation 0 = no 1 = yes
1	Alarm selection 00h = None 01h = Diagnostics 02h = Process alarm 03h = Diagnostics- und Process alarm
2	Assignment of the in-/output channels. Here you define the assignment of the 4 I/O channels. If an I/O channel is used as input, you may output the status of the input via Byte 15 of the input image. For the operation as output, a detailed definition of the control is required in the parameter section of the according counter. Bit 0: 0 = Input I.12 1 = Output Q.12 / Counter output Q.12 Bit 1: 0 = Input I.13 1 = Output Q.13 / Counter output Q.13 Bit 2: 0 = Input I.14 1 = Output Q.14 / Counter output Q.14 Bit 3: 0 = Input I.15 1 = Output Q.15

Counter parameter
Record set 81h : C1
Record set 82h : C2
Record set 83h : C3

The parameters for the counter 1 (C1) to 3 (C3) consist of 3 identical parameter groups with each a size of 19byte.

For every counter you may set a function and start data.

Byte	Description
0	Function 00h = counting continuously 01h = once without main counting direction 02h = once with main counting direction up 03h = once with main counting direction down 04h = periodically without main counting direction 05h = periodically with main counting direction up 06h = periodically with main counting direction down 07h = counter off If the counter is deactivated, the further parameters of this counter are ignored and the according I/O channel is set as "normal" output if you want to use this channel as output. At the main counting direction "up" the counter counts from the load value to the parameterized end value in positive direction and jumps then back again to the load value with the next following encoder pulse. At the main counting direction "down" the counter counts from the load value to the parameterized end value in negative direction and jumps then back again to the load value with the next following encoder pulse.
1	Signal evaluation Bit 1...0: 00b = Impulse/Direction (Impulse at A1 / Direction at B1) 01b = Rotary encoder single (at A1 and B1) 10b = Rotary encoder double (at A1 and B1) 11b = Rotary encoder quadruple (at A1 and B1) Counter direction inverted Bit 7: 0 =Off (Count direction at B1 not inverted) 1 = On (Count direction at B1 inverted)
2	Gate function (Behavior at interruption and gate restart) Bit 0: 0 = abort (counter process starts with load value) Bit 0: 1 = interrupt (counter process continues with counter value)
	HW gate (Hardware gate via input E.6) Bit 7: 0 = Off (Counter starts with set SW gate) 1 = On (Counter only starts with set HW and SW gate)
3	Behavior of the output 0 = no comparison (Output is not influenced by counter) 1 = if counter value ≥ comparison value, set output 2 = if counter value ≤ comparison value, set output 3 = gives a pulse to the output as soon as the comparison value has been reached. The pulse duration is configured via byte 9.

continued ...

... continue

Byte	Description
4	Hysteresis 0 = off 1 = off 2 ... 255: The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value.
5	Pulse duration (Pulse duration for the output) 0 = Counter value = comparison value (without delay) 1 = 2ms 2 = 4ms ... 255 = 510ms Only even values are permitted.
6	Alarm masking Bit 0: 0 = deactivated 1 = Alarm at opening the HW gate
	Bit 1: 0 = deactivated 1 = Alarm at closing HW gate
	Bit 2: 0 = deactivated 1 = Alarm at over-/underrun
	Bit 3: 0 = deactivated 1 = Alarm at reaching comparison value
	Bit 4: 0 = deactivated 1 = Alarm at counter pulse loss
7 ... 10	Load value (Presetting a load value) Here you may load counter 1 with a value
11 ...14	End value (Presetting a end value) The end value for counter 1 is not relevant if there is no main counting direction defined (forwards or backwards).
15 ... 18	Compare value (Presetting a comparison value) The counter value is compared with the comparison value and depending on that the behavior of the according output of counter 1 is controlled.

Attention!

Please regard you have to store the record sets 81h, 82h and 83h within a data block starting with an **odd** address, otherwise you have shifts and incorrect double word accesses!

Data to digital part (output image)

The digital part gets its data from the CPU in form of a 16byte data block. The data block has the following structure:

Byte	Description
0 ... 3	Value counter 1
4 ... 7	Value counter 2
8 ... 11	Value counter 3
12	Bit 0: Output Bit Q.12 / Release counter output 1 [1)] Bit 1: Output Bit Q.13 / Release counter output 2 Bit 2: Output Bit Q.14 / Release counter output 3 Bit 3: Output Bit Q.15 Bit 4: Software Gate counter 1 Bit 5: Software Gate counter 2 Bit 6: Software Gate counter 3 Bit 7: not evaluated
13	Command for counter 1
14	Command for counter 2
15	Command for counter 3

1) The outputs may only be used as digital output if you parameterized them as "output" in the basic parameterization.

Communication via handshake bit

After transmitting a command, the respective counter confirms the successful processing of the command by setting the corresponding handshake bit. To enable the respective counter to accept a new command, you have to transmit the command 00h to the counter. After writing the command 00h, the handshake bit assigned to this counter will be reset. The counter is released for a new command.

Command overview

The following commands are available:

Command	Function	Description
00h	Reset command handshake	Release for a new command (must precede each command)
A0h	Set counter value	By means of these commands, a value set under "Value counter ..." is transferred to the according register of a counter.
A1h	Set load value	
A2h	Set comparison value	
A3h	Set end value	
A4h	Set latch value	
A5h	Set hysteresis value	
A6h	Set value of pulse duration	
A7h	reserved	
80h	Counter value	These commands cause the counter to send back a certain register value in the input image of the corresponding counter.
81h	Load value	
82h	Comparison value	
83h	End value	
84h	Latch (display latch value)	
85h	Hysteresis value	
86h	Pulse duration value	
87h	reserved	

Data from digital part (input image)

The module sends back a 16byte input image that maps into the memory area of the CPU. The structure of input data depends on counter activation:

Byte	Counter activated	Counter deactivated
0 ... 3	Image counter 1	Byte 0 ... 2: 0 Byte 3: Bit 0: I.0 Bit 1: I.1
4 ... 7	Image counter 2	Byte 4 ... 6: 0 Byte 7: Bit 0: I.2 Bit 1: I.3
8 ... 11	Image counter 3	Byte 8 ... 10: 0 Byte 11: Bit 0: I.4 Bit 1: I.5
12	Gate/Latch Bit 0: Input I.6: Status input HW gate counter 1 Bit 1: Input I.8: Status input HW gate counter 2 Bit 2: Input I.10: Status input HW gate counter 3 Bit 3: 0 (fix) Bit 4: Input I.7: Status input Latch 1 Bit 5: Input I.9: Status input Latch 2 Bit 6: Input I.11: Status input Latch 3 Bit 7: 0 (fix)	
13	Internal gate / last counter direction If the counter operating mode is set to "off", these Bits are "0". Bit 0: Status internal gate 1 Bit 1: Status internal gate 2 Bit 2: Status internal gate 3 Bit 3: 0 (fix) Bit 4: 0= counter direction counter 1 down 1= counter direction counter 1 up Bit 5: 0= counter direction counter 2 down 1= counter direction counter 2 up Bit 6: 0= counter direction counter 3 down 1= counter direction counter 3 up Bit 7: 0 (fix)	0
14	Status of the counter outputs/command handshake Bit 0: Status internal counter output counter 1 Bit 1: Status internal counter output counter 2 Bit 2: Status internal counter output counter 3 Bit 3: 0 (fix) Bit 4: Status command handshake counter 1 Bit 5: Status command handshake counter 2 Bit 6: Status command handshake counter 3 Bit 7: 0 (fix)	0
15	Status inputs If the channel is set as output, the according Bit is "0" Bit 0: Status input I.12 Bit 1: Status input I.13 Bit 2: Status input I.14 Bit 3: Status input I.15 Bit 7 ... 4: 0 (fix)	

Digital part - Counter - Functions

Operating modes

The combination module has 3 parameterizable integrated counter that are controlled via the input channels. During the counter process, the counter signal is registered and evaluated. Operating mode and additional functions are set via the parameterization.

For the counter, the following operating modes are available:

- Count endless – Distance measuring with incremental encoder
- Count once – Count to a maximum limit
- Count periodic– Count with repeated counter process

The operating modes "Count once" and "Count periodic“ allow you to transfer the counter area as start res. end value via the parameterization.

Each counter is parameterizable with additional functions like gate function, latch function, comparison, hysteresis a process alarm.

Counter inputs (connections)

For every counter, the following inputs are available:

Pulse/A (A_x)

Pulse input for counter signal res. line A of an encoder. Here you may connect encoders with 1-, 2- or 4-thread evaluation.

Direction/B (B_x)

Here you connect the direction signal res. line B of the encoder.

You may invert the direction signal by parameterization.

Latch (L_x)

A positive edge at the digital input „Latch“ stores the recent internal counter value.

HW Gate (G_x)

You start the counter via the digital input „Hardware gate“.

Counter output

Every counter has an assigned output channel. You may set the following behavior for the according output channel via the parameterization:

- No comparison: Output is not called
- Counter value ≥ comparison value: Output is set
- Counter value ≤ comparison value: Output is set
- Pulse at comparison value: Set output for a configurable pulse duration

Maximum counter frequency

At the designation of maximum counter frequency, two types of indication are distinguished:

- Maximum pulse frequency

  The maximum pulse frequency is the maximum frequency the adjacent signal may have, i.e. the maximum frequency at witch the pulses arrive at the module. At this module the maximum pulse frequency depends on the counter-signal-evaluation chosen.

Signal evaluation	Maximum pulse frequency
single	30kHz
duplicate	15kHz
quaduplicate	7.5kHz

- Maximum counter frequency

  The maximum counter frequency is the frequency at witch can be internally counted to the maximum.
  At employment of all 3 counters, every counter may use a frequency of max. 30kHz. If you employ only 1 counter channel, the counter supports a max. frequency of 100kHz.

Main counting direction

The parameterization allows you to define a main counting direction for every counter.

If you choose "none", the complete counting range is available:

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)

Main counting direction forward

Upper restriction of the count range. The counter counts 0 res. load value in positive direction until the parameterized end value –1 and jumps then back to the load value with the next following encoder pulse.

Main counting direction backwards

Lower restriction of the count range. The counter counts from the parameterized start- res. load value in negative direction to the parameterized end value +1 and jumps then back to the start value with the next following encoder pulse.

Abort - interrupt

Abort count process

The count process starts after closing and restart of the gate beginning with the load value.

Interrupt count process

The count process continuous after closing and restart of the gate beginning with the last recent counter value.

Digital part - Counter - Operating modes

Overview

For the counter, the following operating modes are available separate configurable:

- Count endless – Distance measuring with incremental encoder
- Count once – Count to a maximum limit
- Count periodic– Count with repeated counter process

Continuously

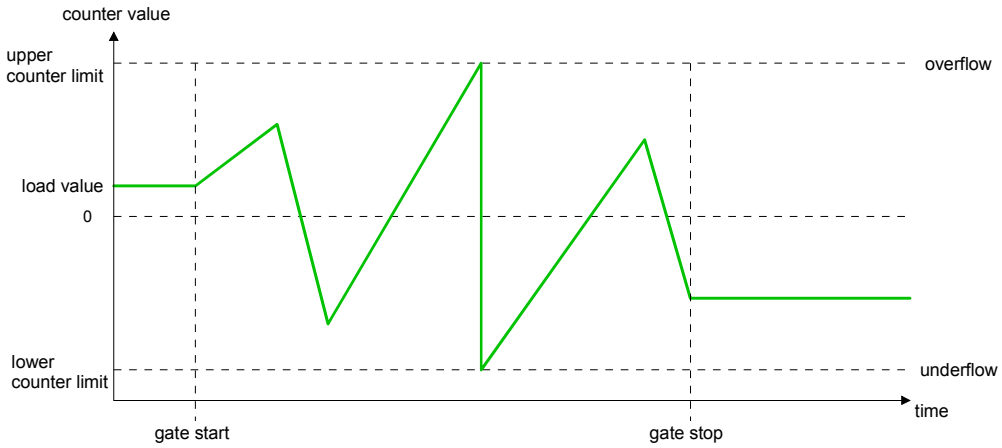
In this operating mode, the counter counts from 0 res. from the load value.

When the counter counts forward and reaches the upper count limit and another counting pulse in positive direction arrives, it jumps to the lower count limit and counts from there on.

When the counter counts backwards and reaches the lower count limit and another counting pulse in negative direction arrives, it jumps to the upper count limit and counts from there on.

The count limits are set to the maximum count range.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)



Note!

When counting continuously the parameter *main counting direction* is ignored!

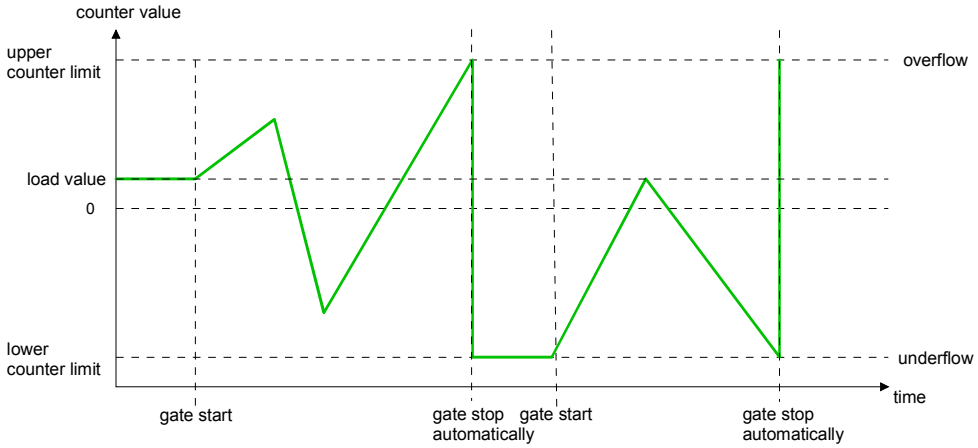
Once

No main counting direction

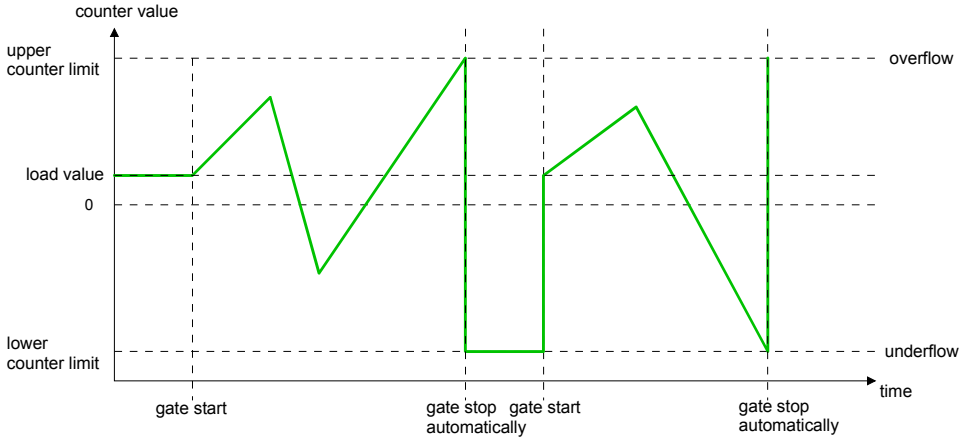
- The counter counts once starting with the load value.
- You may count forward and backwards.
- The count limits are set to the maximum count range.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on. The gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate.
- At interrupting gate control, the count process continuous with the last recent counter value.
- At aborting gate control, the counter starts with the load value.

	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)

Interrupting gate control:



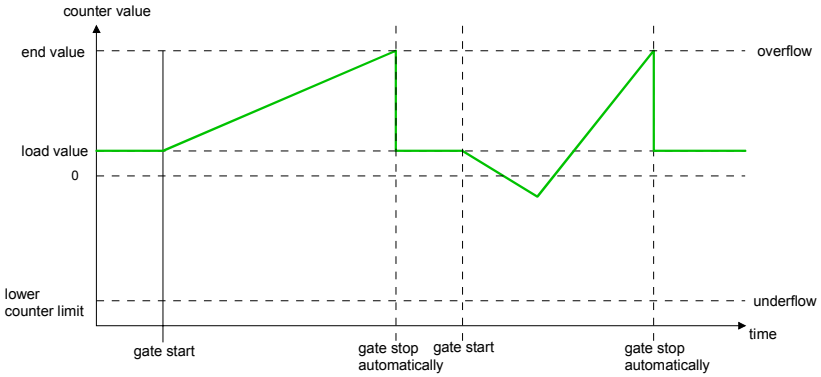
Aborting gate control:



Main counting direction forward

- The counter counts starting with the load value.
- When the counter reaches the end value -1 in positive direction, it jumps to the load value at the next positive count pulse and the gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

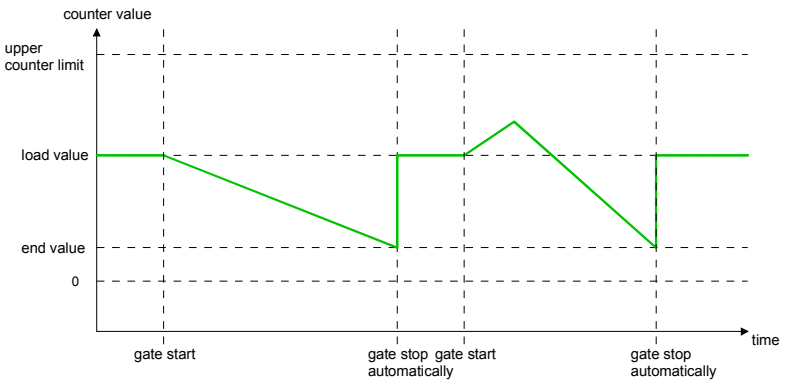
	Valid value range
End value	- 2 147 483 646 ($-2^{31}+1$) to + 2 147 483 646 ($2^{31}-1$)
Lower count limit	- 2 147 483 648 (-2^{31})
Counter value	- 2 147 483 648 (-2^{31}) to end value -1
Load value	- 2 147 483 648 (-2^{31}) to end value -2



Main counting direction backwards

- The counter counts starting with the load value.
- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse and the gate is automatically closed.
- To restart the count process, you must create a positive edge of the gate. The counter starts with the load value.

	Valid value range
End value	- 2 147 483 646 ($-2^{31}+1$) to + 2 147 483 646 ($2^{31}-1$)
Upper count limit	+2 147 483 646 ($2^{31}-1$)
Counter value	- 2 147 483 646 ($-2^{31}+1$) to + 2 147 483 646 ($-2^{31}-1$)
Load value	- 2 147 483 646 ($-2^{31}+1$) to + 2 147 483 646 ($-2^{31}-1$)

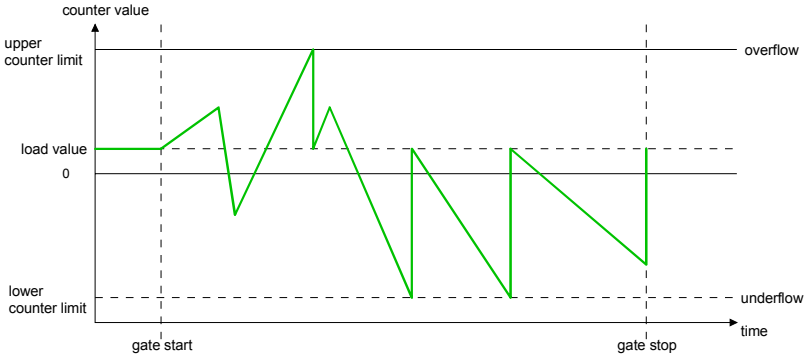


Periodically

No main counting direction:

- The counter counts starting with the load value.
- At over- or underrun at the count limits, the counter jumps to the according other count limit and counts from there on.
- The count limits are set to the maximum count range.

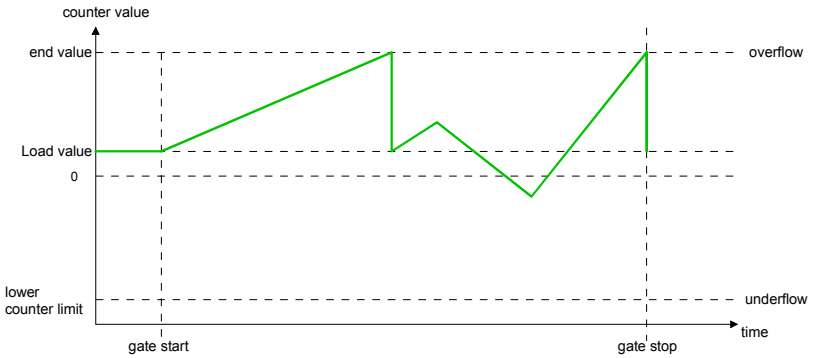
	Valid value range
Lower count limit	- 2 147 483 648 (-2^{31})
Upper count limit	+ 2 147 483 647 (2^{31}-1)
Counter value	- 2 147 483 648 (-2^{31}) to + 2 147 483 647 (2^{31}-1)
Load value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 646 (2^{31}-2)



Main counting direction forward

- The counter counts starting with the load value.
- When the counter reaches the end value -1 in positive direction, it jumps to the load value at the next positive count pulse.

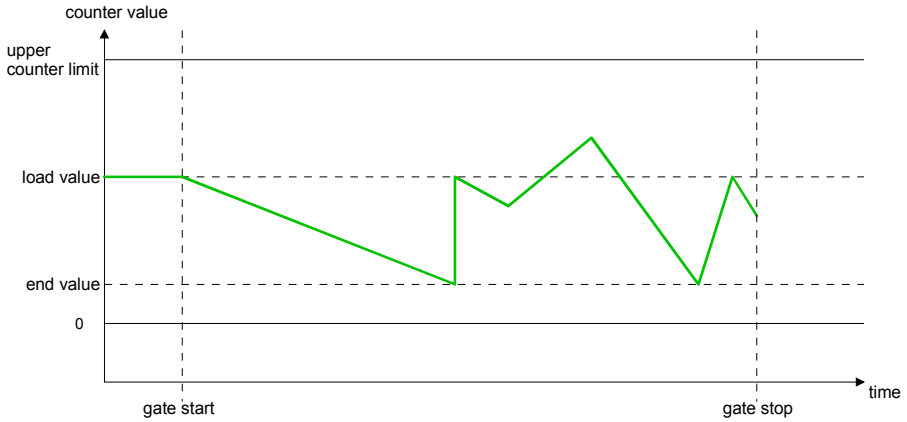
	Valid value range
Limit value	- 2 147 483 647 (-2^{31}+1) to + 2 147 483 647 (2^{31}-1)
Lower count limit	- 2 147 483 648 (-2^{31})
Counter value	- 2 147 483 648 (-2^{31}) to end value -1
Load value	- 2 147 483 648 (-2^{31}) to end value -2



Main counting direction backwards

- The counter counts starting with the load value.
- When the counter reaches the end value in negative direction, it jumps to the load value at the next negative count pulse.
- You may exceed the upper count limit.

	Valid value range
Limit value	- 2 147 483 647 ($-2^{31}+1$) to + 2 147 483 647 ($2^{31}-1$)
Upper count limit	+2 147 483 647 ($2^{31}-1$)
Counter value	- 2 147 483 647 ($-2^{31}+1$) to +2 147 483 647 ($2^{31}-1$)
Load value	- 2 147 483 647 ($-2^{31}+1$) to +2 147 483 647 ($2^{31}-1$)



Digital part - Counter - Additional functions

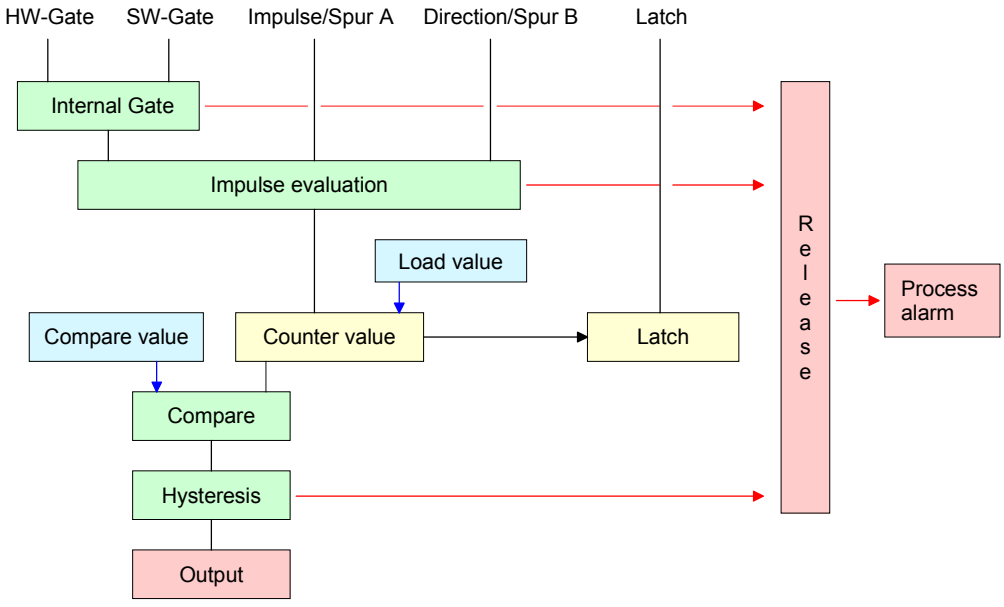
Overview

The additional functions listed in the following can be set for every counter via the parameterization:

- Gate function
  The gate function serves the start, stop and interruption of a counter function
- Latch function
  As soon as a positive edge is registered at the latch input, a recent counter value is stored in the latch register.
- Comparison
  You may set a comparison value that activates a digital output res. throws a process alarm depending on the recent counter value.
- Hysteresis
  By setting a hysteresis you may prevent a continuous toggling of an output if the value of an encoder signal fluctuates around a comparison value.
- Alarm
  For the following events you may parameterize an alarm:
  - status change of the HW gate
  - Over- res. underrun
  - Reaching a comparison value
  - Loss of a counter pulse

Schematic structure

The illustration shows how the additional functions influence the counter behavior. The following pages give you a more detailed explanation of the additional functions:



Gate function

The counter is controlled via the internal gate (I-gate). The I-gate is the result of logic operation of hardware- (HW) and Software-gate (SW), where the HW-gate evaluation may be deactivated via the parameterization.

HW-gate: Input at $Gate_x$-input at module

SW-gate: Open (activate): Output image Byte 12, set Bit 4 ... 6 depending on counter

Close (deactivate): Output image Byte 12, reset Bit 4 ... 6 depending on counter

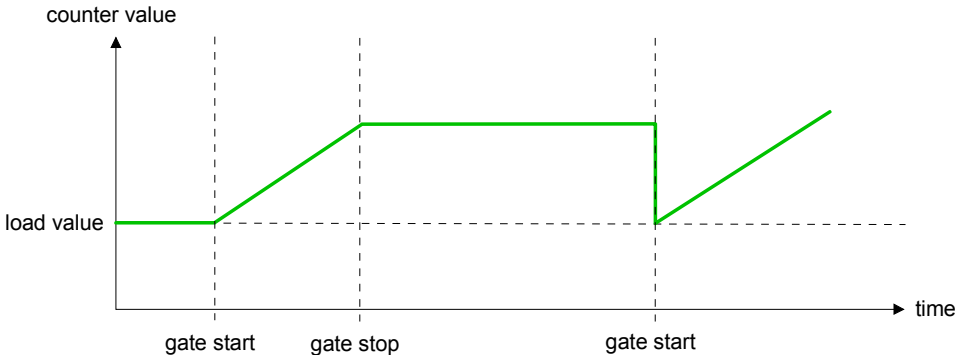
The following states influence the gates:

SW-gate	HW-gate	influences I-gate
0	0	0
1	0	0
0	1	0
1	1	1
0	deactivated	0
1	deactivated	1

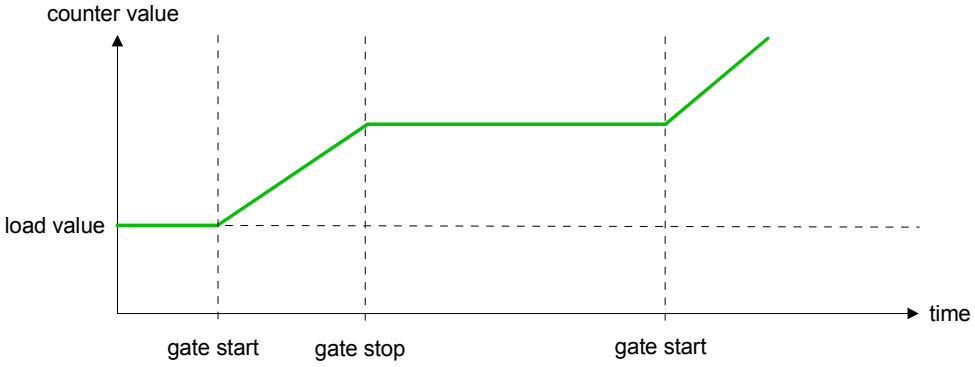
Gate function Abort and Interrupt

The parameterization defines if the gate interrupts or aborts the counter process.

- At *abort function* the counter starts counting with the load value after gate restart.



- At *interrupt function*, the counter starts counting with the last recent counter value after gate restart.



Latch function

As soon as a positive edge at the "latch input" results from the counter process, a recent counter value is stored in the according latch register.

The "input image" gives you access to the latch register.

Compare function

The parameterization presets the behavior of the counter output:

- No comparison
- Counter value ≥ comparison value
- Counter value ≤ comparison value
- Pulse at comparison value

No comparison

The output is set like a normal output.

Counter value ≥ comparison value

If the counter value is equal or higher than the comparison value, the output is set.

Counter value ≤ comparison value

If the counter value is smaller or equal than the comparison value, the output is set.

Pulse at comparison value

When the counter reaches the comparison value, the output is set active for the parameterized pulse duration.

If you've set a main counter direction, the output is only set off the main counter direction at reaching the comparison value.

Pulse duration

The pulse duration tells for what time the output is set. It can be preset in steps of 2ms between 0 and 510ms. Please regard that the counter pulse times must be higher than the minimum toggle times of the digital output.

If the pulse duration = 0, the output is set active until the comparison condition is not longer fulfilled.

The pulse duration starts with the setting of the according digital output. The inaccuracy of the pulse duration is smaller than 1ms.

There is no finish triggering of the pulse duration if the comparison value is not met for a short time during a pulse output.

Hysteresis

The hysteresis serves the avoidance of many toggle processes of the output and the alarm, if the counter value is in the range of the comparison value.

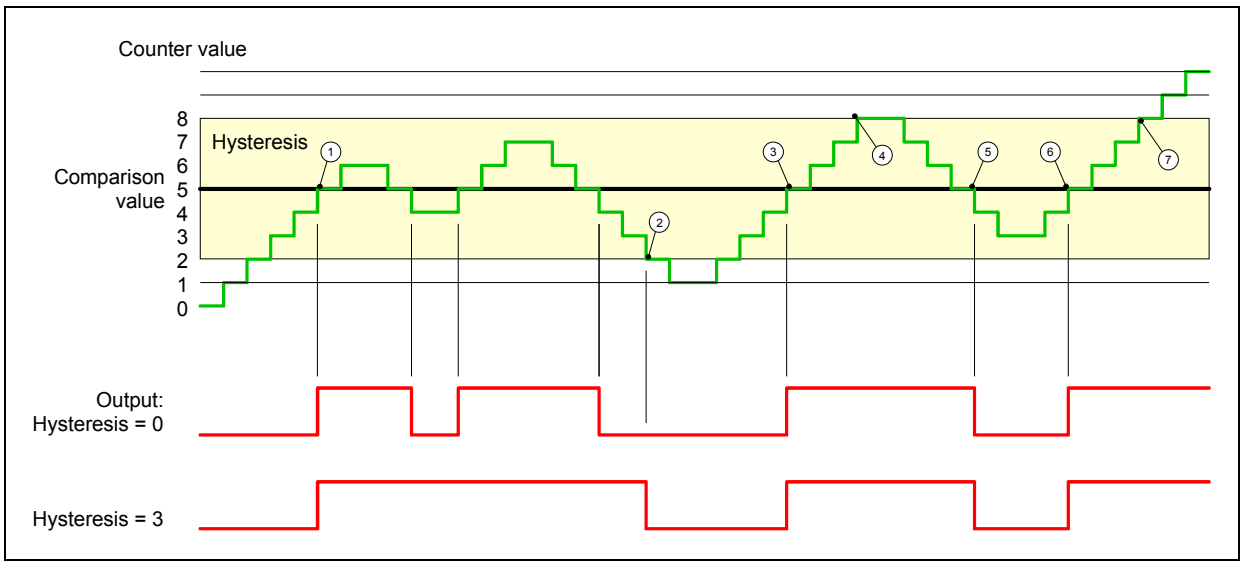
You may set a range of 0 to 255. The settings 0 and 1 deactivate the hysteresis. The hysteresis also influences the over- and underflow.

An activated hysteresis remains active after a change. The new hysteresis range is taken over at the next reach of the comparison value.

The view below shows the action of the at hysteresis 0 and 3

In the following illustration the behavior of the output is represented with hysteresis 0 and hysteresis 3 for the appropriate conditions:

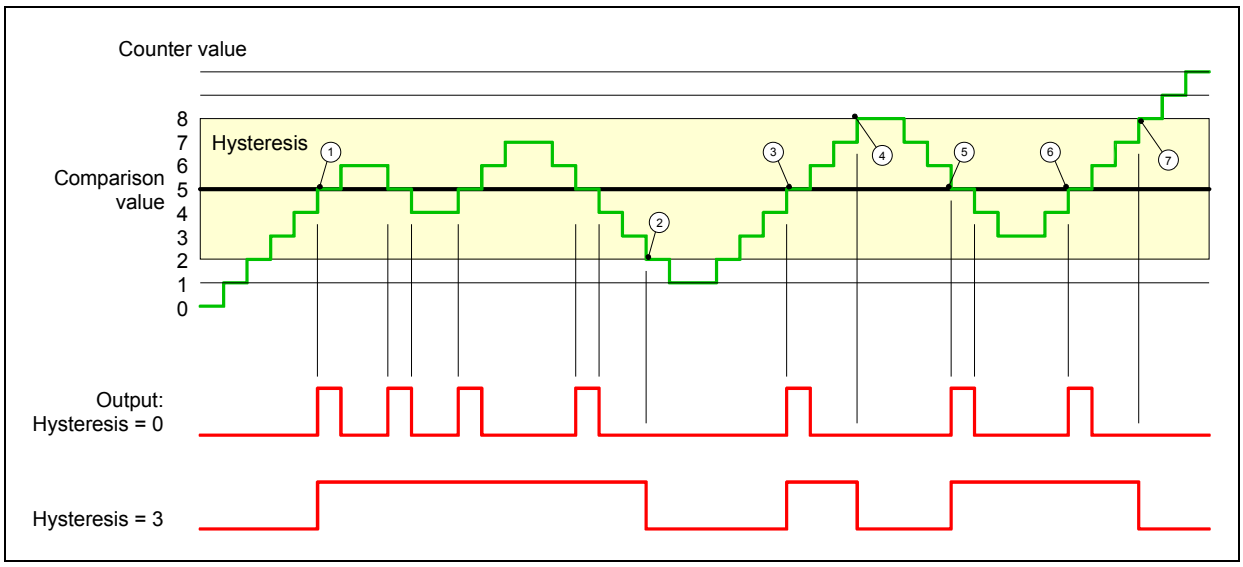
Action when Counter value ≥ Comparison value



① Counter value ≥ Comparison value → Output is set and hysteresis is activated
② Leaving the hysteresis area → Output is reset
③ Counter value ≥ Comparison value → Output is set and hysteresis is activated
④ Leaving the hysteresis area, output is just set as Counter value ≥ Comparison value
⑤ Counter value < Comparison value an hysteresis not activated → Output is reset
⑥ Counter value ≥ Comparison value → Output is set and hysteresis is activated
⑦ Leaving the hysteresis area, output is just set as Counter value ≥ Comparison value

As reaching the comparison condition the hysteresis is activated. The comparison result is as static as the counter value leaves the parameterized hysteresis area. After leaving the hysteresis area only again with reaching comparison condition the hysteresis is activated.

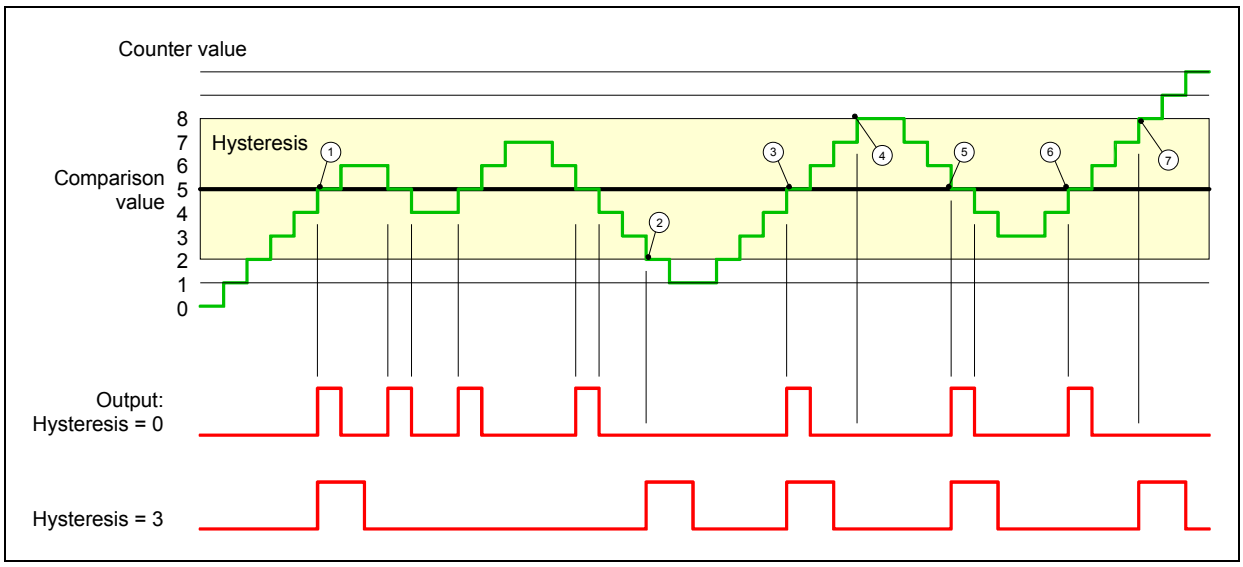
Action at pulse at comparison value and Pulse width equal to zero



① Counter value = Comparison value → Output is set and hysteresis is activated
② Leaving the hysteresis area → Output is reset
③ Counter value = Comparison value → Output is set and hysteresis is activated
④ Counter value > Comparison value and leaving the hysteresis area so output is reset
⑤ Counter value = Comparison value → Output is set and hysteresis is activated
⑥ Counter value = Comparison value and hysteresis is just activated → Output is static set
⑦ Leaving the hysteresis area and Counter value > Comparison value → Output is reset

As reaching the comparison condition the hysteresis is activated. The comparison result is as static as the counter value leaves the parameterized hysteresis area. After leaving the hysteresis area only again with reaching comparison condition the hysteresis is activated.

Action at pulse at comparison value and Pulse width not equal to zero



① Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored

② Leaving the hysteresis area against the stored counter direction → A pulse of the specified length is output and the hysteresis deactivated

③ Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored

④ Leaving Hysteresis area without changing counting direction → Hysteresis is deactivated

⑤ Counter value = Comparison value → Hysteresis is switched active, a pulse of the specified length is output and the counting direction is stored

⑥ Counter value = Comparison value and hysteresis is activated → no pulse

⑦ Leaving the hysteresis area against the stored counting direction → A pulse of the specified length is output and the hysteresis deactivated

As reaching the comparison condition the hysteresis is activated and a pulse of the specified length is output. As long as the counter value is within the hysteresis area no further pulse is output. With hysteresis activation the counting direction is stored by the PLC. If the counter value leaves the hysteresis area against the stored counting direction, an impulse of the of the specified length is output. When leaving the hysteresis area without change of counter direction there is no pulse output.

Digital part - Counter - Alarm and diagnostic

Overview

The parameterization allows you to define the following trigger for a process alarm:

- Status change of the HW gate
- Over- / Underflow
- Reaching a comparison value
- Loss of a counter pulse

You may globally activate a diagnostic alarm for all channels. A diagnostic alarm occurs as soon as at processing a process alarm a process alarm is initialized in OB40 for the same channel and the same event.

Process alarm

A process alarm causes the call of OB40. Within the OB40 you may search the logical basic address of the module that threw the process alarm by using the *local word 6*.

The *local word 8* allows you to access the data that the module provides in case of an alarm. The *local word 8* has the following structure:

Byte	Bit 7 ... Bit 0
8	Bit 0: Channel 1 Comparison value reached Bit 1: Channel 1 Pulse lost Bit 2: Channel 2 HW gate open Bit 3: Channel 2 HW gate closed Bit 4: Channel 2 Overflow Bit 5: Channel 2 Comparison value reached Bit 6: Channel 2 Pulse lost Bit 7: reserved
9	Bit 0: Channel 0 HW gate open Bit 1: Channel 0 HW gate closed Bit 2: Channel 0 Overflow Bit 3: Channel 0 Comparison value reached Bit 4: Channel 0 Pulse lost Bit 5: Channel 1 HW gate open Bit 6: Channel 1 HW gate closed Bit 7: Channel 1 Overflow

Release diagnostic alarm

During a process alarm is processed by the PLC in OB40 a diagnostic alarm can be released (if activated) by the same event at the same channel.

This interrupts the current process alarm execution in OB40 and branches to OB82 for processing the diagnostic alarm (incoming). If during the diagnostic alarm execution further events at other channels occur that may also initialize a process res. diagnostic alarm, these are temporarily stored.

After finishing the current diagnostic alarm execution, the sum diagnostic message "process alarm lost" informs the CPU that in the meantime other process alarms has occurred.

Diagnostic alarm

As soon as you've activated the diagnostic alarm a diagnostic alarm occurs during the processing a process alarm in OB40 for the same channel and the same event.

At accumulated diagnostic the CPU interrupts the user application and branches to the OB82 for diagnostic (incoming). This OB allows you with an according programming to monitor detailed diagnostic information via the SFCs 51 and 59 and to react to it.

After the execution of the OB82 the user application processing is continued. The diagnostic data is consistent until leaving the OB82.

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

In the following the record sets for diagnostic (incoming) and diagnostic (going) are specified:

Record set 0
Diagnostic (incoming)

Record set 0 (Byte 0 to 3):

Byte	Bit 7 ... Bit 0	Default
0	Bit 0: Module malfunction Bit 1: internal error Bit 2: reserved Bit 3: channel error present Bit 7 ... 4: reserved	00h
1	Bit 3 ... 0: Module class 1000: Function module Bit 4: Channel information present Bit 7 ... 5: reserved	18h
2	00h (fix)	00h
3	Bit 5 ... 0: reserved Bit 6: process alarm lost Bit 7: reserved	00h

Record set 0
Diagnostic (going)

After error correction automatically a diagnostic (going) occurs if the diagnostic alarm release is still active.

Record set 0 (Byte 0 to 3:)

Byte	Bit 7 ... Bit 0	Default
0	00h (fix)	00h
1	Bit 3 ... 0: Module class 1000: Function module Bit 4: Channel information present Bit 7 ... 5: reserved	18h
2	00h (fix)	00h
3	00h (fix)	00h

Record set 1
Extended diagnostic (incoming)

Byte 0 to 11:

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

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 76h: Counter Bit 7: reserved	76h
5	Number of diagnostic bits per channel	08h
6	Number of similar channels (Counter)	03h
7	Bit 0: Channel error channel 0 Bit 1: Channel error channel 1 Bit 2: Channel error channel 2 Bit 7 ... 3: reserved	00h
8	Error screen channel 0 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
9	Error screen channel 1 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
10	Error screen channel 2 Bit 0: HW gate open Bit 1: HW gate closed Bit 2: Overflow Bit 3: Comparison value reached Bit 4: Pulse lost Bit 7 ... 5: reserved	00h
11	reserved	00h

Technical Data

Order number	238-2BC00
Type	SM 238C, Digital In-/Output, Counter, Analog In-/Output
Current consumption/power loss	
Current consumption from backplane bus	280 mA
Power loss	5.5 W
Technical data digital inputs	
Number of inputs	16
Cable length, shielded	1000 m
Cable length, unshielded	600 m
Rated load voltage	-
Current consumption from load voltage L+ (without load)	-
Rated value	DC 20.4...28.8 V
Input voltage for signal "0"	DC 0...5 V
Input voltage for signal "1"	DC 15...28.8 V
Input voltage hysteresis	-
Frequency range	-
Input resistance	-
Input current for signal "1"	7 mA
Connection of Two-Wire-BEROs possible	✓
Max. permissible BERO quiescent current	1.5 mA
Input delay of "0" to "1"	3 ms
Input delay of "1" to "0"	3 ms
Number of simultaneously utilizable inputs horizontal configuration	-
Number of simultaneously utilizable inputs vertical configuration	-
Input characteristic curve	IEC 61131, type 1
Initial data size	16 Byte
Technical data digital outputs	
Number of outputs	4
Cable length, shielded	1000 m
Cable length, unshielded	600 m
Rated load voltage	DC 20.4...28.8 V
Reverse polarity protection of rated load voltage	-
Current consumption from load voltage L+ (without load)	20 mA
Total current per group, horizontal configuration, 40°C	-
Total current per group, horizontal configuration, 60°C	-
Total current per group, vertical configuration	-
Output voltage signal "1" at min. current	-
Output voltage signal "1" at max. current	L+ (-0.8 V)
Output current at signal "1", rated value	1 A
Output current, permitted range to 40°C	-
Output current, permitted range to 60°C	-
Output current at signal "0" max. (residual current)	-
Output delay of "0" to "1"	150 µs
Output delay of "1" to "0"	100 µs
Minimum load current	-
Lamp load	5 W
Parallel switching of outputs for redundant control	not possible

Order number	**238-2BC00**
of a load	
Parallel switching of outputs for increased power	not possible
Actuation of digital input	✓
Switching frequency with resistive load	max. 1000 Hz
Switching frequency with inductive load	max. 0.5 Hz
Switching frequency on lamp load	max. 10 Hz
Internal limitation of inductive shut-off voltage	L+ (-52 V)
Short-circuit protection of output	yes, electronic
Trigger level	1.5 A
Number of operating cycle of relay outputs	-
Switching capacity of contacts	-
Output data size	16 Byte
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	70 mA
Voltage inputs	✓
Min. input resistance (voltage range)	120 kΩ
Input voltage ranges	+1 V ... +5 V 0 V ... +10 V -10 V ... +10 V -400 mV ... +400 mV -4 V ... +4 V
Operational limit of voltage ranges	+/-0.3% ... +/-0.7%
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.5%
Current inputs	✓
Max. input resistance (current range)	90 Ω
Input current ranges	+4 mA ... +20 mA 0 mA ... +20 mA -20 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.8%
Basic error limit current ranges with SFU	+/-0.2% ... +/-0.5%
Resistance inputs	✓
Resistance ranges	0 ... 600 Ohm 0 ... 3000 Ohm
Operational limit of resistor ranges	+/-0.4%
Basic error limit	+/-0.2%
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100 Pt1000 Ni100 Ni1000
Operational limit of resistance thermometer ranges	+/-0.4% ... +/-1.0%
Basic error limit thermoresistor ranges	+/-0.2% ... +/-0.5%
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Basic error limit thermoelement ranges	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	7 ms - 272 ms

Order number	238-2BC00
Noise suppression for frequency	50 Hz and 60 Hz
Initial data size	8 Byte
Technical data analog outputs	
Number of outputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Reverse polarity protection of rated load voltage	✓
Current consumption from load voltage L+ (without load)	70 mA
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	1 kΩ
Max. capacitive load (current range)	1 µF
Output voltage ranges	-10 V ... +10 V +1 V ... +5 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.4% ... +/-0.8%
Basic error limit voltage ranges with SFU	+/-0.2% ... +/-0.4%
Current outputs	✓
Max. in load resistance (current range)	500 Ω
Max. inductive load (current range)	10 mH
Output current ranges	-20 mA ... +20 mA 0 mA ... +20 mA 0 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.8%
Basic error limit current ranges with SFU	+/-0.2% ... +/-0.5%
Settling time for ohmic load	0.3 ms
Settling time for capacitive load	1 ms
Settling time for inductive load	0.5 ms
Resolution in bit	12
Conversion time	1.50 ms
Substitute value can be applied	yes
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED per group
Group error display	red SF LED
Channel error display	none
Isolation	
Between channels	-
Between channels of groups to	-
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 4 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-
Max. potential difference between inputs and Mintern (Uiso)	DC 75 V/ AC 60 V
Max. potential difference between Mintern and	-

Order number	**238-2BC00**
outputs	
Insulation tested with	DC 500 V
Datasizes	
Input bytes	8 + 16
Output bytes	4 + 16
Parameter bytes	18 + 71
Diagnostic bytes	12 + 12
Housing	
Material	PPE / PA 6.6
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	50.8 x 76 x 88 mm
Weight	150 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes