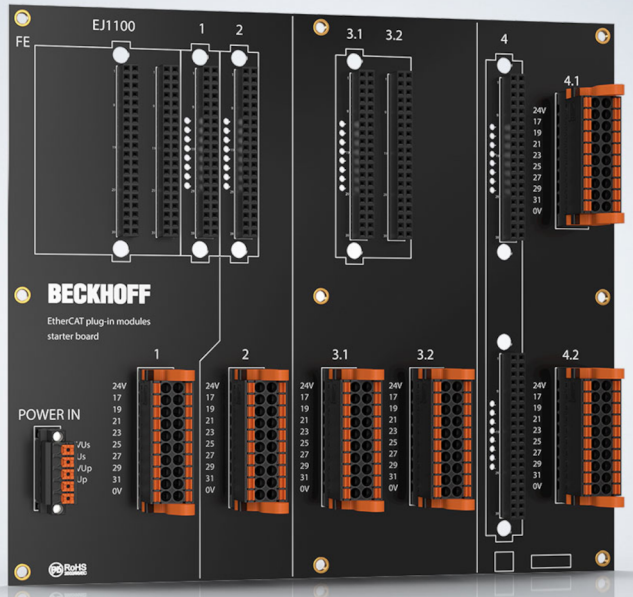
BECKHOFF New Automation Technology

Documentation | EN

EJ8906-0005

EJ starter board (EtherCAT plug-in modules not included)



2023-03-28 | Version: 1.1

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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Disclaimer

The documentation has been prepared 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 prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

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Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

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1.2 Safety instructions

Safety regulations

Please note the following safety instructions and explanations!
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

Exclusion of liability

All the components are supplied in particular hardware and software configurations 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 engineering who are familiar with the applicable national standards.

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ DANGER

Serious risk of injury!

Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ WARNING

Risk of injury!

Failure to follow this safety instruction endangers the life and health of persons.

⚠ CAUTION

Personal injuries!

Failure to follow this safety instruction can lead to injuries to persons.

NOTE

Damage to environment/equipment or data loss

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

Tip or pointer

This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
1.1	• Chapter “EJ8906-0005 – dimensional drawing” added
1.0	• 1st publication of EJ8906-0005 EJ starter board

1.4 Intended use

⚠ WARNING

Caution - Risk of injury!

EJ components may only be used for the purposes described below!

⚠ CAUTION

Intended use of EJ8906-0005 board

The EJ8906-0005 board for EtherCAT plug-in modules is intended for use for testing and evaluation purposes and demonstration applications only.

The EJ8906-0005 board must not be used in machinery, systems and devices for serial applications!

1.5 Guide through documentation

NOTE

Further components of documentation

The documentations named in the following table are further components of the complete documentation. These documentations are required for the use of EtherCAT plug-in modules.

No.	Title	Description
[1]	EtherCAT System Documentation	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • Distributed Clocks • Configuration of EtherCAT-Components
[2]	Infrastructure for EtherCAT/Ethernet	• Technical recommendations and notes for design, implementation an testing
[3]	Design GuideSignal-Distribution-Board for standard EtherCAT plug-in modules	Requirements for the design of a Signal-Distribution-Board for standard EtherCAT plug-in modules • Backplane mounting guidelines • Module placement • Routing guidelines
[4]	Documentation of the corresponding EtherCAT plug-in modules EJxxxx	• Technical data, • Pinout • LEDs • Notes on the principle of operation and • Descriptions for configuration and parameterization

2 System overview

Electronically, the EJxxxx EtherCAT plug-in modules are based on the EtherCAT I/O system. The EJ system consists of the signal distribution board and EtherCAT plug-in modules. It is also possible to connect an IPC to the EJ system.
The EJ system is suitable for mass production applications, applications with small footprint and applications requiring a low total weight.
The machine complexity can be extended by means of the following:

- reserve slots,
- the use of placeholder modules,
- linking of EtherCAT Terminals and EtherCAT Boxes via an EtherCAT connection.

The following diagram illustrates an EJ system. The components shown are schematic, to illustrate the functionality.

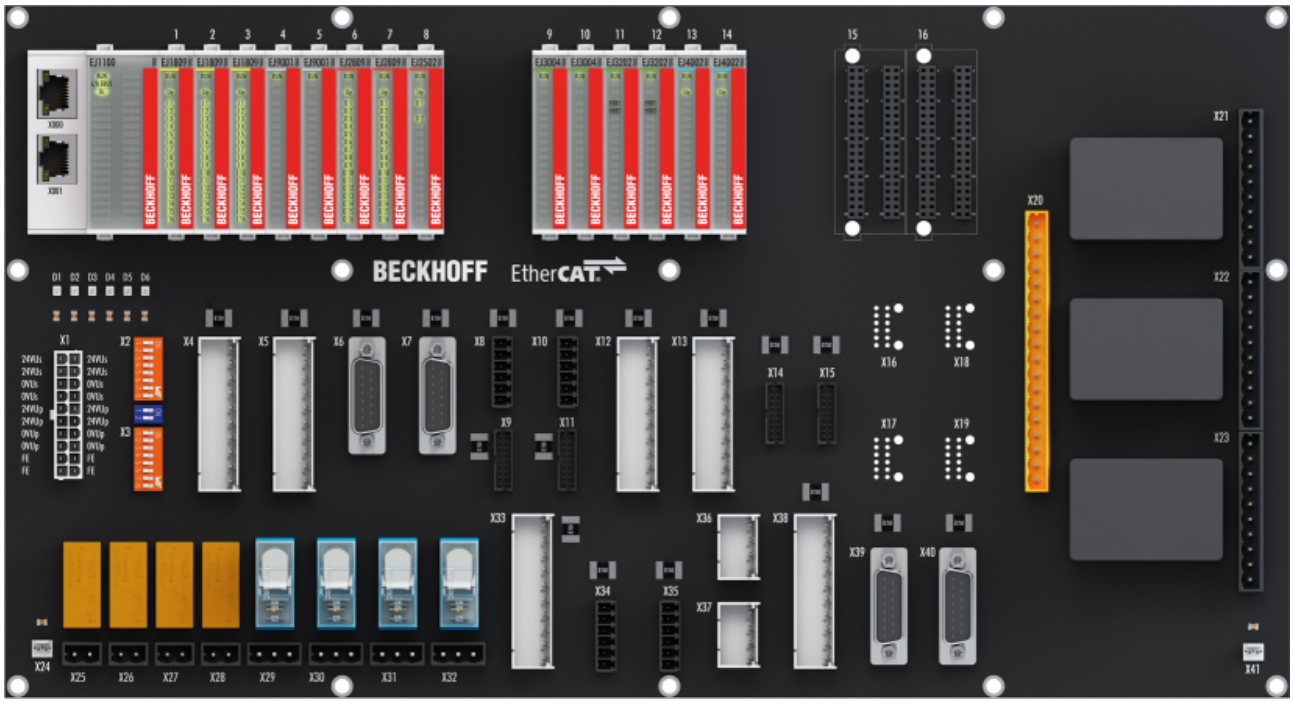


Fig. 1: EJ system sample

Signal distribution board

The signal distribution board distributes the signals and the power supply to individual application-specific plug connectors, in order to connect the controller to further machine modules. Using pre-assembled cable harnesses avoids the need for time-consuming connection of individual wires. Coded components reduce the unit costs and the risk of miswiring.
Beckhoff offers development of signal distribution boards as an engineering service. Customers have the option to develop their own signal distribution board, based on the design guide.

EtherCAT plug-in modules

Similar to the EtherCAT Terminal system, a module strand consists of a bus coupler and I/O modules. Almost all of the EtherCAT Terminals can also be manufactured in the EJ design as EtherCAT plug-in modules. The EJ modules are directly attached to the signal distribution board. The communication, signal distribution and supply take place via the contact pins at the rear of the modules and the PCB tracks of the signal distribution board. The coding pins at the rear serve as mechanical protection against incorrect connection. Color coding on the housing facilitates distinguishing of the modules.

3 Introduction

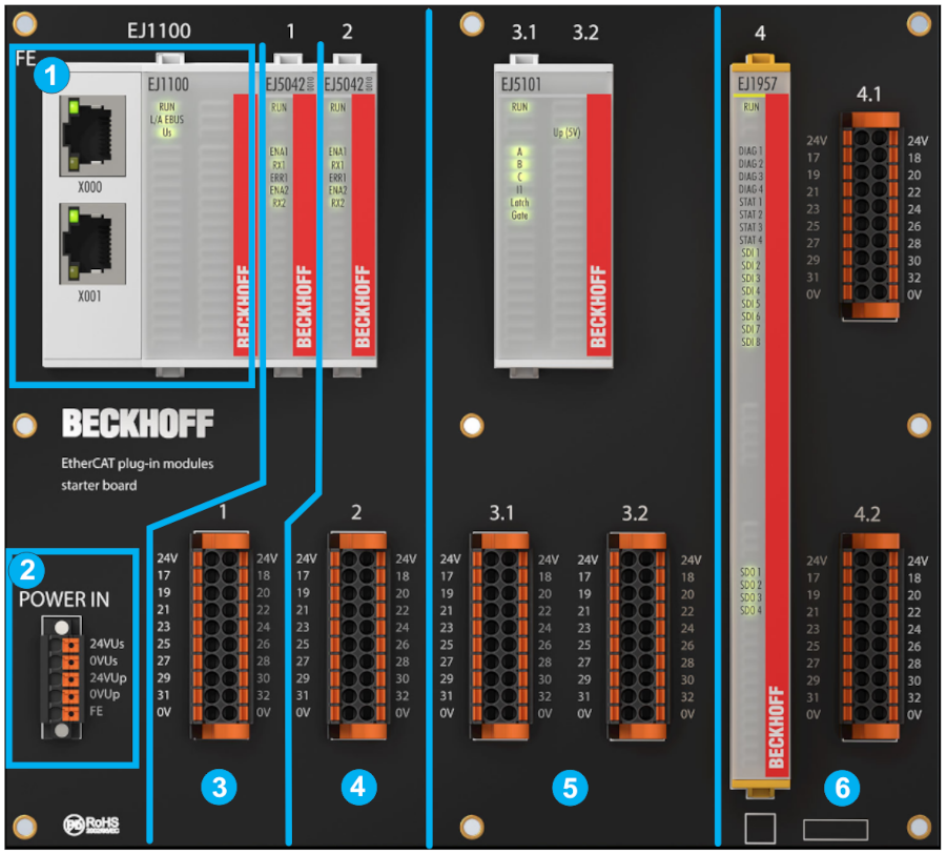


Fig. 2: EJ8906-0005 - Board using the modules EJ5042-0010, EJ5101 and EJ1957 as an example

EJ8906-0005 - EJ starter board (EtherCAT plug-in modules not included)

The EJ starter board offers an effective introduction to the system world of EtherCAT plug-in modules. Without the need for prior investment in the development of individual signal distribution boards, the EJ starter board enables validation and straightforward testing of EtherCAT plug-in modules.

The starter kit contains a predefined PCB (signal distribution board) complete with corresponding slots for four EtherCAT plug-in modules of any design, as well as mating connectors for integrating the cable harnesses. The EtherCAT plug-in modules can be freely selected as required, which provides for individual function testing. They are not included in the scope of delivery.

Section (see fig. above)	Description
1	EtherCAT coupler EJ1100
2	Power Connector (POWER IN)
3 and 4	Slot 1 and 2: Two EtherCAT plug-in modules EJ-12-16pin, Dimensions (W x H x D): 12 mm x 66 mm x 55 mm), e.g. EJ5042-0010 Connector 1 and 2
5	Slot 3.1 and 3.2: One EtherCAT plug-in module EJ-24-2x16pin. Dimensions (W x H x D): 24 mm x 66 mm x 55 mm), e.g. EJ5101 Connector 3.1 and 3.2
6	Slot 4: One EtherCAT plug-in module EJ-12-2x16pin-extended, Dimensions (W x H x D): 12 mm x 152 mm x 55 mm), e.g. EJ1957 Connector 4.1 and 4.2

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the module system into a safe, de-energized state before starting installation, disassembly or wiring of the modules.

4 Technical data

Technical data	EJ8906-0005 Board
EtherCAT coupler	EJ1100
Max. number of EJ-modules	4
Number of connectors	7
Dimensions (W x H x D)	191 mm x 172 mm x 1.6 mm
Wiring specification	When wiring, please refer to the specifications of the cable / connector manufacturer. If available, the shield must be connected to the board.
Operating temperature	0 °C ...+ 55 °C
Storage temperature	-25 °C ...+85 °C
Vibration / shock resistance	according to EN 60068-2-6/EN 60068-2-27

⚠ CAUTION

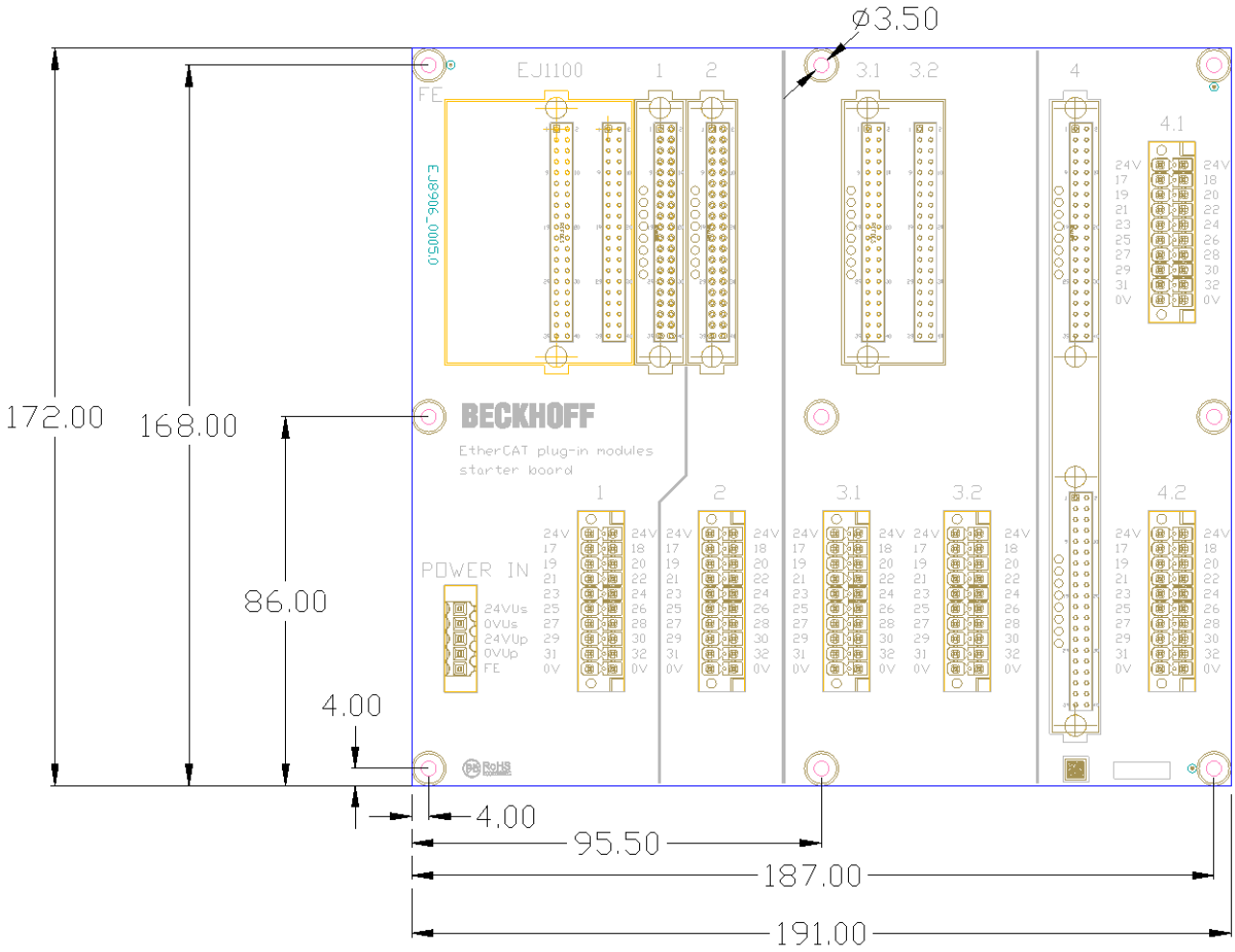
Intended use of EJ8906-0005 board

The EJ8906-0005 board for EtherCAT plug-in modules is intended for use for testing and evaluation purposes and demonstration applications only.

The EJ8906-0005 board must not be used in machinery, systems and devices for serial applications!

5 EJ8906-0005 - dimensional drawing

The following figure shows the dimensions of the EJ8906-0005 EJ starter board (all dimensions in mm). Information on the dimensions of the EtherCAT plug-in modules can be found in chapter EJxxxx – dimensions [▶ 18])



Dimensions of the EJ8906-0005 EJ starter board (all dimensions in mm)

6 Connection and mapping

6.1 Power Supply Connector - POWER IN

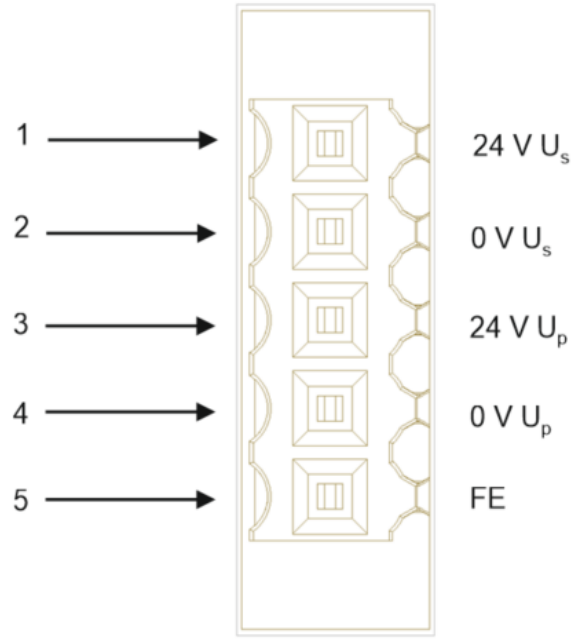


Fig. 3: EJ8906-0005 - POWER IN

POWER IN Connector

Pin Number	Description
1	24 V U_S
2	0 V U_S
3	24 V U_P
4	0 V U_P
5	Functional Earth

6.2 EtherCAT plug-in modules of slot 1 and 2

The signal order on the I/O connector is identical to the pin order of the I/O ports on the EtherCAT plug-in modules. Additional power supply pins are added to the I/O connector.

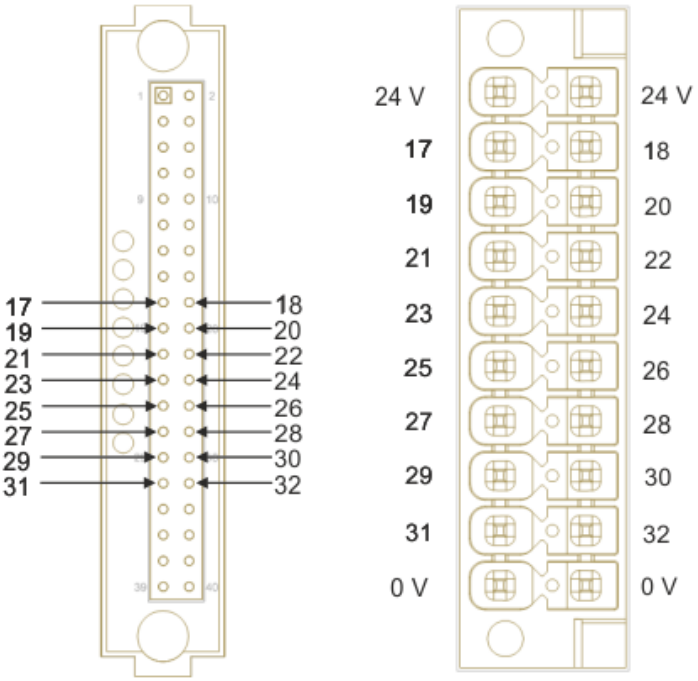


Fig. 4: EJ8906-0005 - Pin numbering Slot 1 and 2 (left), Pin numbering of connector 1 and 2 (right)

NOTE

Description of the pinout for EtherCAT plug-in modules

For the description of the pinout see chapter “Pinout” in the documentation of the EtherCAT plug-in modules (www.beckhoff.com/EJxxxx).

6.3 EtherCAT plug-in modules of slot 3

The I/O signals on both connectors of the EtherCAT plug-in module on Slot 3 are routed to individual connectors on the pcb (**P**rinted-**C**ircuit-**B**oard).

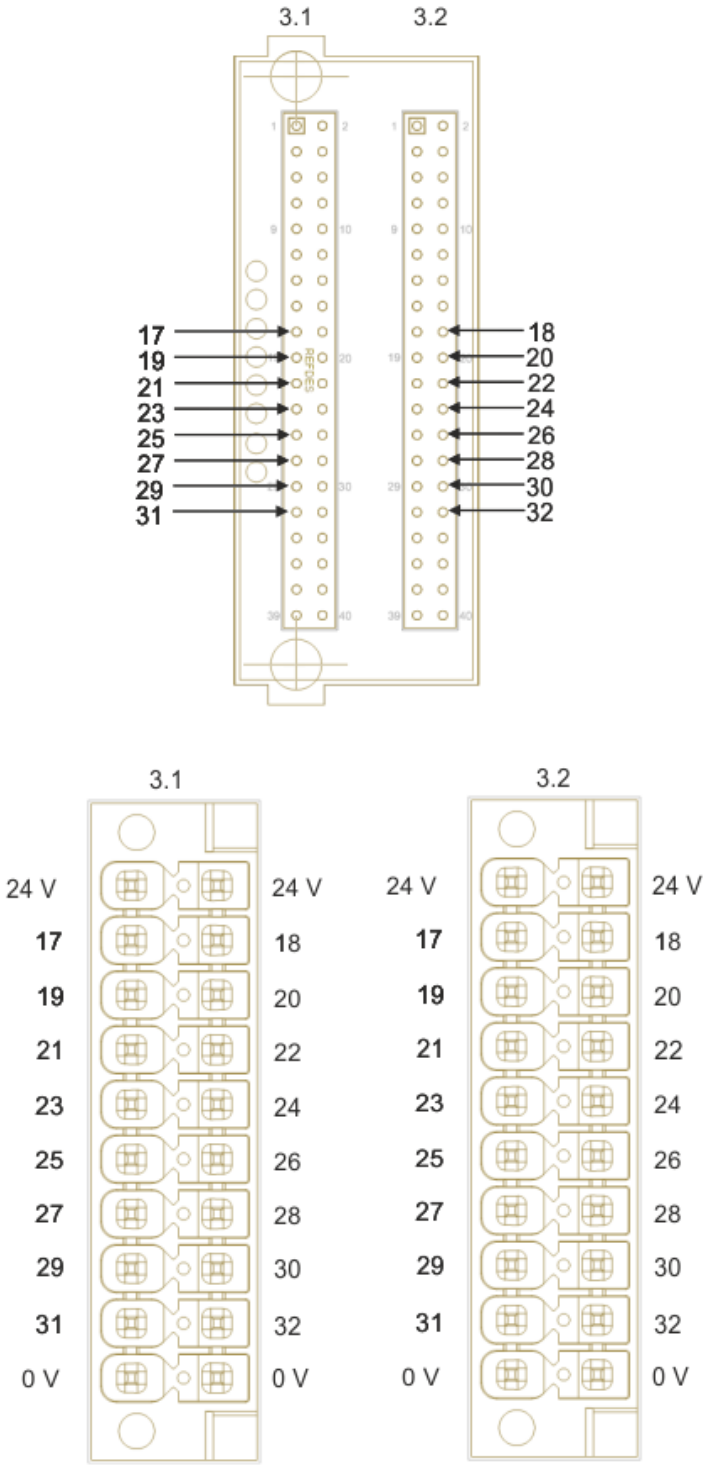


Fig. 5: EJ8906-0005 - Pin numbering Slot 3.1 and 3.2, Pin numbering of connector 3.1 and 3.2

NOTE

Description of the pinout for EtherCAT plug-in modules

For the description of the pinout see chapter “Pinout” in the documentation of the EtherCAT plug-in modules (www.beckhoff.com/EJxxxx).

6.4 EtherCAT plug-in modules of slot 4

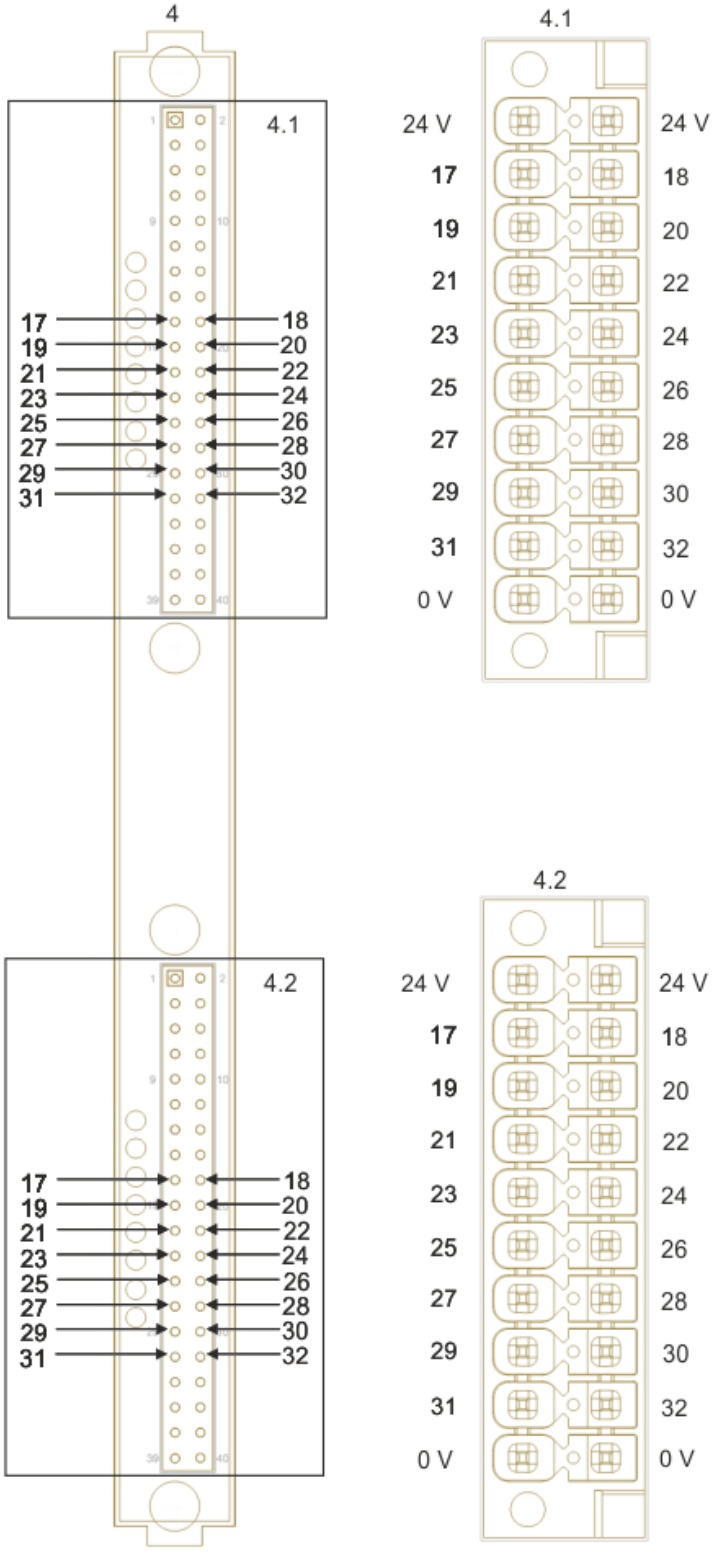


Fig. 6: EJ8906-0005 - Pin numbering Slot 4.1 and 4.2, Pin numbering of connector 4.1 and 4.2

NOTE

Description of the pinout for EtherCAT plug-in modules

For the description of the pinout see chapter “Pinout” in the documentation of the EtherCAT plug-in modules (www.beckhoff.com/EJxxxx).

7 Installation of EJ modules

7.1 Power supply for the EtherCAT plug-in modules

⚠ WARNING

Power supply from SELV/PELV power supply unit!

SELV/PELV circuits (Safety Extra Low Voltage, Protective Extra Low Voltage) according to IEC 61010-2-201 must be used to supply this device.

Notes:

- SELV/PELV circuits may give rise to further requirements from standards such as IEC 60204-1 et al, for example with regard to cable spacing and insulation.
- A SELV (Safety Extra Low Voltage) supply provides safe electrical isolation and limitation of the voltage without a connection to the protective conductor,
  a PELV (Protective Extra Low Voltage) supply also requires a safe connection to the protective conductor.

The signal distribution board should have a power supply designed for the maximum possible current load of the module string. Information on the current required from the E-bus supply can be found for each module in the respective documentation in section “Technical data”, online and in the catalog. The power requirement of the module string is displayed in the TwinCAT System Manager.

E-bus power supply with EJ1100 or EJ1101-0022 and EJ940x

The EJ1100 Bus Coupler supplies the connected EJ modules with the E-bus system voltage of 3.3 V. The Coupler can accommodate a load up to 2.2 A. If a higher current is required, a combination of the coupler EJ1101-0022 and the power supply units EJ9400 (2.5 A) or EJ9404 (12 A) should be used. The EJ940x power supply units can be used as additional supply modules in the module string.

Depending on the application, the following combinations for the E-bus supply are available:

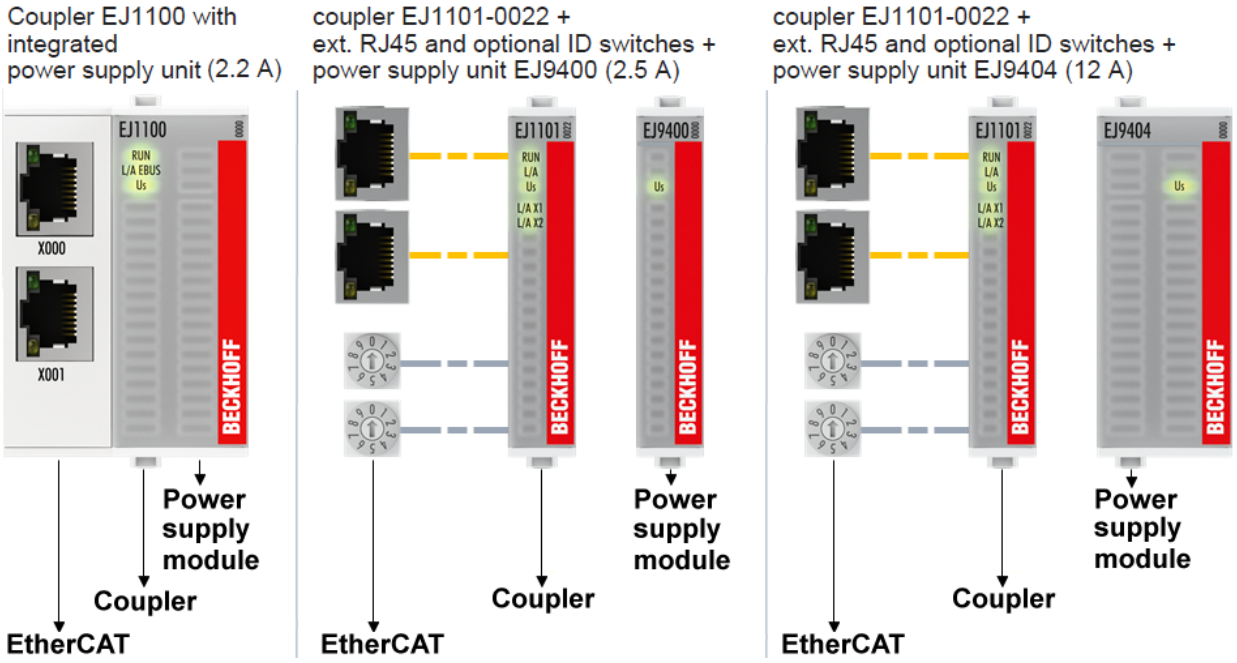


Fig. 7: E-bus power supply with EJ1100 or EJ1101-0022 + EJ940x

In the EJ1101-0022 coupler, the RJ45 connectors and optional ID switches are external and can be positioned anywhere on the signal distribution board, as required. This facilitates feeding through a housing.

The EJ940x power supply plug-in modules provide an optional reset function (see chapter Connection of the documentation for EJ9400 and EJ9404)

E-bus power supply with CXxxxx and EK1110-004x

The Embedded PC supplies the attached EtherCAT Terminals and the EtherCAT EJ coupler

- with a supply voltage Us of 24 V_{DC} (-15 %/+20 %). This voltage supplies the E-bus and the bus terminal electronics.
  The CXxxxx units supply the E-bus with up to 2,000 mA E-bus current. If a higher current is required due to the attached terminals, power feed terminals or power supply plug-in modules must be used for the E-bus supply.
- with a peripheral voltage Up of 24 V_{DC} to supply the field electronics.

The EK1110-004x EtherCAT EJ couplers relay the following parameters to the signal distribution board via the rear connector:

- the E-bus signals,
- the E-bus voltage U_{EBUS} (3.3 V) and
- the peripheral voltage U_P (24 V_{DC}).

Fig. 8: PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

7.2 EJxxxx - dimensions

The EJ modules are compact and lightweight thanks to their design. Their volume is approx. 50 % smaller than the volume of the EL terminals. A distinction is made between four different module types, depending on the width and the height:

Module type	Dimensions (W x H x D)	Sample in figure below
Coupler	44 mm x 66 mm x 55 mm	EJ1100 (ej_44_2xrj45_coupler)
Single module	12 mm x 66 mm x 55 mm	EJ1809 (ej_12_16pin_code13)
Double module	24 mm x 66 mm x 55 mm	EJ7342 (ej_24_2x16pin_code18)
Single module (long)	12 mm x 152 mm x 55 mm	EJ1957 (ej_12_2x16pin_extended_code4747)

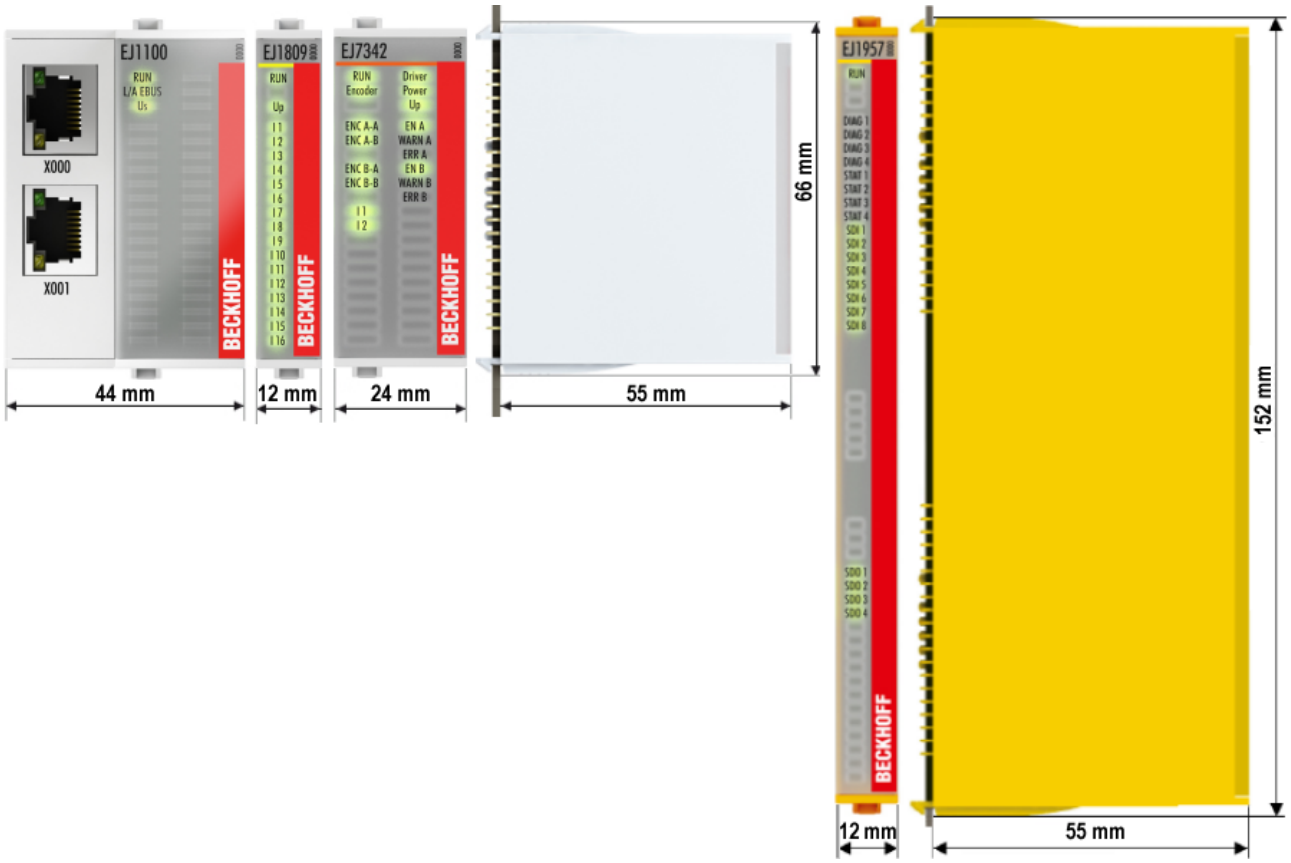


Fig. 9: EJxxxx - Dimensions

The technical drawings can be downloaded from the Beckhoff homepage. The drawings are named as described in the drawing below.

Fig. 10: Naming of the technical drawings

7.3 Installation positions and minimum distances

7.3.1 Minimum distances for ensuring installability

Note the dimensions shown in the following diagram for the design of the signal distribution board to ensure safe latching and simple assembly / disassembly of the modules.

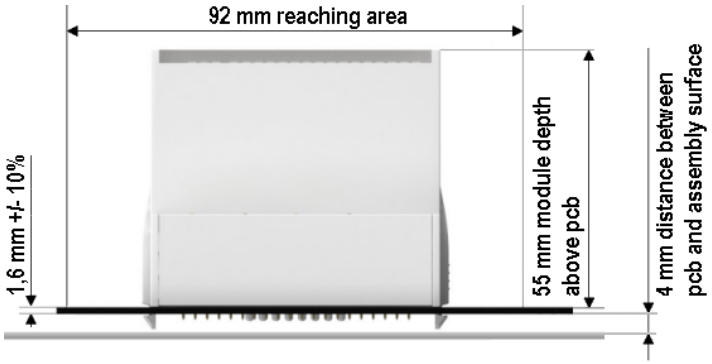


Fig. 11: Mounting distances EJ module - PCB

Observing the reaching area

A minimum reaching area of 92 mm is required for assembly / disassembly, in order to be able to reach the mounting tabs with the fingers.
Adherence to the recommended minimum distances for ventilation (see section Installation position [▶ 20]) ensures an adequate reaching area.

The signal distribution board must have a thickness of 1.6 mm and a minimum distance of 4 mm from the mounting surface, in order to ensure latching of the modules on the board.

7.3.2 Installation positions

NOTE

Constraints regarding installation position and operating temperature range

Please refer to the technical data for the installed components to ascertain whether any restrictions regarding the mounting position and/or the operating temperature range have been specified. During installation of modules with increased thermal dissipation, ensure adequate distance above and below the modules to other components in order to ensure adequate ventilation of the modules during operation!

The standard installation position is recommended. If a different installation position is used, check whether additional ventilation measures are required.

Ensure that the specified conditions (see Technical data) are adhered to!

Optimum installation position (standard)

For the optimum installation position the signal distribution board is installed horizontally, and the fronts of the EJ modules face forward (see Fig. *Recommended distances for standard installation position*). The modules are ventilated from below, which enables optimum cooling of the electronics through convection. “From below” is relative to the acceleration of gravity.

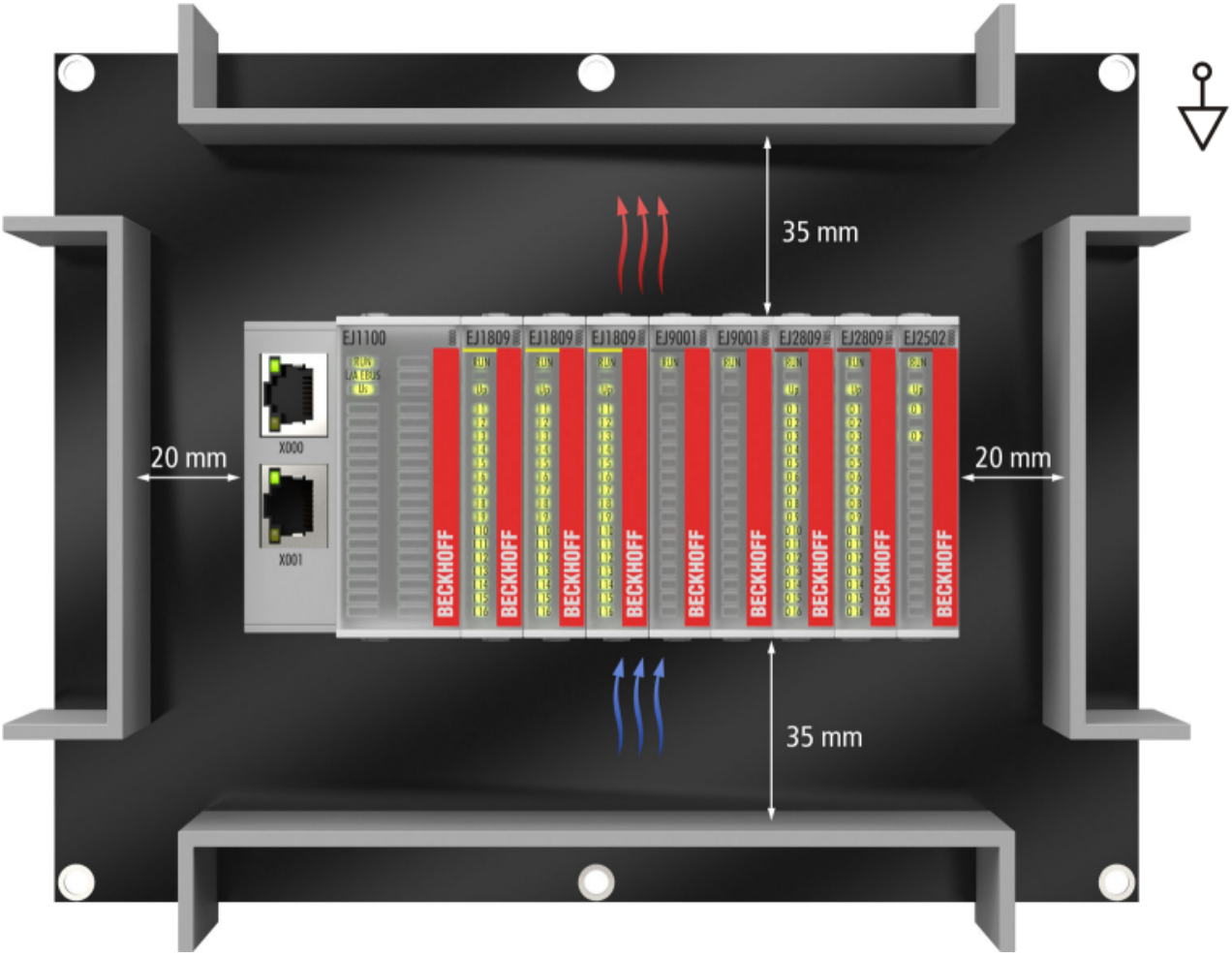


Fig. 12: Recommended distances for standard installation position

Compliance with the distances shown in Fig. *Recommended distances for standard installation position* is recommend. The recommended minimum distances should not be regarded as restricted areas for other components. The customer is responsible for verifying compliance with the environmental conditions described in the technical data. Additional cooling measures must be provided, if required.

Other installation positions

All other installation positions are characterized by a different spatial position of the signal distribution board, see Fig. *Other installation positions.*

The minimum distances to ambient specified above also apply to these installation positions.

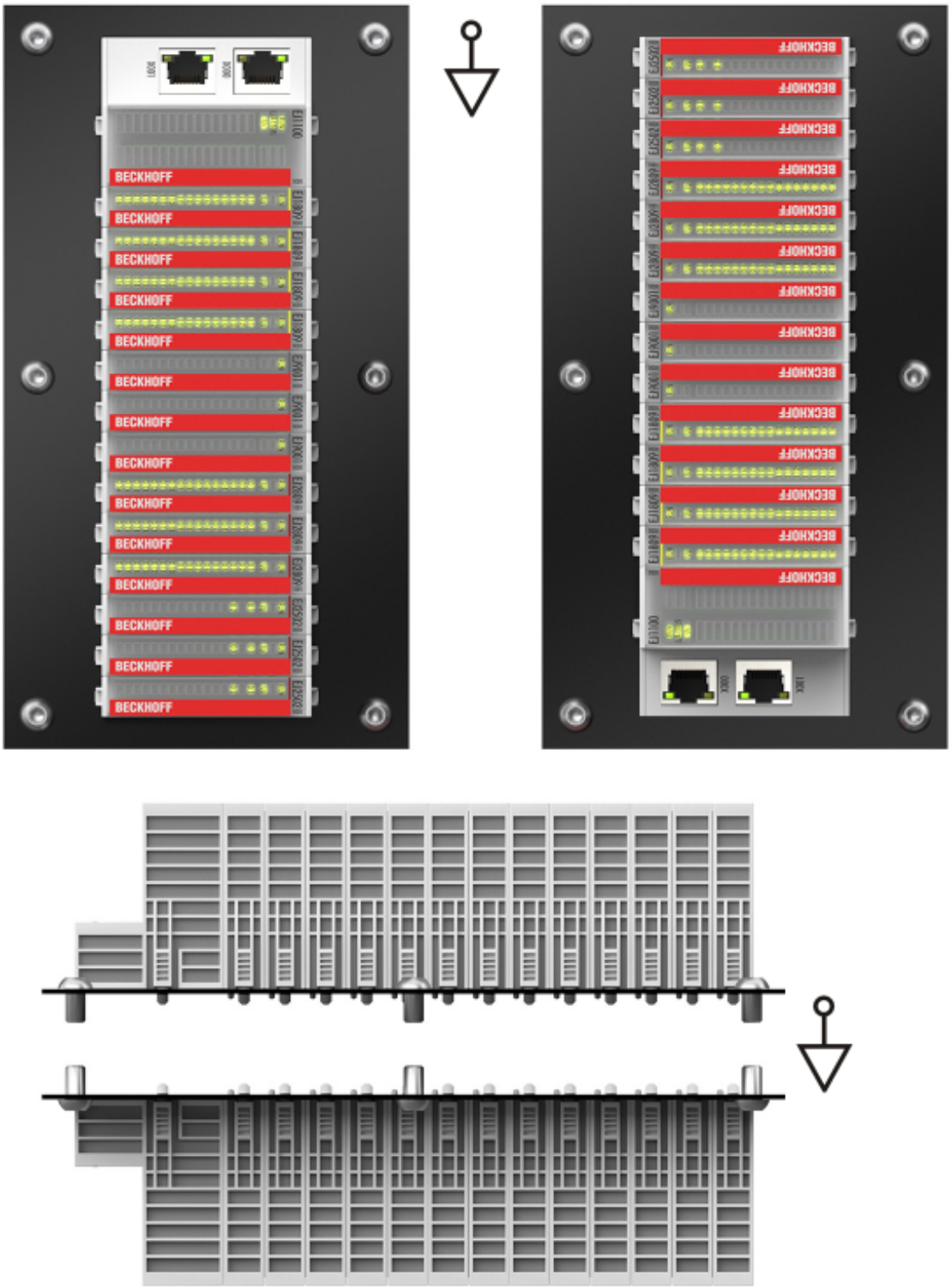


Fig. 13: Other installation positions

7.4 Codings

7.4.1 Color coding

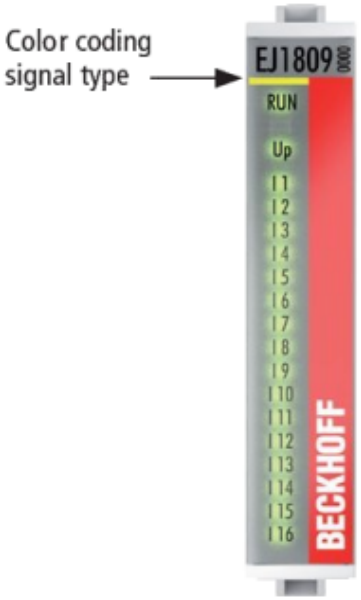


Fig. 14: EJ modules color code; sample: EJ1809

The EJ modules are color-coded for a better overview in the control cabinet (see diagram above). The color code indicates the signal type. The following table provides an overview of the signal types with corresponding color coding.

Signal type	Modules	Color
Coupler	EJ11xx	No color coding
Digital input	EJ1xxx	Yellow
Digital output	EJ2xxx	Red
Analog input	EJ3xxx	Green
Analog output	EJ4xxx	Blue
Position measurement	EJ5xxx	grey
Communication	EJ6xxx	grey
Motion	EJ7xxx	orange
System	EJ9xxx	grey

7.4.2 Mechanical position coding

The modules have two signal-specific coding pins on the underside (see Figs. B1 and B2 below). In conjunction with the coding holes in the signal distribution board (see Figs. A1 and A2 below), the coding pins provide an option for mechanical protection against incorrect connection. This significantly reduces the risk of error during installation and service.
Couplers and placeholder modules have no coding pins.

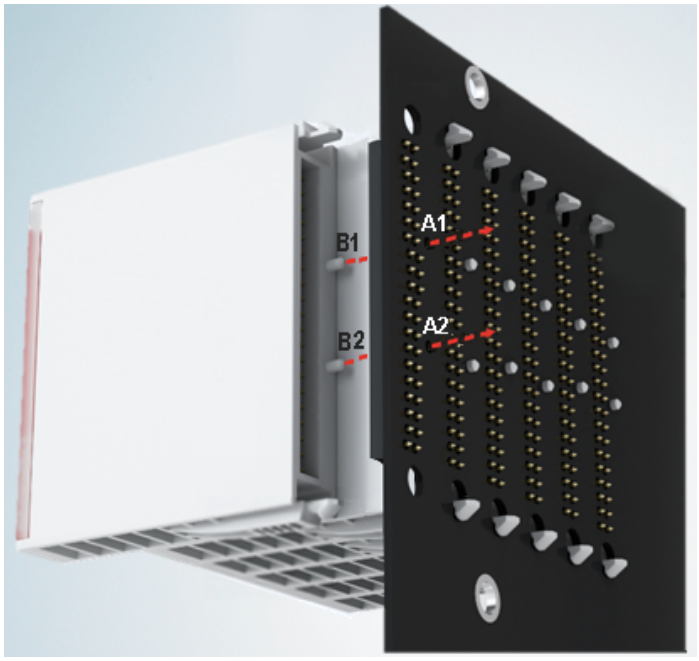


Fig. 15: Mechanical position coding with coding pins (B1 and B2) and coding holes (A1 and A2)

The following diagram shows the position of the position coding with position numbers on the left-hand side. Modules with the same signal type have the same coding. For sample, all digital input modules have the coding pins at positions one and three. There is no plug protection between modules with the same signal type. During installation the module type should therefore be verified based on the device name.

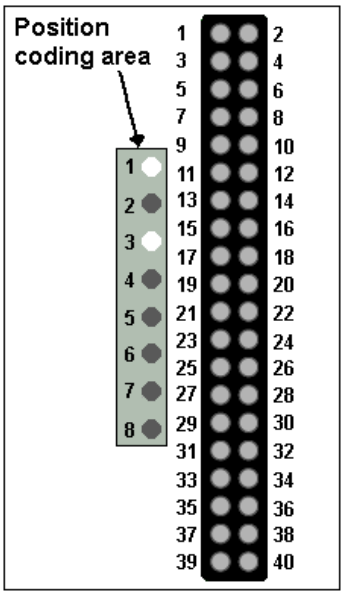


Fig. 16: Pin coding; sample: digital input modules

7.5 Installation on the signal distribution board

EJ modules are installed on the signal distribution board. The electrical connections between coupler and EJ modules are realized via the pin contacts and the signal distribution board.

The EJ components must be installed in a control cabinet or enclosure which must provide protection against fire hazards, environmental conditions and mechanical impact.

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the module system into a safe, de-energized state before starting installation, disassembly or wiring of the modules.

NOTE

Risk of damage to components through electrostatic discharge!

Observe the regulations for ESD protection.

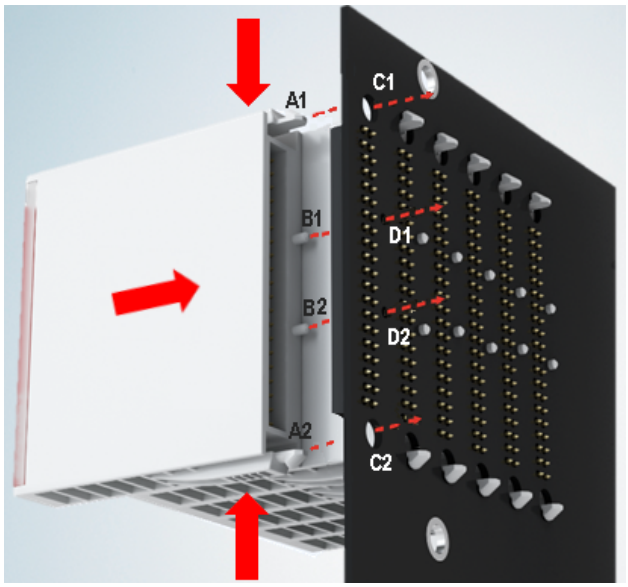


Fig. 17: Installation of EJ modules

A1 / A2	Latching lugs top / bottom	C1 / C2	Mounting holes
B1 / B2	Coding pins	D1 / D2	Coding holes

To install the modules on the signal distribution board proceed as follows:

1. Before the installation, ensure that the signal distribution board is securely connected to the mounting surface. Installation on an unsecured signal distribution board may result in damage to the board.
2. If necessary, check whether the positions of the coding pins (B) match the corresponding holes in the signal distribution board (D).
3. Compare the device name on the module with the information in the installation drawing.
4. Press the upper and the lower mounting tabs simultaneously and push the module onto the board while gently moving it up and down, until the module is latched securely.
   The required contact pressure can only be established and the maximum current carrying capacity ensured if the module is latched securely.
5. Use placeholder modules (EJ9001) to fill gaps in the module strand.

NOTE

- During installation ensure safe latching of the modules on the signal distribution board! The consequences of inadequate contact pressure include:

⇨ loss of quality of the transferred signals,

⇨ increased power dissipation of the contacts,

⇨ impairment of the service life.

7.6 Extension options

Three options are available for modifications and extensions of the EJ system.

- Replacing the placeholder modules with the function modules provided for the respective slot
- Assigning function modules specified for the respective slots for the reserve slots at the end of the module string
- Linking with EtherCAT Terminals and EtherCAT Box modules via an Ethernet/EtherCAT connection

7.6.1 Using placeholder modules for unused slots

The EJ9001 placeholder modules are used to close temporary gaps in the module strands (see Fig. A1 below). Gaps in the module strand cause interruption in EtherCAT communication and must be equipped with placeholder modules.
In contrast to the passive terminals of the EL series, the placeholder modules actively participate in the data exchange. Several placeholder modules can therefore be connected in series, without impairing the data exchange.
Unused slots at the end of the module strand can be left as reserve slots (see Fig. B1 below).

The machine complexity is extended (extended version) by allocating unused slots (see Figs. A2 below - Exchanging placeholder modules and B2 - Assigning reserve slots) according to the specifications for the signal distribution board.

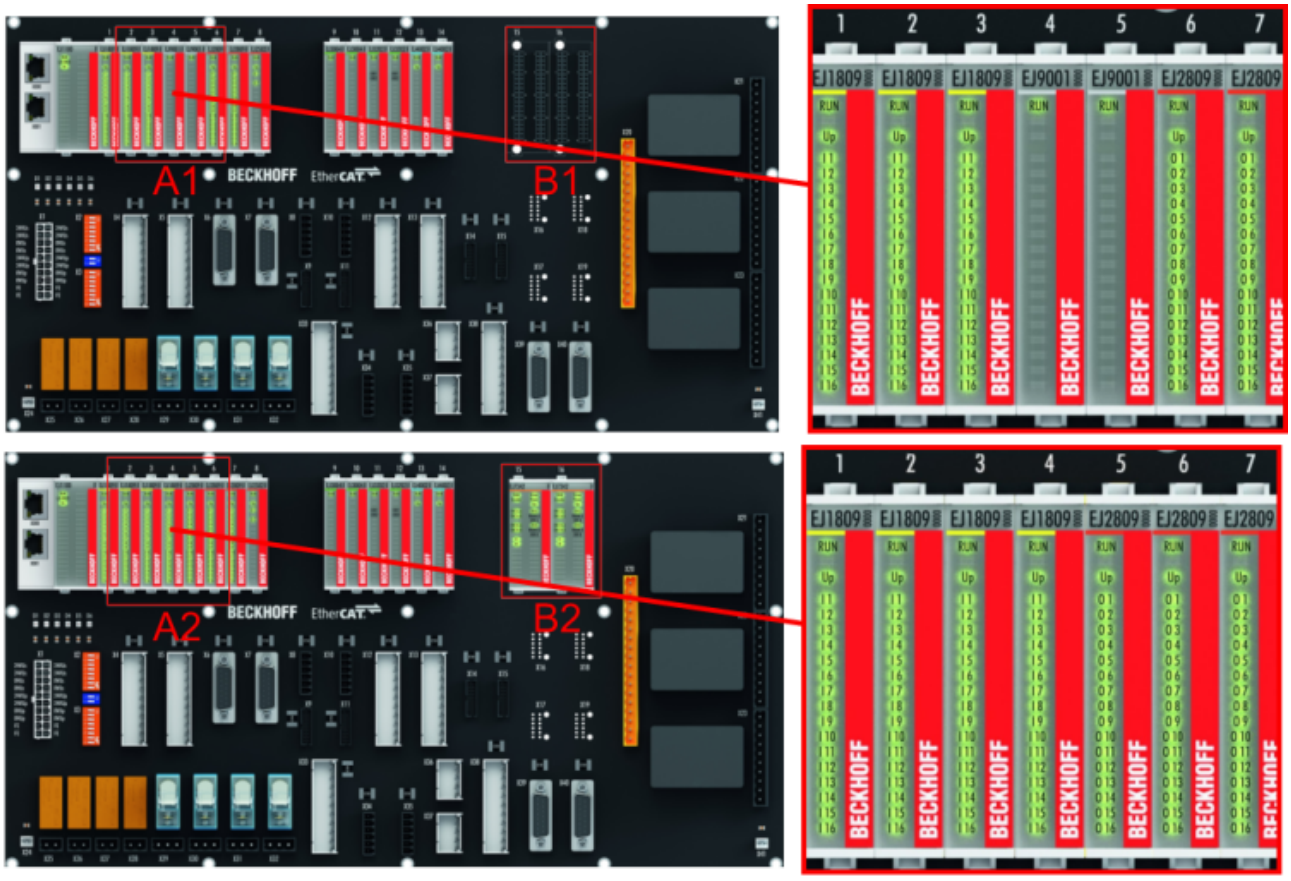


Fig. 18: Sample: Exchanging placeholder modules and assigning reserve slots

E-bus supply

Exchange the placeholder modules with other modules changes the current input from the E-Bus. Ensure that adequate power supply is provided.

7.6.2 Linking with EtherCAT Terminals and EtherCAT Box modules via an Ethernet/EtherCAT connection

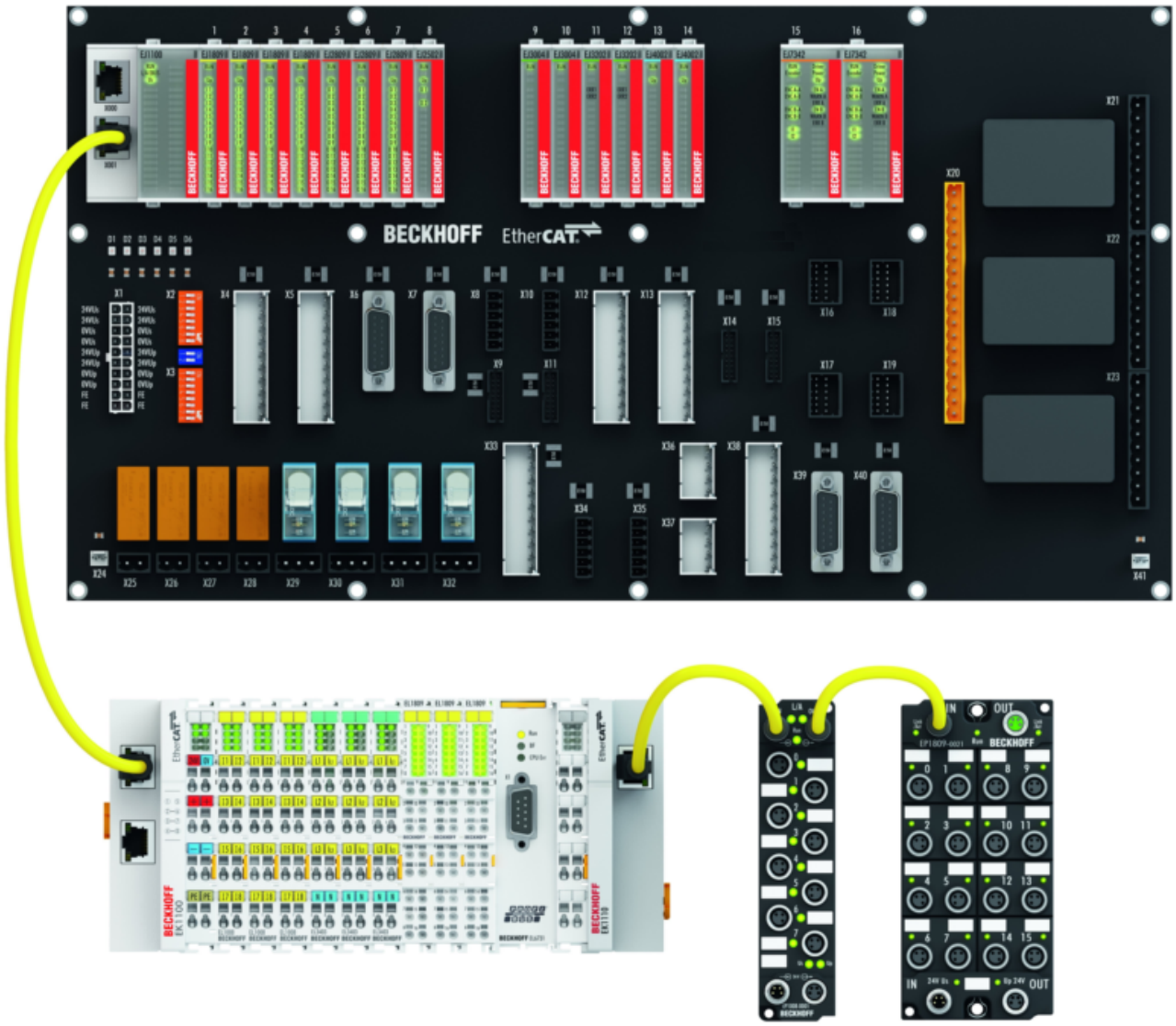


Fig. 19: Example of extension via an Ethernet/EtherCAT connection

7.7 IPC integration

Connection of CX and EL terminals via the EK1110-004x EtherCAT EJ coupler

The EK1110-0043 and EK1110-0044 EtherCAT EJ couplers connect the compact DIN-rail PCs of the CX series and attached EtherCAT Terminals (ELxxxx) with the EJ modules on the signal distribution board.

The EK1110-004x are supplied from the power supply unit of the Embedded PC.
The E-bus signals and the supply voltage of the field side U_P are routed directly to the PCB via a plug connector at the rear of the EtherCAT EJ couplers.

Due to the direct coupling of the Embedded PC and the EL terminals with the EJ modules on the PCB, no EtherCAT Extension (EK1110) or EtherCAT Coupler (EJ1100) is required.

The Embedded PC can be expanded with EtherCAT Terminals that are not yet available in the EJ system, for example.

Fig. 20: Example PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

Connection of C6015 / C6017 via the EJ110x-00xx EtherCAT Coupler

Thanks to their ultra-compact design and versatile mounting options, the C6015 and C6017 IPCs are ideally suited for connection to an EJ system.

In combination with the ZS5000-0003 mounting set, it is possible to place the C6015 and C6017 IPCs compactly on the signal distribution board.
The EJ system is optimally connected to the IPC via the corresponding EtherCAT Cable (see following Fig. [A]).
The IPC can be supplied directly via the signal distribution board using the enclosed power plug (see Fig. [B] below).

NOTE

Positioning on the signal distribution board

The dimensions and distances for placement and other details can be found in the Design Guide and the documentation for the individual components.

The figure below shows the connection of a C6015 IPC to an EJ system as an example. The components shown are schematic, to illustrate the functionality.

Fig. 21: Example for the connection of a C6015 IPC to an EJ system

7.8 Disassembly of the signal distribution board

⚠ WARNING

Risk of injury through electric shock and damage to the device!

Bring the module system into a safe, de-energized state before starting installation, disassembly or wiring of the modules.

Each module is secured through latching on the distribution board, which has to be released for disassembly.

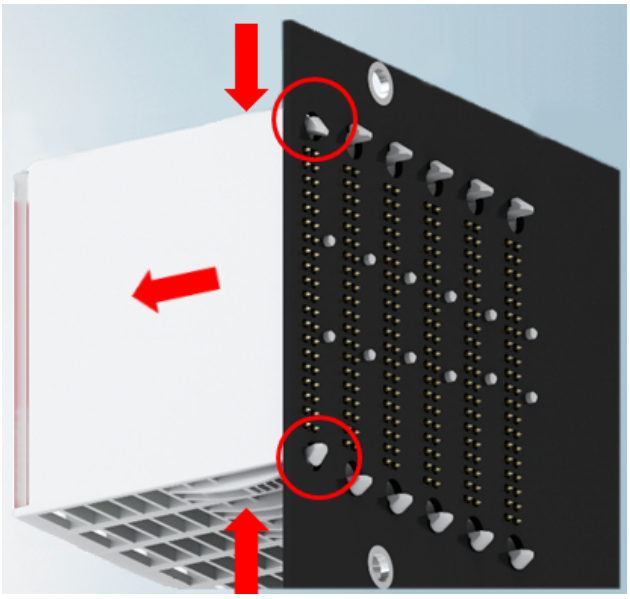


Fig. 22: Disassembly of EJ modules

To disassemble the module from the signal distribution board proceed as follows:

1. Before disassembly, ensure that the signal distribution board is securely connected to the mounting surface. Disassembly of an unsecured signal distribution board may result in damage to the board.
2. Press the upper and lower mounting tabs simultaneously and pull the module from board while gently moving it up and down.

7.9 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.

8 Appendix

8.1 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages: www.beckhoff.com

You will also find further documentation for Beckhoff components there.

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e-mail:	service@beckhoff.com
web:	www.beckhoff.com/service

Headquarters Germany

Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20
33415 Verl
Germany

Phone:	+49 5246 963 0
e-mail:	info@beckhoff.com
web:	www.beckhoff.com

More Information:
www.beckhoff.com/EJ8906-0005

Beckhoff Automation GmbH & Co. KG
Hülshorstweg 20
33415 Verl
Germany
Phone: +49 5246 9630
info@beckhoff.com
www.beckhoff.com