USER MANUAL 1.11

B-Nimis MC-I/O

EtherCAT® I/O Modules

BERGHOF

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General Information on this Manual
This equipment manual contains product-specific information valid at the time of publication.
This equipment manual is only complete in conjunction with the product-related hardware and software user manuals required for the individual application.

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Update

Version	Date	Subject
1.01	16.10.2012	First Version
1.1	09.11.2012	Update of document title and the trademarks
1.2	04.04.2013	Transition in new CD Update of chapter ‘Temperature modules’ with module AI8-Pt/Ni100 Update of ‘Technical data‘ in all chapters
1.3	25.07.2013	Update of tables ‘Analogue values current‘ and ‘Analogue values voltage’ Update of table ‘Analogue outputs’ in chapter ‘Analogue outputs voltage / current AO4-U/I’, section ‘Function’
1.4	20.06.2017	New corporate name ‚Berghof Automation GmbH‘ New EMC Directive Addition of section ‚Installation’ in chapter ‚System description EtherCAT I/O Modules’ Addition of chapter ‚System description EtherCAT I/O Modules‘ with section ‚Technical data (overview)‘ Addition of new module MC-I/O DO8 Relais NO 24V Addition of new module MC-I/O DO8 Relais NO 230VAC Addition of new module MC-I/O BK DI16/DO16 1MS/0,5A Update of section ‚Analogue outputs voltage / current AO4-U/I‘, ‚Technical data‘ Update of section ‚Technical data‘ in chapter ‚Counter modules‘ Update of flash code of EtherCAT LED of all modules Update of ‚Technical data‘ in all chapters Chapter ‚Communication modules‘ is dropped Update of chapter ‚Annex‘ UL certification
1.5	24.11.2017	New title page Updating label of various modules Updating various graphics Update of section ‚Counters with analogues outputs COUNTER/POSI2 5V‘, ‚Technical data‘ Addition of section ‚Overview MC-I/O Modules‘ in chapter ‚System description EtherCAT I/O Modules‘ Addition of new module MC-I/O AI4-I 12BIT CoE Addition of new module MC-I/O AI8-I 12BIT CoE Addition of new module MC-I/O AI4/8-U 13BIT CoE Addition of new module MC-I/O AI8/16-U 13BIT CoE Addition of new module MC-I/O AI4-PT/NI/THERMO 16BIT CoE Addition of new module MC-I/O AI8-PT/NI/THERMO 16BIT CoE Deletion of module MC-I/O COUNTER2 5V

Version	Date	Subject
1.6	13.02.2018	Update of section ‚Technical data‘ in chapter ‚Digital modules with integrated bus coupler‘ Update of section ‚Overview MC-I/O Modules‘ in chapter ‚System description EtherCAT I/O Modules‘ Addition of new module MC-I/O AO4-U/I 16BIT CoE
1.7	23.02.2022	revised
1.8		internal
1.9	30.09.2022	Replacement “CANtrol” with “B-Nimis” Replacement “E-I/O” with “MC-I/O” Update section ‚The Berghof Automation platform‘ Update section ‚List of figures‘ New figure in chapter ‚MC-I/O – B-Nimis EtherCAT I/O-System‘ New figure in section ‚Mechanical design‘ New figure in section ‚EXTENDER 2 PORT‘ Update of the figures of the MC-I/O Modules with order number S-0XXXXXXX-XXXX Update of the order numbers S-02020201-XXXX of the plug-in connectors New figures in section ‚Analogue inputs for voltage measurement AI4/8-U 13BIT CoE‘ Addition of new module MC-I/O CAN S-01030203-0500
1.10	21.05.2024	Module marked with “discontinued/phased out product - MC-I/O DO8 Relais NO 24V – S01030205-0100 - MC-I/O DO8 Relais NO 230VAC – S01030205-0200 Addition of new module - MC-I/O DO8 Relay NO – S-01030205-0300
1.11	18.10.2024	Change of product name from MC-I/O DO8 relay NO to MC-I/O DO8 Relay NO Addition of new module MC-I/O OC AI4-U/I - S-01030202-0600 Addition of new module MC-I/O OC Counter/Encoder - S-01030206-0200

Contents

1. General Information

Documentation
This equipment manual is intended for qualified personnel and contains information regarding mounting, installation, commissioning and maintenance. The information contained in this manual is subject to change without prior notice.

1.1. About This Manual

This equipment manual is an integral part of the product. Make sure the equipment manual is always available near the product’s point-of-employment. The manual contains information about the following topics:

→ Areas of application;
→ Safety;
→ Mechanical construction;
→ Electrical construction;
→ Connections;
→ Commissioning;
→ Care and maintenance;
→ Decommissioning;
→ Disposal.

1.2. Hazard Categories and Terminology

The indications described below are used in connection with safety instructions you will need to observe for your own personal safety and the avoidance of damage to property.

These instructions are emphasised by bordering and/or shading and a bold-printed indication, their meaning being as follows:

DANGER

Immediate danger

Failure to observe the information indicated by this warning will result in death, serious injury or extensive property damage

WARNING

Potential danger

Failure to observe the information indicated by this warning may result in death, serious injury or extensive property damage

CAUTION

Danger

Failure to observe the information indicated by this warning may result in injury or property damage

i NOTE

No hazard

Information indicated in this manner provides additional notes concerning the product

1.3. Conformity Declaration

The EtherCAT I/O Modules comply with and make allowance for the following directives and standards

→ **EMC Directive 2014/30/EU**
→ **RoHS-2 – Directive 2011/65/EU**
→ **IEC 61131-2:2007** Programmable controllers
Part 2: Equipment requirements and tests
→ **UL 508:2013-10** Industrial Control Equipment
17th Edition / 1999-01-28

1.4. Qualified Personnel

Only qualified personnel may install, operate and maintain the EtherCAT I/O Modules.
Within the context of this documentation and the safety information it contains, qualified personnel constitutes trained specialists who have the authority to mount, install, commission, ground and identify equipment, systems and power circuits in accordance with the standards of safety technology, and who are familiar with the safety concepts of automation technology.

1.5. Due Diligence

The operator, or the processor (OEM) must ensure that

→ the EtherCAT I/O Modules are only used for the purpose for which they are intended;
→ the EtherCAT I/O Modules are only operated in impeccable full working order;
→ the user manual is always available in full and in a legible condition;
→ only specialists with sufficient qualification and authorisation mount, install, commission and maintain the controller module;
→ these specialists are regularly instructed in all relevant questions of occupational health and safety and environmental protection and that they also know the contents of the user manual and especially of the safety notes therein;
→ the device markings, identifications, safety and warning notes attached to the EtherCAT I/O Modules are not removed and are always kept in a legible state;
→ the national and international regulations for controlling machines and systems which apply at the relevant usage site are observed;
→ the relevant information about the EtherCAT I/O Modules and their application and operation is always available to the users

1.5.1. Working on the controller module

Before carrying out work on the EtherCAT I/O Modules you must always

→ first ensure that the controller and the system are in a secure state;
→ only then switch off the controller and the system and
→ only now disconnect the EtherCAT I/O Modules from the system.

1.6. Use as Prescribed

This is a modular automation system based on the CANbus, intended for industrial control applications within the medium to high performance range.

The automation system is designed for use within Overvoltage Category I (IEC 364-4-443) for the controlling and regulating of machinery and industrial processes in low-voltage installations in accordance with the following general parameters:

- → maximum rated supply voltage of 1,000 VAC (50/60 Hz) or 1,500 VDC;
- → for use in maximum category 2 pollution environment (EN 60950);
- → for use up to a maximum altitude of 2,000 m above msn;
- → max. ambient temperature inside and outside the control cabinet is within the technical specifications (see section "Technical data")

Qualified project planning and design, proper transport, storage, installation, use and careful maintenance are essential to the flawless and safe operation of the automation system.
The automation system may only be used within the scope of the data and applications specified in the present documentation and associated user manuals.

The automation system is to be used only as follows

- → as prescribed,
- → in technically flawless condition,
- → without arbitrary or unauthorized changes and
- → exclusively by qualified users

The regulations of the German professional and trade associations, the German technical supervisory board (TÜV), the VDE (Association of German electricians) or other corresponding national bodies are to be observed.

Safety-oriented (fail-safe) systems
Particular measures are required in connection with the use of PLCs in safety-oriented systems. If a PLC is to be used in a safety-oriented system, the user ought to seek the full advice of the PLC manufacturer in addition to observing any standards or guidelines on safety installations which may be available.

⚠ WARNING

As with any electronic control system, the failure of particular components may result in uncontrolled and/or unpredictable operation.

All types of failure and the associated fuse systems are to be taken into account at system level. The advice of the PLC manufacturer should be sought if necessary.

2. Introduction EtherCAT I/O Modules

2.1. EtherCAT - Ethernet Control Automation Technology

EtherCAT is one of the most powerful Ethernet-based fieldbus systems. EtherCAT puts up the top speed mark, and its flexible topology and simple configuration make it the perfect means of controlling extremely fast processes, for example, 1000 I/Os are achieved in 30 µs.
Because of its high performance, the simple wiring and its open protocol support, EtherCAT is often used as a fast motion control and I/O bus driven by an industrial PC or in conjunction with control technology on a smaller scale. EtherCAT moves beyond the limits of conventional fieldbus systems. Its interconnections between the controller at one end and both the I/O modules and drives at the other are as fast as those of a backplane bus. EtherCAT controllers thus nearly act like centralized control systems, overcoming the issue of bus transfer times that conventional fieldbus systems are burdened with.

2.2. The Berghof Automation platform

The automation platforms B-Nimis, B-Fortis and B-Primis have been specifically engineered with applications near to the machine in mind. Berghof provides flexible automation solutions including hardware and software PLCs based around industrial PCs, remote I/Os, PLCs with / without display and decentralized drives. EtherCAT, PROFINET, Bacnet, KNX, Ethernet/IP, Modbus and CANopen are supported for networking. Berghof controllers include an EtherCAT master in the standard and are programmable with CODESYS V3.5.

2.3. B-Nimis MC-I/O EtherCAT I/O-System

B-Nimis MC-I/O is a system of I/O modules for connecting the process signals to an EtherCAT network.
B-Nimis MC-I/O consists of the MC-I/O bus coupler and a range of I/O modules.
The B-Nimis MC-I/O bus coupler converts the physical transfer technology (twisted pair) to LVDS (E-bus) and generates the system voltages required by the LVDS modules. The standard 100 Base Tx lines used for office network communications connect to the one side, the B-Nimis MC-I/O Modules for the process signals connect to the other. This is how the Ethernet EtherCAT protocol is retained right through to the last I/O module. At the end of the modular device, the connection between the forward and return lines is automatically closed, the effect being that another 100 Base Tx line can be plugged in to connect the next EtherCAT unit to the second bus coupler port..
If the bus coupler is the last device in the EtherCat network, it means the RJ45 "Out" socket remains free, the connection of the forward and return lines is automatically closed

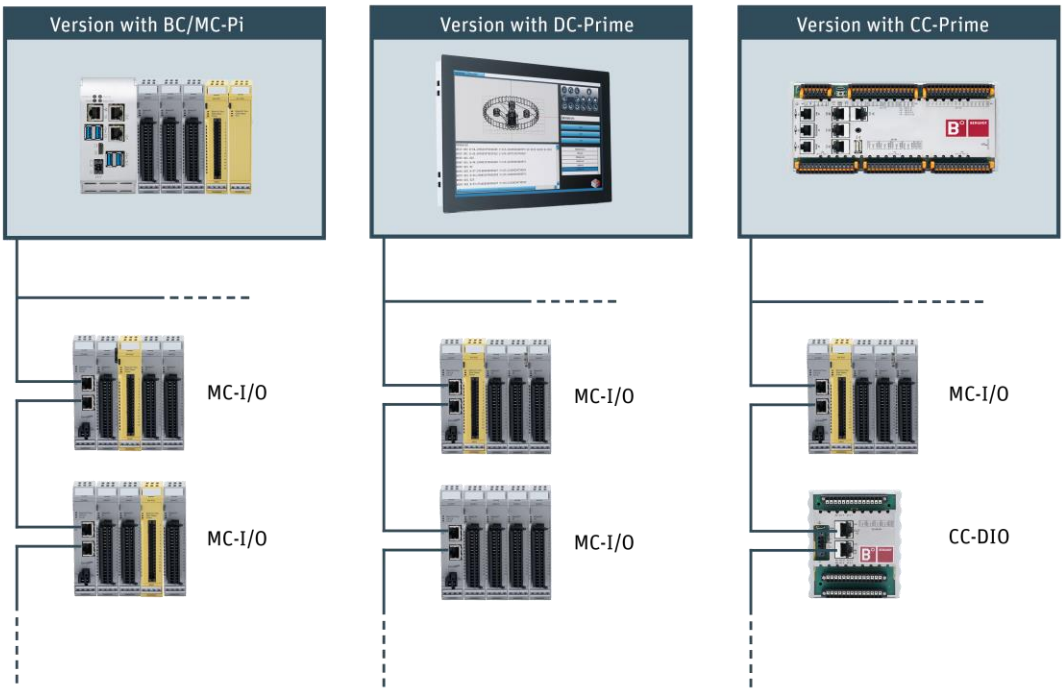


Figure 1: Overview of variants

2.4. Electromagnetic compatibility

2.4.1. Definition

Electromagnetic compatibility is the ability of a device to function satisfactorily in its electromagnetic environment without itself causing any electromagnetic interference that would be intolerable to other devices in this environment.
Of all known phenomena of electromagnetic noise, only a certain range occurs at the location of a given device. It is defined in the relevant product standards.
The design and immunity to interference of programmable logic controllers are internationally governed by Standard IEC 61131-2 which, in Europe, has been the basis for European Standard EN 61131-2.

i NOTE

Refer to IEC 61131-4, User's Guideline, for general installation instructions to be complied with to ensure that hardware interface factors and the ensuing noise voltages are limited to tolerable levels.

2.4.2. Interference emission

Interfering emission of electromagnetic fields, HF compliant to EN 55011, limiting value class A, Group 1

i NOTE

If the controller is designed for use in residential areas, high-frequency emissions must comply with limiting value class B as described in EN 55011. Fitting the controller into earthed metal cabinets and in-stalling filters in the supply lines may produce a shielding compliant to the above standard.

2.4.3. General notes on installation

As component parts of machines, facilities and systems, electronic control systems must comply with valid rules and regulations, depending on their field of application.
General requirements concerning the electrical equipment of machines and aiming at the safety of these machines are contained in Part 1 of European Standard EN 60204 (same as VDE 0113).

For safe installation of our control system please observe the information given below.

2.4.4. Electrical immission safeguard

Connect the control system to the protective earth conductor to eliminate electromagnetic interference.
Practice best cable routing.

2.4.5. Cable routing and wiring

Keep power circuits separate from control circuits:
→ DC voltages 60 V ... 400 V
→ AC voltages 25 V ... 400 V

Joint laying of control circuits is allowed for:
→ shielded data signals
→ shielded analogue signals
→ unshielded digital I/O lines
→ unshielded DC voltages < 60 V
→ unshielded AC voltages < 25 V

i HINWEIS

For EtherCAT data cables, we recommend Cat5e SF/UTP category network cables. Unshielded cables should not be used.

Wire connection specifications: Use AWG wire size 16-22 or equivalent.

2.4.6. Location of installation

Exclude any and all impediments due to temperature, dirt, impact, vibration or electromagnetic interference.

Temperature
Consider heat sources such as general heating of rooms, sunlight, heat accumulation in assembly rooms or control cabinets.

Contamination
Use suitable casings to avoid possible negative influences due to humidity, corrosive gas, liquid or conducting dust.

Impact and vibration
Consider possible influences caused by motors, compressors, transfer lines, presses, ramming machines and vehicles.

Electromagnetic interference
Consider electromagnetic interference from various local sources: motors, switching devices, switching thyristors, radio-controlled devices, welding equipment, arcing, switched-mode power supplies, converters / inverters.

2.4.7. Particular sources of interference

Inductive actuators
Switching off inductances (such as from relays, contactors, solenoids or switching magnets) produces surge voltages. It is necessary to reduce these extra voltages to a minimum. Reducing elements may be diodes, Z-diodes, varistors or RC elements. To find the best adapted elements, we recommend that you contact the manufacturer or supplier of the corresponding actuators for the relevant information.

3. System description EtherCAT I/O Modules

B-Nimis MC-I/O is a system of I/O modules for connecting the process signals to any EtherCAT network station.
B-Nimis MC-I/O consists of the B-Nimis MC-I/O bus coupler and a range of B-Nimis MC-I/O modules.
The B-Nimis MC-I/O bus coupler converts the physical transfer technology (twisted pair) to LVDS (E-bus) and generates the system voltages required by the LVDS modules. The standard 100 Base Tx lines used for office network communications connect to the one side, the B-Nimis MC-I/O modules for the process signals connect to the other. This is how the Ethernet EtherCAT protocol is retained right through to the last I/O module. At the end of the modular device, the connection between the forward and return lines is automatically closed, the effect being that another 100 Base Tx line can be plugged in to connect the next EtherCAT unit to the
second bus coupler port.
If the bus coupler is the last station of the EtherCAT network, i.e. if its RJ45 "Out" socket remains unplugged, the connection between the forward and return lines is automatically closed.

3.1. Mechanical design

The figure shows the basic layout of the B-Nimis MC-I/O modules.
The bus coupler and the I/O modules differ in their connectors and indicators, however.

Module structure

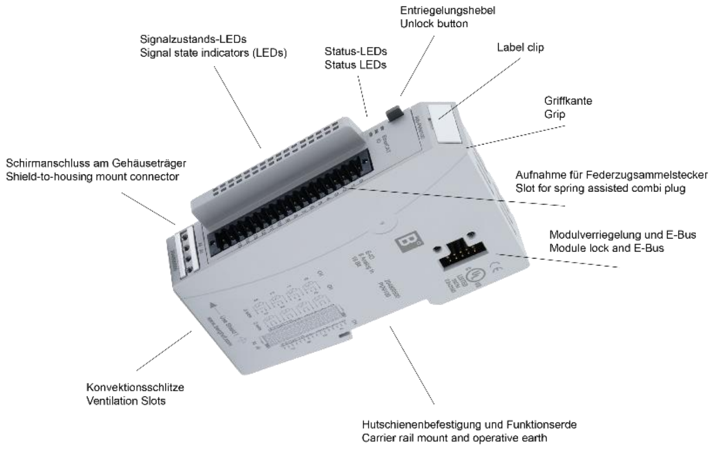


Figure 2: Mechanical design

The housing mount consists of an aluminium profile with an integral snap-on device used to snap the module to a 35mm DIN rail.
The housing trough including the optical fibres for the status indicators, the side face and the front is made of plastic and contains the module.
The optical fibres for the signal state indicators (LEDs) are located next to the spring-assisted combi plug. They slightly protrude from the housing and allow a clear diagnosis at a glance.

3.1.1. Earth

The B-Nimis MC-I/O modules shall be earthed. Thereto the metal housing shall be attached to operative earth.
Since the operative earth connectors dissipate HF currents, it is of utmost importance for the module's noise immunity.
HF interference is dissipated from the electronics board to the metal housing. The metal housing therefore needs to be suitably connected to an operative earth connector.
You will normally have to ensure that

→ the connection between module housing and DIN rail conducts well,
→ the connection between DIN rail and switching cabinet conducts well,
→ the switching cabinet is safely connected to earth.

In special cases you may attach the earth wire straight to the module.

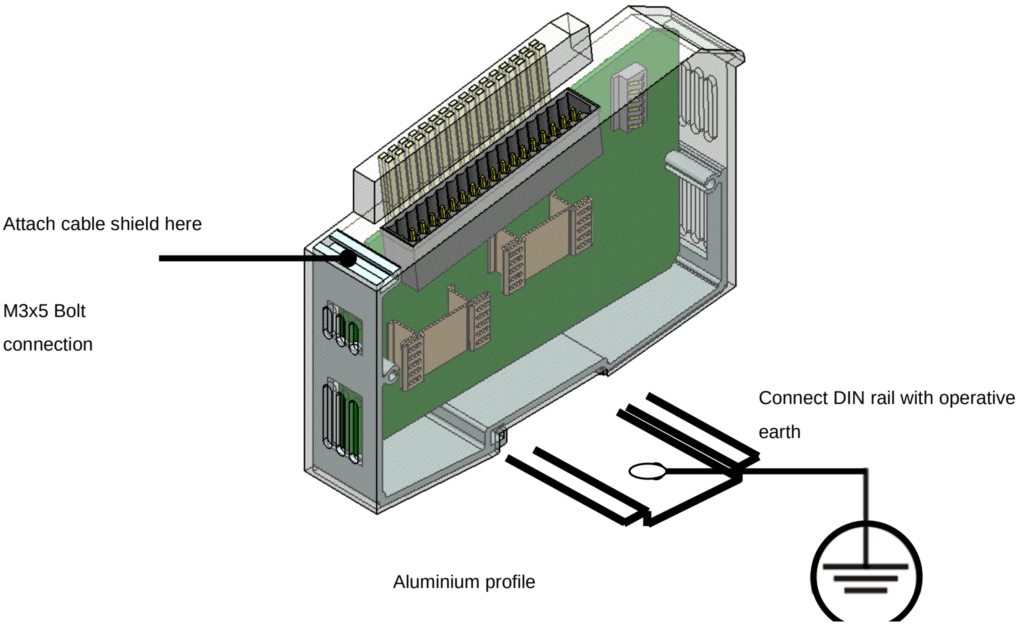


Figure 3: Earth

i NOTE

Earth wires should be short and have a large surface (copper mesh).
Further details has site http://en.wikipedia.org/wiki/Ground_(electricity)

3.1.2. Installation

The B-Nimis MC-I/O modules are intended for mounting rail installation (DIN EN 50022, 35 x 7.5 mm).

The mounting rail is placed horizontally and the female connector strip of the modules face forward. For a sufficient ventilation of the convection slits the minimum distance must not fall below 20 mm upward and 35 mm to adjacent equipment and control cabinets The lateral distance to external devices and cabinet controls must not fall below 20 mm.

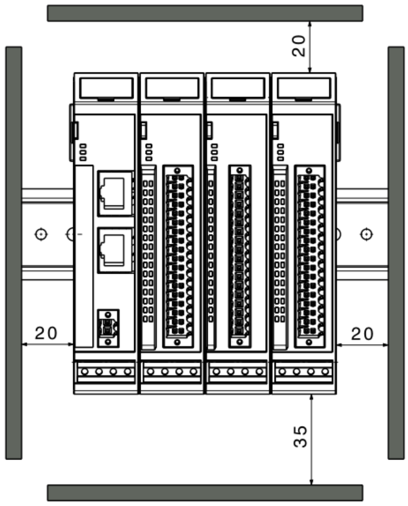


Figure 4: Installation position

Installation order within an MC-I/O system

i NOTE

To ensure smooth function of the entire MC-I/O system, the MC-I/O modules must be arranged based on their e-bus load. The modules with the biggest e-bus load are to be arranged directly next to the head modules (bus coupler or controller). Make sure that you note the maximum bus load of the head module.

→ Push up the module against the mounting rail from below, allowing the metal spring to snap in between mounting rail and mounting area as illustrated.
→ Push the module above against the mounting wall until it snaps in.

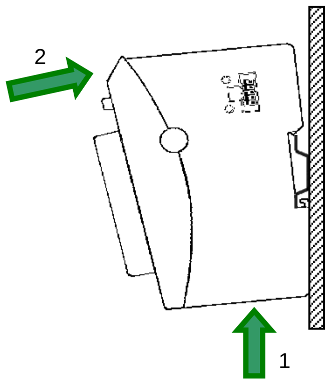


Figure 5: Rail mounting of module

To interconnect two modules

After snapping on the first module to the rail, snap on the second module about 1cm away towards the right of the first module. Push the second module along the rail towards the first module until you hear the locking device snap in.

To disconnect two modules

Push down the unlock button (see figure below) of the module that you wish to
disconnect from the module to the left of it. Push both modules away from one another until they are about 1 cm apart.

- → Push the module up and against the metal spring located on the underside of the rail guide.
- → Tip the module away from the rail as shown in the illustration.
- → Pull the module down and out of the mounting rail.

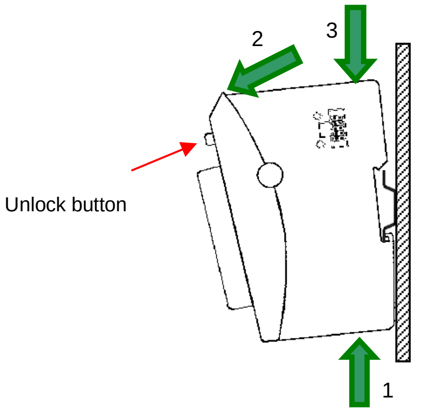


Figure 6: Uninstalling a module

3.2. System power supply

3.2.1. General

Multi-connector plugs provide many connections in a tight space.

- Unlock buttons make it easier to unplug larger connectors where there is little space.
- Screw fittings reliably hold small connectors in place.

i HINWEIS

To avoid excessive force being exerted on the board or problems with the contacts, do not expose the connectors to inadmissibly high tension / pressure.
One reason for too much pulling force is the wiring being too short.

General Spring-assisted blocks of sockets allow fast and simple wiring. A multiple socket connector densely packs the wires on a small footprint. Use the unlock button to easily disconnect the wires where there is little space.

➔ **Tool:** 0.4 x 2.5 blade screwdriver
➔ **Cores:** 0.20 - 1.0 mm² (IEC) / 28 - 18 ENC (UL)
➔ **Rated current:** 5 A (CSA) / 10 A (UL)

⚠ CAUTION

Do not connect the power supply lines through from one I/O power supply port to the next.

To ensure that there is as little interference as possible, install a central power supply point and establish a star topology of as short wires as possible between the central point and the I/O Modules.

3.2.2. Bus coupler

The system power supply connects to the bus coupler through a 2-pole plug-type terminal block. Since the bus coupler supplies power to both the E-bus and the logic
circuits of the I/O modules, its power consumption depends on the number of I/O modules connected.
Power to the I/O module outputs is supplied separately.

Spring-assisted connector and bus coupler unlock button
2VF100532DG00.cdr

3.2.3. I/O Modules

The I/O supply connects to the I/O module, normally together with the I/Os, using plug-type terminal blocks with different numbers of poles.
Power to the I/O module logic circuits is supplied by the bus coupler.

The logic of the I/O modules without their own microcontroller is supplied by the bus coupler. Modules with a microcontroller can have their own power supply unit, which is then supplied via the I/O connector.

Spring-assisted connector with
I/O module unlock button
2VF100533DG00.cdr

i HINWEIS

Externally turning off the I/O power supply (L+) can be used to trip all outputs.
In that case, LED Power indicates that no voltage is being supplied.
Mind, though, that not all modules have a voltage watchdog to indicate the state to the control unit.
To have your control program check whether power is supplied to the I/Os, connect L+ to a digital input and poll that input as an indirect indicator of the I/O power supply.

Remember the following if you choose to do so:

i HINWEIS

Avoid any reverse feeding of outputs while the power supply to the outputs is turned off

This applies if the system is still supplied with power.
Outputs enabled by the user program may be supplied power via the protective diode of a reversely fed output, thus overriding the switch-off function of these outputs. Moreover, the protective diode of the feeding outputs may yield under high loads and be destroyed.

3.3. Status LED

3.3.1. EtherCAT" LED

An LED labeled "EtherCAT" is located on both the bus coupler and the I/O Modules. It indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
Bootstrap	Flickering	Optional if the bootstrap mode is supported

3.3.2. "In" LED, "Out" LED

The "In" and "Out" LEDs are located on the bus coupler. They indicate the respective physical state of the Ethernet.

Ethernet		
State	**LED flash code**	**Explanation**
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Exchanging telegrams

3.3.3. "I/O" LED

Every I/O Module has an LED labeled "IO". It indicates the state of the Module's I/Os. Refer to the I/O Module sections in this manual to know which states of a module are monitored and indicated.

3.3.4. "Power" LED

An LED labeled "Power" is located on every I/O Module that has a power supply connector (e.g. for digital outputs). It indicates the state of the I/O module's I/O power supply.

I/O power supply		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

3.4. Technical data (overview)

System properties B-Nimis MC-I/O	
Fieldbus	EtherCAT 100Mbit/s
Dimensions	25 mm x 120 mm x 90 mm (W x H x D)
Housing mount	aluminium
Shield	connected straight to module housing
Installation	35 mm DIN rail (top-hat rail)
I/O connection	spring-assisted combi plug with mechanical ejector, 4 … 36-pin
Signal indication	LED located next to the terminal
Diagnosis	LED: bus state, module state, broken wire/excessive current
Number of ports	up to 32 digital I/Os on every module, up to 8 analogue channels per module
Supply voltage	24 V DC -20% / +25%
Number of I/O modules	20 per bus coupler (total max. power consumption:3 A)
Electrical insulation	modules electrically insulated from one another and from the bus
Cable length analog signals	< 30 m
Storage temperature	-25 °C … +70 °C
Operating temperature	0 °C ... +55 °C
Rel. humidity	5 % … 95 %, non-condensing
Protection	IP20
Susceptibility to noise	zone B to EN 61131-2, installation on an earthed top hat rail in the earthed control

i NOTE

Exception

The dimensions of the Bus coupler DI16/DO16 amount to
42 mm x 120 mm x 90 mm (W x H x D).

3.5. MC-I/O Modules (overview)

MC-I/O Modules		
Label	**Order number**	**Page**
MC-I/O BUSKOPPLER 3A	S-01030203-0100	29
MC-I/O BK DI16/DO16 1MS/0,5A	S-01030203-0200	32
MC-I/O DI16/DO16 1MS/0,5A	S-01030201-0400	36
MC-I/O DI32 1MS	S-01030201-0200	40
MC-I/O DI16 1MS	S-01030201-0100	42
MC-I/O DO16 0,5A	S-01030201-0300	44
MC-I/O DO8 RELAIS NO 24V	S-01030205-0100	47
MC-I/O DO8 RELAIS NO 230VAC	S-01030205-0200	50
MC-I/O DO8 RELAIS NO	S-01030205-0300	53
MC-I/O AI4-I 12BIT	204801100	58
MC-I/O AI8-I 12BIT	204802700	65
MC-I/O AI4-I 12BIT CoE	S-01030202-0100	73
MC-I/O AI8-I 12BIT CoE	S-01030202-0200	83
MC-I/O AI4/8-U 13BIT	204800200	93
MC-I/O AI4/8-U 13BIT CoE	S-01030202-0300	99
MC-I/O AI8/16-U 13BIT CoE	S-01030202-0400	108
MC-I/O AO4-U/I 12BIT	204801200	118
MC-I/O AO4-U/I 16BIT CoE	S-01030202-0500	124
MC-I/O AI4-PT/NI100 16BIT	204801300	134
MC-I/O AI4-PT/NI1000 16BIT	204802800	134
MC-I/O AI8-PT/NI100 16BIT	204800500	141
MC-I/O AI4-THERMO 16BIT	204801400	147
MC-I/O AI4-PT/NI/THERMO 16BIT CoE	S-01030204-0100	152
MC-I/O AI8-PT/NI/THERMO 16BIT CoE	S-01030204-0200	163
MC-I/O COUNTER/POSI2 5V	S-01030206-0100	177
MC-I/O CAN	S-01030203-0500	196
MC-I/O EXTENDER 2 PORT	S-01030203-0300	213
MC-I/O OC AI4-U/I	S-01030202-0600	217
MC-I/O OC Counter/Encoder	S-01030206-0200	294

Supplement		
POTENTIALVERTEILER 2x16	204802300	382
SCHIRMANSCHLUSSKLEMME 2x8 mm	204802400	383

4. Bus coupler

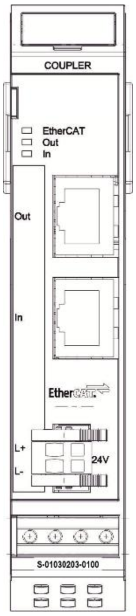


Figure 7: Bus coupler front view

4.1. Terminals

Module power supply
L+: 24 V DC
L-: 0 V

EtherCAT (RJ45 socket)
IN: input (from previous EtherCAT station)
OUT: output (to next EtherCAT station)

4.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“In” LED, “Out” LED
The “In” and “Out” LEDs indicate the physical state of the Ethernet’s ports they are allocated to.

Ethernet		
State	**LED flash code**	**Explanation**
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing	Exchanging telegrams

4.3. Function

The B-Nimis MC-I/O bus coupler converts the physical transfer technology (twisted pair) to LVDS (E-bus) and generates the system voltages required by the LVDS modules.
The standard 100 Base Tx lines used for office network communications connect to the one side, the B-Nimis MC-I/O Modules for the process signals connect to the other. This is how the Ethernet EtherCAT protocol is retained right through to the last I/O module.
At the end of the modular device, the connection between the forward and return lines is automatically closed, the effect being that another 100 Base Tx line can be plugged in to connect the next EtherCAT unit to the second bus coupler port.

Module state		
Variable	**Data type**	**Explanation**
Undervoltage	BOOL	Low voltage (supplied power < 19.2 V)

4.4. Technical data

Bus coupler	
Label	MC-I/O BUSKOPPLER 3A
Part no.	S-01030203-0100
Plug-in connector	2-pole S-02020201-1000 (part of the package)
Function	Connects a 100Base-TX EtherCAT with the B-Nimis MC-I/O Modules Generates the LVDS system voltages
Controller	ASIC ET1100
Baud rate	100Mbit/s
Cable	CAT5
Length of cable	max. 100 m between 2 bus couplers
Terminal EtherCAT	2 x RJ45
Power supply	24 V DC -20% +25%
Input current	50 mA & E-bus power supply
E-bus power supply	max. 3 A (ca. 20 modules)
E-bus load	195 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

5. Digital modules with integrated bus coupler

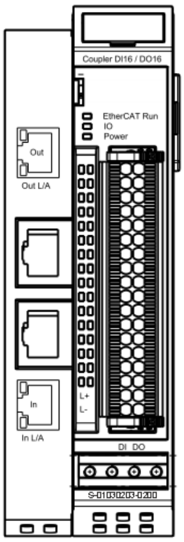


Figure 8: Front view of BK DI16/DO16 1MS/0.5A I/O module

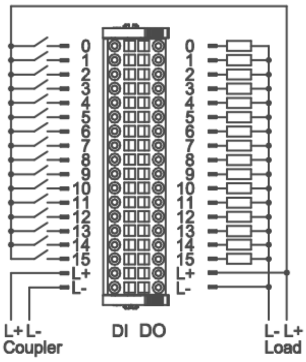


Figure 9: I/O connection

5.1. Terminals

Power supply to module I/Os
L+: 24 V DC
L-: 0 V

EtherCAT (RJ45 socket)
IN: input (from previous EtherCAT station)
OUT: output (to next EtherCAT station)

5.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “IO” indicates the state of the module's I/Os.

I/O		
State	**LED**	**Explanation**
Ok	Off	No error
SC	Red, flashing light	Short-circuited digital output

CAUTION

The output drivers have a thermal fuse to automatically turn off any short-circuited outputs.

In case the short circuit prevails, the outputs are allowed to cool down to be turned back on until the thermal fuse blows again.

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED**	**Explanation**
On	Green	24 V DC supply ok
Off	Off	24 V DC supply not ok

CAUTION

The module is monitored for low voltage states for logic and load!

“In”LED, “Out” LED

The “In” and “Out” LEDs indicate the physical state of the Ethernet’s ports they are allocated to.

Ethernet		
State	**LED flash code**	**Explanation**
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing light	Exchanging telegrams

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Input signal TRUE / output enabled
Off	Off	Input signal FALSE / output disabled

5.3. Function

The B-Nimis MC-I/O Bus coupler DI16/DO16 is an EtherCAT I/O module that combines the functionalities of the existing single modules B-Nimis MC-I/O Bus coupler and B-Nimis MC-I/O DI16/DO16 into one device. It is designed with a reduced E-bus supply of 2 A specifically for use in smaller module blocks.
In the bus coupler part the module converts the transmission physics from Twisted Pair to LVDS (E-Bus) and the generation of the voltage for the LVDS modules takes place. In addition, the module has 16 digital inputs and 16 digital outputs.
About the lateral E-bus connection, the Bus coupler DI16/DO16 can also be flexibly extended with EtherCAT I/O modules of the series B-Nimis MC-I/O.

Module state		
Variable	**Data type**	**Explanation**
U24_Load	BOOL	Undervoltage (supply < 19.2 V)
U24_Logic	BOOL	Undervoltage (supply < 19.2 V)
ShortcutOutput	BOOL	Short-circuited digital output

5.4. Technical data

BK DI16 / DO16	
Label	MC-I/O BK DI16/DO16 1MS/0.5A
Part no.	S-01030203-0200
Plug-in connector	36-pole S-02020201-0900 (not part of the package)
Function	Connects a 100Base-TX EtherCAT with the B-Nimis MC-I/O Modules Generates the LVDS system voltages
Digital inputs	16
Input delay	3 ms (typical)
Signal level	Off: -3 … 5 V (EN 61131-3, Type1) On: 15 V … 30 V
Digital outputs	16
Max. current	0.5 A per output
Total current	max. 8 A
Controller	ASIC ET1100
Baud rate	100 Mbit/s
Cable	CAT5
Cable length	max. 100 m between 2 bus couplers
EtherCAT connection	2 x RJ45
Power supply	24 V DC -20% +25%
Input current	40 mA & E-bus power supply
E-bus power supply	max. 2 A (ca. 11 modules)
E-bus connector	10-pin system plug in side wall
Term. module	not required
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

6. Digital modules

6.1. Digital in- and outputs DI16 / DO16

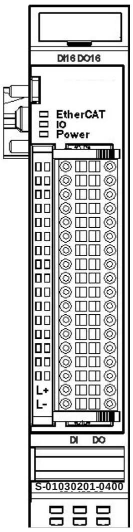


Figure 10: Front view of DI16/DO16 I/O module

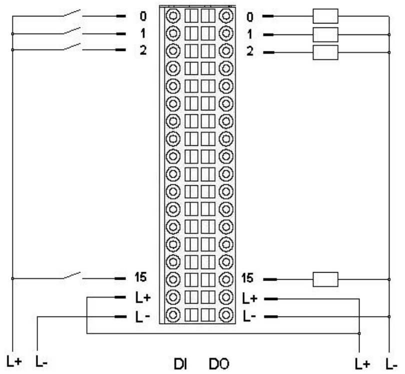


Figure 11: I/O connection

6.1.1. Terminals

Power supply to module I/Os

L+: 24 V DC

L-: 0 V

⚠ CAUTION

Connect L+ to both L+ terminals if the total current exceeds the 6A limit.

6.1.3. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “IO” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output

⚠ CAUTION

The output drivers have a thermal fuse to automatically turn off any short-circuited outputs.
In case the short circuit prevails, the outputs are allowed to cool down to be turned back on until the thermal fuse blows again.

“Power” LED
The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

⚠ CAUTION

The module is not monitored for low voltage states.

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Input signal TRUE / output enabled
Off	Off	Input signal FALSE / output disabled

6.1.4. Function

The DI16/DO16 module features 16 digital inputs and 16 digital outputs.

Function		
Variable	**Data type**	**Explanation**
DigitalInputn	BOOL	Digital input (n=0…15)
DigitalOutputn	BOOL	Digital output (n=0…15)

6.1.5. Technical data

DI16 / DO16	
Label	MC-I/O DI16/DO16 1MS/0.5A
Part no.	S-01030201-0400
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Digital inputs	16
Input delay	1 ms / 5 ms (typically)
Signal level	Off: -3 … 5 V (EN 61131-3, Type1) On: 15 V … 30 V
Digital outputs	16
Max. current	0.5 A per output
Total current	max. 8 A
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	135 mA

UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

6.2. Digital inputs DI32

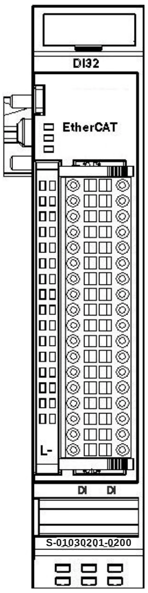


Figure 12: Front view of DI32 I/O module

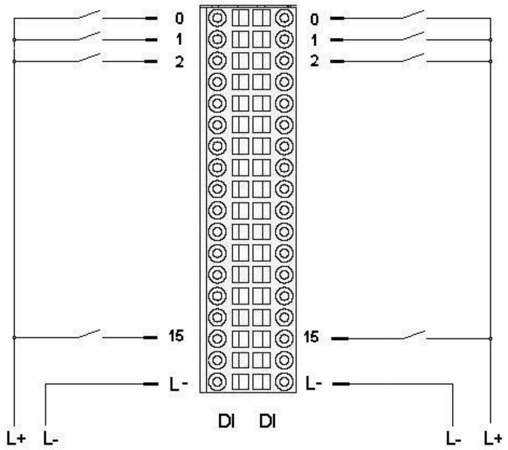


Figure 13: I/O connection

6.2.1. Terminals

Power supply to module I/Os
L-: 0 V

6.2.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
There is no LED labeled “I/O”.

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Input signal TRUE
Off	Off	Input signal FALSE

6.2.3. Function

The DI32 module has 32 digital inputs.

Function		
Variable	**Data type**	**Explanation**
DigitalInputn	BOOL	Digital input (n=0…31)

6.2.4. Technical data

DI32	
Label	MC-I/O DI32 1MS
Part no.	S-01030201-0200
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Digital inputs	32
Input delay	1 ms / 5 ms (typically)
Signal level	Off: -3 … 5 V (EN 61131-3, Type1) On: 15 V … 30 V
Controller	ASIC ET1100
Baud rate	100 Mbit/s
Connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	85 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

6.3. Digital inputs DI16

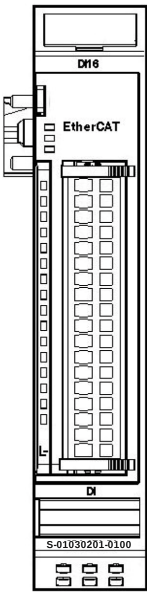


Figure 14: Front view of DI16 I/O module

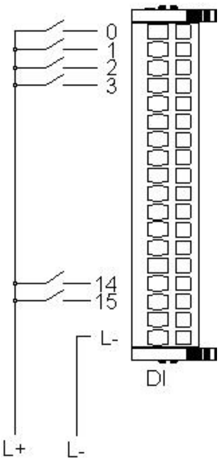


Figure 15: I/O connection

6.3.1. Terminals

Power supply to module I/Os
L-: 0 V

6.3.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
There is no LED labeled “I/O”.

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

"Channel" LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Input signal TRUE
Off	Off	Input signal FALSE

6.3.3. Function

The DI16 module has 16 digital inputs.

Function		
Variable	**Data type**	**Explanation**
DigitalInputn	BOOL	Digital input (n=0…15)

6.3.4. Technical data

DI16	
Label	MC-I/O DI16 1MS
Part no.	S-01030201-0100
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Digital inputs	16
Input delay	1 ms / 5 ms (typically)
Signal level	Off: -3 … 5 V (EN 61131-3, Type1) On: 15 V … 30 V
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	100 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

6.4. Digital outputs DO16

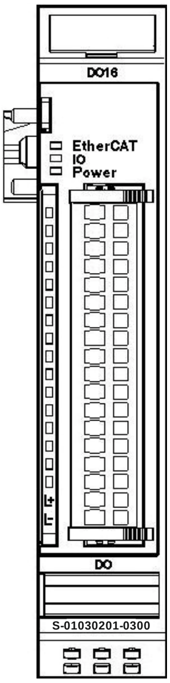


Figure 16: Front view of DO16 I/O module

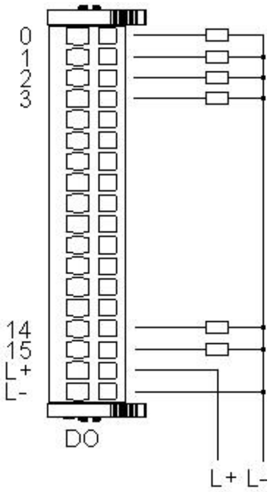


Figure 17: I/O connection

6.4.1. Terminals

Power supply to module I/Os
L+: 24 V DC
L-: 0 V

6.4.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module’s I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Off	No error
SC	Red, on	Short-circuited digital output

CAUTION

The output drivers have a thermal fuse to automatically turn off any short-circuited outputs.

In case the short circuit prevails, the outputs are allowed to cool down to be turned back on until the thermal fuse blows again.

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

CAUTION

The module is not monitored for low voltage states.

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Output enabled
Off	Off	Output disabled

6.4.3. Function

The DO16 module has 16 digital outputs.

Function		
Variable	**Data type**	**Explanation**
DigitalOutputn	BOOL	Digital output (n=0…15)

6.4.4. Technical data

DO16	
Label	MC-I/O DO16 0,5A
Part no.	S-01030201-0300
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Digital outputs	16
Max. current	0,5 A per output
Total current	max. 8 A
Controller	ASIC ET1200
Baud rate	100 Mbit/s
Connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	130 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

6.5. Digital outputs DO8 RELAIS NO 24V (phasing out)

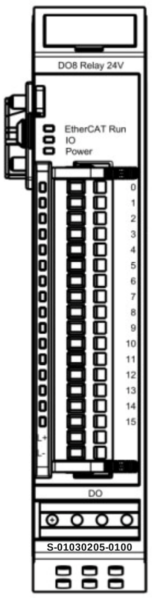


Figure 18: Front view of DO8 RELAIS NO 24V I/O module

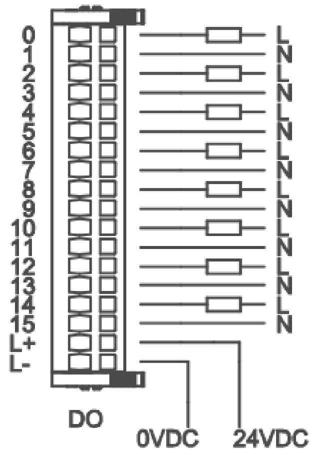


Figure 19: I/O connection

OUT	Pin
0-a	0
0-b	1
1-a	2
1-b	3
2-a	4
2-b	5
3-a	6
3-b	7
4-a	8
4-b	9
5-a	10
5-b	11
6-a	12
6-b	13
7-a	14
7-b	15
24 V	16
0 V	17

6.5.1. Terminals

Power supply to module I/Os
L+: 24 V DC
L-: 0 V

6.5.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
There is no LED labeled “I/O”.
“Power” LED
The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED**	**Explanation**
On	Green	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Output enabled
Off	Off	Output disabled

6.5.3. Function

The DO8 RELAIS NO 24V module has 8 relay outputs.

Function		
Variable	**Data type**	**Explanation**
DigitalOutputn	BOOL	Digital output (n=0…7)
Reserved	BOOL	Unused output addresses

6.5.4. Technical data

DO8 RELAIS NO 24V	
Label	MC-I/O DO8 RELAIS NO 24V
Part no.	S-01030205-0100
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Digital outputs	8 closing relays
Max. switching current (ohmic)	5.0 A per output
Max. switching current (inductive)	2.0 A per output
Min. permitted load	10 mA @ 5 VDC
Operating cycles mech. (min.)	2×10^7
Operating cycles electr. (min.)	3×10^5 (2 A / 30 VDC)
Switching voltage	max. 24 VDC / VAC
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	130 mA

6.6. Digital outputs DO8 RELAIS NO 230VAC (Discontinued)

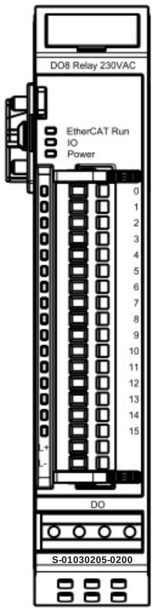


Figure 20: Front view of DO8 RELAIS NO 230VAC I/O module

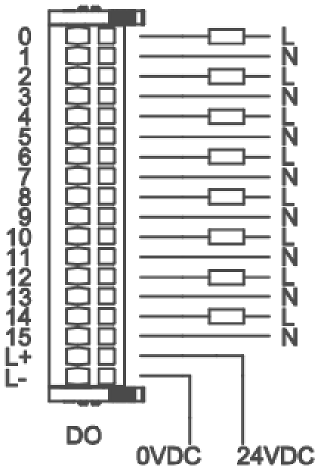


Figure 21: I/O connection

OUT	Pin
0-a	0
0-b	1
1-a	2
1-b	3
2-a	4
2-b	5
3-a	6
3-b	7
4-a	8
4-b	9
5-a	10
5-b	11
6-a	12
6-b	13
7-a	14
7-b	15
24 V	16
0 V	17

6.6.1. Terminals

Power supply to module I/Os
L+: 24 V DC
L-: 0 V

6.6.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
There is no LED labeled “I/O”.
“Power” LED
The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED**	**Explanation**
On	Green	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

Channel		
State	**LED**	**Explanation**
On	Green, on	Output enabled
Off	Off	Output disabled

6.6.3. Function

The DO8 RELAIS NO 230VAC module has 8 relay outputs.

Function		
Variable	**Data type**	**Explanation**
DigitalOutputn	BOOL	Digital output (n=0…7)
Reserved	BOOL	Unused output addresses

6.6.4. Technical data

DO8 RELAIS NO 230VAC	
Label	MC-I/O DO8 RELAIS NO 230VAC
Part no.	S-01030205-0200
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Digital outputs	8 closing relays
Max. switching current (ohmic)	5.0 A je Ausgang
Max. switching current (inductive)	2.0 A je Ausgang
Min. permitted load	10 mA @ 5 VDC
Operating cycles mech. (min.)	2×10^7
Operating cycles electr. (min.)	3×10^5 (2 A / 30 VDC)
Switching voltage	max. 24 VDC / 230 VAC
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus connector	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	130 mA

6.7. Digital outputs DO8 Relay NO

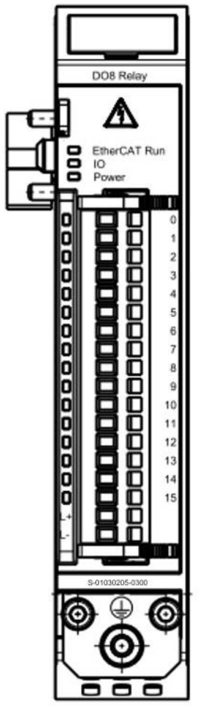


Figure 22: Front view I/O-Modul DO8 RELAY NO

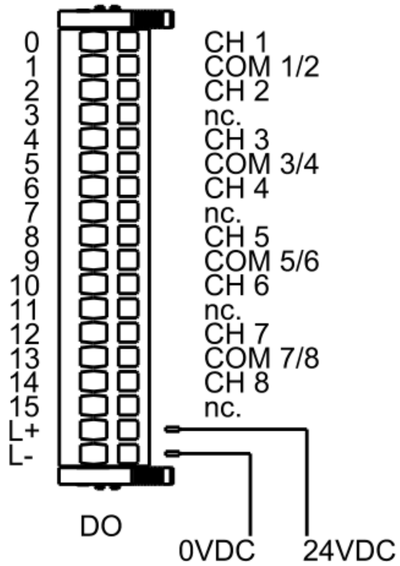


Figure 23: : I/O connection

6.7.1. Connectors

I/O Power Supply (Load)

System connector pin 16: L+ 24 VDC
System connector pin 17: L- 0 V

6.7.2. Relais Contacs

System connector pins 0 … 15
2 relay contacts each have a common COM connection

Channel	1	2	3	4	5	6	7	8	
Contact Pin	0	2	4	6	8	10	12	14	
COM Pin	1		5		9		13		

6.7.3. EtherCAT

E-Bus IN   female 10-pole connector
E-Bus Out 10-pole multi-pin connector

6.7.4. Danger and warning notices

Electrical connection

WARNUNG

Lethal risk of electric shock due to unearthed unit!

If units feature no or a badly installed PE terminal, high currents may occur on non-covered parts. Touching such parts may cause serious injury or death

⇨ Properly connect the unit to earth.

Connecting the PE terminal is subject to the applicable national and local regulations..

Attach a protective earth conductor to provide for protection against indirect contact in case of a fault to frame. Connection is made to the 4 mm bolt on front of the device.

- Do use a crimp terminal lug (approved pursuant to DIN 46234, for example) for a 4 mm bolt matching the cross-section of the chosen cable.
- The cross-section of the protective conductor must have the same current carrying capacity as the mains circuit
- The connection to the earthing terminal should be as short as possible.
- Connecting the PE terminal is subject to the applicable national and local regulations.
- Apply a torque of 1,2 Nm to tighten the 4 mm bolt.
- If several FIO DO8 relay modules are connected in series, a protective conductor must be connected to each individual module.

i HINWEIS

Installation to conform to the protective earth connection regulations of IEC 61010-1!

WARNUNG

Cancellation of the electrical isolation

Connector pins 3, 7, 11 and 15 (n/c marked pins) must not be connected, as this leads to a loss of electrical isolation

Observe the connection diagram

WARNUNG

High electrical voltages due to incorrect connection

Changed pin assignment FIO DO8 Relay: The module with the order number 694 452 05 is not interchangeable with the modules with the order numbers 694 452 03 and 694 452 04.

Danger to life, risk of injury from electric shock.

Observe the connection diagram

6.7.5. Status LED

LED EtherCAT Run:

State	LED flash code	Explanation
Init	Off	Initialising, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

LED IO

No

LED Power

State	LED	Explanation
On	Green	24 V DC supply to I/Os (load) ok
Off	Off	24 V DC supply not ok

LED Channel

State	LED	Explanation
On	On	Output enabled
Off	Off	Output disabled

6.7.6. Process Data Objects

Variable	Data type	Explanation
RelayOutput1 … RelayOutput8	BOOL	Digital relay outputs channel 1 … 8
VoltageOK	BOOL	Supply voltage is within the valid range

6.7.7. Function Notes

i HINWEIS

Low voltage stops the relays from switching and causes energised relays to de-energise.

i HINWEIS

Operating the module near its limits (temperature/total current) will shorten the module's life. Check that the switching currents share well between the outputs, for example: avoid placing two 5A outputs immediately next to each other.

6.7.8. Technische Daten

DO8 RELAY NO	
Label	MC-I/O DO8 RELAY NO
Part no.	S-01030205-0300
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Digital outputs	8 closing relays
Max. switching current (ohmic)	5,0 A each
Max. switching current (inductive)	2,0 A each
Min. permitted load	10mA @ 5 VDC
Operating cycles mech. (min.)	2 x 10^7
Operating cycles electr. (min.)	3 x 10^5 (2 A / 30 VDC)
Switching voltage	max. 24 VDC / 230 VAC
Controller	ASIC ET1200
E-bus connector	10-pin system plug in side wall
Power supply	24 V (DC -15% …+20%)
Electrical insulation (module)	500V E-Bus / power supply
Electrical insulation (relay)	1500 VAC (<=1min) contacts / power supply 750 VAC (<=1min) between contacts
E-Bus-Last	130 mA

Permits: ....

7. Analogue modules

7.1. Analogue inputs for current measurement AI4-I

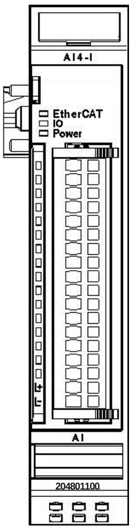


Figure 24: Front view of AI4-I I/O module

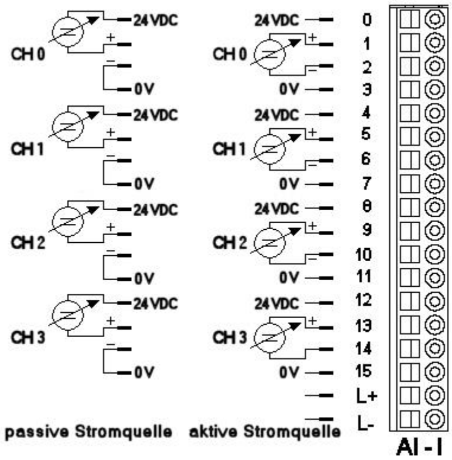


Figure 25: I/O connection passive/active power source

i NOTE

The AI4-I module is no longer recommended for new projects. Please use the successive AI4-I 12BIT CoE module.

7.1.1. Terminals

Module supply

L+: 24 V DC

L-: 0 V

Operative earth / shielding of analog wires → section **3.1.1** Earth

7.1.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 2x	Undervoltage (not implemented)
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Open, overcurrent

7.1.3. Function

The AI4-I module has 4 analogue current signal inputs. Their measuring range can be set separately for every channel, i.e. either to 0..20 mA or to 4..20 mA.

Analogue inputs

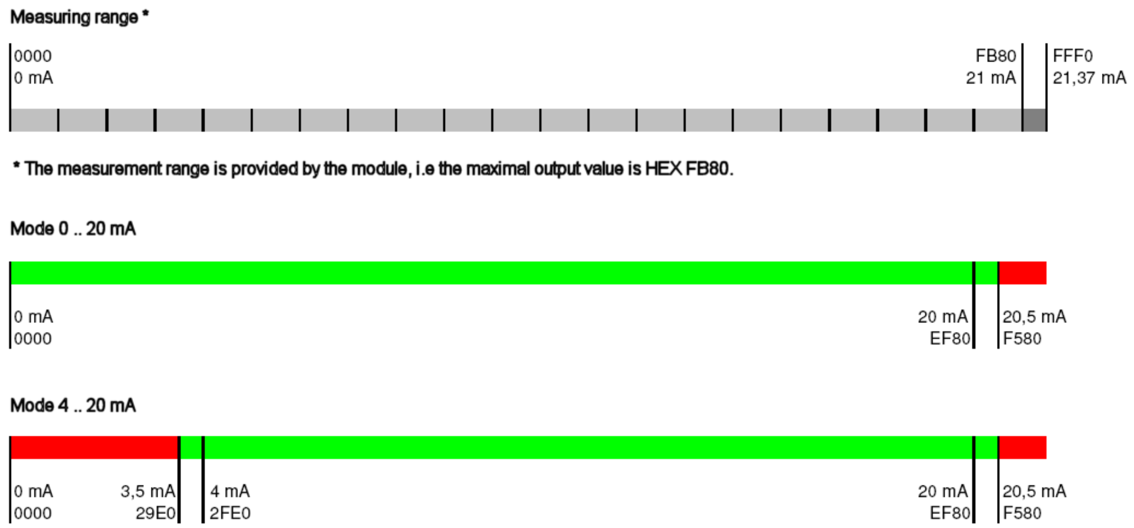
Check the following variable for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Channel_n	INT	Value measured on channel n (n= 0…3)

Measured value

The maximal measuring value (0xFFF0) of the current input module is 0.5 V/23.4 Ω = 21.3675 mA.
The status is shown by the channel LED.

Measuring values, variable values and status



Conversion Output value -> Current [mA]: **Current [mA] = Output value / 3066,336**

Conversion Current [mA] -> Output value: **Output value = Roundoff (Current [mA] *191,646) * 16**

Analogue values current

Measuring	Variable value		
mA	**decimal**	**CODESYS (INT)**	**hexadecimal**
0	0	0	0
1	3056	3056	16#0BF0
2	6128	6128	16#17F0
3	9184	9184	16#23E0
4	12256	12256	16#2FE0
5	15328	15328	16#3BE0
6	18384	18384	16#47D0
7	21456	21456	16#53D0
8	24528	24528	16#5FD0
9	27584	27584	16#6BC0
10	30656	30656	16#77C0
11	33728	-31808	16#83C0
12	36784	-28752	16#8FB0
13	39856	-25680	16#9BB0
14	42928	-22608	16#A7B0
15	45984	-19552	16#B3A0
16	49056	-16480	16#BFA0
17	52112	-13424	16#CB90
18	55184	-10352	16#D790
19	58256	-7280	16#E390
20	61312	-4224	16#EF80
20.5	62848	-2688	16#F580
…			
≥ 21.37	65520	-16	16#FFF0

Module control

The module provides you with various operational options.
To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED. To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge □ accepts module options
ResetError	BOOL	Rising edge □ acknowledges error

Module options

The following options are available for module AI4-I:

Module options			
Variable	**Data type**		**Explanation**
Channel_n_0_20mA	BOOL	TRUE	Channel n to 0…20 mA
		FALSE	Channel n to 4…20 mA
Channel_n_On	BOOL		Enables channel n
Channel_n_Filter	USINT	0..255	Filter on channel n New values avail. in k/3 ms (k=0..255)
n		0 … 3	Channel number

To set and accept options, see Module control

Module state

The following states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Short circuit
Undervoltage	BOOL	Low voltage (supplied power < 19.2 V)
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_Open	BOOL	4..20 mA mode: input current < 3.5 mA → Specific_Error = TRUE
Channel_n_Overcurrent	BOOL	Input current > 20.5 mA → Specific_Error = TRUE

These messages are automatically reset when the state concerned has returned to normal.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.
"Filter" in this case means to compute an average when the set filter time is over.
Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Channel	
Number of channels	**Cycle time in ms (all filters=0)**
1	0.27
2	0.41
3	0.55
4	0.69

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

i NOTE

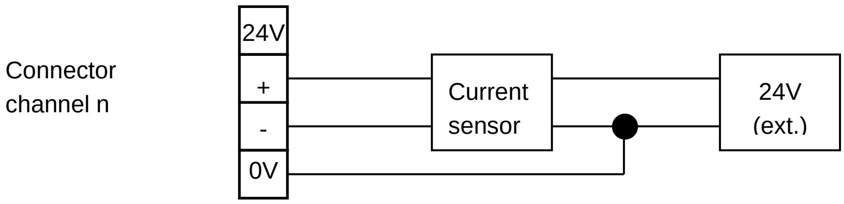
Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values

The inputs connect to both active or passive current sensors.
The module provides terminals for the 24 V DC- supply to the transmitter of every channel.

Passive current sensors:
Interconnect the “–” and “0 V” terminals.

Active current sensors:
Use the power supplied by the module if at all possible.
If power to the current sensors is supplied by an external source, connect the 0 V terminal of that power source to the 0 V terminal of the module.



i NOTE

Best results are obtained by connected the shield of the signal cables to operative earth.

7.1.4. Technical data

AI4-I	
Label	MC-I/O AI4-I 12BIT
Part no.	204801100
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	4 single ended
Resolution	12 Bit (5.2 µA)
Measuring range	0 … 20 mA, 4..20 mA (limit 21.3675 mA)
Temperature drift	< ± 25 ppm/°C regarding range limit
Critical frequency	typical 12.5 kHz
Burden	< 75 Ω
Sampling frequency	1.45 kHz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	from coupler through E-bus connector
E-bus load	140 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.2. Analogue inputs for current measurement AI8-I

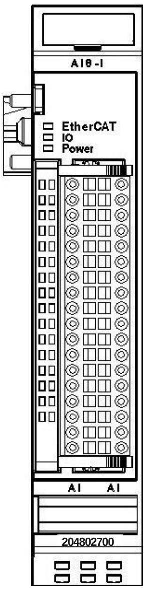


Figure 26: Front view of AI8-I I/O module

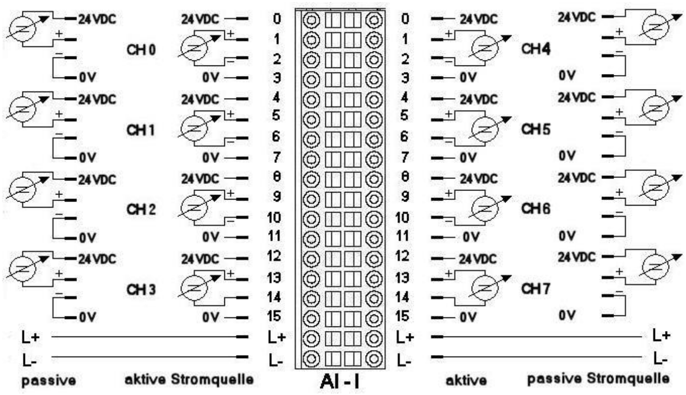


Figure 27: I/O connection passive/active power source

i NOTE

The AI8-I module is no longer recommended for new projects. Please use the successive AI8-I 12BIT CoE module.

7.2.1. Terminals

Module supply
L+: 24 V DC
L-: 0 V
Operative earth / shielding of analog wires □ section **3.1.1** Earth

7.2.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

"I/O" LED

The LED labeled "I/O" indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 2x	Undervoltage (not implemented)
	Red, 3x	Watchdog
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

"Power" LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

"Channel" LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Open, overcurrent

7.2.3. Function

The AI8-I module has 8 analogue current signal inputs. Their measuring range can be set separately for every channel, i.e. either to 0..20 mA or to 4..20 mA.

Analogue inputs

Check the following variable for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Channel_n	INT	Value measured on channel n (n= 0…7)

Measured value

The maximal measuring value (0xFFF0) of the current input module is 0.5 V/23.4 Ω = 21.3675 mA.
The status is shown by the channel LED.

Measuring values, variable values and status

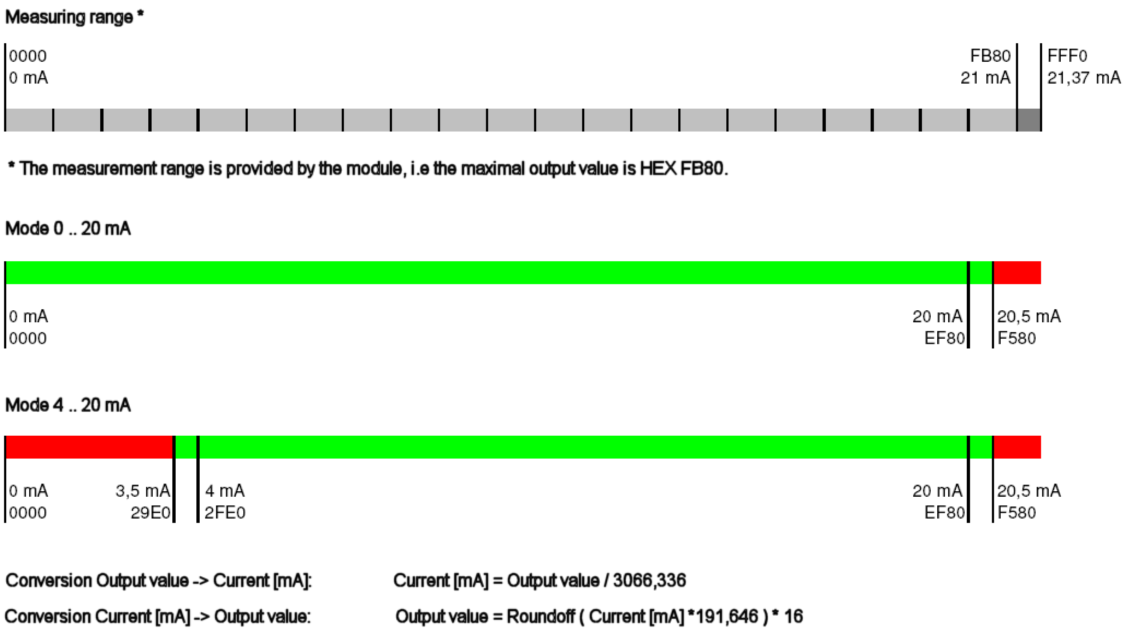


Figure 28: Measuring values

Analogue values current

Measuring	Variable value		
mA	**decimal**	**CODESYS (INT)**	**hexadecimal**
0	0	0	0
1	3056	3056	16#0BF0
2	6128	6128	16#17F0
3	9184	9184	16#23E0
4	12256	12256	16#2FE0
5	15328	15328	16#3BE0
6	18384	18384	16#47D0
7	21456	21456	16#53D0
8	24528	24528	16#5FD0
9	27584	27584	16#6BC0
10	30656	30656	16#77C0
11	33728	-31808	16#83C0
12	36784	-28752	16#8FB0
13	39856	-25680	16#9BB0
14	42928	-22608	16#A7B0
15	45984	-19552	16#B3A0
16	49056	-16480	16#BFA0
17	52112	-13424	16#CB90
18	55184	-10352	16#D790
19	58256	-7280	16#E390
20	61312	-4224	16#EF80
20.5	62848	-2688	16#F580
…			
≥ 21.37	65520	-16	16#FFF0

Module control

The module provides you with various operational options.
To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.
There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED.
To reset the error bits set control bit “ResetError” to a rising edge.

Error bits

Variable	Data type	Explanation
SetOptions	BOOL	Rising edge □ accepts module options
ResetError	BOOL	Rising edge □ acknowledges error

Module options

The following options are available for module AI8-I:

Module options

Variable	Data type		Explanation
Channel_n_0_20mA	BOOL	TRUE	Channel n to 0…20 mA
		FALSE	Channel n to 4…20 mA
Channel_n_On	BOOL		Enables channel n
Channel_n_Filter	USINT	0..255	Filter on channel n New values avail. in k/3 ms (k=0..255)
n		0 … 7	Channel number

To set and accept options, see Module control

Module state

The following states are indicated:

Module state

Variable	Data type	Explanation
Shortcut	BOOL	Short circuit
Undervoltage	BOOL	Low voltage (supplied power < 19.2 V)
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_Open	BOOL	4..20 mA mode: input current < 3.5 mA → Specific_Error = TRUE
Channel_n_Overcurrent	BOOL	Input current > 20.5 mA → Specific_Error = TRUE

These messages are automatically reset when the state concerned has returned to normal.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.
“Filter” in this case means to compute an average when the set filter time is over.
Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Conversion time			
Number of channels	**Cycle time in ms**	**Number of channels**	**Cycle time in ms**
1	0.40	5	0.92
2	0.53	6	1.06
3	0.66	7	1.19
4	0.79	8	1.32

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

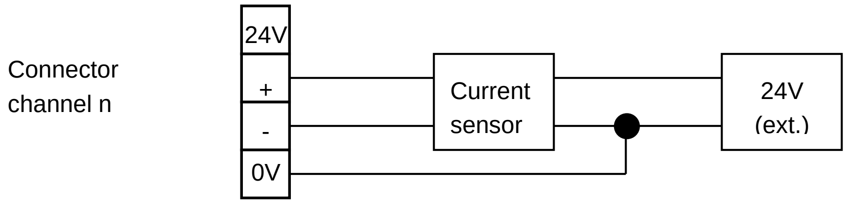
i NOTE

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values
The inputs connect to both active or passive current sensors.
The module provides terminals for the 24 V DC- supply to the transmitter of every channel.

Passive current sensors:
Interconnect the “–” and “0 V” terminals.

Active current sensors:
Use the power supplied by the module if at all possible.
If power to the current sensors is supplied by an external source, connect the 0 V terminal of that power source to the 0 V terminal of the module.



i NOTE

Best results are obtained by connected the shield of the signal cables to operative earth.

7.2.4. Technical data

AI8-I	
Label	MC-I/O AI8-I 12BIT
Part no.	204802700
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Analogue inputs	8 single ended
Resolution	12 Bit (5.2 µA)
Measuring range	0 … 20 mA, 4..20 mA (limit 21.3675 mA)
Temperature drift	< ± 25 ppm/°C regarding range limit
Critical frequency	typical 12.5 kHz
Burden	< 75 Ω
Sampling frequency	0.76 kHz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	from coupler through E-bus connector
E-bus load	160 mA
UL approval	LISTED 59DM E242595 IND.CONT.EQ.

7.3. Analogue inputs for current measurement AI4-I 12BIT CoE

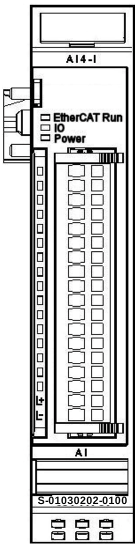


Figure 29: Front view of AI4-I 12BIT CoE I/O module

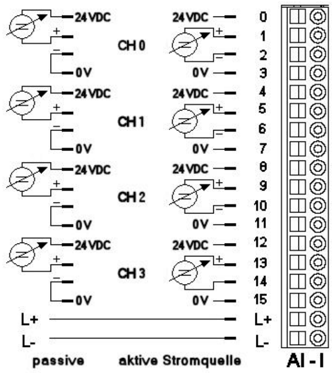


Figure 30: I/O connection

i NOTE

The AI4-I 12BIT CoE module is the successor module NOT compatible with the AI4-I module.

Before replacing an AI4-I module with an AI4-I 12BIT CoE module, you must modify the EtherCAT master's control program.

7.3.1. Terminals

The 24 V connector supplies power to the sensors. Power is supplied to the module through the E-bus connector.

Operative earth / shielding of analogue wires section **3.1.1** Earth

7.3.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

The LED labeled "Power" indicates the state of the power supplied to the I/O module's I/O sensors.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Current > 20.5 mA
	Red, 2x	Current < 3.5 mA (4…20 mA mode)

7.3.3. Function

The AI4-I 12BIT CoE module has 4 analogue current signal inputs. Their measuring range can be set separately for every channel, i.e. either to 0...20 mA or to 4...20 mA.

Analogue inputs

Check the following variable for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
AnalogInputn	INT	Value measured on channel n (n= 0…3)

Measured value

0-20 mA current mode	
Current [mA]	**Value [hex]**
0	0x0
10	0x7FFF
20	0xFFFF

4-20 mA current mode	
Current [mA]	**Value [hex]**
4	0x0
12	0x7FFF
20	0xFFFF

Measured & variable values and state of AI4-I 12BIT CoE

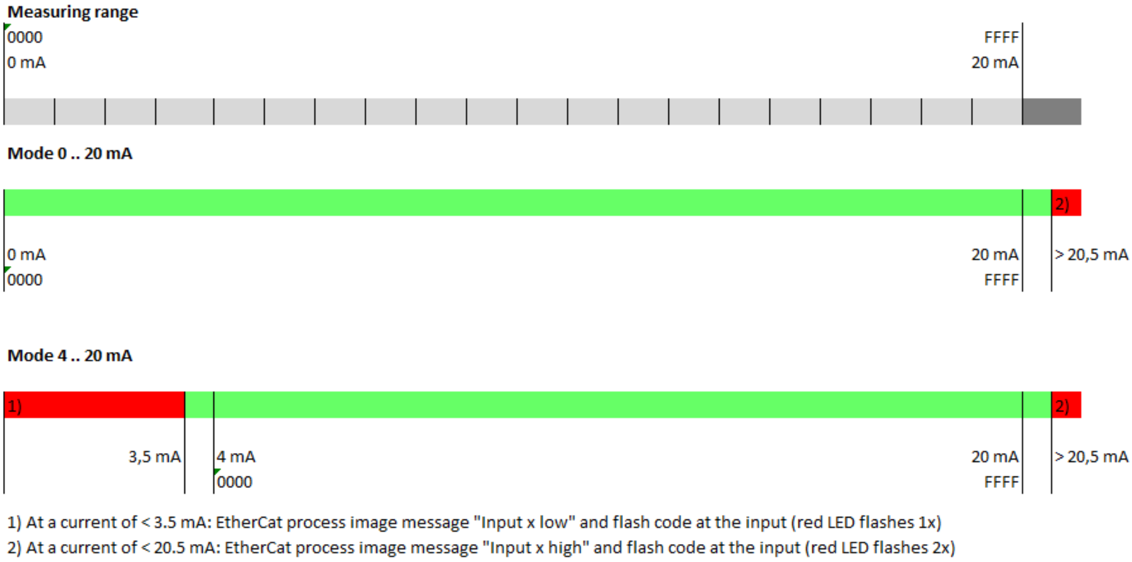


Figure 31: Values

Module options

Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

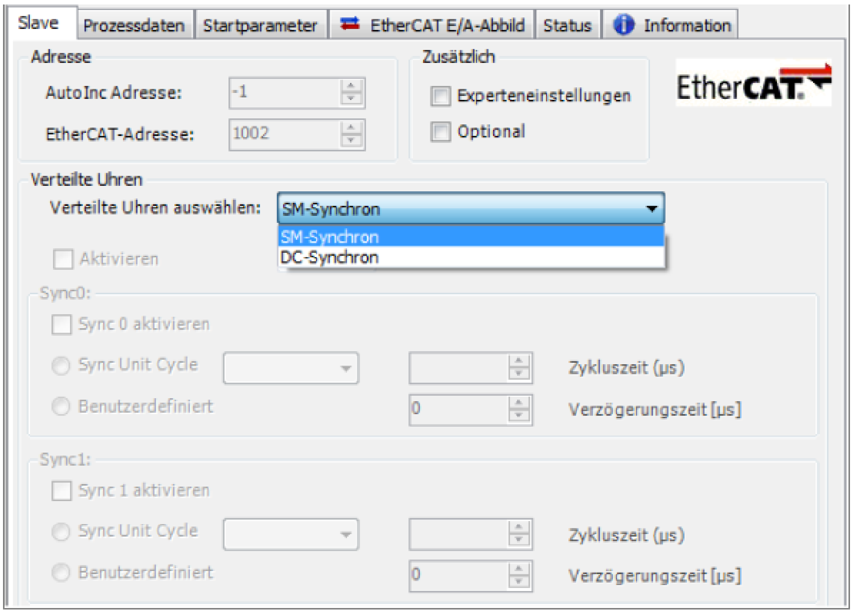


Figure 32: Module options

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

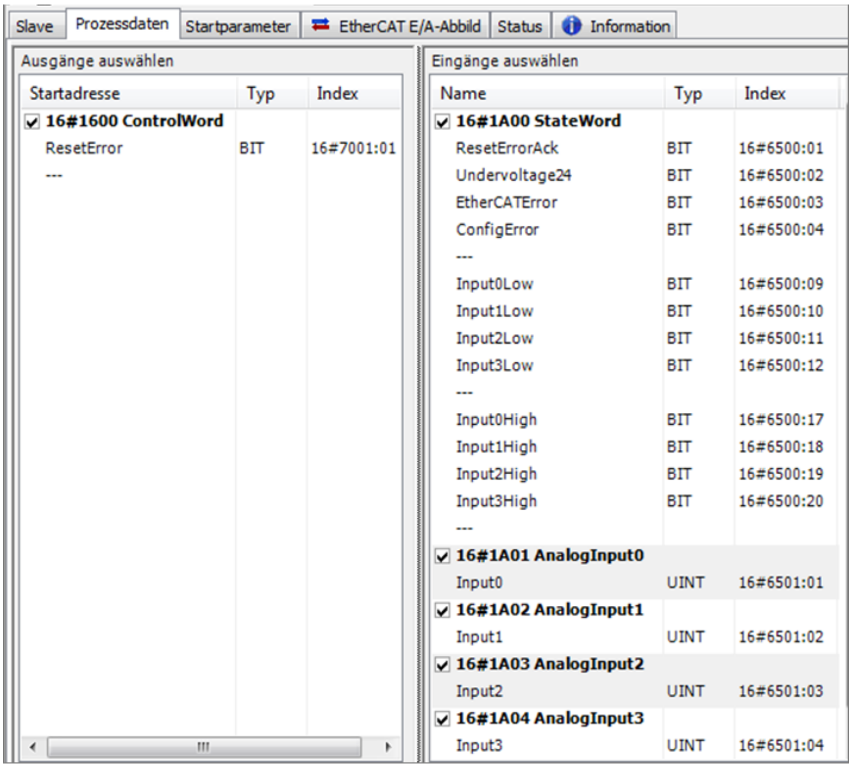


Figure 33: Process data

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of AI4-I 12BIT CoE module (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.

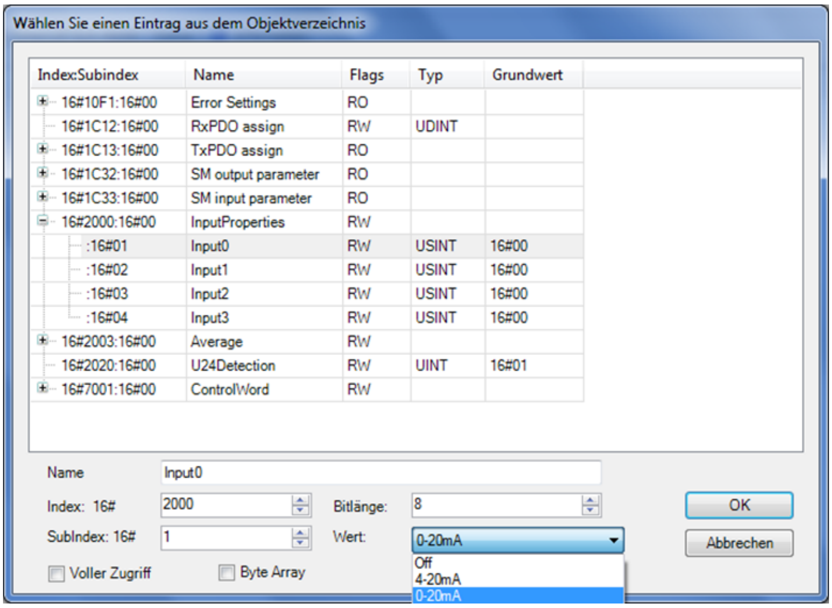


Figure 34: Object dictionary

You can set up the following options for every channel:

Module options		
Name	**Value**	**Explanation**
InputProperties	0	Off (default)
	5	4-20 mA
	6	0-20 mA
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord

The state word (DWORD) is indicative of the module state:

StateWord		
Bit	**Name**	**Explanation**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	Undervoltage24	Power to passive sensors < 19 V (no error, just info)
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7		not used
8	Input0low	Current at 4-20 mA < 3.5 mA
9	Input1low	Current at 4-20 mA < 3.5 mA
10	Input2low	Current at 4-20 mA < 3.5 mA
11	Input3low	Current at 4-20 mA < 3.5 mA
12-15		not used
16	Input0high	Current > 20.5 mA
17	Input1high	Current > 20.5 mA
18	Input2high	Current > 20.5 mA
19	Input3high	Current > 20.5 mA
20-31	-	not used

Analogue inputs

Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Inputn	INT	Value of channel n (n = 0…3)

ControlWord

The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4-I 12-Bit		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185339		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 1	Input 0	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 3	Input 2	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 4	Input 3	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2003	Input Average	Array			
2003, 0	Number of Entries	UINT8	4		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	4		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	32		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	Undervoltage24	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P

Index	Name	Type	Default	Min Max	Access
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13..16	-	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21..32	-	BOOL			RO P
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

7.3.4. Technical data

AI4-I 12BIT CoE	
Label	MC-I/O AI4-I 12BIT CoE
Part no.	S-01030202-0100
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	4
Resolution	12 bit
Measuring range	0 … 20 mA, 4 … 20 mA (final value: 20 mA)
Start AD conversion	synchronized with DC / SM
Conversion time	235 µs (if all channels are enabled)
Input filter cutoff frequency	100 kHz
Measuring error	< ±0,5 %, typ. < ±0,4 % of final value
Internal resistance	< 300 Ω
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	190 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.4. Analogue inputs for current measurement AI8-I 12BIT CoE

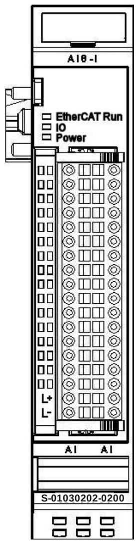


Figure 35: Front view of AI8-I 12BIT CoE I/O module

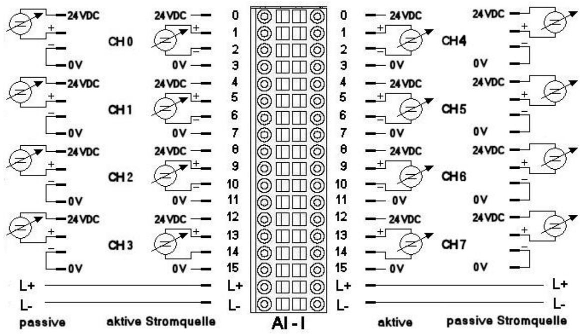


Figure 36: I/O connection

i NOTE

The AI8-I 12BIT CoE module is the successor module NOT compatible with the AI8-I module.
Before replacing an AI8-I module with an AI8-I 12BIT CoE module, you must modify the EtherCAT master's control program.

7.4.1. Terminals

The 24 V connector supplies power to the sensors. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analogue wires section **3.1.1** Earth

7.4.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
The LED labeled "Power" indicates the state of the power supplied to the I/O module's I/O sensors.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs
The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Current > 20.5 mA
	Red, 2x	Current < 3.5 mA (4…20 mA mode)

7.4.3. Function

The AI8-I 12BIT CoE module has 8 analogue current signal inputs. Their measuring range can be set separately for every channel, i.e. either to 0...20 mA or to 4...20 mA.

Analogue inputs

Check the following variable for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
AnalogInputn	INT	Value measured on channel n (n= 0…7)

Measured value

0-20 mA current mode	
Current [mA]	**Value [hex]**
0	0x0
10	0x7FFF
20	0xFFFF

4-20 mA current mode	
Current [mA]	**Value [hex]**
4	0x0
12	0x7FFF
20	0xFFFF

Measured & variable values and state of AI8-I 12BIT CoE

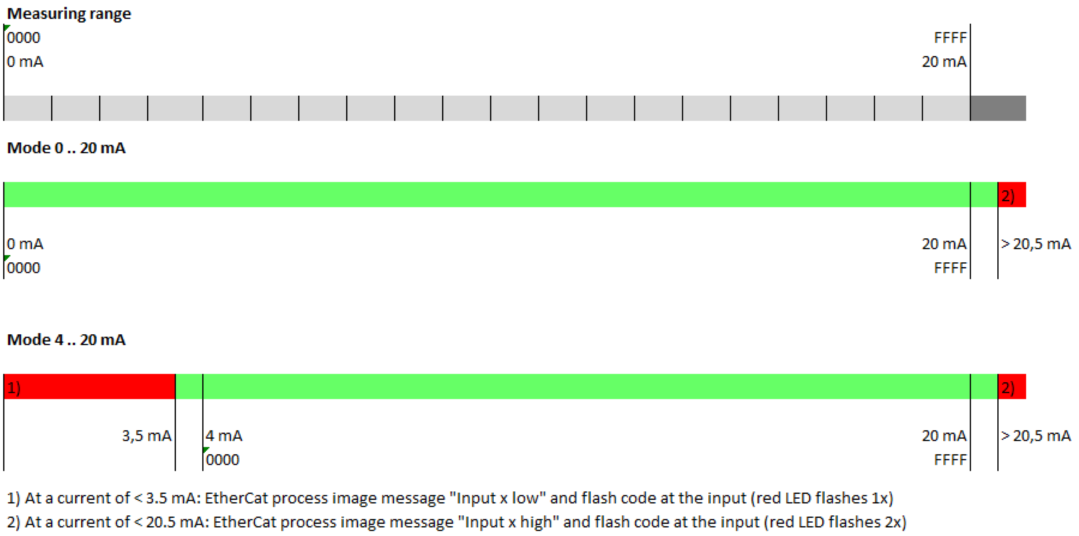


Figure 37: Measured values

Module options

Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

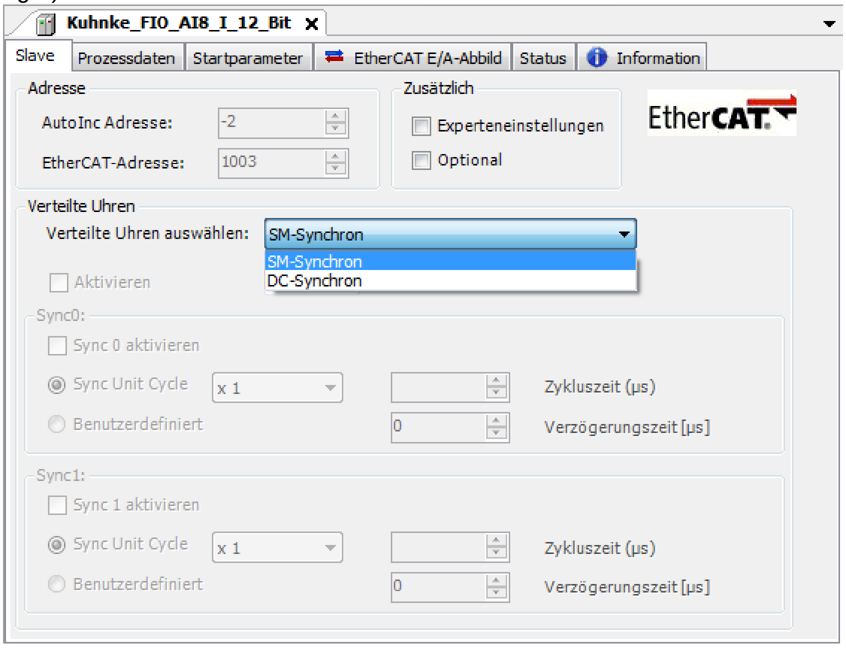


Figure 38: Module options

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

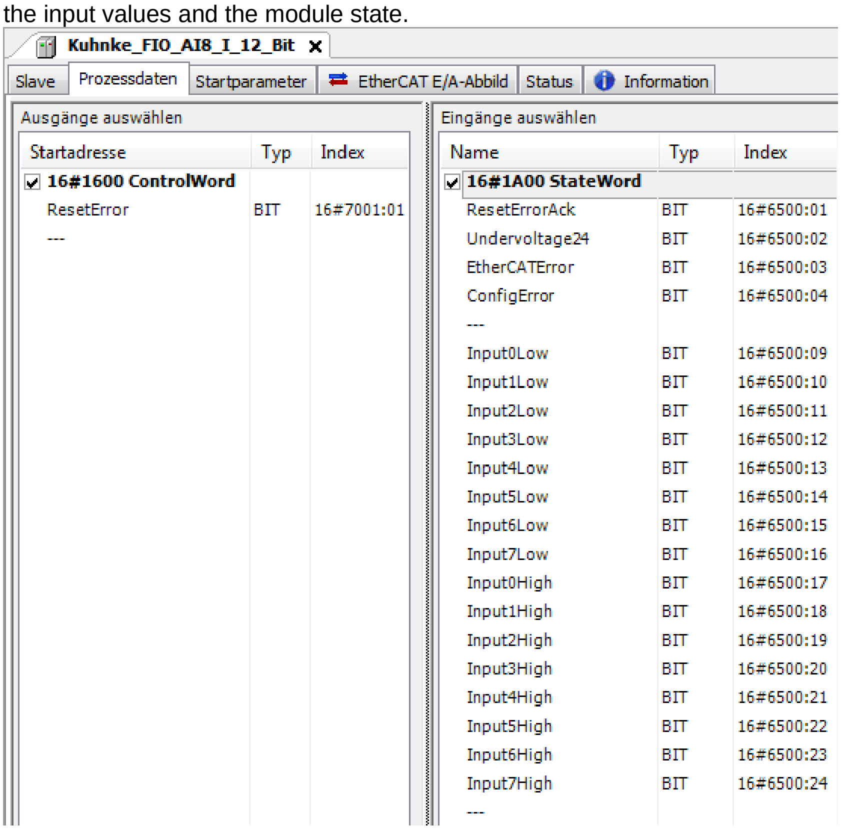


Figure 39: Process data

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of AI8-I 12BIT CoE module (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.

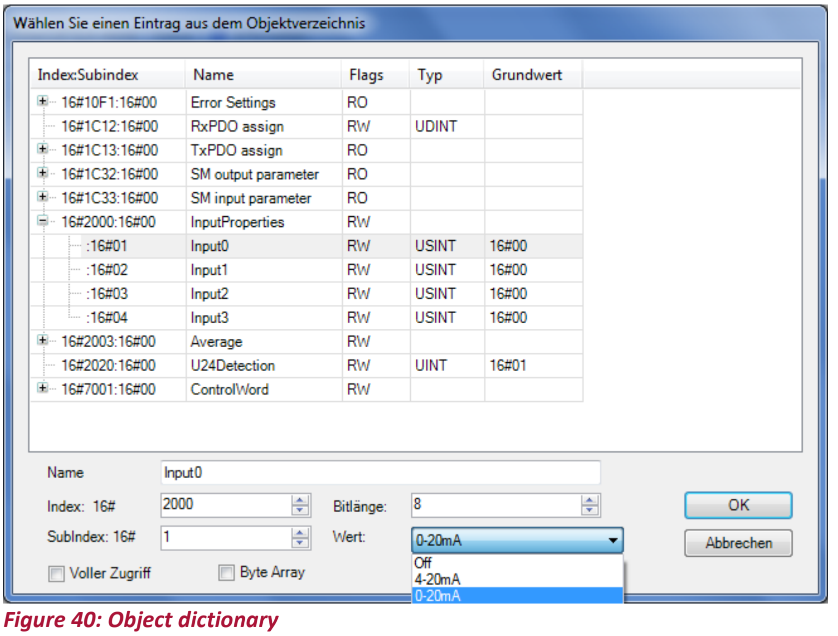


Figure 40: Object dictionary

You can set up the following options for every channel:

Module options		
Name	**Value**	**Explanation**
InputProperties	0	Off (default)
	5	4-20 mA
	6	0-20 mA
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord

The state word (DWORD) is indicative of the module state:

StateWord		
Bit	**Name**	**Explanation**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	Undervoltage24	Power to passive sensors < 19 V (no error, just info)
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7		not used
8	Input0low	Current at 4-20 mA < 3.5 mA
9	Input1low	Current at 4-20 mA < 3.5 mA
10	Input2low	Current at 4-20 mA < 3.5 mA
11	Input3low	Current at 4-20 mA < 3.5 mA
12	Input4low	Current at 4-20 mA < 3.5 mA
13	Input5low	Current at 4-20 mA < 3.5 mA
14	Input6low	Current at 4-20 mA < 3.5 mA
15	Input7low	Current at 4-20 mA < 3.5 mA
16	Input0high	Current > 20.5 mA
17	Input1high	Current > 20.5 mA
18	Input2high	Current > 20.5 mA
19	Input3high	Current > 20.5 mA
20	Input4high	Current > 20.5 mA
21	Input5high	Current > 20.5 mA
22	Input6high	Current > 20.5 mA
23	Input7high	Current > 20.5 mA
24-31	-	not used

Analogue inputs

Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Inputn	INT	Value of channel n (n = 0…7)

ControlWord

The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI8-I 12-Bit		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185345		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	8		RO
2000, 1	Input 0	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 3	Input 2	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 4	Input 3	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 5	Input 4	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 6	Input 5	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2000, 7	Input 6	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW

Index	Name	Type	Default	Min Max	Access
2000, 8	Input 7	UINT8	Off	Off (0), 4-20mA (5), 0-20mA (6)	RW
2003	Input Average	Array			
2003, 0	Number of Entries	UINT8	8		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW
2003, 6	Input 5 Average	UINT8	1	1..255	RW
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	8		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 6	UINT16			RO P
6401, 8	Analog Input 7	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	32		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	Undervoltage24	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13	Input 4 low	BOOL			RO P
6500, 14	Input 5 low	BOOL			RO P
6500, 15	Input 6 low	BOOL			RO P
6500, 16	Input 7 low	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21	Input 4 high	BOOL			RO P
6500, 22	Input 5 high	BOOL			RO P
6500, 23	Input 6 high	BOOL			RO P

Index	Name	Type	Default	Min Max	Access
6500, 24	Input 7 high	BOOL			RO P
6500, 25..32	-	BOOL			RO P
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

7.4.4. Technical data

AI8-I 12BIT CoE	
Label	MC-I/O AI8-I 12BIT CoE
Part no.	S-01030202-0200
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Analogue inputs	8
Resolution	12 bit
Measuring range	0 … 20 mA, 4 … 20 mA (final value: 20 mA)
Start AD conversion	synchronized with DC / SM
Conversion time	290 µs (if all channels are enabled)
Input filter cutoff frequency	100 kHz
Measuring error	< ±0,5 %, typ. < ±0,4 % of final value
Internal resistance	< 300 Ω
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	190 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.5. Analogue inputs for voltage measurement AI4/8-U

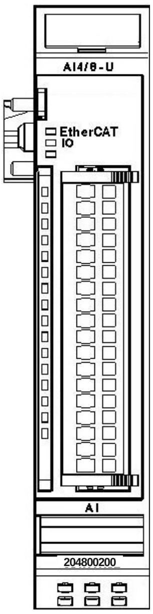


Figure 41: Front view of AI4/8-U I/O module

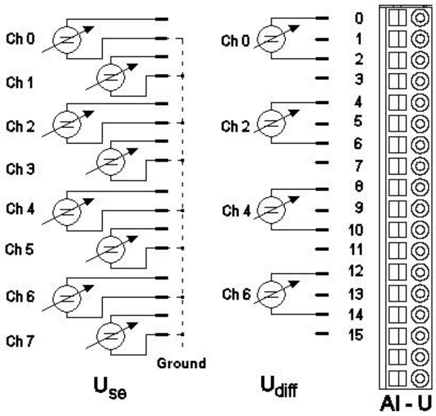


Figure 42: I/O connection

i NOTE

The AI4/8-U module is no longer recommended for new projects. Please use the successive AI4/8-U 13BIT CoE module.

7.5.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.

Operative earth / shielding of analog wires section **3.1.1** Earth

7.5.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 3x	Watchdog
	Red, 4x	EtherCAT response monitoring
	Red, 6x	Module-specific error
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled

7.5.3. Function

The AI4/8-U module has 8 analogue inputs. If signal lines are single-ended (measured against earth, L-), 8 channels are available. To measure differential signals, you will need 2 channels for every signal, i.e. you can pick up no more than 4 differential signals. Channels can be combined as follows: 0/1, 2/3, 4/5 and 6/7.

Analogue inputs
Check the following variable for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Channel_n	INT	Value measured on channel n (n= 0…7)

Analogue values voltage

Measuring	Variable value (for 16 bit)					
	bipolar			unipolar		
volt	decimal	CODESYS (INT)	hexadecimal	decimal	CODESYS (INT)	hexadecimal
-10	32768	-32768	16#8000			
-9	36044	-29492	16#8CCC			
-8	39321	-26215	16#9999			
-7	42598	-22938	16#A666			
-6	45875	-19661	16#B333			
-5	49152	-16384	16#C000			
-4	52428	-13108	16#CCCC			
-3	55705	-9831	16#D999			
-2	58982	-6554	16#E666			
-1	62244	-3292	16#F324			
0	0	0	0	0	0	0
1	3276	3276	16#0CCC	6553	6553	16#1999
2	6553	6553	16#1999	13107	13107	16#3332
3	9830	9830	16#2666	19660	19660	16#4CCC
4	13106	13106	16#3332	26214	26214	16#6665
5	16383	16383	16#3FFF	32767	32767	16#7FFF
6	19660	19660	16#4CCC	39320	-26216	16#9998
7	22936	22936	16#5998	45874	-19662	16#B332

8	26213	26213	16#6665	52427	-13109	16#CCCB
9	29490	29490	16#7332	58981	-6555	16#E665
10	32767	32767	16#7FFF	65534	-2	16#FFFE

Module control
The module provides you with various operational options.
To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED. To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge □ accepts module options
ResetError	BOOL	Rising edge □ acknowledges error

Module options
The following options are available for module AI4/8-U:

Module options		
Variable	**Data type**	**Explanation**
Channel_n_n+1_Differential	BOOL	The difference in voltages of channel n and channel n+1 is measured and output to channel n.
Channel_n_On	BOOL	Enable channel n
Channel_n_Unipolar	BOOL	Change measuring range of channel n from bipolar +10 V ... -10 V to unipolar 0… 10 V (doubles the resolution)
Channel_n_Filter	USINT	Filter on channel n New values avail. in k/3 ms (k=0..255)
n		0 … 7 Channel number

To set and accept options, see Module control

Module state

The following states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Not used
Undervoltage	BOOL	Not used
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

There are no module-specific messages for this module.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.

“Filter” in this case means to compute an average when the set filter time is over.

Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Conversion time			
Number of channels	**Cycle time in ms (all filters=0)**	**Number of channels**	**Cycle time in ms (all filters=0)**
1	270 µs	5	630 µs
2	360 µs	6	710 µs
3	450 µs	7	800 µs
4	540 µs	8	890 µs

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

i NOTE

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values

i NOTE

Best results are obtained by

→ connecting the shield of the signal cables to operative earth

→ connecting unused single-ended lines to Ground

→ short-circuiting unused differential inputs

7.5.4. Technical data

AI4/8-U	
Label	MC-I/O AI4/8-U 13BIT
Part no.	204800200
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	8 single ended or 4 differential
Resolution	13 Bit (1.221 µV unipolar, 2.442 µV bipolar)
Measuring range	0 … 10 V, ± 10 V
Temperature drift	< -15 ppm/°C regarding range limit
Critical frequency	typical 1 MHz
Input resistance	> 100 MΩ
Sampling frequency	1.12 kHz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	from coupler through E-bus connector
E-bus load	190 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.6. Analogue inputs for voltage measurement AI4/8-U 13BIT CoE

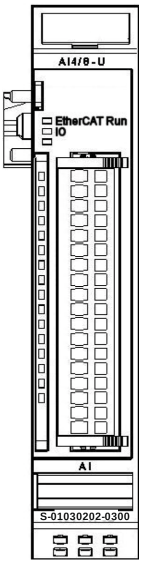


Figure 43: Front view of AI4/8-U 13BIT CoE I/O module

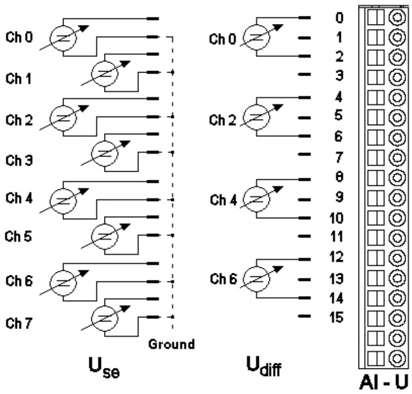


Figure 44: I/O connection

i NOTE

The AI4/8-U 13BIT CoE module is the successor module NOT compatible with the AI8-I module.
Before replacing an AI4/8-U module with an AI4/8-U 13BIT CoE module, you must modify the EtherCAT master's control program.

7.6.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analogue wires □ section 3.1.1 Earth

7.6.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs
The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled

7.6.3. Function

The AI4/8-U 13BIT CoE module has 8 analogue inputs. If signal lines are single-ended (measured against earth, L-), 8 channels are available. To measure differential signals, you will need 2 channels for every signal, i.e. you can pick up no more than 4 differential signals. Channels can be combined as follows: 0/1, 2/3, 4/5 and 6/7.

Analogue voltage values

Measured value			Variable value (@ 16 bits)			
±10 V	±5 V	±2,5 V	Bipolar		Unipolar [UINT*]	
Volt	Volt	Volt	Decimal	Hexadecimal	Decimal	Hexadecimal
-10	-5	-2.5	-32768	16#8000		
-9	-4.5	-2.25	-29492	16#8CCC		
-8	-4	-2	-26215	16#9999		
-7	-3.5	-1.75	-22938	16#A666		
-6	-3	-1.5	-19661	16#B333		
-5	-2.5	-1.25	-16384	16#C000		
-4	-2	-1	-13108	16#CCCC		
-3	-1.5	-0.75	-9831	16#D999		
-2	-1	-0.5	-6574	16#E666		
-1	-0.5	-0.25	-3292	16#F324		
0	0	0	0	0	0	0
1	0.5	0.25	3276	16#0CCC	6553	16#1999
2	1	0.5	6553	16#1999	13107	16#3332
3	1.5	0.75	9830	16#2666	19660	16#4CCC
4	2	1	13106	16#3332	26214	16#6665
5	2.5	1.25	16383	16#3FFF	32767	16#7FFF
6	3	1.5	19660	16#4CCC	39320	16#9998
7	3.5	1.75	22936	16#5998	45874	16#B332
8	4	2	26213	16#6665	52427	16#CCCB
9	4.5	2.25	29490	16#7332	58981	16#E665
10	5	2.5	32767	16#7FFF	65534	16#FFFE

*Data type conversion required

i NOTE

If the inputs are not used but switched on, the measured values displayed in the I / O image are floated. To prevent this, you should deactivate the measurement channel at the start parameters or set the input to ground (short-circuit when measuring differential signals).

Module options

Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

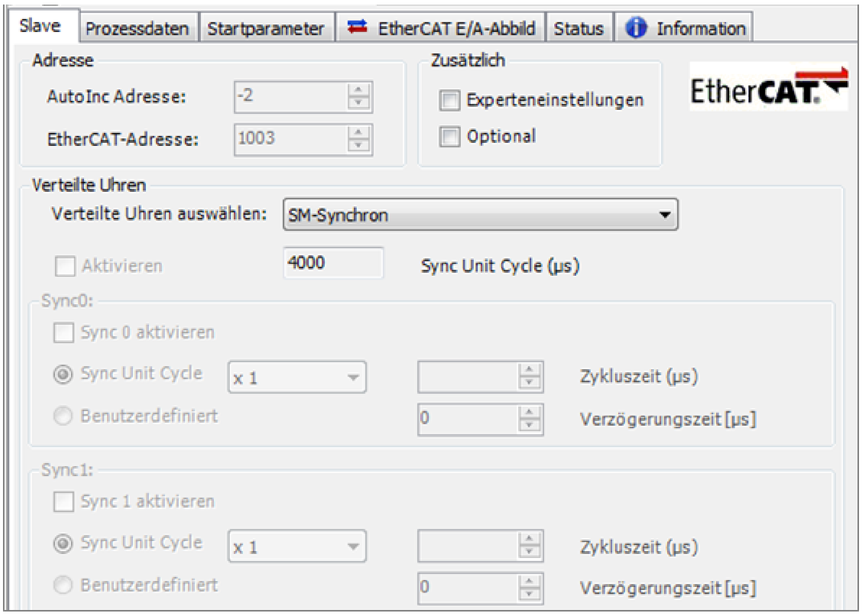


Figure 45: Module options

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

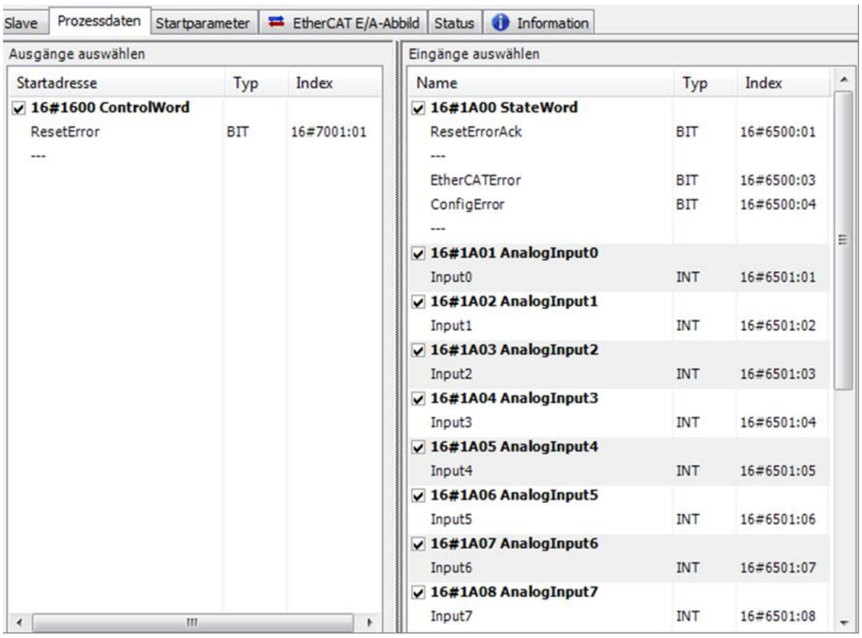


Figure 46: Process data

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of AI4/8-U 13BIT CoE module (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.
Click/tap on "Add…", choose an object, and set the appropriate value.

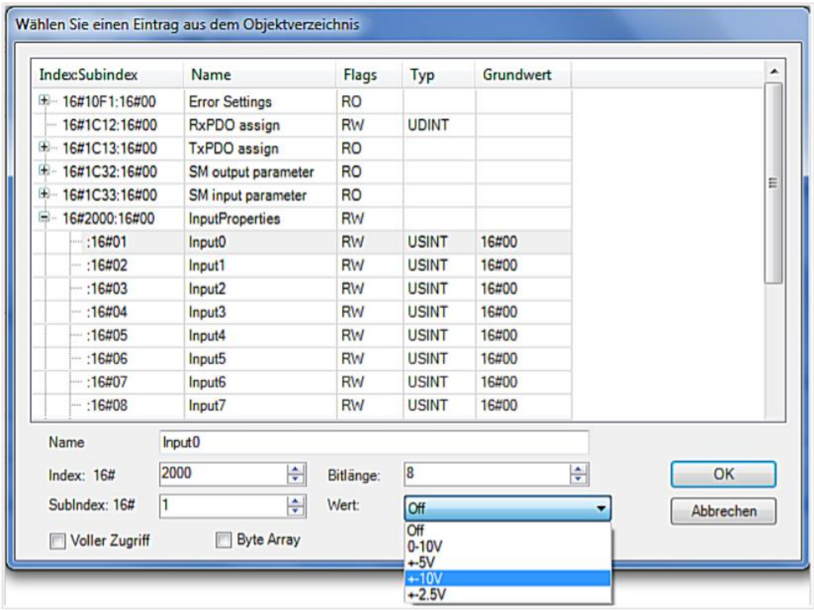


Figure 47: Object dictionary

You can set up the following options:

Module options		
Name	**Value**	**Explanation**
InputProperties	0	Off (default)
	1	0-10 V
	2	±5 V
	3	±10 V
	4	±2.5 V
InputSwitch	0	Single-Ended (default)
	1	Differential
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord
The state word is indicative of the module state:

StateWord		
Bit	**Name**	**Bedeutung**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1		not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-15		not used

Analogue inputs
Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Inputn	INT	Value of channel n (n= 0…7)

ControlWord
The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after re-moving their cause
1-15	-	not used

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4/8-U 13-Bit		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185340		RO

Index	Name	Type	Default	Min Max	Access
1018, 3	Revision Number	UINT32	2		RO
1018, 4	Serial Number	UINT32	0		RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	8		RO
2000, 1	Input 0	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 3	Input 2	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 4	Input 3	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 5	Input 4	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 6	Input 5	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 7	Input 6	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 8	Input 7	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2001	Input Switch	Array			
2001, 0	Number of Entries	UINT8	4		RO
2001, 1	Input 0_1 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 2	Input 2_3 Switch	UINT8	Single-ended	Single-ended (0)	RW

Index	Name	Type	Default	Min Max	Access
				Differential (1)	
2001, 3	Input 4_5 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 4	Input 6_7 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2003	Input Filter	Array			
2003, 0	Number of Entries	UINT8	8		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW
2003, 6	Input 5 Average	UINT8	1	1..255	RW
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	8		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 6	UINT16			RO P
6401, 8	Analog Input 7	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

7.6.4. Technical data

AI4/8-U 13BIT CoE	
Label	MC-I/O AI4/8-U 13BIT CoE
Part no.	S-01030202-0300
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	8 single ended or 4 differential
Resolution	13 bit
Measuring range	0 … 10 V, ± 5 V, ± 10 V, ± 2,5 V
Start AD conversion	synchronized with DC / SM
Conversion time	464 µs (if all channels are enabled)
Input filter cutoff frequency	typ. 1 kHz
Measuring error	< ±0,4 %, typ. < ±0,2 % of final value
Internal resistance	> 1 MΩ
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	190 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.7. Analogue inputs for voltage measurement AI8/16-U 13BIT CoE

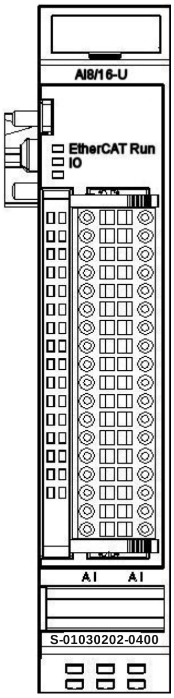


Figure 48: Front view of AI8/16-U 13BIT CoE I/O module

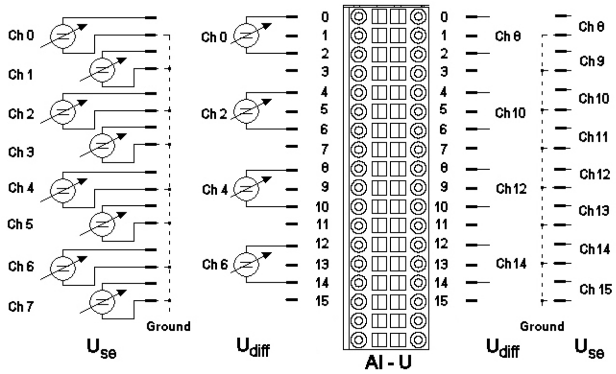


Figure 49: I/O connection

7.7.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analogue wires section 3.1.1 Earth

7.7.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs
The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled

7.7.3. Function

The AI8/16-U 13BIT CoE module has 16 analogue inputs. If signal lines are single-ended (measured against earth, L-), 16 channels are available. To measure differential signals, you will need 2 channels for every signal, i.e. you can pick up no more than 8 differential signals. Channels can be combined as follows: 0/1, 2/3, 4/5, 6/7, 8/9, 10/11, 12/13 and 14/15.

Analogue voltage values

Measured value			Variable value (@ 16 bits)			
±10 V	**±5 V**	**±2.5 V**	**Bipolar**		**Unipolar [UINT*]**	
Volt	**Volt**	**Volt**	**Decimal**	**Hexadecimal**	**Decimal**	**Hexadecimal**
-10	-5	-2.5	-32768	16#8000		
-9	-4.5	-2.25	-29492	16#8CCC		
-8	-4	-2	-26215	16#9999		
-7	-3.5	-1.75	-22938	16#A666		
-6	-3	-1.5	-19661	16#B333		
-5	-2.5	-1.25	-16384	16#C000		
-4	-2	-1	-13108	16#CCCC		
-3	-1.5	-0.75	-9831	16#D999		
-2	-1	-0.5	-6574	16#E666		
-1	-0.5	-0.25	-3292	16#F324		
0	0	0	0	0	0	0
1	0.5	0.25	3276	16#0CCC	6553	16#1999
2	1	0.5	6553	16#1999	13107	16#3332
3	1.5	0.75	9830	16#2666	19660	16#4CCC
4	2	1	13106	16#3332	26214	16#6665
5	2.5	1.25	16383	16#3FFF	32767	16#7FFF
6	3	1.5	19660	16#4CCC	39320	16#9998
7	3.5	1.75	22936	16#5998	45874	16#B332
8	4	2	26213	16#6665	52427	16#CCCB
9	4.5	2.25	29490	16#7332	58981	16#E665
10	5	2.5	32767	16#7FFF	65534	16#FFFE

*Data type conversion required

i NOTE

If the inputs are not used but switched on, the measured values displayed in the I / O image are floated. To prevent this, you should deactivate the measurement channel at the start parameters or set the input to ground (short-circuit when measuring differential signals).

Module options

Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

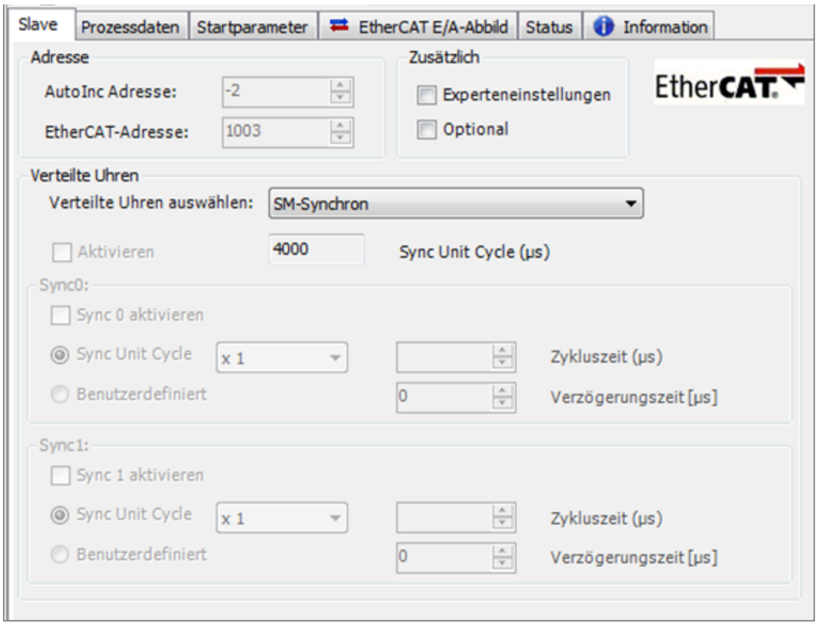


Figure 50: Module options

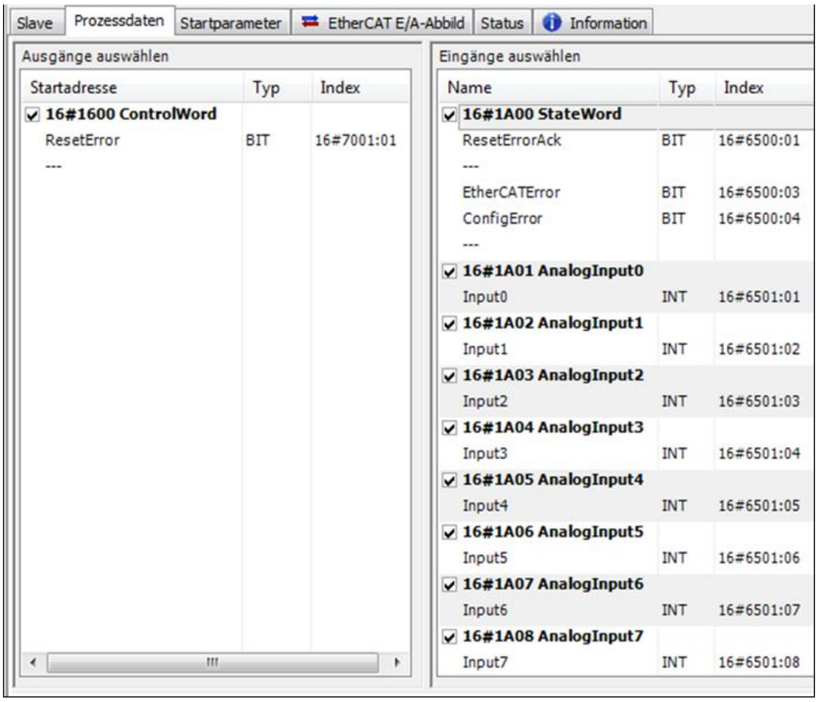


Figure 51: Process data

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI8/16-U 13BIT CoE (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.

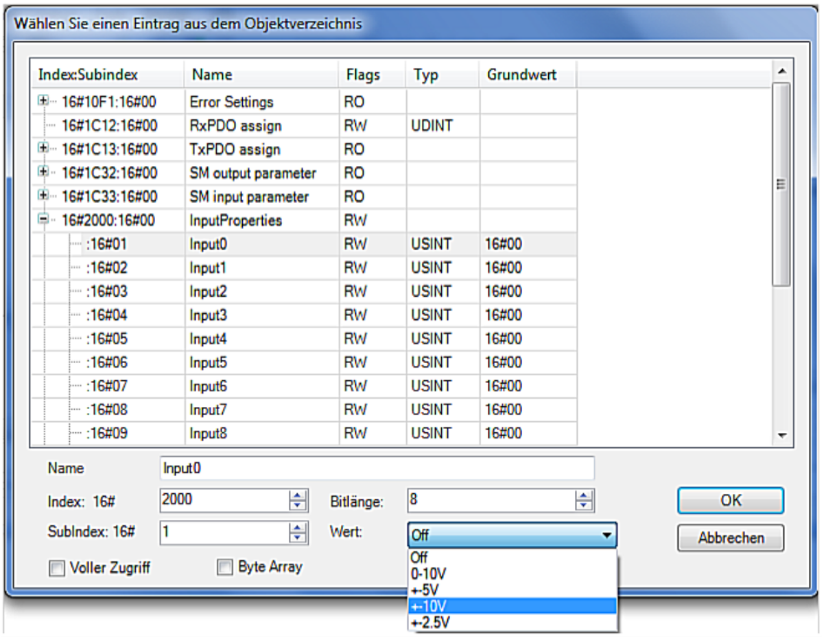


Figure 52: Object dictionary

You can set up the following options for every channel:

Module options		
Name	**Value**	**Explanation**
InputProperties	0	Off (default)
	1	0-10 V
	2	±5 V
	3	±10 V
	4	±2.5 V
InputSwitch	0	Single-Ended (default)
	1	Differential
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord

The state word is indicative of the module state:

StateWord		
Bit	**Name**	**Explanation**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1		not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-15		not used

Analogue inputs

Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
Inputn	INT	Value of channel n (n= 0…15)

ControlWord

The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after re-moving their cause
1-15	-	not used

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4/8-U 13-Bit		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185341		RO

Index	Name	Type	Default	Min Max	Access
1018, 3	Revision Number	UINT32	2		RO
1018, 4	Serial Number	UINT32	0		RO
2000	Analog Input Properties	Array			
2000, 0	Number of Entries	UINT8	16		RO
2000, 1	Input 0	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 2	Input 1	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 3	Input 2	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 4	Input 3	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 5	Input 4	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 6	Input 5	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 7	Input 6	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 8	Input 7	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 9	Input 8	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW

Index	Name	Type	Default	Min Max	Access
2000, 10	Input 9	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 11	Input 10	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 12	Input 11	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 13	Input 12	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 14	Input 13	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 15	Input 14	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2000, 16	Input 15	UINT8	Off	Off (0), 0-10V (1), +-5V (2) +-10V (3) +-2.5V (4)	RW
2001	Number of Entries	UINT8	8		RO
2001, 1	Input 0_1 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 2	Input 2_3 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 3	Input 4_5 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 4	Input 6_7 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 5	Input 8_9 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 6	Input 10_11 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2001, 7	Input 12_13 Switch	UINT8	Single-ended	Single-ended (0)	RW

Index	Name	Type	Default	Min Max	Access
				Differential (1)	
2001, 8	Input 14_15 Switch	UINT8	Single-ended	Single-ended (0) Differential (1)	RW
2003	Input Average	Array			
2003, 0	Number of Entries	UINT8	16		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW
2003, 6	Input 5 Average	UINT8	1	1..255	RW
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
2003, 9	Input 8 Average	UINT8	1	1..255	RW
2003, 10	Input 9 Average	UINT8	1	1..255	RW
2003, 11	Input 10 Average	UINT8	1	1..255	RW
2003, 12	Input 11 Average	UINT8	1	1..255	RW
2003, 13	Input 12 Average	UINT8	1	1..255	RW
2003, 14	Input 13 Average	UINT8	1	1..255	RW
2003, 15	Input 14 Average	UINT8	1	1..255	RW
2003, 16	Input 15 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	16		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 6	UINT16			RO P
6401, 8	Analog Input 7	UINT16			RO P
6401, 9	Analog Input 8	UINT16			RO P
6401, 10	Analog Input 9	UINT16			RO P
6401, 11	Analog Input 10	UINT16			RO P
6401, 12	Analog Input 11	UINT16			RO P
6401, 13	Analog Input 12	UINT16			RO P
6401, 14	Analog Input 13	UINT16			RO P
6401, 15	Analog Input 14	UINT16			RO P
6401, 16	Analog Input 15	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
7001	Module Control	Array			

Index	Name	Type	Default	Min Max	Access
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

7.7.4. Technical data

AI8/16-U 13BIT CoE	
Label	MC-I/O AI8/16-U 13BIT CoE
Part no.	S-01030202-0400
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Analogue inputs	16 single ended or 8 differential
Resolution	13 bit
Measuring range	0 … 10 V, ± 5 V, ± 10 V, ± 2.5 V
Start AD conversion	synchronized with DC / SM
Conversion time	580 µs (if all channels are enabled)
Input filter cutoff frequency	typ. 1 kHz
Measuring error	< ±0,4 %, typ. < ±0,2 % of final value
Internal resistance	> 1 MΩ
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	190 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

7.8. Analogue outputs voltage / current AO4-U/I

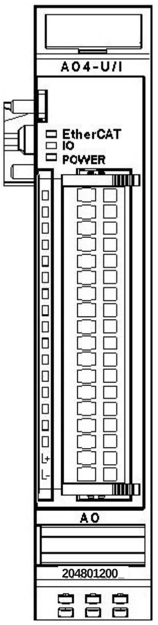


Figure 53: Front view of AO4-U/I I/O module

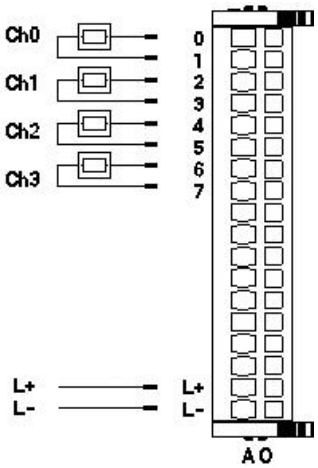


Figure 54: I/O connection

	+	-
Channel0	0	1
Channel1	2	3
Channel2	4	5
Channel3	6	7

i NOTE

The AO4-U/I module is no longer recommended for new projects. Please use the successive AO4-U/I 16BIT CoE module.

7.8.1. Terminals

Power supply to module I/Os
L+: 24 V DC
L-: 0 V

7.8.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 1x	Short circuit
	Red, 2x	Low voltage
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Short circuit
	Red, 3x	Broken wire
	Red, 5x	Excessive temp. of output drivers

7.8.3. Function

The AO4-U/I module has 4 analogue outputs. Every channel can be separately set to the unipolar or bipolar output of voltages or currents.

The letter 'n' in the tables below represents the channel number (n=0…3).

Analogue outputs
Write the output values into the following variables:

Outputs		
Variable	**Data type**	**Explanation**
Channel_n	INT	Output value for channel n (n=0…3)

Values voltage
see table page 95

Values current
0 ... 0xFFF0 for 0... 20 mA

Module control
The module provides you with various operational options.

To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED.

To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge accepts module options
ResetError	BOOL	Rising edge acknowledges error

Module options
The following options are available for module AO4:

Module options		
Variable	**Data type**	**Explanation**
Channel_n_On	BOOL	Enables channel n (set to high impedance to disable)
Channel_n_Current	BOOL	Sets channel n to current output mode
Channel_n_n+1_Unipolar	BOOL	Sets channels 1 and 2 or 2 and 3 to unipolar mode
Outputs_Active_Shortcut	BOOL	Leave outputs unchanged after short circuit
Outputs_Active_Undervoltage	BOOL	Leave outputs unchanged after low voltage
Outputs_Active_Specific_Error	BOOL	Leave outputs unchanged after module-specific error
Outputs_Active_EtherCAT_Error	BOOL	Leave outputs unchanged after short circuit
n		0 … 3 Channel number

To set and accept options, see section Module control

Module state
The following states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Short circuit (not used)
Undervoltage	BOOL	Low voltage (supplied power < 19.2 V)
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see section Module control

Module-specific messages
Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_Overtemp	BOOL	Temperature of output driver of channel n > 140 °C (automatic switch-off) □ Outputs_Active_Shortcut = TRUE
Undervoltage_24	BOOL	Power supplied to module > 19.2V □ Outputs_Active_Undervoltage = TRUE
Channel_n_Open	BOOL	Current mode: channel n load is > 500□ □ Specific_Error = TRUE
Channel_n_Shortcut	BOOL	Voltage mode: channel n load is < 600 □ □ Specific_Error = TRUE

These messages are automatically reset when the state concerned has returned to normal.
These messages are summarized as “Specific_Error” in the module status and mapped as “Module-specific error” onto the I/O-LED.

Conversion time
The AO4-U/I module operates with a cycle time of 320µs which is independent of the number of the enabled channels (time from the acquisition of the output values to the start of the D/A converters).

7.8.4. Technical data

AO4-U/I	
Label	MC-I/O AO4-U/I 12BIT
Part no.	204801200
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue outputs	4
Resolution	16 bit, 12 bit
Measuring range	0 … 10 V, ± 10 V, 0 … +20 mA
Output frequency	3.125 kHz
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	150 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

i NOTE

Measuring range 0 … +20 mA

In order to use the current outputs, the "Channel_n_n + 1_Unipolar" variable of the corresponding outputs must be set to TRUE.

See section Module options, short circuit undetectable.

7.9. Analogue outputs voltage / current AO4-U/I 16BIT CoE

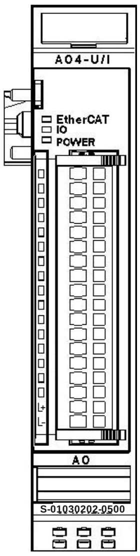


Figure 55: Front view of AO4-U/I

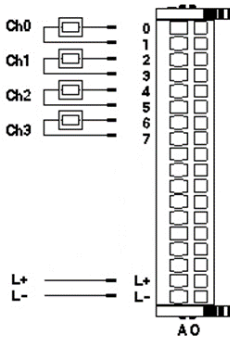


Figure 56: I/O connection

	+	-
Channel0	0	1
Channel1	2	3
Channel2	4	5
Channel3	6	7

i NOTE

The AO4-U/I 16BIT CoE module is the successor module NOT compatible with the AO4-U/I 12BIT module.

Before replacing an AO4-U/I 12BIT module with an AO4-U/I 16BIT CoE module, you must modify the EtherCAT master's control program.

7.9.1. Terminals

Power supply to module I/Os

L+: 24 V DC

L-: 0 V

7.9.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 1x	Short circuit
	Red, 2x	Low voltage
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

“Channel” LEDs

The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Short circuit
	Red, 3x	Broken wire
	Red, 5x	Excessive temp. of output drivers

7.9.3. Function

The AO4-U/I 16BIT CoE module has 4 analogue outputs. Every channel can be separately set to the unipolar or bipolar output of voltages or currents.
To output voltage or current readings (measured values) to the analogue outputs, verify that the associated output variables contain these values in the 2-byte two's complement format.

The letter 'n' in the tables below represents the channel number (n=0…3).

Analogue voltage/current values

Measured value				Variable value (@ 16 bits)			
±10/10	0…20	4…20	0…24	Bipolar [UINT]		Unipolar [UINT]	
Volt	mA	mA	mA	Decimal	Hexadecimal	Decimal	Hexadecimal
-10				32768	16#8000		
-9				36044	16#8CCC		
-8				39321	16#9999		
-7				42598	16#A666		
-6				45875	16#B333		
-5				49152	16#C000		
-4				52428	16#CCCC		
-3				55705	16#D999		
-2				58982	16#E666		
-1				62244	16#F324		
0	0	4	0	0	0	0	0
1	2	5.6	2.4	3276	16#0CCC	6553	16#1999
2	4	7.2	4.8	6553	16#1999	13107	16#3332
3	6	8.8	7.2	9830	16#2666	19660	16#4CCC
4	8	10.4	9.6	13106	16#3332	26214	16#6665
5	10	12.0	12.0	16383	16#3FFF	32767	16#7FFF
6	12	13.6	14.4	19660	16#4CCC	39320	16#9998
7	14	15.2	16.8	22936	16#5998	45874	16#B332
8	16	16.8	19.2	26213	16#6665	52427	16#CCCB
9	18	18.4	21.6	29490	16#7332	58981	16#E665
10	20	20.0	24.0	32767	16#7FFF	65534	16#FFFE

Please note the following differences:

MC-I/O AO4-U/I 12BIT	MC-I/O AO4-U/I 16BIT CoE
Current: 0…±20 mA	Current: 0…+20 mA
Short-circuit detectable	Short-circuit not detectable but outputs are short circuit-protected
Output not synchronized with EtherCAT	Output synchronized with SM or DC

Module options

Output of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

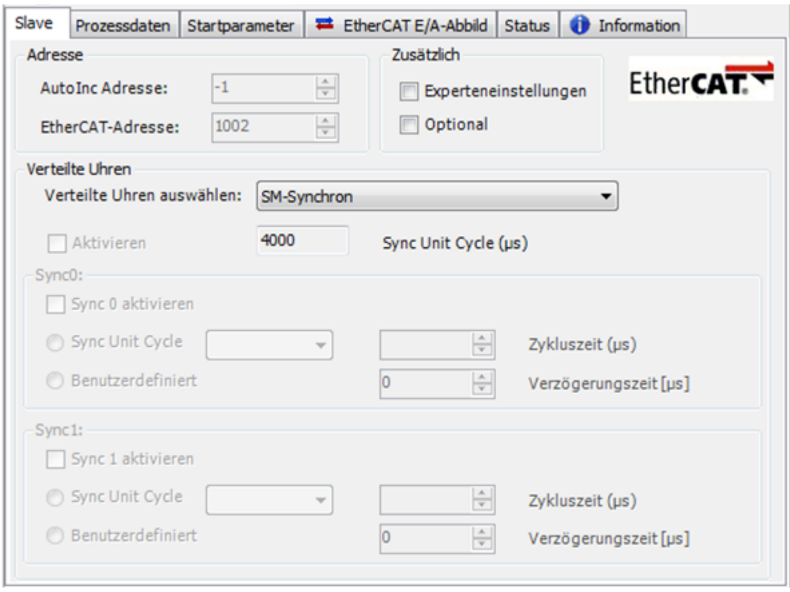


Figure 57: Module options

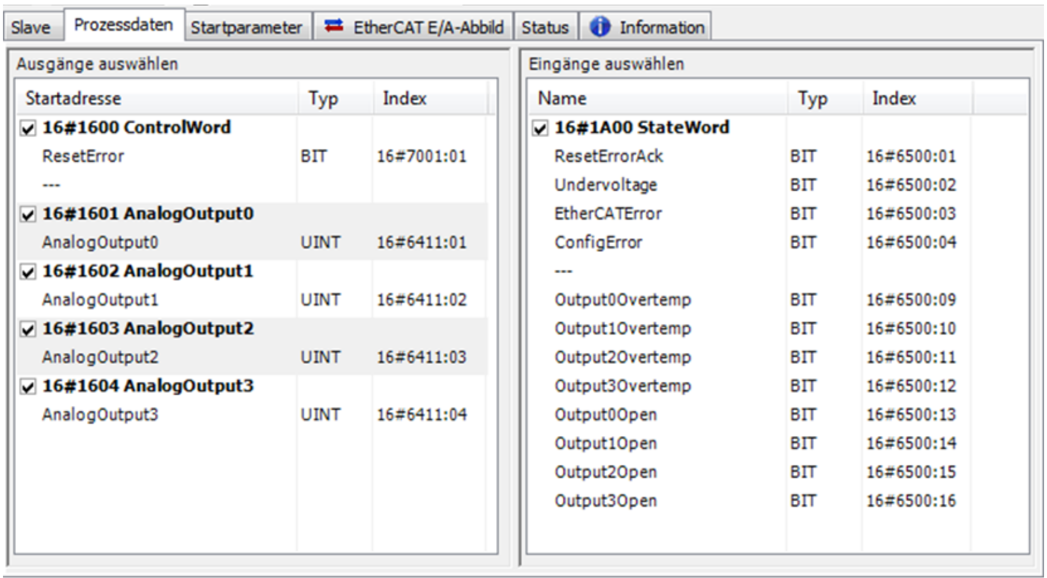


Figure 58: Process data

The process data objects stored as variables in the EtherCAT master's control program are used to access the output values and the module state.

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline to change some settings of module AO4-U/I 16BIT CoE (such as the properties of each of the outputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

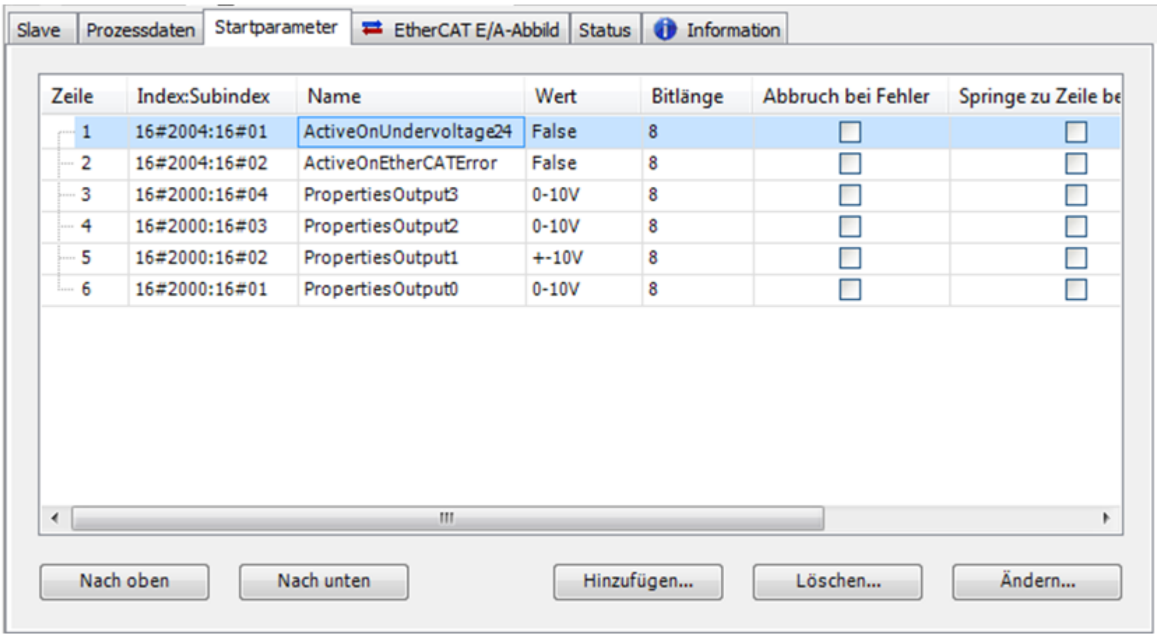


Figure 59: Start parameter

Click/tap on "Add…", choose an object, and set the appropriate value.

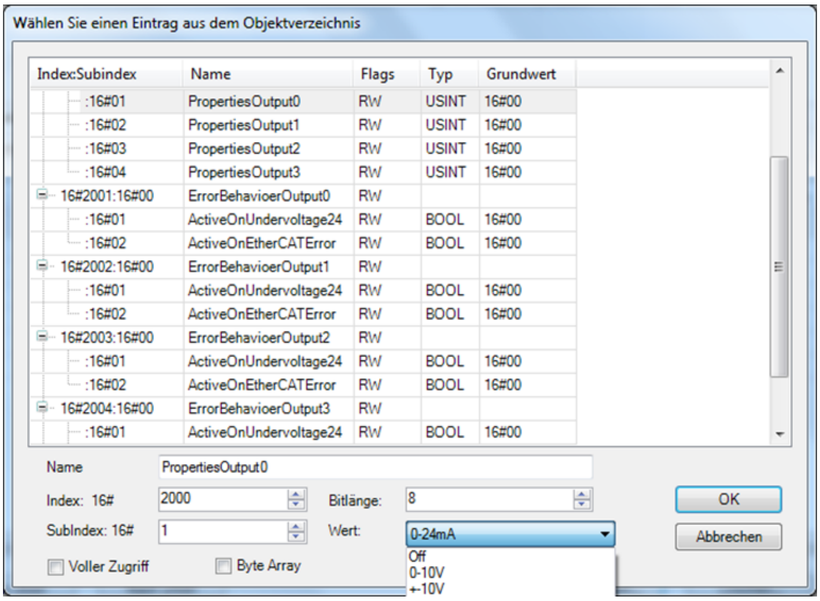


Figure 60: Click/tap on "Add

StateWord
The state word is indicative of the module state:

StateWord		
Bit	**Name**	**Bedeutung**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	Undervoltage24	24 V supply low
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4	-	
5	-	
6	-	
7	-	
8	Output 0 Overtemp	Over-temperature detected by output driver (automatic switch-off)
9	Output 1 Overtemp	Over-temperature detected by output driver (automatic switch-off)
10	Output 2 Overtemp	Over-temperature detected by output driver (automatic switch-off)
11	Output 3 Overtemp	Over-temperature detected by output driver (automatic switch-off)
12	Output 0 Open	If there is no current in Current mode
13	Output 1 Open	If there is no current in Current mode
14	Output 2 Open	If there is no current in Current mode
15	Output 3 Open	If there is no current in Current mode

Analogue outputs
Write the output values into the following variables:

Outputs		
Variable	**Data type**	**Explanation**
AnalogOutputn	UINT	Output value of channel n (n=0…3)

ControlWord
The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0xF0191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String			RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	ARRAY			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32			RO
1018, 3	Revision Number	UINT32	2		RO
1018, 4	Serial Number	UINT32	0		RO
2000	Analogue Output Properties	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 1	Properties Output 0	UINT8	0-10V	Off (0), 0-10V (1), +-10V (3), 0-20mA (6), 4-20mA (5), 0-24mA (7)	RW
2000, 2	Properties Output 1	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2000, 3	Properties Output 2	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2000, 4	Properties Output 3	UINT8	0-10V	Off, 0-10V, +-10V, 0-20mA, 4-20mA, 0-24mA	RW
2001	ErrorBehavior Output 0	Array			
2001, 0	Number of Entries	UINT8	2		RO
2001, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2001, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
2002	ErrorBehavior Output 1	Array			
2002, 0	Number of Entries	UINT8	2		RO
2002, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2002, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW

Index	Name	Type	Default	Min Max	Access
2003	ErrorBehavior Output 2	Array			
2003, 0	Number of Entries	UINT8	2		RO
2003, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2003, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
2004	ErrorBehavior Output 3	Array			
2004, 0	Number of Entries	UINT8	2		RO
2004, 1	Active on Undervoltage 24	BOOL	FALSE		RW
2004, 1	Active on EtherCAT Watchdog Error	BOOL	FALSE		RW
6411	Analogue Outputs	Array			
6411, 0	Number of Entries	UINT8	4		RO
6411, 1	Analogue Output 0	UINT16			RW P
6411, 2	Analogue Output 1	UINT16			RW P
6411, 3	Analogue Output 2	UINT16			RW P
6411, 4	Analogue Output 3	UINT16			RW P
6500	State Word	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	Reset Error Ack	BOOL			RO P
6500, 2	Undervoltage24	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5	-	BOOL			RO P
6500, 6	-	BOOL			RO P
6500, 7	-	BOOL			RO P
6500, 8	-	BOOL			RO P
6500, 9	Output 0 Overtemp	BOOL			RO P
6500, 10	Output 1 Overtemp	BOOL			RO P
6500, 11	Output 2 Overtemp	BOOL			RO P
6500, 12	Output 3 Overtemp	BOOL			RO P
6500, 13	Output 0 Open	BOOL			RO P
6500, 14	Output 1 Open	BOOL			RO P
6500, 15	Output 2 Open	BOOL			RO P
6500, 16	Output 3 Open	BOOL			RO P
7001	Control Word	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

7.9.4. Technical data

AO4-U/I 16BIT CoE	
Label	MC-I/O AO4-U/I 16BIT CoE
Part no.	S-01030202-0500
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue outputs	4
Resolution	16 Bit
Output frequency	Synchronized with SM / DC
Intrinsic error	±0,2 %
Temperature error	±0,005 %/K
Destruction limit (external voltages)	15 V
Voltage	
Measuring range	0 … 10 V, ±10 V
Short circuit protection	Yes
Short circuit current	max. 30 mA
Load resistance	min. 1 kΩ
Settling time	0 → 10 V: ≤ 22 µs at 2 kΩ/<200 pF
Current	
Measuring range	0…20 mA, 4…20 mA, 0…24 mA
Load resistance	max. 500 Ω, max. 1 mH (inductive)
Settling time	0 → 16 V: ≤ 25 µs at 300 Ω/<1 mH
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20 % +25 %
E-bus load	150 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8. Temperature modules

8.1. Analogue temperature inputs AI4-PT/NI100, AI4-PT/NI1000

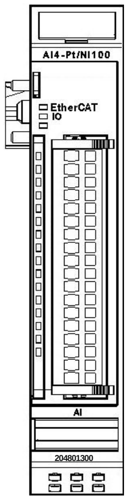


Figure 61: Front view of AI4-PT/NI100 I/O module

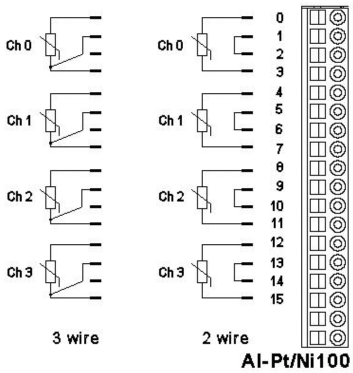


Figure 62: I/O connection

i NOTE

The AI4-PT/NI100 module and the AI4-PT/NI1000 module are no longer recommended for new projects. Please use the successive AI4-PT/NI/THERMO 16BIT CoE module.

8.1.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analog wires □ section 3.1.1 Earth

8.1.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Short circuit, broken wire

8.1.3. Function

Module AI4-PT/NI100 has 4 analogue inputs for PT100 or NI100 temperature sensors.
It can also measure resistances between 70 and 330 □.

Module AI4-PT/NI1000 has 4 analogue inputs for PT1000 or NI1000 temperature sensors.
It can also measure resistances between 700 and 3000 □.

The letter 'n' in the tables below represents the channel number (n=0…3).

Analogue inputs
Check the following variable for the digitized input values:

Inputs				
Variable	**Data type**	**Explanation**		
Channel_n	INT	Value measured on channel n (n= 0…3)		
		Default	in 1/10 °C	
		ResMode	PT100	in 1/100 Ω
			PT1000	in 1/10 Ω

Module control
The module provides you with various operational options.

To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED.
To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge □ accepts module options
ResetError	BOOL	Rising edge □ acknowledges error

Module options
The following options are available for module AI4-PT/NI100 or 1000:

Module options			
Variable	**Data type**	**Explanation**	
Channel_n_Ni	BOOL	Set channel n to NI100 sensor	
Channel_n_On	BOOL	Enables channel n	
Channel_n_ResMode	BOOL	Set channel n to resistance mode	
Channel_n_Filter	USINT	Set filter for channel n The arithmetic mean is output after n+1 conversions.	
n		0 … 3	Channel number

To set and accept options, see Module control

Module state

The following module states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Not used
Undervoltage	BOOL	Not used
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_Open	BOOL	- Channel n load > maximum - Broken wire of connector 0 * - Broken wire of connector 3 * - Broken wire of connector 0/3 * → Specific_Error = TRUE
Channel_n_Shortcut	BOOL	- Channel n load < minimum - Short circuit of connector 0-3 * - Broken wire of connector 1 * → Specific_Error = TRUE

* The causes of 'Short circuit' and 'Broken wire 0..3' are shown for channel 0 (equivalent applies to other channels).

These messages are automatically reset when the state concerned has returned to normal.
They are combined into a single “Specific_Error” state of the module and output to the I/O LED as “module-specific error”.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.

'Filter' in this case means to compute an average when the set filter time is over.
Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams. The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Channel	
Number of channels	**Cycle time in ms (all filters=0)**
1	32
2	65
3	97
4	129

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

i NOTE

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values

i NOTE

Best results are obtained by connecting the shield of the signal cables to operative earth.

8.1.4. Technical data AI4-PT/NI100

AI4-PT/NI100	
Label	MC-I/O AI4-PT/NI100 16BIT
Part no.	204801300
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	4
Resolution	16 bit (resistance 0.01 Ω, temperature 0.1°C)
Pt100 measuring range	- 75°C…+ 670°C
Ni100 measuring range	- 60°C…+ 250°C
Resistance	70…330 Ω
Temperature drift	< ± 50 ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.50 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	150 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8.1.5. Technical data AI4-PT/NI1000

AI4-PT/NI1000	
Label	MC-I/O AI4-PT/NI1000 16BIT
Part no.	204802800
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	4
Resolution	16 bit (resistance 0.1 Ω, temperature 0.1°C)
Pt100 measuring range	- 75°C…+ 570°C
Ni100 measuring range	- 60°C…+ 250°C
Resistance	700…3000 Ω
Temperature drift	< ± 60 ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.12 mA
Sampling frequency	> 7.75 Hz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	150 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8.2. Analogue temperature inputs AI8-PT/NI100

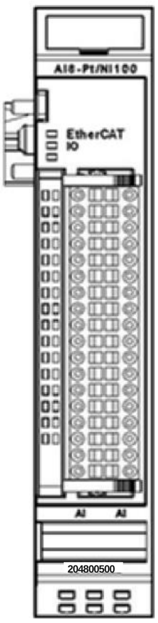


Figure 63: Front view of AI8-PT/NI100 I/O module

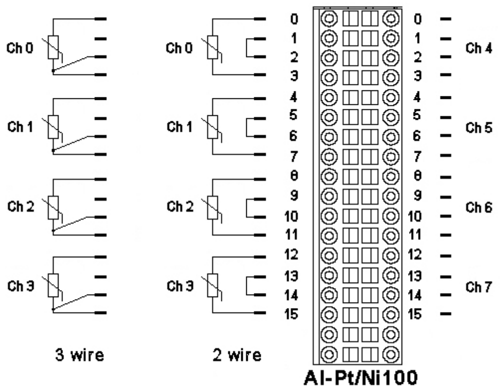


Figure 64: I/O connection

i NOTE

The AI8-PT/NI100 module is no longer recommended for new projects. Please use the successive AI8-PT/NI/THERMO 16BIT CoE module.

8.2.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.

Operative earth / shielding of analog wires □ section 3.1.1 Earth

8.2.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Short circuit, broken wire

8.2.3. Function

Module AI8-PT/NI100 has 8 analogue inputs for PT100 or NI100 temperature sensors.
It can also measure resistances between 70 and 330 □.

The letter 'n' in the tables below represents the channel number (n=0…7).

Analogue inputs
Check the following variable for the digitized input values:

Inputs				
Variable	**Data type**	**Explanation**		
Channel_n	INT	Value measured on channel n (n= 0…7)		
		Default	in 1/10 °C	
		ResMode	PT100	in 1/100 Ω

Module control
The module provides you with various operational options.

To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED.
To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge accepts module options
ResetError	BOOL	Rising edge acknowledges error

Module options
The following options are available for module AI8-PT/NI100:

Module options			
Variable	**Data type**	**Explanation**	
Channel_n_Ni	BOOL	Set channel n to NI100 sensor	
Channel_n_On	BOOL	Enables channel n	
Channel_n_ResMode	BOOL	Set channel n to resistance mode	
Channel_n_Filter	USINT	Set filter for channel n The arithmetic mean is output after n+1 conversions.	
n		0 … 7	Channel number

To set and accept options, see Module control

Module state

The following module states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Not used
Undervoltage	BOOL	Not used
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_Open	BOOL	- Channel n load > maximum - Broken wire of connector 0 * - Broken wire of connector 3 * - Broken wire of connector 0/3 * → Specific_Error = TRUE
Channel_n_Shortcut	BOOL	- Channel n load < minimum - Short circuit of connector 0-3 * - Broken wire of connector 1 * → Specific_Error = TRUE

* The causes of 'Short circuit' and 'Broken wire 0..3' are shown for channel 0 (equivalent applies to other channels).

These messages are automatically reset when the state concerned has returned to normal.
They are combined into a single “Specific_Error” state of the module and output to the I/O LED as “module-specific error”.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.

'Filter' in this case means to compute an average when the set filter time is over.
Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams.
The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Channel			
Number of channels	**Cycle time in ms (all filters=0)**	**Number of channels**	**Cycle time in ms (all filters=0)**
1	34	5	162
2	66	6	194
3	98	7	226
4	130	8	258

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

i NOTE

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values

i NOTE

Best results are obtained by connecting the shield of the signal cables to operative earth.

8.2.4. Technical data AI8-PT/NI100

AI8-PT/NI100	
Label	MC-I/O AI8-PT/NI100 16BIT
Part no.	204800500
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Analogue inputs	8
Resolution	16 bit (resistance 0.01 Ω, temperature 0.1°C)
Pt100 measuring range	- 75°C…+ 670°C
Ni100 measuring range	- 60°C…+ 250°C
Resistance	70…330 Ω
Temperature drift	< ± 50 ppm/°C regarding range limit
Critical frequency	typical 2 Hz
Measurement current	< 0.50 mA
Sampling frequency	> 3.88 Hz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	170 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8.3. Analogue temperature inputs AI4-THERMO 16BIT

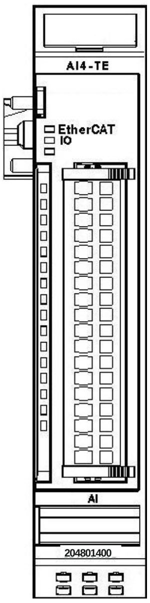


Figure 65: Front view of AI4-THERMO I/O module

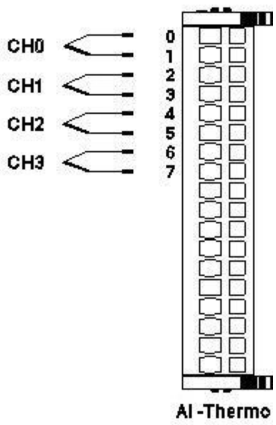


Figure 66: I/O connection

i NOTE

The AI4-THERMO module is no longer recommended for new projects. Please use the successive AI4-PT/NI/THERMO 16BIT CoE module.

8.3.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analog wires section 3.1.1 Earth

8.3.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red	Measuring value is out of range

8.3.3. Function

Module AI4-THERMO has 4 analogue inputs for thermo-element sensors. It can also measure mV-voltages.

The letter 'n' in the tables below represents the channel number (n=0…3).

Analogue inputs
Check the following variable for the digitized input values:

Inputs			
Variable	**Data type**	**Explanation**	
Channel_n	INT	Measuring value of channel n (n = 0…3)	
		mV-Mode	in µV resp. 2 µV
		Default	in 1/10 °C

Module control

The module provides you with various operational options.
To set up the module choose the options as appropriate and accept by setting control bit “SetOptions” to a rising edge. The module will confirm by returning “OptionsSet”.

There are various “module error” bits that the module uses to indicate errors. The states of the error bits are retained and also used for error indication by the “I/O” LED.

To reset the error bits set control bit “ResetError” to a rising edge.

Error bits		
Variable	**Data type**	**Explanation**
SetOptions	BOOL	Rising edge □ accepts module options
ResetError	BOOL	Rising edge □ acknowledges error

Module options

The following options are available for module AI4-THERMO:

Module options			
Variable	**Data type**	**Explanation**	
Channel_n_SensorType	USINT	Sensor type	
		16#00	mV: not used
		16#10	mV: -40 ..+65 mV, values in 2 µV
		16#04	Type K: not used
		16#14	Type K: -200°C .. +1372°C in 0.1°C
Channel_n_On	BOOL	Enable channel n	
Channel_n_Filter	USINT	Set filter for channel n The arithmetic mean is output after n+1 conversions.	
n		0 … 3	Channel number

To set and accept options, see Module control

Module state

The following module states are indicated:

Module state		
Variable	**Data type**	**Explanation**
Shortcut	BOOL	Not used
Undervoltage	BOOL	Not used
Watchdog	BOOL	Internal watchdog of module
EtherCAT_Error	BOOL	Configuration error or watchdog control
Specific_Error	BOOL	Module-specific fault
OptionsSet	BOOL	Sent by module to acknowledge SetOptions

To reset the messages, see Module control

Module-specific messages

Apart from the module error messages, there is a set of messages containing details about the current state of the module:

Messages		
Variable	**Data type**	**Explanation**
Channel_n_ Out_of_Range	BOOL	Measuring value is out of range.

These messages are automatically reset when the state concerned has returned to normal.
They are combined into a single “Specific_Error” state of the module and output to the I/O LED as “module-specific error”.

Conversion time

The analogue signals are converted one by one down every channel. Disabling one or several channels will shorten the entire A/D conversion cycle.

'Filter' in this case means to compute an average when the set filter time is over.
Analogue value conversion runs cyclically and is not synchronized with the receipt of EtherCAT telegrams.
The cycle consists of the analogue value conversion plus transmitting the values into the EtherCAT data area.

Channel	
Number of channels	**Cycle time in ms (all filters=0)**
1	35
2	67
3	99
4	131

i NOTE

If you are aiming for a high sampling frequency, the EtherCAT master should do the filtering (averaging) because it will normally have much more processing power.

i NOTE

Take the EtherCAT cycle into account to assess how much the values stored by the EtherCAT master are up-to-date. The module described in this section will accept the above times as the ideal EtherCAT cycle setup.

Quality of analogue values

i NOTE

Best results are obtained by connecting the shield of the signal cables to operative earth.

8.3.4. Technical data

AI4-THERMO	
Label	MC-I/O AI4-THERMO 16BIT
Part no.	204801400
Plug-in connector	18-pole S-02020201-0800 (not part of the module)
Analogue inputs	4
Resolution	16 bit
mV measuring range	mV: -40 ..+65 mV, values in 2 µV
Type K measuring range	Typ K: -200°C .. +1372°C in 0.1°C
Measurement failure 25°C	< ± 0.4% regarding range limit
Less measurement failure	on demand
Cold junction compensation	yes
Critical frequency	typical 0.33 Hz
Sampling frequency	> 7.63 Hz (if all channels are enabled)
Controller	ASIC ET1200
Baud rate	100 Mbit/s
E-bus port	10-pin system plug in side wall
Term. module	not required
Power supply	24 V DC -20% +25%
E-bus load	150 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8.4. Analogue temperature inputs AI4-PT/NI/THERMO 16BIT CoE

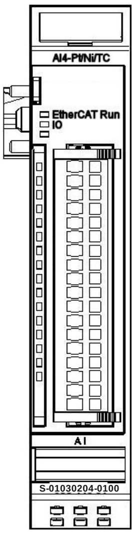


Figure 67: Front view of AI4-PT/NI/THERMO 16BIT CoE I/O module

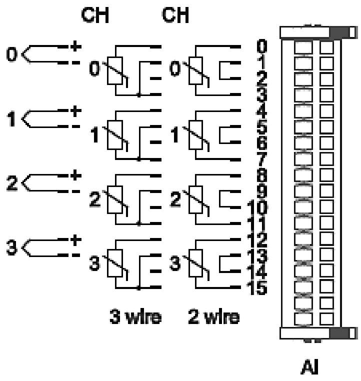


Figure 68: I/O connection

i NOTE

Module AI4-PT/NI/THERMO 16BIT CoE is the incompatible successor to the modules AI4-PT/NI100, AI4-PT/NI1000 and AI4-THERMO.

Before replacing an AI4-PT/NI100 or AI4-PT/NI1000 or AI4-THERMO with an AI4-PT/NI/THERMO 16BIT CoE module, you must modify the EtherCAT master's control program.

8.4.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.

Operative earth / shielding of analog wires section 3.1.1 Earth

8.4.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red 1x	Sensor low
	Red 2x	Sensor high

i NOTE

Note on PT100/NI100 mode

Error "input high" is not shown in the PT100 and NI100 modes, unless a temperature sensor is connected. Check that your wiring is correct (jumpered 2-wire or 3-wire connection) to ensure that all error are detected/shown properly.

i NOTE

Note on thermocouple mode

Errors input low and input high are just indicative of the temperature being out of the set range.

A short circuit (input low) is not detected in thermocouple mode (types J,K) because the thermal voltage is too small for a short circuit to be relevant to the measured result.

Since a broken wire is not detected, the floating module values may provoke an indication of error input high or input low.

8.4.3. Function

Module AI4-PT/NI/THERMO 16BIT CoE features 4 analogue inputs for temperature sensors. Every channel can be separately set to one of the following sensor types: millivolt, PT100, PT1000, NI100, NI1000 (DIN 43760) or thermocouple.

Measured value
Readings are shown in 0.1 °C steps (default). Or you can choose to show them as Ohm/Volt or raw data.

Module options
Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

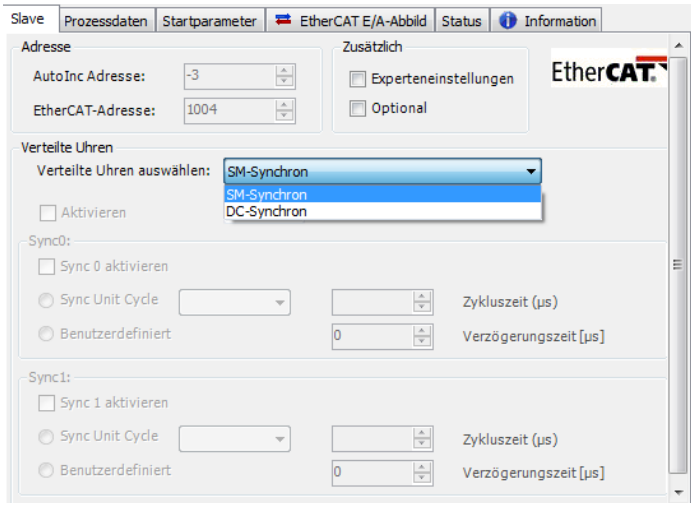


Figure 69: Module options

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

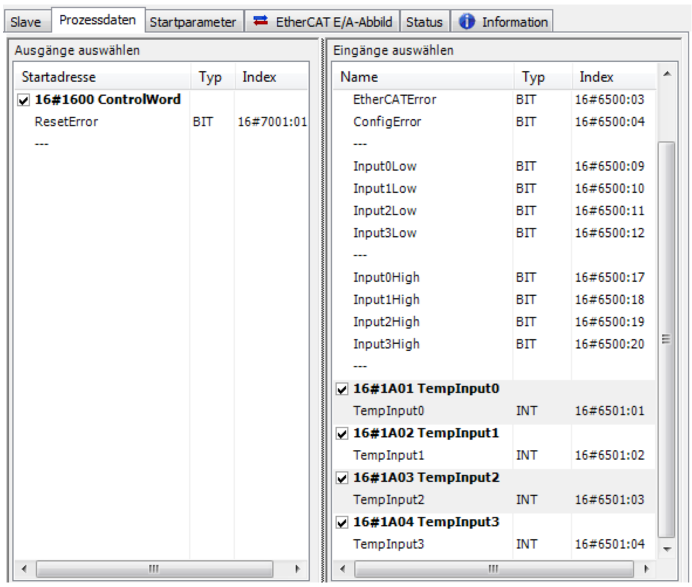


Figure 70: Process data

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI4-Pt/Ni/TC (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.
Click/tap on "Add…", choose an object, and set the appropriate value.

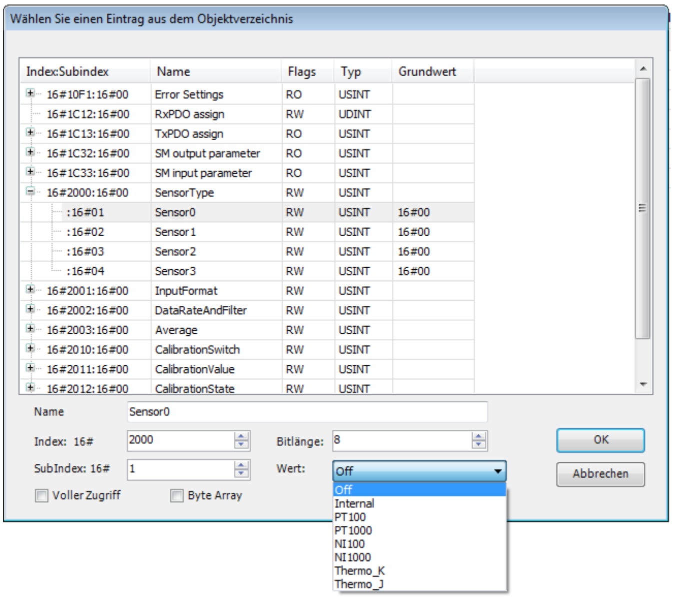


Figure 71: Object dictionary

You can set up the following options for every channel:

Module options		
Name	**Value**	**Explanation**
SensorType	0	Off (default)
	1	Internal (mV)
	2	PT100
	3	PT1000
	4	NI100
	5	NI1000 (DIN43760)
	6	Thermo K
	7	Thermo J
InputFormat	0	0.1 °C
	1	Ω / V
	2	Raw (raw data)

Data rate und Filter	0	1000 readings per second
	1	600 readings per second
	2	330 readings per second
	3	175 readings per second
	4	90 readings per second
	5	45 readings per second
	6	20 readings per second
	7	20 readings per second plus 50 & 60 Hz filter
	8	20 readings per second plus 50 Hz filter
	9	20 readings per second plus 60 Hz filter
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord
The state word (DWORD) is indicative of the module state:

StateWord		
Bit	**Name**	**Explanation**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	-	not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7	-	not used
8	Input0low	Incorrect range of connected reading
9	Input1low	Incorrect range of connected reading
10	Input2low	Incorrect range of connected reading
11	Input3low	Incorrect range of connected reading
12-15	-	not used
16	Input0high	Incorrect range of connected reading
17	Input1high	Incorrect range of connected reading
18	Input2high	Incorrect range of connected reading
19	Input3high	Incorrect range of connected reading
20-31	-	not used

Analogue inputs
Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
TempInputn	INT	Value of channel n (n=0…3) in 0.1 °C, Ω or 2 µV

ControlWord
The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Cold point compensation
Cold points are automatically compensated if thermocouples are used. Temperature readings are taken immediately at the plug near the connections.

Calibration
This module need not be calibrated by the end user because it is calibrated after fabrication.
It can only be calibrated once because the calibration values are kept on memory.
The calibration objects (2010:n; 2011:n and 2012:n) in the “Startup Parameters” are intended for internal use only.

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI4_Pt/Ni/Thermo		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185345		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Sensor Type	Array			
2000, 0	Number of Entries	UINT8	4		RO
2000, 1	Sensor0	UINT8	Off	Off (0), Internal (1), PT100 (2), PT1000 (3), NI100 (4), NI1000 (5), Thermo_K (6), Thermo_J (7),	RW
2000, 2	Sensor1	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 3	Sensor2	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 4	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2001	Input Format	Array			

Index	Name	Type	Default	Min Max	Access
2001, 0	Number of Entries	UINT8	4		RO
2001, 1	Input0Format	UINT8	0.1°C	0.1°C (0), Ω / V (1) Raw (2)	RW
2001, 2	Input1Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 3	Input2Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 4	Input3Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2002	Data RateAndFilter	Array			
2002, 0	Number of Entries	UINT8	4		
2002, 1	Input0DataRateAnd Filter	UINT8	20 PLC	1000 PLC (0) 600 PLC (1) 330 PLC (2) 175 PLC (3) 90 PLC (4) 45 PLC (5) 20 PLC (6) 20 PLC+50&60Hz (7) 20 PLC + 50Hz (8) 20 PLC + 60Hz (9)	RO
2002, 2	Input1DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 3	Input2DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 4	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC	RO

Index	Name	Type	Default	Min Max	Access
				90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	
2003	Average	Array			
2003, 0	Number of Entries	UINT8	4		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	4		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6500	StateWord	Array			RO P
6500, 0	Number of Entries	UINT8	32		RO P
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	-	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5..8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13..16	-	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21..32	-	BOOL			RO P
7001	Module Control	Array			
7001, 0	Number of Entries	UINT8	1		RO
7001, 1	Reset Error	BOOL			RW P

RO=read-only, RW= read/write, P=process image

8.4.4. Technical data

AI4-PT/NI/THERMO 16BIT CoE	
Label	MC-I/O AI4-PT/NI/THERMO 16BIT CoE
Part no.	S-01030204-0100
Analogue inputs	4
Resolution	16 bit
Input filter cutoff frequency	0.33 Hz (typ.)
Conversion time	50 ms (adjustable)
Measuring error	< ±0,54 % (of final measuring range value)
Temperature drift	< ±50 ppm (of final measuring range value)
Thermocouple	
Sensor types	J,K, mV (internal)
Cold point compensation	Yes
Measuring range Type K	-200 °C…+1372 °C
Measuring range Type J	-50 °C…+760 °C
Measuring range mV	-40 … +65 mV
PT100 / NI100	
Measuring range PT	-75 °C…+670 °C
Measuring range NI	-60 °C…+250 °C
Input resistance	70…320 Ω
Measuring current	1 mA (typ.)
PT1000 / NI1000DIN43760	
Measuring range PT	-75 °C…+670 °C
Measuring range NI	-60 °C…+250 °C
Input resistance	700…3200 Ω
Measuring current	0.1 mA (typ.)
General	
Baud rate	100 Mbit/s
Controller	ASIC ET1200
E-bus port	10-pin system plug in side wall
Term. module	not required
Plug-in connector	18-pole S-02020201-0800 (not part of the module)

AI4-PT/NI/THERMO 16BIT CoE	
Power supply	None
E-bus load	170 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

8.5. Analogue temperature inputs AI8-PT/NI/THERMO 16BIT CoE

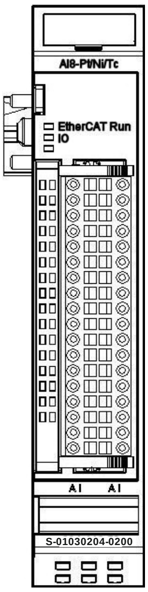


Figure 72: Front view of AI8-PT/NI/THERMO 16BIT CoE I/O module

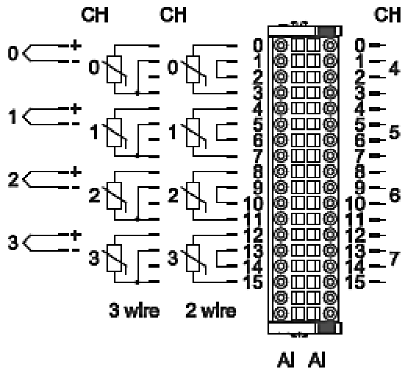


Figure 73: I/O connection

i NOTE

Module AI8-PT/NI/THERMO 16BIT CoE is the incompatible successor to the module AI8-PT/NI100.
Before replacing an AI8-PT/NI100 with an AI8-PT/NI/THERMO 16BIT CoE module, you must modify the EtherCAT master's control program.

8.5.1. Terminals

The module needs no separate 24 V connector. Power is supplied to the module through the E-bus connector.
Operative earth / shielding of analog wires section 3.1.1 Earth

8.5.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

There is no LED labeled “Power” because a separate power feed is not required.

“Channel” LEDs

The "Channel" LEDs indicate the state of every channel.

Channel		
State	**LED flash code**	**Explanation**
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red 1x	Sensor low
	Red 2x	Sensor high

i NOTE

Note on PT100/NI100 mode

Error "input high" is not shown in the PT100 and NI100 modes, unless a temperature sensor is connected. Check that your wiring is correct (jumpered 2-wire or 3-wire connection) to ensure that all error are detected/shown properly.

i NOTE

Note on thermocouple mode

Errors input low and input high are just indicative of the temperature being out of the set range.

A short circuit (input low) is not detected in thermocouple mode (types J,K) because the thermal voltage is too small for a short circuit to be relevant to the measured result.

Since a broken wire is not detected, the floating module values may provoke an indication of error input high or input low.

8.5.3. Function

The AI8-PT/NI/THERMO 16BIT CoE module has 8 analogue temperature sensor inputs. Every channel can be separately set to one of the following sensor types: millivolt, PT100, PT1000, NI100, NI1000 (DIN 43760) or thermocouple.

Measured value

Readings are shown in 0.1 °C steps (default). Or you can choose to show them as Ohm/Volt or raw data.

Module options

Conversion of the analogue values can be synchronized with DC (Distributed Clocks) or SM (Sync Manager).

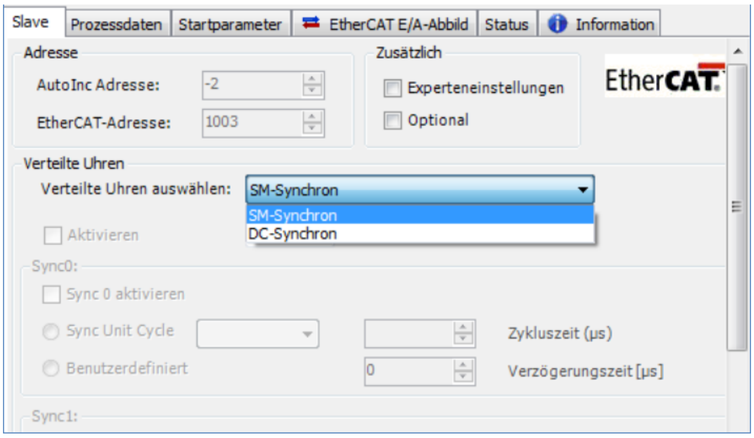


Figure 74: Module options

The process data objects stored as variables in the EtherCAT master's control program are used to access the input values and the module state.

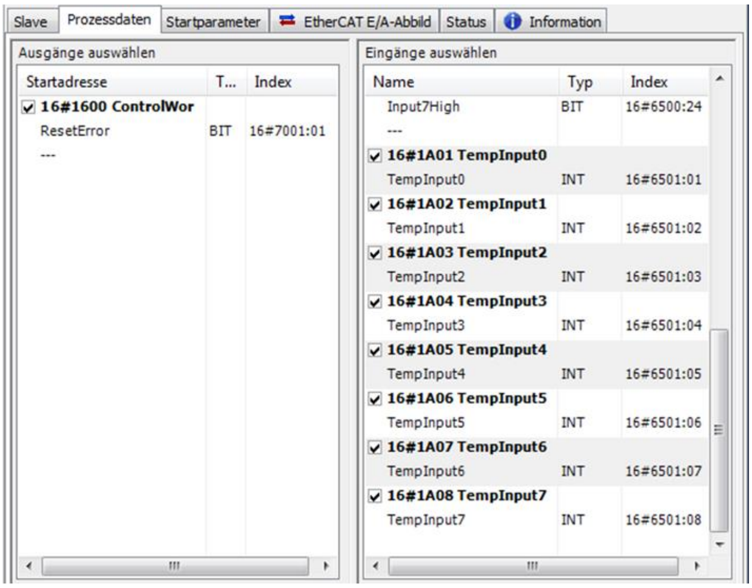


Figure 75: Process data

Service data objects (SDO) are available for details and settings.
You may run the configuration tool offline and choose the "Startup Parameters" to change some settings of module AI8-PT/NI/THERMO 16BIT CoE (such as the properties of each of the inputs). The EtherCAT master will apply the settings when starting up the module.
You can also use the SDO transfer components available for the EtherCAT master to change settings at runtime.

Click/tap on "Add…", choose an object, and set the appropriate value.

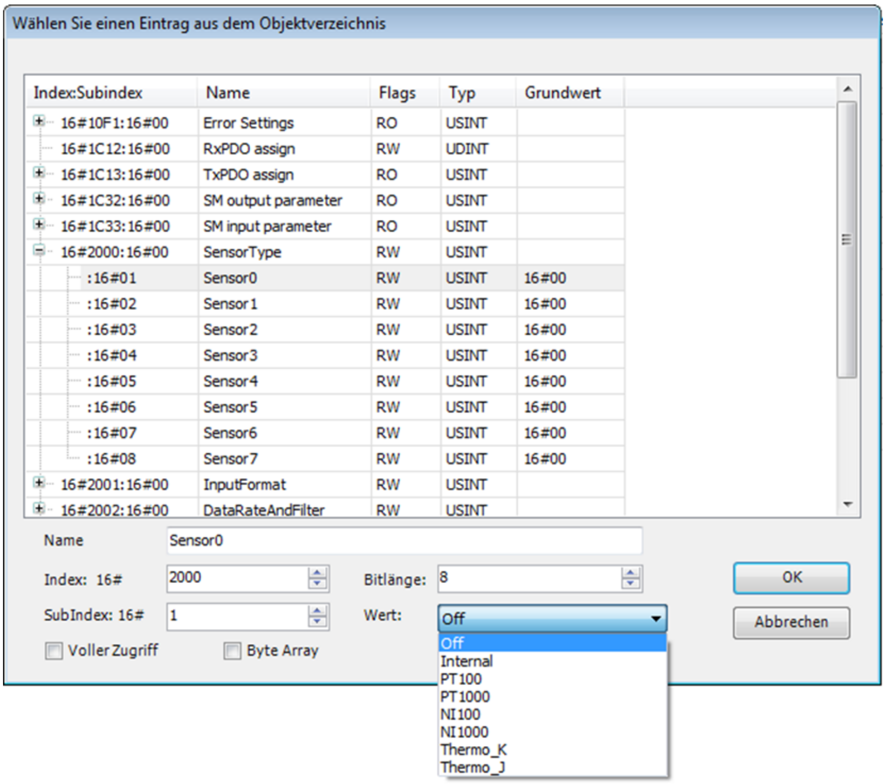


Figure 76: Object dictionary

You can set up the following options for every channel:

Module options		
Name	**Value**	**Explanation**
SensorType	0	Off (default)
	1	Internal (mV)
	2	PT100
	3	PT1000
	4	NI100
	5	NI1000 (DIN43760)
	6	Thermo K
	7	Thermo J
InputFormat	0	0.1 °C
	1	Ω / V
	2	Raw (raw data)
Data rate and filter	0	1000 readings per second
	1	600 readings per second
	2	330 readings per second
	3	175 readings per second
	4	90 readings per second
	5	45 readings per second
	6	20 readings per second
	7	20 readings per second plus 50 & 60 Hz filter
	8	20 readings per second plus 50 Hz filter
	9	20 readings per second plus 60 Hz filter
Average	n=1…255	Inputn=average after n cycles (default=1)

StateWord
The state word (DWORD) is indicative of the module state:

StateWord		
Bit	**Name**	**Explanation**
0	ResetErrorAck	Acknowledges "Reset Error" in Module Control
1	-	not used
2	EtherCATError	Sync Manager Watchdog
3	ConfigError	Mismatch of Sync Manager's quantity structure
4-7	-	not used
8	Input0low	Incorrect range of connected reading
9	Input1low	Incorrect range of connected reading
10	Input2low	Incorrect range of connected reading
11	Input3low	Incorrect range of connected reading
12	Input4low	Incorrect range of connected reading
13	Input5low	Incorrect range of connected reading
14	Input6low	Incorrect range of connected reading
15	Input7low	Incorrect range of connected reading
16	Input0high	Incorrect range of connected reading
17	Input1high	Incorrect range of connected reading
18	Input2high	Incorrect range of connected reading
19	Input3high	Incorrect range of connected reading
20	Input4high	Incorrect range of connected reading
21	Input5high	Incorrect range of connected reading
22	Input6high	Incorrect range of connected reading
23	Input7high	Incorrect range of connected reading
24-31	-	not used

Analogue inputs
Check the following variables for the digitized input values:

Inputs		
Variable	**Data type**	**Explanation**
TempInputn	INT	Value of channel n (n=0…7) in 0.1 °C, Ω or 2 µV

ControlWord
The control word contains a bit for acknowledging errors.

ControlWord		
Bit	**Name**	**Explanation**
0	ResetError	0 -> errors are retained, 1 -> errors cleared after removing their cause
1-15	-	not used

Cold point compensation
Cold points are automatically compensated if thermocouples are used. Temperature readings are taken immediately at the plug near the connections.

Calibration
This module need not be calibrated by the end user because it is calibrated after fabrication.
It can only be calibrated once because the calibration values are kept on memory.
The calibration objects (2010:n; 2011:n and 2012:n) in the “Startup Parameters” are intended for internal use only.

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Type	UINT32	0x40191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	AI8_Pt/Ni/Thermo		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185346		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32			RO
2000	Sensor Type	Array			
2000, 0	Number of Entries	UINT8	8		RO
2000, 1	Sensor0	UINT8	Off	Off (0), Internal (1), PT100 (2), PT1000 (3), NI100 (4), NI1000 (5), Thermo_K (6), Thermo_J (7),	RW
2000, 2	Sensor1	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 3	Sensor2	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 4	Sensor3	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 5	Sensor4	UINT8	Off	Off,	RW

Index	Name	Type	Default	Min Max	Access
				Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	
2000, 6	Sensor5	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 7	Sensor6	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2000, 8	Sensor7	UINT8	Off	Off, Internal, PT100, PT1000, NI100, NI1000, Thermo_K, Thermo_J,	RW
2001	Input Format	Array			
2001, 0	Number of Entries	UINT8	8		RO
2001, 1	Input0Format	UINT8	0.1°C	0.1°C (0), Ω / V (1) Raw (2)	RW
2001, 2	Input1Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 3	Input2Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 4	Input3Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 5	Input4Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 6	Input5Format	UINT8	0.1°C	0.1°C,	RW

Index	Name	Type	Default	Min Max	Access
				Ω / V Raw	
2001, 7	Input6Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2001, 8	Input Format	UINT8	0.1°C	0.1°C, Ω / V Raw	RW
2002	Data RateAndFilter	Array			
2002, 0	Number of Entries	UINT8	8		
2002, 1	Input0DataRateAnd Fil-ter	UINT8	20 PLC	1000 PLC (0) 600 PLC (1) 330 PLC (2) 175 PLC (3) 90 PLC (4) 45 PLC (5) 20 PLC (6) 20 PLC+50&60Hz (7) 20 PLC + 50Hz (8) 20 PLC + 60Hz (9)	RO
2002, 2	Input1DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 3	Input2DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 4	Input3DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz	RO

Index	Name	Type	Default	Min Max	Access
				20 PLC + 60Hz	
2002, 5	Input4DataRateAndFilter	UINT8	20PLC	1000PLC 600PLC 330PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 6	Input5DataRateAnd Fil- ter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 7	Input6DataRateAndFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2002, 8	Input7DataRateandFilter	UINT8	20 PLC	1000 PLC 600 PLC 330 PLC 175 PLC 90 PLC 45 PLC 20 PLC 20 PLC+50&60Hz 20 PLC + 50Hz 20 PLC + 60Hz	RO
2003	Average	Array			
2003, 0	Number of Entries	UINT8	8		RO
2003, 1	Input 0 Average	UINT8	1	1..255	RW
2003, 2	Input 1 Average	UINT8	1	1..255	RW
2003, 3	Input 2 Average	UINT8	1	1..255	RW
2003, 4	Input 3 Average	UINT8	1	1..255	RW
2003, 5	Input 4 Average	UINT8	1	1..255	RW
2003, 6	Input 5 Average	UINT8	1	1..255	RW

Index	Name	Type	Default	Min Max	Access
2003, 7	Input 6 Average	UINT8	1	1..255	RW
2003, 8	Input 7 Average	UINT8	1	1..255	RW
6401	Analogue input	Array			
6401, 0	Number of Entries	UINT8	8		RO
6401, 1	Analog Input 0	UINT16			RO P
6401, 2	Analog Input 1	UINT16			RO P
6401, 3	Analog Input 2	UINT16			RO P
6401, 4	Analog Input 3	UINT16			RO P
6401, 5	Analog Input 4	UINT16			RO P
6401, 6	Analog Input 5	UINT16			RO P
6401, 7	Analog Input 6	UINT16			RO P
6401, 8	Analog Input 7	UINT16			RO P
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	32		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	-	BOOL			RO P
6500, 3	EtherCAT Error	BOOL			RO P
6500, 4	ConfigError	BOOL			RO P
6500, 5...8	-	BOOL			RO P
6500, 9	Input 0 low	BOOL			RO P
6500, 10	Input 1 low	BOOL			RO P
6500, 11	Input 2 low	BOOL			RO P
6500, 12	Input 3 low	BOOL			RO P
6500, 13	Input 4 low	BOOL			RO P
6500, 14	Input 5 low	BOOL			RO P
6500, 15	Input 6 low	BOOL			RO P
6500, 16	Input 7 low	BOOL			RO P
6500, 17	Input 0 high	BOOL			RO P
6500, 18	Input 1 high	BOOL			RO P
6500, 19	Input 2 high	BOOL			RO P
6500, 20	Input 3 high	BOOL			RO P
6500, 21	Input 4 high	BOOL			RO P
6500, 22	Input 5 high	BOOL			RO P
6500, 23	Input 6 high	BOOL			RO P
6500, 24	Input 7 high	BOOL			RO P
6500, 25..32	ResetErrorAck	BOOL			RO P
6500, 1	EtherCAT Error	BOOL			RO P
6500, 3	ConfigError	BOOL			RO P
6500, 4	Module Control	Array			
7001	Number of Entries	UINT8	1		RO
7001, 0	Reset Error	BOOL			RW P
7001, 1					

RO=read-only, RW= read/write, P=process image

8.5.4. Technical data

AI8-PT/NI/THERMO 16BIT CoE	
Label	MC-I/O AI8-PT/NI/THERMO 16BIT CoE
Part no.	S-01030204-0200
Analogue inputs	8
Resolution	16 bit
Input filter cutoff frequency	0.33 Hz (typ.)
Conversion time	50 ms (adjustable)
Measuring error	< ±0,54 % (of final measuring range value)
Temperature drift	< ±50 ppm (of final measuring range value)
Thermocouple	
Sensor types	J,K, mV (internal)
Cold point compensation	Yes
Measuring range Type K	-200 °C…+1372 °C
Measuring range Type J	-50 °C…+760 °C
Measuring range mV	-40 … +65 mV
PT100 / NI100	
Measuring range PT	-75 °C…+670 °C
Measuring range NI	-60 °C…+250 °C
Input resistance	70…320 Ω
Measuring current	1 mA (typ.)
PT1000 / NI1000DIN43760	
Measuring range PT	-75 °C…+670 °C
Measuring range NI	-60 °C…+250 °C
Input resistance	700…3200 Ω
Measuring current	0.1 mA (typ.)
General	
Baud rate	100 Mbit/s
Controller	ASIC ET1200
E-bus port	10-pin system plug in side wall
Term. module	not required
Plug-in connector	36-pole S-02020201-0900 (not part of the module)

AI8-PT/NI/THERMO 16BIT CoE	
Power supply	None
E-bus load	170 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

9. Counter modules

9.1. Counters with analogues outputs COUNTER/POSI2 5V

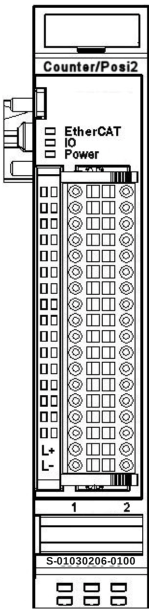


Figure 77: Front view of COUNTER/POSI2 5V I/O module

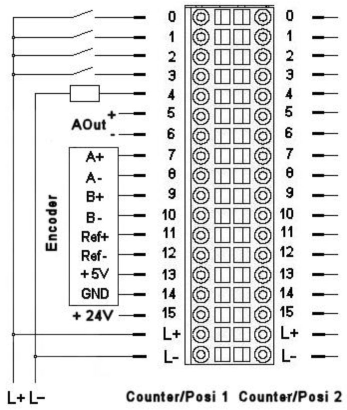


Figure 78: I/O connection

9.1.1. Terminals

COUNTER/POSI2		
Pin	**Signal**	**Explanation**
0..3	In_0..3	Digital inputs
4	Out_0	Digital output
5..6	A_Out	Analogue output (COUNTER/POSI2 only)
7..12	A, B, Ref	Encoder signals
13..14	5 V	Encoder supply 5 V (0.2 A fuse)
15	+24 V	Initiator supply +24 V (0.2 A fuse)
16..17	24 V	Module supply

Operative earth / shielding of analog wires → section 3.1.1 Earth

9.1.2. Status LEDs

“EtherCAT” LED

The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED

The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Off	Malfunction of module if E-bus LED = On
		Inoperative if E-bus LED = Off
	Red, 2x	Low voltage
	Red, 3x	Watchdog internal
	Red, 4x	EtherCAT watchdog control
	Red, 7x	Configuration error (E-bus pre-operational), no. of process data differs from that in the module
Defective	Red, on	Module defective

“Power” LED

The LED labeled "Power" indicates the state of the I/O module's I/O power supply.

Power		
State	**LED flash code**	**Explanation**
On	Green, on	24 V DC supply ok
Off	Off	24 V DC supply not ok

Status LEDs of the I/Os

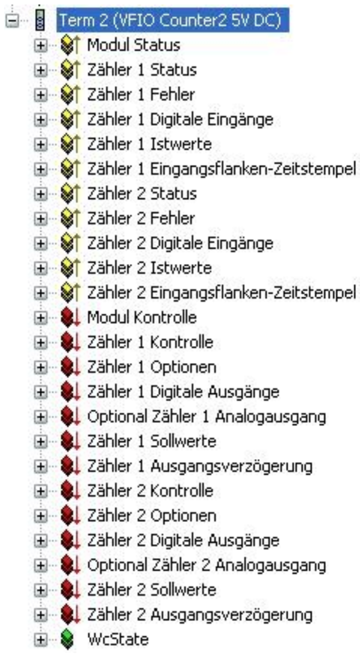
The Status LEDs of the several I/Os indicate the state of the individual digital I/Os.

Status			
Pin	**Voltage**	**LED**	**Explanation**
0..3	24 V	Green	Digital inputs
4	24 V	Green	Digital output
7, 9, 11	5 V	Green	Encoder signals A, B, Ref

9.1.3. Function

Each channel has terminals for one encoder and 4 digital inputs and 1 digital output.

The COUNTER/POSI2 module has 1 additional analogue output.



There are structured groups of variables for.

- → Controlling and watching the entire module: Modul Kontrolle/Modul Status (Module control/Module status)
- → Controlling and watching of Counter 1 resp. 2: Optionen/Kontrolle/Status/Fehler (Options/Control/ Status/Errors)
- → Counter values of Counter 1 resp. 2: Sollwerte/Istwerte (Set values/Current values)
- → State of the digital I/Os of Counter 1 resp. 2: Digitale Ausgänge/Digitale Eingänge/Eingangsflanken-Zeitstempel/Ausgangsverzögerung (Digital outputs/Digital inputs/Input change time stamp/ Output delay)
- → State of the analogue outputs of Counter 1 resp. 2: Optional Analogausgang (Analogue output, Function with module COUNTER/POSI2 only)

Principle of control (controller) and status
If a control bit is set (=TRUE), the module will operate the corresponding function due to the rising edge of the bit.
The module indicates the execution of the function by setting the corresponding status bit (=TRUE). When the control bit is reset (=FALSE) the module will also reset the status bit (=FALSE).

i NOTE

In the following the functions of the counter module are described by Counter/Posi 1. For Counter/Posi 2 the data are valid accordingly.

Frame- or DC- synchronous mode
Dependent on whether Distributed Clocks (DC) are used or not, the module adjusts itself independently on the suitable mode of operation.
The module is preset on Frame synchronous mode. With the receipt of the first DC telegram the module is changed over to DC-synchronous mode and maintains this mode of operation up to next switching off.
Frame-synchronous
The EtherCAT master sends EtherCAT frames with the output data for the module. With the arrival of such frame the output data are taken over and processed by the module. The module places its input data into the EtherCAT frame, so that the master can receive it.

DC-synchronous
If the module is adjusted to DC-synchronous mode, it produces interrupts according to the rules of the Distributed Clocks DC.

The EtherCAT master sends also here EtherCAT Frames away with the output data for the module. With the arrival of such frames the output data of the module are taken over however then processed only if a DC interrupt has occurred. With the DC interrupt the module places its input data into a buffer, from which they are transported with the next EtherCAT Frame to the master.
With this method time-synchronous functions for digital inputs and digital outputs for several modules in one EtherCAT network are possible.

9.1.4. Controlling and watching the entire module

The module control is carried out with the variables from the group “Modul Kontrolle”. The status of the settings having been carried out becomes shown in the variables of the group “Modul Status”.

Modulkontrolle (Module Control)
The module does not have any options at present.

The module reports faults with different “Modul Status” bits. These bits are stored. They can be reset only then if the fault is not there any more. Send a rising edge to “ResetError” to reset the “Modul Status” bits.

Error bits		
Variable	**Data type**	**Explanation**
ResetError	BOOL	Rising edge acknowledges error

Modulstatus (Module Status)
The following module status bits are indicated:

Module status		
Variable	**Data type**	**Explanation**
LowSupplyVoltage	BOOL	Low voltage
Watchdog	BOOL	Module internal Watchdog
EtherCAT_Error	BOOL	Configuration error or watchdog control

Acknowledgement see Module control

9.1.5. Controlling / Watching Counter 1

The setting of the functions of the counter is carried out with the variables from the group "Zähler 1 Optionen".
The module control is carried out with the variables from the group "Zähler 1 Kontrolle".
The status of the settings is indicated in the variables of the group "Zähler 1 Status".

i NOTE

The use of the counter module in a variety of different applications is possible by use of the variables from the groups of Zähler 1-Optionen, -Kontrolle and
–Status.

Zähler 1 Optionen (Counter 1 Options)
The module offers you different options for the operation of Counter 1. The options are set in the module with the help of the control bit "SetOptions_1" (see also

Zähler 1 **Kontrolle**) and then valid up to the next
setting procedure.

→ At first select the options, please. For taking over send a rising edge to the control bit "SetOptions_1".
→ The module indicates the execution by "OptionsSet_1=TRUE".
→ When "SetOptions_1" becomes FALSE again, the module responses by "OptionsSet_1=FALSE". So the module is ready for the next setting process.

Counter 1 Options				
Variable	**Data type**	**Value**	**Explanation**	
Enable_Compare_1	BOOL	0	Deactivate compare function	
		1	Activate compare function	
SelectEncoder_1	BOOL	0	A, B, Ref with detection of direction	
		1	Event counter at A	B=0 down
				B=1 up
SetResolution_1	BOOL		Only if SelectEncoder=1 (Event counter)	
		0	Rising and falling edges	
		1	Only rising edges	
ControlOutput_1	BOOL	0	Output_0_0 is a regular digital output	
		1	Output_0_0 is controlled by the compare function.	

Zähler 1 Kontrolle (Counter 1 Control)
Enabling and disabling of counting and referencing are determined by the state of the control variables.
Set and Reset functions are activated by setting of the appropriate variable. The execution is indicated in the corresponding status variable. If the control variable is reset, the counter module also resets the correspon-ding status variable.

Counter 1 Control			
Variable	**Data type**	**Value**	**Explanation**
SetOptions_1	BOOL	0/1	Take over “Zähler 1 Optionen”
ResetReferenced_1	BOOL	0/1	Reset of status bit “Referenced_1”
ResetCompared_1	BOOL	0/1	Reset of status bit “Compared_1”
ResetCaptured_1	BOOL	0/1	Reset of status bit “Captured_1”
EnableCounter_1	BOOL	0	Disable counter
		1	Enable counter
EnableReferencing_1	BOOL	0	Disable Referencing
		1	Enable Referencing
SetCounter_1	BOOL	0/1	Set counter to preset value
SetCompare_1	BOOL	0/1	Set compare value register
SetPreset_1	BOOL	0/1	Set preset value register
SetMax_1	BOOL	0/1	Set maximum value register

Zähler 1 Status (Counter 1 State)
The status variables indicate the status of the counter. This concerns the appearance of events and the indication of the execution of settings.

Counter 1 Status		
Variable	**Data type**	**Explanation**
Counting_1	BOOL	Counter is enabled
Referenced_1	BOOL	Reference function was executed, reset by ResetReferenced_1
Clockwise_1	BOOL	Counter counts up
Compared_1	BOOL	Compare function was executed, reset by ResetCompared_1
Captured_1	BOOL	Capture function was executed, reset by ResetCaptured_1
CounterSet_1	BOOL	Counter is set to preset value
CompareSet_1	BOOL	Compare value is set
PresetSet_1	BOOL	Preset value is set
MaxSet_1	BOOL	Maximum value is set
OptionsSet_1	BOOL	Options of counter 1 are set.

Zähler 1 Fehler (Counter 1 Errors)
The variables are provided for the indication of error states.

Counter 1 Errors		
Variable	**Data type**	**Explanation**
Err_Reserved_1_x	BOOL	Reserved error bits

9.1.6. Counter values of Zähler 1 (Counter 1)

Zähler 1 Sollwerte (Counter 1 Set Values)
The counter can be preset with different set values. That is done by help of the variable “SetValue_1”. After setting the following control bits from the group “Zähler 1 Kontrolle” the content of “SetValue_1” will be copied as set value in the corresponding registers.

Counter 1 Set Values	
Variable	**Explanation**
SetCounter_1	Copy “SetValue_1” to the current counter value
SetCompare_1	Copy "SetValue_1" to the compare value register
SetPreset_1	Copy "SetValue_1" to the preset value register
SetMax_1	Copy "SetValue_1" to the maximum value register

The current set values can be read in the variable “SelectedValue” from the “Zähleristwerte” (Counter current values) group.
Select by the variable “Select_1”, which value you want to see in the variable “SelectedValue”.

SelectedValue			
Variable	**Data type**	**Explanation**	
Select_1	USINT	Selection which value of counter1 shall be displayed in the variable “SelectedValue”.	
		0	none
		1	Vergleichswert (Compare value)
		2	Vorwahlwert (Preset value)
		3	Endwert (Max value)
		4	Fangwert (Capture value)
		5	Counter pulses/second
		6	Revolutions per minute
		128	Version info
SetValue_1	DINT	Set value of counter 1 (source) to copy (operated by a control bit) into a set value register (target).	

Zähler 1 Istwerte (Counter 1 Actual Values)
These variables display the current counter value and the current set values. The set values are represented multiplexedly in the variable “SelectedValue” (Selection by Select_1).

Counter 1 Actual Values			
Variable	**Data type**	**Explanation**	
Counter_1	DINT	Current value of counter 1	
Selected_1	USINT	Selection of that value of counter 1, which is displayed in the variable SelectedValue (value of Select_1 read from the module).	
		0	none
		1	Vergleichswert (Compare value)
		2	Vorwahlwert (Preset value)
		3	Endwert (Max value)
		4	Fangwert (Capture value)
		5	Counter pulses/second
		6	Revolutions per minute
		128	Version info
SelectedValue	DINT	Selected current value of counter 1	

Version Info				
Byte	**3**	**2**	**1**	**0**
Explanation	Version #	Release	Level	Type code
Example	0x02	0x00	0x00	0x53
	2	0	0	S

9.1.7. Digital I/Os

Zähler 1 (Counter 1) Digital inputs
The variables indicate the status of the digital inputs.

Digital inputs		
Variable	**Data type**	**Explanation**
Input_0_0	BOOL	Digital input 0
Input_0_1	BOOL	Digital input 1
Input_0_2	BOOL	Digital input 2
Input_0_3	BOOL	Digital input 3
In_Output_0_0	BOOL	Status of digital output 0 (reads the status)

Zähler 1 (Counter 1) Input edge timestamp

The variables indicate the time, on which the status of the digital input has changed.
When the time measurement is started depends on the mode of operation (see also section 9.1.3 Frame-synchronous, DC-synchronous).

Input edge timestamp		
Variable	**Data type**	**Explanation**
Input_0_0_TS	UINT	Time stamp for digital input 0 (Hardware Capture)
Input_0_1_TS	UINT	Time stamp for digital input 1 (Software Polling)
Input_0_2_TS	UINT	Time stamp for digital input 2 (Software Polling)
Input_0_3_TS	UINT	Time stamp for digital input 3 (Software Polling)

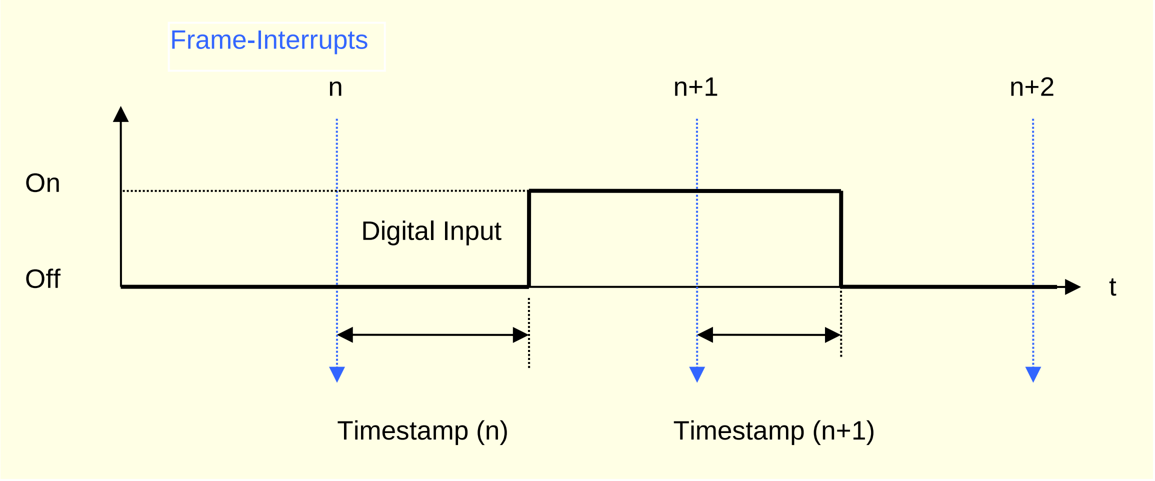
i NOTE

The time stamp is metered between frame- or DC-interrupts and signal changes on the input in µs.

The value of the time stamp becomes to 0xFFFF, when no signal change takes place between two frame- or DC-interrupts.

In frame-synchronous mode

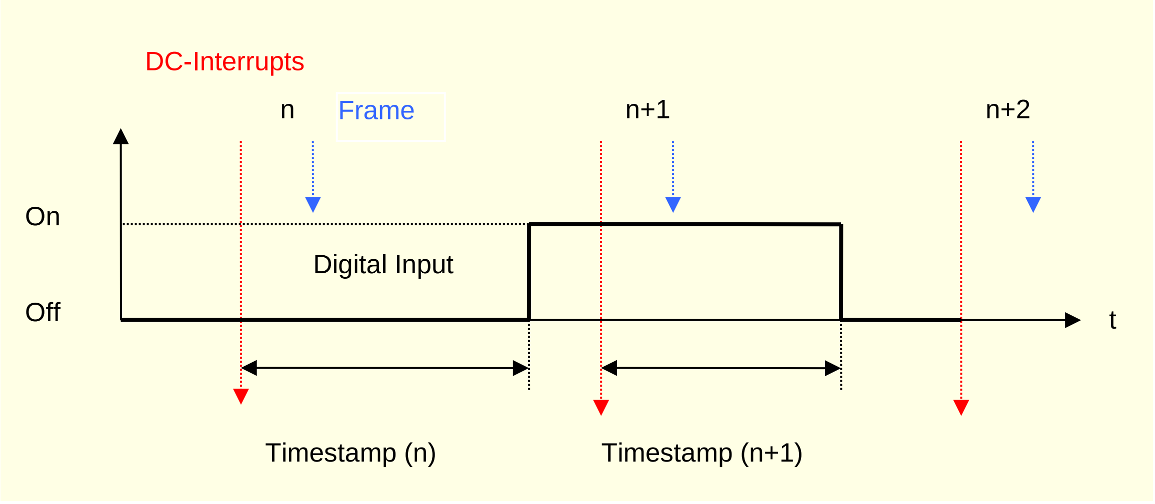
The time from the last frame-interrupt to the status change of the input is stored in the time stamp and sent in the following frame to the EtherCAT Master.



Frame-synchronous		
Frame	**Digital Input**	
	Variable	**Time stamp**
n+1	TRUE	Time stamp (n)
n+2	FALSE	Time stamp (n+1)

In DC-synchronous mode

The time from the last DC-interrupt to the status change of the input is stored in the time stamp and sent in the following frame to the EtherCAT Master.



DC-synchronous		
Frame	**Digital Input**	
	Variable	**Time stamp**
n+1	TRUE	Time stamp (n)
n+2	FALSE	Time stamp (n+1)

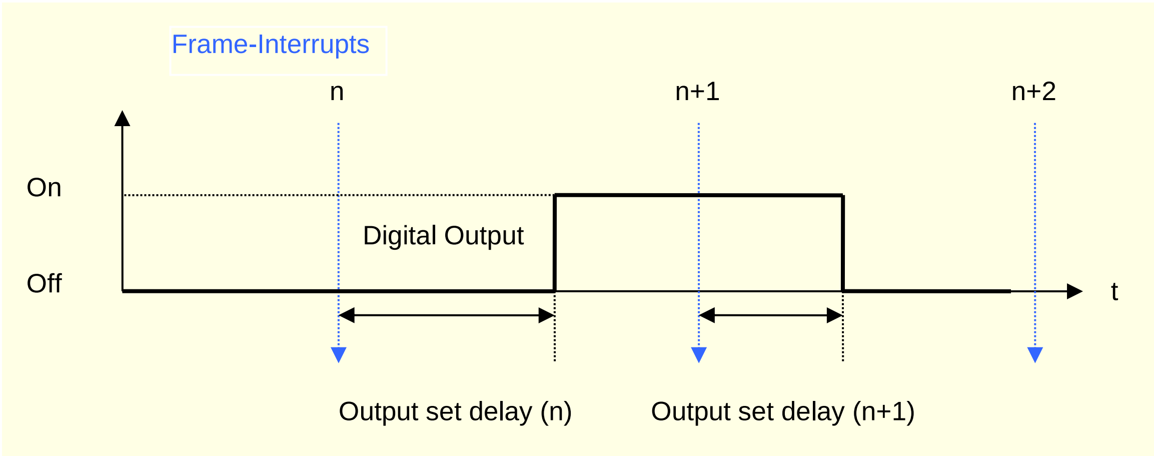
Digital outputs
The variables indicate the status of the digital outputs.

Digital outputs		
Variable	**Data type**	**Explanation**
Output_0_0	BOOL	Digital output 0

Output set delay (in preparation)
This variable defines the time, when the output is set.

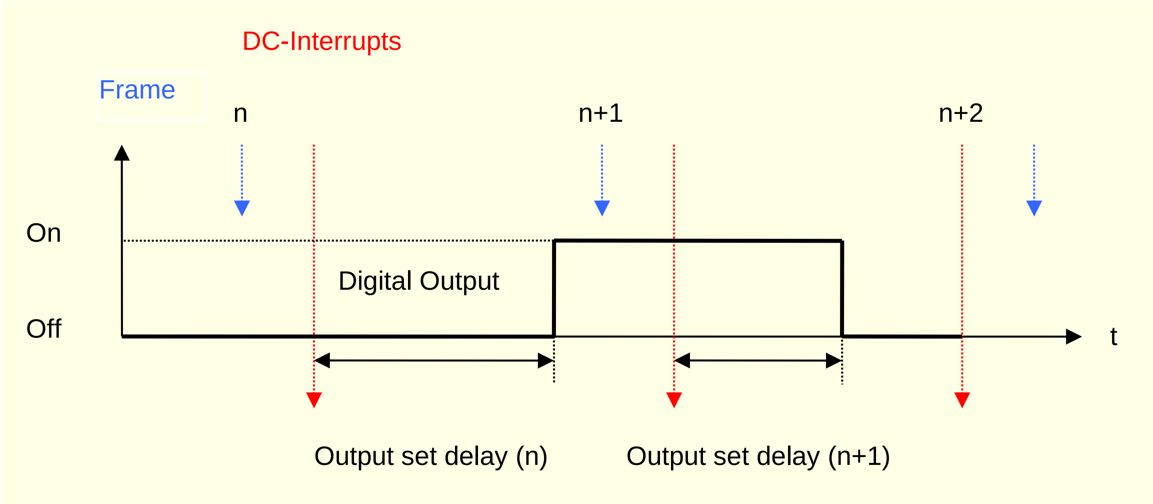
Output set delay		
Variable	**Data type**	**Explanation**
Output_0_0_Del	UINT	Output set delay in µs

In frame-synchronous mode



Frame-synchronous		
Frame	**Digital Output**	
	Variable	**Output set delay**
n	TRUE	Output set delay (n)
n+1	FALSE	Output set delay (n+1)

DC-synchronous mode



DC-synchronous		
Frame	**Digital Output**	
	Variable	**Output set delay**
n	TRUE	Output set delay (n)
n+1	FALSE	Output set delay (n+1)

9.1.8. Analogue outputs (COUNTER/POSI2 5V only)

The variables define the voltage of the analogue outputs.

Analogue outputs		
Variable	**Data type**	**Explanation**
AnalogOutput_1	UINT	Analogue output 1

Output values see table voltage, page 95

9.1.9. Examples

Enable Counter

The counter is active, when the variable “EnableCounter_1” is TRUE.

```
Term2_EnableCounter_1:=TRUE;      (*Release of the counter *)
Term2_Counting_1;                 (*TRUE, if counter is enabled *)
Term2_Clockwise_1;                (*Count direction, TRUE, when up *)
```

Counter set/clear

Copying the contents of “SetValue_1” into the current value is executed by a rising edge to “SetCounter_1”. Execution is indicated by “CounterSet_1=TRUE”.
If “SetCounter_1” is reset (FALSE) again, “CounterSet_1” also becomes FALSE again.

```
Term2_SetValue_1:=diCounterValue ;(*Copy a number into the source var*)
                                          (* 0 = Clear*)
                                          Term2_SetCounter_1:=TRUE;          (*and
                                          copy to the counter current
                                            value*)
Term2_CounterSet_1;                   (*TRUE, if set*)
```

Set compare value

Configuration settings set in “Zähler 1 Optionen” are activated by the rising edge of the control bit “SetOptions_1”. The successful take-over of the options is confirmed with the status bit “OptionsSet_1” (e.g. Set compare function).

```
PROGRAM Initialisierung (Initialization)
VAR
    bInit: BOOL := TRUE;
    Step: USINT;
END_VAR
--------------------------------------------------------------------------------
IF bInit THEN
CASE Step OF
(*Select options, activate them by a rising edge to "Set_Options"*)
    0:  Term2_EnableCounter_1:=TRUE;     (*Release counter *)
    Term2_EnableCompare_1:=TRUE;         (*Activate compare function *)
        Term2_ControlOutput_1:=TRUE;     (*Compare function controls output *)
        Term2_SetValue_1:=10000;     (*Set value = 10000..*)
        Term2_SetCompare_1:=TRUE;(*..use as compare value *)
        Term2_SetOptions_1:=TRUE;   (*Activate selected options *)
        Step:= 1;
(* Wait for confirmations "OptionsSet" and "CompareSet"*)
    1:  IF Term2_OptionsSet_1 AND Term2_CompareSet_1 THEN
            Step:= 2;
        END_IF
(* Set "Set_Options" and "SetCompare" in the starting position*)
```

```
2:    Term2_SetOptions_1:=FALSE;
      Term2_SetCompare_1:=FALSE;
      Step:=0;
      bInit:=FALSE;
END_CASE
END_IF
```

Set preset value
Copying the value of “SetValue_1” into the preset value is executed by a rising edge to “SetPreset_1”. The execution is indicated by “PresetSet_1=TRUE”.
If “SetPreset_1” is reset (FALSE) again, “PresetSet_1” also becomes FALSE again.

```
Term2_SetValue_1:=diPresetValue ;   (*Copy a number into the source var*)
Term2_SetPreset_1:=TRUE;            (*and copy to the preset value*)
Term2_PresetSet_1;                  (*TRUE, if set*)
```

Set maximum value
Copying the value of “SetValue_1” into the maximum value is executed by a rising edge to “SetMax_1”. The execution is indicated by “MaxSet_1=TRUE”.
If “SetMax_1” is reset (FALSE) again, “MaxSet_1” also becomes FALSE again.

```
Term2_SetValue_1:=diMaxValue ;      (*Copy a number into the source var*)
Term2_SetMax_1:=TRUE;               (*and copy to the maximum value*)
Term2_MaxSet_1;                     (*TRUE, if set*)
```

Digital output

see also page 181 Zähler 1 Optionen

The digital output can be controlled optionally by the variable "Output_0_0" or the compare function. Decision is done by the variable "ControlOutput_1" (Set options see also page 190).
The current status of the output is read from the module and displayed in “In_Output_0_0”.

```
Term2_ControlOutput_1:=FALSE;       (*Term2_Output_0_0 controls output*)
Term2_ControlOutput_1:=TRUE;        (*Compare function controls output*)
Term2_In_Output_0_0;                (*Status of the output*)
```

Operating as A-B-Ref-Counter or Event Counter
see also page 181 Zähler 1 Optionen
The counter can be operated as A, B, Ref -Counter with self detection of the direction or as event counter. The selection is done by the variable “SelectEncoder_1” (Set options see also page 190).

```
Term2_SelectEncoder_1:=FALSE;       (*A, B, Ref with self detection of the
                                      direction*)
Term2_SelectEncoder_1:=TRUE;        (*Event counter at A*)
                                    (*B=FALSE:down, B=TRUE:up*)
```

Single and multiple counting
This option is valid in the event counter mode only (see also page 181 Zähler 1 Optionen).

The counter can count edges (all rising and falling edges) or pulses (only the rising edges).
The selection is done by the variable “SetResolution_1” (Set options see also page 190).

```
Term2_SetResolution_1:=FALSE;     (*All edges*)
Term2_SetResolution_1:=TRUE;      (*Pulses*)
```

Referencing
The counter can be set to preset value when a pulse occurs at the Ref input. The preset value can be 0, but also any other 32-bit number.

Task
An encoder with 500 pulses provides 2000 increments per turn in 4-fold mode.
Every Ref pulse shall set the counter to the preset value 2000. It shall be counted down to 0 within 1 turn.
(The counting direction is determined by the turning direction of the encoder.)

```
PROGRAM Referenzierung (Referencing)
VAR
    bInit: BOOL := TRUE;
    StepInit: USINT;
    bInitReady: BOOL;
    Step: USINT;
END_VAR
------------------------------------------------------------------------------

(*1. Initializing: Enabling of the counter and setting of the preset value*)
IF bInit THEN
    CASE StepInit OF
(*Selecing of the options and setting them by a rising edge of "Set_Options"*)
    0:  Term2_EnableCounter_1:=TRUE;
        Term2_SetValue_1:=2000;
        Term2_SetPreset_1:=TRUE;
        Term2_SetOptions_1:=TRUE;
        StepInit:=1;
(*Wait for confirmations "OptionsSet" and "PresetSet"*)
    1:  IF Term2_OptionsSet_1 AND Term2_PresetSet_1 THEN
            StepInit:=2;
        END_IF
(*Reset "Set_Options" und "Set_Preset" into the start position*)
    2:  Term2_SetOptions_1:=FALSE;
        Term2_SetPreset_1:=FALSE;
        StepInit:=0;
        bInit:=FALSE;
        bInitReady:=TRUE;
    END_CASE
END_IF
```

```
(*2. Controlling of the referencing*)
IF  bInitReady THEN
    CASE Step OF
    (*Switch on the referencing mode*)
    0:     Term2_EnableReferencing_1:=TRUE;
           Step:=1;
    (*Wait for a referencing pulse*)
    1:     IF Term2_Referenced_1 THEN
               Step:=2;
           END_IF
    (*Reset of the referencing message*)
    2:     Term2_ResetReferenced_1:=TRUE;
           Step:=3;
    3:     IF NOT Term2_Referenced_1 THEN
    (*Exit reset of the referencing message*)
           Term2_ResetReferenced_1:=FALSE;
    (*Switch off the referencing mode*)
           Term2_EnableReferencing_1:=FALSE;
           Step:=0;    (*reference in the next turn again*)
           END_IF
    END_CASE
END_IF
```

Capture

A falling edge at the digital input 1 can be used as trigger in order to save the current counter value (capture).

You get a message in the status bit “Captured_1” that a capture event has appeared. You have to reset “Captured_1” by “ResetCaptured_1” that the next capture event can be indicated.

```
Term2_Input_0_1;          (*Status of input 1*)
Term2_Select_1:=4;        (*Copy capture register to Term2_SelectedValue_1*)
Term2_Selected_1;         (* =4, if capture value in Term2_SelectedValue_1*)
Term2_SelectedValue_1;(*Here you can read the capture value.*)
Term2_Captured_1;         (*A capture event has appeared.*)
Term2_ResetCaptured_1;    (*Reset of Term2_Captured_1*)
```

Digital inputs (Input_0_x)

The statuses of the digital inputs are indicated in the variables “Input_0_x”.

Permanent additional function: The current counter value is saved in the capture register when a falling edge appears at Input_0_1.

```
Term2_Input_0_0;          (*Status of input 0*)
Term2_Input_0_1;          (*Status of input 1*)
Term2_Input_0_2;          (*Status of input 2*)
Term2_Input_0_3;          (*Status of input 3*)
```

Analogue outputs (COUNTER/POSI2 5V only)
The output values of the analogue outputs are written into the variables “AnalogOutput _x”.

```
Term2_ AnalogOutput_1:= 16#7FFF;  (*Set AnalogOutput_1 to +10V*)
Term2_ AnalogOutput_2:= 16#8000;  (*Set AnalogOutput_2 to -10V*)
```

Output values see table “AI4/8-U, Analogue values voltage”.

9.1.10. Technical data

COUNTER/POSI2 5V	
Label	MC-I/O COUNTER/POSI2 5V
Part no.	S-01030206-0100
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
Encoder	2 A, B, Ref
Encoder type	RS422, 5 V, 24 VDC
Count rate	RS422: 200 kHz 24 V: 200 kHz
Digital inputs	8
Input delay	1 ms
Signal level	**Off:** -3 … 5 V, **On:** 15 V … 30 V (EN 61131-3, Type1)
Digital outputs	2
Max. current	2 A per output
Fieldbus	EtherCAT 100 Mbit/s
EtherCAT file	Berghof EIO Modules.xml
WxHxD	25x120x90 mm
Mounting	35 mm DIN top hat rail
Controller	ASIC ET1200
E-bus port	10-pole system plug at the side wall
Term. module	not required
E-bus load	300 mA
Analogue outputs	2
Voltage	-10 V ...+10 V
Resolution	12 bit

COUNTER/POSI2 5V	
Power supply	
Logic	by EtherCAT coupler via E-bus plug
Power	24 V DC -20% +25%
Galvanic separation	Separated from one another and versus the bus
Storage temperature	-25 °C…+70 °C
Operating temperature	0°C…+55°C
Relative humidity	5%...95% without dewing
Protection	IP20
Interference immunity	Zone B
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

i NOTE

Encoder:

Unused encoder signals must be connected to +5 V.

The unused encoder signals must always be connected to +5 V now, independent of frequency.

10. Interface and communication modules

10.1. Communication module CAN

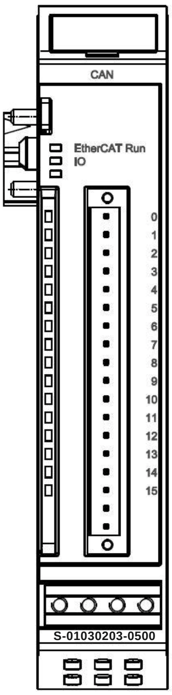


Figure 79: Front view of CAN I/O module

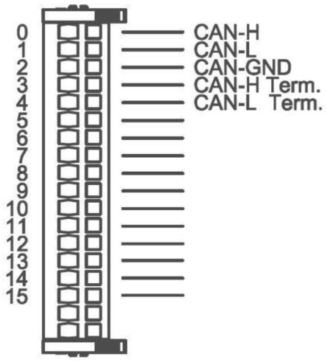


Figure 80: I/O connection

10.1.1. Terminals

CAN		
Pin	**Signal**	**Explanation**
0	CAN-H	CAN-High Signal
1	CAN-L	CAN-Low Signal
2	CAN-GND	Earth potential
3	CAN-H Terminal	Bus termination CAN-H
4	CAN-L Terminal	Bus termination CAN-L
5..15	-	Not used

10.1.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, off	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“I/O” LED
The LED labeled “I/O” indicates the state of the module's I/Os.

I/O		
State	**LED flash code**	**Explanation**
Ok	Green, on	No error
Error	Red, 4x	EtherCAT watchdog
	Red, 5x	Transmit queue overflow
	Red, 6x	Receive queue overflow
	Red, 7x	No Tx counter

“Power” LED
There is no LED labeled “Power” because a separate power feed is not required.

LEDs Channel [COM State]
The LEDs labeled "Channel" indicate the state of every channel.

Channel	
LED colour, flash code	**Explanation**
Red, off	No communication
Green, flashing	Communication
Alternating red/green, flashing	CAN warning while communicating
Red, flashing	CAN warning
Red, on	CAN Bus Off

10.1.3. Function

The MC-I/O CAN module is a layer 2 EtherCAT CAN gateway. CODESYS provides the higher-layer protocols (CANopen Master / Slave, etc.). The module is based on the EtherCAT slave stack version 5.11.
In CODESYS 3, the module provides a CANbus port that further configurations can be connected to. A device description available for CODESYS 3 contains all the required details. Mind that you also need the device driver (CAN Mini Driver).
All required data can be requested from our technical support or downloaded from our website.

Screen if the device description has been installed properly:

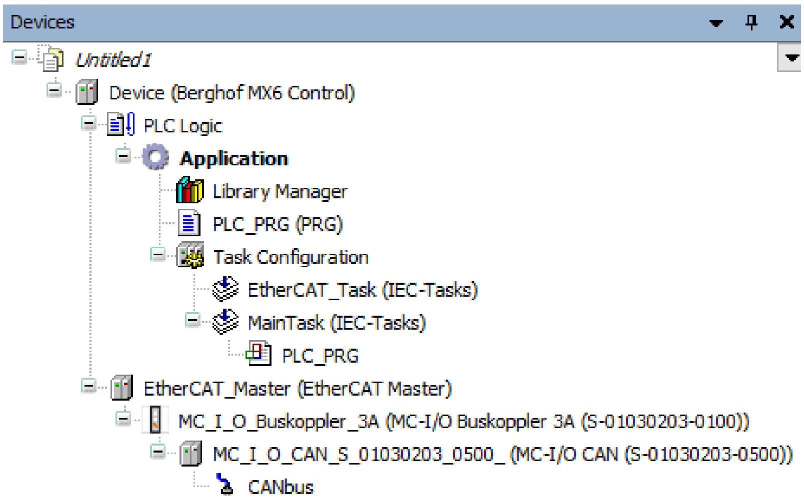


Figure 81: DeviceDescription

Process Image
There are 20 PDOs containing 8 bytes of data each for every direction. Use PDO Assignment (objects 1C12 and 1C13) to vary the volume of data. Taken together with the mailboxes (32 bytes each), this is the maximum configuration of ET1200.

Output Data (PLC -> IO, 0-160 Bytes)

Name	Size	Source
ControlData	8 bytes	PLC
TxData1[0..7]	8 bytes	PLC
…	…	…
TxData19[0..7]	8 bytes	PLC

The CAN data in this data range are superposed. The data range can hold up to 9 CAN messages. If so, Rx/TxData19 stays blank.

ControlData:

Name	Format	Source
TxCounter	Word	Incrementing the TxCounter tells the gateway that the process image contains new data to be sent.
RxCounterCon	Word	If synchronised data (RxSync) is used, this object is used to acknowledge that the data received has been processed. Only then will the gateway send the next data.
TxNrOfMsg	Word	Number of CAN messages in the process image. Range: 0..9.
ResetError	Bit (1)	Bit 0 ->1: Resets errors that have been removed.
unused 0..14	Bit (15)	

TxData1,2 / 3,4 / 5,6 / 7,8 / 9,10 / 11,12 / 13,14 / 15,16 / 17,18:

Byte	Name	Bedeutung
0	CanIdLowWordLowByte	CAN Identifier. ExtendedId = 0 -> 11 bit. ExtendedId = 1 -> 29 bit.
1	CanIdLowWordHighByte	
2	CanIdHighWordLowByte	
3	CanIdHighWordHighByte	
4	CanDataLength	Number of data bytes. Range: 0..8
5	RemoteFrame	RemoteFrame = 1 -> no data, just request to send the identifier
6	ExtendendId	ExtendedId = 0 -> 11 bit, ExtendedId = 1 -> 29 bit.
7	Reserved	-
8	Data[0]	Payload data. Only “CanDataLength” bytes are sent.
9	Data[1]	
10	Data[2]	
11	Data[3]	
12	Data[4]	
13	Data[5]	
14	Data[6]	
15	Data[7]	

Input Data (IO -> PLC, 0..160 bytes)

Name	Size	Source
StateData	8 bytes	IO
RxData1[0..7]	8 bytes	IO
…	…	…
RxData19[0..7]	8 bytes	IO

StateData:

Name	Format	Source
TxCounterCon	Word	The gateway shows the TxCounter again to confirm the new out-queue data.
RxCounter	Word	Incrementing the RxCounter indicates that the process image contains new in-queue data.
RxNrOfMsg	Word	Number of CAN messages in the process image. Range: 0..9.
ResetErrorAck	Bit (1)	Acknowledges the state of the Reset Error signal.
EtherCATError	Bit (1)	If 1: Sync Manager watchdog triggered (watchdog control)
CanTxQueueOvr	Bit (1)	Overflow of the gateway's out-buffer. Too much CAN data is being sent or CAN bus the baud rate is too low.
CanRxQueueOvr	Bit (1)	In-buffer overflow. CAN data is being accepted too slowly. Either speed up the EtherCAT task or reduce the bus load.
TxCounterMiss	Bit (1)	The gateway checks the TxCounter for steady increments. This error indicates a skipped increment. Best use TxCounterCon to send new data.
CanWarning	Bit (1)	Indicates the CAN controller states "CAN Warning" and "Error Passive". These states are retained unless several frames are sent and received without errors. Reset Error is NOT required to acknowledge the bit.
CanBusOff	Bit (1)	Massive problems have changed the CAN controller's state to "bus off". The controller will quit this error state automatically.
unused 0..5	Bit (6)	
CanTxBusy	Bit (1)	1: Data is being sent.
unused 6..7	Bit (2)	

RxData1,2 / 3,4 / 5,6 / 7,8 / 9,10 / 11,12 / 13,14 / 15,16 / 17,18:

Byte	Name	Explanation
0	CanIdLowWordLowByte	CAN Identifier. ExtendedId = 0 -> 11 bit. ExtendedId = 1 -> 29 bit.
1	CanIdLowWordHighByte	
2	CanIdHighWordLowByte	
3	CanIdHighWordHighByte	
4	CanDataLength	Number of data bytes. Range: 0..8
5	RemoteFrame	RemoteFrame = 1 -> no data, just request to send the identifier
6	ExtendendId	ExtendedId = 0 -> 11 bit, ExtendedId = 1 -> 29 bit.
7	Reserved	-
8	Data[0]	Payload data. Only the number of bytes in “CanDataLength” is accepted.
9	Data[1]	
10	Data[2]	
11	Data[3]	
12	Data[4]	
13	Data[5]	
14	Data[6]	
15	Data[7]	

Configuration

To set the baud rate, go down the device tree and find the CAN node immediately underneath the B-Nimis MC-I/O CAN module.

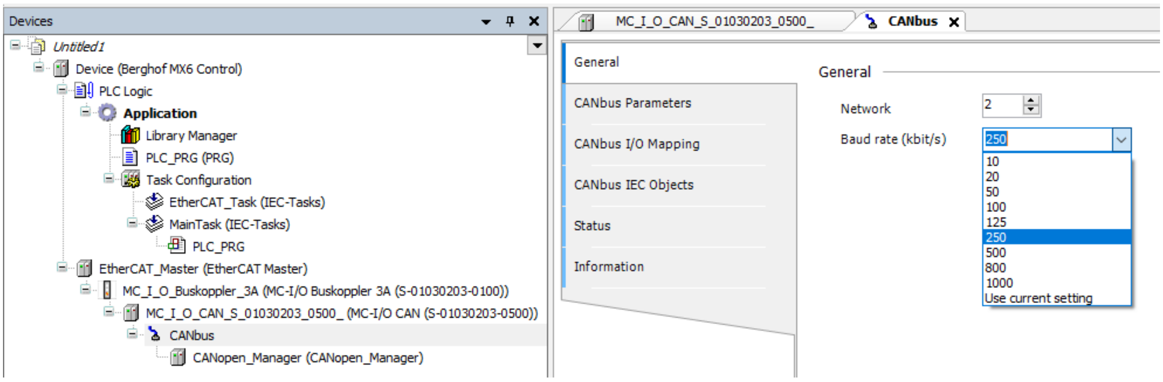


Figure 82: Baud rate setting

i NOTE

Information:

The B-Nimis MC-I/O CAN module does NOT support all CODESYS baud rates (refer to the object dictionary).

The following baud rates are supported:

→ 100, 125, 250, 500 and 1000 kBit/s

Go to the startup parameters of the CAN module to enable or disable data synchronisation.
Select the module and go to "Startup parameters" and "+ Add".

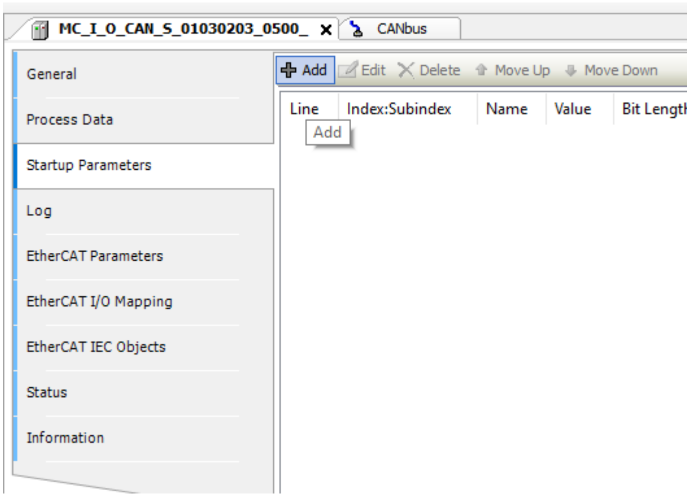


Figure 83: Startup Parameters: add

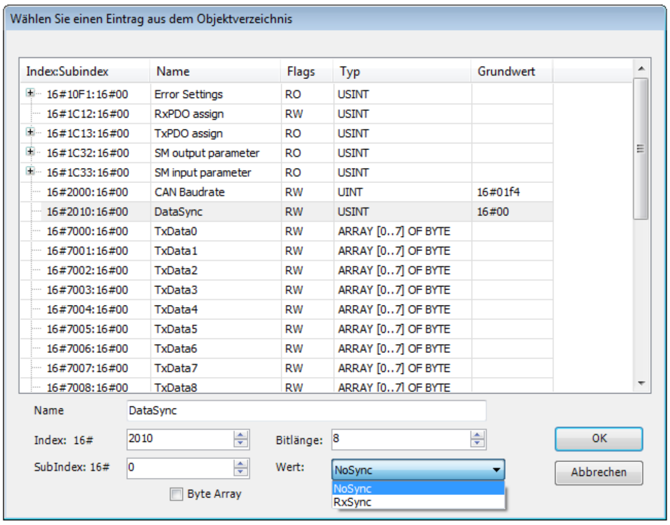


Figure 84: Enable or disable data synchronisation

Your settings are then displayed on tab "Startup Parameters”.

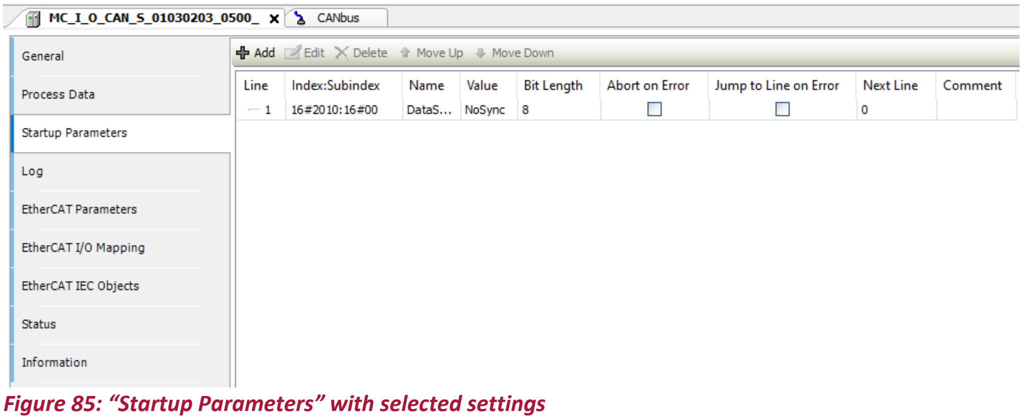


Figure 85: "Startup Parameters" with selected settings

Response to Errors

→ EtherCAT error.
Sync Manager watchdog.
LED "Error" flashes 4x.
Unit changes from Op to Safe-Op.
Use "Reset Error" to acknowledge the error.

→ Out-queue overflow (CanTxQueueOvr).
Failure to send the data fast enough across the CAN bus.
LED "Error" flashes 5x.
Use "Reset Error" to acknowledge the error.

→ In-queue overflow (CanRxQueueOvr).
Too much data is being received via the CAN bus. and cannot be transferred to the control unit fast enough.
LED "Error" flashes 6x.
Use "Reset Error" to acknowledge the error.

→ TxCount error (TxCounterMiss).
The TxCounter received is not "last TxCounter + 1".
The gateway probably missed an EtherCAT frame. The EtherCAT master is sending the data too quickly (< 1ms for 9 messages).
LED "Error" flashes 7x.
Use "Reset Error" to acknowledge the error.

→ CAN warning.
Indicates the CAN controller states "CAN Warning" and "Error Passive". These states are retained unless several frames are sent and received without errors.
LED "CAN" is red and flashes rapidly (or alternates between green and red while communicating).
"Reset Error" is NOT requied to acknowledge the error.

→ CAN Bus Off.
Massive problems have changed the CAN controller's state to "bus off". The controller will quit this error state automatically.
LED "CAN" lights up red.
Use "Reset Error" to acknowledge the error.

Object dictionary

Index	Name	Type	Default	Min Max	Access
1000	Device Typ	UINT32	0x191		RO
1001	Error Register	UINT8			RO
1008	Device Name	String	FIO CAN		RO
1009	Hardware Version	String	1.00		RO
100A	Software Version	String	1.00		RO
1018	Identity Object	Array			
1018, 0	Number of Entries	UINT8	4		RO
1018, 1	Vendor Id	UINT32	0x0048554B		RO
1018, 2	Product Code	UINT32	185580		RO
1018, 3	Revision Number	UINT32	1		RO
1018, 4	Serial Number	UINT32	0		RO
10F1,0	Number of Entries	UINT8	2		RO
10F1,1	Local Error Reaction	UINT32	1		RW
10F1,2	Sync Error Counter Limit	UINT32	4		RW
1600	Receive PDO0 Mapping Parameter	Array			
1600, 0	Number of Entries	UINT8	5		RO
1600, 1	SubIndex 001	UINT32	0x71000010		RO
1600, 2	SubIndex 002	UINT32	0x71010010		RO
1600, 3	SubIndex 003	UINT32	0x71020010		RO
1600, 4	SubIndex 004	UINT32	0x71100101		RO
1600, 5	SubIndex 005	UINT32	0x0000000F		RO
1601	ReceivePDO1 Mapping Parameter	Array			
1601, 0	Number of Entries	UINT8	1		RO
1601, 1	SubIndex 001	UINT32	0x70010040		RO
1602	ReceivePDO2 Mapping Parameter	Array			
1602, 0	Number of Entries	UINT8	1		RO
1602, 1	SubIndex 001	UINT32	0x70020040		RO
1603	ReceivePDO3 Mapping Parameter	Array			
1603, 0	Number of Entries	UINT8	1		RO
1603, 1	SubIndex 001	UINT32	0x70030040		RO
1604	ReceivePDO4 Mapping Parameter	Array			
1604, 0	Number of Entries	UINT8	1		RO
1604, 1	SubIndex 001	UINT32	0x70040040		RO
1605	ReceivePDO5 Mapping Parameter	Array			
1605, 0	Number of Entries	UINT8	1		RO
1605, 1	SubIndex 001	UINT32	0x70050040		RO
1606	ReceivePDO6 Mapping Parameter	Array			

Index	Name	Type	Default	Min Max	Access
1606, 0	Number of Entries	UINT8	1		RO
1606, 1	SubIndex 001	UINT32	0x70060040		RO
1607	ReceivePDO7 Mapping Parameter	Array			
1607, 0	Number of Entries	UINT8	1		RO
1607, 1	SubIndex 001	UINT32	0x70070040		RO
1608	ReceivePDO8 Mapping Parameter	Array			
1608, 0	Number of Entries	UINT8	1		RO
1608, 1	SubIndex 001	UINT32	0x70080040		RO
1609	ReceivePDO9 Mapping Parameter	Array			
1609, 0	Number of Entries	UINT8	1		RO
1609, 1	SubIndex 001	UINT32	0x70090040		RO
160A	ReceivePDO10 Mapping Parameter	Array			
160A, 0	Number of Entries	UINT8	1		RO
160A, 1	SubIndex 001	UINT32	0x700A0040		RO
160B	ReceivePDO11 Mapping Parameter	Array			
160B, 0	Number of Entries	UINT8	1		RO
160B, 1	SubIndex 001	UINT32	0x700B0040		RO
160C	ReceivePDO12 Mapping Parameter	Array			
160C, 0	Number of Entries	UINT8	1		RO
160C, 1	SubIndex 001	UINT32	0x700C0040		RO
160D	ReceivePDO13 Mapping Parameter	Array			
160D, 0	Number of Entries	UINT8	1		RO
160D, 1	SubIndex 001	UINT32	0x700D0040		RO
160E	ReceivePDO14 Mapping Parameter	Array			
160E, 0	Number of Entries	UINT8	1		RO
160E, 1	SubIndex 001	UINT32	0x700E0040		RO
160F	ReceivePDO15 Mapping Parameter	Array			
160F, 0	Number of Entries	UINT8	1		RO
160F, 1	SubIndex 001	UINT32	0x700F0040		RO
1610	ReceivePDO16 Mapping Parameter	Array			
1610, 0	Number of Entries	UINT8	1		RO
1610, 1	SubIndex 001	UINT32	0x70100040		RO
1611	ReceivePDO17 Mapping Parameter	Array			
1611, 0	Number of Entries	UINT8	1		RO
1611, 1	SubIndex 001	UINT32	0x70110040		RO

Index	Name	Type	Default	Min Max	Access
1612	ReceivePDO18 Mapping Parameter	Array			
1612, 0	Number of Entries	UINT8	1		RO
1612, 1	SubIndex 001	UINT32	0x70120040		RO
1613	ReceivePDO19 Mapping Parameter	Array			
1613, 0	Number of Entries	UINT8	1		RO
1613, 1	SubIndex 001	UINT32	0x70130040		RO
1A00	Transmit PDO0 Mapping Parameter	Array			
1A00, 0	Number of Entries	UINT8	13		RO
1A00, 1	SubIndex 001	UINT32	0x66000010		RO
1A00, 2	SubIndex 002	UINT32	0x66010010		RO
1A00, 3	SubIndex 003	UINT32	0x66020010		RO
1A00, 4	SubIndex 004	UINT32	0x65010101		RO
1A00, 5	SubIndex 005	UINT32	0x65010201		RO
1A00, 6	SubIndex 006	UINT32	0x65010301		RO
1A00, 7	SubIndex 007	UINT32	0x65010401		RO
1A00, 8	SubIndex 008	UINT32	0x65010501		RO
1A00, 9	SubIndex 009	UINT32	0x65010601		RO
1A00, 10	SubIndex 010	UINT32	0x65010701		RO
1A00, 11	SubIndex 011	UINT32	0x00000006		RO
1A00, 12	SubIndex 012	UINT32	0x65010E01		RO
1A00, 13	SubIndex 013	UINT32	0x00000002		RO
1A01	Transmit PDO1 Mapping Parameter	Array			
1A01, 0	Number of Entries	UINT8	1		RO
1A01, 1	SubIndex 001	UINT32	0x75010040		RO
1A02	Transmit PDO2 Mapping Parameter	Array			
1A02, 0	Number of Entries	UINT8	1		RO
1A02, 1	SubIndex 001	UINT32	0x75020040		RO
1A03	Transmit PDO3 Mapping Parameter	Array			
1A03, 0	Number of Entries	UINT8	1		RO
1A03, 1	SubIndex 001	UINT32	0x75030040		RO
1A04	Transmit PDO4 Mapping Parameter	Array			
1A04, 0	Number of Entries	UINT8	1		RO
1A04, 1	SubIndex 001	UINT32	0x75040040		RO
1A05	Transmit PDO5 Mapping Parameter	Array			
1A05, 0	Number of Entries	UINT8	1		RO
1A05, 1	SubIndex 001	UINT32	0x75050040		RO
1A06	Transmit PDO6 Mapping Parameter	Array			
1A06, 0	Number of Entries	UINT8	1		RO

Index	Name	Type	Default	Min Max	Access
1A06, 1	SubIndex 001	UINT32	0x75060040		RO
1A07	Transmit PDO7 Mapping Parameter	Array			
1A07, 0	Number of Entries	UINT8	1		RO
1A07, 1	SubIndex 001	UINT32	0x75070040		RO
1A08	Transmit PDO8 Mapping Parameter	Array			
1A08, 0	Number of Entries	UINT8	1		RO
1A08, 1	SubIndex 001	UINT32	0x75080040		RO
1A09	Transmit PDO9 Mapping Parameter	Array			
1A09, 0	Number of Entries	UINT8	1		RO
1A09, 1	SubIndex 001	UINT32	0x75090040		RO
1A0A	Transmit PDO10 Mapping Parameter	Array			
1A0A, 0	Number of Entries	UINT8	1		RO
1A0A, 1	SubIndex 001	UINT32	0x750A0040		RO
1A0B	Transmit PDO11 Mapping Parameter	Array			
1A0B, 0	Number of Entries	UINT8	1		RO
1A0B, 1	SubIndex 001	UINT32	0x750B0040		RO
1A0C	Transmit PDO12 Mapping Parameter	Array			
1A0C, 0	Number of Entries	UINT8	1		RO
1A0C, 1	SubIndex 001	UINT32	0x750C0040		RO
1A0D	Transmit PDO13 Mapping Parameter	Array			
1A0D, 0	Number of Entries	UINT8	1		RO
1A0D, 1	SubIndex 001	UINT32	0x750D0040		RO
1A0E	Transmit PDO14 Mapping Parameter	Array			
1A0E, 0	Number of Entries	UINT8	1		RO
1A0E, 1	SubIndex 001	UINT32	0x750E0040		RO
1A0F	Transmit PDO15 Mapping Parameter	Array			
1A0F, 0	Number of Entries	UINT8	1		RO
1A0F, 1	SubIndex 001	UINT32	0x750F0040		RO
1A10	Transmit PDO16 Mapping Parameter	Array			
1A10, 0	Number of Entries	UINT8	1		RO
1A10, 1	SubIndex 001	UINT32	0x75100040		RO
1A11	Transmit PDO17 Mapping Parameter	Array			
1A11, 0	Number of Entries	UINT8	1		RO
1A11, 1	SubIndex 001	UINT32	0x75110040		RO
1A12	Transmit PDO18 Mapping Parameter	Array			

Index	Name	Type	Default	Min Max	Access
1A12, 0	Number of Entries	UINT8	1		RO
1A12, 1	SubIndex 001	UINT32	0x75120040		RO
1A13	Transmit PDO19 Mapping Parameter	Array			
1A13, 0	Number of Entries	UINT8	1		RO
1A13, 1	SubIndex 001	UINT32	0x75130040		RO
1C00	Sync Manager Type	Array			
1C00, 0	Number of Entries	UINT8	4		RO
1C00, 1	SubIndex 001	UINT8	1		RO
1C00, 2	SubIndex 002	UINT8	2		RO
1C00, 3	SubIndex 003	UINT8	3		RO
1C00, 4	SubIndex 004	UINT8	4		RO
1C12	RxPDO assign	Array			
1C12, 0	Number of Entries	UINT8	20		RW
1C12, 1	SubIndex 001	UINT16	0x1600		RW
1C12, 2	SubIndex 002	UINT16	0x1601		RW
1C12, 3	SubIndex 003	UINT16	0x1602		RW
1C12, 4	SubIndex 004	UINT16	0x1603		RW
1C12, 5	SubIndex 005	UINT16	0x1604		RW
1C12, 6	SubIndex 006	UINT16	0x1605		RW
1C12, 7	SubIndex 007	UINT16	0x1606		RW
1C12, 8	SubIndex 008	UINT16	0x1607		RW
1C12, 9	SubIndex 009	UINT16	0x1608		RW
1C12, 10	SubIndex 010	UINT16	0x1609		RW
1C12, 11	SubIndex 011	UINT16	0x160A		RW
1C12, 12	SubIndex 012	UINT16	0x160B		RW
1C12, 13	SubIndex 013	UINT16	0x160C		RW
1C12, 14	SubIndex 014	UINT16	0x160D		RW
1C12, 15	SubIndex 015	UINT16	0x160E		RW
1C12, 16	SubIndex 016	UINT16	0x160F		RW
1C12, 17	SubIndex 017	UINT16	0x1610		RW
1C12, 18	SubIndex 018	UINT16	0x1611		RW
1C12, 19	SubIndex 019	UINT16	0x1612		RW
1C12, 20	SubIndex 020	UINT16	0x1613		RW
1C13	TxPDO assign	Array			
1C13, 0	Number of Entries	UINT8	20		RO
1C13, 1	SubIndex 001	UINT16	0x1A00		RO
1C13, 2	SubIndex 002	UINT16	0x1A01		RO
1C13, 3	SubIndex 003	UINT16	0x1A02		RO
1C13, 4	SubIndex 004	UINT16	0x1A03		RO
1C13, 5	SubIndex 005	UINT16	0x1A04		RO
1C13, 6	SubIndex 006	UINT16	0x1A05		RO
1C13, 7	SubIndex 007	UINT16	0x1A06		RO
1C13, 8	SubIndex 008	UINT16	0x1A07		RO
1C13, 9	SubIndex 009	UINT16	0x1A08		RO

Index	Name	Type	Default	Min Max	Access
1C13, 10	SubIndex 010	UINT16	0x1A09		RO
1C13, 11	SubIndex 011	UINT16	0x1A0A		RO
1C13, 12	SubIndex 012	UINT16	0x1A0B		RO
1C13, 13	SubIndex 013	UINT16	0x1A0C		RO
1C13, 14	SubIndex 014	UINT16	0x1A0D		RO
1C13, 15	SubIndex 015	UINT16	0x1A0E		RO
1C13, 16	SubIndex 016	UINT16	0x1A0F		RO
1C13, 17	SubIndex 017	UINT16	0x1A10		RO
1C13, 18	SubIndex 018	UINT16	0x1A11		RO
1C13, 19	SubIndex 019	UINT16	0x1A12		RO
1C13, 20	SubIndex 020	UINT16	0x1A13		RO
1C32	SM output parameter	Record			
1C32, 0	Number of Entries	UINT8	32		RO
1C32, 1	Synchronisation Type	UINT16	0x0001		RW
1C32, 2	Cycle Time	UINT32			RO
1C32, 4	Synchronisation Types supported	UINT16	0x8007		RO
1C32, 5	Minimum Cycle Time	UINT32			RO
1C32, 6	Calc and Copy Time	UINT32			RO
1C32, 8	Get Cycle Time	UINT16			RW
1C32, 9	Delay Time	UINT32			RO
1C32, 10	Sync0 Cycle Time	UINT32			RW
1C32, 11	SM-Event Missed	UINT16			RO
1C32, 12	Cycle Time too small	UINT16			RO
1C32, 32	Sync Error	BOOL			RO
1C33	SM input parameter	Record			
1C33, 0	Number of Entries	UINT8	32		RO
1C33, 1	Synchronisation Type	UINT16	0x0022		RW
1C33, 2	Cycle Time	UINT32			RO
1C33, 4	Synchronisation Types supported	UINT16	0x8007		RO
1C33, 5	Minimum Cycle Time	UINT32			RO
1C33, 6	Calc and Copy Time	UINT32			RO
1C33, 8	Get Cycle Time	UINT16			RW
1C33, 9	Delay Time	UINT32			RO
1C33, 10	Sync0 Cycle Time	UINT32			RW
1C33, 11	SM-Event Missed	UINT16			RO
1C33, 12	Cycle Time too small	UINT16			RO
1C33, 32	Sync Error	BOOL			RO
2000	CAN Baudrate	UINT32	500	100 125 250 500 1000	RW
2010	DataSync	UINT8	NoSync	NoSync (0) RxSync (1)	RW

Index	Name	Type	Default	Min Max	Access
6500	StateWord	Array			
6500, 0	Number of Entries	UINT8	16		RO
6500, 1	ResetErrorAck	BOOL			RO P
6500, 2	EtherCAT Error	BOOL			RO P
6500, 3	CanTxQueueOvr	BOOL			RO P
6500, 4	CanRxQueueOvr	BOOL			RO P
6500, 5	TxCounterMiss	BOOL			RO P
6500, 6	CanWarning	BOOL			RO P
6500, 7	CanBusOff	BOOL			RO P
6500, 8	unused0	BOOL			RO P
6500, 9	unused1	BOOL			RO P
6500, 10	unused2	BOOL			RO P
6500, 11	unused3	BOOL			RO P
6500, 12	unused4	BOOL			RO P
6500, 13	unused5	BOOL			RO P
6500, 14	CanTxBusy	BOOL			RO P
6500, 15	unused6	BOOL			RO P
6500, 16	unused7	BOOL			RO P
6600	TxCounterCon	UINT16		0..65535	RO P
6601	RxCounter	UINT16		0..65535	
6602	RxNrOfMsg	UINT16		0..9	
7000	TxData0	UINT64	0		RW P
7001	TxData1	UINT64	0		RW P
7002	TxData2	UINT64	0		RW P
7003	TxData3	UINT64	0		RW P
7004	TxData4	UINT64	0		RW P
7005	TxData5	UINT64	0		RW P
7006	TxData6	UINT64	0		RW P
7007	TxData7	UINT64	0		RW P
7008	TxData8	UINT64	0		RW P
7009	TxData9	UINT64	0		RW P
700A	TxData10	UINT64	0		RW P
700B	TxData11	UINT64	0		RW P
700C	TxData12	UINT64	0		RW P
700D	TxData13	UINT64	0		RW P
700E	TxData14	UINT64	0		RW P
700F	TxData15	UINT64	0		RW P
7010	TxData16	UINT64	0		RW P
7011	TxData17	UINT64	0		RW P
7012	TxData18	UINT64	0		RW P
7013	TxData19	UINT64	0		RW P
7100	TxCounter	UINT16		0..65535	RW P
7101	RxCounterCon	UINT16		0..65535	RW P
7102	TxNrOfMsg	UINT16		0..9	RW P
7110	ControlWord	Array			

Index	Name	Type	Default	Min Max	Access
7110, 0	Number of Entries	UINT8	16		RO
7110, 1	ResetError	BOOL			RW P
7110, 2	unused0	BOOL			RW P
7110, 3	unused1	BOOL			RW P
7110, 4	unused2	BOOL			RW P
7110, 5	unused3	BOOL			RW P
7110, 6	unused4	BOOL			RW P
7110, 7	unused5	BOOL			RW P
7110, 8	unused6	BOOL			RW P
7110, 9	unused7	BOOL			RW P
7110, 10	unused8	BOOL			RW P
7110, 11	unused9	BOOL			RW P
7110, 12	unused10	BOOL			RW P
7110, 13	unused11	BOOL			RW P
7110, 14	unused12	BOOL			RW P
7110, 15	unused13	BOOL			RW P
7110, 16	unused14	BOOL			RW P
7500	RxData0	UINT64			RO P
7501	RxData1	UINT64			RO P
7502	RxData2	UINT64			RO P
7503	RxData3	UINT64			RO P
7504	RxData4	UINT64			RO P
7505	RxData5	UINT64			RO P
7506	RxData6	UINT64			RO P
7507	RxData7	UINT64			RO P
7508	RxData8	UINT64			RO P
7509	RxData9	UINT64			RO P
750A	RxData10	UINT64			RO P
750B	RxData11	UINT64			RO P
750C	RxData12	UINT64			RO P
750D	RxData13	UINT64			RO P
750E	RxData14	UINT64			RO P
750F	RxData15	UINT64			RO P
7510	RxData16	UINT64			RO P
7511	RxData17	UINT64			RO P
7512	RxData18	UINT64			RO P
7513	RxData19	UINT64			RO P

RO=read-only, RW= read/write, P=process image

10.1.4. Technical data

CAN	
Label	MC-I/O CAN
Part no.	S-01030203-0500
Plug-in connector	18-pole, S-02020201-0800 (not part of the module)
Interface	CAN, electrically insulated
Baud rate	100,125, 250, 500 und 1000 kbit/s
Payload data	9 frames of max. 8 bytes In/Out per EtherCAT cycle
Controller	ASIC ET1200
E-bus connector	10-pole system plug in side wall
Term. module	not required
Power supply	via E-bus
E-bus load	max.330 mA
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

11. EXTENDER

11.1. EXTENDER 2 PORT

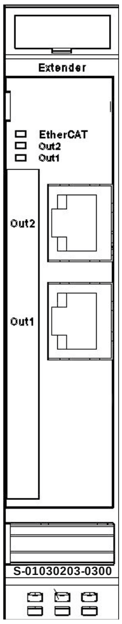


Figure 86: MC-I/O EXTENDER 2 PORT

The purpose of the B-Nimis MC-I/O EXTENDER is the extension of a B-Nimis MC-I/O block or an EC1000 by EtherCAT slaves, which have a standard 100 base TX connection.
The EXTENDER module changes the transmitting physics of LVDS (E-bus) on twisted pair. The module is usually arranged thereby at the end of the block.

In addition, the EXTENDER can be used in arbitrary place behind the bus coupler and/or the EC1000 PLC controller. Thus EtherCAT slaves can also be connected in star topology.

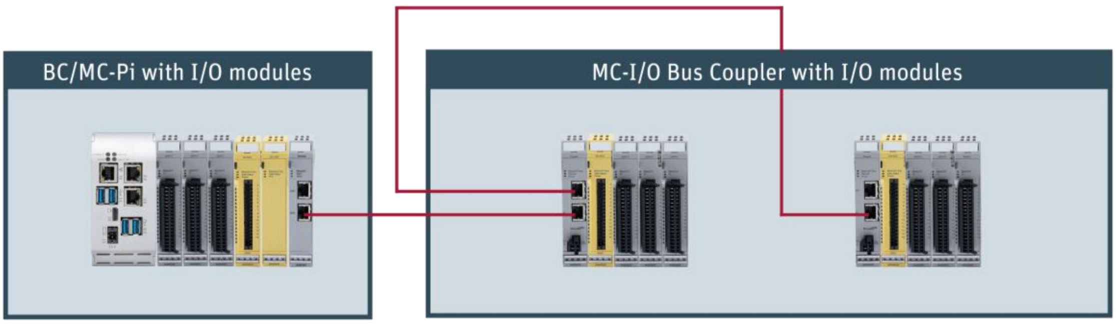


Figure 87: Overview extensions

11.1.1. Terminals

Supply of the module
via E-bus

EtherCAT (RJ45 socket)
OUT1: Output port (to the next EtherCAT device)
OUT2: Output port (to the next EtherCAT device)

11.1.2. Status LEDs

“EtherCAT” LED
The LED labeled “EtherCAT” indicates the state of the EtherCAT ASIC.

EtherCAT		
State	**LED flash code**	**Explanation**
Init	Red, on	Initializing, no data exchange
Pre-Op	Red/green, 1:1	Pre-operational, no data exchange
Safe-Op	Red/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange

“Out2” LED/“Out1” LED
The “Out2” LED and the “Out1” LED indicate the physical state of the Ethernet port they are allocated to.

Out2 / Out1		
State	**LED flash code**	**Explanation**
Not connected	Off	No Ethernet connection
Connected	Green, on	Connected to Ethernet
Traffic	Green, flashing light	Exchanging telegrams

11.1.3. Function

The EXTENDER 2 PORT module has actually 4 ports. Name 2 PORT module was chosen because of the 2 standard 100 base TX (OUT1, OUT2) RJ45 connections. Another 2 ports are covered by the E-bus.

It is important to the configuration in which sequence the connections are operated, i.e. which way the Ether-CAT frame runs.

Function		
Port	**Connection**	**Sequence**
Port A	E-Bus In	1
Port B	Out 1	3
Port C	Out 2	4
Port D	E-Bus Out	2

11.1.4. Technical data

EXTENDER 2 PORT	
Label	MC-I/O EXTENDER 2 PORT
Part no.	S-01030203-0300
Function	Extension of a B-Nimis MC-I/O block resp. of an EC1000 Transformation of transmission physics from LVDS (E-bus) to 100Base-TX
Controller	ASIC ET1100
Baud rate	100 Mbit/s
Cable	CAT5
Cable length	max. 100 m
EtherCAT Connection	2 x RJ45
Power supply	via E-bus
E-bus load	160 mA for Out1 / 210 mA for Out1 + Out2
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

12. OC Modules

12.1. Generalities

The OC modules are comprised of a group of B-Nimis MC-I/O modules expanded by process data objects that allow their integration in safety applications.

12.1.1. B-Nimis OC Technology

Apart from the normal EtherCAT process data, of B-Nimis MC-I/O OC modules can also use "safeguarded" OC data containers for communication. Various mechanisms are deployed to safeguard communication by recognising data loss, interruptions, changed sequences or data corruption. These mechanisms provide sensor values in extra OC data containers. In other words, they additionally safeguard the process data within the EtherCAT communication processes.
OC is short for One Channel, which is to say that these modules are standard, but single-channel modules not containing a two-channel safety architecture to enable their functional safety feature.
Nevertheless, B-Nimis MC-I/O OC modules still allow your safety-related application to make use of two non safety-related signals. They become part of a two-channel input architecture combined to standard components of diverse technologies. A safe control unit (B-Nimis MC-I/O OC modules) can then process both signals to generate a safety-related result.

Extended OC Process Data Objects
The PDO mapping contains a record dedicated to the process data objects you need for an OC data container. These objects are made up as follows:

Variable	Data type	Explanation
CycleCount	UDINT	Cycle count: increments with every communication cycle of the module.
Timestamp	UDINT	Time stamp: generated by the module
SenderId	UINT	Sender identification: equivalent to an EtherCAT not address with a channel number affixed to it. Example EtherCAT node address: 1003 Channel: 2 Resulting SenderId: 10032
Value	DINT	Input value as Field Value Inc
Crc32	UDINT	Checksum: calculated by the module from the above data.

12.1.2. Numeric Values

As a general rule, numeric values are shown as decimals.
A prefixed 0x marks hexadecimal values (example: 0xFFFF)
A prefixed 0b marks binary values (example: 0b01010011)
Objects from the object dictionary generally show as hexadecimal value.

12.1.3. CoE – CANopen over EtherCAT

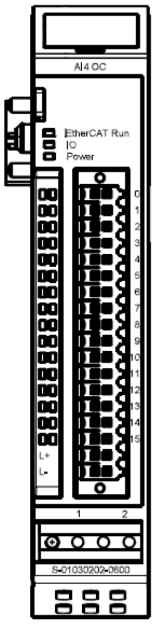
Communication protocol CANopen is based on CAN and designed to interconnect automation devices. Communication profiles for various device classes harmonise device operations and simplify their handling.
EtherCAT features the same communication mechanisms as CANopen, i.e. an object dictionary, process data objects (PDOs), service data objects (SDOs), and a similar network management methodology.
The object dictionary describes the objects available to the EtherCAT slave. It distinguishes between objects with read access (read), write access (write) and read/write access (read/write). The dictionary also classifies these objects as (mappable) process data objects, if so.
A cyclic process exchanges the process data objects (PDOs) and the input and output data they normally carry. Depending on your EtherCAT slave, you may be able to add (map) further object dictionary variables.
Service data objects (SDOs) provide options like setting the parameters of EtherCAT slaves and adding them to the startup parameters. They will then be automatically transferred to the EtherCAT slave as the EtherCAT bus starts up. Setting up the parameters is as easy as that. And if you have to replace your EtherCAT slave, you can simply use another EtherCAT slave of the same type.

12.2. MC-I/O OC AI4

12.2.1. Function

The B-Nimis MC-I/O OC AI4 module has 4 analog inputs. All channels can be configured almost independently, providing a high degree of flexibility.
Input values can be easily scaled according to their application, allowing, for example, a sensor's measurement value to be read directly in the desired unit.
Additionally, it offers an extended process image with OC data containers for each analog input channel.

12.2.2. Frontview



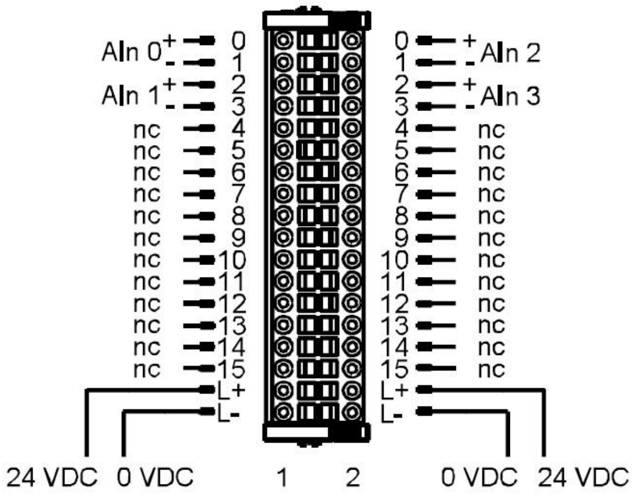


Figure 88: connection oft he I/Os

Figure 89: Frontview I/O Modul OC AI4

12.2.3. Connectors

Power Supply to Module I/Os

System connector pin 16:	L+	24 VDC
System connector pin 17:	L-	0 V

Analogue Inputs

System connector pins 0 … 3

System connector pins 0 … 3

EtherCAT

E-Bus IN	female 10-pole connector
E-Bus OUT	10-pole multi-pin connector

12.2.4. Status LEDs

LED "EtherCAT Run"

State	LED flash code	Explanation
Init	Off	Initialising, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
Bootstrap	Flickering	Optional if the bootstrap mode is supported.

LED "IO"

State	LED flash code	Explanation
Ok	Green	No error
Error	Off	LED "EtherCAT Run" off: n/a LED "EtherCAT Run" green: Module defective
	Red, 1x	Short circuit / overload
	Red, 2x	Low voltage
	Red, 4x	Bus error
	Red, 6x	Module-specific fault
	Red, 7x	Configuration error
	Red, on	Module defective

LED "Power"

State	LED flash code	Explanation
On	Green	24 VDC supply to I/Os (load) ok
Off	Off	24 VDC supply not ok

LED "Channel"

State	LED flash code	Explanation
On	Green, on	Channel enabled
Off	Off	Channel disabled
Error	Red, 1x	Short circuit
	Red, 3x	Wire failure
	Red, 5x	Excessive temp. of output drivers

12.2.5. Module Configuration

Channel Properties of Analogue Inputs (Signal)

Index, Subindex	Name	Type	Default	Admissible Values	Access
6110	AISensorType	Array			
6110, 1	AI sensor type 0	UINT8	0-10V	0-10V (42) 0-20mA (52) 4-20mA (51)	RW
6110, 2	AI sensor type 1	UINT8	0-10V		RW
6110, 3	AI sensor type 2	UINT8	0-10V		RW
6110, 4	AI sensor type 3	UINT8	0-10V		RW

Channel Properties of Analogue Inputs (Scaling)

Input values of a channel scale by adding two control points or a factor and an offset.

Scaled input values transform into a process value (PV) and output to an object mapped separately, i.e. 0x6130 AI Input PV <n>.

Index, Subindex	Name	Type	Default	Admissible Values	Access
2001	AIChannelControl	Array			
2001, 1	Channel Control AI0	UINT8	0	0 1	RW
2001, 2	Channel Control AI1	UINT8	0		RW
2001, 3	Channel Control AI2	UINT8	0		RW
2001, 4	Channel Control AI3	UINT8	0		RW

- 0 = scaled using a factor and an offset
- 1 = scaled using control points

Scaled values (Channel Control AI<n> = 0)

- 0x6126 AI Scaling Factor <n> scaling factor [process value / field value]
- 0x6127 AI Scaling Offset <n> scaling offset [process value]

Scaled values (Channel Control AI<n> = 1)

- 0x6120 AI Input Scaling 1 FV <n> control point 1, field value [V] or [mA]
- 0x6121 AI Input Scaling 1 PV <n> control point 1, process value
- 0x6122 AI Input Scaling 2 FV <n> control point 2, field value [V] or [mA]
- 0x6123 AI Input Scaling 2 PV <n> control point 2, process value

12.2.6. EtherCAT Configuration

The module supports two op modes. Depending on the configuration, you can also select various process data maps.

Mode: Synchronous Syncmanager

The cycling EtherCAT frame triggers data exchange with the bus.

Mode: Distributed Clocks

All EtherCAT network stations should use synchronised clocks, if they are to capture and output data at the same point in time. This is achieved by a local clock in every EtherCAT slave controller that the EtherCAT master automatically synchronises with the EtherCAT network's master clock.

The EtherCAT slave controllers residing in the EtherCAT network generate synchronous interrupts which simultaneously capture input data and/or process output data.

Distributed Clocks Mode with n-fold Oversampling

Oversampling mode supports the capturing of up to 5 sensor reading per bus cycle, allowing you to capture rapidly changing sensor readings.

To enable n-fold oversampling, choose one of the DC synchronous modes for your EtherCAT slave and set the factor n, as appropriate.

Process Data Mappings – Analogue Inputs

There are various predefined mappings to choose from, depending on how your analogue inputs are configured.

They represent in one of two different ways:

- Field Value Physical: [V] or [mA] input value as REAL
  Mapping 1A0x01 enabled
- Field Value Increments: Digits input value as UINT
  Mapping 1A0x02 enabled
- Process Value: scaled input value (process value) as REAL
  Mapping 1A0x03 enabled

Process Data Mappings – Analogue Inputs

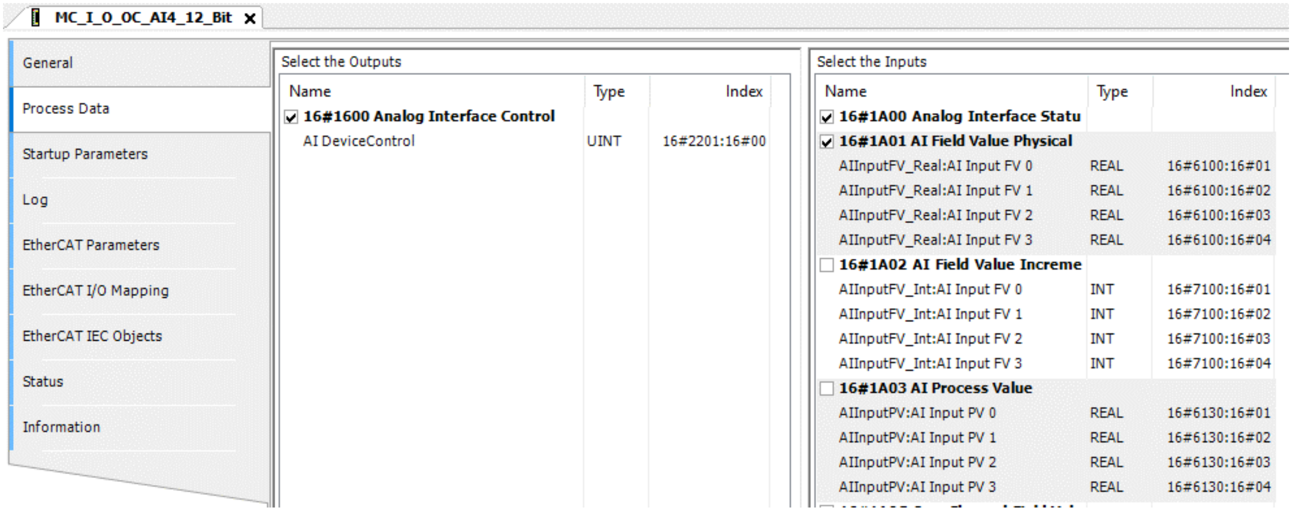
There are various predefined mappings to choose from, depending on how your analogue outputs are configured.

They represent in one of two different ways:

- Field Value Physical: [V] or [mA] output value as REAL
  Mapping 160x01 enabled
- Field Value Increments: Digits output value as UINT
  Mapping 160x02 enabled
- Process Value: scaled output value (process value) as REAL
  Mapping 160x03 enabled

Since the 3 above mappings are mutually exclusive, you can only enable one of them. Check that the mapping you choose matches the "AO operating mode" in the configuration.

View of mapped process data in CODESYS V3's EtherCAT Configurator:



12.2.7. Object Dictionary

Device Type 0x1000

Device type description

Name	Device Type
Index	0x1000
Object Code	VARIABLE
No. of Elements	-
Data Type	UNSIGNED32

Access	read only
PDO Mapping	No
Value Range	Fix
Default Value	0x800A 0192

Additional Information [16] Bit 31…16

Bit 16 = Digital Input FB	o
Bit 17 = Analogue Input FB	✓
Bit 18 = Digital Output FB	o
Bit 19 = Analogue Output FB	✓
Bit 20 = Controller FB	o
Bit 21 = Alarm FB	o
Bit 22 = Device FB	✓
Bit 23 to 26 = Specific Function	o
Bit 27 to 29 = Reserved	o
Bit 30 = Reserved	o
Bit 31 = Manufacturer-specific PDO mapping	✓

Device Profile Number [16] bits 15..0

0194h = 404d = 404 Device Profile Number

Error Register 0x1001

Name	Error Register
Index	0x1001
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED8

Access	read only
PDO Mapping	yes, TX-PDO
Value Range	
Default Value	0

In case of an error, the associated error bit is set. The bit is cleared automatically when the cause of the error has been removed.

7	6	5	4	3	2	1	0
MAN	RES	PROF	COM	TEMP	VOL	CUR	GEN

GEN: general error
CUR: current
VOL: voltage
TEMP: temperature
COM: communication
PROF: device profile
RES: not used, always "0"
MAN: manufacturer-specific

Manufacturer Device Name 0x1008

Name	Manufacturer Device Name
Index	0x1008
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	-
Value Range	Fix
Default Value	FIO AI4AO4

Subindex 0 of this object contains the string length. Subindex 1 contains each of the characters. The character string has no terminating zero.

Manufacturer Hardware Version 0x1009

Name	Manufacturer Hardware Version
Index	0x1009
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Units	-
Value Range	Fix
Default Value	1.00

Subindex 0 of this object contains the string length. Subindex 1 contains each of the characters. The character string has no terminating zero.

Manufacturer Software Version 0x100A

Name	Manufacturer Software Version
Index	0x100A
Object Code	VARIABLE
No. of Elements	0
Data Type	VISIBLE_STRING

Access	read only
PDO Mapping	No
Value Range	Fix
Default Value	1.00

Identity object 0x1018

Name	Identity Object
Index	0x1018
Object Code	RECORD
No. of Elements	0
Data Type	IDENTITY

Name	Highest Sub-index Supported
Subindex	0x00
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	4

Name	Vendor ID
Subindex	0x01
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	0x0048554B

Name	Product Code
Subindex	0x02
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	0x0002EF68h

Name	Revision Number
Subindex	0x03
Data Type	UNSIGNED32
Access	Read only
PDO Mapping	No
Default Value	

Name	Serial Number
Subindex	0x04
Data Type	UNSIGNED32
Access	Read only
PDO Mapping	No
Default Value	

The object contains details of the manufacturer, the product code and the revision and serial numbers.

Error Settings 0x10F1

Name	Error Settings
Index	0x10F1
Object Code	RECORD
No. of Elements	3
Data Type	

Name	Highest Sub-index Supported
Subindex	0x00
Data Type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	2

Name	Local Error Reaction
Subindex	0x01
Data Type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	1

Name	Sync Error Counter Limit
Subindex	0x02
Data Type	UNSIGNED16
Access	read only
PDO Mapping	No
Default Value	4

Not used

Mapping 0x1600 (Device Control)

Name	Drive Control
Index	0x1600
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest Sub-index Supported
Subindex	0x00
Data Type	UNSIGNED8
Access	read write
PDO Mapping	No
Default Value	1

Name	1st Object To Be Mapped
Subindex	0x01
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2201 00 10

Name	2nd Object To Be Mapped
Subindex	0x02
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	3rd Object To Be Mapped
Subindex	0x03
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	4th Object To Be Mapped
Subindex	0x04
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x60600008

Name	5th Object To Be Mapped
Subindex	0x05
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	6th Object To Be Mapped
Subindex	0x06
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object To Be Mapped
Subindex	0x07
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object To Be Mapped
Subindex	0x08
Data Type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16] bits 31..16 index of object to be mapped
SubIndex[8] bits 15..8 subindex of object to be mapped
Length[8] bits 7..0 length of object to be mapped

Mapping 0x1A00 (Error Field)

Name	Error Field
Index	0x1A00
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x01

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x213F 00 10

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A01 (AI Field Value Pysical)

Name	AI Field Value Pysical
Index	0x1A01
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6100 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6100 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6100 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6100 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A02 (AI Field Value Increments)

Name	AI Field Value Increments
Index	0x1A02
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x7100 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x7100 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x7100 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x7100 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A03 (AI Process Value)

Name	AI Process Value
Index	0x1A03
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6130 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6130 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6130 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x6130 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A04 (Oversample FV AI1)

Name	Oversample FV AI1
Index	0x1A04
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2101 01 10

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2101 02 10

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2101 03 10

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2101 04 10

Name	5th Object to be mapped

Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	2101 05 10h

Name	**6th Object to be mapped**
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	**7th Object to be mapped**
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	**8th Object to be mapped**
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A05 (Oversample FV AI2)

Name	Oversample FV AI2
Index	0x1A05
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2102 01 10

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2102 02 10

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2102 03 10

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2102 04 10

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	2102 05 10h

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A06 (Oversample FV AI3)

Name	Oversample FV AI3
Index	0x1A06
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2103 01 10

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2103 02 10

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2103 03 10

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2103 04 10

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2103 05 10

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A07 (Oversample FV AI4)

Name	Oversample FV AI4
Index	0x1A07
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2104 01 10

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2104 02 10

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2104 03 10

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2104 04 10

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2104 05 10

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A08 (Oversample PV AI1)

Name	Oversample PV AI1
Index	0x1A08
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2131 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2131 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2101 03 10

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2131 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2131 05 20

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A09 (Oversample PV AI2)

Name	Oversample PV AI2
Index	0x1A09
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2132 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2132 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2132 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2132 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2132 05 20

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A0A (Oversample PV AI3)

Name	Oversample PV AI3
Index	0x1A0A
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2133 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2133 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2133 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2133 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2133 05 20

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

Mapping 0x1A0B (Oversample PV AI4)

Name	Oversample PV AI4
Index	0x1A0B
Object Code	RECORD
No. of Elements	9
Data Type	PDO_MAPPING

Name	Highest sub index supported
Subindex	0x00
Data type	UNSIGNED8
Access	read only
PDO Mapping	No
Default Value	0x05

Name	1st Object to be mapped
Subindex	0x01
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2134 01 20

Name	2nd Object to be mapped
Subindex	0x02
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2134 02 20

Name	3rd Object to be mapped
Subindex	0x03
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2134 03 20

Name	4th Object to be mapped
Subindex	0x04
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2134 04 20

Name	5th Object to be mapped
Subindex	0x05
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	0x2134 05 20

Name	6th Object to be mapped
Subindex	0x06
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	7th Object to be mapped
Subindex	0x07
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Name	8th Object to be mapped
Subindex	0x08
Data type	UNSIGNED32
Access	read write
PDO Mapping	No
Default Value	

Every subindex (1-8) describes a mapped object each. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

AI Channel Control 0x2001

Name	AI Channel Control
Index	0x2001
Object Code	ARRAY
No. of Elements	5
Data Type	UINT8

Name	Highest sub index supported
Subindex	0x00
Data type	UINT8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Channel Control 1
Subindex	0x01
Data type	UINT8
Access	read write
PDO Mapping	Yes, RX-PDO
Default Value	

Name	AI Channel Control 2
Subindex	0x02
Data type	UINT8
Access	read write
PDO Mapping	Yes, RX-PDO
Default Value	

Name	AI Channel Control 3
Subindex	0x03
Data type	UINT8
Access	read write
PDO Mapping	Yes, RX-PDO
Default Value	

Name	AI Channel Control 4
Subindex	0x04
Data type	UINT8
Access	read write
PDO Mapping	Yes, RX-PDO
Default Value	

Channel status:

7	6	5	4	3	2	1	0
					COMP	SCAL	ACT

ACT:

0 = input inactive

1 = input active

SCAL:

0 = scale input values by factor and offset

1 = scale input values by control points

COMP:

0 = comparator inactive

1 = comparator active

AI Channel Status 0x2002

Name	AI Channel State
Index	0x2002
Object Code	ARRAY
No. of Elements	5
Data Type	UINT8

Name	Highest sub index supported
Subindex	0x00
Data type	UINT8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Channel Status 1
Subindex	0x01
Data type	UINT8
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Channel Status 2
Subindex	0x02
Data type	UINT8
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Channel Status 3
Subindex	0x03
Data type	UINT8
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Channel Status 4
Subindex	0x04
Data type	UINT8
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Channel status:

7	6	5	4	3	2	1	0
						UpLim	LoLim

LoLim (lower limit) or UpLim (upper limit)

0 = limit not exceeded

1 = limit exceeded

Error Log 0x2003

Name	Error Log
Index	0x2003
Object Code	RECORD
No. of Elements	9
Data Type	UNSIGNED32

Name	Number of errors
Subindex	00h
Data type	UNSIGNED8
Access	read write
PDO Mapping	No
Default Value	0x00

Name	Standard error field
Subindex	0x01 .. 0x08
Data type	UNSIGNED32
Access	read only
PDO Mapping	No
Default Value	

A new error occurring is entered in subindex 1. Previous entries in subindices 1 to 7 are moved one place back. The error in subindex 7 is removed.

Check the object with subindex 0 to find the number of previous errors. Setting this object to "0" starts a new count.

The object contains the error numbers retrieved from object Error Code 213Fh

Sample Count 0x2100

Name	Sample Count
Index	0x2100
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED32

Access	read only
PDO Mapping	Yes, TX-PDO
Value Range	
Default Value	0x00

Number of samples since last reset / restart

AI1 Oversample Data FV 0x2101

Name	AI1 Oversample Data FV
Index	0x2101
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	INT16
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI1 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI1

AI2 Oversample Data FV 0x2102

Name	AI2 Oversample Data FV
Index	0x2102
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	INT16
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI2 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI2

AI3 Oversample Data FV 0x2103

Name	AI3 Oversample Data FV
Index	0x2103
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	INT16
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI3 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI3AI4 Oversample Data FV 0x2104

Name	AI4 Oversample Data FV
Index	0x2104
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	INT16
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI4 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI4

AI Input Calibration Gain 0x2125

Name	AI Input Calibration Gain
Index	0x2125
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Calibration Gain 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	1.0

Name	AI Input Calibration Gain 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	1.0

Name	AI Input Calibration Gain 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	1.0

Name	AI Input Calibration Gain 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	1.0

Channel-specific calibration factor for correcting the gain error

AI1 Oversample Data PV 0x2131

Name	AI1 Oversample Data PV
Index	0x2131h
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI1 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI1AI2 Oversample Data PV 0x2132

Name	AI2 Oversample Data PV
Index	0x2132
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI2 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI2

AI3 Oversample Data PV 0x2133

Name	AI3 Oversample Data PV
Index	0x2133
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	00h
Data type	REAL32
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI3 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI3

AI4 Oversample Data PV 0x2134

Name	AI4 Oversample Data PV
Index	0x2134
Object Code	ARRAY
No. of Elements	6

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	NO
Default Value	0x05

Name	AI4 Sample N+0 .. N+4
Subindex	0x01 .. 0x05
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Oversampling input values AI4

Error Code 0x213F

Name	Error Code
Index	0x213F
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read only
PDO Mapping	Yes, TX-PDO
Value Range	
Default Value	00h

3120h undervoltage modul

5100h AI0 Input value outside the parameterized limits
510x01 AI1 Input value outside the parameterized limits
510x02 AI2 Input value outside the parameterized limits
510x03 AI3 Input value outside the parameterized limits

5300h AI0 sensor error (current smaller than 4mA)
530x01 AI1 sensor error (current smaller than 4mA)
530x02 AI2 sensor error (current smaller than 4mA)
530x03 AI3 sensor error (current smaller than 4mA)

6010h Watchdog

8000h communication error

Device Control 2201

Name	Device Control
Index	2201
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read write
PDO Mapping	Yes, RX-PDO
Value Range	
Default Value	00h

Channel status:

7	6	5	4	3	2	1	0
							RES

RES:

0 = do nothing

1 = reset device

Device Status 0x2202

Name	Device Status
Index	0x2202
Object Code	VARIABLE
No. of Elements	0
Data Type	UNSIGNED16

Access	read only
PDO Mapping	Yes, TX-PDO
Value Range	
Default Value	0x00

Not used

AI Input FV 0x6100

Name	AI Input FV
Index	0x6100
Object Code	ARRAY
No. of Elements	5
Data Type	REAL32

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input FV 1
Subindex	0x01
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 2
Subindex	0x02
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 3
Subindex	0x03
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 4
Subindex	0x04
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Analogue input values as measured Real variable or, if oversampling is active, average of sampled input values.

AI Sensor Type 0x6110

Name	AI Sensor Type
Index	0x6110
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	UINT16
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Sensor Type 1
Subindex	0x01
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Sensor Type 2
Subindex	0x02
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Sensor Type 3
Subindex	0x03
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Sensor Type 4
Subindex	0x04
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Channel-specific setting of the attached sensor:

42 = 0…10 V (default)
52 = 0…20 mA
51 = 4…20 mA

AI Input Scaling 1 FV 0x6120

Name	AI Input Scaling 1 FV
Index	0x6120
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Scaling 1 FV 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 FV 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 FV 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 FV 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

AI Input Scaling 1 PV 0x6121

Name	AI Input Scaling 1 PV
Index	0x6121
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Scaling 1 PV 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 PV 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 PV 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 1 PV 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

AI Input Scaling 2 FV 0x6122

Name	AI Input Scaling 2 FV
Index	0x6122
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Scaling 2 FV 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 FV 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 FV 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 FV 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

AI Input Scaling 2 PV 0x6123

Name	AI Input Scaling 2 PV
Index	0x6123
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Scaling 2 PV 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 PV 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 PV 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Scaling 2 PV 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

AI Input Offset 0x6124

Name	AI Input Offset
Index	0x6124
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input Offset 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Offset 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Offset 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Input Offset 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Channel-specific offset in [V] or [mA]

AI Scaling Factor 0x6126

Name	AI Scaling Factor
Index	0x6126
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Scaling Factor 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Factor 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Factor 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Factor 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Scaling factor [process value / field value]

AI Scaling Offset 0x6127h

Name	AI Scaling Offset
Index	0x6127
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Scaling Offset 1
Subindex	0x01
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Offset 2
Subindex	0x02
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Offset 3
Subindex	0x03
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Name	AI Scaling Offset 4
Subindex	0x04
Data type	REAL32
Access	read write
PDO Mapping	No
Default Value	

Scaling offset [process value]

AI Input PV 0x6130

Name	AI Input PV
Index	0x6130
Object Code	ARRAY
No. of Elements	5
Data Type	REAL32

Name	Highest sub index supported
Subindex	0x00
Data type	REAL32
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input PV 1
Subindex	0x01
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input PV 2
Subindex	0x02
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input PV 3
Subindex	0x03
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input PV 4
Subindex	0x04
Data type	REAL32
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Analogue process input values as measured Real quantities, depending on the scaling values.

Average of sampled process input values if oversampling is active.

AI Filter Type 0x61A0

Name	AI Filter Type
Index	0x61A0
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	UINT8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Filter Type 1
Subindex	0x01
Data type	ENUM
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Type 2
Subindex	0x02
Data type	ENUM
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Type 3
Subindex	0x03
Data type	ENUM
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Type 4
Subindex	0x04
Data type	ENUM
Access	read write
PDO Mapping	No
Default Value	

Object for activating the input filter:

0 = no filter active
1 = filter PT1

AI Filter Constant 0x61A1

Name	AI Filter Constant
Index	0x61A1
Object Code	RECORD
No. of Elements	5

Name	Highest sub index supported
Subindex	0x00
Data type	UINT8
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Filter Constant 1
Subindex	0x01
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Constant 2
Subindex	0x02
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Constant 3
Subindex	0x03
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

Name	AI Filter Constant 4
Subindex	0x04
Data type	UINT16
Access	read write
PDO Mapping	No
Default Value	

PT1 filter time, in [ms]

AI Input FV 0x7100

Name	AI Input FV
Index	0x7100
Object Code	ARRAY
No. of Elements	5
Data Type	INT16

Name	Highest sub index supported
Subindex	0x00
Data type	INT16
Access	read only
PDO Mapping	No
Default Value	0x04

Name	AI Input FV 1
Subindex	0x01
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 2
Subindex	0x02
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 3
Subindex	0x03
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Name	AI Input FV 4
Subindex	0x04
Data type	INT16
Access	read only
PDO Mapping	Yes, TX-PDO
Default Value	

Analog input values as integer measured variable, with active oversampling mean value of the total input values.

12.2.8. Object dictionary: Extended OC Process Data Objects

0x1a0c One Channel Field Value AI0 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000520
PDO Mapping	no

0x1a0d One Channel Field Value AI1 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010520
PDO Mapping	no

0x1a0e One Channel Field Value AI2 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020520
PDO Mapping	no

0x1a0f One Channel Field Value AI3 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030520
PDO Mapping	no

0x4000 AI0 OC Fieldvalue (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI0OCFieldvalue.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI0OCFieldvalue.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI0OCFieldvalue.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI0OCFieldvalue.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI0OCFieldvalue.Crc32

0x4001 AI1 OC Fieldvalue (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI1OCFieldvalue.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI1OCFieldvalue.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI1OCFieldvalue.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
Defaultvalue	
PDO Mapping	optional, TPDO only
Accessname	AI1OCFieldvalue.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI1OCFieldvalue.Crc32

0x4002 AI2 OC Fieldvalue (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI2OCFieldvalue.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI2OCFieldvalue.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI2OCFieldvalue.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI2OCFieldvalue.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI2OCFieldvalue.Crc32

0x4003 AI3 OC Fieldvalue (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI3OCFieldvalue.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI3OCFieldvalue.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI3OCFieldvalue.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI3OCFieldvalue.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	AI3OCFieldvalue.Crc32

12.2.9. Technical data

MC-I/O OC AI4	
Label	MC-I/O OC AI4-U/I
Part no.	S-01030202-0600
EtherCAT Slave Controller	ASIC ET1200
Connection E-Bus	10-pole system plug at the side wall
E-Bus-load	150mA
I/O/Power connection	Connector 36-pole
power supply	24 V DC (-15% ... +20%)
Potential isolation	500V E-Bus / power supply
analog inputs	4
Resolution	12 Bit
Start AD conversion	DC-synchron, SM-synchron
Oversampling	2..5 times
Basic error	± 0,2%
Temperature error	± 0,005%/K
Internal resistance	< 300Ω
Input filter cut-off frequency	< 100kHz
Voltage:	
Measuring range	0 … 10V
setting time	0→10V: ≤22µs bei 2kΩ/<200pF
measuring error	< ±0,5%, typisch < ±0,4% from final value
Transformation time	235µs (if all channels are active)
Current:	
Measuring range	0…20mA, 4…20mA
setting time	0 →16V: ≤25µs bei 300Ω/<1mH
measuring error	< ±0,5%, typisch < ±0,4% from final value
Transformation time	200µs (if all channels are active)

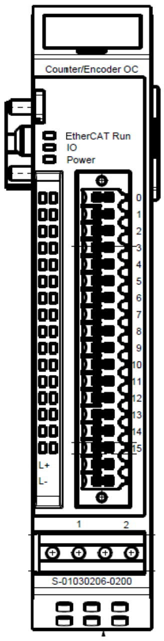
12.3. MC-I/O OC Counter/Encoder

12.3.1. Function

The Counter/Encoder module has 2 counter/sensor interfaces for connecting incremental or absolute position encoders equipped with an SSI or EnDat interface. Using the event counter configuration option provides you with 6 independent event counters.

The interfaces configure almost independently, giving the module a maximum of flexibility.

12.3.2. Frontview



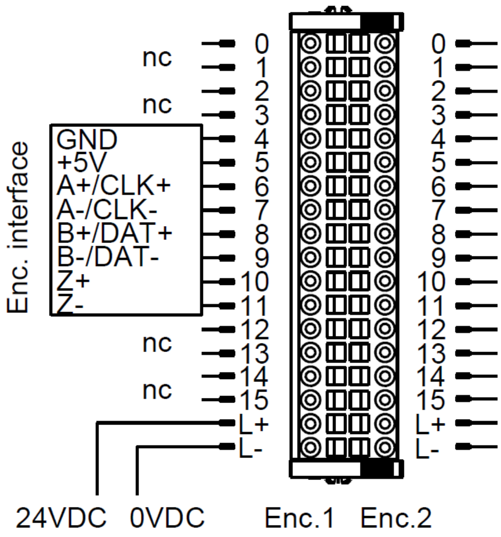
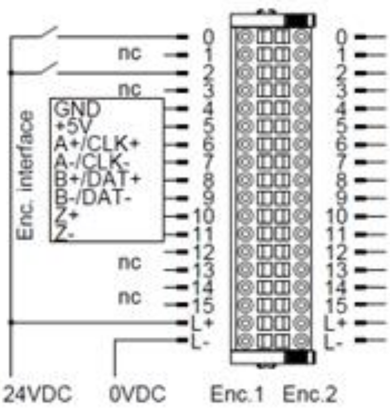


Figure 90: Connections I/Os

Figure 91: Frontview I/O Modul OC Counter/Encoder

12.3.3. Connectors (hardware rev. 2)

I/O Power Supply (Load)



System connector pin 16: L+ 24 VDC
System connector pin 17: L- 0 V

Digital Inputs

Left row of pins of system connector: pins 0, 2 (Enc 1)
Right row of pins of system connector: pins 0, 2 (Enc 2)

Counter/Encoder Inputs

Left row of pins of system connector: pins 4… 11 (Enc 1)
Right row of pins of system connector, pins 4… 11 (Enc 2)

EtherCAT

E-Bus IN female 10-pole connector

E-Bus OUT 10-pole multi-pin connector

12.3.4. Status LEDs

LED "EtherCAT Run"

State	LED Flash Code	Explanation
Init	Off	Initialising, no data exchange
Pre-Op	Off/green, 1:1	Pre-operational, no data exchange
Safe-Op	Off/green, 5:1	Safe operation, inputs readable
Op	Green, on	Operational, unrestricted data exchange
Bootstrap	Flickering	Optional if the bootstrap mode is supported.

LED "IO"

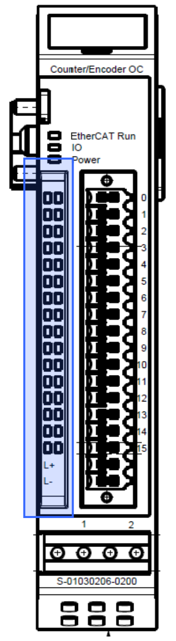
State	LED Flash Code	Explanation
Ok	Green	No error
Error	Off	LED "EtherCAT Run" off: n/a LED "EtherCAT Run" green: Module defective
	Red, 2x	Low voltage
	Red, 3x	Internal watchdog
	Red, 4x	Bus error
	Red, 6x	Module-specific error, see Predefined Error Field 0x1003:01 … 08 for details
	Red, 7x	Configuration error
	Red, on	Module defective

LED "Power"

State	LED	Explanation
On	Green	24 VDC supply to I/Os (load) ok
Off	Off	24 VDC supply not ok

LED "Channel"

Channel			Channel	Description
DI1			DI3	Digital input / capture input (rev. 2 or higher)
DI2			DI4	Digital input / reference input (rev. 2 or higher)
A+/CLK+			A+/CLK+	Incremental encoder: The LEDs indicate the signal state of the incremental encoder track Endat / SSI: The LEDs light up along with the Clock or Data signal Event counter: The LEDs indicate the signal state of the event counter input
A-/CLK-			A-/CLK-	
B+/DAT+			B+/DAT+	
B-/DAT-			B-/DAT-	
Z+			Z+	
Z-			Z-	



12.3.5. Process Data Objects

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EtherCAT Modular Device Profile: Availability of process data objects depends on which modules are installed below the EtherCAT slave.

General Process Data

Variable	Data Type	Explanation
Digital Input State	Byte	Logic level of digital inputs

Module-dependent Process Data Objects (Encoder)

Variable	Data Type	Explanation
Enc <n> Digital Interface Control	UINT	Controls the encoder interface (bit string)
Enc <n> DI Homeoffset Value SD	DINT	Reference position offset
Enc <n> Position Value	UDINT	Actual position
Enc <n> High Resolution Speed Value	DINT	Actual speed
Enc <n> DI Capture Value SD	DINT	Position at time of last capture signal (DI1, DI3)
Enc <n> Digital Interface Status	UINT	Encoder interface status (bit string)
Enc <n> Error Register	USINT	Error register (bit string)

Module-dependent Process Data Objects (Event Counter)

Variable	Data Type	Explanation
Enc 1 digital interface control	UINT	Controls the encoder interface (bit string)
Event counter channel 1	UDINT	Actual counter reading of event counter 1
Event counter channel 2	UDINT	Actual counter reading of event counter 2
Event counter channel 3	UDINT	Actual counter reading of event counter 3
Event counter channel 4	UDINT	Actual counter reading of event counter 4
Event counter channel 5	UDINT	Actual counter reading of event counter 5
Event counter channel 6	UDINT	Actual counter reading of event counter 6
Enc 1 error register	USINT	Error register (bit string)

12.3.6. Module Configuration

The counter/encoder interfaces are configured by plugging modules into the appropriate slots. A slot stands for a counter/encoder interface. A slot will accept the correct types of modules only. The procedure is based on the EtherCAT Modular Device Profile.

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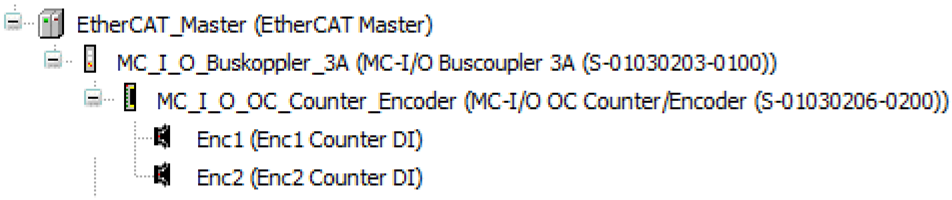
Check that there is a module in every slot.

CODESYS devices explorer configuration example



Configuration – Overview of Matching Modules (V1)

Slot	Slot Name	Function	Module Code	Module Function
1	Enc1	Encoder 1	192361013	Enc1 Counter
			192361014	Enc1 SSI
			192361015	Enc1 Endat
			192361016	Enc Event Counter
2	Enc2	Encoder 2	192361017	Enc2 Counter
			192361018	Enc2 SSI
			192361019	Enc2 Endat
			192361020	Enc event counter dummy module

Configuration – Overview of Matching Modules (V3)

Slot	Slot Name	Function	Module Code	Module Function
1	Enc1	Encoder 1	192362001	Enc1 Counter DI
			192362002	Enc1 SSI DI
			192362003	Enc1 Endat DI
			192361016	Enc Event Counter
			192362005	Enc1 SixStep DI
2	Enc2	Encoder 2	192362006	Enc2 Counter
			192362007	Enc2 SSI
			192362008	Enc2 Endat
			192361020	Enc event counter dummy module
			192362010	Enc2 SixStep DI

Encoder Interface

The general-purpose encoder interface provides you with many options of capturing angles, positions and counting pulses.

The system accepts the following encoders:

- Incremental encoder with RS422 interface (RS422)
- Incremental encoder with 5V single-ended interface (TTL)
- Incremental encoder with 24V single-ended interface (HTL)
- SixStep encoder with 5V single-ended interface (TTL)
- SixStep encoder with 24V single-ended interface (HTL)
- SSI encoder
- Endat 2.1 single-turn encoder
- Endat 2.1 multi-turn encoder

You can arrange them any way you like. The module also supplies max. 150 mA power to every 5V encoder. A power monitor outputs and error if this power rating is exceeded.

Another option is to use the encoder interface as an event counter for capturing 6 fast signals. If you do use this option, you cannot attach an encoder.

The sections below break down your configuration options and list the associated objects, which are linked to the object dictionary.

Encoder Interface Configuration – Incremental Encoder

Available objects

<table>
<tr><th>Slot</th><th>Object</th><th>Description</th></tr>
<tr><td>Enc1</td><td rowspan="2">0x2100, 0x2900 Enc<n> Digital Interface Type</td><td rowspan="2">64 Encoder (automatically assigned by the module)</td></tr>
<tr><td>Enc2</td></tr>
<tr><td>Enc1</td><td rowspan="2">0x2103, 0x2903 Enc<n> Digital Interface Config</td><td rowspan="2">Sub 01 (level): 0=HTL, 1=TTL or 2=RS422
Sub 02 (mode): 0=multi-turn or 1=single-turn
Sub 03 (index level):
0=reference on rising edge
1=reference on falling edge
Sub 04 (SSI):
0=straight binary
1=Gray coded binary
Sub 05 (event counter):
0=count rising edges
1=count falling edges
3=count both edges</td></tr>
<tr><td>Enc2</td></tr>
<tr><td>Enc1</td><td rowspan="2">0x2110, 0x2910 Enc<n> Digital Interface Bit Size</td><td rowspan="2">Encoder resolution as per data sheet</td></tr>
<tr><td>Enc2</td></tr>
<tr><td>Enc1</td><td rowspan="2">0x2111, 0x2911 Enc<n> Digital Interface Baud Rate</td><td rowspan="2">Clock frequency as per data sheet [kHz]</td></tr>
<tr><td>Enc2</td></tr>
<tr><td>Enc1</td><td rowspan="2">0x6002, 0x6802 Enc<n> Total Measuring Range</td><td rowspan="2">Relevant for overflow in single-turn mode</td></tr>
<tr><td>Enc2</td></tr>
</table>

Encoder Interface Configuration – SixStep Encoder

Available objects

Slot	Object	Description
Enc1 Enc2	0x2100, 0x2900 Enc<n> Digital Interface Type	64 Encoder (automatically assigned by the module)
Enc1 Enc2	0x2103, 0x2903 Enc<n> Digital Interface Config	Sub 01 (level): 0=HTL, 1=TTL or 2=RS422 Sub 02 (mode): 0=multi-turn or 1=single-turn Sub 03 (index level): 0=reference on rising edge 1=reference on falling edge Sub 04 (SSI): 0=straight binary 1=Gray coded binary Sub 05 (event counter): 0=count rising edges 1=count falling edges 3=count both edges
Enc1 Enc2	0x2110, 0x2910 Enc<n> Digital Interface Bit Size	Encoder resolution as per data sheet
Enc1 Enc2	0x2111, 0x2911 Enc<n> Digital Interface Baud Rate	Clock frequency as per data sheet [kHz]
Enc1 Enc2	0x6002, 0x6802 Enc<n> Total Measuring Range	Relevant for overflow in single-turn mode

Encoder Interface Configuration – SSI Encoder

Available objects

Slot	Object	Description
Enc1 Enc2	0x2100, 0x2900 Enc<n> Digital Interface Type	65 SSI (automatically assigned by the module)
Enc1 Enc2	0x2103, 0x2903 Enc<n> Digital Interface Config	Sub 01 (level): 0=HTL, 1=TTL or 2=RS422 Sub 02 (mode): 0=multi-turn or 1=single-turn Sub 03 (index level): 0=reference on rising edge 1=reference on falling edge Sub 04 (SSI): 0=straight binary 1=Gray coded binary Sub 05 (event counter): 0=count rising edges 1=count falling edges 3=count both edges
Enc1 Enc2	0x2110, 0x2910 Enc<n> Digital Interface Bit Size	Encoder resolution as per data sheet
Enc1 Enc2	0x2111, 0x2911 Enc<n> Digital Interface Baud Rate	Clock frequency as per data sheet [kHz]
Enc1		Relevant for overflow in single-turn mode

Enc2	0x6002, 0x6802 Enc<n> Total Measuring Range	

Encoder Interface Configuration – ENDAT Encoder

Available objects

Slot	Object	Description
Enc1 Enc2	0x2100, 0x2900 Enc<n> Digital Interface Type	69 Endat (automatically assigned by the module)
Enc1 Enc2	0x2103, 0x2903 Enc<n> Digital Interface Config	Sub 01 (level): 0=HTL, 1=TTL or 2=RS422 Sub 02 (mode): 0=multi-turn or 1=single-turn Sub 03 (index level): 0=reference on rising edge 1=reference on falling edge Sub 04 (SSI): 0=straight binary 1=Gray coded binary Sub 05 (event counter): 0=count rising edges 1=count falling edges
Enc1 Enc2	0x2110, 0x2910 Enc<n> Digital Interface Bit Size	Encoder resolution as per data sheet
Enc1 Enc2	0x2111, 0x2911 Enc<n> Digital Interface Baud Rate	Clock frequency as per data sheet [kHz]
Enc1 Enc2	0x6002, 0x6802 Enc<n> Total Measuring Range	Relevant for overflow in single-turn mode

Encoder Interface Configuration – Event Counter

Available objects

Slot	Object	Description
Enc1	0x2100, 0x2900 Enc<n> Digital Interface Type	80 Event Counter (automatically assigned by the module)
Enc2		Enc event counter dummy module
Enc1 Enc2	0x2103, 0x2903 Enc<n> Digital Interface Config	Sub 01 (level): 0=HTL, 1=TTL or 2=RS422 Sub 02 (mode): 0=multi-turn or 1=single-turn Sub 03 (index level): 0=reference on rising edge 1=reference on falling edge Sub 04 (SSI): 0=straight binary 1=Gray coded binary Sub 05 (event counter): 0=count rising edges 1=count falling edges 3=count both edges
Enc1 Enc2	0x2110, 0x2910 Enc<n> Digital Interface Bit Size	Encoder resolution as per data sheet
Enc1 Enc2	0x2111, 0x2911 Enc<n> Digital Interface Baud Rate	Clock frequency as per data sheet [kHz]
Enc1 Enc2	0x6002, 0x6802 Enc<n> Total Measuring Range	Relevant for overflow in single-turn mode

i HINWEIS

The event counter inputs cannot be used for mechanical switches because they are neither debounced nor filtered.

i HINWEIS

The max. counting frequency of event counter channels 0 & 3 is 400 kHz.

The max. counting frequency of event counter channels 1, 2, 4 & 5 is 5 kHz.

i HINWEIS

Only the event counter dummy module may be in slot 2 if you wish to use the module as an event counter. Also operating an encoder is currently not supported.

Encoder Interface Configuration – User-defined Units

Apart from position values in increments, the module can also output the position value in user-defined units (in REAL format). This option applies to incremental, SSI and ENDAT encoders.

The following objects are available for outputting the position value in user-defined units:

- 0x2014, 0x2814 Enc<n> Linear Position Value
- 0x2031, 0x2831 Enc<n> Linear Speed Value

Add these objects to the PDO mapping as needed.

To calculate the position value:

$$Linear\ Position\ Value = High\ Resolution\ Raw\ Value * \frac{Encoder\ Increments}{Motor\ Revolutions} * \frac{Motor\ Shaft\ Revolutions}{Driving\ Shaft\ Revolutions} * \frac{Feed}{Shaft\ Revolutions}$$

Available objects

Slot	Object	Description
Enc1 Enc2	0x208f, 0x288f Enc<n> Position Encoder Resolution	$\frac{Encoder\ Increments}{Motor\ Revolutions}$
Enc1 Enc2	0x2091, 0x2891 Enc<n> Gear Ratio	$\frac{Motor\ Shaft\ Revolutions}{Driving\ Shaft\ Revolutions}$
Enc1 Enc2	0x2092, 0x2892 Enc<n> Feed Constant	$\frac{Feed}{Shaft\ Revolutions}$

Digital Input Configuration

Prerequisites:

➔ Hardware rev. 2
Software release 2.00 or higher

Proceed as follows to configure the 4 digital inputs of the FIO counter/encoder module:

0x3000 Digital Input Function Select – SubIndex 01…04

- **0 Digital Input (Default)**
  The inputs configured as "digital inputs" respond just like ordinary PLC inputs. Use object 0x3002 to configure the filter time of the input in question. Object 0x3050 (Digital Input State) shows the state of the digital inputs and is contained in the default PDO mapping already.
- 1 Special Function Enable
  The Special Function the inputs may be set to are related to the encoder interface. Use objects 0x3001 to choose which edge will trigger the special function. Then use object 0x3002 to set the filter time. Best practice is to set a special-function input to "0 - no filter / special function is edge triggered".
  - SubIndex 01: Capture input for encoder 1
  - SubIndex 02: Reference input for encoder 1
  - Subindex 03: Capture input for encoder 2
  - Subindex 04: Reference input for encoder 2
- 2 Timestamp Function (Subindexes 01 & 02)
  The timestamp function starts measuring the difference in time between two subsequent input signals sent to DI1 and DI2. The output is made to object 0x3060 / 0x3061. The function also counts the input signals (<=4kHz). Counter readings are output to object 0x3070 / 0x3071.

0x3001 Digital Input Edge Sensitivity Select – Subindex 01…04

- **1 rising edge (default)**
- 2 falling edge
- 3 both edges

0x3002 Digital Input Filter Select – Subindex 01…04

- 0 no filter / special function is edge triggered
- 1 0.3ms filter
- **2 1.0ms filter (default)**
- 3 3.0ms filter
- 4 5.0ms filter
- 5 10ms filter
- 6 20ms filter

i HINWEIS

The inputs cannot be used for mechanical switches because they are not filtered by the configuration.

Encoder Referencing

The FIO counter/encoder module knows various ways of how to reference the position value.

Reference Position Found by Digital Input

Enable the Special Function of the required reference input, see section Digital Input Configuration. Now enable referencing by setting bit 2 (REF DI) of object Enc<n> Digital Interface Control (Enc1 0x2101 bzw. Enc2 0x2801). When a rising edge is detected at the reference input, the current position value is set to Enc<n> Preset Value Signed or Enc<n> High Resolution Preset Value Signed. Absolute value encoders save this value as a remanent value in the module. Bit 7 (Referenced DI) of Enc<n> Digital Interface Status acknowledges that referencing has been successful.

Reset by the Application

i HINWEIS

This function is available for A/B/Ref counter or SixStep encoders only

Setting bit 4 (RES CNT) of object Enc<n> Digital Interface Control (Enc1 0x2101 or Enc2 0x2801) sets the current position value to Enc<n> Preset Value Signed or Enc<n> High Resolution Preset Value Signed.

Factor Group

Use the factor group to convert the encoder's position value to user-defined units.

The following equation calculates the ratio of user-defined and internal (encoder) values (example encoder 1):

$$linear\ position\ value\ 0x2014{:}\,00 = \frac{position\ value\ 0x6005 * feed\ constant\ 0x2092}{position\ encoder\ resolution\ 0x208f * gear\ ratio\ 0x2091}$$

Objects for calculating the user-defined units (example encoder 1):

$$position\ encoder\ resolution\ 0x208f = \frac{Encoder\ Increments\ 0x208f{:}\,01}{Motor\ Revolution\ 0x208f{:}\,02}$$

$$gear\ ratio\ 0x2091 = \frac{Motor\ Shaft\ Revolutions\ 0x2091{:}\,01}{Driving\ Shaft\ Revolutions\ 0x2091{:}\,02}$$

$$feed\ constant\ 0x2092 = \frac{Feed\ 0x2092{:}\,01}{Shaft\ Revolutions\ 0x2092{:}\,02}$$

12.3.7. EtherCAT Configuration

The module supports two op modes

Mode: Synchronous Syncmanager

The cycling EtherCAT frame triggers data exchange with the bus.

Mode: Distributed Clocks

All EtherCAT network stations should use synchronised clocks, if they are to capture and output data at the same point in time. This is achieved by a local clock in every EtherCAT slave controller that the EtherCAT master automatically synchronises with the EtherCAT network's master clock.

The EtherCAT slave controllers residing in the EtherCAT network generate synchronous interrupts which simultaneously capture input data and/or process output data.

12.3.8. Object Dictionary

0x1000 Device Type

Object Code	Variable
SUB	0x00
Name	Device type
Data type	UNSIGNED32
Access	R/O
Default value	5001 (0x1389)
PDO mapping	No

5001 = Modular Device Profile

0x1001 Error Register

Object Code	Variable
Sub	0x00
Name	Error register
Data type	UNSIGNED8
Access	R/O
Default value	
PDO mapping	No

In case of an error, the associated error bit is set. The bit is cleared automatically when the cause of the error has been removed.

This object OR-links the following objects:

0x2001 Enc1 Error Register

0x2801 Enc2 Error Register

7	6	5	4	3	2	1	0
MAN	RES	PROF	COM	TEMP	VOL	CUR	GEN

GEN: general error

CUR: current

VOL: voltage

TEMP: temperature

COM: communication

PROF: device profile

RES: not used, always "0"

MAN: manufacturer-specific

0x1003 Pre-defined Error Field

Object Code	Array

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	RW
Default value	8
Low limit	0
High limit	0
PDO mapping	No

Sub	0x01
Name	Standard error field 1
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[0]

Sub	0x02
Name	Standard error field 2
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[1]

Sub	0x03
Name	Standard error field 3
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[2]

Sub	0x04
Name	Standard error field 4
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No

Access name	Pre-definederrorfield[3]

Sub	0x05
Name	Standard error field 5
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[4]

Sub	0x06
Name	Standard error field 6
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[5]

Sub	0x07
Name	Standard error field 7
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[6]

Sub	0x08
Name	Standard error field 8
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	No
Access name	Pre-definederrorfield[7]

A new error occurring is entered in subindex 1. Previous entries in subindices 1 to 7 are moved one place back. The error in subindex 7 is removed.

Check the object with subindex 0 to find the number of previous errors. Setting this object to "0" starts a new count.

Bit															
31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Error Register								Error Origin				Sub-Number			
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Error Code															

Error Register [31 … 24]

Copy of object 0x1001 after causing an error

Error Origin [23 … 20]

Source of error inside the device

0xF across module / logical device

0x1 encoder 1

0x2 encoder 2

0x3 AI/AO

Sub-Number [19 … 16]

See Error Code table

Error Code [15 … 0]

Error Code	Sub	Device	Channel	Reaction	Explanation
0x2110	0x0	Enc1/Enc2		None	Encoder supply overload
0x3100	0x0	Module		None	Low module voltage
0x3110	0x1	Enc1/Enc2		None	Signal integrity error
0x6100	0x0	Module		Device no longer operational	Watchdog
0x7000	0x0	Enc1/Enc2		None	Endat CRC error
0x7000	0x1	Enc1/Enc2		None	Endat encoder error
0x7000	0x2	Enc1/Enc2		None	Endat timeout/answer format
0x7000	0x3	Enc1/Enc2		None	SixStep encoder error: - Illegal input bit pattern - Step width <> 1
0x8100	0x0	Module		Device no longer operational	Communication error

0x1008 Manufacturer Device Name

Object Code	Variable

Sub	0x00
Name	Manufacturer device name
Data type	VISIBLE_STRING
Access	R/O
Default value	Counter/encoder (694.454.53)
PDO mapping	No

0x1009 Manufacturer Hardware Version

Object Code	Variable

Sub	0x00
Name	Manufacturer hardware version
Data type	VISIBLE_STRING
Access	R/O
Default value	1.00
PDO mapping	No

0x100a Manufacturer Software Version

Object Code	Variable

Sub	0x00
Name	Manufacturer software version
Data type	VISIBLE_STRING
Access	R/O
Default value	C017
PDO mapping	No

0x1010 Store Parameters

Object Code	Array

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	5
PDO mapping	No

Sub	0x01
Name	Save all parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Storeparameters[0]

Sub	0x02
Name	Save communication parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Storeparameters[1]

Sub	0x03
Name	Save application parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Storeparameters[2]

Sub	0x04
Name	Save Enc1 parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Storeparameters[3]

Sub	0x05
Name	Save Enc2 parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Storeparameters[4]

Entering 65766173h (ASCII "save") in subindex 01h … 05h starts the saving process

Subindex 01: Saves all parameters (Enc1 and Enc2)
Subindex 02: No function assigned, available for normative reasons
Subindex 03: Saves all application parameters (Enc1 and Enc2)
Subindex 04: Saves the parameters of Enc1
Subindex 05: Saves the parameters of Enc2

The process saves both the on-board reference position and a reference flag. If running absolute value encoders, re-referencing is not necessary after switching on. Saving is automatically starting if you are using absolute value encoders.

0x1011 Restore Default Parameters

Object Code	**Array**

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	5
PDO mapping	No

Sub	0x01
Name	Restore all default parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Restoredefaultparameters[0]

Sub	0x02
Name	Restore communication default parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Restoredefaultparameters[1]

Sub	0x03
Name	Restore application default parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Restoredefaultparameters[2]

Sub	0x04
Name	Restore Enc1 default parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Restoredefaultparameters[3]

Sub	0x05
Name	Restore Enc2 default parameters
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Restoredefaultparameters[4]

Entering 64616F6Ch (ASCII "load") in subindex 01h … 05h starts the associated restoring process.

Subindex 01: Clears all parameters (Enc1 and Enc2)
Subindex 02: No function assigned, available for normative reasons
Subindex 03: Clears all application parameters (Enc1 and Enc2)
Subindex 04: Clears the parameters of Enc1
Subindex 05: Clears the parameters of Enc2

0x1018 Identity Object

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	0x04
PDO mapping	No

Sub	0x01
Name	Vendor ID
Data type	UNSIGNED32
Access	R/O
Default value	0x48554B
PDO mapping	No

Sub	0x02
Name	Product code
Data type	UNSIGNED32
Access	R/O
Default value	0x2EF6A
PDO mapping	No

Sub	0x03
Name	Revision number
Data type	UNSIGNED32
Access	R/O
Default value	0x00000001
PDO mapping	No

Sub	0x04
Name	Serial number
Data type	UNSIGNED32
Access	R/O
Default value	0x00000000
PDO mapping	No

0x10f1 Error Settings

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	2
PDO mapping	No

Sub	0x01
Name	Local error reaction
Data type	UNSIGNED32
Access	R/W
Default value	1
PDO mapping	No

Sub	0x02
Name	Sync error counter limit
Data type	UNSIGNED16
Access	R/W
Default value	4
PDO mapping	No

0x10f8 Timestamp Object

Object Code	Variable

Sub	0x00
Name	Timestamp object
Data type	UNSIGNED64
Access	R/W
Default value	
PDO mapping	Optional, TPDO only

0x1601 Digital Interface Control Encoder 1

Object Code	**Record**

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	2
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x21010010
PDO mapping	No

Sub	0x02
Name	Mapping entry 2
Data type	UNSIGNED32
Access	R/O
Default value	0x32000020
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1602 Digital Interface Control Encoder 2

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	2
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x29010010
PDO mapping	No

Sub	0x02
Name	Mapping entry 2
Data type	UNSIGNED32
Access	R/O
Default value	0x3a000020
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1a00 Counter / Encoder Device

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	1
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x30500008
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1a05 Rotary Encoder SD Encoder 1

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	4
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x60040020
PDO mapping	No

Sub	0x02
Name	Mapping entry 2
Data type	UNSIGNED32
Access	R/O
Default value	0x20300020
PDO mapping	No

Sub	0x03
Name	Mapping entry 3
Data type	UNSIGNED32
Access	R/O
Default value	0x31000020
PDO mapping	No

Sub	0x04
Name	Mapping entry 4
Data type	UNSIGNED32
Access	R/O
Default value	0x20010008
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1a06 Event Counter

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	6
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x24080120
PDO mapping	No

Sub	0x02
Name	Mapping entry 2
Data type	UNSIGNED32
Access	R/O
Default value	0x24080220
PDO mapping	No

Sub	0x03
Name	Mapping entry 3
Data type	UNSIGNED32
Access	R/O
Default value	0x24080320
PDO mapping	No

Sub	0x04
Name	Mapping entry 4

Data type	UNSIGNED32
Access	R/O
Default value	0x24080420
PDO mapping	No
Sub	0x05
Name	Mapping entry 5
Data type	UNSIGNED32
Access	R/O
Default value	0x24080520
PDO mapping	No

Sub	0x06
Name	Mapping entry 6
Data type	UNSIGNED32
Access	R/O
Default value	0x24080620
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1a07 Rotary Encoder SD Encoder 2

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	4
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Mapping entry 1
Data type	UNSIGNED32
Access	R/O
Default value	0x68040020
PDO mapping	No

Sub	0x02
Name	Mapping entry 2
Data type	UNSIGNED32
Access	R/O
Default value	0x28300020
PDO mapping	No

Sub	0x03
Name	Mapping entry 3
Data type	UNSIGNED32
Access	R/O
Default value	0x39000020
PDO mapping	No

Sub	0x04
Name	Mapping entry 4
Data type	UNSIGNED32
Access	R/O
Default value	0x28010008
PDO mapping	No

A subindex (1-8) describes exactly one mapped object. A mapping entry contains four bytes which are made up as follows:

Index[16]	bits 31..16	index of object to be mapped
SubIndex[8]	bits 15..8	subindex of object to be mapped
Length[8]	bits 7..0	length of object to be mapped

0x1c00 Sync Manager Communication Type

Object Code	Array

Sub	0x00
Name	Highest subindex supported
Data type	UNSIGNED8
Access	R/O
Default value	4
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	SubIndex 1
Data type	UNSIGNED8
Access	R/O
Default value	1
PDO mapping	No

Sub	0x02
Name	SubIndex 2
Data type	UNSIGNED8
Access	R/O
Default value	2
PDO mapping	No

Sub	0x03
Name	SubIndex 3
Data type	UNSIGNED8
Access	R/O
Default value	3
PDO mapping	No

Sub	0x04
Name	SubIndex 4
Data type	UNSIGNED8

Access	R/O
Default value	4
PDO mapping	No

0x1c12 Sync Manager 2 PDO Assignment

Object Code	Array

Sub	0x00
Name	Highest subindex supported
Data type	UNSIGNED8
Access	R/O
Default value	2
Low limit	0
High limit	2
PDO mapping	No
Access	R/O

0x1c13 Sync Manager 3 PDO Assignment

Object Code	Array

Sub	0x00
Name	Highest subindex supported
Data type	UNSIGNED8
Access	R/W
Default value	1
Low limit	0
High limit	4
PDO mapping	No

Sub	0x01
Name	Subindex
Data type	UNSIGNED16
Access	R/O
Default value	0x1a00
PDO mapping	No

0x1c32 Sync Manager 2 Synchronization

Object Code	Record

Sub	0x00
Name	Highest subindex supported
Data type	UNSIGNED8
Access	R/O
Default value	32
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Synchronization type
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x02
Name	Cycle Time
Data type	UNSIGNED32
Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x04
Name	Synchronization types supported
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x05
Name	Cycle time
Data type	UNSIGNED32
Access	R/O
Default value	0x20
PDO mapping	No
Sub	0x06
Name	Calc and copy time
Data type	UNSIGNED32

Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x08
Name	Cycle time
Data type	UNSIGNED16
Access	R/W
Default value	0x10
PDO mapping	No

Sub	0x09
Name	Delay time
Data type	UNSIGNED32
Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x0a
Name	Sync0 cycle time
Data type	UNSIGNED32
Access	R/W
Default value	0x20
PDO mapping	No

Sub	0x0b
Name	SM event missed
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x0c
Name	Cycle time too small
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No
Sub	0x20
Name	Sync error
Data type	BOOLEAN
Access	R/O
Default value	0x01
PDO mapping	No

0x1c33 Sync Manager 3 Synchronization

Object Code	Record

Sub	0x00
Name	Highest subindex supported
Data type	UNSIGNED8
Access	R/O
Default value	32
Low limit	0
High limit	8
PDO mapping	No

Sub	0x01
Name	Synchronization type
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x02
Name	Cycle time
Data type	UNSIGNED32
Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x04
Name	Synchronization types supported
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x05
Name	Cycle time
Data type	UNSIGNED32
Access	R/O
Default value	0x20
PDO mapping	No
Sub	0x06
Name	Calc and copy time
Data type	UNSIGNED32

Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x08
Name	Cycle time
Data type	UNSIGNED16
Access	R/W
Default value	0x20
PDO mapping	No

Sub	0x09
Name	Delay time
Data type	UNSIGNED32
Access	R/O
Default value	0x10
PDO mapping	No

Sub	0x0a
Name	Sync0 cycle time
Data type	UNSIGNED32
Access	R/W
Default value	0x20
PDO mapping	No

Sub	0x0b
Name	SM event missed
Data type	UNSIGNED16
Access	R/O
Default value	0x20
PDO mapping	No

Sub	0x0c
Name	Cycle time too small
Data type	UNSIGNED16
Access	R/O
Default value	0x10
PDO mapping	No
Sub	0x20
Name	Sync error
Data type	BOOLEAN
Access	R/O
Default value	0x01
PDO mapping	No

0x2001, 0x2801 Enc<n> Error Register

Object Code	Variable

Sub	0x00
Name	Enc1 error register
Data type	UNSIGNED8
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1ErrorRegister

See object 0x1001 Error Register

0x2003, 0x2803 Enc<n> Preset Value Signed

Object Code	Variable

Sub	0x00
Name	Enc1 preset value signed
Data type	INTEGER32
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1PresetValueSigned

A/B/Ref or Six-Step encoder only: preset value used when resetting the encoder.

0x2004, 0x2804 Enc<n> Position Value Signed

Object Code	Variable

Sub	0x00
Name	Enc1 position value signed
Data type	INTEGER32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1PositionValueSigned

0x2008, 0x2808 Enc<n> High Resolution Position Value Signed

Object Code	Variable

Sub	0x00
Name	Enc1 high resolution position value signed
Data type	INTEGER64
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1HighResolutionPositionValueSig-ned

0x2009, 0x2809 Enc<n> High Resolution Preset Value Signed

Object Code	Variable

Sub	0x00
Name	Enc1 high resolution preset value signed
Data type	INTEGER64
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1HighResolutionPresetValueSigned

A/B/Ref or Six-Step encoder only: preset value used when resetting the encoder.

0x2014, 0x2814 Enc<n> Linear Position Value

Object Code	Variable

Sub	0x00
Name	Enc1 linear position value
Data type	REAL32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1LinearPositionValue

Position value in user-defined units

0x2015, 0x2815 Enc<n> Linear Position Preset Value

Object Code	Variable
Sub	0x00
Name	Enc1 linear position preset value
Data type	REAL32
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1LinearPositionPresetValue

Position offset in user-defined units

0x2030, 0x2830 Enc<n> High Resolution Speed Value

Object Code	Variable
Sub	0x00
Name	Enc1 high resolution speed value
Data type	INTEGER32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1HighResolutionSpeedValue

Speed value

0x2031, 0x2831 Enc<n> Linear Speed Value

Object Code	Variable
Sub	0x00
Name	Enc1 linear speed value
Data type	REAL32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1LinearSpeedValue

Speed value in user-defined units

0x2032, 0x2832 Enc<n> Speed Value Filter Select

Object Code	Variable

Sub	0x00
Name	Enc1 speed value filter select
Data type	unknown
Access	R/O
Default value	11
PDO mapping	No
Access name	Enc1SpeedValueFilterSelect

Configuration object for calculating the speed:

0 no filter
10 PT1 filter
11 integration (default)

0x208f, 0x288f Enc<n> Position Encoder Resolution

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	2
PDO mapping	No

Sub	0x01
Name	Encoder increments
Data type	UNSIGNED32
Access	R/W
Default value	0x000003E8
PDO mapping	No
Access name	Enc1PositionEncoderResolution.EncoderIncre-ments

Sub	0x02
Name	Motor revolutions
Data type	UNSIGNED32
Access	R/W
Default value	0x00000001
PDO mapping	No
Access name	Enc1PositionEncoderResolution.MotorRevolutions

To convert the units:

$$\frac{Encoder\ Increments\ 208f: 01}{Motor\ Revolution\ 208f: 02}$$

0x2091, 0x2891 Enc<n> Gear Ratio

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	Ro0
Default value	2
PDO mapping	No

Sub	0x01
Name	Motor shaft revolutions
Data type	UNSIGNED32
Access	R/W
Default value	0x00000001
PDO mapping	No
Access name	Enc1GearRatio.MotorShaftRevolutions

Sub	0x02
Name	Driving shaft revolutions
Data type	UNSIGNED32
Access	R/W
Default value	0x00000001
PDO mapping	No
Access name	Enc1GearRatio.DrivingShaftRevolutions

To convert the units:

$$\frac{Motor\ Shaft\ Revolutions\ 2091{:}\,01}{Driving\ Shaft\ Revolutions\ 2091{:}\,02}$$

0x2092, 0x2892 Enc<n> Feed Constant

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	2
PDO mapping	No

Sub	0x01
Name	Feed
Data type	UNSIGNED32
Access	R/W
Default value	0x00000064
PDO mapping	No
Access name	Enc1FeedConstant.Feed

Sub	0x02
Name	Shaft revolutions
Data type	UNSIGNED32
Access	R/W
Default value	0x00000001
PDO mapping	No
Access name	Enc1FeedConstant.ShaftRevolutions

To convert the units:

$$\frac{Feed\ 2092{:}\,01}{Shaft\ Revolutions\ 2092{:}\,02}$$

0x2100, 0x2900 Enc<n> Digital Interface Type

Object Code	Variable

Sub	0x00
Name	Enc1 digital interface type
Data type	UNKNOWN
Access	R/W
Default value	64
PDO mapping	No
Access name	Enc1DigitalInterfaceType

To set up the encoder connected:

64 Encoder (default)
65 SSI
69 Endat
80 EventCounter

0x2101, 0x2901 Enc<n> Digital Interface Control

Object Code	Variable

Sub	0x00
Name	Enc1 digital interface control
Data type	UNSIGNED16
Access	R/W
Default value	0
PDO mapping	Optional, RPDO only
Access name	Enc1DigitalInterfaceControl

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RC6	RC5	RC4	RC3	RC2	RC1					RTS	RES CNT		REF DI	REF CNT	RES Err

RES Err

0 = do nothing

1 = reset device

REF CNT

A/B/Ref counter: Rising edge starts referencing the A/B/Ref counter's Ref track

REF DI: (software release 1.10 or higher)

Enables referencing the digital reference input

RES CNT: (software release 1.10 or higher)

A/B/Ref counter: A rising edge resets the current counter reading

RTS: (software release 2.20 or higher)

Reset Timestamp Count: Resets the timestamp counter

RC1…6 (Reset Event Counter 1...6)

A rising edge resets the associated event counter

0x2102, 0x2902 Enc<n> Digital Interface Status

Object Code	Variable

Sub	0x00
Name	Enc1 digital interface status
Data type	UNSIGNED16
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1DigitalInterfaceStatus

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
							TTO	HOME					DIR	REF	

REF:

0 = A/B/Ref encoder not referenced

1 = A/B/Ref encoder referenced

DIR

0 = clockwise (CW)

1 = counterclockwise (CCW)

HOME

0 = no referencing

1 = home offset value applies, referencing using the digital input was successful

TTO (Timestamp Timeout):

0 = < 6 seconds between two subsequent input signals

1 = new edge not detected within 6 seconds => standstill

0x2103, 0x2903 Enc<n> Digital Interface Config

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	5
PDO mapping	No

Sub	0x01
Name	Enc1 encoder: level
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	Enc1DigitalInterfaceConfig.Enc1Encoder:Level

Sub	0x02
Name	Enc1 encoder: mode
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	Enc1DigitalInterfaceConfig.Enc1Encoder:Mode

Sub	0x03
Name	Enc1 encoder: index level
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	Enc1DigitalInterfaceConfig.Enc1Encoder:Indexlevel
Sub	0x04
Name	Enc1 SSI: use Gray code
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No

Access name	Enc1DigitalInterfaceConfig.Enc1SSI:Usegreycode

Sub	0x05
Name	Enc1 event counter: sensitivity
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	Enc1DigitalInterfaceConfig.Enc1EventCounter:Sensitivity

Object for configuring the counter/encoder interface

Subindex 01 (Encoder: Level)

0 HTL (default)

1 TTL

2 RS422

Subindex 02 (Encoder: Mode)

0 multi-turn encoder, no index (default)

1 single-turn encoder

Subindex 03 (Encoder: Index Level)

0 reference on rising edge (default)

1 reference on falling edge

3 reference on both edges

Subindex 04 (SSI: Use Gray Code)

0 straight binary (default)

1 Gray coded binary

Subindex 05 (Event Counter: Sensitivity)

0 count rising edges (default)

1 count falling edges

3 count both edges

0x2110, 0x2910 Enc<n> Digital Interface Bit Size

Object Code	Variable
Sub	0x00
Name	Enc1 digital interface bit size
Data type	UNSIGNED8
Access	R/O
Default value	
PDO mapping	No
Access name	Enc1DigitalInterfaceBitSize

SSI / ENDAT: Encoder resolution as per the data sheet

0x2111, 0x2911 Enc<n> Digital Interface Baud Rate

Object Code	Variable
Sub	0x00
Name	Enc1 digital interface baud rate
Data type	UNSIGNED16
Access	R/W
Default value	0x03E8
PDO mapping	No
Access name	Enc1DigitalInterfaceBaudRate

SSI / ENDAT: Clock frequency, in kHz, as per encoder data sheet

0x2120, 0x2920 Enc<n> Index Capture Value

Object Code	Variable
Sub	0x00
Name	Enc1 index capture value
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1IndexCaptureValue

0x2121, 0x2921 Enc<n> Capture Input Value

Object Code	Variable

Sub	0x00
Name	Enc1 capture input value
Data type	UNKNOWN
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1CaptureInputValue

0x2122, 0x2922 Enc<n> Encoder Track ABRef

Object Code	Variable

Sub	0x00
Name	Enc1 encoder track ABRef
Data type	UNSIGNED8
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1EncoderTrackABRef

7	6	5	4	3	2	1	0
					Ref	B	A

Level of encoder track signal

0x2123, 0x2923 Enc<n> Continuous Position Value

Object Code	Variable

Sub	0x00
Name	Enc1 Continuous position value
Data type	UNKNOWN
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1CaptureInputValue

Counter reading without index in single-turn mode

0x213f, 0x293f Enc<n> ErrorCode

Object Code	Variable

Sub	0x00
Name	Enc1 ErrorCode
Data type	UNSIGNED16
Access	R/O
Default value	
PDO mapping	No
Access name	Enc1ErrorCode

See table for object "0x1003 Pre-defined error field"

0x2408 Event Counter Count

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	6
PDO mapping	No

Sub	0x01
Name	Event counter channel 1
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel1

Sub	0x02
Name	Event counter channel 2
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel2

Sub	0x03
Name	Event counter channel 3
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel3

Sub	0x04
Name	Event counter channel 4
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel4

Sub	0x05
Name	Event counter channel 5
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel5

Sub	0x06
Name	Event counter channel 6
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	EventCounterCount.EventCounterChannel6

0x3000 Digital Input Function Select

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	4
PDO mapping	No

Sub	0x01
Name	DI01 input function select
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	DigitalInputFunctionSelect.DI01InputFunctionSelect

Sub	0x02
Name	DI02 input function select
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	DigitalInputFunctionSelect.DI02InputFunctionSelect

Sub	0x03
Name	DI03 input function select
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	DigitalInputFunctionSelect.DI03InputFunctionSelect

Sub	0x04
Name	DI04 input function select
Data type	UNKNOWN
Access	R/O
Default value	0
PDO mapping	No
Access name	DigitalInputFunctionSelect.DI04InputFunctionSelect

Object for configuring the input function

0 digital input (default)
1 special function enable
2 timestamp function (subs 0x01 and 0x02)

0x3001 Digital Input Edge Sensitivity Select

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	4
PDO mapping	No

Sub	0x01
Name	DI01 edge sensitivity select
Data type	UNKNOWN
Access	R/O
Default value	1
PDO mapping	No
Access name	DigitalInputEdgeSensivitySelect.DI01EdgeSensitivitySelect

Sub	0x02
Name	DI02 edge sensitivity select
Data type	UNKNOWN
Access	R/O
Default value	1
PDO mapping	No
Access name	DigitalInputEdgeSensivitySelect.DI02EdgeSensitivitySelect

Sub	0x03
Name	DI03 edge sensitivity select
Data type	UNKNOWN
Access	R/O
Default value	1
PDO mapping	No
Access name	DigitalInputEdgeSensivitySelect.DI03EdgeSensitivitySelect

Sub	0x04
Name	DI04 edge sensitivity select

Data type	UNKNOWN
Access	R/O
Default value	1
PDO mapping	No
Access name	DigitalInputEdgeSensivitySelect.DI04EdgeSensitivitySelect

Object for configuring the input edges

1 rising edge (default)

2 falling edge

3 both edges

0x3002 Digital Input Filter Select

Object Code	Record

Sub	0x00
Name	Highest sub-index supported
Data type	UNSIGNED8
Access	R/O
Default value	4
PDO mapping	No

Sub	0x01
Name	DI01 input filter select
Data type	UNKNOWN
Access	R/O
Default value	2
PDO mapping	No
Access name	DigitalInputFilterSelect.DI01InputFilterSelect

Sub	0x02
Name	DI02 input filter select
Data type	UNKNOWN
Access	R/O
Default value	2
PDO mapping	No
Access name	DigitalInputFilterSelect.DI02InputFilterSelect

Sub	0x03
Name	DI03 input filter select
Data type	UNKNOWN
Access	R/O
Default value	2

PDO mapping	No
Access name	DigitalInputFilterSelect.DI03InputFilterSelect

Sub	0x04
Name	DI04 input filter select
Data type	UNKNOWN
Access	R/O
Default value	2
PDO mapping	No
Access name	DigitalInputFilterSelect.DI04InputFilterSelect

Object for selecting the input filter:

0 no filter / special function is edge triggered
1 0.3ms filter
2 1.0ms filter (default)
3 3.0ms filter
4 5.0ms filter
5 10ms filter
6 20ms filter

0x3060 DI01 Timestamp Period, 0x0361 DI02 Timestamp Period

Object Code	Variable

Sub	0x00
Name	DI01 timestamp period, DI02 timestamp period
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	DI01TimestampPeriod, DI02TimestampPeriod

Actual time between 2 subsequent input pulses, if the Timestamp input function has been set in 0x3000.

0x3070 DI01 Timestamp Event Count, 0x3071 DI02 Timestamp Event Count

Object Code	Variable

Sub	0x00
Name	DI01 timestamp event count, DI02 timestamp event count
Data type	UNSIGNED32
Access	R/O
Default value	

PDO mapping	Optional, TPDO only
Access name	DI01TimestampEventCount, DI02TimestampEventCount

Actual counter reading of inputs DI01 and DI02, if the Timestamp input function has been set in 0x3000.

0x3100, 0x3900 Enc<n> DI Capture Value SD

Object Code	Variable

Sub	0x00
Name	Enc01 DI capture value SD
Data type	INTEGER32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc01DICaptureValueSD

0x3101, 0x3901 Enc<n> DI Capture Value HD

Object Code	Variable

Sub	0x00
Name	Enc01 DI capture value HD
Data type	INTEGER64
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc01DICaptureValueHD

0x3200, 0x3a00 Enc<n> DI Homeoffset Value SD

Object Code	Variable

Sub	0x00
Name	Enc01 DI homeoffset value SD
Data type	INTEGER32
Access	R/W
Default value	
PDO mapping	Optional, RPDO only
Access name	Enc01DIHomeoffsetValueSD

0x3201, 0x3a01 Enc<n> DI Homeoffset Value HD

Object Code	Variable

Sub	0x00
Name	Enc01 DI homeoffset value HD
Data type	INTEGER64
Access	R/W
Default value	
PDO mapping	Optional, RPDO only
Access name	Enc01DIHomeoffsetValueHD

0x6000, 0x6800 Enc<n> Operating Parameters

Object Code	Variable

Sub	0x00
Name	Enc1 operating parameters
Data type	UNSIGNED16
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1OperatingParameters

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
												DIR			

Bit 3 DIR

0 = clockwise

1 = counterclockwise

0x6002, 0x6802 Enc<n> Total Measuring Range

Object Code	Variable

Sub	0x00
Name	Enc1 total measuring range
Data type	UNSIGNED32
Access	R/W
Default value	4000
PDO mapping	No
Access name	Enc1TotalMeasuringRange

Encoder resolution. Relevant for overflow in single-turn mode

0x6003, 0x6803 Enc<n> Preset Value

Object Code	Variable

Sub	0x00
Name	Enc1 preset value
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1PresetValue

0x6004, 0x6804 Enc<n> Position Value

Object Code	Variable

Sub	0x00
Name	Enc1 position value
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1PositionValue

0x6005, 0x6805 Enc<n> Linear Encoder Measuring Step Settings

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	1
PDO mapping	No

Sub	0x01
Name	Position step setting
Data type	UNSIGNED32
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1LinearEncoderMeasuringStepSettings.PositionStepSetting

0x6008, 0x6808 Enc<n> High Resolution Position Value

Object Code	Variable

Sub	0x00
Name	Enc1 high resolution position value
Data type	UNSIGNED64
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1HighResolutionPositionValue

0x6009, 0x6809 Enc<n> High Resolution Preset Value

Object Code	Variable

Sub	0x00
Name	Enc1 high resolution preset value
Data type	UNSIGNED64
Access	R/W
Default value	
PDO mapping	No
Access name	Enc1HighResolutionPresetValue

0x600b, 0x680b Enc<n> High Resolution Raw Value

Object Code	Variable

Sub	0x00
Name	Enc1 high resolution raw value
Data type	UNSIGNED64
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1HighResolutionRawValue

64-bit raw encoder value without any offsets, homing and index

0x600c, 0x680c Enc<n> Position Raw Value

Object Code	Variable

Sub	0x00
Name	Enc1 position raw value
Data type	UNSIGNED32
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1PositionRawValue

32-bit raw encoder value without any offsets, homing and index

0x6030, 0x6830 Enc<n> Speed Value

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	1
PDO mapping	No

Sub	0x01
Name	Enc1 speed value channel 1
Data type	INTEGER16
Access	R/O
Default value	
PDO mapping	Optional, TPDO only
Access name	Enc1SpeedValue.Enc1SpeedValueChannel1

0x6031, 0x6831 Enc<n> Speed Parameters

Object Code	Record

Sub	0x00
Name	SubIndex 000
Data type	UNSIGNED8
Access	R/O
Default value	4
PDO mapping	No

Sub	0x01
Name	Enc1 speed source selector
Data type	UNKNOWN
Access	R/W
Default value	4
PDO mapping	No
Access name	Enc1SpeedParameters.Enc1SpeedSourceSelector

Sub	0x02
Name	Enc1 speed integration time
Data type	UNSIGNED16
Access	R/O
Default value	100
PDO mapping	No
Access name	Enc1SpeedParameters.Enc1SpeedIntegrationTime

Sub	0x03
Name	Enc1 multiplier value
Data type	UNSIGNED16
Access	R/O
Default value	1
Low limit	1
High limit	65535
PDO mapping	No
Access name	Enc1SpeedParameters.Enc1Multipliervalue
Sub	0x04
Name	Enc1 divider value
Data type	UNSIGNED16
Access	R/W

Default value	1
Low limit	1
High limit	65535
PDO mapping	No
Access name	Enc1SpeedParameters.Enc1Dividervalue

Sub 01:

0x04 = use object 0x600B

0xF0 = use object 0x2123

Sub 02:

Integration time in [ms]

Sub 03:

Conversion factor for calculating the speed; result output to 0x6030

Sub 04:

Conversion divider for calculating the speed; result output to 0x6030

0x6500, 0x6d00 Enc<n> Operating Status

Object Code	Variable

Sub	0x00
Name	Enc1 operating status
Data type	UNSIGNED16
Access	R/O
Default value	
PDO mapping	No
Access name	Enc1OperatingStatus

12.3.9. Objektverzeichnis: Erweiterte OC-Prozessdatenobjekte

0x1a08 One Channel Position Encoder 1 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000310
PDO Mapping	no

0x1a08 One Channel Position Encoder 1 (Record)	
Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40000520
PDO Mapping	no

0x1a09 One Channel Speed Encoder 1 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40010520
PDO Mapping	no

0x1a0a One Channel Position Encoder 2 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40020520
PDO Mapping	no

0x1a0b One Channel Speed Encoder 2 (Record)	
Sub	0x00
Name	SubIndex 000
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	Mapping Entry 1
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030120
PDO Mapping	no

Sub	0x02
Name	Mapping Entry 2
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030220
PDO Mapping	no

Sub	0x03
Name	Mapping Entry 3
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030310
PDO Mapping	no

Sub	0x04
Name	Mapping Entry 4
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030420
PDO Mapping	no

Sub	0x05
Name	Mapping Entry 5
Data Type	UNSIGNED32
Access	ro
Defaultvalue	0x40030520
PDO Mapping	no

0x4000 Enc01 OC Position (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCPosition.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCPosition.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCPosition.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCPosition.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCPosition.Crc32

0x4001 Enc01 OC Speed (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCSpeed.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCSpeed.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCSpeed.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCSpeed.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc01OCSpeed.Crc32

0x4002 Enc02 OC Position (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCPosition.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCPosition.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCPosition.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCPosition.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCPosition.Crc32

0x4003 Enc02 OC Speed (Record)	
Sub	0x00
Name	Highest sub-index supported
Data Type	UNSIGNED8
Access	ro
Defaultvalue	5
PDO Mapping	no

Sub	0x01
Name	CycleCnt
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCSpeed.CycleCnt

Sub	0x02
Name	Timestamp
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCSpeed.Timestamp

Sub	0x03
Name	SenderId
Data Type	UNSIGNED16
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCSpeed.SenderId

Sub	0x04
Name	Value
Data Type	INTEGER32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCSpeed.Value

Sub	0x05
Name	Crc32
Data Type	UNSIGNED32
Access	ro
PDO Mapping	optional, TPDO only
Accessname	Enc02BCSpeed.Crc32

12.3.10. Technische Daten

MC-I/O OC Counter/Encoder	
Allgemein	
Channel	2 (counters/encoders) or 6 (event counters)
EtherCAT Slave Control-ler	ASIC ET1200
Connection E-Bus	10-pole system plug in side wall
E-Bus-Load	150mA
I/O/Power connection	Connector 36-pole
Power supply	24 V DC (-15% ... +20%)
Potential isolation	500V E-Bus / Spannungsversorgung
Part no.	S-01030206-0200
Counter/encoder	
RS422	32Bit, 5 MHz
5/24V SE	32Bit, 1,6 MHz
Six-Step-encoder	32Bit, 8 kHz
SSI	18-32 Bit, 80-1000 Kbit/s
EnDAT 2.1	100 kHz – 2 MHz
Ereigniszähler	2 x HTL/TTL 32Bit, 400 kHz (Kanal 0, 3) 4 x HTL/TTL 32Bit, 5 kHz (Kanal 1, 2, 4, 5)
Counter/encoder supply voltage	5 V/150 mA / counter/encoder
Line length	<30m shielded cable
Digital inputs (hardware rev. 2)	
Quantity	4
Function	Digital Input oder Encoder capture / encoder reference or Event counter, 32-bit, 4kHz with timestamp function
Signal level	„Off“: < 8,0V (EN61131-3 Typ 3)

12.4. Use with CODESYS Safety

12.4.1. Prerequisites

Know how to programme and configure EtherCAT.

12.4.2. Applicability

Software

i HINWEIS

Note on software releases: Note that safety applications set requirements as to the software releases you use. Refer to the release documentation of the Safety Packages for details.

- → CODESYS V3.5 SP16 Patch40 (32 Bit)
  - o Berghof_SafetyPackageV1.6.1_SafetyModulesV1.4.0.zip
  - o E-IO_Safety_Extension_V1.6.1.0_for_CODESYS_V3.5.16.40.package
  - o Berghof_Safety_Library

Hardware

- → CODESYS Control with EtherCAT Master in the CODESYS version compatible with the software
- → B-Nimis MC-I/O Buskoppler
- → B-Nimis MC-I/O Safety PLC
- → B-Nimis MC-I/O OC

Virtual Devices

External Communication Monitoring V1.0.0.0

12.4.3. Other Applicable Documents

- → CODESYS Safety user manual
- → User manual: B-Nimis MC-I/O Safety PLC

12.4.4. Example Application

The example application below uses a B-Nimis MC-I/O OC AI4. In this case, all analogue input channels are transferred to the safety application and monitored there.

Overview

Figure 92: application example B-Nimis MC-I/O OC AI4:

Working steps

1. B-Nimis MC-I/O OC AI4 12
   Analogue input module based on B-Nimis OC technology
2. External Communication Monitoring
   These modules hold the safeguarded OC data containers for logic data interchange with the safety application
3. PLC_PRG
   PLC_PRG converts the OC variables into the variables of module External Communication Monitor-ing.
4. Data PDO DINT
   Logic data interchange unit containing the OC data containers inside the safety application.
5. SafetyPOU
   SafetyPOU checks the data received from logic data interchange. Every OC data container needs a separate function block instance of type SF01_ECM.

Configuring the B-Nimis MC-I/O OC Module

In this example, the B-Nimis MC-I/O OC AI4 12Bit module is used. The standard configuration of the analog inputs can be found in the product manual *B-Nimis MC-I/O Analog I/O Modules*.
To use OC technology, activate the desired OC data containers in the process data configuration. To do this, open the configuration of the B-Nimis MC-I/O OC AI4 module and navigate to the 'Process Data' tab.

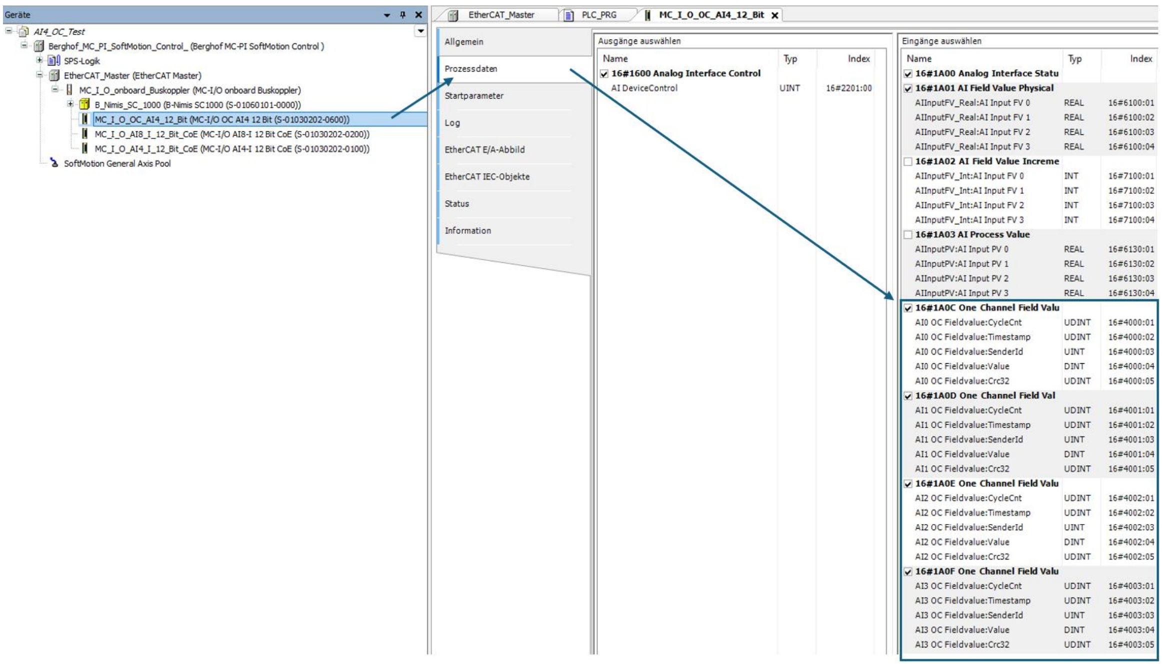


Figure 93: configuration B-Nimis MC-I/O OC AI4 12Bit

Now go to tab EtherCAT I/O Mapping and assign symbolic names to the process data, for example.,

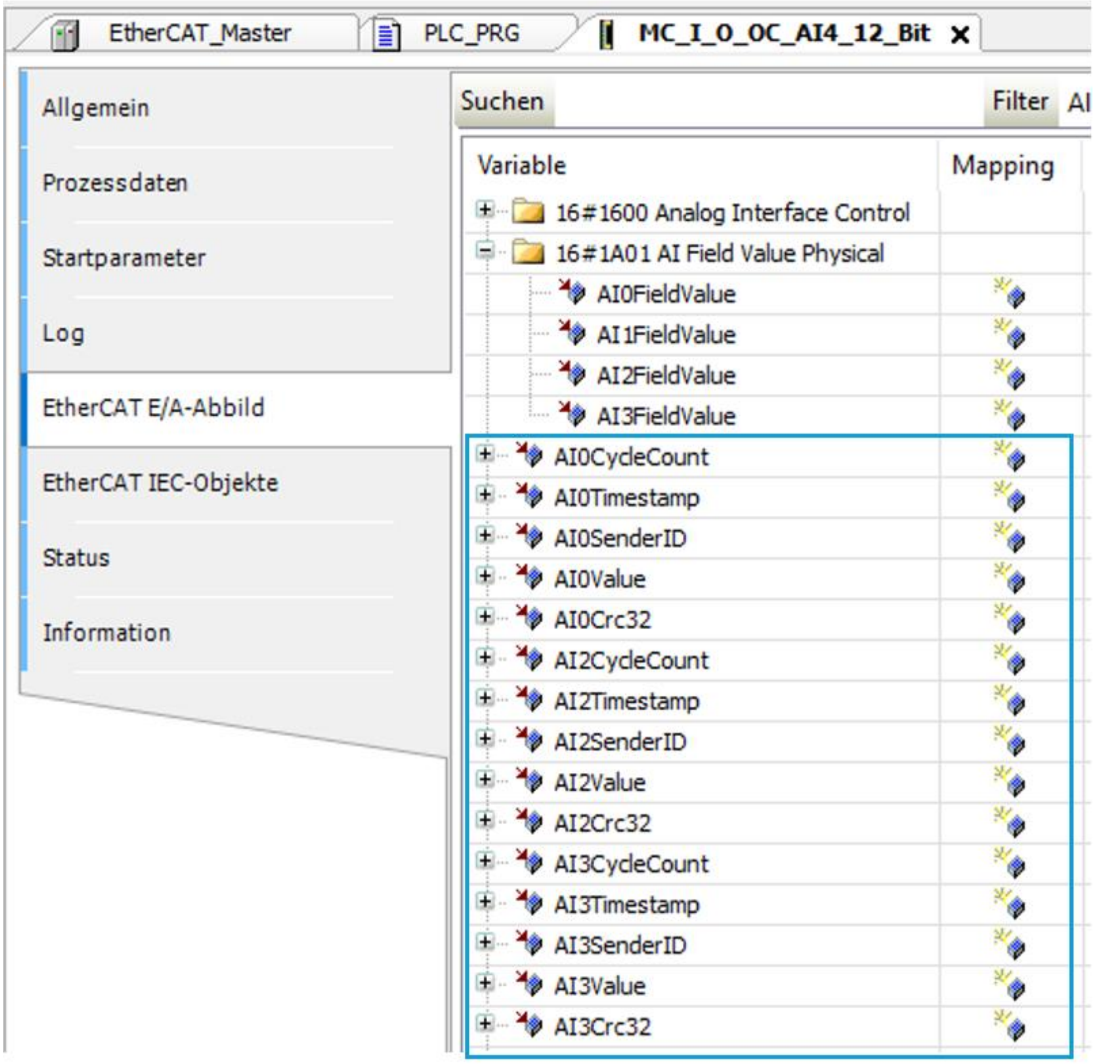


Figure 94: Tab „EtherCAT I/O Mapping“

Appending the External Communication Monitoring Module(s)

You need a module of type External Communication Monitoring for every OC data container in your application. To add the modules to the Devices Explorer, right-click on the control unit and pick Add Device from the right-click menu.

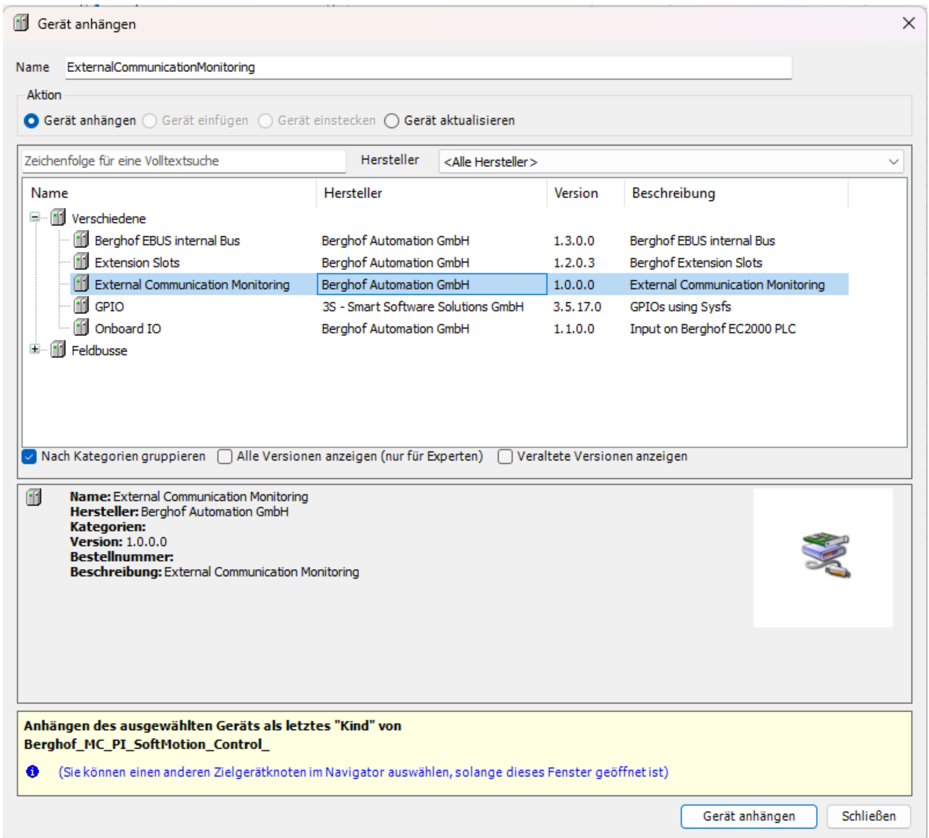


Figure 95: External Communication Monitoring Modul(e)

Assign any name to the device and click on Add Device. Repeat the process until every OC data container has an External Communication Monitoring module to it.

Then display the associated configuration. Go to tab DataPDO I/O Mapping and assign a symbolic name to each of your OC data containers.

Sample symbolic name of the first OC data container:

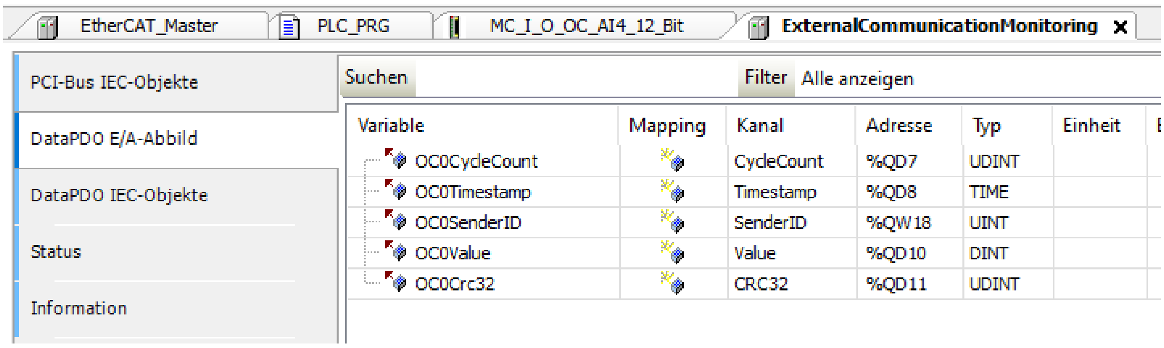


Figure 96: Symbolic names for the first OC data container

Copying the Data for the OC Data Containers

A standard POU (in PLC_PRG in this case) is used to copy the data. Using the previously assigned symbolic names, the resulting ST programme code looks as follows:

```
OC0CycleCount := AI0CycleCount;
OC0Timestamp := UDINT_TO_TIME(AI0Timestamp);
OC0SenderID := AI0SenderID;
OC0Value := AI0Value;
OC0Crc32 := AI0Crc32;

OC1CycleCount := AI1CycleCount;
OC1Timestamp := UDINT_TO_TIME(AI1Timestamp);
OC1SenderID := AI1SenderID;
OC1Value := AI1Value;
OC1Crc32 := AI1Crc32;

OC2CycleCount := AI2CycleCount;
OC2Timestamp := UDINT_TO_TIME(AI2Timestamp);
OC2SenderID := AI2SenderID;
OC2Value := AI2Value;
OC2Crc32 := AI2Crc32;

OC3CycleCount := AI3CycleCount;
OC3Timestamp := UDINT_TO_TIME(AI3Timestamp);
OC3SenderID := AI3SenderID;
OC3Value := AI3Value;
OC3Crc32 := AI3Crc32;
```

Logic Data Interchange Devices
Appending an External Communication Monitoring module already added the associated logic data interchange devices of type DataPDO DINT 1x below the Logic Devices level within the safety application. There is no more configuration than that.

Using the OC Data Containers in the Safety Application
Before the safety application can make use of the data, it must first analyse the OC data containers. This is done by function block SF01_ECM, ECM being short for External Communication Monitoring. External communication monitoring targets a CRC32-verified data element consisting of a cycle counter, a timestamp, a sender ID and a value needed to check whether cyclic data element reception occurs within the set monitoring time.

Run an existing program module in your safety application or create a new program module.

Add a new network to that module, as necessary.

Right-click on the network and pick "Insert empty box" from the menu and then select the “SF01_ECM” function block inside the input assistant.

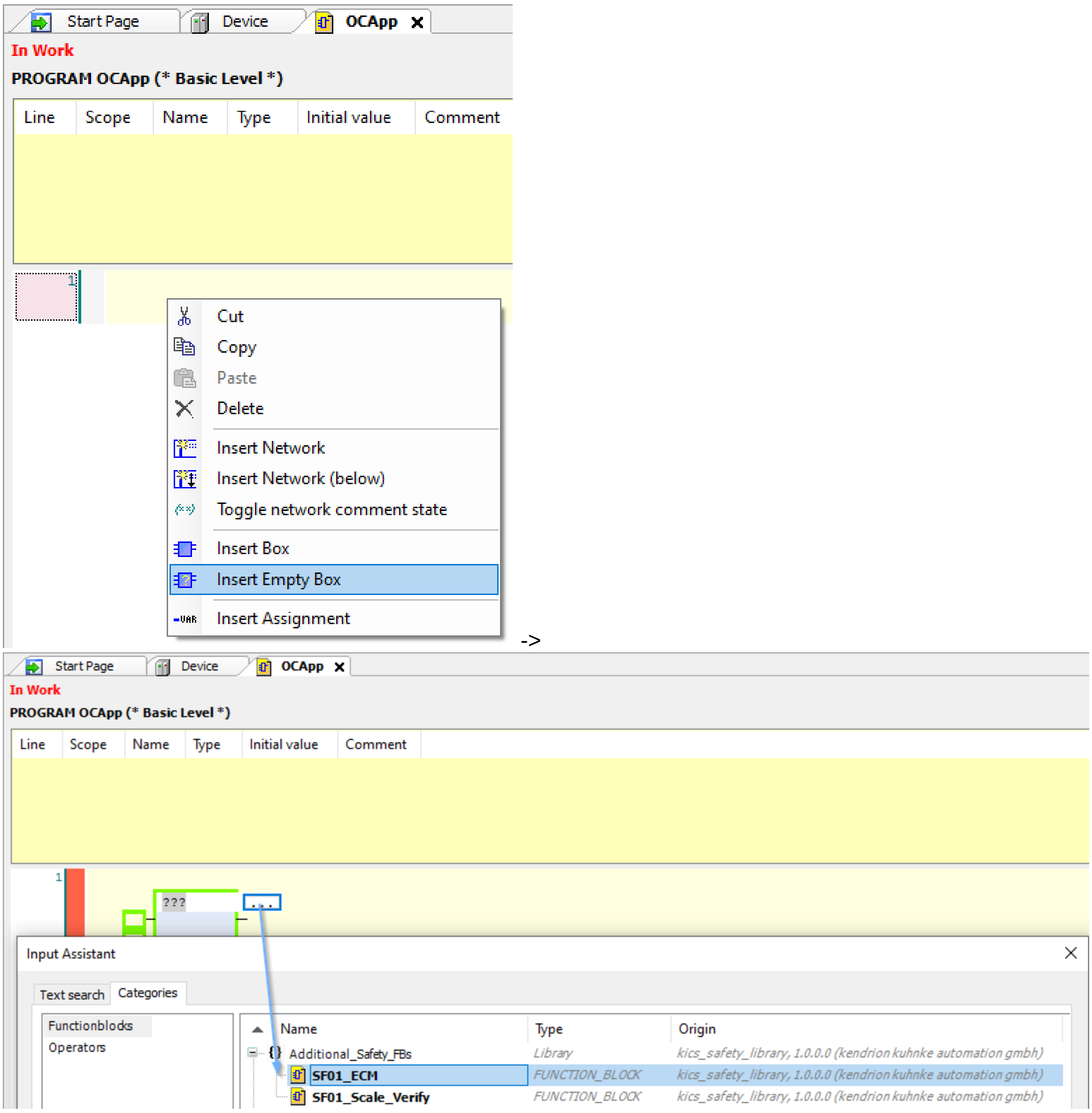


Figure 97: Context menu “Insert empty box

Now reference the resulting function block instance to any of the OC data containers in the logic I/Os.

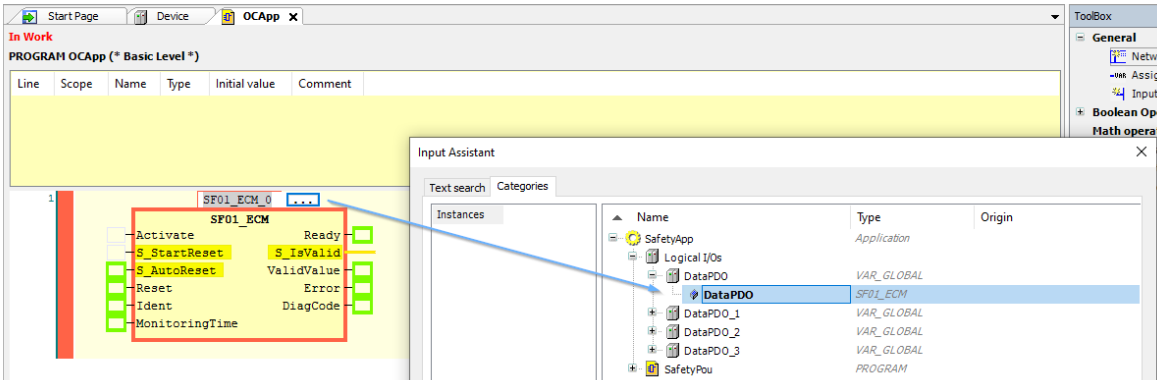


Figure 98: Referencing function block instance

i NOTE

Information:

→ A full description of the „SF01_ECM“ function block can be found in the Safety PLC manual.

To actually enable the function block, check that the following inputs are set:

➔ Activate: Can be set to a constant TRUE

➔ Reset: Link this input to any signal used for error acknowledgment. Our example also uses a signal from logic data interchange between the standard application and the safety application. This allows you to acknowledge safety application errors by means of a button on the machine visualisation display screen, for example.
Optionally you can set the Input S_StartReset on “TRUE” so that the function block will perform a communication reset once during the startup.

➔ Ident: Enter the SenderID of the channel and be sure to use the same ID as in the OC data container. First of all, go to the declaration section of the POU, declare a constant of type WORD and enter the SenderID as the initial value. Then change the name of column Scope VAR to VAR_CONSTANT.

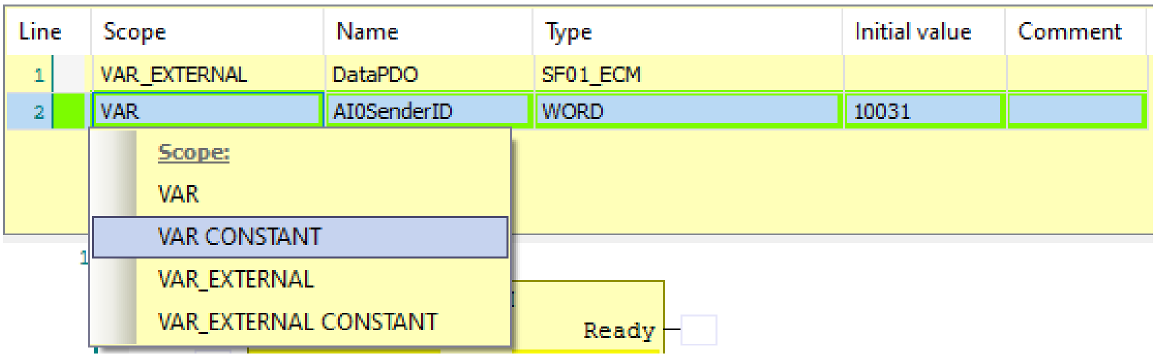


Figure 99: Change Scope VAR in VAR_CONSTANT

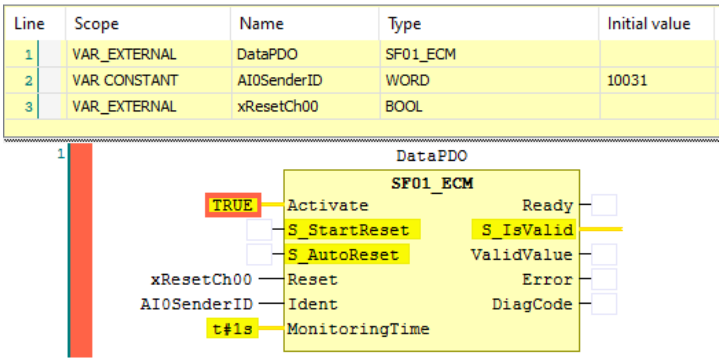
i NOTE

Information:

→ The SenderID for the respective function block is derived from the EtherCAT address of the OC module and the used I/O channel.
e.g. if the OC module has an EtherCAT address of 1003 and the value from channel 1 is to be read, the SenderID would be 10031. For channel 2, the SenderID would be 10032, and so on.

➔ MonitoringTime: Set the monitoring time, as appropriate. The function block will return an error if the OC data container does not change within the set monitoring time.

Example:



Line	Scope	Name	Type	Initial value
1	VAR_EXTERNAL	DataPDO	SF01_ECM	
2	VAR CONSTANT	AI0SenderID	WORD	10031
3	VAR_EXTERNAL	xResetCh00	BOOL	

Figure 100: Create variable status output "S_IsValid"

Your application defines how the outputs are used. In our example, status output S_IsValid was expanded by a variable called xOC00IsValid (type: SAFEBOOL) as well as variable xCH00IsValid (type: BOOL) needed for data exchange with the PLC.

Repeat the above steps to add further OC data containers to your safety application.

Considering all 4 of the analogue inputs, your application might look like this:

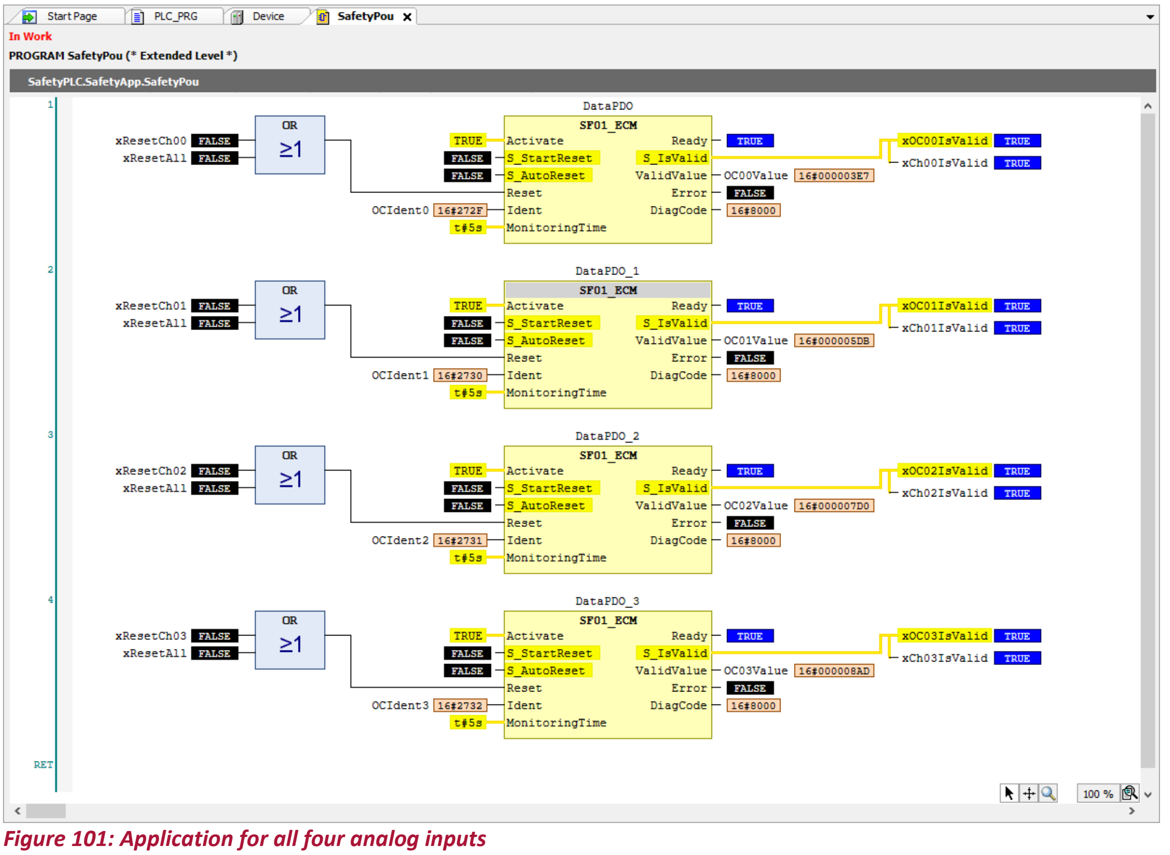


Figure 101: Application for all four analog inputs

12.5. Gesamtübersicht MC-I/O OC-Module

MC-I/O OC-Module		
Bezeichnung	**Bestellnummer**	**Seite**
B-Nimis MC-I/O OC AI4-U/I 12 Bit	S-01030202-0600	217
B-Nimis MC-I/O OC Counter/Encoder	S-01030206-0200	294
Zubehör		
Hier Stecker hinzufügen		
B-Nimis MC-I/O Schirmanschlussklemme 2x8mm	S-02060101-0100	
B-Nimis MC-I/O Schirmanschlussklemme 1x14mm	S-02060101-0200	

13. Supplement

13.1. POTENTIALVERTEILER 2x16 (Potential distributor)

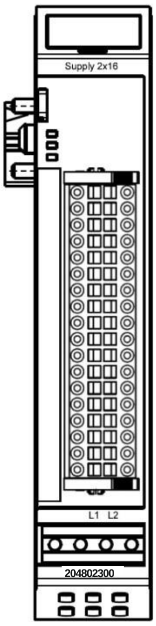


Figure 102: Front view of POTENTIALVERTEILER 2x16

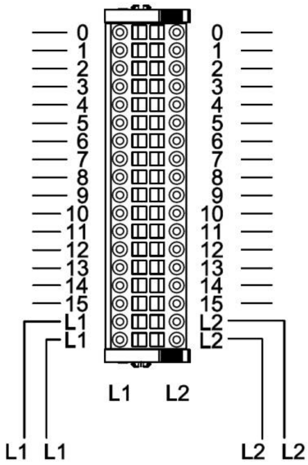


Figure 103: I/O connection

13.1.1. Terminals

The module POTENTIALVERTEILER 2x16 has 2 separate potential lines.
It distributes the potential (optional 0 V DC or 24 V DC) attached at the pins L1 or L2 on the pins 0 to 15 of the same row.
The E-bus is passed on from the previous one to the next module.

13.1.2. Status LEDs

The module has no status LEDs.

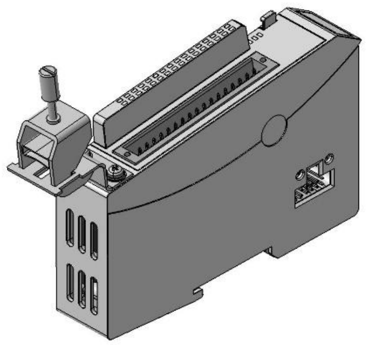
13.1.3. Function

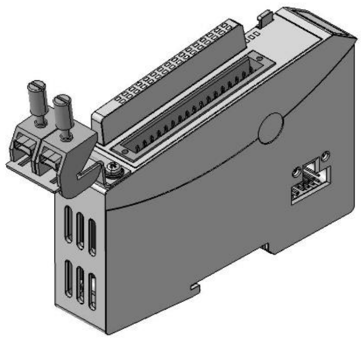
2-wire or 3-wire terminals for digital I/O modules

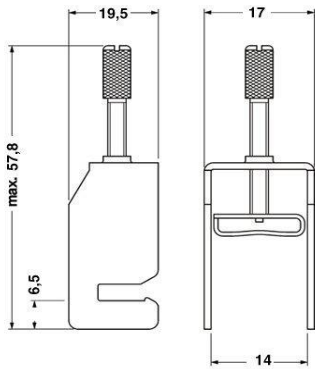
13.1.4. Technical data

Potential distributor	
Label	POTENTIALVERTEILER 2x16
Part no.	204802300
Plug-in connector	36-pole S-02020201-0900 (not part of the module)
E-bus port	10-pin system plug in side wall
E-bus load	none
UL approval	c UL us LISTED 59DM E242595 IND.CONT.EQ.

13.2. SHIELD CONNECTION CLAMP (Shield connection terminal block)







SHIELD CONNECTION CLAMP 1x14 mm; 2x8 mm Dimensions of the 14 mm terminal

13.2.1. Terminals

The shield connection terminal block consists of the shield clamp, the clamp holder, 2 screws M3x5, 2 washers and 2 spring washers. Fasten the clamp holder with the 2 screws by using the washers and spring washers on the housing of the B-Nimis MC-I/O module. Use the two tapped holes on the front side below. They are provided for it.

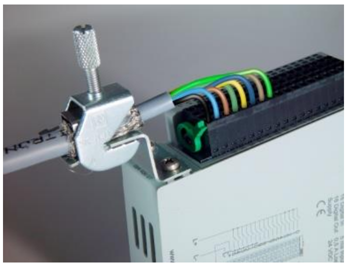


Figure 104: SHIELD CONNECTION CLAMP 14 mm

13.2.2. Function

The shield connection terminal block makes it easy to apply the cable shield. The shield connection terminal block conducts the potential of the cable screen on the DIN top hat rail on which the B-Nimis MC-I/O module is picked up.

WARNING

The mounting rail must have a suitable earth connection.

The shield connection terminal blocks may not be used as strain relief. See also section 3.1.1 Earth.

13.2.3. Technical data

Shield connection terminal block	
Label	SCHIRMANSCHLUSSKLEMME 2x8 mm
Part no.	204802400

14. Annex

14.1. Environmental Protection

14.1.1. Emission

When used correctly, our modules do not produce any harmful emissions.

14.1.2. Disposal

At the end of their service life, modules may be returned to the manufacturer against payment of an all-inclusive charge to cover costs. The manufacturer will then arrange for the modules to be recycled.

14.2. Maintenance/Upkeep

⚠ WARNING

Do not insert, apply, detach or touch connections while in operation – risk of destruction or malfunction.

Disconnect all incoming power supplies before working on our modules; this also applies to connected peripheral equipment such as externally powered sensors, programming devices, etc. All ventilation openings must always be kept free of any obstruction.

- → The modules are maintenance-free when used correctly.
- → Clean only with a dry, non-fluffing cloth.
- → Do not use detergents!

14.3. Repairs/Service

⚠ WARNING

Repair work may only be carried out by the manufacturer or its authorised service engineers.

14.3.1. Warranty

Sold under statutory warranty conditions. Warranty lapses in the event of unauthorised attempts to repair the equipment and/or product, or in the event of any other form of intervention.

14.4. Product identification

The product identification is on the front part and on the side part.

Product identification descriptions (example)

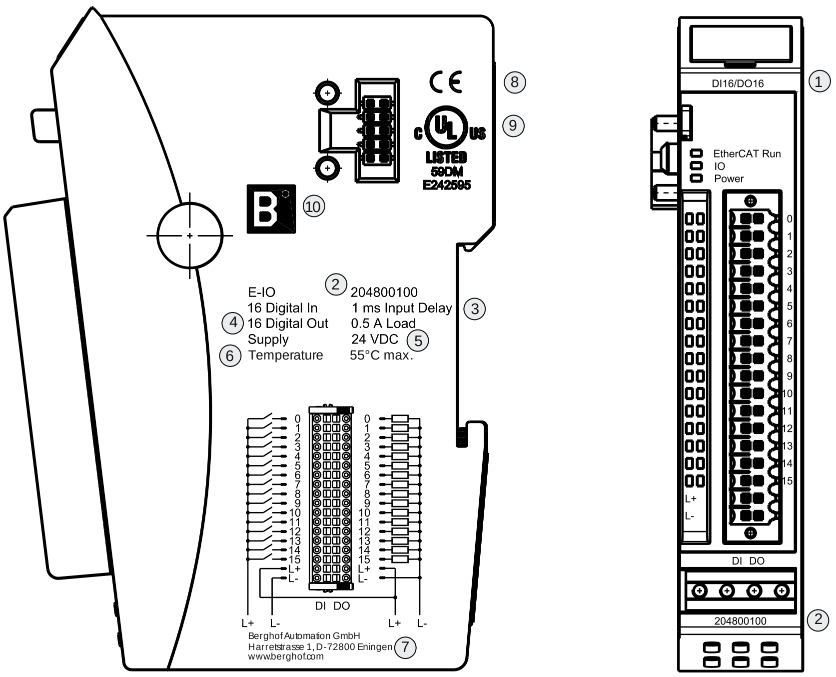


Figure 105: Product identification

2VF100670DG00.cdr

1	**Designation of device type**
2	**Item no.**
3	**Input delay**
4	**Max. current**
5	**Power supply**
6	**Temperature**
7	**Manufacturer's address**
8	**CE marking**
9	**UL approval**
10	**Brand of the manufacturer (trademark)**

14.5. Addresses and Bibliography / Standards

14.5.1. Addresses

CAN in Automation; international manufacturers and users organisation for CAN users in the field of automation:
CAN in Automation e.V. (CiA)
Am Weichselgarten 26
D-91058 Erlangen / Germany
headquarters@can-cia.de
www.can-cia.de

EtherCAT Technology Group
ETG Headquarters
Ostendstraße 196
D-90482 Nürnberg / Germany
info@ethercat.org
www.ethercat.org

DIN Media Verlag GmbH, 10787 Berlin

or

VDE-Verlag GmbH, 10625 Berlin

VDE Verlag GmbH, 10625 Berlin

or

Internet search: www.iec.ch

14.5.2. Bibliography / Standards

Standard	Label
IEC61131-1 / EN61131-1	Programmable controllers Part 1: General information
IEC61131-2 / EN61131-2	Programmable controllers Part 2: Equipment requirements and tests
IEC61131-3 / EN61131-3	Programmable controllers Part 3: Programming languages
IEC61131-4 / EN61131Bl1	Programmable logic controllers Supplementary Sheet 1: User guidelines
IEC61000-6-4 / EN61000-6-4	German EMC Standard: Emitted interference
IEC61000-6-2 / EN61000-6-2	German EMC Standard: Noise immunity
ISO/DIS 11898	Draft International Standard: Road vehicles - Interchange of digital information - Controller Area Network (CAN) for high-speed communication
DIN EN ISO 13849-1	Safety of machinery: Safety-related parts of control systems (Part 1)
UL 508:2013-10	Industrial Control Equipment 17th Edition / 1999-01-28

Notice: Our Technical Support team will be glad to provide other literature references on request.

14.6. List of figures