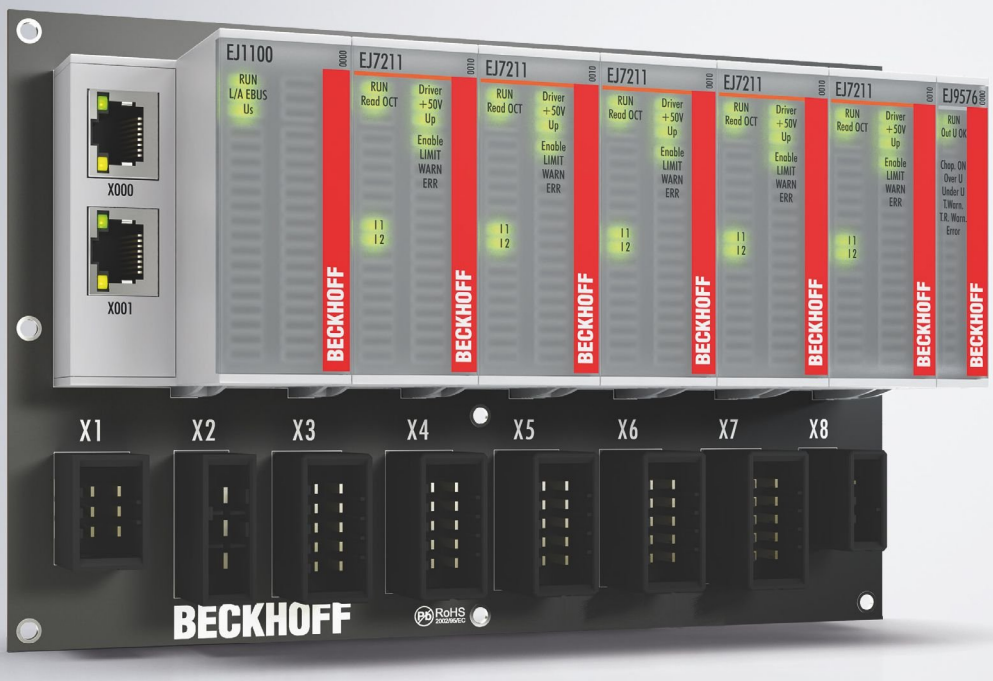
BECKHOFF New Automation Technology

Documentation | EN

EJ3318

8-channel thermocouple input with open-circuit recognition



2024-12-16 | Version: 2.3

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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.
It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.
The qualified personnel is obliged to always use the currently valid documentation.

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

Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

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

Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered trademarks of and licensed by Beckhoff Automation GmbH. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

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

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

Copyright

1.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Signal words

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

Personal injury warnings

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

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

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

Warning of damage to property or environment

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

Information on handling the product

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

1.3 Intended use

⚠ WARNING

Caution - Risk of injury!

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

1.4 Signal distribution board

NOTICE

Signal distribution board

Make sure that the EtherCAT plug-in modules are used only on a signal distribution board that has been developed and manufactured in accordance with the Design Guide.

1.5 Documentation issue status

Version	Changes
2.3	• Update Technical data • Update chapter "Connection" • Structural update
2.2	• Update chapter *Marking of EtherCAT plug-in modules* • Update Technical data • Chapter *Disposal* added • Structural update
2.1	• New title page • Chapter *Marking of EtherCAT plug-in modules* added • Update Technical data • Update chapter *Connection* • Chapter *Basics of TC technology* added • Update chapter *EJ3318 - Notes on commissioning* • Note *Signal-Distribution-Board* added • Chapters *Basics communication, TwinCAT Quick Start* , *TwinCAT development environment* and *General Notes - EtherCAT Slave Application* replaced by references in the chapter *Guide through the documentation* • Chapter *EJ3318 - Object description and parameterization* added • Update revision status • Structural update
2.0	• First publication EJ3318 • Chapter *Intended use* added • Chapter *System overview* added • Update chapter *Product overview* • Chapter *Basics communication* added • Chapter *Mounting and wiring* replaced by chapter *Installation of EJ modules* • Update chapter *Appendix*
1.0	• First version

1.6 Guide through documentation

NOTICE

Further components of documentation

This documentation describes device-specific content. It is part of the modular documentation concept for Beckhoff I/O components. For the use and safe operation of the device / devices described in this documentation, additional cross-product descriptions are required, which can be found in the following table.

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
Design Guide EJ8xxx - Signal distribution board for standard EtherCAT plug-in modules (PDF)	Notes on the design of a signal distribution board for standard EtherCAT plug-in modules. • Requirements for the signal distribution board • Backplane mounting guidelines • Module placement • Routing guidelines
Documentation of the corresponding ELxxxx EtherCAT Terminal (s. note on documentation of ELxxxx) [▶ 53]	• Notes on the principle of operation and • descriptions for configuration and parameterization are transferable to the corresponding EtherCAT plug-in modules
I/O Analog Manual (PDF)	Notes on I/O components with analog in and outputs
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

The documentations can be viewed at and downloaded from the Beckhoff website (www.beckhoff.com) via:

- the “Documentation and Download” area of the respective product page,
- the Download finder,
- the Beckhoff Information System.

If you have any suggestions or proposals for our documentation, please send us an e-mail stating the documentation title and version number to: documentation@beckhoff.com

1.7 Marking of EtherCAT plug-in modules

Designation

A Beckhoff EtherCAT device has a 14-digit **technical designation**, made up as follows (e.g. EJ1008-0000-0017)

- **Order identifier**
  - family key: EJ
  - product designation: The first digit of product designation is used for assignment to a product group (e.g. EJ2xxx = digital output module).
  - Version number: The four digit version number identifies different product variants.

- **Revision number:**
  It is incremented when changes are made to the product.

The Order identifier and the revision number are printed on the side of EtherCAT plug-in modules (s. following illustration (A and B).

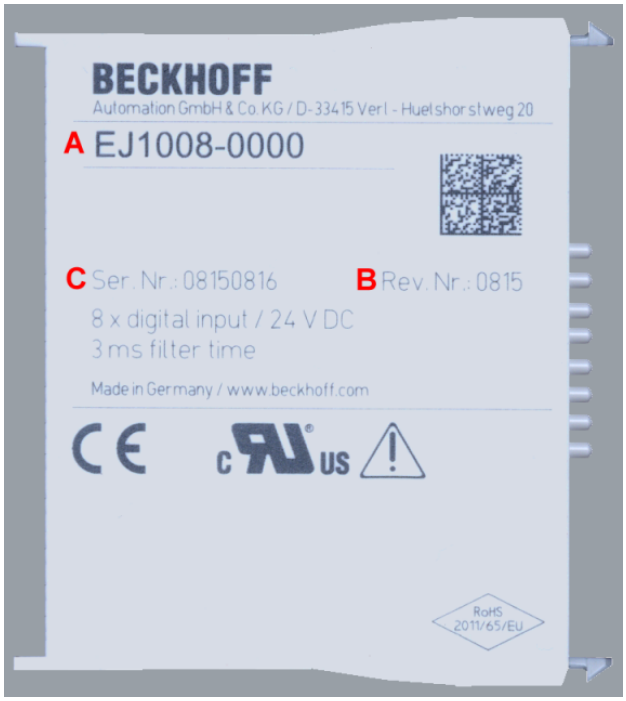


Fig. 1: Order identifier (A), Revision number (B) and serial number (C) using the example of EJ1008

Product group	Example		
	Product designation	Version	Revision
EtherCAT Coupler EJ11xx	EJ1101	-0022 (Coupler with external connectors, power supply module and optional ID switches	-0016
Digital input modules EJ1xxx	EJ1008 8-channel	-0000 (basic type)	-0017
Digital output modules EJ2xxx	EJ2521 1-channel	-0224 (2 x 24 V outputs)	-0016
Analog input modules EJ3xxx	EJ3318 8-channel thermocouple	-0000 (basic type)	-0017
Analog output modules EJ4xxx	EJ4134 4-channel	-0000 (basic type)	-0019
Special function modules EJ5xxx, EJ6xxx	EJ6224 IO-Link master	-0090 (with TwinSAFE SC)	-0016
Motion modules EJ7xxx	EJ7211 servomotor	-9414 (with ECT, STO and TwinSAFE SC)	-0029

Notes

- The elements mentioned above result in the **technical designation**. EJ1008-0000-0017 is used in the example below.
- EJ1008-0000 is the **order identifier**, in the case of “-0000” usually abbreviated to EJ1008.
- The **revision** -0017 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
- The product designation, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

Serial number

The serial number for EtherCAT plug-in modules is usually the 8-digit number printed on the side of the module (see following illustration C). The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules of a batch.

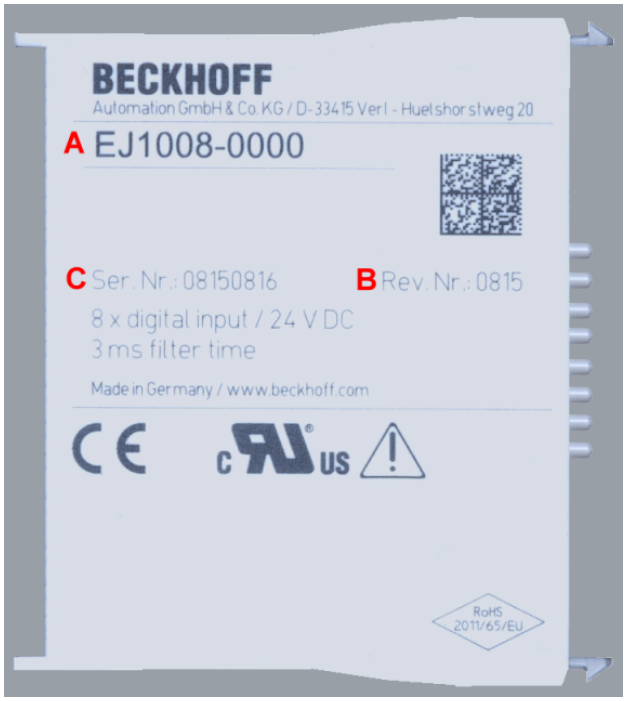


Fig. 2: Order identifier (A), revision number (B) and serial number (C) using the example of EJ1008

Serial number	Example serial number: 08 15 08 16
KK - week of production (CW, calendar week)	08 - week of production: 08
YY - year of production	15 - year of production: 2015
FF - firmware version	08 -f irmware version: 08
HH - hardware version	16 - hardware version: 16

1.7.1 Beckhoff Identification Code (BIC)

The **B**eckhoff **I**dentification **C**ode (BIC) is increasingly being applied to Beckhoff products to uniquely identify the product. The BIC is represented as a Data Matrix Code (DMC, code scheme ECC200), the content is based on the ANSI standard MH10.8.2-2016.

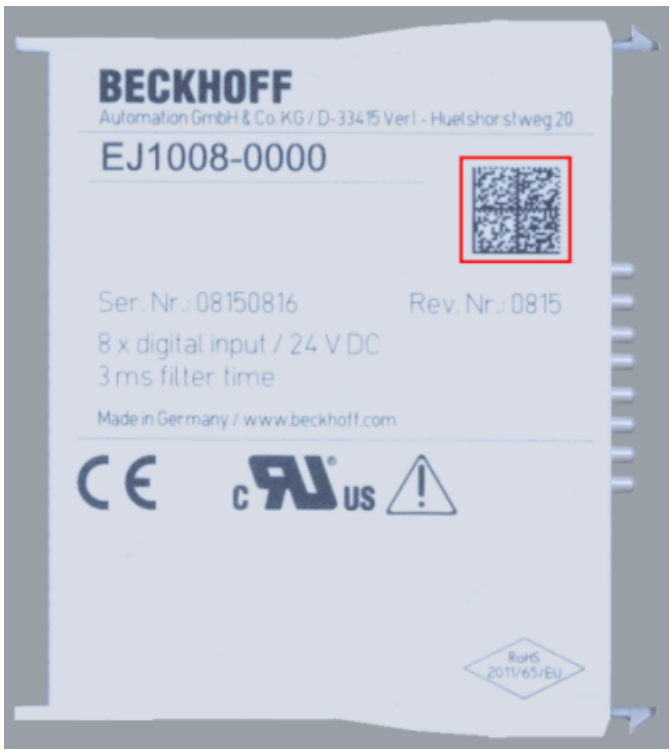


Fig. 3: BIC as data matrix code (DMC, code scheme ECC200)

The BIC will be introduced step by step across all product groups.

Depending on the product, it can be found in the following places:

- on the packaging unit
- directly on the product (if space suffices)
- on the packaging unit and the product

The BIC is machine-readable and contains information that can also be used by the customer for handling and product management.

Each piece of information can be uniquely identified using the so-called data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length according to the table below. If the information is shorter, it shall be replaced by spaces. The data under positions 1-4 are always available.

The following information is contained:

Item no.	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	S	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294104
7	Variant number	Optional: Product variant number on the basis of standard products	30P	12	30PF971 , 2*K183
...					

Further types of information and data identifiers are used by Beckhoff and serve internal processes.

Structure of the BIC

Example of composite information from items 1 - 4 and with the above given example value on positon 6. The data identifiers are marked in bold font for better display:

1P072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

Accordingly as DMC:

Fig. 4: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, item no. 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

This information has been carefully prepared. However, the procedure described is constantly being further developed. We reserve the right to revise and change procedures and documentation at any time and without prior notice. No claims for changes can be made from the information, illustrations and descriptions in this information.

1.7.2 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

The Beckhoff Identification Code (BIC) is applied to the outside of Beckhoff products in a visible place. If possible, it should also be electronically readable.

The interface that the product can be electronically addressed by is crucial for the electronic readout.

K-bus devices (IP20, IP67)

Currently, no electronic storage or readout is planned for these devices.

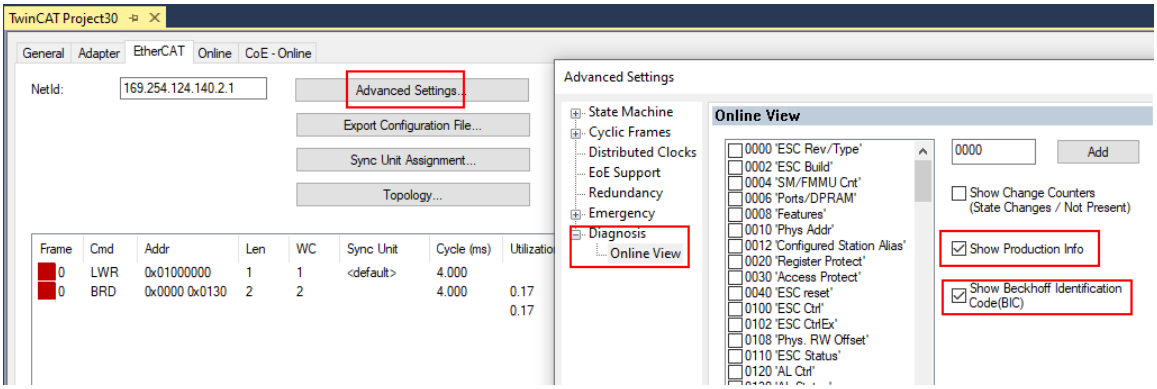
EtherCAT devices (IP20, IP67)

All Beckhoff EtherCAT devices have an ESI-EEPROM which contains the EtherCAT identity with the revision number. The EtherCAT slave information, also colloquially known as the ESI/XML configuration file for the EtherCAT master, is stored in it. See the corresponding chapter in the EtherCAT system manual (Link) for the relationships.

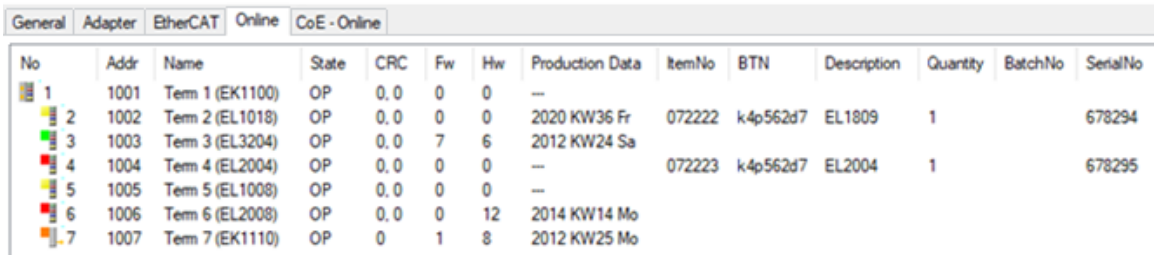
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

The user can electronically access the eBIC (if present) as follows:

- With all EtherCAT devices, the EtherCAT master (TwinCAT) can read the eBIC from the ESI-EEPROM
  - From TwinCAT 3.1 build 4024.11, the eBIC can be displayed in the online view.
  - To do this, check the "Show Beckhoff Identification Code (BIC)" checkbox under EtherCAT → Advanced Settings → Diagnostics:

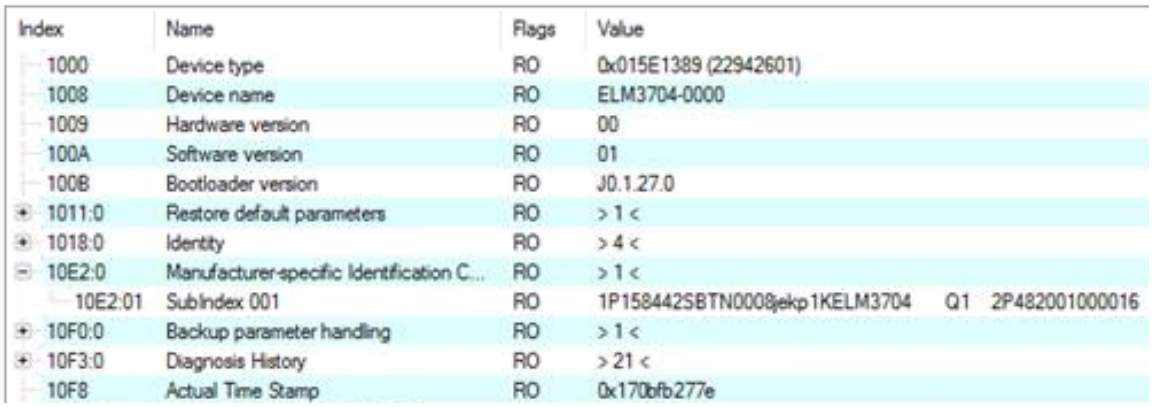


  - The BTN and its contents are then displayed:



  - Note: As shown in the figure, the production data HW version, FW version, and production date, which have been programmed since 2012, can also be displayed with "Show production info".
  - Access from the PLC: From TwinCAT 3.1. build 4024.24, the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0.
- EtherCAT devices with a CoE directory may also have the object 0x10E2:01 to display their own eBIC, which can also be easily accessed by the PLC:

- The device must be in PREOP/SAFEOP/OP for access:



Index	Name	Flags	Value
1000	Device type	RO	0x015E1389 (22942601)
1008	Device name	RO	ELM3704-0000
1009	Hardware version	RO	00
100A	Software version	RO	01
100B	Bootloader version	RO	J0.1.27.0
1011:0	Restore default parameters	RO	> 1 <
1018:0	Identity	RO	> 4 <
10E2:0	Manufacturer-specific Identification C...	RO	> 1 <
10E2:01	SubIndex 001	RO	1P158442SBTN0008jekp1KELM3704 Q1 2P482001000016
10F0:0	Backup parameter handling	RO	> 1 <
10F3:0	Diagnosis History	RO	> 21 <
10F8	Actual Time Stamp	RO	0x170bfb277e

  - The object 0x10E2 will be preferentially introduced into stock products in the course of necessary firmware revision.
  - From TwinCAT 3.1. build 4024.24, the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC are available in the Tc2_EtherCAT library from v3.3.19.0
- The following auxiliary functions are available for processing the BIC/BTN data in the PLC in *Tc2_Utilities* as of TwinCAT 3.1 build 4024.24
  - F_SplitBIC: The function splits the Beckhoff Identification Code (BIC) sBICValue into its components using known identifiers and returns the recognized substrings in the ST_SplittedBIC structure as a return value
  - BIC_TO_BTN: The function extracts the BTN from the BIC and returns it as a return value
- Note: If there is further electronic processing, the BTN is to be handled as a string(8); the identifier "SBTN" is not part of the BTN.
- Technical background
  The new BIC information is written as an additional category in the ESI-EEPROM during device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored using a category in accordance with the ETG.2010. ID 03 tells all EtherCAT masters that they may not overwrite these data in the event of an update or restore the data after an ESI update.
  The structure follows the content of the BIC, see here. The EEPROM therefore requires approx. 50..200 bytes of memory.
- Special cases
  - If multiple hierarchically arranged ESCs are installed in a device, only the top-level ESC carries the eBIC information.
  - If multiple non-hierarchically arranged ESCs are installed in a device, all ESCs carry the eBIC information.
  - If the device consists of several sub-devices which each have their own identity, but only the top-level device is accessible via EtherCAT, the eBIC of the top-level device is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

PROFIBUS; PROFINET, and DeviceNet devices

Currently, no electronic storage or readout is planned for these devices.

1.7.3 Certificates

- The EhterCAT plug-in modules meet the requirements of the EMC and Low Voltage Directive. The CE mark is printed on the side of the modules.
- The cRUus imprint identifies devices that meet product safety requirements according to U.S. and Canadian regulations.
- The warning symbol is a request to read the corresponding documentation. The documentations for EtherCAT plug-in modules can be downloaded from the Beckhoff homepage.

Fig. 5: Marking for CE and UL using EJ1008 as an example

2 System overview

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

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

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

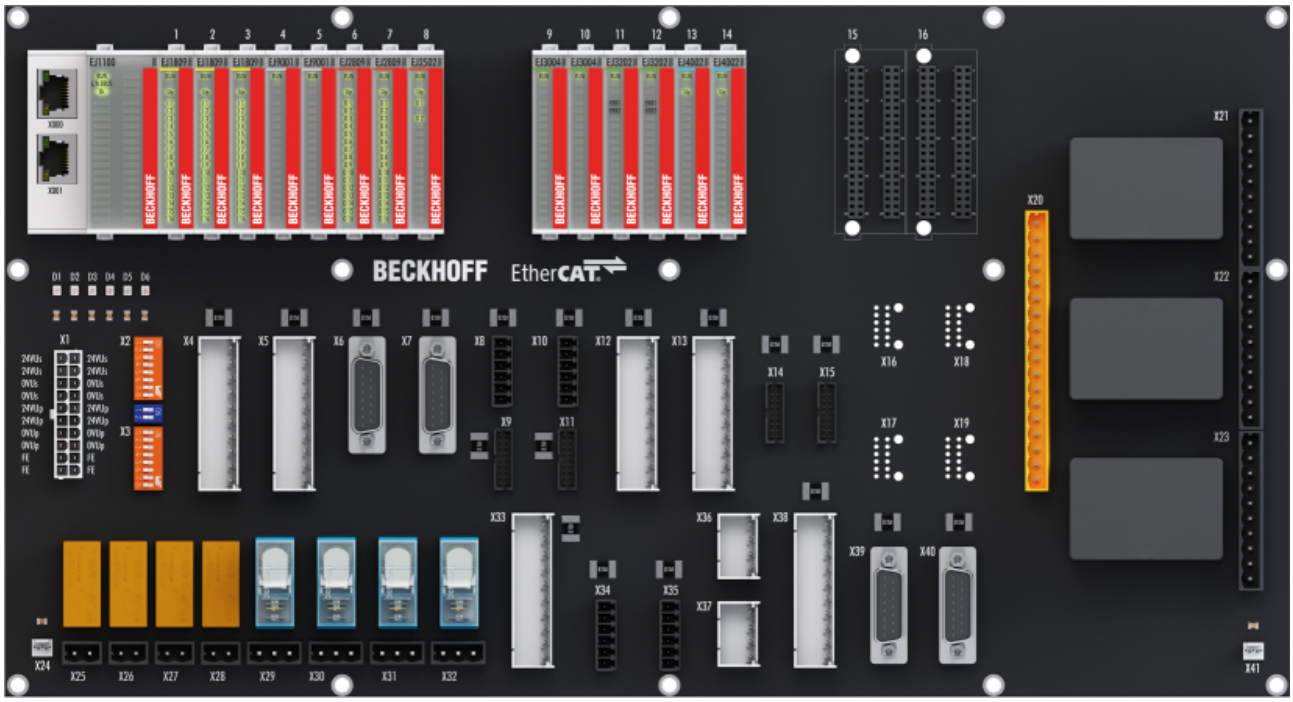


Fig. 6: EJ system sample

Signal distribution board

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

EtherCAT plug-in modules

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

3 EJ3318 - Product description

3.1 Introduction

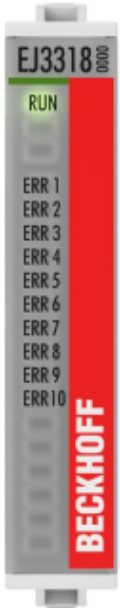


Fig. 7: EJ3318

8-channel input, thermocouple with open-circuit recognition

The EJ3318 EtherCAT module enables the direct connection of eight thermocouples. The circuit of the EtherCAT module can operate thermocouple sensors in 2-wire technology. A microprocessor handles linearization across the whole temperature range, which is freely selectable. Cold junction compensation is achieved by external temperature measurement via RTDs. Measurements in the mV range are also possible with the EJ3318 EtherCAT plug-in module.

The error LEDs indicate a broken wire.

3.2 Technical data

Analog inputs	EJ3318
Number of inputs	8 x TC 2 x PT1000 for cold junction compensation
Temperature measurement (thermocouple)	Type B, C, E, J, K, L, N, R, S, T, U (pre-set type K), mV measurement
Connection technology	2-wire
Maximum cable length to the sensor	30 m (see note [▶ 19])
Temperature range	Defined in the range for each sensor (Pre-set: type K; -200 ... +1370°C); voltage measurement ±30 mV ... ±75 mV Lower limit of -454°F (-270°C) for type K, T thermocouples
Resolution	0.01°C/ digit (selectable, default: 0.1°C)
Input filter limit frequency	Typ. 1 kHz; depending on sensor length, conversion time, sensor type
Conversion time	approx. 5 s up to 40 ms, depending on configuration and filter setting, pre-set approx. 500 ms
Wire break detection	yes
Special features	Idle detection, error detection of external cold junction compensation (CJC)

Voltage measurement	EJ3318
Measuring range, technically available	approx. ±78 mV
Measuring ranges (nominal) and resolution	±30 mV (1 µV per digit, thus max. 32.768 mV can be displayed) ±60 mV (2 µV per digit, thus max. 65.536 mV can be displayed) ±75 mV (4 µV per digit, thus max. 131 mV can be displayed, note technically available measuring range) The measuring ranges 30 and 60 mV are executed in software to increase the resolution and always use the same electrical measuring range of ±75 mV.
Measurement uncertainty	at ±75 mV, 23°C ambient temperature: < ±0.096% (relative to the full scale value): for further information, see chapter "Measurement ±30 mV, ±60 mV, ±75 mV" [▶ 20]

Temperature measurement	EJ3318
Electrical measuring range used	±75 mV
Measuring ranges	Type B: +200...+1820°C Type C: 0...+2320°C Type E: -100...+1000°C Type J: -100...+1200°C Type K: -270...+1370°C (pre-set) Type L: 0...+900°C Type N: -100...+1300°C Type R: -50...+1767°C Type S: -50...+1760°C Type T: -200...+400°C Type U: 0...+600°C
Resolution	Temperature display 0.1/0.01°C per digit, pre-set 0.1°C **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at “Resolution 0.01°C”; type K: approx. 0.04°C.**
Measurement uncertainty	at 23°C ambient temperature, with reference configuration, according to type: B: ±6.3°C; C: ±4.9°C; E: ±3.1°C; J: ±3.2°C; K: ±3.0°C; L: ±3.1°C; N: ±3.4°C; R: ±5.2°C; S: ±5.4°C; T: ±3.3°C; U: ±3.2°C for further details see Chapter "Measurement of thermocouples" [▶ 21]

Supply and potentials	EJ3318
Current consumption load voltage (Up contacts)	-
Power supply	via the E-bus
Current consumption via E-bus	190 mA
Electrical isolation	500 V (E-bus/signal voltage)

Communication	EJ3318
Distributed clocks	-

Environmental conditions	EJ3318
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 air humidity	95%, no condensation
Operating altitude	max. 2,000 m

General data	EJ3318
Dimensions (W x H x D)	approx. 12 mm x 66 mm x 55 mm
Weight	approx. 30 g
Installation	on signal distribution board
Pollution degree	2
Installation position	Standard [▶ 42]
Position of the coding pins [▶ 45]	2 and 7
Color coding	green

Standards and approvals	EJ3318
Vibration/shock resistance	conforms to EN 60068-2-6 /EN 60068-2-27 (with corresponding signal distribution board)
EMC immunity/emission	conforms to EN 61000-6-2 /EN 61000-6-4 (with corresponding signal distribution board)
Protection rating	EJ module: IP20 EJ system: dependent on the signal distribution board and housing
Approvals/markings*	CE, EAC, UKCA, UL

*) Real applicable approvals/markings see type plate on the side (product marking).

CE approval

The CE Marking refers to the EtherCAT plug-in module mentioned above.
If the EtherCAT plug-in module is used in the production of a ready-to-use end product (PCB in conjunction with a housing), the manufacturer of the end product must check compliance of the overall system with relevant directives and CE certification.
To operate the EtherCAT plug-in modules, they must be installed in a housing.

Maximum cable length to the sensor

Without additional protective measures, the maximum cable length from the EtherCAT Module to the sensor is 30 m. For longer cable lengths, suitable surge protection should be provided.

3.2.1 Measurement ±30 mV...±75 mV

Specification ±30 mV

Note: this measuring range is not a separate electrical measuring range but a digital section of the 75 mV measuring range

Measurement mode		±30 mV
Measuring range, nominal		-30…+30 mV
Measuring range, end value (full scale value)		30 mV
PDO resolution		1 µV / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< ±0.155%$_{FSV}$ typ. ≈ < ± 0.047 mV
	@ 55°C ambient temperature[1]	< ±0.189%$_{FSV}$ typ. ≈ < ± 0.057 mV
Offset/zero point deviation (at 23°C)[2]	F_{Offset}	< ±40 µV
Gain/scale/amplification deviation (at 23°C)[2]	F_{Gain}	< 800 ppm
Temperature coefficient	Tk_{Gain}	< 1 µV/K
	Tk_{Offset}	< 30 ppm/K

Specification ±60 mV

Note: this measuring range is not a separate electrical measuring range but a digital section of the 75 mV measuring range

Measurement mode		±60 mV
Measuring range, nominal		-60…+60 mV
Measuring range, end value (full scale value)		60 mV
PDO resolution		2 µV / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< ±0.104%$_{FSV}$ typ. ≈ < ± 0.062 mV
	@ 55°C ambient temperature[1]	< ±0.117%$_{FSV}$ typ. ≈ < ± 0.070 mV
Offset/zero point deviation (at 23°C)[2]	F_{Offset}	< ±40 µV
Gain/scale/amplification deviation (at 23°C)[2]	F_{Gain}	< 800 ppm
Temperature coefficient	Tk_{Gain}	< 1 µV/K
	Tk_{Offset}	< 30 ppm/K

Specification ±75 mV

Measurement mode		±75 mV
Measuring range, nominal		-75…+75 mV
Measuring range, end value (full scale value)		75 mV
PDO resolution		4 µV / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< ±0.096%$_{FSV}$ typ. ≈ < ± 0.072 mV
	@ 55°C ambient temperature[1]	< ±0.105%$_{FSV}$ typ. ≈ < ± 0.079 mV
Offset/zero point deviation (at 23°C)[2]	F_{Offset}	< ±40 µV
Gain/scale/amplification deviation (at 23°C)[2]	F_{Gain}	< 800 ppm
Temperature coefficient	Tk_{Gain}	< 1 µV/K
	Tk_{Offset}	< 30 ppm/K

[1] This specification value includes the temperature coefficient for gain (Tk_{Gain}) and offset (Tk_{Offset}).

[2] These specifications are already included in the basic accuracy. They are listed here for a detailed, individual uncertainty consideration.

3.2.2 Thermocouples measurement

In the measuring range of a specified thermocouple type, a measured voltage is converted internally into a temperature according to the set transformation. Since the channel measures a voltage internally, the corresponding measuring error in the voltage measuring range must be used.

NOTICE

Basics of thermocouple technology

- Observe the descriptions and notes on the basics of thermocouple technology in the I/O Analog Manual.

Specifications for reference configuration with EtherCAT Terminals (internal cold junction)

The following tables with the specification of the thermocouple measurement only apply to the reference configuration with EL331x EtherCAT Terminals when using the internal cold junction.

As the cold junction of EtherCAT plug-in modules is implemented externally on the application-specific signal distribution board, the specified values are to be regarded as reference values that are only achieved with a comparable implementation.

- The uncertainties must then be determined for the external cold junction on the application side. This temperature can then be transferred to the module for cold junction compensation and calculation of the absolute temperature via the process data.
- The effect on the measurement of the thermocouples must then be calculated on the system side.

The specifications for the internal cold junction and the measuring range given here apply only if the following times are adhered to for thermal stabilization at constant ambient temperature:

- after switching on: 60 min
- after changing wiring/connectors: 15 min

Specification of the internal cold junction measurement

The EL3318 EtherCAT Terminal has an internal cold junction measurement.

Measurement mode		Cold junction
Basic accuracy: measurement deviation at 23 °C, with averaging		< ±3.0 °C
Temperature coefficient	Tk	< 40 mK/K

3.2.2.1 Specification - thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		±75 mV
Measuring range, technically available		+600°C ≈ 1.792 mV … +1820°C ≈ 13.820 mV
Measuring range, end value (full scale value)		+1820°C
Measuring range, recommended		+750°C… +1800°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type B: approx. 0.05°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±6.3 K ≈ ±0.35%$_{FSV}$
	@ 55°C ambient temperature	±7.8 K ≈ ±0.29%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb}= 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*

Measurement uncertainty for thermocouple type B:

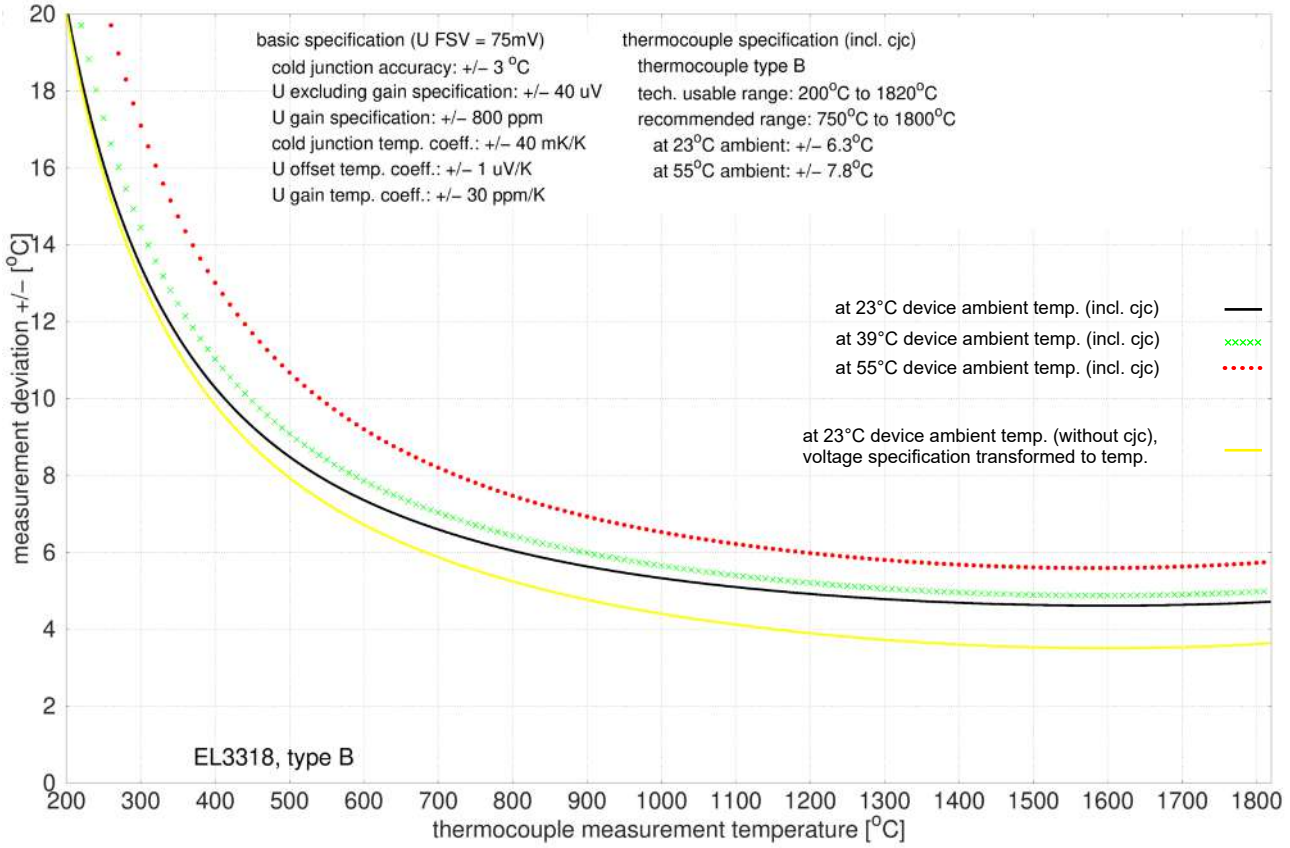


Fig. 8: EL3318, type B

3.2.2.2 Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		±75 mV
Measuring range, technically available		0°C ≈ 0 mV … +2320°C ≈ 37.107 mV
Measuring range, end value (full scale value)		+2320°C
Measuring range, recommended		0 °C…+2000°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type C: approx. 0.07°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±4.9 K ≈ ±0.21%$_{FSV}$
	@ 55°C ambient temperature	±6.3 K ≈ ±0.27%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type C:

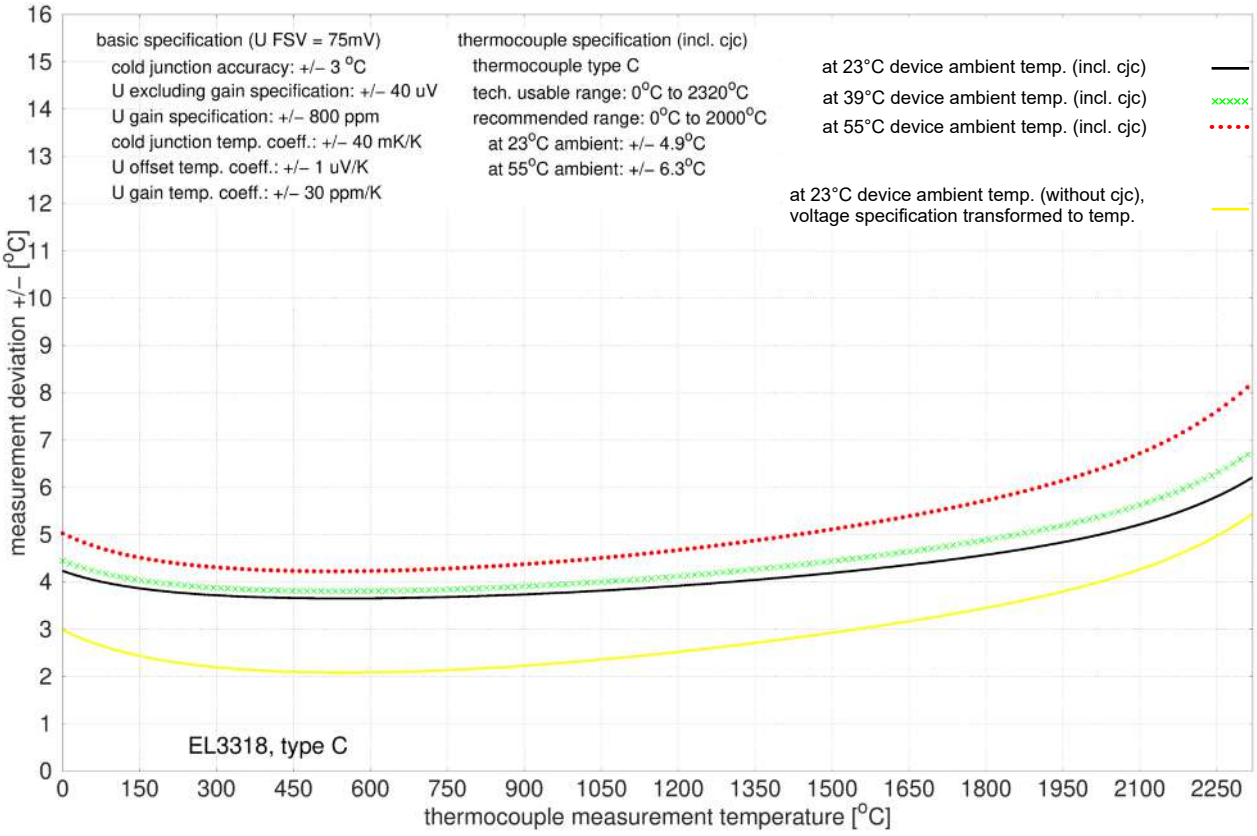


Fig. 9: EL3318, type C

3.2.2.3 Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		±75 mV
Measuring range, technically available		-100°C ≈ -5.237 mV … +1000°C ≈ 76.372 mV
Measuring range, end value (full scale value)		+1000°C
Measuring range, recommended		-100°C…+1000°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type E: approx. 0.03°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.1 K ≈ ±0.31%$_{FSV}$
	@ 55°C ambient temperature	±3.6 K ≈ ±0.36%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type E:

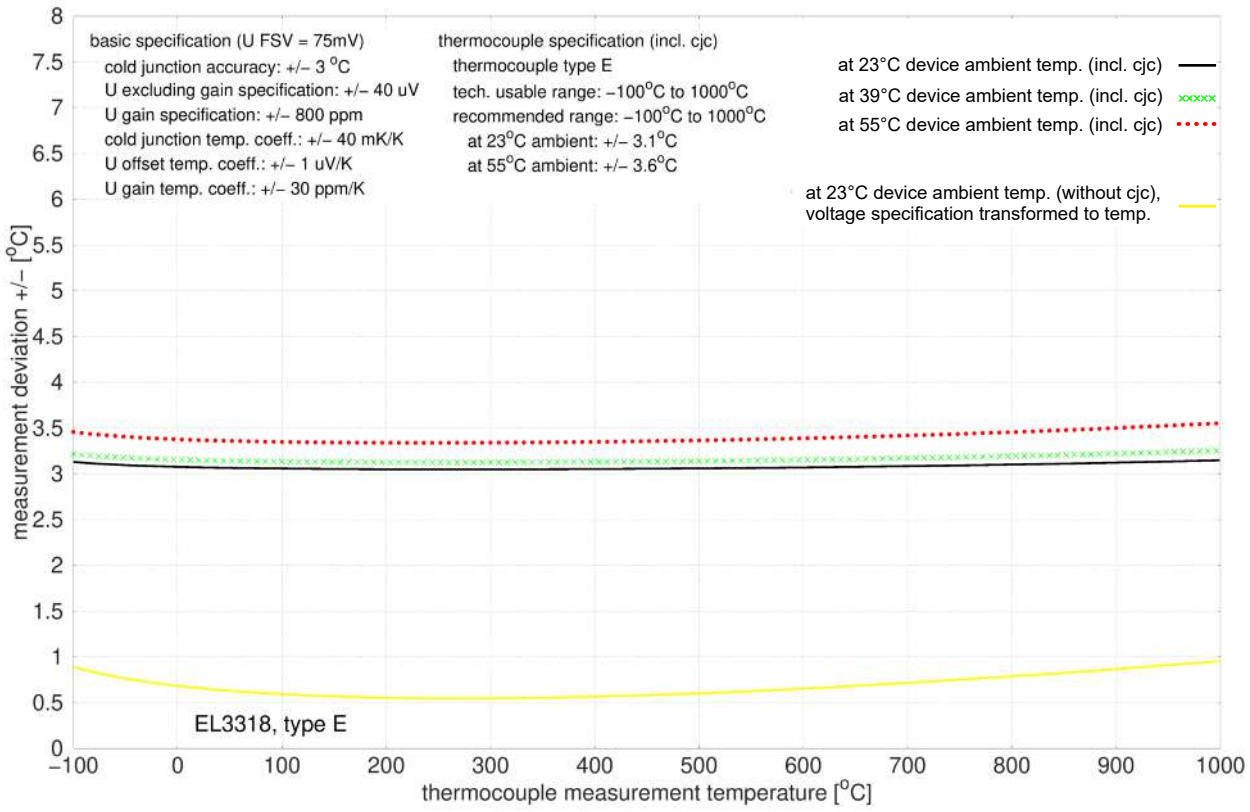


Fig. 10: EL3318, type E

3.2.2.4 Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		±75 mV
Measuring range, technically available		-100°C ≈ -4.632 mV … +1200°C ≈ 69.553 mV
Measuring range, end value (full scale value)		+1200°C
Measuring range, recommended		-100°C…+1200°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type J: approx. 0.04°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.2 K ≈ ±0.27%$_{FSV}$
	@ 55°C ambient temperature	±3.7 K ≈ ±0.31%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type J:

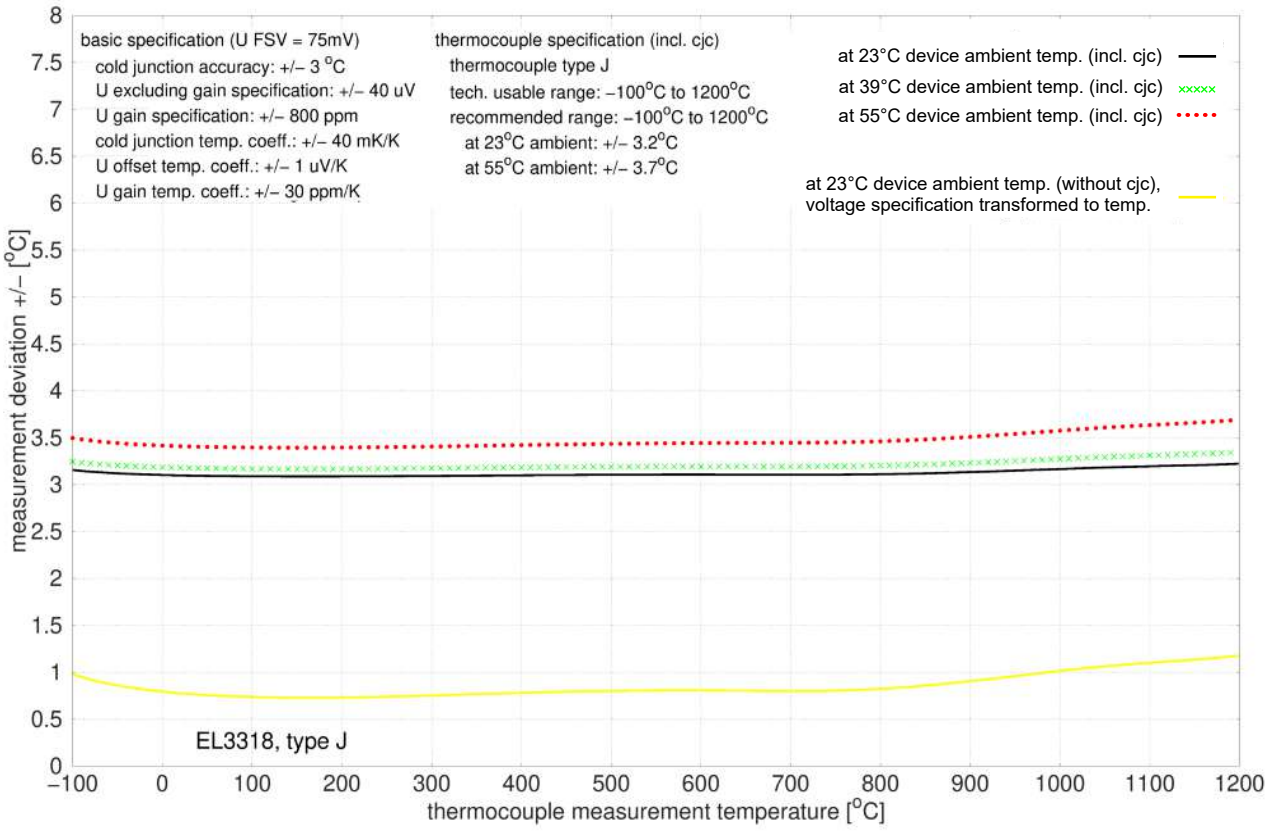


Fig. 11: EL3318, type J

3.2.2.5 Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		±75 mV
Measuring range, technically available		-200°C ≈ -5.891 mV … +1370°C ≈ 54.818 mV
Measuring range, end value (full scale value)		+1370°C
Measuring range, recommended		-100°C…+1200°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type K: approx. 0.04°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.0 K ≈ ±0.22%$_{FSV}$
	@ 55°C ambient temperature	±3.6 K ≈ ±0.26%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type K:

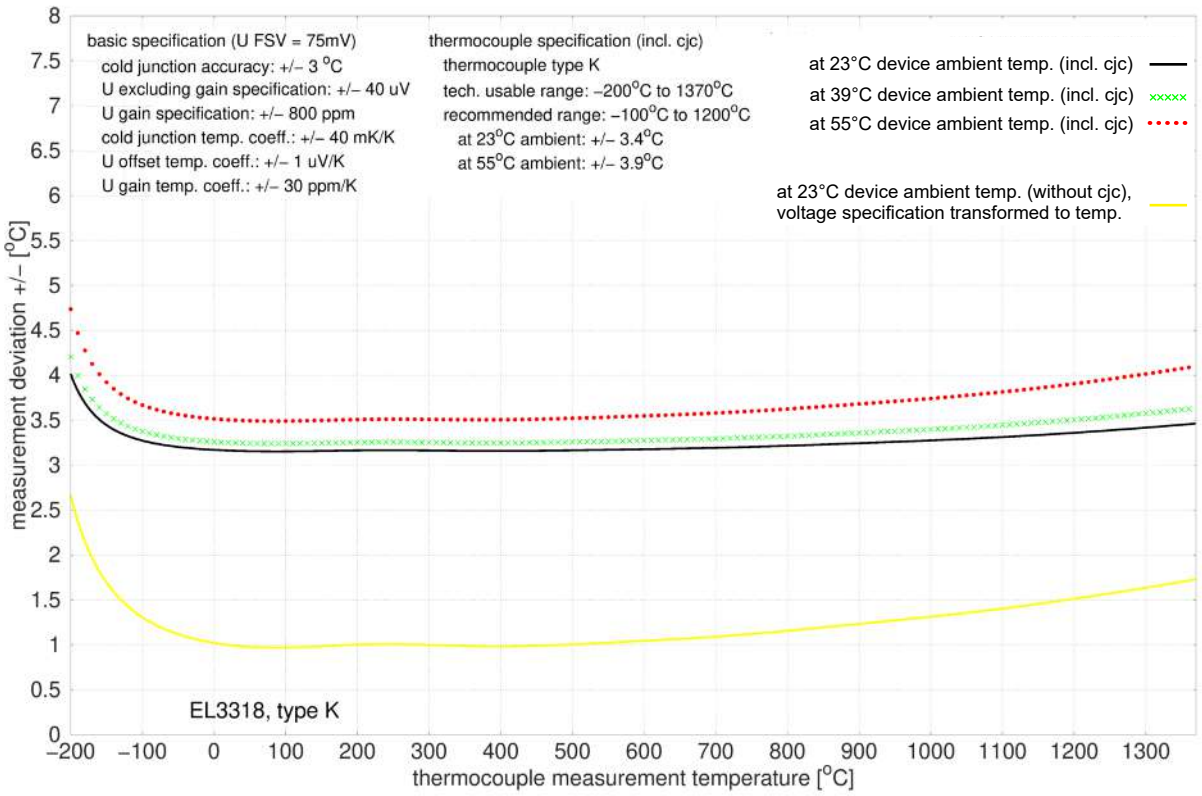


Fig. 12: EL3318, type K

3.2.2.6 Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		±75 mV
Measuring range, technically available		0°C ≈ 0 mV … +900°C ≈ 52.430 mV
Measuring range, end value (full scale value)		+900°C
Measuring range, recommended		0°C…+900°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type L: approx. 0.03°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.1 K ≈ ±0.34%$_{FSV}$
	@ 55°C ambient temperature	±3.5 K ≈ ±0.39%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb}= 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*

Measurement uncertainty for thermocouple type L:

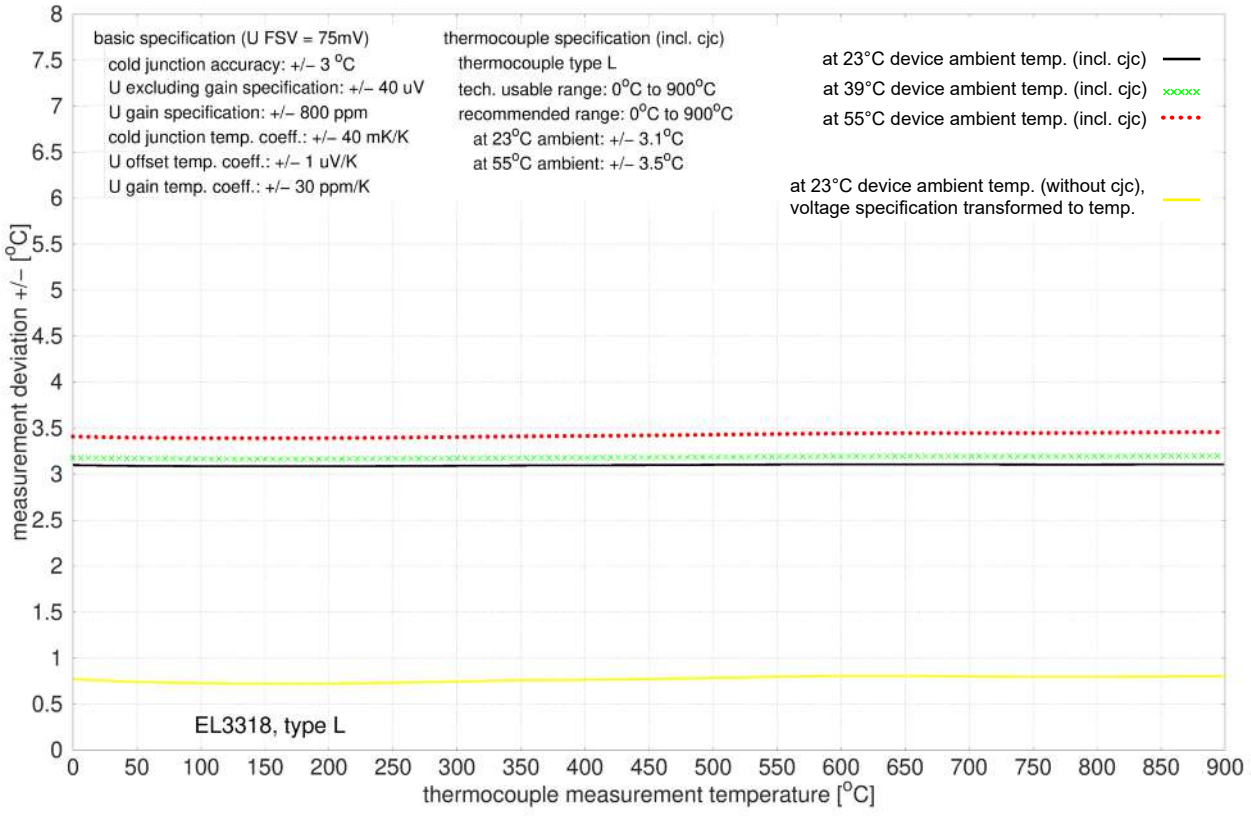


Fig. 13: EL3318, type L

3.2.2.7 Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		±75 mV
Measuring range, technically available		-100°C ≈ -2.406 mV … +1300°C ≈ 47.513 mV
Measuring range, end value (full scale value)		+1300°C
Measuring range, recommended		0°C…+1300°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice** **Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type N: approx. 0.04°C**.
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.4 K ≈ ±0.26%$_{FSV}$
	@ 55°C ambient temperature	±3.8 K ≈ ±0.29%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb}= 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type N:

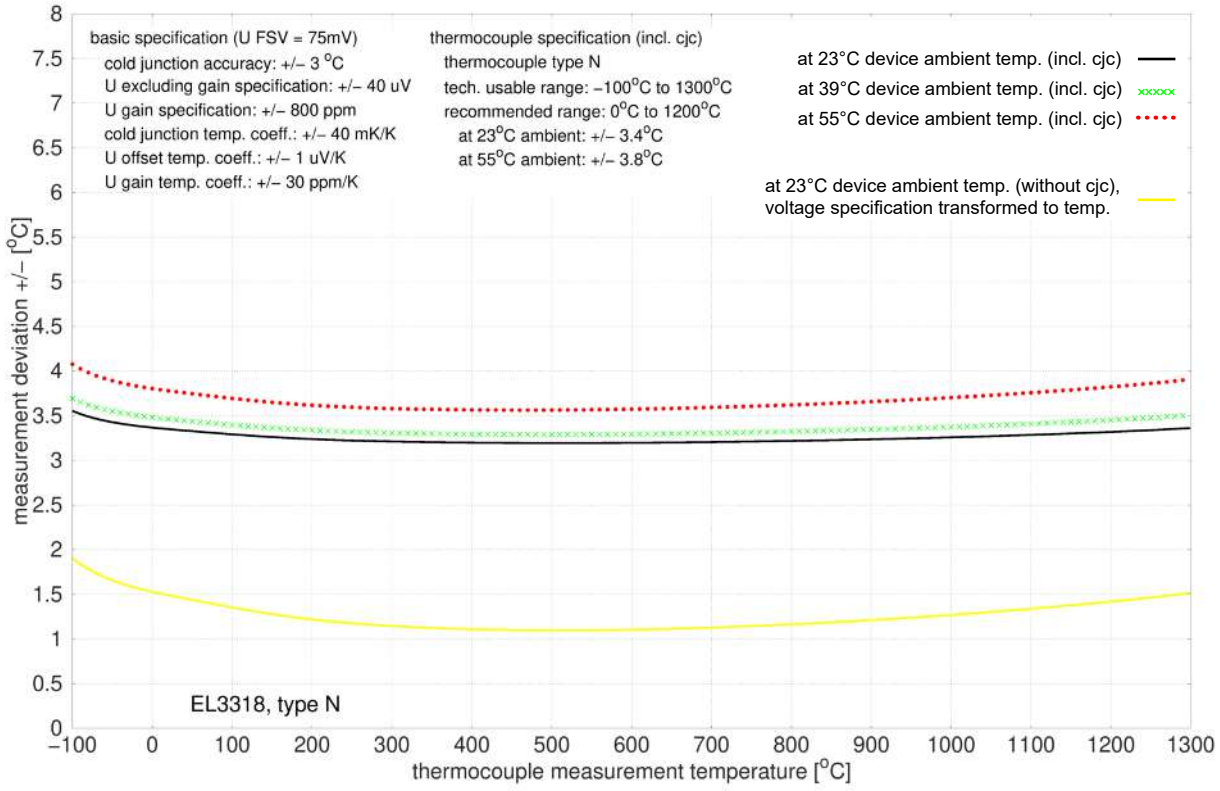


Fig. 14: EL3318, type N

3.2.2.8 Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		±75 mV
Measuring range, technically available		0°C ≈ 0 mV … +1767°C ≈ 21.089 mV
Measuring range, end value (full scale value)		+1767°C
Measuring range, recommended		+250°C…+1700°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type R: approx. 0.05°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±5.2 K ≈ ±0.29%$_{FSV}$
	@ 55°C ambient temperature	±6.4 K ≈ ±0.36%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type R:

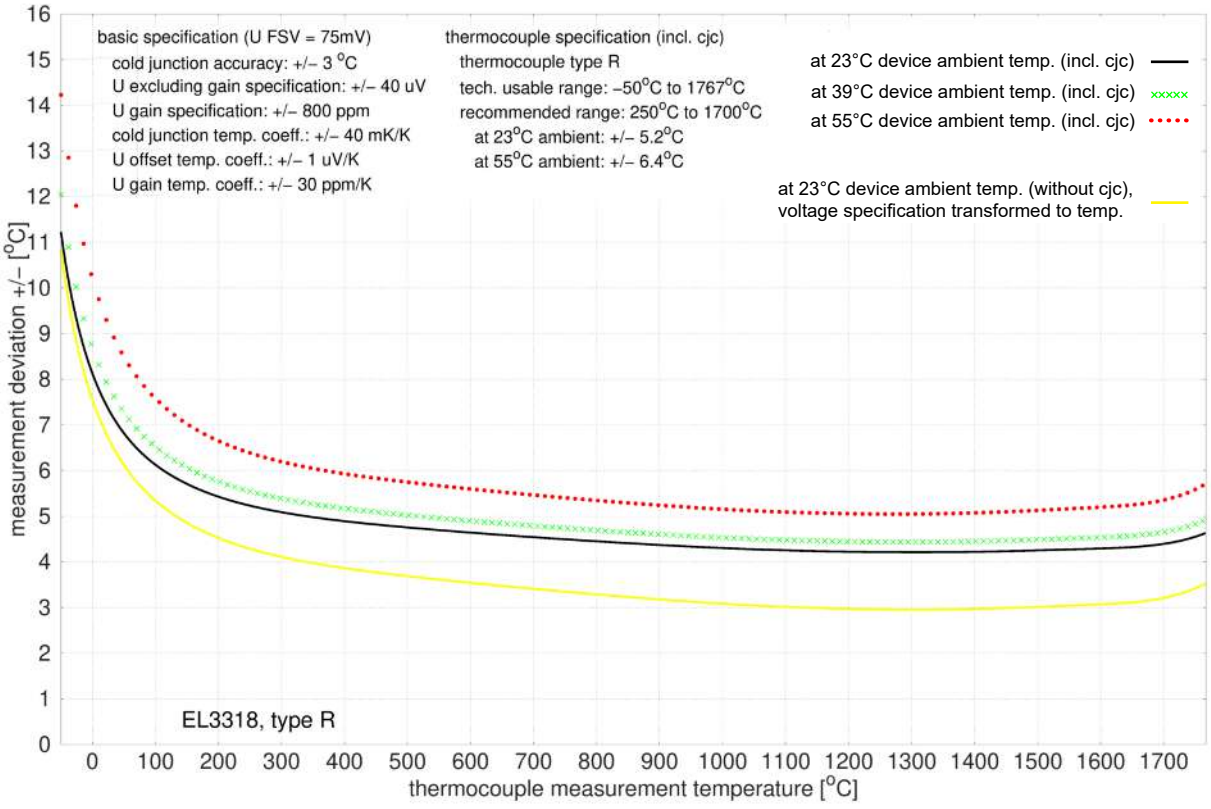


Fig. 15: EL3318, type R

3.2.2.9 Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		±75 mV
Measuring range, technically available		0°C ≈ 0 mV … +1760°C ≈ 17.947 mV
Measuring range, end value (full scale value)		+1760°C
Measuring range, recommended		+250°C…+1700°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice** **Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type S: approx. 0.05°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±5.4 K ≈ ±0.31%$_{FSV}$
	@ 55°C ambient temperature	±6.7 K ≈ ±0.38%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type S:

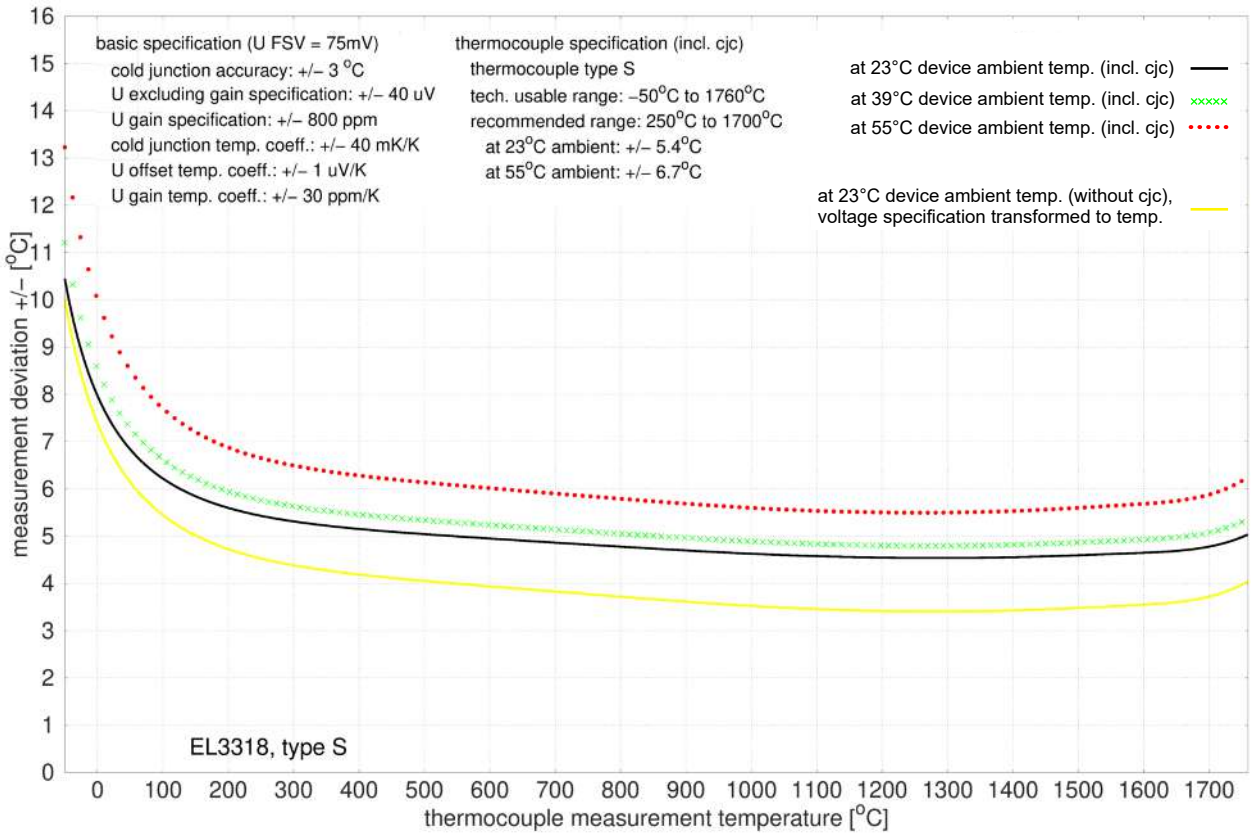


Fig. 16: EL3318, type S

3.2.2.10 Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		±75 mV
Measuring range, technically available		-200°C ≈ -5.603 mV … +400°C ≈ 20.872 mV
Measuring range, end value (full scale value)		+400°C
Measuring range, recommended		-100°C…+400°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.3 K ≈ ±0.83%$_{FSV}$
	@ 55°C ambient temperature	±3.7 K ≈ ±0.93%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb}= 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type T:

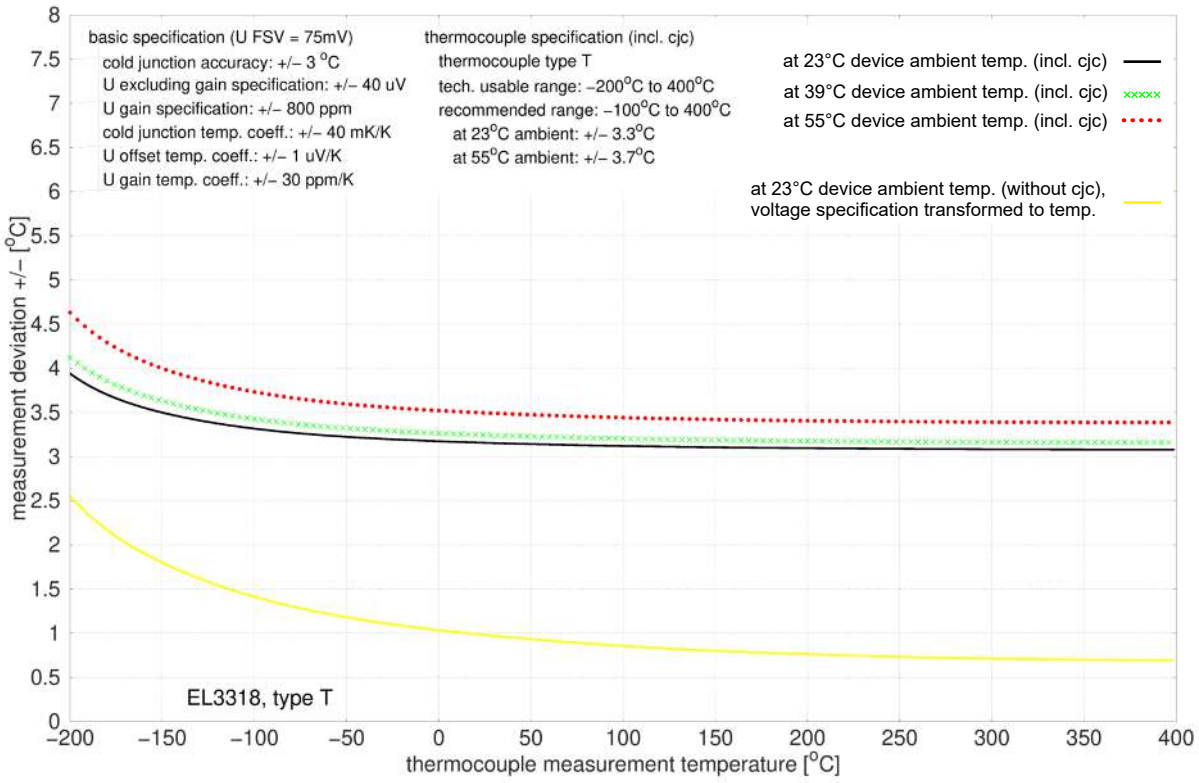


Fig. 17: EL3318, type T

3.2.2.11 Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		±75 mV
Measuring range, technically available		0°C ≈ 0 mV … +600°C ≈ 33.600 mV
Measuring range, end value (full scale value)		+600°C
Measuring range, recommended		0°C…+600°C
PDO LSB		0.1/0.01°C/digit, depending on PDO setting **Notice Internally, the full scale value is calculated with 16 bits, so depending on the thermocouple set, there may be value jumps >0.01°C at "Resolution 0.01°C"; type U: approx. 0.02°C.**
Uncertainty in the recommended measuring range, with averaging	@ 23°C ambient temperature	±3.2 K ≈ ±0.53%$_{FSV}$
	@ 55°C ambient temperature	±3.5 K ≈ ±0.58%$_{FSV}$
Temperature coefficient (change in the measured value when the ambient temperature of the terminals changes)		*Since the value is highly dependent on the sensor temperature, as can be seen in the specification plot shown below, it must basically be derived from the specification plot. For better approximation, the measurement uncertainty at T_{amb} = 39°C as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.*	

Measurement uncertainty for thermocouple type U:

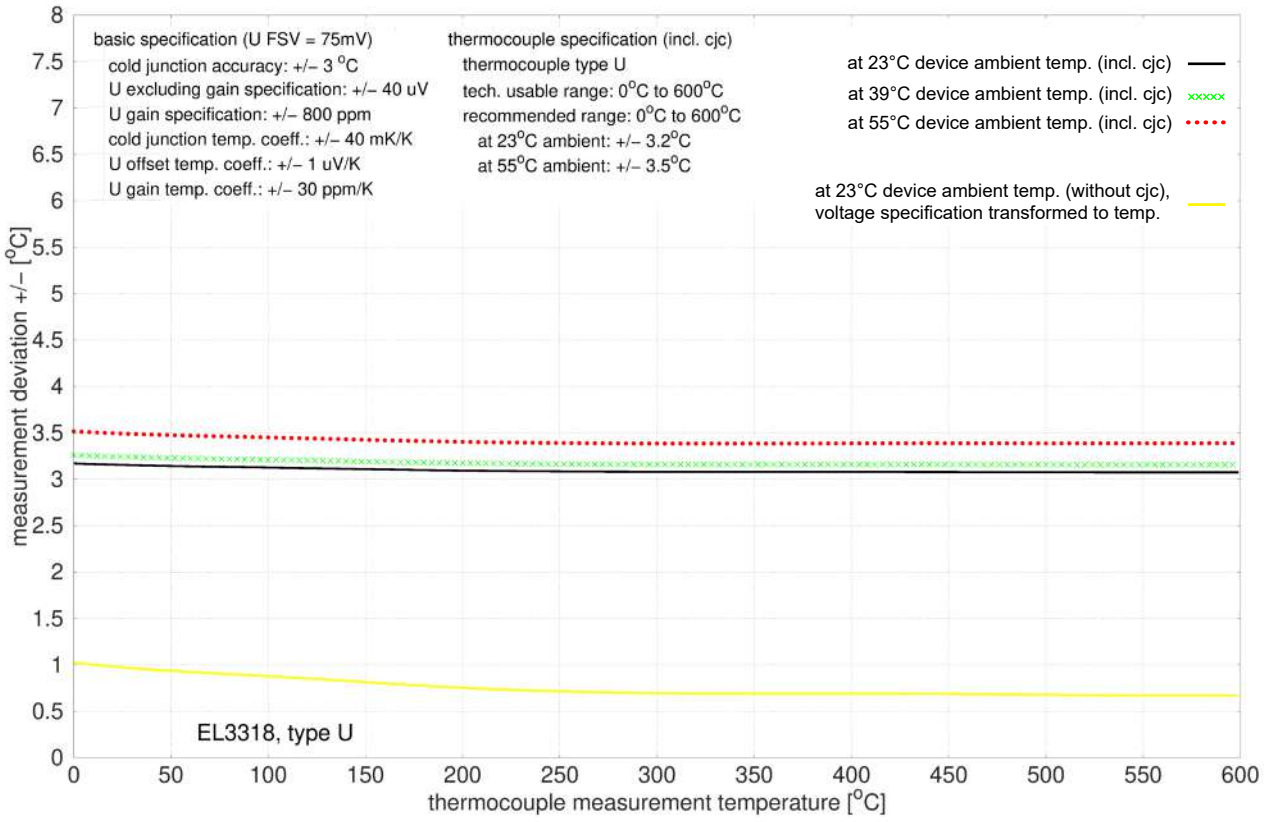


Fig. 18: EL3318, type U

3.3 EJ3318 - Connection

EJ3318				
Pin#		Signal		
1	2	U_{EBUS}	U_{EBUS}	**E-Bus contacts** The power supply U_{EBUS} is provided by the coupler and supplied from the supply voltage U_S of the EtherCAT coupler.
3	4	GND	GND	
5	6	RX0+	TX1+	
7	8	RX0-	TX1-	
9	10	GND	GND	
11	12	TX0+	RX1+	
13	14	TX0-	RX1-	
15	16	GND	GND	
17	18	TC1-	TC1+	**Signals**
19	20	TC2-	TC2+	
21	22	TC3-	TC3+	
23	24	TC4-	TC4+	
25	26	TC5-	TC5+	
27	28	TC6-	TC6+	
29	30	TC7-	TC7+	
31	32	TC8-	TC8+	
33	34	R1- PT1000	R1+ PT1000	
35	36	R2- PT1000	R2+ PT1000	
37	38	NC	NC	**U_P-Contacts**
39	40	SGND	SGND	The device has no U_P-contacts. The power is supplied exclusively via U_{EBUS}.

Signal	Description
U_{EBUS}	E-Bus power supply 3.3 V
GND	E-Bus GND signal. Don't connect with 0V Up!
RXn+	Positive E-Bus receive signal
RXn-	Negative E-Bus receive signal
TXn+	Positive E-Bus transmit signal
TXn-	Negative E-Bus transmit signal
TC1-...TC8-	Inputs TC1-...TC8-
TC1+...TC8+	Inputs TC1+...TC8+
R1- PT1000	Input R1-
R2- PT1000	Input R2-
R1+ PT1000	Input R1+
R2+ PT1000	Input R2+
NC	Do not connect
SGND	Shield Ground

Fig. 19: EJ3318 - Connection

The PCB footprint can be downloaded from the Beckhoff homepage.

NOTICE

Damage may result!

- The pins labeled "NC" must not be contacted.
- Before installation and commissioning, please also read the chapters Installation of EJ modules [▶ 38] and Commissioning [▶ 53]!

Earthed thermocouples

Observe for earthed thermocouples: Differential inputs max. ±2 V to ground!

3.4 Notes for installation and commissioning

The accuracy of the TC temperature measurement is directly influenced by the cold junction measurement. Please note the following design guidelines!

- Use high-quality PT1000 thermocouples with low tolerance and position them very close to the TC connection on the "backplane" (or other position where the cold junction is located).
- Parasitic resistances in the RTD circuit, such as poor connections or long cables, should be avoided; approx. +3 Ω → +1°C applies.
- Covering the signal lines with SGND on both sides improves immunity to EMC interference.
- Avoid excessive external heating (e.g. near transformers) or cooling (e.g. air flow) of the PT1000 sensor, which lead to a significant temperature difference between the sensor and the connector of the TC elements.
- The cable can be adjusted using the indices

  ⇨ 0x8040:1B and 0x8050:1B "wire calibration 1/32 Ohm" (for 4-channel modules)

  ⇨ 0x8080:1B and 0x8090:1B "wire calibration 1/32 Ohm" (for 8-channel modules)

Notes on measuring the cold junction temperature

The measurement and calculation of the correct temperature with TC elements requires the additional measurement of the so-called cold junction temperature (CJC). The cold junction temperature is measured by two RTDs. These are positioned very close to the thermocouple connection on the "backplane" (setting the TC material copper).

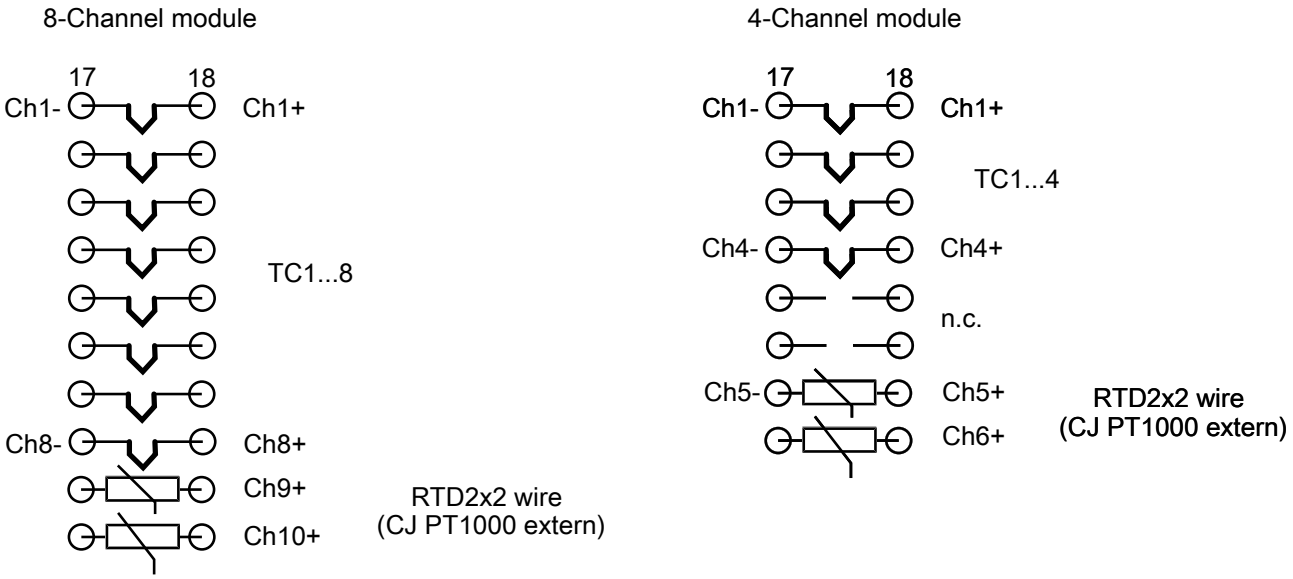


Fig. 20: TC/ RTD connections on the "backplane"

Examples:

1. An isothermal block → all TC connections on the "backplane" are located close together in one place and therefore have the same temperature:
   - one RTD is sufficient; any other TC can be referenced to RTD1.

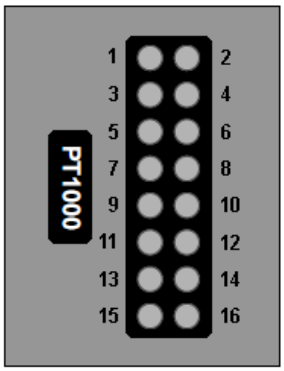


Fig. 21: An isothermal block

2. Two isothermal blocks with different temperatures and each with its own RTD:
   - the number of TCs on one and the other block can be freely selected, e.g. for EJ3318 TCs 1-3-4-7-8 close to RTD1 and TCs 2-5-6 close to RTD2.
3. If there is a temperature gradient across the connected connections of the TCs,
   - an average temperature can be calculated by the PLC and provided in the process data. In this case, the TC channels should be referenced as follows
     - for the 4-channel module, TC channels 1..2 on CJ1 and TC channels 3..4 on CJ2
     - for the 8-channel module 1..4 on CJ1 and the TC channels 5..8 on CJ2

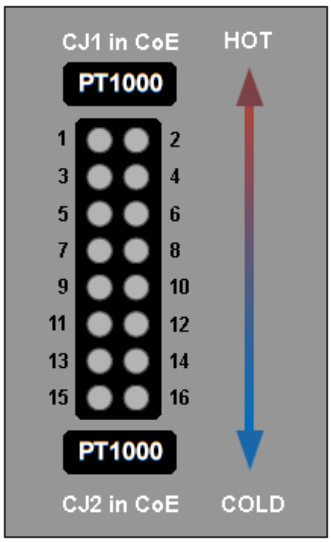


Fig. 22: Temperature gradient across the connected connections of the TCs

4. If necessary, the TC channels can be routed to two different TC connectors. Follow the rules mentioned above!

Fig. 23: Routing of the TCs to two different TC connectors using the example of EJ3318

Setting the cold junction compensation

intern RTD Ch1 is set for each channel, the assignment can be selected separately for each channel in index 0x80n0:0C (n=0: channel 1 ... n=7: channel 8, depending on the number of channels).

8000:0	TC Settings Ch.1	RW	> 25 <
8000:01	Enable user scale	RW	FALSE
8000:02	Presentation	RW	signed (0)
8000:05	Siemens bits	RW	FALSE
8000:06	Enable filter	RW	FALSE
8000:0A	Enable user calibration	RW	FALSE
8000:0B	Enable vendor calibration	RW	TRUE
8000:0C	Coldjunction compensation	RW	intern RTD Ch1 (0)
8000:11	User scale offset	RW	0
8000:12	User scale gain	RW	65536
8000:15	Filter settings	RW	50 Hz (0)
8000:17	User calibration offset	RW	0
8000:18	user calibration gain	RW	0xFFFF (65535)
8000:19	TC Element	RW	K -200...1370°C (0)

Fig. 24: TC Settings using the example of channel 1, index 0x8000:0C

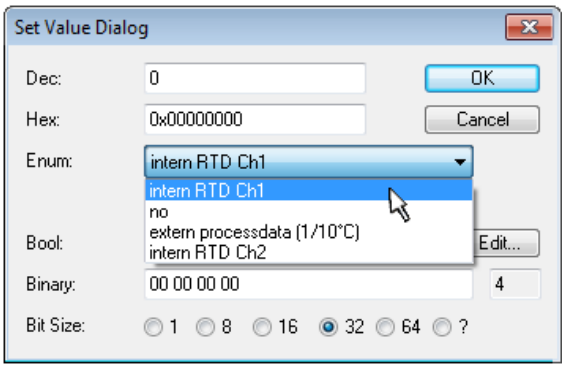


Fig. 25: CJC selection dialog

Name	Value	Description
intern RTD Ch1	0_{dec}	Cold junction compensation is carried out via *intern RTD Ch.1* of the module (default).
no	1_{dec}	Cold junction compensation is not active.
extern procecssdata (1/10°C)	2_{dec}	Cold junction compensation is carried out via the process data 0x160n (n=0: channel 1 ... n=7: channel 8, depending on the number of channels). These must then be mapped via the PDO assignment.
intern RTD Ch2	3_{dec}	Cold junction compensation is carried out via *intern RTD Ch.2* of the module.

Other settings:

1. Filter: the index 0x8000:15 applies to all channels, pre-set 50 Hz
2. Index 0x80n0:19 - Setting the TC element separately for each channel

3.5 LEDs

LED No.	EJ3318
A	RUN
B	
C	
1	ERR 1
2	ERR 2
3	ERR 3
4	ERR 4
5	ERR 5
6	ERR 6
7	ERR 7
8	ERR 8
9	ERR 9
10	ERR 10
11	
12	
13	
14	
15	
16	

Fig. 26: EJ3318 - LEDs

LED	Color	Description	
RUN	green	off	State of the EtherCAT State Machine: **INIT** = initialization of the module
		flashing	State of the EtherCAT State Machine: **PREOP =** function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = Check the channels of the Sync-Manager and the Distributed Clocks (if supported)
		on	State of the EtherCAT State Machine: **OP =** normal operating state; mailbox and process data communication are possible
		flickering	State of the EtherCAT State Machine: **BOOTSTRAP** = Function for firmware updates of the module

LED	Color	Display	State	Description
ERR 1 ... 8	red	off	-	No error
		on	-	Error TC 1 ... 8
ERR 9	red	off	-	No error
		on	-	Error 9 CJC PT1000
ERR 10	red	off	-	No error
		on	-	Error 10 CJC PT1000

4 Installation of EJ modules

4.1 Power supply for the EtherCAT plug-in modules

⚠ WARNING

Power supply from SELV / PELV power supply unit!

SELV / PELV circuits (safety extra-low voltage / protective extra-low voltage) according to IEC 61010-2-201 must be used to supply this device.

Notes:

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

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

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

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

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

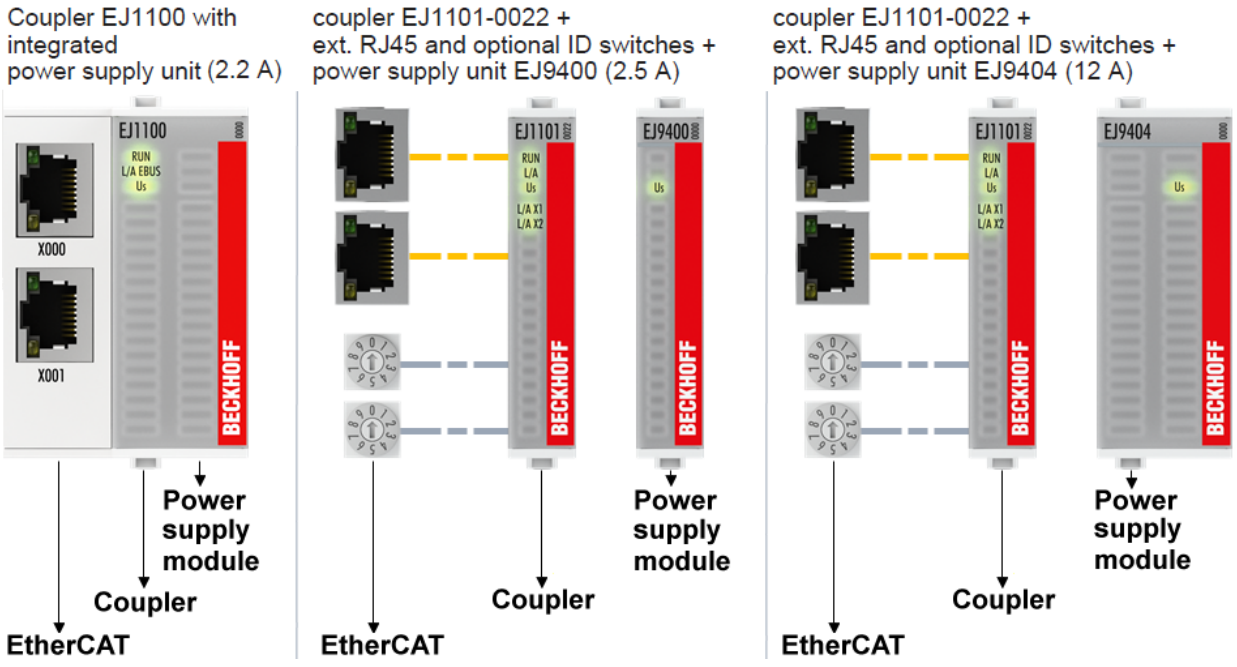


Fig. 27: E-bus power supply with EJ1100 or EJ1101-0022 + EJ940x

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

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

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

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

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

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

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

Fig. 28: PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

4.2 Note on load voltage supply

⚠ WARNING

Load voltage supply

Some devices permit an additional load voltage, e.g. 48 V DC, to be connected for the operation of a motor. In order to avoid stray currents on the protective conductor during operation, EN 60204-1:2018 provides for the possibility that the negative pole of the load voltage does not necessarily have to be connected to the protective conductor system (SELV).
Therefore, the load voltage supply should be designed as an SELV supply.

4.3 EJxxxx - dimensions

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

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

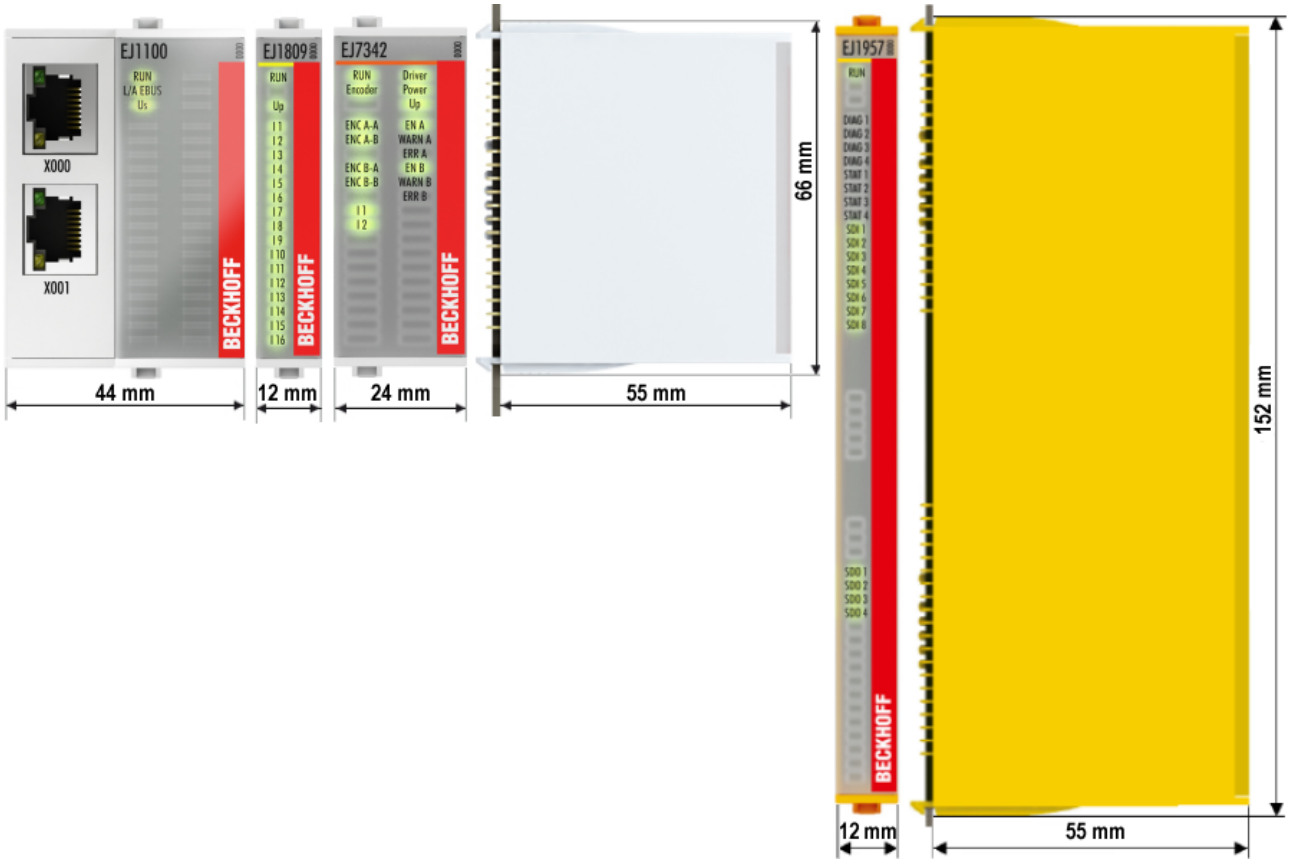


Fig. 29: EJxxxx - Dimensions

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

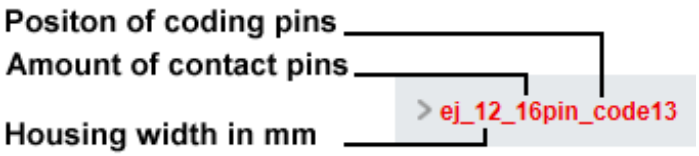


Fig. 30: Naming of the technical drawings

4.4 Installation positions and minimum distances

4.4.1 Minimum distances for ensuring installability

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

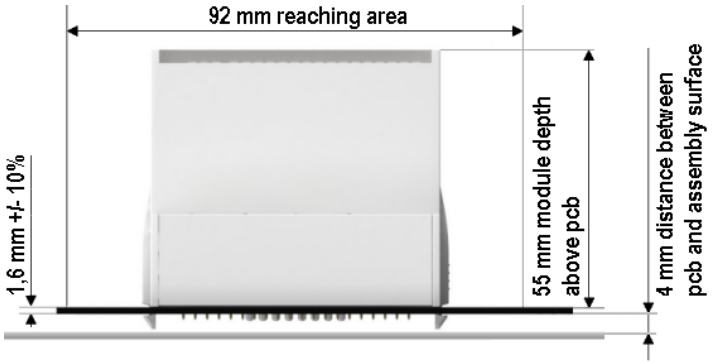


Fig. 31: Mounting distances EJ module - PCB

Observing the reaching area

A minimum reaching area of 92 mm is required for assembly / disassembly, in order to be able to reach the mounting tabs with the fingers.
Adherence to the recommended minimum distances for ventilation (see section Installation position [▶ 42]) ensures an adequate reaching area.

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

4.4.2 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

Please refer to the technical data [▶ 18] for the installed components to ascertain whether any restrictions regarding the mounting position and/or the operating temperature range have been specified. During installation of modules with increased thermal dissipation, ensure adequate distance above and below the modules to other components in order to ensure adequate ventilation of the modules during operation!

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

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

Optimum installation position (standard)

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

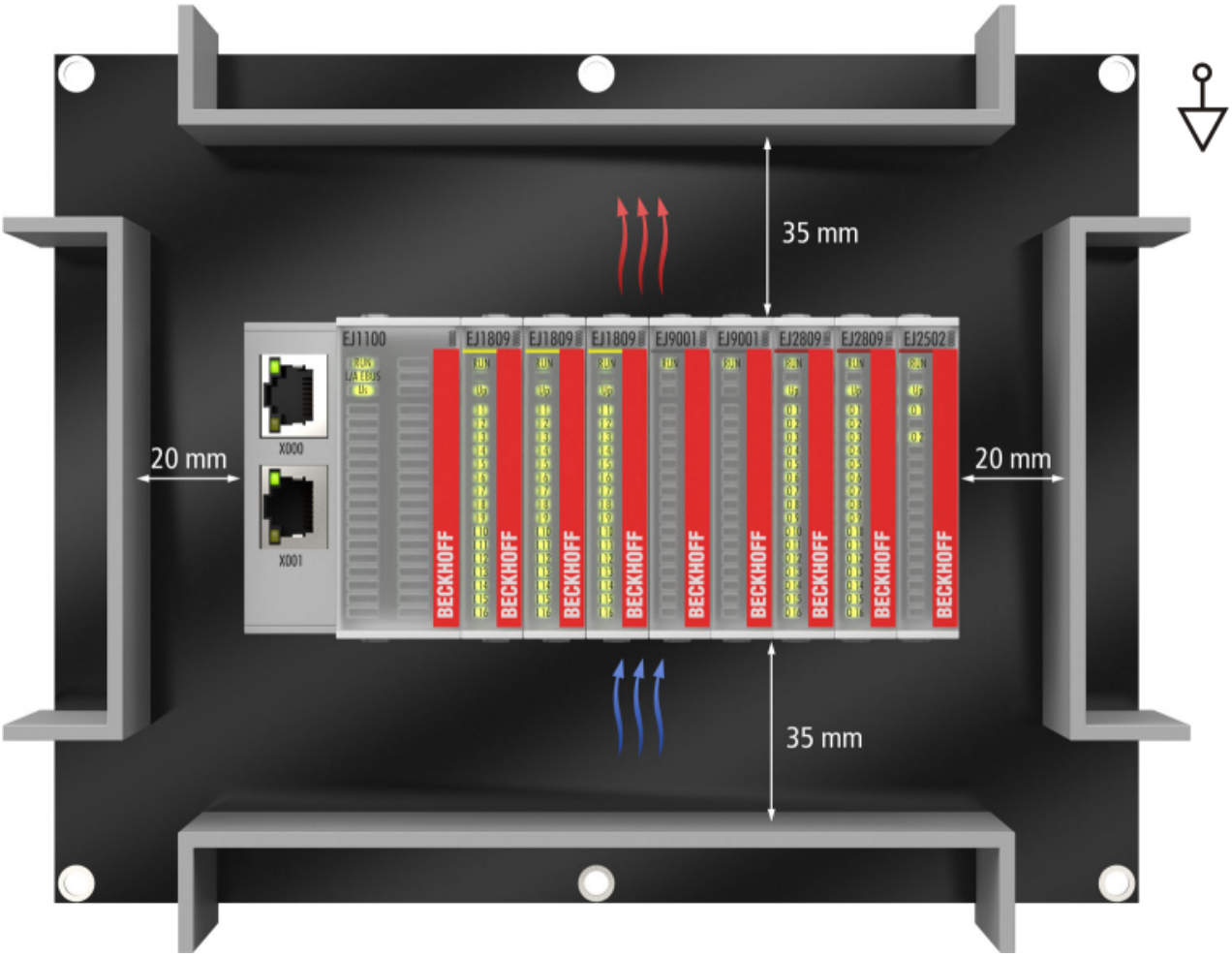


Fig. 32: Recommended distances for standard installation position

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

Other installation positions

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

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

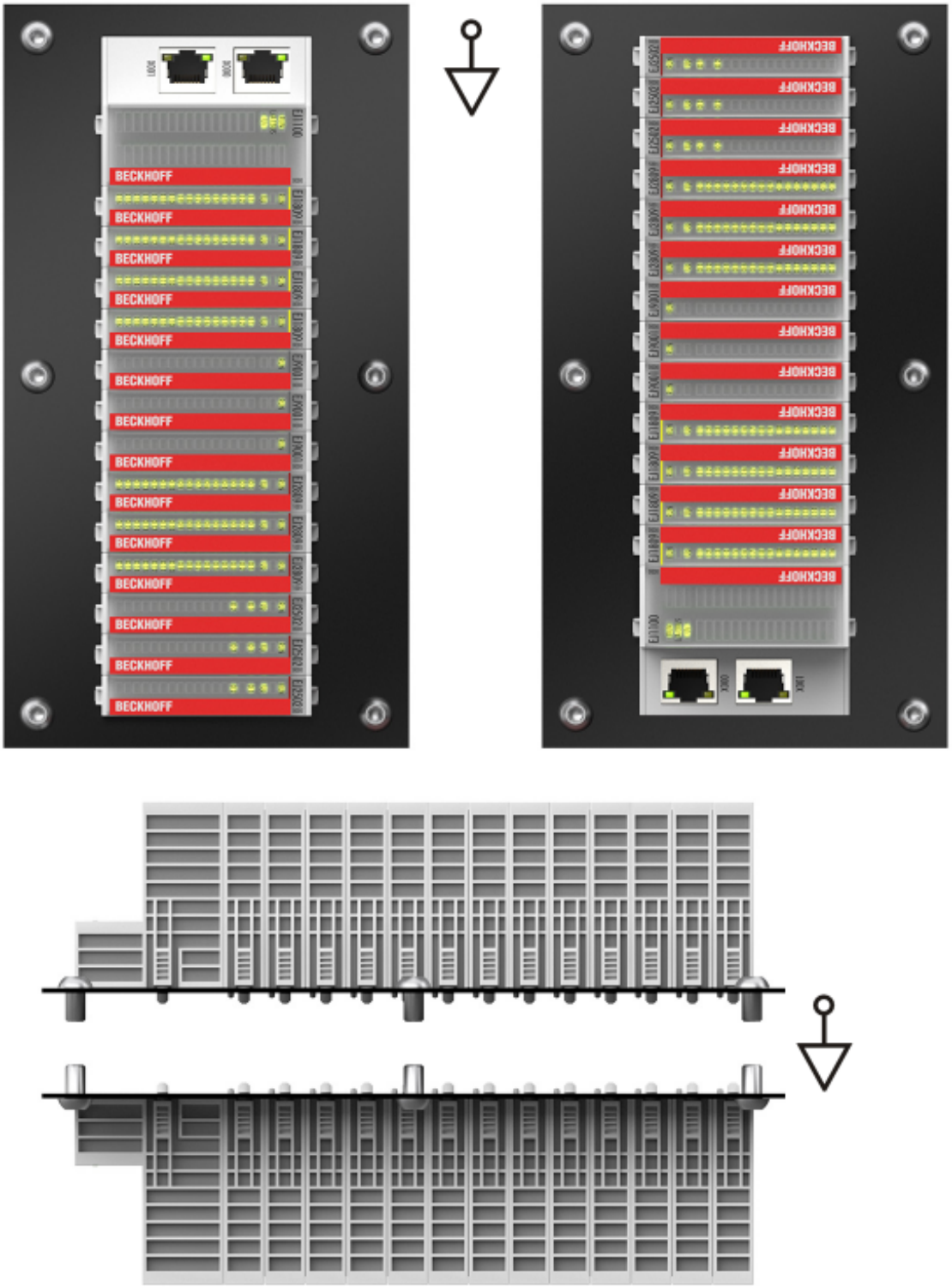


Fig. 33: Other installation positions

4.5 Codings

4.5.1 Color coding

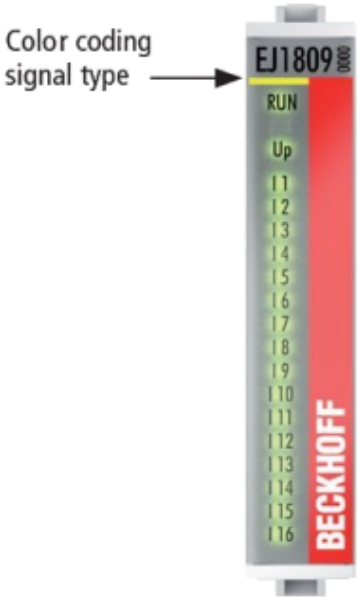


Fig. 34: EJ modules color code; sample: EJ1809

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

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

4.5.2 Mechanical position coding

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

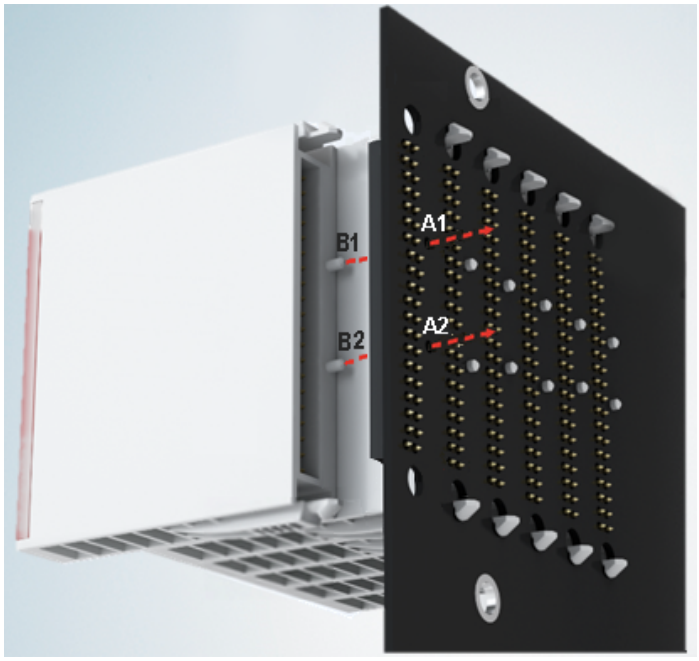


Fig. 35: Mechanical position coding with coding pins (B1 and B2) and coding holes (A1 and A2)

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

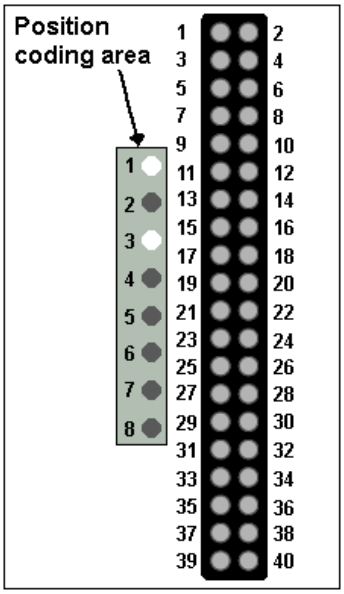


Fig. 36: Pin coding; sample: digital input modules

4.6 Installation on the signal distribution board

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

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

⚠ WARNING

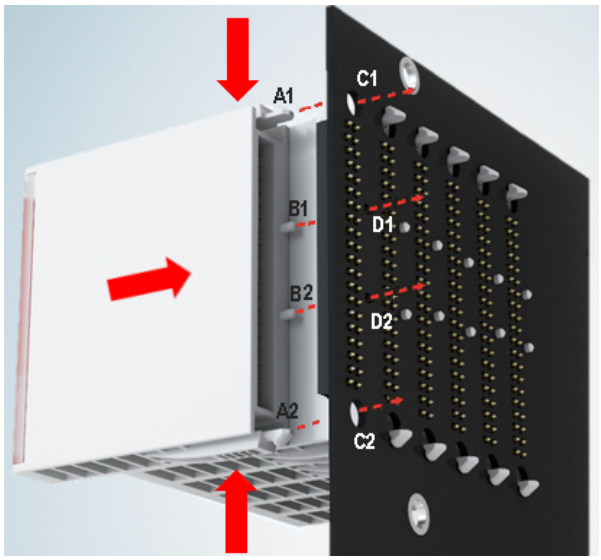
Risk of injury through electric shock and damage to the device!

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

NOTICE

Risk of damage to components through electrostatic discharge!

Observe the regulations for ESD protection.



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

Installation of EJ modules

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

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

NOTICE

Ensure safe latching of the modules on the signal distribution board

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

⇨ loss of quality of the transferred signals,

⇨ increased power dissipation of the contacts,

⇨ impairment of the service life.

4.7 Extension options

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

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

4.7.1 Using placeholder modules for unused slots

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

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

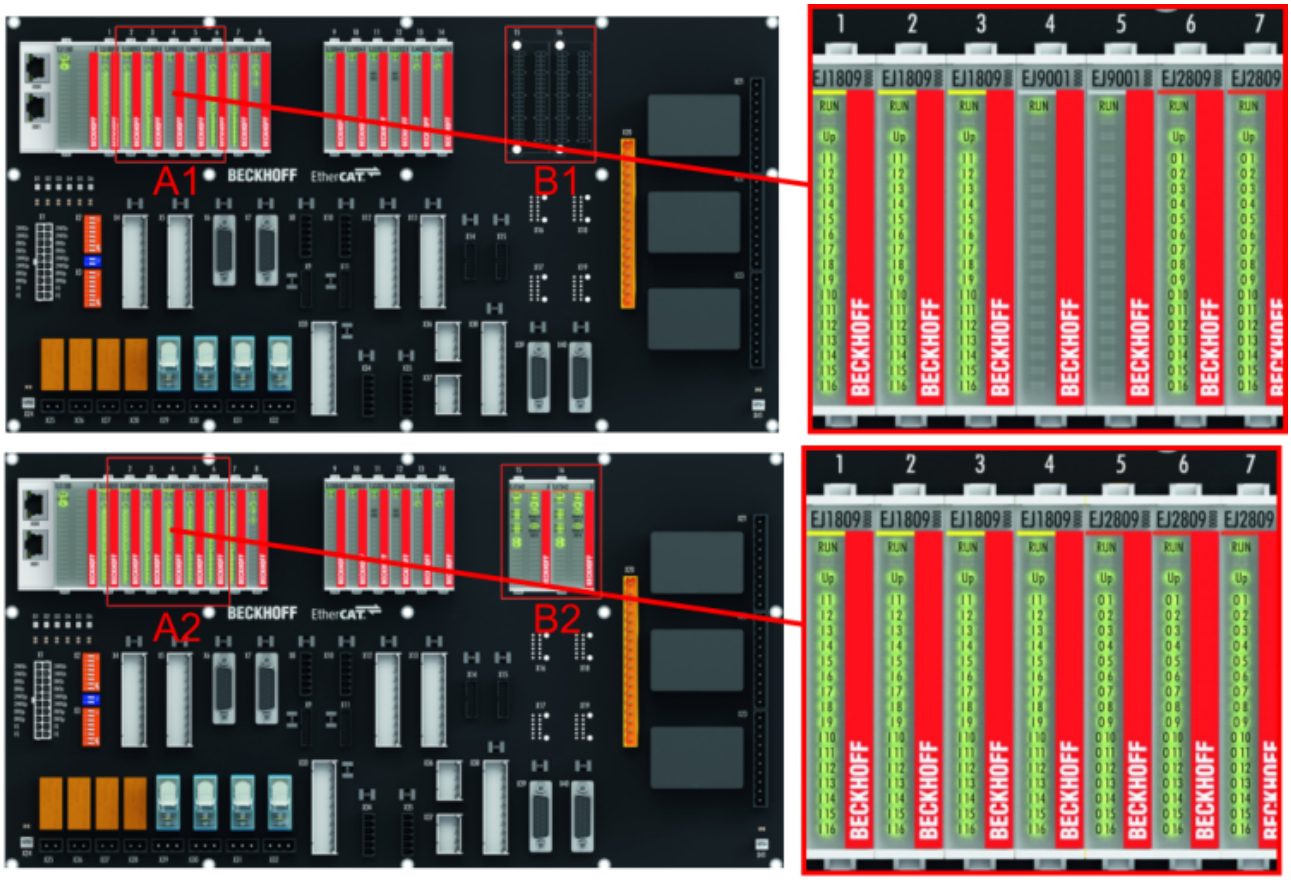


Fig. 37: Sample: Exchanging placeholder modules and assigning reserve slots

E-bus supply

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

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

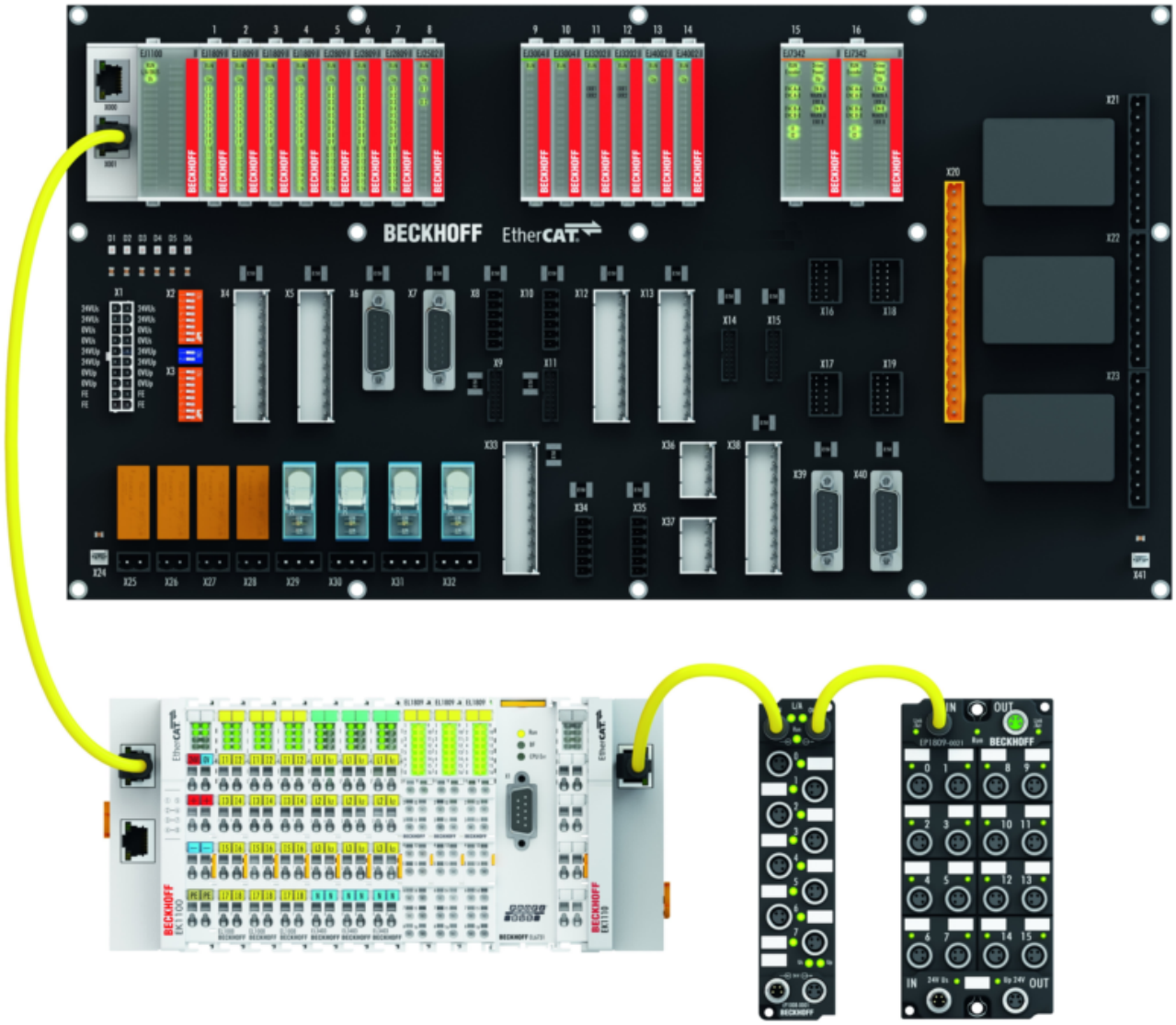


Fig. 38: Example of extension via an Ethernet/EtherCAT connection

4.8 IPC integration

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

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

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

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

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

Fig. 39: Example PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

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

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

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

NOTICE

Positioning on the signal distribution board

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

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

Fig. 40: Example for the connection of a C6015 IPC to an EJ system

4.9 Disassembly of the signal distribution board

⚠ WARNING

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

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

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

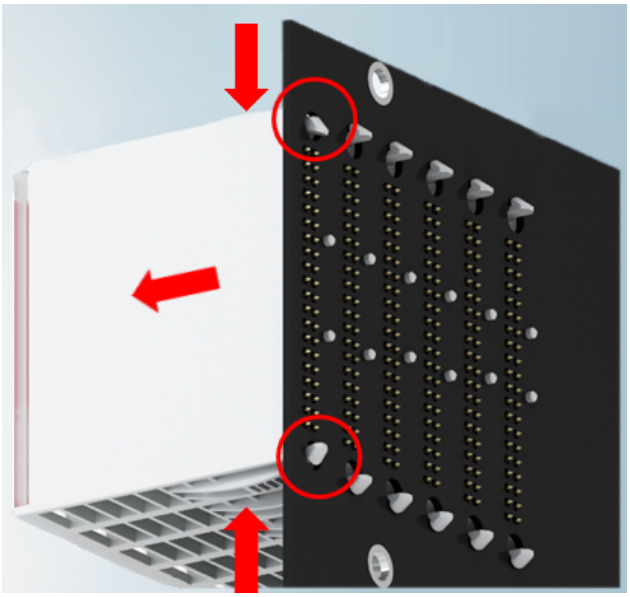


Fig. 41: Disassembly of EJ modules

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

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

4.10 Disposal

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

5 EtherCAT basics

Please refer to the EtherCAT System Documentation for the EtherCAT fieldbus basics.

6 Commissioning

6.1 Note on documentation for the EL331x

Detailed documentation on the commissioning of the EJ3318 module is being prepared.

NOTICE	
	**Damage to devices or loss of data** The descriptions and notes on the commissioning of the EL3318 EtherCAT Terminal are transferable to the EJ3318 EtherCAT plug-in module. Before commissioning, read the detailed description of the process data, operating modes and parameterization in the EL331x documentation.

7 EJ3318 - Object description and parameterization

EtherCAT XML Device Description

The display matches that of the CoE objects from the EtherCAT XML Device Description. We recommend downloading the latest XML file from the download area of the Beckhoff website and installing it according to installation instructions.

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

The EtherCAT device is parameterized via the CoE - Online tab (with a double click on the respective object) or via the Process Data tab (assignment of PDOs). A detailed description can be found in the EtherCAT System-Documentation in chapter “EtherCAT subscriber configuration”

Please note the general CoE notes in the EtherCAT System Documentation in chapter “CoE-interface” when using/manipulating the CoE parameters:
- Keep a startup list if components have to be replaced
- Differentiation between online/offline dictionary,
- existence of current XML description
- use "CoE reload" for resetting changes

Introduction

The CoE overview contains objects for different purposes of use:

- Objects required for parameterization [▶ 55] and profile-specific objects [▶ 57] required during commissioning
- Objects for indicating internal settings [▶ 59] (may be fixed)

The following section first describes the objects required for normal operation, followed by a complete overview of missing objects.

7.1 Restore object

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	Restore default parameters	UINT8	RO	0x01 (1_{dec})
1011:01	SubIndex 001	If this object is set to **"0x64616F6C"** in the set value dialog, all backup objects are reset to their delivery state.	UINT32	RW	0x00000000 (0_{dec})

7.2 Configuration data

Index 80n0 TC settings for 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n0:01	Enable user scale	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
80n0:02	Presentation	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C)	BIT3	RW	0x00 (0_{dec})
80n0:05	Siemens bits	The S5 bits are superimposed on the three low-order bits (value 0x60n0:11) Bit 0 = 1 ("overrange" or "underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:06	Enable filter	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
80n0:0C	Coldjunction compensation	0: internal 1: no Cold junction compensation is not active 2: Extern process data Cold junction compensation takes place via the process data (resolution [1/10]°C)	BIT2	RW	0x00 (0_{dec})
80n0:11	User scale offset	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n0:12	User scale gain	This is the user scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n0:15	Filter settings	This object determines the digital filter settings, if it is active via Enable filter (index 80n0:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:17	User calibration offset	User offset calibration	UINT16	RW	0x0000 (0_{dec})
80n0:18	User calibration gain	User gain compensation	UINT16	RW	0xFFFF (65535_{dec})
80n0:19	TC element	Thermocouple Implemented temperature range 0: K, -200°C to 1370°C 1: J, -100°C to 1200°C 2: L, 0°C to 900°C 3: E, -100°C to 1000°C 4: T, -200°C to 400°C 5: N, -100°C to 1300°C 6: U, 0°C to 600 °C 7: B, 200°C to 1820°C 8: R, -50°C to 1767°C 9: S, -50°C to 1766°C 10: C, 0°C to 2320°C 100: +/-30mV (1µV resolution) 101: +/-60mV (2µV resolution) 102: +/-75mV (4µV resolution)	UINT16	RW	0x0000 (0_{dec})

The filter characteristics are set via index 0x8000:15 [▶ 55]

The filter frequencies are set for all channels of the module centrally via index 0x8000:15 (channel 1). All other corresponding indices 0x80n0:15 have no parameterization function! The latest firmware version (see status table) returns an EtherCAT-compliant error message, if the filter characteristics of other channels (index 0x80n0:06, 0x80n0:15) are set.

Index 8080 RTD Settings Ch. 1

Index (hex)	Name	Bedeutung	Datentyp	Flags	Default
8080:0	RTD Settings Ch1.	Maximum subindex	UINT8	RO	0x1B (27_{dec})
8080:19	RTD element	RTD element 2: PT1000 (-200…850°C) 8: 1/16 Ohm resolution (0..4059 Ohm)	BOOLEAN	RW	0x02 (2_{dec})
8080:1A	Connection technology	Permitted values 0: Two-wire connection 3: not connected	BIT3	RW	0x00 (0_{dec})
8080:1B	Wire calibration 1/32 Ohm	Offset-value for calibration of supply lines [1/32] Ohm	INT16	RW	0x0000 (0_{dec})

Index 8090 RTD Settings Ch. 2

Index (hex)	Name	Bedeutung	Datentyp	Flags	Default
8090:0	RTD Settings Ch2.	Maximum subindex	UINT8	RO	0x1B (27_{dec})
8090:19	RTD element	RTD element 2: PT1000 (-200…850°C) 8: 1/16 Ohm resolution (0..4059 Ohm)	BOOLEAN	RW	0x02 (2_{dec})
8090:1A	Connection technology	Permitted values 0: Two-wire connection 3: not connected	BIT3	RW	0x00 (0_{dec})
8090:1B	Wire calibration 1/32 Ohm	Offset-value for calibration of supply lines [1/32] Ohm	INT16	RW	0x0000 (0_{dec})

7.3 Profile-specific objects (0x6000-0xFFFF)

The profile-specific objects have the same meaning for all EtherCAT slaves that support the profile 5001.

7.4 Input data

Index 60n0 TC Inputs for 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs Ch.n	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 6080 RTD Inputs Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
6080:0	RTD Inputs Ch.1	Maximum subindex	UINT8	RO	0x11 (17_{dec})
6080:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
6080:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07]) is set	BOOLEAN	RO	0x00 (0_{dec})
6080:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
6080:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6080:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6080:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 6090 RTD Inputs Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
6090:0	RTD Inputs Ch.2	Maximum subindex	UINT8	RO	0x11 (17_{dec})
6090:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
6090:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07]) is set	BOOLEAN	RO	0x00 (0_{dec})
6090:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
6090:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6090:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6090:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

7.5 Output data

Index 70n0 TC Outputs for 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default value
70n0:0	TC Outputs Chn.	Maximum subindex	UINT8	RO	0x11 (17_{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C [▶ 55]), comparison via the process data)	INT16	RO	0x0000 (0_{dec})

7.6 Configuration data vendor specific

Index 80nF TC Vendor data for 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data Ch.n	Maximum subindex	UINT8	RO	0x02 (2_{dec})
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})

Index 808F RTD Vendor data Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
808F:0	RTD Vendor data Ch.1	Maximum subindex	UINT8	RO	0x04 (4_{dec})
808F:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
808F:04	Calibration gain Pt1000	Manufacturer calibration gain Pt1000	UINT16	RW	-

Index 809F RTD Vendor data Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
809F:0	RTD Vendor data Ch.2	Maximum subindex	UINT8	RO	0x04 (4_{dec})
809F:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
809F:04	Calibration gain Pt1000	Manufacturer calibration gain Pt1000	UINT16	RW	-

7.7 Information and diagnostic data

Index 80nE TC Internal data for 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data Ch.n	Maximum subindex	UINT8	RO	0x05 (5_{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	INT32	RO	0x00000000 (0_{dec})
80nE:03	CJ temperature	Cold junction temperature (resolution [1/10]°C)	INT16	RO	0x0000 (0_{dec})
80nE:04	CJ voltage	Cold junction voltage (resolution 1 µV)	INT32	RO	0x00000000 (0_{dec})
80nE:05	CJ resistor	reserved	UINT16	RO	0x0000 (0_{dec})

Index 808E RTD Internal data Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
808E:0	RTD Internal data Ch.1	Maximum subindex	UINT8	RO	0x04 (4_{dec})
808E:01	ADC raw value	ADC raw value	INT32	RO	0x00000000 (0_{dec})
808E:02	Resistor	Resistance (measured value of resistance sensor, resolution 1/256 Ohm)	UINT32	RO	0x00000000 (0_{dec})

Index 809E RTD Internal data Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
809E:0	RTD Internal data Ch.2	Maximum subindex	UINT8	RO	0x04 (4_{dec})
809E:01	ADC raw value	ADC raw value	INT32	RO	0x00000000 (0_{dec})
809E:02	Resistor	Resistance (measured value of resistance sensor, resolution 1/256 Ohm)	UINT32	RO	0x00000000 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x000A (10_{dec})

Index F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default
F008:0	Code word	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Maximum subindex	UINT8	RO	0x0A (10_{dec})
F010:01	Subindex 001	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:02	Subindex 002	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:03	Subindex 003	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:04	Subindex 004	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:05	Subindex 005	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:06	Subindex 006	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:07	Subindex 007	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:08	Subindex 008	Profile 330	INT32	RO	0x0000014A (330_{dec})
F010:09	Subindex 009	Profile 320	INT32	RO	0x00000140 (320_{dec})
F010:0A	Subindex 010	Profile 320	INT32	RO	0x00000140 (320_{dec})

7.8 Standard objects (0x1000-0x1FFF)

The standard objects have the same meaning for all EtherCAT slaves.

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default value
1000:0	Device type	Device type of the EtherCAT slave: the Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default value
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EJ3318

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	00

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	01

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	(0x0CF62852) (217458770_{dez})
1018:03	Revision	Revision number of the EtherCAT slave; • The low word (bit 0-15) indicates the special terminal number, • The high word (bit 16-31) refers to the device description.	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; • Low word (bit 0-15) ◦ The low byte (bit 0-7) of the low word contains the year of production ◦ The high byte (bit 8-15) of the low word contains the week of production, • The high word (bit 16-31) is 0.	UINT32	RO	( )

Index 10F0 Backup parameter handling

Index (hex)	Name	Meaning	Data type	Flags	Default
10F0:0	Backup parameter handling	Information for standardized loading and saving of backup entries	UINT8	RO	0x01 (1_{dec})
10F0:01	Checksum	Checksum across all backup entries of the EtherCAT slave	UINT32	RO	0x00000000 (0_{dec})

Index 160n TC RxPDO-Map für 0 ≤ n ≤ 7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	TC RxPDO-Map Ch.n	PDO Mapping RxPDO n+1	UINT8	RW	0x01 (1_{dez})
160n:01	SubIndex 001	n. PDO Mapping entry (object 0x70n0 (TC Outputs Ch.n+1), entry 0x11 (CJCompensation))	UINT32	RW	0x70n0:11, 16

Index 1A0n TC TxPDO Map for 0 ≤ n ≤7 (Ch. 1 - 8)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TC TxPDO Map Ch.n	PDO Mapping TxPDO 1	UINT8	RW	0x08 (8_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x02 (Overrange))	UINT32	RW	0x60n0:02, 1
1A0n:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:05	SubIndex 005	5. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:06	SubIndex 006	6. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO-State))	UINT32	RW	0x60n0:0F, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 16

Index 1A08 RTD TxPDO-Map Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A08:0	RTD TxPDO Map-Inputs Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x08 (8_{dec})
1A08:01	SubIndex 001	1. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1), entry 0x01 (Underrange))	UINT32	RW	0x6080:01, 1
1A08:02	SubIndex 002	2. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1), entry 0x02 (Overrange))	UINT32	RW	0x6080:02, 1
1A08:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A08:04	SubIndex 004	4. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1), entry 0x07 (Error))	UINT32	RW	0x6080:07, 1
1A08:05	SubIndex 005	5. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A08:06	SubIndex 006	6. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1), entry 0x0F (TxPDO-State))	UINT32	RW	0x6080:0F, 1
1A08:07	SubIndex 007	7. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x6080:10, 1
1A08:08	SubIndex 008	8. PDO Mapping entry (object 0x6080 (RTD Inputs Ch.1) entry 0x11 (Value))	UINT32	RW	0x6080:11, 16

Index 1A09 RTD TxPDO-Map Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A09:0	RTD TxPDO Map-Inputs Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x08 (8_{dec})
1A09:01	SubIndex 001	1. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x01 (Underrange))	UINT32	RW	0x6090:01, 1
1A09:02	SubIndex 002	2. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x02 (Overrange))	UINT32	RW	0x6090:02, 1
1A09:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A09:04	SubIndex 004	4. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x07 (Error))	UINT32	RW	0x6090:07, 1
1A09:05	SubIndex 005	5. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A09:06	SubIndex 006	6. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x0F (TxPDO-State))	UINT32	RW	0x6090:0F, 1
1A09:07	SubIndex 007	7. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x6090:10, 1
1A09:08	SubIndex 008	8. PDO Mapping entry (object 0x6090 (RTD Inputs Ch.2), entry 0x11 (Value))	UINT32	RW	0x6090:11, 16

Index 1C00 Sync manager type

Index (hex)	Name	Meaning	Data type	Flags	Default
1C00:0	Sync manager type	Using the Sync Managers	UINT8	RO	0x04 (4_{dec})
1C00:01	SubIndex 001	Sync-Manager Type Channel 1: Mailbox Write	UINT8	RO	0x01 (1_{dec})
1C00:02	SubIndex 002	Sync-Manager Type Channel 2: Mailbox Read	UINT8	RO	0x02 (2_{dec})
1C00:03	SubIndex 003	Sync-Manager Type Channel 3: Process Data Write (Outputs)	UINT8	RO	0x03 (3_{dec})
1C00:04	SubIndex 004	Sync-Manager Type Channel 4: Process Data Read (Inputs)	UINT8	RO	0x04 (4_{dec})

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0A (10_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C32:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A05 (6661_{dec})
1C13:07	Subindex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:08	Subindex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A07 (6663_{dec})
1C13:09	Subindex 009	9. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A08 (6664_{dec})
1C13:0A	Subindex 010	10. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A09 (6665_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 2 event • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event	UINT16	RW	0x0000 (0_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: output shift with SYNC1 event (DC mode only) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0xC001 (49153_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 Event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time	Minimum time between SYNC1 event and output of the outputs (in ns, DC mode only) 0 because DC mode is not supported by EJ3318	UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06, 0x1C33:09 [▶ 64] are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and reading of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 [▶ 63] or 0x1C33:08)	UINT16	RO	0xC001 (49153_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time	Minimum time between Sync1 Event and reading of the inputs (in ns, DC mode only) 0 because DC mode is not supported by EJ3318			
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09 [▶ 63], 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values.. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Maximum delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

8 Appendix

8.1 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Support

The Beckhoff Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

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web:	www.beckhoff.com/support

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