

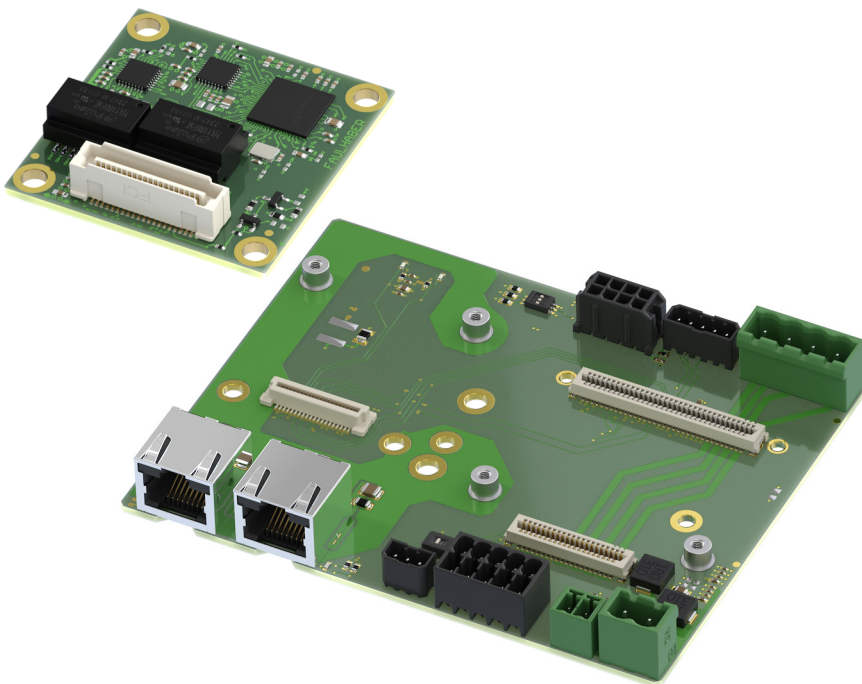
Technical Manual

EtherCAT Module

EB MC ET ADDON

for combination with Motion Controller

MC 3001 B
MC 3602 B
MC 3606 B



Imprint

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The relevant regulations regarding safety engineering
and interference suppression as well as the requirements
specified in this document are to be noted and followed
when using the software.

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available on FAULHABER's internet site:
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About this document

1 About this document

1.1 Validity of this document

This document describes the installation and use of the EB MC ET ADDON EtherCAT module.

This document is intended for use by trained experts authorized to perform installation and electrical connection of the product.

All data in this document relate to the standard versions of the series listed above. Changes relating to customer-specific versions can be found in the corresponding data sheet.

1.2 Associated documents

For certain actions during commissioning and operation of FAULHABER products additional information from the following manuals is useful:

| Manual | Description |
|--|--|
| Motion Manager 7 | Operating instructions for FAULHABER Motion Manager PC software |
| Accessories manual | Description of the accessories |
| Communications manual | Interface description – EtherCAT |
| MC 3001 B/P Technical Manual | Instructions for installing and using the FAULHABER MC 3001 B/P Motion Controller |
| MC 3602 B / MC 3606 B Technical Manual | Instructions for installing and using the FAULHABER MC 3602 B and MC 3606 B Motion Controllers |

These manuals can be downloaded in pdf format from the web page www.faulhaber.com.

1.3 Using this document

- ▶ Read the document carefully before undertaking configuration, in particular chapter "Safety".
- ▶ Retain the document throughout the entire working life of the product.
- ▶ Keep the document accessible to the operating and, if necessary, maintenance personnel at all times.
- ▶ Pass the document on to any subsequent owner or user of the product.

About this document

1.4 List of abbreviations

| Abbreviation | Meaning |
|-------------------------|---|
| AnIn | Analog input |
| CLK | Clock |
| $\overline{\text{CLK}}$ | Clock with logically inverted signal |
| CS | Chip Select |
| DigIn | Digital input |
| DigOut | Digital output |
| EGND | Earth Ground |
| EMC | Electromagnetic compatibility |
| ESD | Electrostatic discharge |
| ET | EtherCAT (Ethernet for Control Automation Technology) |
| GND | Ground |
| I/O | Input/Output |
| IRQ | Interrupt Request |
| LA | Link LED EtherCAT |
| MC | Motion Controller |
| MISO | Master In Slave Out |
| MOSI | Master Out Slave In |
| N | With differential signals: Line with negative logic |
| n.c. | not connected |
| P | With differential signals: Line with positive logic |
| PHY | Physical layer: Integrated semiconductor that establishes the physical connection to the network line |
| RX | See RxD |
| RxD | Receive Data |
| SEL | Select line of an SPI |
| SPI | Serial Peripheral Interface |
| SYNC | Synchronization |
| TX | See TxD |
| TxD | Transmit data |
| U_{DD} | Power supply |
| U_p | Power supply for the control unit of a Motion Controller |
| U_{mot} | Power supply for the power unit of a Motion Controller |
| U_{mot} | Motor power supply |

About this document

1.5 Symbols and designations

DANGER!

Danger with high level of risk: if not avoided, death or serious injury will result.

- ▶ Measures for avoidance

WARNING!

Danger with medium level of risk: if not avoided, death or serious injury may result.

- ▶ Measures for avoidance

CAUTION!


Danger with low level of risk: if not avoided, minor or moderate injury may result.

- ▶ Measures for avoidance

NOTICE!


Risk of damage.

- ▶ Measures for avoidance


 Instructions for understanding or optimizing the operational procedures

- ✓ Pre-requirement for a requested action

1. First step for a requested action

-  Result of a step

2. Second step of a requested action

-  Result of an action

- ▶ Request for a single-step action

2 Safety

2.1 Intended use

In conjunction with the Motion Controllers MC 3001 B, MC 3602 B and MC 3606 B, the EtherCAT module EB MC ET ADDON described here is designed for control and positioning tasks for the following motors:

- DC-Micromotors
- Linear DC-Servomotors
- Brushless DC-motors
- Stepper motors

The EtherCAT module is suitable in particular for tasks in the following fields of application:

- Robotics
- Automation technology
- Industrial equipment and special machine building
- Medical technology
- Laboratory technology

The following aspects must be taken into consideration when using the EtherCAT module:

- The EtherCAT module contains electronic components and should be handled in accordance with the ESD regulations.
- Do **not** use the EtherCAT module in environments where it will come into contact with water, chemicals and/or dust, **nor** in explosion hazard areas.
- Always operate the EtherCAT module within the limits specified in the data sheet.
- Please ask the manufacturer for information about use under individual special environmental conditions.

2.2 Safety instructions

In addition to the safety risks described in this technical manual, machine-specific dangers could arise that cannot be foreseen by the manufacturer of the EtherCAT module (e.g., risk of injury from driven components). The manufacturer of the machine in which the EtherCAT module is installed must perform a risk analysis in accordance with the regulations applicable to the machine and inform the end user of the residual risks.

2.2.1 Dangers in the event of damages and changes

Damage to the EtherCAT module may impair its function. If an EtherCAT module is damaged, this may cause the drive system to behave in unexpected ways (e.g. starting, stopping or jamming). This can result in damage to other components and materials.

- ▶ Do **not** start up a drive system with a defective or damaged EtherCAT module.
- ▶ Label a defective or damaged EtherCAT module and the higher-level drive system accordingly.
- ▶ Do **not** replace defective or damaged components of the EtherCAT module.
- ▶ Make no changes (modifications, repairs) to the EtherCAT module.
- ▶ After replacing a defective or damaged EtherCAT module, test and document the correct function.

2.2.2 Correct installation and commissioning

Errors during the installation and commissioning of the EtherCAT module could impair its function. If an EtherCAT module is installed incorrectly, this may cause the drive system to behave in unexpected ways (e.g. starting, stopping or jamming). This can result in damage to other components and materials.

- ▶ Closely follow the instructions for implementing the EtherCAT module on the customer board.
- ▶ Only have work on electrical operating equipment performed by an electrician.
- ▶ During all work on the electrical equipment, observe the 5 safety rules:
 - a) Disconnect from power
 - b) Secure against being switched on again
 - c) Check that no voltage is present
 - d) Ground and short-circuit
 - e) Cover or block-off adjacent parts that are under voltage

Electrostatic discharges can damage the electronics.

- ▶ Store and transport the EtherCAT module in suitable ESD packaging.
- ▶ Handle the EtherCAT module in compliance with the ESD handling regulations (e.g. wear an ESD wristband, ground surrounding components).
- ▶ During installation, ensure that components in the surroundings cannot be electrostatically discharged.

Soiling, foreign bodies, humidity and mechanical influences can damage the electronics.

- ▶ Keep foreign objects away from the electronics.

Safety

- ▶ Install the customer board together with the EtherCAT module in a housing that protects it from mechanical influences and is adapted to the ambient conditions (protection class determination).

Installation and connection work whilst supply voltage is applied at the device can damage the electronics.

- ▶ Prior to any more installation and connection work on the drive system, switch off the power supply.

Incorrect connection of the pins can damage the electronic components.

- ▶ Connect the wires as shown in the connection assignment.

2.3 Environmental conditions

- ▶ In the event of installation in an environment with little convection or a temperature higher than room temperature, it is essential to ensure that adequate heat dissipation is provided.
- ▶ Select a power supply that is within the defined tolerance range.
- ▶ Protect the EtherCAT module against heavy deposits of dust, in particular metal dust and chemical pollutants.
- ▶ Protect the EtherCAT module against humidity and wet.

2.4 EC directives on product safety

- ▶ The following EC directives on product safety must be observed.
- ▶ If the EtherCAT module is being used outside the EU, international, national and regional directives must be also observed.

Machinery Directive (2006/42/EC)

The EtherCAT module with connected Motion Controller and motor described in this technical manual may be drive systems according to the Machinery Directive. They are therefore to be considered incomplete machines according to the Machinery Directive. Compliance is documented by the Declaration of Incorporation for the product and by the EC Declaration of the Conformity.

EMC Directive (2014/30/EU)

The directive concerning electromagnetic compatibility (EMC) applies to all electrical and electronic devices, installations and systems sold to an end user. In addition, CE marking can be undertaken for built-in components according to the EMC Directive. Conformity with the directive is documented in the Declaration of Conformity.

Applied standards

Various harmonized standards were applied to the products described in this technical manual; these standards are documented in the EC Declaration of Conformity. The EU declaration of conformity is issued together with the Motion Controller used, see the associated technical manual (chap. 1.2, p. 4).

WEEE Directive (2012/19/EU)

The directive on the disposal of electrical and electronic devices prescribes the separate collection of old electrical and electronic devices. The products described in this technical manual fall within the scope of this directive.

Product description

3 Product description

3.1 General product description

FAULHABER Motion Controllers (MCs) are available as different device variants:

- Compact devices whose components are contained in a housing and e.g. can be installed in a switch cabinet.
- Unhoused Motion Controllers that are mounted directly on the customer's electronics board as a module (e.g. MC3001 B, MC3602 B, MC3606 B).
These modules can be used in applications such as complex machines with multiple Motion Controllers or constricted installation situations, e.g. in tool heads or autonomous machines. The FAULHABER Motion Controller module is integrated directly into the electronics of the device via board-to-board connector.

There are several types of communication interfaces to enable communication with a higher-level controller or parameterization. The serial, USB and CANopen interfaces are already integrated in the FAULHABER Motion Controller.

The EtherCAT module EB MC ET ADDON, which is described in this technical manual, implements the EtherCAT communication for unhoused Motion Controllers. Due to its size, it is not integrated directly into the Motion Controller. Instead it is installed on a customer base board as a separate extension board.

To control a motor via EtherCAT, two modules are required:

- FAULHABER Motion Controller (MC)
- FAULHABER EtherCAT module EB MC ET ADDON

In addition, the necessary connectors for the power supply, the connection to the motor and the communication sockets are required.

3.2 Product information

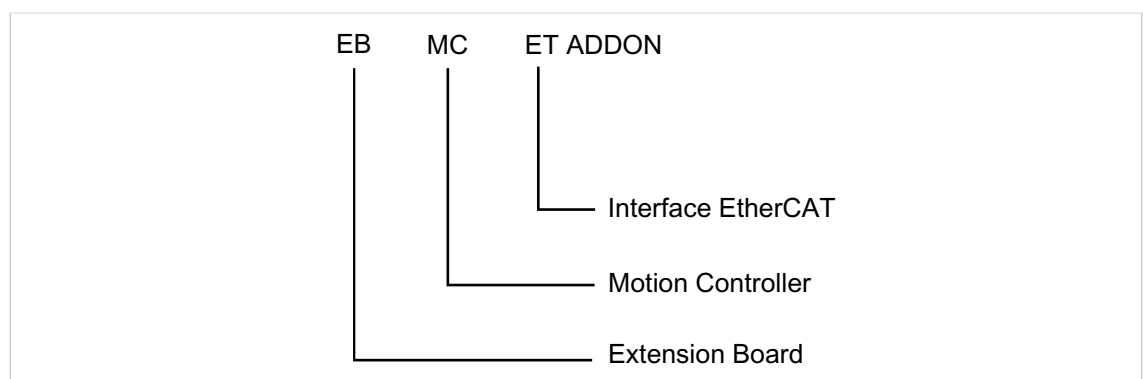


Fig. 1: Designation key

Product description

3.3 Product variants

The EtherCAT module can be operated with the 3 Motion Controller modules mentioned in chap. 2.1, p. 7. In the EtherCAT master, the module initially appears as "FAULHABER Motion Controller" regardless of the type used. By querying the corresponding objects (e.g. Manufacturer Device Name 0x1008, Serial Number 0x1018.04), it is possible to determine which Motion Controller is actually coupled to the module. See Communications Manual EtherCAT (chap. 1.2, p. 4).

The EtherCAT module and the Motion Controller must be mounted on a base board. The optionally available FAULHABER evaluation board provides space for one Motion Controller and one EtherCAT module. See Motion Controller Technical Manual (chap. 1.2, p. 4). However, the FAULHABER evaluation board is only suitable for testing and setup work. For the customer's application, the customer must create their own base board.

i There is no EtherCAT version of Motion Controller MC 3001 P because it lacks some of the necessary pins. For communication via EtherCAT, the EtherCAT module with board-to-board connectors must be used.

3.4 Extension board EB MC ET ADDON

Layout

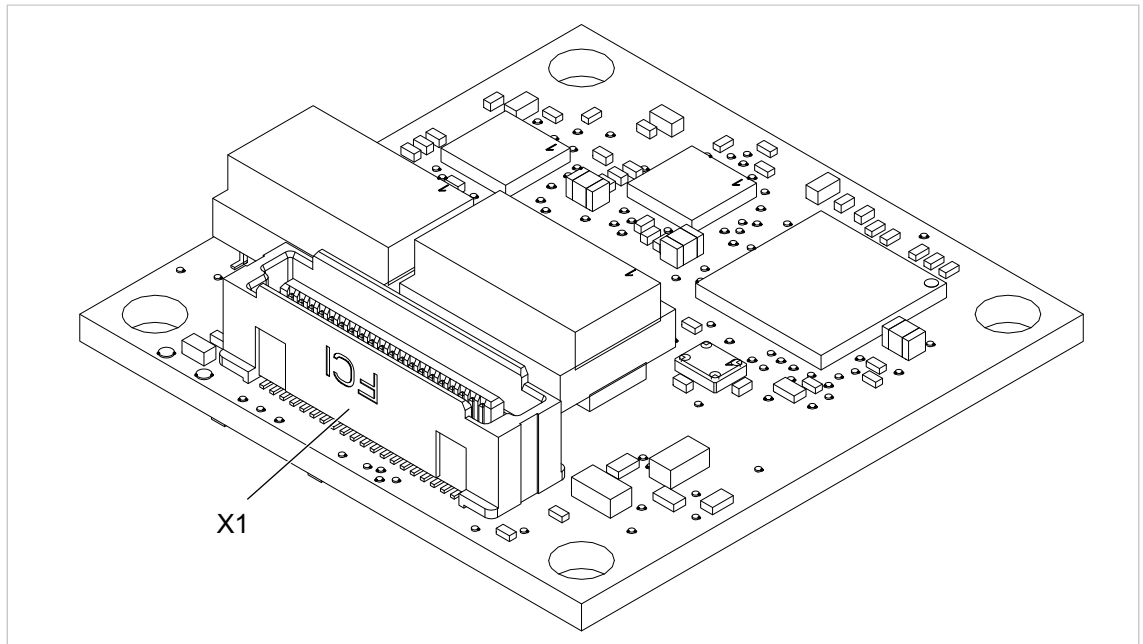


Fig. 2: EB MC ET ADDON PCB layout

Tab. 1: Connector

| Designation | Function |
|-------------|---|
| B2B (X1) | Connector for connecting to the customer base board |

Product description

Dimensions

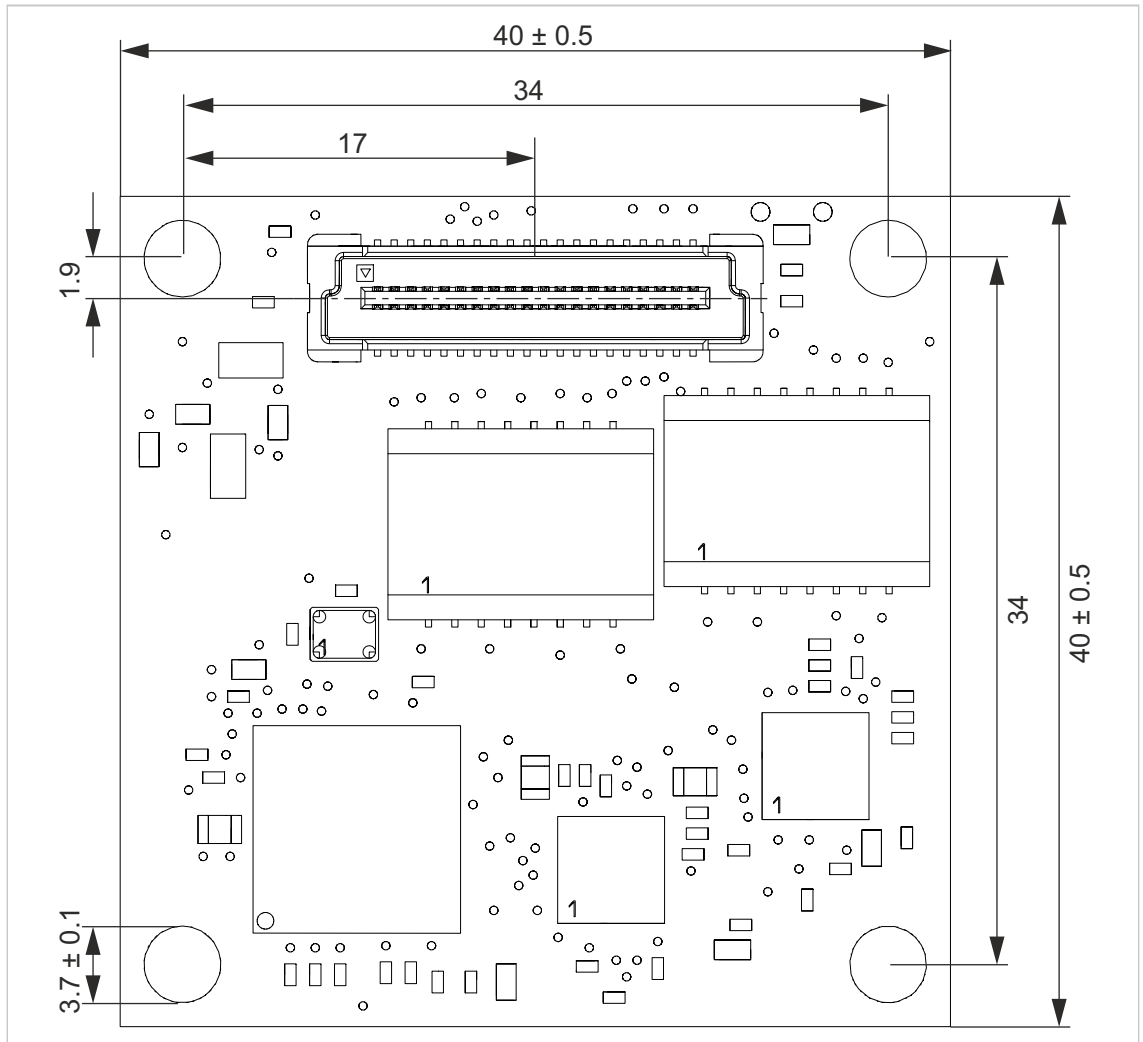


Fig. 3: Dimensions of the EB MC ET ADDON

4 Installation

Only trained experts and instructed persons with knowledge of the following fields may install and commission the EtherCAT module:

- Automation technology
- Standards and regulations (such as the EMC Directive)
- Low Voltage Directive
- Machinery Directive
- VDE regulations (DIN VDE 0100)
- Accident prevention regulations

Also comply with the supplementary instructions for installation (see chap. 2.3, p. 9).

4.1 Mounting

4.1.1 Mounting instructions

DANGER!

Incorrect handling and installation of the EtherCAT module can cause the drive system to perform uncontrolled movements.

Depending on the use of the drive system, this can lead to severe or fatal injury.

- ▶ Observe the safety information in the chap. 2.2, p. 8.
- ▶ Closely follow the instructions for implementing the EtherCAT module on the customer board (see the following chapter).

Visual inspection

- ▶ After unpacking the EtherCAT module, perform and document a visual inspection:
 - EtherCAT module is undamaged?
 - Sticker with product number is present?
 - Contacts in the connectors are OK (not oxidized, not bent)?

DANGER!

The function of the EtherCAT module is not ensured if the visual inspection criteria are not satisfied.

If the function is not ensured, the drive may start unexpectedly. Depending on the use of the drive system, this can lead to severe or fatal injury.

- ▶ Do not start up the EtherCAT module.

DANGER!

During operation, the drive system produces mechanical forces and movements.

- ▶ Protect the drive system and components driven by the drive system from being touched.

Installation

4.1.2 Mounting the EtherCAT module on the customer base board

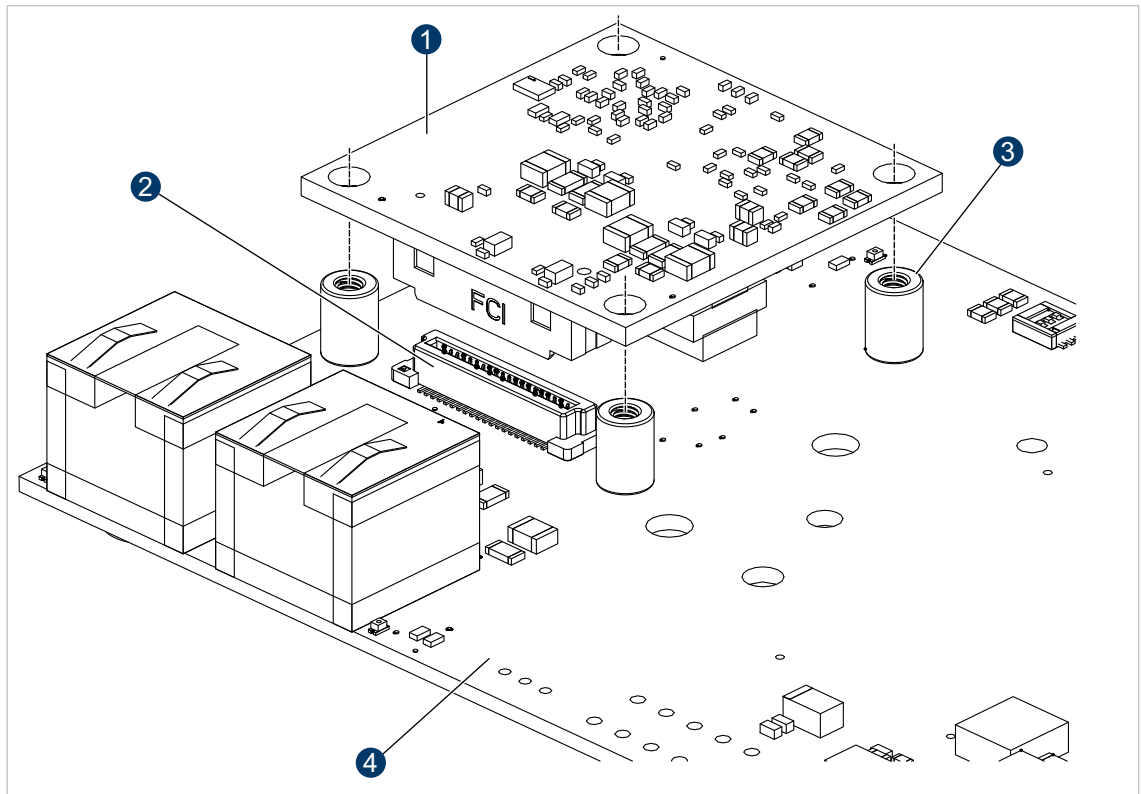


Fig. 4: Mounting the EtherCAT module on the customer base board

- | | |
|-------------------|-----------------------|
| 1 EtherCAT module | 3 Spacer |
| 2 B2B port | 4 Customer base board |

1. Via the B2B connection, connect the EtherCAT module with the customer base board that has been prepared for this purpose, see chap. 4.1.2.1, p. 15.
2. Fasten the EtherCAT module to the 4 spacers of the customer base board, see chap. 4.1.2.2, p. 16.

4.1.2.1 B2B connector (X1)

The connector on the EtherCAT module is a 40-pole Amphenol 10144518-043802LF. In the drawing from Amphenol, this is labeled "Plug 3".

On the customer base board, a corresponding mating connector from Amphenol is required, see chap. 4.1.2.2, p. 16.

For the pin assignment of the mating connector, see chap. 4.3.1, p. 21.

Installation

4.1.2.2 Spacers

The customer base board must be equipped with 4 spacers to which the EtherCAT module is fastened. Combining the connections from Amphenol (connector of the EtherCAT module + mating connector of the base board) results in the necessary minimum height of 7.0 mm above the base board.

Moreover, the spacers establish an EMC-compliant, broadband connection to the module. They must therefore be conductive.

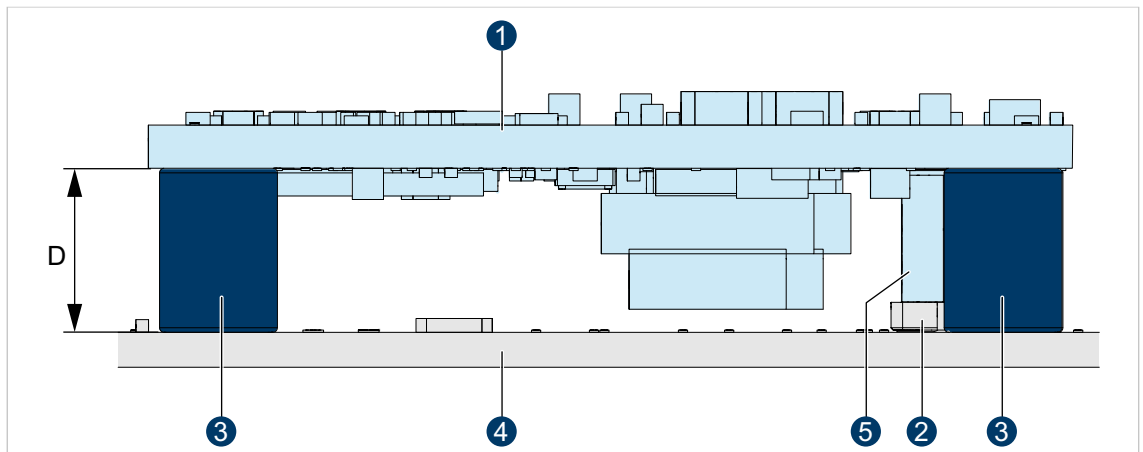


Fig. 5: Spacers

- | | |
|-------------------------------------|------------------------------|
| 1 EtherCAT module | 4 Customer base board |
| 2 B2B connection (mating connector) | 5 B2B connection (connector) |
| 3 Spacers | |

The following table shows the mating connectors available from Amphenol for the connectors used as well as the resulting distances D between the PCBs (i.e. the required heights of the spacers).

| Amphenol designation | Amphenol mating connector | Distance D between the PCBs / height of the spacers |
|----------------------|---------------------------|---|
| Recep 1 | 10144517-041802LF | 7 mm |
| Recep 2 | 10144517-042802LF | 11 mm |
| Recep 3 | 10144517-043802LF | 15 mm |
| Recep 4 | 10144517-044802LF | 19 mm |

The size of the screws used to fasten the EtherCAT module to the spacers is M2.5.

Installation

4.2 Electrical connection

4.2.1 Notes on the electrical connection

NOTICE!

Electrostatic discharges to the EtherCAT module connections can damage the electronic components.

- ▶ Observe the ESD protective measures.

NOTICE!

Incorrect wiring can damage the electronic components.

- ▶ Connect the wires as shown in the connection assignment.

4.2.2 Overview

The base board must be prepared by the customer in such a way that the FAULHABER Motion Controller and the associated FAULHABER EtherCAT module EB MC ET ADDON can be connected to it according to the principle shown in the following figure.

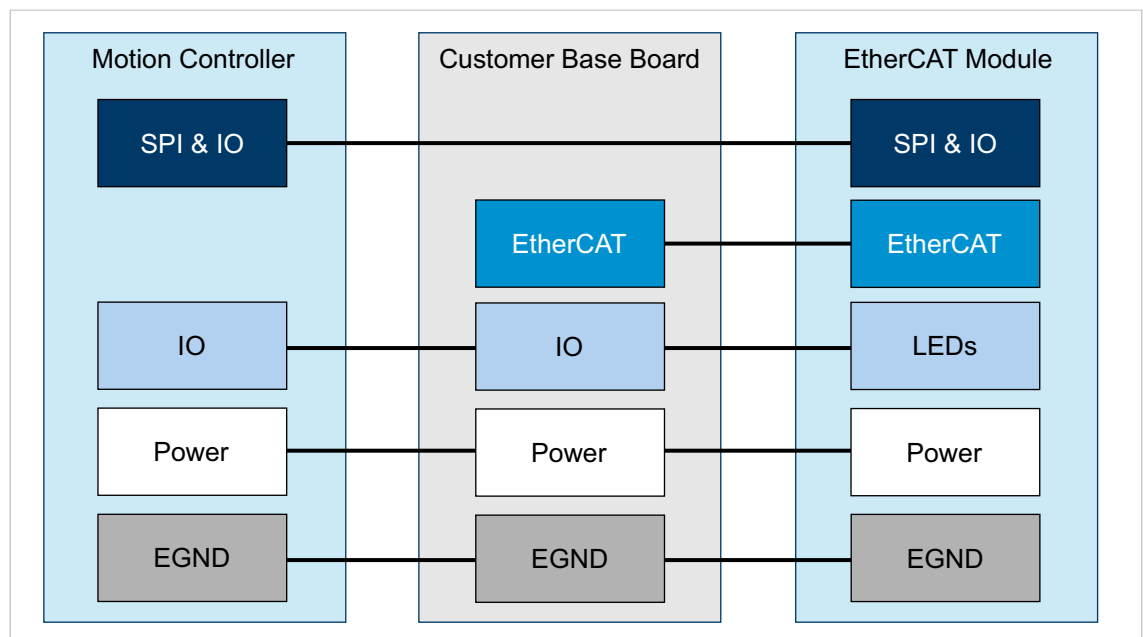


Fig. 6: Setup of the overall system in principle

- Motor controller: FAULHABER Motion Controller, which performs the basic functions for operating a motor.
- EtherCAT modules: FAULHABER EtherCAT module, which implements the EtherCAT communication with the EtherCAT master and the devices subordinate to the master.
- Customer base board: Base board developed by the customer.

The power supply is connected to the corresponding connector pins of the Motion Controller module (see the technical manual for the Motion Controller). The power supply of the EtherCAT module is generated by the Motion Controller.

Installation

The SPI lines and some digital IO lines enable the EtherCAT module to communicate with the processor of the Motion Controller.

The EtherCAT communication takes place between the EtherCAT module and the customer base board.

LED signals are generated by both the Motion Controller and the EtherCAT module (see chap. 4.3.3, p. 25).

With high-frequency network signals, it is particularly important for the connection to the functional earth EGND to be broadband.

The following figure shows a detailed setup using the same color coding as in Fig. 6.

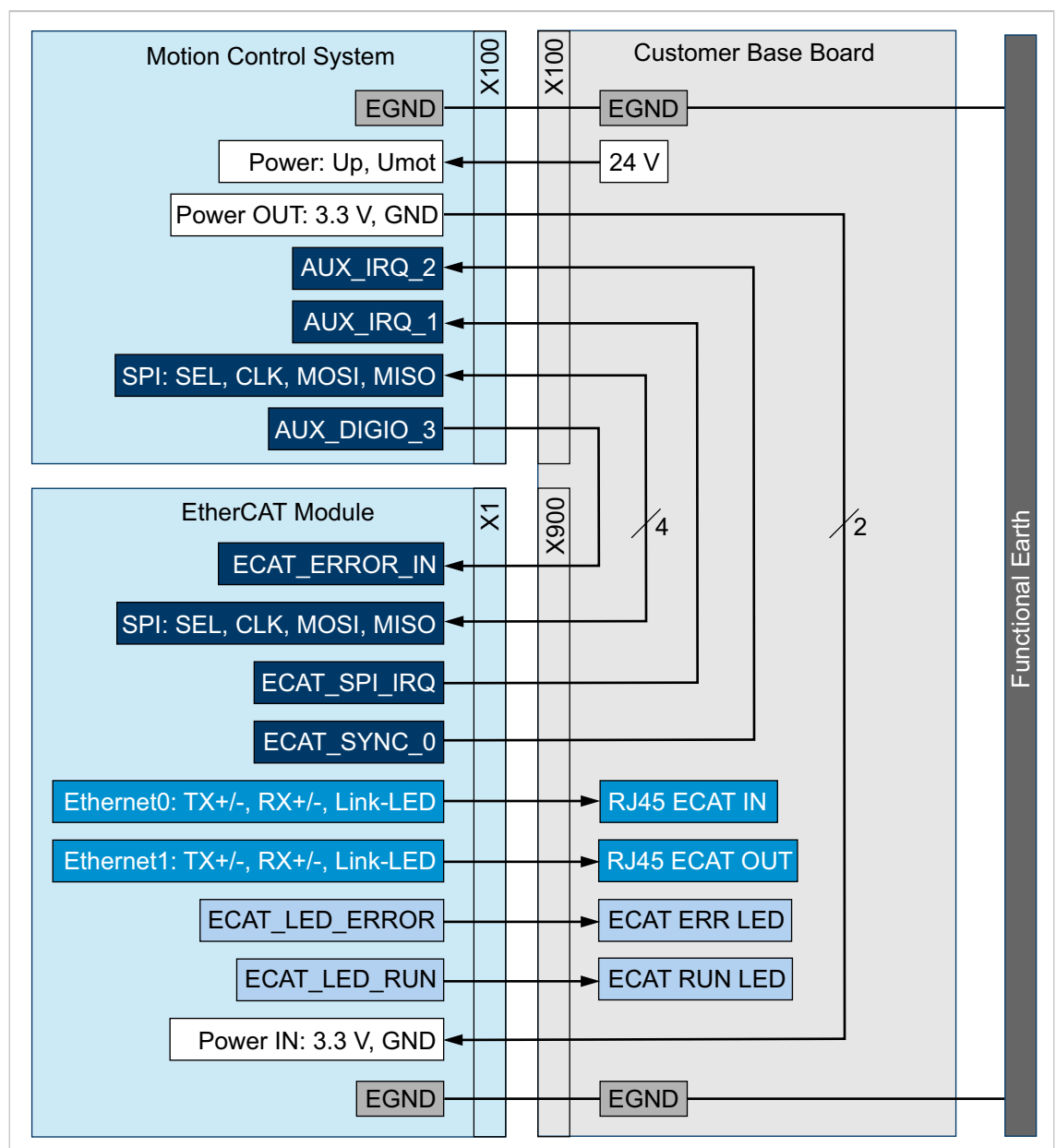


Fig. 7: Detailed setup of the overall system

Installation

4.2.3 Pin assignment of the B2B connector (X1)

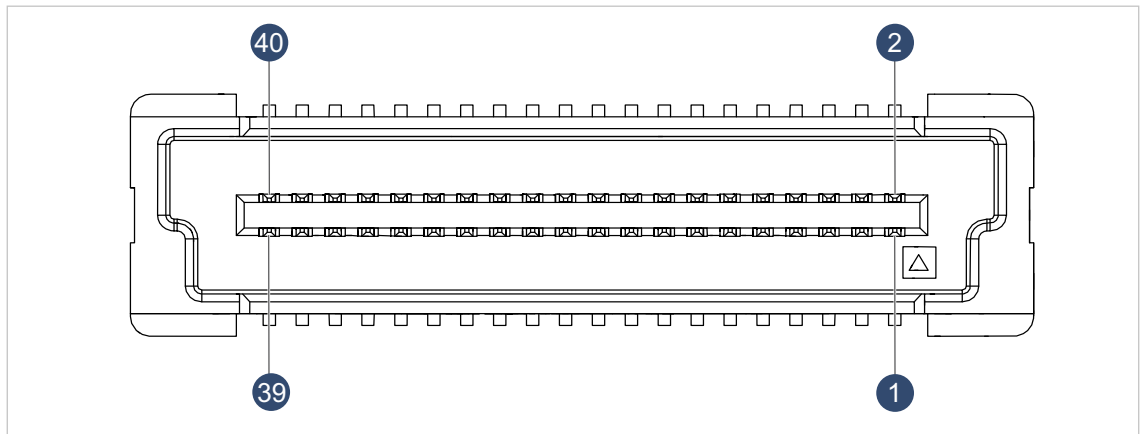


Fig. 8: B2B connector (X1) on the EtherCAT module

Tab. 2: Pin assignment of the B2B connector on the EtherCAT module

| Pin | Designation | Meaning |
|-----|----------------|---|
| 1 | EGND | Functional earth for discharging high-frequency interference. |
| 2 | EGND | The EtherCAT module must be connected to an earth system with low impedance, e.g. via screw connections, flat copper braiding or conductor paths that are at least 6 mm wide. |
| 3 | +3.3 V IN | Power supply input. The power is supplied by the FAULHABER Motion Controller. |
| 4 | n.c. | – |
| 5 | GND | Ground connection of the power supply, which is supplied by the FAULHABER Motion Controller. |
| 6 | GND | |
| 7 | ECAT_ERROR_IN | ECAT error signal (connection to AUX-DIGIO3 of the Motion Controller) |
| 8 | ECAT_LED_RUN | Optical indicator of the EtherCAT state machine. A green LED must be pulled to +3.3 V via a series resistor so that the current flowing is max. 20 mA. The LED must be attached to the device in such a way that it is clearly visible and the LED must be labeled "RUN". |
| 9 | ECAT_SYNC_1 | Internal connection |
| 10 | ECAT_LED_ERROR | Optical indicator of EtherCAT error states. A red LED must be pulled to +3.3 V via a series resistor so that the current flowing is max. 20 mA. The LED must be attached to the device in such a way that it is clearly visible and the LED must be labeled "ERR" or "Error". |
| 11 | GND | Ground connection |
| 12 | ECAT_SPI_IRQ | Interrupt requirement of the EtherCAT module (connection to SPI-IRQ1 of the Motion Controller) |
| 13 | ECAT_SYNC_0 | Synchronization of the EtherCAT module (connection to SPI-IRQ2 of the Motion Controller) |
| 14 | GND | Ground connection |
| 15 | GND | |
| 16 | ECAT_SPI_SEL | SPI line between the EtherCAT module and the Motion Controller (connection to SPI-SEL1 of the Motion Controller) The characteristic impedance must be $Z_0 = 70 \Omega$. |

Installation

| Pin | Designation | Meaning |
|-----|---------------|---|
| 17 | ECAT_SPI_MISO | SPI line between the EtherCAT module and the Motion Controller (connection to SPI-MISO of the Motion Controller) The characteristic impedance must be $Z_0 = 70 \Omega$. |
| 18 | GND | Ground connection |
| 19 | GND | |
| 20 | ECAT_SPI_CLK | SPI line between the EtherCAT module and the Motion Controller (connection to SPI-SCLK of the Motion Controller) The characteristic impedance must be $Z_0 = 70 \Omega$. |
| 21 | ECAT_SPI_MOSI | SPI line between the EtherCAT module and the Motion Controller (connection to SPI-MOSI of the Motion Controller) The characteristic impedance must be $Z_0 = 70 \Omega$. |
| 22 | GND | Ground connection |
| 23 | PHY1_LED_LINK | Network Link LED. Connection to a green LED near the "ECAT OUT" socket. The LED must be pulled to +3.3 V via a series resistor so that the current flowing is max. 20 mA. |
| 24 | PHY1_TX_P | Outgoing Ethernet line from the EtherCAT module to the "EtherCAT OUT" RJ45 socket. The socket must be labeled "EtherCAT OUT" or "ECAT OUT". |
| 25 | GND | Ground connection |
| 26 | PHY1_TX_N | Differential line paired with PHY1_TX_P, see pin 24. |
| 27 | PHY1_RX_P | Outgoing Ethernet line from the EtherCAT module to the "EtherCAT OUT" RJ45 socket, to which pin 24 is also connected. |
| 28 | GND | Ground connection |
| 29 | PHY1_RX_N | Differential line paired with PHY1_RX_P, see pin 27. |
| 30 | GND | Ground connection |
| 31 | GND | Ground connection |
| 32 | PHY0_TX_P | Outgoing Ethernet line from the EtherCAT module to the "EtherCAT IN" RJ45 socket. The socket must be labeled "EtherCAT IN" or "ECAT IN". |
| 33 | GND | Ground connection |
| 34 | PHY0_TX_N | Differential line paired with PHY0_TX_P, see pin 32. |
| 35 | PHY0_RX_P | Outgoing Ethernet line from the EtherCAT module to the "EtherCAT IN" RJ45 socket, to which pin 32 is also connected. |
| 36 | GND | Ground connection |
| 37 | PHY0_RX_N | Differential line paired with PHY0_RX_P, see pin 35. |
| 38 | PHY0_LED_LINK | Network Link LED. Connection to a green LED near the "ECAT IN" socket. The LED must be pulled to +3.3 V via a series resistor so that the current flowing is max. 20 mA. |
| 39 | GND | Ground connection |
| 40 | n.c. | – |

B2B connector type: See chap. 4.1.2.1, p. 15.

A suggestion for the wiring of the X1 connector can be found in chap. 4.3.1, p. 21.

Installation

4.3 Implementation on the customer base board

On the customer base board, the following connections must be implemented:

- Connector to the EtherCAT module (EB MC ET ADDON), see chap. 4.3.1, p. 21
- Connector to the Motion Controller, see technical manual for the Motion Controller
- Connection of power supply, see chap. 4.3.4, p. 26
- EtherCAT connections (ECAT IN/OUT), see chap. 4.3.2, p. 24
- LEDs for indicating communication, connection and error states, see chap. 4.3.3, p. 25
- Motor connections

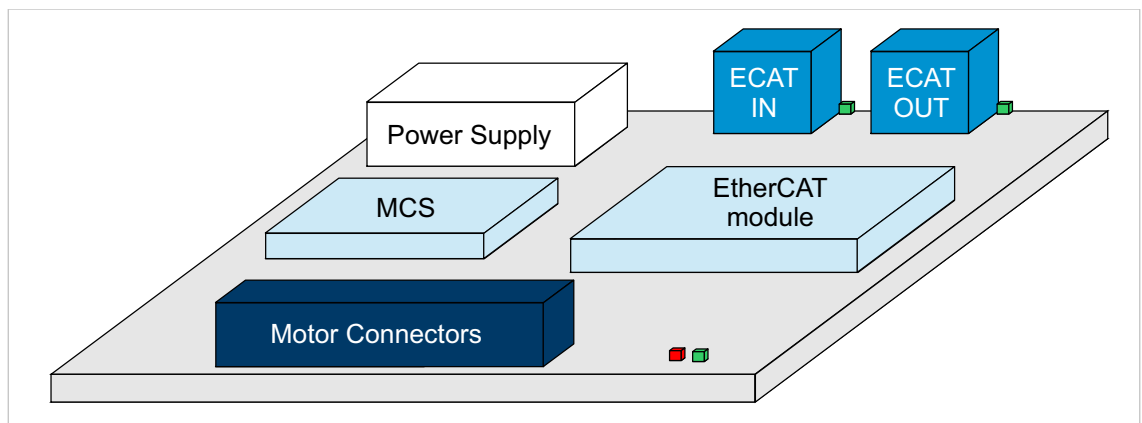


Fig. 9: Setup of the customer base board in principle

4.3.1 Connector to the EtherCAT module

On the customer base board, a mating connector for the 40-pole B2B connector (X1) of the EtherCAT module must be implemented. The following figure shows the corresponding connector (X900) of the FAULHABER evaluation board as an example, together with its connections.

Installation

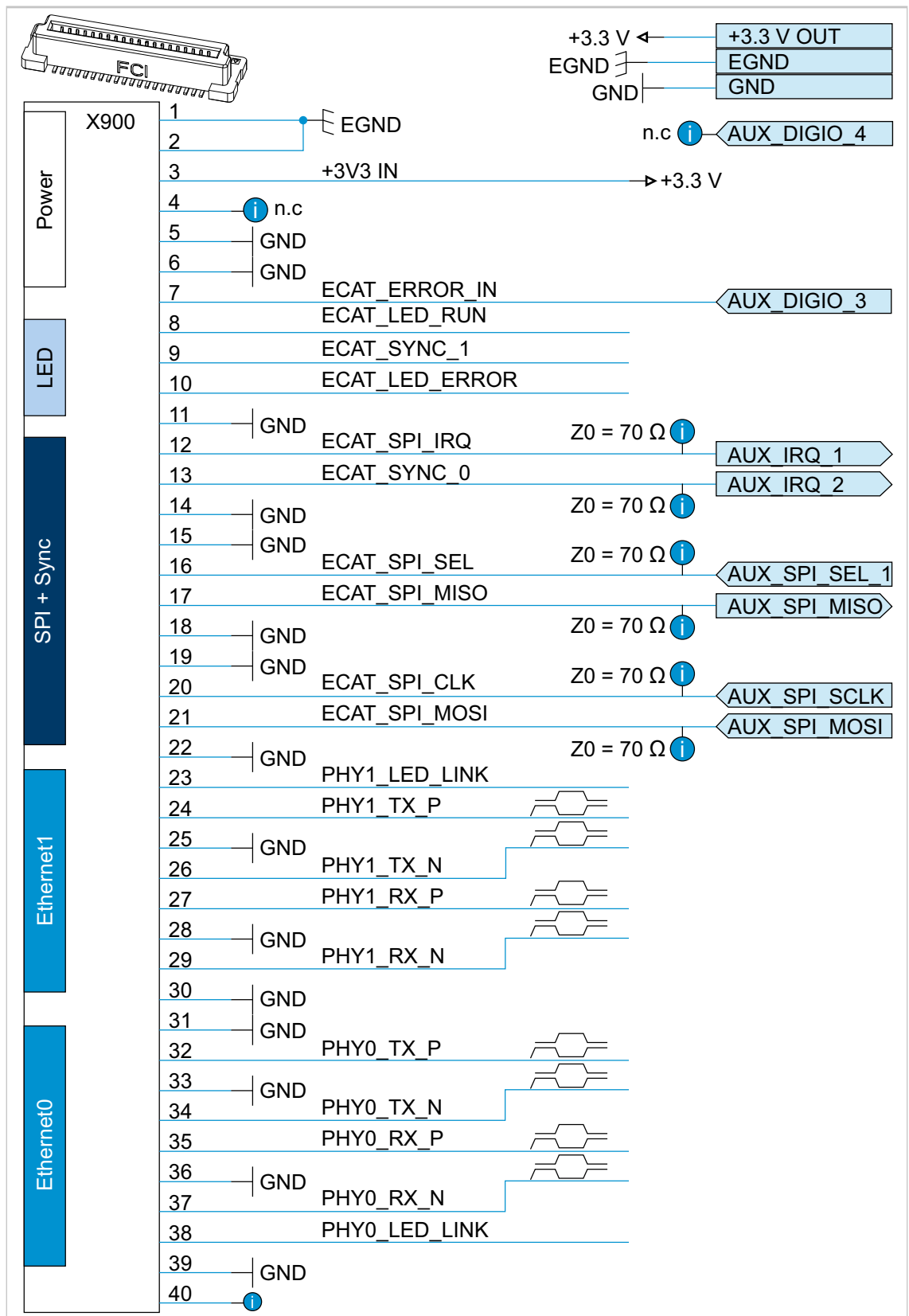



Fig. 10: Connections of the X900 connector of the FAULHABER evaluation board

Installation

The light-blue connectors on the right side are connected to the B2B connector (X100) of the Motion Controller, see e.g. MC 3602 / MC 3606 Technical Manual.

 AUX_DIGIO_4 is reserved for future applications and should remain unconnected.

Functional earthing

The functional earth with the designation EGND discharges interference. Incorrect functional earthing will inevitably lead to EMC problems in terms of both interference immunity and interference emission.

- ▶ Always connect the functional earth using a broadband connection, via either solid screw connections or wide copper braiding.


High-frequency behavior

Signal integrity plays an important role in relation to the EtherCAT module because the lines are long relative to the wavelength of the signals. The lines are also routed via a connector and continued on the extension board.

When designing the customer base board, the following points must be complied with:

- ▶ On the customer base board, design the line routings for the steep-edged SPI signals with an impedance of approx. 68...70 Ω . In the example wiring diagram (Fig. 10), this is marked with $Z_0 = 70 \Omega$.

The SPI lines are equipped with 68 Ω series termination resistors.

- ▶ Design the Ethernet lines on the customer base board with a differential impedance of 100 Ω and a line impedance of 50 Ω . In the example wiring diagram (Fig. 10), this is marked with the symbol .

The Ethernet lines have a physical frequency of 31.5 MHz.

- ▶ Develop a layout with controlled impedance in consultation with the PCB supplier.
- ▶ Comply with the general information and recommendations for preventing electromagnetic interference and for ensuring signal integrity in Ethernet networks.

Various manufacturers of Ethernet products offer literature on this topic online.

Installation

4.3.2 RJ45 socket (ECAT)

To enable the discharge of interference on the cable shield, the RJ45 socket must be shielded. Therefore, the housing of the socket must be connected to the functional earth (EGND) in such a way that DC current is blocked, e.g. via a ceramic capacitor (10 nF, 500 V).

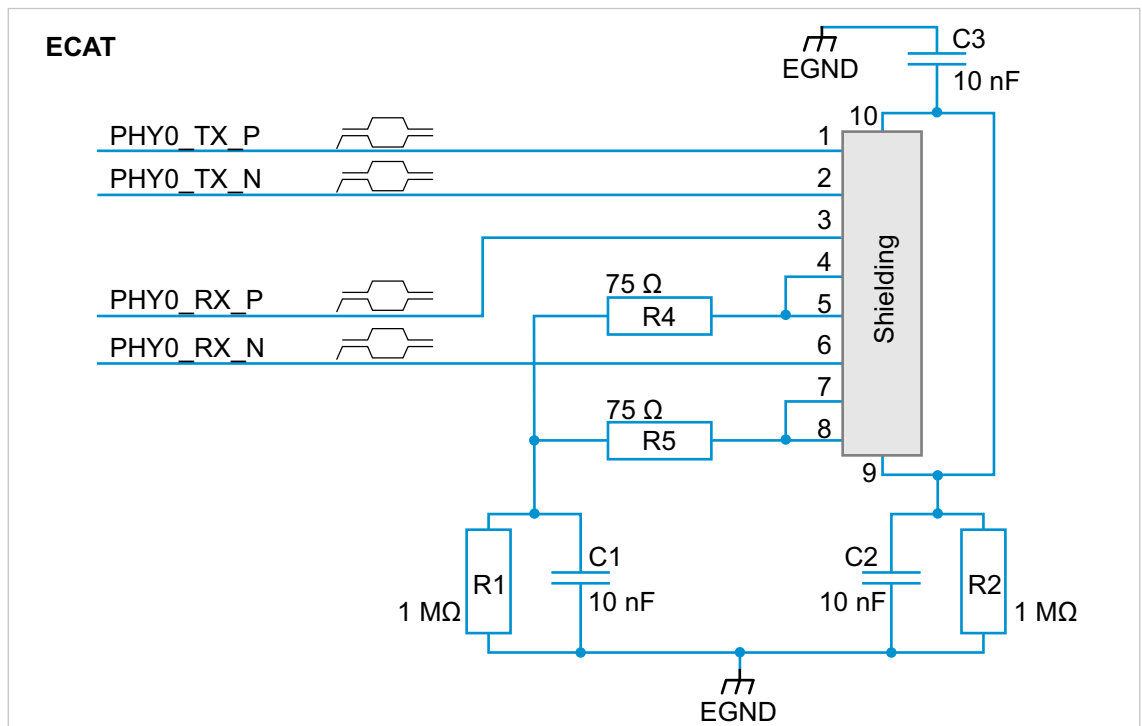


Fig. 11: Wiring of the RJ45 socket, using socket RJSE-5380 from the manufacturer Amphenol as an example

Interference on the unused cable pairs 4/5 and 7/8 is discharged via a Bob Smith termination. The suitability of this termination must be checked individually for each application.

Installation

4.3.3 LEDs

According to the requirements of ETG.1300 (EtherCAT Indicator and Labeling Specification), LEDs must be implemented on the customer base board to indicate communication, connection and error states. Detailed information on this topic is available from the EtherCAT Technology Group.

LED wiring according to ETG.1300

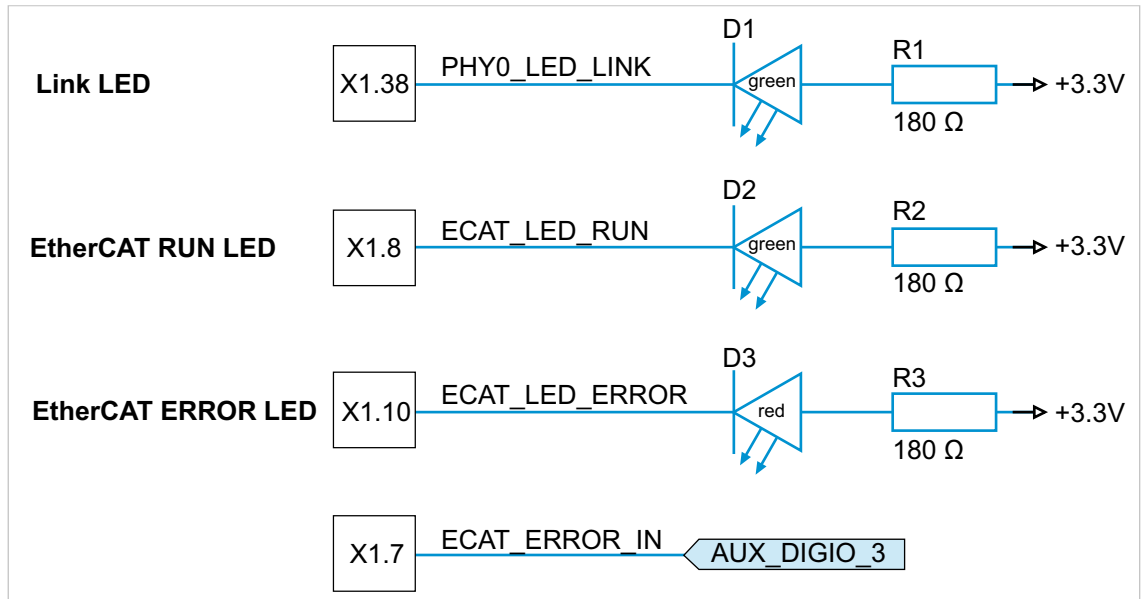


Fig. 12: Wiring of the LEDs according to ETG.1300

Simplified LED wiring

If it is necessary to reduce the number of lines from the EtherCAT module to the LED, the simple amplifier circuit included on the EtherCAT module for the error LED can be replaced with the customer's own circuit. In this case, the pins ECAT_LED_ERROR and ECAT_ERROR_IN no longer need to be contacted: The line AUX_DIGIO_3, which comes from the Motion Controller, is amplified via transistor and switches the error LED directly.

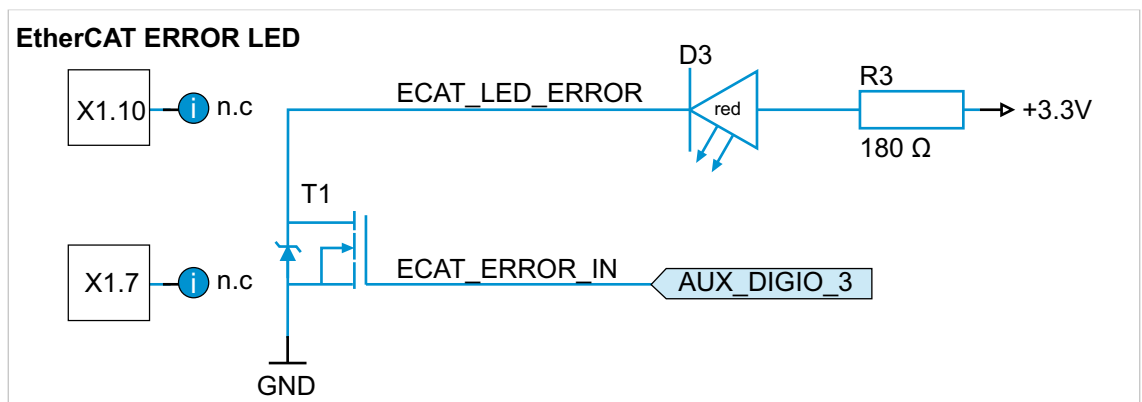


Fig. 13: Simplified wiring to reduce the number of lines

Installation

Positions on the customer base board

The LEDs should be arranged on the customer base board in such a way that they are clearly visible and their function can be easily assigned. The following figure shows the arrangement of the LEDs on the FAULHABER evaluation board as an example.

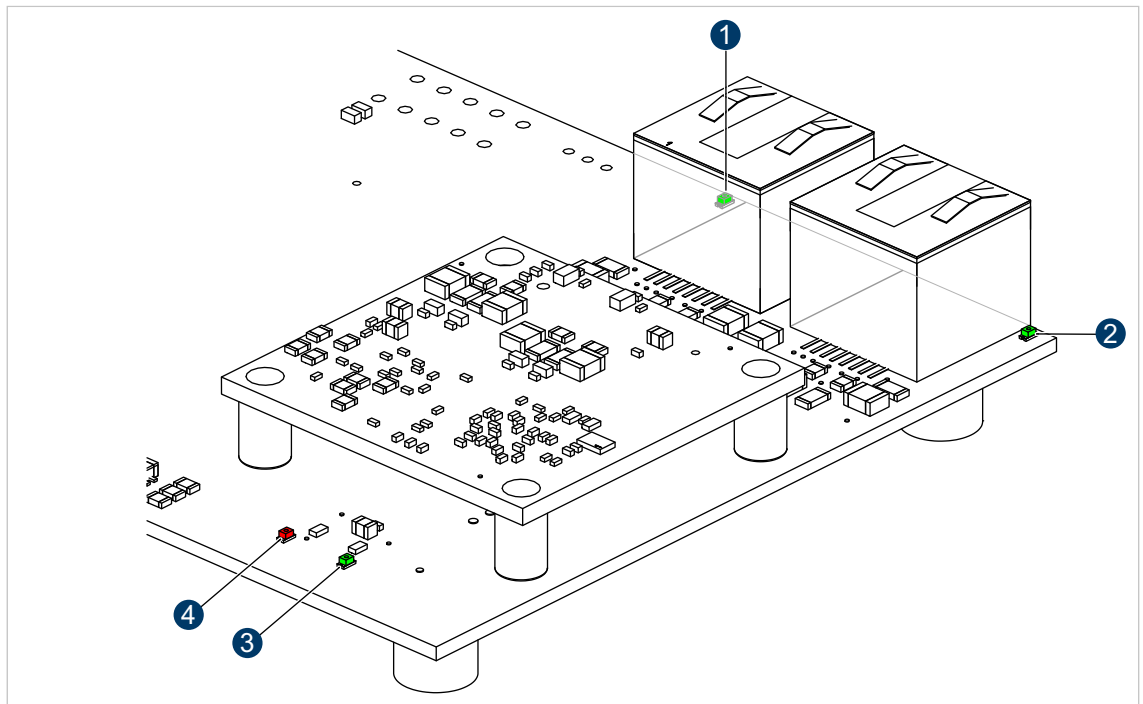


Fig. 14: LEDs as EtherCAT function indicators on the FAULHABER evaluation board

- | | | | |
|---|---------------------|---|---------------------------|
| 1 | <i>Link In LED</i> | 3 | <i>EtherCAT RUN LED</i> |
| 2 | <i>Link Out LED</i> | 4 | <i>EtherCAT ERROR LED</i> |

4.3.4 Current consumption

The typical current consumption of the EtherCAT module at room temperature is 220 mA. The 4 LEDs that must be provided on the customer base board require additional power.

Maintenance and diagnostics

5 Maintenance and diagnostics

5.1 Maintenance tasks

The EtherCAT module is generally maintenance free. Where the device is mounted in a cabinet, depending on the deposition of dust the air filter should be regularly checked and cleaned if necessary.

5.2 Diagnosis

The contact between the EtherCAT module and the customer base board is easy to check.

1. Connect pin 14 of the EtherCAT module to GND via a 100 pF || 100 nF combination, rather than directly.
2. Equip pin 14 with a pull-up resistor.

 If pin 14 is HIGH, the EtherCAT module is not mounted correctly.

5.3 Troubleshooting

If unexpected malfunctions occur during operation according to the intended use, please contact your support partner.

6 Warranty

Products of the company Dr. Fritz Faulhaber GmbH & Co. KG are produced using the most modern production methods and are subject to strict quality inspections. All sales and deliveries are performed exclusively on the basis of our General Conditions of Sale and Delivery which can be viewed on the FAULHABER home page www.faulhaber.com/agb and downloaded from it.

