VIPA System SLIO

SM-AIO | | Manual

HB300 | SM-AIO | | GB | 14-48

A YASKAWA COMPANY

VIPA GmbH
Ohmstr. 4
91074 Herzogenaurach
Telephone: 09132-744-0
Fax: 09132-744-1864
email: info@vipa.com
Internet: www.vipa.com

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1 General

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Tel.: +49 9132 744 -0

Fax.: +49 9132 744-1864

EMail: info@vipa.de

http://www.vipa.com

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1.2 About this manual

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
- References with page numbers

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.

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

Supplementary information and useful tips.

1.3 Safety information

Applications conforming with specifications

The system is constructed and produced for:

- communication and process control
- 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

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

– Hardware modifications to the process control system should only be carried out when the system has been disconnected from power!
– Installation and hardware 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!

2 Basics and Assembly

2.1 Safety information for users

Handling of electro-static 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 modules

Modules must be shipped in the original packing material.

Measurements and alterations on electro-static 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.

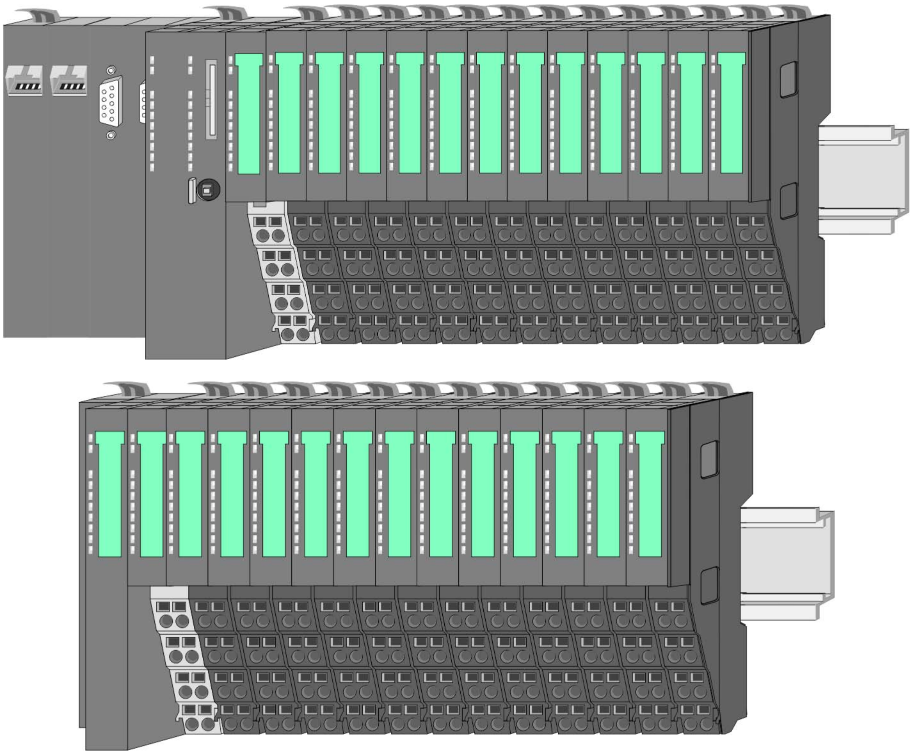
Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

> **CAUTION!**
> Personnel and instruments should be grounded when working on electrostatic sensitive modules.

2.2 System conception

Overview

System SLIO is a modular automation system for assembly on a 35mm mounting rail. By means of the peripheral modules with 2, 4 or 8 channels this system may properly be adapted matching to your automation tasks. The wiring complexity is low, because the supply of the DC 24V power section is integrated to the backplane bus and defective modules may be replaced with standing wiring. By deployment of the power modules in contrasting colours within the system, further isolated areas may be defined for the DC 24V power section supply, respectively the electronic power supply may be extended with 2A.

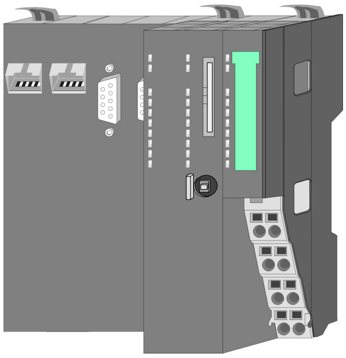


Components

- CPU (head module)
- Bus coupler (head module)
- Periphery modules
- Power modules
- Accessories

CAUTION!
Only modules of VIPA may be combined. A mixed operation with third-party modules is not allowed!

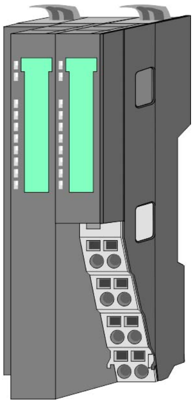
CPU



With a CPU, CPU electronic and power module are integrated to one casing. As head module via the integrated power module for power supply the CPU electronic is supplied as well as the electronic of the connected periphery modules. The DC 24 power section supply for the linked periphery modules is established via a further connection at the power module. By installing of up to 64 periphery modules at the CPU, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

CAUTION!
CPU part and power module of a CPU may not be separated! Here you may only exchange the electronic module!

Bus coupler

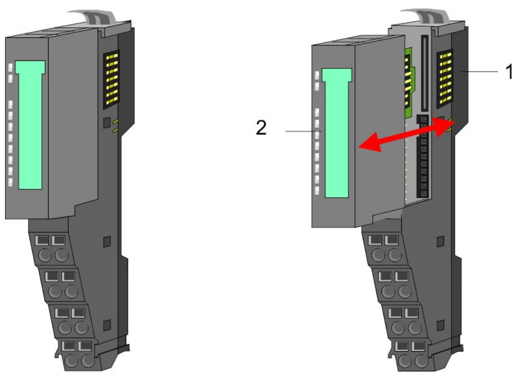


With a bus coupler bus interface and power module are integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module via the integrated power module for power supply the bus interface is supplied as well as the electronic of the connected periphery modules. The DC 24 power section supply for the linked periphery modules is established via a further connection at the power module. By installing of up to 64 periphery modules at the bus coupler, these are electrically connected, this means these are assigned to the backplane bus, the electronic modules are power supplied and each periphery module is connected to the DC 24V power section supply.

CAUTION!
Bus interface and power module of the bus coupler may not be separated! Here you may only exchange the electronic module!

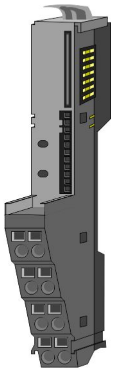
Periphery modules

Each periphery module consists of a *terminal* and an *electronic module*.



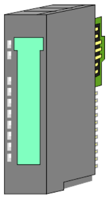
1 Terminal module
2 Electronic module

Terminal module



The *terminal module* serves to carry the electronic module, contains the backplane bus with power supply for the electronic, the DC 24V power section supply and the staircase-shaped terminal for wiring. Additionally the terminal module has a locking system for fixing at a mounting rail. By means of this locking system your SLIO system may be assembled outside of your switchgear cabinet to be later mounted there as whole system.

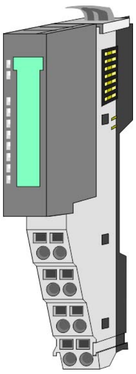
Electronic module



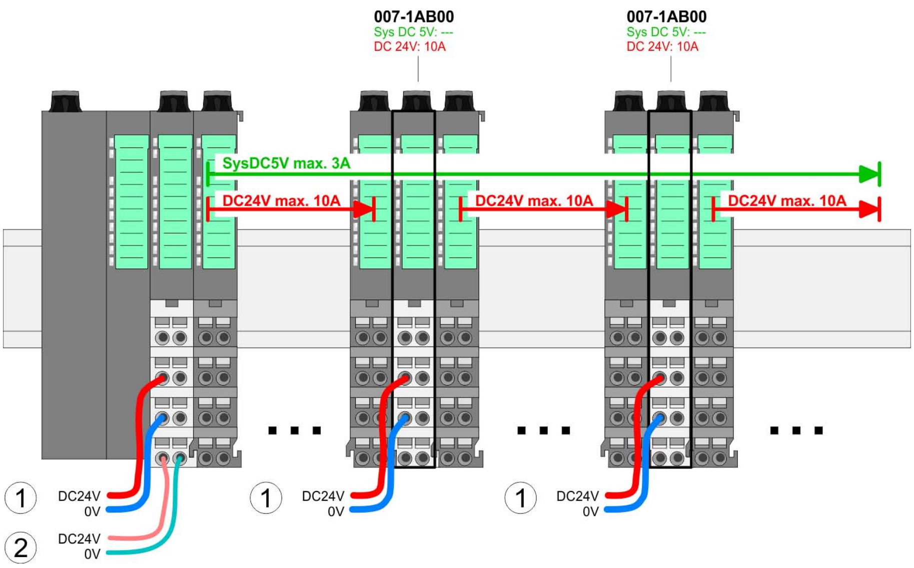
The functionality of a SLIO periphery module is defined by the *electronic module*, which is mounted to the terminal module by a safe sliding mechanism. With an error the defective module may be exchanged for a functional module with standing installation.

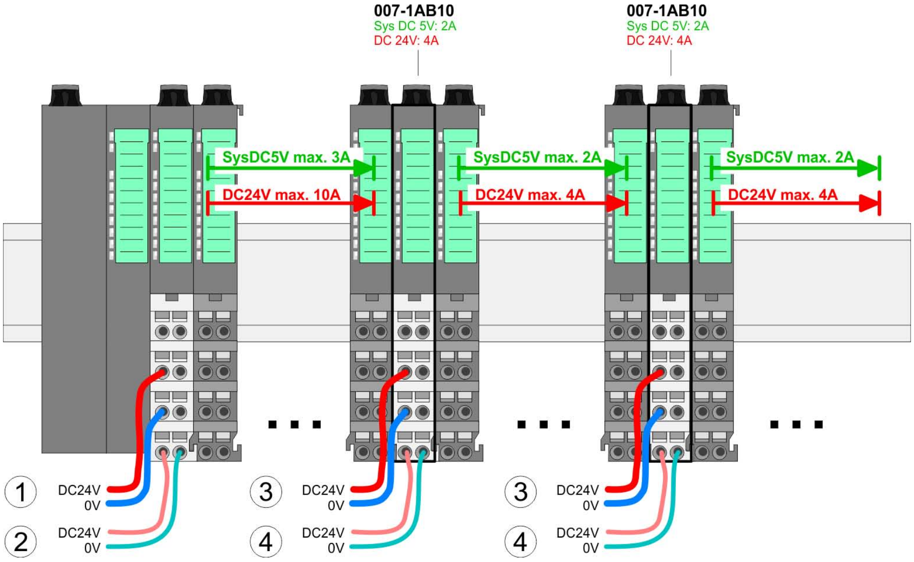
At the front side there are LEDs for status indication. For simple wiring each module shows a corresponding connection diagram at the front and at the side.

Power module



In the System SLIO the power supply is established by power modules. These are either integrated to the head module or may be installed between the periphery modules. Depending on the power module isolated areas of the DC 24V power section supply may be defined respectively the electronic power supply may be extended with 2A. For better recognition the colour of the power modules are contrasting to the periphery modules.

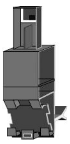




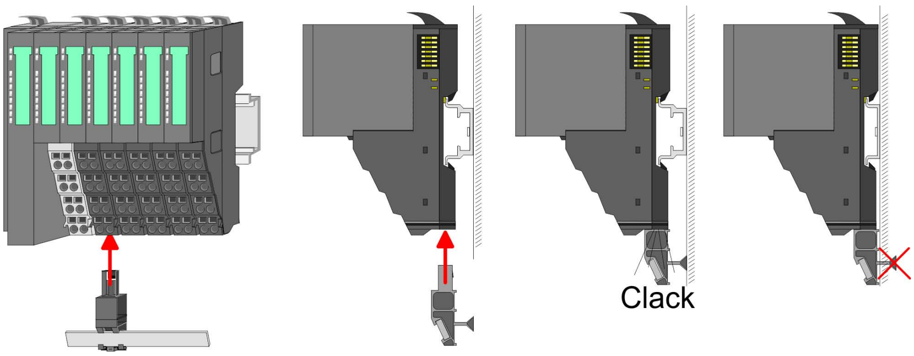
(1) DC 24V for power section supply I/O area (max. 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area
(3) DC 24V for power section supply I/O area (max. 4A)
(4) DC 24V for electronic power supply I/O area

Accessories

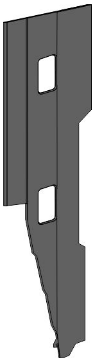
Shield bus carrier



The shield bus carrier (order no. 000-0AB00) serves to carry the shield bus (10mm x 3mm) to connect cable shields. Shield bus carriers, shield bus and shield fixings are not in the scope of delivery. They are only available as accessories. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.



Bus cover



With each bus coupler, to protect the backplane bus connectors, there is a mounted bus cover in the scope of delivery. You have to remove the bus cover of the bus coupler before mounting a SLIO module. For the protection of the backplane bus connector you always have to mount the bus cover at the last module of your system again.

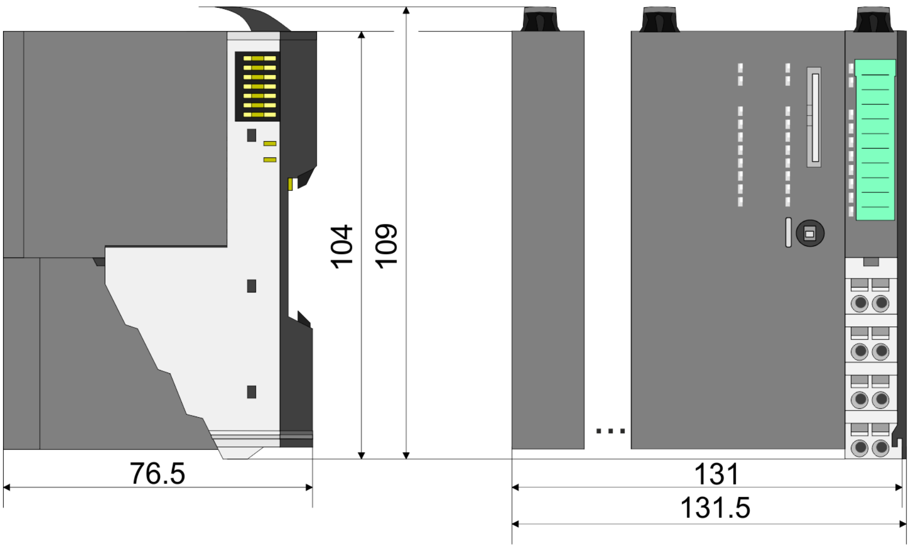
The bus cover has the order no. 000-0AA00.

Coding pins

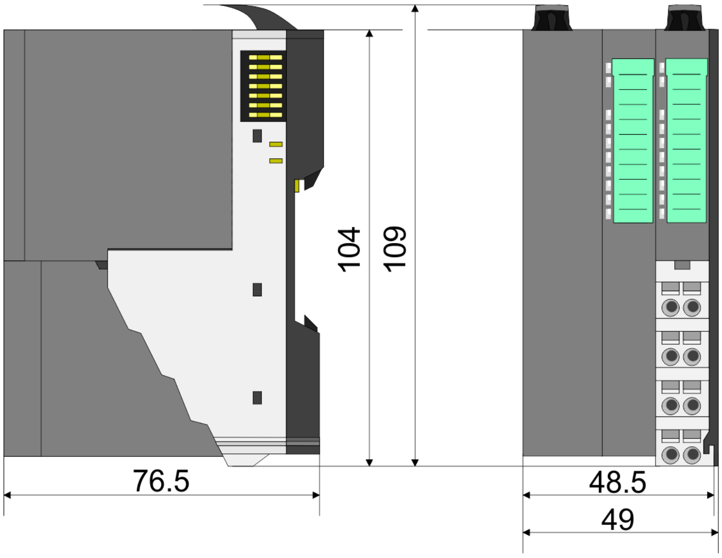
There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module. This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.

2.3 Dimensions

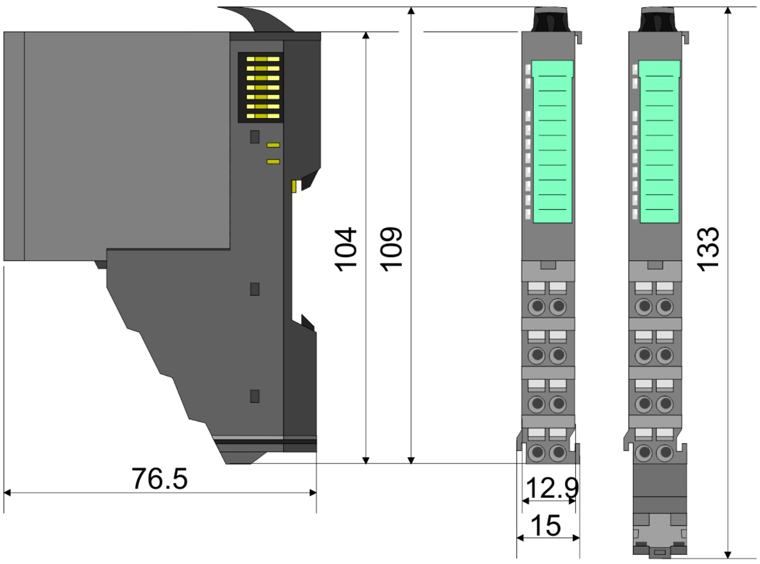
Dimensions CPU



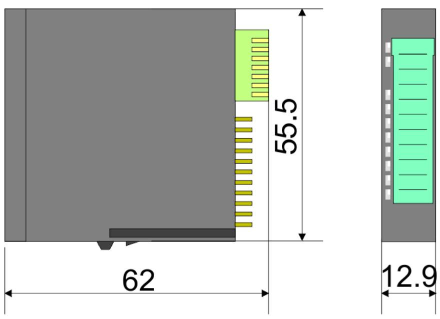
Dimensions bus coupler



Dimensions periphery module



Dimensions electronic module

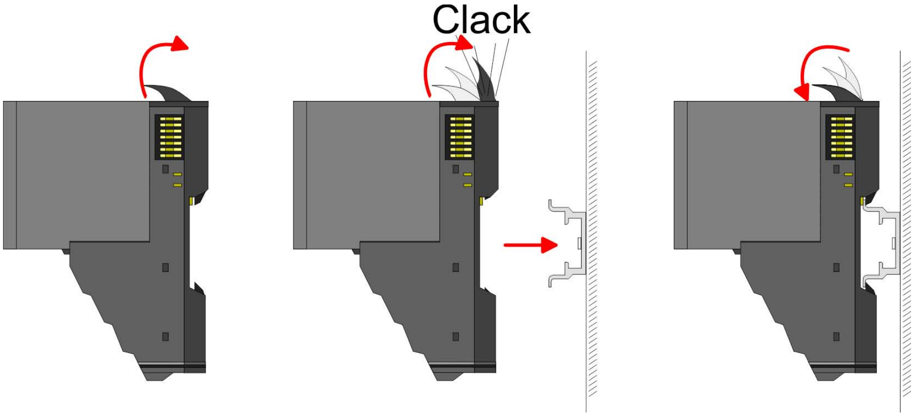


Dimensions in mm

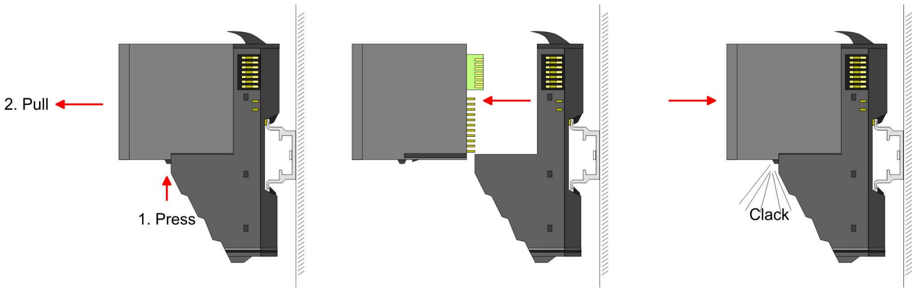
2.4 Installation

Functional principle

There is a locking lever at the top side of the terminal module. For mounting and demounting this locking lever is to be turned upwards until this engages audible. Now the module may be pulled forward. For mounting plug the module to the module installed before and push the module to the mounting rail guided by the strips at the upper and lower side of the module. The module is fixed to the mounting rail by pushing downward the locking lever. The modules may either separately be mounted to the mounting rail or as block. Here is to be considered that each locking lever is opened.

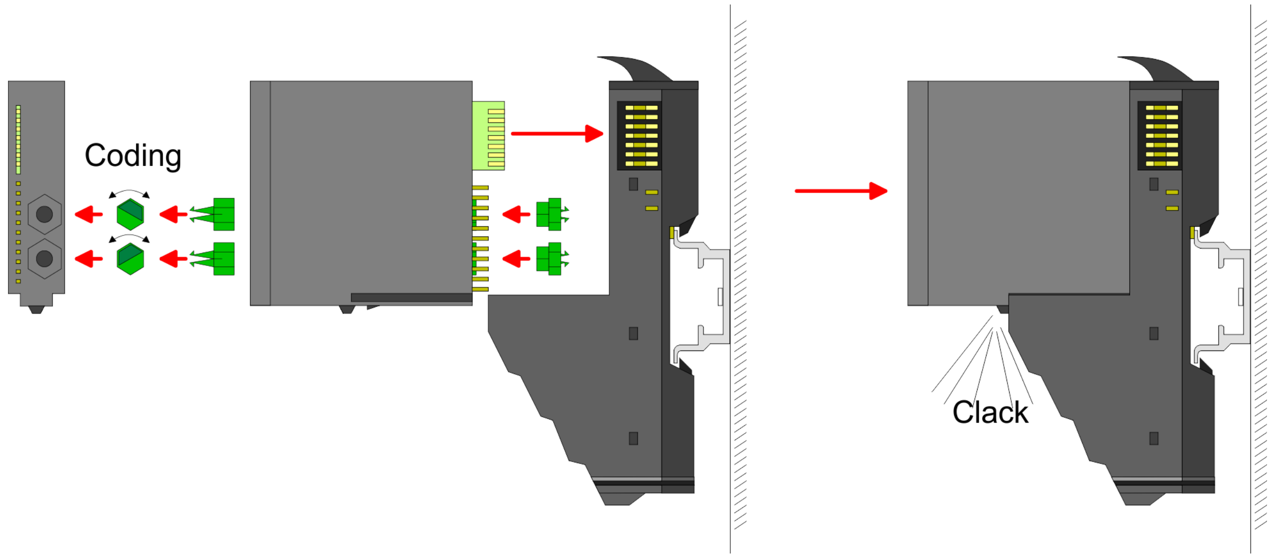


For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.



Coding

There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic module and the coding plug in the terminal module. This ensures that after replacing the electronics module just another electronic module can be plugged with the same encoding.



Each electronic module has on its back 2 coding sockets for coding jacks. Due to the characteristics, with the coding jack 6 different positions can be plugged, each. Thus there are 36 possible combinations for coding with the use of both coding sockets.

1. Plug, according to your coding, 2 coding jacks in the coding sockets of your electronic module until they lock.
2. Now plug the according coding plugs into the coding jacks.
3. To fix the coding put both the electronic and terminal module together until they lock.

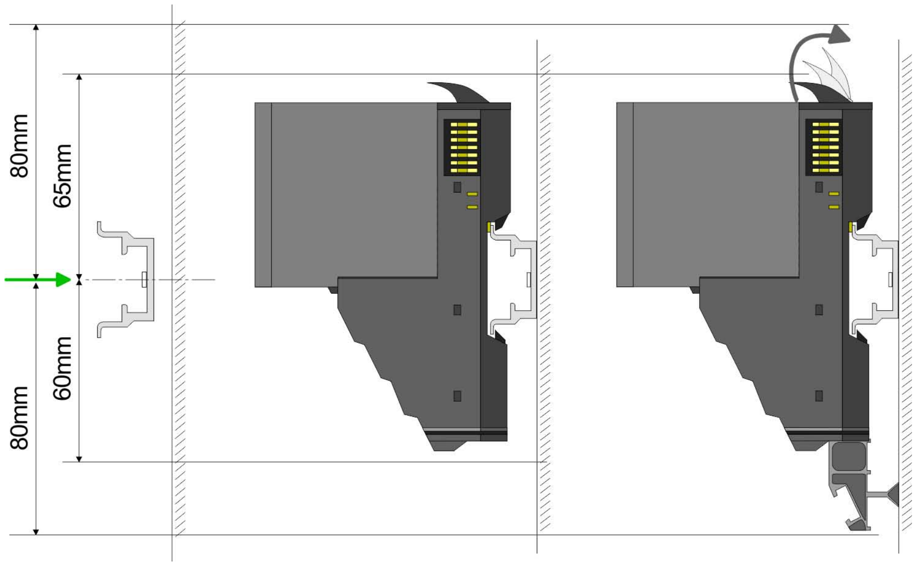
CAUTION!
Please consider that when replacing an already coded electronic module, this is always be replaced by an electronic module with the same coding.

Even with an existing coding on the terminal module, you can plug an electronic module without coding. The user is responsible for the correct usage of the coding pins. VIPA assumes no liability for incorrectly attached electronic modules or for damages which arise due to incorrect coding!

Mounting Proceeding

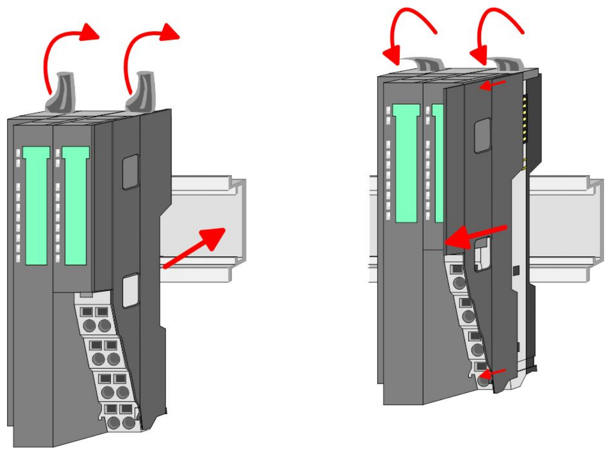
The modules were directly be mounted to the mounting rail and so connected to the backplane bus and the power supply for the electronic and power section. Up to 64 modules may be mounted. Please consider here that the sum current of the electronic power supply does not exceed the maximum value of 3A. By means of the power module 007-1AB10 the current of the electronic power supply may be expanded with 2A. *Chapter 2.6 'Wiring' on page 26*

Mounting rail



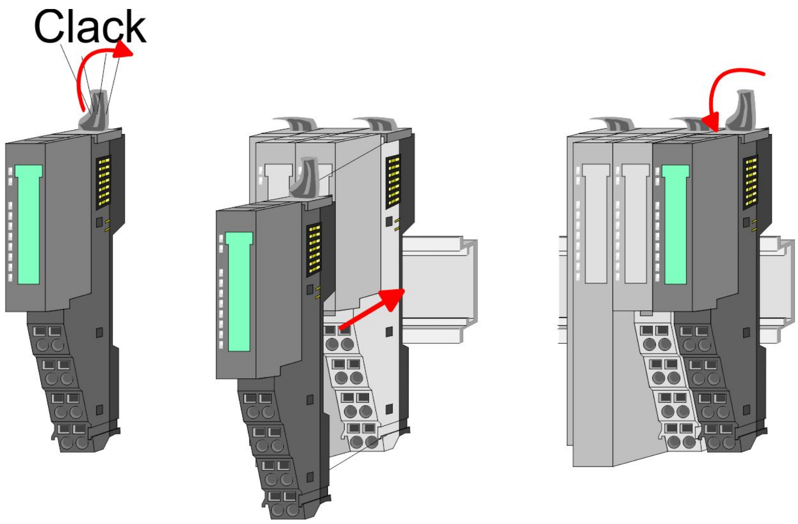
Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.

Mounting Head module (e.g. bus coupler)



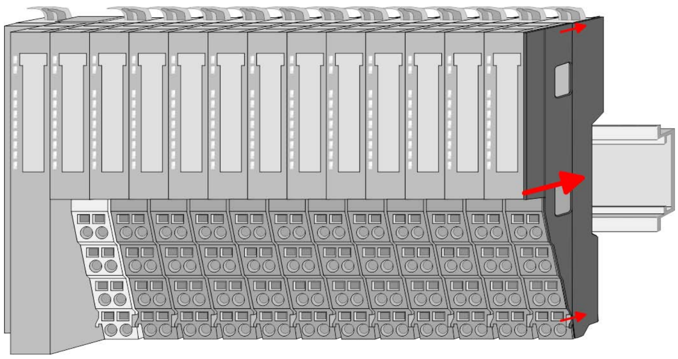
1. Start at the left side with the head module (e.g. bus coupler). For this turn both locking lever upwards, put the head module to the mounting rail and turn both locking lever downward.
2. Before mounting the periphery modules you have to remove the bus cover at the right side of the Head module by pulling it forward. Keep the cover for later mounting.

Mounting periphery modules



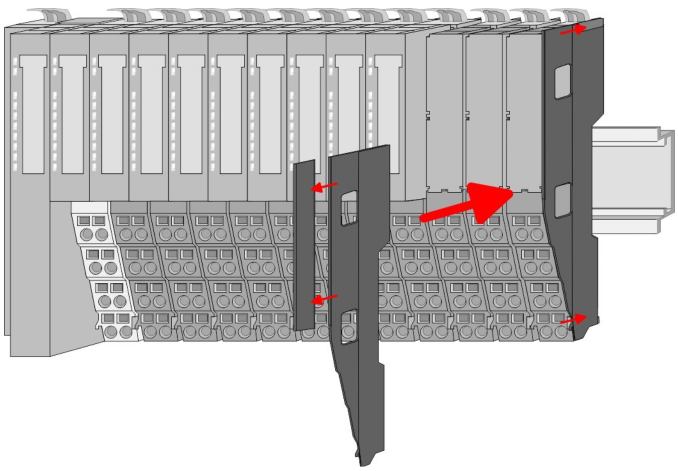
➞ Mount the periphery modules you want.

Mounting the bus cover



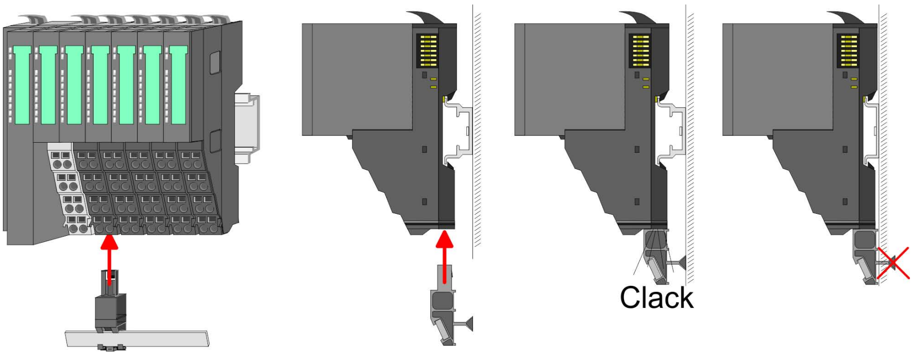
➞ After mounting the whole system, to protect the backplane bus connectors at the last module you have to mount the bus cover, now.

Mounting the bus cover at a clamp module



➞ If the last module is a clamp module, for adaptation the upper part of the bus cover is to be removed

Mounting shield bus carrier



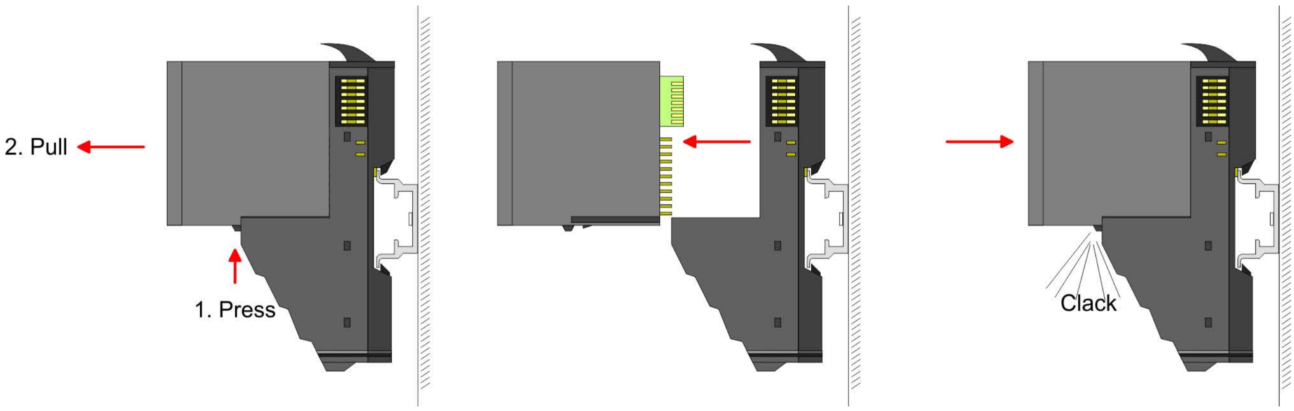
The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

2.5 Demounting and module exchange

Proceeding

With demounting and exchange of a module, head module (e.g. bus coupler) or a group of modules for mounting reasons you have always to remove the electronic module of the just mounted right module. After the mounting it may be plugged again.

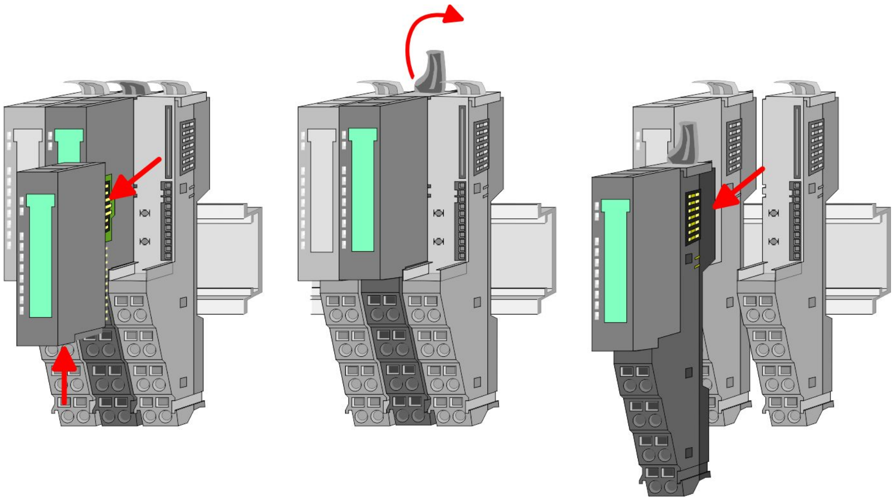
Exchange of an electronic module



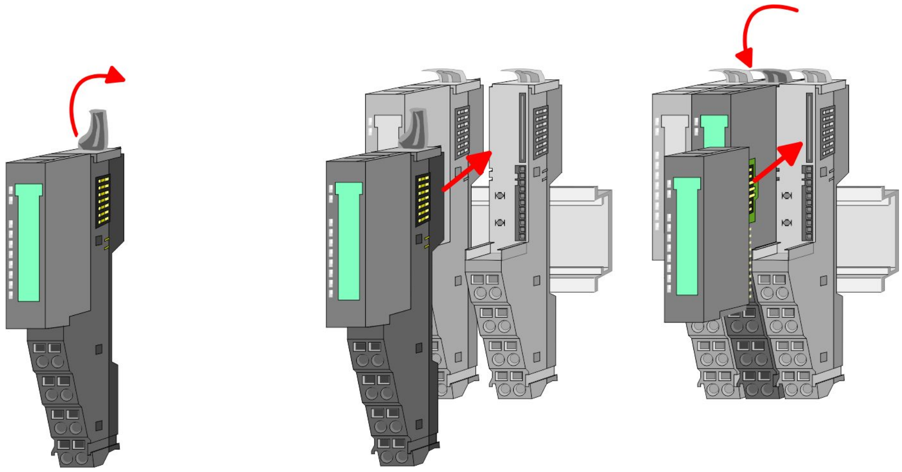
1. For the exchange of an electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
2. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.

Exchange of a module

1. Remove if exists the wiring. ➪ *Chapter 2.6 'Wiring' on page 26*.



2. Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
3. Turn the locking lever of the module to be exchanged upwards.
4. Pull the module forward.



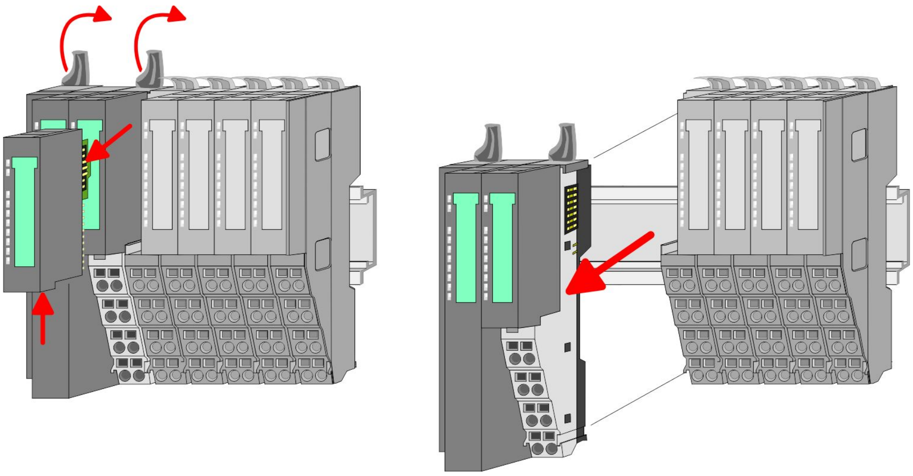
5. For mounting turn the locking lever of the module to be mounted upwards.
6. To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
7. Turn the locking lever downward again.
8. Plug again the electronic module, which you have removed before.

Exchange of a head module (e.g. bus coupler)

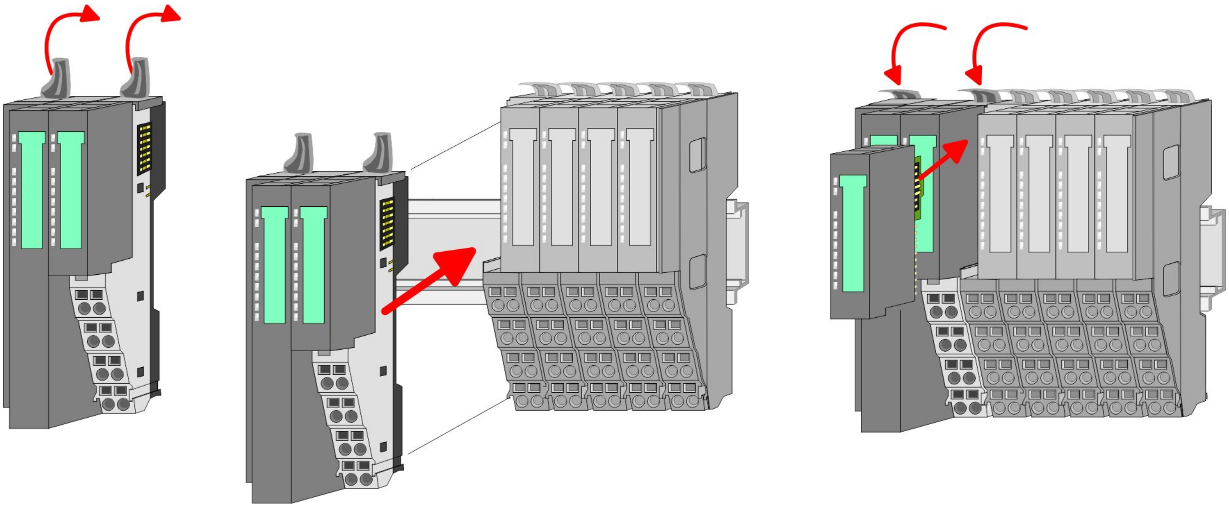
CAUTION!
Bus interface and power module of a head module may not be separated!

Here you may only exchange the electronic module!

1. Remove if exists the wiring of the head module. ✍ *Chapter 2.6 'Wiring' on page 26.*



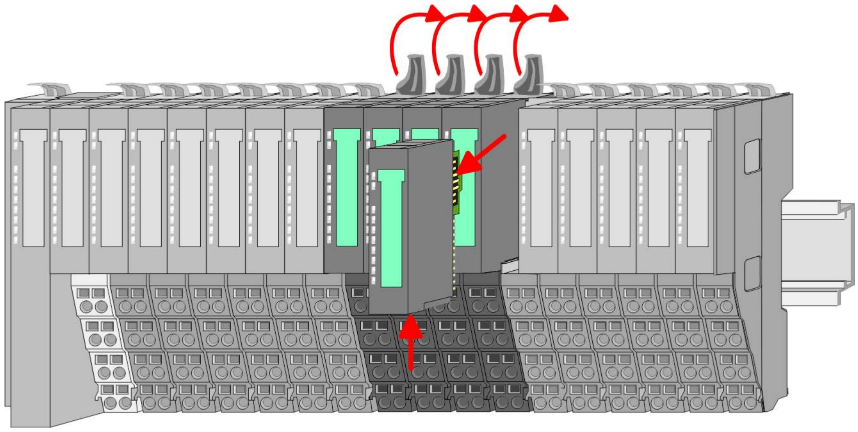
2. Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
3. Turn all the locking lever of the head module to be exchanged upwards.
4. Pull the head module forward.



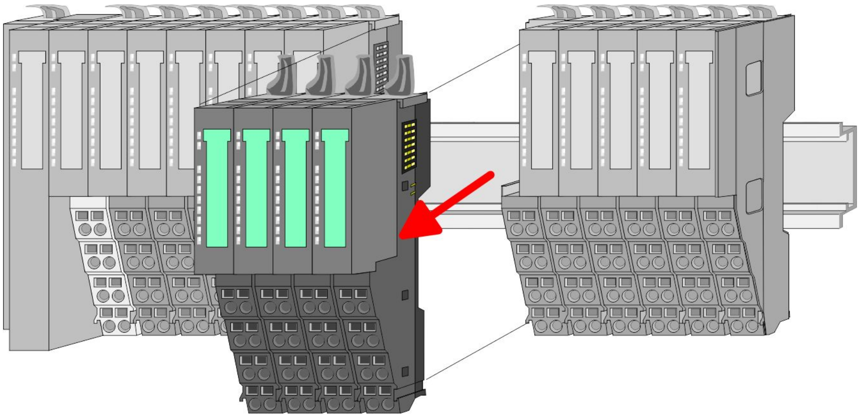
5. For mounting turn all the locking lever of the head module to be mounted upwards.
6. To mount the head module put it to the left module and push it, guided by the stripes, to the mounting rail.
7. Turn all the locking lever downward again.
8. Plug again the electronic module, which you have removed before.

Exchange of a module group

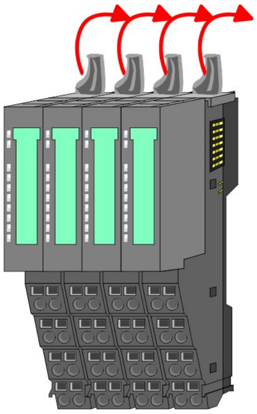
1. Remove if exists the wiring of the module group. ↳ *Chapter 2.6 'Wiring' on page 26*.

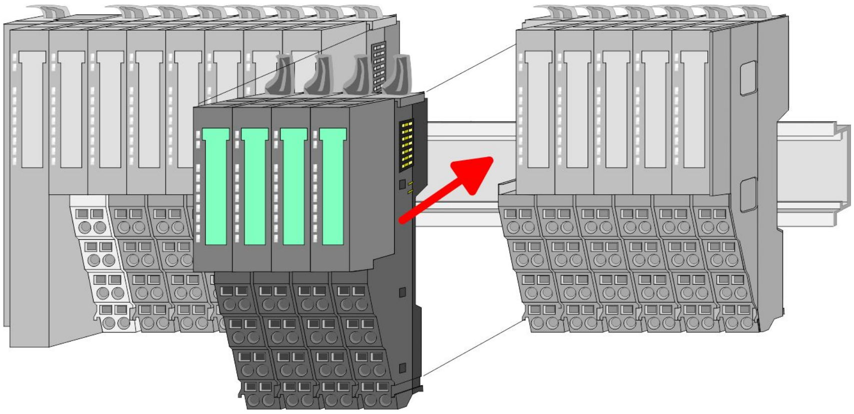


2. Press the unlocking lever at the lower side of the just mounted right module of the module group and pull it forward.

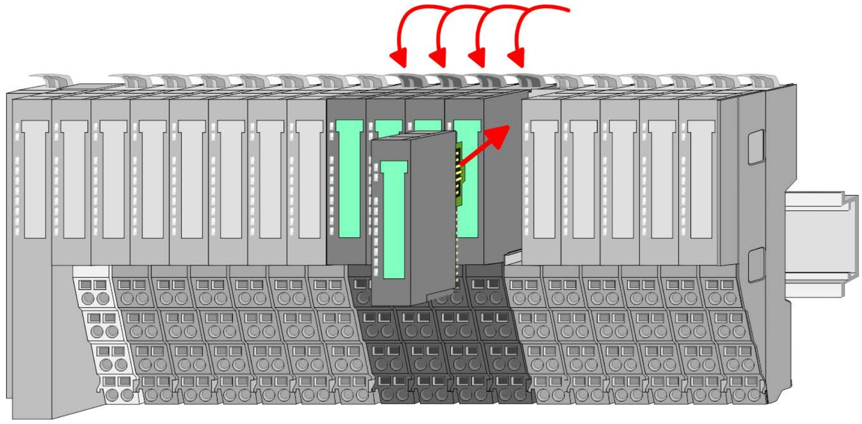


3. Turn all the locking lever of the module group to be exchanged upwards.
4. Pull the module group forward.





5. For mounting turn all the locking lever of the module group to be mounted upwards.
6. To mount the module group put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.



7. Turn all the locking lever downward again.

8. Plug again the electronic module, which you have removed before.

2.6 Wiring

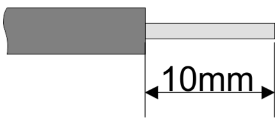
Connectors

Terminals with spring clamp technology are used for wiring.

The spring clamp technology allows quick and easy connection of your signal and supply lines.

In contrast to screw terminal connections this type of connection is vibration proof.

Data



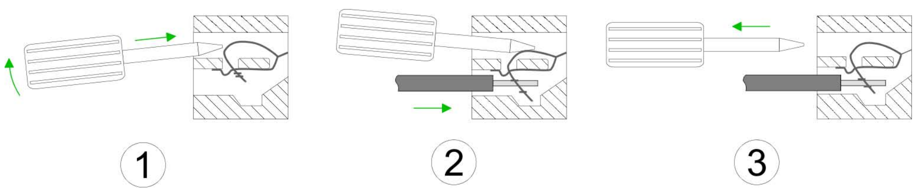
U_{max}: 240V AC / 30V DC

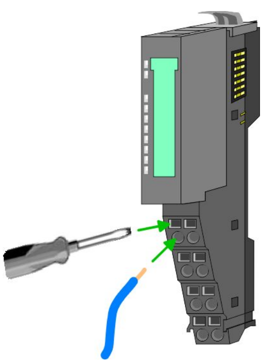
I_{max}: 10A

Cross section: 0.08 ... 1.5mm^2 (AWG 28 ... 16)

Stripping length: 10mm

Wiring procedure



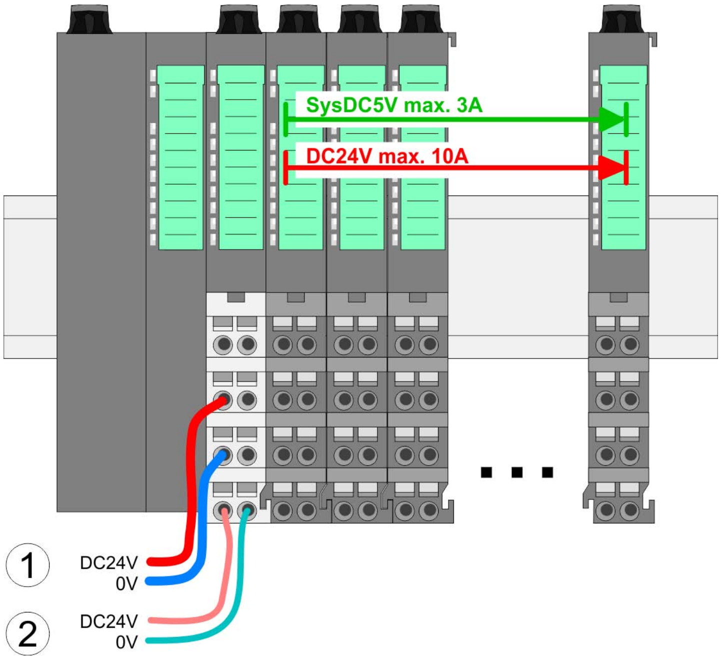


1. Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.

2. Insert the stripped end of wire into the round opening. You can use wires with a cross section of 0.08mm^2 to 1.5mm^2.

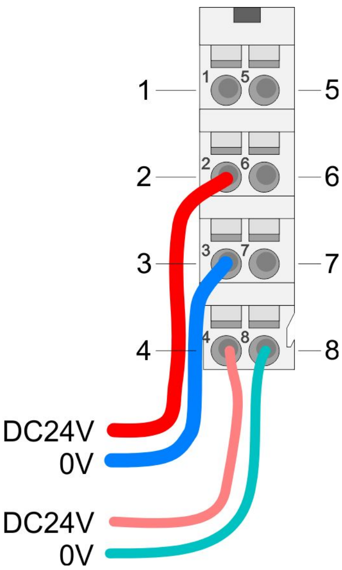
3. By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

Standard wiring



(1) DC 24V for power section supply I/O area (max 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area

PM - Power module



For wires with a core cross-section of 0.08mm² up to 1.5mm².

Pos.	Function	Type	Description
1	---	---	not connected
2	DC 24V	I	DC 24V for power section supply
3	0V	I	GND for power section supply
4	Sys DC 24V	I	DC 24V for electronic section supply
5	---	---	not connected
6	DC 24V	I	DC 24V for power section supply
7	0V	I	GND for power section supply
8	Sys 0V	I	GND for electronic section supply

I Input

CAUTION!
Since the power section supply is not internally protected, it is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected by a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!

The electronic power section supply is internally protected against higher voltage by fuse. The fuse is within the power module. If the fuse releases, its electronic module must be exchanged!

Fusing

- The power section supply is to be externally protected with a fuse, which corresponds to the maximum current. This means max. 10A is to be protected with a 10A fuse (fast) respectively by a line circuit breaker 10A characteristics Z!
- It is recommended to externally protect the electronic power supply for bus coupler and I/O area with a 2A fuse (fast) respectively by a line circuit breaker 2A characteristics Z.
- The electronic power supply for the I/O area of the power module 007-1AB10 should also be externally protected with a 1A fuse (fast) respectively by a line circuit breaker 1A characteristics Z.

State of the electronic power supply via LEDs

After PowerON of the System SLIO the LEDs RUN respectively MF get on so far as the sum current does not exceed 3A.

With a sum current greater than 3A the LEDs may not be activated.

Here the power module with the order number 007-1AB10 is to be placed between the peripheral modules.

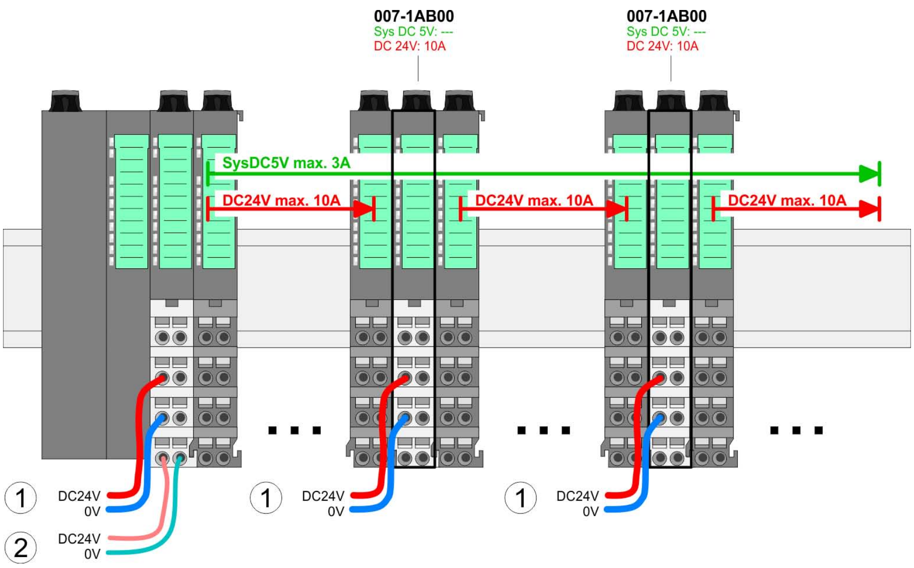
Deployment of the power modules

If the 10A for the power section supply is no longer sufficient, you may use the power module from VIPA with the order number 007-1AB00. So you have also the possibility to define isolated groups.

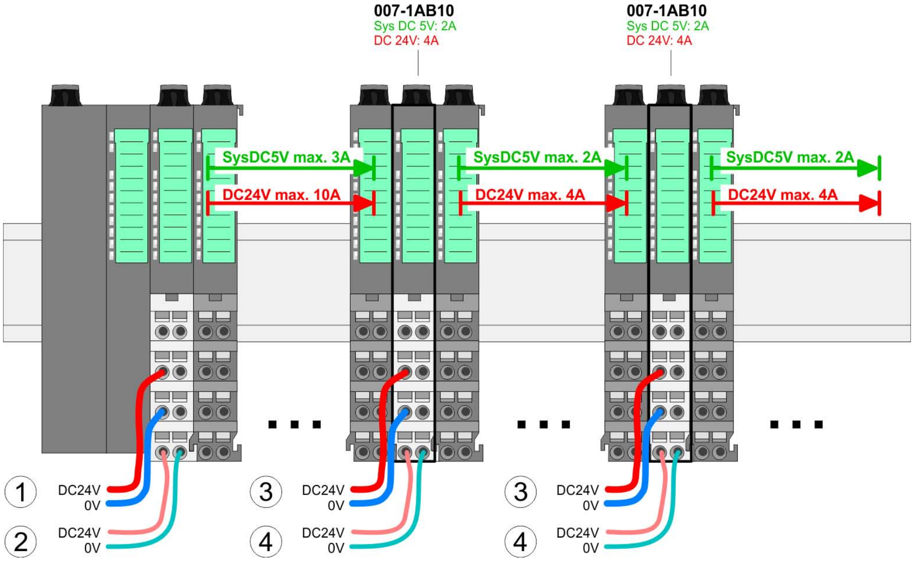
The power module with the order number 007-1AB10 is to be used if the 3A for the electronic power supply at the backplane bus is no longer sufficient. Additionally you get an isolated group for the DC 24V power section supply with 4A.

By placing the power module 007-1AB10 at the following backplane bus modules may be placed with a sum current of max. 2A. Afterwards the power module 007-1AB10 is to be placed again. To secure the power supply, the power modules may be mixed used.

Power module 007-1AB00



Power module 007-1AB10



(1) DC 24V for power section supply I/O area (max. 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area
(3) DC 24V for power section supply I/O area (max. 4A)
(4) DC 24V for electronic power supply I/O area

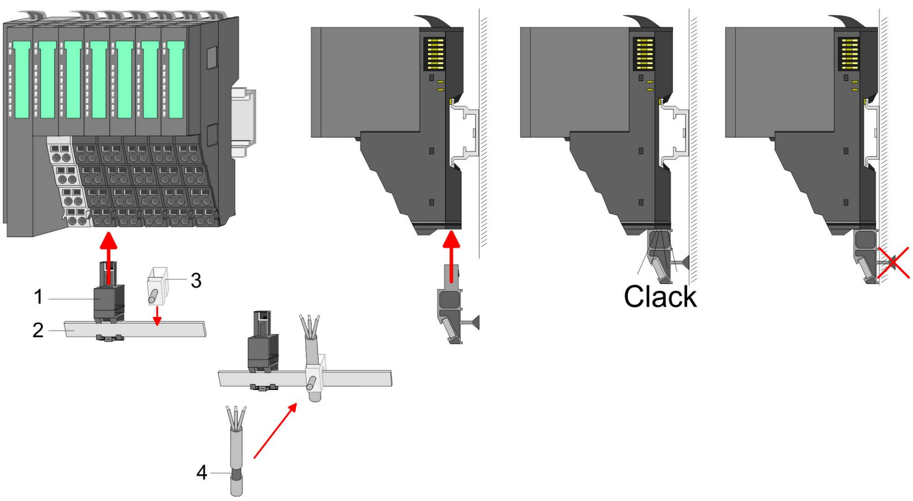
Shield attachment

To attach the shield the mounting of shield bus carriers are necessary.

The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields.

The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

After mounting the shield bus carrier with the shield bus, the cables with the accordingly stripped cable screen may be attached and fixed by the shield clamp.



1 Shield bus carrier
2 Shield bus (10mm x 3mm)
3 Shield clamp
4 Cable shield

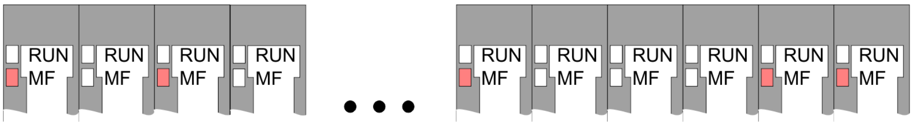
2.7 Trouble shooting - LEDs

General

Each module has the LEDs RUN and MF on its front side. Errors or incorrect modules may be located by means of these LEDs.

In the following illustrations flashing LEDs are marked by ☼.

Sum current of the electronic power supply exceeded

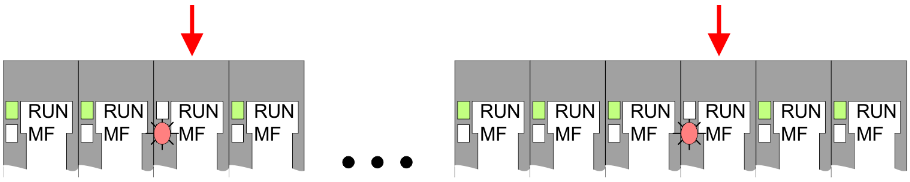


Behaviour: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

Reason: The maximum current for the electronic power supply is exceeded.

Remedy: As soon as the sum current of the electronic power supply is exceeded, always place the power module 007-1AB10.
✎ *Chapter 2.6 'Wiring' on page 26*.

Error in configuration

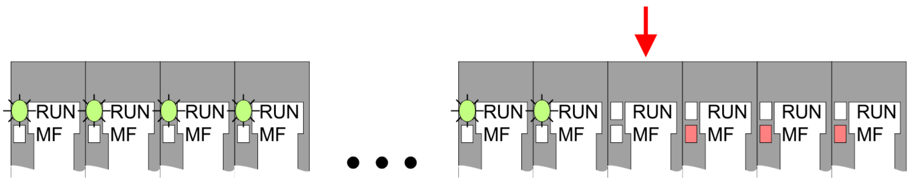


Behaviour: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

Reason: At this position a module is placed, which does not correspond to the configured module.

Remedy: Match configuration and hardware structure.

Module failure



Behaviour: After PowerON all of the RUN LEDs up to the defective module are flashing. With all following modules the MF LED is on and the RUN LED is off.

Reason: The module on the right of the flashing modules is defective.

Remedy: Replace the defective module.

2.8 Installation guidelines

General

The installation guidelines contain information about the interference free deployment of a PLC system. There is the description of the ways, interference may occur in your PLC, how you can make sure the electromagnetic compatibility (EMC), and how you manage the isolation.

What does EMC mean?

Electromagnetic compatibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interfered respectively without interfering the environment.

The components of VIPA are developed for the deployment in industrial environments and meets 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:

- Electromagnetic fields (RF coupling)
- Magnetic fields with power frequency
- Bus system
- Power 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.

There are:

- 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 aluminium parts. Aluminium 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 respectively 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 favourable.
  – 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 metallised plug cases for isolated data lines.

- In special use cases you should appoint special EMC actions.
  – Consider to 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 serves for protection and functionality activity.
  – Connect installation parts and cabinets with your PLC in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  – If there are potential differences between installation parts and cabinets, 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. Here 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 respectively µA) are transferred.
  – foil isolations (static isolations) are used.
- With data lines always use metallic or metallised 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 your PLC and don't lay it on there again!

CAUTION!
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

2.9 General data

Conformity and approval		
Conformity		
CE	2006/95/EG	Low-voltage directive
	2004/108/EG	EMC directive
Approval		
UL	UL 508	Approval for USA and Canada
others		
RoHS	2011/65/EU	Product is lead-free; Restriction of the use of certain hazardous substances in electrical and electronic equipment

Protection of persons and device protection		
Type of protection	-	IP20
Electrical isolation		
to the field bus	-	electrically isolated
to the process level	-	electrically isolated
Insulation resistance		-
Insulation voltage to reference earth		
Inputs / outputs	-	AC / DC 50V, test voltage AC 500V
Protective measures	-	against short circuit

Environmental conditions to EN 61131-2		
Climatic		
Storage / transport	EN 60068-2-14	-25…+70°C
Operation		
Horizontal installation	EN 61131-2	0…+60°C
Vertical installation	EN 61131-2	0…+60°C
Air humidity	EN 60068-2-30	RH1 (without condensation, rel. humidity 10…95%)
Pollution	EN 61131-2	Degree of pollution 2
Mechanical		
Oscillation	EN 60068-2-6	1g, 9Hz ... 150Hz
Shock	EN 60068-2-27	15g, 11ms

Mounting conditions		
Mounting place	-	In the control cabinet
Mounting position	-	Horizontal and vertical

EMC	Standard		Comment
Emitted interfer-ence	EN 61000-6-4		Class A (Industrial area)
Noise immunity zone B	EN 61000-6-2		Industrial area
		EN 61000-4-2	ESD 8kV at air discharge (degree of severity 3), 4kV at contact discharge (degree of severity 2)
		EN 61000-4-3	HF field immunity (casing) 80MHz … 1000MHz, 10V/m, 80% AM (1kHz) 1.4GHz ... 2.0GHz, 3V/m, 80% AM (1kHz) 2GHz ... 2.7GHz, 1V/m, 80% AM (1kHz)
		EN 61000-4-6	HF conducted 150kHz … 80MHz, 10V, 80% AM (1kHz)
		EN 61000-4-4	Burst, degree of severity 3
		EN 61000-4-5	Surge, installation class 3 *

*) Due to the high-energetic single pulses with Surge an appropriate external protective circuit with lightning protection elements like conductors for lightning and overvoltage is necessary.

3 Analog Input

3.1 General

Cables for analog signals

For analog signals you should use screened cables to reduce interference. The cable screening should be grounded at both ends. If there are differences in the potential between the cable ends, there may occur a potential compensating current that could disturb the analog signals. In this case you should ground the cable screening only at one end.

Connecting sensors

Depending on the module the following sensors may be connected to the analog input modules:

- Current sensor
- Voltage sensor
- Resistance-type sensors
- Temperature sensors

Please take care of the correct polarity when installing the sensors! Please install short circuits at non-used inputs by connecting the positive contact with the channel ground of the according channel.

Parameterization

The parameterization via CPU, PROFIBUS and PROFINET happens by means of record sets (DS). The corresponding record set number may be found at the respective module description. Here also the indices (IX) respectively subindices (SX) for CANopen respectively EtherCAT are listed.

Diagnostic functions

The modules have diagnostics capability. The following errors can release a diagnostic:

- Error in parameterization
- Measuring range over-/underflow
- Wire break

3.2 Analog value

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															
	High byte (byte 0)								Low byte (byte 1)							
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												0	0	0
15Bit+sign	SG	Measuring value														

Resolution

With a resolution of 12bit plus sign bit, the not used low value positions (3bits) are filled with "0".

Sign bit (SG)

Here it is essential:

- Bit 15 = "0": → positive value
- Bit 15 = "1": → negative value

Behavior at error

As soon as a measured value exceeds the overdrive region respectively falls below the underdrive region, the following value is issued:

- Measuring value > end of overdrive region:
  – 32767 (7FFFh)
- Measuring value < end of underdrive region:
  – -32768 (8000h)

At a parameterization error the value 32767 (7FFFh) is issued.

3.3 Measuring ranges and function numbers

General

In the following there are the measuring ranges with function number listed, which were supported by the corresponding analog module.

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.

Voltage

-80 ... 80mV

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
-80 ... 80mV Siemens S7 format (11h)	94.07mV	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{27648}$
	80mV	27648	6C00h	nominal range	
	0V	0	0000h		
	-80mV	-27648	9400h		
	-94.07mV	-32512	8100h	underrange	
-80 ... 80mV Siemens S7 format (21h)	100mV	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{16384}$
	80mV	16384	4000h	nominal range	
	0V	0	0000h		
	-80mV	-16384	C000h		
	-100mV	-20480	B000h	underrange	

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

±10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S7 format (12h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

Current

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

0 ... 20mA / 4KM format

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA 4KM format (3Fh)	20.457mA	4095	0FFFh	overrange	$D = 4000 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{4000}$
	20mA	4000	0FA0h	nominal range	
	10mA	2000	07D0h		
	0mA	0	0000h		
	---			underrange	

Resistance

Measuring range (funct. no.)	Measuring value	Signal range	Range
2 wire: PT100 (50h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: PT1000 (51h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: NI100 (52h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: NI1000 (53h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: PT100 (58h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
3 wire: PT1000 (59h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
3 wire: NI100 (5Ah)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: NI1000 (5Bh)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: PT100 (60h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: PT1000 (61h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: NI100 (62h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: NI1000	+295°C	+2950	overrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
(63h)	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: 0 ... 60Ω (70h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (71h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (72h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (78h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (79h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (7Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (80h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (81h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (82h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (90h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (91h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
2 wire: 0 ... 3000Ω (92h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (98h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (99h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (9Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (A0h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (A1h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (A2h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (D0h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (D1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (D2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (D8h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (D9h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range

Measuring range (funct. no.)	Measuring value	Signal range	Range
	---	---	underrange
3 wire: 0 ... 3000Ω (DAh)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (E0h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (E1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (E2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange

Temperature

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
Type J: -210 ... +1200°C -346 ... 2192°F 63.2 ... 1473.2K (B0h: ext. comp. 0°C) (C0h: int. comp. 0°C)	+14500	26420	17232	overrange
	-2100 ... +12000	-3460 ... 21920	632 ... 14732	nominal range
	---	---	---	underrange
Type K: -270 ... +1372°C -454 ... 2501.6°F 0 ... 1645.2K (B1h: ext. comp. 0°C) (C1h: int. comp. 0°C)	+16220	29516	18952	overrange
	-2700 ... +13720	-4540 ... 25016	0 ... 16452	nominal range
	---	---	---	underrange
Type N: -270 ... +1300°C -454 ... 2372°F 0 ... 1573.2K (B2h: ext. comp. 0°C) (C2h: int. comp. 0°C)	+15500	28220	18232	overrange
	-2700 ... +13000	-4540 ... 23720	0 ... 15732	nominal range

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
	---	---	---	underrange
Type R: -50 ... +1769°C -58 ... 3216.2°F 223.2 ... 2042.2K (B3h: ext. comp. 0°C) (C3h: int. comp. 0°C)	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range
	-1700	-2740	1032	underrange
Type S: -50 ... +1769°C -58 ... 3216.2°F 223.2 ... 2042.2K (B4h: ext. comp. 0°C) (C4h: int. comp. 0°C)	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range
	-1700	-2740	1032	underrange
Type T: -270 ... +400°C -454 ... 752°F 3.2 ... 673.2K (B5h: ext. comp. 0°C) (C5h: int. comp. 0°C)	+5400	10040	8132	overrange
	-2700 ... +4000	-4540 ... 7520	32 ... 6732	nominal range
	---	---	---	underrange
Type B: 0 ... +1820°C 32 ... 2786.5°F 273.2 ... 2093.2K (B6h: ext. comp. 0°C) (C6h: int. comp. 0°C)	+20700	32766	23432	overrange
	0 ... +18200	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type C: 0 ... +2315°C 32 ... 2786.5°F 273.2 ... 2093.2K (B7h: ext. comp. 0°C) (C7h: int. comp. 0°C)	+25000	32766	23432	overrange
	0 ... +23150	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type E: -270 ... +1000°C -454 ... 1832°F 0 ... 1273.2K (B8h: ext. comp. 0°C) (C8h: int. comp. 0°C)	+12000	21920	14732	overrange
	-2700 ... +10000	-4540 ... 18320	0 ... 12732	nominal range
	---	---	---	underrange

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
Type L:	+11500	21020	14232	overrange
-200 ... +900°C	-2000 ... +9000	-3280 ... 16520	732 ... 11732	nominal range
-328 ... 1652°F 73.2 ... 1173.2K (B9h: ext. comp. 0°C) (C9h: int. comp. 0°C)	---	---	---	underrange

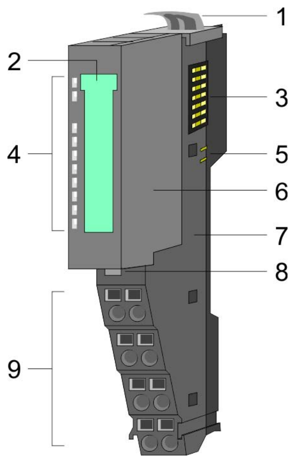
3.4 031-1BB10 - AI 2x12Bit 0(4)...20mA - ISO

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. The sensor supplies are isolated from each other and via DC/DC converter from the DC 24V power supply.

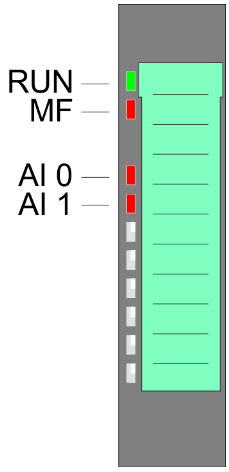
- 2 galvanically separated analog inputs
- Integrated sensor supply for each channel max. 35mA, (short circuit to 39mA)
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Interrupt and diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

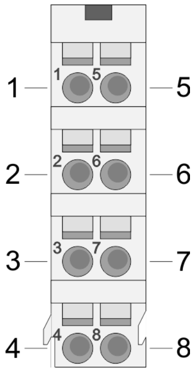
Status indication

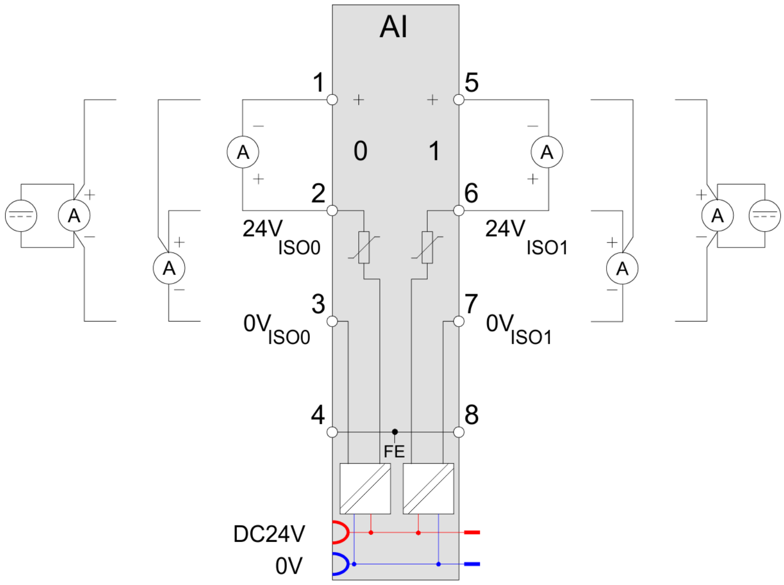


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization ■ Overload/short circuit of the DC 24V_ISO
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	24V_ISO_0	O	DC 24V encoder supply Channel 0
3	0V_ISO_0	O	Ground channel 0
4	FE	---	Shield
5	AI 1	I	+ Channel 1
6	24V_ISO_1	O	DC 24V encoder supply Channel 1
7	0V_ISO_1	O	Ground Channel 1
8	FE	---	Shield

I: Input, O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.4.1 Technical data

Order no.	**031-1BB10**
Type	SM 031
Module ID	0411 1543
Current consumption/power loss	
Current consumption from backplane bus	50 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	20 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	60 Ω
Input current ranges	+4 mA ... +20 mA 0 mA ... +20 mA
Operational limit of current ranges	+/-0.5%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.3%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-

Order no.	031-1BB10
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	1.15 ms all channels
Noise suppression for frequency	>80dB (UCM<20V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
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)	-
Max. potential difference between inputs and Mana (Ucm)	DC 75 V/ AC 60 V

Order no.	031-1BB10
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	4
Output bytes	0
Parameter bytes	20
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.4.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
SHORT_EN	1	Monitoring of sensor voltage*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
RES	1	reserved*	00h	00h	3103h	04h
CH0FN	1	Function number channel 0	31h	80h	3104h	05h
CH0FO	1	Function option channel 0	00h	80h	3105h	06h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h

Name	Bytes	Function	Default	DS	IX	SX
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	31h	81h	310Ah	09h
CH1FO	1	Function option channel 1	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch
* This record set may only be transferred at STOP state.						

DIAG_EN Diagnostic interrupt

Byte	Bit 7 ... 0
0	■ Diagnostic interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

SHORT_EN Monitoring sensor voltage

Byte	Bit 7 ... 0
0	■ Bit 0: Monitoring of sensor voltage channel 0 (1: on) ■ Bit 1: Monitoring of sensor voltage channel 1 (1: on) ■ Bit 7 ... 2: reserved

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is disabled and disabled the respective sensor supply. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

0 ... 20mA / 4KM format

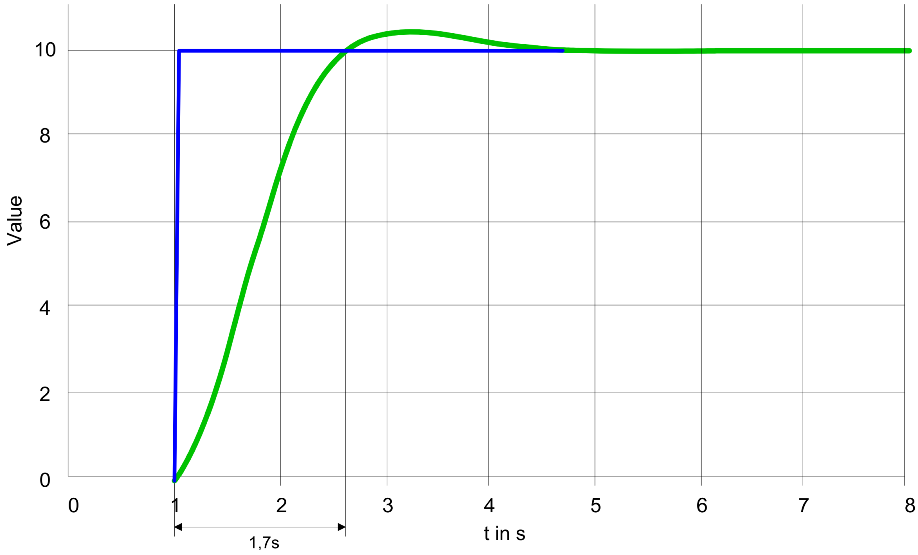
Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA 4KM format (3Fh)	20.457mA	4095	0FFFh	overrange	$D = 4000 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{4000}$
	20mA	4000	0FA0h	nominal range	
	10mA	2000	07D0h		
	0mA	0	0000h		
	---			underrange	

CHxFO Function option channel x

As function option for each channel a time constant x10ms may be preset for a low-pass filter. This is a second-order Butterworth filter. Here frequencies, which lie above the critical frequency, can be filtered. The setting for interference suppression of 50Hz respectively 60Hz is 200ms respectively 170ms.

Range of values: 0 ... 250 (0 = deactivated)

The following diagram shows the transient behavior of the filter with a time constant of 500ms. Here the filter reaches the desired value after 1700ms for the first time.



CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.4.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/param.	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
diagnostics buffer overflow	-	X	-
Process interrupt lost	-	X	-
Sensor voltage monitoring	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram. SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Upper limit overflow channel x	00h	02h
PRIT_UL	1	Lower limit underflow channel x	00h	03h
PRIT_US	2	µs-Ticker	00h	04h ... 05h

PRIT_OL upper limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Upper limit overflow channel 0 ■ Bit 1: Upper limit overflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Lower limit underflow channel 0 ■ Bit 1: Lower limit underflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_US µs-Ticker

Byte	Bit 7 ... 0
0...1	16bit µs value at the moment of the interrupt

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going}$) the MF-LED of the module is on.

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h

Name	Bytes	Function	Default	DS	IX	SX
RES2	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error: Channel x: ■ Bit 0: set at project engineering/parameterization error ■ Bit 1: row value above the permissible range ■ Bit 2: row value below the acceptable range ■ Bit 3: reserved ■ Bit 4: error sensor supply voltage ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

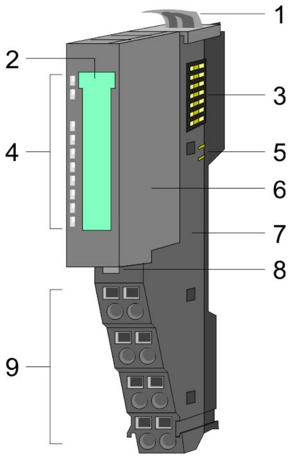
3.5 031-1BB30 - AI 2x12Bit 0...10V

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

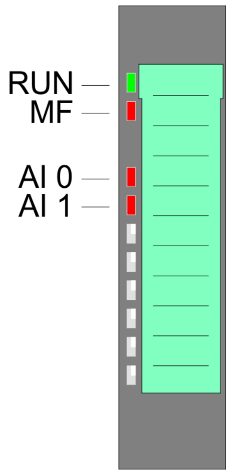
- 2 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

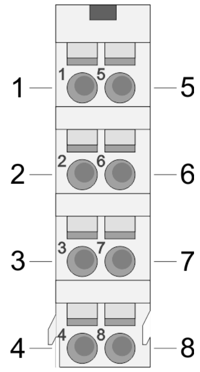
Status indication

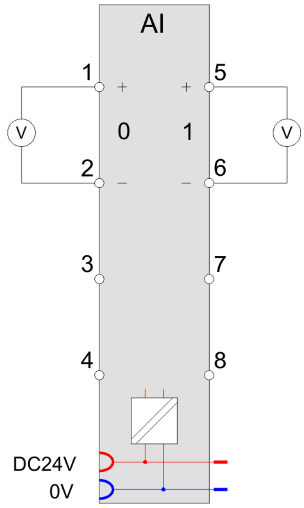


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	---	---	not connected
4	---	---	not connected
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	---	---	not connected
8	---	---	not connected

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules.

SX - Subindex for access via EtherCAT.

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.5.1 Technical data

Order no.	**031-1BB30**
Type	SM 031
Module ID	0401 15C3
Current consumption/power loss	
Current consumption from backplane bus	70 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.2%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-

Order no.	031-1BB30
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	2 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 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

Order no.	031-1BB30
Max. potential difference between Mintern and outputs	-
Insulation tested with	DC 500 V
Datasizes	
Input bytes	4
Output bytes	0
Parameter bytes	6
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.5.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	10h	80h	3100h	01h
CH1FN	1	Function number channel 1	10h	81h	3101h	02h

CHxFN Function number channel x

In the following there are the measuring ranges with function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

3.5.3 Diagnostic data

This module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h

Name	Bytes	Function	Default	DS	IX	SX
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

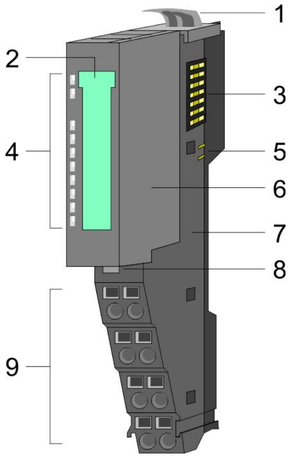
3.6 031-1BB40 - AI 2x12Bit 0(4)...20mA

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

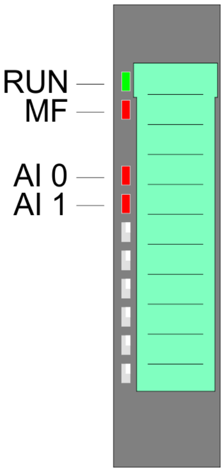
- 2 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

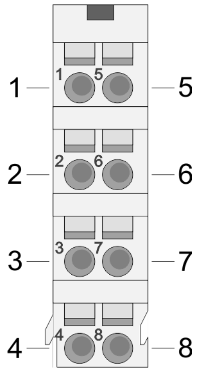
Status indication

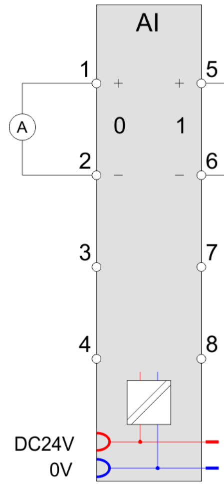


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ➪ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm^2 up to 1.5mm^2.





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	---	---	not connected
4	---	---	not connected
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	---	---	not connected
8	---	---	not connected

I: Input

If a 2wire measuring transducer is used, you have to connect in line an external power supply.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area No byte of the output area is used by the module.

3.6.1 Technical data

Order no.	031-1BB40
Type	SM 031
Module ID	0402 15C3
Current consumption/power loss	
Current consumption from backplane bus	70 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	110 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.5%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.2% ... +/-0.3%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-

Order no.	031-1BB40
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	2 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 2 V
Max. potential difference between Mana and Mintern (Uiso)	-

Order no.	**031-1BB40**
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	4
Output bytes	0
Parameter bytes	6
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.6.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	31h	80h	3100h	01h
CH1FN	1	Function number channel 1	31h	81h	3101h	02h

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

3.6.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

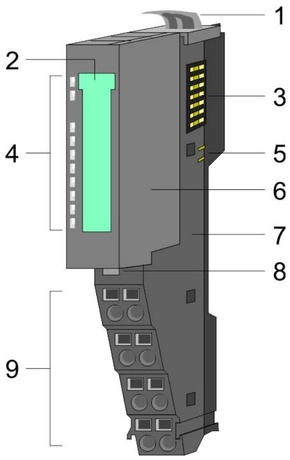
3.7 031-1BB60 - AI 2x12Bit 0(4)...20mA - Sensor

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are isolated to the backplane bus.

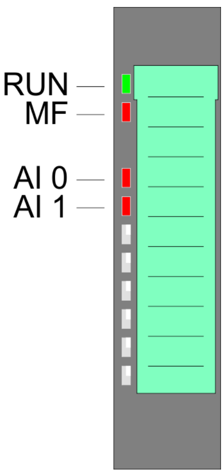
- 2 analog inputs
- Integrated sensor supply
- Suited for sensors with 0(4) ... 20mA with external supply
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication



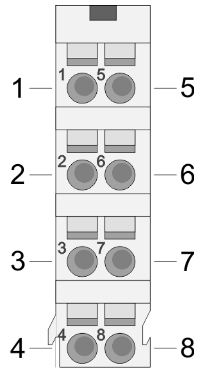
RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*

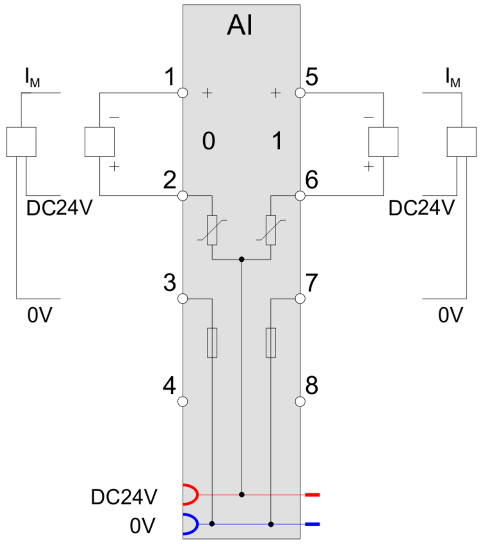
RUN	MF	AI x	Description
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

If the terminal module is not yet wired, when the module is power supplied the AI x LEDs get on due to the default parameterization 4 ... 20mA.

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	DC 24V	O	DC 24V for sensor Channel 0
3	0V	O	Ground for sensor (with 3 wire measurement)
4	---	---	not connected
5	+AI 0	I	+ Channel 0
6	DC 24V	O	DC 24V for sensor Channel 1
7	0V	O	Ground for sensor (with 3 wire measurement)
8	---	---	not connected

I: Input, O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.7.1 Technical data

Order no.	**031-1BB60**
Type	SM 031
Module ID	0407 15C3
Current consumption/power loss	
Current consumption from backplane bus	50 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	110 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.5%
Operational limit of current ranges with SFU	-

Order no.	031-1BB60
Basic error limit current ranges	+/-0.3%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	2 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED

Order no.	031-1BB60
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)	-
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	4
Output bytes	0
Parameter bytes	6
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.7.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	30h	80h	3100h	01h
CH1FN	1	Function number channel 1	30h	81h	3101h	02h

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

3.7.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR ... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

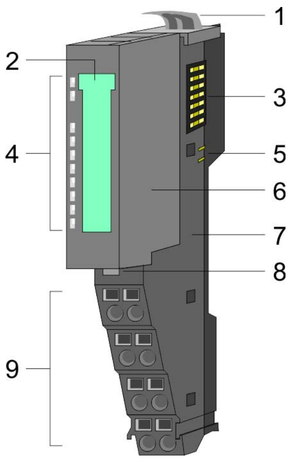
3.8 031-1BB70 - AI 2x12Bit ±10V

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

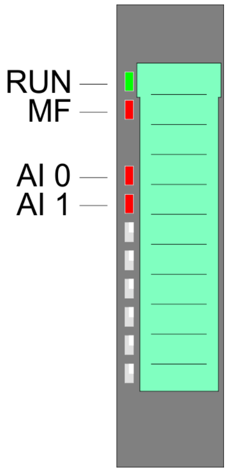
- 2 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



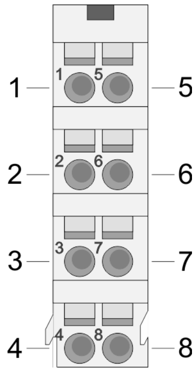
1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

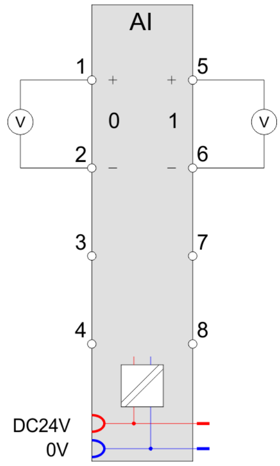


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment



For wires with a cross section of 0.08mm² up to 1.5mm².



Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	---	---	not connected
4	---	---	not connected
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	---	---	not connected
8	---	---	not connected

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.8.1 Technical data

Order no.	**031-1BB70**
Type	SM 031
Module ID	0408 15C3
Current consumption/power loss	
Current consumption from backplane bus	50 mA
Power loss	0.5 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.2%
Basic error limit voltage ranges with SFU	-
Destruction limit current	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Radical error limit current ranges with SFU	-
Destruction limit current inputs (voltage)	-
Destruction limit current inputs (electrical current)	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-

Order no.	031-1BB70
Destruction limit resistance inputs	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Operational limit of resistance thermometer ranges with SFU	-
Basic error limit thermoresistor ranges	-
Operational limit of resistance thermometer ranges with SFU	-
Destruction limit resistance thermometer inputs	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Destruction limit thermocouple inputs	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Internal temperature compensation	-
Technical unit of temperature measurement	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	2 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED

Order no.	**031-1BB70**
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 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	4
Output bytes	0
Parameter bytes	6
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.8.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	12h	80h	3100h	01h
CH1FN	1	Function number channel 1	12h	81h	3101h	02h

CHxFN Function number channel x

In the following there are the measuring ranges with function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S7 format (12h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

3.8.3 Diagnostic data

This module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

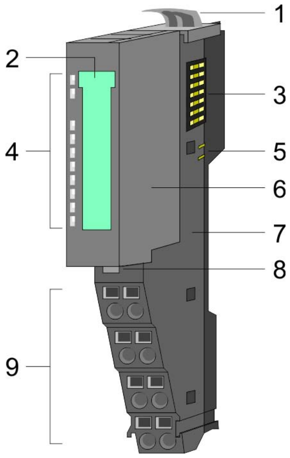
3.9 031-1BB90 - AI 2x16Bit TC

Properties

The electronic module has 2 inputs for temperature and voltage measuring with parameterizable functions. The channels of the module are isolated to the backplane bus.

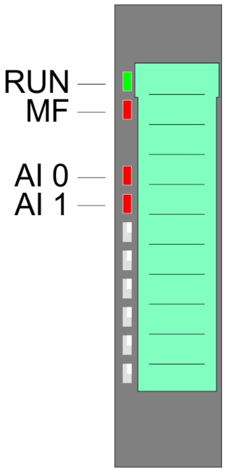
- 2 analog inputs
- Suited for sensors with type J, K, N, R, S, T, B, C, E, L and for voltage measuring ± 80mV
- Interrupt and diagnostics function
- 16bit resolution
- Internal temperature compensation
- High potential gradient of DC140V/AC60V between the inputs

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

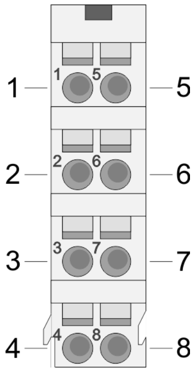
Status indication

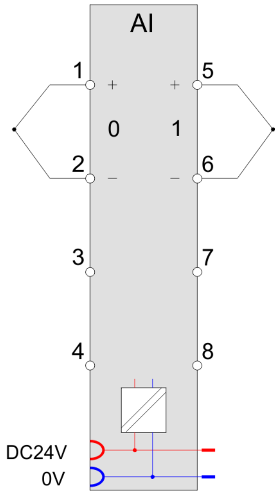


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ➪ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization ■ Wire break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+TC 0	I	+ Channel 0
2	-TC 0	I	Ground Channel 0
3	---	---	not connected
4	---	---	not connected
5	+TC 1	I	+ Channel 1
6	-TC 1	I	Ground Channel 1
7	---	---	not connected
8	---	---	not connected

I: Input

CAUTION!
Please consider that the electronic module AI 2x16Bit TC may exclusively be used together with the terminal module 001-0AA20!

Supplementation to the installation guidelines

To avoid variations in temperature within the module, which may affect the accuracy of the measurement, you should consider the following points when assembling:

- Do not arrange the module directly apart from a power module with a high feeding current.
- Do not install the module at the end of a line.
- The module should be in a static condition, i.e. the temperature should be as constant as possible in the environment of your module (closed switchgear cabinet free from air draught).
- The accuracy is reached after approx. 30 minutes after entering the static condition.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.9.1 Technical data

Order no.	031-1BB90
Type	SM 031
Module ID	0403 1543
Current consumption/power loss	
Current consumption from backplane bus	75 mA
Power loss	1.1 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	30 mA
Voltage inputs	-
Min. input resistance (voltage range)	10 MΩ
Input voltage ranges	-80 mV ... +80 mV
Operational limit of voltage ranges	±0.3%
Operational limit of voltage ranges with SFU	±0.1%
Basic error limit voltage ranges	±0.25%
Basic error limit voltage ranges with SFU	±0.05%
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-

Order no.	031-1BB90
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	✓
Thermocouple ranges	type B type C type E type J type K type L type N type R type S type T
Operational limit of thermocouple ranges	Type E, L, T, J, K, N: ±2.5K / Type B, C, R, S: ±8.0K
Operational limit of thermocouple ranges with SFU	Type E, L, T, J, K, N: ±1.5K / Type B, C, R, S: ±4.0K
Basic error limit thermoelement ranges	Type E, L, T, J, K, N: ±2.0K / Type B, C, R, S: ±7.0K
Basic error limit thermoelement ranges with SFU	Type E, L, T, J, K, N: ±1.0K / Type B, C, R, S: ±3.0K
Programmable temperature compensation	✓
External temperature compensation	✓
Internal temperature compensation	✓
Resolution in bit	16
Measurement principle	Sigma-Delta

Order no.	031-1BB90
Basic conversion time	4.2...324.1 ms (50 Hz) 3.8...270.5 ms (60 Hz) per channel
Noise suppression for frequency	>90dB at 50Hz (UCM<10V)
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
Module state	green LED
Module error display	red 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 140 V/ AC 60 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	4
Output bytes	0
Parameter bytes	22
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	

Order no.	031-1BB90
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

The indicated error limits are valid starting from the following temperatures:

- Thermoelement type T: -200 °C
- Thermoelement type K: -100 °C
- Thermoelement type B: +700 °C
- Thermoelement type N: -150 °C
- Thermoelement type E: -150 °C
- Thermoelement type R: +200 °C
- Thermoelement type S: +100 °C
- Thermoelement type J: -100 °C

3.9.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
WIBRK_EN	1	Wire break recognition*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
RES3	1	reserved*	00h	00h	3103h	04h
TEMPCNF	1	Temperature system	00h	01h	3104h	05h
SUPR	1	Interference frequency suppression	02h	01h	3105h	06h
CH0FN	1	Function number channel 0	C1h	80h	3106h	07h
CH0FO	1	Function option channel 0	02h	80h	3107h	08h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3108h... 3109h	09h
CH0LL	2	Lower limit value channel 0	8000h	80h	310Ah... 310Bh	0Ah
CH1FN	1	Function number channel 1	C1h	81h	310Ch	0Bh
CH1FO	1	Function option channel 1	02h	81h	310Dh	0Ch

Name	Bytes	Function	Default	DS	IX	SX
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Eh... 310Fh	0Dh
CH1LL	2	Lower limit value channel 1	8000h	81h	3110h... 3111h	0Eh

* This record set may only be transferred at STOP state.

DIAG_EN Diagnostic interrupt

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

WIBRK_EN Wire break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire break recognition channel 0 (1: on) ■ Bit 1: Wire break recognition channel 1 (1: on) ■ Bit 7 ... 2: reserved

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 7 ... 2: reserved

TEMPCNF Temperature system

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Temperature system – 00: °C – 01: °F – 10: K ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Interference frequency suppression – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module.

With FFh the corresponding channel is deactivated.

-80 ... 80mV

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
-80 ... 80mV Siemens S7 format (11h)	94.07mV	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{27648}$
	80mV	27648	6C00h	nominal range	
	0V	0	0000h		
	-80mV	-27648	9400h		
	-94.07mV	-32512	8100h	underrange	
-80 ... 80mV Siemens S7 format (21h)	100mV	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{16384}$
	80mV	16384	4000h	nominal range	
	0V	0	0000h		
	-80mV	-16384	C000h		
	-100mV	-20480	B000h	underrange	

Temperature

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
Type J: -210 ... +1200°C -346 ... 2192°F 63.2 ... 1473.2K (B0h: ext. comp. 0°C) (C0h: int. comp. 0°C)	+14500	26420	17232	overrange
	-2100 ... +12000	-3460 ... 21920	632 ... 14732	nominal range
	---	---	---	underrange
Type K: -270 ... +1372°C -454 ... 2501.6°F 0 ... 1645.2K (B1h: ext. comp. 0°C) (C1h: int. comp. 0°C)	+16220	29516	18952	overrange
	-2700 ... +13720	-4540 ... 25016	0 ... 16452	nominal range
	---	---	---	underrange
Type N: -270 ... +1300°C -454 ... 2372°F 0 ... 1573.2K (B2h: ext. comp. 0°C) (C2h: int. comp. 0°C)	+15500	28220	18232	overrange
	-2700 ... +13000	-4540 ... 23720	0 ... 15732	nominal range
	---	---	---	underrange
Type R: -50 ... +1769°C -58 ... 3216.2°F	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
223.2 ... 2042.2K (B3h: ext. comp. 0°C) (C3h: int. comp. 0°C)	-1700	-2740	1032	underrange
Type S: -50 ... +1769°C -58 ... 3216.2°F 223.2 ... 2042.2K (B4h: ext. comp. 0°C) (C4h: int. comp. 0°C)	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range
	-1700	-2740	1032	underrange
Type T: -270 ... +400°C -454 ... 752°F 3.2 ... 673.2K (B5h: ext. comp. 0°C) (C5h: int. comp. 0°C)	+5400	10040	8132	overrange
	-2700 ... +4000	-4540 ... 7520	32 ... 6732	nominal range
	---	---	---	underrange
Type B: 0 ... +1820°C 32 ... 2786.5°F 273.2 ... 2093.2K (B6h: ext. comp. 0°C) (C6h: int. comp. 0°C)	+20700	32766	23432	overrange
	0 ... +18200	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type C: 0 ... +2315°C 32 ... 2786.5°F 273.2 ... 2093.2K (B7h: ext. comp. 0°C) (C7h: int. comp. 0°C)	+25000	32766	23432	overrange
	0 ... +23150	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type E: -270 ... +1000°C -454 ... 1832°F 0 ... 1273.2K (B8h: ext. comp. 0°C) (C8h: int. comp. 0°C)	+12000	21920	14732	overrange
	-2700 ... +10000	-4540 ... 18320	0 ... 12732	nominal range
	---	---	---	underrange
Type L: -200 ... +900°C -328 ... 1652°F 73.2 ... 1173.2K (B9h: ext. comp. 0°C)	+11500	21020	14232	overrange

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
(C9h: int. comp. 0°C)	-2000 ... +9000	-3280 ... 16520	732 ... 11732	nominal range
	---	---	---	underrange

CHxFO Function option channel x

Depending on the Interference frequency suppression for each channel the transducer velocity may be set.

Code*	Velocity (in ms) / channel at interference frequency suppression	
	50Hz	60Hz
00h*	324.1	270.5
01h*	164.2	137.2
02h*	84.2	70.5
03h	44.1	37.2
04h	24.2	20.5
05h	14.2	12.2
06h	9.2	8.0
07h	6.6	5.9
08h	4.2	3.8
*) For Code 00h, 01h and 02h the tolerances of the technical data "with interference frequency suppression" are valid.		

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated.

As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.9.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/ param.	-	X	-
Wire break	-	X	X

Event	Process interrupt	Diagnostics interrupt	parameterizable
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram.

SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs-Ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	Bit 0: Limit overflow channel 0 Bit 1: Limit overflow channel 1 Bit 7 ... 2: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	Bit 0: Limit underflow channel 0 Bit 1: Limit underflow channel 1 Bit 7 ... 2: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	16bit µs value at the moment of the interrupt

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going)}$ the MF-LED of the module is on.

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
RES2	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR … CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error: Channel x: ■ Bit 0: set at project engineering/parameterization error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire break ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

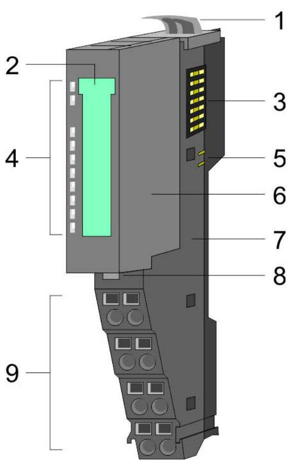
3.10 031-1BD30 - AI 4x12Bit 0...10V

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

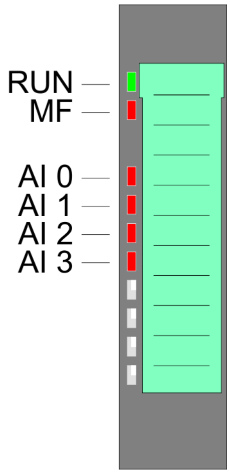
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

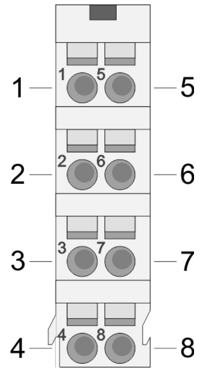
Status indication

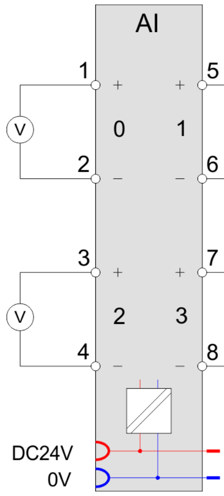


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.10.1 Technical data

Order no.	**031-1BD30**
Type	SM 031
Module ID	0404 15C4
Current consumption/power loss	
Current consumption from backplane bus	70 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.2%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-

Order no.	031-1BD30
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	4 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 2 V
Max. potential difference between Mana and Mintern (Uiso)	-

Order no.	031-1BD30
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	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.10.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	10h	80h	3100h	01h
CH1FN	1	Function number channel 1	10h	81h	3101h	02h
CH2FN	1	Function number channel 2	10h	82h	3102h	03h
CH3FN	1	Function number channel 3	10h	83h	3103h	04h

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

3.10.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h

Name	Bytes	Function	Default	DS	IX	SX
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

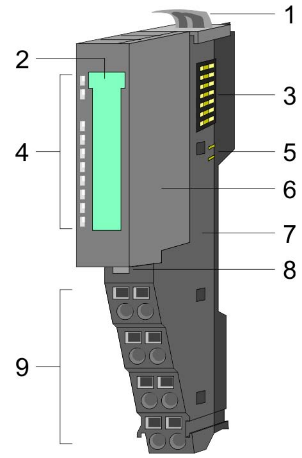
3.11 031-1BD40 - AI 4x12Bit 0(4)...20mA

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

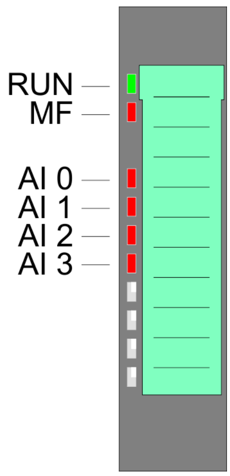
- 4 analog inputs
- Suited for sensors with 0 ... 20mA; 4 ... 20mA with external supply
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

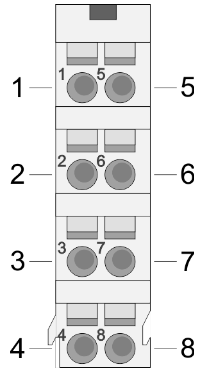
Status indication

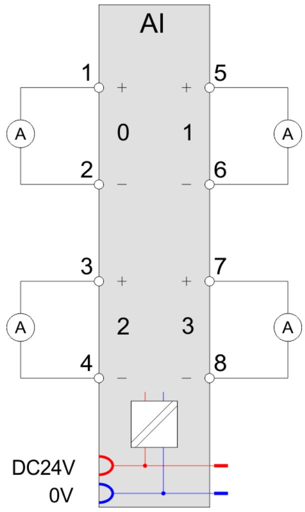


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





I: Input

Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

If a 2wire measuring transducer is used, you have to connect in line an external power supply.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules.

SX - Subindex for access via EtherCAT.

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Addr.	Name	Bytes	Function	IX	SX
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area

No byte of the output area is used by the module.

3.11.1 Technical data

Order no.	031-1BD40
Type	SM 031
Module ID	0405 15C4
Current consumption/power loss	
Current consumption from backplane bus	70 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	110 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.3% ... +/-0.5%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.2% ... +/-0.3%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-

Order no.	031-1BD40
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	4 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-

Order no.	031-1BD40
Between channels and backplane bus	✓
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	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.11.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	31h	80h	3100h	01h
CH1FN	1	Function number channel 1	31h	81h	3101h	02h
CH2FN	1	Function number channel 2	31h	82h	3102h	03h
CH3FN	1	Function number channel 3	31h	83h	3103h	04h

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

3.11.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR ... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs-Ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: reserved ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

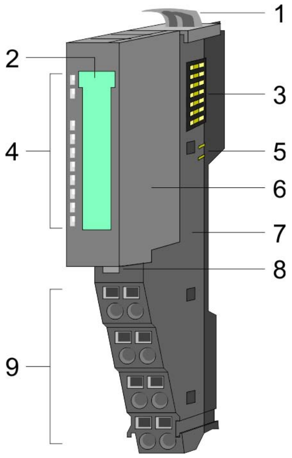
3.12 031-1BD70 - AI 4x12Bit ±10V

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

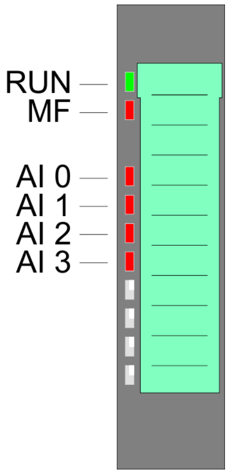
- 4 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

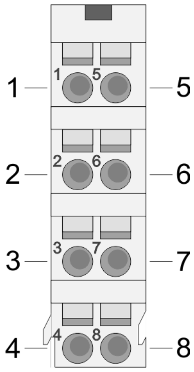
Status indication

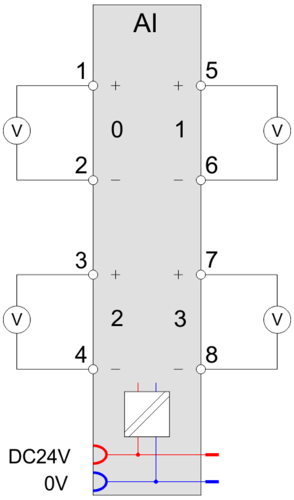


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.12.1 Technical data

Order no.	031-1BD70
Type	SM 031
Module ID	0409 15C4
Current consumption/power loss	
Current consumption from backplane bus	50 mA
Power loss	0.5 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	✓
Min. input resistance (voltage range)	100 kΩ
Input voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.2%
Basic error limit voltage ranges with SFU	-
Destruction limit current	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Radical error limit current ranges with SFU	-
Destruction limit current inputs (voltage)	-
Destruction limit current inputs (electrical current)	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-

Order no.	031-1BD70
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Destruction limit resistance inputs	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Operational limit of resistance thermometer ranges with SFU	-
Basic error limit thermoresistor ranges	-
Operational limit of resistance thermometer ranges with SFU	-
Destruction limit resistance thermometer inputs	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Destruction limit thermocouple inputs	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Internal temperature compensation	-
Technical unit of temperature measurement	-
Resolution in bit	12
Measurement principle	successive approximation
Basic conversion time	4 ms all channels
Noise suppression for frequency	>50dB at 50Hz (UCM<2V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes

Order no.	031-1BD70
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 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	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.12.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	12h	80h	3100h	01h
CH1FN	1	Function number channel 1	12h	81h	3101h	02h
CH2FN	1	Function number channel 2	12h	82h	3102h	03h
CH3FN	1	Function number channel 3	12h	83h	3103h	04h

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S7 format (12h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

3.12.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

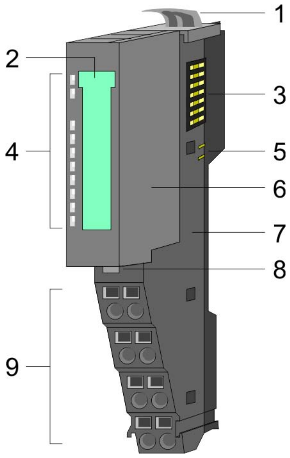
3.13 031-1BD80 - AI 4x16Bit R/RTD

Properties

The electronic module has 4 inputs for resistance measurement with parameterizable functions. The channels of the module are isolated to the backplane bus.

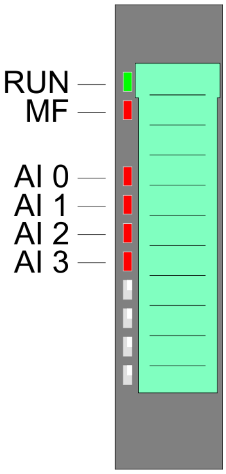
- 4 analog inputs
- Suited for resistance-type sensors 0 ... 3000Ω
  and resistance temperature sensors Pt100, Pt1000, NI100 and NI1000
- Resistance measurement with 2, 3 and 4 wire
  (3 and 4 wire only via channel 0 respectively 1)
- Interrupt and diagnostics function
- 16bit resolution

Structure



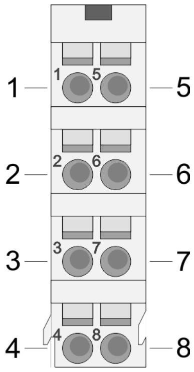
1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

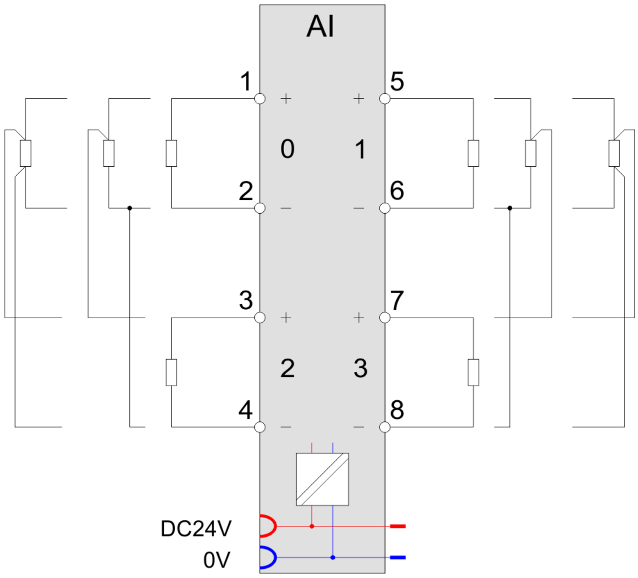


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization ■ Wire break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment



For wires with a cross section of 0.08mm² up to 1.5mm².



Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

2, 3, 4 wire measurement

At the pin assignment above you can see how the sensors are to be connected at 2, 3 respectively 4 wire measurement.

- With every channel a 2 wire measurement may be performed.
- 3 wire measurement is only possible via the channels 0 and 1.
  - Please consider with 3 wire measurement that the corresponding channel is always deactivated in the parametrization. The corresponding channel of channel 0 is channel 2 and of channel 1 is channel 3. Not used channels must always be deactivated in the parametrization.
- 4 wire measurement is only possible via the channels 0 and 1.
  - The measurement current for channel 0 is applied at pin 1 and 2. The measurement for channel 0 happens at pin 3 and 4. The analog value for channel 0 is represented in input word 0.
  - The measurement current for channel 1 is applied at pin 5 and 6. The measurement for channel 1 happens at pin 7 and 8. The analog value for channel 1 is represented in input word 1.
  - Please consider with 4 wire measurement that the corresponding channel is always deactivated in the parametrization. The corresponding channel of channel 0 is channel 2 and of channel 1 is channel 3. Not used channels must always be deactivated in the parametrization.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area

No byte of the output area is used by the module.

3.13.1 Technical data

Order no.	031-1BD80
Type	SM 031
Module ID	0406 1544
Current consumption/power loss	
Current consumption from backplane bus	75 mA

Order no.	031-1BD80
Power loss	1 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	30 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	✓
Resistance ranges	0 ... 60 Ohm 0 ... 600 Ohm 0 ... 3000 Ohm
Operational limit of resistor ranges	+/- 0.4 %
Operational limit of resistor ranges with SFU	-
Basic error limit	+/- 0.2 %
Basic error limit with SFU	-
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100 Pt1000 Ni100 Ni1000
Operational limit of resistance thermometer ranges	+/- 0.4 %
Basic error limit thermoresistor ranges	+/- 0.2 %

Order no.	**031-1BD80**
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	4.2...324.1 ms (50 Hz) 3.8...270.5 ms (60 Hz) per channel
Noise suppression for frequency	>80dB at 50Hz (UCM<6V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 6 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	-

Order no.	**031-1BD80**
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	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.13.2 Parameter data

DS - DS = Record set for access via CPU, PROFIBUS and PROFINET

IX - IX = Index for access via CANopen

SX - SX = Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics[1]	00h	00h	3100h	01h
WIBRK_EN	1	Wire break recognition[1]	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring[1]	00h	00h	3102h	03h
RES3	1	reserved	00h	00h	3103h	04h
TEMPCNF	1	Temperature system	00h	01h	3104h	05h
SUPR	1	Interference frequency suppression	02h	01h	3105h	06h

Name	Bytes	Function	Default	DS	IX	SX
CH0FN	1	Function number channel 0	50h	80h	3106h	07h
CH0FO	1	Function option channel 0	00h	80h	3107h	08h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3108h... 3109h	09h
CH0LL	2	Lower limit value channel 0	8000h	80h	310Ah... 310Bh	0Ah
CH1FN	1	Function number channel 1	50h	81h	310Ch	0Bh
CH1FO	1	Function option channel 1	00h	81h	310Dh	0Ch
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Eh... 310Fh	0Dh
CH1LL	2	Lower limit value channel 1	8000h	81h	3110h... 3111h	0Eh
CH2FN	1	Function number channel 2	50h[2]	82h	3112h	0Fh
CH2FO	1	Function option channel 2	00h	82h	3113h	10h
CH2UL	2	Upper limit value channel 2	7FFFh	82h	3114h... 3115h	11h
CH2LL	2	Lower limit value channel 2	8000h	82h	3116h... 3117h	12h
CH3FN	1	Function number channel 3	50h[2]	83h	3118h	13h
CH3FO	1	Function option channel 3	00h	83h	3119h	14h
CH3UL	2	Upper limit value channel 3	7FFFh	83h	311Ah... 311Bh	15h
CH3LL	2	Lower limit value channel 3	8000h	83h	311Ch... 311Dh	16h

1) This record set may only be transferred at STOP state.

2) with 2 channel operation FFh

DIAG_EN Diagnostic interrupt

Byte	Bit 7 ... 0
0	■ Diagnostic interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

WIBRK_EN Wire break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire break recognition channel 0 (1: on) ■ Bit 1: Wire break recognition channel 1 (1: on) ■ Bit 2: Wire break recognition channel 2 (1: on) ■ Bit 3: Wire break recognition channel 3 (1: on) ■ Bit 7 ... 4: reserved

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 2: Limit value monitoring channel 2 (1: on) ■ Bit 3: Limit value monitoring channel 3 (1: on) ■ Bit 7 ... 4: reserved

TEMPCNF Temperature system

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Temperature system – 00: °C – 01: °F – 10: K ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Interference frequency suppression – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated.

Measuring range (funct. no.)	Measuring value	Signal range	Range
2 wire: PT100 (50h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: PT1000 (51h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: NI100 (52h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: NI1000 (53h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: PT100 (58h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
3 wire: PT1000 (59h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
3 wire: NI100 (5Ah)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: NI1000 (5Bh)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: PT100 (60h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: PT1000 (61h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: NI100 (62h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: NI1000 (63h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: 0 ... 60Ω (70h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (71h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (72h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (78h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (79h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range

Measuring range (funct. no.)	Measuring value	Signal range	Range
	---	---	underrange
3 wire: 0 ... 3000Ω (7Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (80h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (81h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (82h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (90h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (91h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (92h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (98h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (99h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (9Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (A0h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω	---	---	overrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
(A1h)	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (A2h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (D0h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (D1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (D2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (D8h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (D9h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (DAh)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (E0h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (E1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (E2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange

CHxFO Function option channel x

Depending on the Interference frequency suppression for each channel the transducer velocity may be set.

Code*	Velocity (in ms) / channel at Interference frequency suppression	
	50Hz	60Hz
00h*	324.1	270.5
01h*	164.2	137.2
02h*	84.2	70.5
03h	44.1	37.2
04h	24.2	20.5
05h	14.2	12.2
06h	9.2	8.0
07h	6.6	5.9
08h	4.2	3.8
*) For Code 00h, 01h and 02h the tolerances of the technical data "with interference frequency suppression" are valid.		

CHxUL / CHxLL channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated.

As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.13.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/ param.	-	X	-
Wire break	-	X	X
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram.

SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs-Ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	Bit 0: Limit overflow channel 0 Bit 1: Limit overflow channel 1 Bit 7 ... 4: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	Bit 0: Limit underflow channel 0 Bit 1: Limit underflow channel 1 Bit 7 ... 4: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	16bit µs value at the moment of the interrupt

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going)}$ the MF-LED of the module is on.

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnose

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR/CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error: channel x: ■ Bit 0: set at error in project engineering/parameterization ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire break ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

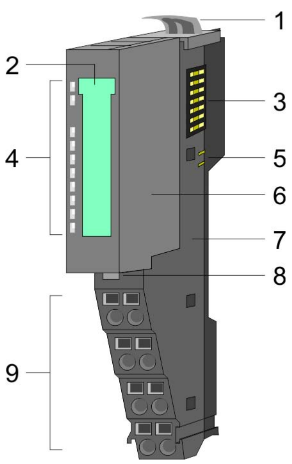
3.14 031-1CB30 - AI 2x16Bit 0...10V

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

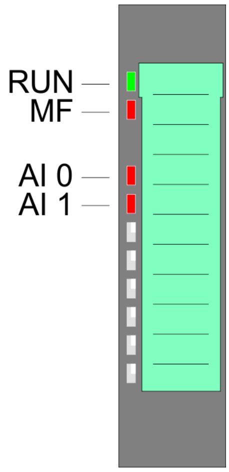
- 2 analog inputs
- Suited for sensors with 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

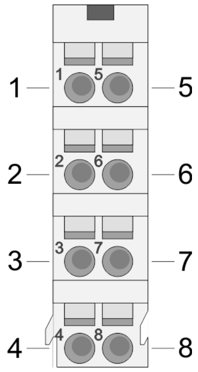
Status indication

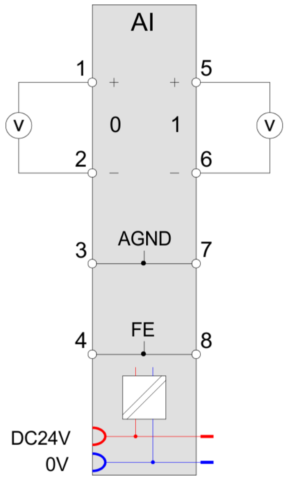


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	AGND	I	Reference potential for differential-mode input
4	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	AGND	I	Reference potential for differential-mode input
8	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area No byte of the output area is used by the module.

3.14.1 Technical data

Order no.	031-1CB30
Type	SM 031
Module ID	040A 1543
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	20 mA
Voltage inputs	✓
Min. input resistance (voltage range)	200 kΩ
Input voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.1%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-

Order no.	031-1CB30
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	240 µs all channels
Noise suppression for frequency	>80dB at 50Hz (UCM<9V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 9 V
Max. potential difference between Mana and Mintern (Uiso)	-

Order no.	**031-1CB30**
Max. potential difference between inputs and Mana (Ucm)	DC 1 V
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	4
Output bytes	0
Parameter bytes	20
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.14.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	10h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h

Name	Bytes	Function	Default	DS	IX	SX
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	10h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch
* This record set may only be transferred at STOP state.						

DIAG Diagnostics

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enable – 40h: disable

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 – 00: deaktiviert – 01: 60Hz – 10: 50Hz ■ Bit 3, 2: Interference frequency suppression channel 1 – 00: deaktiviert – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.14.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram. SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going}$) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR … CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

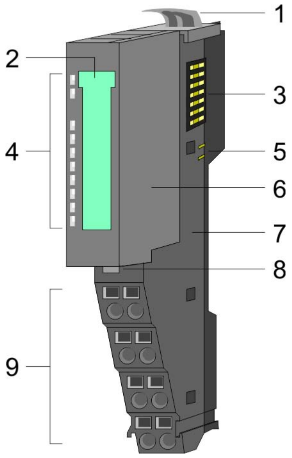
3.15 031-1CB40 - AI 2x16Bit 0(4)...20mA

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

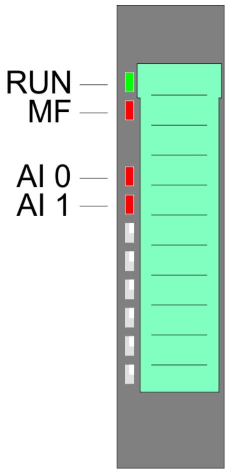
- 2 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

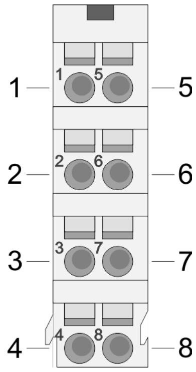
Status indication

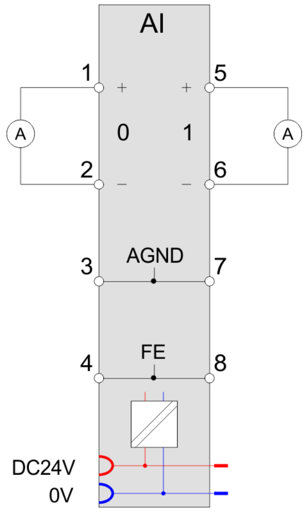


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	AGND	I	Reference potential for differential-mode input
4	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	AGND	I	Reference potential for differential-mode input
8	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)

I: Input

If a 2wire measuring transducer is used, you have to connect in line an external power supply.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - SX = Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s +1	02h

Output area No byte of the output area is used by the module.

3.15.1 Technical data

Order no.	031-1CB40
Type	SM 031
Module ID	040B 1543
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.7 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	15 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	60 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.1%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-

Order no.	031-1CB40
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	240 µs all channels
Noise suppression for frequency	>80dB (UCM<4V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-

Order no.	031-1CB40
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)	DC 3 V
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	4
Output bytes	0
Parameter bytes	20
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.15.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	31h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	31h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch

* This record set may only be transferred at STOP state.

DIAG_EN Diagnostic interrupt

Byte	Bit 7 ... 0
0	■ Diagnostic interrupt – 00h: enable – 40h: disable

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 – 00: deaktiviert – 01: 60Hz – 10: 50Hz ■ Bit 3, 2: Interference frequency suppression channel 1 – 00: deaktiviert – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.15.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram. SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

PRIT_US µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 232-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going}$) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

_ERR_A Diagnostic_

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

_ERR_D Diagnostic_

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

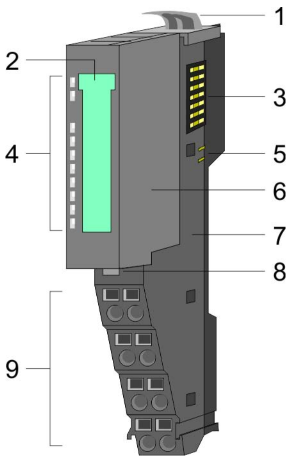
3.16 031-1CB70 - AI 2x16Bit ±10V

Properties

The electronic module has 2 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

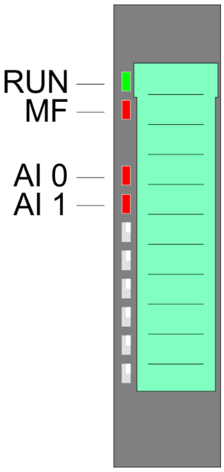
- 2 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

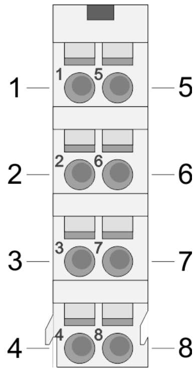
Status indication

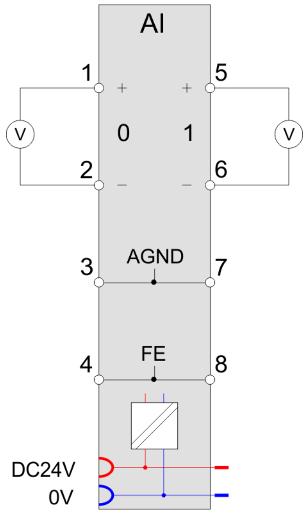


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	AGND	I	Reference potential for differential-mode input
4	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	AGND	I	Reference potential for differential-mode input
8	FE	I	Functional ground for cable shield (an additional shield bus carrier is not necessary)

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.16.1 Technical data

Order no.	031-1CB70
Type	SM 031
Module ID	040C 1543
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	20 mA
Voltage inputs	✓
Min. input resistance (voltage range)	200 kΩ
Input voltage ranges	-10 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.1%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-

Order no.	031-1CB70
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	240 µs all channels
Noise suppression for frequency	>80dB at 50Hz (UCM<9V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-

Order no.	**031-1CB70**
Between channels and backplane bus	✓
Between channels and power supply	✓
Max. potential difference between circuits	-
Max. potential difference between inputs (Ucm)	DC 9 V
Max. potential difference between Mana and Mintern (Uiso)	-
Max. potential difference between inputs and Mana (Ucm)	DC 1 V
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	4
Output bytes	0
Parameter bytes	20
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.16.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	12h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	12h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch

* This record set may only be transferred at STOP state.

DIAG_EN Diagnostics

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression Byte Bit 7 ... 0

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 – 00: deactivated – 01: 60Hz – 10: 50Hz ■ Bit 3, 2: Interference frequency suppression channel 1 – 00: deactivated – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S7 format (12h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

CHxUL / CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.16.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram.

SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 7 ... 2: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

µs-ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interrupt$_{incoming}$. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interrupt$_{going}$ automatically takes place. All events of a channel between diagnostic interrupt$_{incoming}$ and diagnostic interrupt$_{going}$ are not stored and get lost. Within this time window (1. diagnostic interrupt$_{incoming}$ until last diagnostic interrupt$_{going}$) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h

Name	Bytes	Function	Default	DS	IX	SX
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

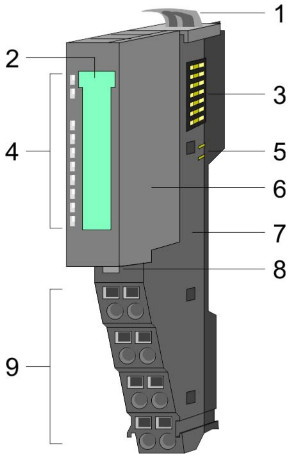
3.17 031-1CD30 - AI 4x16Bit 0...10V

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

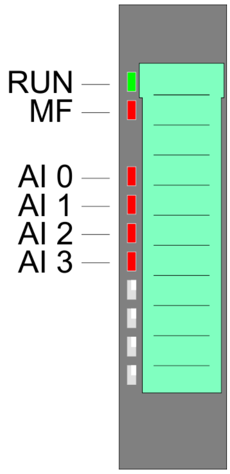
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

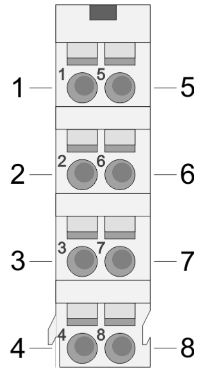
Status indication

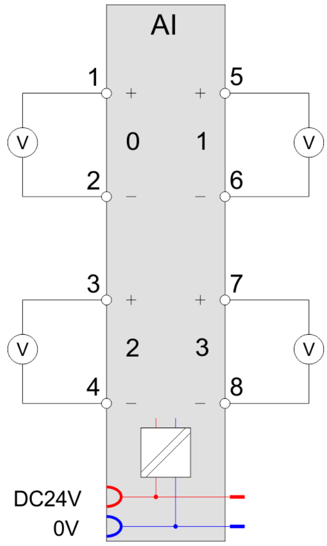


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.17.1 Technical data

Order no.	031-1CD30
Type	SM 031
Module ID	040D 1544
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.9 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	25 mA
Voltage inputs	✓
Min. input resistance (voltage range)	200 kΩ
Input voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.1%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-

Order no.	031-1CD30
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	480 µs all channels
Noise suppression for frequency	>80dB at 50Hz (UCM<9V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 9 V
Max. potential difference between Mana and Mintern (Uiso)	-

Order no.	031-1CD30
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	32
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.17.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	10h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h

Name	Bytes	Function	Default	DS	IX	SX
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	10h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch
CH2FN	1	Function number channel 2	10h	82h	3110h	0Dh
RES19	1	reserved	00h	82h	3111h	0Eh
CH2UL	2	Upper limit value channel 2	7FFFh	82h	3112h... 3113h	0Fh
CH2LL	2	Lower limit value channel 2	8000h	82h	3114h... 3115h	10h
CH3FN	1	Function number channel 3	10h	83h	3116h	11h
RES25	1	reserved	00h	83h	3117h	12h
CH3UL	2	Upper limit value channel 3	7FFFh	83h	3118h... 3119h	13h
CH3LL	2	Lower limit value channel 3	8000h	83h	311Ah... 311Bh	14h
* This record set may only be transferred at STOP state.						

DIAG_EN Diagnostic interrupt

Byte	Bit 7 ... 0
0	■ Diagnostic interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 2: Limit value monitoring channel 2 (1: on) ■ Bit 3: Limit value monitoring channel 3 (1: on) ■ Bit 7 ... 4: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 ■ Bit 3, 2: Interference frequency suppression channel 1 ■ Bit 5, 4: Interference frequency suppression channel 2 ■ Bit 7, 6: Interference frequency suppression channel 3 – 00: deactivated – 01: 60Hz – 10: 50Hz e.g.: 10101010: all channels frequency suppression 50Hz

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.17.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameteriz-able
Error in project engineering/parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram. SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 2: Limit overflow channel 2 ■ Bit 3: Limit overflow channel 3 ■ Bit 7 ... 4: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 2: Limit underflow channel 2 ■ Bit 3: Limit underflow channel 3 ■ Bit 7 ... 4: reserved

_PRIT_US µs ticker_

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interruptincoming. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interruptgoing automatically takes place. All events of a channel between diagnostic interruptincoming and diagnostic interruptgoing are not stored and get lost. Within this time window (1. diagnostic interruptincoming until last diagnostic interruptgoing) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh

Name	Bytes	Function	Default	DS	IX	SX
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

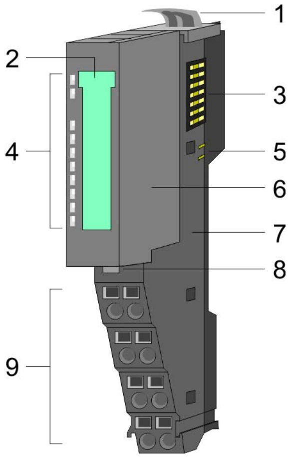
3.18 031-1CD35 - AI 4x16Bit 0...10V

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

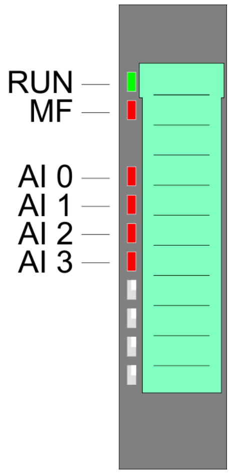
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

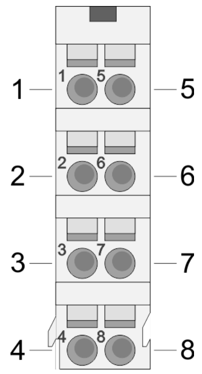
Status indication

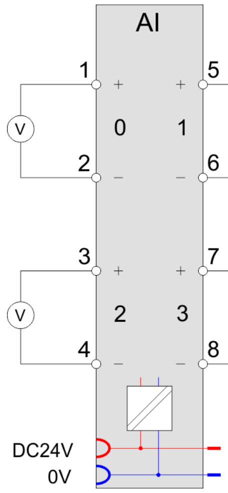


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.18.1 Technical data

Order no.	031-1CD35
Type	SM 031
Module ID	0413 15C4
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.9 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	25 mA
Voltage inputs	✓
Min. input resistance (voltage range)	200 kΩ
Input voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.1%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-

Order no.	031-1CD35
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	480 µs all channels
Noise suppression for frequency	>80dB at 50Hz (UCM<9V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 9 V
Max. potential difference between Mana and Mintern (Uiso)	-

Order no.	031-1CD35
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	9
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	in preparation

3.18.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
SUPR	1	Interference frequency suppression	00h	01h	3100h	01h
CH0FN	1	Function number channel 0	10h	80h	3101h	02h
CH1FN	1	Function number channel 1	10h	81h	3102h	03h
CH2FN	1	Function number channel 2	10h	82h	3103h	04h
CH3FN	1	Function number channel 3	10h	83h	3104h	05h

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 ■ Bit 3, 2: Interference frequency suppression channel 1 ■ Bit 5, 4: Interference frequency suppression channel 2 ■ Bit 7, 6: Interference frequency suppression channel 3 – 00: deactivated – 01: 60Hz – 10: 50Hz e.g.: 10101010: all channels frequency suppression 50Hz

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

3.18.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

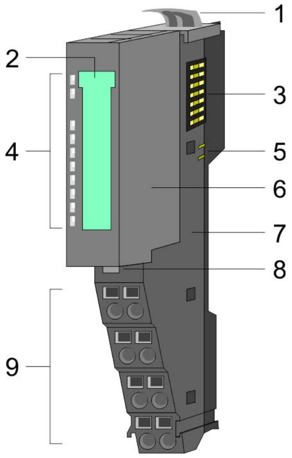
3.19 031-1CD40 - AI 4x16Bit 0(4)...20mA

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

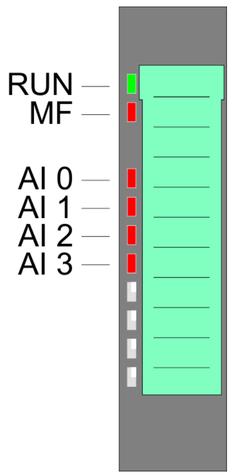
- 4 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

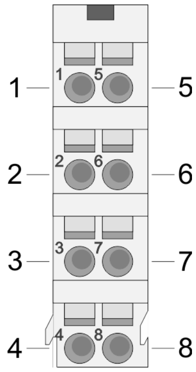
Status indication

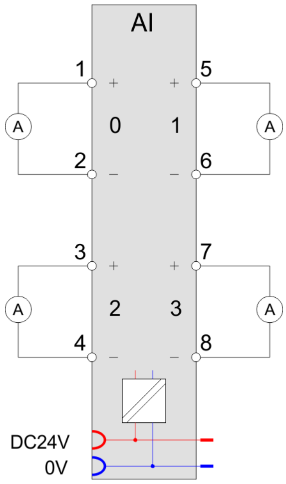


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

If a 2wire measuring transducer is used, you have to connect in line an external power supply.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Addr.	Name	Bytes	Function	IX	SX
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.19.1 Technical data

Order no.	031-1CD40
Type	SM 031
Module ID	0412 1544
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	20 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	60 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.1%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-

Order no.	031-1CD40
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	240 µs all channels
Noise suppression for frequency	>80dB (UCM<4V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-

Order no.	**031-1CD40**
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	32
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.19.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	10h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	10h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch
CH2FN	1	Function number channel 2	10h	82h	3110h	0Dh
RES19	1	reserved	00h	82h	3111h	0Eh
CH2UL	2	Upper limit value channel 2	7FFFh	82h	3112h... 3113h	0Fh
CH2LL	2	Lower limit value channel 2	8000h	82h	3114h... 3115h	10h
CH3FN	1	Function number channel 3	10h	83h	3116h	11h
RES25	1	reserved	00h	83h	3117h	12h
CH3UL	2	Upper limit value channel 3	7FFFh	83h	3118h... 3119h	13h
CH3LL	2	Lower limit value channel 3	8000h	83h	311Ah... 311Bh	14h
* This record set may only be transferred at STOP state.						

DIAG_EN Diagnostics

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 2: Limit value monitoring channel 2 (1: on) ■ Bit 3: Limit value monitoring channel 3 (1: on) ■ Bit 7 ... 4: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 ■ Bit 3, 2: Interference frequency suppression channel 1 ■ Bit 5, 4: Interference frequency suppression channel 2 ■ Bit 7, 6: Interference frequency suppression channel 3 – 00: deactivated – 01: 60Hz – 10: 50Hz e.g.: 10101010: all channels frequency suppression 50Hz

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.19.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameteriz-able
Error in project engineering/parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X

Event	Process interrupt	Diagnostics interrupt	parameteriz- able
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram. SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 2: Limit overflow channel 2 ■ Bit 3: Limit overflow channel 3 ■ Bit 7 ... 4: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 2: Limit underflow channel 2 ■ Bit 3: Limit underflow channel 3 ■ Bit 7 ... 4: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interruptincoming. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interruptgoing automatically takes place. All events of a channel between diagnostic interruptincoming and diagnostic interruptgoing are not stored and get lost. Within this time window (1. diagnostic interruptincoming until last diagnostic interruptgoing) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

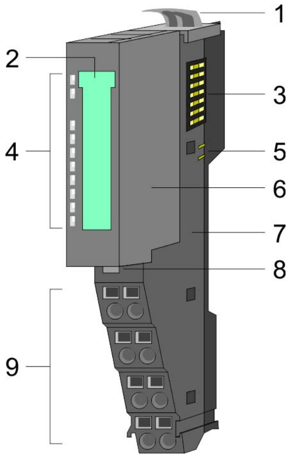
3.20 031-1CD45 - AI 4x16Bit 0(4)...20mA

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the backplane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

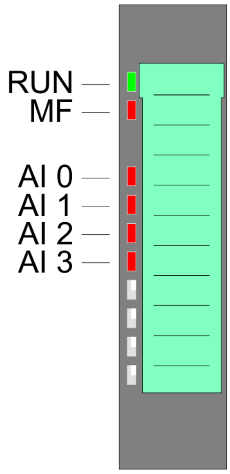
- 4 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

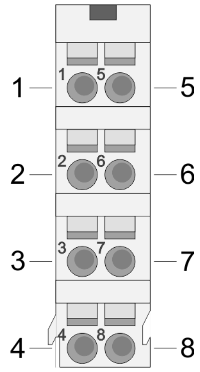
Status indication

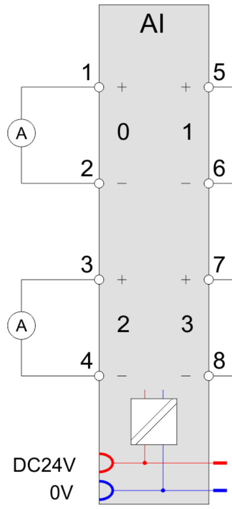


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ♦ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

If a 2wire measuring transducer is used, you have to connect in line an external power supply.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Addr.	Name	Bytes	Function	IX	SX
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area No byte of the output area is used by the module.

3.20.1 Technical data

Order no.	031-1CD45
Type	SM 031
Module ID	0414 15C4
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	20 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	✓
Max. input resistance (current range)	60 Ω
Input current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2%
Operational limit of current ranges with SFU	-
Basic error limit current ranges	+/-0.1%
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-

Order no.	031-1CD45
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	240 µs all channels
Noise suppression for frequency	>80dB (UCM<4V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel
Isolation	
Between channels	-
Between channels of groups to	-

Order no.	031-1CD45
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	9
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	in preparation

3.20.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
SUPR	1	Interference frequency suppression	00h	01h	3100h	01h
CH0FN	1	Function number channel 0	10h	80h	3101h	02h
CH1FN	1	Function number channel 1	10h	81h	3102h	03h
CH2FN	1	Function number channel 2	10h	82h	3103h	04h
CH3FN	1	Function number channel 3	10h	83h	3104h	05h

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 ■ Bit 3, 2: Interference frequency suppression channel 1 ■ Bit 5, 4: Interference frequency suppression channel 2 ■ Bit 7, 6: Interference frequency suppression channel 3 – 00: deactivated – 01: 60Hz – 10: 50Hz e.g.: 10101010: all channels frequency suppression 50Hz

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0(4) ... 20mA

Meas. range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{27648}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	-3.52mA	-4864	ED00h	underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{16384}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	-4,00mA	-3277	F333h	underrange	
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$D = 27648 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{27648} + 4$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	1.19mA	-4864	ED00h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$D = 16384 \cdot \frac{I-4}{16}$ $I = D \cdot \frac{16}{16384} + 4$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0.8mA	-3277	F333h	underrange	

3.20.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 5 ... 1: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

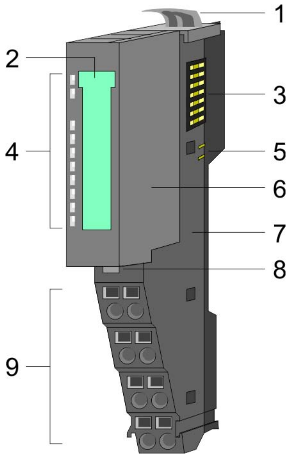
3.21 031-1CD70 - AI 4x16Bit ±10V

Properties

The electronic module has 4 inputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

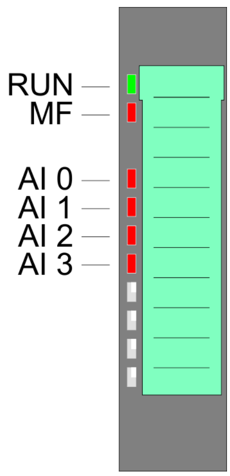
- 4 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

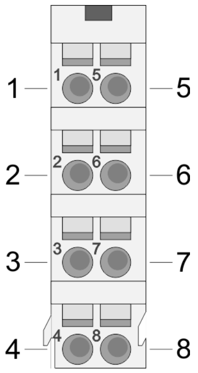


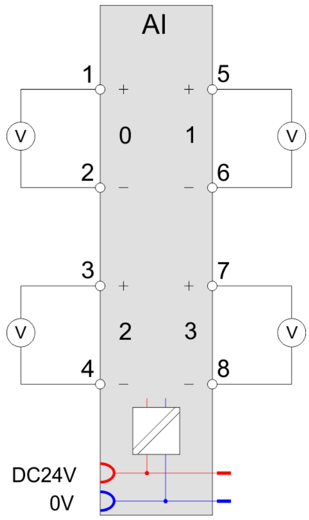
RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply

RUN	MF	AI x	Description
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area

No byte of the output area is used by the module.

3.21.1 Technical data

Order no.	**031-1CD70**
Type	SM 031
Module ID	040E 1544
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.9 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	25 mA
Voltage inputs	✓
Min. input resistance (voltage range)	200 kΩ
Input voltage ranges	-10 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	+/-0.1%
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-

Order no.	031-1CD70
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
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	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	successive approximation
Basic conversion time	480 µs all channels
Noise suppression for frequency	>80dB at 50Hz (UCM<35V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red LED
Channel error display	red LED per channel

Order no.	031-1CD70
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 9 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	32
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.21.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
RES1	1	reserved*	00h	00h	3101h	02h
LIMIT_EN	1	Limit value monitoring*	00h	00h	3102h	03h
SUPR	1	Interference frequency suppression	00h	01h	3103h	04h
CH0FN	1	Function number channel 0	10h	80h	3104h	05h
RES7	1	reserved	00h	80h	3105h	06h
CH0UL	2	Upper limit value channel 0	7FFFh	80h	3106h... 3107h	07h
CH0LL	2	Lower limit value channel 0	8000h	80h	3108h... 3109h	08h
CH1FN	1	Function number channel 1	10h	81h	310Ah	09h
RES13	1	reserved	00h	81h	310Bh	0Ah
CH1UL	2	Upper limit value channel 1	7FFFh	81h	310Ch... 310Dh	0Bh
CH1LL	2	Lower limit value channel 1	8000h	81h	310Eh... 310Fh	0Ch
CH2FN	1	Function number channel 2	10h	82h	3110h	0Dh
RES19	1	reserved	00h	82h	3111h	0Eh
CH2UL	2	Upper limit value channel 2	7FFFh	82h	3112h... 3113h	0Fh
CH2LL	2	Lower limit value channel 2	8000h	82h	3114h... 3115h	10h
CH3FN	1	Function number channel 3	10h	83h	3116h	11h
RES25	1	reserved	00h	83h	3117h	12h
CH3UL	2	Upper limit value channel 3	7FFFh	83h	3118h... 3119h	13h
CH3LL	2	Lower limit value channel 3	8000h	83h	311Ah... 311Bh	14h
* This record set may only be transferred at STOP state.						

DIAG_EN Diagnostics

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

LIMIT_EN Limit value monitoring

Byte	Bit 7 ... 0
0	■ Bit 0: Limit value monitoring channel 0 (1: on) ■ Bit 1: Limit value monitoring channel 1 (1: on) ■ Bit 2: Limit value monitoring channel 2 (1: on) ■ Bit 3: Limit value monitoring channel 3 (1: on) ■ Bit 7 ... 4: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression channel 0 ■ Bit 3, 2: Interference frequency suppression channel 1 ■ Bit 5, 4: Interference frequency suppression channel 2 ■ Bit 7, 6: Interference frequency suppression channel 3 – 00: deactivated – 01: 60Hz – 10: 50Hz e.g.: 10101010: all channels frequency suppression 50Hz

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S7 format (12h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11.76V	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{27648}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-1.76V	-4864	ED00h	underrange	
0 ... 10V Siemens S5 format (20h)	12.5V	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{10}$ $U = D \cdot \frac{10}{16384}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-2V	-3277	F333h	underrange	

CHxUL CHxLL Upper limit value Lower limit value channel x

For each channel an *upper* and a *lower limit* may be defined. Here only values of the nominal range may be preset, otherwise you receive a parameterization error. By presetting 7FFFh for the upper respectively 8000h for the lower limit value the corresponding limit is deactivated. As soon as the measuring value is beyond the limits and the limit value monitoring is activated, a process interrupt is initialized.

3.21.3 Diagnostics and interrupt

Event	Process interrupt	Diagnostics interrupt	parameterizable
Error in project engineering/ parameterization	-	X	-
Measuring range overflow	-	X	-
Measuring range underflow	-	X	-
Limit overflow	X	-	X
Limit underflow	X	-	X
Diagnostic buffer overflow	-	X	-
Communication error	-	X	-
Process interrupt lost	-	X	-

Process interrupt

So you may react to asynchronous events, there is the possibility to activate a process interrupt. A process interrupt interrupts the linear program sequence and jumps depending on the master system to a corresponding Interrupt routine. Here you can react to the process interrupt accordingly.

With CANopen the process interrupt data a transferred via an emergency telegram. Operating with CPU, PROFIBUS and PROFINET the process interrupt data were transferred via diagnostics telegram.

SX = Subindex for access via EtherCAT.

Name	Bytes	Function	Default	SX
PRIT_OL	1	Limit overflow channel x	00h	02h
PRIT_UL	1	Limit underflow channel x	00h	03h
PRIT_US	2	µs ticker	00h	04h ... 05h

PRIT_OL Limit overflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit overflow channel 0 ■ Bit 1: Limit overflow channel 1 ■ Bit 2: Limit overflow channel 2 ■ Bit 3: Limit overflow channel 3 ■ Bit 7 ... 4: reserved

PRIT_UL Limit underflow

Byte	Bit 7 ... 0
0	■ Bit 0: Limit underflow channel 0 ■ Bit 1: Limit underflow channel 1 ■ Bit 2: Limit underflow channel 2 ■ Bit 3: Limit underflow channel 3 ■ Bit 7 ... 4: reserved

PRIT_US µs ticker

Byte	Bit 7 ... 0
0 ... 1	Value of the µs ticker at the moment of the diagnostic.

µs ticker

In the SLIO module there is a 32 bit timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again. PRIT_US represents the lower 2 byte of the µs ticker value (0 ... 2^{16}-1).

Diagnostic data

Via the parameterization you may activate a diagnostic interrupt for the module. With a diagnostics interrupt the module serves for diagnostics data for diagnostic interruptincoming. As soon as the reason for releasing a diagnostic interrupt is no longer present, the diagnostic interruptgoing automatically takes place. All events of a channel between diagnostic interruptincoming and diagnostic interruptgoing are not stored and get lost. Within this time window (1. diagnostic interruptincoming until last diagnostic interruptgoing) the MF-LED of the module is on.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

- Process interrupt lost
- Power supply failed

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 5: reserved ■ Bit 6: set at process interrupt lost ■ Bit 7: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 4 ... 1: reserved ■ Bit 5: set at process interrupt lost ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

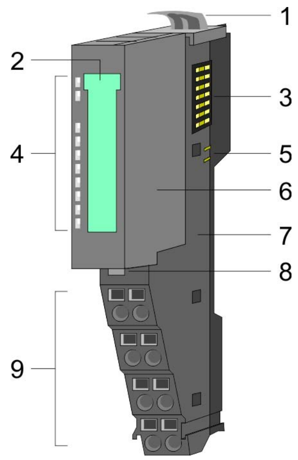
3.22 031-1LB90 - AI 2x16Bit TC

Properties

The electronic module has 2 inputs for temperature and voltage measuring with parameterizable functions. The channels of the module are isolated to the backplane bus.

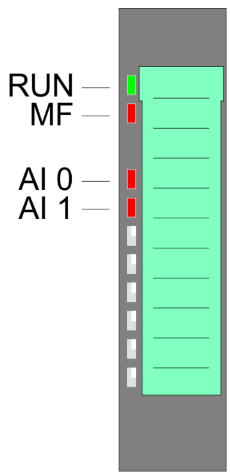
- 2 analog inputs
- Suited for sensors with type J, K, N, R, S, T, B, C, E, L and for voltage measuring ± 80mV
- Diagnostics function
- 16bit resolution
- Internal temperature compensation
- High potential gradient of DC140V/AC60V between the inputs

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

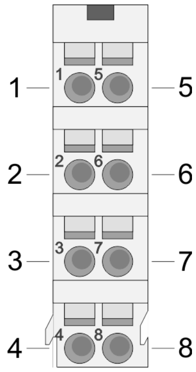


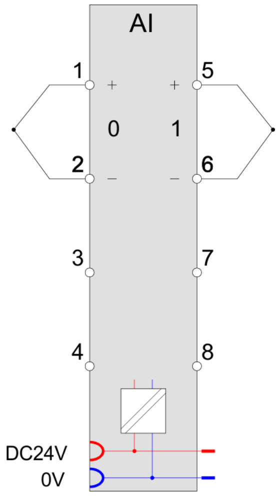
RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply

RUN	MF	AI x	Description
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization ■ Wire break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm^2 up to 1.5mm^2.





Pos.	Function	Type	Description
1	+TC 0	I	+ Channel 0
2	-TC 0	I	Ground Channel 0
3	---	---	not connected
4	---	---	not connected
5	+TC 1	I	+ Channel 1
6	-TC 1	I	Ground Channel 1
7	---	---	not connected
8	---	---	not connected

I: Input

CAUTION!
Please consider that the electronic module AI 2x16Bit TC may exclusively be used together with the terminal module 001-0AA20!

Supplementation to the installation guidelines

To avoid variations in temperature within the module, which may affect the accuracy of the measurement, you should consider the following points when assembling:

- Do not arrange the module directly apart from a power module with a high feeding current.
- Do not install the module at the end of a line.
- The module should be in a static condition, i.e. the temperature should be as constant as possible in the environment of your module (closed switchgear cabinet free from air draught).
- The accuracy is reached after approx. 30 minutes after entering the static condition.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h

Output area

No byte of the output area is used by the module.

3.22.1 Technical data

Order no.	031-1LB90
Type	SM 031
Module ID	040F 1543
Current consumption/power loss	
Current consumption from backplane bus	55 mA
Power loss	1 W
Technical data analog inputs	
Number of inputs	2
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	30 mA
Voltage inputs	-
Min. input resistance (voltage range)	10 MΩ
Input voltage ranges	-80 mV ... +80 mV

Order no.	**031-1LB90**
Operational limit of voltage ranges	±0.3%
Operational limit of voltage ranges with SFU	±0.1%
Basic error limit voltage ranges	±0.25%
Basic error limit voltage ranges with SFU	±0.05%
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	-
Resistance ranges	-
Operational limit of resistor ranges	-
Operational limit of resistor ranges with SFU	-
Basic error limit	-
Basic error limit with SFU	-
Resistance thermometer inputs	-
Resistance thermometer ranges	-
Operational limit of resistance thermometer ranges	-
Basic error limit thermoresistor ranges	-
Thermocouple inputs	✓
Thermocouple ranges	type B type C type E type J type K type L type N type R type S type T
Operational limit of thermocouple ranges	Type E, L, T, J, K, N: ±2.5K / Type B, C, R, S: ±8.0K
Operational limit of thermocouple ranges with SFU	Type E, L, T, J, K, N: ±1.5K / Type B, C, R, S: ±4.0K

Order no.	031-1LB90
Basic error limit thermoelement ranges	Type E, L, T, J, K, N: ±2.0K / Type B, C, R, S: ±7.0K
Basic error limit thermoelement ranges with SFU	Type E, L, T, J, K, N: ±1.0K / Type B, C, R, S: ±3.0K
Programmable temperature compensation	✓
External temperature compensation	✓
Internal temperature compensation	✓
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	84.2 ms (50 Hz) 70.5 ms (60 Hz) per channel
Noise suppression for frequency	>90dB at 50Hz (UCM<10V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 140 V/ AC 60 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	

Order no.	031-1LB90
Input bytes	4
Output bytes	0
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

The indicated error limits are valid starting from the following temperatures:

- Thermoelement type T: -200 °C
- Thermoelement type K: -100 °C
- Thermoelement type B: +700 °C
- Thermoelement type N: -150 °C
- Thermoelement type E: -150 °C
- Thermoelement type R: +200 °C
- Thermoelement type S: +100 °C
- Thermoelement type J: -100 °C

3.22.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG_EN	1	Diagnostics*	00h	00h	3100h	01h
WIBRK_EN	1	Wire break recognition*	00h	00h	3101h	02h
TEMPCNF	1	Temperature system	00h	01h	3102h	03h
SUPR	1	Interference frequency suppression	02h	01h	3103h	04h
CH0FN	1	Function number channel 0	C1h	80h	3104h	05h

Name	Bytes	Function	Default	DS	IX	SX
CH1FN	1	Function number channel 1	C1h	81h	3105h	06h

* This record set may only be transferred at STOP state.

DIAG_EN Diagnostics

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

WIBRK_EN Wire break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire break recognition channel 0 (1: on) ■ Bit 1: Wire break recognition channel 1 (1: on) ■ Bit 7 ... 2: reserved

TEMPCNF Temperature system

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Temperature system – 00: °C – 01: °F – 10: K ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 0, 1: Interference frequency suppression – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated.

-80 ... 80mV

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
-80 ... 80mV Siemens S7 format (11h)	94.07mV	32511	7EFFh	overrange	$D = 27648 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{27648}$
	80mV	27648	6C00h	nominal range	
	0V	0	0000h		
	-80mV	-27648	9400h		
	-94.07mV	-32512	8100h	underrange	

Meas. range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
-80 ... 80mV Siemens S7 format (21h)	100mV	20480	5000h	overrange	$D = 16384 \cdot \frac{U}{80}$ $U = D \cdot \frac{80}{16384}$
	80mV	16384	4000h	nominal range	
	0V	0	0000h		
	-80mV	-16384	C000h		
	-100mV	-20480	B000h	underrange	

Temperature

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
Type J: -210 ... +1200°C -346 ... 2192°F 63.2 ... 1473.2K (B0h: ext. comp. 0°C) (C0h: int. comp. 0°C)	+14500	26420	17232	overrange
	-2100 ... +12000	-3460 ... 21920	632 ... 14732	nominal range
	---	---	---	underrange
Type K: -270 ... +1372°C -454 ... 2501.6°F 0 ... 1645.2K (B1h: ext. comp. 0°C) (C1h: int. comp. 0°C)	+16220	29516	18952	overrange
	-2700 ... +13720	-4540 ... 25016	0 ... 16452	nominal range
	---	---	---	underrange
Type N: -270 ... +1300°C -454 ... 2372°F 0 ... 1573.2K (B2h: ext. comp. 0°C) (C2h: int. comp. 0°C)	+15500	28220	18232	overrange
	-2700 ... +13000	-4540 ... 23720	0 ... 15732	nominal range
	---	---	---	underrange
Type R: -50 ... +1769°C -58 ... 3216.2°F 223.2 ... 2042.2K (B3h: ext. comp. 0°C) (C3h: int. comp. 0°C)	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range
	-1700	-2740	1032	underrange
Type S: -50 ... +1769°C -58 ... 3216.2°F 223.2 ... 2042.2K	+20190	32766	22922	overrange
	-500 ... +17690	-580 ... 32162	2232 ... 20422	nominal range

Measuring range (funct. no.)	Measuring value in °C (0.1°C/digit)	Measuring value in °F (0.1°F/digit)	Measuring value in K (0.1K/digit)	Range
(B4h: ext. comp. 0°C) (C4h: int. comp. 0°C)	-1700	-2740	1032	underrange
Type T: -270 ... +400°C -454 ... 752°F 3.2 ... 673.2K (B5h: ext. comp. 0°C) (C5h: int. comp. 0°C)	+5400	10040	8132	overrange
	-2700 ... +4000	-4540 ... 7520	32 ... 6732	nominal range
	---	---	---	underrange
Type B: 0 ... +1820°C 32 ... 2786.5°F 273.2 ... 2093.2K (B6h: ext. comp. 0°C) (C6h: int. comp. 0°C)	+20700	32766	23432	overrange
	0 ... +18200	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type C: 0 ... +2315°C 32 ... 2786.5°F 273.2 ... 2093.2K (B7h: ext. comp. 0°C) (C7h: int. comp. 0°C)	+25000	32766	23432	overrange
	0 ... +23150	320 ... 27865	2732 ... 20932	nominal range
	-1200	-1840	1532	underrange
Type E: -270 ... +1000°C -454 ... 1832°F 0 ... 1273.2K (B8h: ext. comp. 0°C) (C8h: int. comp. 0°C)	+12000	21920	14732	overrange
	-2700 ... +10000	-4540 ... 18320	0 ... 12732	nominal range
	---	---	---	underrange
Type L: -200 ... +900°C -328 ... 1652°F 73.2 ... 1173.2K (B9h: ext. comp. 0°C) (C9h: int. comp. 0°C)	+11500	21020	14232	overrange
	-2000 ... +9000	-3280 ... 16520	732 ... 11732	nominal range
	---	---	---	underrange

3.22.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
RES2	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error: Channel x: ■ Bit 0: set at project engineering/parameterization error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire break ■ Bit 5: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

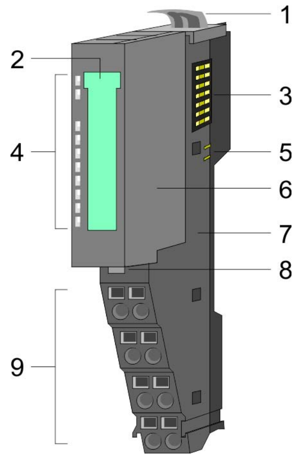
3.23 031-1LD80 - AI 4x16Bit R/RTD

Properties

The electronic module has 4 inputs for resistance measurement with parameterizable functions. The channels of the module are isolated to the backplane bus.

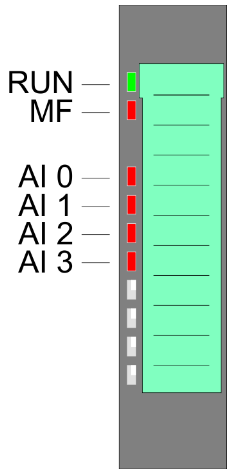
- 4 analog inputs
- Suited for resistance-type sensors 0 ... 3000Ω and resistance temperature sensors Pt100, Pt1000, NI100 and NI1000
- Resistance measurement with 2, 3 and 4 wire (3 and 4 wire only via channel 0 respectively 1)
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

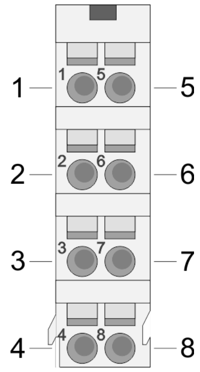
Status indication

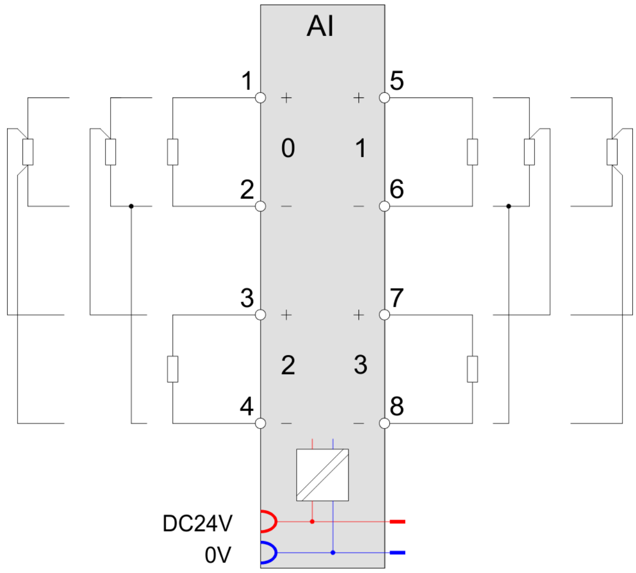


RUN	MF	AI x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Signal leaves measuring range ■ Error in parameterization ■ Wire break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	+AI 0	I	+ Channel 0
2	-AI 0	I	Ground Channel 0
3	+AI 2	I	+ Channel 2
4	-AI 2	I	Ground Channel 2
5	+AI 1	I	+ Channel 1
6	-AI 1	I	Ground Channel 1
7	+AI 3	I	+ Channel 3
8	-AI 3	I	Ground Channel 3

I: Input

2, 3, 4 wire measurement

At the pin assignment above you can see how the sensors are to be connected at 2, 3 respectively 4 wire measurement.

- With every channel a 2 wire measurement may be performed.
- 3 wire measurement is only possible via the channels 0 and 1.
  - Please consider with 3 wire measurement that the corresponding channel is always deactivated in the parametrization. The corresponding channel of channel 0 is channel 2 and of channel 1 is channel 3. Not used channels must always be deactivated in the parametrization.
- 4 wire measurement is only possible via the channels 0 and 1.
  - The measurement current for channel 0 is applied at pin 1 and 2. The measurement for channel 0 happens at pin 3 and 4. The analog value for channel 0 is represented in input word 0.
  - The measurement current for channel 1 is applied at pin 5 and 6. The measurement for channel 1 happens at pin 7 and 8. The analog value for channel 1 is represented in input word 1.
  - Please consider with 4 wire measurement that the corresponding channel is always deactivated in the parametrization. The corresponding channel of channel 0 is channel 2 and of channel 1 is channel 3. Not used channels must always be deactivated in the parametrization.

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

Addr.	Name	Bytes	Function	IX	SX
+0	AI 0	2	Analog value channel 0	6401h/s	01h
+2	AI 1	2	Analog value channel 1	6401h/s+1	02h
+4	AI 2	2	Analog value channel 2	6401h/s+2	03h
+6	AI 3	2	Analog value channel 3	6401h/s+3	04h

Output area

No byte of the output area is used by the module.

3.23.1 Technical data

Order no.	031-1LD80
Type	SM 031
Module ID	0410 1544
Current consumption/power loss	
Current consumption from backplane bus	55 mA

Order no.	**031-1LD80**
Power loss	1 W
Technical data analog inputs	
Number of inputs	4
Cable length, shielded	200 m
Rated load voltage	DC 24 V
Current consumption from load voltage L+ (without load)	30 mA
Voltage inputs	-
Min. input resistance (voltage range)	-
Input voltage ranges	-
Operational limit of voltage ranges	-
Operational limit of voltage ranges with SFU	-
Basic error limit voltage ranges	-
Basic error limit voltage ranges with SFU	-
Current inputs	-
Max. input resistance (current range)	-
Input current ranges	-
Operational limit of current ranges	-
Operational limit of current ranges with SFU	-
Basic error limit current ranges	-
Basic error limit current ranges with SFU	-
Resistance inputs	✓
Resistance ranges	0 ... 60 Ohm 0 ... 600 Ohm 0 ... 3000 Ohm
Operational limit of resistor ranges	+/- 0.4 %
Operational limit of resistor ranges with SFU	-
Basic error limit	+/- 0.2 %
Basic error limit with SFU	-
Resistance thermometer inputs	✓
Resistance thermometer ranges	Pt100 Pt1000 Ni100 Ni1000
Operational limit of resistance thermometer ranges	+/- 0.4 %
Basic error limit thermoresistor ranges	+/- 0.2 %

Order no.	031-1LD80
Thermocouple inputs	-
Thermocouple ranges	-
Operational limit of thermocouple ranges	-
Operational limit of thermocouple ranges with SFU	-
Basic error limit thermoelement ranges	-
Basic error limit thermoelement ranges with SFU	-
Programmable temperature compensation	-
External temperature compensation	-
Internal temperature compensation	-
Resolution in bit	16
Measurement principle	Sigma-Delta
Basic conversion time	324.1 ms (50 Hz) 270.5 ms (60 Hz) per channel
Noise suppression for frequency	>80dB at 50Hz (UCM<6V)
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	no
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes
Diagnostics information read-out	possible
Module state	green LED
Module error display	red 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 6 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

Order no.	**031-1LD80**
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	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

3.23.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
DIAG	1	Diagnostic[1]	00h	00h	3100h	01h
WIBRK_EN	1	Wire break recognition[1]	00h	00h	3101h	02h
TEMPCNF	1	Temperature system	00h	01h	3102h	03h
SUPR	1	Interference frequency suppression	02h	01h	3103h	04h
CH0FN	1	Function number channel 0	50h	80h	3104h	05h
CH1FN	1	Function number channel 1	50h	81h	3105h	06h
CH2FN	1	Function number channel 2	50h[2]	82h	3106h	07h

Name	Bytes	Function	Default	DS	IX	SX
CH3FN	1	Function number channel 3	50h[2]	83h	3107h	08h

1) This record set may only be transferred at STOP state.

2) with 2 channel operation FFh

DIAG_EN Diagnostic

Byte	Bit 7 ... 0
0	■ Diagnostics interrupt – 00h: enabled – 40h: disabled

- Here you can enable respectively disable the diagnostic interrupt.

WIBRK_EN Wire break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire break recognition channel 0 (1: on) ■ Bit 1: Wire break recognition channel 1 (1: on) ■ Bit 2: Wire break recognition channel 2 (1: on) ■ Bit 3: Wire break recognition channel 3 (1: on) ■ Bit 7 ... 4: reserved

TEMPCNF Temperature system

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Temperature system – 00: °C – 01: °F – 10: K ■ Bit 7 ... 2: reserved

SUPR Interference frequency suppression

Byte	Bit 7 ... 0
0	■ Bit 1, 0: Interference frequency suppression – 01: 60Hz – 10: 50Hz ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated.

Measuring range (funct. no.)	Measuring value	Signal range	Range
2 wire: PT100 (50h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: PT1000	+1000°C	+10000	overrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
(51h)	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
2 wire: NI100 (52h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: NI1000 (53h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: PT100 (58h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
3 wire: PT1000 (59h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
3 wire: NI100 (5Ah)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
3 wire: NI1000 (5Bh)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: PT100 (60h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: PT1000 (61h)	+1000°C	+10000	overrange
	-200 ... +850°C	-2000 ... +8500	nominal range
	-243°C	-2430	underrange
4 wire: NI100 (62h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
4 wire: NI1000 (63h)	+295°C	+2950	overrange
	-60 ... +250°C	-600 ... +2500	nominal range
	-105°C	-1050	underrange
2 wire: 0 ... 60Ω (70h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
2 wire: 0 ... 600Ω (71h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (72h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (78h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (79h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (7Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (80h)	---	---	overrange
	0 ... 60Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (81h)	---	---	overrange
	0 ... 600Ω	0 ... 32767	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (82h)	---	---	overrange
	0 ... 3000Ω	0 ... 32767	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (90h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (91h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (92h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (98h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range

Measuring range (funct. no.)	Measuring value	Signal range	Range
	---	---	underrange
3 wire: 0 ... 600Ω (99h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (9Ah)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω (A0h)	---	---	overrange
	0 ... 60Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (A1h)	---	---	overrange
	0 ... 600Ω	0 ... 6000	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (A2h)	---	---	overrange
	0 ... 3000Ω	0 ... 30000	nominal range
	---	---	underrange
2 wire: 0 ... 60Ω (D0h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 600Ω (D1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
2 wire: 0 ... 3000Ω (D2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 60Ω (D8h)	70.55Ω	32511	overrange
	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 600Ω (D9h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
3 wire: 0 ... 3000Ω (DAh)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 60Ω	70.55Ω	32511	overrange

Measuring range (funct. no.)	Measuring value	Signal range	Range
(E0h)	0 ... 60Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 600Ω (E1h)	705.5Ω	32511	overrange
	0 ... 600Ω	0 ... 27648	nominal range
	---	---	underrange
4 wire: 0 ... 3000Ω (E2h)	3528Ω	32511	overrange
	0 ... 3000Ω	0 ... 27648	nominal range
	---	---	underrange

3.23.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Measuring range overflow
- Measuring range underflow

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	71h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh

Name	Bytes	Function	Default	DS	IX	SX
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error: channel x: ■ Bit 0: set at error in project engineering/parameterization ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire break ■ Bit 5: reserved ■ Bit 6: set at measuring range underflow ■ Bit 7: set at measuring range overflow

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

4 Analog Output

4.1 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 actuators with current or voltage.

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

The parameterization via CPU, PROFIBUS and PROFINET happens by means of record sets (DS). The corresponding record set number may be found at the respective module description. Here also the indices (IX) respectively subindices (SX) for CANopen respectively EtherCAT are listed.

Diagnostic functions

The modules have diagnostics capability. The following errors may release a diagnostic:

- Error in parameterization
- Short-circuit recognition
- Wire-break recognition

4.2 Analog value

Analog value representation

The analog values are only processed in binary representation. Hereby the binary word variable is transformed into an analog process signal and put out via the corresponding channel.

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

Resolution

With a resolution of 12bit plus sign bit, the least significant bits (3bit) are not relevant.

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

4.3 Output ranges and function numbers

General

In the following there are the output ranges listed with function number, which were supported by the corresponding analog module. The here listed formulas allow you to transform a value (digital value) to an analog value and vice versa.

Output ranges

Voltage

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

±10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S format (12h)	11.76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

Output ranges Current

0 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$I = D \times \frac{20}{27648}$ $D = 27648 \times \frac{I}{20}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$I = D \times \frac{20}{16384}$ $D = 16384 \times \frac{I}{20}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	

4 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$I = D \times \frac{16}{27648} + 4$ $D = 27648 \times \frac{I-4}{16}$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	0mA	-6912	E500h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$I = D \times \frac{16}{16384} + 4$ $D = 16384 \times \frac{I-4}{16}$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0mA	-4096	F000h	underrange	

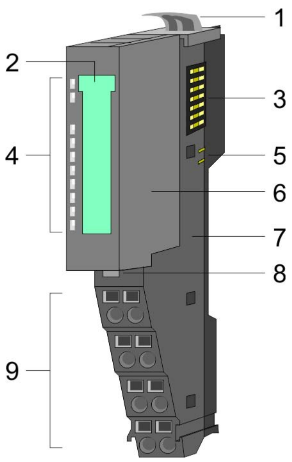
4.4 032-1BB30 - AO 2x12Bit 0...10V

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the backplane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

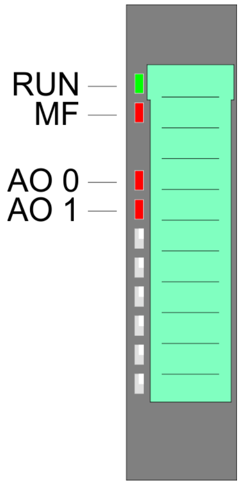
- 2 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

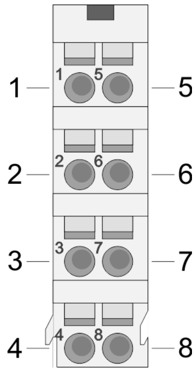
Status indication

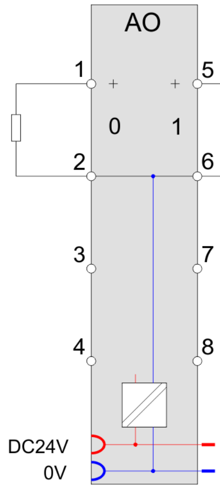


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Fehler Busversorgungsspannung
X	B	X	Error at bus power supply ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● |off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules.

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.4.1 Technical data

Order no.	**032-1BB30**
Type	SM 032
Module ID	0501 25D8
Current consumption/power loss	
Current consumption from backplane bus	80 mA
Power loss	1.2 W
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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Basic error limit voltage ranges	+/-0.2%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	1.5 ms
Settling time for capacitive load	2 ms
Settling time for inductive load	-
Resolution in bit	12
Conversion time	2 ms all channels

Order no.	**032-1BB30**
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm

Order no.	**032-1BB30**
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.4.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	10h	80h	3102h	03h
CH1FN	1	Function number channel 1	10h	81h	3103h	04h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated.

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

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \; x \; \frac{10}{27648}$ $D = 27648 \; x \; \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \; x \; \frac{10}{16384}$ $D = 16384 \; x \; \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.4.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

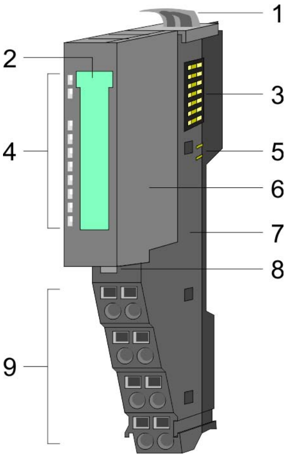
4.5 032-1BB40 - AO 2x12Bit 0(4)...20mA

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

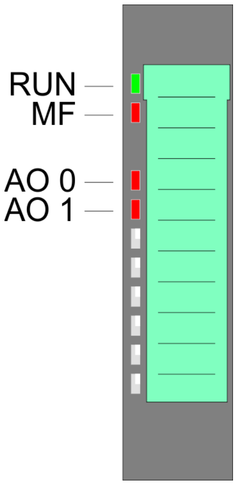
- 2 analog outputs
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

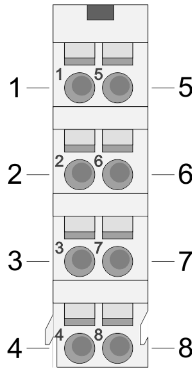
Status indication

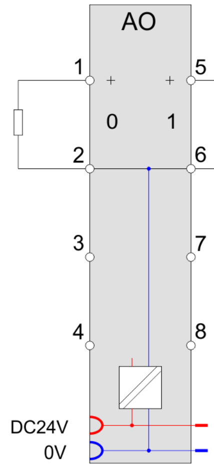


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Error in parameterization ■ Wire-break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules.

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.5.1 Technical data

Order no.	**032-1BB40**
Type	SM 032
Module ID	0502 25D8
Current consumption/power loss	
Current consumption from backplane bus	80 mA
Power loss	0.8 W
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)	-
Voltage output short-circuit protection	-
Voltage outputs	-
Min. load resistance (voltage range)	-
Max. capacitive load (current range)	-
Max. inductive load (current range)	-
Output voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges	-
Destruction limit against external applied voltage	-
Current outputs	✓
Max. in load resistance (current range)	350 Ω
Max. inductive load (current range)	10 mH
Max. inductive load (current range)	12 V
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.4% ... +/-0.5%
Basic error limit current ranges	+/-0.2% ... +/-0.3%
Destruction limit against external applied voltage	-
Settling time for ohmic load	0.25 ms
Settling time for capacitive load	-
Settling time for inductive load	1.5 ms
Resolution in bit	12

Order no.	**032-1BB40**
Conversion time	2 ms all channels
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	

Order no.	032-1BB40
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.5.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
WIBRK_EN	1	Wire-break recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	31h	80h	3102h	03h
CH1FN	1	Function number channel 1	31h	81h	3103h	04h

WIBRK_EN Wire-break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire-break recognition channel 0 (1: on) ■ Bit 1: Wire-break recognition channel 1 (1: on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$I = D \times \frac{20}{27648}$ $D = 27648 \times \frac{I}{20}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$I = D \times \frac{20}{16384}$ $D = 16384 \times \frac{I}{20}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	

4 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$I = D \times \frac{16}{27648} + 4$ $D = 27648 \times \frac{I-4}{16}$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	0mA	-6912	E500h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$I = D \times \frac{16}{16384} + 4$ $D = 16384 \times \frac{I-4}{16}$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0mA	-4096	F000h	underrange	

4.5.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Wire-break (if parameterized)

DS - Record set for access via CPU, PROFIBUS und PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - IIndex for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x ■ Bit 0: set at configuring/parameter assignment error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire-break ■ Bit 7 ... 5: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

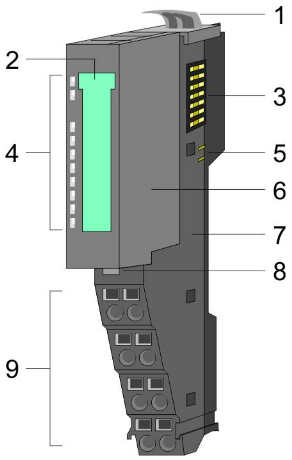
4.6 032-1BB70 - AO 2x12Bit ±10V

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

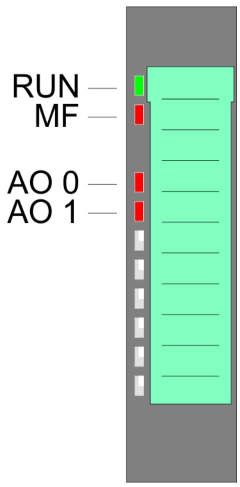
- 2 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

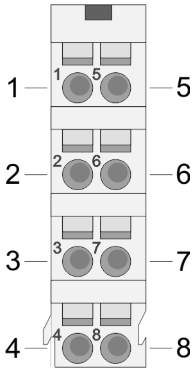


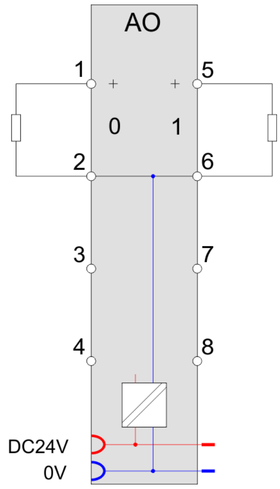
RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*

RUN	MF	AO x	Description
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● |off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Adr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.6.1 Technical data

Order no.	032-1BB70
Type	SM 032
Module ID	0505 25D8
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Basic error limit voltage ranges	+/-0.2%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-

Order no.	**032-1BB70**
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	1.5 ms
Settling time for capacitive load	2 ms
Settling time for inductive load	-
Resolution in bit	12
Conversion time	2 ms all channels
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0

Order no.	**032-1BB70**
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.6.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	12h	80h	3102h	03h
CH1FN	1	Function number channel 1	12h	81h	3103h	04h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S format (12h)	11.76V	32511	7EFFh	overrange	$U = D \ x \ \frac{10}{27648}$ $D = 27648 \ x \ \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$U = D \ x \ \frac{10}{16384}$ $D = 16384 \ x \ \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \ x \ \frac{10}{27648}$ $D = 27648 \ x \ \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \ x \ \frac{10}{16384}$ $D = 16384 \ x \ \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.6.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

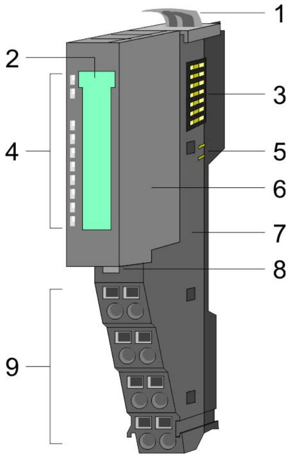
4.7 032-1BD30 - AO 4x12Bit 0...10V

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

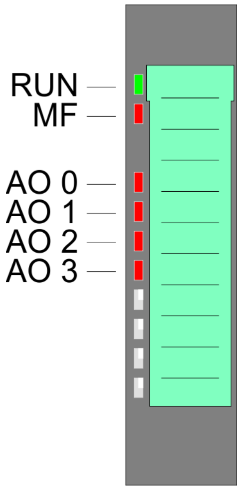
- 4 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



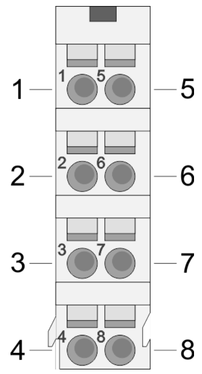
1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

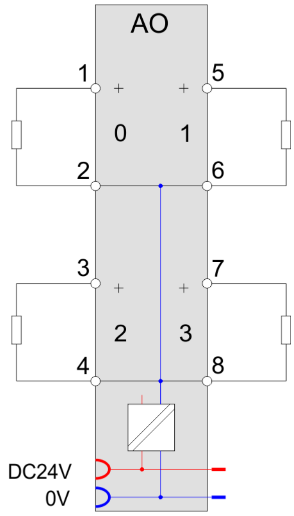


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ✎ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment



For wires with a cross section of 0.08mm^2 up to 1.5mm^2.



Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

Addr.	Name	Bytes	Function	IX	SX
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.7.1 Technical data

Order no.	032-1BD30
Type	SM 032
Module ID	0503 25E0
Current consumption/power loss	
Current consumption from backplane bus	80 mA
Power loss	1.2 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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Basic error limit voltage ranges	+/-0.2%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-

Order no.	**032-1BD30**
Destruction limit against external applied voltage	-
Settling time for ohmic load	1.5 ms
Settling time for capacitive load	2 ms
Settling time for inductive load	-
Resolution in bit	12
Conversion time	2 ms all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	8

Order no.	032-1BD30
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.7.2 Parameter data

DS - Record set for access via CPU, PROFIBUS und PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	10h	80h	3102h	03h
CH1FN	1	Function number channel 1	10h	81h	3103h	04h
CH2FN	1	Function number channel 2	10h	82h	3104h	05h
CH3FN	1	Function number channel 3	10h	83h	3105h	06h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 2: Short-circuit recognition channel 2 (1:on) ■ Bit 3: Short-circuit recognition channel 3 (1:on) ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D\ x\ \frac{10}{27648}$ $D = 27648\ x\ \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D\ x\ \frac{10}{16384}$ $D = 16384\ x\ \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.7.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS und PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h

Name	Bytes	Function	Default	DS	IX	SX
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

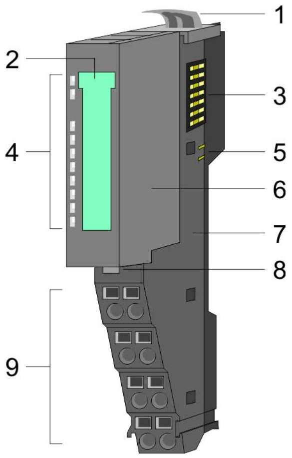
4.8 032-1BD40 - AO 4x12Bit 0(4)...20mA

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

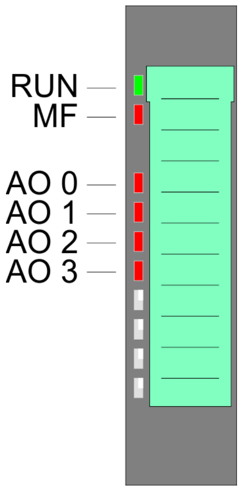
- 4 analog outputs
- Suited for sensors with 0...20mA; 4...20mA
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

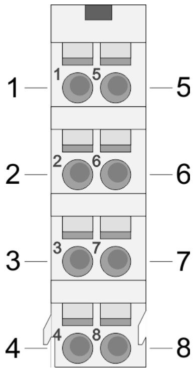
Status indication

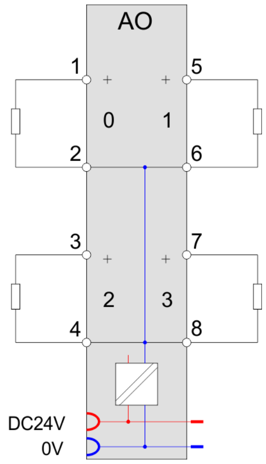


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Error in parameterization ■ Wire-break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.8.1 Technical data

Order no.	**032-1BD40**
Type	SM 032
Module ID	0504 25E0
Current consumption/power loss	
Current consumption from backplane bus	80 mA
Power loss	0.8 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)	-
Voltage output short-circuit protection	-
Voltage outputs	-
Min. load resistance (voltage range)	-
Max. capacitive load (current range)	-
Max. inductive load (current range)	-
Output voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges	-
Destruction limit against external applied voltage	-
Current outputs	✓
Max. in load resistance (current range)	350 Ω
Max. inductive load (current range)	10 mH
Max. inductive load (current range)	12 V
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.4% ... +/-0.5%
Basic error limit current ranges	+/-0.2% ... +/-0.3%
Destruction limit against external applied voltage	-
Settling time for ohmic load	0.25 ms
Settling time for capacitive load	-
Settling time for inductive load	1.5 ms
Resolution in bit	12

Order no.	**032-1BD40**
Conversion time	2 ms all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	8
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	

Order no.	032-1BD40
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.8.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
WIBRK_EN	1	Wire-break recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	31h	80h	3102h	03h
CH1FN	1	Function number channel 1	31h	81h	3103h	04h
CH2FN	1	Function number channel 2	31h	82h	3104h	05h
CH3FN	1	Function number channel 3	31h	83h	3105h	06h

WIBRK_EN Wire-break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire-break recognition channel 0 (1: on) ■ Bit 1: Wire-break recognition channel 1 (1: on) ■ Bit 2: Wire-break recognition channel 2 (1: on) ■ Bit 3: Wire-break recognition channel 3 (1: on) ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$I = D \times \frac{20}{27648}$ $D = 27648 \times \frac{I}{20}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$I = D \times \frac{20}{16384}$ $D = 16384 \times \frac{I}{20}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	

4 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$I = D \times \frac{16}{27648} + 4$ $D = 27648 \times \frac{I-4}{16}$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	0mA	-6912	E500h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$I = D \times \frac{16}{16384} + 4$ $D = 16384 \times \frac{I-4}{16}$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0mA	-4096	F000h	underrange	

4.8.3 Diagnostic data

So this module does not support interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Wire-break (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire-break ■ Bit 7 ... 5: reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

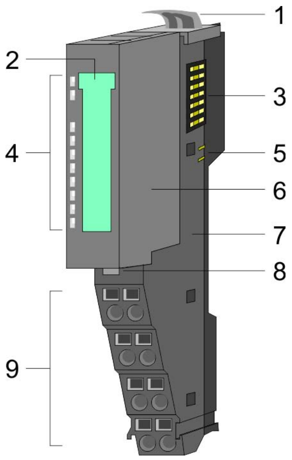
4.9 032-1BD70 - AO 4x12Bit ±10V

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

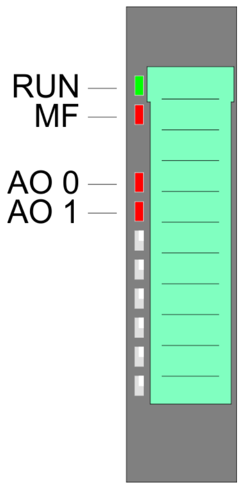
- 4 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

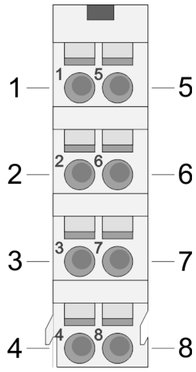


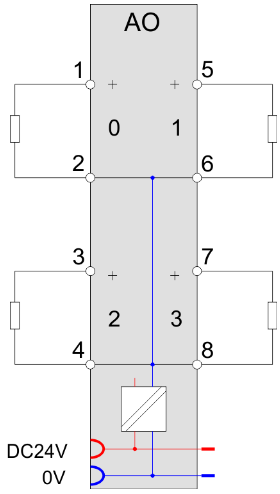
RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
B	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*

RUN	MF	AO x	Description
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.9.1 Technical data

Order no.	032-1BD70
Type	SM 032
Module ID	0506 25E0
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.3%
Basic error limit voltage ranges	+/-0.2%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-

Order no.	032-1BD70
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	1.5 ms
Settling time for capacitive load	2 ms
Settling time for inductive load	-
Resolution in bit	12
Conversion time	2 ms all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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 no.	032-1BD70
Insulation tested with	DC 500 V
Datasizes	
Input bytes	0
Output bytes	8
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.9.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	12h	80h	3102h	03h
CH1FN	1	Function number channel 1	12h	81h	3103h	04h
CH2FN	1	Function number channel 2	12h	82h	3104h	05h
CH3FN	1	Function number channel 3	12h	83h	3105h	06h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 2: Short-circuit recognition channel 2 (1:on) ■ Bit 3: Short-circuit recognition channel 3 (1:on) ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S format (12h)	11.76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \cdot \frac{10}{27648}$ $D = 27648 \cdot \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \cdot \frac{10}{16384}$ $D = 16384 \cdot \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.9.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR… CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

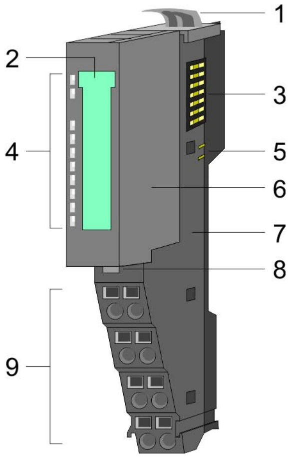
4.10 032-1CB30 - AO 2x16Bit 0...10V

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

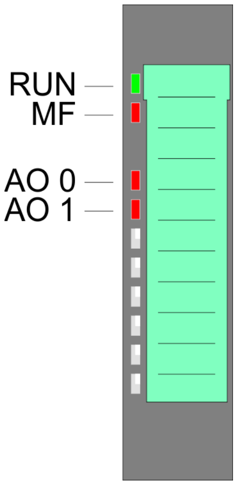
- 2 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

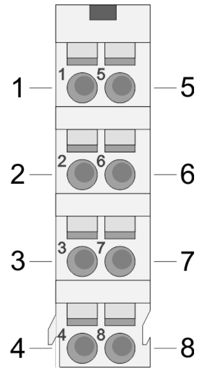
Status indication

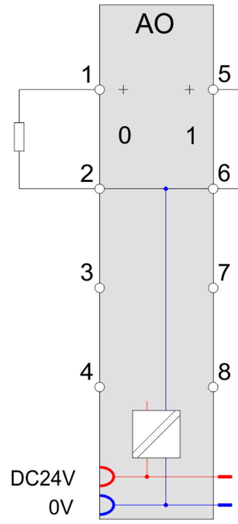


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ⇨ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.10.1 Technical data

Order no.	**032-1CB30**
Type	SM 032
Module ID	0507 2558
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Basic error limit voltage ranges	+/-0.1%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	150 µs
Settling time for capacitive load	1 ms
Settling time for inductive load	-
Resolution in bit	16
Conversion time	200 µs all channels

Order no.	032-1CB30
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm

Order no.	032-1CB30
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.10.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	10h	80h	3102h	03h
CH1FN	1	Function number channel 1	10h	81h	3103h	04h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated.

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

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.10.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR... CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

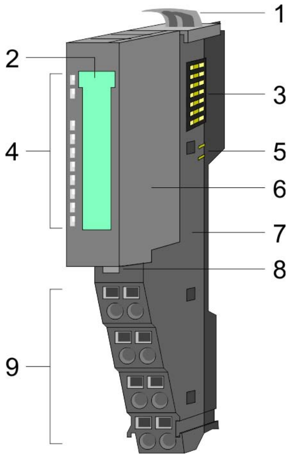
4.11 032-1CB40 - AO 2x16Bit 0(4)...20mA

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

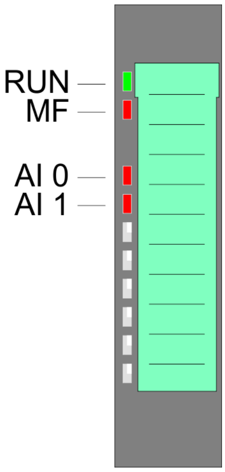
- 2 analog outputs
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

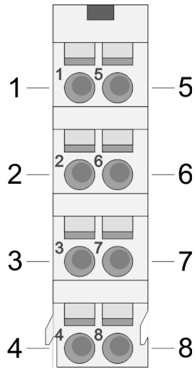
Status indication

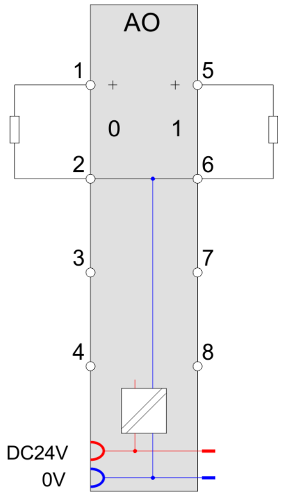


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ➪ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Error in parameterization ■ Wire-break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.11.1 Technical data

Order no.	032-1CB40
Type	SM 032
Module ID	050B 25D8
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.7 W
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)	-
Voltage output short-circuit protection	-
Voltage outputs	-
Min. load resistance (voltage range)	-
Max. capacitive load (current range)	-
Max. inductive load (current range)	-
Output voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges	-
Destruction limit against external applied voltage	-
Current outputs	✓
Max. in load resistance (current range)	350 Ω
Max. inductive load (current range)	10 mH
Max. inductive load (current range)	12 V
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2%
Basic error limit current ranges	+/-0.1%
Destruction limit against external applied voltage	-
Settling time for ohmic load	0.25 ms
Settling time for capacitive load	-
Settling time for inductive load	1.5 ms
Resolution in bit	16

Order no.	**032-1CB40**
Conversion time	400 µs all channels
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	

Order no.	**032-1CB40**
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	in preparation

4.11.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
WIBRK_EN	1	Wire-break recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	31h	80h	3102h	03h
CH1FN	1	Function number channel 1	31h	81h	3103h	04h

WIBRK_EN Wire-break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire-break recognition channel 0 (1: on) ■ Bit 1: Wire-break recognition channel 1 (1: on) ■ Bit 7 ... 2: reserved

Please consider with enabled wire break recognition with the output range 0 ... 20mA, when the current goes below of 40µA (100 Digits), this can may lead to sporadic wire break messages!

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$I = D \; x \; \frac{20}{27648}$ $D = 27648 \; x \; \frac{I}{20}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$I = D \; x \; \frac{20}{16384}$ $D = 16384 \; x \; \frac{I}{20}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	

4 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$I = D \; x \; \frac{16}{27648} + 4$ $D = 27648 \; x \; \frac{I-4}{16}$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	0mA	-6912	E500h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$I = D \; x \; \frac{16}{16384} + 4$ $D = 16384 \; x \; \frac{I-4}{16}$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0mA	-4096	F000h	underrange	

4.11.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Wire-break (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x ■ Bit 0: set at configuring/parameter assignment error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire-break ■ Bit 7 ... 5: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

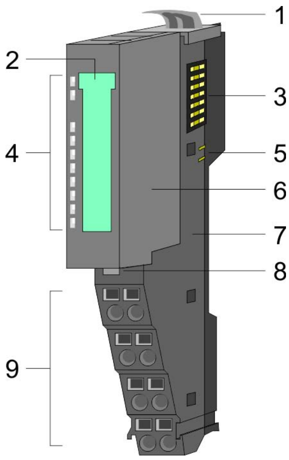
4.12 032-1CB70 - AO 2x16Bit ±10V

Properties

The electronic module has 2 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

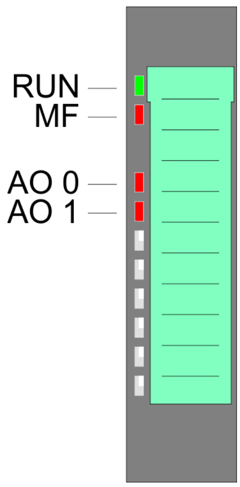
- 2 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

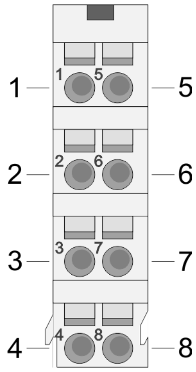


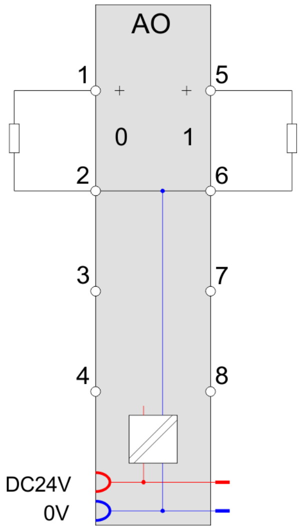
RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*

RUN	MF	AO x	Description
●	○	●	Error channel x ■ Error in parameterization ■ Overload, short-circuit
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm^2 up to 1.5mm^2.





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	---	---	not connected
4	---	---	not connected
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	---	---	not connected
8	---	---	not connected

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules.

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h

4.12.1 Technical data

Order no.	**032-1CB70**
Type	SM 032
Module ID	0508 2558
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 W
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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Basic error limit voltage ranges	+/-0.1%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-

Order no.	**032-1CB70**
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	150 µs
Settling time for capacitive load	1 ms
Settling time for inductive load	-
Resolution in bit	16
Conversion time	200 µs all channels
Substitute value can be applied	no
Output data size	4 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0

Order no.	032-1CB70
Output bytes	4
Parameter bytes	8
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.12.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	12h	80h	3102h	03h
CH1FN	1	Function number channel 1	12h	81h	3103h	04h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 7 ... 2: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S format (12h)	11.76V	32511	7EFFh	overrange	$U = D \text{ x } \frac{10}{27648}$ $D = 27648 \text{ x } \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$U = D \text{ x } \frac{10}{16384}$ $D = 16384 \text{ x } \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \text{ x } \frac{10}{27648}$ $D = 27648 \text{ x } \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \text{ x } \frac{10}{16384}$ $D = 16384 \text{ x } \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.12.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h

SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	02h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR… CH7ERR	6	reserved	00h			0Ch ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 02h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 7 ... 2: reserved

CH0ERR / CH1ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH2ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

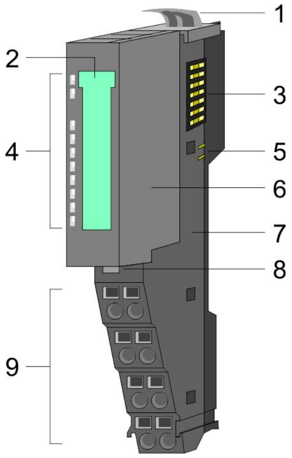
4.13 032-1CD30 - AO 4x16Bit 0...10V

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

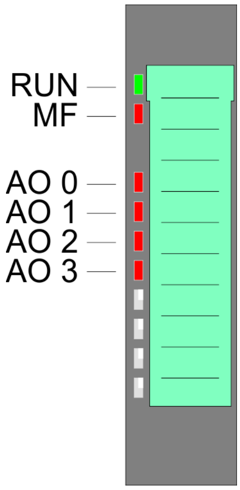
- 4 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

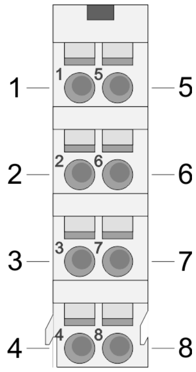
Status indication

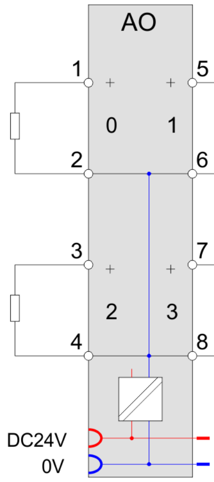


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm² up to 1.5mm².





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.13.1 Technical data

Order no.	032-1CD30
Type	SM 032
Module ID	0509 2560
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Basic error limit voltage ranges	+/-0.1%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	150 µs
Settling time for capacitive load	1 ms
Settling time for inductive load	-
Resolution in bit	16
Conversion time	200 µs all channels

Order no.	032-1CD30
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	8
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm

Order no.	032-1CD30
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.13.2 Parameter data

DS - Record set for access via CPU, PROFIBUS und PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	10h	80h	3102h	03h
CH1FN	1	Function number channel 1	10h	81h	3103h	04h
CH2FN	1	Function number channel 2	10h	82h	3104h	05h
CH3FN	1	Function number channel 3	10h	83h	3105h	06h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 2: Short-circuit recognition channel 2 (1:on) ■ Bit 3: Short-circuit recognition channel 3 (1:on) ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.13.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS und PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR... CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

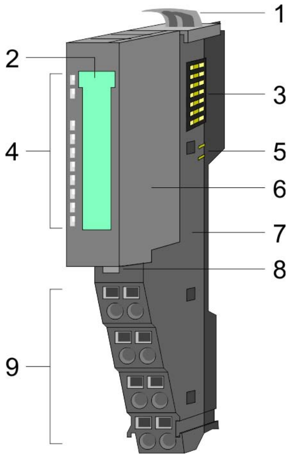
4.14 032-1CD40 - AO 4x16Bit 0(4)...20mA

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

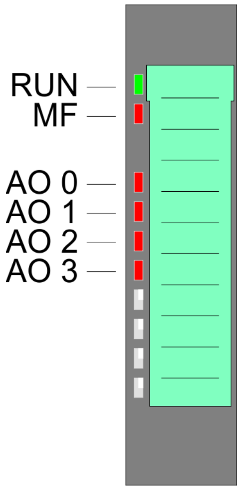
- 4 analog outputs
- Suited for sensors with 0...20mA; 4...20mA
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

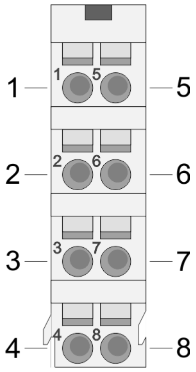
Status indication

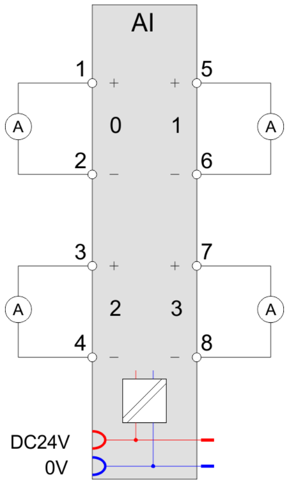


RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30*
●	○	●	Error channel x ■ Error in parameterization ■ Wire-break
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm^2 up to 1.5mm^2.





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.14.1 Technical data

Order no.	**032-1CD40**
Type	SM 032
Module ID	0509 25E0
Current consumption/power loss	
Current consumption from backplane bus	65 mA
Power loss	0.8 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)	-
Voltage output short-circuit protection	-
Voltage outputs	-
Min. load resistance (voltage range)	-
Max. capacitive load (current range)	-
Max. inductive load (current range)	-
Output voltage ranges	-
Operational limit of voltage ranges	-
Basic error limit voltage ranges	-
Destruction limit against external applied voltage	-
Current outputs	✓
Max. in load resistance (current range)	350 Ω
Max. inductive load (current range)	10 mH
Max. inductive load (current range)	12 V
Output current ranges	0 mA ... +20 mA +4 mA ... +20 mA
Operational limit of current ranges	+/-0.2%
Basic error limit current ranges	+/-0.1%
Destruction limit against external applied voltage	-
Settling time for ohmic load	0.25 ms
Settling time for capacitive load	-
Settling time for inductive load	1.5 ms
Resolution in bit	16

Order no.	032-1CD40
Conversion time	400 µs all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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	0
Output bytes	8
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	

Order no.	032-1CD40
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	in preparation

4.14.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
WIBRK_EN	1	Wire-break recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	31h	80h	3102h	03h
CH1FN	1	Function number channel 1	31h	81h	3103h	04h
CH2FN	1	Function number channel 2	31h	82h	3104h	05h
CH3FN	1	Function number channel 3	31h	83h	3105h	06h

WIBRK_EN Wire-break recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Wire-break recognition channel 0 (1: on) ■ Bit 1: Wire-break recognition channel 1 (1: on) ■ Bit 2: Wire-break recognition channel 2 (1: on) ■ Bit 3: Wire-break recognition channel 3 (1: on) ■ Bit 7 ... 4: reserved

Please consider with enabled wire break recognition with the output range 0 ... 20mA, when the current goes below of 40µA (100 Digits), this can may lead to sporadic wire break messages!

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

0 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
0 ... 20mA Siemens S7 format (31h)	23.52mA	32511	7EFFh	overrange	$I = D \times \frac{20}{27648}$ $D = 27648 \times \frac{I}{20}$
	20mA	27648	6C00h	nominal range	
	10mA	13824	3600h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	
0 ... 20mA Siemens S5 format (41h)	25.00mA	20480	5000h	overrange	$I = D \times \frac{20}{16384}$ $D = 16384 \times \frac{I}{20}$
	20mA	16384	4000h	nominal range	
	10mA	8192	2000h		
	0mA	0	0000h		
	Not possible, is limited to 0mA.			underrange	

4 ... 20mA

Output range (funct. no.)	Current (I)	Decimal (D)	Hex	Range	Formulas
4 ... 20mA Siemens S7 format (30h)	22.81mA	32511	7EFFh	overrange	$I = D \times \frac{16}{27648} + 4$ $D = 27648 \times \frac{I-4}{16}$
	20mA	27648	6C00h	nominal range	
	12mA	13824	3600h		
	4mA	0	0000h		
	0mA	-6912	E500h	underrange	
4 ... 20mA Siemens S5 format (40h)	24.00mA	20480	5000h	overrange	$I = D \times \frac{16}{16384} + 4$ $D = 16384 \times \frac{I-4}{16}$
	20mA	16384	4000h	nominal range	
	12mA	8192	2000h		
	4mA	0	0000h		
	0mA	-4096	F000h	underrange	

4.14.3 Diagnostic data

So this module does not support interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Wire-break (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR… CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 3 ... 1: reserved ■ Bit 4: set at wire-break ■ Bit 7 ... 5: reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.

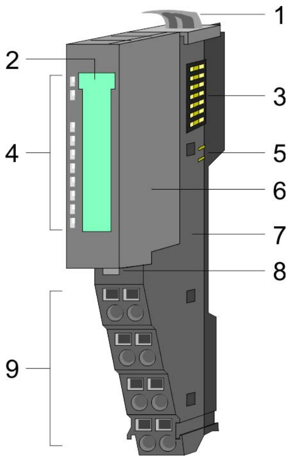
4.15 032-1CD70 - AO 4x16Bit ±10V

Properties

The electronic module has 4 outputs with parameterizable functions. The channels of the module are electrically isolated from the back-plane bus. In addition, the channels are isolated to the DC 24V power supply by means of DC/DC converter.

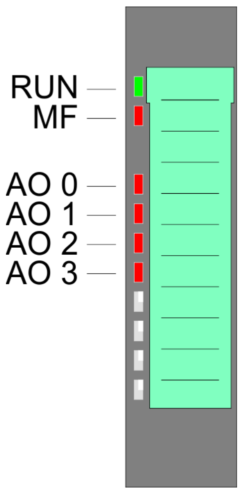
- 4 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 16bit resolution

Structure



1 Locking lever terminal module
2 Labeling strip
3 Backplane bus
4 LED status indication
5 DC 24V power section supply
6 Electronic module
7 Terminal module
8 Locking lever electronic module
9 Terminal

Status indication

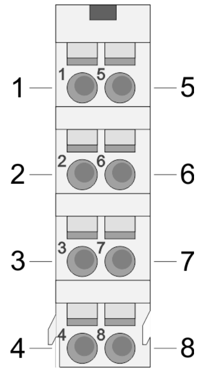


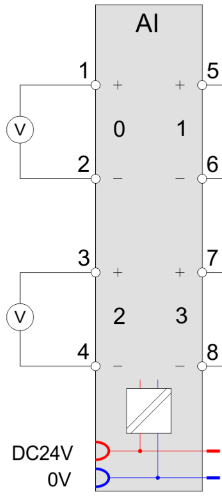
RUN	MF	AO x	Description
green	red	red	
●	○	X	Bus communication is OK Module status is OK
●	●	X	Bus communication is OK Module status reports an error
○	●	X	Bus communication is not possible Module status reports an error
○	○	X	Error at bus power supply
X	B	X	Error in configuration ➪ *Chapter 2.7 ‘Trouble shooting - LEDs’ on page 30*

RUN	MF	AO x	Description
●	○	●	Error channel x ■ Overload, short-circuit ■ Error in parameterization
on: ● | off: ○ | blinks with 2Hz: B | not relevant: X			

Pin assignment

For wires with a cross section of 0.08mm^2 up to 1.5mm^2.





Pos.	Function	Type	Description
1	AO 0	O	Channel 0
2	AGND	O	Ground channels
3	AO 2	O	Channel 2
4	AGND	O	Ground channels
5	AO 1	O	Channel 1
6	AGND	O	Ground channels
7	AO 3	O	Channel 3
8	AGND	O	Ground channels

O: Output

In-/Output area

At CPU, PROFIBUS and PROFINET the input respectively output area is embedded to the corresponding address area.

IX - Index for access via CANopen with s = Subindex, depends on number and type of analog modules

SX - Subindex for access via EtherCAT

Input area

No byte of the input area is used by the module.

Output area

Addr.	Name	Bytes	Function	IX	SX
+0	AO 0	2	Analog value channel 0	6411h/s	01h
+2	AO 1	2	Analog value channel 1	6411h/s+1	02h
+4	AO 2	2	Analog value channel 2	6411h/s+2	03h
+6	AO 3	2	Analog value channel 3	6411h/s+3	04h

4.15.1 Technical data

Order no.	**032-1CD70**
Type	SM 032
Module ID	050A 2560
Current consumption/power loss	
Current consumption from backplane bus	60 mA
Power loss	0.8 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)	-
Voltage output short-circuit protection	✓
Voltage outputs	✓
Min. load resistance (voltage range)	5 kΩ
Max. capacitive load (current range)	1 µF
Max. inductive load (current range)	10 mA
Output voltage ranges	-10 V ... +10 V 0 V ... +10 V
Operational limit of voltage ranges	+/-0.2%
Basic error limit voltage ranges	+/-0.1%
Destruction limit against external applied voltage	-
Current outputs	-
Max. in load resistance (current range)	-
Max. inductive load (current range)	-

Order no.	032-1CD70
Max. inductive load (current range)	-
Output current ranges	-
Operational limit of current ranges	-
Basic error limit current ranges	-
Destruction limit against external applied voltage	-
Settling time for ohmic load	150 µs
Settling time for capacitive load	2 ms
Settling time for inductive load	-
Resolution in bit	16
Conversion time	200 µs all channels
Substitute value can be applied	no
Output data size	8 Byte
Status information, alarms, diagnostics	
Status display	yes
Interrupts	no
Process alarm	no
Diagnostic interrupt	no
Diagnostic functions	yes
Diagnostics information read-out	possible
Supply voltage display	green LED
Group error display	red 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)	-
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 no.	**032-1CD70**
Insulation tested with	DC 500 V
Datasizes	
Input bytes	0
Output bytes	8
Parameter bytes	10
Diagnostic bytes	20
Housing	
Material	PPE / PPE GF10
Mounting	Profile rail 35 mm
Mechanical data	
Dimensions (WxHxD)	12.9 mm x 109 mm x 76.5 mm
Weight	60 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

4.15.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex for access via EtherCAT

Name	Bytes	Function	Default	DS	IX	SX
RES0	1	reserved	00h	00h	3100h	01h
SHORT_EN	1	Short-circuit recognition	00h	00h	3101h	02h
CH0FN	1	Function number channel 0	12h	80h	3102h	03h
CH1FN	1	Function number channel 1	12h	81h	3103h	04h
CH2FN	1	Function number channel 2	12h	82h	3104h	05h
CH3FN	1	Function number channel 3	12h	83h	3105h	06h

SHORT_EN Short-circuit recognition

Byte	Bit 7 ... 0
0	■ Bit 0: Short-circuit recognition channel 0 (1:on) ■ Bit 1: Short-circuit recognition channel 1 (1:on) ■ Bit 2: Short-circuit recognition channel 2 (1:on) ■ Bit 3: Short-circuit recognition channel 3 (1:on) ■ Bit 7 ... 4: reserved

CHxFN Function number channel x

In the following there are the measuring ranges with corresponding function number listed, which were supported by the analog module. With FFh the corresponding channel is deactivated. The formulas listed here allow you to transform an evaluated measuring value (digital value) to a value assigned to the measuring range (analog value) and vice versa.

±10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
±10V Siemens S format (12h)	11.76V	32511	7EFFh	overrange	$U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	-5V	-13824	CA00h		
	-10V	-27648	9400h		
	-11.76V	-32512	8100h	underrange	
±10V Siemens S5 format (22h)	12.5V	20480	5000h	overrange	$U = D \times \frac{10}{16384}$ $D = 16384 \times \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	-5V	-8192	E000h		
	-10V	-16384	C000h		
	-12.5V	-20480	B000h	underrange	

0 ... 10V

Output range (funct. no.)	Voltage (U)	Decimal (D)	Hex	Range	Formulas
0 ... 10V Siemens S7 format (10h)	11,76V	32511	7EFFh	overrange	$U = D\ x\ \frac{10}{27648}$ $D = 27648\ x\ \frac{U}{10}$
	10V	27648	6C00h	nominal range	
	5V	13824	3600h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	
0 ... 10V Siemens S5 format (20h)	12,5V	20480	5000h	overrange	$U = D\ x\ \frac{10}{16384}$ $D = 16384\ x\ \frac{U}{10}$
	10V	16384	4000h	nominal range	
	5V	8192	2000h		
	0V	0	0000h		
	Not possible, is limited to 0V.			underrange	

4.15.3 Diagnostic data

So this module does not support diagnostic interrupt functions, the diagnostics data serve for information about this module. On error the corresponding channel LED of the module is activated and the error is registered in the diagnostics data.

The following errors are listed in the diagnostics data:

- Error in project engineering / parameterization
- Short-circuit/overload (if parameterized)

DS - Record set for access via CPU, PROFIBUS and PROFINET. The access happens by DS 01h. Additionally the first 4 bytes may be accessed by DS 00h.

IX - Index for access via CANopen. The access happens by IX 2F01h. Additionally the first 4 bytes may be accessed by IX 2F00h.

SX - Subindex for access via EtherCAT.

Name	Bytes	Function	Default	DS	IX	SX
ERR_A	1	Diagnostic	00h	01h	2F01h	02h
MODTYP	1	Module information	15h			03h
ERR_C	1	reserved	00h			04h
ERR_D	1	Diagnostic	00h			05h
CHTYP	1	Channel type	73h			06h
NUMBIT	1	Number diagnostic bits per channel	08h			07h
NUMCH	1	Number of channels of a module	04h			08h

Name	Bytes	Function	Default	DS	IX	SX
CHERR	1	Channel error	00h			09h
CH0ERR	1	Channel-specific error channel 0	00h			0Ah
CH1ERR	1	Channel-specific error channel 1	00h			0Bh
CH2ERR	1	Channel-specific error channel 2	00h			0Ch
CH3ERR	1	Channel-specific error channel 3	00h			0Dh
CH4ERR… CH7ERR	4	reserved	00h			0Eh ... 11h
DIAG_US	4	µs ticker	00h			12h

ERR_A Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 0: set at module failure ■ Bit 1: set at internal error ■ Bit 2: set at external error ■ Bit 3: set at channel error ■ Bit 4: set at external auxiliary supply missing ■ Bit 6 ... 5: reserved ■ Bit 7: set at error in parameterization

MODTYP Module information

Byte	Bit 7 ... 0
0	■ Bit 3 ... 0: module class – 0101b analog module ■ Bit 4: set at channel information present ■ Bit 7 ... 5: reserved

ERR_D Diagnostic

Byte	Bit 7 ... 0
0	■ Bit 2 ... 0: reserved ■ Bit 3: set at internal diagnostics buffer overflow ■ Bit 4: set at internal communication error ■ Bit 7 ... 5: reserved

CHTYP Channel type

Byte	Bit 7 ... 0
0	■ Bit 6 ... 0: Channel type – 70h: Digital input – 71h: Analog input – 72h: Digital output – 73h: Analog output – 74h: Analog input/-output ■ Bit 7: reserved

NUMBIT Diagnostic bits

Byte	Bit 7 ... 0
0	Number of diagnostic bits per channel (here 08h)

NUMCH Channels

Byte	Bit 7 ... 0
0	Number of channels of a module (here 04h)

CHERR Channel error

Byte	Bit 7 ... 0
0	■ Bit 0: set at error in channel group 0 ■ Bit 1: set at error in channel group 1 ■ Bit 2: set at error in channel group 2 ■ Bit 3: set at error in channel group 3 ■ Bit 7 ... 4: reserved

CH0ERR ... CH3ERR Channel-specific

Byte	Bit 7 ... 0
0	Channel-specific error channel x: ■ Bit 0: set at configuring/parameter assignment error ■ Bit 2 ... 1: reserved ■ Bit 3: set at short-circuit to ground ■ Bit 7 ... 4: reserved

CH4ERR ... CH7ERR reserved

Byte	Bit 7 ... 0
0	reserved

DIAG_US µs ticker

Byte	Bit 7 ... 0
0...3	Value of the µs ticker at the moment of the diagnostic

µs ticker

In the SLIO module there is a timer (µs ticker). With PowerON the timer starts counting with 0. After 2^{32}-1µs the timer starts with 0 again.