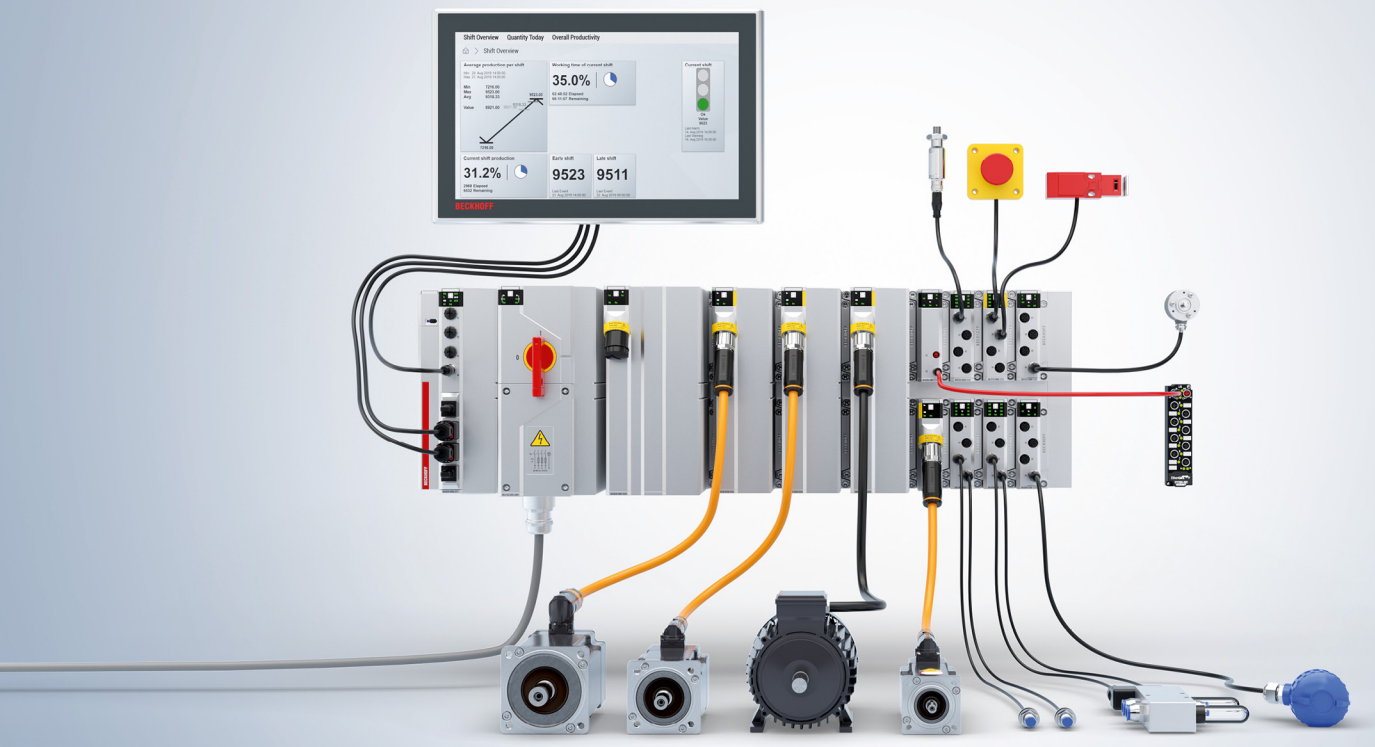
BECKHOFF New Automation Technology

Manual | EN

MO3004-2255-1112

2-channel analog input, ±10 V, 0/4...20 mA + 2-channel analog combi, 0... 10 V, 0/4...20 mA, multi-function, 16 bit, single-ended, M12



2026-10-28 | Version: 1.0

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1 Foreword

1.1 Notes on the documentation

This description is intended exclusively for trained specialists in control and automation technology who are familiar with the applicable national standards.
The documentation and the following notes and explanations must be complied with when installing and commissioning the components.
The trained specialists must always use the current valid documentation.

The trained specialists must ensure that the application and use of the products described is in line with all safety requirements, including all relevant laws, regulations, guidelines, and standards.

Disclaimer

The documentation has been compiled with care. The products described are, however, constantly under development.
We reserve the right to revise and change the documentation at any time and without notice.
Claims to modify products that have already been supplied may not be made on the basis of the data, diagrams, and descriptions in this documentation.

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1.2 For your safety

Safety regulations

Read the following explanations for your safety.
Always observe and follow product-specific safety instructions, which you may find at the appropriate places in this document.

Exclusion of liability

All the components are supplied in particular hardware and software configurations which are appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

Personnel qualification

This description is only intended for trained specialists in control, automation, and drive technology who are familiar with the applicable national standards.

Signal words

The signal words used in the documentation are classified below. In order to prevent injury and damage to persons and property, read and follow the safety and warning notices.

Personal injury warnings

⚠ DANGER
Hazard with high risk of death or serious injury.

⚠ WARNING
Hazard with medium risk of death or serious injury.

⚠ CAUTION
There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
recommendations for action, assistance or further information on the product.

1.3 Intended use

Intended use of an MX-System

Application in machines and systems in industrial environments and exclusively inside buildings.

The electrical wiring must be permanent wiring.

Improper use

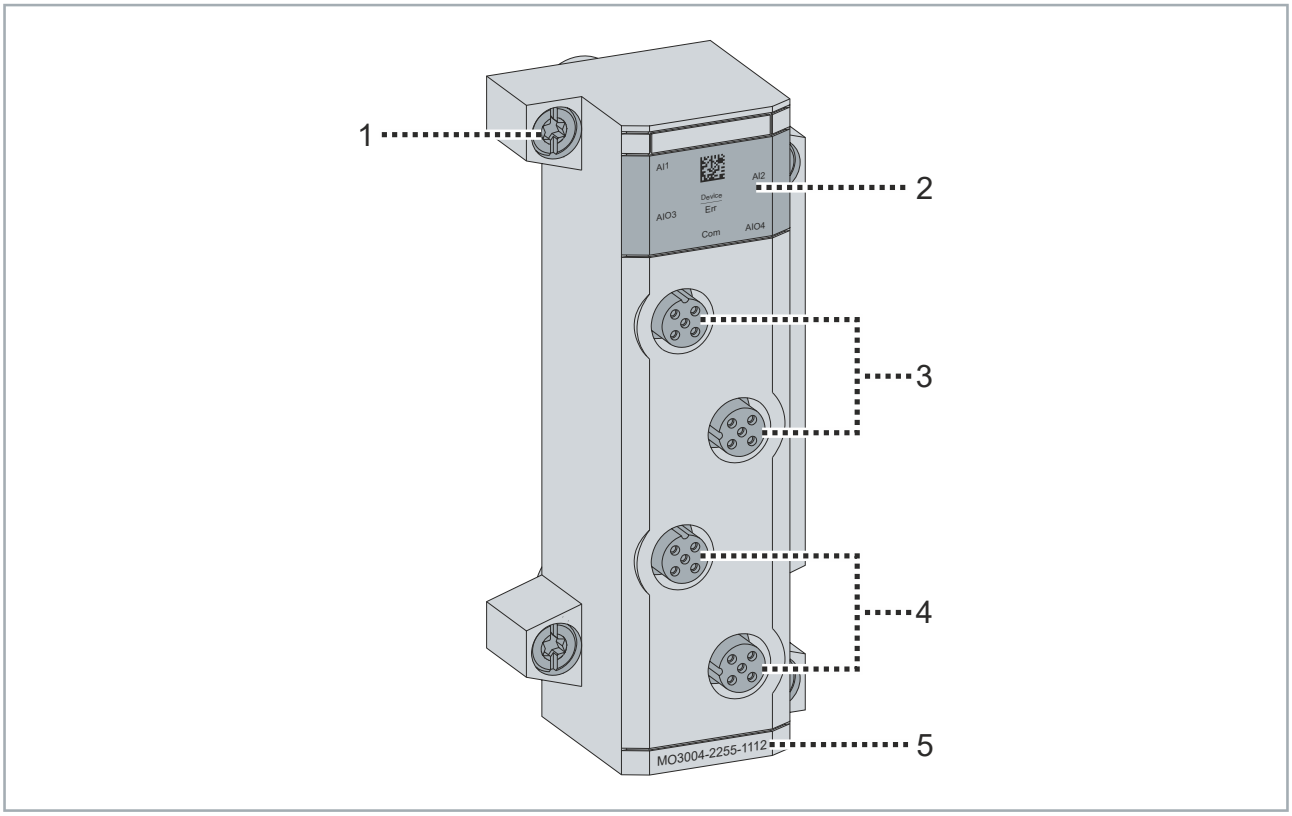
Improper use is not permitted and will result in the exclusion of liability on the part of Beckhoff Automation GmbH & Co. KG.

2 Product overview

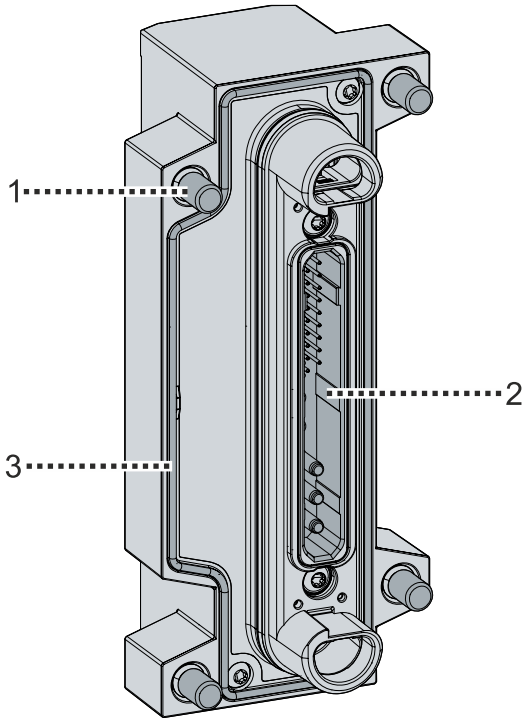
The I/O modules in the MX-System offer a wide choice for all signal types and directions. The MO3004-2255-1112 can be used with four analog channels, two of which can be configured as either inputs or outputs, for standard +10 V and +20 mA signals. The module supports -10…+10 V, 0…+10 V, and 0…+20 mA analog inputs, as well as 0…+10 V, 0…+20 mA, and 4…+20 mA analog outputs. This enables several measurement tasks to be performed simultaneously. With 16-bit resolution, a sampling rate of 2 ksps, and low measurement and output uncertainty, it is also suitable for demanding automation tasks.

Special properties:

- Combined input and output module: 10 V, 20 mA
- 107% measuring and output range
- high output power at 20 mA: load up to 750 Ω
- 2 ksps conversion rate per channel for standard automation tasks



Position	Name
1	Fastening screw, captive, 4 x
2	Status display
3	Analog input, 2 x
4	Analog combi, 2 x
5	Module name



Position	Name
1	Fastening screw, captive, 4 x
2	Data connector
3	Seal

2.1 Product functions

2.1.1 Analog inputs

The module supports analog inputs of -10…+10 V, 0…+10 V, 0…+20 mA, and +4…+20 mA. The short-circuit proof 24 V DC supply of sensors and actuators for the screw-type M12 connectors is electronically protected. The signal status is shown on the display, and various diagnostic options are available for each channel.

The rated input voltage is U_B = 24 V DC.

2.1.2 Sensor power supply outputs

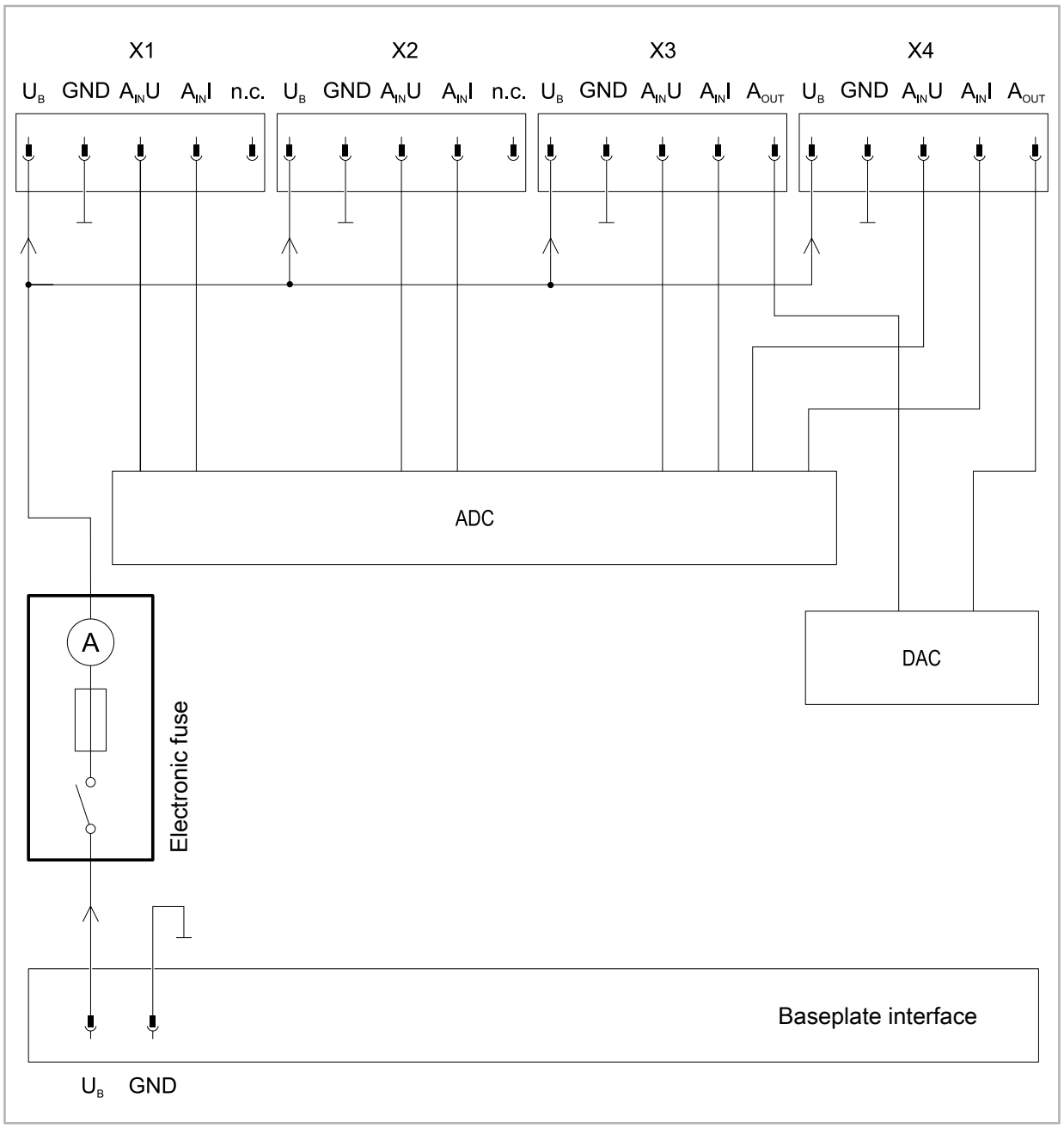
There is also a sensor power supply output on each sensor connection. This supplies the connected sensor with 24 V DC from the supply voltage U_B.

The module has a common electronic fuse for all sensor power supply outputs. If a short circuit occurs at a sensor power supply output, the fuse trips and all sensor power supply outputs of the module are shut down.

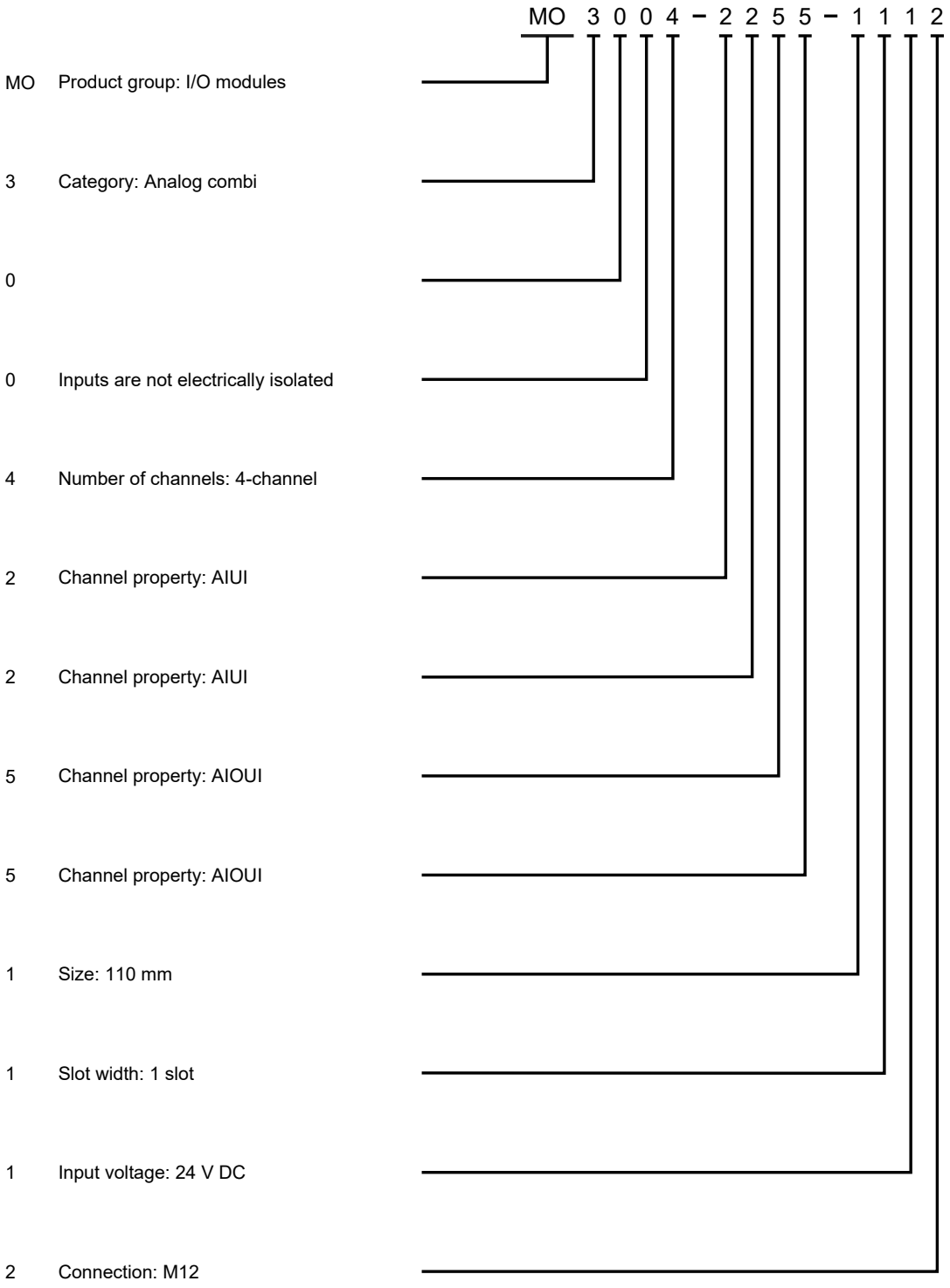
2.1.3 Analog combi output

An analog combi channel can be used either as an analog input or as an analog output. The module supports voltage signals ranging from 0 to +10 V and current signals ranging from 0 to +20 mA and from +4 to +20 mA.

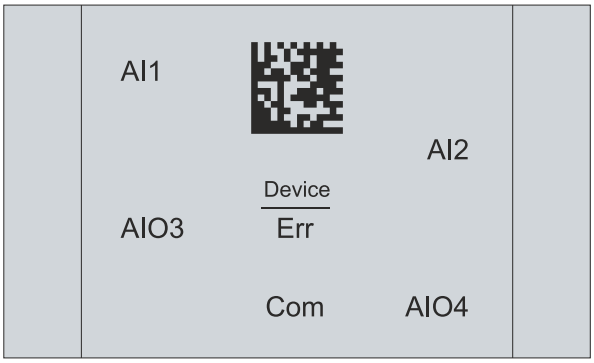
2.2 Block diagram



2.3 Type key


MO 3 0 0 4 – 2 2 5 5 – 1 1 1 2
MO Product group: I/O modules
3 Category: Analog combi
0
0 Inputs are not electrically isolated
4 Number of channels: 4-channel
2 Channel property: AIUI
2 Channel property: AIUI
5 Channel property: AIOUI
5 Channel property: AIOUI
1 Size: 110 mm
1 Slot width: 1 slot
1 Input voltage: 24 V DC
2 Connection: M12

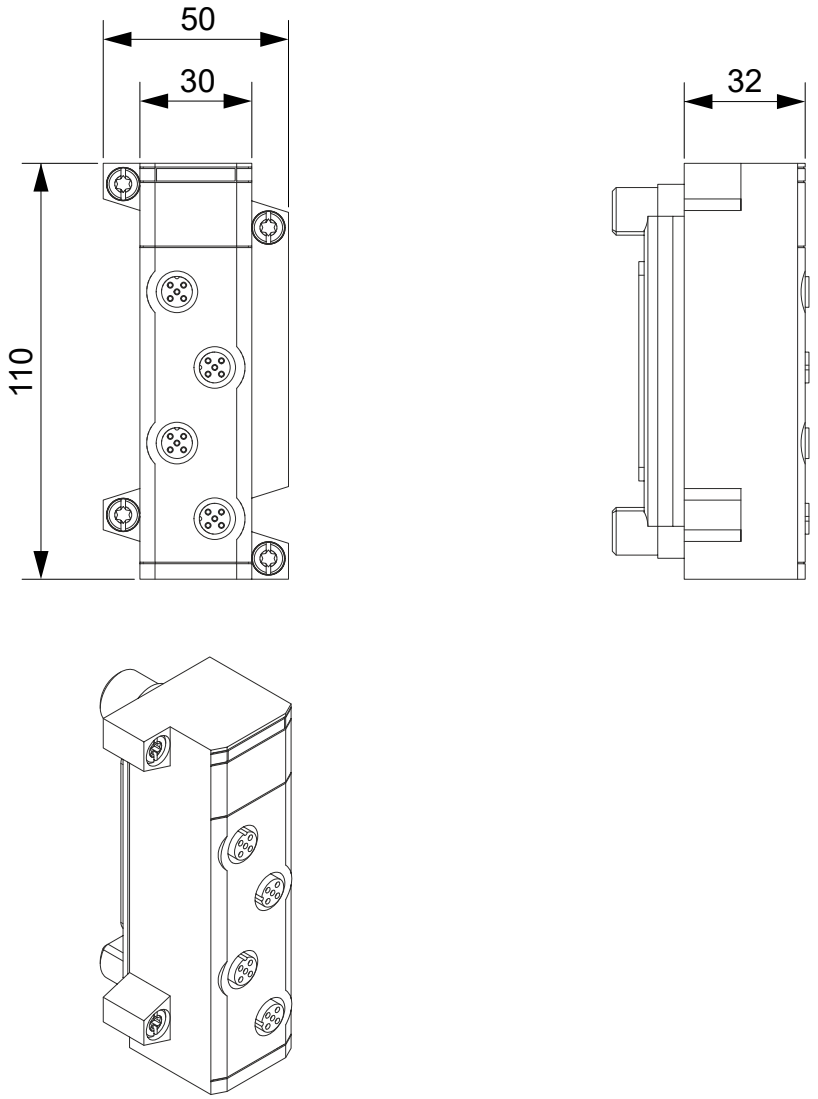
2.4 Status display



LED	State	Meaning
	-	Beckhoff Identification Code as Data Matrix code
Device | Err	off	There are no active error messages.
	lights up red	There are active error messages. You can find more detailed information in TwinCAT.
Com	off	EtherCAT communication status: Initialization Initial state after switching on. The device is detected and initialized; no process data exchange is taking place yet.
	flashes green	EtherCAT communication status: Pre-Operational The device is configurable. Mailbox communication (e.g., CoE/ SDO accesses) is possible, but process data is not yet being transmitted.
	green single flash	EtherCAT communication status: Safe-Operational Configuration is now complete. The device receives and processes process data; however, the outputs remain in a safe state and are not yet activated.
	lights up green	EtherCAT communication status: Operational Normal operating state. Full cyclic process data exchange; inputs and outputs are active.
	flickers green	EtherCAT communication status: Bootstrap Special maintenance mode for firmware updates. Normal process data communication is not possible.
AI1/AI2	off	The measured values are within the valid range.
	lights up red	The value is significantly below or significantly above the measuring range.
AIO3/AIO4 as input	off	The measured values are within the valid range.
	lights up red	The value is significantly below or significantly above the measuring range.
AIO3/AIO4 as output	off	No overload of the analog output.
	lights up red	Analog output overload: Signal level has fallen below the limiter's low threshold or exceeded the limiter's high threshold.

2.5 Dimensions

All dimensions in mm



3 Technical data

All values are typical values over the entire temperature range, unless stated otherwise.

Baseplate interface	
Connector	1 data connector
Fieldbus	EtherCAT
Distributed clocks	yes
Analog input and output isolation	Functional isolation from the internal system: insulation strength 707 V DC (type test). This isolation is intended solely for functional purposes and does not serve as a protective isolation. An externally supplied voltage is not permitted.

Analog inputs	
Number	2 x analog inputs
Connection	4 x M12 socket, 5-pin, A-coded
Rated input voltage	24 V DC (-15%…+20%)
Max. sampling rate	min. 500 µs (max. 2 ksps) per channel
Internal resistance	> 200 kΩ | 100 Ω typical
Input filter cut-off frequency	2 kHz
Dielectric strength	Voltage, current: max ±30 V to GND
Measuring range, nominal	-10…+10 V / 0…+10 V 0…+20 mA / +4…+20 mA
Measuring range, technical	-10.737…+10.737 V 0…+21.474 mA
Resolution	16 bits (including sign)
Measuring error/uncertainty	< ±0.20% typ. (at 25°C ±5°C, otherwise < ±0.3%)
Electrical isolation channel/channel	no

Analog outputs / combi I/O	
Number of channels	2 x analog inputs and outputs
Connection	2 x M12 socket, 5-pin, A-coded
Rated voltage	24 V DC (-15%…+20%)
Output rate	min. 500 µs (max. 2 ksps) per channel
Load	Voltage: > 2 kΩ (short-circuit proof) Current: < 750 Ω
Measuring range, nominal	-10…+10 V / 0…+10 V 0…+20 mA / +4…+20 mA
Measuring range, technical	-10.737…+10.737 V 0…+21.474 mA
Output range, nominal	0…+10 V 0…+20 mA / +4…+20 mA
Output range, technical	0…+10.747 V 0…+21.474 mA
Resolution	16 bits (including sign)
Output error	< ±0.1% typ.
Electrical isolation channel/channel	no

Housing data	
Width (slots)	1
Height (rows)	1
Dimensions W × H × D	50 mm × 110 mm × 33 mm 50 mm × 110 mm × 32 mm (housing only)
Material	Zinc die-cast and aluminum die-cast
Cooling	Convection
Installation position	Vertical. See system manual, chapter "Installation conditions".
Weight	Approx. 320 g

Standards, approvals	
Device safety	conforms to EN 61010-2-201
EMC immunity/emission	conforms to EN IEC 61000-6-2/EN IEC 61000-6-4
Vibration/shock resistance	conforms to EN 60068-2-6/EN 60068-2-27
Approvals	• CE • $_{C}UL_{US}$

Environmental conditions	
Operating temperature	0 … 50 °C
Storage temperature	-25 … +60 °C
Air humidity	95 %, no condensation
Protection rating	IP20 as a separate module
	IP65 / IP67 as part of a fully and correctly assembled MX-System
Pollution degree	2
Overvoltage category	III
Maximum installation altitude	2000 m

4 Software functions

Software functions are the functions of a module's firmware that a controller can access via EtherCAT.

Functionality

The following descriptions document the full range of software functions at the time of publication of this manual. The range of functions that can actually be used depends on the firmware version of a module.

Process data objects

Process data objects (PDOs) are used for the cyclic transmission of process data between the EtherCAT MainDevice and EtherCAT SubDevice. The data is exchanged at fixed intervals as part of the real-time cycle and serves as the basis for control and monitoring of field devices. PDOs typically contain input and output data required for the direct operation of a device. Cyclic transfer ensures a continuous and deterministic data exchange.

Inputs Profile AI Standard (Real32) Channel x

Variable		Type	Description
Status		Status_C3072030	
	Underrange	BIT	0 = within the valid measuring range 1 = the value fell below the lower limit
	Overrange	BIT	0 = within the valid measuring range 1 = the upper limit has been exceeded
	Limit x	BIT2	1: Value is smaller than the limit value x 2: Value is larger than the limit value x 3: Value is equal to the limit value x
	Error	BIT	0 = Data within the valid range 1 = data is invalid
	Steady State	BIT	The value refers to the time spent in a stationary state within the stationary time window. The values are defined in the advanced settings.
	Tare Active	BIT	0: no tare, tare is running - begins with the falling edge 1: Tare is active
	Warning	BIT	Set when the warning threshold for the lower or upper range is exceeded. This range can be specified in the advanced settings.
	TxPDO State	BIT	0 = The data in the corresponding TxPDO is valid. 1 = The data in the corresponding TxPDO is invalid.
	TxPDO Toggle	BIT	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.
Value (Real32)		REAL	Analog input value

Inputs Profile EFU (Ux) Inputs (IO)

Variable	Type	Description
Error	BIT	0 = No pending error in the electronic fuse that requires acknowledgment, and no watchdog error. 1 = The electronic fuse could not be reactivated after the configured auto-retry attempts were completed, or a watchdog error occurred. Reset via a rising edge at **Reset**.
Tripped	BIT	0 = The electronic fuse has not triggered. 1 = The electronic fuse has triggered due to the protection limit.
Enabled	BIT	0 = The electronic fuse is turned off; there is no output voltage. 1 = The electronic fuse is turned on and the output voltage is present.
Input Cycle Counter	BIT2	A 2-bit counter that increments when the TxPDO data is updated.
Current	REAL	Current in amperes flowing through the electronic fuse.

Outputs Profile EFU (Ux) Outputs (IO)

Variable	Type	Description
Enable	BIT	0 = The electronic fuse is disabled. 1 = The electronic fuse is activated. Becomes active only if the process data output is set to **Control via Process Data**.
Control via Process Data	BIT	0 = The output state is determined by the **Default State** parameter of the electronic fuse. The process data bit **Enable** is not evaluated. 1 = The output state is controlled via the process data bit **Enable**. **Enable** = 1 requests the output driver to turn on; **Enable** = 0 turns it off. The electronic fuse's protective function remains active.
Reset	BIT	0 = No error acknowledgment. 1 = An error is acknowledged on a rising edge.

WcState

WcState indicates whether an EtherCAT SubDevice correctly participated in the cyclic process data exchange during the last bus cycle.

Variable	Type	Description
WcState	BIT	0 = data is valid 1 = data is invalid
InputToggle	BIT	A 1-bit counter that increments after each cycle

InfoData

InfoData indicates which diagnostic and status information an EtherCAT SubDevice provides.

Variable		Type	Description
State		UINT	0x___1 = EtherCAT SubDevice in INIT state 0x___2 = EtherCAT SubDevice in PREOP state 0x___3 = EtherCAT SubDevice in BOOT state 0x___4 = EtherCAT SubDevice in SAFEOP state 0x___8 = EtherCAT SubDevice in OP state 0x001_ = EtherCAT SubDevice reports an error 0x002_ = Invalid vendor ID, product code x read 0x004_ = Initialization error occurred 0x008_ = EtherCAT SubDevice disabled 0x010_ = EtherCAT SubDevice not present 0x020_ = EtherCAT SubDevice reports a connection error 0x040_ = EtherCAT SubDevice reports no connection 0x080_ = EtherCAT SubDevice reports an unexpected connection 0x100_ = Communication Port A 0x200_ = Communication Port B 0x400_ = Communication Port C 0x800_ = Communication Port D
AdsAddr		AMSADDR	Full ADS address for accessing the EtherCAT SubDevice (mailbox)
	netId	AMSNETID	unique network address
	port	WORD	Internal ADS port number of the EtherCAT device

5 Mechanical installation

Required tools

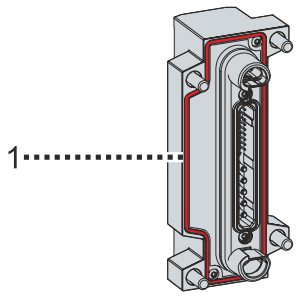
- Torx T25 screwdriver
- Torque wrench 5 Nm

5.1 Preparation

NOTICE

Check the module for damage

If the seal is worn or damaged, liquids and dirt can penetrate and damage the MX-System. The IP65/IP67 protection rating is not met if the seals are worn or damaged.

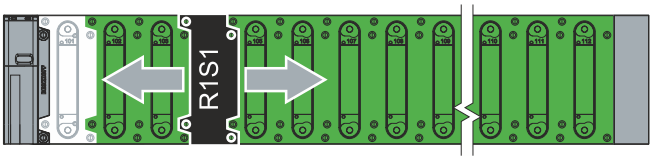


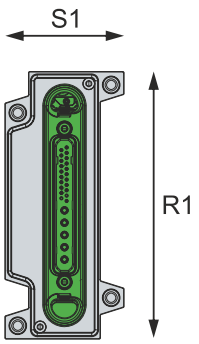
1. Check the seal [1] of the module for wear and damage
2. Replace worn and damaged seals

5.2 Placement of the module on the baseplate

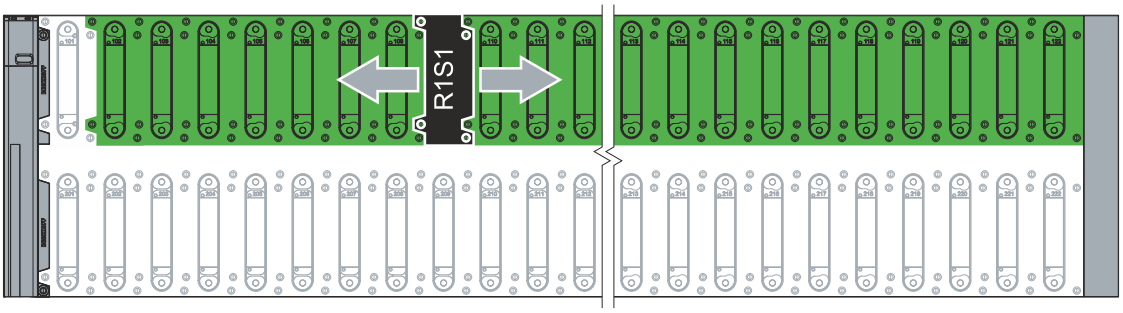
The module can be plugged into the following areas marked in green:

MB11xx-0000-0000

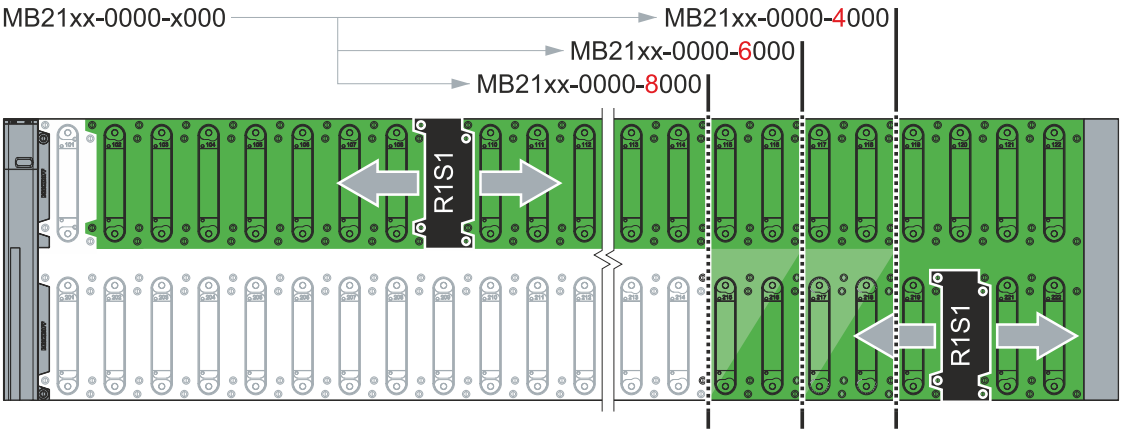




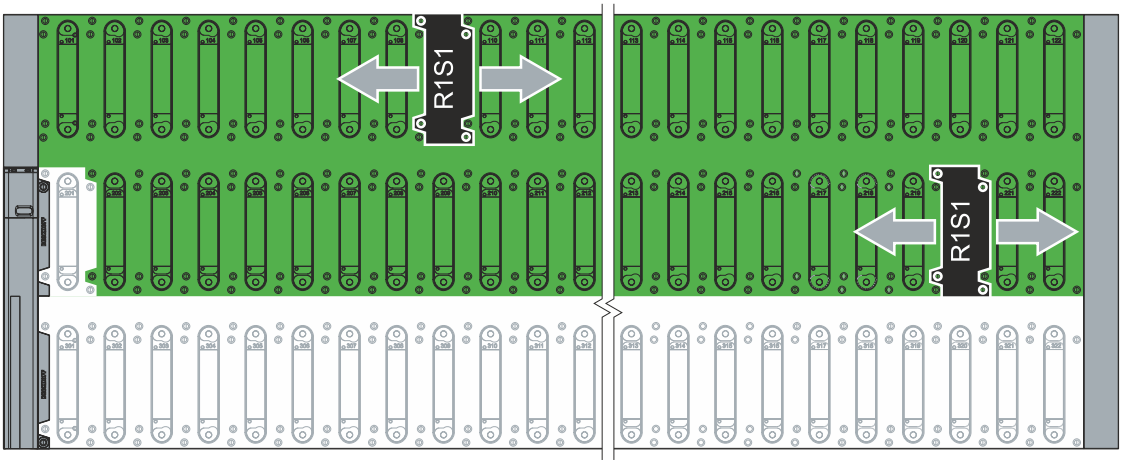
MB21xx-0000-0000



MB21xx-0000-x000



MB31xx-0000-0000



5.3 Mounting the module

⚠ CAUTION

Danger due to the high weight of an equipped baseplate

First mount the baseplate and then the modules to the baseplate. If you mount the modules on the baseplate first, the total weight of the MX-System will increase. Another person is required to transport and installation an equipped baseplate.

- Wear personal protective equipment.
- The equipped baseplate must be transported and mounted by two people.

NOTICE

Ensure correct installation

If the module is not installed correctly, liquids and dirt may enter and damage the MX-System. The IP65/IP67 protection rating is not met if the installation is incorrect.

NOTICE

Limited number of mating cycles

The module may be plugged in a maximum of 25 times to attach it to the baseplate. If the module is plugged into the baseplate more than 25 times, a secure connection between the module and the baseplate cannot be guaranteed.

- Observe the permissible number of mating cycles.
- Replace the module if the number of mating cycles is exceeded.
- Replace the baseplate if the number of mating cycles is exceeded.

The module can be plugged into any position on a data slot on a baseplate. Slot *101* must not be used.

1. Plug the module on the baseplate
2. Tighten all screws
3. Observe tightening torques:

Components	Tightening torque [Nm]
Screws	5

Further information on installation can be found in the system manual in the “Mounting” chapter.

6 Connection

NOTICE

PELV voltage source

The module must be powered by a PELV voltage source.

NOTICE

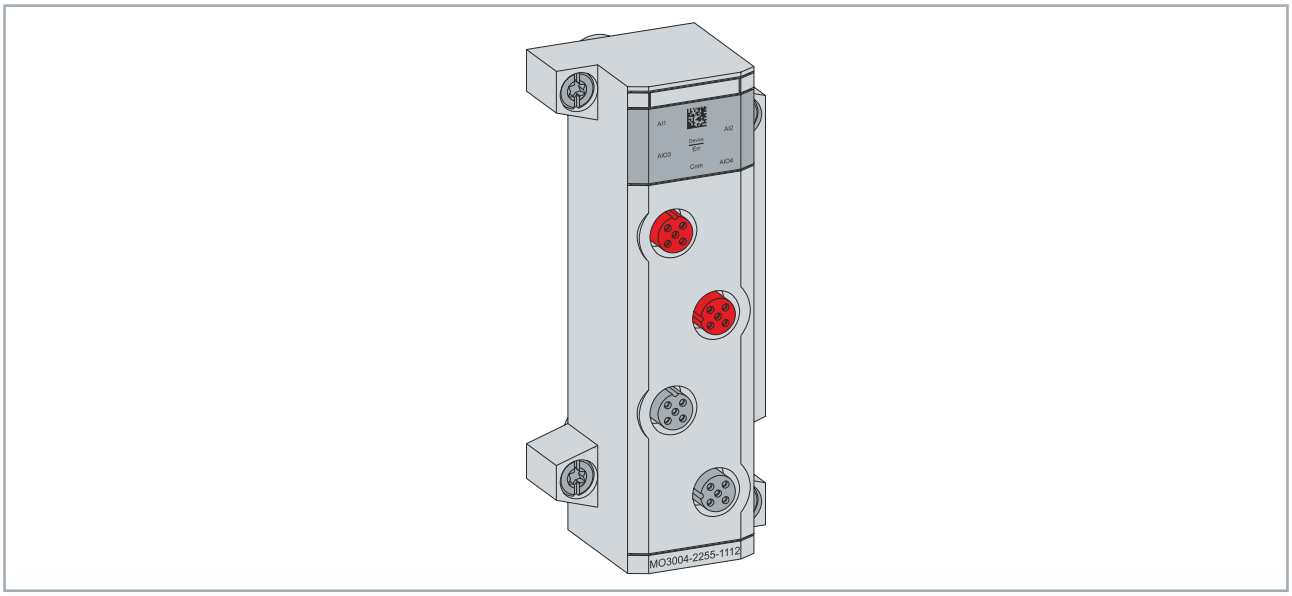
Cover unused sockets with protective caps

IP67 protection rating is only guaranteed if plugs are connected to all sockets and unused sockets are covered with protective caps.

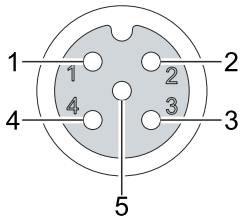
Tested with a UL-listed circuit breaker (without current limiting) rated at 20 A.

6.1 Analog Inputs

The analog inputs are 5-pin A-coded M12 sockets.

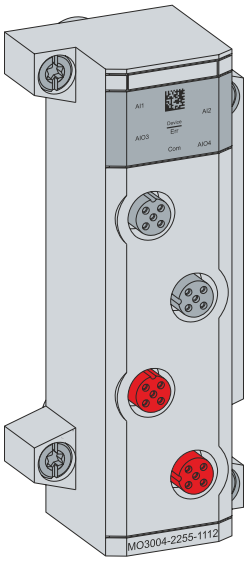


Tightening torque: 0.6 Nm

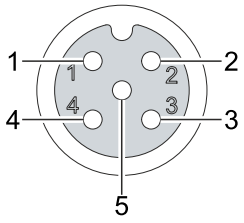
M12 socket, A-coded	Pin	Symbol	Function
	1	U_B	Supply voltage
	2	A_{IN} U	Analog input voltage
	3	GND	Ground
	4	A_{IN} I	Analog input current
	5	n. c.	not used

6.2 Analog Combi

The analog combi channels are 5-pin A-coded M12 sockets.



Tightening torque: 0.6 Nm

M12 socket, A-coded	Pin	Symbol	Function
	1	U_B	Supply voltage
	2	A_{IN} U	Analog input voltage
	3	GND	Ground
	4	A_{IN} I	Analog input current
	5	A_{OUT}	Analog output voltage/current

7 Commissioning and operation

NOTICE

Damage to property due to operation in an unsuitable environment

Before commissioning, ensure that the environmental conditions at the place of commissioning and operation are complied with at all times.

1. Plug the module onto a baseplate.
2. Screw the module onto the baseplate.
3. Wire the module.
4. Switch on the external supply voltage.

8 Decommissioning

8.1 Disassembly

NOTICE

Damage to property due to electrical voltage

Disassembling this module under voltage can lead to material damage.

- Switch off the supply voltage before disassembling.

✓ The supply voltage is shut down.

1. Remove cables.
2. Loosen all mounting screws of the module.
3. Take the module off the baseplate.

⇨ The module has been removed correctly.

8.2 Disposal



Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

9 Appendix

9.1 CoE parameters

CoE parameters (CANopen over EtherCAT) describe the configuration values and settings of an EtherCAT device. They are organized as entries in the device's object directory and are used for parameterization, commissioning, and diagnostics. CoE parameters are accessed acyclically, that is, independently of the real-time cycle, by reading and writing the corresponding objects. This allows devices to be flexibly configured and adapted to the specific application.

See parameter list in the Beckhoff Information System: Link

9.2 Manual version history

The following table shows the version history of this manual.

Version	Comment
1.0	• First release

9.3 Accessories

Suitable accessories can be found on the product website:

www.beckhoff.com/MO3004-2255-1112

Product	Description
ZMX1000-0010	M5x17.5 combi-TX25 replacement screws for module fastening (PU = 10 pcs.)
ZMX3001-0011	1-row, 1-slot replacement seal for module base
ZMX4001-0001	Replacement cover for potential equalization for 1-row baseplate with Beckhoff logo
ZMX4001-0002	Replacement cover for potential equalization for 2- and 3-row baseplate with Beckhoff logo
ZMX4001-0003	Replacement cover for MA6060 interface
ZS5000-0020	Protective cap for M12 socket, plastic, black, IP65/67

9.4 Support and Service

Beckhoff Support and Service provides assistance with questions regarding Beckhoff products and system solutions, as well as with their planning, commissioning, and operation.

Beckhoff subsidiaries and representative offices

Please contact your Beckhoff subsidiary or your representative office for local support and service for Beckhoff products. You can find the addresses of Beckhoff subsidiaries and representative offices at: www.beckhoff.com/worldwide.

For Beckhoff products and technologies, we offer Training programs, tutorials, and webinars.

Beckhoff Support

Beckhoff Support provides assistance with technical questions regarding the use, planning, programming, and commissioning of Beckhoff products.

☎ Hotline:	+49 5246 963-157
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The Download finder serves as a central source for downloadable documents and files related to Beckhoff products, such as application reports, technical documentation, drawings, and configuration files.

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