# VIPA System SLIO

## SM-AIO | | Manual

HB300 | SM-AIO | | GB | 15-13

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# 1 General

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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.

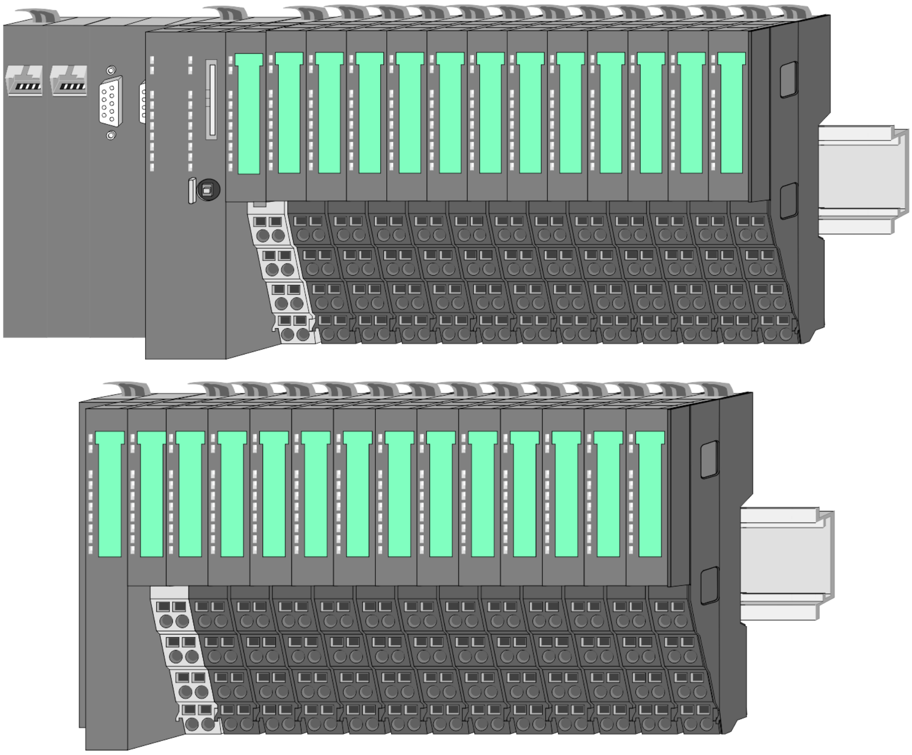
Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

**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.

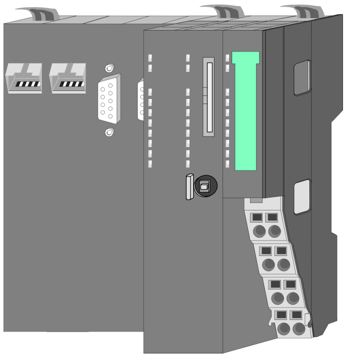


***Components***

- 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!

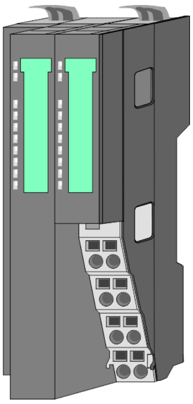
**CPU**



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**

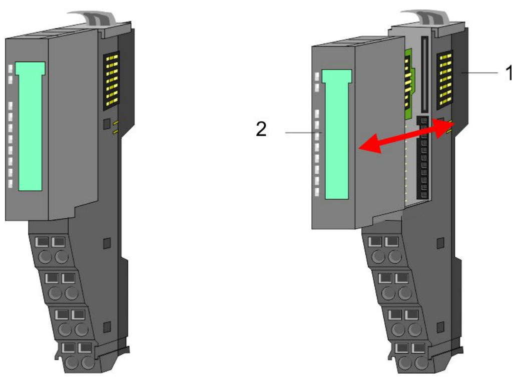


With a bus coupler bus interface and power module are integrated to one casing. With the bus interface you get access to a subordinated bus system. As head module via the integrated power module for power supply the bus interface is supplied as well as the electronic of the connected periphery modules. 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!

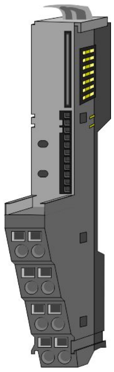
**Periphery modules**

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



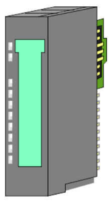

1 Terminal module
2 Electronic module

### *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.

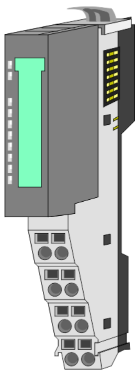
### *Electronic module*



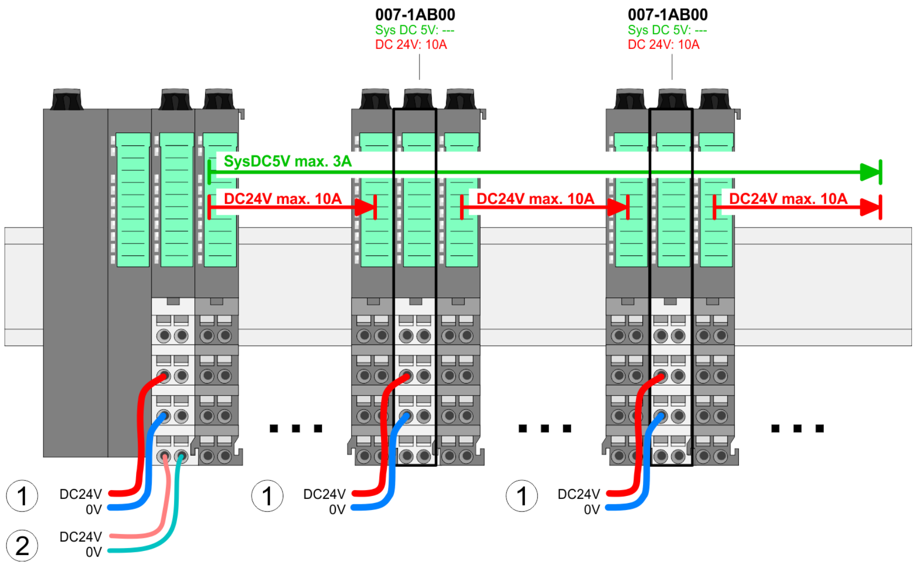
The functionality of a SLIO periphery module is defined by the *electronic module*, which is mounted to the terminal module by a safe sliding mechanism. With an error the defective module may be exchanged for a functional module with standing installation.

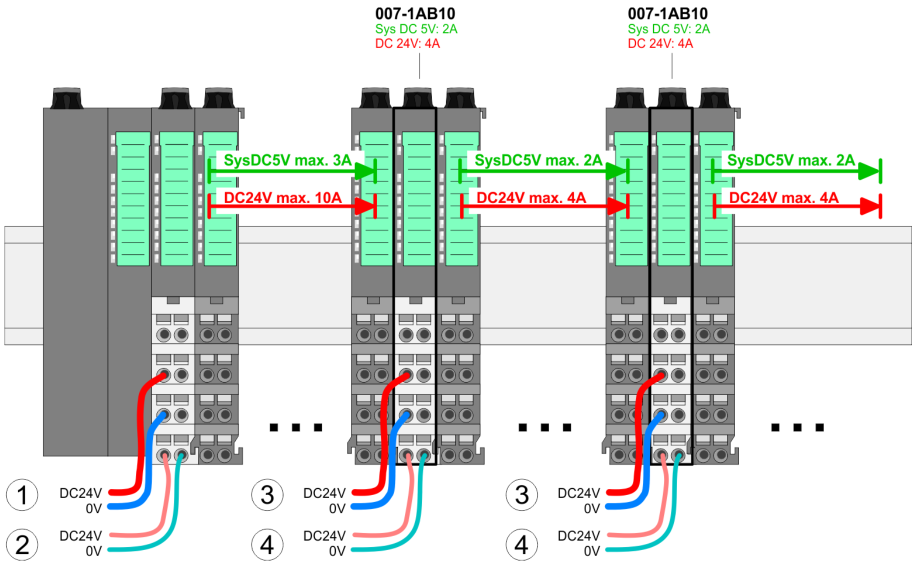
At the front side there are LEDs for status indication. For simple wiring each module shows a corresponding connection diagram at the front and at the side.

### 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.

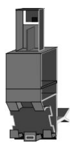




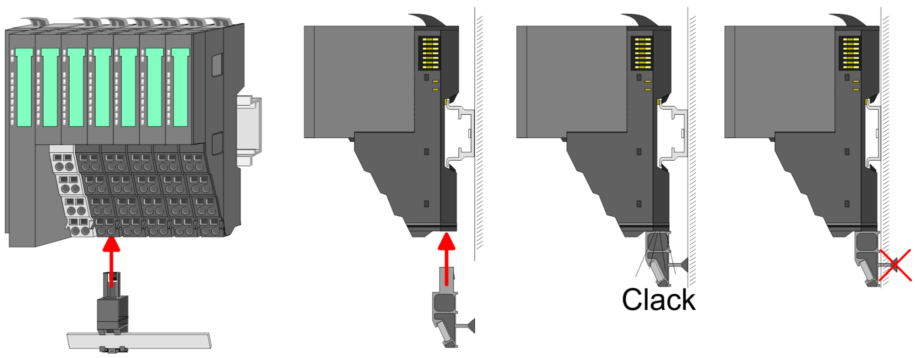

(1) DC 24V for power section supply I/O area (max. 10A)
(2) DC 24V for electronic power supply bus coupler and I/O area
(3) DC 24V for power section supply I/O area (max. 4A)
(4) DC 24V for electronic power supply I/O area

## Accessories

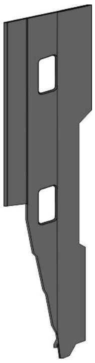
### *Shield bus carrier*



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.

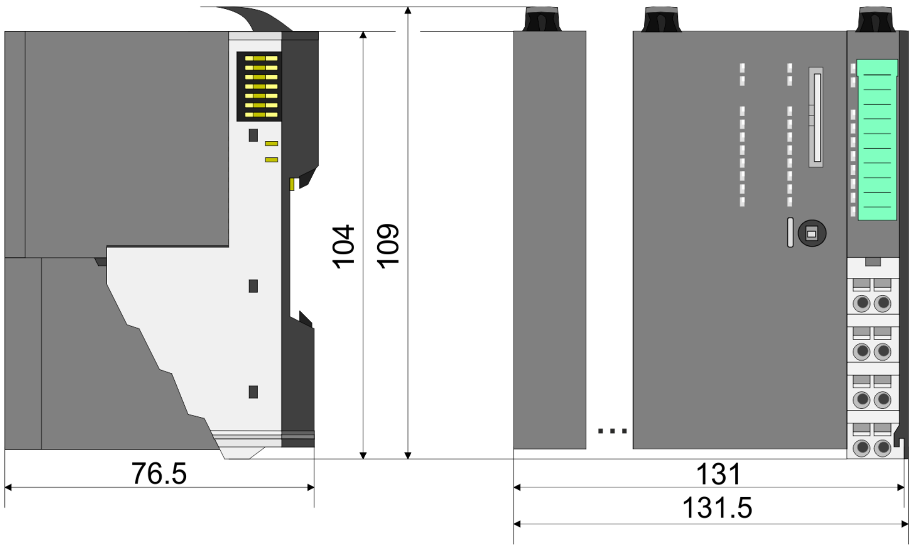
The bus cover has the order no. 000-0AA00.

***Coding pins***

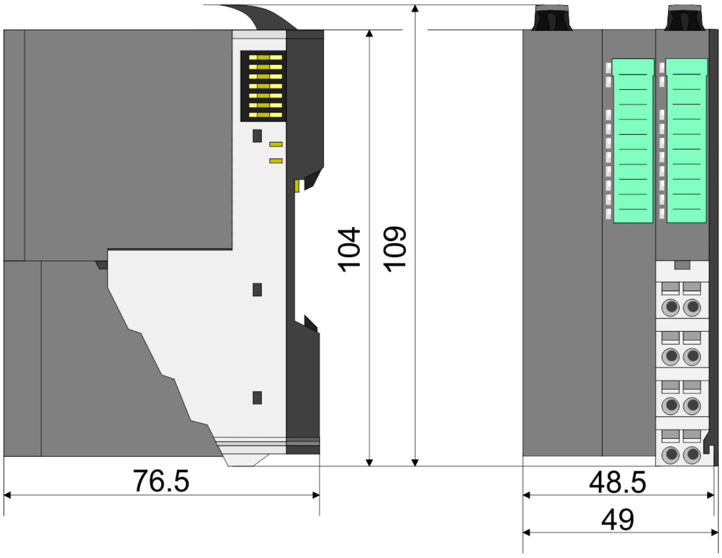
There is the possibility to fix the assignment of electronic and terminal module. Here coding pins (order number 000-0AC00) from VIPA can be used. The coding pin consists of a coding jack and a coding plug. By combining electronic and terminal module with coding pin, the coding jack remains in the electronic 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

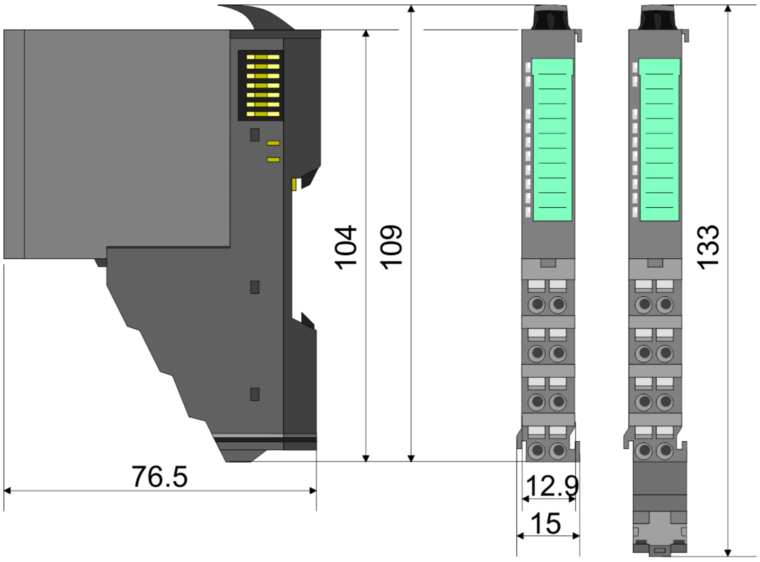
**Dimensions CPU**



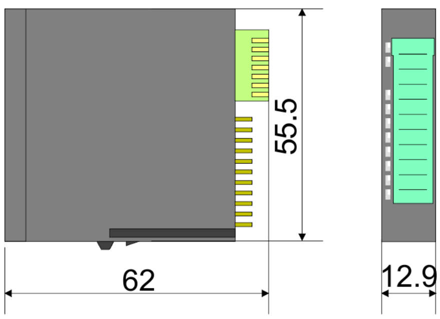
**Dimensions bus coupler**




**Dimensions periphery module**




**Dimensions electronic module**

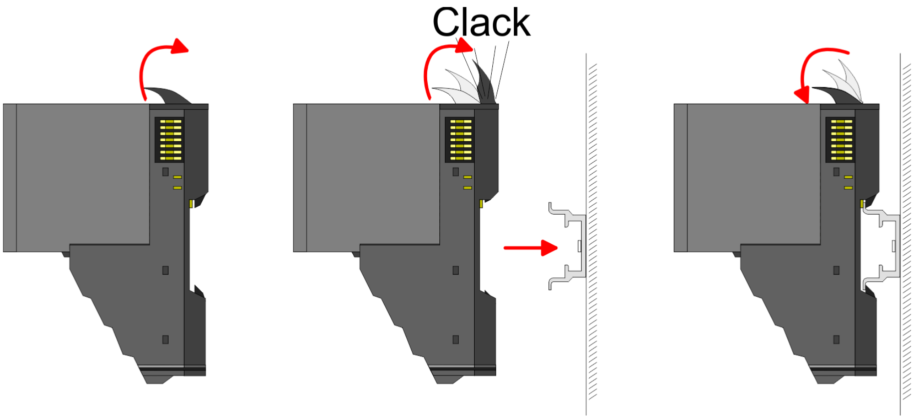



Dimensions in mm

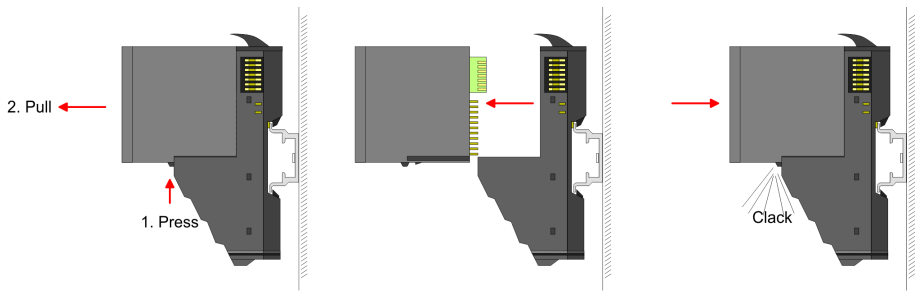
## 2.4 Installation

**Functional principle**

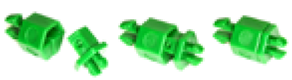
There is a locking lever at the top side of the terminal module. For mounting and demounting this locking lever is to be turned upwards until this engages audible. Now the module may be pulled forward. For mounting plug the module to the module installed before and push the module to the mounting rail 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.



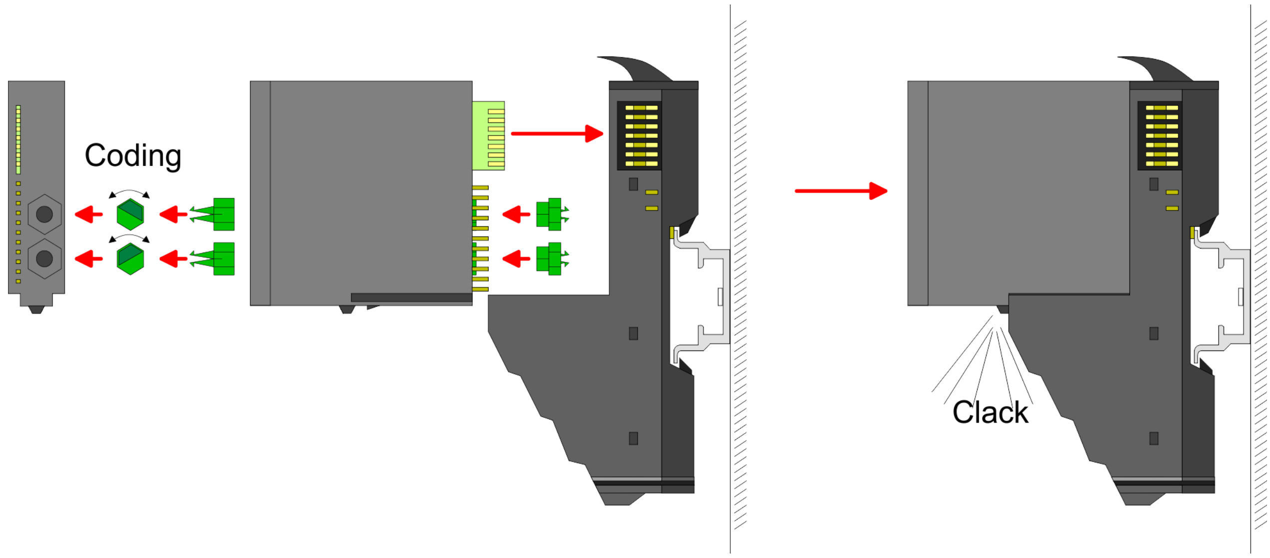

For the exchange of a electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.




**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.

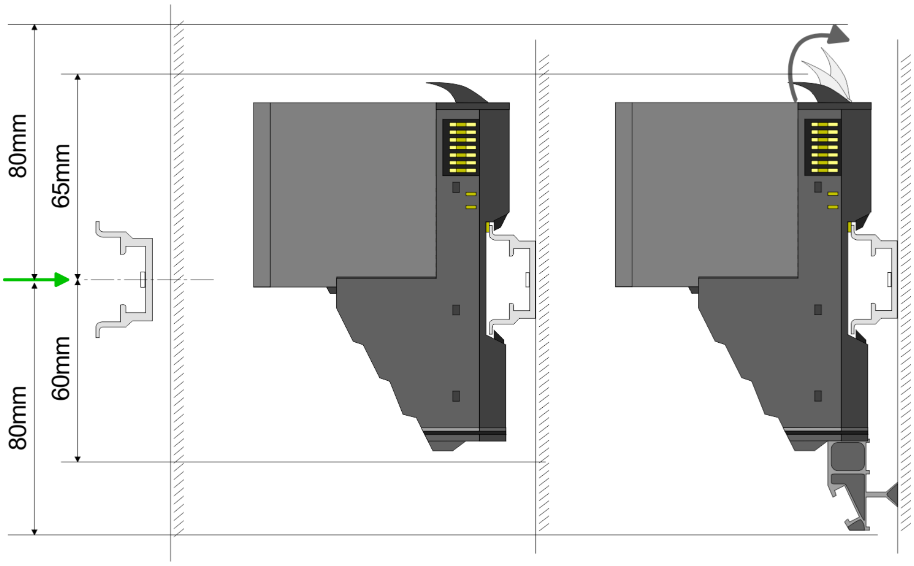
**CAUTION!**
Please consider that when replacing an already coded electronic module, this is always be replaced by an electronic module with the same coding.

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**

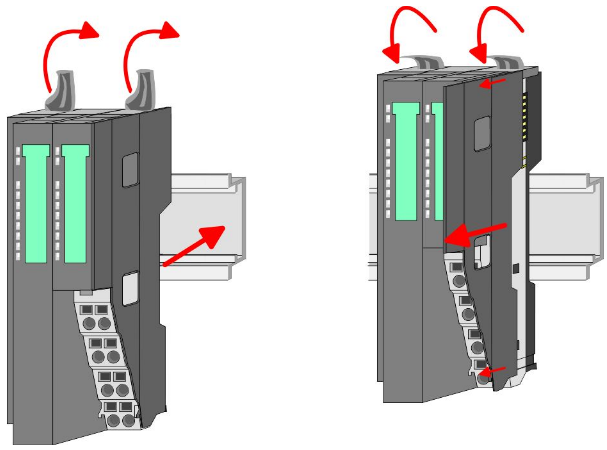
The modules were directly be mounted to the mounting rail and so connected to the backplane bus and the power supply for the electronic and power section. Up to 64 modules may be mounted. Please consider here that the sum current of the electronic power supply does not exceed the maximum value of 3A. 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



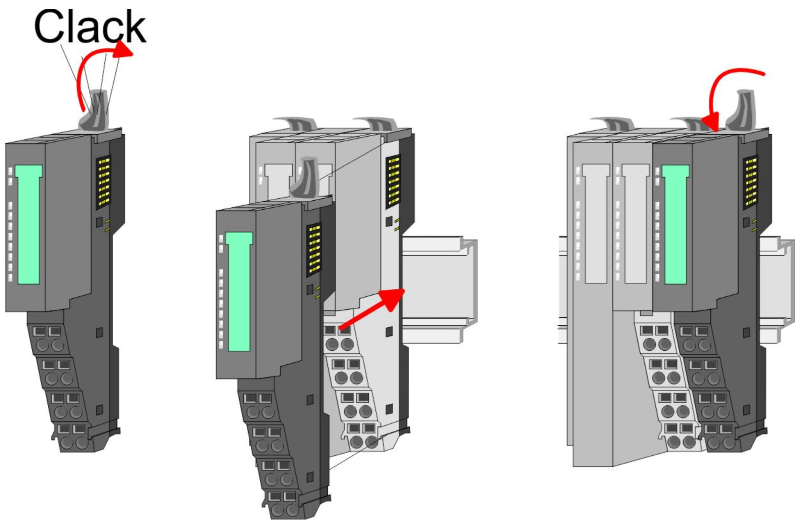

Mount the mounting rail! Please consider that a clearance from the middle of the mounting rail of at least 80mm above and 60mm below, respectively 80mm by deployment of shield bus carriers, exist.

Mounting Head module (e.g. bus coupler)



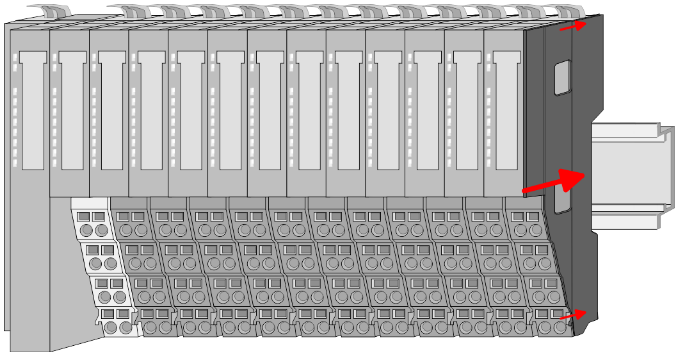
1. Start at the left side with the head module (e.g. bus coupler). For this turn both locking lever upwards, put the head module to the mounting rail and turn both locking lever downward.
2. Before mounting the periphery modules you have to remove the bus cover at the right side of the Head module by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

Mounting periphery modules



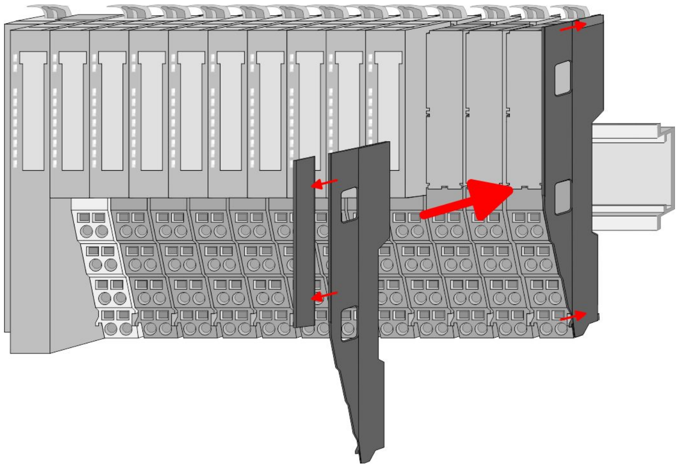

→ Mount the periphery modules you want.

Mounting the bus cover



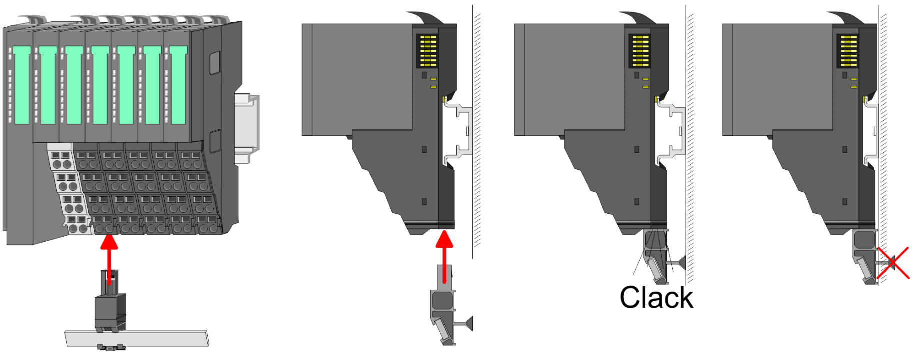
→ After mounting the whole system, to protect the backplane bus connectors at the last module you have to mount the bus cover, now.

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



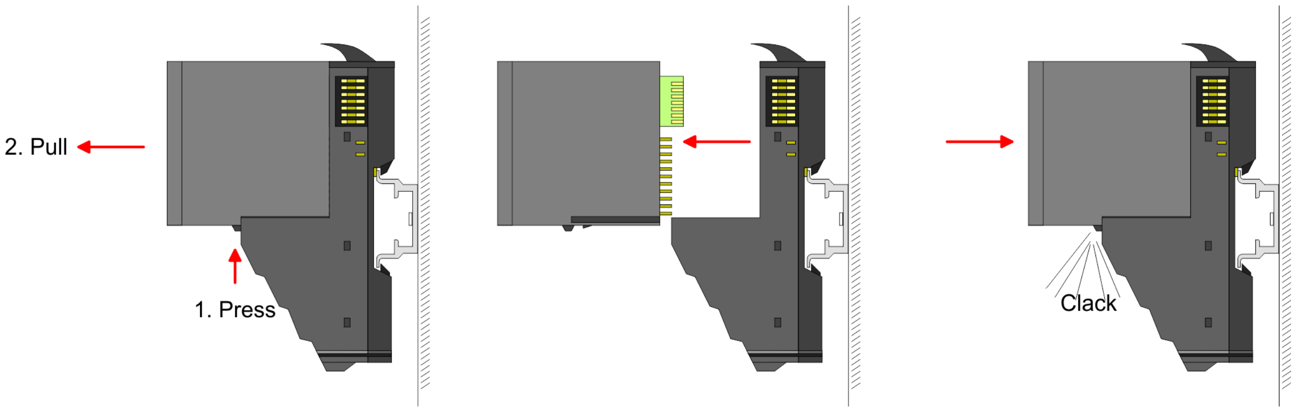

➞ The shield bus carrier (available as accessory) serves to carry the shield bus to connect cable shields. The shield bus carrier is mounted underneath the terminal of the terminal module. With a flat mounting rail for adaption to a flat mounting rail you may remove the spacer of the shield bus carrier.

## 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.

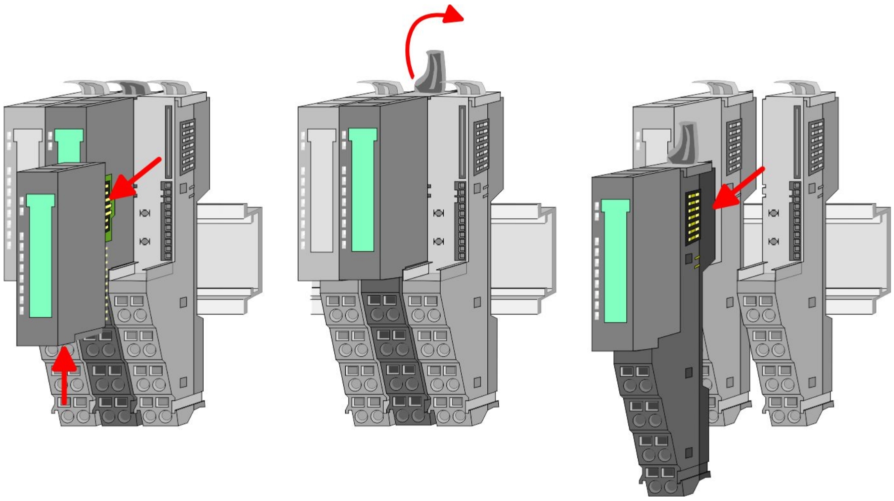
Exchange of an electronic module



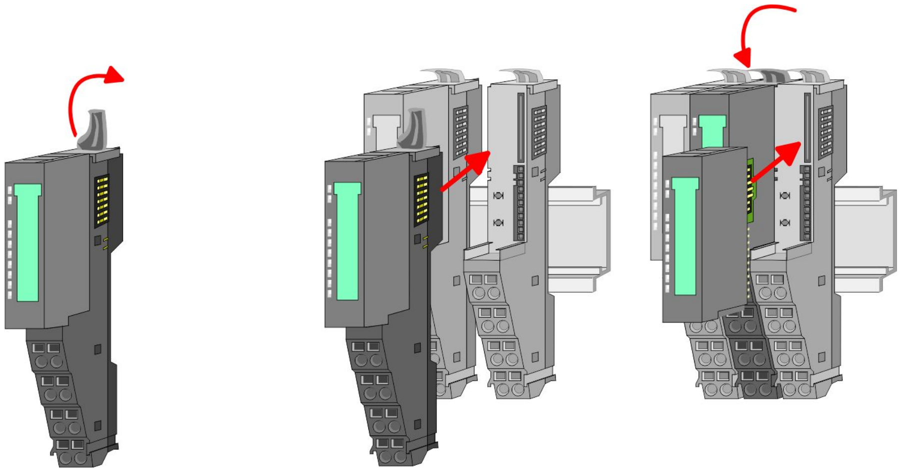

1. For the exchange of an electronic module, the electronic module may be pulled forward after pressing the unlocking lever at the lower side of the module.
2. For installation plug the electronic module guided by the strips at the lower side until this engages audible to the terminal module.

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.



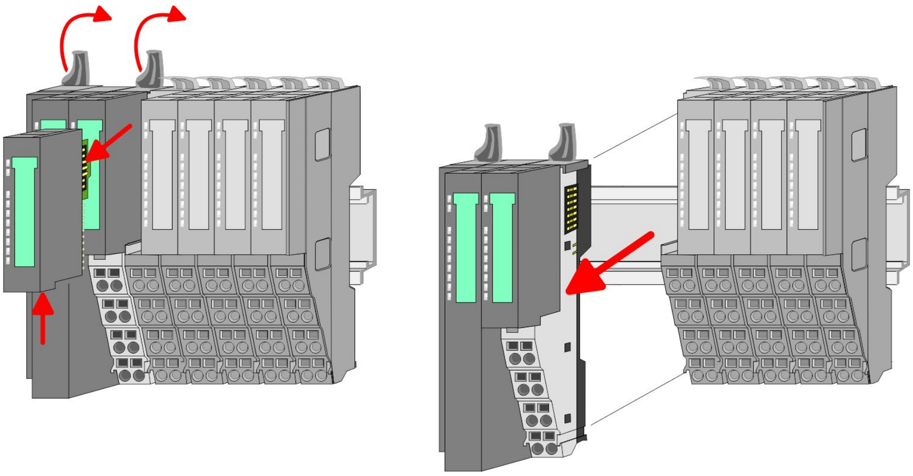
5. For mounting turn the locking lever of the module to be mounted upwards.
6. To mount the module put it to the gap between the both modules and push it, guided by the stripes at both sides, to the mounting rail.
7. Turn the locking lever downward again.
8. Plug again the electronic module, which you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

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

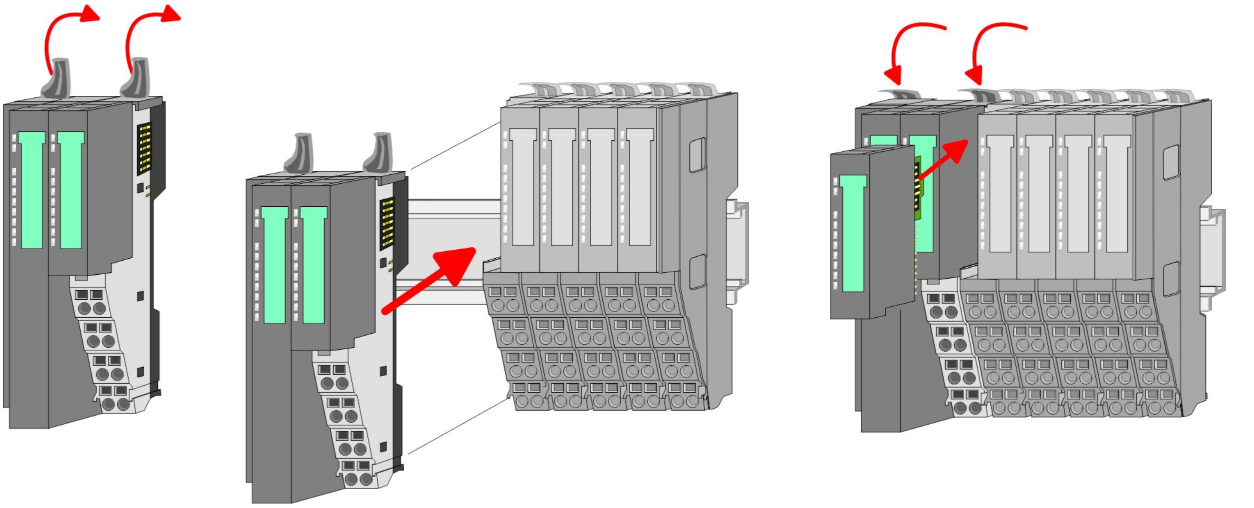
**CAUTION!**
Bus interface and power module of a head module may not be separated!

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.*



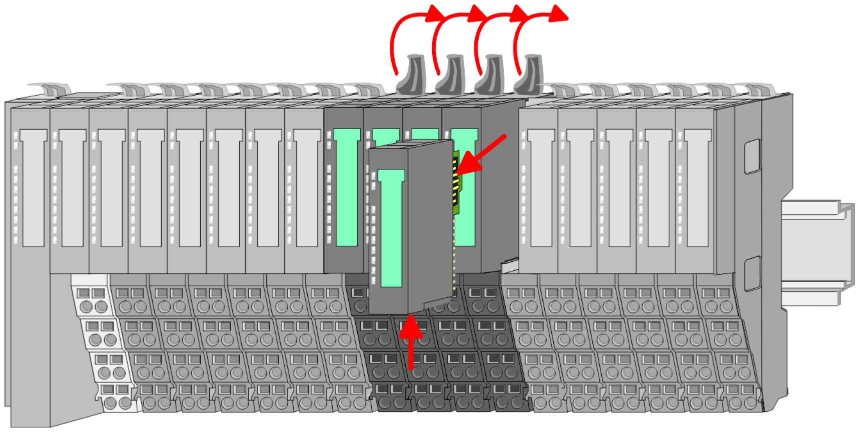
2. Press the unlocking lever at the lower side of the just mounted right module and pull it forward.
3. Turn all the locking lever of the head module to be exchanged upwards.
4. Pull the head module forward.



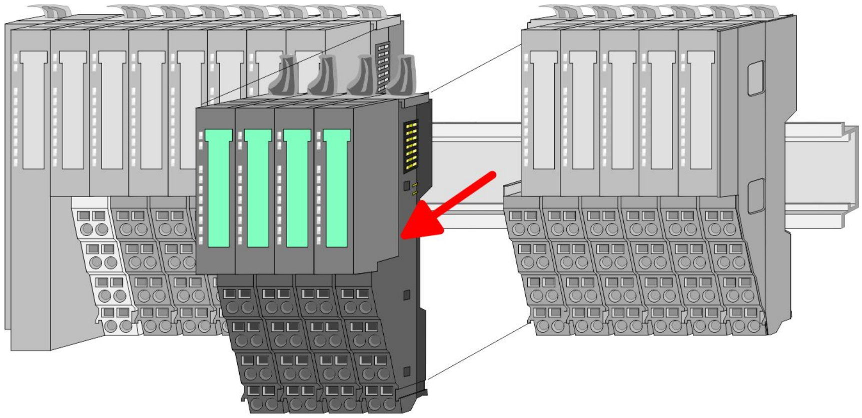
5. For mounting turn all the locking lever of the head module to be mounted upwards.
6. To mount the head module put it to the left module and push it, guided by the stripes, to the mounting rail.
7. Turn all the locking lever downward again.
8. Plug again the electronic module, which you have removed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

Exchange of a module group

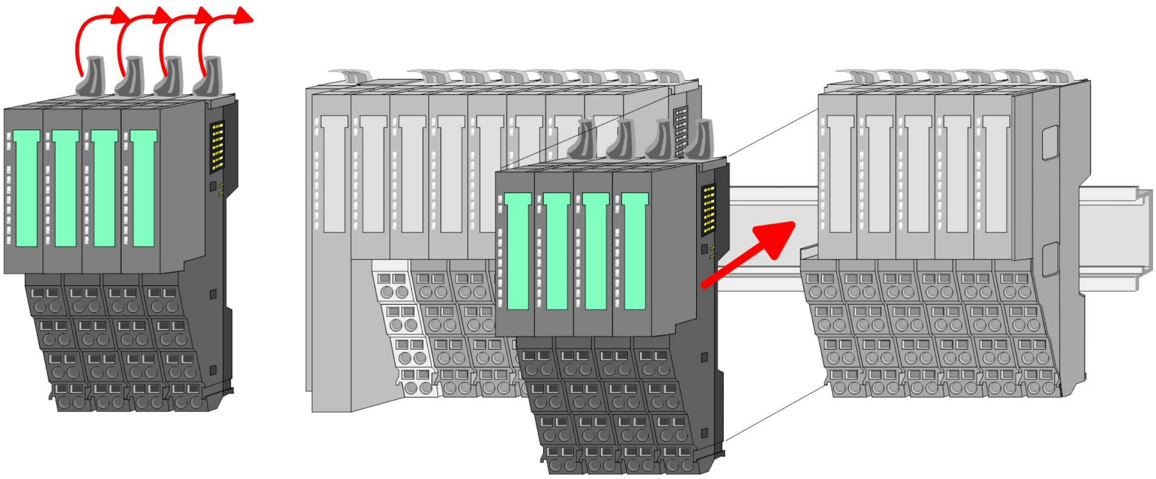
1. Remove if exists the wiring of the module group. ↳ *Chapter 2.6 'Wiring' on page 26*.



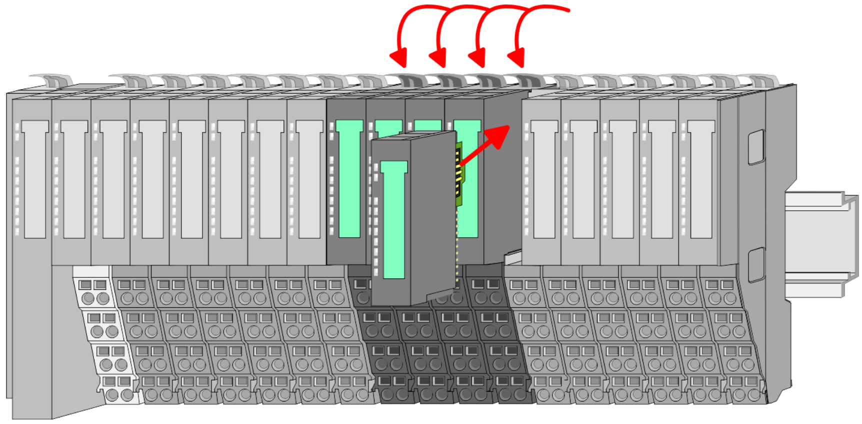
2. Press the unlocking lever at the lower side of the just mounted right module of the module group and pull it forward.



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

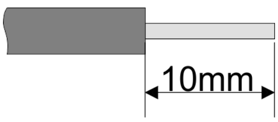
**Connectors**

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***



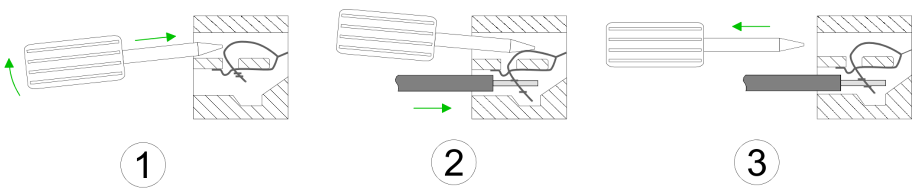

$U_{max}$: 240V AC / 30V DC

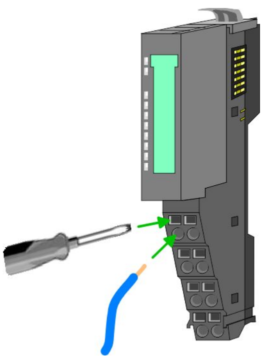
$I_{max}$: 10A

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

Stripping length: 10mm

***Wiring procedure***



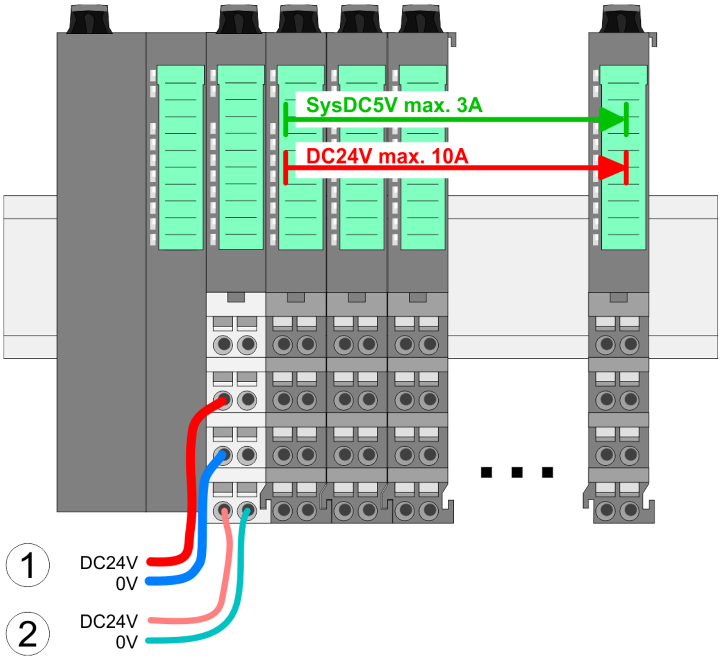



**1.** Insert a suited screwdriver at an angel into the square opening as shown. Press and hold the screwdriver in the opposite direction to open the contact spring.

**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$^2$.

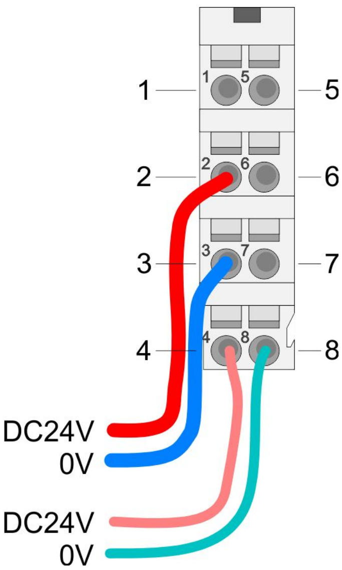
**3.** By removing the screwdriver, the wire is securely fixed via the spring contact to the terminal.

**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.

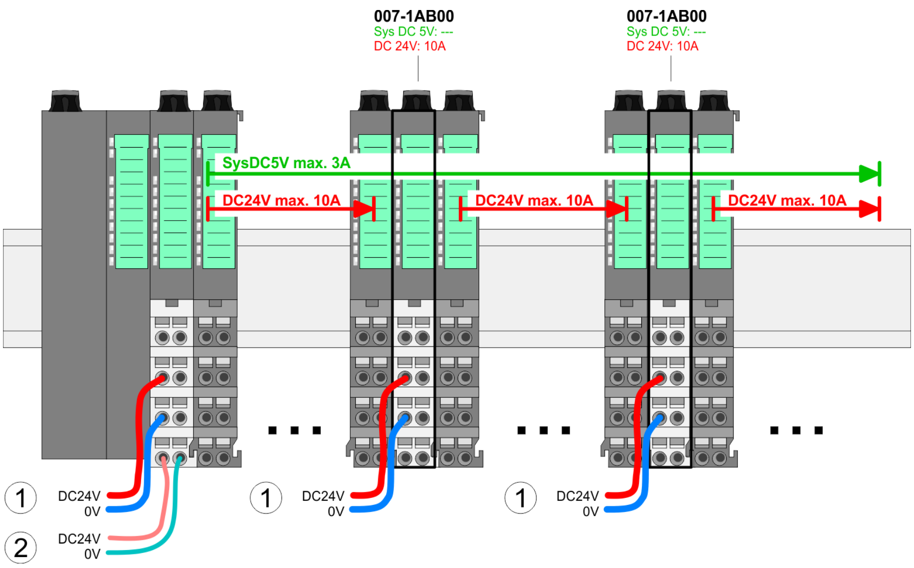
**Deployment of the power modules**

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.

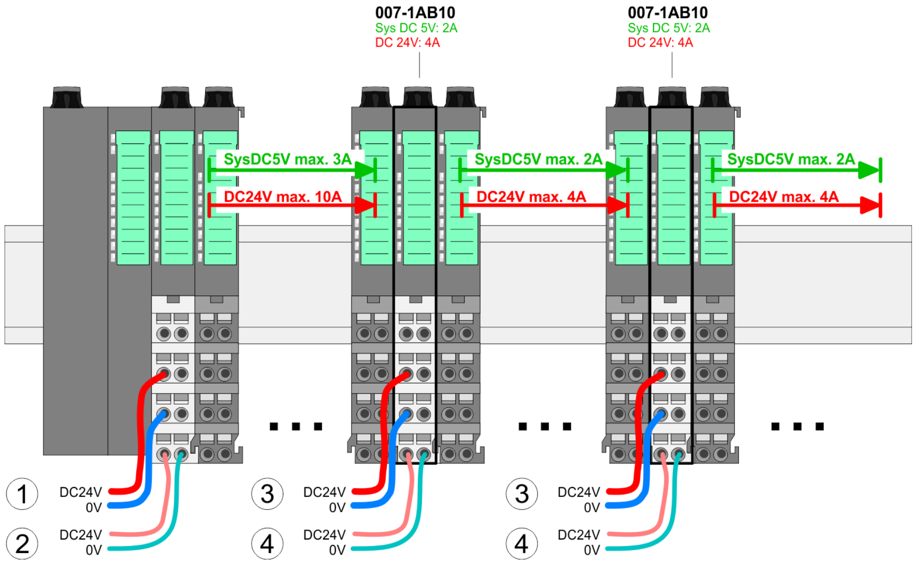
The power module with the order number 007-1AB10 is to be used if the 3A for the electronic power supply at the backplane bus is no longer sufficient. Additionally you get an isolated group for the DC 24V power section supply with 4A.

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

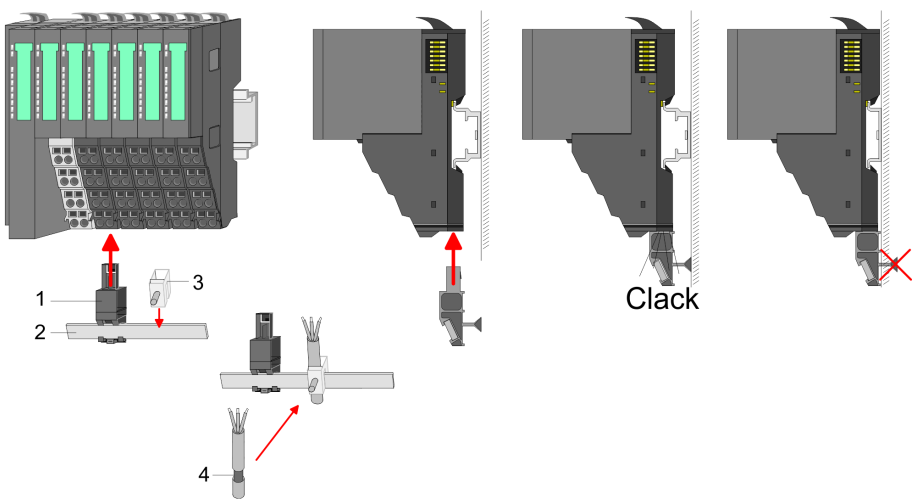
**Shield attachment**

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

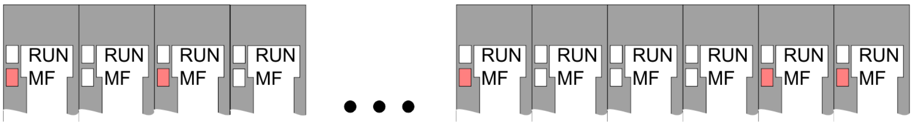
## 2.7 Trouble shooting - LEDs

**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**

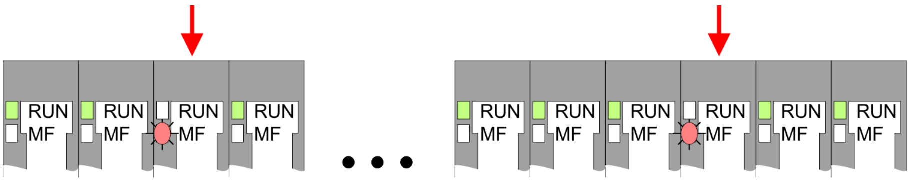



*Behaviour*: After PowerON the RUN LED of each module is off and the MF LED of each module is sporadically on.

*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**

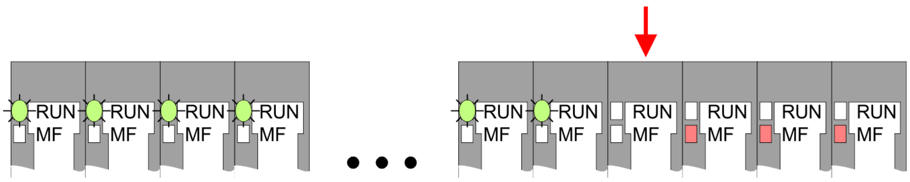



*Behaviour*: After PowerON the MF LED of one module respectively more modules flashes. The RUN LED remains off.

*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<br>8kV at air discharge (degree of severity 3),<br>4kV at contact discharge (degree of severity 2) |
| | | EN 61000-4-3 | HF field immunity (casing)<br>80MHz … 1000MHz, 10V/m, 80% AM (1kHz)<br>1.4GHz ... 2.0GHz, 3V/m, 80% AM (1kHz)<br>2GHz ... 2.7GHz, 1V/m, 80% AM (1kHz) |
| | | EN 61000-4-6 | HF conducted<br>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<br>Siemens S7 format<br>(11h) | 94.07mV | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{80}$<br>$U = D \cdot \frac{80}{27648}$ |
| | 80mV | 27648 | 6C00h | nominal range | |
| | 0V | 0 | 0000h | | |
| | -80mV | -27648 | 9400h | | |
| | -94.07mV | -32512 | 8100h | underrange | |
| -80 ... 80mV<br>Siemens S7 format<br>(21h) | 100mV | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{80}$<br>$U = D \cdot \frac{80}{16384}$ |
| | 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:<br>-50 ... +1769°C<br>-58 ... 3216.2°F<br>223.2 ... 2042.2K<br>(B3h: ext. comp. 0°C)<br>(C3h: int. comp. 0°C) | +20190 | 32766 | 22922 | overrange |
| | -500 ... +17690 | -580 ... 32162 | 2232 ... 20422 | nominal range |
| | -1700 | -2740 | 1032 | underrange |
| Type S:<br>-50 ... +1769°C<br>-58 ... 3216.2°F<br>223.2 ... 2042.2K<br>(B4h: ext. comp. 0°C)<br>(C4h: int. comp. 0°C) | +20190 | 32766 | 22922 | overrange |
| | -500 ... +17690 | -580 ... 32162 | 2232 ... 20422 | nominal range |
| | -1700 | -2740 | 1032 | underrange |
| Type T:<br>-270 ... +400°C<br>-454 ... 752°F<br>3.2 ... 673.2K<br>(B5h: ext. comp. 0°C)<br>(C5h: int. comp. 0°C) | +5400 | 10040 | 8132 | overrange |
| | -2700 ... +4000 | -4540 ... 7520 | 32 ... 6732 | nominal range |
| | --- | --- | --- | underrange |
| Type B:<br>0 ... +1820°C<br>32 ... 2786.5°F<br>273.2 ... 2093.2K<br>(B6h: ext. comp. 0°C)<br>(C6h: int. comp. 0°C) | +20700 | 32766 | 23432 | overrange |
| | 0 ... +18200 | 320 ... 27865 | 2732 ... 20932 | nominal range |
| | -1200 | -1840 | 1532 | underrange |
| Type C:<br>0 ... +2315°C<br>32 ... 2786.5°F<br>273.2 ... 2093.2K<br>(B7h: ext. comp. 0°C)<br>(C7h: int. comp. 0°C) | +25000 | 32766 | 23432 | overrange |
| | 0 ... +23150 | 320 ... 27865 | 2732 ... 20932 | nominal range |
| | -1200 | -1840 | 1532 | underrange |
| Type E:<br>-270 ... +1000°C<br>-454 ... 1832°F<br>0 ... 1273.2K<br>(B8h: ext. comp. 0°C)<br>(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:<br>-200 ... +900°C<br>-328 ... 1652°F<br>73.2 ... 1173.2K<br>(B9h: ext. comp. 0°C)<br>(C9h: int. comp. 0°C) | +11500 | 21020 | 14232 | overrange |
| | -2000 ... +9000 | -3280 ... 16520 | 732 ... 11732 | nominal range |
| | --- | --- | --- | underrange |

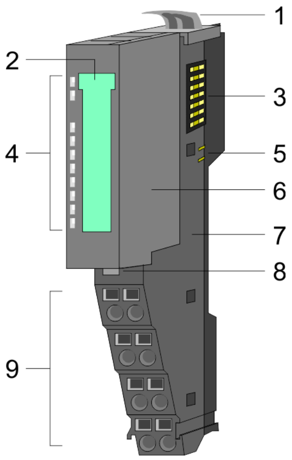
## 3.4 031-1BB10 - AI 2x12Bit 0(4)...20mA - ISO

**Properties**

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

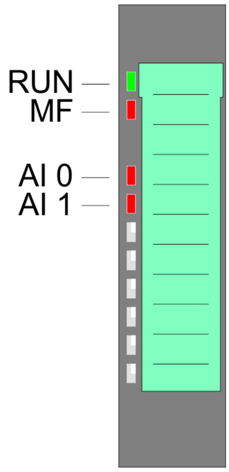
- 2 galvanically separated analog inputs
- Integrated sensor supply for each channel max. 35mA, (short circuit to 39mA)
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Interrupt and diagnostics function
- 12bit resolution

**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

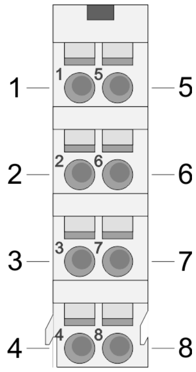
### Status indication

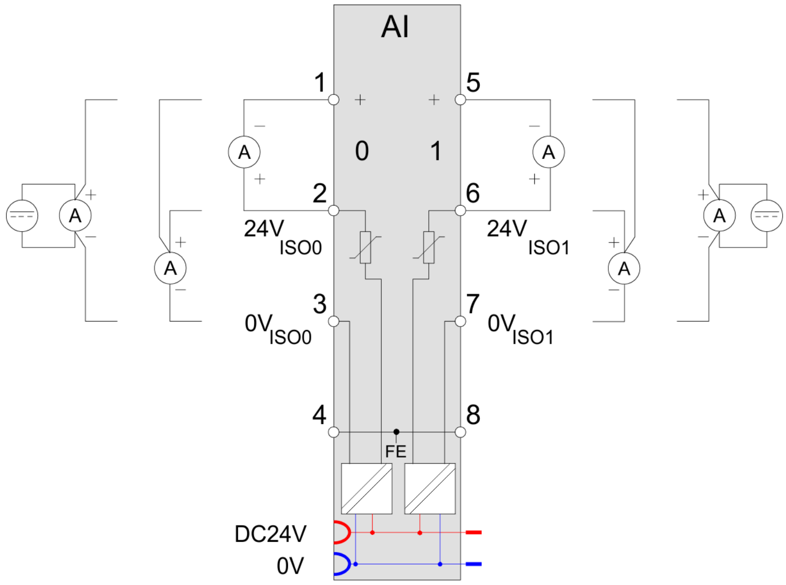



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ➡ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ Error in parameterization<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>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 | - |

| Order no. | 031-1BB10 |
|---|---|
| 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 | 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) | - |

| Order no. | 031-1BB10 |
|---|---|
| Max. potential difference between inputs and Mana (Ucm) | DC 75 V/ AC 60 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 |

## 3.4.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

| 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 | 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Monitoring of sensor voltage channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**LIMIT_EN Limit value monitoring**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit value monitoring channel 0 (1: on)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ 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**

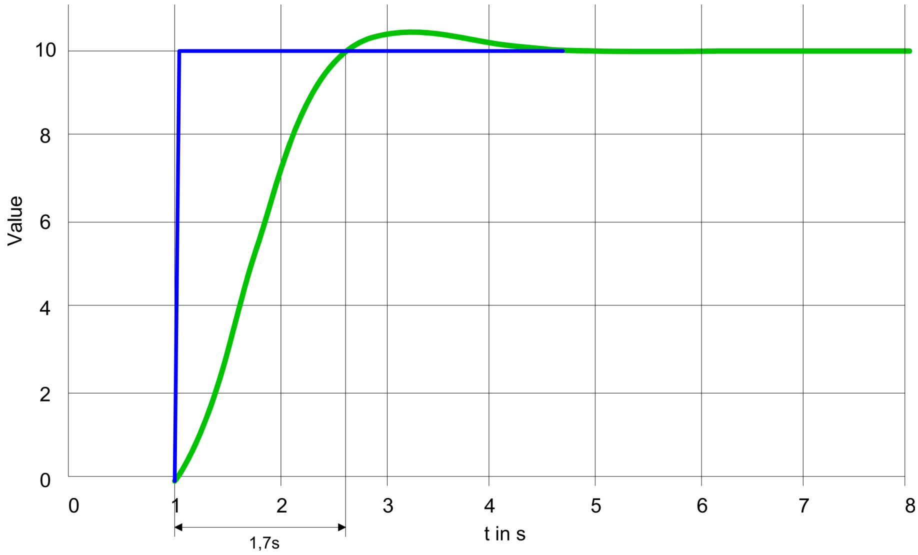
| Meas. range (funct. no.) | Current (I) | Decimal (D) | Hex | Range | Formulas |
|---|---|---|---|---|---|
| 0 ... 20mA 4KM format (3Fh) | 20.457mA | 4095 | 0FFFh | overrange | $D = 4000 \cdot \frac{I}{20}$ $I = D \cdot \frac{20}{4000}$ |
| | 20mA | 4000 | 0FA0h | nominal range | |
| | 10mA | 2000 | 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Upper limit overflow channel 1<br>■ Bit 7 ... 2: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Lower limit underflow channel 0<br>■ Bit 1: Lower limit underflow channel 1<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

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

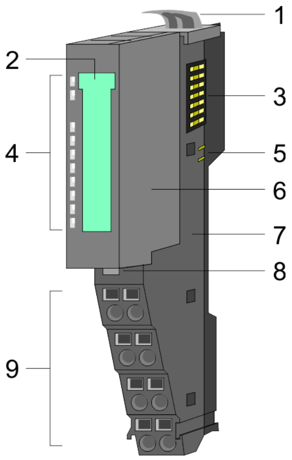
## 3.5 031-1BB30 - AI 2x12Bit 0...10V

**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.

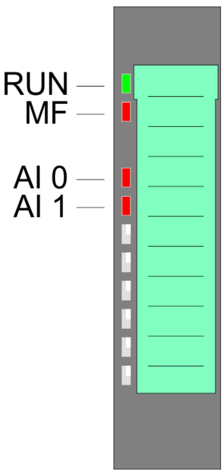
- 2 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

**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**

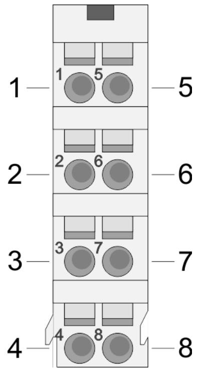


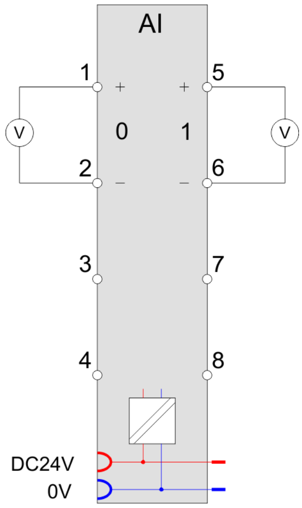

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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 | - |

| Order no. | 031-1BB30 |
|---|---|
| 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 |
| Channel error display | red LED per channel |
| **Isolation** | |
| Between channels | - |
| Between channels of groups to | - |

| Order no. | 031-1BB30 |
|---|---|
| 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 |

### 3.5.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>Siemens S7 format<br>(10h) | 11.76V | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{27648}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -1.76V | -4864 | ED00h | underrange | |
| 0 ... 10V<br>Siemens S5 format<br>(20h) | 12.5V | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{16384}$ |
| | 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

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

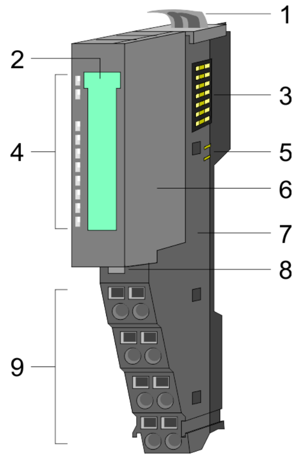
## 3.6 031-1BB40 - AI 2x12Bit 0(4)...20mA

**Properties**

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

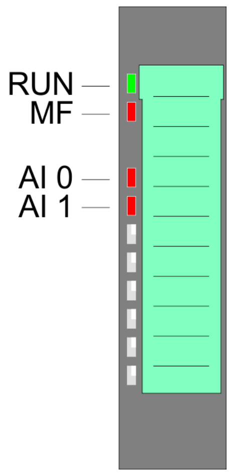
- 2 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Diagnostics function
- 12bit resolution

**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

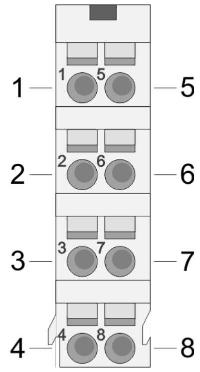
**Status indication**

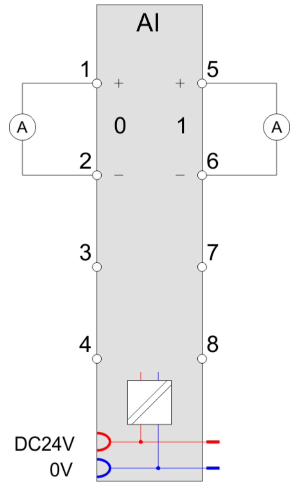



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○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

*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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>+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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

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

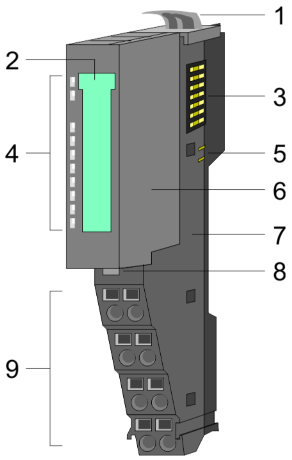
## 3.7 031-1BB60 - AI 2x12Bit 0(4)...20mA - Sensor

**Properties**

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

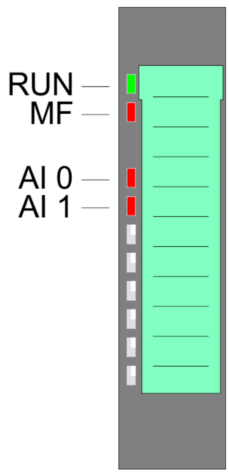
- 2 analog inputs
- Integrated sensor supply
- Suited for sensors with 0(4) ... 20mA with external supply
- Diagnostics function
- 12bit resolution

**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**



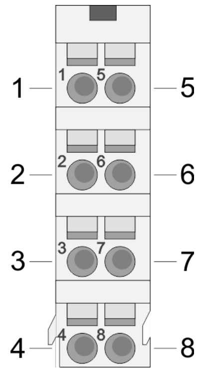

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○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

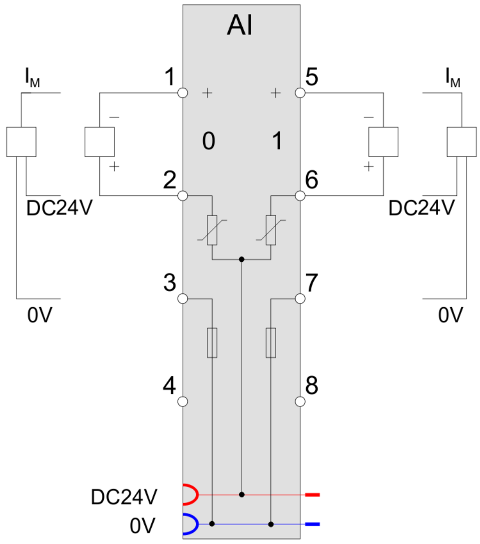
| RUN | MF | AI x | Description |
|---|---|---|---|
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ Error in parameterization |
| on: ● \| off: ○ \| blinks with 2Hz: B \| not relevant: X | | | |

*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<br>(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<br>(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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>+4 mA ... +20 mA |
| Operational limit of current ranges | +/-0.5% |

| **Order no.** | **031-1BB60** |
|---|---|
| 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 | - |
| 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 |

| **Order no.** | **031-1BB60** |
|---|---|
| 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) | - |
| 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

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

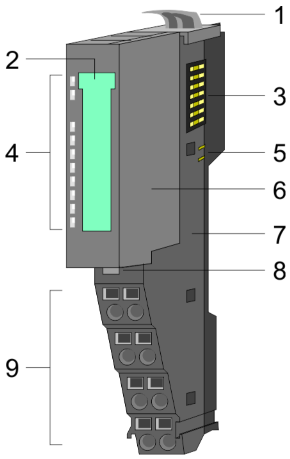
## 3.8 031-1BB70 - AI 2x12Bit ±10V

**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.

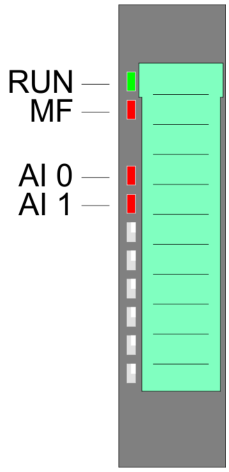
- 2 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

**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

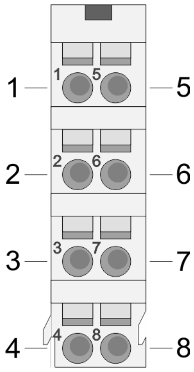
**Status indication**

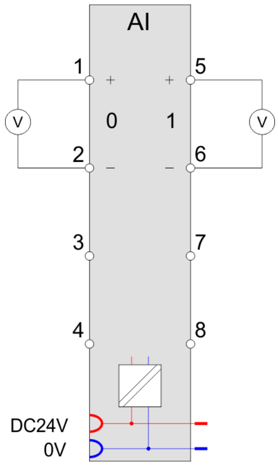



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

*ERR_A Diagnostic*

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

*MODTYP Module information*

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

*ERR_D Diagnostic*

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

*CHTYP Channel type*

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

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

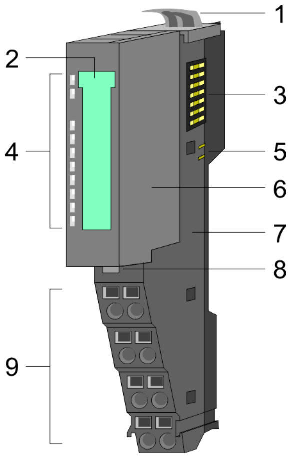
## 3.9 031-1BB90 - AI 2x16Bit TC

**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.

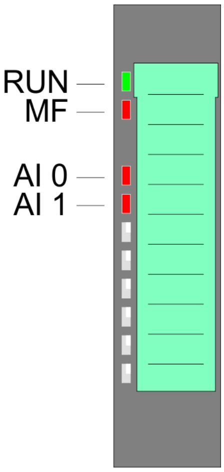
- 2 analog inputs
- Suited for sensors with type J, K, N, R, S, T, B, C, E, L and for voltage measuring ± 80mV
- Interrupt and diagnostics function
- 16bit resolution
- Internal temperature compensation
- High potential gradient of DC140V/AC60V between the inputs

**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

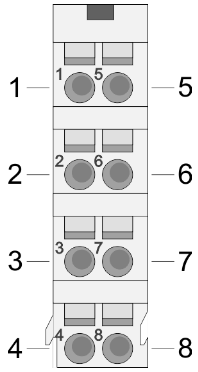
**Status indication**

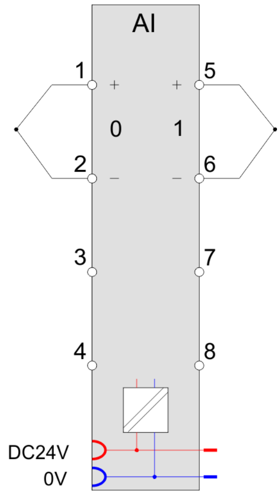



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ➪ *Chapter 2.7 ‘Trouble shooting - LEDs’ on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ Error in parameterization<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>type C<br>type E<br>type J<br>type K<br>type L<br>type N<br>type R<br>type S<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| CH1FO | 1 | Function option channel 1 | 02h | 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 |
| * This record set may only be transferred at STOP state. | | | | | | |

**DIAG_EN Diagnostic interrupt**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Diagnostics interrupt<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Wire break recognition channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**LIMIT_EN Limit value monitoring**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit value monitoring channel 0 (1: on)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**TEMPCNF Temperature system**

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

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0, 1: Interference frequency suppression<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>Bit 1: Limit overflow channel 1<br>Bit 7 ... 2: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Bit 0: Limit underflow channel 0<br>Bit 1: Limit underflow channel 1<br>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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

*ERR_A Diagnostic*

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

*MODTYP Module information*

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

*ERR_D Diagnostic*

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

*CHTYP Channel type*

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

**CH0ERR / CH1ERR Channel-specific**

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

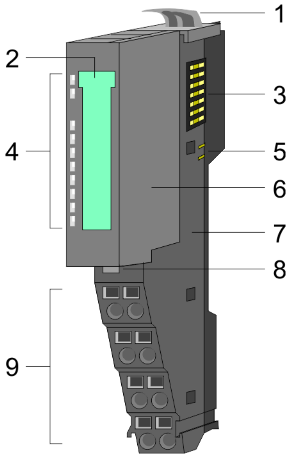
## 3.10 031-1BD30 - AI 4x12Bit 0...10V

**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.

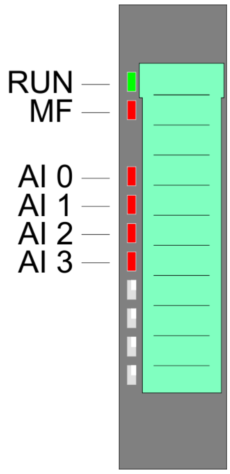
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

## 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

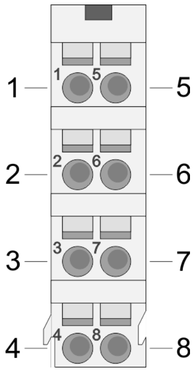
## Status indication

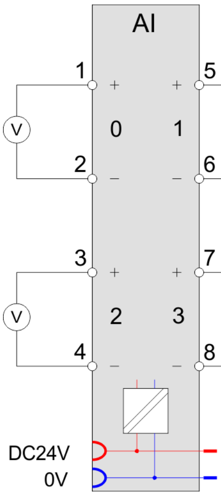



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ↪ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

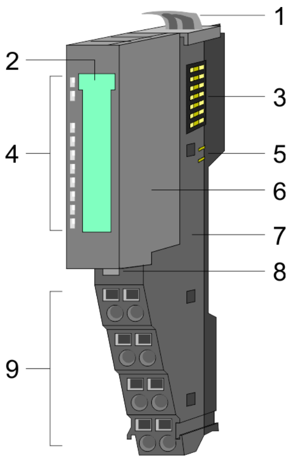
## 3.11 031-1BD40 - AI 4x12Bit 0(4)...20mA

**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.

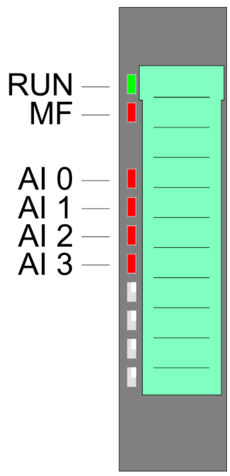
- 4 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Diagnostics function
- 12bit resolution

**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**

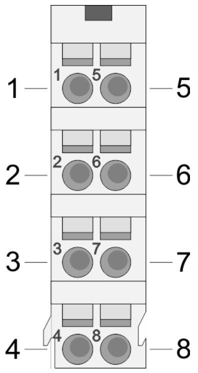


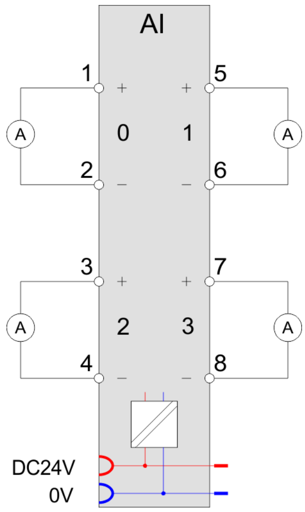

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

### 3.11.1 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 |

| **Order no.** | **031-1BD40** |
|---|---|
| Input current ranges | 0 mA ... +20 mA<br>+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 | - |
| 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 |

| Order no. | 031-1BD40 |
| --- | --- |
| 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 |
| 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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. 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

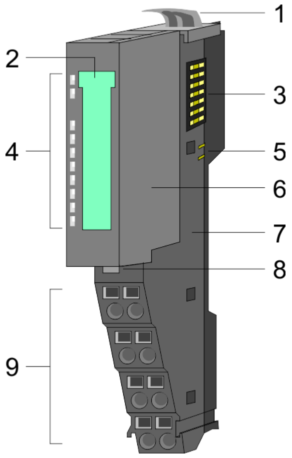
## 3.12 031-1BD70 - AI 4x12Bit ±10V

**Properties**

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

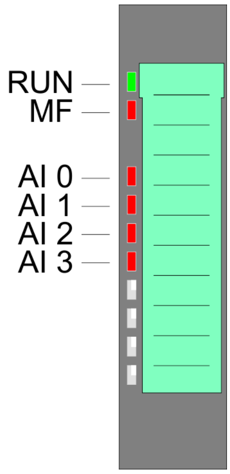
- 4 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

**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

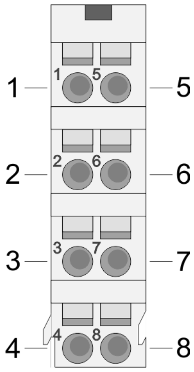
**Status indication**

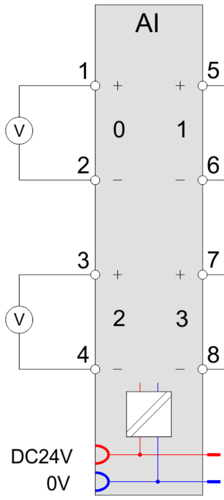



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ↯ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>Siemens S7 format<br>(12h) | 11.76V | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{27648}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -5V | -13824 | CA00h | | |
| | -10V | -27648 | 9400h | | |
| | -11.76V | -32512 | 8100h | underrange | |
| ±10V<br>Siemens S5 format<br>(22h) | 12.5V | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{16384}$ |
| | 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

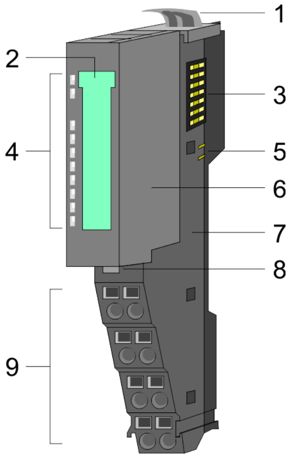
## 3.13 031-1BD80 - AI 4x16Bit R/RTD

**Properties**

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

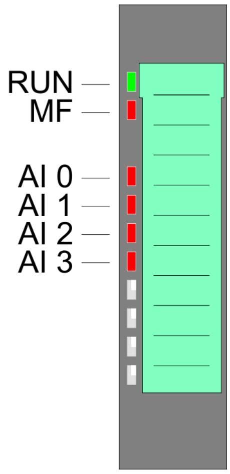
- 4 analog inputs
- Suited for resistance-type sensors 0 ... 3000Ω
  and resistance temperature sensors Pt100, Pt1000, NI100 and NI1000
- Resistance measurement with 2, 3 and 4 wire
  (3 and 4 wire only via channel 0 respectively 1)
- Interrupt and diagnostics function
- 16bit resolution

**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

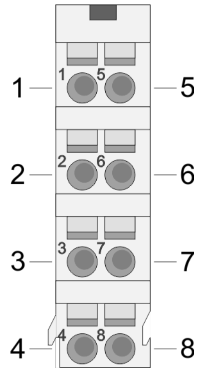
**Status indication**

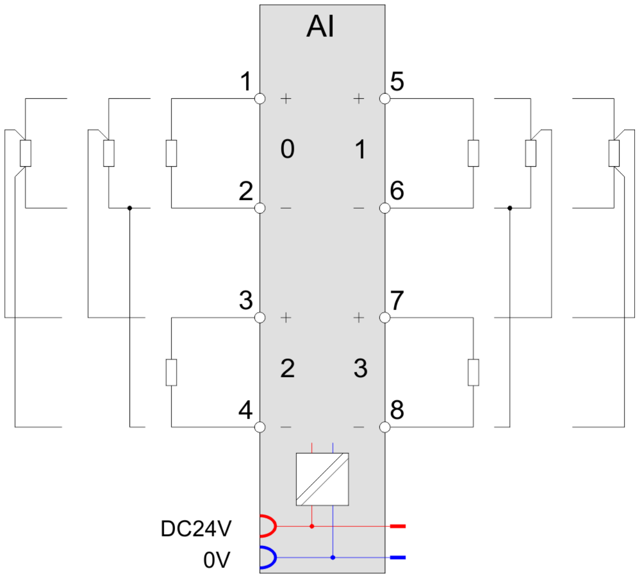



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ➔ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ Error in parameterization<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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** | |

| Order no. | 031-1BD80 |
|---|---|
| Current consumption from backplane bus | 75 mA |
| 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<br>0 ... 600 Ohm<br>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<br>Pt1000<br>Ni100<br>Ni1000 |
| Operational limit of resistance thermometer ranges | +/- 0.4 % |

| Order no. | 031-1BD80 |
|---|---|
| Basic error limit thermoresistor ranges | +/- 0.2 % |
| 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 - Record set for access via CPU, PROFIBUS and PROFINET

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Wire break recognition channel 1 (1: on)<br>■ Bit 2: Wire break recognition channel 2 (1: on)<br>■ Bit 3: Wire break recognition channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**LIMIT_EN Limit value monitoring**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit value monitoring channel 0 (1: on)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 2: Limit value monitoring channel 2 (1: on)<br>■ Bit 3: Limit value monitoring channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**TEMPCNF Temperature system**

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

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0, 1: Interference frequency suppression<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>Bit 1: Limit overflow channel 1<br>Bit 7 ... 4: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Bit 0: Limit underflow channel 0<br>Bit 1: Limit underflow channel 1<br>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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnose***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR/CH3ERR Channel-specific***

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

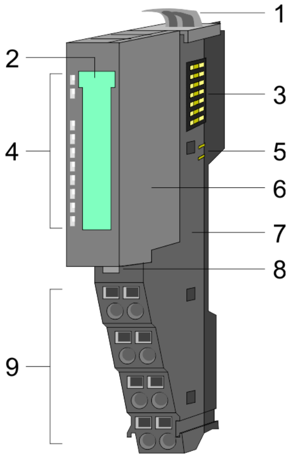
## 3.14 031-1CA20 - AI 1x16Bit Strain gauge (DMS)

**Properties**

The electronic module has one channel and is suited to connect it to a strain gauge DMS sensor in load cells, force transducer and torque measuring shaft. The module has a configurable input filter and supports diagnostic interrupt.

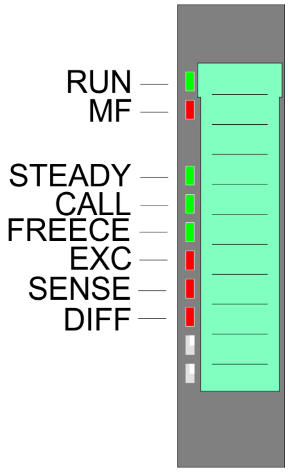
- 1-channel for connecting a full bridge
- Absolute accuracy (basic error ±0.1%)
- Manual calibration (zero and load adjustment)
- Configurable self-calibration (offset and gain error)
- Fast measurement by high signal bandwidth (ADC with 4 kHz limit frequency)
- Parametrizable IIR filter (300µs - 3.6s or dynamic)
- Parametrizable 50/60 Hz rejection
- Programmable power supply for the load cell(s) / full bridge(s)
- Parallel operation of load cells possible
- Diagnostic 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**



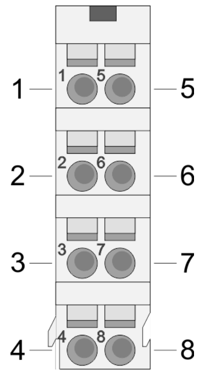

| RUN | MF | Description |
|---|---|---|
| green | red | |
| ● | ○ | Bus communication is OK<br>Module status is OK |
| ● | ● | Bus communication is OK<br>Module status reports an error |
| ○ | ● | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | Error at bus power supply |
| X | B | Error in configuration ↬ *Chapter 2.7 ‘Trouble shooting - LEDs’ on page 30* |
| on: ● \| off: ○ \| blinking (2Hz): B \| not relevant: X | | |

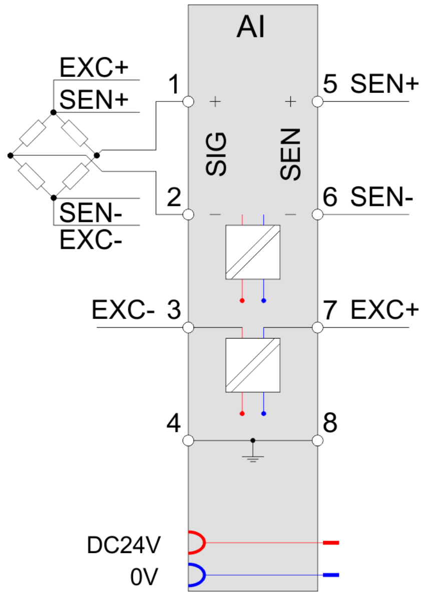
| STEADY | CAL | FREECE | EXC | SENSE | DIFF | Description |
|---|---|---|---|---|---|---|
| green | green | green | red | red | red | |
| ● | X | X | X | X | X | On in *Steady State*. |
| X | ● | X | X | X | X | On at active self-calibration |
| X | X | ● | X | X | X | On at activated *Input-Freeze*. |
| X | X | X | ● | X | X | On at short circuit respectively overload of the excitation voltage. |
| X | X | X | X | ● | X | On at overrange of the excita-tion voltage |

| STEADY | CAL | FREECE | EXC | SENSE | DIFF | Description |
|---|---|---|---|---|---|---|
| X | X | X | X | X | ● | On at overrange of the differential voltage |
| on: ● \| off: ○ \| blinking (2Hz): B \| not relevant: X | | | | | | |

**Pin assignment**

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



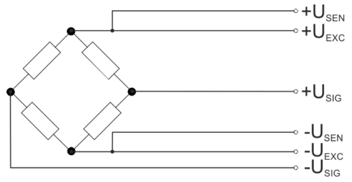




| Pos. | Function | Type | Description |
|---|---|---|---|
| 1 | SIG+ | I | + Signal of the differential voltage $U_{SIG}$ of the measuring bridge |
| 2 | SIG- | I | - Signal of the differential voltage $U_{SIG}$ of the measuring bridge |
| 3 | EXC- | O | - Signal of the excitation voltage $U_{EXC}$ |
| 4 | Shield | --- | Connection for cable shield |
| 5 | SEN+ | I | + Sensor of the excitation voltage $U_{SEN}$ |
| 6 | SEN- | I | - Sensor of the excitation voltage $U_{SEN}$ |
| 7 | EXC+ | O | + Signal of the excitation voltage $U_{EXC}$ |
| 8 | Shield | --- | Connection for cable shield |
| O: Output, I: Input | | | |

*Please always use the excitation voltage $U_{EXC}$ of the module! The connection of sensors with external power supply is not possible.*

### 3.14.1 Connection variants

**6 wire measurement**

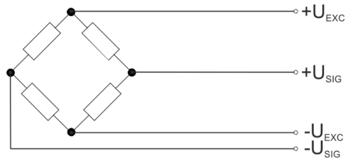



The following table shows the properties of the sensors, which can be used with the 6 wire measurement.

**Sensor properties**

| Excitation voltage $U_{EXC}$ | Bridge resistance $R_B$ | | | |
|---|---|---|---|---|
| | 120Ω | 350Ω | 700Ω | 1000Ω |
| 2.5V | X | X | X | X |
| 5V | X | X | X | X |
| 7.5V | X | X | X | X |
| 10V | X | X | X | X |
| 12V | X | X | X | X |

**4 wire measurement**



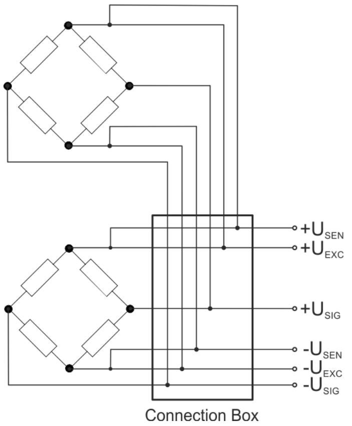

With the 4 wire measurement the $U_{SEN}$ pins are not connected. With this operating mode there is an internal connection between $U_{EXC}$ and $U_{SEN}$.

The following table shows the properties of the sensors, which can be used with the 4 wire measurement.

**Sensor properties**

| Excitation voltage $U_{EXC}$ | Bridge resistance $R_B$ | | | |
|---|---|---|---|---|
| | 120Ω | 350Ω | 700Ω | 1000Ω |
| 2.5V | X | X | X | X |
| 5V | X | X | X | X |
| 7.5V | X | X | X | X |
| 10V | X | X | X | X |
| 12V | X | X | X | X |

### Parallel connection




Normally large mechanical loads are divided to multiple strain gauge DMS load cells and these parallel connected via a connection box to the strain gauge DMS module. Please consider that the load cells are aligned together for this operating mode and approved by the manufacturer. And the current feed capacity of the transducer electronic should not be overloaded. The current feed capacity is derived from the number of parallel-connected load cells, excitation voltage $U_{EXC}$ and the bridge resistance.

Depending on the excitation voltage $U_{EXC}$, $I_{EXC}$ may not exceed a maximum current:

- 2.5V: maximum current 120mA
- 5V: maximum current 120mA
- 7.5V: maximum current 100mA
- 10V: maximum current 90mA
- 12V: maximum current 80mA

For the calculation of $I_{EXC}$ the following formula is used:

$$I_{EXC} = \frac{U_{EXC}}{\frac{R_B}{n}}$$

$I_{EXC}$ Supply current
$U_{EXC}$ Excitation voltage
$R_B$ Bridge resistance
$n$ Number of parallel connections

The following tables show the properties of the sensors for e.g. 2 respectively 3 parallel connected load cells.

#### Example

| 2 parallel | Bridge resistance $R_B$ | | | |
|---|---|---|---|---|
| **Excitation voltage $U_{EXC}$** | **60Ω** | **175Ω** | **350Ω** | **500Ω** |
| 2.5V | X | X | X | X |
| 5V | X | X | X | X |
| 7.5V | not possible | X | X | X |
| 10V | not possible | X | X | X |
| 12V | not possible | X | X | X |

| 3 parallel | Bridge resistance $R_B$ | | | |
|---|---|---|---|---|
| **Excitation voltage $U_{EXC}$** | **40Ω** | **116.7Ω** | **233.3Ω** | **333.3Ω** |
| 2.5V | X | X | X | X |
| 5V | not possible | X | X | X |
| 7.5V | not possible | X | X | X |
| 10V | not possible | X | X | X |
| 12V | not possible | not possible | X | X |

*To connect your sensors please always use shielded cables!*

*Please always use the excitation voltage $U_{EXC}$ of the module! The connection of sensors with external power supply is not possible.*

### 3.14.2 In-/Output area

**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 (6000h/7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

**Input area**

| Addr. | Name | Bytes | Function | IX | SX |
|---|---|---|---|---|---|
| +0 | DMS_VAL | 4 | Measured value | 5470h/s | 01h |
| +3 | DMS_STAT | 1 | Status | 5471h/s | 02h |

***DMS_VAL measured value*** **(weight value)**

| | Byte 0 | | | | | | | | Byte 1 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit number | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| Signifi-cance | SG | $2^{30}$ | $2^{29}$ | $2^{28}$ | $2^{27}$ | $2^{26}$ | $2^{25}$ | $2^{24}$ | $2^{23}$ | $2^{22}$ | $2^{21}$ | $2^{20}$ | $2^{19}$ | $2^{18}$ | $2^{17}$ | $2^{16}$ |
| 31Bit+SG | SG | **Measured value ...** | | | | | | | | | | | | | | |

| | Byte 2 | | | | | | | | Byte 3 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit number | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Signifi-cance | $2^{15}$ | $2^{14}$ | $2^{13}$ | $2^{12}$ | $2^{11}$ | $2^{10}$ | $2^{9}$ | $2^{8}$ | $2^{7}$ | $2^{6}$ | $2^{5}$ | $2^{4}$ | $2^{3}$ | $2^{2}$ | $2^{1}$ | $2^{0}$ |
| 31Bit+SG | **... Measured value** | | | | | | | | | | | | | | | |

### *DMS_STAT Status*

| Addr. | Name | Bytes | Function |
|---|---|---|---|
| +3 | DMS_STAT | 1 | ■ Status byte<br>– Bit 0: 1 = *Input Freeze* active<br>– Bit 1: 1 = *Steady State* active *<br>– Bit 2: 1 = Self-calibration is running *<br>– Bit 3: 1 = Tara was changed<br>– Bit 4: 1 = Error in adjustment<br>– Bit 5: 1 = Adjustment was changed<br>– Bit 6: reserved<br>– Bit 7: 1 = Zero balance respectively reference point set |
| *) These status bits are set by internal event of the module. | | | |

- Input Freeze
  - In the activated state no measurement values are passed to the digital filter.
  - As long as the command bit is set, this bit remains set.
- Steady State
  - As soon as a measured value is longer than the time *SSW* within the tolerance window *SST*, in the status word the *Steady State* bit is set.
  - As soon as this condition is not true, the last measured value is first used, the comparison timer restarted and the bit is reset.
  - The values *SSW* and *SST* can be specified by the parametrization. *Chapter 3.14.5 'Parameter data' on page 158*
- Self calibration
  - As long as the self calibration is active, this bit is set.
  - During the self calibration there are two reference values internally measured and based on this the internal offset & factor are calculated.
  - With the self calibration the internal offset and gain error may be compensated.
  - The calibration interval *CI* can be preset by the parametrization.
- Tara
  - When setting or clearing the tare value, this bit is set.
  - As long as the corresponding command bit is set, this bit remains set.

- Adjustment
  - When you save or delete the adjustment data, this bit is set.
  - As long as the corresponding command bit is set, this bit remains set.
- Zero balance respectively reference point
  - When setting the zero balance respectively reference point this bit is set.
  - As long as the corresponding command bit is set, this bit remains set.

**Output area**

| Addr. | Name | Bytes | Function | IX | SX |
|---|---|---|---|---|---|
| +0 | DMS_CMD | 1 | Command byte | 5670h/s | 01h |

***DMS_CMD***

| Addr. | Name | Bytes | Function |
|---|---|---|---|
| +0 | DMS_CMD | 1 | ■ Command byte Each set bit in DMS_CMD is acknowledged by a bit in DMS_STAT.<br>– Bit 0: Activate *Input Freeze* → DMS_STAT bit 0: active<br>– Bit 1: Store adjustment → DMS_STAT bit 5: active<br>– Bit 2: Delete adjustment → DMS_STAT bit 5: active<br>– Bit 3: Set *Tara* → DMS_STAT bit 3: active<br>– Bit 4: Delete *Tara* → DMS_STAT bit 3: active<br>– Bit 5: reserved<br>– Bit 6: Set zero point → DMS_STAT bit 7: active<br>– Bit 7: Set reference point → DMS_STAT bit 7: active |

- Input Freeze
  - In the activated state no measurement values are passed to the digital filter.
  - By a brief activation of *Input Freeze* pulses, e.g. caused by a filling procedure can be prevented, which would override the filter unnecessarily.
  - The status of *Input Freeze* can be determined at any time via bit 0 of DMS_STAT.
- Adjustment
  - Store adjustment: Used to store the adjustment data when loaded with the reference weight.
  - Delete adjustment: Used to delete the adjustment data.
  - With both commands bit 5 of DMS_STAT is set. In case of error bit 4 is set.
- Tara
  - Set Tara: The current value is taken as tara.
  - Delete Tara: Tara is reset to 0.
  - With both commands bit 3 of DMS_STAT is set.
- Zero balance respectively reference point
  - Both commands are used for user adjustment and on both commands bit 7 of DMS_STAT is set.
  - Set zero balance: Used to set the balance to 0 when operated without load.
  - Set reference point: Used to adjust the balance when it is loaded with a reference weight.

### 3.14.3 Technical data

| **Order no.** | **031-1CA20** |
|---|---|
| Type | SM 031 |
| Module ID | 0841 1809 |
| **Current consumption/power loss** | |
| Current consumption from backplane bus | 55 mA |
| Power loss | 1 W |
| **Technical data strain gauge DMS inputs** | |
| Number of inputs | 1 |
| 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) | 85 mA |
| Relative accuracy according to self-calibration | +/-0.01% |
| Operational limit Usense | +/-0.2% |
| Operational limit Usig | +/-0.2% |
| Basic error limit Usense | +/-0.1% |
| Basic error limit Usig | +/-0.1% |
| Destruction limit current | max. 12V |
| External bridge supply possible | - |
| Internal bridge supply possible | ✓ |
| Configurable bridge supply | 2.5V / max. 120mA<br>5V / max. 120mA<br>7.5V / max. 100mA<br>10V / max. 90mA<br>12V / max. 80mA |
| Resolution in bit | 24 |
| Measurement principle | successive approximation |
| Basic conversion time | 1ms cycle, 10ms...330ms depending on the filter |
| Input filter hardware | Low pass 10kHz 3rd order |
| Input filter software | dynamic IIR filter<br>configurable IIR filter 0.1Hz...1000Hz<br>configurable FIR filter 50Hz/60Hz |
| Initial data size | 4 Byte |
| **Data for selecting of the strain gauge DMS sensor** | |

| Order no. | 031-1CA20 |
| --- | --- |
| Bridge supply voltage EXC | 0...12V |
| Bridge differential voltage SIG | +/-29mV |
| Rated output | 0.5...4mV/V |
| 4 wire connection possible | ✓ |
| 6 wire connection possible | ✓ |
| Possible bridge configuration | symmetric full bridge |
| **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 error display | red LED |
| Channel error display | red LED |
| **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 | 5 |
| Output bytes | 1 |
| Parameter bytes | 30 |
| Diagnostic bytes | 20 |
| **Housing** | |
| Material | PC / PPE GF10 |

| **Order no.** | **031-1CA20** |
| --- | --- |
| 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 |

## 3.14.4 Functionality

### 3.14.4.1 Basics - Strain gauge DMS

**Strain gauge DMS**

Strain gauge DMS are fixed directly on a body or part of a sensor and serve for the following possibilities:

- Measurement of strains, compressions or torsions
- Measurement of forces and movements

There are the following strain gauge DMS types:

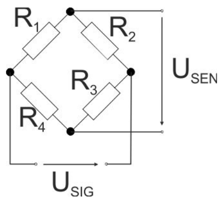
- electrical strain gauge DMS
  - An *electrical strain gauge DMS* consists of a carrier material (e.g. stretchable plastic film) with applied metal film. From this a grid of electrically conductive resistive material is created. During the measurement the behavior is used, that e.g. at the elongation of a metallic conductor resistance its length increases and its diameter decreases. Here the electrical resistance increases proportionally.
- optical strain gauge DMS
  - An *optical strain gauge DMS* consists of a fibre used as a sensor, with a laser-applied grid in the fibre. During the measurement the behavior is used, that with mechanical load the optical properties of the sensor are changed. Light is passed with a certain wavelength into the sensor. Depending on the deformation of the laser-applied grid of the sensor, a part of the light is reflected and evaluated with a suitable sensor (interrogator).

**Characteristics of an strain gauge DMS**

- Nominal load
  - Maximum permissible load for normal operation.
  - The *nominal load* is preset unit-free.
- Rated output
  - The rated output is a measure of the sensitivity of the resistance bridge in dependence of the used excitation voltage.
  - A typical value for a full bridge is 2mV/V, this means at nominal load with an excitation voltage of 12V the bridge differential voltage is ±24mV.
  - The common area is 0.5...4mV/V, depending on the bridge and sensor type.

### 3.14.4.2 Function

**Measurement**




To get a weight value a power supply is applied to the bridge circuit and a differential voltage ($U_{SIG}$) and excitation voltage ($U_{SEN}$) are measured. The principle of measurement is based on that the differential voltage $U_{SIG}$ of the bridge changes with a deformation. Thus, a relative weight value is calculated by the difference of the both voltages $U_{SIG}$ and $U_{SEN}$, which are measured at the same time. The resulting difference is converted to a weight value and stored as process data in the input area.

**Weight value determination**

With the exception of *differential* and *excitation voltage* the remaining values are to be preset by the parametrization. The resulting weight value Y is determined within the module via the following formulas:

$$Y_R = \frac{\frac{U_{SIG}}{U_{SEN}}}{RO}$$

$Y_R$ Relative value
$U_{SIG}$ Measured differential voltage of the measuring bridge
$U_{SEN}$ Measured excitation voltage
RO Rated output

$$Y_A = Y_R \cdot NL \cdot SF$$

$Y_A$ Absolute value
$Y_R$ Relative value
NL Nominal load
SF Scale factor

$$Y = Y_A \cdot GN + TA$$

Y Resulting weight value
$Y_A$ Absolute value
GN Gain
TA Tara

### 3.14.5 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

**Parameters**

Due to the extensive parameter data you can use up to 8 of these modules with a PROFIBUS slave system.

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| DIAG_EN | 1 | Diagnostic interrupt * | 00h | 00h | 3100h | 01h |
| UEXC | 1 | Excitation voltage | 00h | 01h | 3101h | 02h |
| CAL | 2 | Calibration interval | 0000 | 01h | 3102h | 03h |
| MEAS | 1 | Measurement method | 23h | 80h | 3104h | 04h |
| FILT | 1 | Filter selection | 00h | 80h | 3105h | 05h |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| DFCT | 2 | Dynamic filter change time | 10h | 80h | 3106h | 06h |
| DFD | 2 | Dynamic filter delta | 20h | 80h | 3108h | 07h |
| RO | 2 | Rated output | 4E20h | 80h | 310Ah | 08h |
| ZB | 2 | Zero balance | 0000h | 80h | 310Ch | 09h |
| GN | 2 | Gain | 1000h | 80h | 310Eh | 0Ah |
| TA | 2 | Tara | 0000h | 80h | 3110h | 0Bh |
| NL | 2 | Nominal load | 0002h | 80h | 3112h | 0Ch |
| SF | 2 | Scale factor | 03E8h | 80h | 3114h | 0Dh |
| SST | 2 | Steady state tolerance | 0005h | 80h | 3116h | 0Eh |
| SSW | 2 | Steady state window | 03E8h | 80h | 3118h | 0Fh |
| RL | 4 | Reference load | 00000100 | 80h | 311Ah | 10h |

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

**DIAG_EN Diagnostic interrupt**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Diagnostic interrupt<br>– 00h: disable<br>– 40h: enable |

- Here you activate respectively de-activate the diagnostic function.

**UEXC select power supply**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Power supply<br>– 00h: 2.5V<br>– 01h: 5V<br>– 02h: 7.5V<br>– 03h: 10V<br>– 04h: 12V |

- Here you can specify the power supply for the excitation voltage $U_{EXC}$, which the module provides via the pins EXC+ und EXC-.

*Please always use the excitation voltage U of the module$_{EXC}$! The connection of strain gauge DMS sensors with external power supply is not possible.*

**CAL Calibration interval**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | ■ Interval for the calibration.<br>– Calibration interval as 100ms value<br>– 00h: de-activates the calibration |

- By setting a calibration interval as 100ms value, the self-calibration is always performed after this time.
- With the self-calibration the internal offset and gain error may be compensated.
- There is always the entire signal path including all passive components checked.
- During self-calibration, the CAL LED is on an the measured value is frozen.
- 00h de-activates the calibration.

**MEAS Measurement method**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Measurement method<br>– 23h: 6 wire measurement<br>– 25h: 4 wire measurement<br>– FFh: de-activated |

- Here you can choose between 4 and 6 wire measurement respectively disable the measurement.

**FILT Filter selection**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Filter selection<br>– 00h: Filter de-activated<br>– 01h: Activate dynamic IIR filter<br>– 02h: IIR1<br>– 03h: IIR2<br>– 04h: IIR3<br>– 05h: IIR4<br>– 06h: IIR5<br>– 07h: IIR6<br>– 08h: IIR7<br>– 09h: IIR8<br>– 0Ah: FIR 50Hz<br>– 0Bh: FIR 60Hz |

Filter functions

- FIR 50/60 Hz
  – Suppression of mains frequency interference
- Dynamic IIR filter
  – automatic selection
  – Filter selection dependent on the current weight change
- Static IIR filter
  – De-activation respectively fix setting of a filter level (IIR1...IIR8)

**DFCT Dynamic Filter Change Time**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Sampling rate for filter change-over in ms |

- Here you can specify the time for re-evaluation for the filter change-over in ms.

**Dynamic filter delta**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Limit value for filter change-over |

- Here you can specify the limit value for the filter change-over.

**RO Rated output**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Rated output in 0.0001mV/V |

- Here you can specify the rated output in 0.0001mV/V. Information to the rated output can be found in the data sheet of you force transducer.

**ZB Zero balance**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Zero balance in 0.0001mV/V |

- Here you can specify the zero balance as 0.0001mV/V value. Information to the zero balance can be found in the data sheet of you force transducer.

**GN Gain**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Gain for user scaling of the output value |

- Here you can specify a factor as $2^{-12}$ value. The factor is multiplied with the output value.

**TA Tara**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | User offset for the output value |

- Here you can specify an offset as $2^{-12}$ value. The offset is added to the determined output value.

**NL Nominal load**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Nominal load of the force transducer |

- Here you can specify the nominal load of the force transducer unit-free. Information to nominal load can be found in the data sheet of you force transducer.

**SF Scale factor**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Scale factor for the nominal load |

- Here you can specify the scale factor for the nominal load, such as to convert kg to g.
  – Example: Nominal load in kg and scale factor 1000 (03E8h) results display in g.

**SST Steady state tolerance**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Tolerance for *Steady State* |

- Here you can specify a tolerance window for the state *Steady State*. This is specified as a deviation of the scaled nominal load.
  – Example: With a rated load in kg and scaling factor of 1000 (03E8h) you must specify the value 0005h to set a tolerance window of 5g.

**SSW Steady state window**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...1 | Time interval for *Steady State* in ms |

- Here you can specify a time interval for the setting of the *Steady State* bit (DMS_STAT-Bit 1).
- If the measured value is within the tolerance window SST longer than the time interval SSW, then bit 1 of the status word DMS_STAT is set.

**RL Reference load**

| Byte | Bit 7 ... 0 |
|---|---|
| 0...3 | Reference load for the calibration |

- Here you can specify the reference load for the calibration unit-free. The reference load must be at least 20% of the *Nominal load* NL.

### 3.14.6 Deployment of the filter functions

**Overview**

The module has the following filter functions, which can be activated via the parametrization:

- FIR 50/60 Hz
- Dynamic IIR filter
- Static IIR filter

**FIR 50/60 Hz**

In the parametrization via FILT you can specify the filter *FIR 50 Hz* respectively *FIR 60 Hz*. These filters acts a notch filter. Notch filter generate at the configured frequency and the multiple thereof zeros (notches) in the frequency response. They attenuate these frequencies here in the amplitude. When filters are used, these influence the conversion time of your module. The higher the filter frequency, the faster the conversion time. This can be used for the suppression of mains frequency interferences.

**Dynamic IIR filter**

- By activation of the dynamic IIR filter in the FILT parameter, dependent on the current weight change, it is automatically switched between 8 different filters. The aim here is to obtain a filter with the best possible damping, which must lead to stable measuring values. The *Dynamic IIR filter* acts as 1. order low-pass filter and has the following properties:
  – If there is a rapid change of the input value, it is switched-over to the next lower filter (e.g. IIR1→IIR2). In this way the load changes are less precise, but it is faster recognized.
  – If there is small change in the measured value, it is switched-over to the next higher filter (e.g. IIR2→IIR1), so you will get a higher precision.
  – With the IIR1 filter you get the lowest noise suppression and the most unstable measured value.
  – With the IIR8 filter you get the highest noise suppression and the most stable measured value.
  – The revaluation, which can lead to a modification of the filter levels, takes place in a fixed interval, which can be specified via parameter *DFCT* in ms.

| Filter level | Limit frequency | Filter constant | Rise time 10-90% [s] (typ.) |
|---|---|---|---|
| 02h: IIR1 | 1000 | $a_0$ = 0.5 | 0.0003 |
| 03h: IIR2 | 500Hz | $a_0$ = 0.25 | 0.0008 |
| 04h: IIR3 | 125Hz | $a_0 = 62.5\text{x}10^{-3}$ | 0.0035 |
| 05h: IIR4 | 30Hz | $a_0 = 15.6\text{x}10^{-3}$ | 0.014 |
| 06h: IIR5 | 8Hz | $a_0 = 3.91\text{x}10^{-3}$ | 0.056 |
| 07h: IIR6 | 2Hz | $a_0 = 977\text{x}10^{-6}$ | 0.225 |
| 08h: IIR7 | 0.5Hz | $a_0 = 244\text{x}10^{-6}$ | 0.9 |
| 09h: IIR8 | 0.1Hz | $a_0 = 61.0\text{x}10^{-6}$ | 3.6 |

***Prevent overriding the filter***

*By a brief activation of Input Freeze in the command byte DMS_CMD pulses, e.g. caused by a filling procedure can be prevented, which would override the filter unnecessarily. As soon as Input Freeze is activated, no measurement values are passed to the digital filter.*

**Static IIR filter**

Via the FILT parameter you can de-activate the filter function or you can specify a fix filter level (IIR1...IIR8).

### 3.14.7 Calibration

**Proceeding**

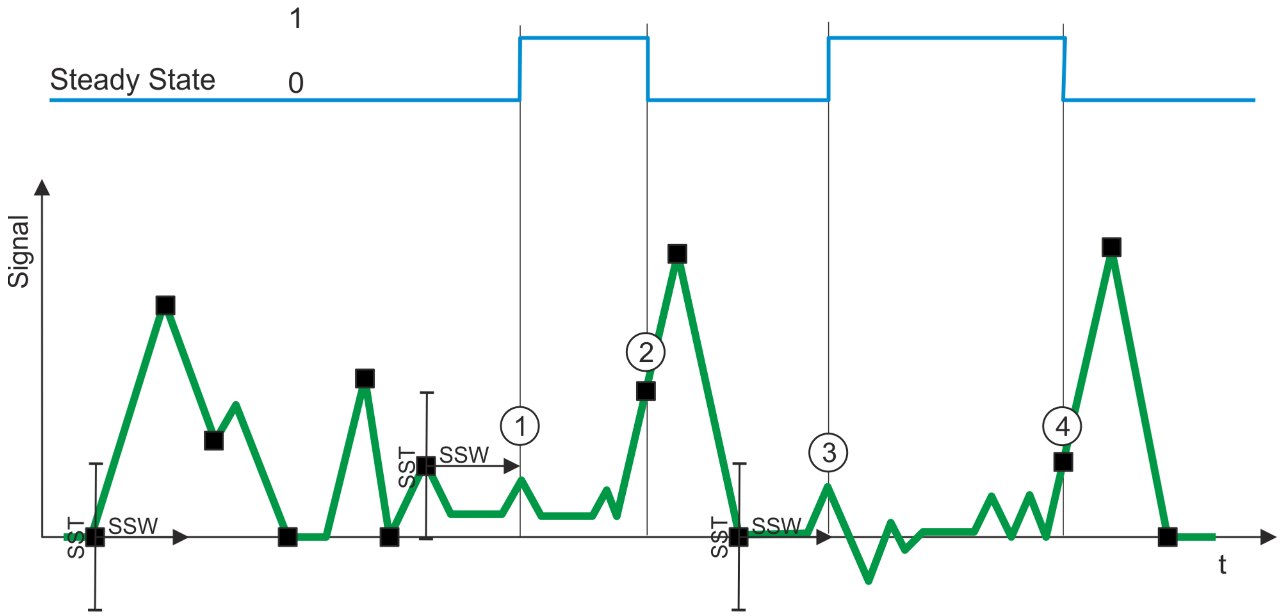
Please use for the calibration the software filter IR8 (slow). The following steps are necessary for the calibration:

1. Specify in the parametrization the *Reference load* RL. The *Reference load* must be at least 20% of the *Nominal load*.
2. Operate the balance without load.
3. As soon as a stable value is shown, bit 6 (set zero point) in the command byte *DMS_CMD* is to set.
4. Apply the balance with the reference load. As soon as a stable value is shown, bit 7 (set reference point) in the command byte *DMS_CMD* is to set.
5. Set bit 1 (store adjustment) in the command byte *DMS_CMD*.
   ⇨ As soon as the adjustment data were stored successfully, the module measures with these parameters. The adjustment data remain even after a power loss condition and can be deleted (delete adjustment) via bit 2. The adjustment data can be rewritten only every 120 seconds.

### 3.14.8 Steady state detection

**Functionality**

- If the measured value is within the range of values *SST* longer than the the time interval *SSW*, then bit 1 (steady state active) of the status word DMS_STAT is set. The current measured value is used as the starting point for the range of values and the steady state timer is started. *'DMS_STAT Status' on page 153*
- If the measured value remains within *SST* over the period *SSW*, the steady-state bit is set.
- If the tolerance range *SST* is exceeded, the last measured value is used as starting point and the time is newly started.
- The values *SSW* and *SST* can be specified by the parametrization. *'Parameter data' on page 158*




- ■ Starting point of the SSW timer is newly started. Only when the measured signal is longer than the time *SSW* within the range of values *SST*, steady state is set.
- [1] SSW timer has expired and the measured signal is within the range of values → Steady state bit is set.
- [2] Measured signal exceeds the range of values → Steady state bit is reset.
- [3] SSW timer has expired and the measured signal is within the range of values → Steady state bit is set.
- [4] Measured signal exceeds the range of values → Steady state bit is reset.

## 3.14.9 Diagnostics

**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 events can cause a diagnostic interrupt:

- External auxiliary supply is missing
- Internal diagnostic puffer overflow
- Internal communication error
- Project engineering/parametrization error
- Measuring range underflow
- Measuring range overerflow

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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | 01h | | | 08h |
| CHERR | 1 | Channel error | 00h | | | 09h |
| CHxERR | 8 | Channel-specific error channel x | 00h | | | 0Ah...11h |
| DIAG_US | 4 | µs ticker | 00h | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_C reserved***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | reserved |

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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 the module (here 01h) |

***CHERR Channel error***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: set at error in channel 0 |

***CHxERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel 0<br>■ Bit 0: set at project engineering respectively parametrization error<br>■ Bit 2...1: reserved<br>■ Bit 3: set at short circuit of excitation voltage $U_{EXC}$<br>■ Bit 5...4: reserved<br>■ Bit 6: set at measuring range underflow<br>■ Bit 7: set at measuring range overflow |
| 1...7 | 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.

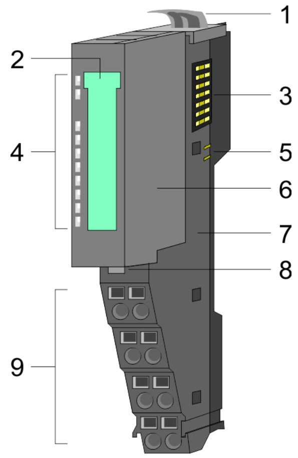
## 3.15 031-1CB30 - AI 2x16Bit 0...10V

**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.

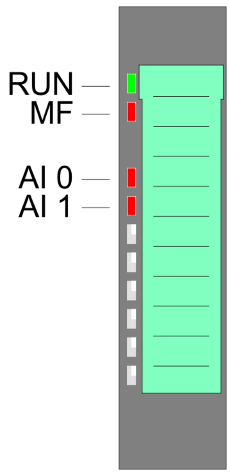
- 2 analog inputs
- Suited for sensors with 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

**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

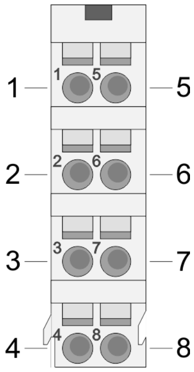
**Status indication**

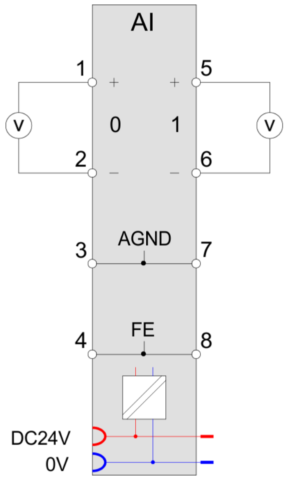



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ⇨ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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. | 031-1CB30 |
|---|---|
| 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 | - |

| Order no. | 031-1CB30 |
|---|---|
| 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. | 031-1CB30 |
|---|---|
| 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 |

### 3.15.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |
| 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<br>– 00h: enable<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression channel 0<br>– 00: deaktiviert<br>– 01: 60Hz<br>– 10: 50Hz<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>– 00: deaktiviert<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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<br>Siemens S7 format<br>(10h) | 11.76V | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{27648}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -1.76V | -4864 | ED00h | underrange | |
| 0 ... 10V<br>Siemens S5 format<br>(20h) | 12.5V | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{16384}$ |
| | 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.

## 3.15.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 7 ... 2: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

**CH0ERR CH1ERR Channel-specific**

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

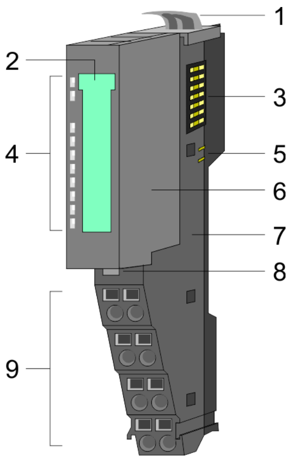
## 3.16 031-1CB40 - AI 2x16Bit 0(4)...20mA

**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.

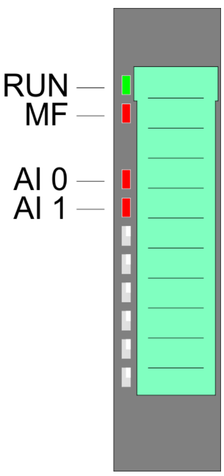
- 2 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

**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**

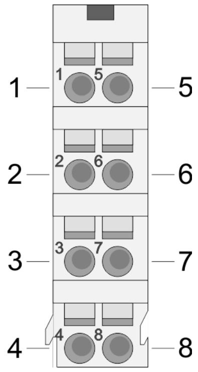


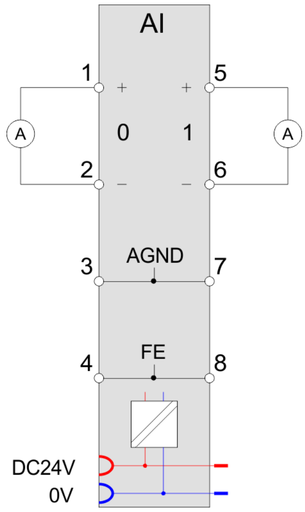

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Signal leaves measuring range<br>■ 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 - Subindex (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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. | 031-1CB40 |
|---|---|
| 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<br>+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 |

### 3.16.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>– 00h: enable<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression channel 0<br>– 00: deaktiviert<br>– 01: 60Hz<br>– 10: 50Hz<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>– 00: deaktiviert<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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.

### 3.16.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 7 ... 2: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| CH1ERR | 1 | Channel-specific error channel 1 | 00h | | | 0Bh |
| CH2ERR... CH7ERR | 6 | reserved | 00h | | | 0Ch ... 11h |
| DIAG_US | 4 | µs ticker | 00h | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

**CH0ERR CH1ERR Channel-specific**

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

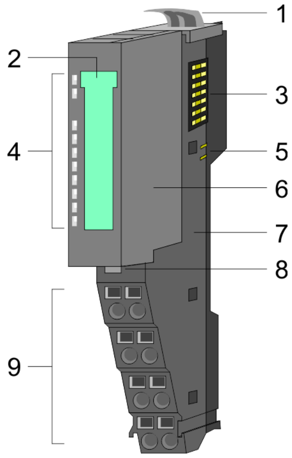
## 3.17 031-1CB70 - AI 2x16Bit ±10V

**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.

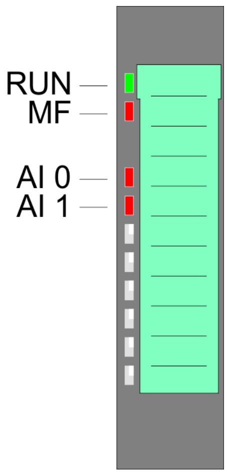
- 2 analog inputs
- Suited for sensors with ±10V,
  0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

## 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

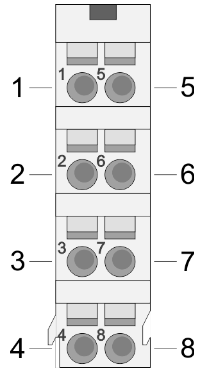
## Status indication

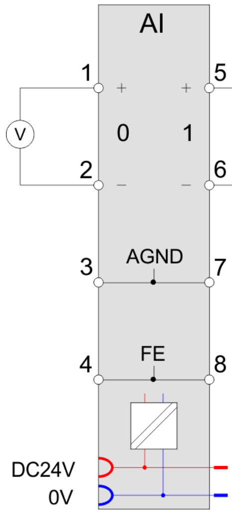



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ↳ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

## 3.17.1 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 |

## 3.17.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ 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<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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.

### 3.17.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 7 ... 2: reserved |

**PRIT_UL Limit underflow**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR CH1ERR Channel-specific***

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

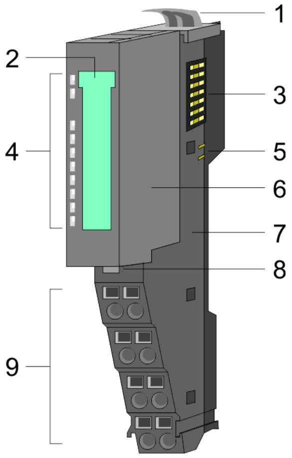
## 3.18 031-1CD30 - AI 4x16Bit 0...10V

**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.

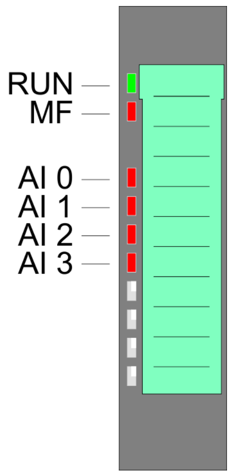
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

## 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

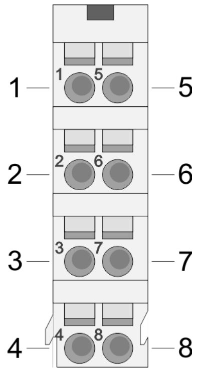
## Status indication

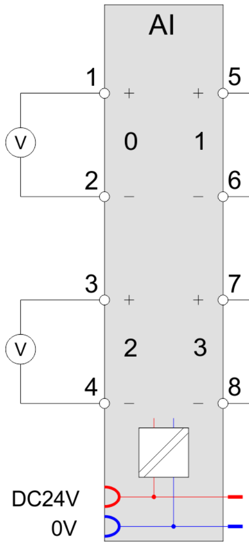



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ✎ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

## 3.18.1 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 | - |

| Order no. | 031-1CD30 |
|---|---|
| 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<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. | 031-1CD30 |
|---|---|
| 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 |

### 3.18.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 Diagnostic interrupt

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Diagnostic interrupt<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 2: Limit value monitoring channel 2 (1: on)<br>■ Bit 3: Limit value monitoring channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression channel 0<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>■ Bit 5, 4: Interference frequency suppression channel 2<br>■ Bit 7, 6: Interference frequency suppression channel 3<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>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<br>Siemens S7 format<br>(10h) | 11.76V | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{27648}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -1.76V | -4864 | ED00h | underrange | |
| 0 ... 10V<br>Siemens S5 format<br>(20h) | 12.5V | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{16384}$ |
| | 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.

### 3.18.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 2: Limit overflow channel 2<br>■ Bit 3: Limit overflow channel 3<br>■ Bit 7 ... 4: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ Bit 2: Limit underflow channel 2<br>■ Bit 3: Limit underflow channel 3<br>■ 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

### *ERR_A Diagnostic*

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

### *MODTYP Module information*

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

### *ERR_D Diagnostic*

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

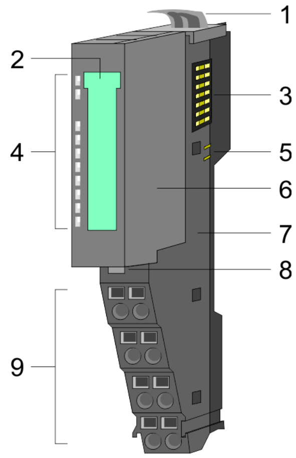
## 3.19 031-1CD35 - AI 4x16Bit 0...10V

**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.

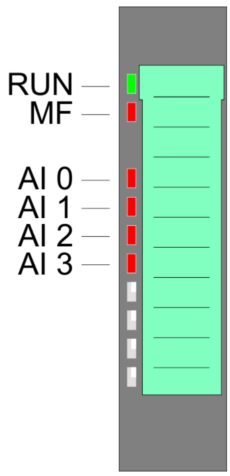
- 4 analog inputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

**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

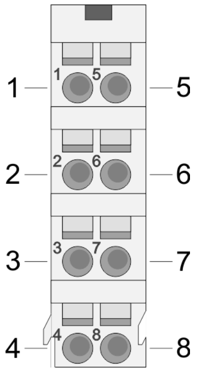
**Status indication**

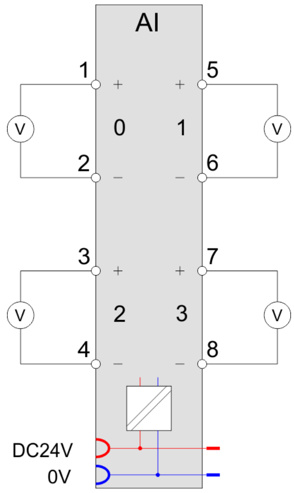



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ↻ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 | +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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

### 3.19.1 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 |

## 3.19.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>■ Bit 5, 4: Interference frequency suppression channel 2<br>■ Bit 7, 6: Interference frequency suppression channel 3<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>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<br>Siemens S7 format<br>(10h) | 11.76V | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{27648}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -1.76V | -4864 | ED00h | underrange | |
| 0 ... 10V<br>Siemens S5 format<br>(20h) | 12.5V | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{10}$<br>$U = D \cdot \frac{10}{16384}$ |
| | 10V | 16384 | 4000h | nominal range | |
| | 5V | 8192 | 2000h | | |
| | 0V | 0 | 0000h | | |
| | -2V | -3277 | F333h | underrange | |

### 3.19.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

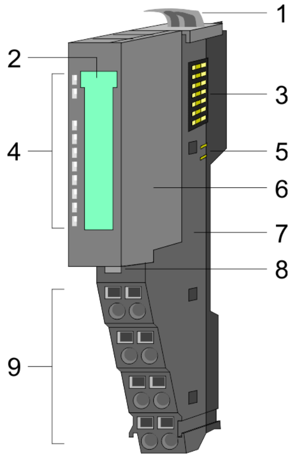
## 3.20 031-1CD40 - AI 4x16Bit 0(4)...20mA

**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.

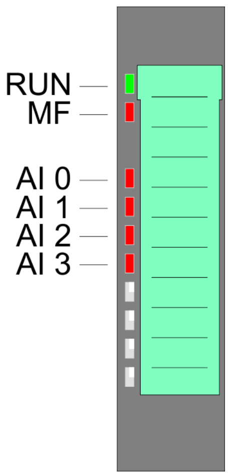
- 4 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

**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

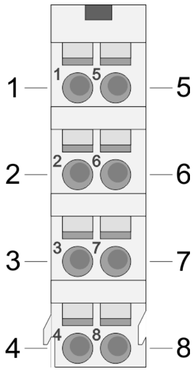
**Status indication**

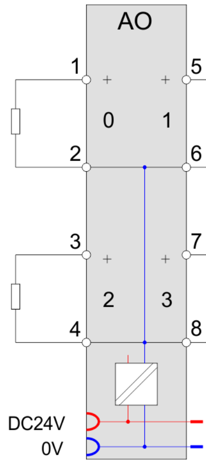



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 | +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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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. | 031-1CD40 |
|---|---|
| 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<br>+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 |

## 3.20.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 2: Limit value monitoring channel 2 (1: on)<br>■ Bit 3: Limit value monitoring channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression channel 0<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>■ Bit 5, 4: Interference frequency suppression channel 2<br>■ Bit 7, 6: Interference frequency suppression channel 3<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>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.

### 3.20.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 2: Limit overflow channel 2<br>■ Bit 3: Limit overflow channel 3<br>■ Bit 7 ... 4: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ Bit 2: Limit underflow channel 2<br>■ Bit 3: Limit underflow channel 3<br>■ 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

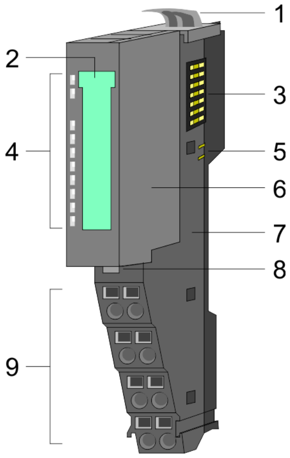
## 3.21 031-1CD45 - AI 4x16Bit 0(4)...20mA

**Properties**

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

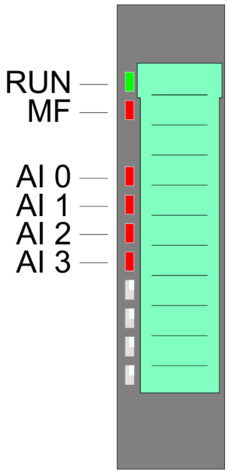
- 4 analog inputs
- Suited for sensors with 0 ... 20mA;
  4 ... 20mA with external supply
- Diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

## 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

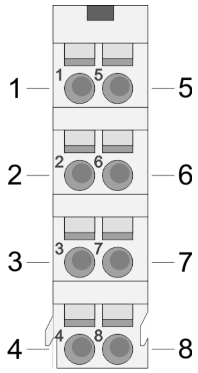
## Status indication

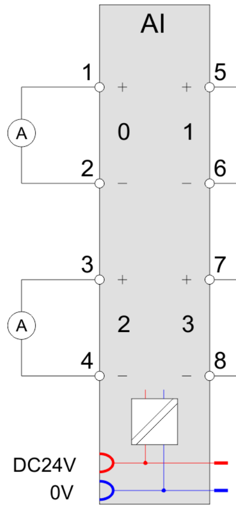



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ➜ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

## 3.21.1 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<br>+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 |

### 3.21.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>■ Bit 5, 4: Interference frequency suppression channel 2<br>■ Bit 7, 6: Interference frequency suppression channel 3<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>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 | |

## 3.21.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Bit 3 ... 0: module class<br>– 0101b analog module<br>Bit 4: set at channel information present<br>Bit 7 ... 5: reserved |

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

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

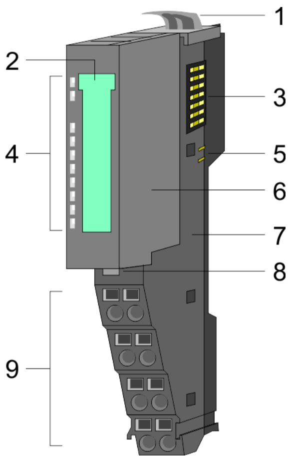
## 3.22 031-1CD70 - AI 4x16Bit ±10V

**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.

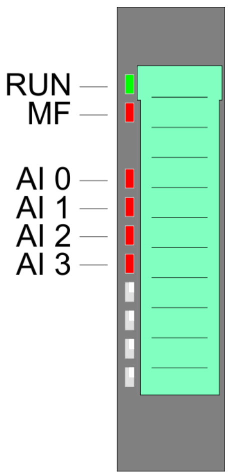
- 4 analog inputs
- Suited for sensors with ±10V, 0 ... 10V
- Interrupt and diagnostics function
- Interference frequency suppression parameterizable (50/60Hz)
- 16bit resolution

**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**

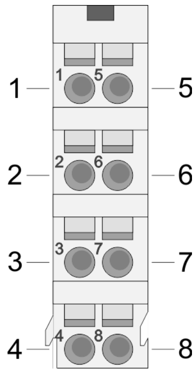


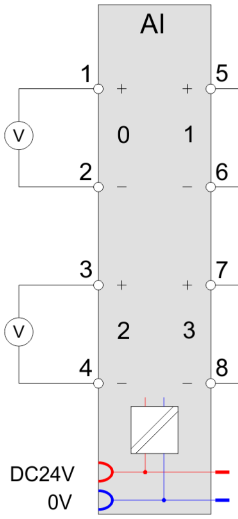

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Signal leaves measuring range<br>■ 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 | +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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

### 3.22.1 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 |

### 3.22.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Limit value monitoring channel 1 (1: on)<br>■ Bit 2: Limit value monitoring channel 2 (1: on)<br>■ Bit 3: Limit value monitoring channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression channel 0<br>■ Bit 3, 2: Interference frequency suppression channel 1<br>■ Bit 5, 4: Interference frequency suppression channel 2<br>■ Bit 7, 6: Interference frequency suppression channel 3<br>– 00: deactivated<br>– 01: 60Hz<br>– 10: 50Hz<br>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.

### 3.22.3 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 (5000h) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>■ Bit 1: Limit overflow channel 1<br>■ Bit 2: Limit overflow channel 2<br>■ Bit 3: Limit overflow channel 3<br>■ Bit 7 ... 4: reserved |

***PRIT_UL Limit underflow***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0: Limit underflow channel 0<br>■ Bit 1: Limit underflow channel 1<br>■ Bit 2: Limit underflow channel 2<br>■ Bit 3: Limit underflow channel 3<br>■ 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

**CH0ERR ... CH3ERR Channel-specific**

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

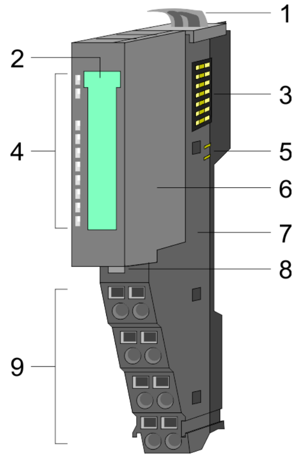
## 3.23 031-1LB90 - AI 2x16Bit TC

**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.

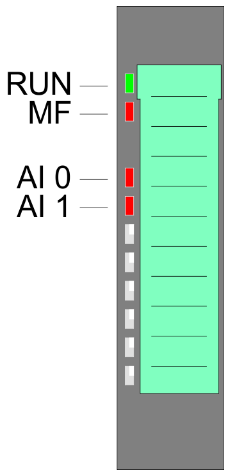
- 2 analog inputs
- Suited for sensors with type J, K, N, R, S, T, B, C, E, L and for voltage measuring ± 80mV
- Diagnostics function
- 16bit resolution
- Internal temperature compensation
- High potential gradient of DC140V/AC60V between the inputs

**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

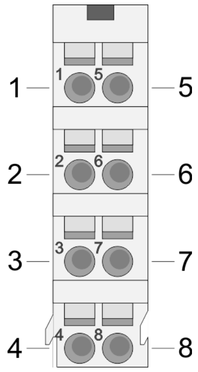
**Status indication**

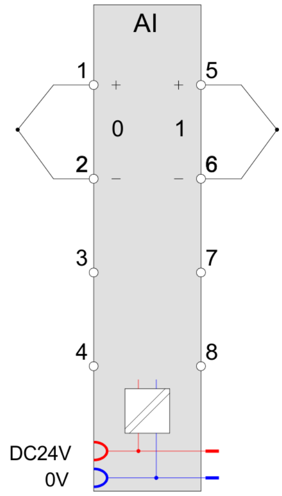



| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Signal leaves measuring range<br>■ Error in parameterization<br>■ 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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

### 3.23.1 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 |
| 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. | 031-1LB90 |
|---|---|
| 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<br>type C<br>type E<br>type J<br>type K<br>type L<br>type N<br>type R<br>type S<br>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 |
| Basic conversion time | 84.2 ms (50 Hz) 70.5 ms (60 Hz) per channel |

| Order no. | 031-1LB90 |
|---|---|
| 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** | |
| 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 |

| Order no. | 031-1LB90 |
|---|---|
| **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

### 3.23.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |
| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Wire break recognition channel 1 (1: on)<br>■ Bit 7 ... 2: reserved |

**TEMPCNF Temperature system**

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

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 0, 1: Interference frequency suppression<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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<br>Siemens S7 format<br>(11h) | 94.07mV | 32511 | 7EFFh | overrange | $D = 27648 \cdot \frac{U}{80}$<br>$U = D \cdot \frac{80}{27648}$ |
| | 80mV | 27648 | 6C00h | nominal range | |
| | 0V | 0 | 0000h | | |
| | -80mV | -27648 | 9400h | | |
| | -94.07mV | -32512 | 8100h | underrange | |
| -80 ... 80mV<br>Siemens S7 format<br>(21h) | 100mV | 20480 | 5000h | overrange | $D = 16384 \cdot \frac{U}{80}$<br>$U = D \cdot \frac{80}{16384}$ |
| | 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:<br>-210 ... +1200°C<br>-346 ... 2192°F<br>63.2 ... 1473.2K<br>(B0h: ext. comp. 0°C)<br>(C0h: int. comp. 0°C) | +14500 | 26420 | 17232 | overrange |
| | -2100 ... +12000 | -3460 ... 21920 | 632 ... 14732 | nominal range |
| | --- | --- | --- | underrange |
| Type K:<br>-270 ... +1372°C<br>-454 ... 2501.6°F<br>0 ... 1645.2K<br>(B1h: ext. comp. 0°C)<br>(C1h: int. comp. 0°C) | +16220 | 29516 | 18952 | overrange |
| | -2700 ... +13720 | -4540 ... 25016 | 0 ... 16452 | nominal range |
| | --- | --- | --- | underrange |
| Type N:<br>-270 ... +1300°C<br>-454 ... 2372°F<br>0 ... 1573.2K<br>(B2h: ext. comp. 0°C)<br>(C2h: int. comp. 0°C) | +15500 | 28220 | 18232 | overrange |
| | -2700 ... +13000 | -4540 ... 23720 | 0 ... 15732 | nominal range |
| | --- | --- | --- | underrange |
| Type R:<br>-50 ... +1769°C<br>-58 ... 3216.2°F<br>223.2 ... 2042.2K<br>(B3h: ext. comp. 0°C)<br>(C3h: int. comp. 0°C) | +20190 | 32766 | 22922 | overrange |
| | -500 ... +17690 | -580 ... 32162 | 2232 ... 20422 | nominal range |
| | -1700 | -2740 | 1032 | underrange |
| Type S:<br>-50 ... +1769°C<br>-58 ... 3216.2°F<br>223.2 ... 2042.2K<br>(B4h: ext. comp. 0°C)<br>(C4h: int. comp. 0°C) | +20190 | 32766 | 22922 | overrange |
| | -500 ... +17690 | -580 ... 32162 | 2232 ... 20422 | nominal range |
| | -1700 | -2740 | 1032 | underrange |
| Type T:<br>-270 ... +400°C<br>-454 ... 752°F<br>3.2 ... 673.2K<br>(B5h: ext. comp. 0°C)<br>(C5h: int. comp. 0°C) | +5400 | 10040 | 8132 | overrange |
| | -2700 ... +4000 | -4540 ... 7520 | 32 ... 6732 | 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 B:<br>0 ... +1820°C<br>32 ... 2786.5°F<br>273.2 ... 2093.2K<br>(B6h: ext. comp. 0°C)<br>(C6h: int. comp. 0°C) | +20700 | 32766 | 23432 | overrange |
| | 0 ... +18200 | 320 ... 27865 | 2732 ... 20932 | nominal range |
| | -1200 | -1840 | 1532 | underrange |
| Type C:<br>0 ... +2315°C<br>32 ... 2786.5°F<br>273.2 ... 2093.2K<br>(B7h: ext. comp. 0°C)<br>(C7h: int. comp. 0°C) | +25000 | 32766 | 23432 | overrange |
| | 0 ... +23150 | 320 ... 27865 | 2732 ... 20932 | nominal range |
| | -1200 | -1840 | 1532 | underrange |
| Type E:<br>-270 ... +1000°C<br>-454 ... 1832°F<br>0 ... 1273.2K<br>(B8h: ext. comp. 0°C)<br>(C8h: int. comp. 0°C) | +12000 | 21920 | 14732 | overrange |
| | -2700 ... +10000 | -4540 ... 18320 | 0 ... 12732 | nominal range |
| | --- | --- | --- | underrange |
| Type L:<br>-200 ... +900°C<br>-328 ... 1652°F<br>73.2 ... 1173.2K<br>(B9h: ext. comp. 0°C)<br>(C9h: int. comp. 0°C) | +11500 | 21020 | 14232 | overrange |
| | -2000 ... +9000 | -3280 ... 16520 | 732 ... 11732 | 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error: Channel x:<br>■ Bit 0: set at project engineering/parameterization error<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire break<br>■ Bit 5: reserved<br>■ Bit 6: set at measuring range underflow<br>■ 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.

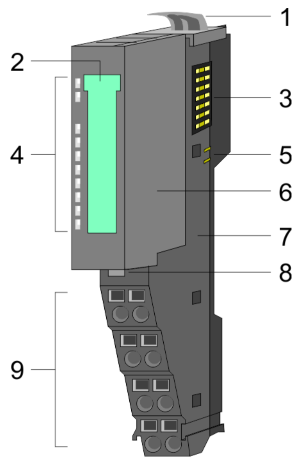
## 3.24 031-1LD80 - AI 4x16Bit R/RTD

**Properties**

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

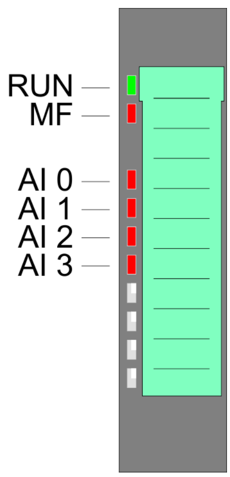
- 4 analog inputs
- Suited for resistance-type sensors 0 ... 3000Ω and resistance temperature sensors Pt100, Pt1000, NI100 and NI1000
- Resistance measurement with 2, 3 and 4 wire (3 and 4 wire only via channel 0 respectively 1)
- Diagnostics function
- 16bit resolution

**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**

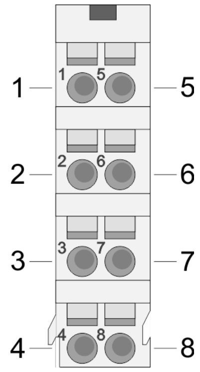


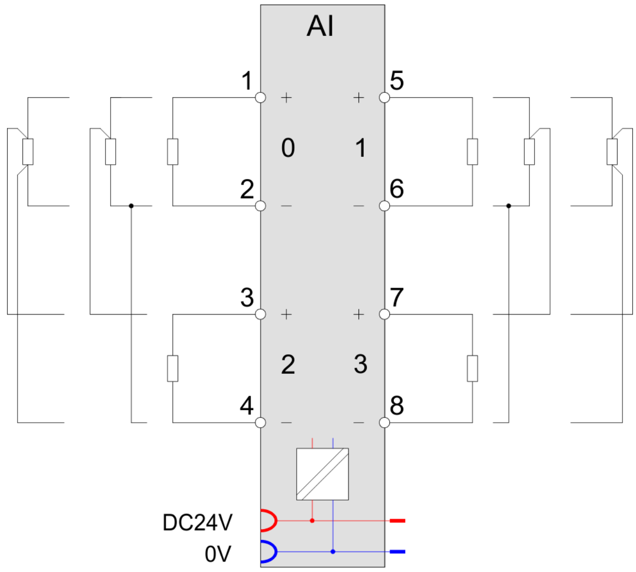

| RUN | MF | AI x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Signal leaves measuring range<br>■ Error in parameterization<br>■ 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 | +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 (6000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

***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.

### 3.24.1 Technical data

| Order no. | 031-1LD80 |
|---|---|
| Type | SM 031 |
| Module ID | 0410 1544 |
| **Current consumption/power loss** | |

| Order no. | 031-1LD80 |
| --- | --- |
| Current consumption from backplane bus | 55 mA |
| 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<br>0 ... 600 Ohm<br>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<br>Pt1000<br>Ni100<br>Ni1000 |
| Operational limit of resistance thermometer ranges | +/- 0.4 % |

| Order no. | 031-1LD80 |
|---|---|
| Basic error limit thermoresistor ranges | +/- 0.2 % |
| 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) | - |

| **Order no.** | **031-1LD80** |
|---|---|
| Max. potential difference between inputs and Mintern (Uiso) | DC 75 V/ AC 60 V |
| Max. potential difference between Mintern and outputs | - |
| Insulation tested with | DC 500 V |
| **Datasizes** | |
| Input bytes | 8 |
| Output bytes | 0 |
| Parameter bytes | 12 |
| Diagnostic bytes | 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 |

### 3.24.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 sup-pression | 02h | 01h | 3103h | 04h |
| CH0FN | 1 | Function number channel 0 | 50h | 80h | 3104h | 05h |
| CH1FN | 1 | Function number channel 1 | 50h | 81h | 3105h | 06h |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| CH2FN | 1 | Function number channel 2 | 50h[2] | 82h | 3106h | 07h |
| 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<br>– 00h: enabled<br>– 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)<br>■ Bit 1: Wire break recognition channel 1 (1: on)<br>■ Bit 2: Wire break recognition channel 2 (1: on)<br>■ Bit 3: Wire break recognition channel 3 (1: on)<br>■ Bit 7 ... 4: reserved |

**TEMPCNF Temperature system**

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

**SUPR Interference frequency suppression**

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 1, 0: Interference frequency suppression<br>– 01: 60Hz<br>– 10: 50Hz<br>■ 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 |

| Measuring range (funct. no.) | Measuring value | Signal range | Range |
|---|---|---|---|
| 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 (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 |

| Measuring range (funct. no.) | Measuring value | Signal range | 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 |
| 2 wire: 0 ... 3000Ω (92h) | --- | --- | overrange |
| | 0 ... 3000Ω | 0 ... 30000 | nominal range |
| | --- | --- | underrange |
| 3 wire: 0 ... 60Ω | --- | --- | overrange |

| Measuring range (funct. no.) | Measuring value | Signal range | Range |
|---|---|---|---|
| (98h) | 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 |
| | --- | --- | underrange |
| 3 wire: 0 ... 3000Ω (DAh) | 3528Ω | 32511 | overrange |
| | 0 ... 3000Ω | 0 ... 27648 | nominal range |
| | --- | --- | underrange |

| Measuring range (funct. no.) | Measuring value | Signal range | Range |
|---|---|---|---|
| 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 |

### 3.24.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| 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 | 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error: channel x:<br>■ Bit 0: set at error in project engineering/parameterization<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire break<br>■ Bit 5: reserved<br>■ Bit 6: set at measuring range underflow<br>■ 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 | |

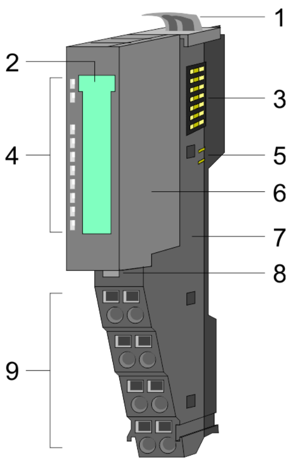
## 4.4 032-1BB30 - AO 2x12Bit 0...10V

**Properties**

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

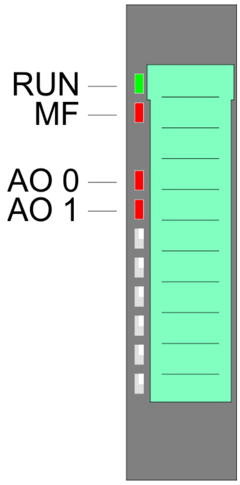
- 2 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

**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

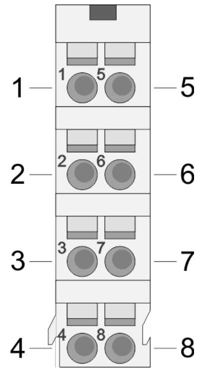
**Status indication**

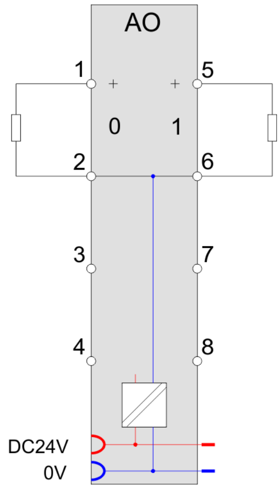



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Fehler Busversorgungsspannung |
| X | B | X | Error at bus power supply ↬ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Overload, short-circuit<br>■ 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 | --- | --- | not connected |
| 4 | --- | --- | not connected |
| 5 | AO 1 | O | Channel 1 |
| 6 | AGND | O | Ground channels |
| 7 | --- | --- | not connected |
| 8 | --- | --- | not connected |

O: Output

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

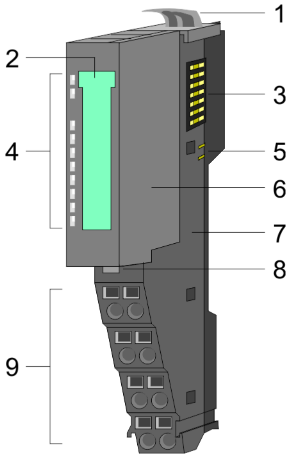
## 4.5 032-1BB40 - AO 2x12Bit 0(4)...20mA

**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.

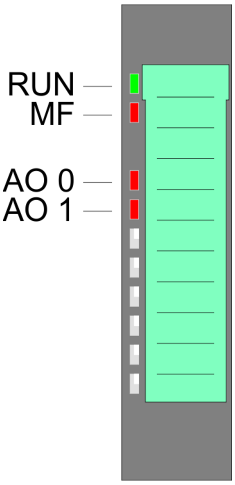
- 2 analog outputs
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Diagnostics function
- 12bit resolution

## 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

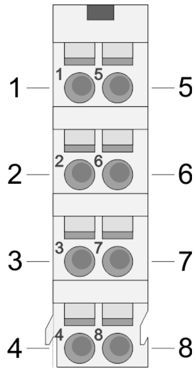
## Status indication

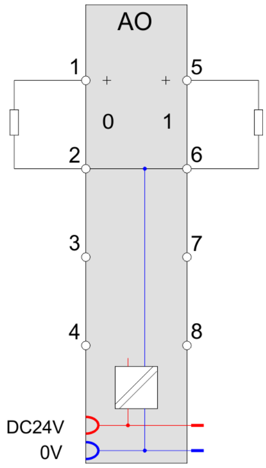



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ⇨ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Error in parameterization<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>+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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Wire-break recognition channel 1 (1: on)<br>■ 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 | $I = D \; x \; \frac{20}{27648}$ $D = 27648 \; x \; \frac{I}{20}$ |
| | 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 | |

## 4.5.3 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire-break<br>■ 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.

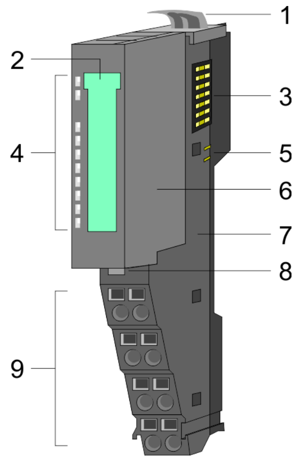
## 4.6 032-1BB70 - AO 2x12Bit ±10V

**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.

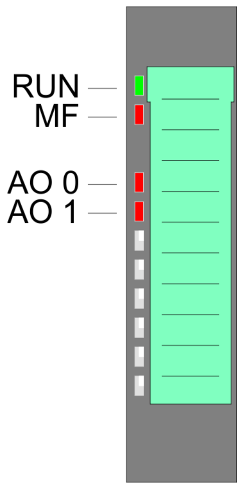
- 2 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

**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**

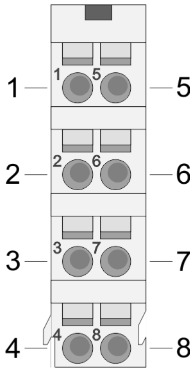


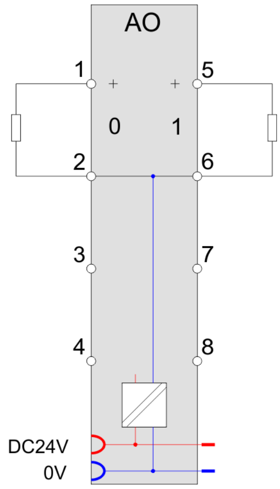

| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

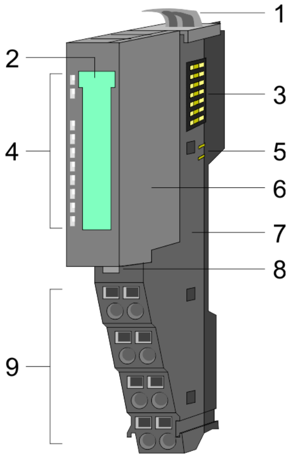
## 4.7 032-1BD30 - AO 4x12Bit 0...10V

**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.

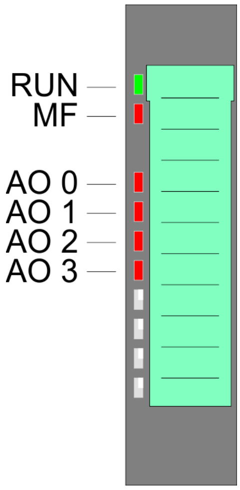
- 4 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 12bit resolution

**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

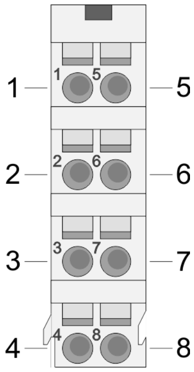
**Status indication**

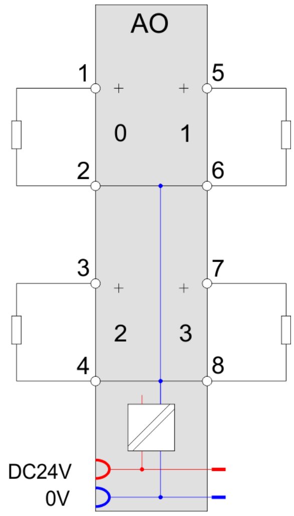



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 and PROFINET

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ Bit 2: Short-circuit recognition channel 2 (1:on)<br>■ Bit 3: Short-circuit recognition channel 3 (1:on)<br>■ 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |
|---|---|---|---|---|---|---|
| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

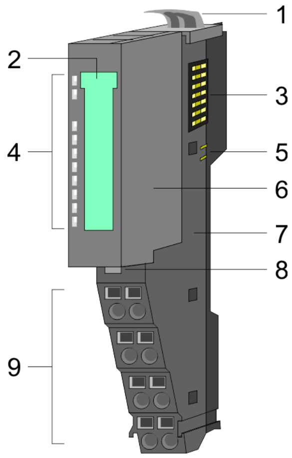
## 4.8 032-1BD40 - AO 4x12Bit 0(4)...20mA

**Properties**

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

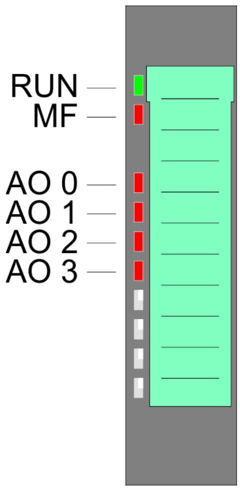
- 4 analog outputs
- Suited for sensors with 0...20mA; 4...20mA
- Diagnostics function
- 12bit resolution

**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

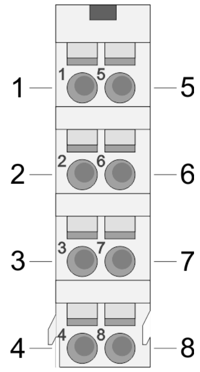
**Status indication**

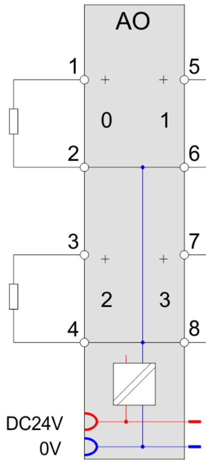



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

### 4.8.1 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<br>+4 mA ... +20 mA |
| Operational limit of current ranges | +/-0.4% ... +/-0.5% |

| **Order no.** | **032-1BD40** |
|---|---|
| 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 |
| 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 |

| Order no. | 032-1BD40 |
|---|---|
| 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 |

## 4.8.2 Parameter data

DS - Record set for access via CPU, PROFIBUS and PROFINET
IX - Index for access via CANopen
SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Wire-break recognition channel 1 (1: on)<br>■ Bit 2: Wire-break recognition channel 2 (1: on)<br>■ Bit 3: Wire-break recognition channel 3 (1: on)<br>■ 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 | $I = D \; x \; \frac{20}{27648}$ <br> $D = 27648 \; x \; \frac{I}{20}$ |
| | 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 | $I = D \; x \; \frac{20}{16384}$ <br> $D = 16384 \; x \; \frac{I}{20}$ |
| | 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 | $I = D \; x \; \frac{16}{27648} + 4$ <br> $D = 27648 \; x \; \frac{I-4}{16}$ |
| | 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 | $I = D \; x \; \frac{16}{16384} + 4$ <br> $D = 16384 \; x \; \frac{I-4}{16}$ |
| | 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire-break<br>■ 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.

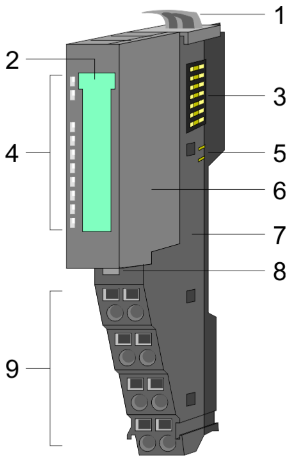
## 4.9 032-1BD70 - AO 4x12Bit ±10V

**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.

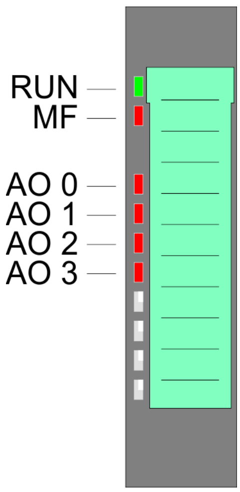
- 4 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 12bit resolution

**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**

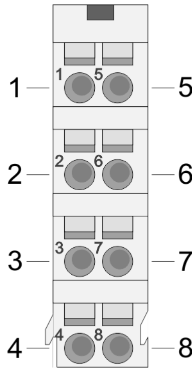


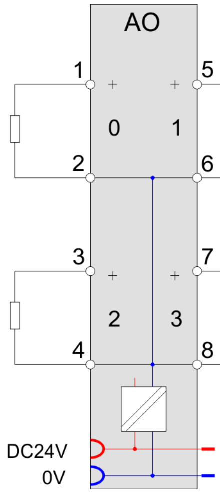

| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ Bit 2: Short-circuit recognition channel 2 (1:on)<br>■ Bit 3: Short-circuit recognition channel 3 (1:on)<br>■ 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<br>Siemens S format<br>(12h) | 11.76V | 32511 | 7EFFh | overrange | $U = D \times \frac{10}{27648}$<br>$D = 27648 \times \frac{U}{10}$ |
| | 10V | 27648 | 6C00h | nominal range | |
| | 5V | 13824 | 3600h | | |
| | 0V | 0 | 0000h | | |
| | -5V | -13824 | CA00h | | |
| | -10V | -27648 | 9400h | | |
| | -11.76V | -32512 | 8100h | underrange | |
| ±10V<br>Siemens S5 format<br>(22h) | 12.5V | 20480 | 5000h | overrange | $U = D \times \frac{10}{16384}$<br>$D = 16384 \times \frac{U}{10}$ |
| | 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 | $U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$ |
| | 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 | |

## 4.9.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| Name | Bytes | Function | Default | DS | IX | SX |
|---|---|---|---|---|---|---|
| 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 | | | 13h |

### ERR_A Diagnostic

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

### MODTYP Module information

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

### ERR_D Diagnostic

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

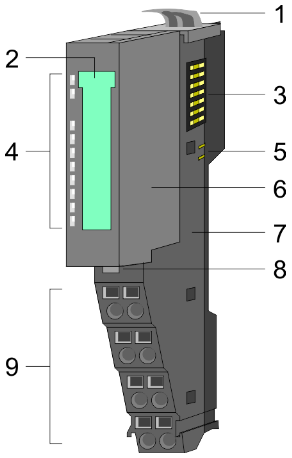
## 4.10 032-1CB30 - AO 2x16Bit 0...10V

**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.

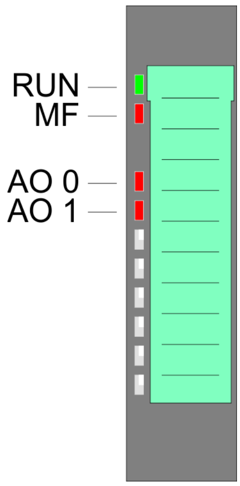
- 2 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 16bit resolution

**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

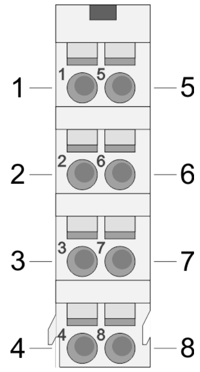
**Status indication**

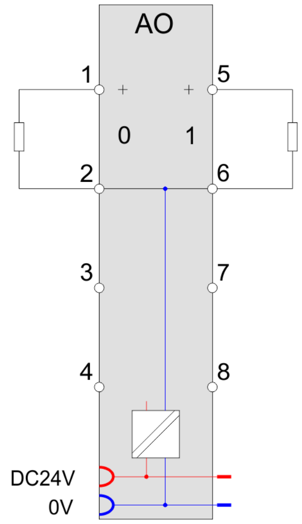



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ␦ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

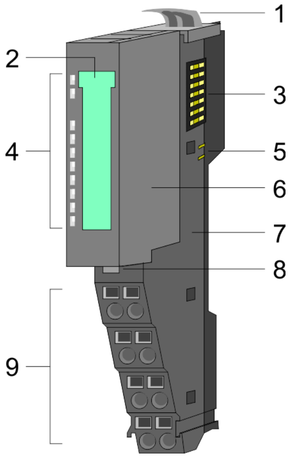
## 4.11 032-1CB40 - AO 2x16Bit 0(4)...20mA

**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.

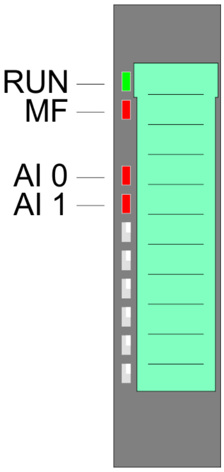
- 2 analog outputs
- Suited for sensors with 0 ... 20mA; 4 ... 20mA
- Diagnostics function
- 16bit resolution

## 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

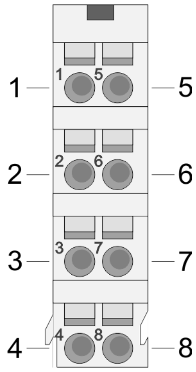
## Status indication

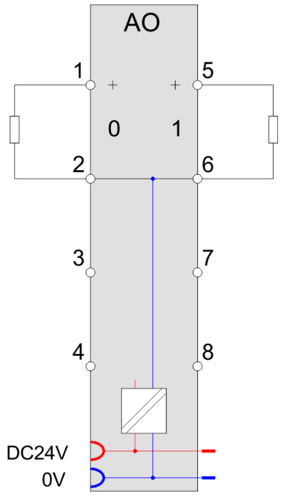



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>+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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Wire-break recognition channel 1 (1: on)<br>■ 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

### *ERR_A Diagnostic*

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

### *MODTYP Module information*

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire-break<br>■ 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.

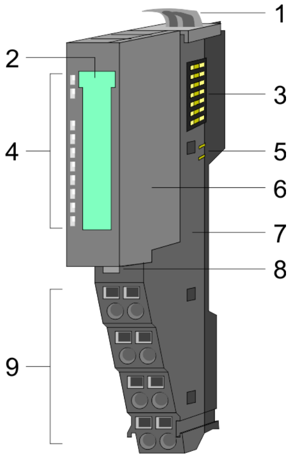
## 4.12 032-1CB70 - AO 2x16Bit ±10V

**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.

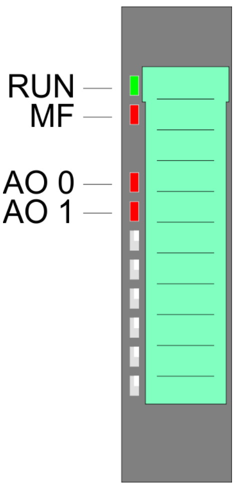
- 2 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 16bit resolution

**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**

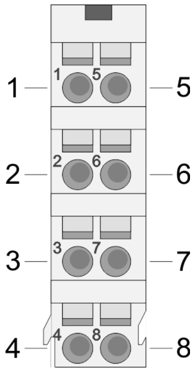


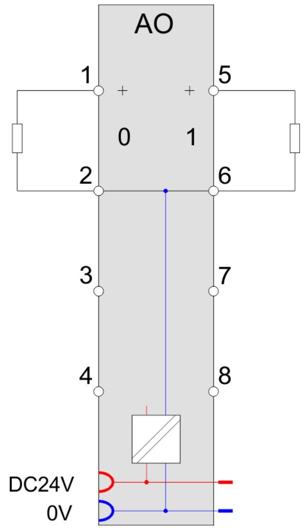

| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | 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<br>■ Error in parameterization<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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<br>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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ 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 | |

### 4.12.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 7 ... 2: reserved |

***CH0ERR / CH1ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

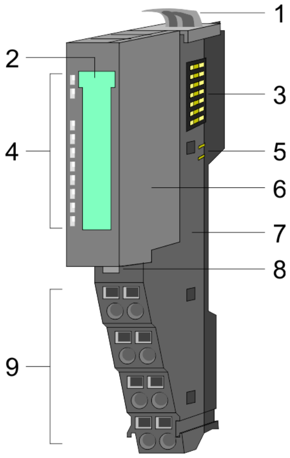
## 4.13 032-1CD30 - AO 4x16Bit 0...10V

**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.

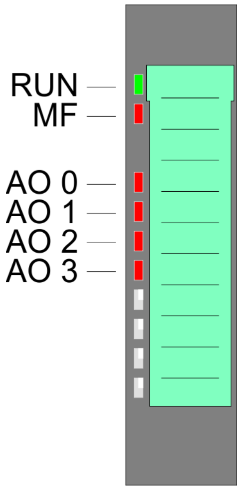
- 4 analog outputs
- Suited for sensors with 0 ... 10V
- Diagnostics function
- 16bit resolution

**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

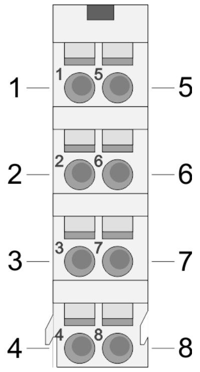
**Status indication**

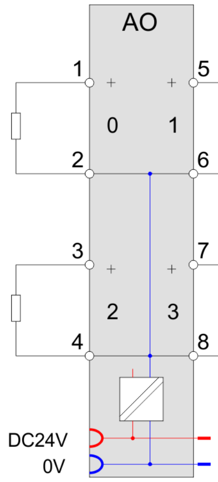



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ↯ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

### 4.13.1 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 | - |

| Order no. | 032-1CD30 |
|---|---|
| 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 | 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. | 032-1CD30 |
|---|---|
| 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 |

### 4.13.2 Parameter data

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

IX - Index for access via CANopen

SX - Subindex (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ Bit 2: Short-circuit recognition channel 2 (1:on)<br>■ Bit 3: Short-circuit recognition channel 3 (1:on)<br>■ 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 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 |
|---|---|---|---|---|---|---|
| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.

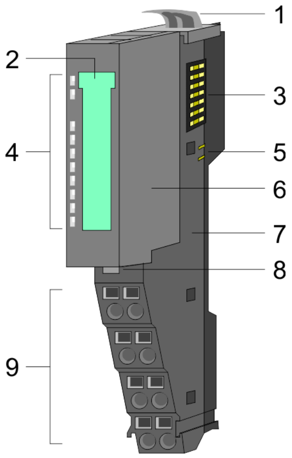
## 4.14 032-1CD40 - AO 4x16Bit 0(4)...20mA

**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.

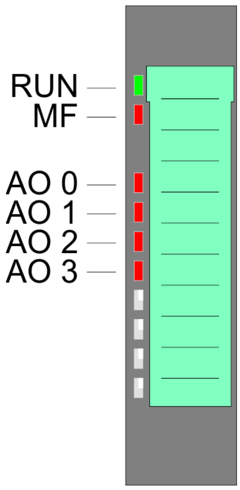
- 4 analog outputs
- Suited for sensors with 0...20mA; 4...20mA
- Diagnostics function
- 16bit resolution

**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

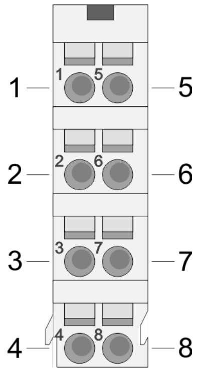
**Status indication**

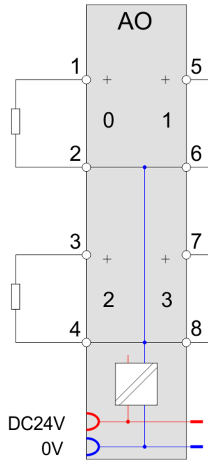



| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration ➡ *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Error in parameterization<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

### 4.14.1 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<br>+4 mA ... +20 mA |
| Operational limit of current ranges | +/-0.2% |

| Order no. | 032-1CD40 |
|---|---|
| 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 |
| 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 |

| Order no. | 032-1CD40 |
|---|---|
| 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 | 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Wire-break recognition channel 1 (1: on)<br>■ Bit 2: Wire-break recognition channel 2 (1: on)<br>■ Bit 3: Wire-break recognition channel 3 (1: on)<br>■ 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 | $I = D \; x \; \frac{20}{27648}$ <br> $D = 27648 \; x \; \frac{I}{20}$ |
| | 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 | $I = D \; x \; \frac{20}{16384}$ <br> $D = 16384 \; x \; \frac{I}{20}$ |
| | 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 | $I = D \; x \; \frac{16}{27648} + 4$ <br> $D = 27648 \; x \; \frac{I-4}{16}$ |
| | 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 | $I = D \; x \; \frac{16}{16384} + 4$ <br> $D = 16384 \; x \; \frac{I-4}{16}$ |
| | 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 3 ... 1: reserved<br>■ Bit 4: set at wire-break<br>■ 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.

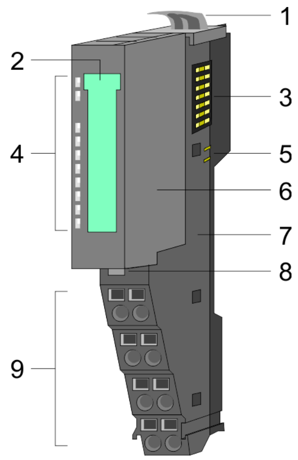
## 4.15 032-1CD70 - AO 4x16Bit ±10V

**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.

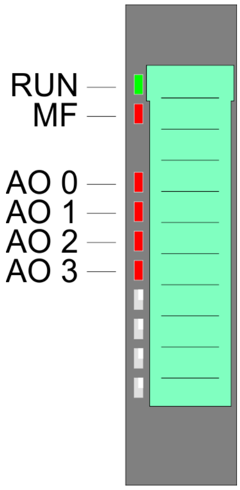
- 4 analog outputs
- Suited for sensors with ±10V, 0 ... 10V
- Diagnostics function
- 16bit resolution

**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**

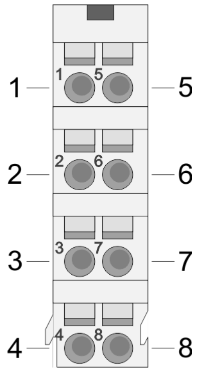


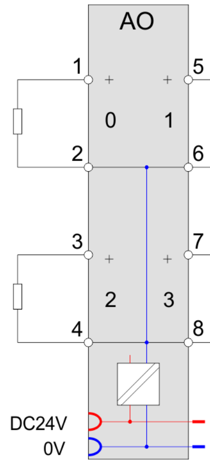

| RUN | MF | AO x | Description |
|---|---|---|---|
| green | red | red | |
| ● | ○ | X | Bus communication is OK<br>Module status is OK |
| ● | ● | X | Bus communication is OK<br>Module status reports an error |
| ○ | ● | X | Bus communication is not possible<br>Module status reports an error |
| ○ | ○ | X | Error at bus power supply |
| X | B | X | Error in configuration *Chapter 2.7 'Trouble shooting - LEDs' on page 30* |
| ● | ○ | ● | Error channel x<br>■ Overload, short-circuit<br>■ 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

***Input area***

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

***Output area***

At CPU, PROFIBUS and PROFINET the 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 (7000h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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 |

## 4.15.1 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<br>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. | 032-1CD70 |
| --- | --- |
| 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 | - |
| Insulation tested with | DC 500 V |
| **Datasizes** | |
| Input bytes | 0 |

| Order no. | 032-1CD70 |
|---|---|
| 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 (3100h + EtherCAT-Slot) for access via EtherCAT

More can be found in the according manual of your bus coupler.

| 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)<br>■ Bit 1: Short-circuit recognition channel 1 (1:on)<br>■ Bit 2: Short-circuit recognition channel 2 (1:on)<br>■ Bit 3: Short-circuit recognition channel 3 (1:on)<br>■ 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 | $U = D \times \frac{10}{27648}$ $D = 27648 \times \frac{U}{10}$ |
| | 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 | |

### 4.15.3 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 (5005h) for access via EtherCAT.

More can be found in the according manual of your bus coupler.

| 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 | | | 13h |

***ERR_A Diagnostic***

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

***MODTYP Module information***

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

***ERR_D Diagnostic***

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

***CHTYP Channel type***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | ■ Bit 6 ... 0: Channel type<br>– 70h: Digital input<br>– 71h: Analog input<br>– 72h: Digital output<br>– 73h: Analog output<br>– 74h: Analog input/-output<br>– 76h: Counter<br>■ 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<br>■ Bit 1: set at error in channel group 1<br>■ Bit 2: set at error in channel group 2<br>■ Bit 3: set at error in channel group 3<br>■ Bit 7 ... 4: reserved |

***CH0ERR ... CH3ERR Channel-specific***

| Byte | Bit 7 ... 0 |
|---|---|
| 0 | Channel-specific error channel x:<br>■ Bit 0: set at configuring/parameter assignment error<br>■ Bit 2 ... 1: reserved<br>■ Bit 3: set at short-circuit to ground<br>■ 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.