

Instruction handbook

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be in motion **be in motion**




BAUMÜLLER

b maXX[®] Systems

**EtherCAT Bus Coupler
ECxxxE**

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Read the instruction handbook before starting work!

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1

GENERAL INFORMATION

This Instruction handbook is an important component of your b maXX system; this means that you must thoroughly read this document, not least to ensure your own safety.

Additionally, the valid accident prevention regulations and general safety regulations applicable to the scope of application the device must be complied with.

In this chapter, we will describe the first steps.

1.1 First Steps

The Bus Terminal System

Currently, the input/output signals are wired locally at fieldbus devices and centrally at programmable control devices. The manufacturer-specific fieldbus devices with fixed input/output configuration and design that are currently available often make it necessary to install an entire group of devices with similar functionality.

This costly method of signal acquisition gives rise to high material, installation, planning and documentation costs as well as high costs for subsequent modification or expansion. Inventory management and service staff are put under unnecessary strain.

Flexible and stable

The Baumüller E-Bus Terminal is a flexible periphery concept consisting of electronic terminal blocks. The head of an electronic terminal block is the Bus Coupler with the EtherCAT interface.

1.2 Legend

Warnings

Warnings are marked by symbols in this instruction handbook. The warnings are introduced by signal words, which express the extent of the hazard.

Comply with the warnings under all circumstances and act with caution in order to avoid accidents, personal injury and property damage.

**DANGER!**

...notifies of an imminent dangerous situation, which will lead to death or serious injuries if not avoided.

**WARNING!**

...notifies of a potentially dangerous situation, which can lead to death or serious injuries if not avoided.

**CAUTION!**

...notifies of a potentially dangerous situation, which can lead to minor or slight injuries if not avoided.

**NOTICE!**

...notifies of a potentially dangerous situation, which can lead to property damage if not avoided.

Recommendations

**NOTE!**

...draws attention to useful tips and recommendations as well as information for efficient and trouble-free operation.

1.3 Limitation of liability

All statements and instructions in this instruction handbook have been compiled in compliance with the applicable standards and legislation while taking the current level of technology and our long-term experience and findings into account.

The manufacturer assumes no liability for damages resulting from:

- failure to follow the application manual
- application for purposes other than those intended
- untrained personnel

The actual scope of materials delivered can vary from the explanations and illustrations described here in the event of custom designs, the use of additional ordering options or due to the most recent changes in technology.

The user assumes the responsibility of conducting maintenance and commissioning in accordance with the safety regulations of the applicable standards and all other relevant national or regional legislation relating to conductor dimensioning and protection, grounding, circuit breakers, overvoltage protection, etc.

The person who conducted the assembly or installation shall be accountable for damages occurring during assembly or connection.

1.4 Preliminary information



NOTICE!

The following shall apply if the document you are reading is designated as preliminary information:

This version pertains to preliminary technical information, which the user of the described devices and functions should receive ahead of time, in order to be able to adjust to potential changes and/or all expansions.

This information is to be seen as preliminary, since it has not yet been subjected to the Baumüller internal review process. In particular, this information is still subject to changes, meaning that this preliminary information cannot be construed as legally binding. Baumüller assumes no liability for damages resulting from this potentially incorrect or incomplete version.

Should you detect or suspect content-related and/or serious formal errors in this preliminary information, please contact the contact person at Baumüller assigned to you and inform us of your findings and comments, so that they can be taken into account and potentially incorporated during the transition from the preliminary information to the final (reviewed by Baumüller) information.

1.5 Copyright

Treat the instruction handbook as confidential. It is intended exclusively for those working with the device. It is not permissible to transfer the application manual to third parties without the written approval of the manufacturer.



NOTE!

The content-related statements, texts, diagrams, images and other illustrations are copyright protected and subject to industrial property rights. Any improper use is liable to prosecution.

b maXX[®] is a registered trademark of Baumüller Nürnberg GmbH

EtherCAT[®] is a registered trademark of Beckhoff Automation GmbH,
33415 Verl, Deutschland

1.6 Further applicable documents from other manufacturers

Components from other manufacturers are built into the device. Hazard evaluations for these bought-in parts have been conducted by the applicable manufacturers. The conformity of the designs with the applicable European and national legislation has been declared by the respective component manufacturers.

1.7 Spare parts



WARNING!

Improper or defective spare parts can lead to damage, malfunctions or total failure as well as jeopardize safety.

Therefore:

- Only use original spare parts from the manufacturer

Procure replacement parts from authorized dealers or directly at the manufacturer.

1.8 Disposal

If no return or disposal agreement has been made, dismantled components can be taken for recycling after proper disassembly.

1.9 Warranty provisions

The warranty provisions are found as a separate document in the sales documents.

The operation of the devices described here in accordance with the specified methods/procedures/requirements is permitted. Everything else, even the operation of devices in installation positions not depicted here, for instance, is not permissible and must be clarified with the factor on a case-by-case base. The warranty will be rendered null and void if the devices are operated differently than described here.

1.10 Customer service

Our customer service is available for technical support.

Information on the competent contact person can be found at any time via telephone, fax, E-mail or over the internet.

1.11 Terms Used

In this documentation, we will also refer to Baumüller's "**EtherCAT Bus Coupler**" product as „ECxxxE", or "plug-in module".

SAFETY

This section provides an overview of all of the important safety aspects for optimum protection of personnel as well as for the safe and problem-free operation.

2.1 Contents of the application manual

Each person who is tasked with performing work on or with the device must have read and understood the application manual before working with the device. This also applies if the person involved with this kind of device or a similar one, or has been trained by the manufacturer.

2.2 Changes and modifications to the device

In order to prevent hazards and to ensure optimum performance, no changes, additions or modifications may be undertaken on the device that have not been explicitly approved by the manufacturer.

2.3 Usage for the intended purpose



WARNING!

Caution - Risk of injury

E-bus terminals may only be used for the purposes described below!

You must always use the module appropriately. Some important information is listed below. The information below should give you an idea of what is meant by appropriate use of the module. The information below has no claim to being complete; always observe all the information that is given in these operating instructions.

2.3 Usage for the intended purpose

- Configure the application such that the module is always operating within its specifications.
- Ensure that only qualified personnel works with this module.
- Install the module as specified in this documentation.
- Ensure that connections always comply with the stipulated specifications.
- Operate the module only when it is in technically perfect condition.
- Always operate the module in an environment that is specified in the technical data.
- Always operate the module in a standard condition.
For safety reasons, you must not make any changes to the module.
- Observe all the information on this topic if you intend to store the module.

You will be using the module in an appropriate way if you observe all the comments and information in these operating instructions.



WARNING!

Power supply from SELV/PELV power supply unit!

The terminal components must be supplied with 24 V_{DC} by an SELV/PELV power supply unit with an output voltage limit U_{max} of 36 V_{DC}. Failure to observe this can result in a loss of safety.



WARNING!

Danger due to use other than intended!

Any use of the device different from and/or exceeding beyond the scope of the intended use can lead to dangerous situations.

Therefore:

- Only use the device as intended.
- Follow all specifications of this Operation Manual.
- Ensure that exclusively qualified personnel work on or with this device.
- Take care in project planning to see that the device is always used within its specifications.
- The device and/or mounting rail is mounted on a wall which is sufficiently sturdy.
- Ensure that the power supply meets the required specifications.
- Only operate the device if it is in technically faultless condition.
- Only use the device in combination with components approved by Baumüller Nürnberg GmbH.

2.4 Responsibility of the operator

The device will be used in commercial areas. Thus, the proprietor of the device is subject to the legal work safety regulations.

Along with the notes on work safety in this operating manual, the safety, accident prevention and environmental protection regulations valid for the area of application of this device must be complied with. Whereby:

- The proprietor must inform himself about the applicable work health and safety regulations and ascertain, in a hazard assessment, any additional hazards that could arise from the special working conditions in the use area of the device. These must then be implemented in the form of operating instruction for operation of the device.
- This application manual must be kept accessible to personnel working with the device at all times in the immediate vicinity of the device.
- The specifications of the instruction handbook must be adhered to completely and without exception.
- The device may only be operated in a technically faultless and operationally safe condition.

2.5 Protective devices

Protection rating	
ECxxxE	IP 20

All devices must be installed in an appropriate control cabinet to meet the protection ratings required in IEC 60529 (IP54).



DANGER!

Risk of fatal injury from electrical current!

There is an immediate risk of fatal injury if live electrical parts are contacted.

Therefore:

- Operate the device in an electrical cabinet which provides protection from direct contact with the devices and meets at least the protective categories (IP54) of EN 60529.

2.6 Training of the personnel



WARNING!

Risk of injury due to insufficient qualifications!

Improper handling can lead to significant personal injury and material damage.

Therefore:

- Certain activities can only be performed by the persons stated in the respective chapters of this application manual.

In this application manual, the following qualifications are stipulated for various areas of activity:

- Operating personnel
 - The drive system may only be operated by persons who have been specially trained, familiarized and authorized.
 - Troubleshooting, maintenance, cleaning, maintenance and replacement may only be performed by trained or familiarized personnel. These persons must be familiar with the application manual and act accordingly.
 - Initial operation and familiarization may only be performed by qualified personnel.
- Qualified personnel
 - Electrical engineers authorized by Baumüller Nürnberg GmbH, and qualified electricians of the customer or a third party who have learned to install and maintain Baumüller drive systems and are authorized to ground and identify electrical power circuits and devices in accordance with the safety engineering standards of the company.
 - Qualified personnel have had occupational training or instruction in accordance with the respective locally applicable safety engineering standards for the upkeep and use of appropriate safety equipment.

2.7 Personal protective equipment

The wearing of personal protective equipment is required when working in order to minimize health and safety risks.

- The protective equipment necessary for each respective type of work shall always be worn during work.
- The personal safety signs present in each working area must be observed.



Protective work clothing

should be snug-fitting work clothes, with low tearing resistance, narrow sleeves and with no extending parts.

No rings or chains may be worn.



Hard hat

protection against falling and flying objects.



Safety shoes

protection against heavy falling objects.



Protective gloves

to protect hands against friction, abrasion, puncturing or more severe injuries, as well as the contact with hot objects.

Wear for special tasks



Protective glasses

protection of the eyes against objects, which are flying around and against splashing liquids.

2.8 Special hazards

In the following section the residual risks are specified, which result from the hazard analysis.

Observe the safety notes listed here and the warning notes in the further chapters of this manual to reduce health risks and dangerous situations.

Electricity



DANGER!

Risk of fatal injury from electricity!

There is an immediate risk of fatal injury if live electrical parts are contacted. Damage to the insulation or individual components can be life-threatening.

Therefore:

- Switch off the electrical power immediately in case of damage to the power supply insulation.
- Only allow work on the electrical system to be performed by qualified personnel.
- Switch off the current when any kind of work is being performed on the electrical system and secure it against being started again.

Danger from residual energy



DANGER!

Risk of fatal injury from electrical current!

After separation of the device from the mains parts under voltage as e. g. power connections may only be touched if the capacitors in the device have been discharged.

Therefore:

- Do not touch before taking the discharge time of the capacitors and the electrically live parts into account.
- Pay attention to corresponding notes on the equipment.
- If additional capacitors are connected to the intermediate circuit, the DC-link discharge can take much longer. In this case, the necessary waiting period must be determined itself or a measurement made as to whether the equipment is de-energized.

Moving components

**WARNING!**

Risk of injury from moving components!

Rotating components and/or those moving linearly can result in severe injury.

Therefore:

- Do not intervene in moving components during operation.
- Do not open any covering during operation.
- The amount of residual mechanical energy depends on the application. Powered components still turn/move for a certain length of time even after the power supply has been switched off. Ensure that adequate safety measures are taken.

2.9 Fire fighting

**DANGER**

Risk of fatal injury from electrical current!

There is a risk of electric shock if an electrically-conductive, fire-extinguishing agent is used.

Therefore:

- Use the following fire-extinguishing agent:



Firefighting equipment

2.10 Electrical safety

The option module is laid out for degree of pollution 2 accordant to EN 50178. This means, that only non-conductive pollutions may occur during operating time. Short-term conductivity by condensation is permitted only, if the module is out of operation.



WARNING!

Risk of injury due to conductive pollutions!

No conductive pollutions may occur during operating time.

Therefore:

- If necessary, assure with additional measures that the degree of pollution 2 is not exceeded before installing the system.

2.10.1 Notes according to the power supply



WARNING!

Risk of injury from electrical current!

Only those devices may be connected to the module, which ensure a reliable electrical isolation to the 230 V system.

The power-supply unit for that generates the 24 volt-supply must be in accordance with the requirements for PELV referring to EN 50178.

2.11 Safety equipment



WARNING!

Risk of fatal injury due to non-functional safety equipment!

Safety equipment provides for the highest level of safety in a facility. Even if safety equipment makes work processes more awkward, under no circumstances may they be circumvented. Safety can only be ensured by intact safety equipment.

Therefore:

- Before starting to work, check whether the safety equipment in good working order and properly installed.

2.12 Rules of conduct in case of danger or accidents

Preventive measures

- Always be prepared for accidents or fire!
- Keep first-aid equipment (e.g. first-aid kits, blankets, etc.) and fire extinguishers readily accessible.
- Familiarize personnel with accident alarm, first aid and rescue equipment.

And if something does happen: respond properly

- Stop operation of the device immediately with an EMERGENCY Stop.
- Initiate first aid measures.
- Evacuate persons from the danger zone.
- Notify the responsible persons at the scene of operations.
- Alarm medical personnel and/or the fire department.
- Keep access routes clear for rescue vehicles.

2.13 Signs and labels

The following symbols and information signs are located in the working area. They refer to the immediate vicinity in which they are affixed.



WARNING!

Risk of injury due to illegible symbols!

Over the course of time, stickers and symbols on the device can become dirty or otherwise unrecognizable.

Therefore:

- Maintain all safety, warning and operating labels on the device in easily readable condition



Electrical voltage

The working area, which is marked with this sign, is authorized for qualified personnel to work in it, only

Unauthorized persons may not touch the marked work equipment.



DANGER!

Risk of fatal injury from electrical current!

Discharge time > 1 minute

Stored electrical current!

Therefore:

- Do not touch before taking into account the discharge time of the capacitors and electrically live parts.
- Heed corresponding notes on the equipment.
- If additional capacitors are connected to the intermediate circuit, the intermediate circuit discharge can take a much longer time. In this case, the necessary waiting period must itself be determined or a measurement made as to whether the equipment is de-energized. This discharge time must be posted, together with an IEC 60417-5036 (2002-10) warning symbol, on a clearly visible location of the control cabinet.

BASICS

This chapter informs about data exchange over EtherCAT.

3.1 General information on EtherCAT and the use of the EtherCAT-networks

EtherCAT is an Ethernet-based field bus system that combines the advantages of Ethernet (high speed, easy configuration) with real-time capability. The use of internet technologies on the I/O level is also possible with EtherCAT. As with other field busses, device profiles are used for communication with EtherCAT.

New device profiles were not defined for EtherCAT, however. Instead, interfaces for existing device profiles (already familiar to the user) are provided. This facilitates the migration from the existing field bus to EtherCAT, both for the user and for the device manufacturer.

The Baumüller EtherCAT master module supports CANopen over EtherCAT (CoE), Ethernet over EtherCAT (EoE) and File-Access over EtherCAT (FoE).

Additional information is found on the website of the EtherCAT Technology Group (ETG) at www.EtherCAT.org.

CANopen over EtherCAT (CoE)

CANopen devices and application profiles are available for a wide variety of device classes and applications, such as

- I/O modules
- drives
- encoders
- proportional valves and hydraulic regulators

and application profiles as

- plastics processing
- textile machines

EtherCAT can provide the same communication mechanisms as CANopen:

- object directory
- PDO (process data objects)
- SDO (service data objects)

Even the network management is comparable.

Ethernet over EtherCAT (EoE)

The EtherCAT technology is Ethernet-compatible. The protocol is compatible with other Ethernet-based services and protocols on the same physical network, generally with a minimum loss of performance. Any required Ethernet devices can be connected within the EtherCAT line via a switch port. The Ethernet frames are tunneled via the EtherCAT protocol, as it is usual with internet technologies. The EtherCAT network is fully transparent to the Ethernet device, and the real-time properties are not taken into account. EtherCAT devices can also use other Ethernet protocols, and thus act like an external standard Ethernet station. Here, the master functions as a layer 2 switch that passes on the frames to the corresponding stations, using the address information.

This means that all internet technologies, e.g.

- integrated webservers
- FTP-transfer

can be used in the EtherCAT-environment.

File-Access over EtherCAT (FoE)

This simple protocol enables file access in a device and a uniform firmware upload to devices across a network. The protocol has been deliberately specified in a lean manner, so that it can be supported by boot loader programs – a TCP/IP stack isn't required.

Telegrams

EtherCAT overcomes the principle limitations of other Ethernet solutions. An Ethernet telegram (containing the EtherCAT protocol) no longer receives, interprets and then copies the process data after each switch-on. Instead of that, each EtherCAT slave takes the related data from the telegram (e.g. set values) while the telegram is running through the EtherCAT slave. The input data (e.g. actual values) is also written in the telegram, while the telegram is running through the EtherCAT-slave.

Thereby, the Ethernet telegrams are delayed by a few nanoseconds, only.

Since an Ethernet telegram reaches many EtherCAT slaves in the transmitting direction as well as in the receiving direction, the user data rate rises to over 90%.

Protocol

The EtherCAT protocol, optimized for process data is directly transmitted in the Ethernet telegram. EtherCAT uses standard telegrams (standard frames) pursuant to IEEE802.3, only.

Network

EtherCAT supports the bus and line configuration used for field busses. Fast Ethernet physics (100BaseTX) allow a cable length up to 100 m between two devices on the EtherCAT bus. With the EtherCAT master module up to 1023 devices can be connected to the EtherCAT bus.

Distributed Clocks

High-precision synchronization is possible with "Distributed Clocks". The slave's EtherCAT-ASIC contains a real-time clock with a capture/compare unit and generation of HW-cycle signals. These real-time clocks of the slave are compared with one another. There-with, the slave's event generation can be synchronized to <100 ns.

3.2 EtherCAT cabling – wire-bound

The cable length between two EtherCAT devices must not exceed 100 m. This results from the FastEthernet technology, which, above all for reasons of signal attenuation over the length of the cable, allows a maximum link length of 5 + 90 + 5 m if cables with appropriate properties are used.

Cables and connectors

For connecting EtherCAT devices only Ethernet connections (cables + plugs) that meet the requirements of at least category 5 (Cat5) according to EN 50173 or ISO/IEC 11801 should be used. EtherCAT uses 4 wires for signal transfer.

EtherCAT uses RJ45 plug connectors, for example. The pin assignment is compatible with the Ethernet standard (ISO/IEC 8802-3).

Pin	Color of conductor	Signal	Description
1	yellow	TD+	Transmission Data +
2	orange	TD-	Transmission Data -
3	white	RD+	Receiver Data +
6	blue	RD-	Receiver Data -

Due to automatic cable detection (auto-crossing) symmetric (1:1) or cross-over cables can be used between EtherCAT devices from Baumüller.

E-Bus supply

A bus coupler can supply the E-bus terminals attached to it with the E-bus system voltage of 5 V; a coupler usually has a load capacity of up to 2 A in this situation (see documentation for the respective devices). Information on how much current each E-bus terminal requires from the E-bus supply is available online and in the catalogue. If the added terminals require more current than the coupler can supply, then power feed terminals (e.g. ES000E) must be inserted at appropriate places in the terminal strand.

3.3 EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational and
- Operational

Init

After switch-on the EtherCAT slave in the Init state. No mailbox or process data communication is possible. The EtherCAT master initializes sync manager channels 0 and 1 for mailbox communication.

Pre-Operational (Pre-Op)

During the transition between Init and Pre-Op the EtherCAT slave checks whether the mailbox was initialized correctly.

In Pre-Op state mailbox communication is possible, but not process data communication. The EtherCAT master initializes the sync manager channels for process data (from sync manager channel 2), the FMMU channels and, if the slave supports configurable mapping, PDO mapping or the sync manager PDO assignment. In this state the settings for the process data transfer and perhaps terminal-specific parameters that may differ from the default settings are also transferred.

The Ethernet over EtherCAT (EoE) protocol is only available in Pre-Op, because this protocol is based on the mailbox principle.

Safe-Operational (Safe-Op)

During transition between Pre-Op and Safe-Op the EtherCAT slave checks whether the sync manager channels for process data communication and, if required, the distributed clocks settings are correct. Before it acknowledges the change of state, the EtherCAT slave copies current input data into the associated DP-RAM areas of the EtherCAT slave controller (ECSC).

In Safe-Op state mailbox and process data communication is possible, although the slave keeps its outputs in a safe state, while the input data are updated cyclically.



NOTE!

Outputs in SAFEOP state

The default set watchdog monitoring sets the outputs of the module in a safe state - depending on the settings in SAFEOP and OP - e.g. in OFF state. If this is prevented by deactivation of the watchdog monitoring in the module, the outputs can be switched or set also in the SAFEOP state.

Operational (Op)

Before the EtherCAT master switches the EtherCAT slave from Safe-Op to Op it must transfer valid output data.

In the Op state the slave copies the output data of the masters to its outputs. Process data and mailbox communication is possible.

ETHERCAT COUPLER

4.1 EtherCAT Coupler EC000E

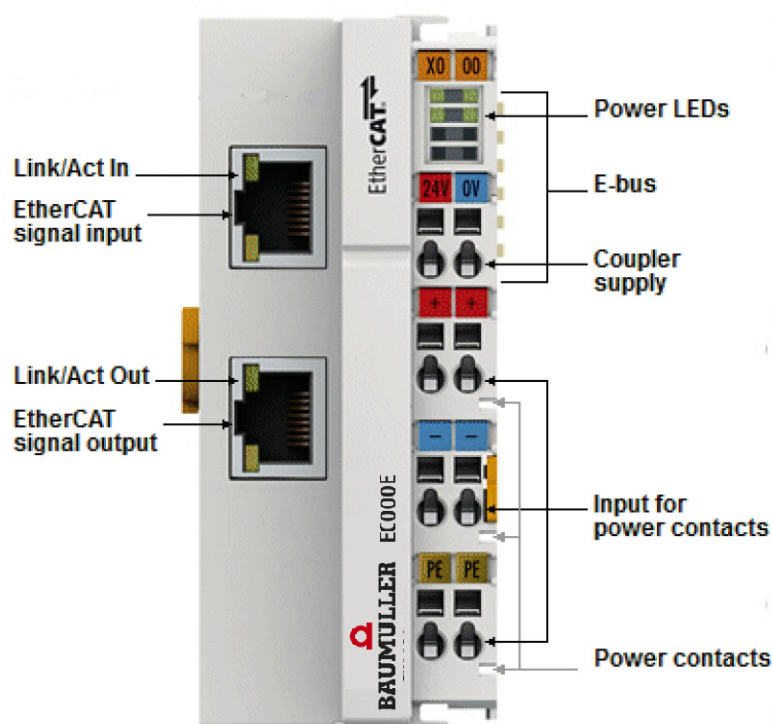


Figure 1: EC000E

The EC000E coupler connects the EtherCAT Device Protocol with the EtherCAT Terminals. One station consists of a coupler, any number of EtherCAT Terminals and a bus end terminal, e.g. EK000E.

The coupler converts the telegrams from Ethernet 100BASE-TX to E-bus signal representation in passing with minimum latency. The coupler connected to the network via the upper Ethernet interface. The lower RJ-45 socket may be used to connect further EtherCAT devices in the same strand.

4.2 EtherCAT Coupler EC001E with ID switch

The coupler supplies the connected terminals with the necessary E-bus current for communication. The coupler can supply a maximum of 5V/2A. Power feed terminals (e.g. ES-000E) must be integrated if more current is required.

In the EtherCAT network, the EC000E coupler can be installed anywhere in the Ethernet signal transfer section (100BASE-TX). The coupler thereby processes exclusively unaddressed MAC Broadcast telegrams of the type EtherCAT Device Protocol from the EtherCAT master. Since directed addressing via MAC Unicast or IP addressing is not used, neither a switch nor a router can be used.

4.2 EtherCAT Coupler EC001E with ID switch

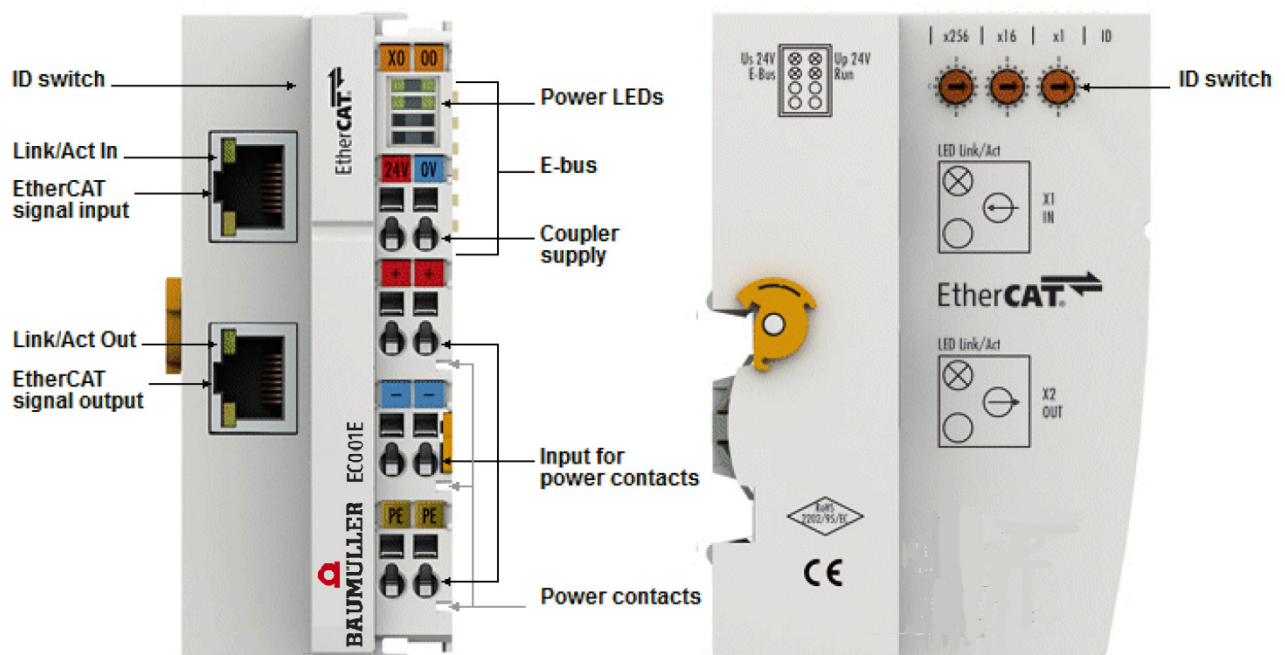


Figure 2: EC001E

The EC001E coupler connects the EtherCAT Device Protocol with the EtherCAT Terminals. One station consists of a coupler, any number of EtherCAT Terminals and a bus end terminal, e.g. EK000E.

The coupler converts the telegrams from Ethernet 100BASE-TX to E-bus signal representation in passing with minimum latency. The coupler is connected to the network via the upper Ethernet interface. The lower RJ-45 socket may be used to connect further EtherCAT devices in the same strand.

The coupler supplies the connected terminals with the necessary E-bus current for communication. The coupler can supply a maximum of 5 V/2 A. Power feed terminals (e.g. ES000E) must be integrated if more current is required.

In the EtherCAT network, the coupler can be installed anywhere in the Ethernet signal transfer section (100BASE-TX). The coupler thereby processes exclusively unaddressed MAC Broadcast telegrams of the type EtherCAT Device Protocol from the EtherCAT master. Since directed addressing via MAC Unicast or IP addressing is not used, neither a switch nor a router can be used.

The EC001E supports optional groups (positioned freely). The characteristics of the EK1101 in relation to this are:

- ID can be set on the device via 3 rotary selector switches within the range 0 to 4095 (hexadecimal)
- the ID is readable online by the EtherCAT master via the process data

4.3 EtherCAT coupler EC440E/EC840E/EC480E with digital inputs and outputs

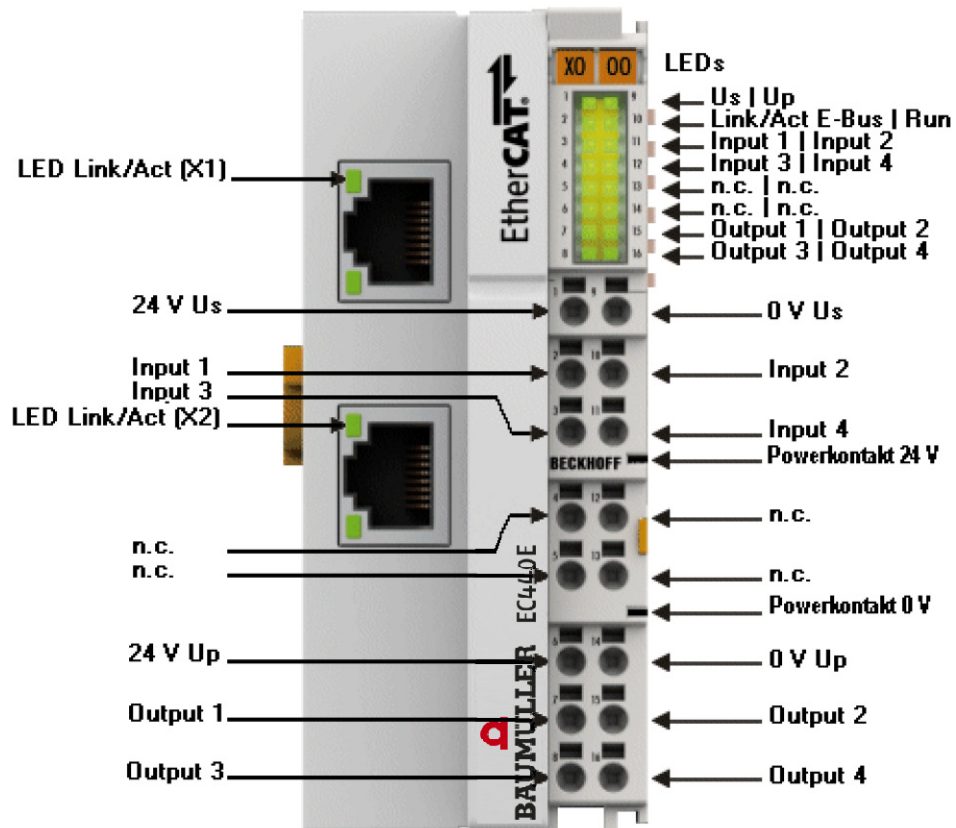


Figure 3: EC440E (connections / LEDs characterized with n.c. are allocated with four inputs at EC840E and connections / LEDs characterized with n.c. are allocated with four outputs at EC480E)

The EtherCAT couplers (EC440E/EC840E/EC480E) link the EtherCAT device protocol with the EtherCAT Terminals. Depending on the type, they contain a certain number of digital inputs 24 VDC (IEC61131-2 type 3) and outputs 24 VDC; 0.5 A. The coupler in a modern High-Density (HD) housing can be wired using the toolless direct plug-in technique.

One station consists of a coupler, any number of EtherCAT Terminals and a bus end terminal, e.g. EK000E.

The coupler converts the telegrams from Ethernet 100BASE-TX to E-bus signal representation in passing with minimum latency. The coupler is connected to the network via the upper Ethernet interface. The lower RJ-45 socket may be used to connect further EtherCAT devices in the same strand.

4.4 EtherCAT coupler port allocation

The coupler supplies the connected terminals with the necessary E-bus current for communication. The coupler can supply a maximum of 5 V/1000 mA. Power feed terminals (e.g. ES000E) must be integrated if more current is required (see Technical Data (chapter D.13 in Instruction handbook E-Bus Terminals).

In the EtherCAT network, the EK1100 coupler can be installed anywhere in the Ethernet signal transfer section (100BASE-TX). The coupler thereby processes exclusively unaddressed MAC Broadcast telegrams of the type EtherCAT Device Protocol from the EtherCAT master. Since directed addressing via MAC Unicast or IP addressing is not used, neither a switch nor a router can be used.

4.4 EtherCAT coupler port allocation

According to the EtherCAT specification, an ESC (EtherCAT Slave Controller, hardware processing unit of the EtherCAT protocol) can have 1 to 4 ports, which it controls itself. Via an open port it can handle outgoing and incoming Ethernet traffic.

The following figure shows the direction of data flow in a fully connected EC001E as an example:

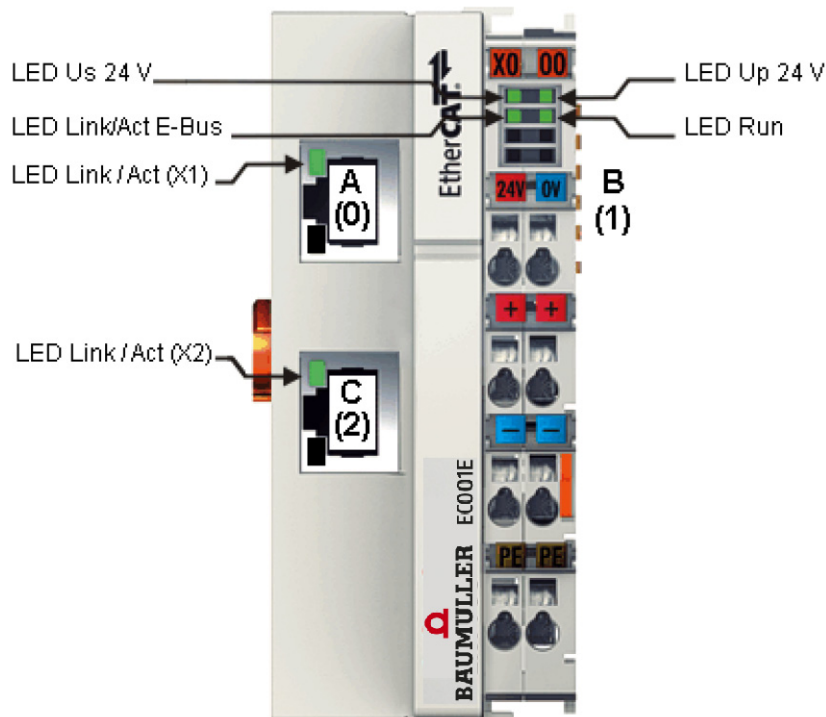


Figure 4: E.g. EC001E EtherCAT coupler with 3 ports

The port assignment in the case of the EC000E, EC440E, EC840E and EC480E applies accordingly.

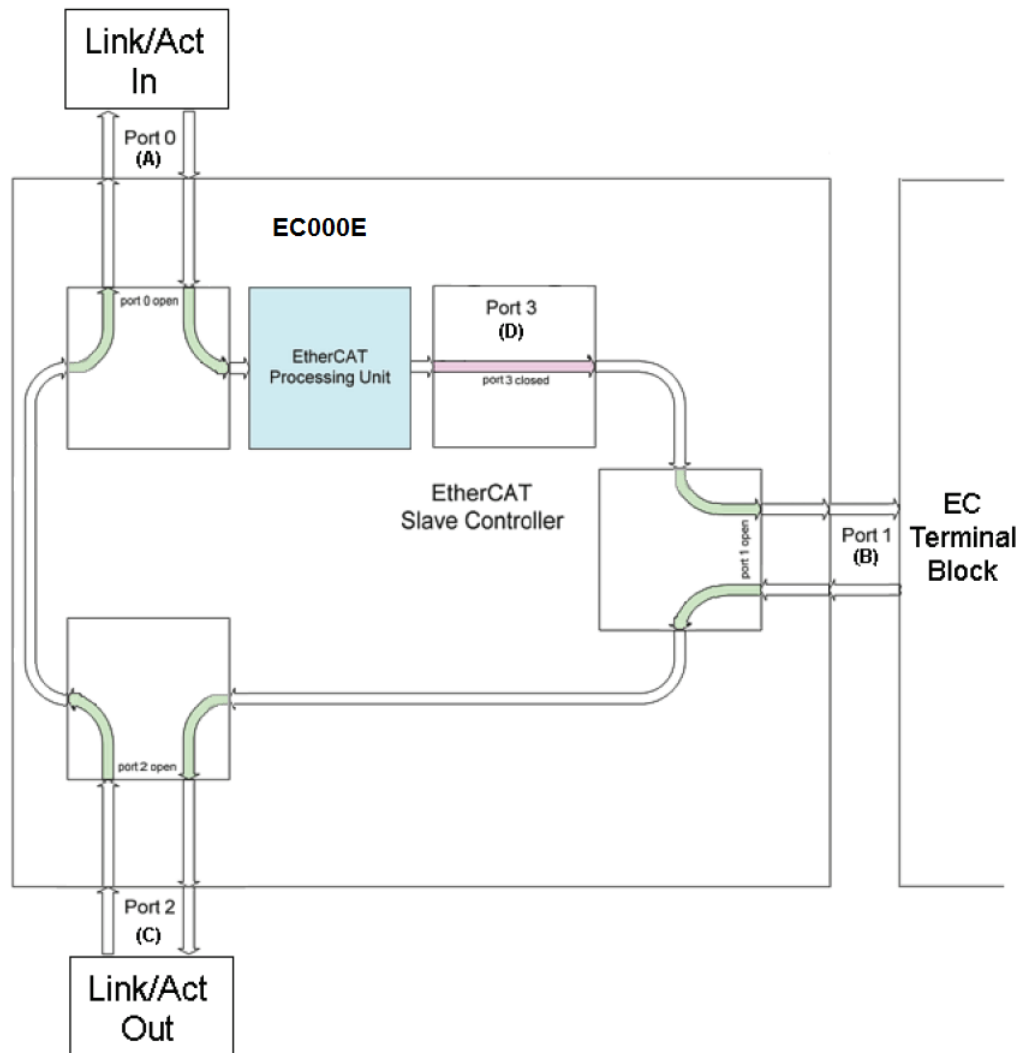


Figure 5: Internal and external port assignment for Bus Coupler EC000E

Frame processing sequence

- The EtherCAT frame arriving at the EtherCAT signal input is passed on by Port 0 (A) to the EtherCAT processing unit.
- The EtherCAT frame arrives at Port 1 (B) and the data frame departs via Port 1 (B) to the following slave in the EtherCAT terminal network (if a slave is connected there and reports 'Link').
- After the arrival of the data frame at Port 1 (B) from the terminal network, this is passed on to Port 2 (C) and leaves the coupler at the following EtherCAT output (if a slave is connected there and reports 'Link').
- The data frame arrives at Port 2 (C). This is now forwarded to port 0 (A) and leaves the EC000E via the EtherCAT input.

4.4 EtherCAT coupler port allocation



NOTE!

Processing of the data

The data in the EtherCAT datagrams are processed only between Ports 0 (A) and 3 (D) in the EtherCAT processing unit. The non-implemented (internal) Port 3 (D) is considered to be closed and passes on the datagram to Port 1 (B).

ASSEMBLY AND INSTALLATION

5.1 Instructions for ESD protection



CAUTION!

Destruction of the devices by electrostatic discharge possible!

Please ensure you are electrostatically discharged and avoid touching the contacts of the device directly.

- Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.).
- Surroundings (working place, packaging and personnel) should be grounded probably, when handling with the devices.
- Each assembly must be terminated at the right hand end with an EK000E bus end cap, to ensure the protection class and ESD protection.

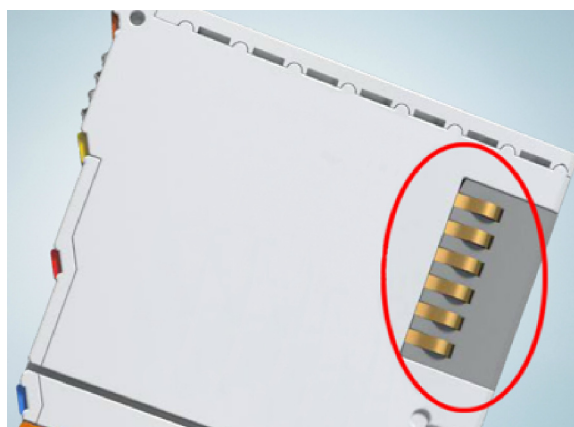


Figure 6: Spring contacts of the I/O components

5.2 Installation on mounting rails



WARNING!

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Assembly

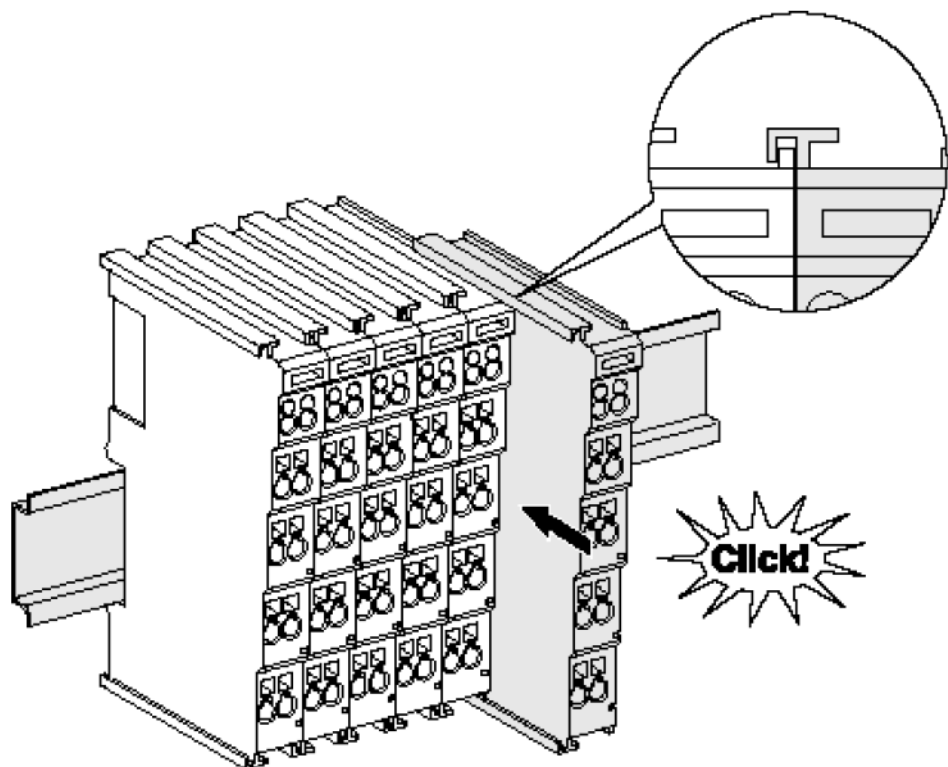


Figure 7: Attaching on mounting rail

The Bus Coupler and Bus Terminals are attached to commercially available 35 mm mounting rails (DIN rails according to EN 60715) by applying slight pressure:

- 1 First attach the Fieldbus Coupler to the mounting rail.
- 2 The Bus Terminals are now attached on the right-hand side of the Fieldbus Coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.

If the Terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.



NOTE!

Fixing of mounting rails

The locking mechanism of the terminals and couplers extends to the profile of the mounting rail. At the installation, the locking mechanism of the components must not come into conflict with the fixing bolts of the mounting rail. To mount the mounting rails with a height of 7.5 mm under the terminals and couplers, you should use flat mounting connections (e.g. countersunk screws or blind rivets).

Disassembly

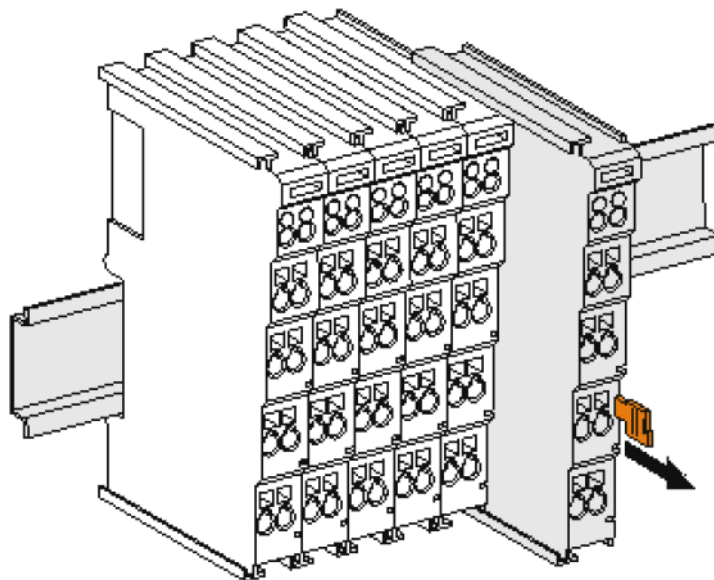


Figure 8: Disassembling of terminal

Each terminal is secured by a lock on the mounting rail, which must be released for disassembly:

- 1 Pull the terminal by its orange-colored lugs approximately 1 cm away from the mounting rail. In doing so for this terminal the mounting rail lock is released automatically and you can pull the terminal out of the bus terminal block easily without excessive force.
- 2 Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal out of the bus terminal block.

Connections within a bus terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realized by joining the components:

- The six spring contacts of the E-Bus deal with the transfer of the data and the supply of the Bus Terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via terminals on the Bus Coupler (up to 24 V) or for higher voltages via power feed terminals.



NOTE!

Power Contacts

During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts.

Power Feed Terminals (ES000E) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.



CAUTION!

Possible damage of the device

Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a nominal voltage of 230 V).

Therefore:

- For insulation testing, disconnect the PE supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.



NOTICE!

Risk of electric shock!

The PE power contact must not be used for other potentials!

5.3 Installation positions



NOTICE!

Constraints regarding installation position and operating temperature range

Please refer to the technical data for a terminal to ascertain whether any restrictions regarding the installation position and/or the operating temperature range have been specified. When installing high power dissipation terminals ensure that an adequate spacing is maintained between other components above and below the terminal in order to guarantee adequate ventilation!

Optimum installation position (standard)

The optimum installation position requires the mounting rail to be installed horizontally and the connection surfaces of the terminals to face forward (see Fig. "Recommended distances for standard installation position"). The terminals are ventilated from below, which enables optimum cooling of the electronics through convection. "From below" is relative to the acceleration of gravity.

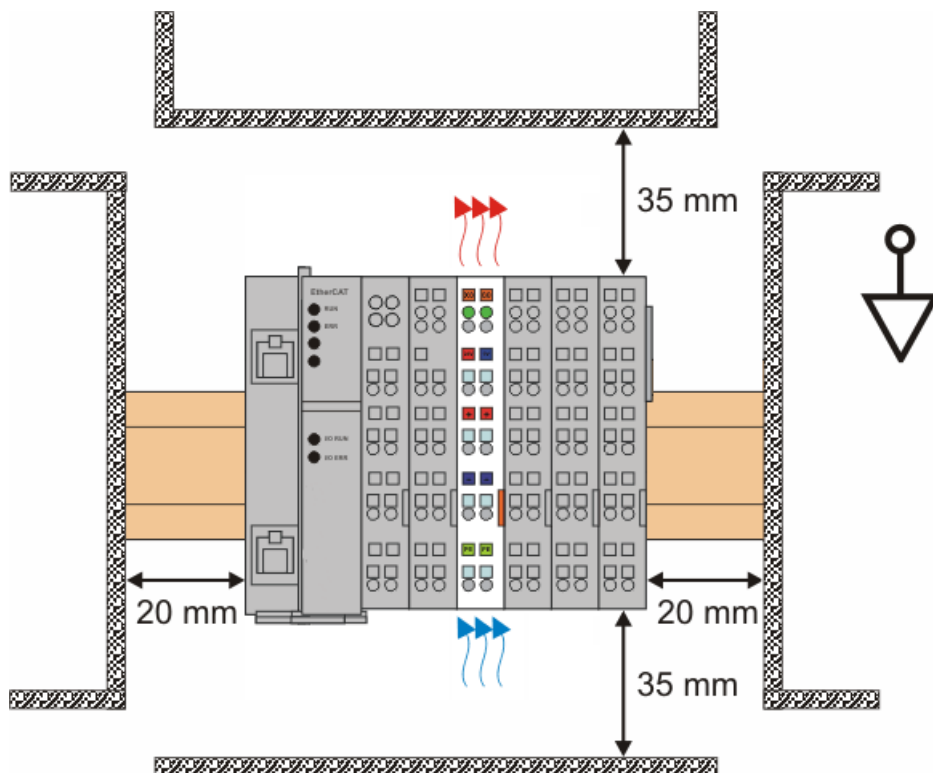


Figure 9: Recommended distances for standard installation position

Compliance with the distances shown in Fig. "Recommended distances for standard installation position" is recommended.

Other installation positions

All other installation positions are characterized by different spatial arrangement of the mounting rail.

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

5.4 Wiring



WARNING!

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

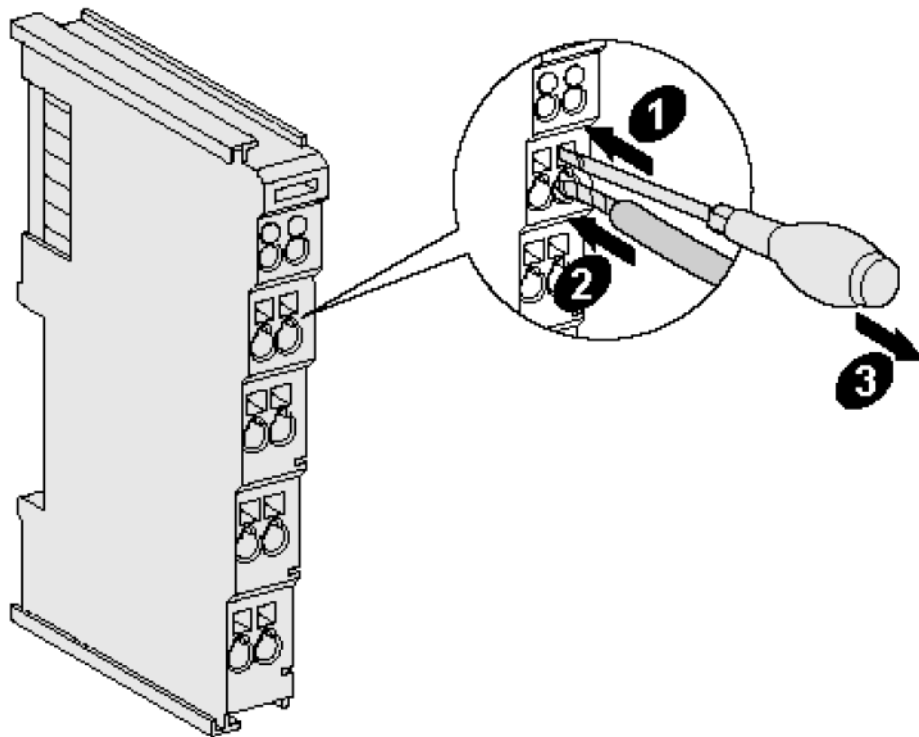


Figure 10: Connecting a cable on a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the Bus Terminal. The terminal points are implemented in spring force technology. Connect the cables as follows:

- 1 Open a terminal point by pushing a screwdriver straight against the stop into the square opening above the terminal point. Do not turn the screwdriver or move it alternately (don't toggle).

- 2 The wire can now be inserted into the round terminal opening without any force.
- 3 The terminal point closes automatically when the pressure is released, holding the wire securely and permanently.

See the following table for the suitable wire size width.

Terminal housing	
Wire size width (single core wires)	0.08 ... 2.5 mm ²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm ²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm ²
Wire stripping length	8 ... 9 mm

High Density Terminals (HD Terminals) with 16 terminal points

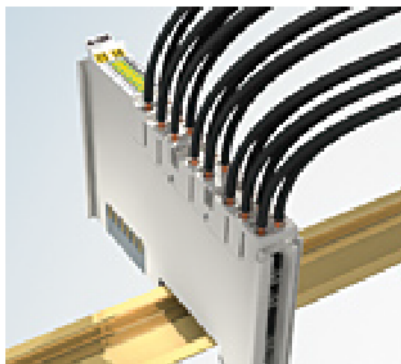


Figure 11: High Density Terminals

The Bus Terminals from these series with 16 terminal points are distinguished by a particularly compact design, as the packaging density is twice as large as that of the standard 12 mm Bus Terminals. Massive conductors and conductors with a wire end sleeve can be inserted directly into the spring loaded terminal point without tools.

The conductors of the HD Terminals are connected without tools for single-wire conductors using the direct plug-in technique, i.e. after stripping the wire is simply plugged into the terminal point. The cables are released, as usual, using the contact release with the aid of a screwdriver. See the following table for the suitable wire size width.

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm ²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm ²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm ²
Wire size width (ultrasonically "bonded" conductors)	only 1.5 mm ²
Wire stripping length	8 ... 9 mm

5.5 Power supply, potential groups

Bus Coupler power supply

The Bus Couplers require a 24 V DC supply for their operation. The connection is made by means of the upper spring-loaded terminals labeled 24 V and 0 V. The supply voltage is used by the Bus Coupler electronics and for direct voltage generation for the E-bus. The voltage generation for the E-bus takes place in a DC/DC converter without electrical isolation.

The ECxxxE units supply the E-bus with max. 2,000 mA E-bus current (see ##). Power feed terminals are to be inserted if the added terminals require more current.

Input for power contacts

The bottom six connections with spring-loaded terminals can be used to feed the supply for the peripherals. The spring-loaded terminals are joined in pairs to a power contact. The feed for the power contacts has no connection to the voltage supply for the Bus Coupler. The design of the feed permits voltages of up to 24 V. The assignment in pairs and the electrical connection between feed terminal contacts allows the connection wires to be looped through to various terminal points. The current load via the power contacts may not permanently exceed 10 A; the supply line must therefore be protected by a 10 A fuse (slow-blow).

Power contacts

On the right hand face of the Bus Coupler there are three spring contacts for the power contact connections. The spring contacts are hidden in slots so that they can not be accidentally touched. By attaching a Bus Terminal the blade contacts on the left hand side of the Bus Terminal are connected to the spring contacts. The tongue and groove guides on the top and bottom of the Bus Coupler and of the Bus Terminals guarantees that the power contacts mate securely.

The current load of the power contacts may not permanently exceed 10 A.

Electrical isolation

The bus couplers operate by means of three independent potential groups. The supply voltage feeds the E-bus electronics in the bus coupler and the E-bus itself, which are electrically isolated. The supply voltage is also used to generate the operating voltage for the fieldbus.

Note: All the Bus Terminals are electrically isolated from the E-bus. The E-bus is thus electrically isolated from everything else.

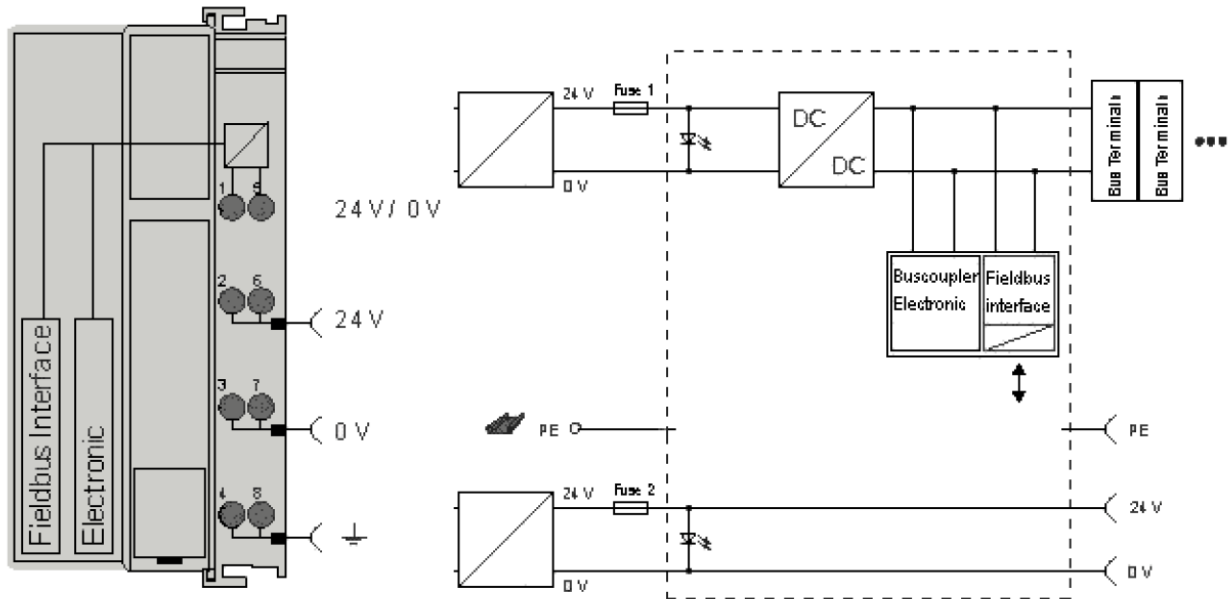


Figure 12: Potential diagram ECxxxE

GND concept

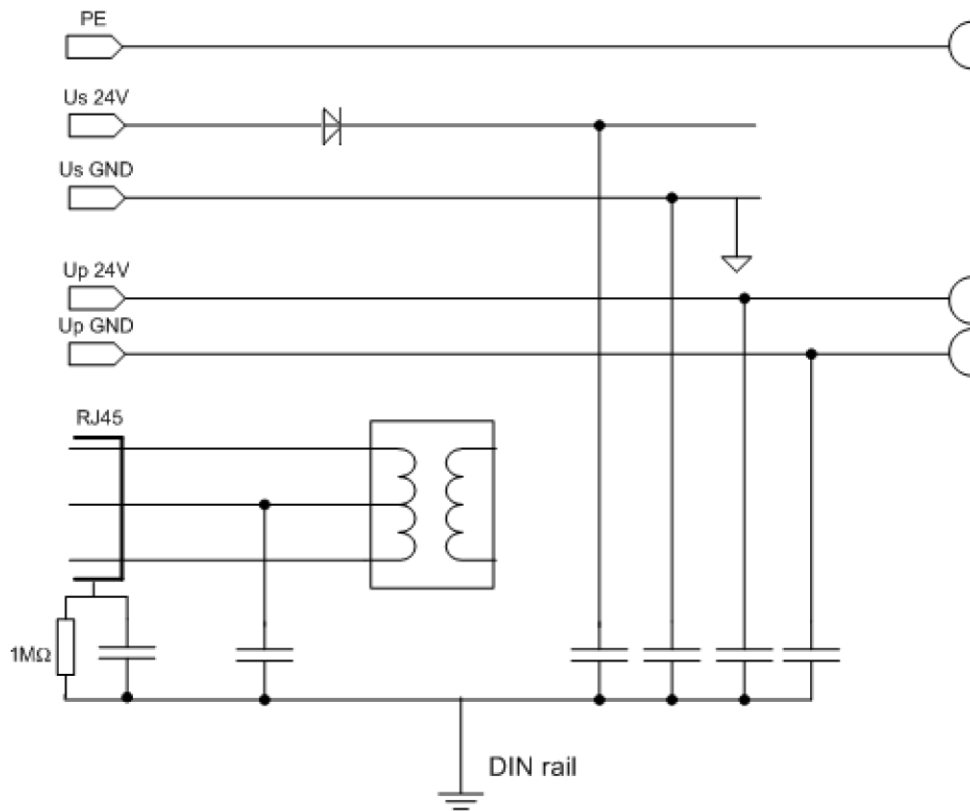


Figure 13: GND concept ECxxxE

5.6 Mounting of Passive Terminals

Fuse protection

Coupler supply, fuse 1:

- depending on the required current consumption and hence the configured terminals typical max. 1 A

Power contacts, fuse 2:

- permitted max. 10 A (slow-blow)
- The coupler electronics and the power contacts can be supplied together from the same source. In this case the fuse should be dimensioned for 10 A max.

5.6 Mounting of Passive Terminals



NOTE!

Hint for mounting passive terminals

EtherCAT Terminals, which do not take an active part in data transfer within the bus terminal block are so called Passive Terminals. The Passive Terminals have no current consumption out of the E-Bus. To ensure an optimal data transfer, you must not directly string together more than 2 Passive Terminals!

Examples for mounting passive terminals (highlighted)

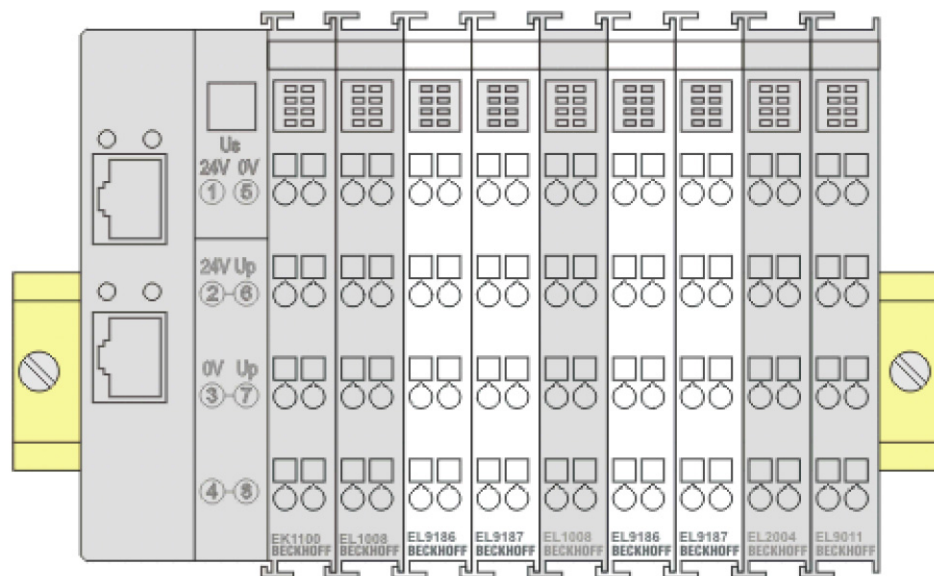


Figure 14: Correct configuration

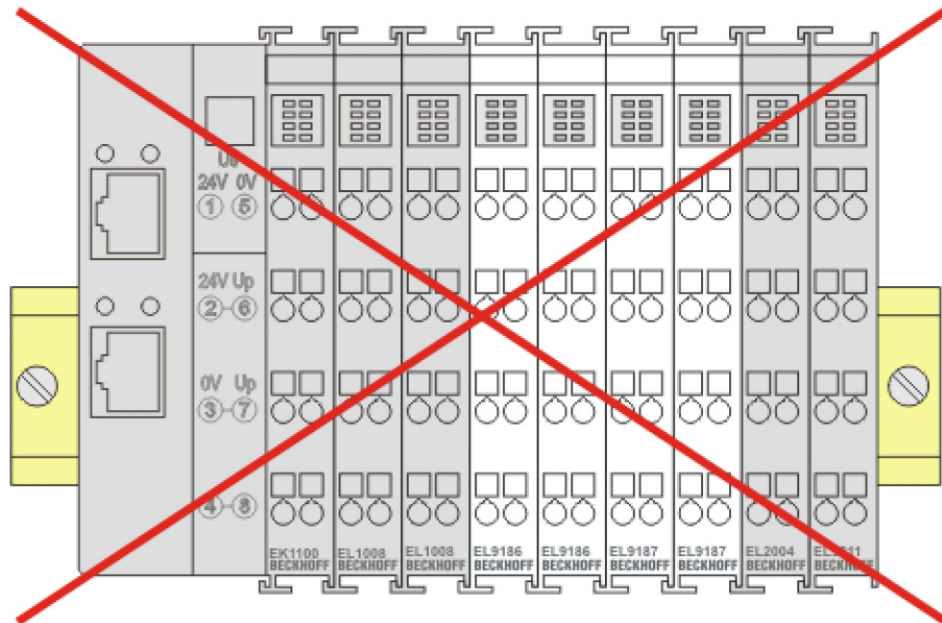


Figure 15: Incorrect configuration

5.7 UL notice

Application

Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.

Examination

For cULus examination, the Beckhoff I/O System has only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).

For devices with Ethernet connectors

Not for connection to telecommunication circuits.

Basic principles

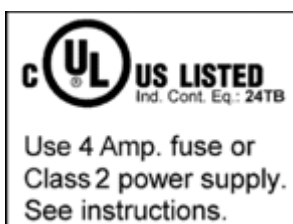
Two UL certificates are met in the Beckhoff EtherCAT product range, depending upon the components:

1. UL certification according to UL508. Devices with this kind of certification are marked by this sign:

5.8 Requirements of the connection cable



2. UL certification according to UL508 with limited power consumption. The current consumed by the device is limited to a max. possible current consumption of 4 A. Devices with this kind of certification are marked by this sign:



Almost all current EtherCAT products are UL certified without restrictions.

Application

If terminals certified with restrictions are used, then the current consumption at 24 V_{DC} must be limited accordingly by means of supply

- from an isolated source protected by a fuse of max. 4 A (according to UL248) or
- from a voltage supply complying with NEC class 2.
A voltage source complying with NEC class 2 may not be connected in series or parallel with another NEC class 2 compliant voltage supply!

These requirements apply to the supply of all EtherCAT bus couplers, power adaptor terminals, Bus Terminals and their power contacts.

5.8 Requirements of the connection cable

Baumüller has released the following cables for use:

- Ethernet cable K-ETH-33-0-xx

Line type: K-ETH-33-0-xx (RJ45 male connector, RJ45 male connector):

Type	Length [m]	Article Number
K-ETH-33-0-0,5	0,5	325160
K-ETH-33-0-01	1	325161
K-ETH-33-0-02	2	325162
K-ETH-33-0-03	3	325163

Type	Length [m]	Article Number
K-ETH-33-0-04	4	325317
K-ETH-33-0-05	5	325164
K-ETH-33-0-10	10	325165

Further types available on request.

5.9 Pin assignment

5.9.1 Pin assignment EC000E and EC001E

Terminal point		Description
Name	No.	
U _s 24 V	1	Supply for Bus Coupler and E-bus circuit
U _p 24 V	2	Supply for power contacts (internally connected with terminal point 6)
U _p 0 V	3	Supply for power contacts (internally connected with terminal point 7)
PE	4	PE connection (internally connected with terminal point 8)
U _s 0 V	5	Supply for Bus Coupler and E-bus circuit
U _p 24 V	6	Supply for power contacts (internally connected with terminal point 2)
U _p 0 V	7	Supply for power contacts (internally connected with terminal point 3)
PE	8	PE connection (internally connected with terminal point 4)

5.9.2 Pin assignment EC440E

Terminal point		Description
Name	No.	
U _s 24 V	1	Power supply for Bus Coupler and E-bus electronics
Input 1	2	Input channel 1
Input 3	3	Input channel 3
n.c.	4	not connected
n.c.	5	not connected
U _p 24 V	6	Power supply for the power contacts
Output 1	7	Output channel 1

5.9 Pin assignment

Terminal point		
Output 3	8	Output channel 3
U _s 0 V	9	Power supply for Bus Coupler and E-bus electronics
Input 2	10	Input channel 2
Input 4	11	Input channel 4
n.c.	12	not connected
n.c.	13	not connected
U _p 0 V	14	Power supply for the power contacts
Output 2	15	Output channel 2
Output 4	16	Output channel 4

5.9.3 Pin assignment EC840E

Terminal point		
Name	No.	Description
U _s 24 V	1	Power supply for Bus Coupler and E-bus electronics
Input 1	2	Input channel 1
Input 3	3	Input channel 3
Input 5	4	Input channel 5
Input 7	5	Input channel 7
U _p 24 V	6	Power supply for the power contacts
Output 1	7	Output channel 1
Output 3	8	Output channel 3
U _s 0 V	9	Power supply for Bus Coupler and E-bus electronics
Input 2	10	Input channel 2
Input 4	11	Input channel 4
Input 6	12	Input channel 6
Input 8	13	Input channel 8
U _p 0 V	14	Power supply for the power contacts
Output 2	15	Output channel 2
Output 4	16	Output channel 4

5.9.4 Pin assignment EC480E

Terminal point		Description
Name	No.	
U _s 24 V	1	Power supply for Bus Coupler and E-bus electronics
Input 1	2	Input channel 1
Input 3	3	Input channel 3
Output 1	4	Output channel 1
Output 3	5	Output channel 3
U _p 24 V	6	Power supply for the power contacts
Output 5	7	Output channel 5
Output 7	8	Output channel 7
U _s 0 V	9	Power supply for Bus Coupler and E-bus electronics
Input 2	10	Input channel 2
Input 4	11	Input channel 4
Output 2	12	Output channel 2
Output 4	13	Output channel 4
U _p 0 V	14	Power supply for the power contacts
Output 6	15	Output channel 6
Output 8	16	Output channel 8

6

PROCESS DATA

6.1 PDO Assignment EC440E

SM1, PDO Assignment 0x1C11			
Index	Size (byte.bit)	Name	PDO content
0x1A00	0.1	Channel 1	Index 0x6000:01 - Input
0x1A01	0.1	Channel 2	Index 0x6010:01 - Input
0x1A02	0.1	Channel 3	Index 0x6020:01 - Input
0x1A03	0.1	Channel 4	Index 0x6030:01 - Input

SM0, PDO Assignment 0x1C10			
Index	Size (byte.bit)	Name	PDO content
0x1608	0.1	Channel 5	Index 0x7080:01 - Output
0x1609	0.1	Channel 6	Index 0x7090:01 - Output
0x160A	0.1	Channel 7	Index 0x70A0:01 - Output
0x160B	0.1	Channel 8	Index 0x70B0:01 - Output

6.2 PDO Assignment EC840E

SM1, PDO Assignment 0x1C11			
Index	Size (byte.bit)	Name	PDO content
0x1A00	0.1	Channel 1	Index 0x6000:01 - Input
0x1A01	0.1	Channel 2	Index 0x6010:01 - Input
0x1A02	0.1	Channel 3	Index 0x6020:01 - Input
0x1A03	0.1	Channel 4	Index 0x6030:01 - Input
0x1A04	0.1	Channel 5	Index 0x6040:01 - Input
0x1A05	0.1	Channel 6	Index 0x6050:01 - Input
0x1A06	0.1	Channel 7	Index 0x6060:01 - Input
0x1A07	0.1	Channel 8	Index 0x6070:01 - Input

SM0, PDO Assignment 0x1C10			
Index	Size (byte.bit)	Name	PDO content
0x1600	0.1	Channel 9	Index 0x7000:01 - Output
0x1601	0.1	Channel 10	Index 0x7010:01 - Output
0x1602	0.1	Channel 11	Index 0x7020:01 - Output
0x1603	0.1	Channel 12	Index 0x7030:01 - Output

6.3 PDO Assignment EC480E

SM2, PDO Assignment 0x1C12			
Index	Size (byte.bit)	Name	PDO content
0x1A00	0.1	Channel 1	Index 0x6000:01 - Input
0x1A01	0.1	Channel 2	Index 0x6010:01 - Input
0x1A02	0.1	Channel 3	Index 0x6020:01 - Input
0x1A03	0.1	Channel 4	Index 0x6030:01 - Input

SM0, PDO Assignment 0x1C10			
Index	Size (byte.bit)	Name	PDO content
0x1600	0.1	Channel 5	Index 0x7000:01 - Output
0x1601	0.1	Channel 6	Index 0x7010:01 - Output
0x1602	0.1	Channel 7	Index 0x7020:01 - Output
0x1603	0.1	Channel 8	Index 0x7030:01 - Output

SM1, PDO Assignment 0x1C11			
Index	Size (byte.bit)	Name	PDO content
0x1604	0.1	Channel 9	Index 0x7040:01 - Output
0x1605	0.1	Channel 10	Index 0x7050:01 - Output
0x1606	0.1	Channel 11	Index 0x7060:01 - Output
0x1607	0.1	Channel 12	Index 0x7070:01 - Output

DIAGNOSTICS AND ERROR HANDLING

7.1 Diagnostic LEDs EC000E and EC001E

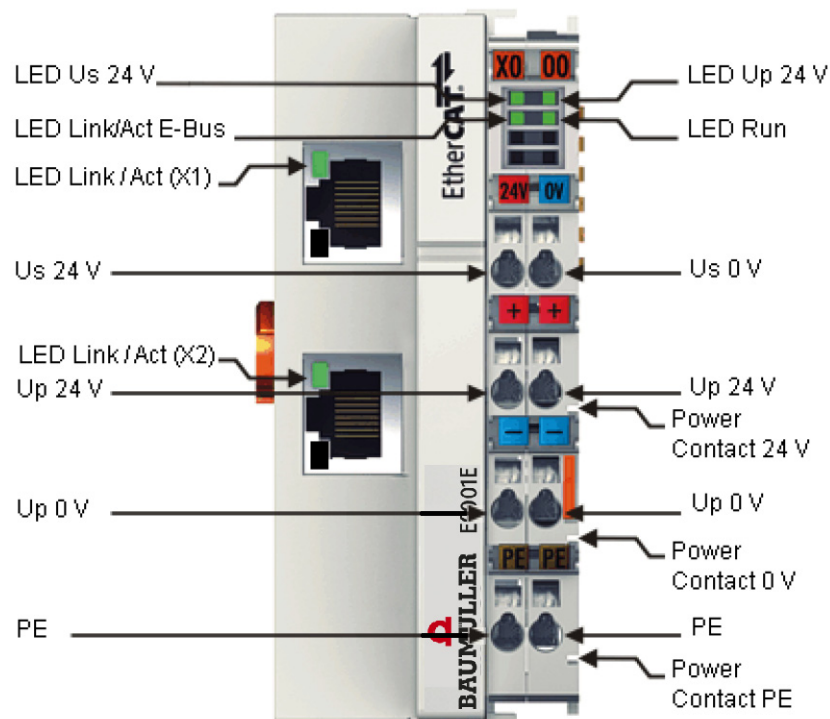


Figure 16: Diagnostic LEDs EC000E and EC001E

7.1 Diagnostic LEDs EC000E and EC001E

7.1.1 LEDs for power supply diagnostics

LED		Display	State	Description
Us	green	off	-	No operating voltage present at the Bus Coupler
		on	-	24 V _{DC} operating voltage present at the Bus Coupler
Up	green	off	-	No power supply present at the power contacts
		on	-	24 V _{DC} power supply present at the power contacts

7.1.2 Diagnostic LEDs for EtherCAT State Machine/PLC

LED		Display	State	Description
RUN	green	off	Init	The Bus Coupler is in initialization state
		flashing	Pre-Operational	The Bus Coupler is in pre-operational state
		single flash	Safe-Operational	The Bus Coupler is in safe-operational state
		on	Operational	The Bus Coupler is in operational state
		flickers	Bootstrap	Firmware is being loaded.

7.1.3 LEDs for fieldbus diagnosis

LED		Display	State	Description
LINK / ACT (X1 IN)	green	off	-	No connection on the incoming EtherCAT strand
		on	linked	Preceding EtherCAT device connected
		flashing	active	Communication with preceding EtherCAT device
LINK / ACT (X2 OUT)	green	off	-	No connection on the outgoing EtherCAT strand
		on	linked	Following EtherCAT device connected
		flashing	active	Communication with following EtherCAT device
LINK / ACT E-BUS	green	off	-	No connection to internal E-bus
		on	linked	Connection to internal E-bus
		flashing	active	Connection/communication internal E-bus

7.2 Diagnostic LEDs EC440E, EC840E and EC4800E

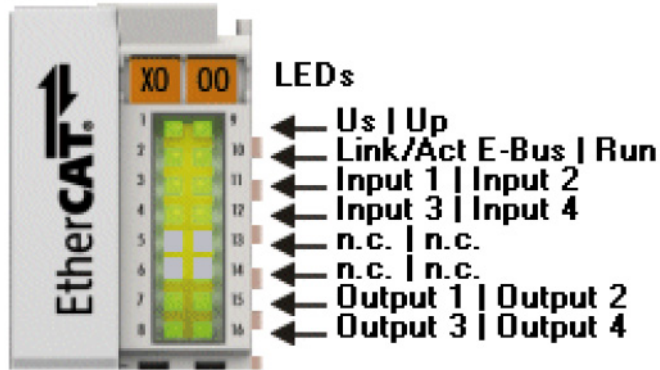


Figure 17: Diagnose-LEDs EC440E

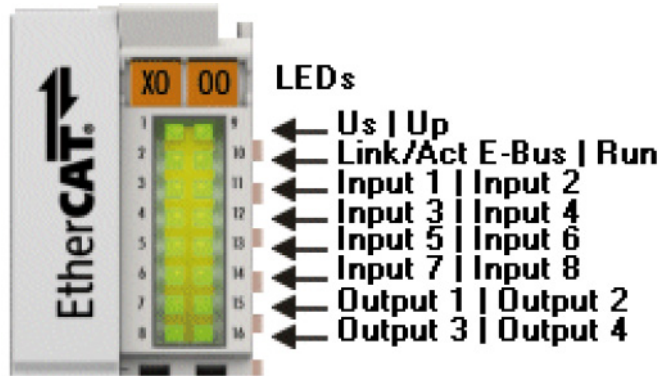


Figure 18: Diagnose-LEDs EC840E

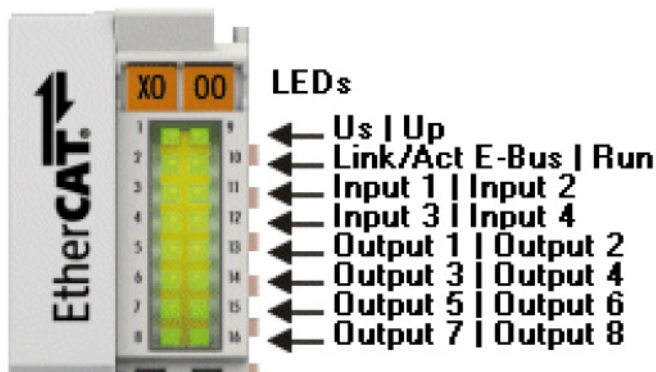


Figure 19: Diagnose-LEDs EC4800E

7.2 Diagnostic LEDs EC440E, EC840E and EC4800E

7.2.1 LEDs for power supply diagnostics

LED		Display	State	Description
Us	green	off	-	No operating voltage present at the Bus Coupler
		on	-	24 V _{DC} operating voltage present at the Bus Coupler
Up	green	off	-	No power supply present at the power contacts
		on	-	24 V _{DC} power supply present at the power contacts

7.2.2 Diagnostic LEDs for EtherCAT State Machine/PLC

LED		Display	State	Description
RUN	green	off	Init	The Bus Coupler is in initialization state
		flashing	Pre-Operational	The Bus Coupler is in pre-operational state
		single flash	Safe-Operational	The Bus Coupler is in safe-operational state
		on	Operational	The Bus Coupler is in operational state
		flickers	Bootstrap	Firmware is being loaded.

7.2.3 LEDs for fieldbus diagnosis

LED		Display	State	Description
LINK / ACT (X1 IN)	green	off	-	No connection on the incoming EtherCAT strand
		on	linked	Preceding EtherCAT device connected
		flashing	active	Communication with preceding EtherCAT device
LINK / ACT (X2 OUT)	green	off	-	No connection on the outgoing EtherCAT strand
		on	linked	Following EtherCAT device connected
		flashing	active	Communication with following EtherCAT device
LINK / ACT E-BUS	green	off	-	No connection to internal E-bus
		on	linked	Connection to internal E-bus
		flashing	active	Connection/communication internal E-bus

7.2.4 LEDs for diagnostics of the digital inputs and outputs

LED		Display	Description
INPUT *)	green	off	Signal voltage "0" (-3 V ... 5 V)
		on	Signal voltage "1" (11 V ... 30 V)
OUTPUT *)	green	off	No output signal
		on	24 V _{DC} output signal at the respective output

*) depending on version

TECHNICAL DATA

8.1 General Operating Conditions

The following conditions must be observed if the fieldbus components are to function without error.

8.1.1 Environmental conditions

Operation

The components may not be used without additional protection in the following locations:

- in difficult environments, such as where there are corrosive vapors or gases, or high dust levels
- in the presence of high levels of ionizing radiation

Condition	Permissible range
Permissible ambient temperature range during operation	0°C ... +55°C
Permissible relative humidity during operation	95 %, no condensation
Installation position	variable
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27
EMC resistance burst	conforms to EN 61000-6-2
ESD emission	conforms to EN 61000-6-4

Transport and storage

Condition	Permissible range
Permissible ambient temperature range during storage	-25 °C ... +85°C
Permissible relative humidity	95 %, no condensation
Free fall	up to 1 m in the original packaging

Protection classes and types

Condition	Permissible range
Protection class in accordance with IEC 536 (VDE 0106, Part 1)	A protective conductor connection to the mounting rail is necessary!
Protection class according to IEC 529	IP20 (protection against contact with a standard test finger)
Protection against foreign objects	Less than 12 mm in diameter
Protection against water	No protection

8.2 Technical Data

8.2.1 EC000E

Technical Data	EC000E
Task within the EtherCAT system	Coupling of EtherCAT Terminals to 100BASE-TX EtherCAT networks
Number of EtherCAT Terminals	Up to 65535 in the overall system
Number of peripheral signals	max. 4.2 GB addressable IO points
Transmission medium	at least Ethernet CAT-5 cable
Cable length between two Bus Couplers	max. 100 m (100BASE-TX)
Protocol / Baud rate	EtherCAT Device Protocol / 100 MBaud
HotConnect	no
Delay	typical 1 µs
Bus connection	2 x RJ45
Power supply	24 V _{DC} (-15%/+20%)
Power consumption	70 mA + E-Bus current/4
E-bus power supply (5 V) depending on ambient temperature	max. 2000 mA (-25°C ... +55°C) max. 1000 mA (> +55°C)

Technical Data	EC000E
Power contacts	max. 24 V _{DC} , max. 10 A
Electrical isolation	500 V (power contact/supply voltage/EtherCAT)
Dimensions (W x H x D)	approx. 44 mm x 100 mm x 68 mm
Weight	approx. 105 g
Permissible ambient temperature range during operation	-25°C ... + 60°C
Permissible ambient temperature range during storage	-40°C ... + 85°C
Permissible relative humidity	95%, no condensation
Mounting	on 35 mm mounting rail conforms to EN 60715
Vibrations / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	variable
Approval	CE UL (see UL requirements!)

8.2.2 EC001E

Technical Data	EC001E
Task within the EtherCAT system	Coupling of EtherCAT Terminals to 100BASE-TX EtherCAT networks
Number of EtherCAT Terminals	Up to 65535 in the overall system
Number of peripheral signals	max. 4.2 GB addressable IO points
Transmission medium	at least Ethernet CAT-5 cable
Cable length between two Bus Couplers	max. 100 m (100BASE-TX)
Protocol / Baud rate	EtherCAT Device Protocol / 100 MBaud
HotConnect	max. number of configurable IDs: 4096
Delay	typical 1 µs
Bus connection	2 x RJ45
Power supply	24 V _{DC} (-15%/+20%)
Power consumption	70 mA + E-Bus current/4
E-bus power supply (5 V) depending on ambient temperature	max. 2000 mA (-25°C ... +55°C) max. 1000 mA (> +55°C)
Power contacts	max. 24 V _{DC} , max. 10 A

8.2 Technical Data

Technical Data	EC001E
Electrical isolation	500 V (power contact/supply voltage/EtherCAT)
Dimensions (W x H x D)	approx. 44 mm x 100 mm x 68 mm
Weight	approx. 105 g
Permissible ambient temperature range during operation	-25°C ... + 60°C
Permissible ambient temperature range during storage	-40°C ... + 85°C
Permissible relative humidity	95%, no condensation
Mounting	on 35 mm mounting rail conforms to EN 60715
Vibrations / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection class	IP 20
Installation position	variable
Approval	CE UL (see UL requirements!)

8.2.3 EC440E/EC840E/EC480E

Technical data	EC440E	EC840E	EC480E
Task in the EtherCAT system	Coupling of EtherCAT Terminals to 100BASE-TX EtherCAT networks		
Number of digital inputs	4	8	4
Number of simultaneously controllable inputs, depending on the ambient temperature	4 (-25°C ... +60°C)	8 (-25°C ... +55°C) 4 (> +55°C)	4 (-25°C ... +60°C)
Number of digital outputs	4	4	8
Number of EtherCAT Terminals	up to 65534 in the overall system		
Number of peripheral signals	max. 4.2 GB addressable IO points		
Transmission medium	at least Ethernet CAT-5 cable		
Cable length between two Bus Couplers	max. 100 m (100BASE-TX)		
Protocol / Baud rate	EtherCAT Device Protocol / 100 MBaud		
Nominal voltage of the inputs	24 V _{DC} (-15%/+20%)		
Signal voltage "0"	-3 V ... 5 V (EN 61131-2, type 1/3)		
Signal voltage "1"	11 V ... 30 V (EN 61131-2, type 3)		
Input filter	3 ms		

Technical data	EC440E	EC840E	EC480E
Input current	typically 3 mA (EN 61131-2, type 3)		
Load type	ohmic, inductive, lamp load		
Rated voltage of the outputs	24 V _{DC} (-15% / +20%)		
Switching times	T _{ON} : 60 μs typ.; T _{OFF} : 300 μs typ.		
Output current per channel	max. 0,5 A (short-circuit-proof)		
Short circuit current	< 2 A typ.		
Breaking energy (inductive)	max. 150 mJ/channel		
Distributed Clocks	no		
HotConnect	no		
Delay	typical 1 μs		
Bus connection	2 x RJ45		
Power supply	24 V _{DC} (-15%/+20%)		
Current consumption from U _p	40 mA + load		
Current consumption from U _s	100 mA + (total. E-bus current)/4		
E-bus Power supply (5 V)	max. 1000 mA (in case of higher current consumption, please use additional power feed terminals!)		
Power contacts	max. 24 V _{DC} , max. 10 A		
Electrical isolation	500 V (power contact/supply voltage/EtherCAT) 500 V (E-bus/field voltage)		
Dimensions (W x H x D)	approx. 44 mm x 100 mm x 68 mm		
Weight	approx. 125 g		
Permissible ambient temperature range during operation	-25°C ... + 60°C (extended temperature range)		
Permissible ambient temperature range during storage	-40°C ... + 85°C		
Permissible relative humidity	95%, no condensation		
Mounting	on 35 mm mounting rail conforms to EN 60715		
Vibrations / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27		
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4		
Protection class	IP 20		
Installation position	variable		
Approval	CE UL (see UL requirements!)		



APPENDIX A ABBREVIATIONS

ADC	Analog digital converter
CPU	Central Processing Unit
EEPROM	Electrically erasable programmable read only memory
EMC	Electromagnetic compatibility
EN	European standard
EPROM	Erasable Programmable Read Only Memory
EXT, ext	Extern
I/O	Input/Output, Eingang und Ausgang
LED	Light Emitting Diode
MSB	most significant bit
OVRL	Over range limit
PLC	Process loop control, Speicher programmierbare Steuerung, SPS
RAM	Random Access Memory
ROM	Read Only Memory
SEEPROM	serial EEPROM
SW	Software
UNRL	Under range limit



APPENDIX B ACCESSORIES

In this appendix, you will find a list of all the accessories that are available for Baumüller Nürnberg GmbH's I/O terminals.

If you have any queries about accessories or suggestions for improvements, Baumüller's Product Management will be pleased to hear from you.

B.1 List of all accessories

At the moment there are no accessories available for the I/O terminals.



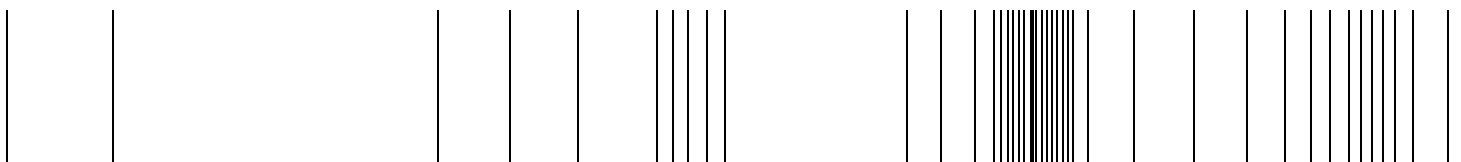
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