

Documentation | EN

EL331x-00x0

EtherCAT Terminals, analog input, temperature, thermocouple



EtherCAT®

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1 Foreword

1.1 Product overview Analog Thermocouple Input Terminals

[EL3311](#) [[▶ 18](#)]

1-channel input terminal for thermocouples

[EL3312](#) [[▶ 36](#)]

2-channel input terminal for thermocouples

[EL3314](#) [[▶ 54](#)]

4-channel input terminal for thermocouples

[EL3314-0002](#) [[▶ 73](#)]

4-channel input terminal, thermocouple, high-precision, electrically isolated

[EL3314-0010](#) [[▶ 92](#)]

4-channel input terminal for thermocouples, high-precision

[EL3314-0030](#) [[▶ 111](#)]

4-channel input terminal for thermocouples, high-precision, with [external calibration certificate](#) [[▶ 187](#)]

[EL3314-0090](#) [[▶ 130](#)]

4-channel input terminal for thermocouples, TwinSAFE Single Channel

[EL3314-0092](#) [[▶ 149](#)]

4-channel input terminal, thermocouple, high-precision, electrically isolated, TwinSAFE Single Channel

[EL3318](#) [[▶ 167](#)]

8-channel HD input terminal for thermocouples

1.2 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.

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1.3 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 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)	<ul style="list-style-type: none"> • System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
I/O Analog Manual (PDF)	Notes on I/O components with analog in and outputs
Application guide TwinSAFE (PDF)	Examples for the calculation of safety parameters for safety functions
Explosion Protection for Terminal Systems (PDF)	Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx
Control Drawing I/O, CX, CPX (PDF)	Connection diagrams and Ex markings (conform to cFMus)
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

1.4 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.

1.5 Documentation issue status

Version	Comment
6.5.0	- Update chapter "Technical data" - Update chapter "Object description and parameterization" - Update revision status - Update structure
6.4.0	- Update chapter "Technical data" - Update chapter "Commissioning"
6.3.0	- Update revision status - Update structure
6.2.0	- Update chapter "Product description" - Update structure
6.1.0	- Update chapter "Technical data" - Update structure
6.0.0	- Update chapter "Measurement thermocouples" - Update structure
5.9.0	- Update structure
5.8.1	- Update structure
5.8.0	- Update chapter "Technical data" - Update revision status - Update structure
5.7	- EL3314-0092 added - Update chapter "Technical data" - Update chapter "Temperature measurement with thermocouples" - Update revision status - Update structure
5.6	- Update revision status - Update structure
5.5	- Update chapter "Technical data" - Update chapter "Commissioning" - Update revision status - Update structure
5.4	- Update chapter "Technical data" - Update chapter "Product description" - Update chapter "Commissioning" - Update structure
5.3	- Update chapter "Technical data" - Update chapter "Commissioning" - Update structure
5.2	- Update chapter "Technical data" - Update chapter "Settings" - Update structure
5.1	- Update chapter "Object description and parameterization" - Update revision status - Update structure
5.0	- Update structure - Update chapter "Technical data" - Update chapter "Version identification"
0.1 – 4.9	*archived*

1.6 Version identification of EtherCAT devices

1.6.1 General notes on marking

Name

A Beckhoff EtherCAT device has a 14-digit technical designation consisting of

- Family key
- Type
- Version
- Revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL Terminal 12 mm, fixed connection level	3314 4-channel thermocouple terminal	0000 basic type	0016
ES3602-0010-0017	ES Terminal 12 mm, pluggable connection level	3602 2-channel voltage measurement	0010 high-precision version	0017
CU2008-0000-0000	CU device	2008 8-port Fast Ethernet switch	0000 basic type	0000

Notes

- The elements stated above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, for “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is composed of
 - family key (EL, EP, CU, ES, KL, CX, etc.)
 - type (3314)
 - version (0000)
- The **revision** -0016 reflects the technical progress such as feature enhancement with regard to EtherCAT communication and is managed by Beckhoff.
In principle, a device with a higher revision can replace a device with a lower revision, unless otherwise specified, e.g. in the documentation.
There is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file which is associated and synonymous with each revision, and this is available for download from the Beckhoff website.
Since January 2014, the revision has been marked on the outside of the IP20 terminals; see Fig. *“EL2872 with revision 0022 and serial number 01200815.”*
- The type, version, and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

1.6.2 Version identification of EL Terminals

The serial number/date code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules within a batch.

Structure of the serial number: **KK YY FF HH**

KK – week of production (calendar week)

YY – year of production

FF – firmware version

HH – hardware version

Example with serial number 12 06 3A 02:

12 – week of production 12

06 – year of production 2006

3A – firmware version 3A

02 – hardware version 02



Fig. 1: EL2872 with revision 0022 and serial number 01200815

1.6.3 Beckhoff Identification Code (BIC)

The Beckhoff Identification Code (BIC) is increasingly being applied to Beckhoff products to uniquely identify them. The BIC is represented as a Data Matrix code (DMC, code schema ECC200); its content is based on ANSI standard MH10.8.2-2016.

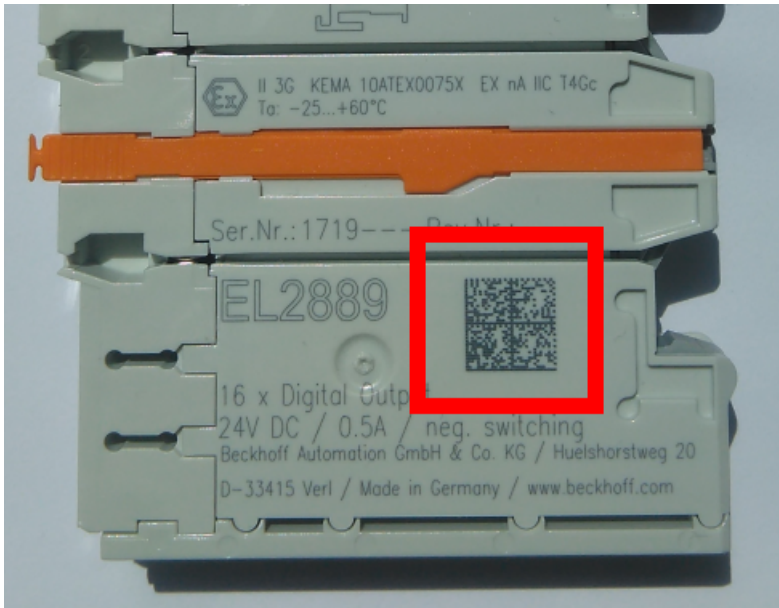


Fig. 2: BIC as a Data Matrix code (DMC, ECC200 code scheme)

The BIC is being introduced gradually across all product groups. Depending on the product, it can be found in the following locations:

- 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 be used for handling and product management by the customer.

Each item of information is clearly identifiable with the data identifier (ANSI MH10.8.2-2016). The data identifier is followed by a character string. Both together have a maximum length stated by the following table. If the items of information are shorter, spaces are added.

The following information may be present; items 1 through 4 are always included, while the others depend on the product family's requirements:

Item no.	Type of information	Explanation	Data identifier	Number of characters including the data identifier	Example
1	Beckhoff order number	Beckhoff order number	1P	8	1P 072222
2	Beckhoff Traceability Number (BTN)	Unique serial number, see note below	SBTN	12	SBTN k4p562d7
3	Article description	Beckhoff article description, e.g. EL1008	1K	32	1K EL1809
4	Quantity	Quantity in packaging unit, e.g. 1, 10, etc.	Q	6	Q 1
5	Batch number	Optional: Year and week of production	2P	14	2P 401503180016
6	ID/serial number	Optional: Previous serial number system, e.g., for safety products or calibrated terminals	51S	12	51S 678294
7	Variant	Optional: Product variant number on the basis of standard products	30P	12	30P F971, 2*K183
...					

Beckhoff uses additional types of information and data identifiers for internal processes.

Structure of the BIC

Example of composite information consisting of items 1 through 4 and the example value mentioned above in item 6. The data identifiers are highlighted in bold:

1P072222**SBTN**k4p562d7**1K**EL1809 **Q**1 **51S**678294

The same number as a DMC:



Fig. 3: Example DMC **1P**072222**SBTN**k4p562d7**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 8-character serial number that will replace all other serial number systems at Beckhoff in the future (e.g. batch designations on IO components, previous serial number circle for safety products, etc.). The BTN is also being introduced gradually, so it may not yet be coded in the BIC.

NOTICE

This information has been carefully prepared. However, the method described is constantly being refined. We reserve the right to revise and change procedures and documentation at any time and without notice. No claims for modification may be made on the basis of the data, diagrams, and descriptions in this documentation.

1.6.4 "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.

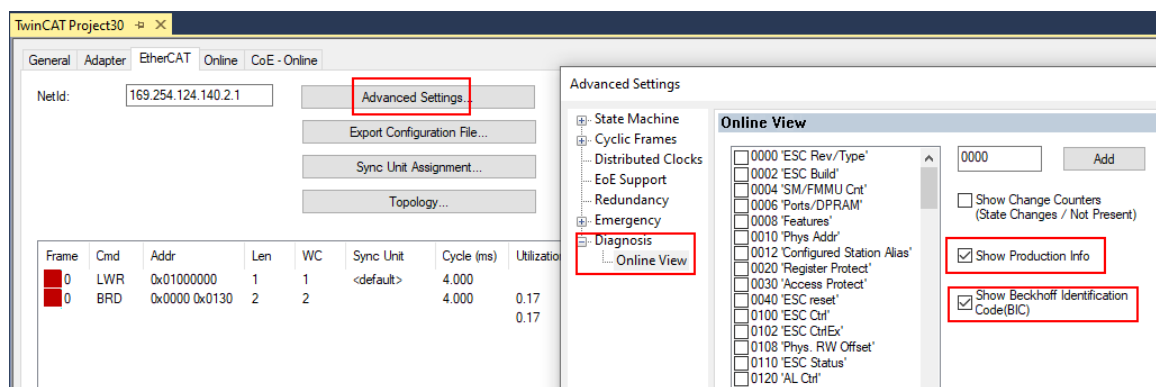
EtherCAT devices (IP20, IP67)

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 writes 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:

No	Addr	Name	State	CRC	Fw	Hw	Production Data	ItemNo	BTN	Description	Quantity	BatchNo	SerialNo
1	1001	Term 1 (EK1100)	OP	0, 0	0	0	---						
2	1002	Term 2 (EL1018)	OP	0, 0	0	0	2020 KW36 Fr	072222	k4p562d7	EL1809	1		678294
3	1003	Term 3 (EL3204)	OP	0, 0	7	6	2012 KW24 Sa						
4	1004	Term 4 (EL2004)	OP	0, 0	0	0	---	072223	k4p562d7	EL2004	1		678295
5	1005	Term 5 (EL1008)	OP	0, 0	0	0	---						
6	1006	Term 6 (EL2008)	OP	0, 0	0	12	2014 KW14 Mo						
7	1007	Term 7 (EK1110)	OP	0	1	8	2012 KW25 Mo						

- 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_Uutilities* as of TwinCAT 3.1 build 4024.24
 - *F_SplitBIC*: The function splits the 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.
- On the 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
 - In a hierarchical configuration of multiple ESCs (EtherCAT Slave Controllers) within a single 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 that ESC is located in the CoE object directory 0x10E2:01 and the eBICs of the sub-devices follow in 0x10E2:nn.

PROFIBUS, PROFINET, DeviceNet® devices, etc.

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

2 Product description

2.1 EL3311

2.1.1 Introduction

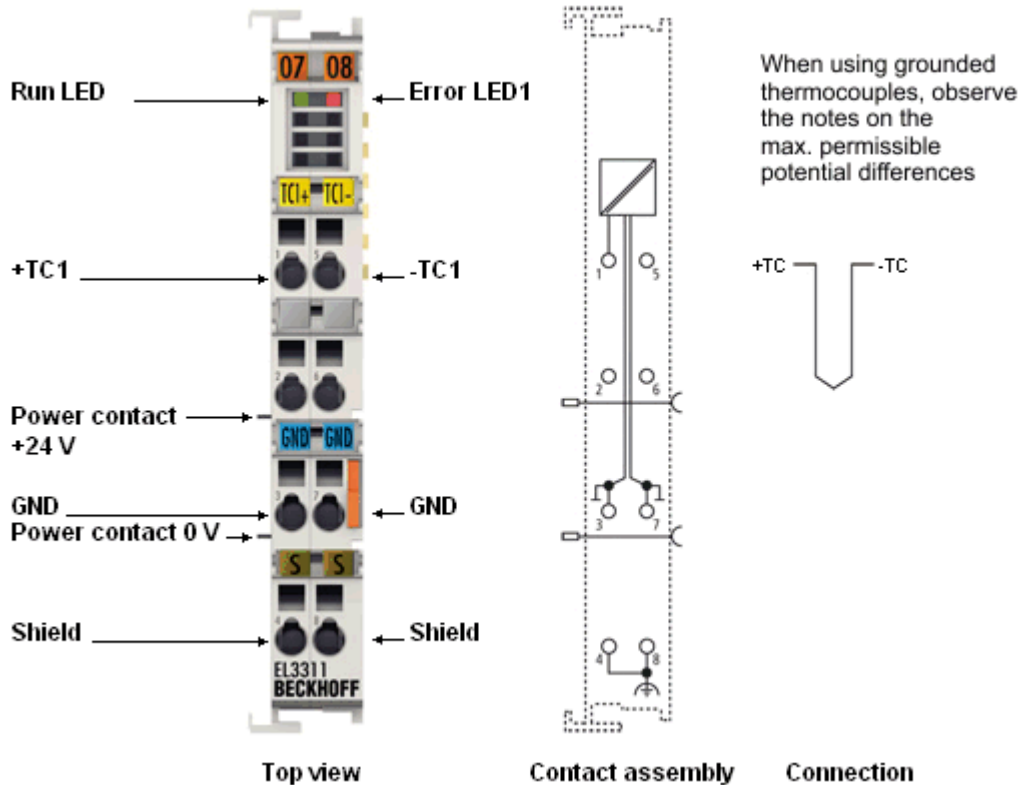


Fig. 4: EL3311

1 channel analog thermocouple input terminals with open-circuit recognition

The EL3311 analog input terminals allow the direct connection of thermocouples. The EtherCAT Terminals circuit can operate thermocouple sensors using the 2-wire technique. Linearization over the full temperature range is realized with the aid of a microprocessor. The temperature range can be selected freely. The error LEDs indicate a broken wire. Compensation for the cold junction is made through an internal temperature measurement at the terminals. The EL33xx can also be used for mV measurement.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [CoE object description and parameterization \[► 258\]](#)
- [Process data and operation modes \[► 230\]](#)

2.1.2 Technical data

2.1.2.1 General technical data

Analog inputs	EL3311
Number of inputs	1
Thermocouple sensor types, measured variables	Types B, C, E, J, K, L, N, R, S, T, U (default setting type K), mV measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 16 bit
Sampling type	simultaneous
Ground reference	Differential
Conversion time	approx. 600 ms to 3 ms, depending on the configuration and filter setting; default: approx. 63 ms
Input filter cut-off frequency	typ. 1 kHz
Software filter	5 Hz...30 kHz, adjustable, notch characteristic; preset: disabled
Wire break detection	yes
Supports NoCoeStorage [► 197] function	yes, from firmware 01

Voltage measurement	EL3311
Measuring range, technically available	approx. ± 78 mV
Measuring ranges (nominal) and resolution	± 30 mV (1 μ V per digit, thus max. 32.768 mV can be displayed) ± 60 mV (2 μ V per digit, thus max. 65.536 mV can be displayed) ± 75 mV (4 μ V per digit, thus max. 131 mV can be displayed, observe technical 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	See Measurement ± 30 mV...± 75 mV [► 21]

Temperature measurement	EL3311
Electrical measuring range used	± 75 mV
Measuring ranges ¹⁾	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01 °C per digit, preset 0.1 °C Note: internally, 16 bit are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type K: approx. 0.04 °C.
Measurement uncertainty	See chapter Thermocouples measurement [► 22]

1) from FW07, Rev0024

Supply and potentials		EL3311
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±10 V within U_{CM} limits (CommonMode voltage)
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	±5 V
	Destruction limit, short-term/continuous	±15 V
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3311
Configuration		via TwinCAT System Manager
Width in the process image		max. 4 bytes input, max. 2 bytes output
Distributed Clocks		-

Environmental conditions		EL3311
Permissible ambient temperature range during operation		-25 °C...+60 °C (extended temperature range), from firmware 06
Permissible ambient temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3311
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		variable

Extended features		EL3311
Pluggable connection level		-
Electrical isolation		-
TwinSAFE SC		-
Calibration certificate		-

Standards and approvals		EL3311
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [► 214]
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 206] , IECEx [► 207] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEx	Ex ec IIC T4 Gc

2.1.2.2 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< $\pm 0.24\%_{FSV}$ typ. $\approx \pm 0.070$ mV
	@ 55°C ambient temperature ¹	< $\pm 0.26\%_{FSV}$ typ. $\approx \pm 0.077$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< $\pm 0.16\%_{FSV}$ typ. $\approx \pm 0.094$ mV
	@ 55°C ambient temperature ¹	< $\pm 0.17\%_{FSV}$ typ. $\approx \pm 0.10$ mV
Offset/zero point deviation (at 23 °C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< $\pm 0.14\%_{FSV}$ typ. $\approx \pm 0.11$ mV
	@ 55°C ambient temperature ¹	< $\pm 0.15\%_{FSV}$ typ. $\approx \pm 0.12$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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.

2.1.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3311 each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±2.0°C
Temperature coefficient	Tk	< 40 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 75 mV
Measuring range, technically available		+200 °C ≈ 0.178 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 Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type B: approx. 0.05 °C.
Uncertainty in the recommended measuring range ^{*)}	@ 23 °C ambient temperature	± 8.5 K ≈ ± 0.47 % _{FSV}
	@ 55 °C ambient temperature	± 9.7 K ≈ ± 0.54 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ °C}$ as the middle point between 23 °C and 55 °C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

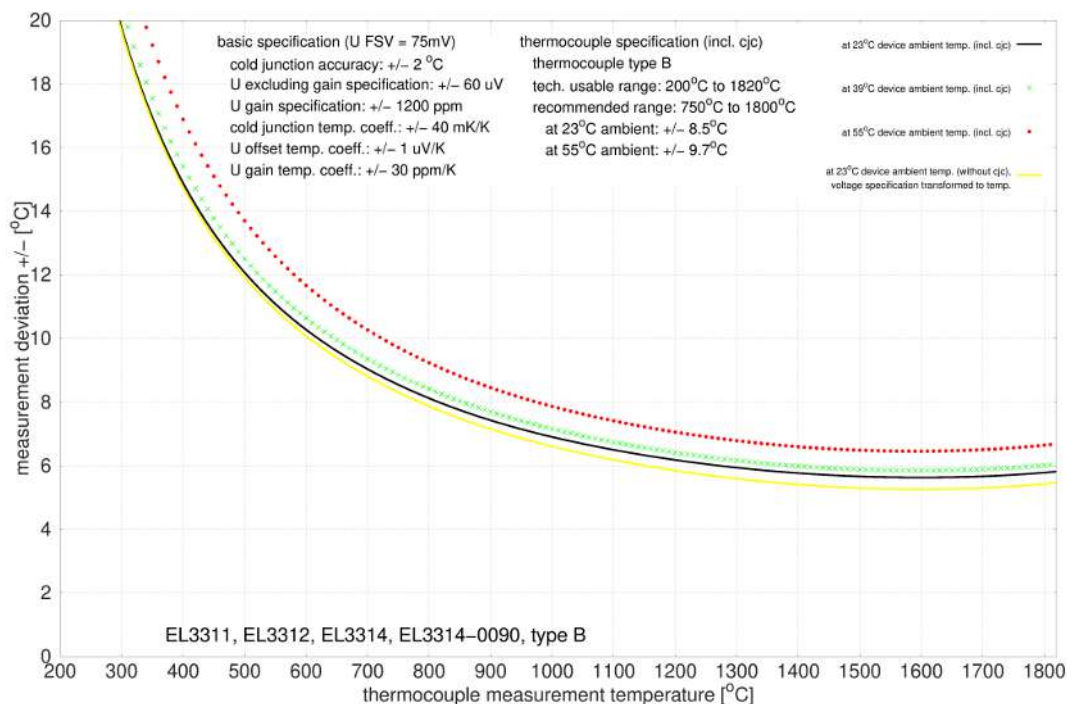


Fig. 5: EL3311, EL3312, EL3314, EL3314-0090, type B

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type C: approx. 0.07°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 6.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.4\text{ K} \approx \pm 0.32\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

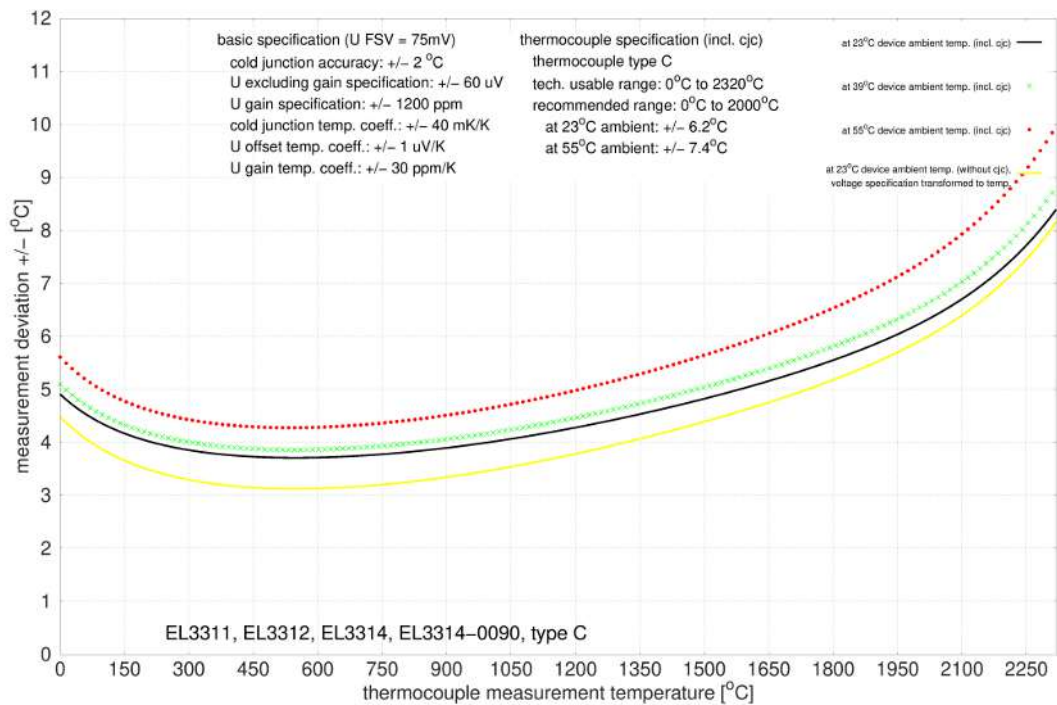


Fig. 6: EL3311, EL3312, EL3314, EL3314-0090, type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -9.835\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.373\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type E: approx. 0.03°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

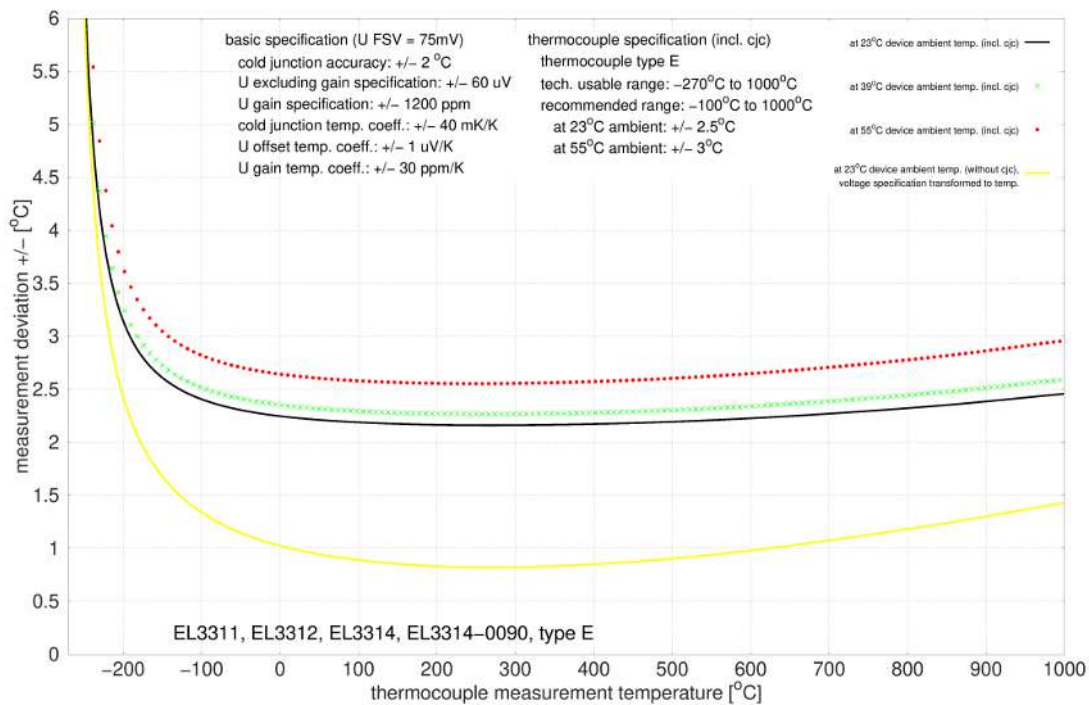


Fig. 7: EL3311, EL3312, EL3314, EL3314-0090, type E

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-210^\circ\text{C} \approx -8.095\text{ mV} \dots +1200^\circ\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type J: approx. 0.04°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.7\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

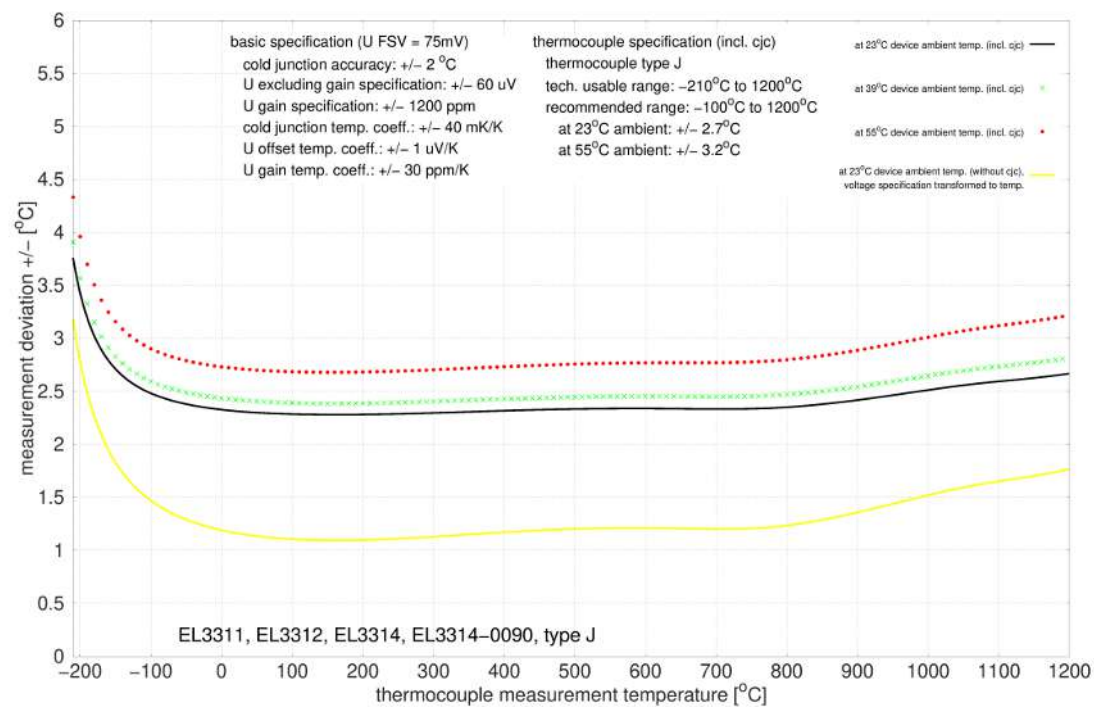


Fig. 8: EL3311, EL3312, EL3314, EL3314-0090, type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -6.458\text{ mV} \dots +1372\text{ }^{\circ}\text{C} \approx 54.886\text{ mV}$
Measuring range, end value (full scale value)		$+1372\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +1200\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01\text{ }^{\circ}\text{C/digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01\text{ }^{\circ}\text{C}$ occur with "resolution $0.01\text{ }^{\circ}\text{C}$ "; e.g. type K: approx. $0.04\text{ }^{\circ}\text{C}$.
Uncertainty in the recommended measuring range ^{*)}	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.22\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

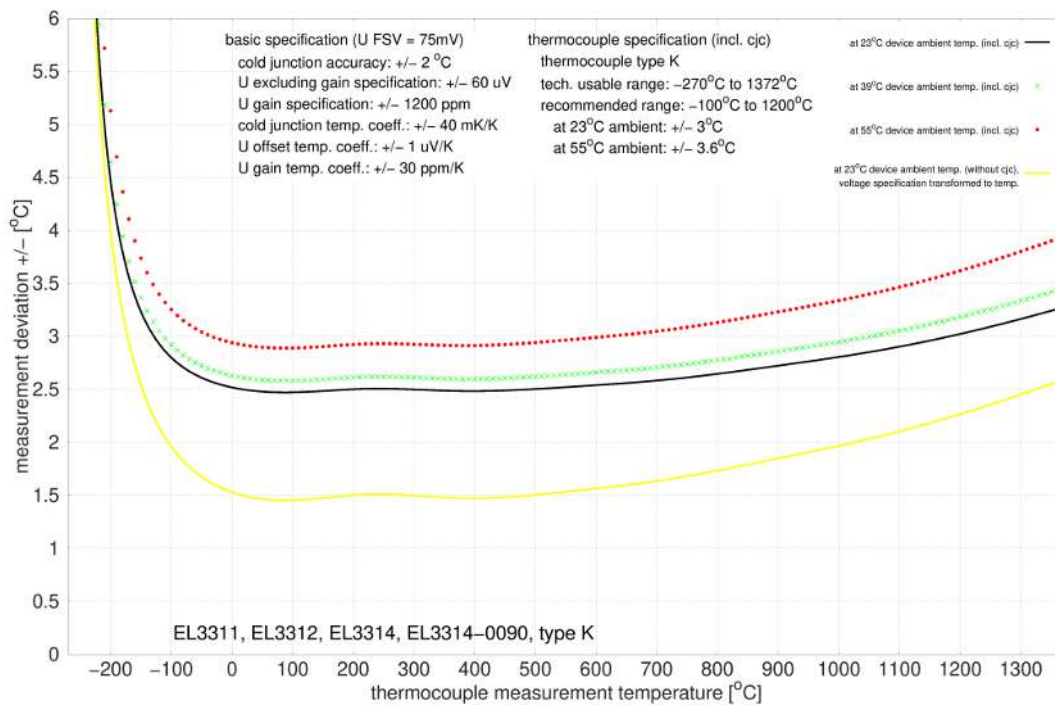


Fig. 9: EL3311, EL3312, EL3314, EL3314-0090, type K

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx 2.510\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type L: approx. 0.03°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.8\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

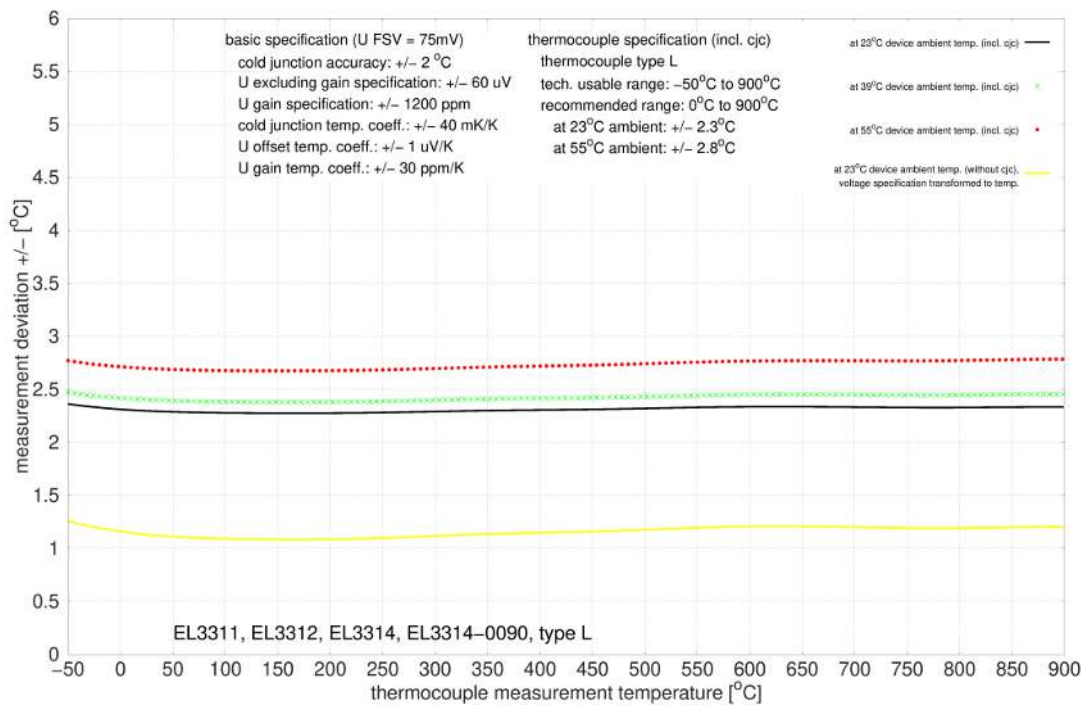


Fig. 10: EL3311, EL3312, EL3314, EL3314-0090, type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -4.346\text{ mV} \dots +1300^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type N: approx. 0.04°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

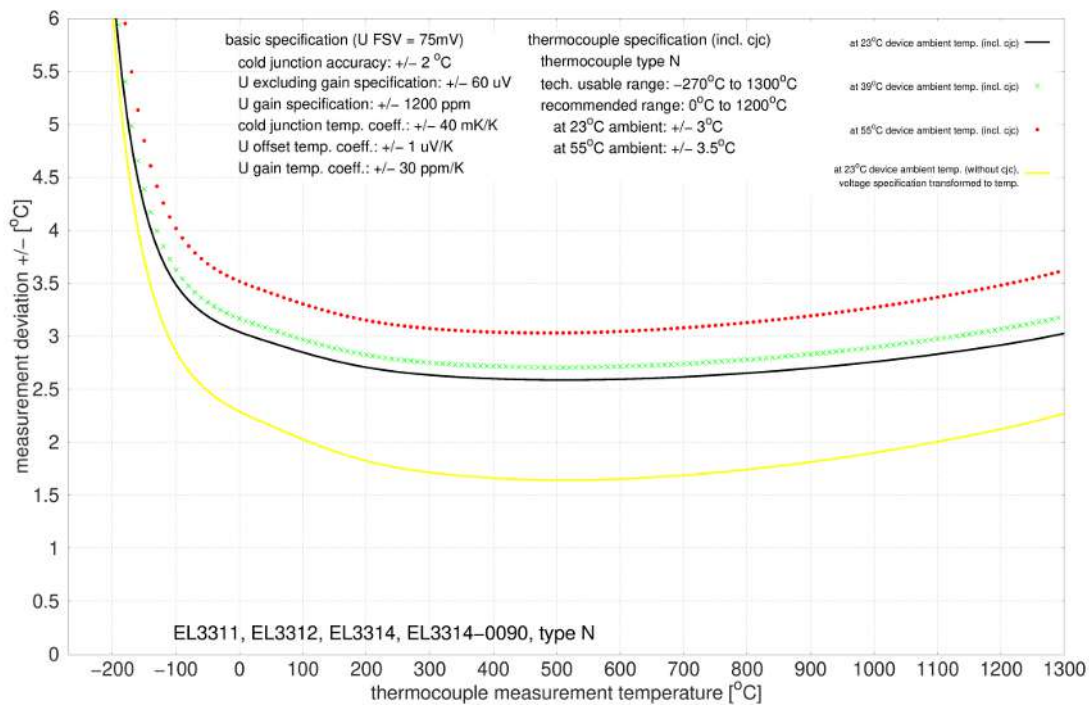


Fig. 11: EL3311, EL3312, EL3314, EL3314-0090, type N

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -0.226\text{ mV} \dots +1768^{\circ}\text{C} \approx 21.101\text{ mV}$
Measuring range, end value (full scale value)		$+1768^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		0.1/0.01 $^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01 $^{\circ}\text{C}$ "; e.g. type R: approx. 0.05 $^{\circ}\text{C}$.
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 6.7\text{ K} \approx \pm 0.38\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.7\text{ K} \approx \pm 0.44\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

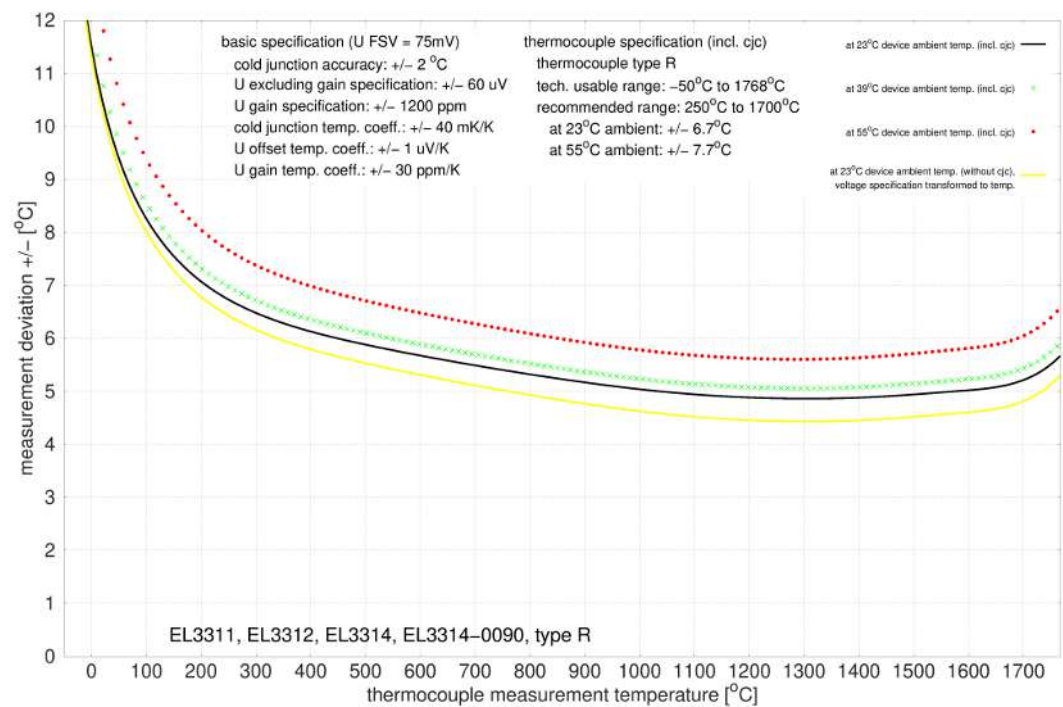


Fig. 12: EL3311, EL3312, EL3314, EL3314-0090, type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -0.236\text{ mV} \dots +1768^{\circ}\text{C} \approx 18.693\text{ mV}$
Measuring range, end value (full scale value)		$+1768^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		0.1/0.01 $^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01 $^{\circ}\text{C}$ "; e.g. type S: approx. 0.05 $^{\circ}\text{C}$.
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 7.1\text{ K} \approx \pm 0.40\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 8.1\text{ K} \approx \pm 0.46\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

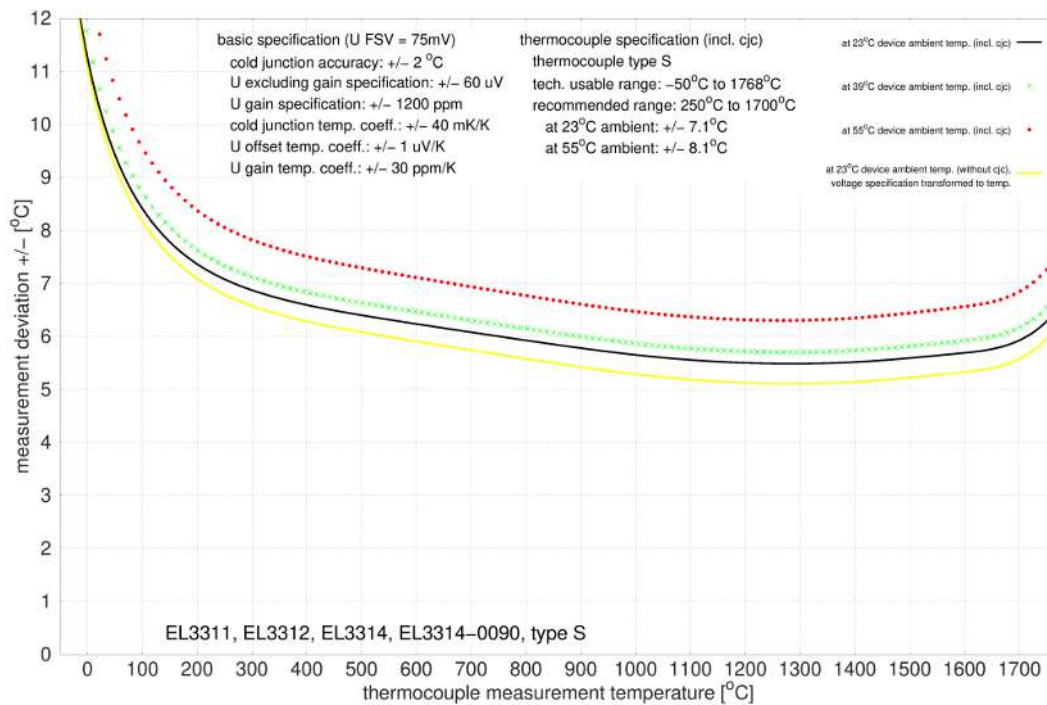


Fig. 13: EL3311, EL3312, EL3314, EL3314-0090, type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -6.258\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.73\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.4\text{ K} \approx \pm 0.85\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

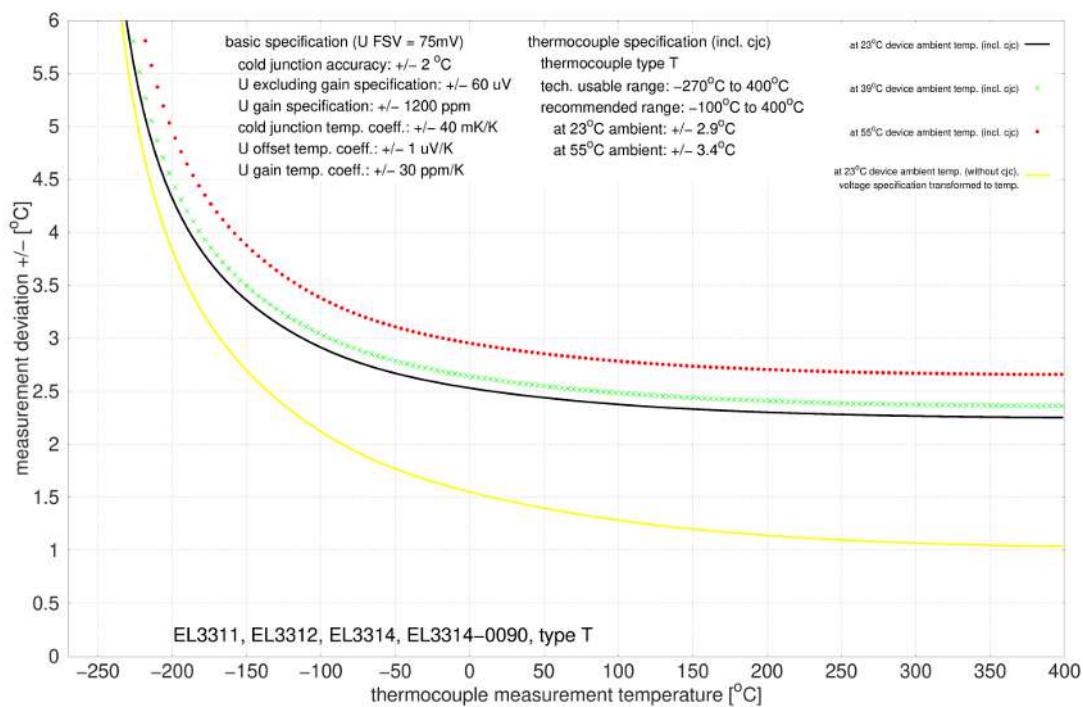


Fig. 14: EL3311, EL3312, EL3314, EL3314-0090, type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -1.850\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type U: approx. 0.02°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.42\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.48\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

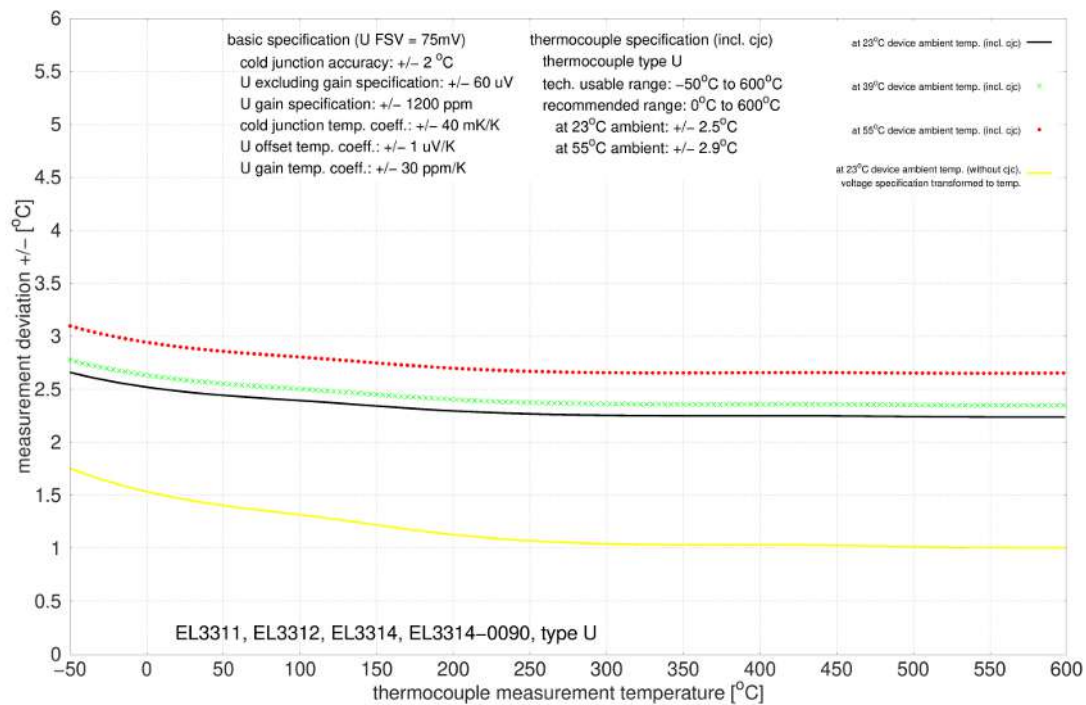


Fig. 15: EL3311, EL3312, EL3314, EL3314-0090, type U

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.1.3 Connection

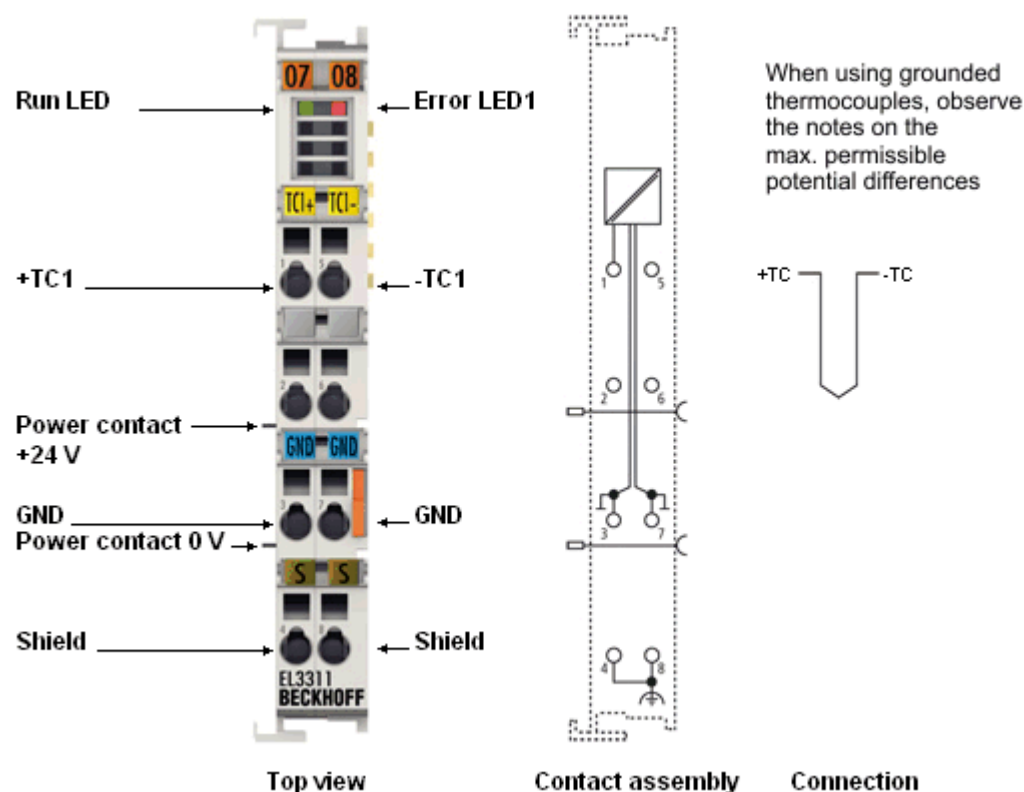


Fig. 16: EL3311

EL3311 - Connection

Terminal point	No.	Comment
Input +TC1	1	Input +TC1
n. c.	2	not connected
GND	3	Ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected to terminal point 8)
Input -TC1	5	Input -TC1
n. c.	6	not connected
GND	7	Ground (internally connected with terminal point 3)
Shield	8	Shield (internally connected to terminal point 4)

● Earthed thermocouples

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

2.1.4 Display, diagnostics

EL3311 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different standard-settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve

2.2 EL3312

2.2.1 Introduction

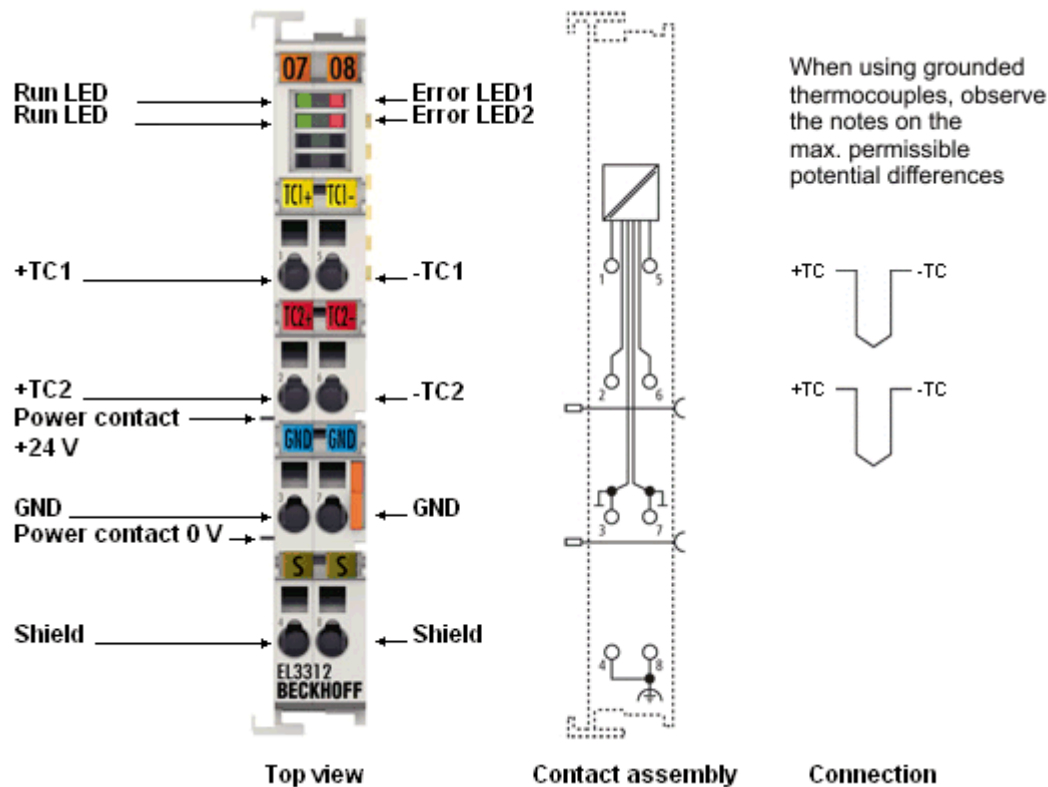


Fig. 17: EL3312

2 channel analog thermocouple input terminals with open-circuit recognition

The EL3312 analog input terminals allow the direct connection of thermocouples. The EtherCAT Terminals circuit can operate thermocouple sensors using the 2-wire technique. Linearization over the full temperature range is realized with the aid of a microprocessor. The temperature range can be selected freely. The error LEDs indicate a broken wire. Compensation for the cold junction is made through an internal temperature measurement at the terminals. The EL33xx can also be used for mV measurement.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [CoE object description and parameterization \[► 264\]](#)
- [Process data and operation modes \[► 230\]](#)

2.2.2 Technical data

2.2.2.1 General technical data

Analog inputs	EL3312
Number of inputs	2
Thermocouple sensor types, measured variables	Types B, C, E, J, K, L, N, R, S, T, U (default setting type K), mV measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 16 bit
Sampling type	multiplex
Ground reference	Differential
Conversion time	approx. 1.2 s to 7 ms, depending on the configuration and filter setting, default: approx. 125 ms
Input filter cut-off frequency	typ. 1 kHz
Software filter	5 Hz...30 kHz, adjustable, notch characteristic; preset: disabled
Wire break detection	yes
Supports NoCoeStorage [► 197] function	yes, from firmware 01

Voltage measurement	EL3312
Measuring range, technically available	approx. ± 78 mV
Measuring ranges (nominal) and resolution	± 30 mV (1 μ V per digit, thus max. 32.768 mV can be displayed) ± 60 mV (2 μ V per digit, thus max. 65.536 mV can be displayed) ± 75 mV (4 μ V per digit, thus max. 131 mV can be displayed, observe technical 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	See Measurement ± 30 mV...± 75 mV [► 39]

Temperature measurement	EL3312
Electrical measuring range used	± 75 mV
Measuring ranges ¹⁾	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01 °C per digit, preset 0.1 °C Note: internally, 16 bit are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type K: approx. 0.04 °C.
Measurement uncertainty	See Thermocouples measurement [► 40]

1) from FW07, Rev0024

Supply and potentials		EL3312
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±10 V within U_{CM} limits (CommonMode voltage)
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	±5 V
	Destruction limit, short-term/continuous	±15 V
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3312
Configuration		via TwinCAT System Manager
Width in the process image		max. 8 bytes input, max. 4 bytes output
Distributed Clocks		-

Environmental conditions		EL3312
Permissible ambient temperature range during operation		-25 °C...+60 °C (extended temperature range), from firmware 06
Permissible ambient temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3312
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		variable

Extended features		EL3312
Pluggable connection level		-
Electrical isolation		-
TwinSAFE SC		-
Calibration certificate		-

Standards and approvals		EL3312
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [► 214]
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 206] , IECEx [► 207] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEx	Ex ec IIC T4 Gc

2.2.2.2 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.24\%_{FSV}$ typ. $\approx \pm 0.070$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.26\%_{FSV}$ typ. $\approx \pm 0.077$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 60$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.16\%_{FSV}$ typ. $\approx \pm 0.094$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.17\%_{FSV}$ typ. $\approx \pm 0.10$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 60$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.14\%_{FSV}$ typ. $\approx \pm 0.11$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.15\%_{FSV}$ typ. $\approx \pm 0.12$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 60$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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.

2.2.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3312 each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±2.0°C
Temperature coefficient	Tk	< 40 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 75 mV
Measuring range, technically available		+600 °C ≈ 1.792 mV ... +1800 °C ≈ 13.591 mV
Measuring range, end value (full scale value)		+1800 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01 °C/digit, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type B: approx. 0.05 °C.
Uncertainty in the recommended measuring range ^{*)}	@ 23 °C ambient temperature	± 8.5 K ≈ ± 0.47 % _{FSV}
	@ 55 °C ambient temperature	± 9.7 K ≈ ± 0.54 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ °C}$ as the middle point between 23 °C and 55 °C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

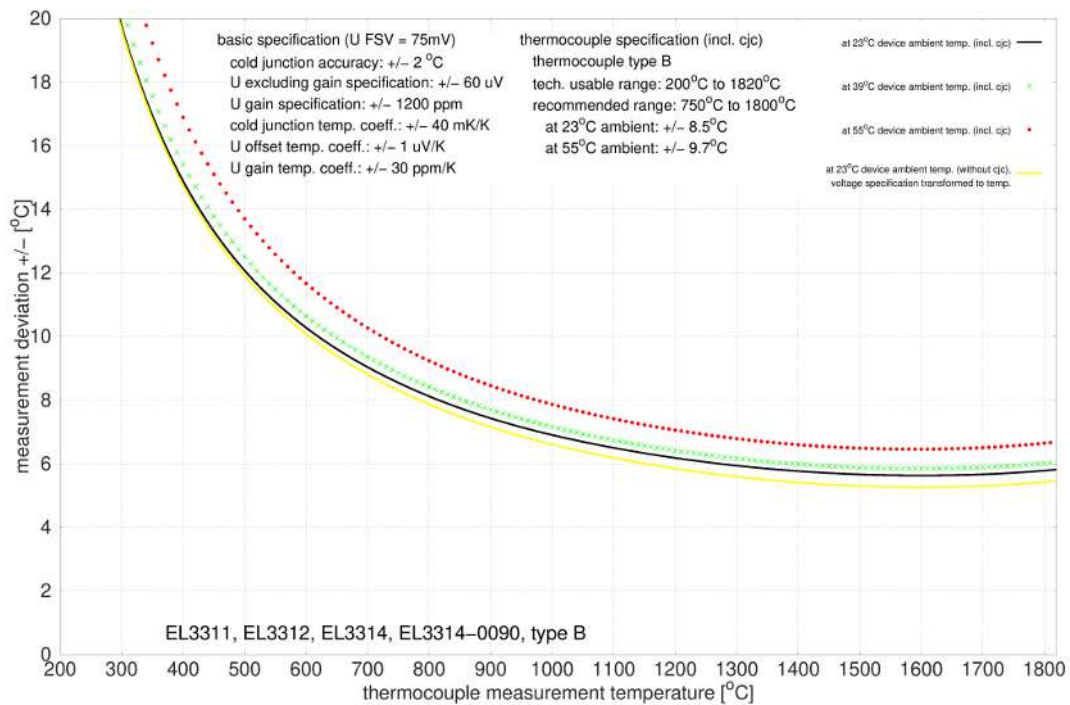


Fig. 18: EL3311, EL3312, EL3314, EL3314-0090, type B

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type C: approx. 0.07°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 6.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.4\text{ K} \approx \pm 0.32\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

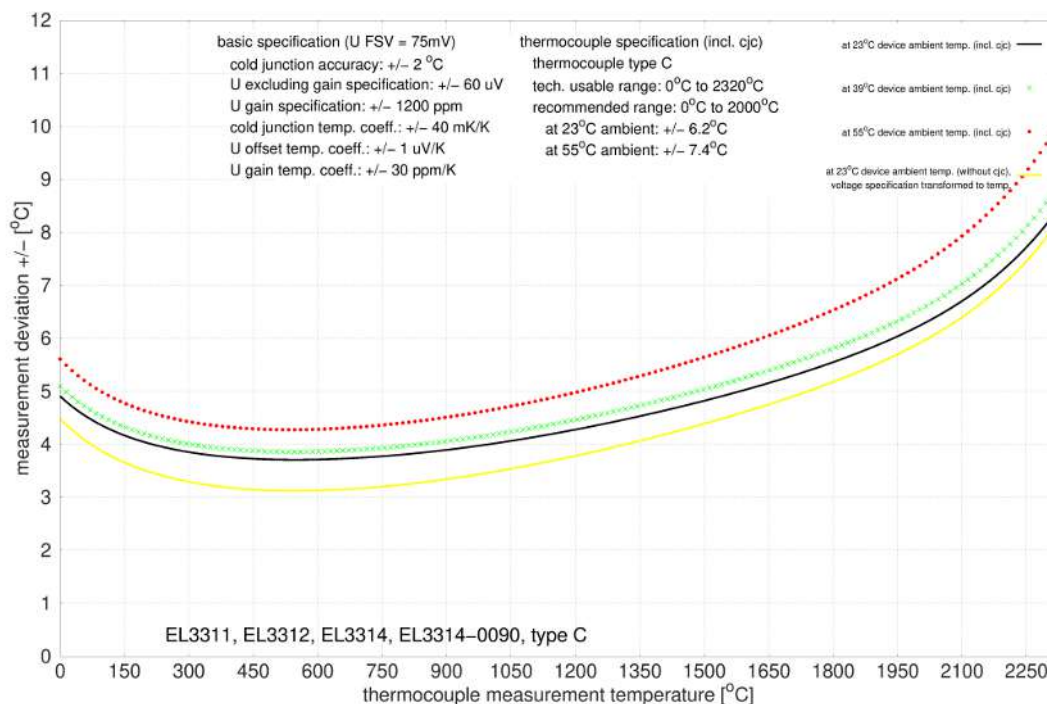


Fig. 19: EL3311, EL3312, EL3314, EL3314-0090, type C

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -5.237\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type E: approx. 0.03°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

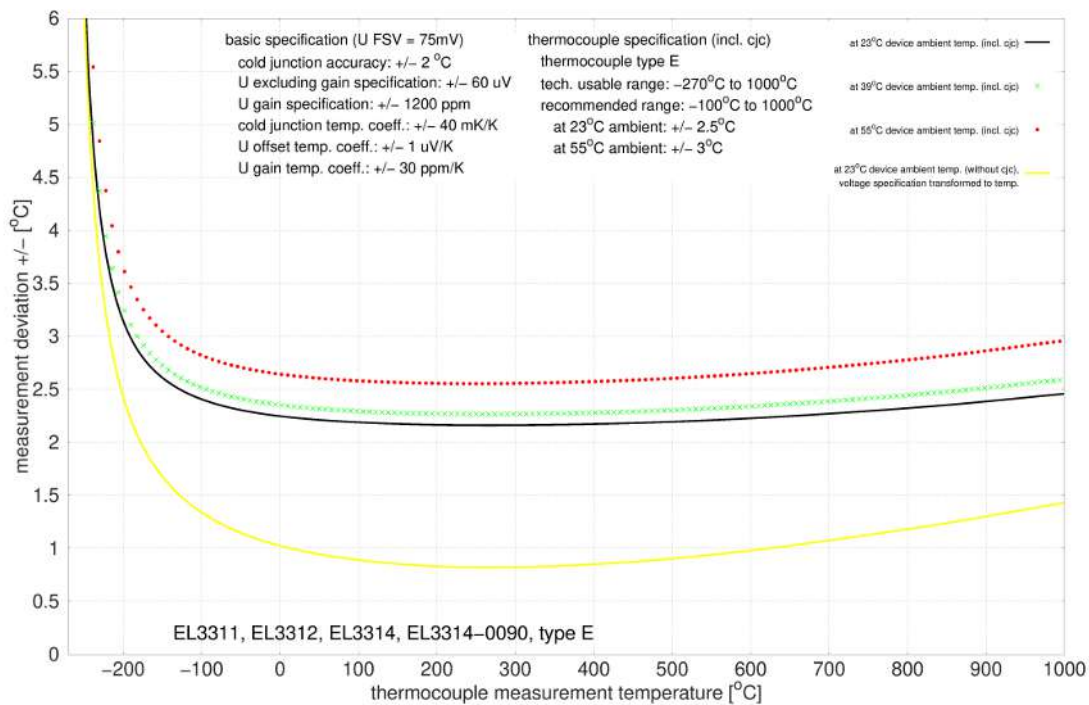


Fig. 20: EL3311, EL3312, EL3314, EL3314-0090, type E

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^\circ\text{C} \approx -4.632\text{ mV} \dots +1200^\circ\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type J: approx. 0.04°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.7\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

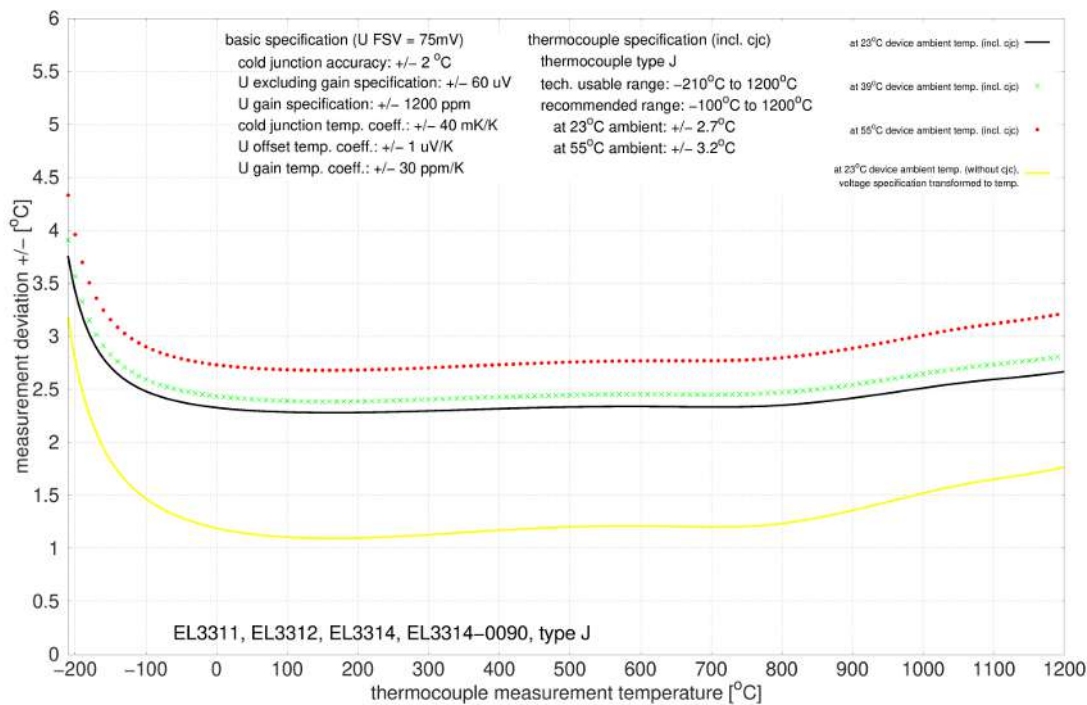


Fig. 21: EL3311, EL3312, EL3314, EL3314-0090, type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.891\text{ mV} \dots +1370^{\circ}\text{C} \approx 54.818\text{ mV}$
Measuring range, end value (full scale value)		$+1370^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		0.1/0.01 $^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01 $^{\circ}\text{C}$ "; e.g. type K: approx. 0.04 $^{\circ}\text{C}$.
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.22\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

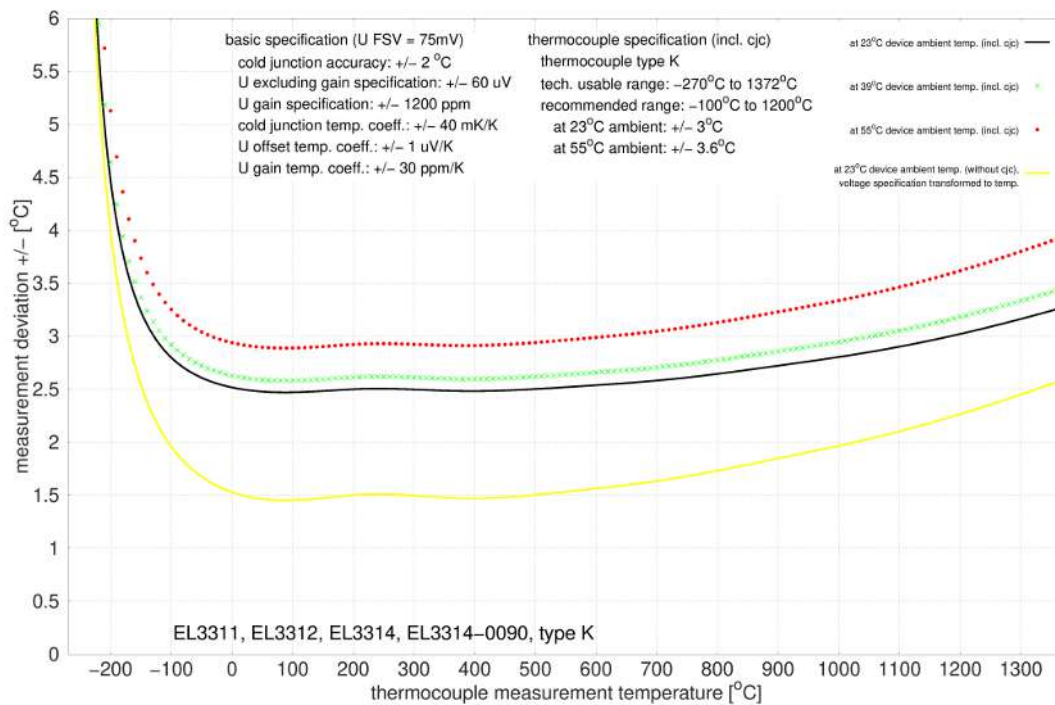


Fig. 22: EL3311, EL3312, EL3314, EL3314-0090, type K

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type L: approx. 0.03°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.8\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

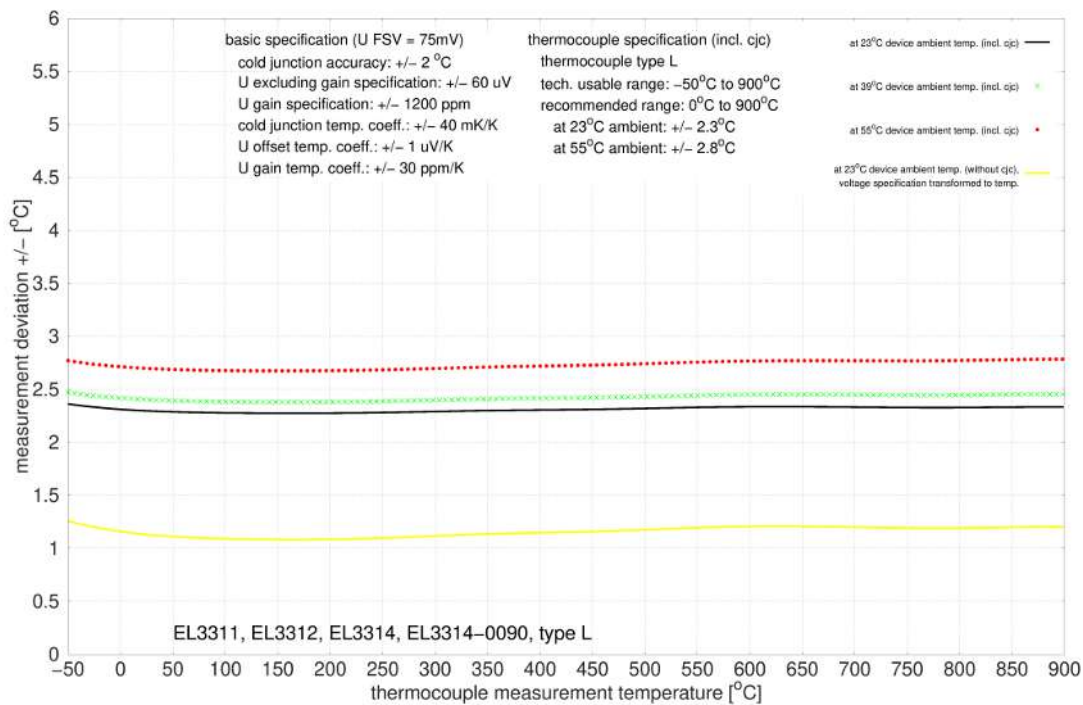


Fig. 23: EL3311, EL3312, EL3314, EL3314-0090, type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -2.406\text{ mV} \dots +1300^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +1300^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type N: approx. 0.04°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

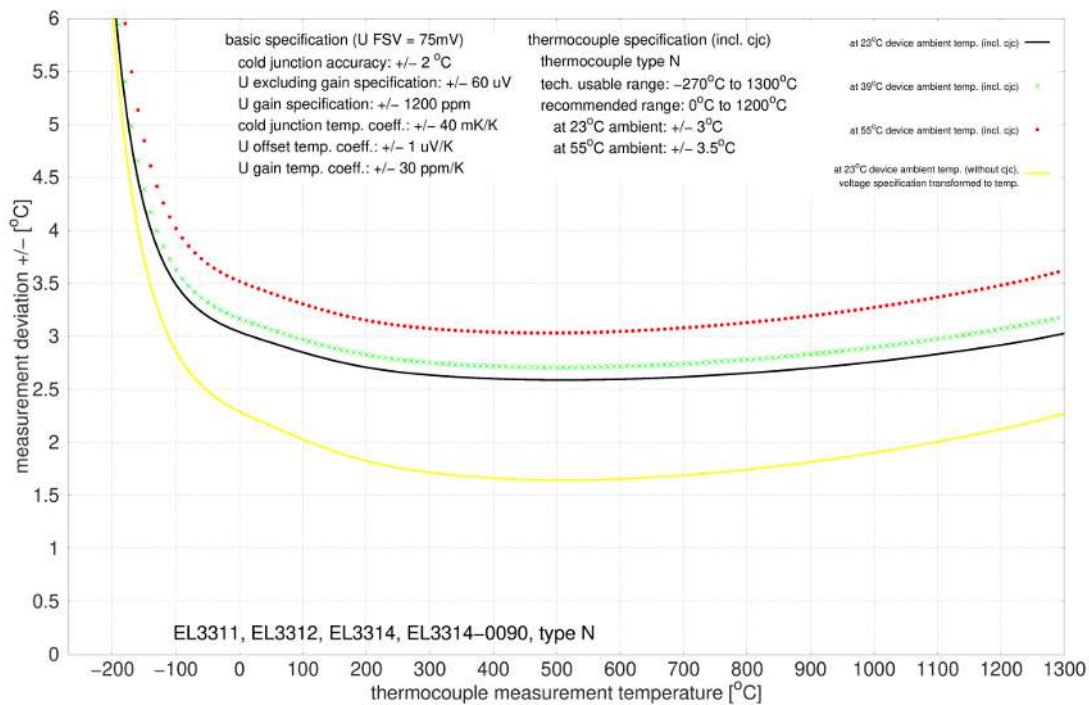


Fig. 24: EL3311, EL3312, EL3314, EL3314-0090, type N

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1767^{\circ}\text{C} \approx 21.089\text{ mV}$
Measuring range, end value (full scale value)		$+1767^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type R: approx. 0.05°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 6.7\text{ K} \approx \pm 0.38\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.7\text{ K} \approx \pm 0.44\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

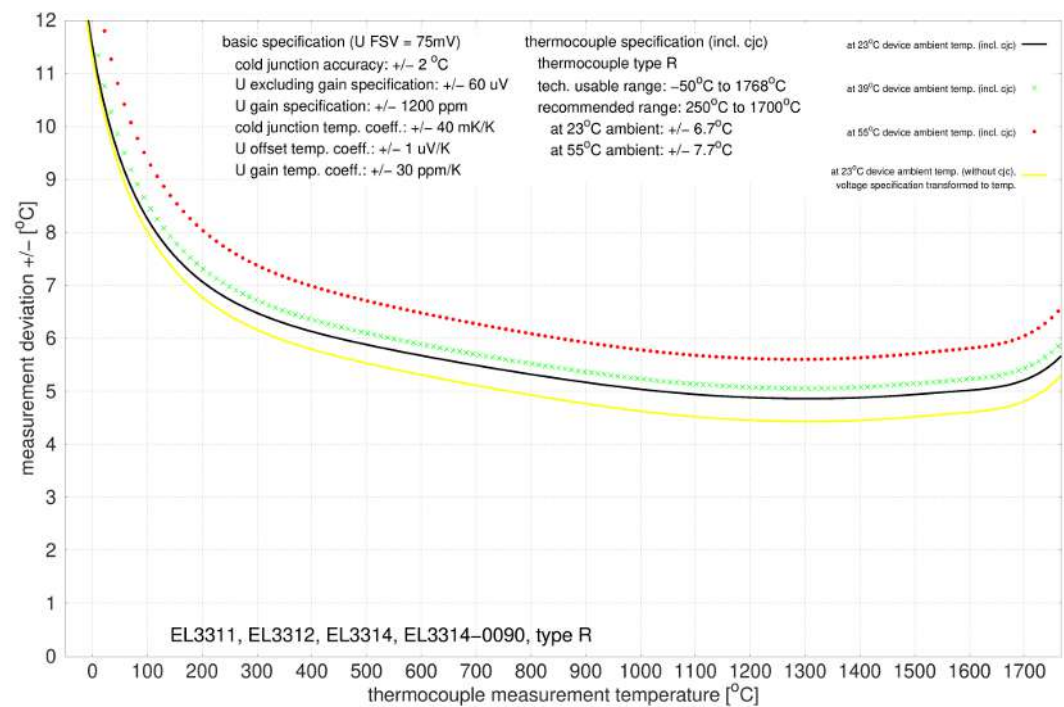


Fig. 25: EL3311, EL3312, EL3314, EL3314-0090, type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1760^{\circ}\text{C} \approx 17.947\text{ mV}$
Measuring range, end value (full scale value)		$+1760^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type S: approx. 0.05°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 7.1\text{ K} \approx \pm 0.40\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 8.1\text{ K} \approx \pm 0.46\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

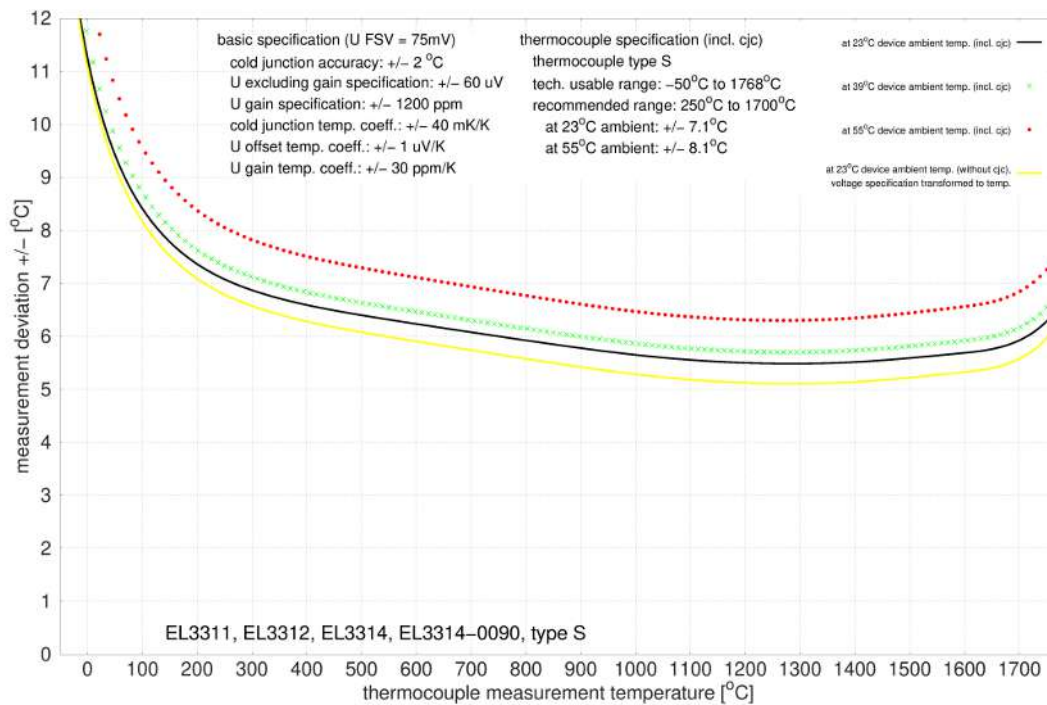


Fig. 26: EL3311, EL3312, EL3314, EL3314-0090, type S

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.603\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.73\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.4\text{ K} \approx \pm 0.85\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

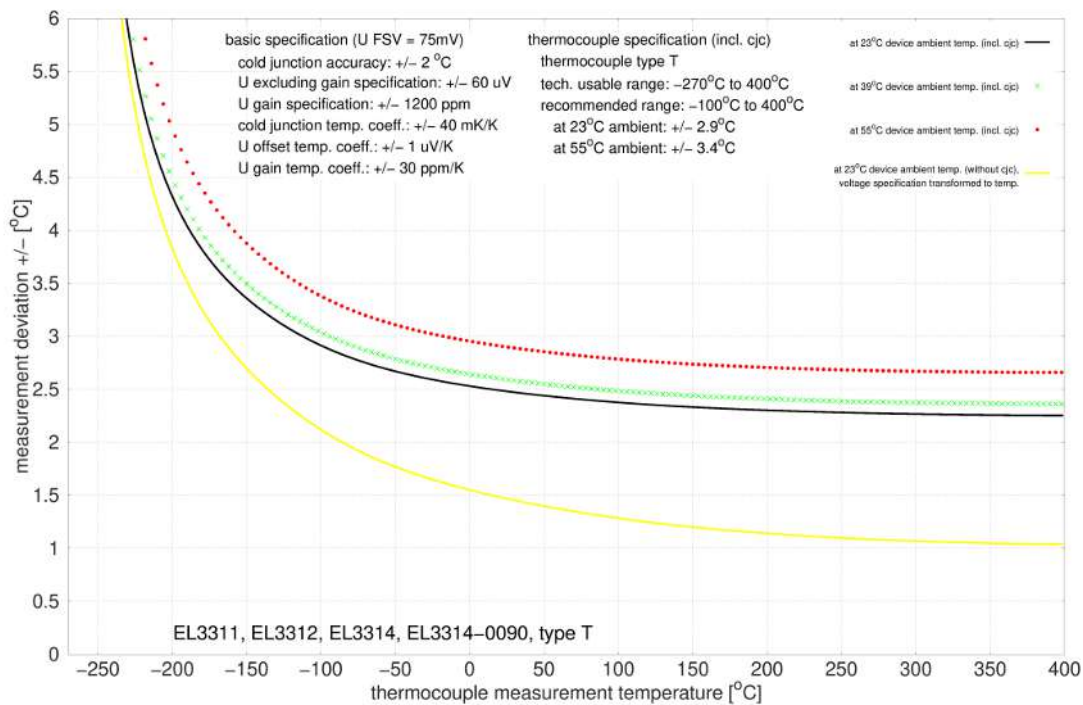


Fig. 27: EL3311, EL3312, EL3314, EL3314-0090, type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type U: approx. 0.02°C .
Uncertainty in the recommended measuring range ^{*)}	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.42\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.48\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

^{*)} with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

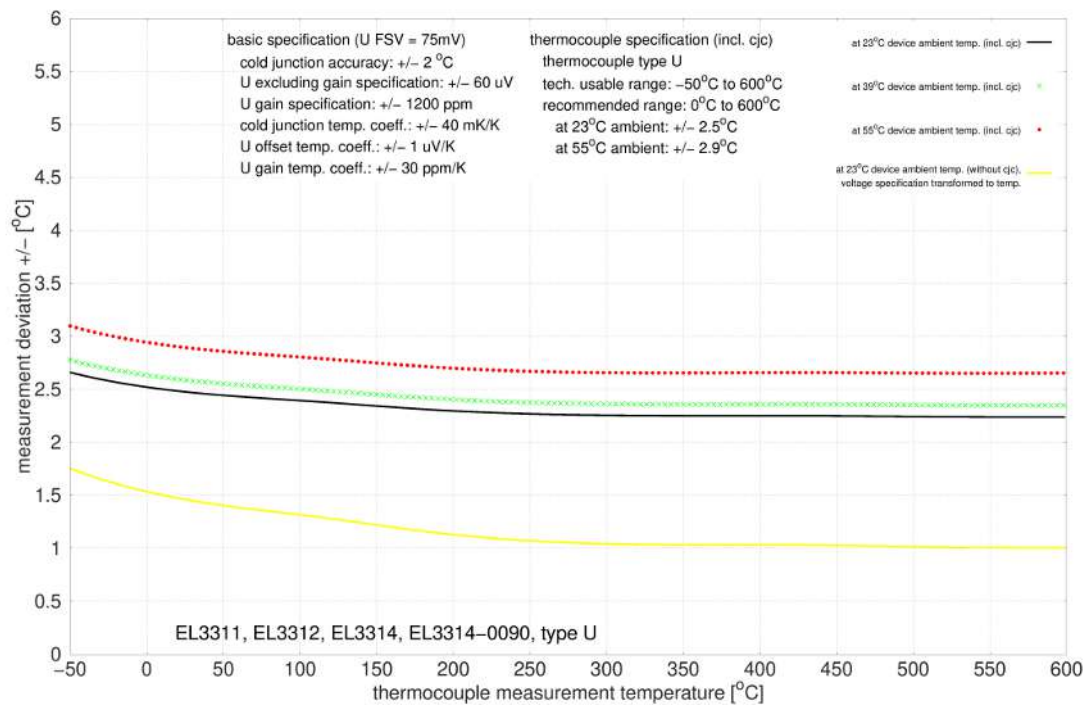


Fig. 28: EL3311, EL3312, EL3314, EL3314-0090, type U

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.2.3 Connection

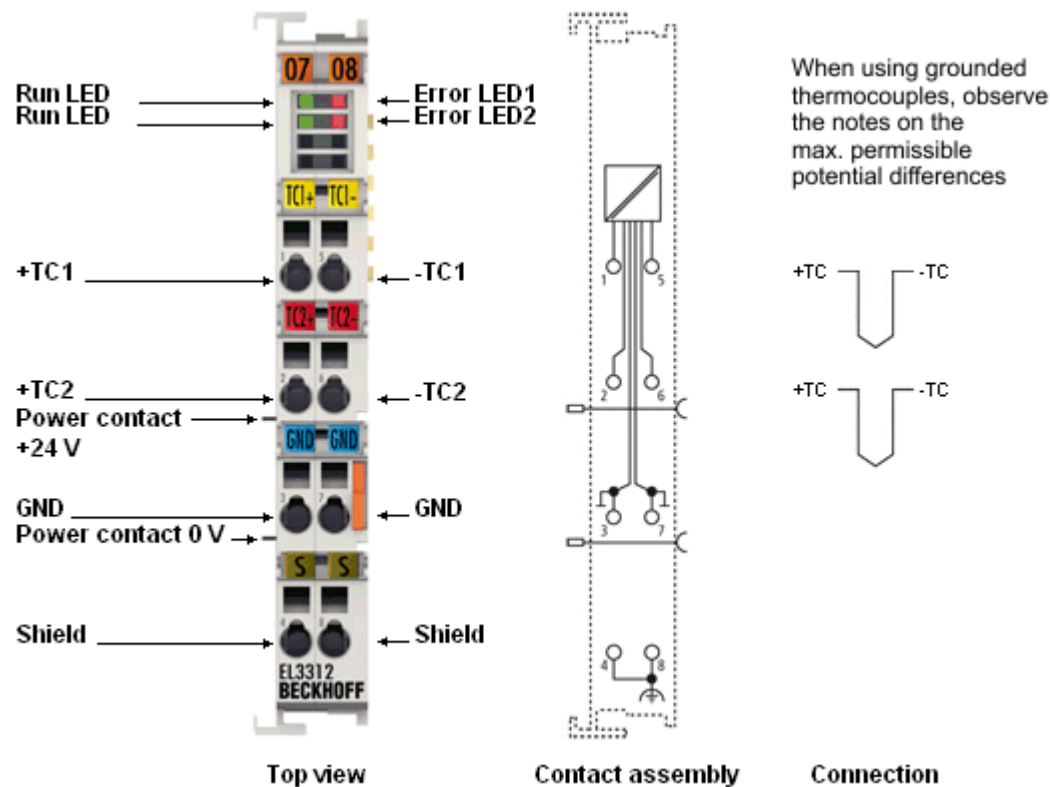


Fig. 29: EL3312

EL3312 - Connection

Terminal point	No.	Comment
Input +TC1	1	Input +TC1
Input +TC2	2	Input +TC2
GND	3	Ground (internally connected with terminal point 7)
Shield	4	Shield (internally connected to terminal point 8)
Input -TC1	5	Input -TC1
Input -TC2	6	Input -TC2
GND	7	Ground (internally connected with terminal point 3)
Shield	8	Shield (internally connected to terminal point 4)



Earthed thermocouples

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

2.2.4 Display, diagnostics

EL3312 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different standard-settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1, ERROR2	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve

2.3 EL3314

2.3.1 Introduction

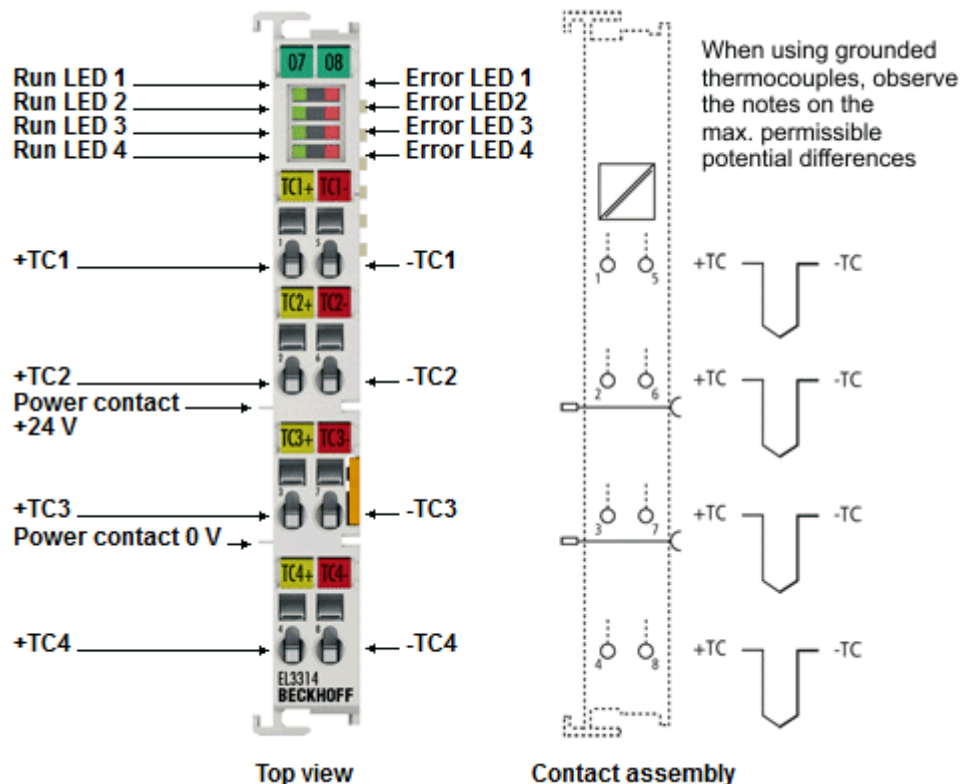


Fig. 30: EL3314

4-channel analog thermocouple input terminals with open-circuit recognition

The EL3314 analog input terminals allow the direct connection of thermocouples. The EtherCAT Terminals circuit can operate thermocouple sensors using the 2-wire technique. Linearization over the full temperature range is realized with the aid of a microprocessor. The temperature range can be selected freely. The error LEDs indicate a broken wire. Cold junction compensation is made through an internal temperature measurement at the terminals. The EL33xx can also be used for mV measurement.

With the EL3314-0010, Beckhoff offers a high-precision variant [► 93] of the 4 channel thermocouple input terminal.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [CoE object description and parameterization](#) [► 270]
- [Process data and operation modes](#) [► 230]

2.3.2 Technical data

2.3.2.1 General technical data

Analog inputs	EL3314
Number of inputs	4
Thermocouple sensor types, measured variables	Types B, C, E, J, K, L, N, R, S, T, U (default setting type K), mV measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 16 bit
Sampling type	multiplex
Ground reference	Differential
Conversion time	approx. 2.5 s to 10 ms, depending on the configuration and filter setting, default: approx. 250 ms
Input filter cut-off frequency	typ. 1 kHz
Software filter	5 Hz...30 kHz, adjustable, notch characteristic; preset: disabled
Wire break detection	yes (can be disabled)
Supports NoCoeStorage [► 197] function	yes, from firmware 01

Voltage measurement	EL3314
Measuring range, technically available	approx. ± 78 mV
Measuring ranges (nominal) and resolution	± 30 mV (1 μ V per digit, thus max. 32.768 mV can be displayed) ± 60 mV (2 μ V per digit, thus max. 65.536 mV can be displayed) ± 75 mV (4 μ V per digit, thus max. 131 mV can be displayed, observe technical 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	See Measurement ± 30 mV...± 75 mV [► 58]

Temperature measurement	EL3314
Electrical measuring range used	± 75 mV
Measuring ranges ¹⁾	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01 °C per digit, preset 0.1 °C Note: internally, 16 bit are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type K: approx. 0.04 °C.
Measurement uncertainty	See Thermocouples measurement [► 59]

1) from FW10, Rev0025

Supply and potentials		EL3314
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±2 V
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	Not applicable because GND is not accessible
	Destruction limit, short-term/continuous	
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3314
Configuration		via TwinCAT System Manager
Width in the process image		max. 16 bytes input, max. 8 bytes output
Distributed Clocks		-

Environmental conditions		EL3314
Permissible ambient temperature range during operation		-25 °C...+60 °C (extended temperature range), from firmware 06
Permissible ambient temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3314
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		variable

Standards and approvals		EL3314
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [► 214]
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 206] , IECEX [► 207] , cFMus [► 208] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEX	Ex ec IIC T4 Gc
cFMus	Class I, Division 2, Groups A, B, C, D Class I, Zone 2, AEx/Ex ec IIC T4 Gc

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.3.2.2 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.24\%_{FSV}$ typ. $\approx \pm 0.070$ mV
	@ 55°C ambient temperature	< $\pm 0.26\%_{FSV}$ typ. $\approx \pm 0.077$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.16\%_{FSV}$ typ. $\approx \pm 0.094$ mV
	@ 55°C ambient temperature	< $\pm 0.17\%_{FSV}$ typ. $\approx \pm 0.10$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.14\%_{FSV}$ typ. $\approx \pm 0.11$ mV
	@ 55°C ambient temperature	< $\pm 0.15\%_{FSV}$ typ. $\approx \pm 0.12$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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.

2.3.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314 and EL3314-0090, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±2.0°C
Temperature coefficient	Tk	< 40 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 75 mV
Measuring range, technically available		+600 °C ≈ 1.792 mV ... +1800 °C ≈ 13.591 mV
Measuring range, end value (full scale value)		+1800 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01 °C/digit, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type B: approx. 0.05 °C.
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 8.5 K ≈ ± 0.47 % _{FSV}
	@ 55 °C ambient temperature	± 9.7 K ≈ ± 0.54 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ °C}$ 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:

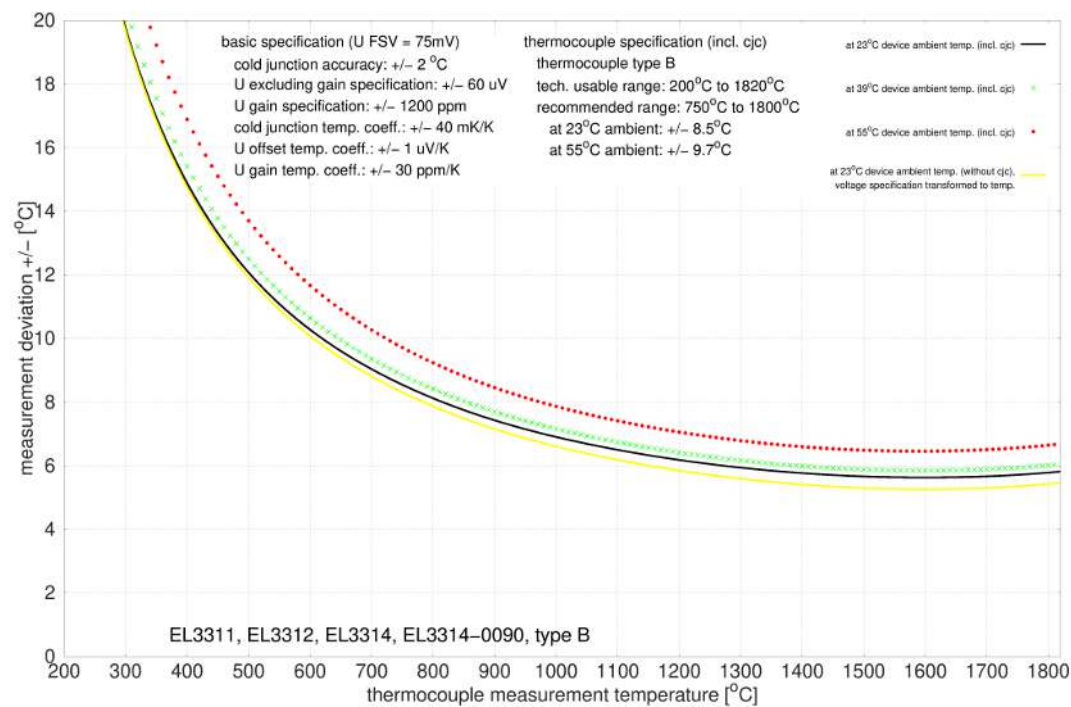


Fig. 31: EL3311, EL3312, EL3314, EL3314-0090, type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type C: approx. 0.07°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 6.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.4\text{ K} \approx \pm 0.32\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ 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:

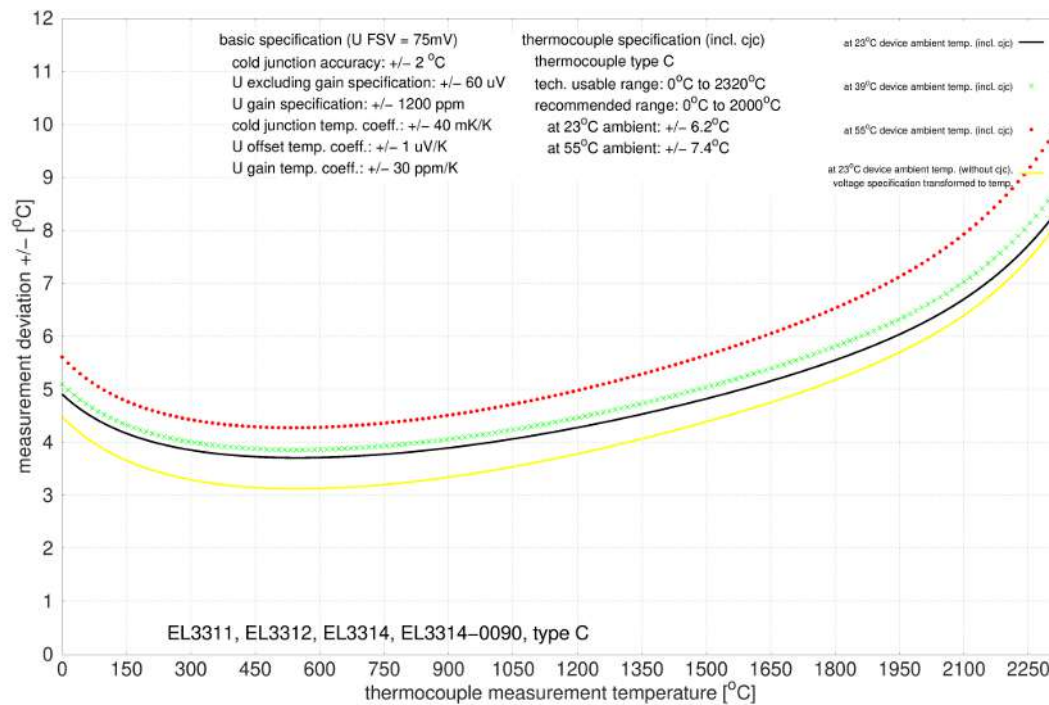


Fig. 32: EL3311, EL3312, EL3314, EL3314-0090, type C

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -5.237\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type E: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

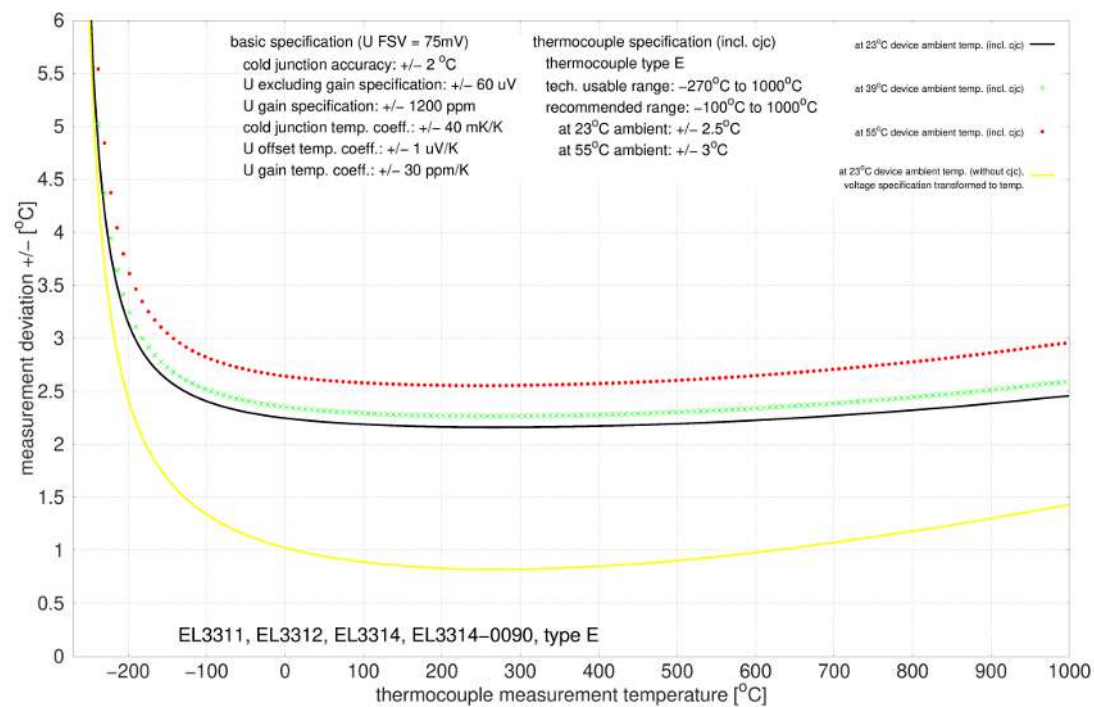


Fig. 33: EL3311, EL3312, EL3314, EL3314-0090, type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -4.632\text{ mV} \dots +1200^{\circ}\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		0.1/0.01 $^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01 $^{\circ}\text{C}$ "; e.g. type J: approx. 0.04 $^{\circ}\text{C}$.
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.7\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

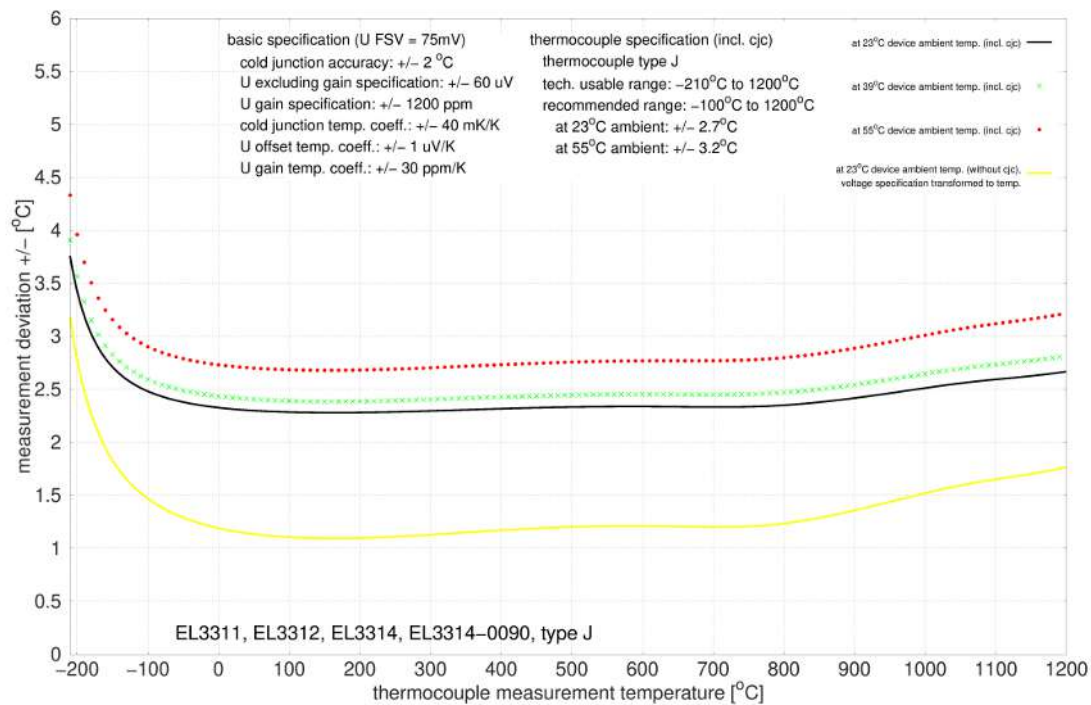


Fig. 34: EL3311, EL3312, EL3314, EL3314-0090, type J

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^\circ\text{C} \approx -5.891\text{ mV} \dots +1370^\circ\text{C} \approx 54.818\text{ mV}$
Measuring range, end value (full scale value)		$+1370^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type K: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.22\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

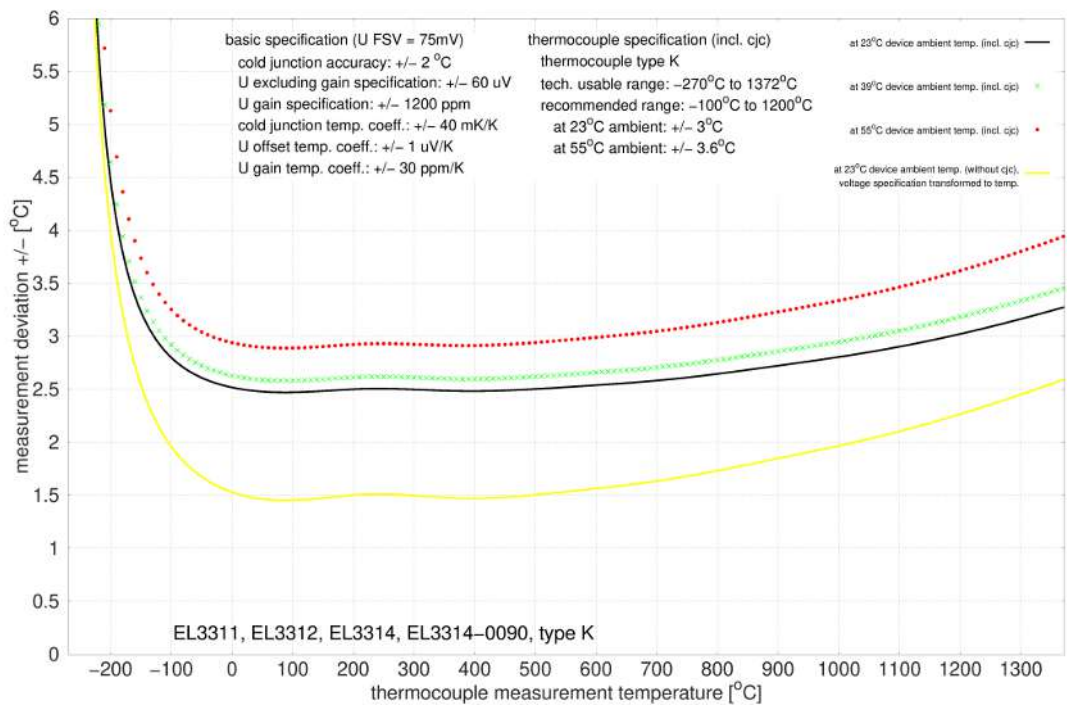


Fig. 35: EL3311, EL3312, EL3314, EL3314-0090, type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type L: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.8\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

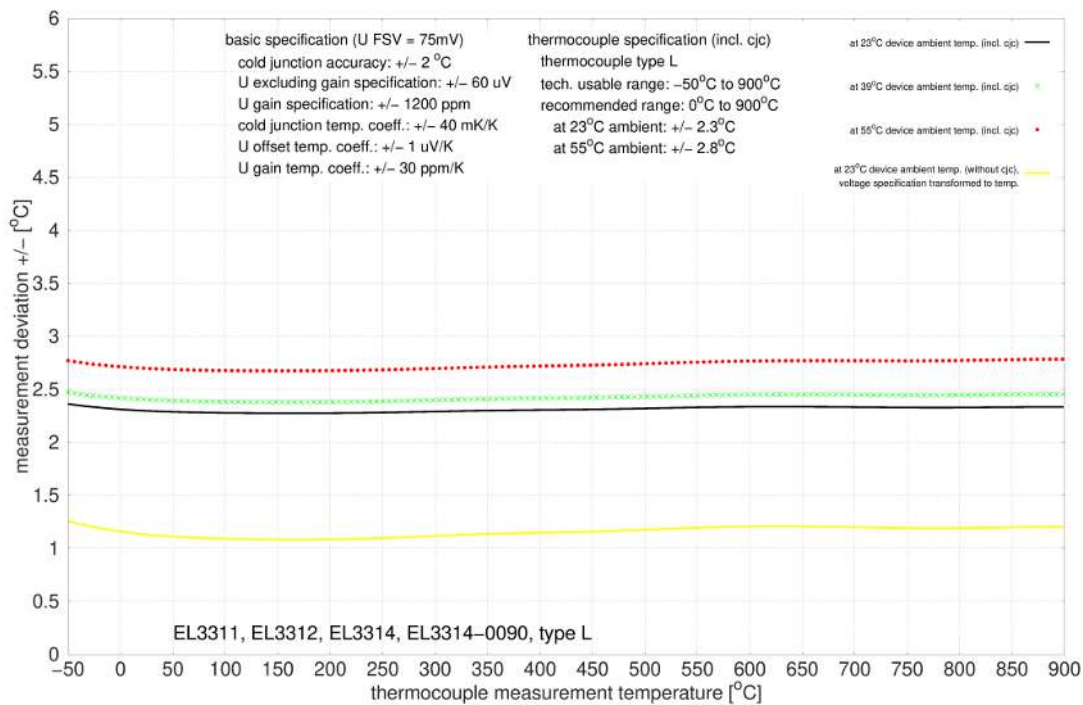


Fig. 36: EL3311, EL3312, EL3314, EL3314-0090, type L

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^\circ\text{C} \approx -2.406\text{ mV} \dots +1300^\circ\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300^\circ\text{C}$
Measuring range, recommended		$0^\circ\text{C} \dots +1300^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type N: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

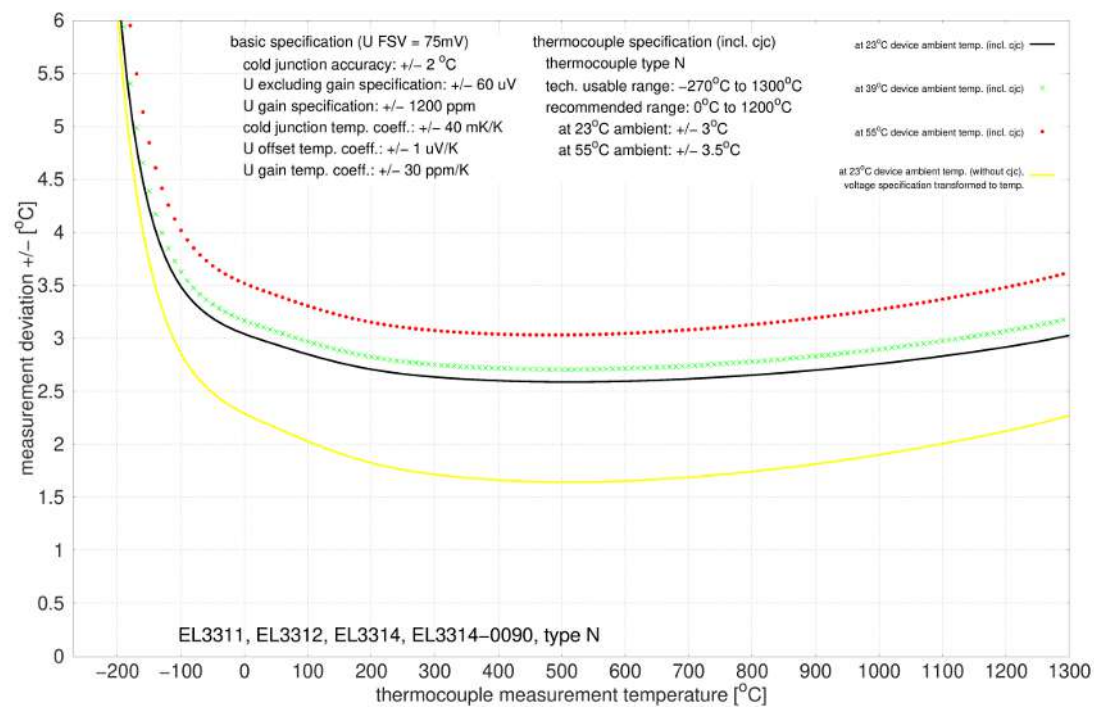


Fig. 37: EL3311, EL3312, EL3314, EL3314-0090, type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1767^{\circ}\text{C} \approx 21.089\text{ mV}$
Measuring range, end value (full scale value)		$+1767^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type R: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 6.7\text{ K} \approx \pm 0.38\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.7\text{ K} \approx \pm 0.44\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

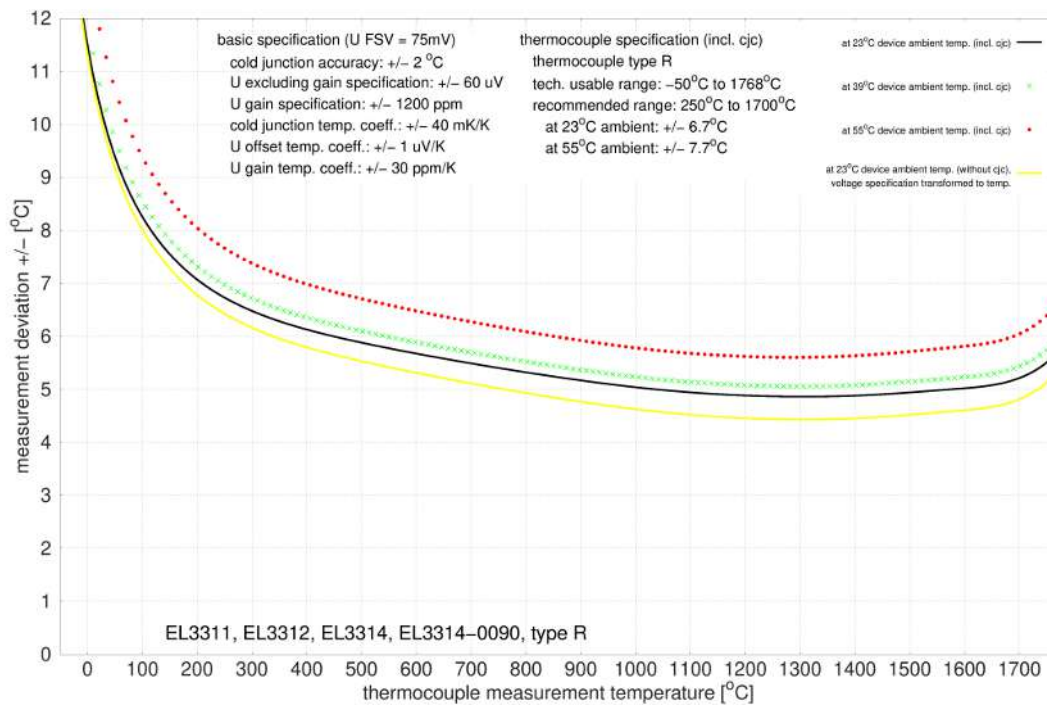


Fig. 38: EL3311, EL3312, EL3314, EL3314-0090, type R

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1760^{\circ}\text{C} \approx 17.947\text{ mV}$
Measuring range, end value (full scale value)		$+1760^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type S: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 7.1\text{ K} \approx \pm 0.40\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 8.1\text{ K} \approx \pm 0.46\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

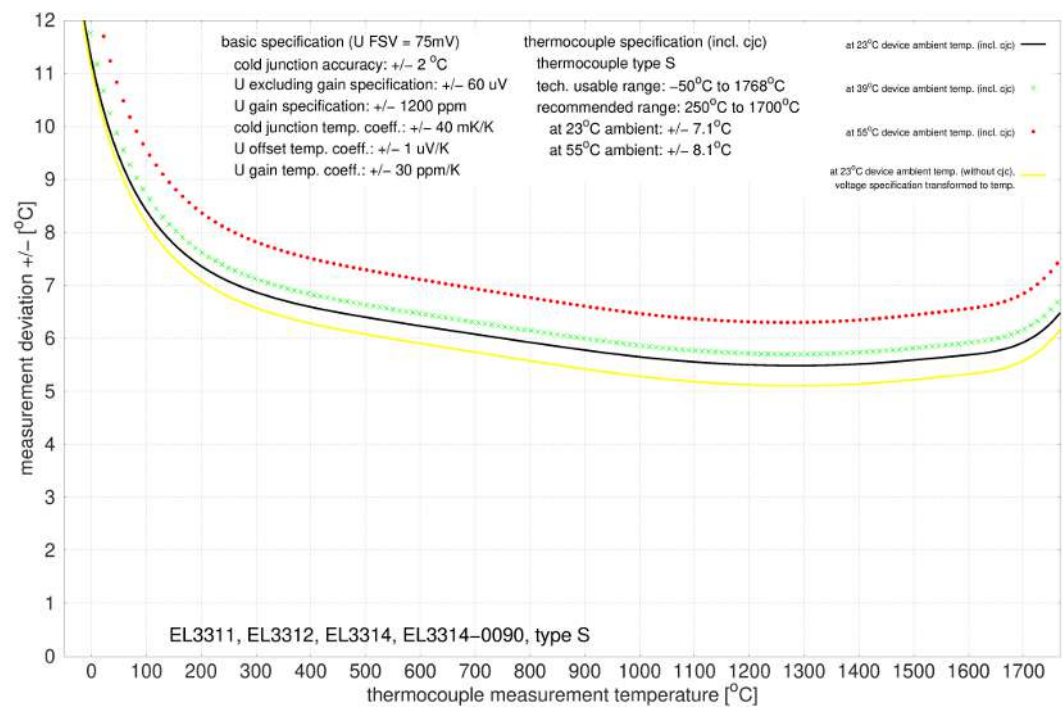


Fig. 39: EL3311, EL3312, EL3314, EL3314-0090, type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.603\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.73\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.4\text{ K} \approx \pm 0.85\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

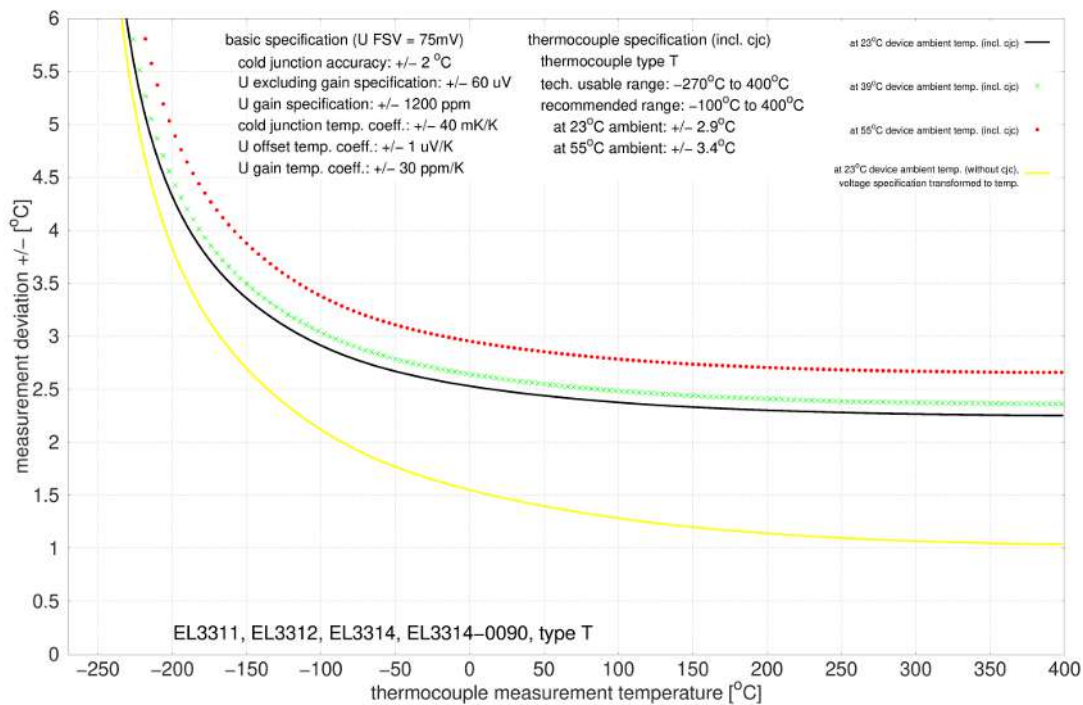


Fig. 40: EL3311, EL3312, EL3314, EL3314-0090, type T

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type U: approx. 0.02°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.42\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.48\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

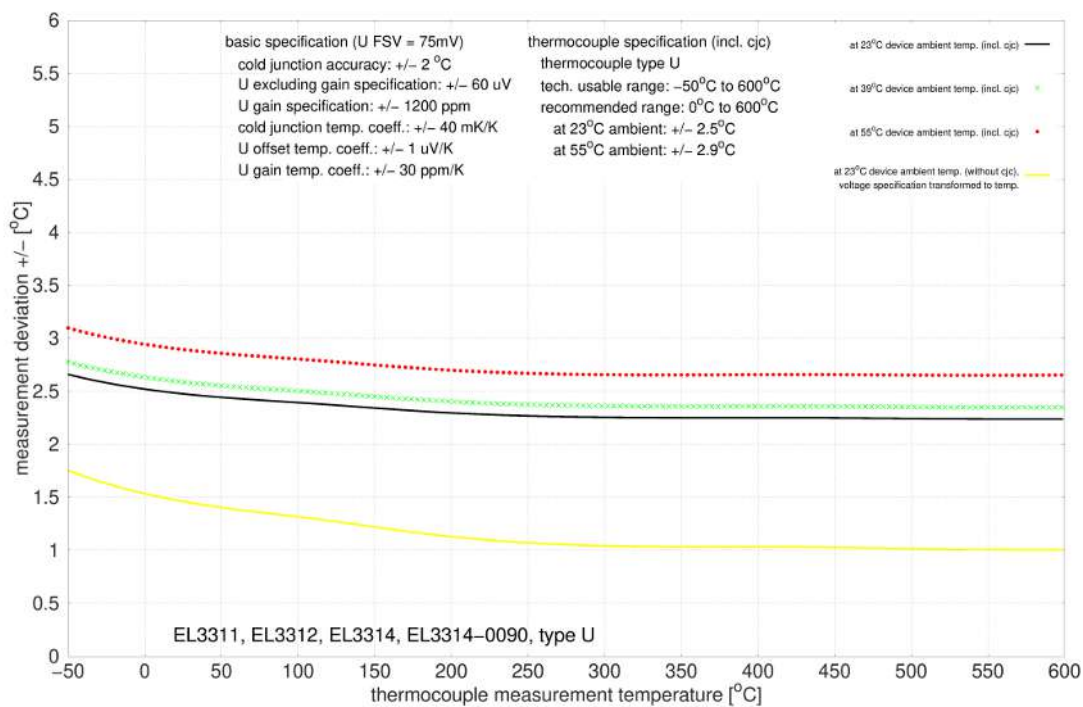


Fig. 41: EL3311, EL3312, EL3314, EL3314-0090, type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.3.3 Connection

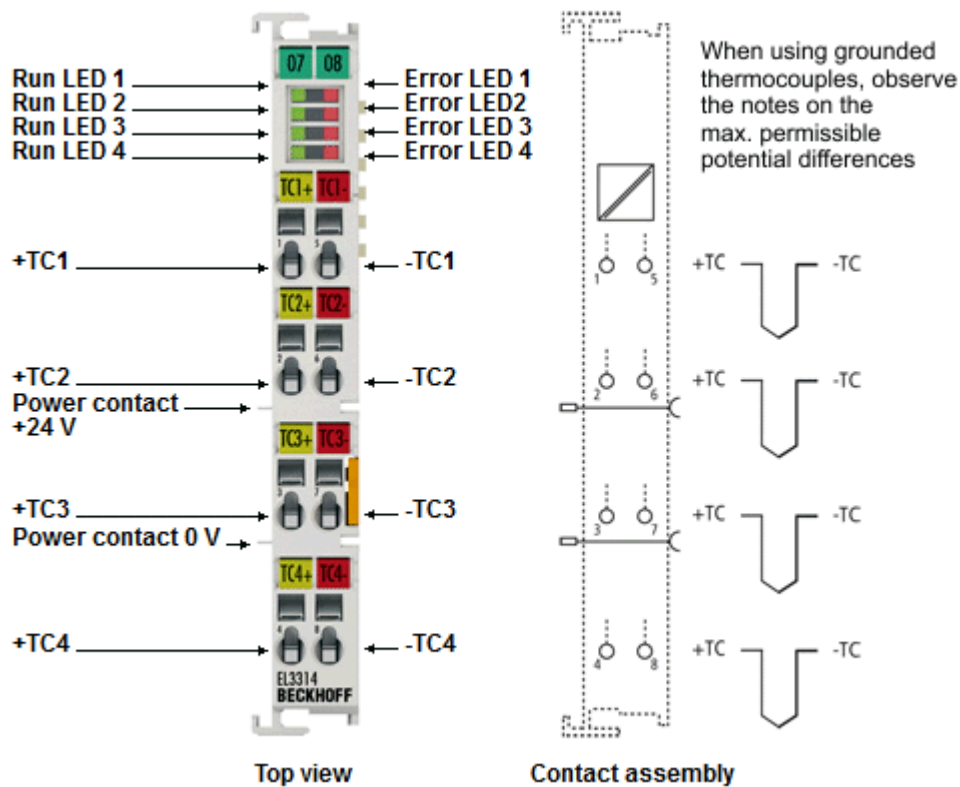


Fig. 42: EL3314

EL3314 - Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

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

2.3.4 Display, diagnostics

EL3314 - LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly	State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly	State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly	State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-4	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.	

2.4 EL3314-0002

2.4.1 Introduction

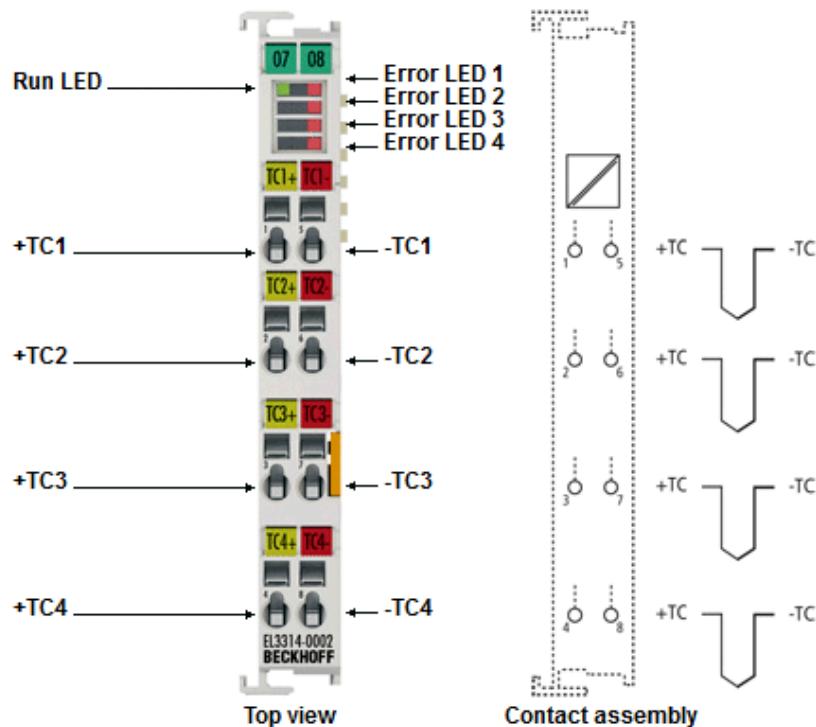


Fig. 43: EL3314-0002

4-channel input terminal, thermocouple, high-precision, electrically isolated

The EL3314-0002 analog input terminal allows the direct connection of four thermocouples in 2-wire configuration. The channels are electrically isolated from each other and from the E-bus, thus preventing adverse effects and damage due to cross currents. Various types of thermocouple are supported; the conversion of the voltage to temperature is already carried out within the terminal. Wire break is signaled by error LEDs and on the fieldbus. The cold junction compensation is carried out by an internal precise temperature measurement at the connection terminals; however, operation with an external cold junction or voltage measurement without cold junction calculation is also possible.

For high-precision measurements please note the following:

- Before delivery the terminal is calibrated against a high-precision reference voltage.
- The terminal is set by default to 0.01 °C/digit "high resolution".
- The assured accuracy applies to the following settings:
 - 50 Hz filter
 - 23 ± 5 °C ambient temperature
 - horizontal installation position
- In addition it has the following features:
 - An additional software-based "MC filter" can be used for smoothing the measured value.
 - External cold junction compensation is possible.
- We advise against the use of compensation wires, because they reduce the measuring accuracy of the terminal.
- We recommend using thermocouples with suitable accuracy.

Quick links

- [EtherCAT basics](#)
- [CoE object description and parameterization](#) [► 276]
- [Technology EL33xx](#)
- [Process data and operation modes](#) [► 230]

2.4.2 Technical data

2.4.2.1 General technical data

Analog inputs	EL3314-0002
Number of inputs	4
Thermocouple sensor types, measured variables	Type B, C, E, J, K, L, N, R, S, T, U (default setting: type K), voltage measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 24 bit
Sampling type	simultaneous
Ground reference	Differential
Conversion time	approx. 2.4 s to 4 ms depending on configuration and filter setting; Preset: approx. 120 ms at 50/60 Hz
Input filter cut-off frequency	typ. 1 kHz
Software filter	2.5...4000 Hz, adjustable, notch characteristic; preset 50/60 Hz additional low-pass filter possible
Wire break detection	yes (can be disabled)
Supports NoCoeStorage [► 197] function	yes
Special features	high-precision, electrical isolation

Voltage measurement	EL3314-0002
Measuring ranges	$\pm 78 \text{ mV}$ $\pm 2.5 \text{ V}$
Resolution	1 μV per digit
Measurement uncertainty	See Measurement $\pm 78 \text{ mV} \dots \pm 2.5 \text{ V}$ [► 76]

Temperature measurement	EL3314-0002
Electrical measuring range used	$\pm 78 \text{ mV}$
Measuring ranges	Type B: $+200 \dots +1820 \text{ }^{\circ}\text{C}$ Type C: $0 \dots +2320 \text{ }^{\circ}\text{C}$ Type E: $-270 \dots +1000 \text{ }^{\circ}\text{C}$ Type J: $-210 \dots +1200 \text{ }^{\circ}\text{C}$ Type K: $-270 \dots +1372 \text{ }^{\circ}\text{C}$ (preset) Type L: $-50 \dots +900 \text{ }^{\circ}\text{C}$ Type N: $-270 \dots +1300 \text{ }^{\circ}\text{C}$ Type R: $-50 \dots +1768 \text{ }^{\circ}\text{C}$ Type S: $-50 \dots +1768 \text{ }^{\circ}\text{C}$ Type T: $-270 \dots +400 \text{ }^{\circ}\text{C}$ Type U: $-50 \dots +600 \text{ }^{\circ}\text{C}$
Resolution	Temperature display 0.1/0.01/0.001 $^{\circ}\text{C}$ per digit, preset 0.01 $^{\circ}\text{C}$
Measurement uncertainty	See Thermocouples measurement [► 77]

Supply and potentials	EL3314-0002
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 200 mA
Electrical isolation	2.5 kV functional isolation (test voltage 7 s channel/channel and channel/fieldbus, production test)
Max. potential $\pm\text{TC}$ to ground	2.5 kV (test voltage production test)
Max. differential voltage between the $\pm\text{TC}$ inputs	$\pm 15 \text{ V}$ continuous

Communication	EL3314-0002
Configuration	via TwinCAT System Manager
Width in the process image	max. 24 bytes input, max. 8 bytes output
Distributed Clocks	-

Environmental conditions	EL3314-0002
Permissible temperature range during operation	0 °C... + 55 °C
Permissible temperature range during storage	-25 °C... + 85 °C
Permissible relative air humidity	95 %, no condensation

General data	EL3314-0002
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight	approx. 60 g
Installation [► 203]	on 35 mm mounting rail, conforms to EN 60715
Installation position	To ensure enhanced measuring accuracy, the terminal must be installed in the <u>prescribed standard position!</u> See note! [► 224]

Standards and approvals	EL3314-0002
Protection rating	IP20
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}	CE, UKCA, EAC cULus [► 210]

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

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.4.2.2 Measurement $\pm 78 \text{ mV} \dots \pm 2.5 \text{ V}$

Specification $\pm 78 \text{ mV}$

Measurement mode		$\pm 78 \text{ mV}$
Measuring range, nominal		$-78 \dots +78 \text{ mV}$
Measuring range, end value (full scale value)		78 mV
PDO resolution		$1 \mu\text{V}$
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.06\%_{\text{FSV}}$ typ.
	@ 55°C ambient temperature ¹	$< \pm 0.13\%_{\text{FSV}}$ typ.
Offset/zero point deviation (at 23°C) ²	F_{Offset}	$< \pm 10 \mu\text{V}$
Gain/scale/amplification deviation (at 23°C) ²	F_{Gain}	$< 500 \text{ ppm}$
Temperature coefficient	Tk_{Offset}	$< 0.5 \mu\text{V/K}$
	Tk_{Gain}	$< 15 \text{ ppm/K}$

Specification $\pm 2.5 \text{ V}$

The EL3314-0002 and EL3314-0092 are not calibrated in the electrical measuring range $\pm 2.5 \text{ V}$ at the factory. However, the measuring range can be used after calibration on the application side.

Measurement mode		$\pm 2.5 \text{ V}$
Measuring range, nominal		$-2.5 \dots +2.5 \text{ V}$
Measuring range, end value (full scale value)		2.5 V
PDO resolution		$1 \mu\text{V}$

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.

2.4.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314-0002 and EL3314-0092, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: measurement deviation at 23 °C, with averaging		< ±1.75 °C
Temperature coefficient	Tk	< 25 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 78 mV
Measuring range, technically available		+200 °C ≈ 0.178 mV ... +1820 °C ≈ 13.820 mV
Measuring range, end value (full scale value)		+1820 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.2 K ≈ ± 0.12 % _{FSV}
	@ 55 °C ambient temperature	± 3.3 K ≈ ± 0.18 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

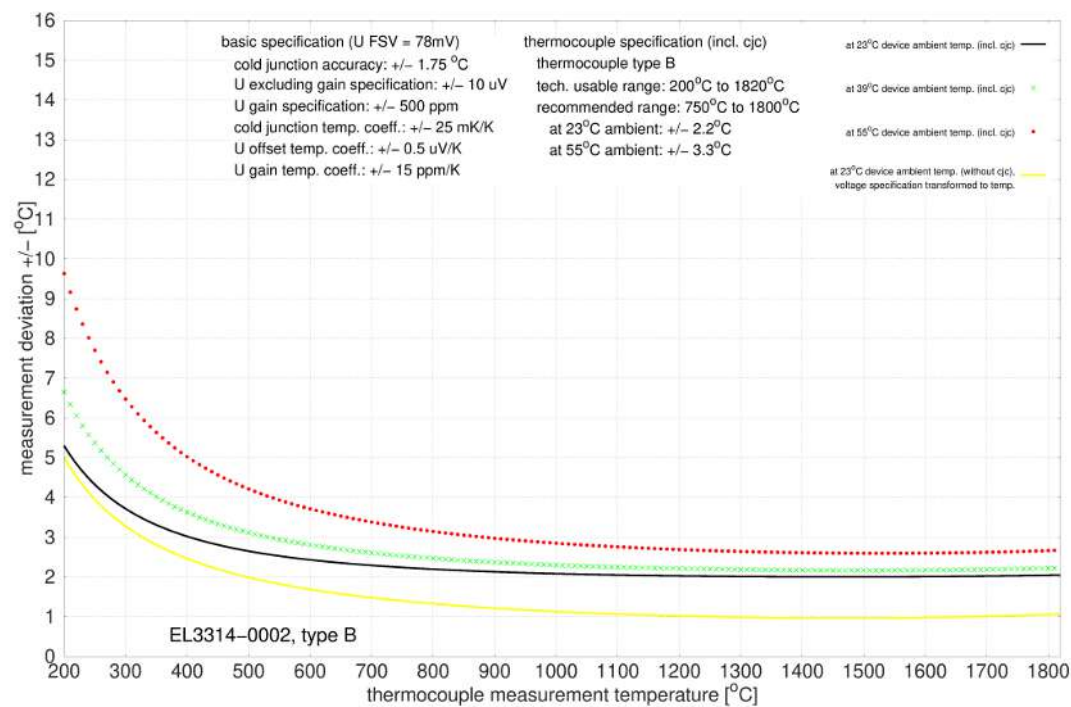


Fig. 44: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$0\text{ }^{\circ}\text{C} \approx 0\text{ mV} \dots +2320\text{ }^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +2000\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.4\text{ K} \approx \pm 0.10\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.1\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

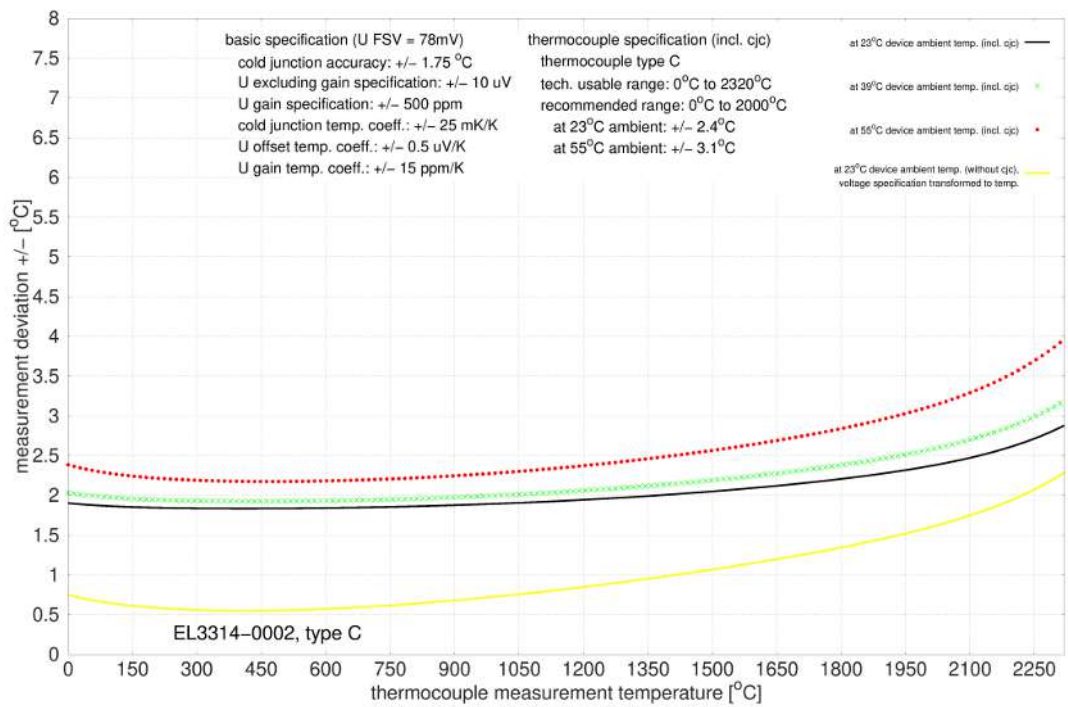


Fig. 45: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -9.835\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.18\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.21\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

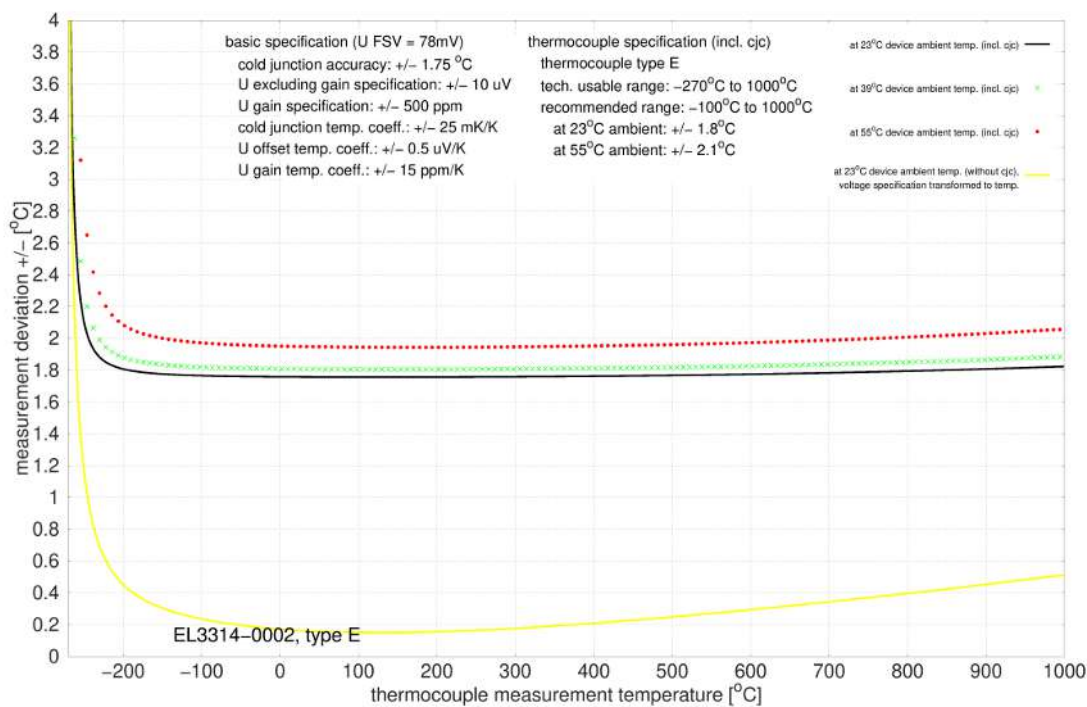


Fig. 46: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-210^{\circ}\text{C} \approx -8.095\text{ mV} \dots +1200^{\circ}\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.18\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

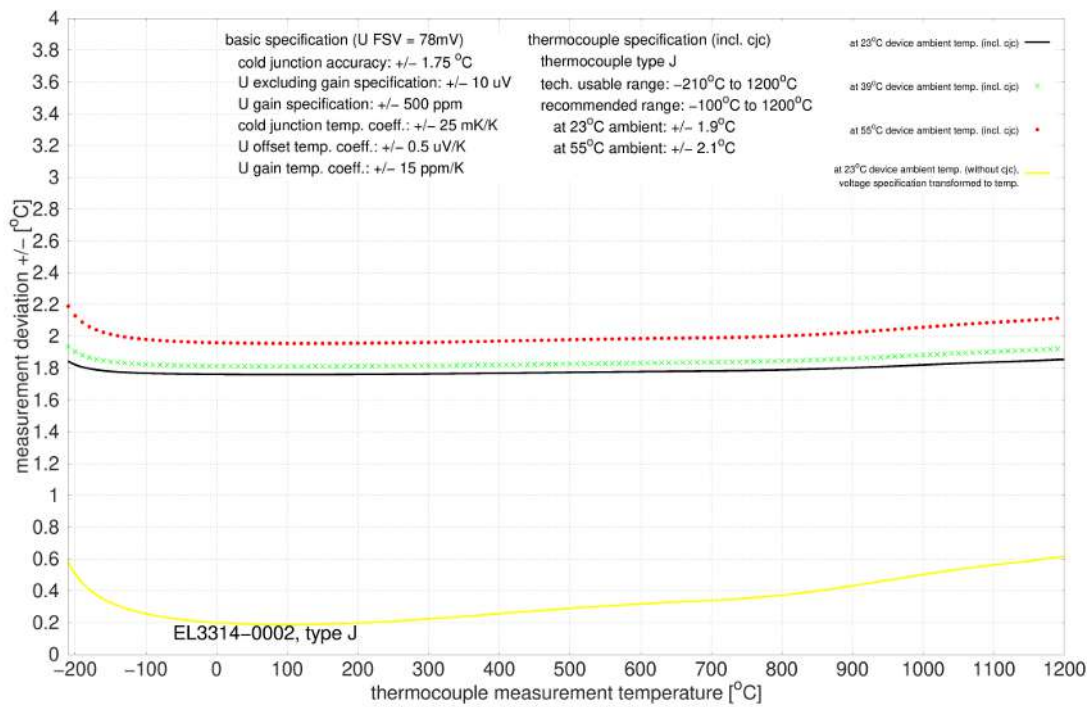


Fig. 47: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -6.458\text{ mV} \dots +1372^{\circ}\text{C} \approx 54.886\text{ mV}$
Measuring range, end value (full scale value)		$+1372^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.14\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.2\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

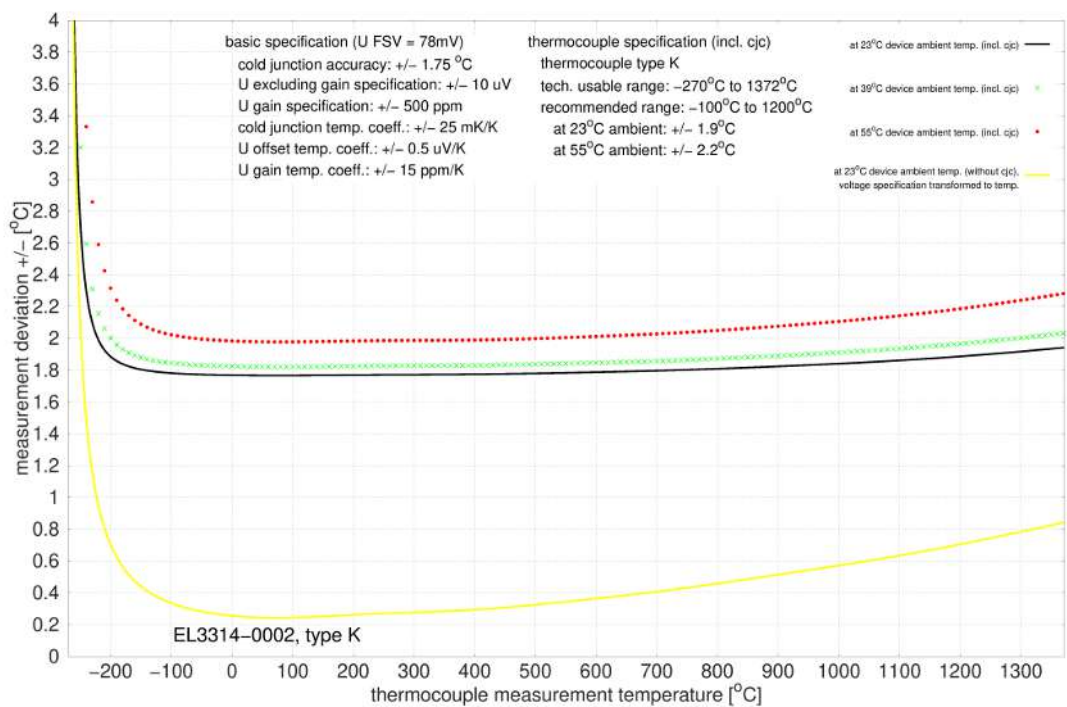


Fig. 48: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -2.510\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.20\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.22\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

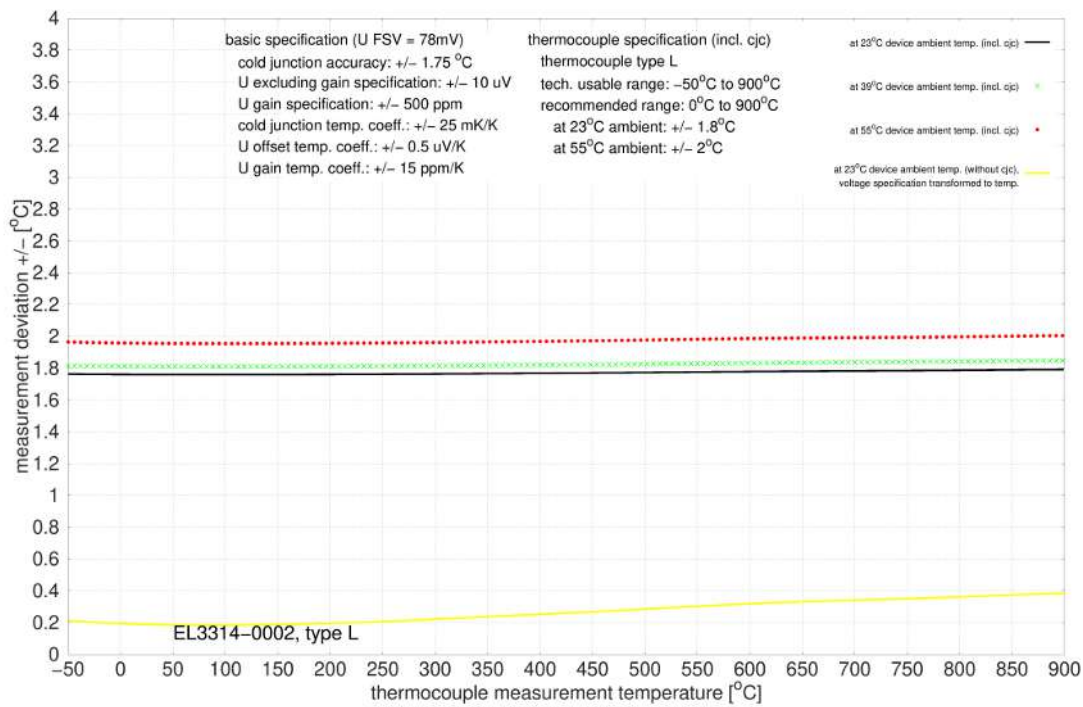


Fig. 49: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		± 78 mV
Measuring range, technically available		-270 °C ≈ -4.346 mV ... +1300 °C ≈ 47.513 mV
Measuring range, end value (full scale value)		+1300 °C
Measuring range, recommended		0 °C ... +1300 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 1.9 K ≈ ± 0.15 % _{FSV}
	@ 55 °C ambient temperature	± 2.1 K ≈ ± 0.16 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

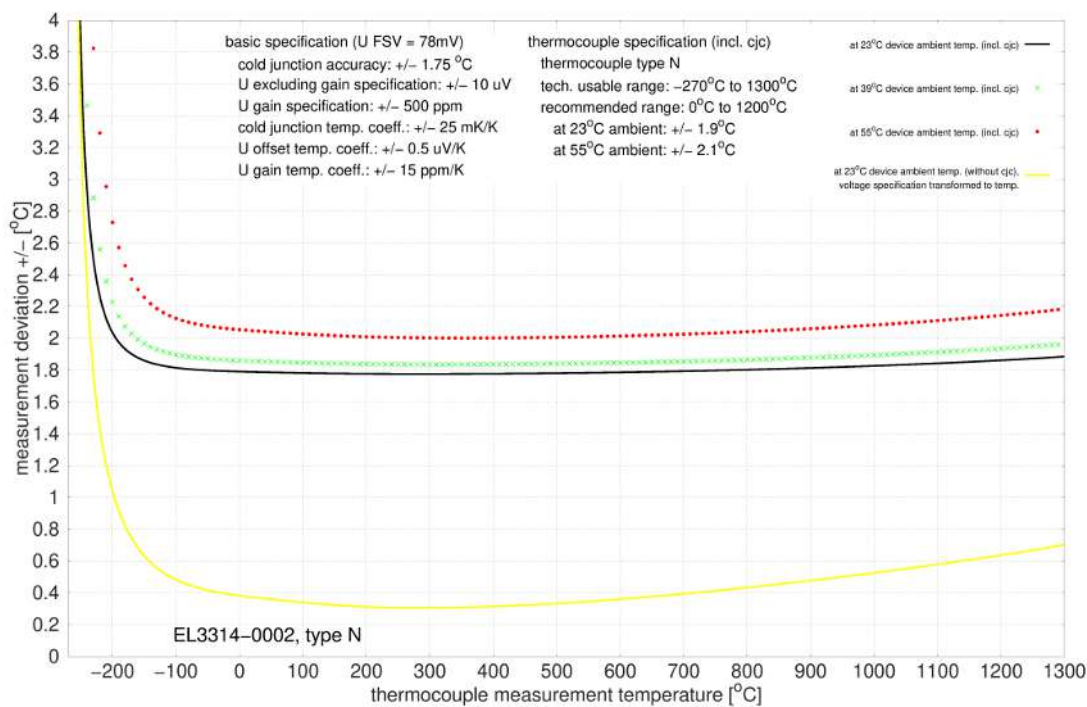


Fig. 50: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -0.226\text{ mV} \dots +1768\text{ }^{\circ}\text{C} \approx 21.101\text{ mV}$
Measuring range, end value (full scale value)		$+1768\text{ }^{\circ}\text{C}$
Measuring range, recommended		$+250\text{ }^{\circ}\text{C} \dots +1700\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.12\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.8\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

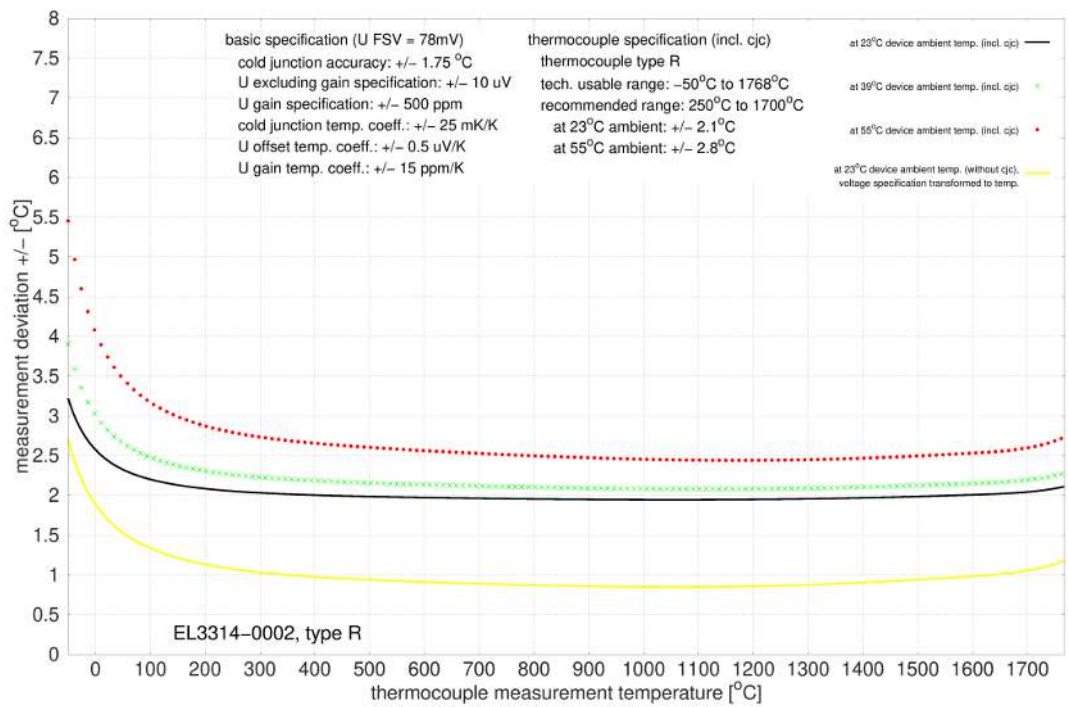


Fig. 51: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -0.236\text{ mV} \dots +1768\text{ }^{\circ}\text{C} \approx 18.693\text{ mV}$
Measuring range, end value (full scale value)		$+1768\text{ }^{\circ}\text{C}$
Measuring range, recommended		$+250\text{ }^{\circ}\text{C} \dots +1700\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.12\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.16\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

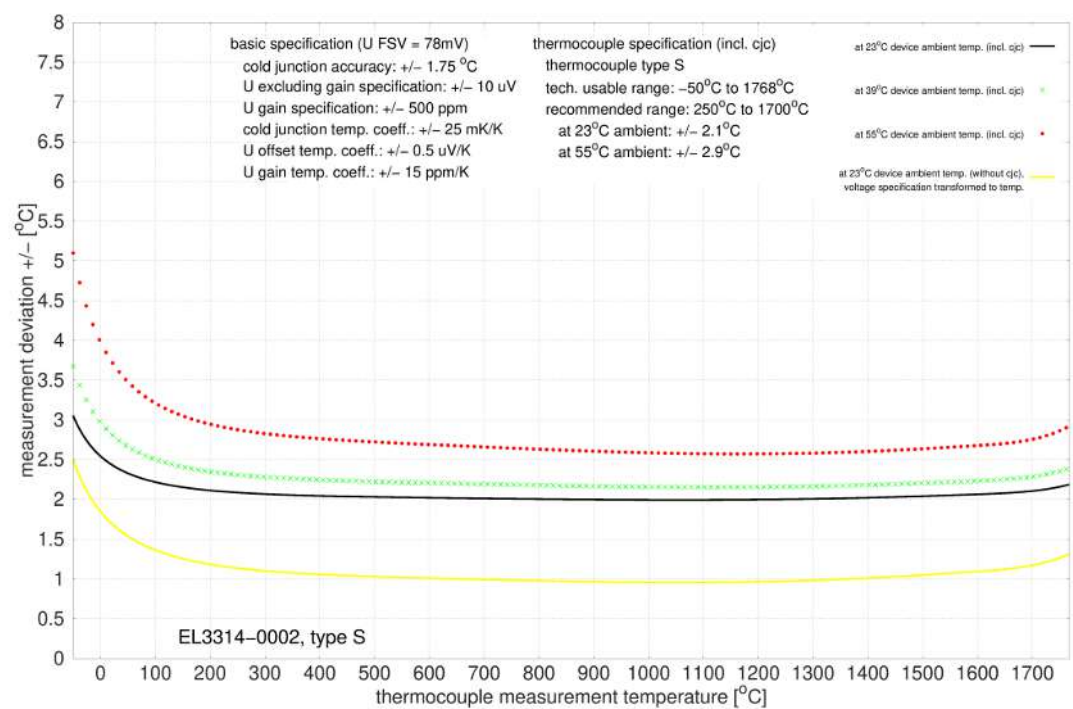


Fig. 52: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -6.258\text{ mV} \dots +400\text{ }^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +400\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.45\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.50\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

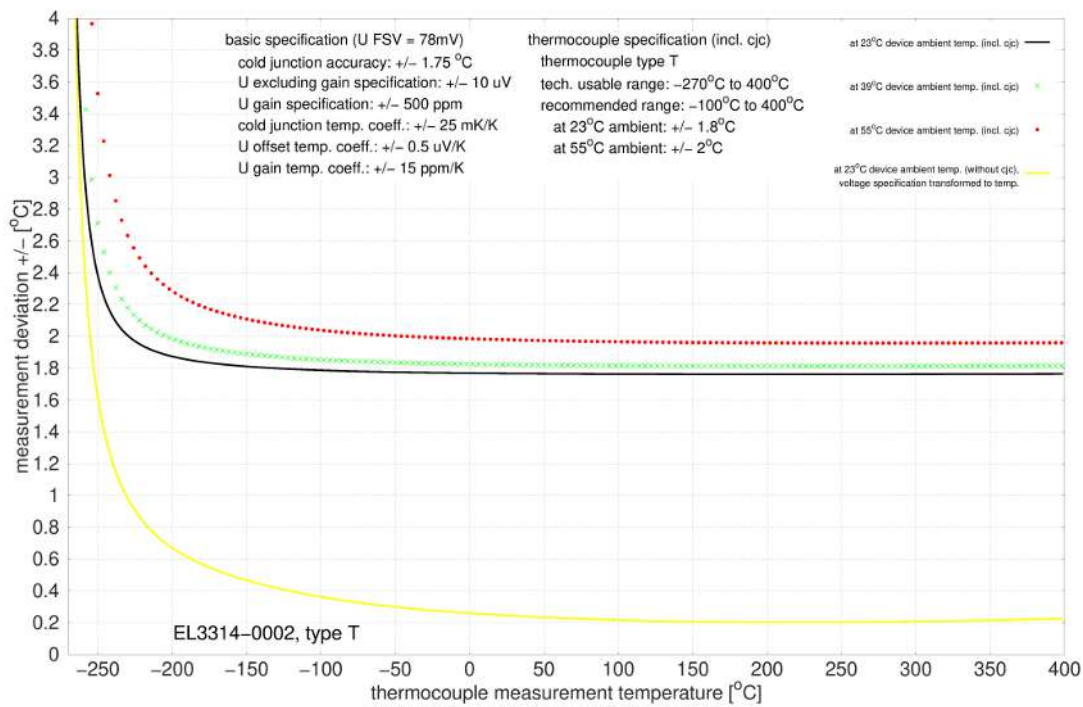


Fig. 53: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -1.850\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.33\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

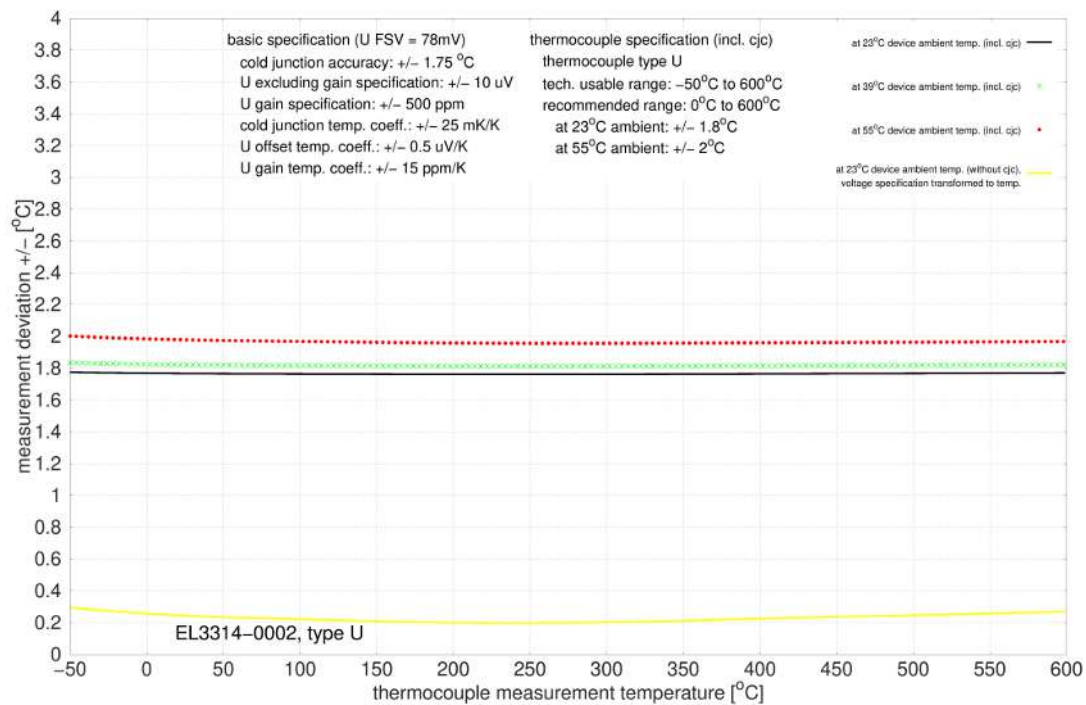


Fig. 54: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.4.3 Connection

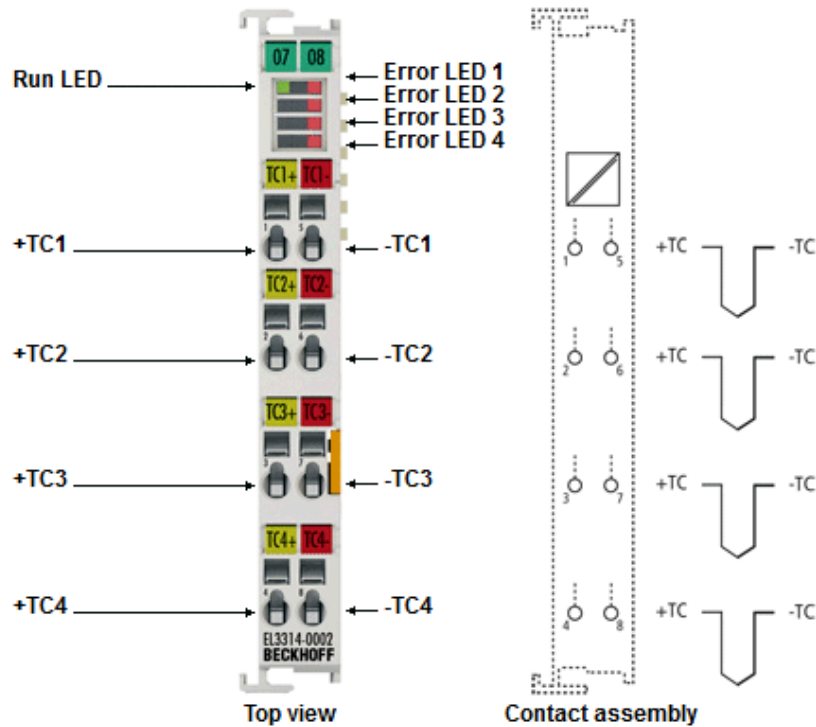


Fig. 55: EL3314-0002

EL3314-0002 – Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

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

2.4.4 Display, diagnostics

EL3314-0002 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-4	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.

2.4.5 Recommended accessory: Insertable label cover BZ32xx



Fig. 56: BZ3201

NOTICE**Accessory recommendation (BZ32xx) for terminals with potentially hazardous voltages**

When connecting potentially hazardous voltages to terminals of the ELxxxx and KLxxxx series with standard wiring, Beckhoff recommends using the insertable, transparent labeling cover [BZ3201](#) with the laser-engraved lettering "HIGH VOLTAGE" or the unlabeled version [BZ3200](#).

2.5 EL3314-0010

2.5.1 Introduction

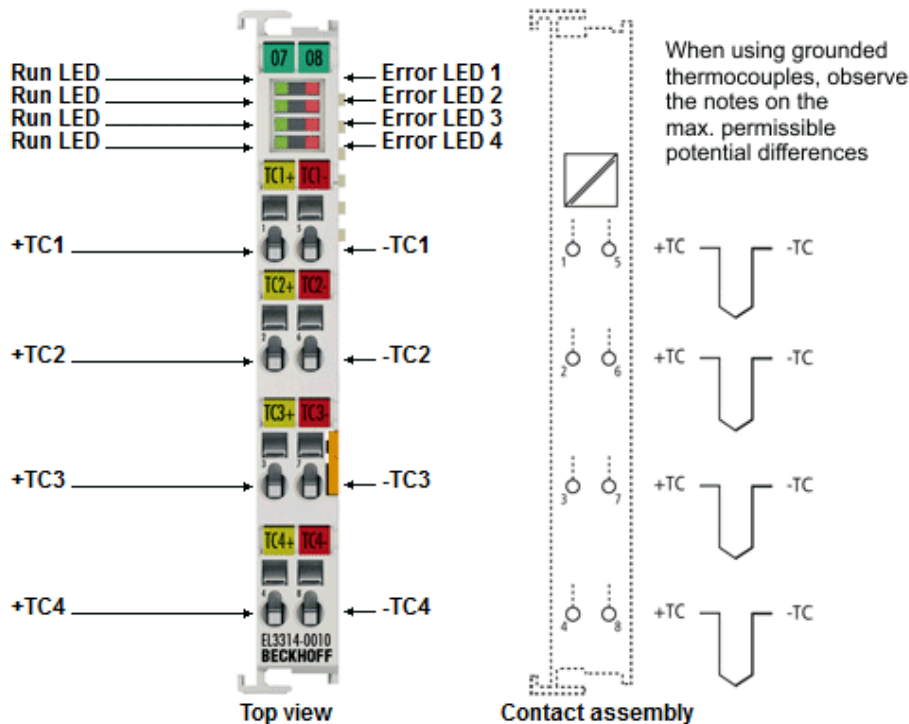


Fig. 57: EL3314-0010

High-precision 4 channel analog input terminal for thermocouples, with wire break detection

The EL3314-0010 analog Input Terminal enables direct connection of thermocouples. Compared with the standard EL3314 model, it offers significantly more precise temperature measurements thanks to improved measuring circuit and more precise reference junction measurement. Otherwise the EL3314-0010 behaves similar to the EL3314.

For high-precision measurements please note the following:

- Before delivery the EL3314-0010 is calibrated against a high-precision reference voltage.
- The terminal is set by default to 0.01 °C/digit "high resolution".
- The assured accuracy applies to the following settings:
 - 50 Hz filter
 - 23 ± 5 °C ambient temperature
 - horizontal installation position
- In addition it has the following features:
 - An additional software-based "MC filter" can be used for smoothing the measured value.
 - External cold junction compensation is possible (cold junction compensation, from FW03).
- We advise against the use of compensation wires, because they reduce the measuring accuracy of the EL3314-0010.
- We recommend using thermocouples with suitable accuracy.

Quick links

- [EtherCAT basics](#)
- [CoE object description and parameterization](#) [► 283]
- [Technology EL33xx](#)
- [Process data and operation modes](#) [► 230]

2.5.2 Technical data

2.5.2.1 General technical data

Analog inputs	EL3314-0010
Number of inputs	4
Thermocouple sensor types, measured variables	Type B, C, E, J, K, L, N, R, S, T, U (default setting: type K), voltage measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 24 bit
Sampling type	multiplex
Ground reference	Differential
Conversion time	approx. 1.6 s to 12 ms depending on configuration and filter setting; Preset: approx. 165 ms at 50/60 Hz
Input filter cut-off frequency	typ. 1 kHz
Software filter	5...30 kHz, adjustable, notch characteristic; preset 50 Hz additional low-pass filter possible
Wire break detection	yes
Supports NoCoeStorage [► 197] function	yes
Special features	high-precision

Voltage measurement	EL3314-0010
Measuring range, technically available	approx. ± 80 mV
Measuring range, nominal	± 78 mV
Resolution	10 nV per digit
Measurement uncertainty	See Measurement ± 78 mV [► 96]

Temperature measurement	EL3314-0010
Electrical measuring range used	± 78 mV
Measuring ranges	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01/0.001 °C per digit, preset 0.01 °C
Measurement uncertainty	See Thermocouples measurement [► 97]

Supply and potentials		EL3314-0010
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±2 V
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	Not applicable because GND is not accessible
	Destruction limit, short-term/continuous	
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3314-0010
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Electrical isolation		500 V (E-bus/field voltage)

Environmental conditions		EL3314-0010
Permissible temperature range during operation		-25 °C...+60 °C
Permissible temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3314-0010
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		To ensure enhanced measuring accuracy, the terminal must be installed in the prescribed standard position! See note [► 224] !

Standards and approvals		EL3314-0010
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 205] , IECEx [► 207] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEx	Ex ec IIC T4 Gc

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.5.2.2 Measurement ± 78 mV**Specification ± 78 mV**

Measurement mode		± 78 mV
Measuring range, nominal		-78...+78 mV
Measuring range, end value (full scale value)		78 mV
PDO resolution		10 nV
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< $\pm 0.06\%_{FSV}$ typ.
	@ 55°C ambient temperature ¹	< $\pm 0.13\%_{FSV}$ typ.
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 15 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 400 ppm
Temperature coefficient	Tk _{Offset}	< 0.5 μ V/K
	Tk _{Gain}	< 15 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.

2.5.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314-0010 and EL3314-0030, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±1.5°C
Temperature coefficient	Tk	< 25 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 78 mV
Measuring range, technically available		+200 °C ≈ 0.178 mV ... +1820 °C ≈ 13.820 mV
Measuring range, end value (full scale value)		+1820 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.6 K ≈ ± 0.14 % _{FSV}
	@ 55 °C ambient temperature	± 3.5 K ≈ ± 0.19 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{amb} = 39\text{ °C}$ as the middle point between 23 °C and 55 °C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

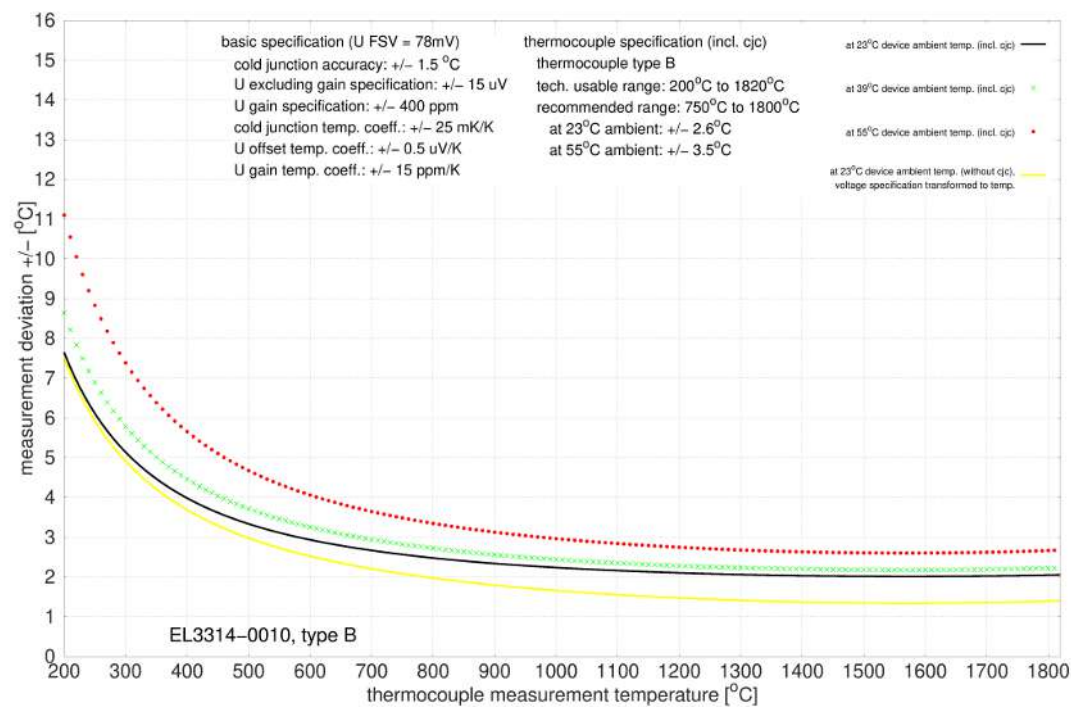


Fig. 58: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$0\text{ }^{\circ}\text{C} \approx 0\text{ mV} \dots +2320\text{ }^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +2000\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.2\text{ K} \approx \pm 0.10\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

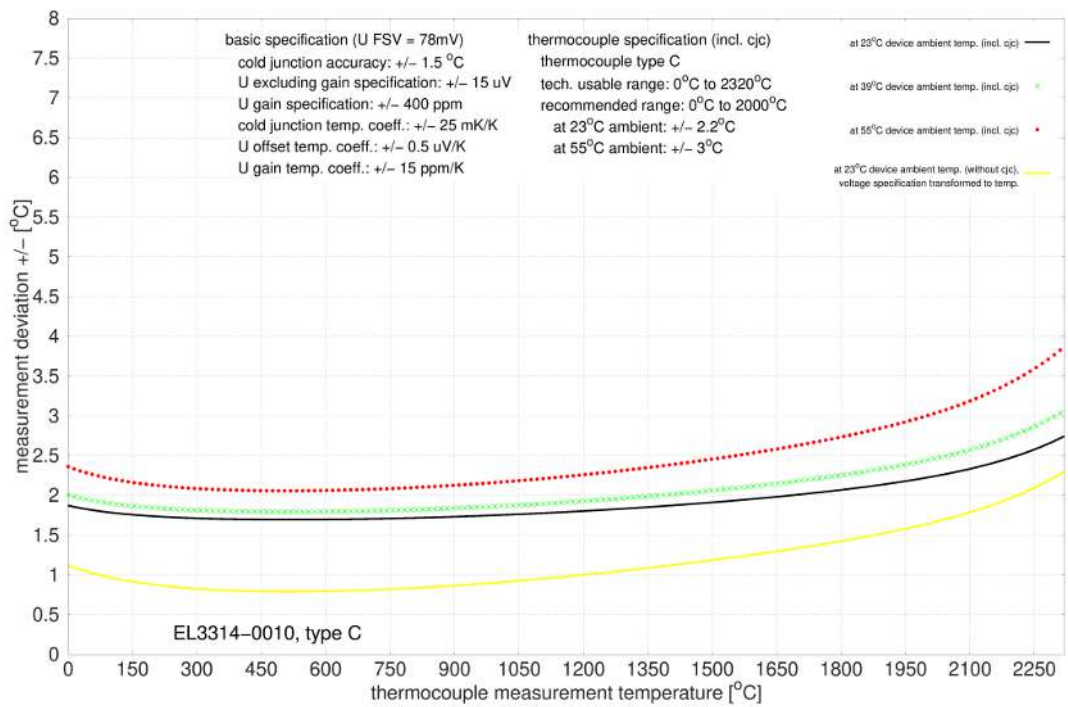


Fig. 59: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -9.835\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.18\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

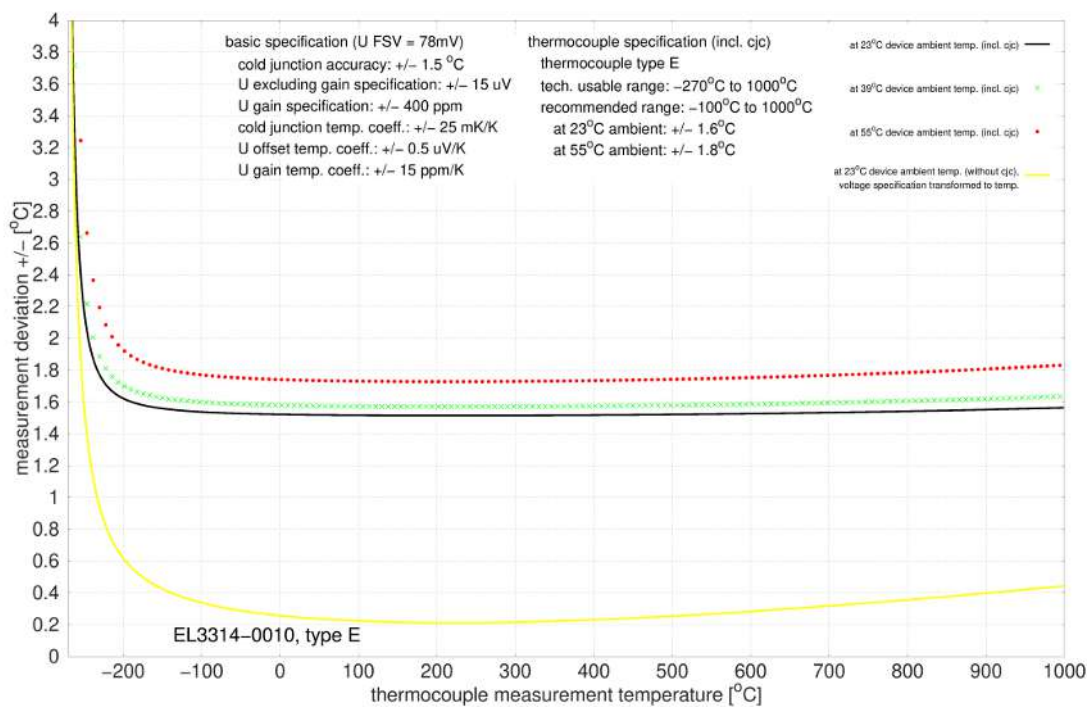


Fig. 60: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		± 78 mV
Measuring range, technically available		-210 °C ≈ -8.095 mV ... +1200 °C ≈ 69.553 mV
Measuring range, end value (full scale value)		+1200 °C
Measuring range, recommended		-100 °C ... +1200 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 1.6 K ≈ ± 0.13 % _{FSV}
	@ 55 °C ambient temperature	± 1.9 K ≈ ± 0.16 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

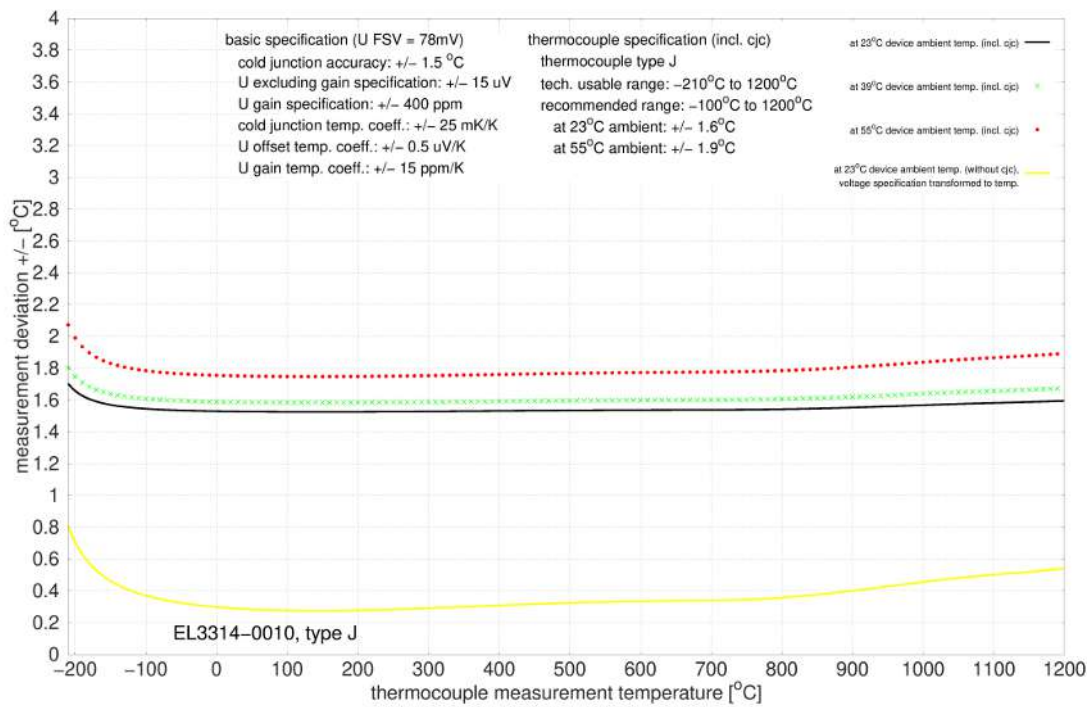


Fig. 61: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		± 78 mV
Measuring range, technically available		-270 °C ≈ -6.458 mV ... +1372 °C ≈ 54.886 mV
Measuring range, end value (full scale value)		+1372 °C
Measuring range, recommended		-100 °C ... +1200 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 1.6 K ≈ ± 0.12 % _{FSV}
	@ 55 °C ambient temperature	± 2.0 K ≈ ± 0.15 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

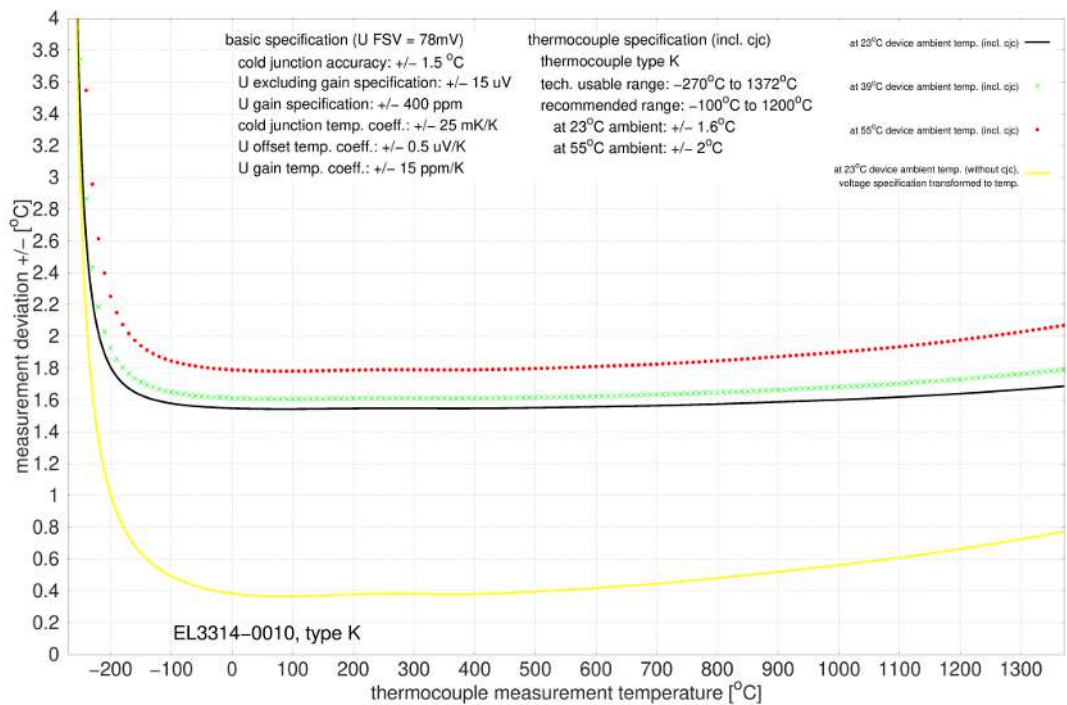


Fig. 62: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		± 78 mV
Measuring range, technically available		-50 °C ≈ -2.510 mV ... +900 °C ≈ 52.430 mV
Measuring range, end value (full scale value)		+900 °C
Measuring range, recommended		0 °C ... +900 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 1.5 K ≈ ± 0.17 % _{FSV}
	@ 55 °C ambient temperature	± 1.8 K ≈ ± 0.20 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

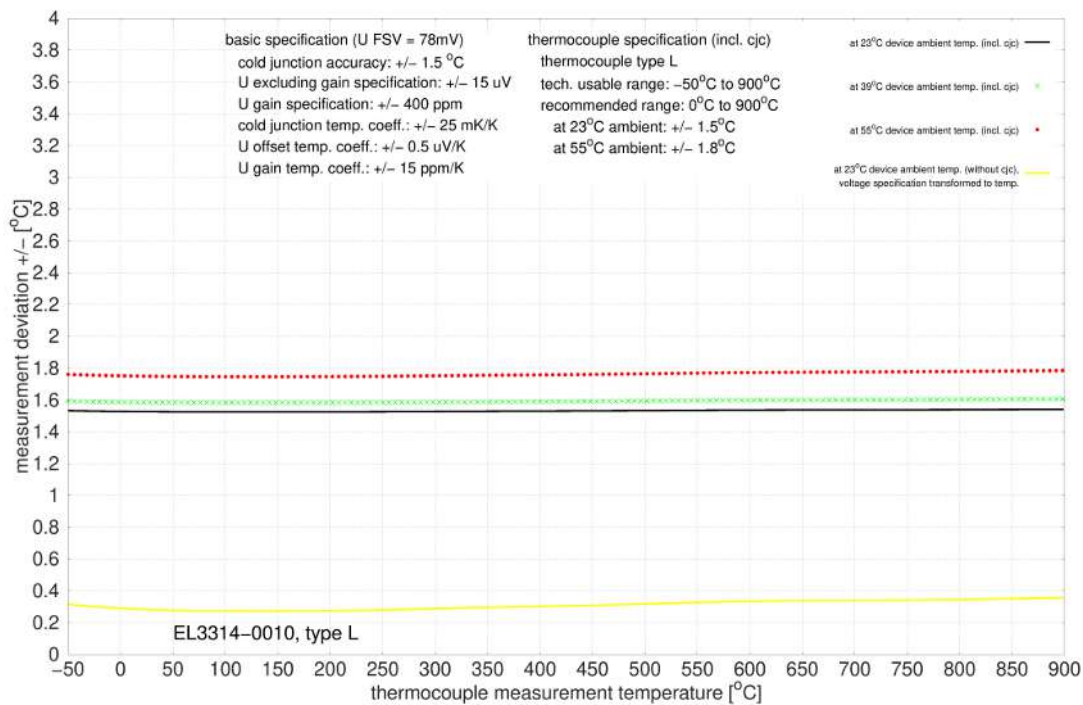


Fig. 63: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -4.346\text{ mV} \dots +1300\text{ }^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +1300\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.12\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.15\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

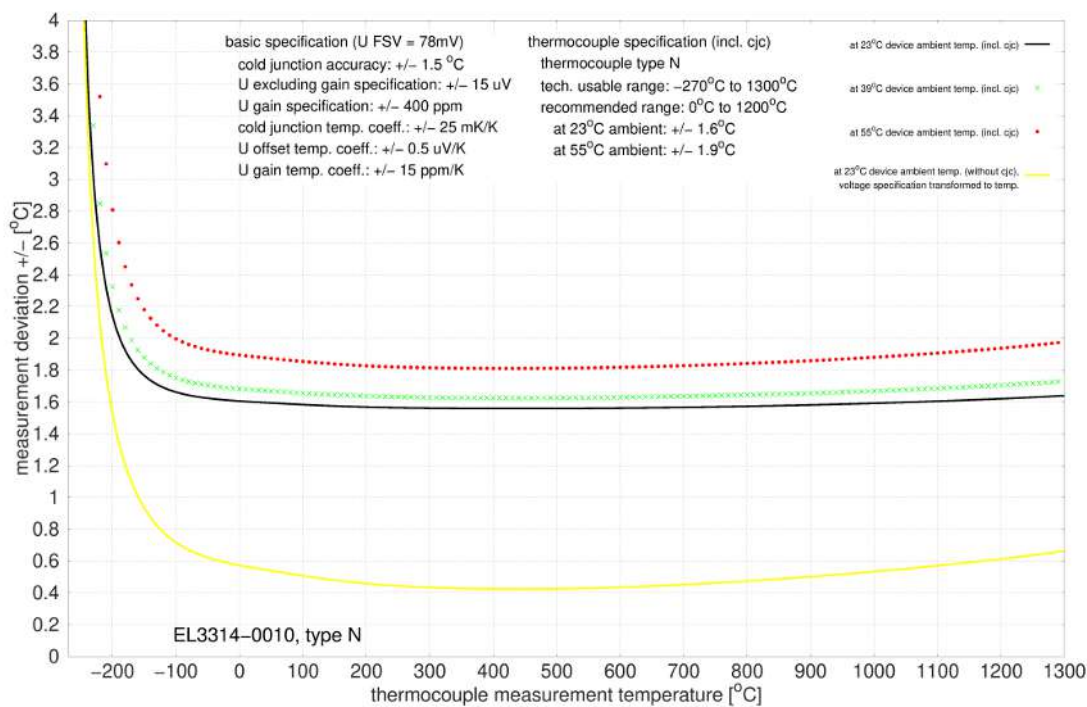


Fig. 64: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -0.226\text{ mV} \dots +1768^{\circ}\text{C} \approx 21.101\text{ mV}$
Measuring range, end value (full scale value)		$+1768^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.2\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.17\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

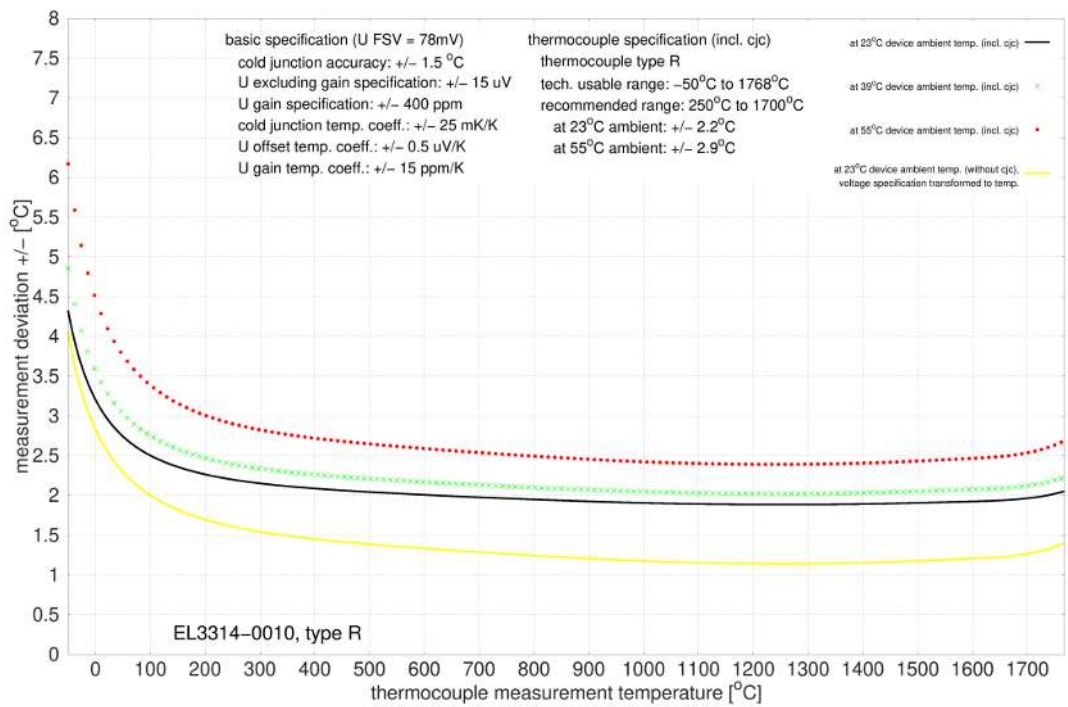


Fig. 65: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -0.236\text{ mV} \dots +1768\text{ }^{\circ}\text{C} \approx 18.693\text{ mV}$
Measuring range, end value (full scale value)		$+1768\text{ }^{\circ}\text{C}$
Measuring range, recommended		$+250\text{ }^{\circ}\text{C} \dots +1700\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.13\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.17\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

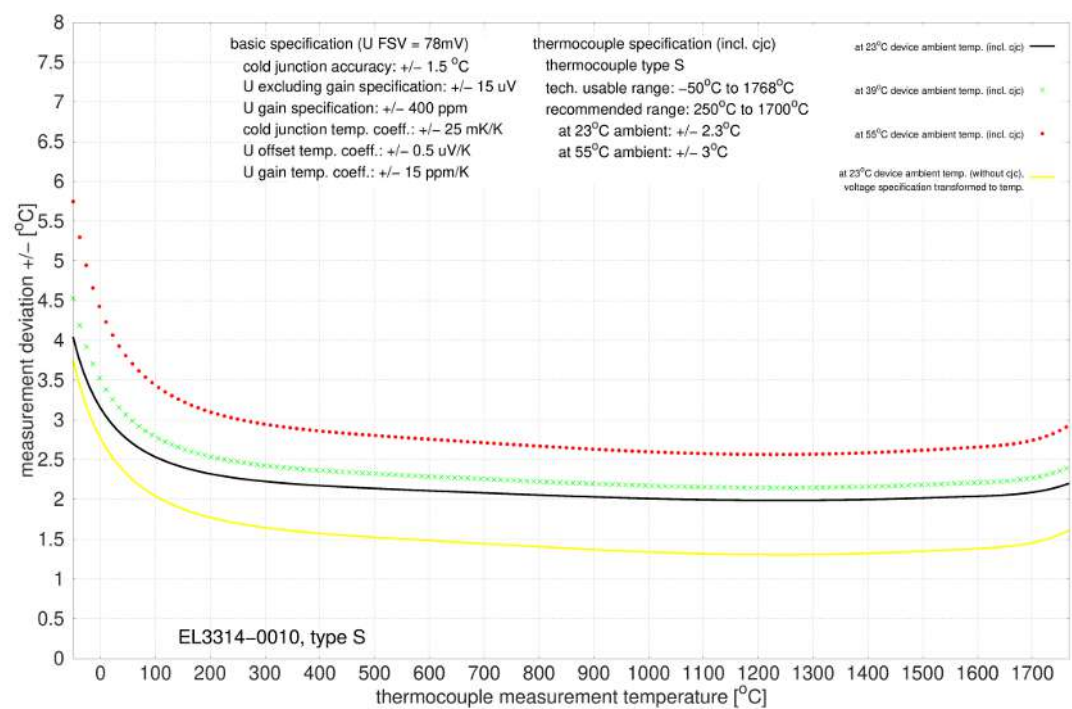


Fig. 66: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -6.258\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.40\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.48\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

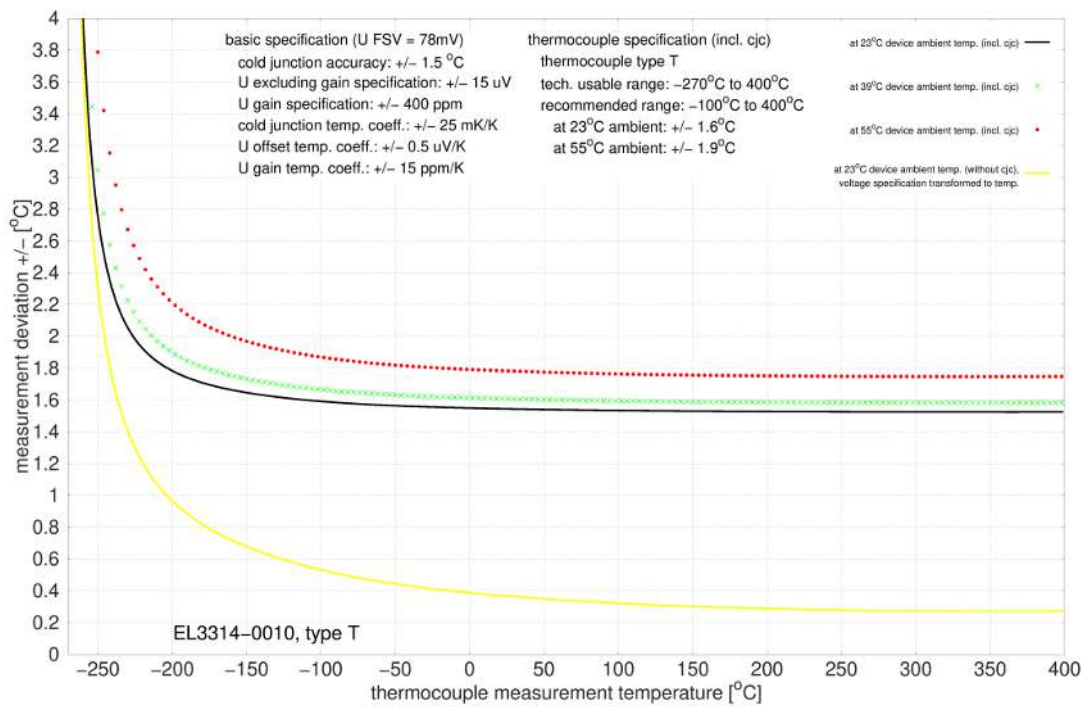


Fig. 67: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -1.850\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

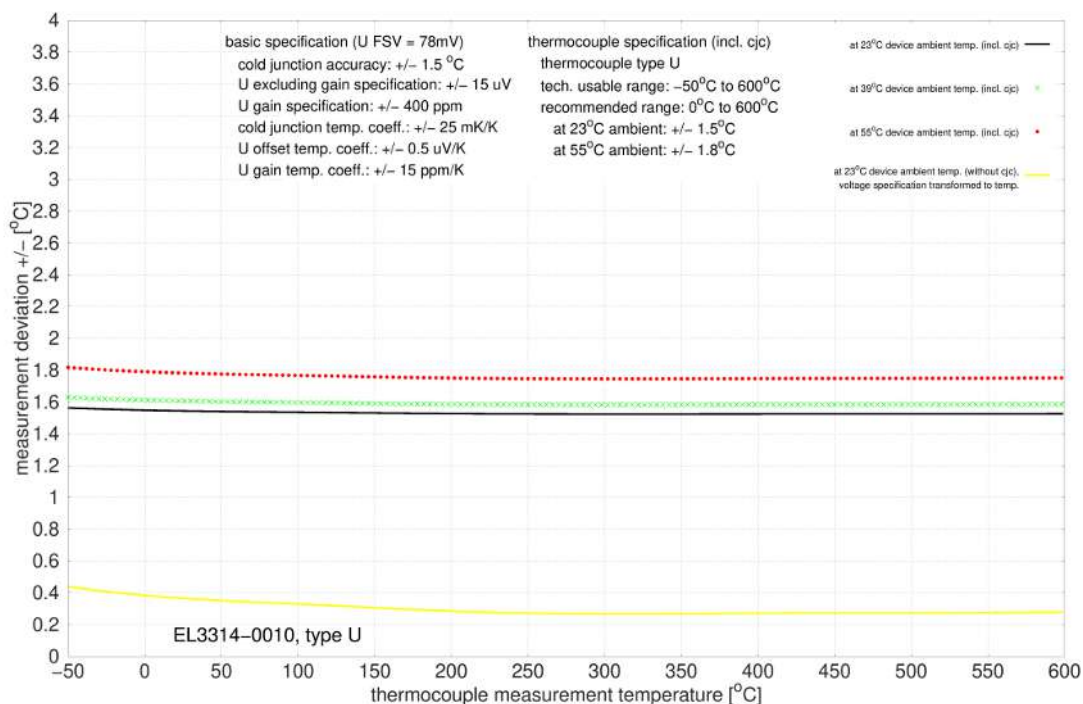


Fig. 68: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.5.3 Connection

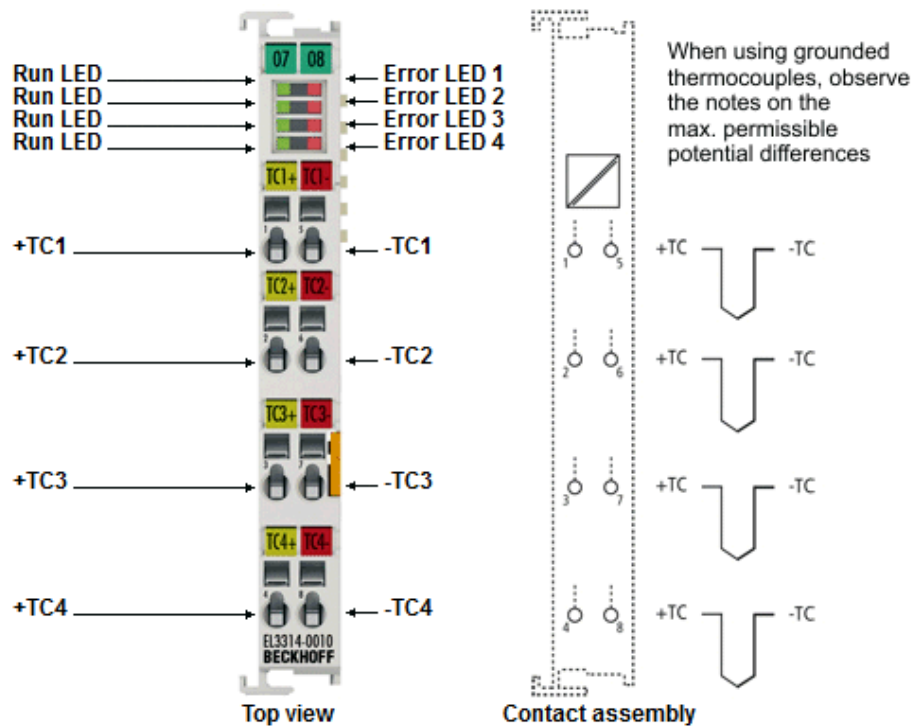


Fig. 69: EL3314-0010

EL3314-0010 – Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

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

2.5.4 Display, diagnostics

EL3314-0010 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-4	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.

2.6 EL3314-0030

2.6.1 Introduction

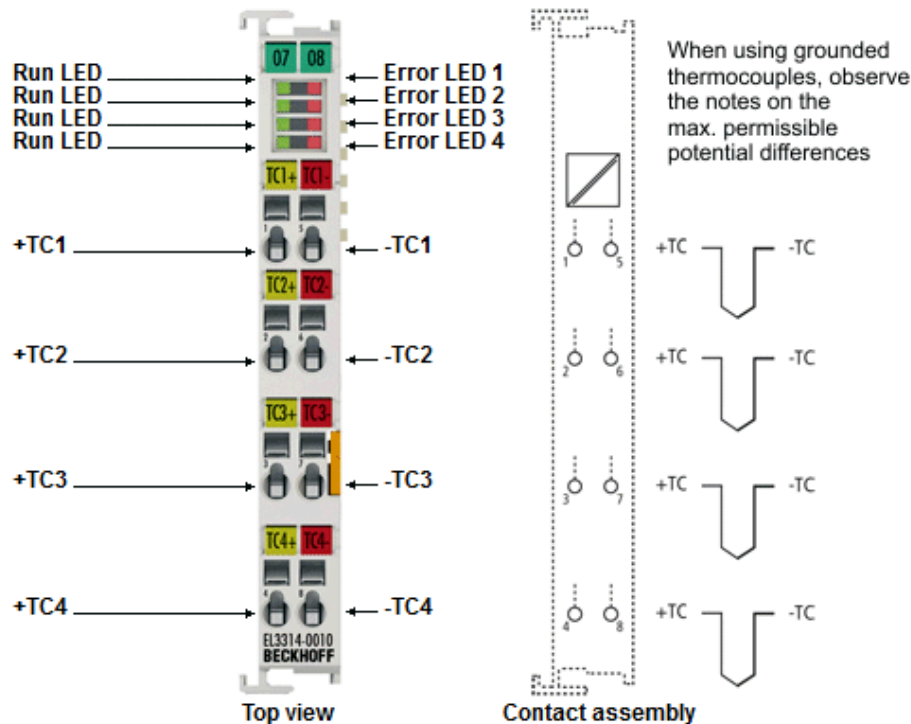


Fig. 70: EL3314-0030 (EL3314-0010)

High-precision 4-channel analog input terminal for thermocouples, with wire break detection, with external calibration certificate

The EL3314-0030 analog input terminal is based on the EL3314-0010. It has the same properties. The EL3314-0030 is additionally supplied with an external calibration certificate.

The EL3314-0010 allows the direct connection of thermocouples. Compared with the standard EL3314 model, it offers significantly more precise temperature measurements thanks to improved measuring circuit and more precise reference junction measurement. Otherwise the EL3314-0030 behaves similar to the EL3314.

For high-precision measurements please note the following:

- Before delivery the EL3314-0030 is calibrated against a high-precision reference voltage.
- The terminal is set by default to 0.01 °C/digit "high resolution".
- The assured accuracy applies to the following settings:
 - 50 Hz filter
 - 23 ± 5 °C ambient temperature
 - horizontal installation position
- In addition it has the following features:
 - an additional software-based "MC filter" can be used for smoothing the measured value
 - External cold junction compensation is possible (cold junction compensation, from FW03).
- We advise against the use of compensation wires, because they reduce the measuring accuracy of the EL3314-0030.
- We recommend using thermocouples with suitable accuracy.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [CoE object description and parameterization](#) [► 283]
- [Note on Beckhoff calibration certificates](#) [► 187]
- [Process data and operation modes](#) [► 230]

2.6.2 Technical data

2.6.2.1 General technical data

Analog inputs	EL3314-0030
Number of inputs	4
Thermocouple sensor types, measured variables	Type B, C, E, J, K, L, N, R, S, T, U (default setting: type K), voltage measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 24 bit
Sampling type	multiplex
Ground reference	Differential
Conversion time	approx. 1.6 s to 12 ms depending on configuration and filter setting; Preset: approx. 165 ms at 50/60 Hz
Input filter cut-off frequency	typ. 1 kHz
Software filter	5 Hz...30 kHz, adjustable, notch characteristic; preset: disabled additional low-pass filter possible
Wire break detection	yes (can be disabled)
Supports NoCoeStorage [► 197] function	yes
Special features	High-precision, calibration certificate [► 187] (ISO17025 or DAkkS certificate)

Voltage measurement	EL3314-0030
Measuring range, technically available	approx. ± 80 mV
Measuring range, nominal	± 78 mV
Resolution	10 nV per digit
Measurement uncertainty	See Measurement ± 78 mV [► 115]

Temperature measurement	EL3314-0030
Electrical measuring range used	± 78 mV
Measuring ranges	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01/0.001 °C per digit, preset 0.01 °C
Measurement uncertainty	See Thermocouples measurement [► 116]

Supply and potentials		EL3314-0030
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±2 V
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	Not applicable because GND is not accessible
	Destruction limit, short-term/continuous	
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3314-0030
Configuration		via TwinCAT System Manager
Width in the process image		max. 24 bytes input, max. 8 bytes output
Distributed Clocks		-

Environmental conditions		EL3314-0030
Permissible temperature range during operation		-25 °C...+60 °C
Permissible temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3314-0030
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		To ensure enhanced measuring accuracy, the terminal must be installed in the prescribed standard position! See note [► 224] !

Standards and approvals		EL3314-0030
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 205] , IECEx [► 207] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEx	Ex ec IIC T4 Gc

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.6.2.2 Measurement ± 78 mV

Specification ± 78 mV

Measurement mode		± 78 mV
Measuring range, nominal		-78...+78 mV
Measuring range, end value (full scale value)		78 mV
PDO resolution		10 nV
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	< $\pm 0.06\%_{\text{FSV}}$ typ.
	@ 55°C ambient temperature ¹	< $\pm 0.13\%_{\text{FSV}}$ typ.
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 15 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 400 ppm
Temperature coefficient	Tk _{Offset}	< 0.5 μ V/K
	Tk _{Gain}	< 15 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.

2.6.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314-0010 and EL3314-0030, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±1.5°C
Temperature coefficient	Tk	< 25 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 78 mV
Measuring range, technically available		+200 °C ≈ 0.178 mV ... +1820 °C ≈ 13.820 mV
Measuring range, end value (full scale value)		+1820 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.6 K ≈ ± 0.14 % _{FSV}
	@ 55 °C ambient temperature	± 3.5 K ≈ ± 0.19 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{amb} = 39\text{ °C}$ as the middle point between 23 °C and 55 °C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

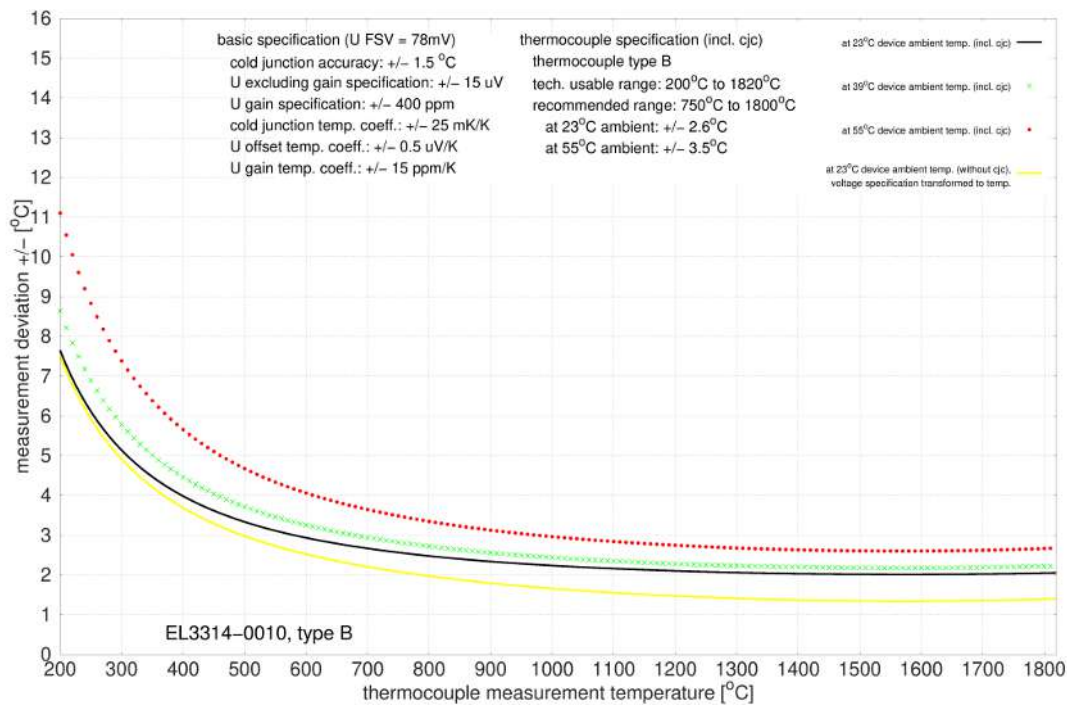


Fig. 71: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$0^\circ\text{C} \approx 0\text{ mV} \dots +2320^\circ\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^\circ\text{C}$
Measuring range, recommended		$0^\circ\text{C} \dots +2000^\circ\text{C}$
PDO LSB		$0.1/0.01/0.001^\circ\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.2\text{ K} \approx \pm 0.10\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

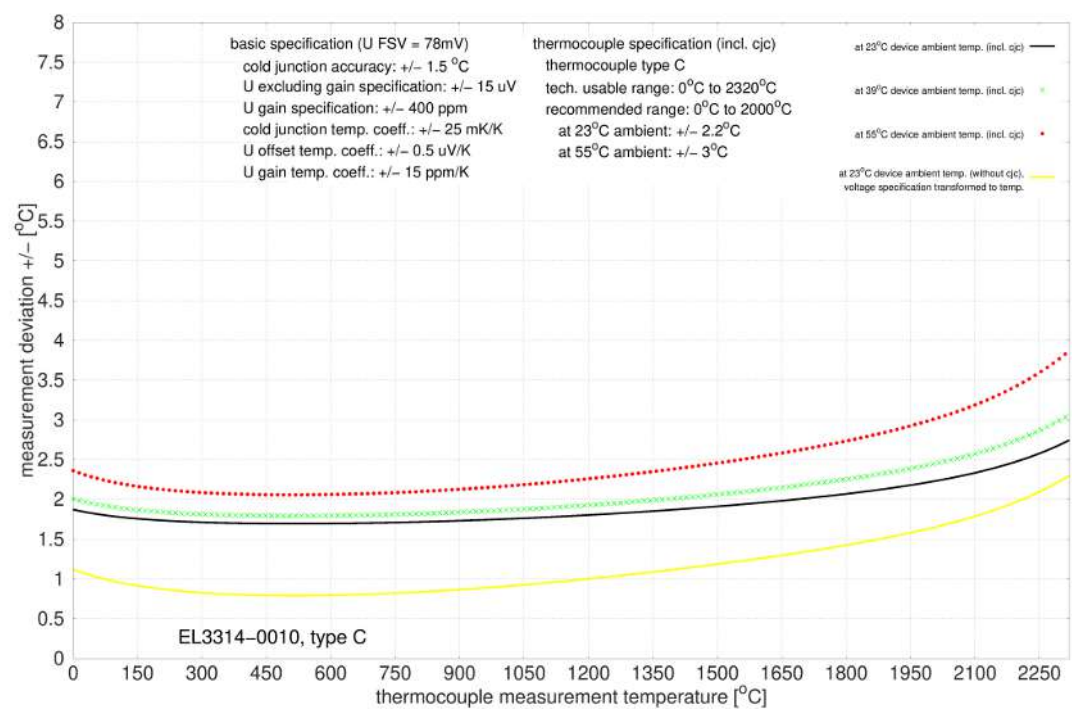


Fig. 72: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -9.835\text{ mV} \dots +1000\text{ }^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +1000\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.18\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

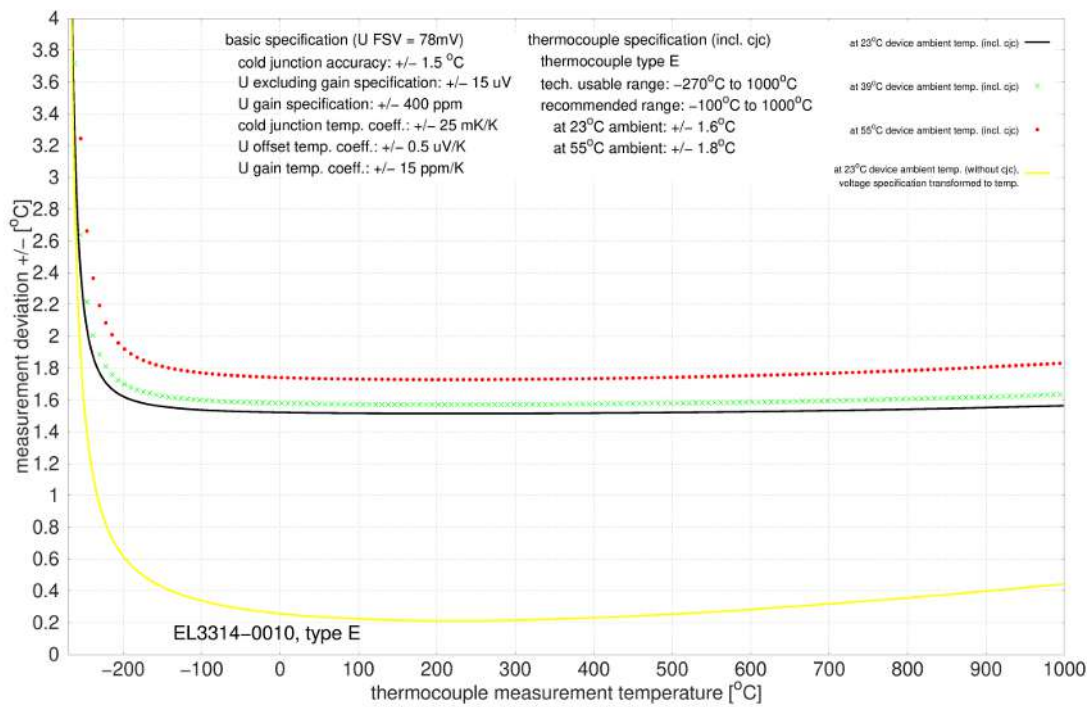


Fig. 73: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-210^\circ\text{C} \approx -8.095\text{ mV} \dots +1200^\circ\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01/0.001^\circ\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.13\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.16\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

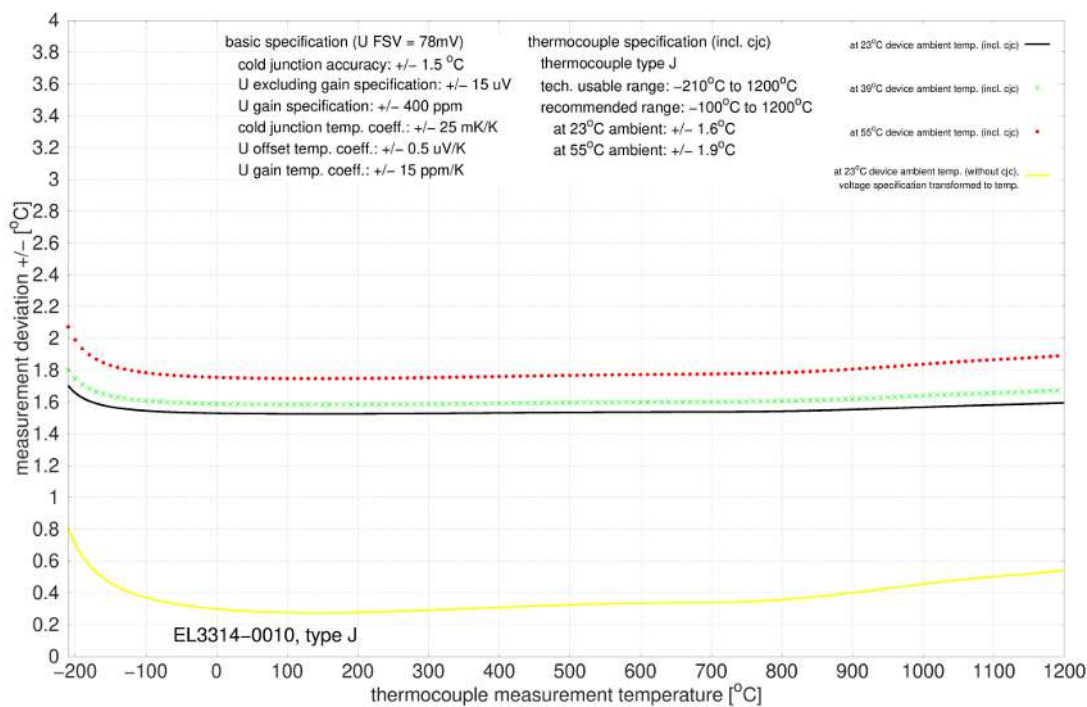


Fig. 74: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -6.458\text{ mV} \dots +1372^{\circ}\text{C} \approx 54.886\text{ mV}$
Measuring range, end value (full scale value)		$+1372^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.12\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.15\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

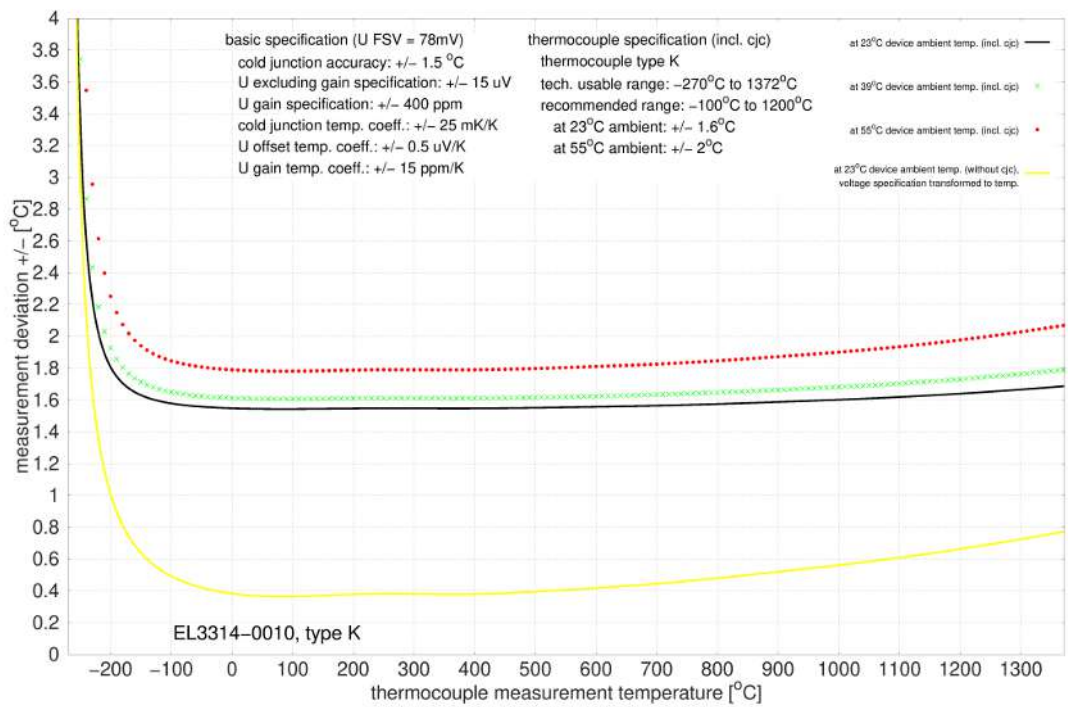


Fig. 75: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^\circ\text{C} \approx -2.510\text{ mV} \dots +900^\circ\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^\circ\text{C}$
Measuring range, recommended		$0^\circ\text{C} \dots +900^\circ\text{C}$
PDO LSB		$0.1/0.01/0.001^\circ\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.5\text{ K} \approx \pm 0.17\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.20\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

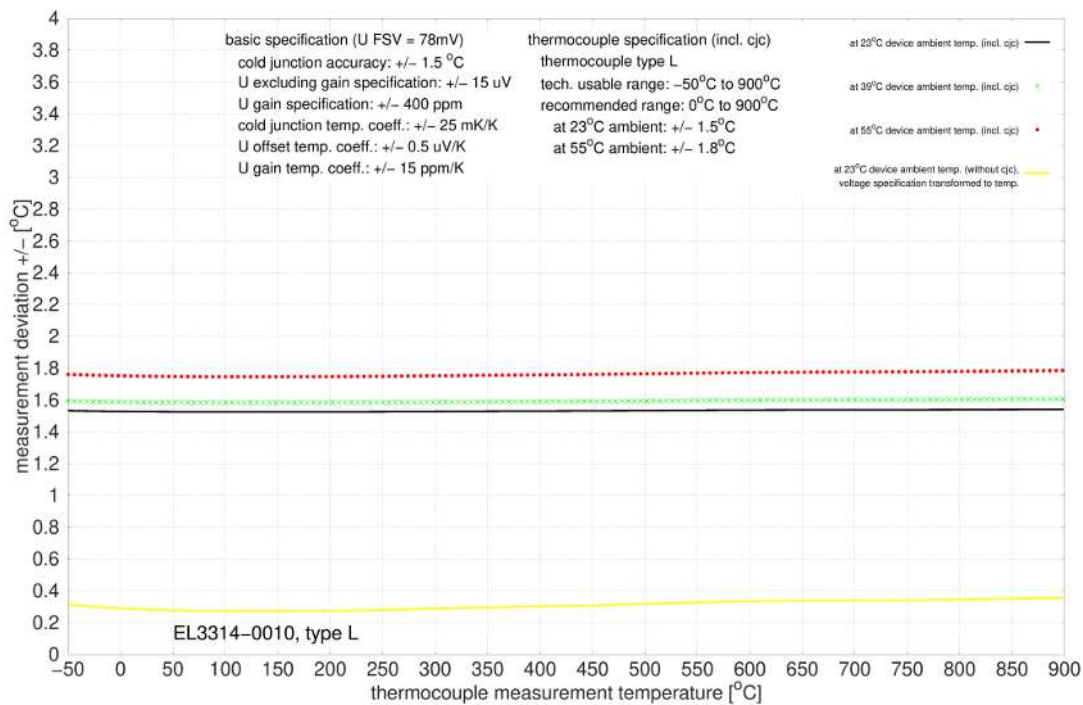


Fig. 76: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -4.346\text{ mV} \dots +1300\text{ }^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +1300\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.12\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.15\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

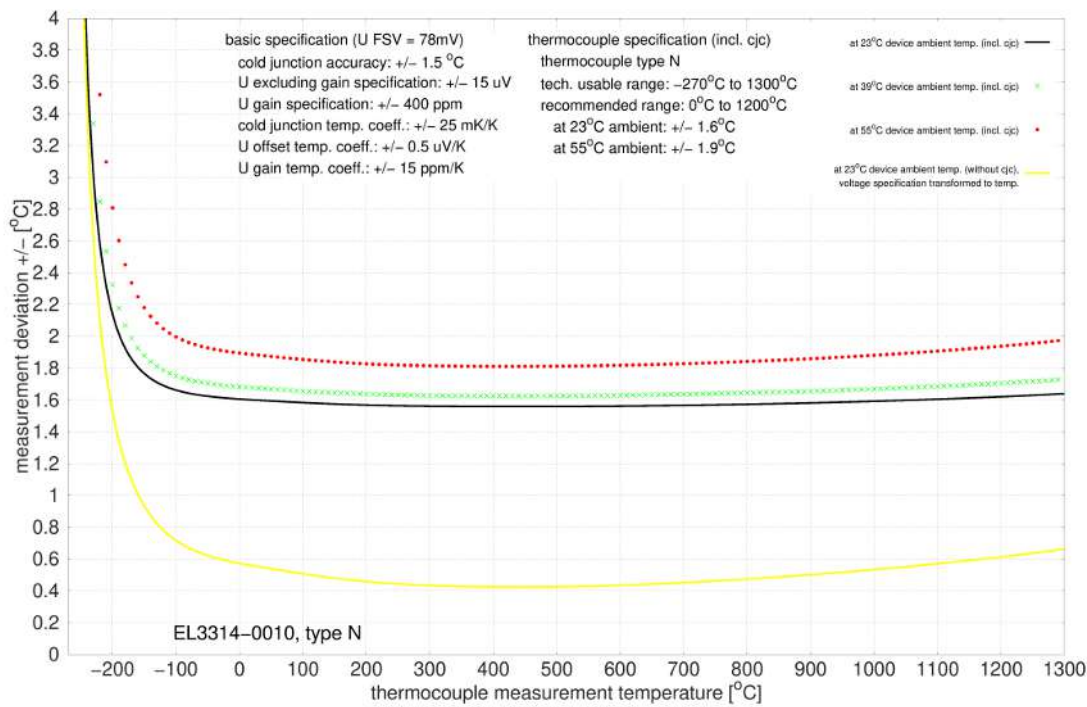


Fig. 77: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		± 78 mV
Measuring range, technically available		-50 °C ≈ -0.226 mV ... +1768 °C ≈ 21.101 mV
Measuring range, end value (full scale value)		+1768 °C
Measuring range, recommended		+250 °C ... +1700 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.2 K ≈ ± 0.13 % _{FSV}
	@ 55 °C ambient temperature	± 2.9 K ≈ ± 0.17 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

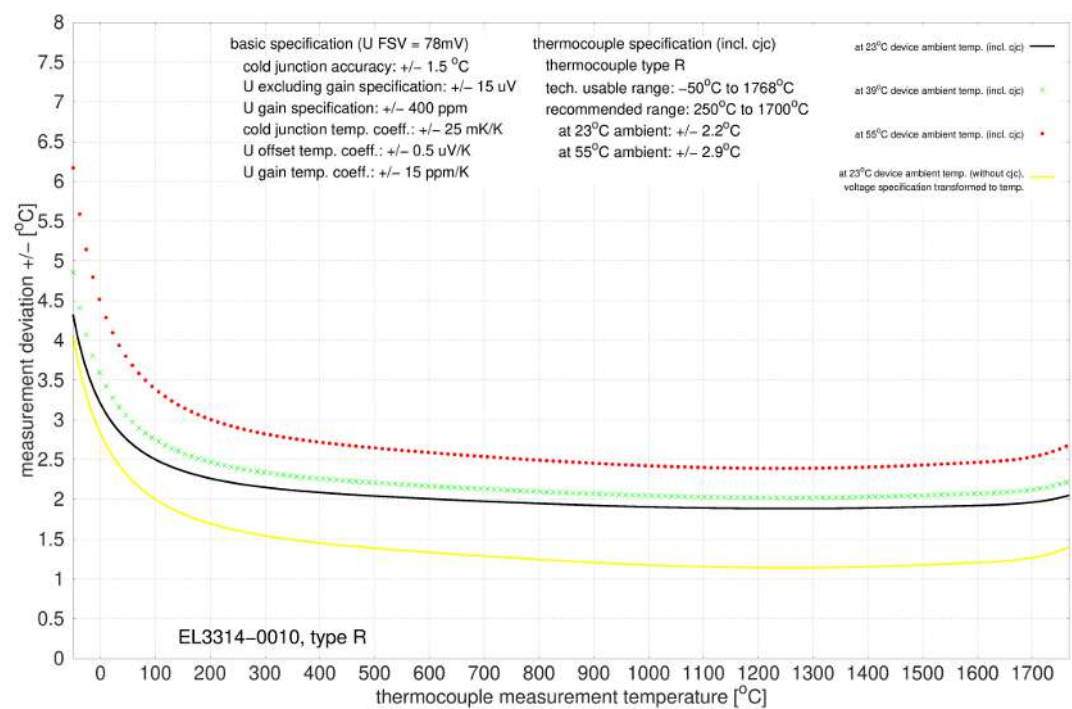


Fig. 78: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -0.236\text{ mV} \dots +1768\text{ }^{\circ}\text{C} \approx 18.693\text{ mV}$
Measuring range, end value (full scale value)		$+1768\text{ }^{\circ}\text{C}$
Measuring range, recommended		$+250\text{ }^{\circ}\text{C} \dots +1700\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.17\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

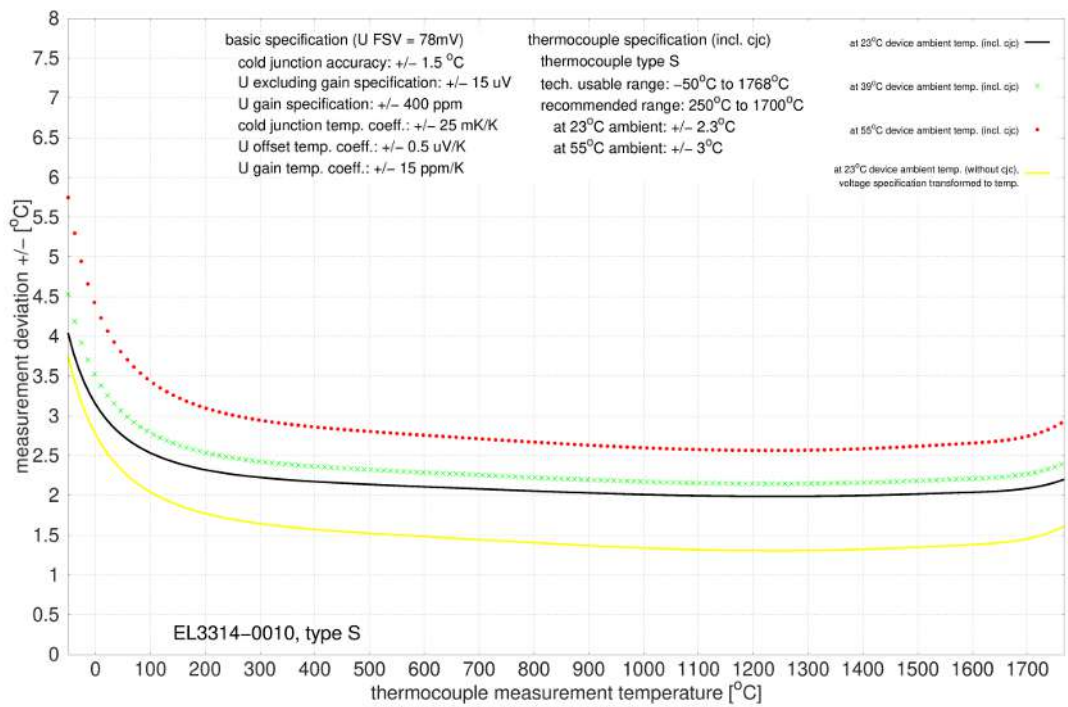


Fig. 79: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270^{\circ}\text{C} \approx -6.258\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.6\text{ K} \approx \pm 0.40\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.48\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

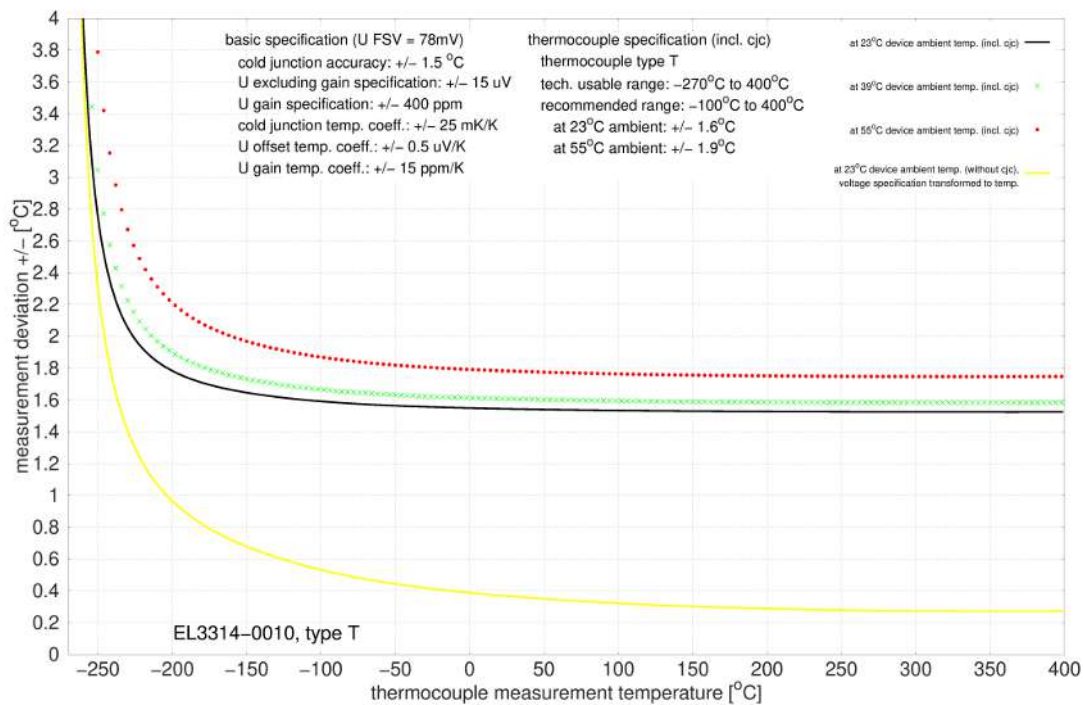


Fig. 80: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -1.850\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

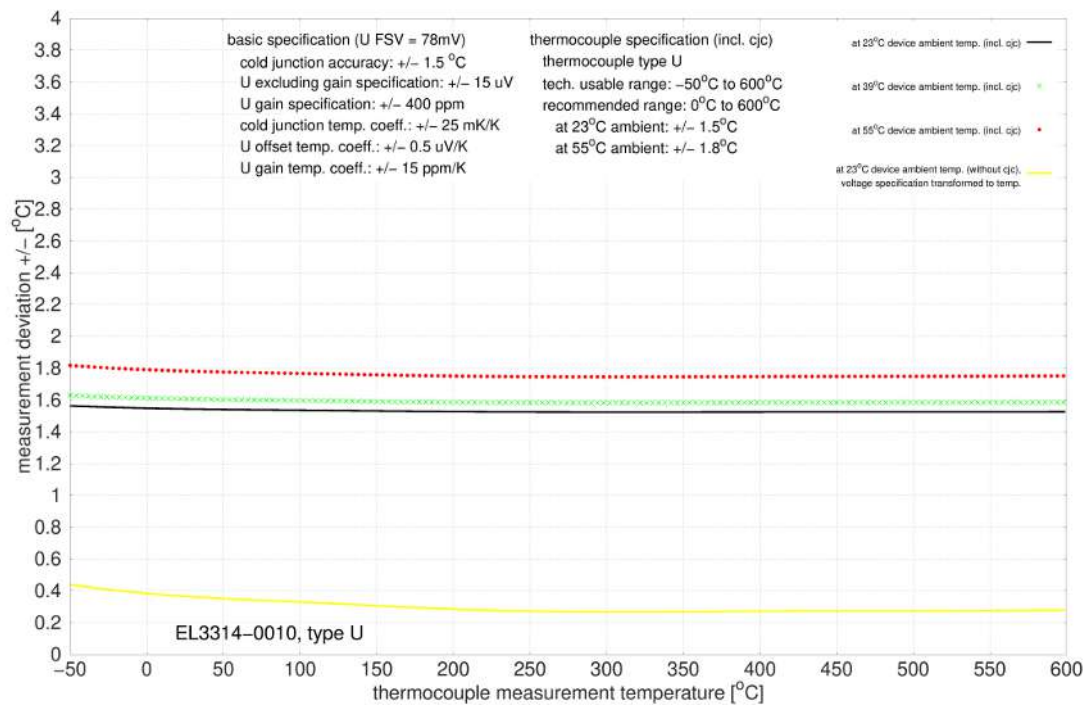


Fig. 81: EL3314-0010 and EL3314-0030 (equivalent to EL3314-0010), type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.6.3 Connection

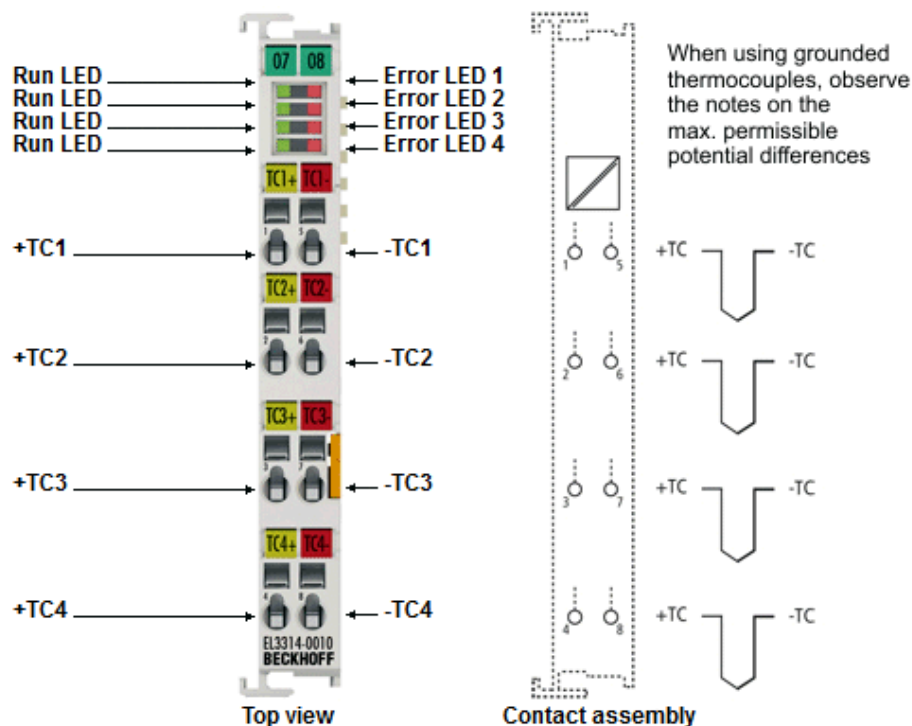


Fig. 82: EL3314-0030 (EL3314-0010)

EL3314-0030 – Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

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

2.6.4 Display, diagnostics

EL3314-0030 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-4	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.

2.7 EL3314-0090

2.7.1 Introduction

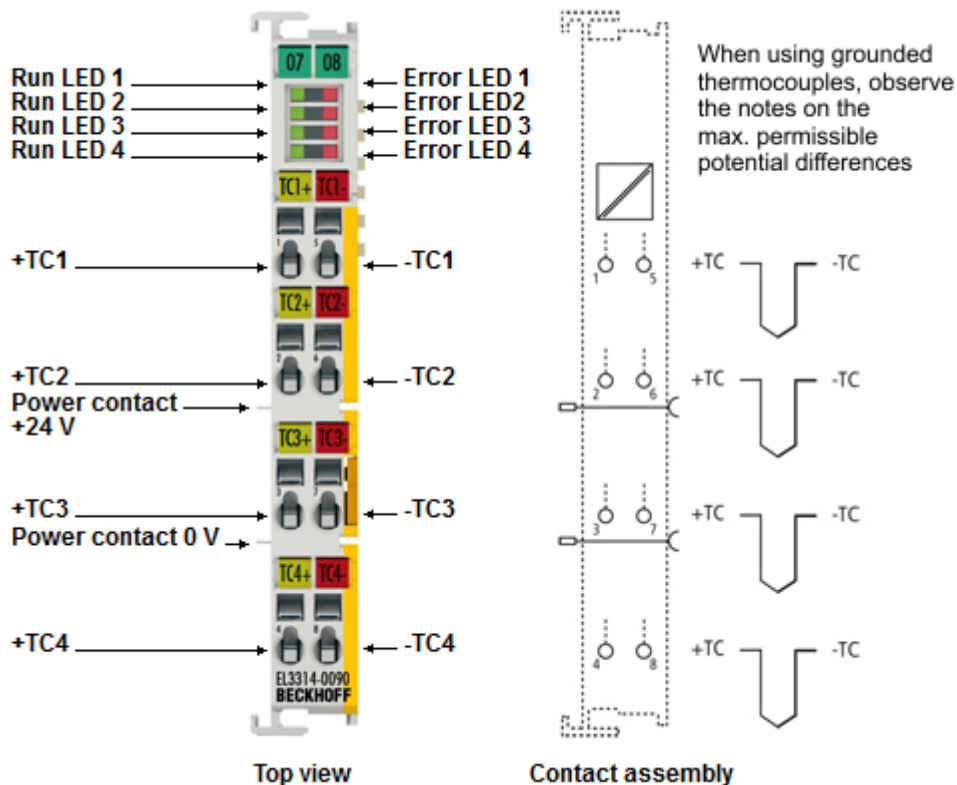


Fig. 83: EL3314-0090

4-channel input terminal, thermocouple with wire break detection, TwinSAFE Single Channel

The EL3314-0090 analog input terminal is based on the EL3314, but is also equipped with the TwinSAFE SC function.

The EL3314-0090 analog input terminal allows four thermocouples to be connected directly. The EtherCAT Terminal circuit can operate thermocouple sensors using the 2-wire technique. A microprocessor handles linearization across the whole temperature range, which is freely selectable. Cold junction compensation is made through an internal temperature measurement at the terminals. The EL3314-0090 can also be used for mV measurement.

The TwinSAFE SC technology [► 250] (TwinSAFE Single Channel) enables the use of standard signals for safety tasks in any networks or fieldbuses. The standard functionalities and features of the I/Os are retained. The data of the TwinSAFE SC I/Os are routed to the TwinSAFE logic and processed there in a multichannel safety-related manner. In the Safety Logic the data originating from different sources are analyzed, checked for plausibility and submitted to a 'voting'. This is done using certified function blocks such as Scale, Compare/Voting (1oo2, 2oo3, 3oo5), Limit, etc. For safety reasons, at least one of the data sources must be a TwinSAFE SC component. The remainder of the data can originate from other standard bus terminals, drive controllers or measuring transducers. With the aid of the TwinSAFE SC technology it is typically possible to achieve a safety level equivalent to PL d/Cat. 3 in accordance with EN ISO 13849-1 or SIL 2 in accordance with EN 62061.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [Process data and operation modes \[► 230\]](#)
- [CoE object description and parameterization \[► 289\]](#)

2.7.2 Technical data

2.7.2.1 General technical data

Analog inputs	EL3314-0090
Number of inputs	4
Thermocouple sensor types, measured variables	Types B, C, E, J, K, L, N, R, S, T, U (default setting type K), mV measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 16 bit
Sampling type	multiplex
Ground reference	Differential
Conversion time	approx. 2.5 s to 10 ms, depending on the configuration and filter setting, default: approx. 250 ms
Input filter cut-off frequency	typ. 1 kHz
Wire break detection	yes (can be disabled)
Supports NoCoeStorage [► 197] function	yes
Special features	TwinSAFE SC

Voltage measurement	EL3314-0090
Measuring range, technically available	approx. ± 78 mV
Measuring ranges (nominal) and resolution	± 30 mV (1 μ V per digit, thus max. 32.768 mV can be displayed) ± 60 mV (2 μ V per digit, thus max. 65.536 mV can be displayed) ± 75 mV (4 μ V per digit, thus max. 131 mV can be displayed, observe technical 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	See Measurement ± 30 mV...± 75 mV [► 134]

Temperature measurement	EL3314-0090
Electrical measuring range used	± 75 mV
Measuring ranges ¹⁾	Type B: +200...+1820 °C Type C: 0...+2320 °C Type E: -270...+1000 °C Type J: -210...+1200 °C Type K: -270...+1372 °C (preset) Type L: -50...+900 °C Type N: -270...+1300 °C Type R: -50...+1768 °C Type S: -50...+1768 °C Type T: -270...+400 °C Type U: -50...+600 °C
Resolution	Temperature display 0.1/0.01 °C per digit, preset 0.1 °C Note: internally, 16 bit are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type K: approx. 0.04 °C.
Measurement uncertainty	See Thermocouples measurement [► 135]

1) from FW04, Rev0018

Supply and potentials		EL3314-0090
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 200 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±2 V
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	Not applicable because GND is not accessible
	Destruction limit, short-term/continuous	
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3314-0090
Configuration		via TwinCAT System Manager
Width in the process image		max. 16 bytes input, max. 8 bytes output
Distributed Clocks		-

Environmental conditions		EL3314-0090
Permissible ambient temperature range during operation		-25 °C...+60 °C (extended temperature range), from firmware 06
Permissible ambient temperature range during storage		-40 °C...+85 °C
Permissible relative air humidity		95 %, no condensation

General data		EL3314-0090
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Installation [► 203]		on 35 mm mounting rail, conforms to EN 60715
Installation position		variable
MTBF (55 °C)		> 1,010,000 h

Standards and approvals		EL3314-0090
Protection rating		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [► 214]
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 206] , IECEx [► 207] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEx	Ex ec IIC T4 Gc

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.7.2.2 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.24\%_{FSV}$ typ. $\approx \pm 0.070$ mV
	@ 55°C ambient temperature	< $\pm 0.26\%_{FSV}$ typ. $\approx \pm 0.077$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.16\%_{FSV}$ typ. $\approx \pm 0.094$ mV
	@ 55°C ambient temperature	< $\pm 0.17\%_{FSV}$ typ. $\approx \pm 0.10$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature ¹	< $\pm 0.14\%_{FSV}$ typ. $\approx \pm 0.11$ mV
	@ 55°C ambient temperature	< $\pm 0.15\%_{FSV}$ typ. $\approx \pm 0.12$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	< ± 60 μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 1200 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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.

2.7.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314 and EL3314-0090, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: Measurement deviation at 23°C, with averaging		< ±2.0°C
Temperature coefficient	Tk	< 40 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 75 mV
Measuring range, technically available		+600 °C ≈ 1.792 mV ... +1800 °C ≈ 13.591 mV
Measuring range, end value (full scale value)		+1800 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01 °C/digit, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type B: approx. 0.05 °C.
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 8.5 K ≈ ± 0.47 % _{FSV}
	@ 55 °C ambient temperature	± 9.7 K ≈ ± 0.54 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ °C}$ 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:

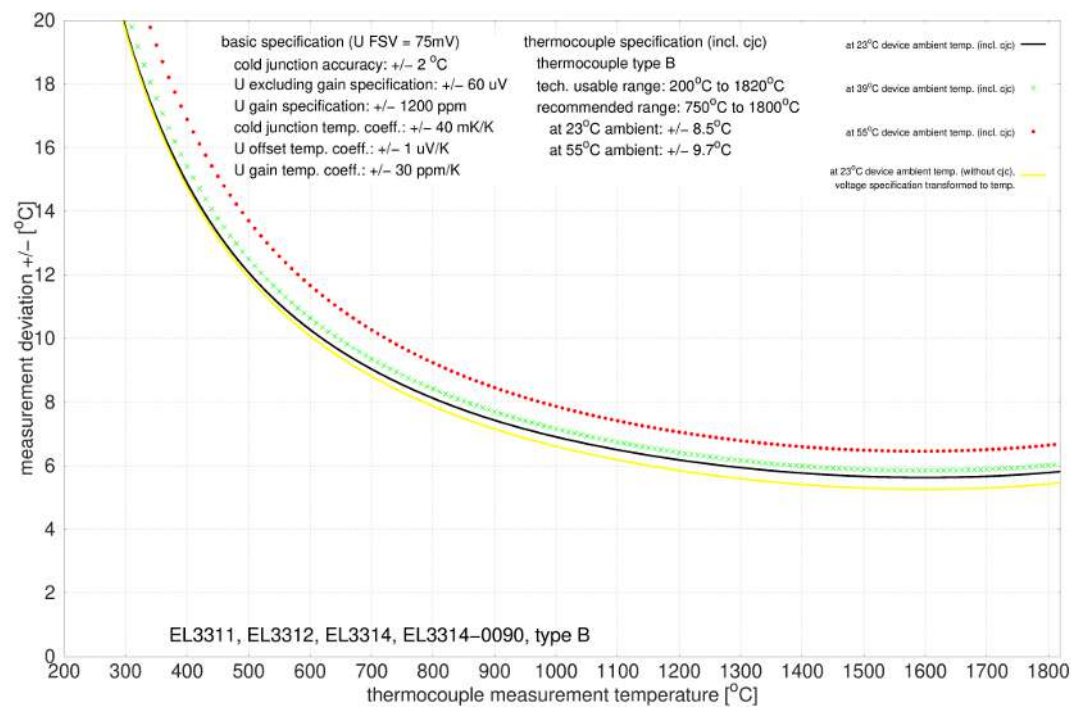


Fig. 84: EL3311, EL3312, EL3314, EL3314-0090, type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type C: approx. 0.07°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 6.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.4\text{ K} \approx \pm 0.32\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ 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:

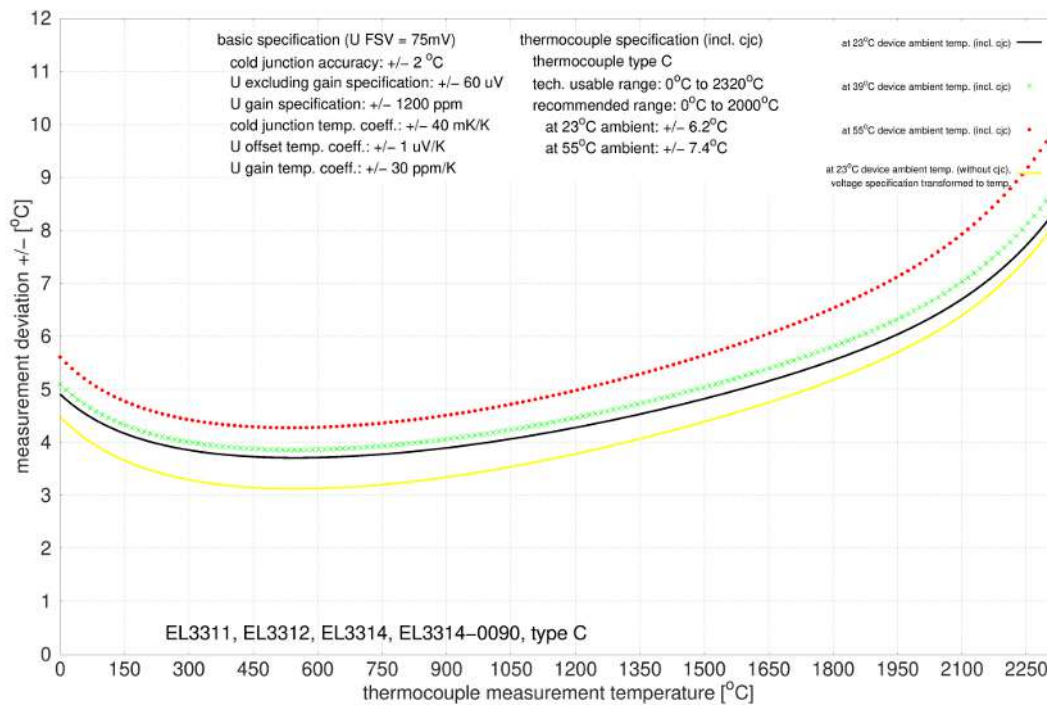


Fig. 85: EL3311, EL3312, EL3314, EL3314-0090, type C

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^\circ\text{C} \approx -5.237\text{ mV} \dots +1000^\circ\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1000^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type E: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.25\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.30\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

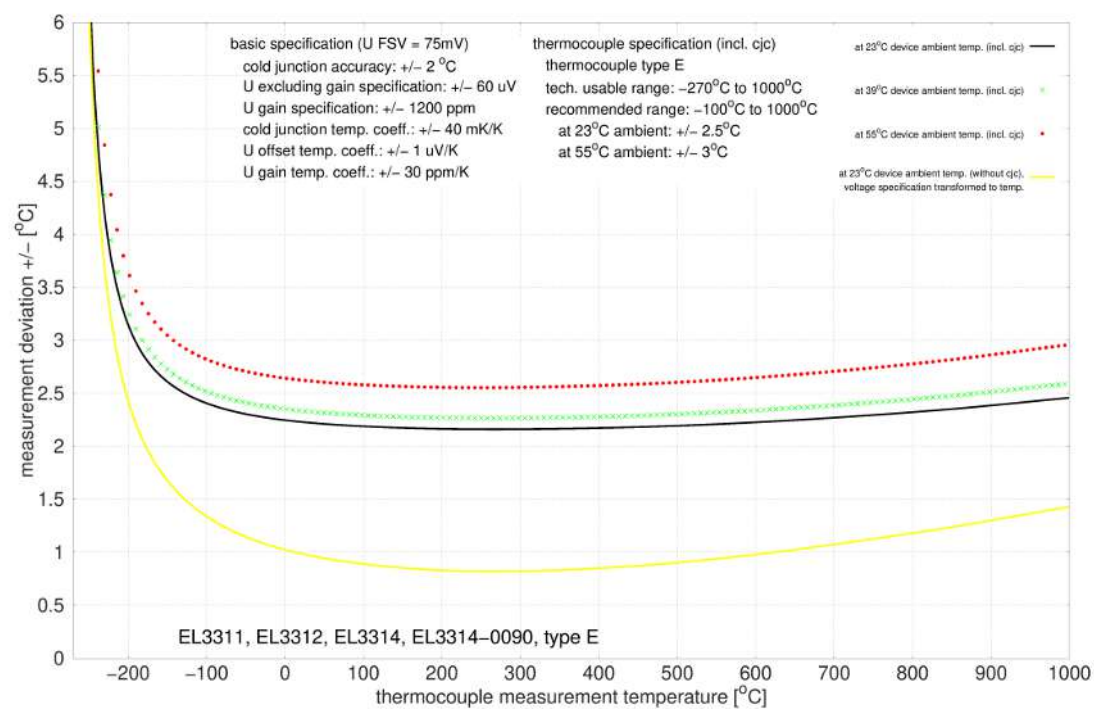


Fig. 86: EL3311, EL3312, EL3314, EL3314-0090, type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

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 Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type J: approx. 0.04 °C.
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.7 K ≈ ± 0.23 % _{FSV}
	@ 55 °C ambient temperature	± 3.2 K ≈ ± 0.27 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

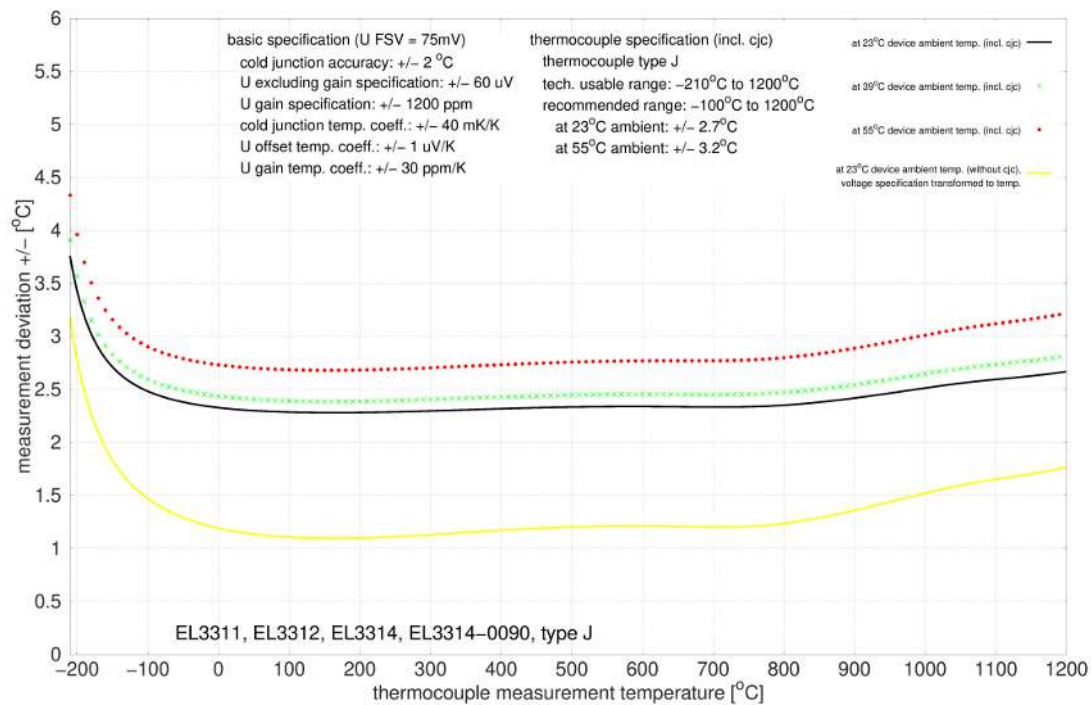


Fig. 87: EL3311, EL3312, EL3314, EL3314-0090, type J

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^\circ\text{C} \approx -5.891\text{ mV} \dots +1370^\circ\text{C} \approx 54.818\text{ mV}$
Measuring range, end value (full scale value)		$+1370^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type K: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.22\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

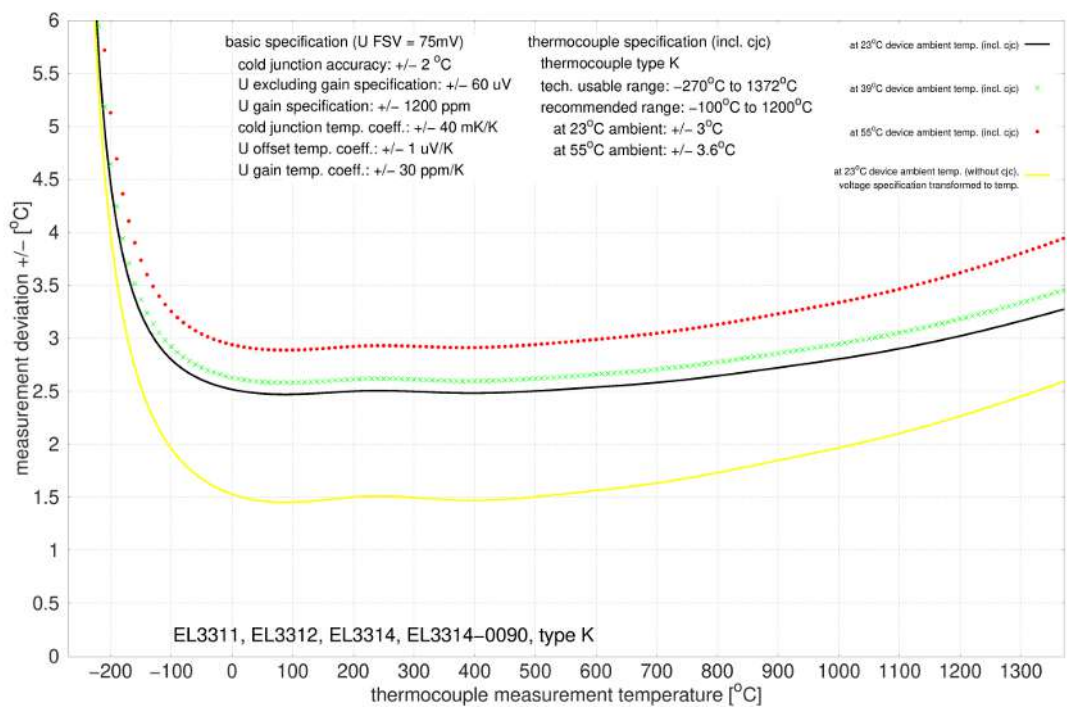


Fig. 88: EL3311, EL3312, EL3314, EL3314-0090, type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type L: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.3\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.8\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

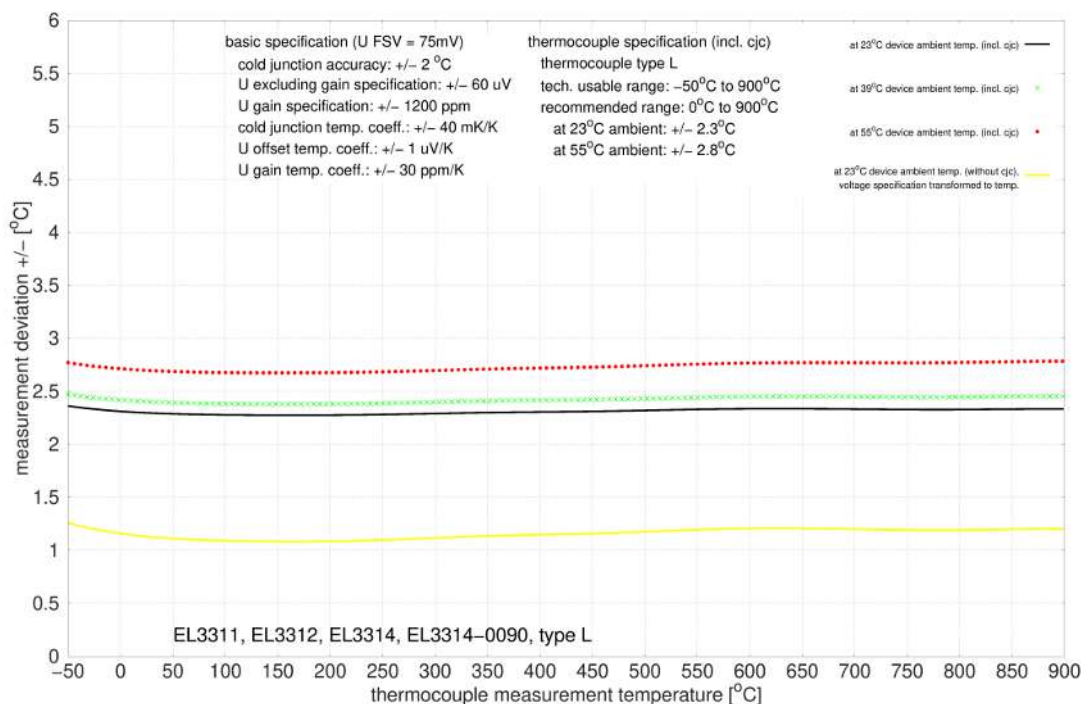


Fig. 89: EL3311, EL3312, EL3314, EL3314-0090, type L

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^\circ\text{C} \approx -2.406\text{ mV} \dots +1300^\circ\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300^\circ\text{C}$
Measuring range, recommended		$0^\circ\text{C} \dots +1300^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type N: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.23\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

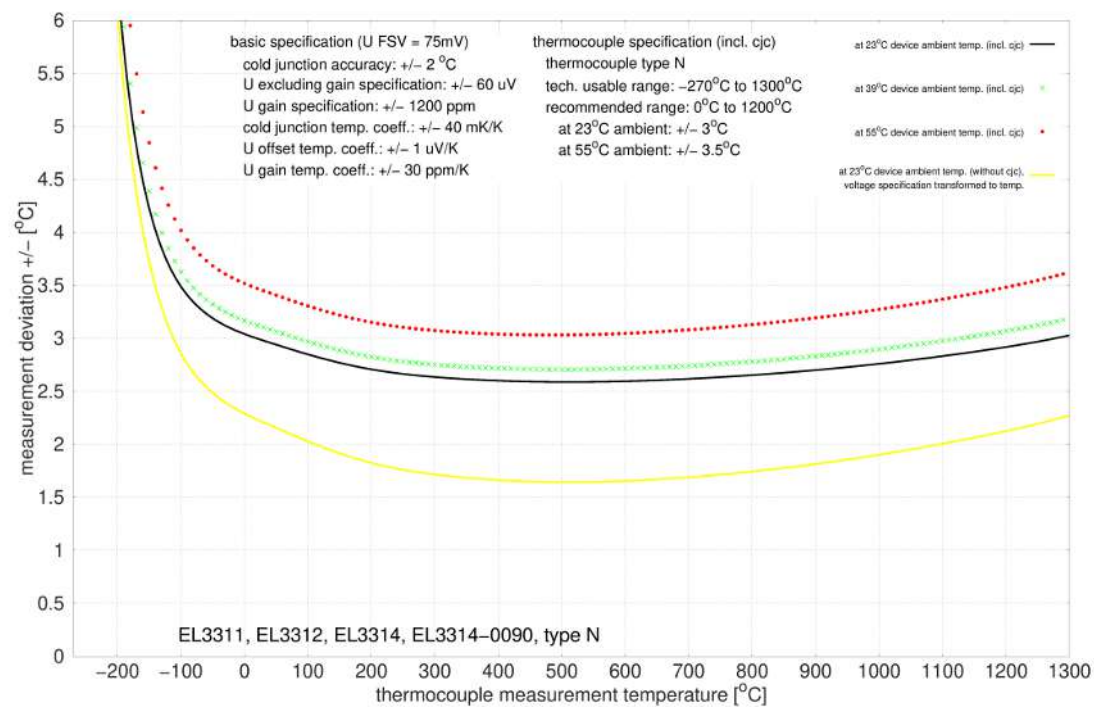


Fig. 90: EL3311, EL3312, EL3314, EL3314-0090, type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1767^{\circ}\text{C} \approx 21.089\text{ mV}$
Measuring range, end value (full scale value)		$+1767^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type R: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 6.7\text{ K} \approx \pm 0.38\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 7.7\text{ K} \approx \pm 0.44\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

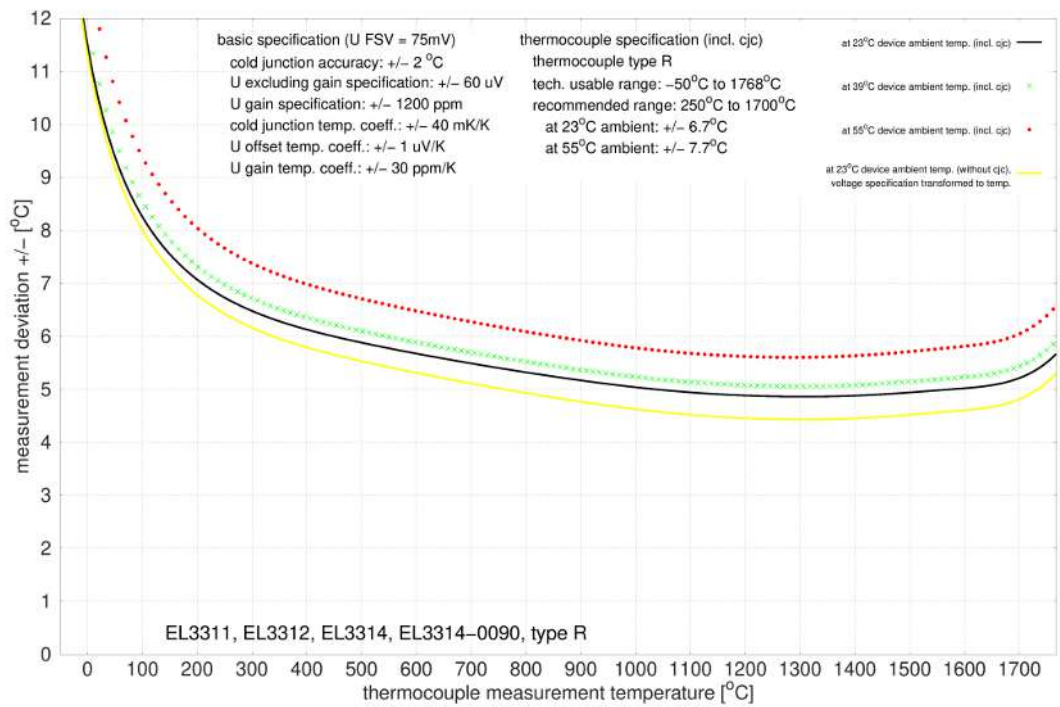


Fig. 91: EL3311, EL3312, EL3314, EL3314-0090, type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1760^{\circ}\text{C} \approx 17.947\text{ mV}$
Measuring range, end value (full scale value)		$+1760^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type S: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 7.1\text{ K} \approx \pm 0.40\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 8.1\text{ K} \approx \pm 0.46\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

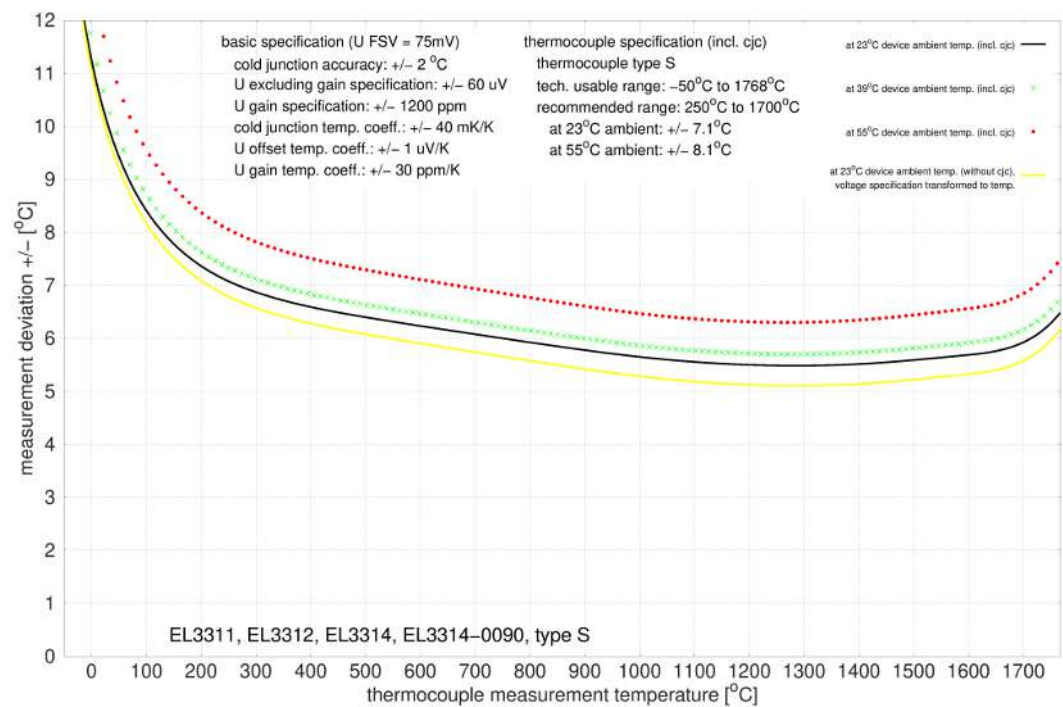


Fig. 92: EL3311, EL3312, EL3314, EL3314-0090, type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.603\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.73\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.4\text{ K} \approx \pm 0.85\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

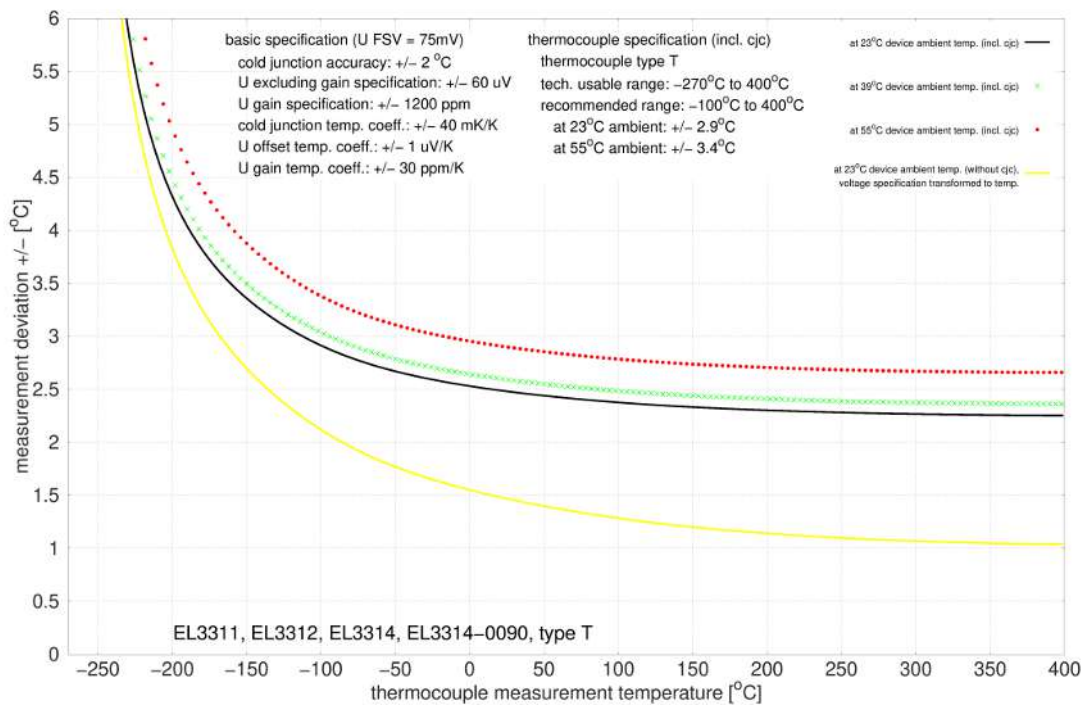


Fig. 93: EL3311, EL3312, EL3314, EL3314-0090, type T

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type U: approx. 0.02°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.5\text{ K} \approx \pm 0.42\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.48\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

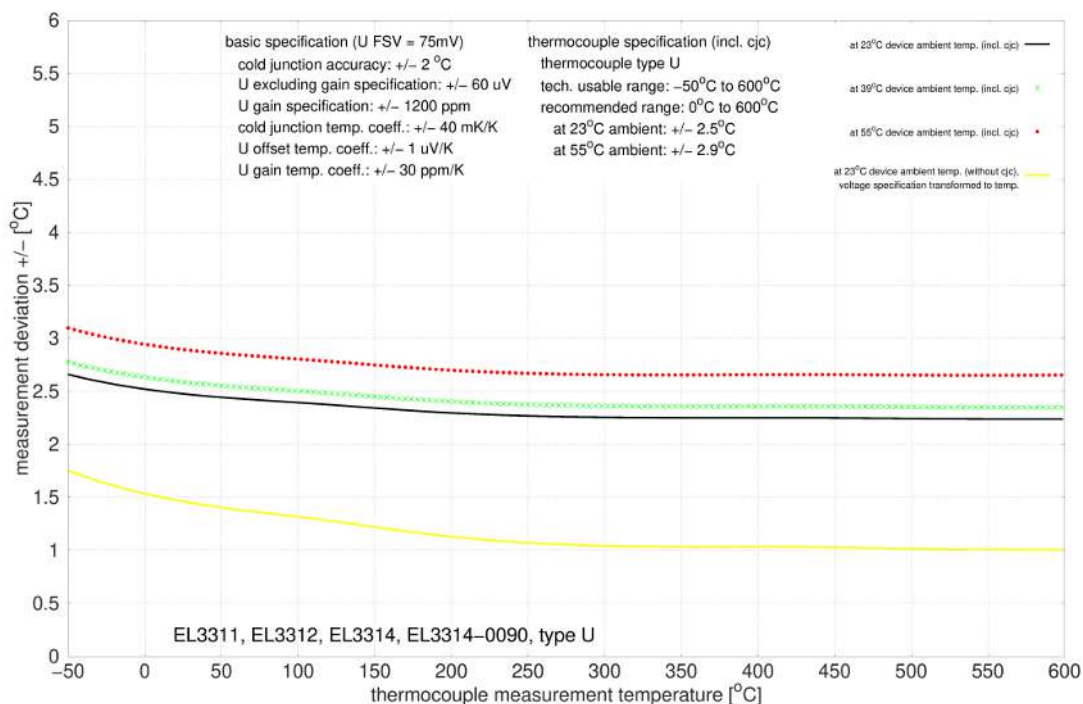


Fig. 94: EL3311, EL3312, EL3314, EL3314-0090, type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.7.3 Connection

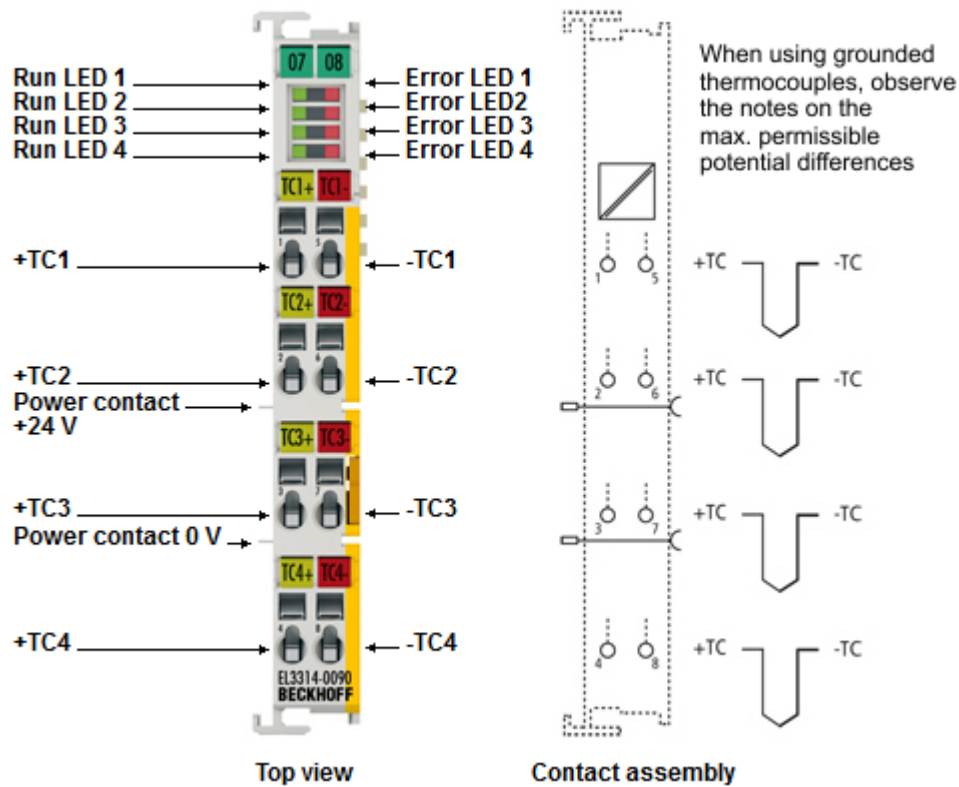


Fig. 95: EL3314-0090

EL3314-0090 – Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

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

2.7.4 Display, diagnostics

EL3314-0090 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-4	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.

2.8 EL3314-0092

2.8.1 Introduction

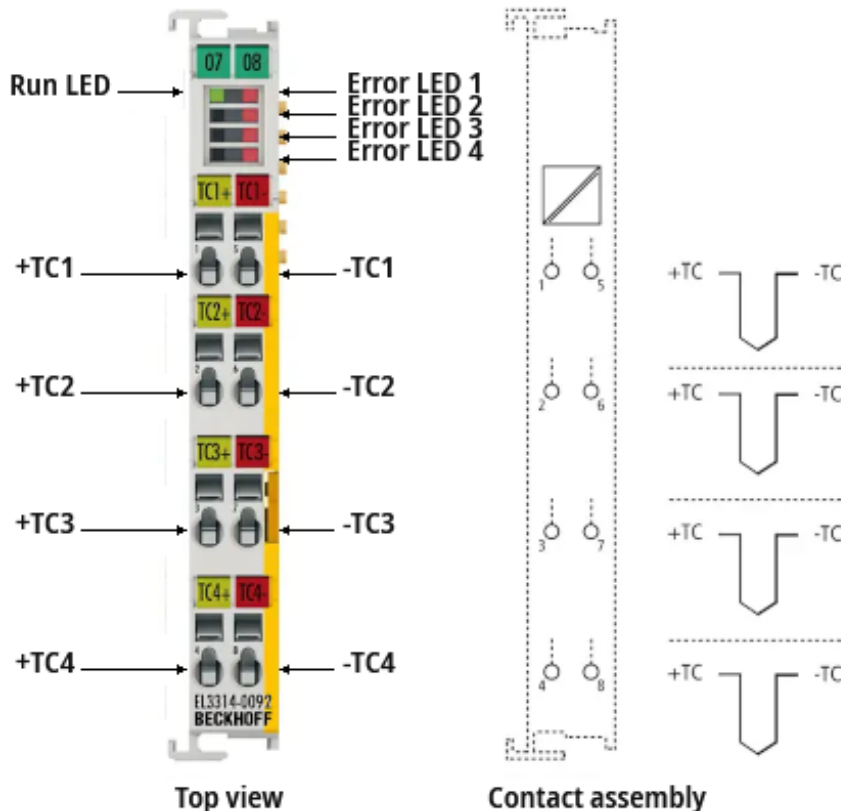


Fig. 96: EL3314-0092

4-channel input terminal, thermocouple with wire break detection, TwinSAFE Single Channel

The EL3314-0092 analog input terminal is based on the EL3314-0002, but is also equipped with the TwinSAFE SC function.

The EL3314-0092 analog input terminal allows four thermocouples to be connected directly. The channels are electrically isolated from each other and from the E-bus, thus preventing adverse effects and damage due to cross currents. Various types of thermocouple are supported; the conversion of the voltage to temperature is already carried out within the terminal. Wire break is signaled by error LEDs and on the fieldbus. The cold junction compensation is carried out by an internal precise temperature measurement at the connection terminals; however, operation with an external cold junction or voltage measurement without cold junction calculation is also possible.

The [TwinSAFE SC technology \[► 250\]](#) (TwinSAFE Single Channel) enables the use of standard signals for safety tasks in any networks or fieldbuses. The standard functionalities and features of the I/Os are retained. The data of the TwinSAFE SC I/Os are routed to the TwinSAFE logic and processed there in a multichannel safety-related manner. In the Safety Logic the data originating from different sources are analyzed, checked for plausibility and submitted to a 'voting'. This is done using certified function blocks such as Scale, Compare/Voting (1oo2, 2oo3, 3oo5), Limit, etc. For safety reasons, at least one of the data sources must be a TwinSAFE SC component. The remainder of the data can originate from other standard bus terminals, drive controllers or measuring transducers.

With the aid of the TwinSAFE SC technology it is typically possible to achieve a safety level equivalent to PL d/Cat. 3 in accordance with EN ISO 13849-1 or SIL 2 in accordance with EN 62061.

Quick links

[EtherCAT basics](#),

[Technology EL33xx](#),

[CoE object description and parameterization \[► 289\]](#)

[Process data and operation modes \[► 230\]](#).

2.8.2 Technical data

2.8.2.1 General technical data

Analog inputs	EL3314-0092
Number of inputs	4
Thermocouple sensor types, measured variables	Type B, C, E, J, K, L, N, R, S, T, U (default setting: type K), voltage measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 24 bit
Sampling type	simultaneous
Ground reference	Differential
Conversion time	approx. 2.4 s to 4 ms depending on configuration and filter setting; Preset: approx. 120 ms at 50/60 Hz
Input filter cut-off frequency	typ. 1 kHz
Software filter	2.5...4000 Hz, adjustable, notch characteristic; preset: 50/60 Hz additional low-pass filter possible
Wire break detection	yes (can be disabled)
Supports NoCoeStorage [► 197] function	yes
Special features	high-precision, electrical isolation

Voltage measurement	EL3314-0092
Measuring ranges	$\pm 78 \text{ mV}$ $\pm 2.5 \text{ V}$
Resolution	1 μV per digit
Measurement uncertainty	See Measurement $\pm 78 \text{ mV} \dots \pm 2.5 \text{ V}$ [► 152]

Temperature measurement	EL3314-0092
Electrical measuring range used	$\pm 78 \text{ mV}$
Measuring ranges	Type B: $+200 \dots +1820 \text{ }^{\circ}\text{C}$ Type C: $0 \dots +2320 \text{ }^{\circ}\text{C}$ Type E: $-270 \dots +1000 \text{ }^{\circ}\text{C}$ Type J: $-210 \dots +1200 \text{ }^{\circ}\text{C}$ Type K: $-270 \dots +1372 \text{ }^{\circ}\text{C}$ (preset) Type L: $-50 \dots +900 \text{ }^{\circ}\text{C}$ Type N: $-270 \dots +1300 \text{ }^{\circ}\text{C}$ Type R: $-50 \dots +1768 \text{ }^{\circ}\text{C}$ Type S: $-50 \dots +1768 \text{ }^{\circ}\text{C}$ Type T: $-270 \dots +400 \text{ }^{\circ}\text{C}$ Type U: $-50 \dots +600 \text{ }^{\circ}\text{C}$
Resolution	Temperature display 0.1/0.01/0.001 $^{\circ}\text{C}$ per digit, preset 0.01 $^{\circ}\text{C}$
Measurement uncertainty	See Thermocouples measurement [► 153]

Supply and potentials	EL3314-0092
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 200 mA
Electrical isolation	2.5 kV functional isolation (test voltage 7 s channel/channel and channel/fieldbus, production test)
Max. potential $\pm\text{TC}$ to ground	2.5 kV (test voltage production test)
Max. differential voltage between the $\pm\text{TC}$ inputs	$\pm 15 \text{ V}$ continuous

Communication	EL3314-0092
Configuration	via TwinCAT System Manager
Width in the process image	max. 24 bytes input, max. 8 bytes output
Distributed Clocks	-

Environmental conditions	EL3314-0092
Permissible ambient temperature range during operation	0 °C... + 55 °C
Permissible ambient temperature range during storage	-25 °C... + 85 °C
Permissible relative air humidity	95 %, no condensation

General data	EL3314-0092
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight	approx. 60 g
Installation [► 203]	on 35 mm mounting rail, conforms to EN 60715
Installation position	To ensure enhanced measuring accuracy, the terminal must be installed in the <u>prescribed standard position</u> ! See note [► 224]!
MTBF (55 °C)	> 1,000,000 h

Standards and approvals	EL3314-0092
Protection rating	IP20
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4
Identification / approval ^{*)}	CE, UKCA, EAC, CCC

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

Terminal	Extended features			
	Electrical isolation	TwinSAFE SC	high-precision	Calibration certificate
EL3314 [► 54]	No	No	No	No
EL3314-0002 [► 73]	Yes	No	Yes	No
EL3314-0010 [► 92]	No	No	Yes	No
EL3314-0030 [► 111]	No	No	Yes	External calibration certificate (ISO17025 or DAkkS certificate)
EL3314-0090 [► 130]	No	Yes	No	No
EL3314-0092 [► 149]	Yes	Yes	Yes	No

2.8.2.2 Measurement $\pm 78 \text{ mV} \dots \pm 2.5 \text{ V}$

Specification $\pm 78 \text{ mV}$

Measurement mode		$\pm 78 \text{ mV}$
Measuring range, nominal		$-78 \dots +78 \text{ mV}$
Measuring range, end value (full scale value)		78 mV
PDO resolution		$1 \mu\text{V}$
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.06\%_{\text{FSV}}$ typ.
	@ 55°C ambient temperature ¹	$< \pm 0.13\%_{\text{FSV}}$ typ.
Offset/zero point deviation (at 23°C) ²	F_{Offset}	$< \pm 10 \mu\text{V}$
Gain/scale/amplification deviation (at 23°C) ²	F_{Gain}	$< 500 \text{ ppm}$
Temperature coefficient	Tk_{Offset}	$< 0.5 \mu\text{V/K}$
	Tk_{Gain}	$< 15 \text{ ppm/K}$

Specification $\pm 2.5 \text{ V}$

The EL3314-0002 and EL3314-0092 are not calibrated in the electrical measuring range $\pm 2.5 \text{ V}$ at the factory. However, the measuring range can be used after calibration on the application side.

Measurement mode		$\pm 2.5 \text{ V}$
Measuring range, nominal		$-2.5 \dots +2.5 \text{ V}$
Measuring range, end value (full scale value)		2.5 V
PDO resolution		$1 \mu\text{V}$

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.

2.8.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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

In the EL3314-0002 and EL3314-0092, each channel has its own cold junction sensor.

Measurement mode		Cold junction
Basic accuracy: measurement deviation at 23 °C, with averaging		< ±1.75 °C
Temperature coefficient	Tk	< 25 mK/K

Specification: Thermocouple type B

Temperature measurement thermocouple		Type B
Electrical measuring range used		± 78 mV
Measuring range, technically available		+200 °C ≈ 0.178 mV ... +1820 °C ≈ 13.820 mV
Measuring range, end value (full scale value)		+1820 °C
Measuring range, recommended		+750 °C ... +1800 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.2 K ≈ ± 0.12 % _{FSV}
	@ 55 °C ambient temperature	± 3.3 K ≈ ± 0.18 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

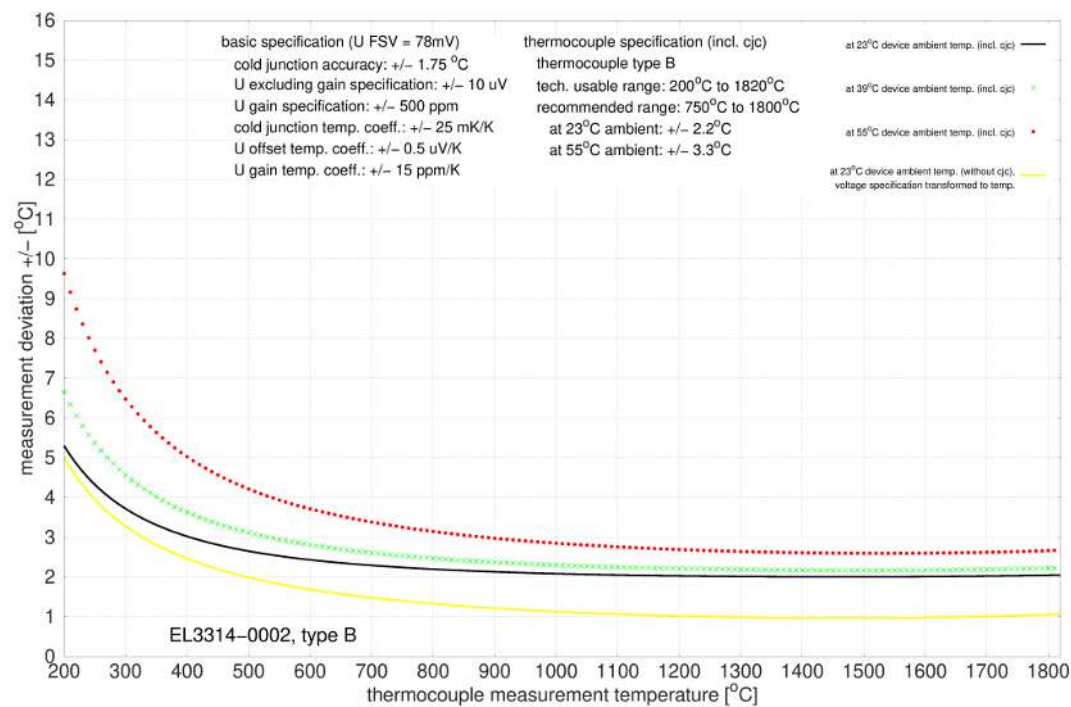


Fig. 97: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 2.4\text{ K} \approx \pm 0.10\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.1\text{ K} \approx \pm 0.13\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

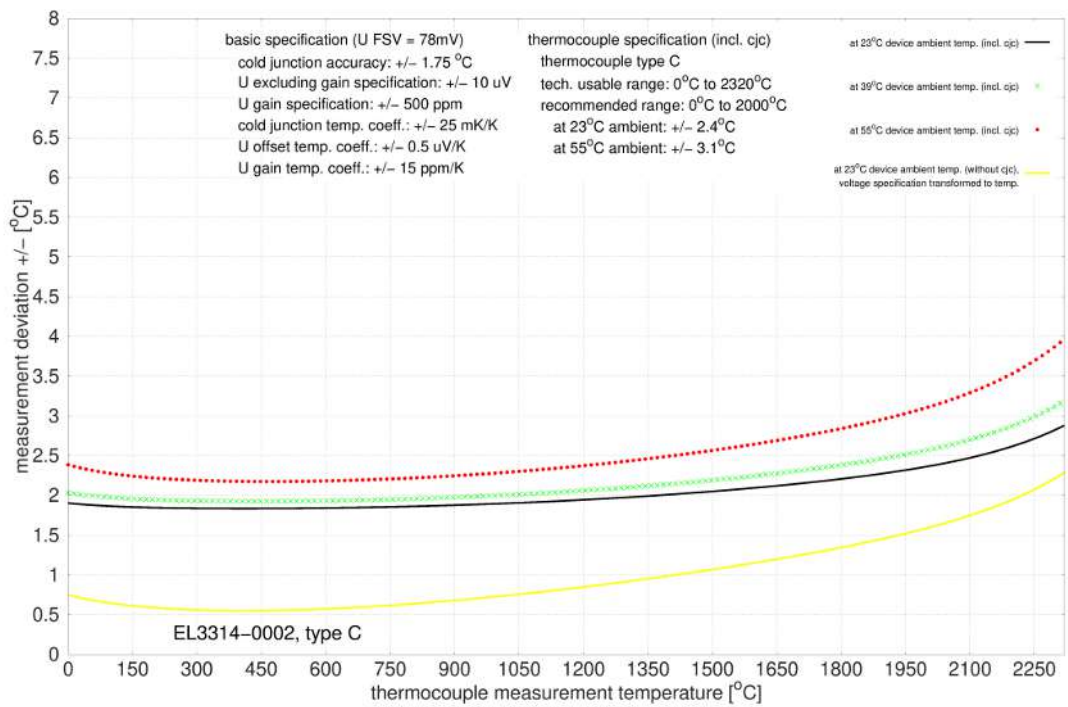


Fig. 98: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -9.835\text{ mV} \dots +1000\text{ }^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +1000\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.18\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.21\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

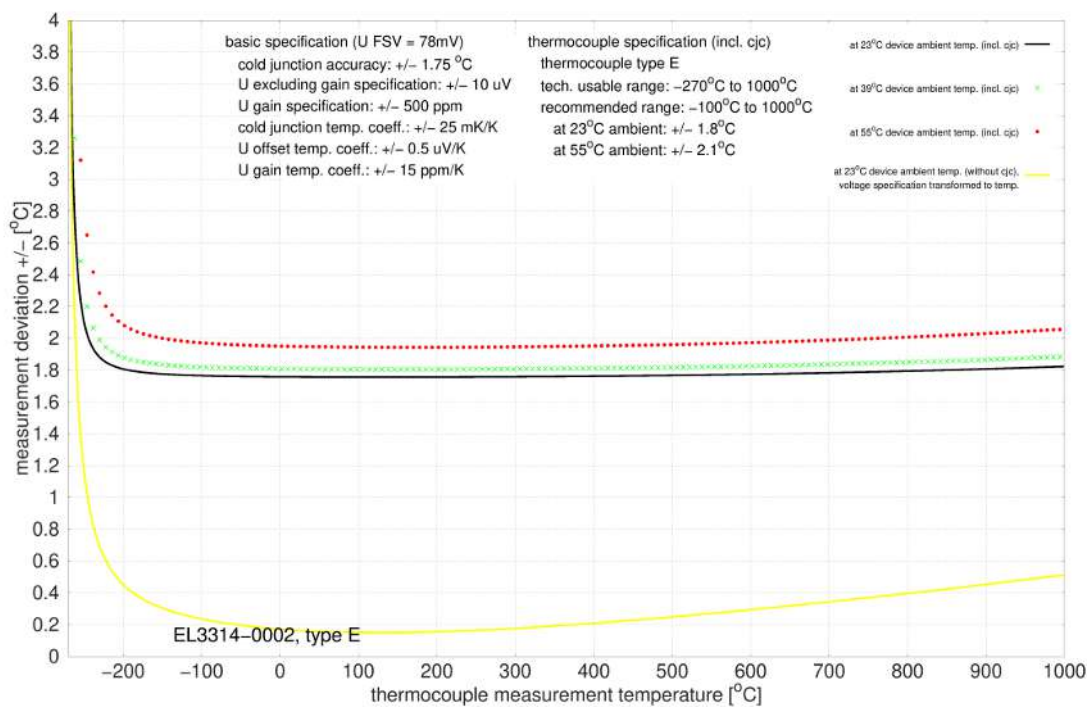


Fig. 99: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type E

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-210\text{ }^{\circ}\text{C} \approx -8.095\text{ mV} \dots +1200\text{ }^{\circ}\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +1200\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.18\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

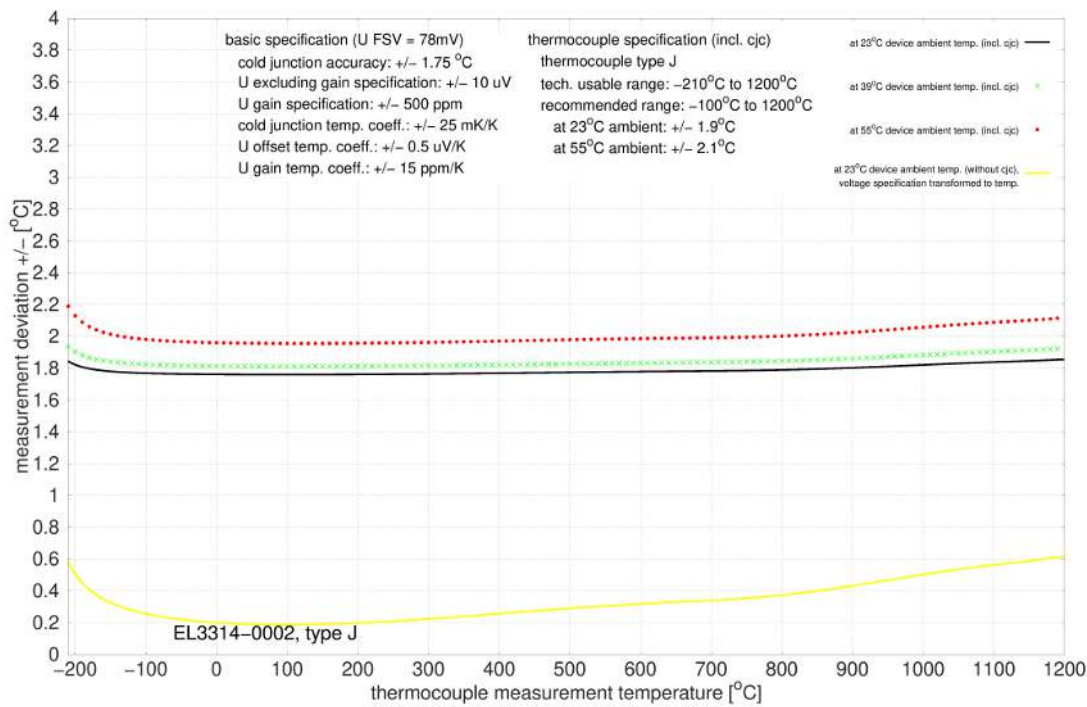


Fig. 100: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -6.458\text{ mV} \dots +1372\text{ }^{\circ}\text{C} \approx 54.886\text{ mV}$
Measuring range, end value (full scale value)		$+1372\text{ }^{\circ}\text{C}$
Measuring range, recommended		$-100\text{ }^{\circ}\text{C} \dots +1200\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.14\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.2\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

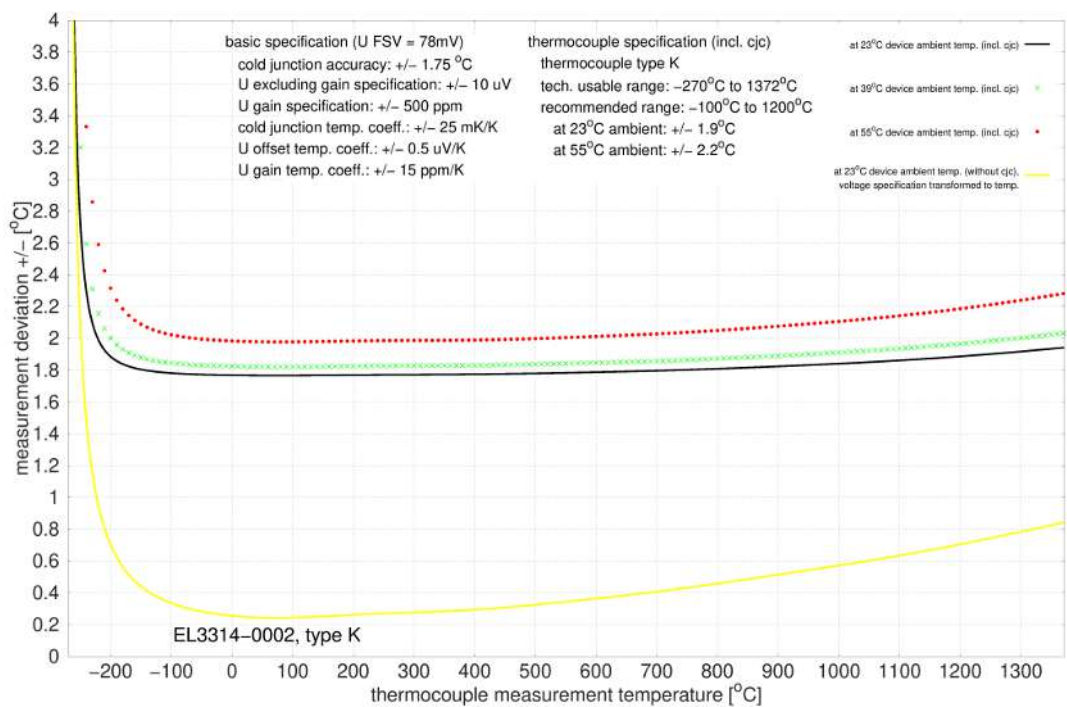


Fig. 101: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type K

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -2.510\text{ mV} \dots +900\text{ }^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +900\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.20\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.22\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

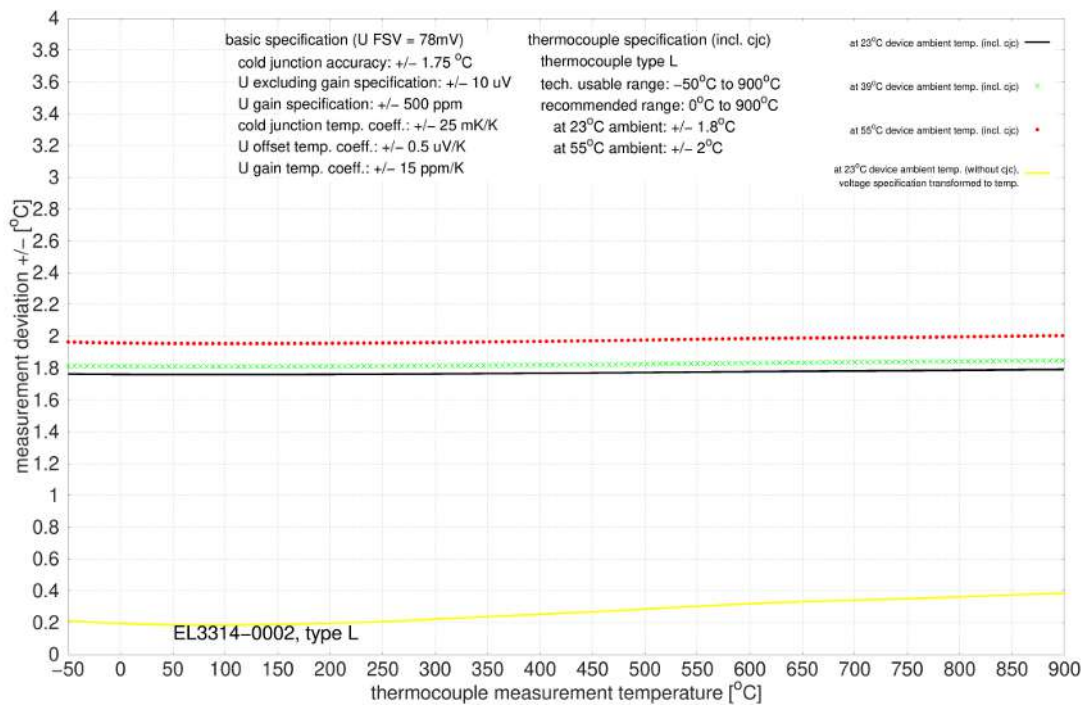


Fig. 102: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-270\text{ }^{\circ}\text{C} \approx -4.346\text{ mV} \dots +1300\text{ }^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300\text{ }^{\circ}\text{C}$
Measuring range, recommended		$0\text{ }^{\circ}\text{C} \dots +1300\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C/digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 1.9\text{ K} \approx \pm 0.15\text{ \%}_{\text{FSV}}$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.16\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

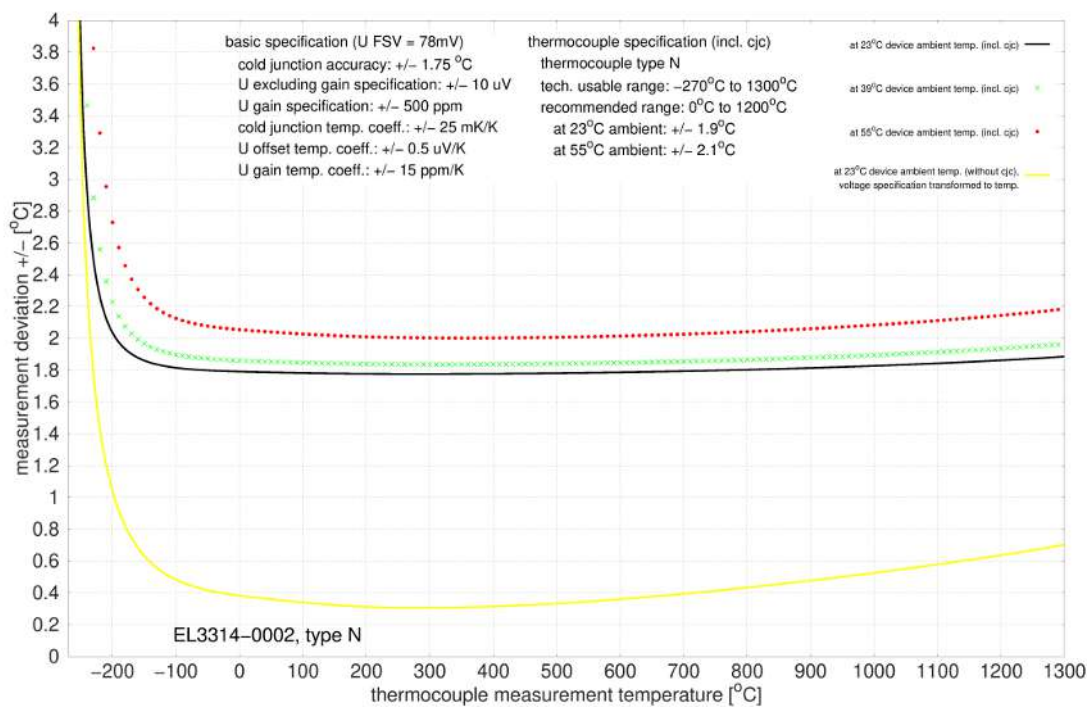


Fig. 103: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		± 78 mV
Measuring range, technically available		-50 °C ≈ -0.226 mV ... +1768 °C ≈ 21.101 mV
Measuring range, end value (full scale value)		+1768 °C
Measuring range, recommended		+250 °C ... +1700 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 2.1 K ≈ ± 0.12 % _{FSV}
	@ 55 °C ambient temperature	± 2.8 K ≈ ± 0.16 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

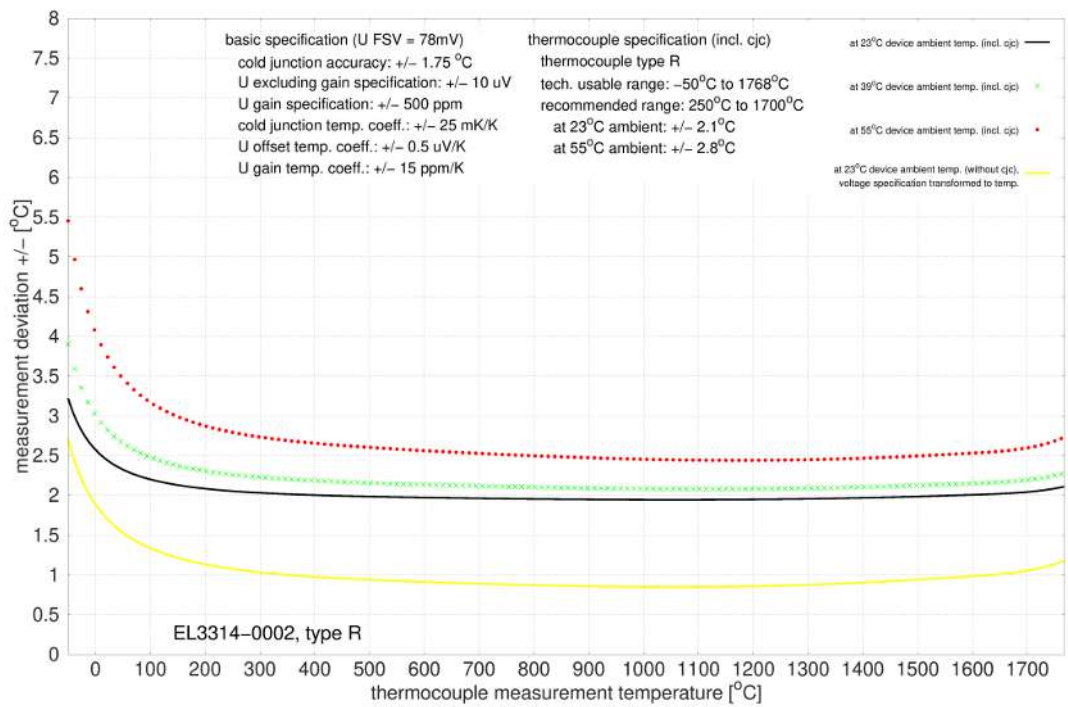


Fig. 104: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50\text{ }^{\circ}\text{C} \approx -0.236\text{ mV} \dots +1768\text{ }^{\circ}\text{C} \approx 18.693\text{ mV}$
Measuring range, end value (full scale value)		$+1768\text{ }^{\circ}\text{C}$
Measuring range, recommended		$+250\text{ }^{\circ}\text{C} \dots +1700\text{ }^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001\text{ }^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ $23\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.1\text{ K} \approx \pm 0.12\text{ }_{\text{FSV}}\%$
	@ $55\text{ }^{\circ}\text{C}$ ambient temperature	$\pm 2.9\text{ K} \approx \pm 0.16\text{ }_{\text{FSV}}\%$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39\text{ }^{\circ}\text{C}$ as the middle point between $23\text{ }^{\circ}\text{C}$ and $55\text{ }^{\circ}\text{C}$ is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

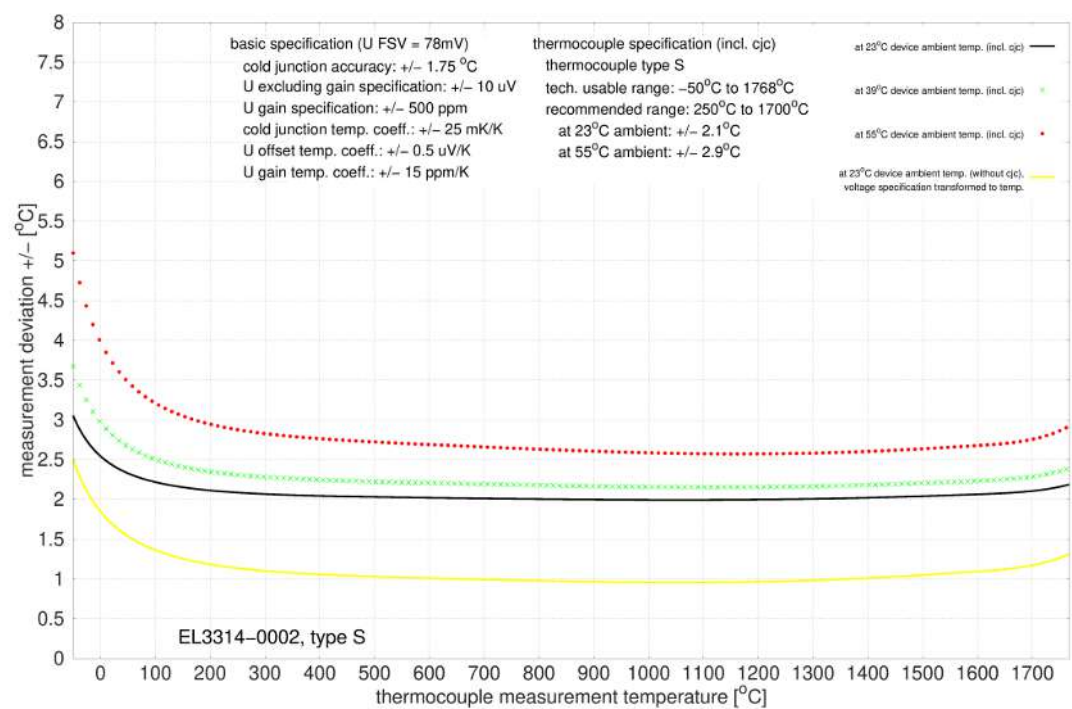


Fig. 105: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		± 78 mV
Measuring range, technically available		-270 °C ≈ -6.258 mV ... +400 °C ≈ 20.872 mV
Measuring range, end value (full scale value)		+400 °C
Measuring range, recommended		-100 °C ... +400 °C
PDO LSB		0.1/0.01/0.001 °C/digit, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23 °C ambient temperature	± 1.8 K ≈ ± 0.45 % _{FSV}
	@ 55 °C ambient temperature	± 2.0 K ≈ ± 0.50 % _{FSV}
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

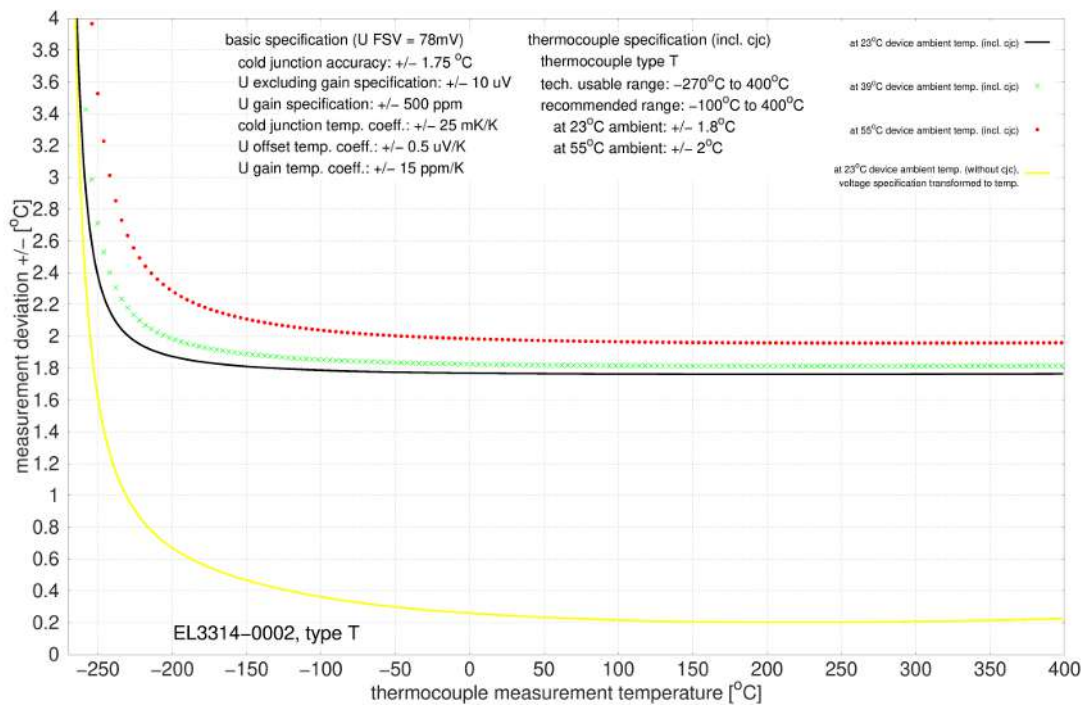


Fig. 106: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 78\text{ mV}$
Measuring range, technically available		$-50^{\circ}\text{C} \approx -1.850\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01/0.001^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 1.8\text{ K} \approx \pm 0.30\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 2.0\text{ K} \approx \pm 0.33\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

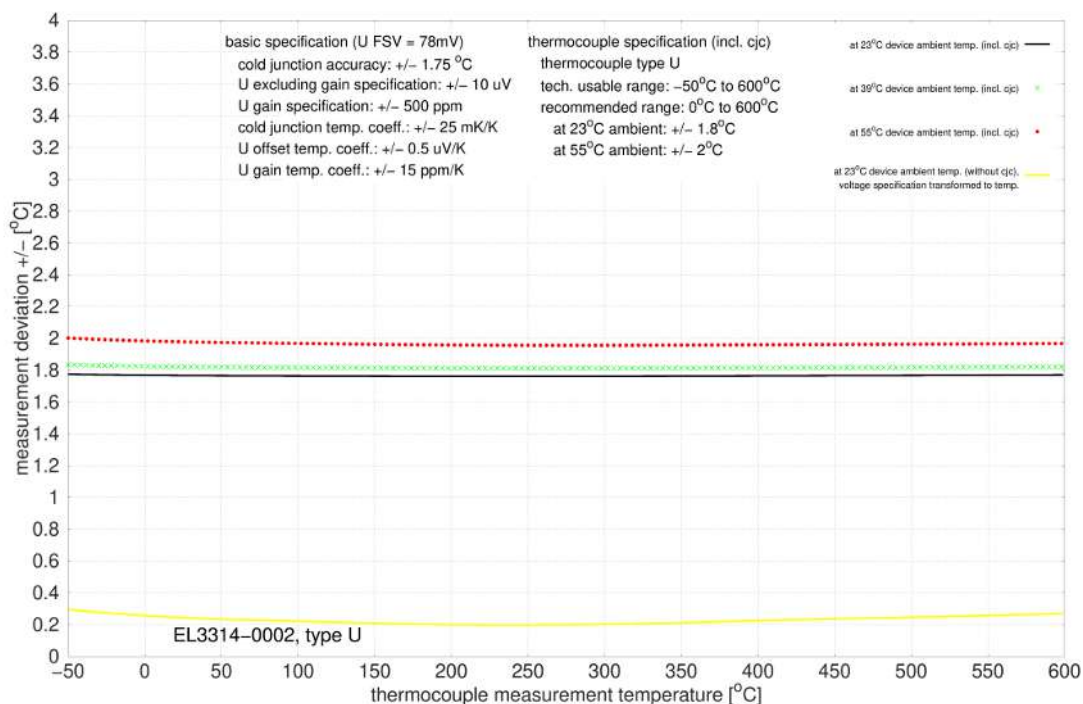


Fig. 107: EL3314-0002 and EL3314-0092 (corresponds to EL3314-0002), type U

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.8.3 Connection

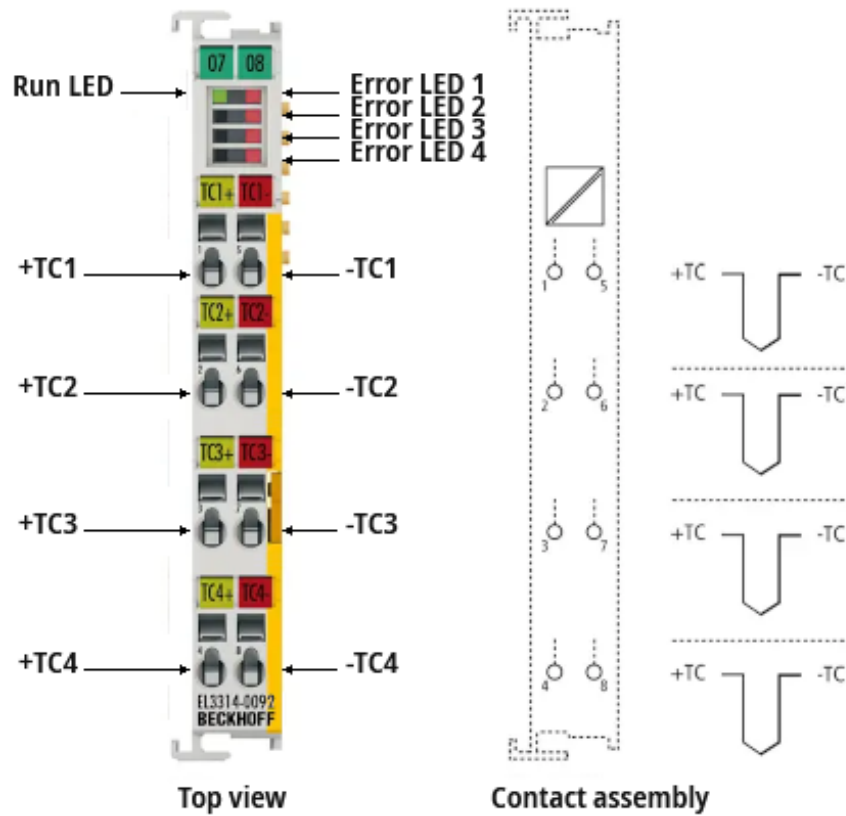


Fig. 108: EL3314-0092

EL3314-0092 – Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
-TC3	3	Input +TC3
+TC4	4	Input +TC4
-TC1	5	Input -TC1
-TC2	6	Input -TC2
-TC3	7	Input -TC3
-TC4	8	Input -TC4



Earthed thermocouples

Observe for earthed thermocouples: Differential inputs max. $\pm 2\text{ V}$ to ground!

2.8.4 Display, diagnostics

EL3314-0092 - LEDs

LED	Color	Meaning
RUN	green	This LED indicates the terminal's operating state:
		off State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly State of the EtherCAT State Machine: PREOP = function for mailbox communication and different default settings set
		flashing slowly State of the EtherCAT State Machine: SAFEOP = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly State of the EtherCAT State Machine: BOOTSTRAP = function for Firmware updates of the terminal
ERROR1-4	red	Short circuit or wire break. The voltage value is in the invalid range of the characteristic curve.

2.9 EL3318

2.9.1 Introduction

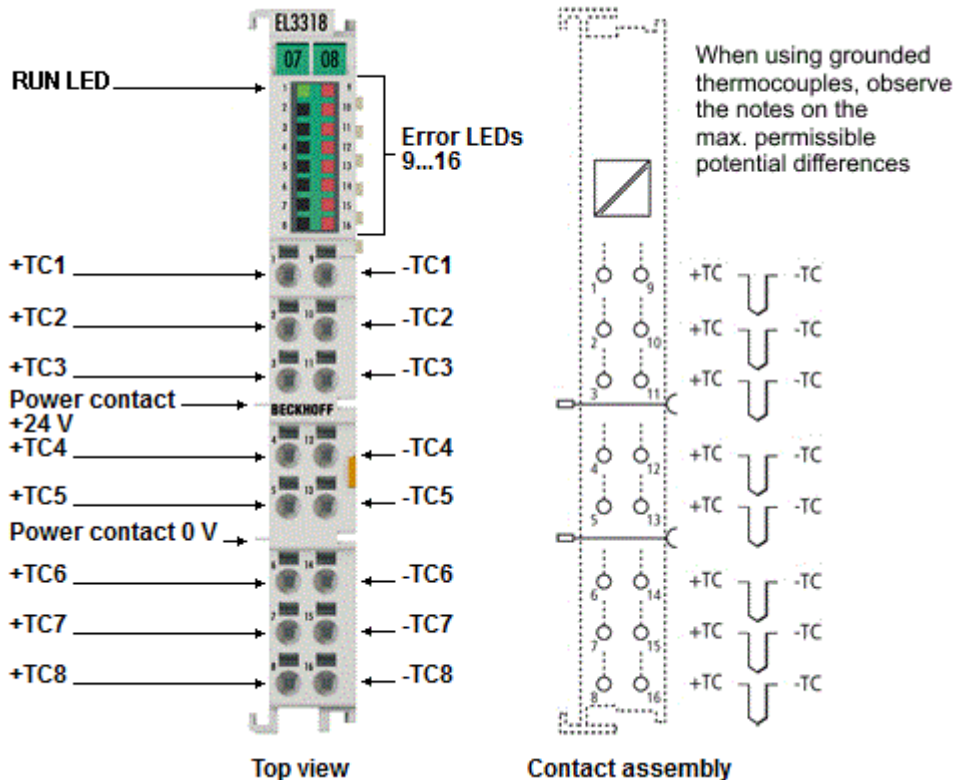


Fig. 109: EL3318

8 channel HD analog thermocouple input terminal with open-circuit recognition

The EL3318 analog input terminal allows direct connection of eight thermocouples and is therefore particularly suitable for space-saving use in control cabinets. The EtherCAT Terminal circuit can operate thermocouple sensors using the 2-wire technique. A microprocessor handles linearization across the whole temperature range, which is freely selectable. The error LEDs indicate a broken wire. Compensation for the cold junction is made through an internal temperature measurement at the terminals. The EL3318 also enables measurements in the mV range.

The HD EtherCAT Terminals (High Density) with increased packing density are equipped with 16 connection points in the housing of a 12-mm terminal block.

Quick links

- [EtherCAT basics](#)
- [Technology EL33xx](#)
- [CoE object description and parameterization \[► 306\]](#)
- [Process data and operation modes \[► 230\]](#)

2.9.2 Technical data

2.9.2.1 General technical data

Analog inputs	EL3318
Number of inputs	8
Thermocouple sensor types, measured variables	Types B, C, E, J, K, L, N, R, S, T, U (default setting type K), mV measurement
Connection technology	2-wire
Maximum cable length to the thermocouple	30 m (without protective measures), suitable surge protection must be provided for longer cable lengths
Resolution	internal 16-bit
Sampling type	multiplex
Ground reference	differential
Conversion time	approx. 3.5 s to 30 ms, depending on the configuration and filter setting; default: approx. 380 ms
Input filter cut-off frequency	1 kHz typ.
Software filter	5 Hz... 30 kHz, adjustable, notch characteristic; preset: disabled
Open-circuit recognition	yes (can be disabled)
Supports NoCoEStorage [► 197]	yes, from firmware 01

Voltage measurement	EL3318
Measuring range, technically usable	approx. ± 78 mV
Measuring ranges (nominal) and resolution	± 30 mV (1 μ V per digit, thus max. 32.768 mV can be displayed) ± 60 mV (2 μ V per digit, thus max. 65.536 mV can be displayed) ± 75 mV (4 μ V per digit, thus max. 131 mV can be displayed, observe technical 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	See Measurement ± 30 mV... ± 75 mV [► 171]

Temperature measurement	EL3318
Electrical measuring range used	± 75 mV
Measuring ranges	Type B: $+200...+1820^{\circ}\text{C}$ Type C: $0...+2320^{\circ}\text{C}$ Type E: $-100...+1000^{\circ}\text{C}$ Type J: $-100...+1200^{\circ}\text{C}$ Type K: $-270...+1370^{\circ}\text{C}$ (preset) Type L: $0...+900^{\circ}\text{C}$ Type N: $-100...+1300^{\circ}\text{C}$ Type R: $-50...+1767^{\circ}\text{C}$ Type S: $-50...+1760^{\circ}\text{C}$ Type T: $-200...+400^{\circ}\text{C}$ Type U: $0...+600^{\circ}\text{C}$
Resolution	Temperature display 0.1/0.01 $^{\circ}\text{C}$ per digit, preset 0.1 $^{\circ}\text{C}$ Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $> 0.01^{\circ}\text{C}$ occur with "resolution 0.01 $^{\circ}\text{C}$ "; e.g. type K: approx. 0.04 $^{\circ}\text{C}$
Measurement uncertainty	See Thermocouples measurement [► 172]

Supply and potentials		EL3318
Power supply for the electronics		via the E-bus
Current consumption via E-bus		typ. 210 mA
Differential voltage between +TC and -TC	Recommended area of application	respective measuring range
	Destruction limit, short-term/continuous	±15 V
Max. potential of the twisted TC ends to one another (non-isolated/grounded TC)	Recommended area of application	±2 V
	Destruction limit, short-term/continuous	±15 V
Max. potential U_{CM} (CommonMode voltage) of the twisted TC to GND	Recommended area of application	Not applicable because GND is not accessible
	Destruction limit, short-term/continuous	
Max. potential of twisted TC or GND to SGND or 0 V power	Recommended area of application	±30 V
	Destruction limit, short-term/continuous	±50 V
Electrical isolation: Max. potential of twisted TC or GND to bus side	Recommended area of application and short-term/continuous destruction limit	500 V

Communication		EL3318
Configuration		via TwinCAT System Manager
Width in the process image		max. 16 bytes input, max. 8 bytes output
Distributed Clocks		-

Environmental conditions		EL3318
Permissible ambient temperature range during operation		-25°C... +60°C (extended temperature range), from firmware 06
Permissible ambient temperature range during storage		-40°C ... +85°C
Permissible relative air humidity		95%, no condensation

General data		EL3318
Dimensions (W x H x D)		approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Weight		approx. 60 g
Mounting and wiring [► 203]		on 35 mm support rail according to EN 60715
Installation position		variable

Standards and approvals		EL3318
Protection class		IP20
Vibration / shock resistance		conforms to EN 60068-2-6 / EN 60068-2-27, see also Installation instructions for enhanced mechanical load capacity [► 214]
EMC immunity / emission		conforms to EN 61000-6-2 / EN 61000-6-4
Marking / Approval ^{*)}		CE, UKCA, EAC, CCC ATEX [► 206] , IECEX [► 207] , cFMus [► 208] , cULus [► 210]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex ec IIC T4 Gc
IECEX	Ex ec IIC T4 Gc
cFMus	Class I, Division 2, Groups A, B, C, D Class I, Zone 2, AEx/Ex ec IIC T4 Gc

Extended features	EL3318
Pluggable connection level	-
Electrical isolation	-
TwinSAFE SC	-
Calibration certificate	-

2.9.2.2 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.155\%_{FSV}$ typ. $\approx \pm 0.047$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.189\%_{FSV}$ typ. $\approx \pm 0.057$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 40$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 800 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.104\%_{FSV}$ typ. $\approx \pm 0.062$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.117\%_{FSV}$ typ. $\approx \pm 0.070$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 40$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 800 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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 μ V / digit
Basic accuracy: Measurement deviation, with averaging	@ 23°C ambient temperature	$< \pm 0.096\%_{FSV}$ typ. $\approx \pm 0.072$ mV
	@ 55°C ambient temperature ¹	$< \pm 0.105\%_{FSV}$ typ. $\approx \pm 0.079$ mV
Offset/zero point deviation (at 23°C) ²	F _{Offset}	$< \pm 40$ μ V
Gain/scale/amplification deviation (at 23°C) ²	F _{Gain}	< 800 ppm
Temperature coefficient	Tk _{Offset}	< 1 μ V/K
	Tk _{Gain}	< 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.

2.9.2.3 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.

The following tables with the specification of the thermocouple measurement apply only when using the internal cold junction.

The EL331x-00xx can also be used with an external cold junction if required. The uncertainties must then be determined for the external cold junction on the application side. The temperature value of the external cold junction must then be communicated to the EL331x-00xx via the process data for its own calculation. 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 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

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 Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value >0.01 °C occur with "resolution 0.01 °C"; e.g. type B: approx. 0.05 °C.
Uncertainty in the recommended measuring range*)	@ 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 in relation to the change in the ambient temperature of the terminal)		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.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type B:

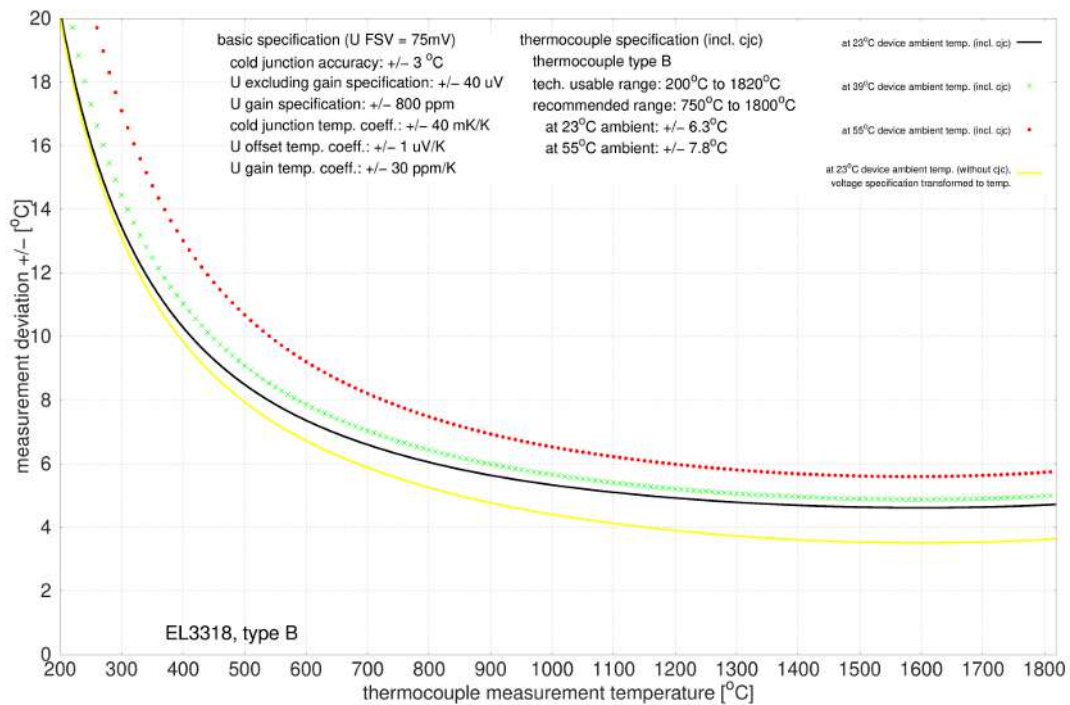


Fig. 110: EL3318, type B

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type C

Temperature measurement thermocouple		Type C
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +2320^{\circ}\text{C} \approx 37.107\text{ mV}$
Measuring range, end value (full scale value)		$+2320^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +2000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type C: approx. 0.07°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 4.9\text{ K} \approx \pm 0.21\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 6.3\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type C:

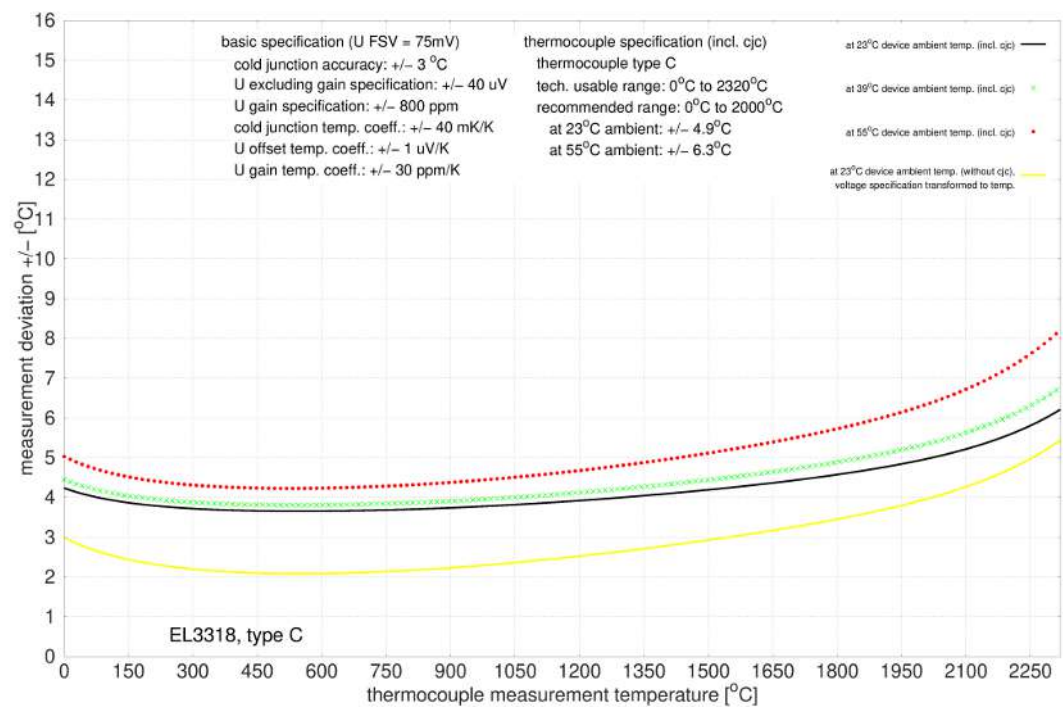


Fig. 111: EL3318, type C

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type E

Temperature measurement thermocouple		Type E
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -5.237\text{ mV} \dots +1000^{\circ}\text{C} \approx 76.372\text{ mV}$
Measuring range, end value (full scale value)		$+1000^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1000^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type E: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.1\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.36\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type E:

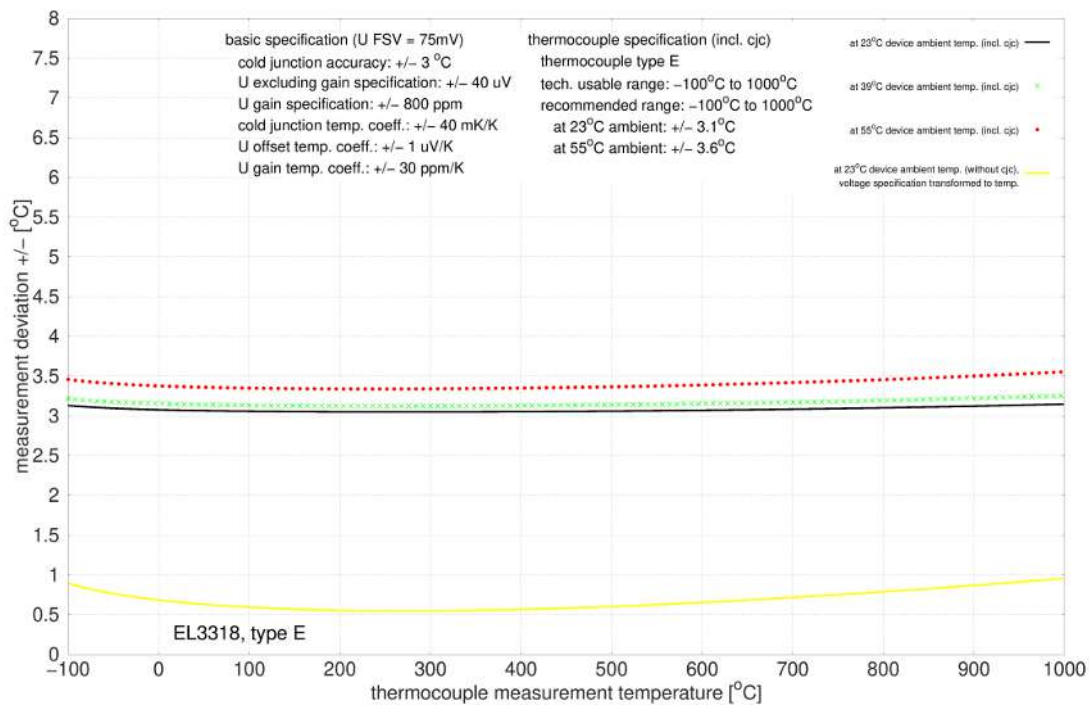


Fig. 112: EL3318, type E

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type J

Temperature measurement thermocouple		Type J
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^\circ\text{C} \approx -4.632\text{ mV} \dots +1200^\circ\text{C} \approx 69.553\text{ mV}$
Measuring range, end value (full scale value)		$+1200^\circ\text{C}$
Measuring range, recommended		$-100^\circ\text{C} \dots +1200^\circ\text{C}$
PDO LSB		$0.1/0.01^\circ\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^\circ\text{C}$ occur with "resolution 0.01°C "; e.g. type J: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.2\text{ K} \approx \pm 0.27\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.7\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^\circ\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type J:

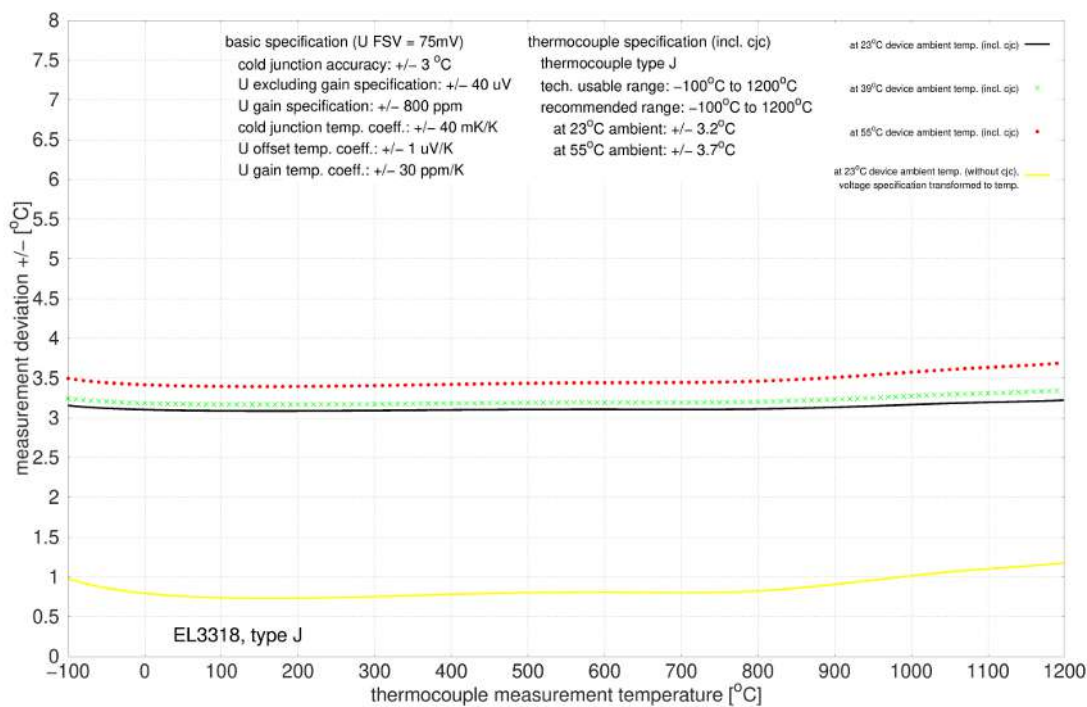


Fig. 113: EL3318, type J

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type K

Temperature measurement thermocouple		Type K
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.891\text{ mV} \dots +1370^{\circ}\text{C} \approx 54.818\text{ mV}$
Measuring range, end value (full scale value)		$+1370^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +1200^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type K: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.0\text{ K} \approx \pm 0.22\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.6\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type K:

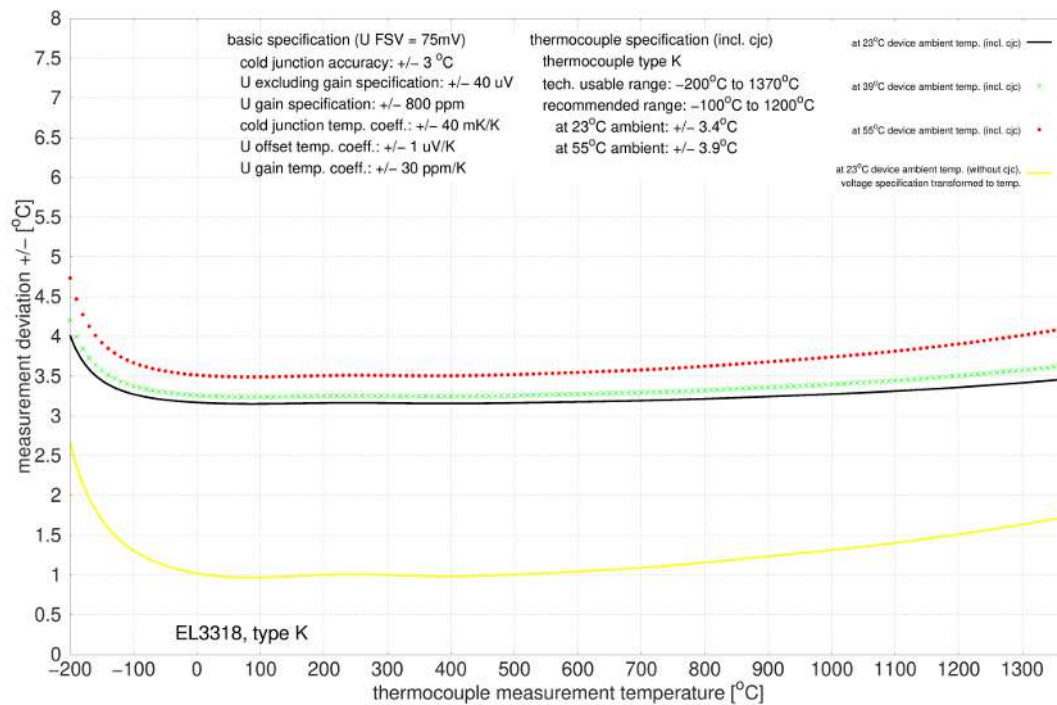


Fig. 114: EL3318, type K

NOTICE**Voltage specification transferred to Temp.**

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type L

Temperature measurement thermocouple		Type L
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +900^{\circ}\text{C} \approx 52.430\text{ mV}$
Measuring range, end value (full scale value)		$+900^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +900^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type L: approx. 0.03°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.1\text{ K} \approx \pm 0.34\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.39\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		<i>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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.</i>

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type L:

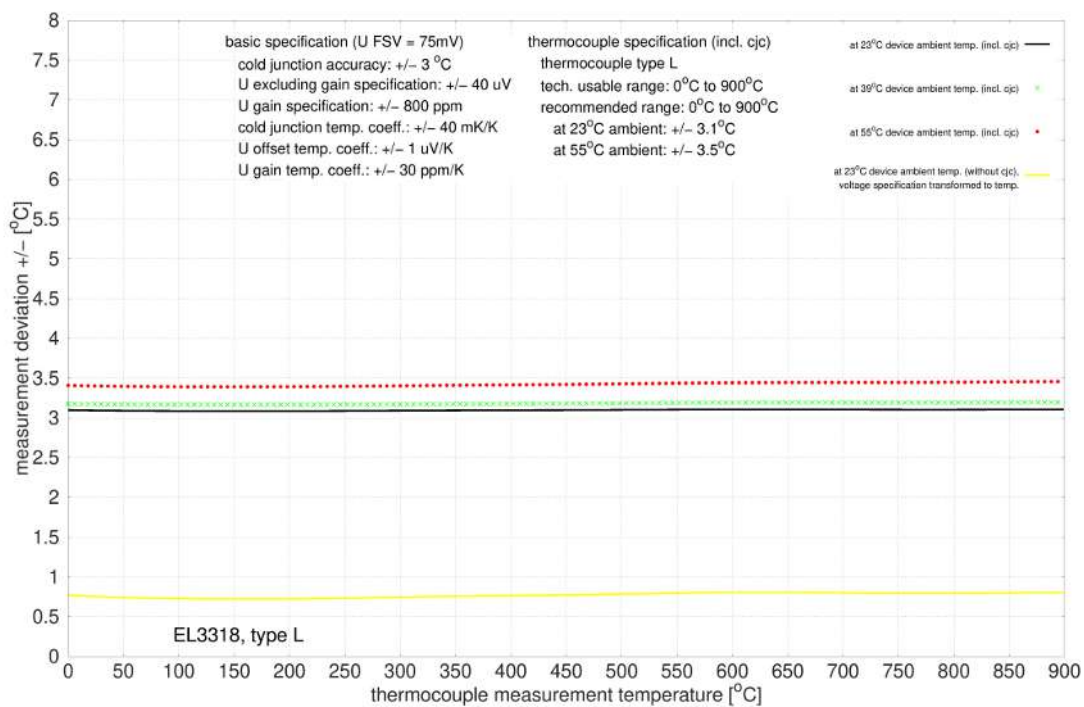


Fig. 115: EL3318, type L

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type N

Temperature measurement thermocouple		Type N
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-100^{\circ}\text{C} \approx -2.406\text{ mV} \dots +1300^{\circ}\text{C} \approx 47.513\text{ mV}$
Measuring range, end value (full scale value)		$+1300^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +1300^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type N: approx. 0.04°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.4\text{ K} \approx \pm 0.26\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.8\text{ K} \approx \pm 0.29\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type N:

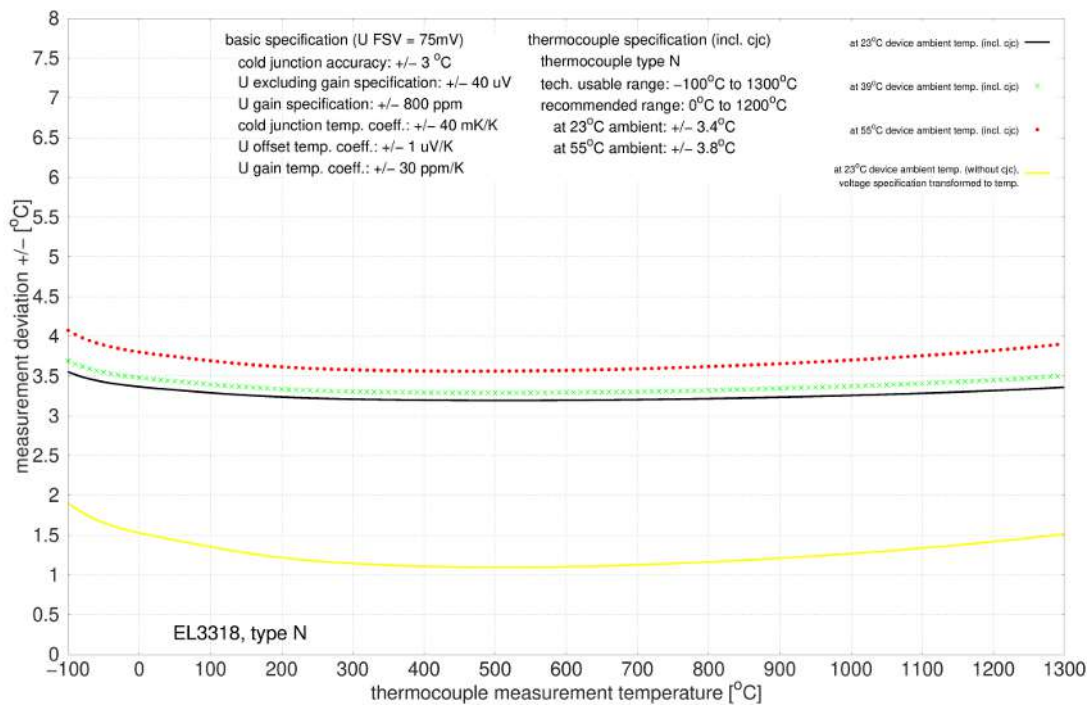


Fig. 116: EL3318, type N

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type R

Temperature measurement thermocouple		Type R
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1767^{\circ}\text{C} \approx 21.089\text{ mV}$
Measuring range, end value (full scale value)		$+1767^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type R: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 5.2\text{ K} \approx \pm 0.29\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 6.4\text{ K} \approx \pm 0.36\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type R:

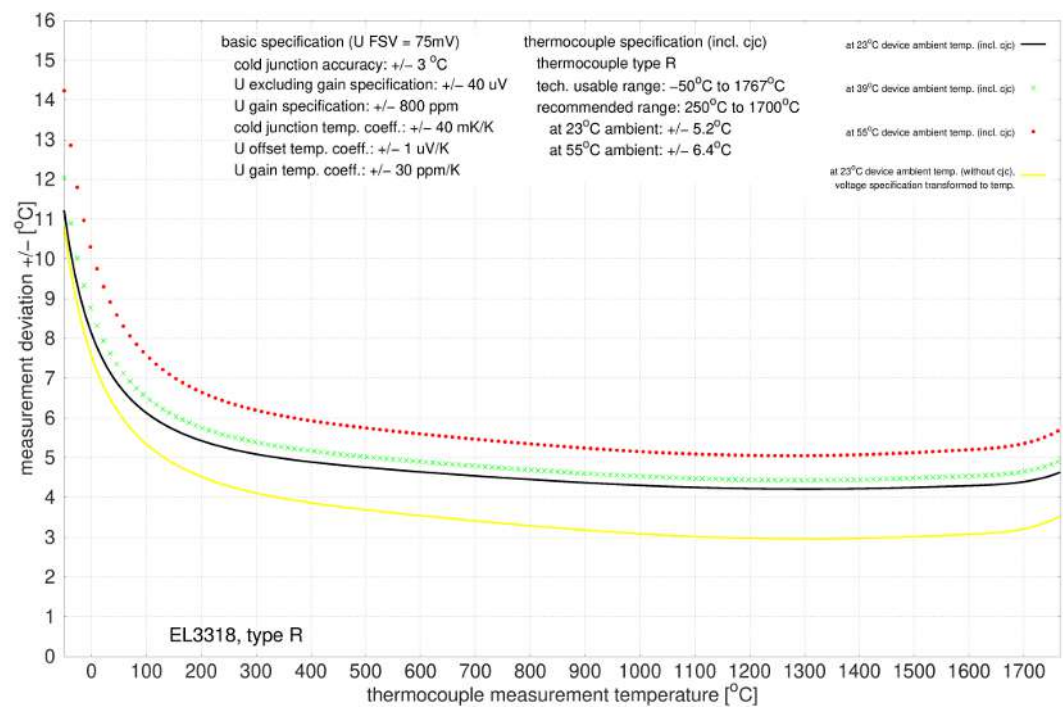


Fig. 117: EL3318, type R

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type S

Temperature measurement thermocouple		Type S
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +1760^{\circ}\text{C} \approx 17.947\text{ mV}$
Measuring range, end value (full scale value)		$+1760^{\circ}\text{C}$
Measuring range, recommended		$+250^{\circ}\text{C} \dots +1700^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type S: approx. 0.05°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 5.4\text{ K} \approx \pm 0.31\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 6.7\text{ K} \approx \pm 0.38\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type S:

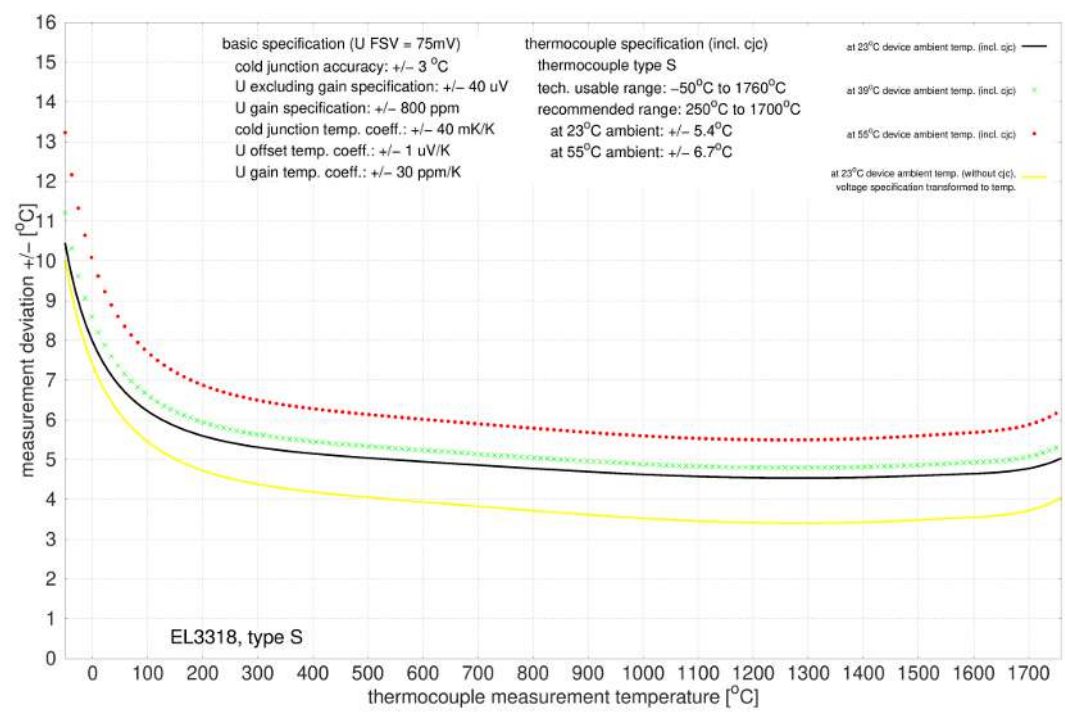


Fig. 118: EL3318, type S

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type T

Temperature measurement thermocouple		Type T
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$-200^{\circ}\text{C} \approx -5.603\text{ mV} \dots +400^{\circ}\text{C} \approx 20.872\text{ mV}$
Measuring range, end value (full scale value)		$+400^{\circ}\text{C}$
Measuring range, recommended		$-100^{\circ}\text{C} \dots +400^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.3\text{ K} \approx \pm 0.83\text{ }\%_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.7\text{ K} \approx \pm 0.93\text{ }\%_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type T:

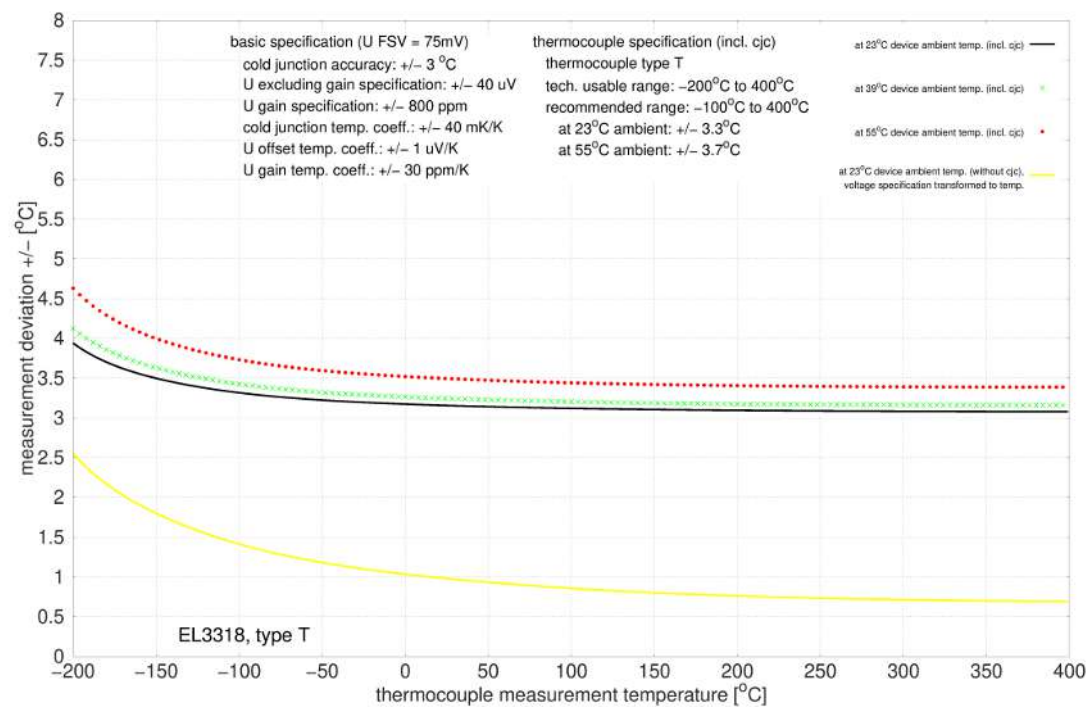


Fig. 119: EL3318, type T

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

Specification - thermocouple type U

Temperature measurement thermocouple		Type U
Electrical measuring range used		$\pm 75\text{ mV}$
Measuring range, technically available		$0^{\circ}\text{C} \approx 0\text{ mV} \dots +600^{\circ}\text{C} \approx 33.600\text{ mV}$
Measuring range, end value (full scale value)		$+600^{\circ}\text{C}$
Measuring range, recommended		$0^{\circ}\text{C} \dots +600^{\circ}\text{C}$
PDO LSB		$0.1/0.01^{\circ}\text{C}/\text{digit}$, depending on PDO setting Note: internally, 16 bits are used for the calculation up to the FSV; depending on the set thermocouple, therefore, jumps in value $>0.01^{\circ}\text{C}$ occur with "resolution 0.01°C "; e.g. type U: approx. 0.02°C .
Uncertainty in the recommended measuring range*)	@ 23°C ambient temperature	$\pm 3.2\text{ K} \approx \pm 0.53\text{ \%}_{\text{FSV}}$
	@ 55°C ambient temperature	$\pm 3.5\text{ K} \approx \pm 0.58\text{ \%}_{\text{FSV}}$
Temperature coefficient (Change in the measured value in relation to the change in the ambient temperature of the terminal)		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 $T_{\text{amb}} = 39^{\circ}\text{C}$ as the middle point between 23°C and 55°C is also shown informatively in order to illustrate the non-linear curve.

*) with averaging, incl. int. CJ uncertainty (added quadratically in the voltage dimension)

Measurement uncertainty for thermocouple type U:

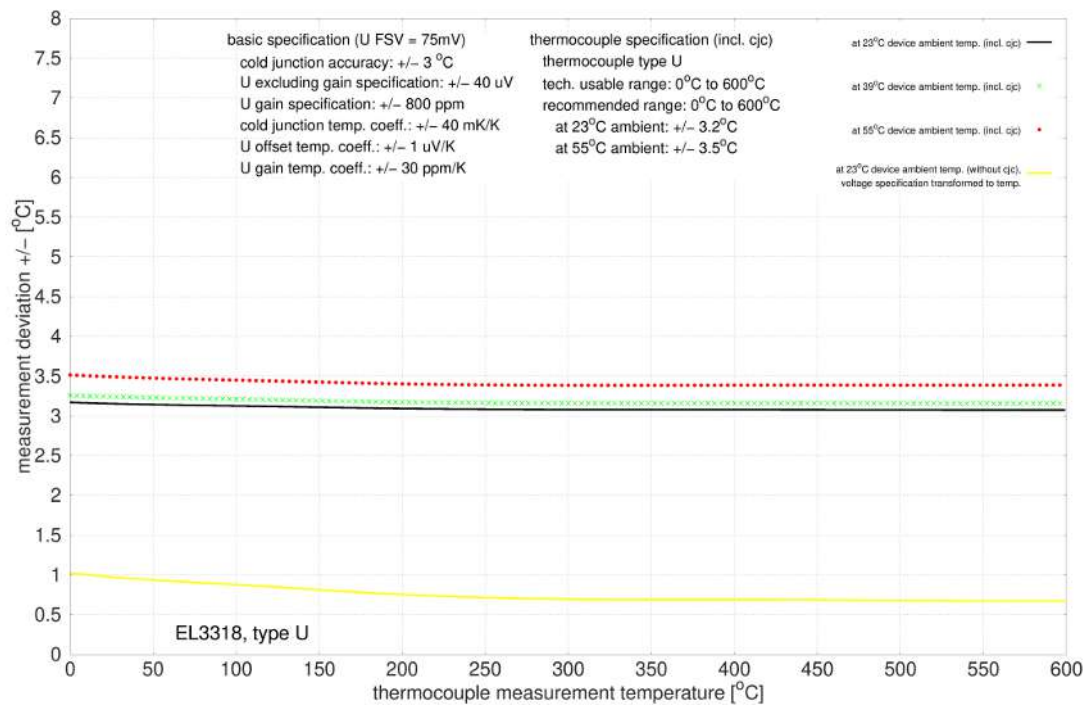


Fig. 120: EL3318, type U

NOTICE

Voltage specification transferred to Temp.

This characteristic curve is calculated with the respective voltage-dependent gain/offset uncertainties and may therefore provide significantly smaller values than the formal recalculation with the specifications of the electrical measuring range used.

2.9.3 Connection

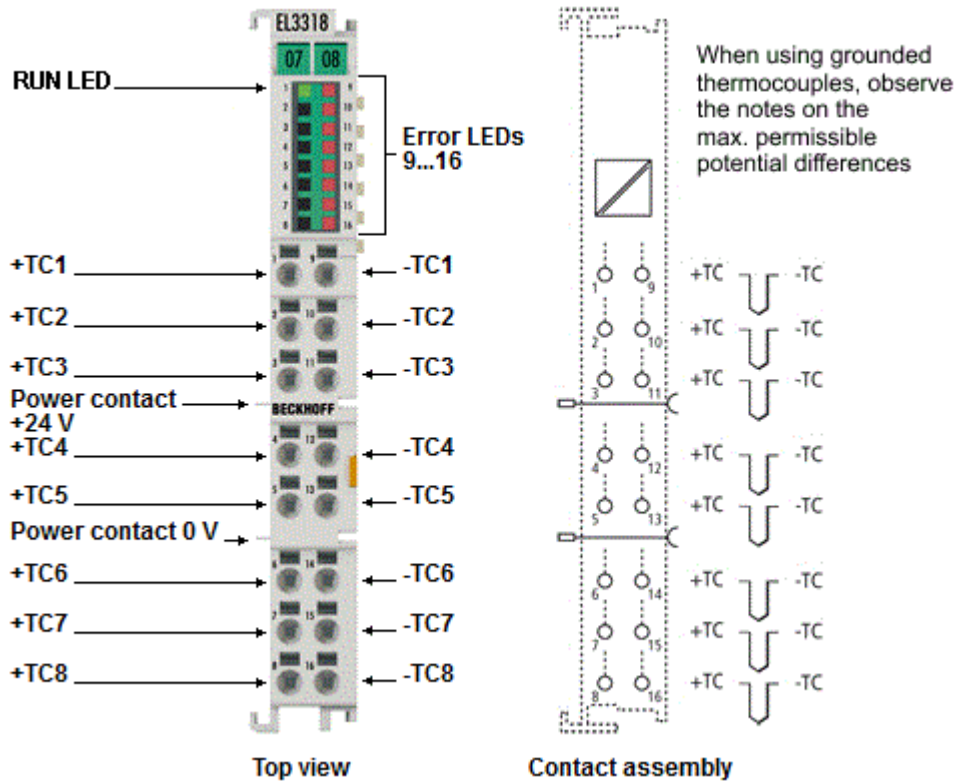


Fig. 121: EL3318

EL3318 - Connection

Terminal point	No.	Comment
+TC1	1	Input +TC1
+TC2	2	Input +TC2
+TC3	3	Input +TC3
+TC4	4	Input +TC4
+TC5	5	Input +TC5
+TC6	6	Input +TC6
+TC7	7	Input +TC7
+TC8	8	Input +TC8
-TC1	9	Input -TC1
-TC2	10	Input -TC2
-TC3	11	Input -TC3
-TC4	12	Input -TC4
-TC5	13	Input -TC5
-TC6	14	Input -TC6
-TC7	15	Input -TC7
-TC8	16	Input -TC8

2.9.4 Display, diagnostics

EL3318 - LEDs

LED	Color	Meaning	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: INIT = initialization of the terminal
		flashing uniformly	State of the EtherCAT State Machine: PREOP = function for mailbox communication and different standard-settings set
		flashing slowly	State of the EtherCAT State Machine: SAFEOP = verification of the sync manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: OP = normal operating state; mailbox and process data communication is possible
		flashing rapidly	State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
ERROR1-8	red	Short circuit or wire breakage. The voltage is in the invalid range of the characteristic curve.	

2.10 Use of EL33xx in the TwinCAT System Manager

In the full configuration (all possible PDOs activated, see PDO assignment), the EL3314, for example, offers the following process data for use:

The screenshot shows the TwinCAT System Manager interface. On the left, a tree view displays the configuration hierarchy: SYSTEM - Configuration, NC - Configuration, PLC - Configuration, Cam - Configuration, I/O - Configuration, I/O Devices, Device 1 (EtherCAT), Device 1-Image, Device 1-Image-Info, Inputs, Outputs, InfoData, Term 1 (EK1100), InfoData, and Term 2 (EL3314). Under Term 2 (EL3314), there are four TC Inputs Channels and four TC Outputs Channels, each with associated process data like Underrange, Overrange, Limit 1, Limit 2, Error, TxPDO State, TxPDO Toggle, and Value. The right pane shows the 'Process Data' tab for Term 2 (EL3314). It contains a 'Sync Manager' table and a 'PDO Assignment (0x1C12)' list.

SM	Size	Type	Flags
0	128	MbxOut	
1	128	MbxIn	
2	8	Outputs	
3	16	Inputs	

The 'PDO Assignment (0x1C12)' list shows the following active PDOs:

- ☒ 0x1600
- ☒ 0x1601
- ☒ 0x1602
- ☒ 0x1603

Below the list, there are checkboxes for 'Download', 'PDO Assignment' (checked), and 'PDO Configuration' (unchecked). At the bottom, a table shows the 'Name' and 'Type' of the process data:

Name	Type
Underrange	BOOL

Fig. 122: EL3314 process data

In the case of the EL3314, 4 sets of process data are available, one for each measurement channel.

- **Underrange:** Measurement is below range
- **Overrange:** Range of measurement exceeded ("Cable break" together with "Error")
- **Limit 1*:** Limit value monitoring 0: ok, 1: Limit value overshoot, 2: Limit value undershoot
- **Limit 2*:** Limit value monitoring 0: ok, 1: Limit value overshoot, 2: Limit value undershoot
- **Error:** The error bit is set if the process data is invalid (cable break, over-range, under-range)
- **TxPDO State:** Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).
- **TxPDO Toggle:** The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated. This allows the currently required conversion time to be derived.
- **CJCompensation:** Externally measured temperature of the reference measuring point for cold junction compensation

*) not for EL3318

For detailed information on settings and operating modes, please read the chapter "[Process data and operating modes](#) [► 230]".

2.11 Note on Beckhoff calibration certificates

Basically every Beckhoff analog device (input or output) will be justified i.e. will be calibrated during production. However, this process is not documented individually. This documentation in the form of a calibration certificate is only provided for devices that are explicitly supplied with a certificate.

The calibration certificate indicates the remaining deviation from the standard used (reference device) after adjustment. The calibration certificate (as a PDF document) can be assigned to the device via a unique number. It is therefore not a statement about a device class, such as an approval, but only applies to an individual, named device. It is available for [download](#) from the Beckhoff website.

The calibration certificate documents the measuring accuracy at the time the certificate was issued and includes information about the ambient conditions and the reference device used. It contains no statement about the behavior or the change of measuring accuracy in the future. A calibration certificate is used to review the previous period of use. If the calibration process is repeated several times over several years (without readjusting the device), it allows conclusions to be drawn about the aging behavior, the so-called calibration history.

Performance levels of the calibration certificates

Different "qualities" of a calibration certificate are common:

- *Beckhoff factory working standard calibration certificates*
These IP20 terminals can usually be recognized by the product suffix -0020.
The device-specific certificate is issued by Beckhoff as a PDF. It is available for [download](#) on the Beckhoff website. The terminals can be obtained from Beckhoff and recalibrated via the Beckhoff service.
- *ISO17025 calibration certificates*
These IP20 terminals can usually be recognized by the suffix -0030.
The device-specific certificate is issued by a service provider on behalf of Beckhoff as part of Beckhoff production and delivered by Beckhoff as a PDF. For the initial calibration (newly delivered terminals), it is available for [download](#) on the Beckhoff website. The terminals can be obtained from Beckhoff, recalibration must be carried out directly by the service provider (see details in the certificate).
- *DAkkS calibration certificates (Deutsche Akkreditierungsstelle GmbH)*
These IP20 terminals can usually be recognized by the suffix -0030.
The device-specific certificate is issued by a service provider on behalf of Beckhoff as part of Beckhoff production and delivered by Beckhoff as a PDF. For the initial calibration (newly delivered terminals), it is available for [download](#) on the Beckhoff website. The terminals can be obtained from Beckhoff, recalibration must be carried out directly by the service provider (see details in the certificate).

Unique device number

Depending on the device, the following numbers are used for identification:

- EL/ELM terminals up to year of manufacture 2020: the ID number lasered on the side.



Fig. 123: ID number

- From year of manufacture 2021 onwards, the BTN number (Beckhoff Traceability Number) will gradually replace the ID number, this is also lasered on the side.

Beckhoff produces a wide range of analog input/output devices as IP20 terminals or IP67 boxes. A selection is also available with factory/ISO/DAkkS calibration certificates. For specific details and availability, please refer to the technical data of the devices or contact Beckhoff Sales.

i Linguistic note

In American English, "calibration" or "alignment" is understood to mean compensation/adjustment, thus a modifying effect on the device. "Verification", on the other hand, refers to observational determination and documentation of the residual error, referred to in German as *Kalibrierung*.

2.12 Start

For commissioning:

- mount the EL33xx as described in the chapter [Mounting and wiring](#) [► 203]
- configure the EL33xx in TwinCAT as described in the chapter [Commissioning](#) [► 227].

3 Basics communication

3.1 EtherCAT basics

Please refer to the [EtherCAT System Documentation](#) for the EtherCAT fieldbus basics.

3.2 EtherCAT cabling – wire-bound

The cable length between two EtherCAT devices must not exceed 100 m. This results from the FastEthernet technology, which, above all for reasons of signal attenuation over the length of the cable, allows a maximum link length of 5 + 90 + 5 m if cables with appropriate properties are used. See also the [Design recommendations for the infrastructure for EtherCAT/Ethernet](#).

Cables and connectors

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

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

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

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



Recommended cables

It is recommended to use the appropriate Beckhoff components e.g.

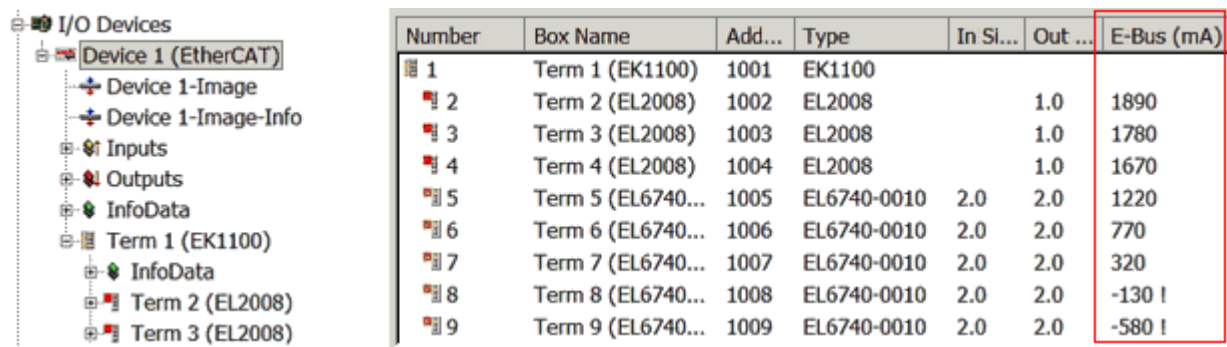
- cable sets ZK1090-9191-xxxx respectively
- RJ45 connector, field assembly ZS1090-0005
- EtherCAT cable, field assembly ZB9010, ZB9020

Suitable cables for the connection of EtherCAT devices can be found on the [Beckhoff website!](#)

E-Bus supply

A bus coupler can supply the EL terminals added to it with the E-bus system voltage of 5 V; a coupler is thereby loadable up to 2 A as a rule (see details in respective device documentation). Information on how much current each EL terminal requires from the E-bus supply is available online and in the catalogue. If the added terminals require more current than the coupler can supply, then power feed terminals (e.g. [EL9410](#)) must be inserted at appropriate places in the terminal strand.

The pre-calculated theoretical maximum E-Bus current is displayed in the TwinCAT System Manager. A shortfall is marked by a negative total amount and an exclamation mark; a power feed terminal is to be placed before such a position.



The screenshot shows the 'I/O Devices' tree on the left with 'Device 1 (EtherCAT)' expanded, showing 'Inputs', 'Outputs', 'InfoData', and three terms. The table on the right lists 9 terminals with their addresses, types, and E-Bus current values. The 'E-Bus (mA)' column is highlighted with a red box.

Number	Box Name	Add...	Type	In Si...	Out ...	E-Bus (mA)
1	Term 1 (EK1100)	1001	EK1100			
2	Term 2 (EL2008)	1002	EL2008		1.0	1890
3	Term 3 (EL2008)	1003	EL2008		1.0	1780
4	Term 4 (EL2008)	1004	EL2008		1.0	1670
5	Term 5 (EL6740-0010)	1005	EL6740-0010	2.0	2.0	1220
6	Term 6 (EL6740-0010)	1006	EL6740-0010	2.0	2.0	770
7	Term 7 (EL6740-0010)	1007	EL6740-0010	2.0	2.0	320
8	Term 8 (EL6740-0010)	1008	EL6740-0010	2.0	2.0	-130 I
9	Term 9 (EL6740-0010)	1009	EL6740-0010	2.0	2.0	-580 I

Fig. 124: System manager current calculation

NOTICE

Malfunction possible!

The same ground potential must be used for the E-Bus supply of all EtherCAT terminals in a terminal block!

3.3 General notes for setting the watchdog

The EtherCAT terminals are equipped with a safety device (watchdog) which, e. g. in the event of interrupted process data traffic, switches the outputs (if present) to a presettable state after a presettable time, depending on the device and setting, e. g. to FALSE (off) or an output value.

The EtherCAT slave controller features two watchdogs:

- Sync Manager (SM) watchdog (default: 100 ms)
- Process Data (PDI) watchdog (default: 100 ms)

Their times are individually parameterized in TwinCAT as follows:

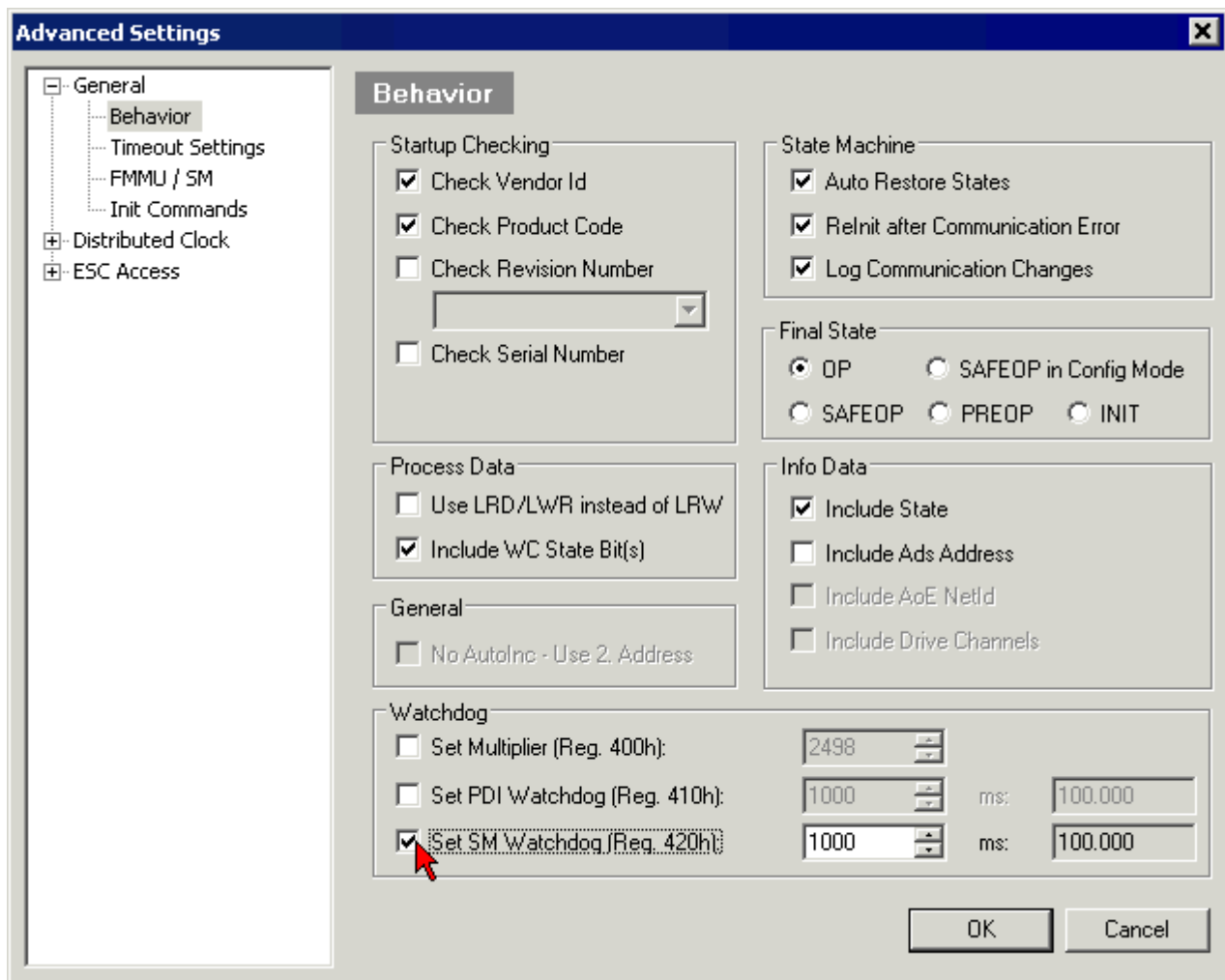


Fig. 125: eEtherCAT tab -> Advanced Settings -> Behavior -> Watchdog

Notes:

- the Multiplier Register 400h (hexadecimal, i. e. 0x0400) is valid for both watchdogs.
- each watchdog has its own timer setting 410h or 420h, which together with the Multiplier results in a resulting time.
- important: the Multiplier/Timer setting is only loaded into the slave at EtherCAT startup if the checkbox in front of it is activated.
- if it is not checked, nothing is downloaded and the setting located in the ESC remains unchanged.
- the downloaded values can be seen in the ESC registers 400h, 410h and 420h: ESC Access -> Memory

SM watchdog (Sync Manager Watchdog)

The Sync Manager watchdog is reset with each successful EtherCAT process data communication with the terminal. If, for example, no EtherCAT process data communication with the terminal takes place for longer than the set and activated SM watchdog time due to a line interruption, the watchdog is triggered. The status of the terminal (usually OP) remains unaffected. The watchdog is only reset again by a successful EtherCAT process data access.

The Sync Manager watchdog is therefore a monitoring for correct and timely process data communication with the ESC from the EtherCAT side.

The maximum possible watchdog time depends on the device. For example, for "simple" EtherCAT slaves (without firmware) with watchdog execution in the ESC it is usually up to 170 seconds. For complex EtherCAT slaves (with firmware) the SM watchdog function is usually parameterized via register 400h/420h but executed by the microcontroller (μ C) and can be significantly lower. In addition, the execution may then be subject to a certain time uncertainty. Since the TwinCAT dialog may allow inputs up to 65535, a test of the desired watchdog time is recommended.

PDI watchdog (Process Data Watchdog)

If there is no PDI communication with the ESC for longer than the set and activated Process Data Interface (PDI) watchdog time, this watchdog is triggered.

The PDI is the internal interface of the ESC, e.g. to local processors in the EtherCAT slave. With the PDI watchdog this communication can be monitored for failure.

The PDI watchdog is therefore a monitoring for correct and timely process data communication with the ESC, but viewed from the application side.

Calculation

Watchdog time = $[1/25 \text{ MHz} * (\text{Watchdog multiplier} + 2)] * \text{SM/PDI watchdog}$

Example: default setting Multiplier = 2498, SM watchdog = 1000 => 100 ms

The value in "Watchdog multiplier + 2" in the formula above corresponds to the number of 40ns base ticks representing one watchdog tick.

CAUTION

Undefined state possible!

The function for switching off the SM watchdog via SM watchdog = 0 is only implemented in terminals from revision -0016. In previous versions this operating mode should not be used.

CAUTION

Damage of devices and undefined state possible!

If the SM watchdog is activated and a value of 0 is entered the watchdog switches off completely. This is the deactivation of the watchdog! Set outputs are NOT set in a safe state if the communication is interrupted.

3.4 EtherCAT State Machine

The state of the EtherCAT slave is controlled via the EtherCAT State Machine (ESM). Depending upon the state, different functions are accessible or executable in the EtherCAT slave. Specific commands must be sent by the EtherCAT master to the device in each state, particularly during the bootup of the slave.

A distinction is made between the following states:

- Init
- Pre-Operational
- Safe-Operational
- Operational
- Bootstrap

The regular state of each EtherCAT slave after bootup is the OP state.

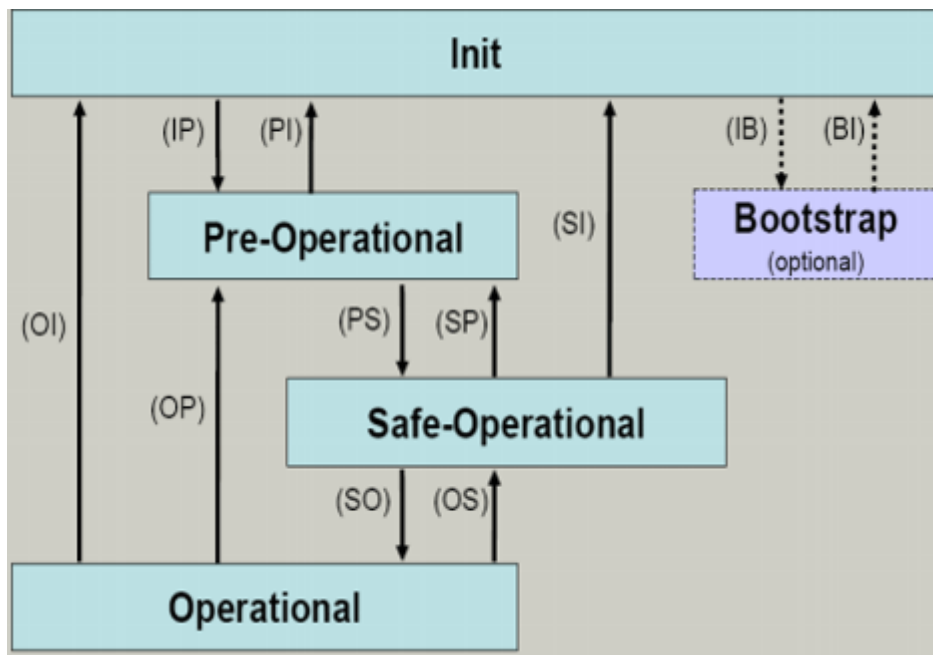


Fig. 126: States of the EtherCAT State Machine

Init

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

Pre-Operational (Pre-Op)

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

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

Safe-Operational (Safe-Op)

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

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

● **Outputs in SAFEOP state**

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

Operational (Op)

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

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

Boot

In the *Boot* state the slave firmware can be updated. The *Boot* state can only be reached via the *Init* state.

In the *Boot* state mailbox communication via the file access over EtherCAT (FoE) protocol is possible, but no other mailbox communication and no process data communication.

3.5 CoE Interface

General description

The CoE interface (CAN application protocol over EtherCAT interface) is used for parameter management of EtherCAT devices. EtherCAT slaves or the EtherCAT master manage fixed (read only) or variable parameters which they require for operation, diagnostics or commissioning.

CoE parameters are arranged in a table hierarchy. In principle, the user has access via the fieldbus. The EtherCAT master (TwinCAT System Manager) can access the local CoE lists of the slaves via EtherCAT in read or write mode, depending on the attributes.

Different CoE data types are possible, including string (text), integer numbers, Boolean values or larger byte fields. They can be used to describe a wide range of features. Examples of such parameters include manufacturer ID, serial number, process data settings, device name, calibration values for analog measurement or passwords.

The order is specified in two levels via hexadecimal numbering: (main)index, followed by subindex.

The value ranges are

- Index: 0x0000 ... 0xFFFF (0...65535_{dec})
- Subindex: 0x00...0xFF (0...255_{dec})

A parameter localized in this way is normally written as 0x8010:07, with preceding "0x" to identify the hexadecimal numerical range and a colon between index and subindex.

The relevant ranges for EtherCAT fieldbus users are:

- 0x1000: This is where fixed identity information for the device is stored, including name, manufacturer, serial number etc., plus information about the current and available process data configurations.
- 0x8000: This is where the operational and functional parameters for all channels are stored, such as filter settings or output frequency.

Other important ranges are:

- 0x4000: here are the channel parameters for some EtherCAT devices. Historically, this was the first parameter area before the 0x8000 area was introduced. EtherCAT devices that were previously equipped with parameters in 0x4000 and changed to 0x8000 support both ranges for compatibility reasons and mirror internally.
- 0x6000: Input PDOs ("inputs" from the perspective of the EtherCAT master)
- 0x7000: Output PDOs ("outputs" from the perspective of the EtherCAT master)

● Availability

I Not every EtherCAT device must have a CoE list. Simple I/O modules without dedicated processor usually have no variable parameters and therefore no CoE list.

If a device has a CoE list, it is shown in the TwinCAT System Manager as a separate tab with a listing of the elements:

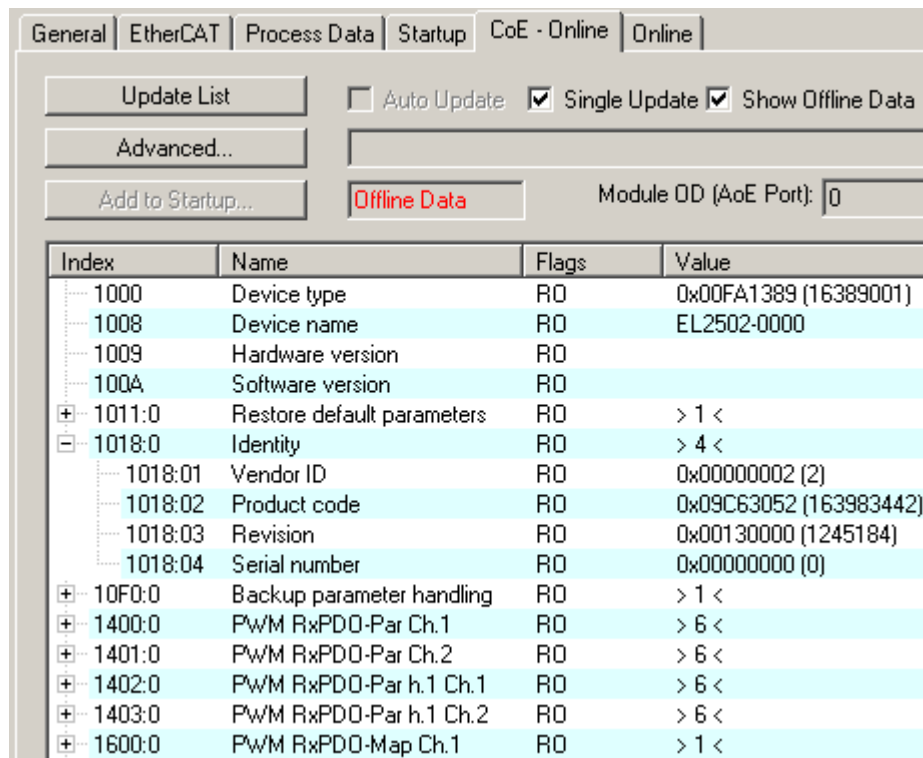


Fig. 127: "CoE Online" tab

The figure "CoE Online" tab shows the CoE objects available in device "EL2502", ranging from 0x1000 to 0x1600. The subindices for 0x1018 are expanded.

NOTICE

Changes in the CoE directory (CAN over EtherCAT directory), program access

When using/manipulating the CoE parameters observe the general CoE notes in chapter "[CoE interface](#)" of the EtherCAT system documentation:

- Keep a startup list if components have to be replaced,
- Distinction between online/offline dictionary,
- Existence of current XML description (download from the [Beckhoff website](#)),
- "[CoE-Reload](#)" for resetting the changes
- Program access during operation via PLC (see [TwinCAT 3 | PLC Library: "Tc2_EtherCAT"](#) and [Example program R/W CoE](#))

Data management and function "NoCoeStorage"

Some parameters, particularly the setting parameters of the slave, are configurable and writeable,

- via the System Manager (Fig. "CoE Online" tab) by clicking.
This is useful for commissioning of the system or slaves. Click on the row of the index to be parameterized and enter a value in the "SetValue" dialog.
- from the control system or PLC via ADS, e.g. through blocks from the TcEtherCAT.lib library.
This is recommended for modifications while the system is running or if no System Manager or operating staff are available.

i Data management

If slave CoE parameters are modified online, Beckhoff devices store any changes in a fail-safe manner in the EEPROM, i.e. the modified CoE parameters are still available after a restart. The situation may be different with other manufacturers.

An EEPROM is subject to a limited lifetime with respect to write operations. From typically 100,000 write operations onwards it can no longer be guaranteed that new (changed) data are reliably saved or are still readable. This is irrelevant for normal commissioning. However, if CoE parameters are continuously changed via ADS at machine runtime, it is quite possible for the lifetime limit to be reached. Support for the NoCoeStorage function, which suppresses the saving of changed CoE values, depends on the firmware version.

Please refer to the technical data in this documentation as to whether this applies to the respective device.

- If the function is supported: the function is activated by entering the code word 0x12345678 once in CoE index 0xF008 and remains active as long as the code word is not changed. After switching the device on it is then inactive. Changed CoE values are not saved in the EEPROM and can thus be changed any number of times.
- If the function is not supported: continuous changing of CoE values is not permissible in view of the lifetime limit.

i Startup list

Changes in the local CoE list of the terminal are lost if the terminal is replaced. If a terminal is replaced with a new Beckhoff terminal, it will have the default settings. It is therefore advisable to link all changes in the CoE list of an EtherCAT slave with the Startup list of the slave, which is processed whenever the EtherCAT fieldbus is started. In this way a replacement EtherCAT slave can automatically be parameterized with the specifications of the user.

If EtherCAT slaves are used which are unable to store local CoE values permanently, the Startup list must be used.

Recommended approach for manual modification of CoE parameters

- Make the required change in the System Manager (the values are stored locally in the EtherCAT slave).
- If the value is to be stored permanently, enter it in the Startup list.
The order of the Startup entries is usually irrelevant.

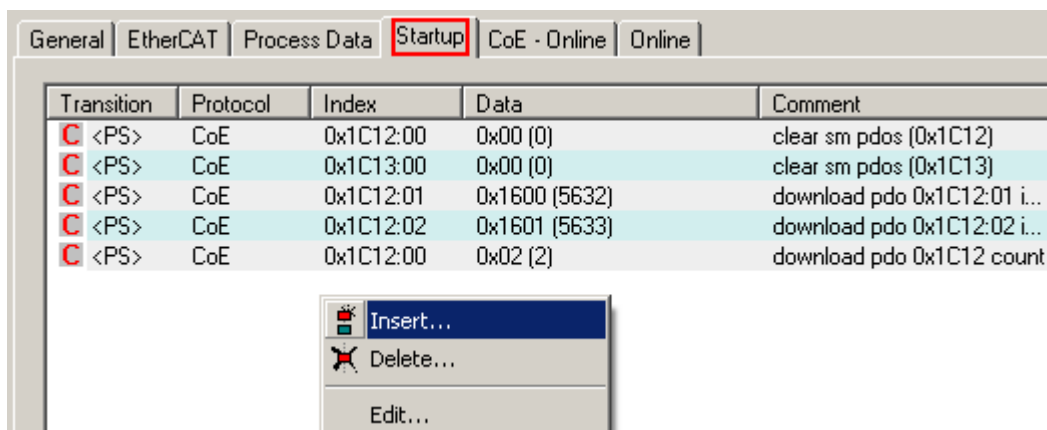


Fig. 128: Startup list in the TwinCAT System Manager

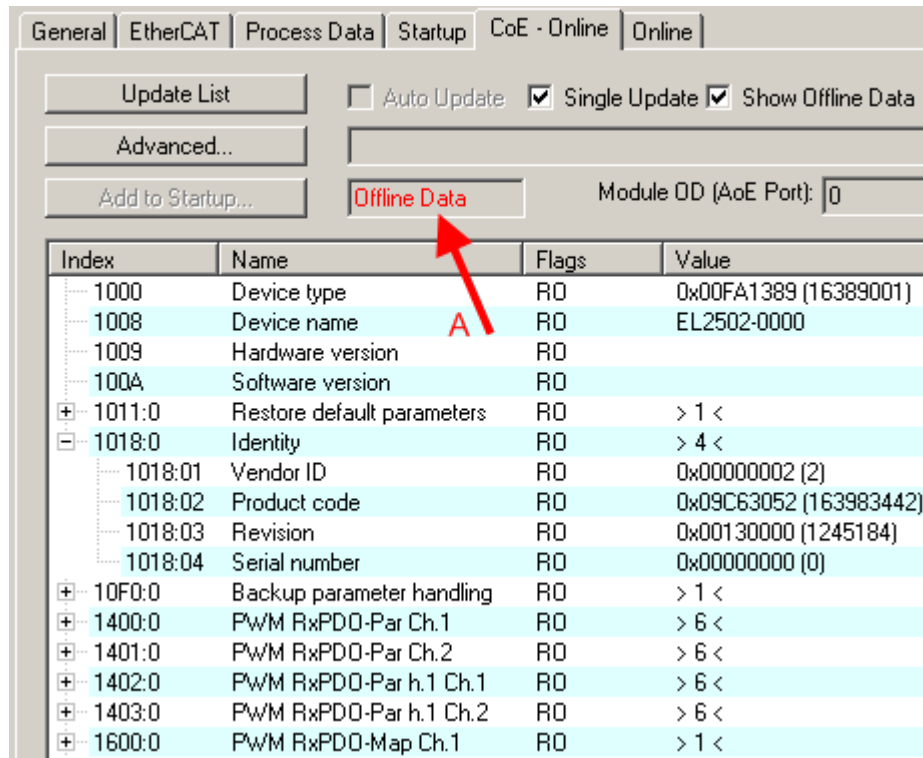
The Startup list may already contain values that were configured by the System Manager based on the ESI specifications. Additional application-specific entries can also be created.

Online / offline list

When working with the TwinCAT System Manager, a distinction must be made as to whether the EtherCAT device is currently "available", i.e. switched on and connected via EtherCAT - i.e. **online** - or whether a configuration is created **offline** without slaves being connected.

In both cases a CoE list as shown in Fig. “CoE online tab” is displayed. The connectivity is shown as offline/online.

- If the slave is offline:
 - The offline list from the ESI file is displayed. In this case modifications are not meaningful or possible.
 - The configured status is shown under Identity.
 - No firmware or hardware version is displayed since these are features of the physical device.
 - **Offline Data** is shown in red.



Index	Name	Flags	Value
1000	Device type	RO	0x00FA1389 (16389001)
1008	Device name	RO	EL2502-0000
1009	Hardware version	RO	
100A	Software version	RO	
1011:0	Restore default parameters	RO	> 1 <
1018:0	Identity	RO	> 4 <
1018:01	Vendor ID	RO	0x00000002 (2)
1018:02	Product code	RO	0x09C63052 (163983442)
1018:03	Revision	RO	0x00130000 (1245184)
1018:04	Serial number	RO	0x00000000 (0)
10F0:0	Backup parameter handling	RO	> 1 <
1400:0	PWM RxD0-Par Ch.1	RO	> 6 <
1401:0	PWM RxD0-Par Ch.2	RO	> 6 <
1402:0	PWM RxD0-Par h.1 Ch.1	RO	> 6 <
1403:0	PWM RxD0-Par h.1 Ch.2	RO	> 6 <
1600:0	PWM RxD0-Map Ch.1	RO	> 1 <

Fig. 129: Offline list

- If the slave is online:
 - The actual current slave list is read. This may take several seconds, depending on the size and cycle time.
 - The actual identity is displayed.
 - The firmware and hardware status of the device is displayed in the CoE.
 - **Online Data** is shown in green.

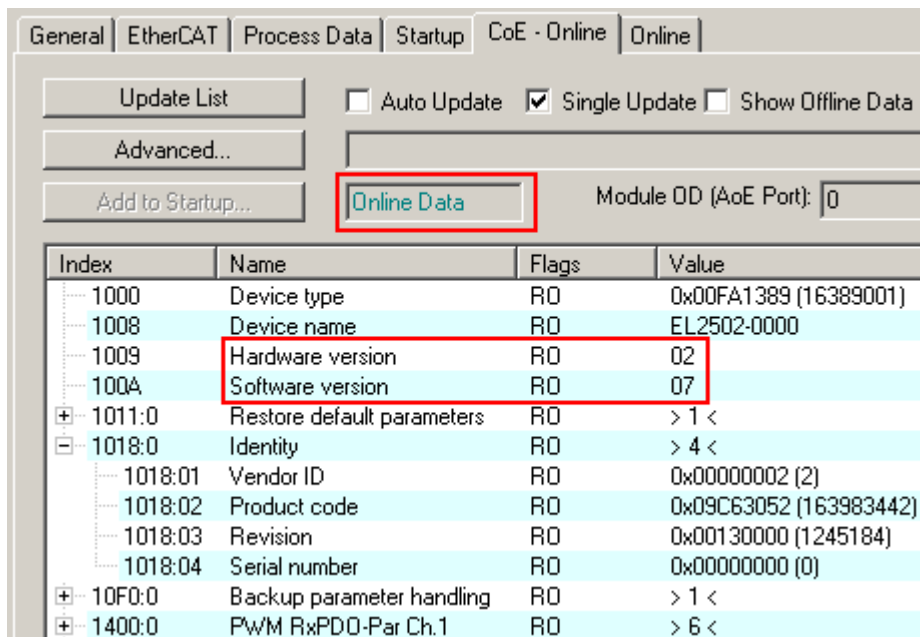


Fig. 130: Online list

Channel-based order

The CoE list is available in EtherCAT devices that usually feature several functionally equivalent channels, for example, a 4-channel analog input terminal also has four logical channels and therefore four identical sets of parameter data for the channels. In order to avoid having to list each channel in the documentation, the placeholder “n” tends to be used for the individual channel numbers.

In the CoE system 16 indices, each with 255 subindices, are generally sufficient for representing all channel parameters. The channel-based order is therefore arranged in 16_{dec} or 10_{hex} steps. The parameter range 0x8000 exemplifies this:

- Channel 0: parameter range 0x8000:00 ... 0x800F:255
- Channel 1: parameter range 0x8010:00 ... 0x801F:255
- Channel 2: parameter range 0x8020:00 ... 0x802F:255
- ...

This is generally written as 0x80n0.

Detailed information on the CoE interface can be found in the [EtherCAT system documentation](#) on the Beckhoff website.

BackUp objects and checksum 0x10F0:01

The following object types, among others, are defined for the CoE parameter/object directory with regard to information retention, but they do not all have to appear in every device at the same time:

- Vendor objects
 - Are stored persistently (fail-safe) in the device.
 - Technically with the property ReadWrite (RW).
 - Can only be modified/deleted if the corresponding vendor password is known.
 - Used for vendor-specific adjustment or identity data.
- BackUp objects
 - These are objects that are stored persistently in the device, even after changes.
 - Technically with the property ReadWrite (RW).
 - They can be modified/deleted at any time via CoE access from the EtherCAT master

- In particular, they are reset to their initial state, which is stored permanently in the firmware, by selecting "Restore Default Parameters" (see chapter "Restoring the delivery state"). Since this reset to a previous value resembles the restoration of a backup, these are referred to as "BackUp objects".
- They are used for regular function parameters of the device that determine the behavior.
- BackUp objects with write protection option.
 - The same applies as for the BackUp objects.
 - In addition, the user can activate write protection for these objects using a code word in xF009, thereby preventing accidental changes. Details can be found in the device documentation of the devices that contain these objects.
- Volatile objects
 - These are objects that are not stored persistently in the device.
 - They are used to display internal information (process data, states, temperatures ...) and are available as ReadOnly (RO) or as function parameters (ReadWrite). However, the latter must be written by the EtherCAT master for each PowerOn if they are to have a value other than the default value.

The device indicates a 16-bit CRC in the 32-bit object 0x10F0:01 CheckSum, subindex 01 of Backup Parameter Handling by means of the current state of the so-called BackUp objects:

10F0:0	Backup parameter handling	RO	> 1 <
10F0:01	Checksum	RO	0x00003C62 (15458)

Fig. 131: CoE index 10F0

If a BackUp object is changed, the firmware calculates a new checksum accordingly. This can be used to detect changes to the BackUp objects.

Note: The initial value of the checksum may vary depending on the firmware version, as function extensions can add additional objects to the CRC's detection range.

3.6 Distributed Clock

The distributed clock represents a local clock in the EtherCAT slave controller (ESC) with the following characteristics:

- Unit *1 ns*
- Zero point *1.1.2000 00:00*
- Size *64 bit* (sufficient for the next 584 years; however, some EtherCAT slaves only offer 32-bit support, i.e. the variable overflows after approx. 4.2 seconds)
- The EtherCAT master automatically synchronizes the local clock with the master clock in the EtherCAT bus with a precision of < 100 ns.

For detailed information please refer to the [EtherCAT system description](#).

4 Mounting and wiring

4.1 Safety instructions

Before installing and commissioning the TwinSAFE components please read the safety instructions in the foreword of this documentation.

4.2 Environmental conditions

Please ensure that the TwinSAFE components are only transported, stored and operated under the specified conditions (see technical data)!

WARNING

Risk of injury!

The TwinSAFE components must not be used under the following operating conditions.

- under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation)
- in corrosive environments¹
- in an environment that leads to unacceptable soiling of the TwinSAFE component

¹ A corrosive environment exists when corrosion damage becomes apparent.

NOTICE

Electromagnetic compatibility

The TwinSAFE components comply with the current standards on electromagnetic compatibility with regard to spurious radiation and immunity to interference in particular.

However, in cases where devices such as mobile phones, radio equipment, transmitters or high-frequency systems that exceed the interference emissions limits specified in the standards are operated near TwinSAFE components, the function of the TwinSAFE components may be impaired.

4.3 Transport / storage

Use the original packaging in which the components were delivered for transporting and storing the TwinSAFE components.

CAUTION

Note the specified environmental conditions

Please ensure that the digital TwinSAFE components are only transported and stored under the specified environmental conditions (see technical data).

4.4 Control cabinet / terminal box

The TwinSAFE terminals must be installed in a control cabinet or terminal box with IP54 protection class according to IEC 60529 as a minimum.

4.5 Notes on ESD protection

NOTICE

Devices can be destroyed by electrostatic charging!

The devices contain electrostatically sensitive components which can be damaged by improper handling.

- When handling the components, take care to avoid electrostatic discharge; also, prevent direct contact with the spring-loaded contacts (see illustration).
- Contact with highly insulating materials (synthetic fibers, plastic films, etc.) should be avoided when simultaneously handling components.
- When handling the components, ensure proper earthing of the environment (workplace, packaging, and persons).
- Each bus station must be terminated with the [EL9011](#) or [EL9012](#) end cap on its right side to guarantee the protection rating and ESD protection.

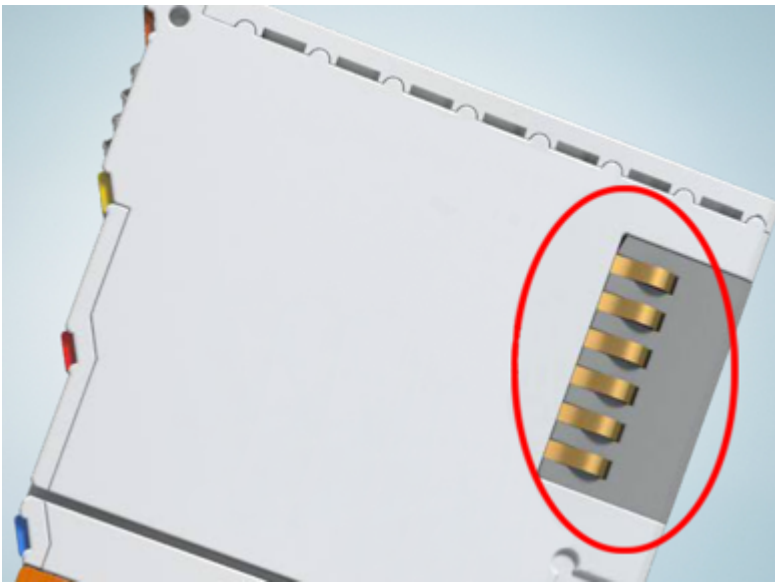


Fig. 132: Spring contacts of Beckhoff I/O components

4.6 Explosion protection

4.6.1 ATEX - Special conditions (standard temperature range)

WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components with standard temperature range in potentially explosive areas!

- The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-7! The environmental conditions during use are thereby to be taken into account!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of 0 to 55°C for the use of Beckhoff fieldbus components standard temperature range in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN IEC 60079-0:2018
- EN 60079-7:2015+A1:2018

Marking

The Beckhoff fieldbus components with standard temperature range certified according to regulations for potentially explosive areas bear the following marking:



II 3 G Ex ec IIC T4 Gc
KEMA 10 ATEX0075 X
DEKRA 22UKEX6024X
Ta: 0 ... + 55°C

4.6.2 ATEX - Special conditions (extended temperature range)

WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas!

- The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-7! The environmental conditions during use are thereby to be taken into account!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of -25 to 60°C for the use of Beckhoff fieldbus components with extended temperature range (ET) in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN IEC 60079-0:2018
- EN 60079-7:2015+A1:2018

Marking

The Beckhoff fieldbus components with extended temperature range (ET) certified according to regulations for potentially explosive areas bear the following marking:



II 3 G Ex ec IIC T4 Gc
KEMA 10 ATEX0075 X
DEKRA 22UKEX6024X
Ta: -25 ... + 60°C

4.6.3 IECEx - Special conditions

⚠ WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas!

- For gas: The equipment shall be installed in a suitable enclosure providing a degree of protection of IP54 according to IEC 60079-7, taking into account the environmental conditions under which the equipment is used!
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1!
- Provisions shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 119 V!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range for the use of Beckhoff fieldbus components in potentially explosive areas!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The front hatch of certified units may only be opened if the supply voltage has been switched off or a non-explosive atmosphere is ensured!

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- IEC 60079-0:2017 (Edition 7.0)
- IEC 60079-7:2017 (Edition 5.1)

Marking

Beckhoff fieldbus components that are certified in accordance with IECEx for use in areas subject to an explosion hazard bear the following marking:

IECEx DEK 16.0078 X

Ex ec IIC T4 Gc

4.6.4 Continuative documentation for ATEX and IECEx

NOTICE



Continuative documentation about explosion protection according to ATEX and IECEx

Pay also attention to the continuative documentation

Ex. Protection for Terminal Systems

Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx,

that is available for [download](#) within the download area of your product on the Beckhoff homepage www.beckhoff.com!

4.6.5 cFMus - Special conditions

WARNING

Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas!

- The equipment shall be installed within an enclosure that provides a minimum ingress protection of IP54 in accordance with ANSI/UL 60079-0 (US) or CSA C22.2 No. 60079-0 (Canada).
- The equipment shall only be used in an area of at least pollution degree 2, as defined in IEC 60664-1.
- Transient protection shall be provided that is set at a level not exceeding 140% of the peak rated voltage value at the supply terminals to the equipment.
- The circuits shall be limited to overvoltage Category II as defined in IEC 60664-1.
- The Fieldbus Components may only be removed or inserted when the system supply and the field supply are switched off, or when the location is known to be non-hazardous.
- The Fieldbus Components may only be disconnected or connected when the system supply is switched off, or when the location is known to be non-hazardous.

Standards

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

M20US0111X (US):

- FM Class 3600:2018
- FM Class 3611:2018
- FM Class 3810:2018
- ANSI/UL 121201:2019
- ANSI/ISA 61010-1:2012
- ANSI/UL 60079-0:2020
- ANSI/UL 60079-7:2017

FM20CA0053X (Canada):

- CAN/CSA C22.2 No. 213-17:2017
- CSA C22.2 No. 60079-0:2019
- CAN/CSA C22.2 No. 60079-7:2016
- CAN/CSA C22.2 No.61010-1:2012

Marking

Beckhoff fieldbus components that are certified in accordance with cFMus for use in areas subject to an explosion hazard bear the following markings:

FM20US0111X (US): **Class I, Division 2, Groups A, B, C, D**
 Class I, Zone 2, AEx ec IIC T4 Gc

FM20CA0053X (Canada): **Class I, Division 2, Groups A, B, C, D**
 Ex ec T4 Gc

4.6.6 Continuative documentation for cFMus

NOTICE

**Continuative documentation about explosion protection according to cFMus**

Pay also attention to the continuative documentation

Control Drawing I/O, CX, CPX

Connection diagrams and Ex markings,

that is available for [download](#) within the download area of your product on the Beckhoff homepage www.beckhoff.com!

4.7 UL notice

⚠ CAUTION	
	Application Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.
⚠ CAUTION	
	Examination For cULus examination, the Beckhoff I/O System has only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).
⚠ CAUTION	
	For devices with Ethernet connectors Not for connection to telecommunication circuits.

Basic principles

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



4.8 Mounting rail installation

⚠ WARNING

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

Bring the bus terminal system into a safe, de-energized state before beginning to mount, disassemble, or wire the bus terminals!

The bus terminal system is designed for installation in a control cabinet or junction box.

Installation

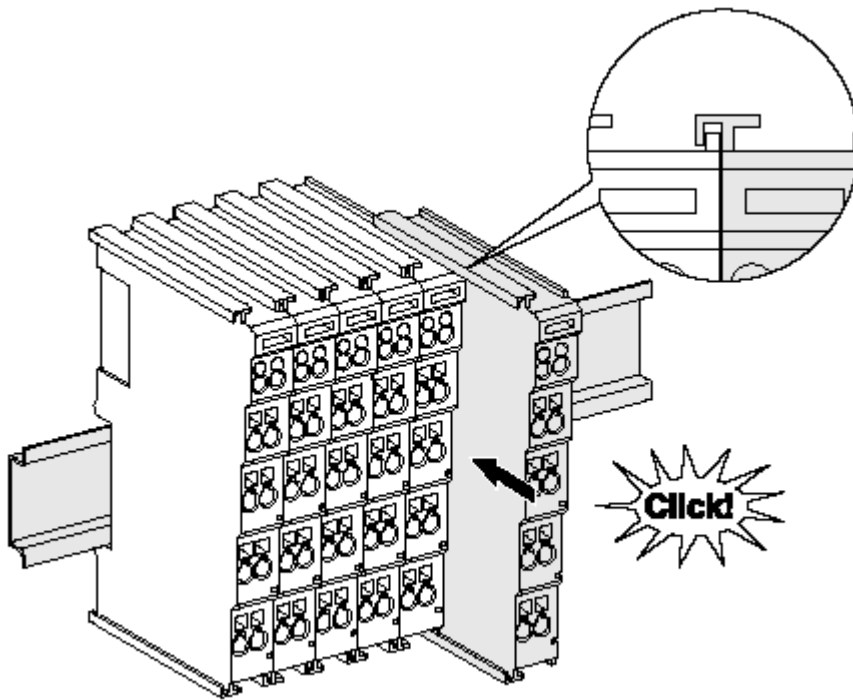


Fig. 133: Installation on the mounting rail

The bus couplers and bus terminals are attached to commercially available 35 mm mounting rails (DIN rail according to EN 60715) by applying slight pressure:

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. To do this, connect the components with the slot and key and push the terminals against the mounting rail until the latch audibly engages on the mounting rail.

If you snap the terminals onto the mounting rail first and then push them next to each other without the slot and key engaging, no functional connection will be established! When correctly assembled, no significant gap should be visible between the housing units.

i Fastening the mounting rails

The locking mechanism of the terminals and couplers protrudes into the profile of the mounting rail. When installing the components, make sure that the locking mechanism doesn't come into conflict with the fixing bolts of the mounting rail. When fastening mounting rails with a height of 7.5 mm under the terminals and couplers, use flat fastening components such as countersunk head screws or blind rivets.

NOTICE

Eath the mounting rail!

Make sure the mounting rail is properly earthed.

Connections within a bus terminal block

The electric connections between the bus coupler and the bus terminals are made automatically by joining the components:

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

i Power contacts

When configuring a bus terminal block, note the contact assignments of the individual bus terminals, as some types

- do not loop through the power contacts or do not loop them through completely (e. g. analog bus terminals or digital 4-channel bus terminals),
- the power contacts are disconnected, thus marking the start of a new supply rail (power supply terminals).

Power contact $\perp$

The power contact marked $\perp$ (ground connection in accordance with IEC 60417-5017) can be used as a ground. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

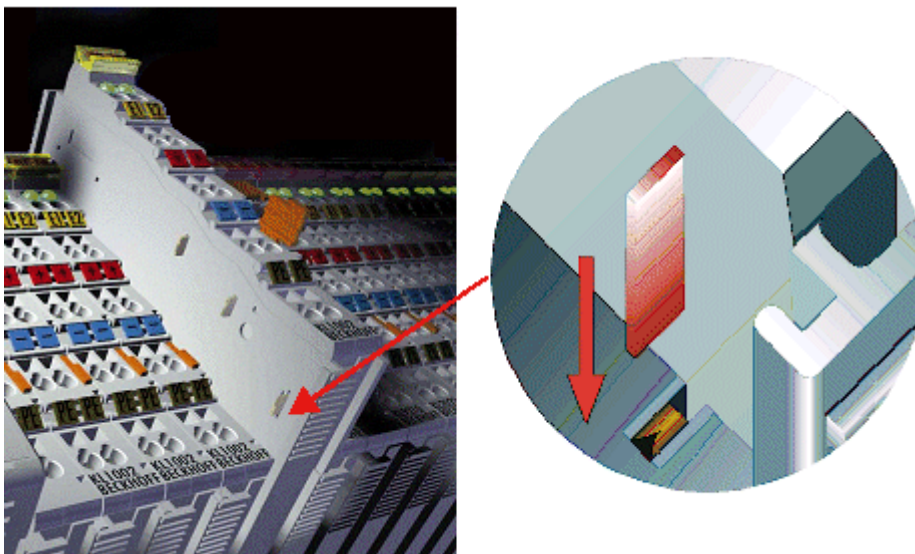


Fig. 134: Power contact on the left

⚠ WARNING

Risk of injury from electric shock!

The power contact marked $\perp$ may not be used for other potentials!

NOTICE

Risk of damage to the device

Note that, for electromagnetic compatibility, the earth contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage to the terminal (e.g. disruptive discharge to the earth line during insulation testing of a consumer with a rated voltage of 230 V). For insulation testing, disconnect the earth supply line at the bus coupler or the power supply terminal! In order to decouple further supply points for testing, these power supply terminals can be released and pulled at least 10 mm from the group of terminals.

Disassembly

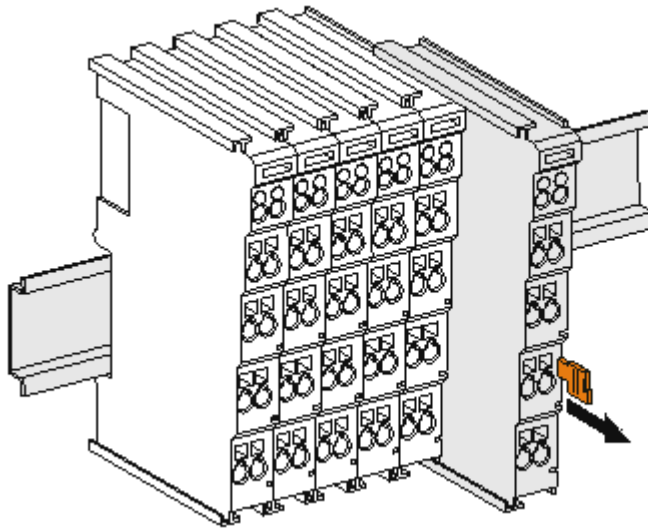


Fig. 135: Removal from mounting rail

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

1. Pull down the terminal at its orange-colored straps from the mounting rail by approx. 1 cm. The rail locking of this terminal is automatically released, and you can now pull the terminal out of the bus terminal block with little effort.
2. To do this, grasp the unlocked terminal simultaneously at the top and bottom of the housing surfaces with your thumb and index finger and pull it out of the bus terminal block.

4.9 Installation instructions for enhanced mechanical load capacity

WARNING

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

Bring the Bus Terminal system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals!

Additional checks

The terminals have undergone the following additional tests:

Verification	Explanation
Vibration	10 frequency runs in 3 axes
	6 Hz < f < 60 Hz displacement 0.35 mm, constant amplitude
	60.1 Hz < f < 500 Hz acceleration 5 g, constant amplitude
Shocks	1000 shocks in each direction, in 3 axes
	25 g, 6 ms

Additional installation instructions and notes

For terminals with enhanced mechanical load capacity, the following additional installation instructions and notes apply:

- The enhanced mechanical load capacity is valid for all permissible installation positions.
- Use a mounting rail according to EN 60715 TH35-15.
- Fix the terminal segment on both sides of the mounting rail with a mechanical fixture, e.g. an earth terminal or reinforced end clamp.
- The maximum total extension of the terminal segment (without coupler) is:
64 terminals (12 mm mounting width) or 32 terminals (24 mm mounting width)
- Avoid deformation, twisting, crushing and bending of the mounting rail during edging and installation of the rail.
- The mounting points of the mounting rail must be set at 5 cm intervals.
- Use countersunk head screws to fasten the mounting rail.
- The free length between the strain relief and the wire connection should be kept as short as possible. A distance of approx. 10 cm should be maintained to the cable duct.

4.10 Connection

4.10.1 Connection system

⚠ WARNING

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

Bring the bus terminal system into a safe, de-energized state before beginning to mount, disassemble, or wire the bus terminals!

Overview

The bus terminal system offers different connection options for optimum adaptation to the respective application:

- The terminals of ELxxxx and KLxxxx series with standard wiring include electronics and connection level in a single enclosure.
- The terminals of ESxxxx and KSxxxx series feature a pluggable connection level and enable steady wiring while replacing.
- The High Density Terminals (HD Terminals) include electronics and connection level in a single enclosure and have advanced packaging density.

Standard wiring (ELxxxx / KLxxxx)



Fig. 136: Standard wiring

The terminals of the ELxxxx and KLxxxx series integrate screwless spring-cage technology for quick and easy wiring.

Pluggable wiring (ESxxxx / KSxxxx)



Fig. 137: Pluggable wiring

The terminals of ESxxxx and KSxxxx series feature a pluggable connection level. The assembly and wiring procedure is the same as for the ELxxxx and KLxxxx series. The pluggable connection level enables the complete wiring to be removed as a plug connector from the top of the housing for servicing. The lower section can be removed from the terminal block by pulling the unlocking tab. Insert the new component and plug in the connector with the wiring. This reduces the installation time and eliminates the risk of wires being mixed up.

The familiar dimensions of the terminal only had to be changed slightly. The new connector adds about 3 mm. The maximum height of the terminal remains unchanged.

A tab for strain relief of the cable simplifies assembly in many applications and prevents tangling of individual connection wires when the connector is removed.

Conductor cross sections between 0.08 mm² and 2.5 mm² can continue to be used with the proven spring force technology.

The overview and nomenclature of the product names for ESxxxx and KSxxxx series has been retained as known from ELxxxx and KLxxxx series.

High Density Terminals (HD Terminals)



Fig. 138: High Density Terminals

The terminals from these series with 16/32 terminal points are distinguished by a particularly compact design, as the packaging density is twice as large as that of the standard 12 mm bus terminals. Massive conductors and conductors with a wire end sleeve can be inserted directly into the spring loaded terminal point without tools.



Wiring HD Terminals

The High Density Terminals of the ELx8xx and KLx8xx series doesn't support pluggable wiring.

Ultrasonically compacted (ultrasonically welded) strands



Ultrasonically compacted (ultrasonically welded) strands

Ultrasonically compacted (ultrasonically welded) strands can also be connected to the standard and high-density terminals. In this case, please note the tables concerning the wire-size width [► 218]!

4.10.2 Wiring

⚠ WARNING

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

Bring the bus terminal system into a safe, de-energized state before beginning to mount, disassemble, or wire the bus terminals!

Terminals for standard wiring ELxxxx/KLxxxx and for pluggable wiring ESxxxx/KSxxxx

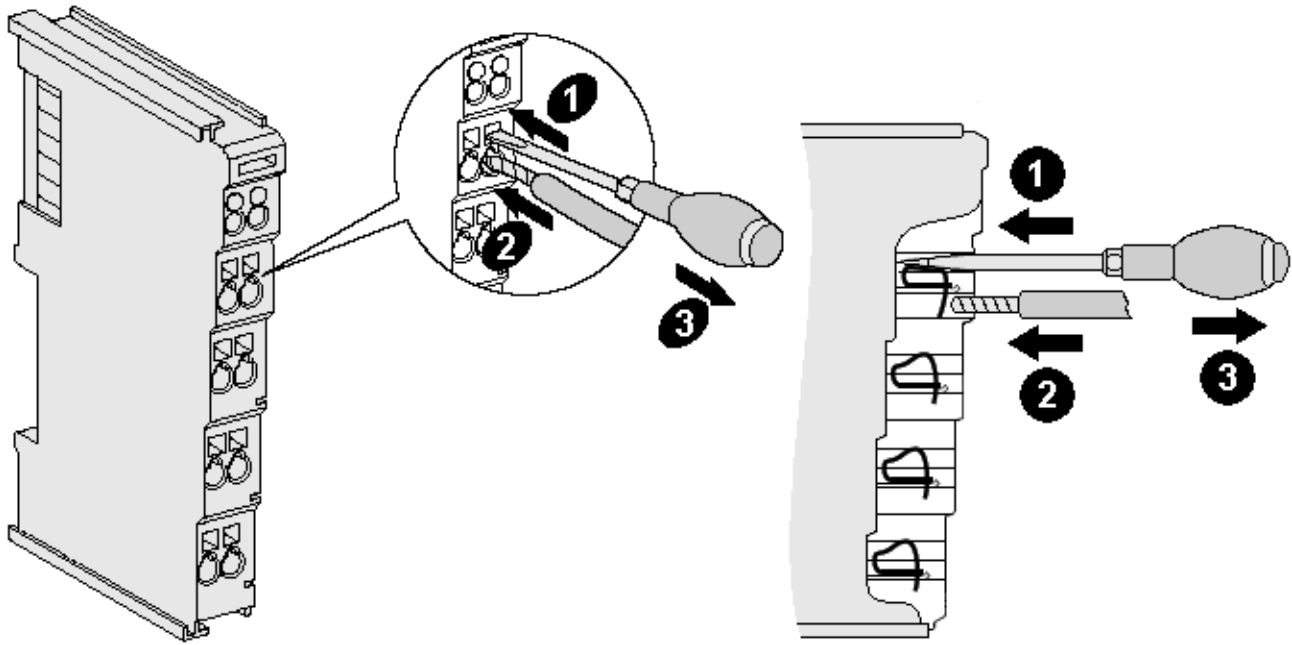


Fig. 139: Connecting a cable on a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the bus terminal. The terminal points are implemented in spring force technology. Connect the cables as follows (see fig. "Connecting a cable on a terminal point"):

1. Open a terminal point by pushing a screwdriver straight against the stop into the square opening above the terminal point. Do not turn the screwdriver or move it alternately (don't toggle).
2. The wire can now be inserted into the round terminal opening without any force.
3. When the screwdriver is removed, the terminal point closes automatically and holds the wire securely and permanently in place

See the following table for the suitable wire size width:

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width (single core wires)	0.08 ... 2.5 mm ²	0.08 ... 2.5 mm ²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm ²	0.08 ... 2.5 mm ²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm ²	0.14 ... 1.5 mm ²
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals ([HD Terminals](#) [[► 216](#)]) with 16/32 terminal points

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

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm ²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm ²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm ²
Wire size width (ultrasonically compacted [ultrasonically welded] strands)	only 1.5 mm ² (see notice [► 216])
Wire stripping length	8 ... 9 mm

4.10.3 Shielding**Shielding**

Encoders, analog sensors, and actuators should always be connected with shielded, pair-wise twisted cables.

4.11 Connection instructions for earthed/potential-free thermocouples

Due to the differential inputs of the terminals, different connection types are recommended depending on the type of thermocouple used. For earthed thermocouples, ground is not connected to the shielding. If the thermocouple does not have an ground connection, the ground and shielding contacts can be connected (see Fig. *Connection of earthed and earth-free thermocouples* and Connection instructions for thermocouples).



Connection instructions for thermocouples

- *Earthed thermocouple*

- ⇒ Do not connect GND to the shielding
- ⇒ For EL3312: potential difference **max. 2 V**

- *Potential-free / earth-free thermocouple*

- ⇒ GND can be connected to the shielding
- ⇒ or: GND can be connected to any potential, **max. 35 V** to 0 V power

- *Non-potential-free thermocouple*

- ⇒ Do not connect GND to the shielding
- ⇒ Do not connect GND to thermocouple potential.
- ⇒ Thermocouple-potential **max. 35 V** to 0 V power
- ⇒ For **different thermocouple potentials** several 1-channel EL3311 units should be used.

- *Unused inputs*

- ⇒ For the multi-channel versions EL3312, EL3314 and EL3318 unused inputs should be short-circuited (low-resistance connection of +TC, -TC)
- Unused high-resistance inputs can affect the EMC of the terminal and thus influence the channels used.
- Unused channels can also generate unwanted waste heat.

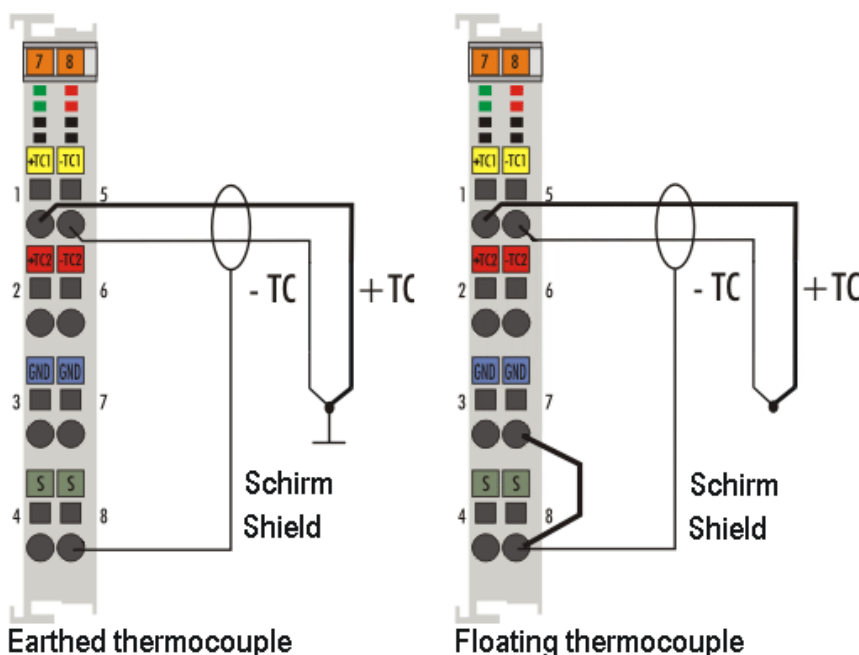


Fig. 140: Connection methods for earthed and earth-free thermocouples

The example shows EL3312. For the EL3314, the shield should be connected to an additional shield terminal (EL9195).

4.12 Note on power supply

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.

4.13 Positioning of passive terminals



Note on the placement of passive terminals in the bus terminal block

EtherCAT Terminals that do not take part in active data exchange within the bus terminal block are referred to as passive terminals. These terminals can be recognized because they do not consume power from the E-bus. To ensure optimal data exchange, no more than two passive terminals may be connected directly to each other!

Examples of the placement of passive terminals (highlighted in light color)

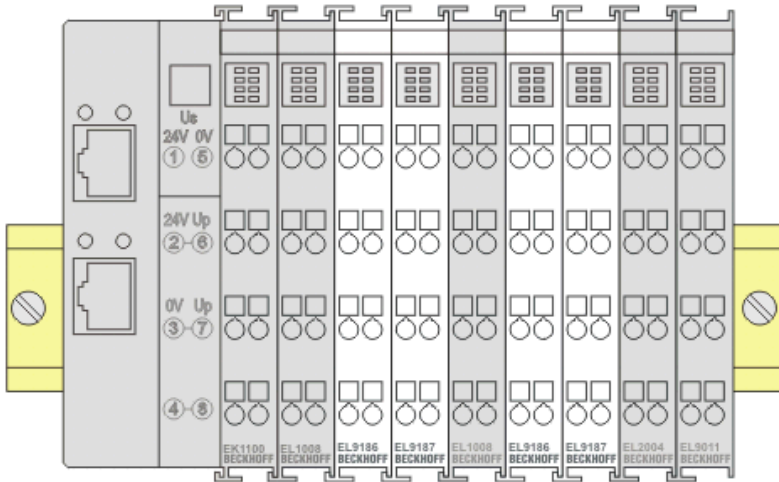


Fig. 141: Proper positioning

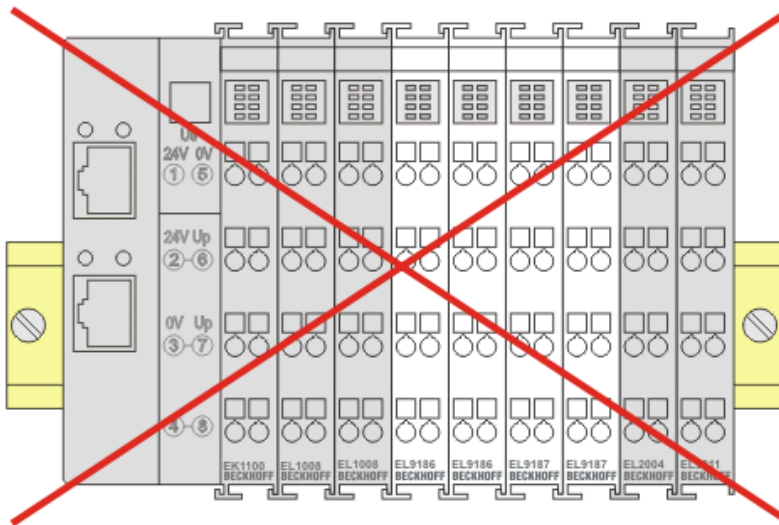


Fig. 142: Incorrect positioning

4.14 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

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

Optimum installation position (standard)

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

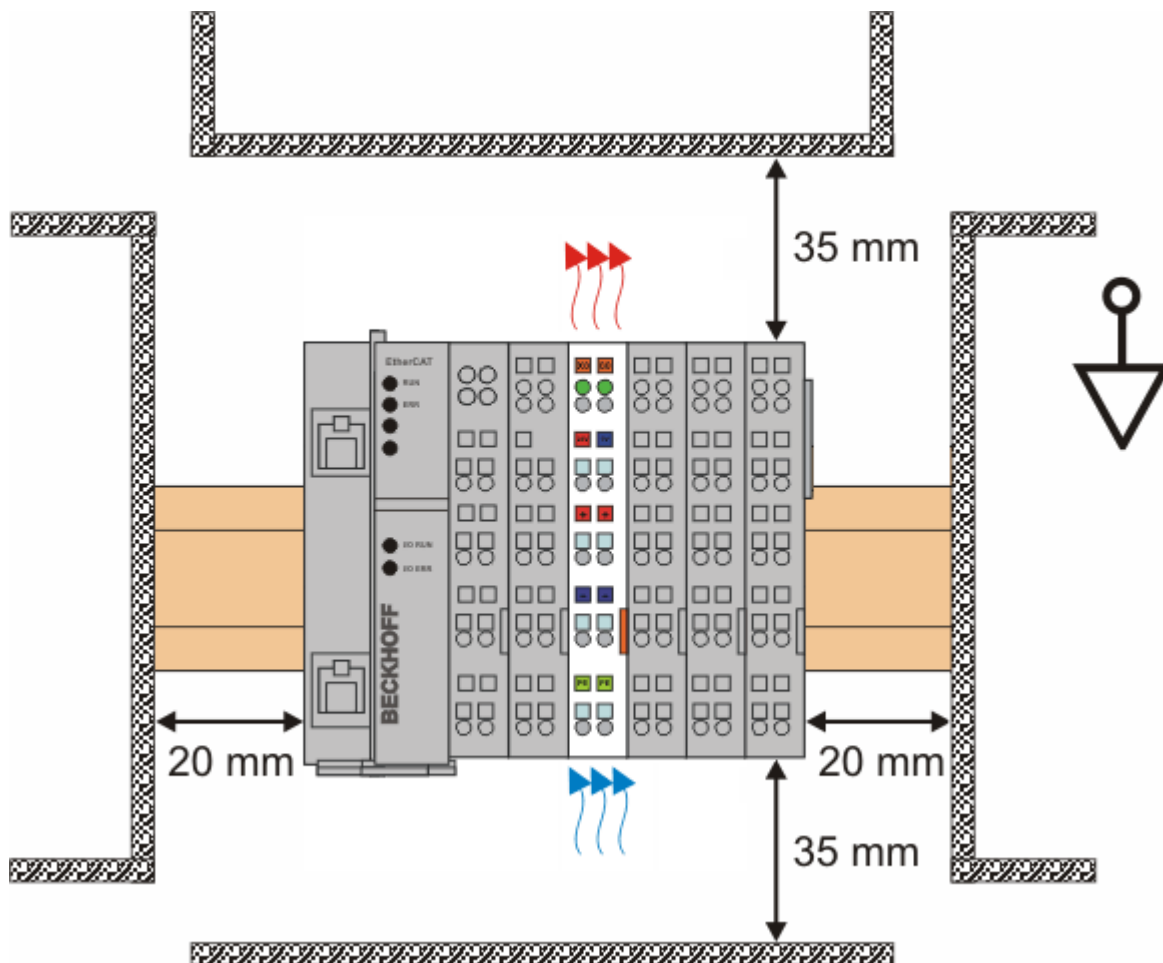


Fig. 143: Recommended distances for standard installation position

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

Prescribed installation position

NOTICE

Prescribed installation position for high-precision terminals

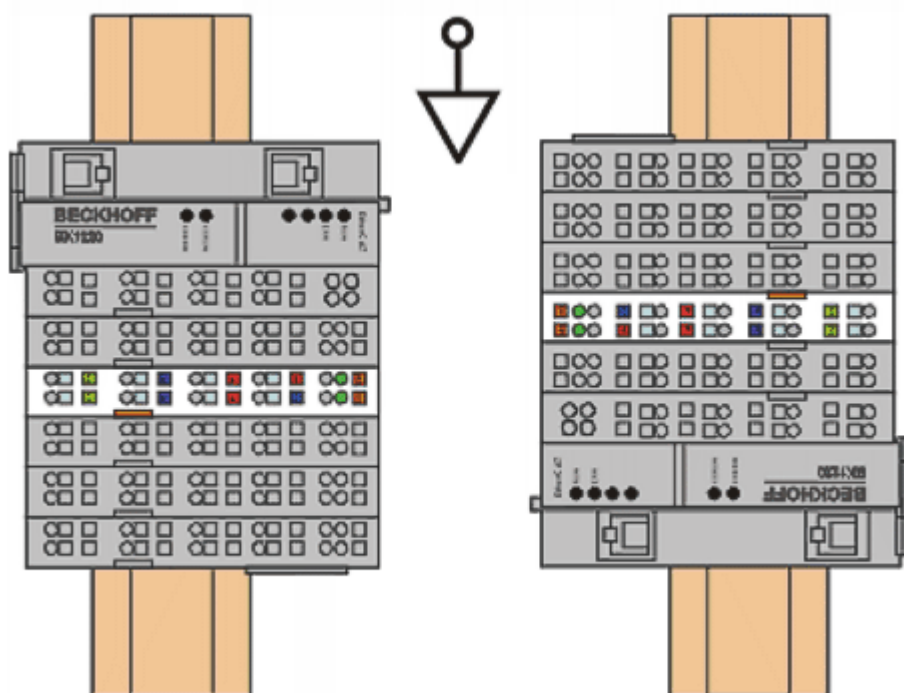
The high-precision terminals (e.g. EL3314-0002, EL3314-0010), see technical data of the relevant terminals, may only be operated in the above described **Optimum installation position (standard)**, since only in this installation position the increased measuring accuracy is ensured.

Compliance with the clearances (see figure above "Recommended clearances for standard installation position") is strongly recommended!

Other installation positions

All other installation positions are characterized by different spatial arrangement of the mounting rail - see Fig "Other installation positions".

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



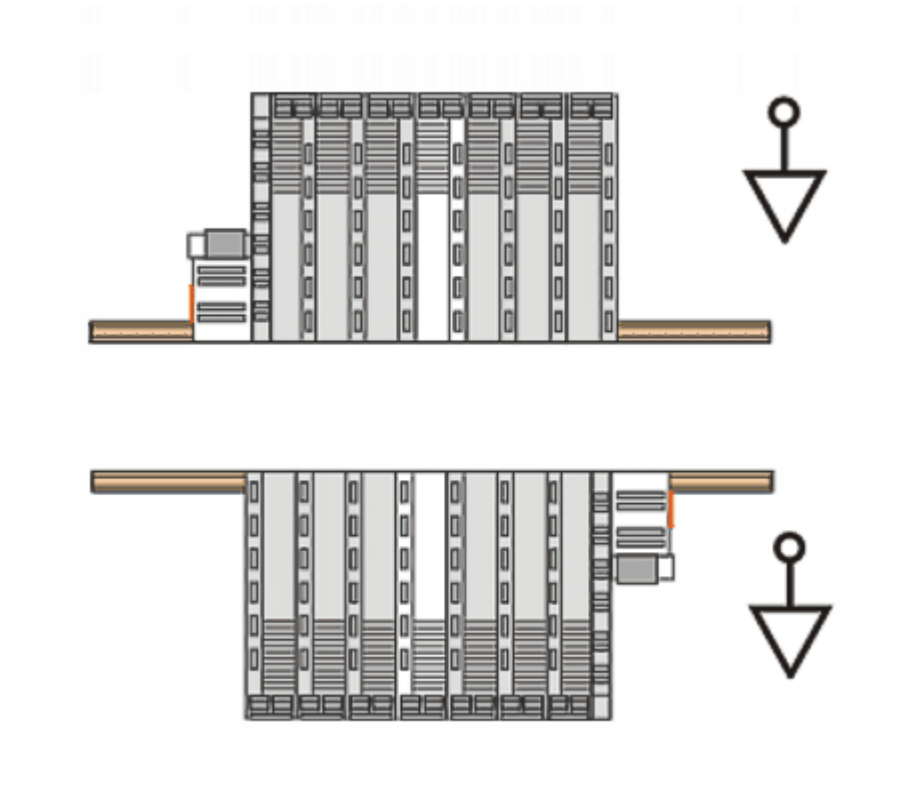


Fig. 144: Other installation positions

4.15 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 Commissioning

NOTICE



Further information

For information on commissioning with TwinCAT and EtherCAT basics, please refer to the [“EtherCAT system manual”](#).

⚠ CAUTION

Watchdog settings

Changes to the watchdog settings can lead to unwanted system behavior or damage to devices.

- Observe the information in the chapter [“Notes on watchdog settings”](#) in the EtherCAT system documentation before making any changes to the watchdog settings!

5.1 Brief instructions for commissioning / quick start

5.1.1 Notes on commissioning

- When operating the EL33xx analog EtherCAT Terminals, high frequency superimposed signals from interfering devices (e.g. proportional valves, stepper motors or DC motor output stages) can be picked up by the terminal. In order to guarantee interference-free operation, we recommend the use of separate power supply units for the terminals and the interference-causing devices.
- Without additional protective measures, the maximum cable length from the EtherCAT Terminal to the thermocouple is 30 m. For longer cable lengths, suitable surge protection should be provided.
- A modification of the sensor circuit with additional devices such as change over switches or multiplexer decreases the measuring accuracy. We strongly advise against such modifications.
- When using the high-precision thermocouple terminals (EL3314-0002, EL3314-0010, EL3314-0030, EL3314-0092), it is recommended to use thermocouples of a correspondingly high accuracy class. The use of compensation wires is not recommended when using the high-precision thermocouple terminals.

5.1.2 Commissioning of the temperature or voltage measurement

For simple commissioning of the EL331x-xxxx, the thermocouple or the voltage to be measured must first be connected to the terminal in the 2-wire connection configuration. The connection of the terminals can be found in the specific chapter "Connection" under the selected product in the [product overview](#) [► 18].

The basic setting for a channel of the EL3314 is shown here as an example. The procedure is the same for all EL331x-xxxx terminals. It differs only in the selectable measuring ranges and the number of channels for which these settings must be made.

All [channel-specific settings](#) [► 258] are located in the CoE object [0x80n0](#) [► 258], where n+1 specifies the number of the channel to be parameterized.

For simple commissioning, it is only necessary to specify the thermocouple type or the measuring range.

1. For simple commissioning with the use of the internal cold junction measurement, make sure that the value "internal (0)" is selected in the object [0x80n0:0C](#) [► 258] "Cold junction compensation" (see Fig. "Setting the measuring range", A).
2. To specify the type of thermocouple or the voltage measuring range, the object [0x80n0:19](#) [► 258] "TC element" must be opened with a double click (see fig. "Setting the measuring range", B). There, in the dropdown list (see fig. "Setting the measuring range", C), you can choose between all possible ranges. This setting must then be made specifically for each wired channel.
3. The measurement can then be started and the measured value is displayed in the process data in the preset [display](#) [► 239].

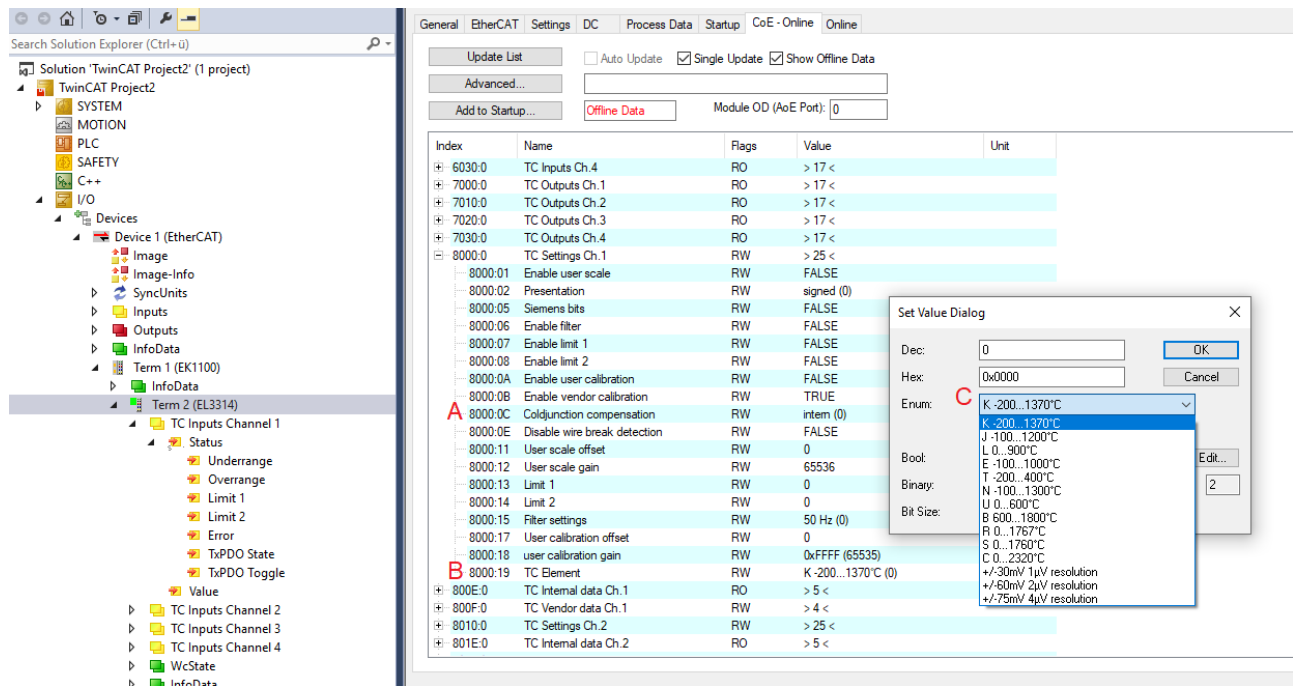


Fig. 145: Setting the measuring range

5.2 Process data

5.2.1 Sync Manager

SyncManager PDO allocation (for channel 1 - 8, $0 \leq n \leq 7$)

SM2, PDO assignment 0x1C12				
Index	Index of excluded PDOs	Size (byte.bit)	Name	PDO content
0x160n	-	2.0	TC Outputs Channel n	Index <u>0x70n0:11</u> [► 260] - CJCompensation

SM3, PDO Assignment 0x1C13				
Index	Index of excluded PDOs	Size (byte.bit)	Name	PDO content
0x1A0n (default)	-	4.0	TC Inputs Channel n	Index <u>0x60n0:01</u> [► 259] - Underrange Index <u>0x60n0:02</u> [► 259] - Overrange Index <u>0x60n0:03</u> [► 259] - limit 1 (not EL3318) Index <u>0x60n0:05</u> [► 259] - limit 2 (not EL3318) Index 0x60n0:07 - Error Index <u>0x60n0:0F</u> [► 259] - TxPDO Status Index 0x180n:09 - TxPDO Toggle Index <u>0x60n0:11</u> [► 259] - Value

5.2.2 Process data preselection (predefined PDOs)

An EtherCAT device usually offers several different process data objects (PDO) for input and output data, which can be configured in the System Manager, i.e. they can be enabled or disabled for cyclic transmission.

From TwinCAT 2.11, for suitable EtherCAT devices (as per ESI/XML description) the process data for input and output can be activated simultaneously through suitable predefined sets via "Predefined PDO assignment".

The EL33xx devices have the following "Predefined PDO" sets in the "Process data" tab (EL3318 shown in the example):

General | EtherCAT | Process Data | Startup | CoE - Online | Online

Sync Manager:

SM	Size	Type	Flags
0	128	MbxOut	
1	128	MbxIn	
2	0	Outputs	
3	32	Inputs	

PDO List:

Index	Size	Name	Flags	SM
0x1A00	4.0	TC Channel 1	MF	3
0x1A01	4.0	TC Channel 2	MF	3
0x1A02	4.0	TC Channel 3	MF	3
0x1A03	4.0	TC Channel 4	MF	3
0x1A04	4.0	TC Channel 5	MF	3
0x1A05	4.0	TC Channel 6	MF	3
0x1A06	4.0	TC Channel 7	MF	3
0x1A07	4.0	TC Channel 8	MF	3

PDO Assignment (0x1C13):

- ☒ 0x1A00
- ☒ 0x1A01
- ☒ 0x1A02
- ☒ 0x1A03
- ☒ 0x1A04
- ☒ 0x1A05
- ☒ 0x1A06
- ☒ 0x1A07

Download

- ☒ PDO Assignment
- ☐ PDO Configuration

PDO Content (0x1A00):

Index	Size	Offs	Name	Type
0x6000:01	0.1	0.0	Status__Underrange	BOOL
0x6000:02	0.1	0.1	Status__Overrange	BOOL
---	0.4	0.2	---	
0x6000:07	0.1	0.6	Status__Error	BOOL
---	0.7	0.7	---	

Predefined PDO Assignment: "Standard"

Predefined PDO Assignment: (none)

Predefined PDO Assignment: "Standard"

Predefined PDO Assignment: External Compensation

Fig. 146: TwinCAT System Manager with predefined PDO option "Standard"

When selecting "Standard" [A] (or "inputs only", EL3311, EL3312, EL3314)

- the input PDOs 0x1A0n are enabled for the corresponding input channels,
- the output PDOs 0x160n of Sync Manager 2 [B] are disabled.

General EtherCAT Process Data Startup CoE - Online Online

Sync Manager:

SM	Size	Type	Flags
0	128	MbxOut	
1	128	MbxIn	
2	16	Outputs	
3	32	Inputs	

PDO List:

Index	Size	Name	Flags	SM
0x1A00	4.0	TC Channel 1	MF	3
0x1A01	4.0	TC Channel 2	MF	3
0x1A02	4.0	TC Channel 3	MF	3
0x1A03	4.0	TC Channel 4	MF	3
0x1A04	4.0	TC Channel 5	MF	3
0x1A05	4.0	TC Channel 6	MF	3
0x1A06	4.0	TC Channel 7	MF	3
0x1A07	4.0	TC Channel 8	MF	3

PDO Assignment (0x1C13):

- ☒ 0x1A00
- ☒ 0x1A01
- ☒ 0x1A02
- ☒ 0x1A03
- ☒ 0x1A04
- ☒ 0x1A05
- ☒ 0x1A06
- ☒ 0x1A07

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- ☒ PDO Assignment
- ☐ PDO Configuration

PDO Content (0x1A00):

Index	Size	Offs	Name	Type
0x6000:01	0.1	0.0	Status__Underrange	BOOL
0x6000:02	0.1	0.1	Status__Overrange	BOOL
---	0.4	0.2	---	
0x6000:07	0.1	0.6	Status__Error	BOOL
---	0.7	0.7	---	

Predefined PDO Assignment: "External Compensation"

Predefined PDO Assignment: (none)

Predefined PDO Assignment: "Standard"

Predefined PDO Assignment: "External Compensation"

Fig. 147: TwinCAT System Manager with the predefined PDO option "External Compensation"

In the "External Compensation" option [A] (or "with ColdJunction Compensation", EL3311, EL3312, EL3314), the input and output PDOs 0x1A0n or 0x160n of the respective channels are enabled.

5.2.3 Data processing

EL33xx TC temperature

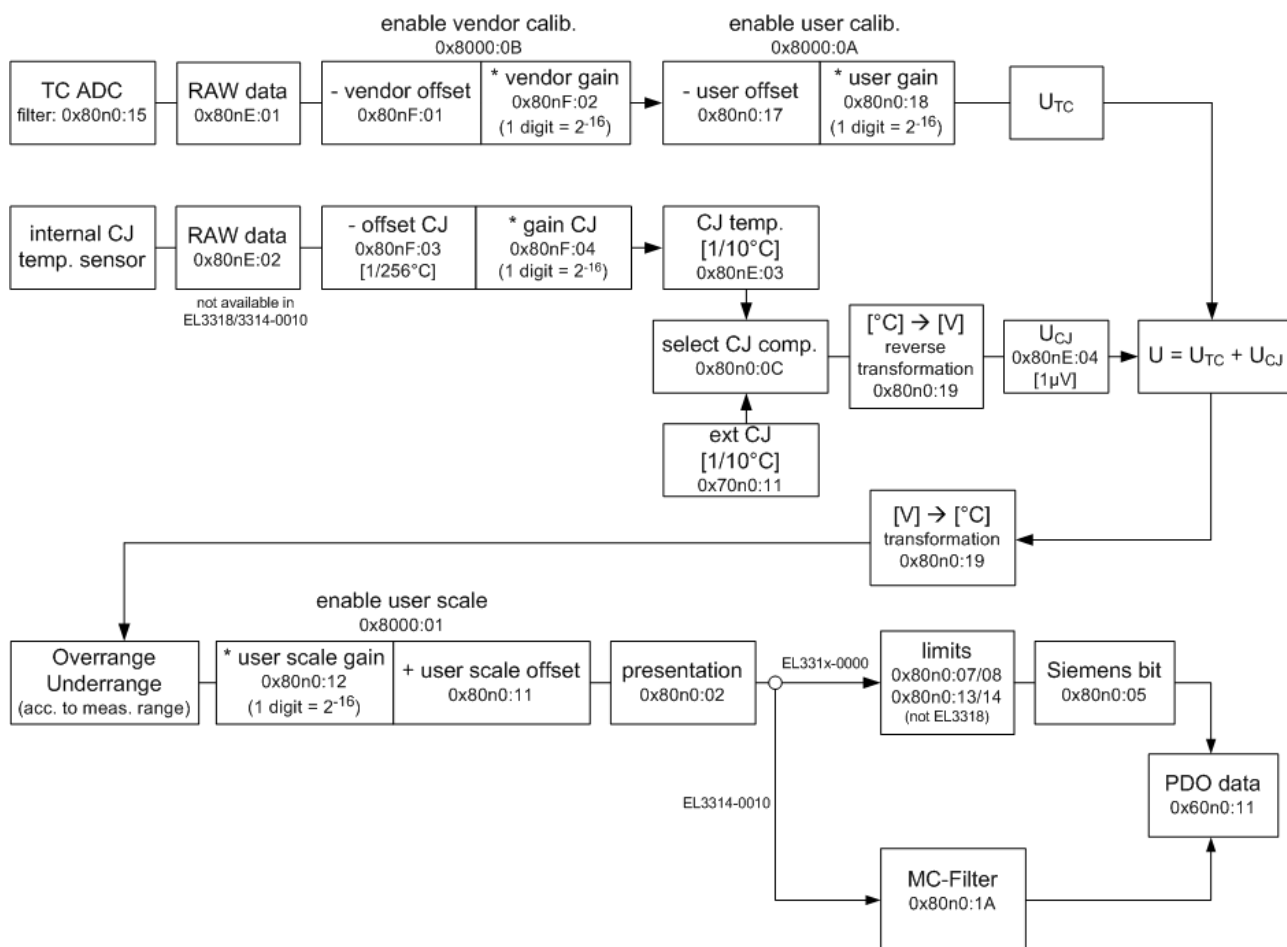


Fig. 148: EL33xx Dataflow

5.2.4 TwinSAFE SC process data EL3314-0090

The EL3314-0090 transmits the following process data to the TwinSAFE logic:

Index (hex)	Name	Type	Size
6000:11	AI Module 1.Value	INT	2.0
6010:11	AI Module 2.Value	INT	2.0
6020:11	AI Module 2.Value	INT	2.0
6030:11	AI Module 2.Value	INT	2.0

The process data of all four channels are transmitted by default. Via the „Process Image“ tab, the other data types of the frequency value can be selected or completely deselected in the Safety Editor.

Depending on the TwinCAT 3.1 version, process data can be renamed automatically when linking to the Safety Editor.

5.2.5 TwinSAFE SC process data EL3314-0092

The EL3314-0092 transmits the following process data to the TwinSAFE logic:

Index (hex)	Name	Type	Size
6000:11	TC Module 1.Value	DINT	4.0
6010:11	TC Module 2.Value	DINT	4.0
6020:11	TC Module 3.Value	DINT	4.0
6030:11	TC Module 4.Value	DINT	4.0

The process data of all four channels are initially transmitted. Individual channels can be completely deselected on the "Process Image" tab in the Safety Editor.

Depending on the TwinCAT 3.1 version, process data can be automatically renamed when linking to the Safety Editor.

5.3 Status word

The status information for each channel of the EL32xx and EL33xx is transmitted cyclically from the terminal to the EtherCAT Master as process data (PDO). Two versions of the device description are available for the EL32xx and EL33xx, representing the process image in individual and extended forms.

The difference can be seen in the revision number EL3xxx-xxxx-**XXXX**.

The EL32xx or EL33xx transmit the following process data:

- **Underrange:** Measurement is below range
- **Overrange:** Range of measurement exceeded ("Cable break" together with "Error")
- **Limit 1:** Limit value monitoring 0: ok, 1: Limit value overshoot, 2: limit range undershot
- **Limit 2:** Limit value monitoring 0: ok, 1: Limit value overshoot, 2: limit range undershot
- **Error:** The error bit is set if the process data is invalid (cable break, overrange, underrange)
- **TxPDO State:** Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).
- **TxPDO Toggle:** The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated. This allows the currently required conversion time to be derived.

The limit evaluation is set in the "8000" objects in the CoE directory.



Differences in the versions of the EL32xx and EL33xx series

The revision differences are illustrated below, using the EL32xx series as an example. The principles of the description apply equally to the EL33xx series.

Revision -0016 (EL32xx-xxxx-0016)

These terminal revisions have the **single process image**, see fig. *EL32xx-0000-0016 process image in the TwinCAT 2.11 representation*.

Each item of status information is transmitted as a single, linkable process data.

Term 2 (EL3202-0000-0016)		Name	Type	Size
RTD Inputs Channel 1	↕	Underrange	BOOL	0.1
	↕	Overrange	BOOL	0.1
	↕	Limit 1	BIT2	0.2
	↕	Limit 2	BIT2	0.2
	↕	Error	BOOL	0.1
	↕	TxPDO State	BOOL	0.1
	↕	TxPDO Toggle	BOOL	0.1
	↕	Value	INT	2.0
	↕	Underrange	BOOL	0.1
	↕	Overrange	BOOL	0.1
	↕	Limit 1	BIT2	0.2
RTD Inputs Channel 2	↕	Limit 2	BIT2	0.2
	↕	Error	BOOL	0.1
	↕	TxPDO State	BOOL	0.1
	↕	TxPDO Toggle	BOOL	0.1
	↕	Value	INT	2.0
	↕	WcState	BOOL	0.1
	↕	State	UINT	2.0
	↕	AdsAddr	AMSADD...	8.0
	↕	Underrange	BOOL	0.1
	↕	Overrange	BOOL	0.1
	↕	Limit 1	BIT2	0.2

Fig. 149: EL32xx-0000-0016 process image in the TwinCAT 2.11 representation

Revisions -0017 (EL32xx-xxxx-0017) and higher

These terminal revisions also have the **summarized process image**, see *EL32xx-0000-0017 process image in the TwinCAT 2.11 representation*.
The individual units of information are assembled here in the usual Beckhoff representation as a 16-bit status word, and can be linked into the controller in this way.

Table 1: Status word

Bit	SW.15	SW.14	SW.13 - SW.7	SW.6	SW.5	SW.4	SW.3	SW.2	SW.1	SW.0
Name	TxPDO Toggle	TxPDO State	-	Error	Limit 2		Limit 1		Overrange	Underrange

In addition to this, the consolidated "status" can be folded out through the "+" symbol, and the items of process data linked individually.

Term 3 (EL3202-0000-0017)

RTD Inputs Channel 1

Status

- Underrange
- Overrange
- Limit 1
- Limit 2
- Error
- TxPDO State
- TxPDO Toggle

Value

RTD Inputs Channel 2

WcState

- WcState

InfoData

- State

AdsAddr

Name	Type	Size
Status	Status_4...	2.0
Value	INT	2.0
Status	Status_4...	2.0
Value	INT	2.0
WcState	BOOL	0.1
State	UINT	2.0
AdsAddr	AMSADD...	8.0

A

Fig. 150: EL32xx-0000-0017 process image in the TwinCAT 2.11 representation

The individual items of information can also be displayed in the overview window (A) on the right. By clicking on the button



Fig. 151: Button show subvariables

in the menu bar the information can also be displayed there.

Term 3 (EL3202-0000-0017)			
	Name	Type	Size
RTD Inputs Channel 1	↑ Status	Status_4096	2.0
↑ Status	↑ Underrange	BOOL	0.1
↑ Underrange	↑ Overrange	BOOL	0.1
↑ Limit 1	↑ Limit 2	BIT2	0.2
↑ Limit 1	↑ Limit 2	BIT2	0.2
↑ Error	↑ Error	BOOL	0.1
↑ TxPDO State	↑ TxPDO State	BOOL	0.1
↑ TxPDO Toggle	↑ TxPDO To...	BOOL	0.1
↑ Value	↑ Value	INT	2.0
RTD Inputs Channel 2	↑ Status	Status_4096	2.0
↑ Status	↑ Underrange	BOOL	0.1
↑ Underrange	↑ Overrange	BOOL	0.1
↑ Limit 1	↑ Limit 2	BIT2	0.2
↑ Limit 1	↑ Limit 2	BIT2	0.2
↑ Error	↑ Error	BOOL	0.1
↑ TxPDO State	↑ TxPDO State	BOOL	0.1
↑ TxPDO To...	↑ TxPDO To...	BOOL	0.1
↑ Value	↑ Value	INT	2.0
↑ WcState	↑ WcState	BOOL	0.1
↑ State	↑ State	UINT	2.0
↑ AdsAddr	↑ AdsAddr	AMSADDRESS	8.0
↑ netId	↑ netId	ARRAY [0..5] OF USINT	6.0
↑ netId[0]	↑ netId[0]	USINT	1.0
↑ netId[1]	↑ netId[1]	USINT	1.0
↑ netId[2]	↑ netId[2]	USINT	1.0
↑ netId[3]	↑ netId[3]	USINT	1.0
↑ netId[4]	↑ netId[4]	USINT	1.0
↑ netId[5]	↑ netId[5]	USINT	1.0
↑ port	↑ port	UINT	2.0

Fig. 152: Consolidated process image in the extended representation under TwinCAT 2.11

Notes

- The **consolidated representation** is only visible from TwinCAT 2.11 and above. For reasons of compatibility, if a EL32xx-xxxx-0017 (or later) is operated in earlier TwinCAT configurations, the individual process image is displayed, prepended with the identifier "Status__".

Term 2 (EL3202)		Name	Type	Size
RTD Inputs Channel 1	Status__Underrange	Status__Underrange	BOOL	0.1
	Status__Overrange	Status__Overrange	BOOL	0.1
	Status__Limit 1	Status__Limit 1	BIT2	0.2
	Status__Limit 2	Status__Limit 2	BIT2	0.2
	Status__Error	Status__Error	BOOL	0.1
	Status__TxPDO State	Status__TxPDO State	BOOL	0.1
	Status__TxPDO Toggle	Status__TxPDO Toggle	BOOL	0.1
	Value	Value	INT	2.0
	Status__Underrange	Status__Underrange	BOOL	0.1
	Status__Overrange	Status__Overrange	BOOL	0.1
RTD Inputs Channel 2	Status__Limit 1	Status__Limit 1	BIT2	0.2
	Status__Limit 2	Status__Limit 2	BIT2	0.2
WcState	Status__Error	Status__Error	BOOL	0.1
	Status__TxPDO State	Status__TxPDO State	BOOL	0.1
InfoData	Status__TxPDO Toggle	Status__TxPDO Toggle	BOOL	0.1
	Value	Value	INT	2.0
State	WcState	WcState	BOOL	0.1
	State	State	UINT	2.0
AdsAddr	AdsAddr	AMSADD...	8.0	

Fig. 153: Consolidated process image represented under TwinCAT 2.10

- Revisions -0016 and -0017 do not depend on the revision of the firmware installed in the terminal. This means that terminals that were supplied as EL32xx-xxxx-0016 can also be operated with a "newer" -0017 configuration, and therefore can be addressed using the consolidated process image. This case of "upwards compatibility" is permitted for the EL32xx-xxxx-0016 and -0017.
- The easiest way to determine the revision that is installed in the terminal is through a scan of the EtherCAT system. The comparison report shows the differences.

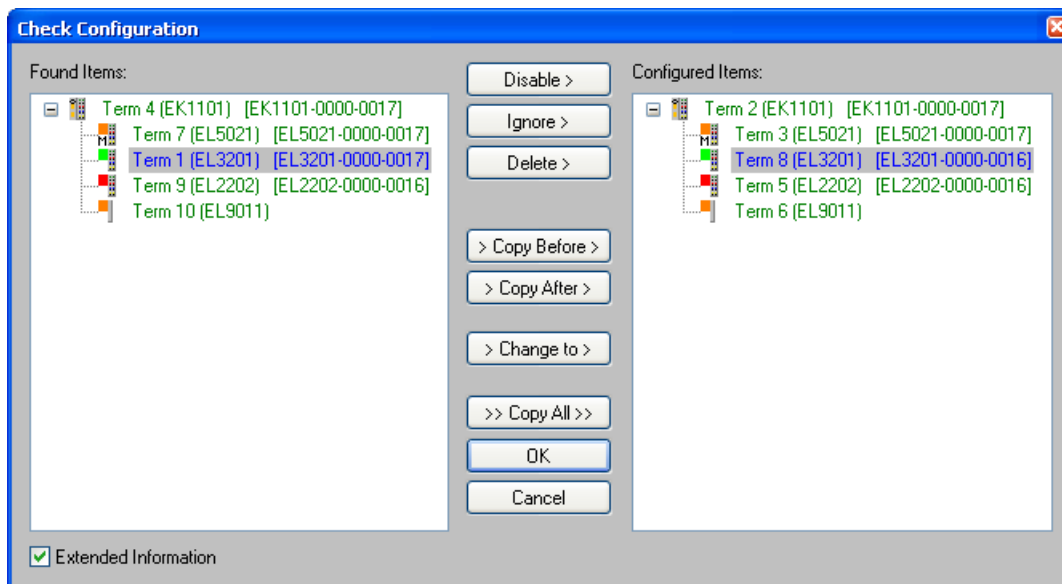


Fig. 154: Typical result after scanning an EtherCAT system

Explanation about fig. *Typical result after scanning an EtherCAT system*: According to the overview on the right, an EL3201-0000-0016 was found in the configuration (*.tsm file), whereas the overview on the left shows revision -0017. The general downward compatibility of the EL terminals ensures that this kind of application is possible.

5.4 Settings

5.4.1 Presentation, index 0x80n0:02

Index 0x80n0:02 [► 258] "Presentation" offers the possibility to change the method of representation of the measured value.

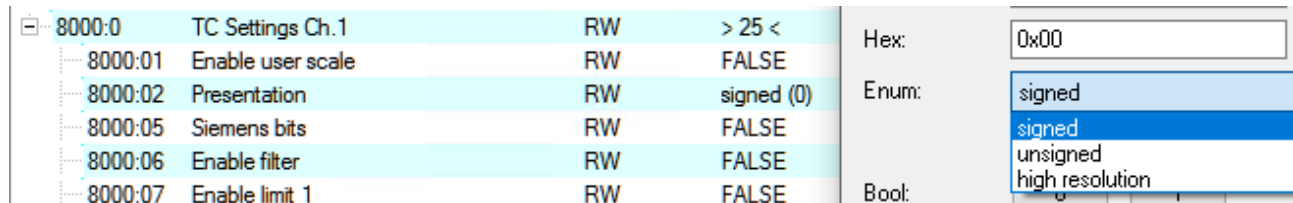


Fig. 155: Index 0x8000:02, selection of the representation

Three value representations are possible in the 16bit PDO:

- **Signed Integer (default setting):**

The measured value with resolution 1 bit = 1/10°C is displayed signed in two's complement. Maximum representation range for 16 bit = -32768 ... +32767, corresponding theoretically to -3276.8°C ... +3276.7°C (in reality the measured value is limited by the set transformation).

Example:

- 1000 0000 0000 0000_{bin} = 0x8000_{hex} = -32768_{dec}
- 1111 1111 1111 1110_{bin} = 0xFFFE_{hex} = -2_{dec}
- 1111 1111 1111 1111_{bin} = 0xFFFF_{hex} = -1_{dec}
- 0000 0000 0000 0001_{bin} = 0x0001_{hex} = +1_{dec}
- 0000 0000 0000 0010_{bin} = 0x0002_{hex} = +2_{dec}
- 0111 1111 1111 1111_{bin} = 0x7FFF_{hex} = +32767_{dec}

K -270...1372°C
J -210...1200°C
L -50...900°C
E -270...1000°C
T -270...400°C
N -270...1300°C
U -50...600°C
B 200...1820°C
R -50...1768°C
S -50...1768°C
C 0...2320°C

Fig. 156: Selection options transformation

- **High resolution:**

The measured value with resolution 1 bit = 1/100°C is displayed signed in two's complement, see there. Maximum representation range for 16-bit = -32768 ... +32767, corresponding theoretically to -327.68°C ... +327.67°C (in reality the measured value is limited by the set transformation).

The achievable accuracy is not increased by the finer representation! However, the additional decimal place can be useful for control tasks, where the internal ADC resolution limits the resolution: for example, real measured value changes of 60 mK can be read for type K:

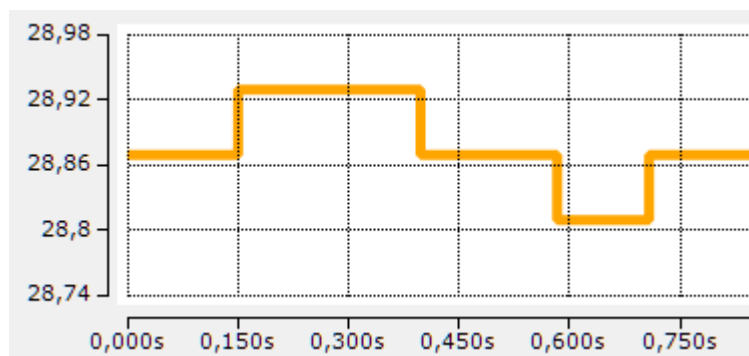


Fig. 157: Representation of measured value change thermocouple type K

Measured value	Output (hexadecimal)	Output (signed integer, decimal)	Corresponds in 1/10°C	Corresponds in 1/100°C
-200.0°C	0xF830	-2000	-200°C	-20°C
-100.0°C	0xFC18	-1000	-100°C	-10°C
-0.1°C	0xFFFF	-1	-0.1°C	-0.01°C
0.0°C	0x0000	0	0°C	0°C
0.1°C	0x0001	1	0.1°C	0.01°C
100.0°C	0x03E8	1000	100°C	10°C
200.0°C	0x07D0	2000	200°C	20°C
500.0°C	0x1388	5000	500°C	50°C
850.0°C	0x2134	8500	850°C	85°C
1000.0°C	0x2170	10000	1000°C	10°C

Table: Output of process data and measured value

- Absolute value with MSB as sign:**

The measured value with resolution 1 bit = 1/10°C is output signed in the signed amount representation.

Maximum representation range with 16 bit = -32768 ... +32767, corresponding theoretically to -3276.8°C ... +3276.7°C (in reality the measured value is limited by the set transformation)

Example:

- 1111 1111 1111 1111_{bin} = 0xFFFF_{hex} = - 32767_{dec}
- 1000 0000 0000 0010_{bin} = 0x8002_{hex} = - 2_{dec}
- 1000 0000 0000 0001_{bin} = 0x8001_{hex} = - 1_{dec}
- 0000 0000 0000 0001_{bin} = 0x0001_{hex} = +1_{dec}
- 0000 0000 0000 0010_{bin} = 0x0002_{hex} = +2_{dec}
- 0111 1111 1111 1111_{bin} = 0x7FFF_{hex} = +32767_{dec}

5.4.2 Siemens bits, index 0x80n0:05

If the bit in index 0x80n0:05 [► 258] is set, status displays are shown for the lowest 3 bits. In the error case "overrange" or "underrange", bit 0 is set.

5.4.3 Underrange, Overage

Under- and overshoot of the measuring range (underrange index [0x60n0:01](#) [[▶ 259](#)], overrange index [0x60n0:02](#) [[▶ 259](#)])

- $U_k > U_{k_{\max}}$: Index [0x60n0:02](#) [[▶ 259](#)] and index [0x60n0:07](#) [[▶ 259](#)] (overrange and error bit) are set. The linearization of the characteristic curve is continued with the coefficients of the overrange limit up to the limit stop of the A/D converter or to the maximum value of 0x7FFF.
- $U_k < U_{k_{\min}}$: Index [0x60n0:01](#) [[▶ 259](#)] and index [0x60n0:07](#) [[▶ 259](#)] (underrange and error bit) are set. The linearization of the characteristic curve is continued with the coefficients of the underrange limit up to the limit stop of the A/D converter or to the minimum value of 0x8000.

For overrange or underrange the red error LED is switched on.

5.4.4 Filter (conversion times)

The EL331x terminals are equipped with the following digital filters, cf. the data flow in chapter [Data processing](#) [[▶ 233](#)]

- Filter 1: in ADC, "ADC filter"
 - in all EL331x
 - setting in CoE [0x80n0:15](#) [[▶ 258](#)]
 - the higher the filter frequency, the faster the conversion time.
 - always have notch filter behavior (average filter)
 - the filter frequencies are set for all channels of the EL331x terminals centrally via index [0x8000:15](#) [[▶ 258](#)] (channel 1). The corresponding higher channel indices [0x8010:15](#), [0x8020:15](#), [0x8030:15](#) etc. of the EL3312/EL3314/EL3318 have no function
 - "Enable Filter" in CoE [0x80n0:06](#) [[▶ 258](#)] has no function, the ADC filter is always active
- Filter 2: in firmware, "MC Filter (software filter in the microcontroller (MC))"
 - Only for EL3314-0002, EL3314-0092, EL3314-0010/0020/0030
 - Setting in CoE [0x80n0:1A](#) [[▶ 276](#)]: inactiv/IIR/FIR

Filter behavior

Example IIR low-pass 100 Hz:

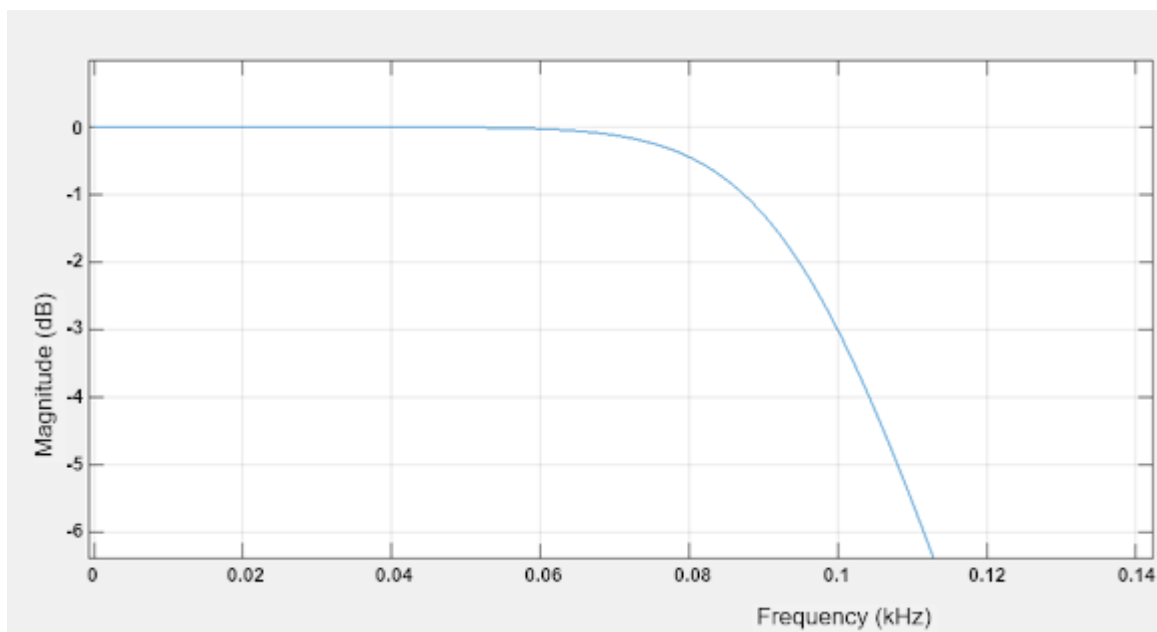


Fig. 158: Example IIR low-pass 100Hz

The notch filters attenuate the designated frequency and multiples thereof, here using the example 50 Hz FIR,
Typical curve of a notch filter set to 50 Hz:

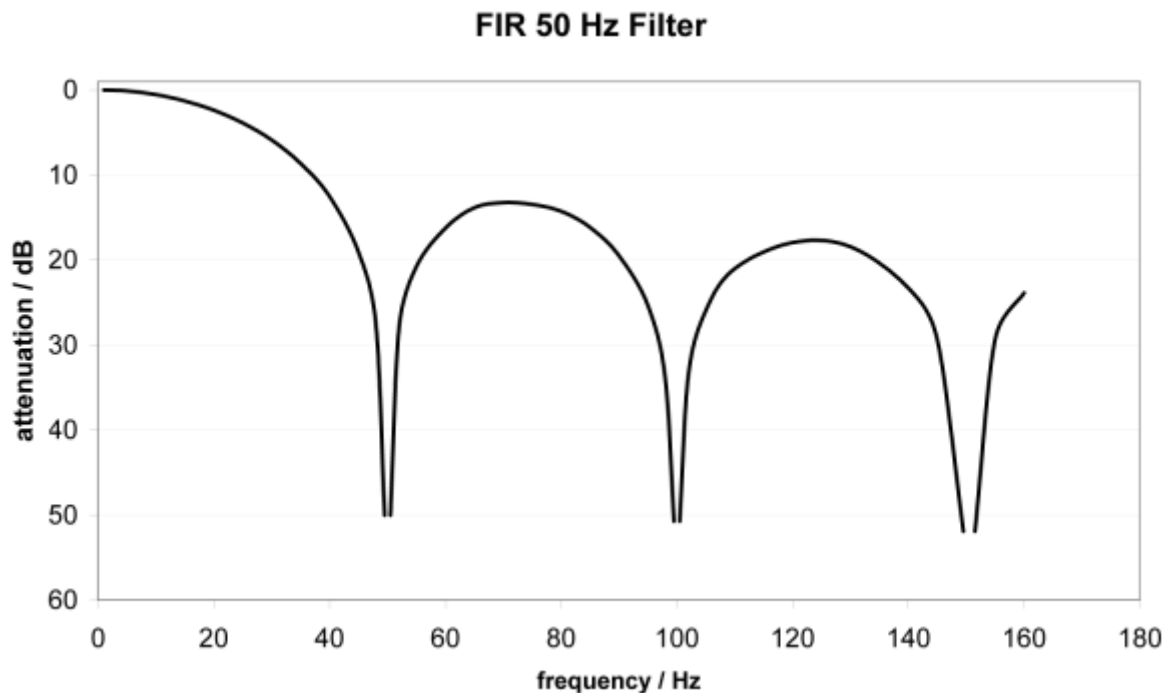


Fig. 159: Example notch filter

Conversion time/update rate from filter 1 (ADC filter)

The conversion time is dependent on the following:

Active channels * Number of measurements * Filter period + Calculation time = Conversion time

Example: EL3311 (1 channel), 3 measurements (thermocouple, wire break, cold junction), filter 50 Hz

$1 \text{ channel} * 3 \text{ measurements} * (1/50 \text{ Hz}) + 3 \text{ ms} \approx 63 \text{ ms}$

Example: EL3314 (2 channels), 3 measurements (thermocouple, wire break, cold junction), filter 50 Hz

$2 \text{ channels} * 3 \text{ measurements} * (1/50 \text{ Hz}) + 6 \text{ ms} \approx 126 \text{ ms}$

Example: EL3314 (4 channels), 3 measurements (thermocouple, wire break, cold junction), filter 50 Hz

$4 \text{ channels} * 3 \text{ measurements} * (1/50 \text{ Hz}) + 12 \text{ ms} \approx 252 \text{ ms}$

Typical conversion times with 3 measurements (thermocouple, wire break, cold junction)

Conversion times in relation to the filter frequencies:

Filter frequency	Conversion time (update time)				
	EL3311	EL3312	EL3314	EL3314-0010 EL3314-0030	EL3318
5 Hz	0.6 s	1.2 s	2.4 s	1.6 s	3.5 s
10 Hz	0.3 s	0.6 s	1.2 s	800 ms	1.75 s
50 Hz	63 ms	126 ms	250 ms	165 ms	380 ms
60 Hz	53 ms	106 ms	210 ms	145 ms	320 ms
100 Hz	33 ms	66 ms	130 ms	86 ms	200 ms
500 Hz	9 ms	18 ms	33 ms	26 ms	70 ms
1000 Hz	6 ms	12 ms	24 ms	18 ms	50 ms
2000 Hz	5 ms	10 ms	20 ms (14 from FW10)	14 ms	40 ms
3750 Hz	4 ms	8 ms	19 ms (12 from FW10)	12 ms	35 ms
7500 Hz	4 ms	7 ms	19 ms (10 from FW10)	12 ms	30 ms
15000 Hz	3 ms	7 ms	19 ms (9 from FW10)	12 ms	30 ms
30000 Hz	3 ms	7 ms	19 ms (8 from FW10)	12 ms	30 ms
mV range	3 ms	6 ms	12 ms	12 ms	25 ms

Conversion times in relation to the filter frequencies, EL3314-0002 (from FW02), EL3314-0092:

Filter frequency	EL3314-0002, EL3314-0092
50/60 Hz	114 ms
2.5 Hz	2400 ms
5 Hz	1200 ms
10 Hz	600 ms
16.6 Hz	360 ms
20 Hz	300 ms
50 Hz	122 ms
60 Hz	102 ms
100 Hz	62 ms
200 Hz	31 ms
400 Hz	17 ms
800 Hz	10 ms
1000 Hz	8 ms
2000 Hz	5 ms
4000 Hz	4 ms
mV range	4 ms

Conversion time from filter 2 (MC filter)

If available, the MC filter can further attenuate the temperature value. The final conversion rate results from the conversion time set in the ADC (table in previous section) and the MC setting according to

$$F_{\text{Filter frequency final}} [\text{Hz}] = 1 / (k * t_{\text{conversion time ADC}})$$

with k as measure for the signal rise up to 70% (-3 dB) after

Filter designation	k	Behavior
FIR4	3	Notch filter behavior
FIR8	6	
FIR16	12	
FIR32	23	
IIR0	2	Low-pass behavior
IIR1	5	
IIR2	10	
IIR3	19	

Example: for the EL3314-0010 with ADC filter 50 Hz (thus 166 ms according to the above table) and FIR16 results in $F_{\text{Filter frequency final}} = 1 / (12 * 166 \text{ ms}) = 0.5 \text{ Hz}$.

5.4.5 Limit 1 and Limit 2 (not for EL3318)

Limit 1 (Index [0x80n0:13](#) [▶ 258](#)) and Limit 2, (Index [0x80n0:14](#) [▶ 258](#))

The Limit function is enabled via index [0x80n0:07](#) [▶ 258](#) "Enable Limit 1" and index [0x80n0:08](#) [▶ 258](#) "Enable Limit 2".

A temperature range can be set that is limited by the values in the indices [0x80n0:13](#) [▶ 258](#) "Limit 1" and [0x80n0:14](#) [▶ 258](#) "Limit 2".

When the limits are exceeded, the bits in the indices [0x60n03](#) [▶ 259](#) "Limit 1" and [0x60n05](#) [▶ 259](#) "Limit 2" are set to 1.

The temperature value is entered with a resolution of 0.1 °C.

Example:

Limit 1= 30 °C

Value Index [0x80n0:13](#) [▶ 258](#) = 300

5.4.6 Calibration

Vendor calibration, index [0x80n0:0B \[► 258\]](#)

The vendor calibration is enabled via index [0x80n0:0B \[► 258\]](#). Parameterization takes place via the indices

- [0x80nF:01 \[► 259\]](#)
Thermocouple offset (vendor calibration)
- [0x80nF:02 \[► 259\]](#)
Thermocouple gain (vendor calibration)
- [0x80nF:03 \[► 259\]](#)
Reference point offset [Pt1000] (vendor calibration)
- [0x80nF:04 \[► 259\]](#)
Reference point gain [Pt1000] (vendor calibration)



Vendor and user calibration

User calibration (index [0x80n0:0A \[► 258\]](#)) should only be performed instead of the vendor calibration (index [0x80n0:0B \[► 258\]](#)), but this is generally only necessary in exceptional cases.

User calibration , index [0x80n0:0A \[► 258\]](#)

User calibration is enabled via index [0x80n0:0A \[► 258\]](#). Parameterization takes place via the indices

- [0x80n0:17 \[► 258\]](#)
Thermocouple offset (index [0x80nF:01 \[► 259\]](#), user calibration)
- [0x80n0:18 \[► 258\]](#)
Thermocouple gain (index [0x80nF:02 \[► 259\]](#), user calibration)

User scaling, index [0x80n0:01 \[► 258\]](#)

The user scaling is enabled via index [0x80n0:01 \[► 258\]](#). Parameterization takes place via the indices

- [0x80n0:11 \[► 258\]](#)
User scaling offset

The offset describes a vertical shift of the characteristic curve by a linear amount.

At a resolution of 0.1° , 1 digit_(dec) corresponds to an increase in measured value by 0.1°

At a resolution of 0.01° , 1 digit_(dec) corresponds to an increase in measured value by 0.01

- [0x80n0:12 \[► 258\]](#)
User scaling gain

The default value of 65536_(dec) corresponds to gain = 1.

The new gain value for 2-point user calibration after offset calibration is determined as follows:

$$\text{Gain}_{\text{new}} = \text{reference temperature} / \text{measured value} \times 65536_{(\text{dec})}$$

Calculation of process data

The concept "calibration", which has historical roots at Beckhoff, is used here even if it has nothing to do with the deviation statements of a calibration certificate. Actually, this is a description of the vendor or customer calibration data/adjustment data used by the device during operation in order to maintain the assured measuring accuracy.

The terminal constantly records measured values and saves the raw values from its A/D converter in the ADC raw value objects [0x80nE:01 \[► 260\]](#), [0x80nE:02 \[► 260\]](#). After each recording of the analog signal, the correction calculation takes place with the vendor and user calibration data as well as the user scaling, if these are activated (see following picture).

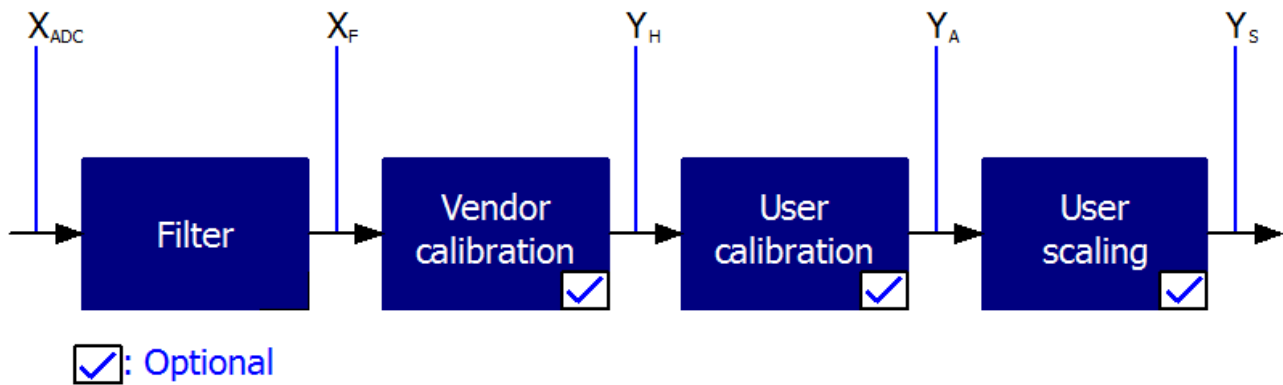


Fig. 160: Calculation of process data

Calculation	Designation
X_{ADC}	Output of the A/D converter
X_F	Output value after the filter
$Y_H = (X_{ADC} - B_H) \times A_H \times 2^{-14}$	Measured value after vendor calibration,
$Y_A = (Y_H - B_A) \times A_A \times 2^{-14}$	Measured value after vendor and user calibration
$Y_S = Y_A \times A_S \times 2^{-16} + B_S$	Measured value following user scaling

Table 2: Legend

Name	Name	Index
X_{ADC}	Output value of the A/D converter	0x80nE:01 [► 260]
X_F	Output value after the filter	-
B_H	Vendor calibration offset (not changeable)	0x80nF:01 [► 259]
A_H	Vendor calibration gain (not changeable)	0x80nF:02 [► 259]
B_A	User calibration offset (can be activated via index 0x80n0:0A [► 258])	0x80n0:17 [► 258]
A_A	User calibration gain (can be activated via index 0x80n0:0A [► 258])	0x80n0:18 [► 258]
B_S	User scaling offset (can be activated via index 0x80n0:01 [► 258])	0x80n0:11 [► 258]
A_S	User scaling gain (can be activated via index 0x80n0:01 [► 258])	0x80n0:12 [► 258]
Y_S	Process data for controller	-

Measurement result

The accuracy of the result may be reduced if the measured value is smaller than 32767 / 4 due to one or more multiplications.

5.4.7 Producer Codeword

Producer Codeword

The vendor reserves the authority for the basic calibration of the terminals. The Producer codeword is therefore at present reserved.

5.5 Operation with an external cold junction

The EL331x supports operation with an internal cold junction as standard. This means that the thermocouple is attached to the terminal points at the front of the terminal housing, so that the material transition and the cold junction are located at the front of the terminal housing. The terminal measures the cold junction temperature with its own internal temperature sensor and calculates the desired measuring point temperature value.

In special applications, operation with an external cold junction is required. The external cold junction is connected to the EL331x with a normal copper connection cable, the material transition then takes place in the external connection point. This is supported by the EL331x-xxxx.

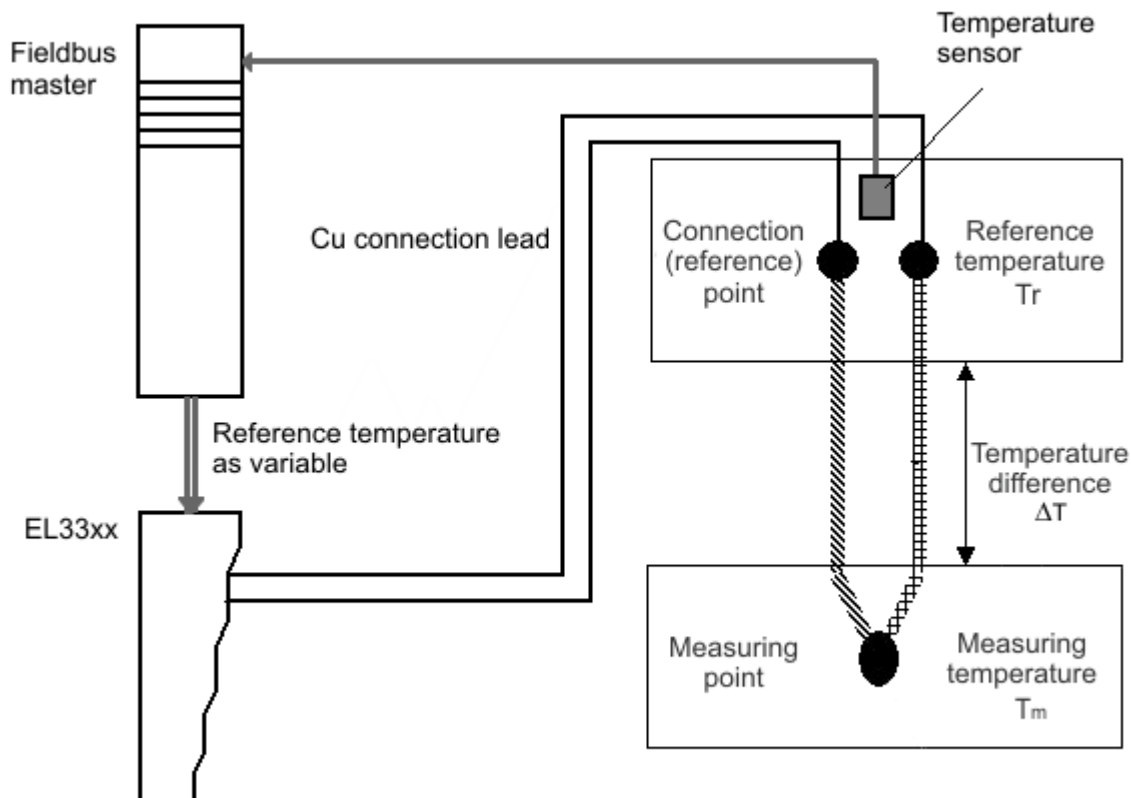


Fig. 161: External cold junction

For this operation the following must be set

- all CJCompensation PDO of the terminal must be activated, even if the "external cold junction" function is only used on isolated channels

General EtherCAT Settings DC Process Data Plc Startup CoE - Online Online

Sync Manager:

SM	Size	Type	Fla...
0	128	Mbx...	
1	128	MbxIn	
2	8	Outp...	
3	16	Inputs	

PDO List

Index	Size	Name	Flags	SM	SU
0x1A00	4.0	TC Inputs Channel 1	MF	3	0
0x1A01	4.0	TC Inputs Channel 2	MF	3	0
0x1A02	4.0	TC Inputs Channel 3	MF	3	0
0x1A03	4.0	TC Inputs Channel 4	MF	3	0
0x1600	2.0	TC Outputs Channel 1	F	2	0
0x1601	2.0	TC Outputs Channel 2	F	2	0
0x1602	2.0	TC Outputs Channel 3	F	2	0
0x1603	2.0	TC Outputs Channel 4	F	2	0

PDO Assignment (0x1C12):

☒ 0x1600
☒ 0x1601
☒ 0x1602
☒ 0x1603

Download

☒ PDO Assignment
☐ PDO Configuration

PDO Content (0x1A00):

Index	Size	Offs	Name	Type	Defau
0x6000...	0.1	0.0	Status__Underrange	BIT	
0x6000...	0.1	0.1	Status__Overrange	BIT	
0x6000...	0.2	0.2	Status__Limit 1	BIT2	
0x6000...	0.2	0.4	Status__Limit 2	BIT2	
0x6000...	0.1	0.6	Status__Error	BIT	
---	0.7	0.7	---		
0x6000...	0.1	1.6	Status__TpPDO State	BIT	

Predefined PDO Assignment: 'with ColdJunction Compensation'

Predefined PDO Assignment: (none)

Predefined PDO Assignment: 'Inputs only'

Predefined PDO Assignment: 'with ColdJunction Compensation'

Sync Unit Assignment...

Name	Online	Type	Size	>Ad...	In/O...	User...	Lin
Status		Status_B...	2.0	135.0	Input	0	
Value		INT	2.0	137.0	Input	0	
Status		Status_B...	2.0	139.0	Input	0	
Value		INT	2.0	141.0	Input	0	
Status		Status_B...	2.0	143.0	Input	0	
Value		INT	2.0	145.0	Input	0	
Status		Status_B...	2.0	147.0	Input	0	
Value		INT	2.0	149.0	Input	0	
WcState		BIT	0.1	1522.3	Input	0	
InputToggle		BIT	0.1	1524.3	Input	0	
State		UINT	2.0	1568.0	Input	0	
AdsAddr		AMSAD...	8.0	1570.0	Input	0	
CJCompensation		INT	2.0	135.0	Out...	0	
CJCompensation		INT	2.0	137.0	Out...	0	
CJCompensation		INT	2.0	139.0	Out...	0	
CJCompensation		INT	2.0	141.0	Out...	0	

Fig. 162: Activation of all CJ-PDO via Predefined PDO

- In CoE `0x80n0:0C` [► 258] of the desired channel, the external cold junction calculation must be activated by the value "2" (external process data).

8000:0	TC Settings Ch.1	R/W	> 25 <
8000:01	Enable user scale	R/W	FALSE
8000:02	Presentation	R/W	signed (0)
8000:05	Siemens bits	R/W	FALSE
8000:06	Enable filter	R/W	FALSE
8000:07	Enable limit 1	R/W	FALSE
8000:08	Enable limit 2	R/W	FALSE
8000:0A	Enable user calibration	R/W	FALSE
8000:0B	Enable vendor calibration	R/W	TRUE
8000:0C	Coldjunction compensation	R/W	extern processdata (1/10°C) (2)
8000:11	User scale offset	R/W	0

Fig. 163: Setting the cold junction billing in the CoE

The cold junction temperature T_v must now be recorded by a separate temperature sensor at the cold junction and fed to the terminal via the fieldbus master and the fieldbus as a linked variable ("external") (see Fig. *External cold junction*).

The separate measurement can technically be done via another thermocouple connected to an EL331x, or an RTD element connected to an EL32xx, or any other temperature measurement whose value is known to the controller.

The EL331x then supplies the measured value *Value*, taking into account the temperature value supplied with *CJCompensation*:

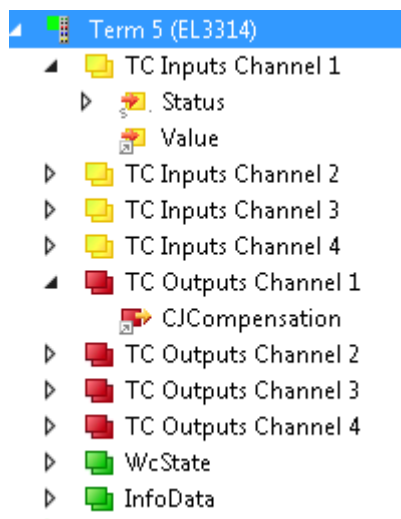


Fig. 164: Display of the "Value" in the TwinCAT tree

The comparison data is written to CoE `0x70n0:11` [► 260].

● Alternative to cold junction measurement

i As an alternative to the procedure described above, the cold junction can be maintained at a defined temperature through ice water (0° C), for example. In this case, the temperature is known without measurement of the cold junction temperature (Fig. *External cold junction*) and can be reported to the EL33xx via the process data.

● EL3314-0002, EL3314-0010

i The EL3314-0002 since FW01 and the EL3314-0010 since FW03 does also support the external reference point measurement. The user have to ensure, that an application of external cold junction measurement have no negative effect to the measurement accuracy.

5.6 TwinSAFE SC

5.6.1 TwinSAFE SC - operating principle

The TwinSAFE SC (Single Channel) technology enables the use of standard signals for safety tasks in any networks of fieldbuses. To do this, EtherCAT Terminals from the areas of analog input, angle/displacement measurement or communication (4...20 mA, incremental encoder, IO-Link, etc.) are extended by the TwinSAFE SC function. The typical signal characteristics and standard functionalities of the I/O components are retained. TwinSAFE SC I/Os have a yellow strip at the front of the housing to distinguish them from standard I/Os.

The TwinSAFE SC technology enables communication via a TwinSAFE protocol. These connections can be distinguished from the usual safe communication via Safety over EtherCAT.

The data of the TwinSAFE SC components are transferred via a TwinSAFE protocol to the TwinSAFE logic, where they can be used in the context of safety-relevant applications. Detailed examples for the correct application of the TwinSAFE SC components and the respective normative classification, which were confirmed/calculated by TÜV SÜD, can be found in the [TwinSAFE application manual](#).

5.6.2 TwinSAFE SC - configuration

The TwinSAFE SC technology enables communication with standard EtherCAT terminals via the Safety over EtherCAT protocol. These connections use another checksum, in order to be able to distinguish between TwinSAFE SC and TwinSAFE. Eight fixed CRCs can be selected, or a free CRC can be entered by the user.

By default the TwinSAFE SC communication channel of the respective TwinSAFE SC component is not enabled. In order to be able to use the data transfer, the corresponding TwinSAFE SC module must first be added under the Slots tab. Only then is it possible to link to a corresponding alias device.

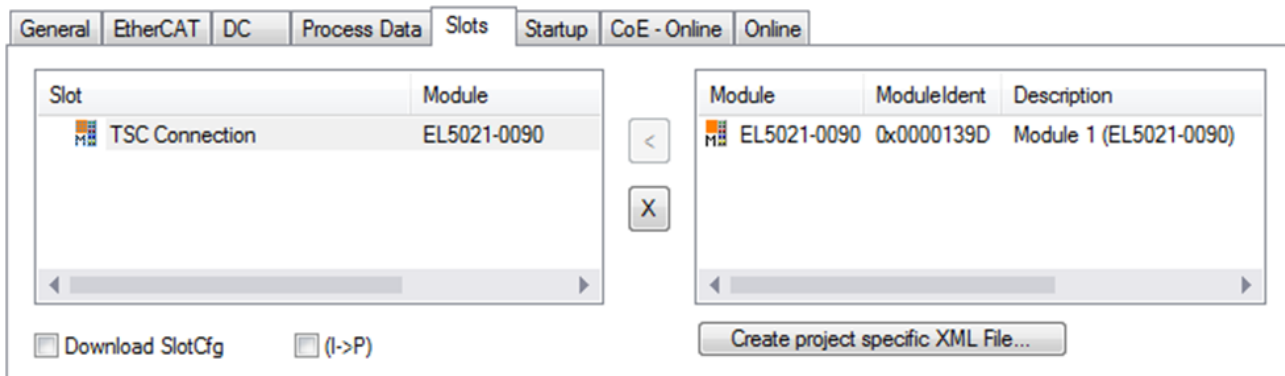


Fig. 165: Adding the TwinSAFE SC process data under the component, e.g. EL5021-0090

Additional process data with the ID TSC Inputs, TSC Outputs are generated (TSC - TwinSAFE Single Channel).

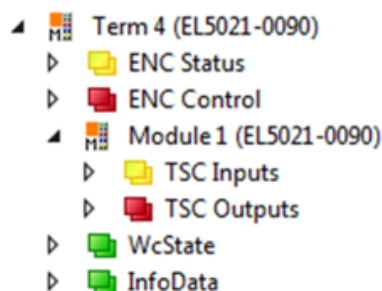


Fig. 166: TwinSAFE SC component process data, example EL5021-0090

A TwinSAFE SC connection is added by adding an alias devices in the safety project and selecting TSC (*TwinSAFE Single Channel*)

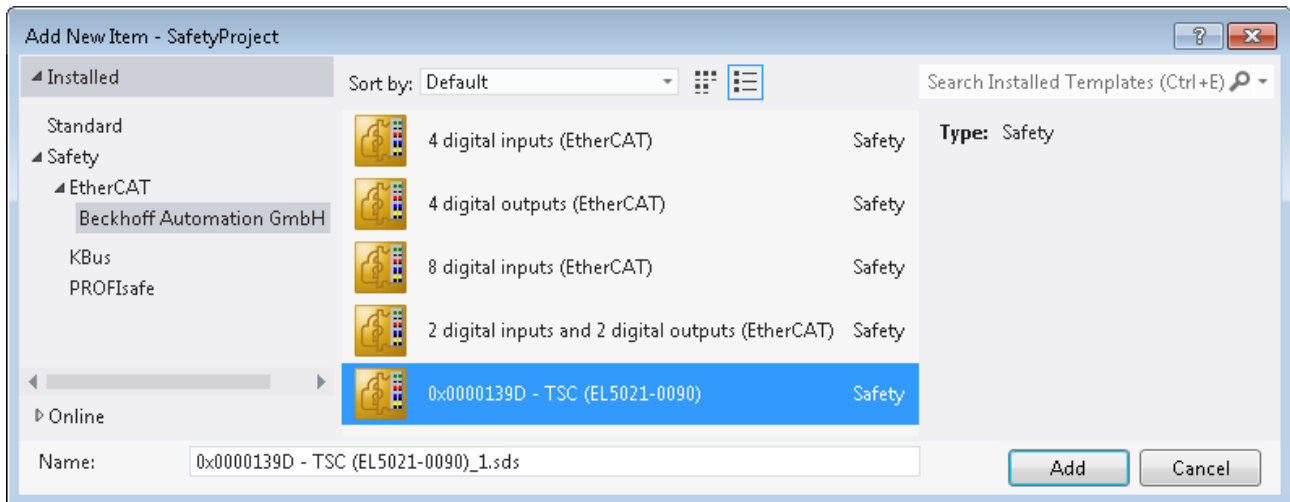


Fig. 167: Adding a TwinSAFE SC connection

After opening the alias device by double-clicking, select the Link button  next to *Physical Device*, in order to create the link to a TwinSAFE SC terminal. Only suitable TwinSAFE SC terminals are offered in the selection dialog.

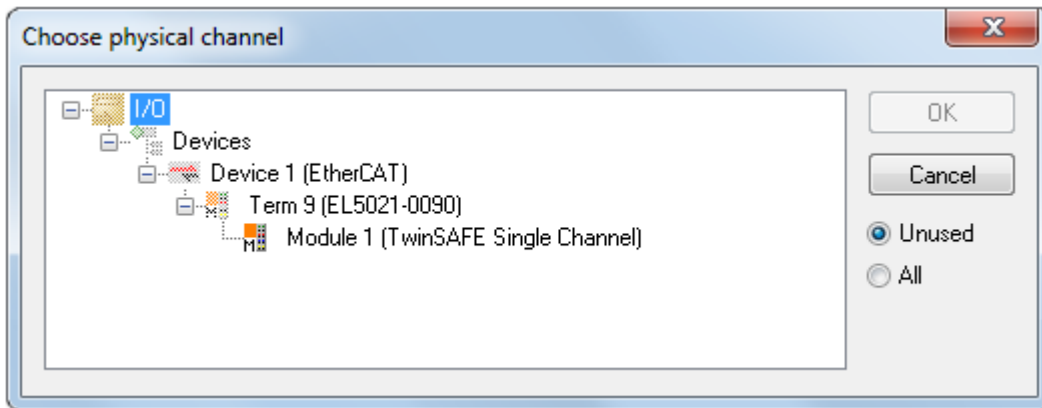


Fig. 168: Creating a link to TwinSAFE SC terminal

The CRC to be used can be selected or a free CRC can be entered under the Connection tab of the alias device.

Entry Mode	Used CRCs
TwinSAFE SC CRC 1 master	0x17B0F
TwinSAFE SC CRC 2 master	0x1571F
TwinSAFE SC CRC 3 master	0x11F95
TwinSAFE SC CRC 4 master	0x153F1
TwinSAFE SC CRC 5 master	0x1F1D5
TwinSAFE SC CRC 6 master	0x1663B
TwinSAFE SC CRC 7 master	0x1B8CD
TwinSAFE SC CRC 8 master	0x1E1BD

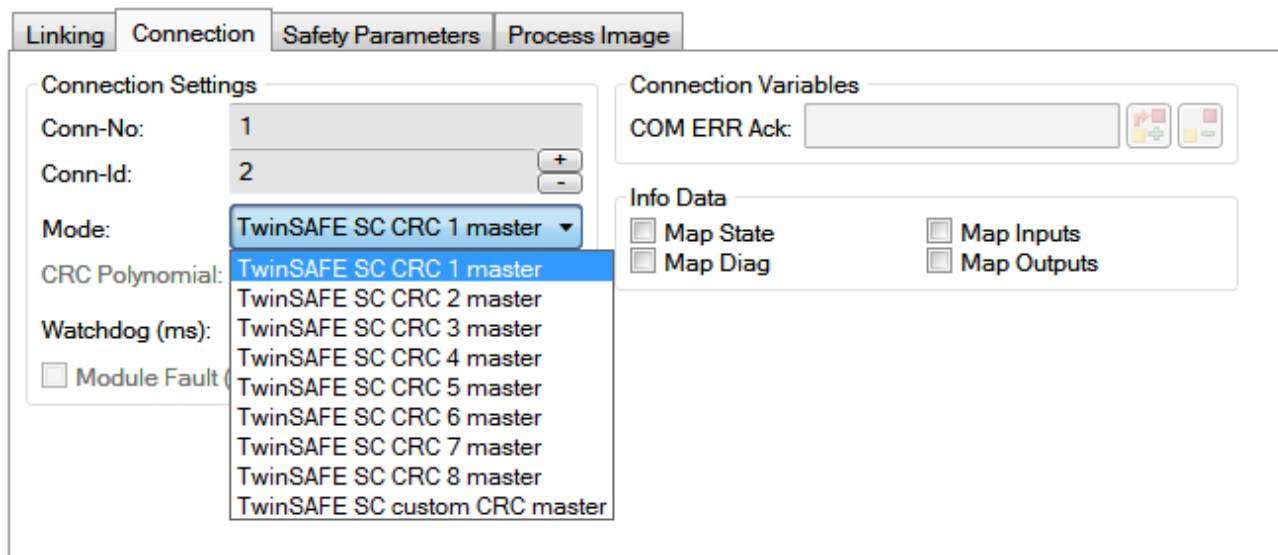


Fig. 169: Selecting a free CRC

These settings must match the settings in the CoE objects of the TwinSAFE SC component. The TwinSAFE SC component initially makes all available process data available. The *Safety Parameters* tab typically contains no parameters. The process data size and the process data themselves can be selected under the *Process Image* tab.

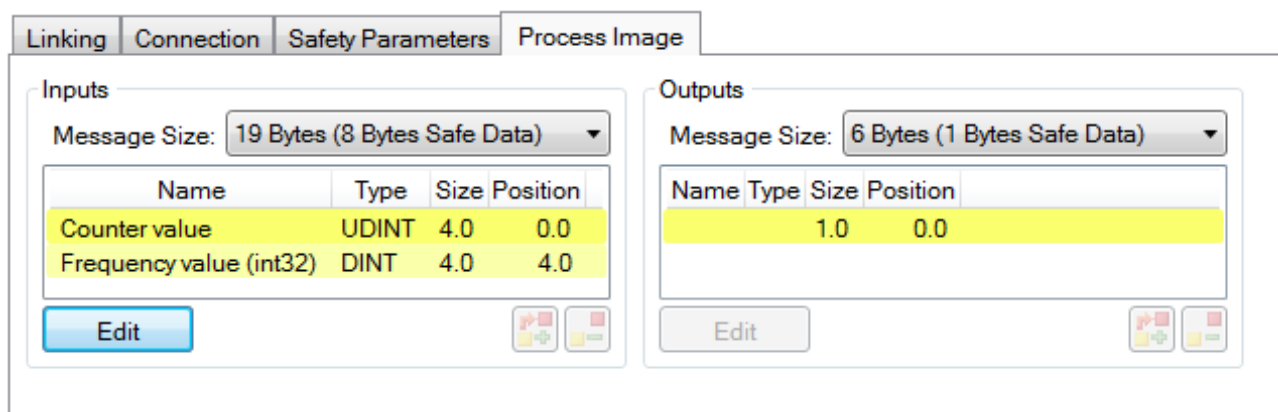


Fig. 170: Selecting the process data size and the process data

The process data (defined in the ESI file) can be adjusted to user requirements by selecting the *Edit* button in the dialog *Configure I/O element(s)*.

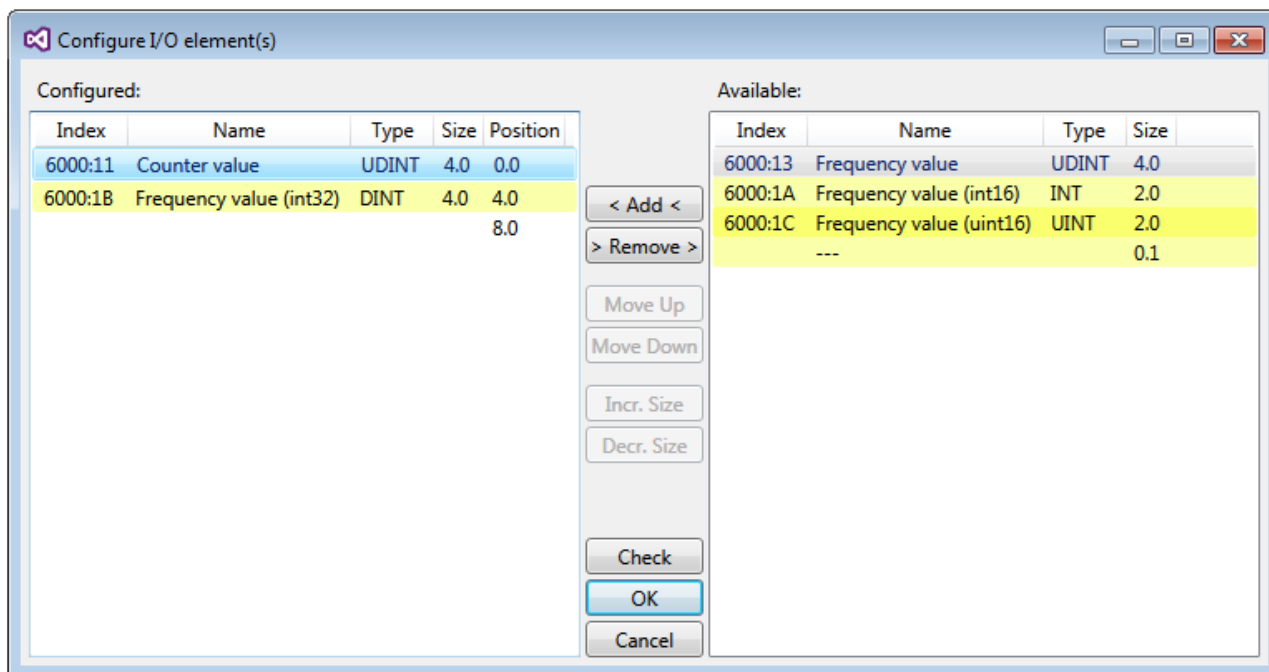


Fig. 171: Selection of the process data

The safety address together with the CRC must be entered on the TwinSAFE SC slave side. This is done via the CoE objects under *TSC settings* of the corresponding TwinSAFE SC component (here, for example, EL5021-0090, 0x8010: 01 and 0x8010: 02). The address set here must also be set in the *alias device* as *FSoE* address under the *Linking* tab.

Under the object 0x80n0:02 Connection Mode the CRC to be used is selected or a free CRC is entered. A total of 8 CRCs are available. A free CRC must start with 0x00ff in the high word.

8010:0	TSC Settings	RW	> 2 <
8010:01	Address	RW	0x0000 (0)
8010:02	Connection Mode	RW	TwinSAFE SC CRC1 master (97039)

Fig. 172: CoE objects 0x8010:01 and 0x8010:02

Object TSC Settings

Depending on the terminal, the index designation of the configuration object *TSC Settings* can vary. Example:

- EL3214-0090 and EL3314-0090, TSC Settings, Index 8040
- EL5021-0090, TSC Settings, Index 8010
- EL6224-0090, TSC Settings, Index 800F

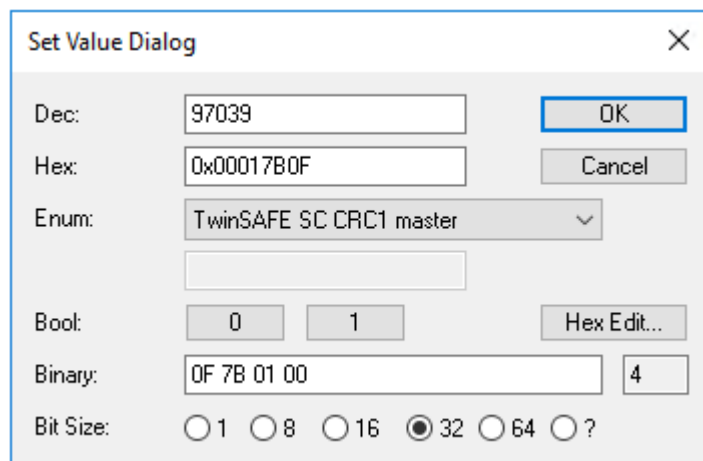


Fig. 173: Entering the safety address and the CRC

**TwinSAFE SC connections**

If several TwinSAFE SC connections are used within a configuration, a different CRC must be selected for each TwinSAFE SC connection.

5.7 Interference from equipment

When operating the EL33xx analog EtherCAT terminals, high frequency superimposed signals from interfering devices (e.g. proportional valves, stepper motors or DC motor output stages) can be picked up by the terminal. In order to guarantee interference-free operation, we recommend the use of separate power supply units for the terminals and the interference-causing devices.

5.8 Wire break detection

The EL33xx-xxxx terminals have a wire break detection of the connected thermocouple. For this purpose, a test current of a few μA is periodically sent through the thermocouple. No voltage measurement takes place during the test.

In individual cases this test current can have a disturbing effect, therefore the wire break detection can be switched off from the following firmware states in the CoE (object `0x80n0:0E` [► 260], "Disable wire break detection"):

	EL3311	EL3312	EL3314 0010	EL3314	EL3314-00 02 EL3314-00 92	EL3314-00 20 EL3314-00 30	EL3314-00 90	EL3318
Firmware	Switch-off not possible			04	01	04	02	03
ESI/ Revision				0024	0016	0021	0017	0021

5.9 Object description and parameterization



EtherCAT XML Device Description

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



Parameterization via the CoE list (CAN over EtherCAT)

The EtherCAT device is parameterized via the CoE-Online tab (double-click on the respective object) or via the Process Data tab (allocation of PDOs). Please note the following general [CoE notes](#) [[▶ 196](#)] 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 intended applications:

- Objects required for parameterization during commissioning:
 - [Restore object](#) [[▶ 257](#)] index 0x1011
 - [Configuration data](#) [[▶ 258](#)] index 0x80n0 (described in more detail in Settings of the configuration data in the CoE)
- Profile-specific objects:
 - [Configuration data \(manufacturer-specific\)](#) [[▶ 259](#)] index 0x80nF
 - [Input data](#) [[▶ 259](#)] index 0x60n0
 - [Output data](#) [[▶ 260](#)] index 0x70n0
 - [Information and diagnostic data](#) [[▶ 260](#)] index 0x80nE, 0xF000, 0xF008, 0xF010
- [Standard objects](#) [[▶ 260](#)]

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

5.9.1 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})

5.9.2 EL3311 - Object description and parameterization

5.9.2.1 EL3311 - Configuration data

Index 8000 TC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	TC Settings	Max. Subindex	UINT8	RW	0x19 (25 _{dec})
8000:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
8000:02	Presentation	0: Signed presentation, 0.1°C/digit (default) 1: Absolute value with MSB as sign (signed amount representation), 0.1°C/digit 2: High resolution, 0.01°C/digit	UINT8	RW	0x00 (0 _{dec})
8000:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
8000:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
8000:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
8000:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
8000:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
8000:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
8000:0C	Coldjunction compensation	0: internal (default) 1: no Cold junction compensation is not active 2: Extern process data [1/10°C] Cold junction compensation takes place via the process data	UINT8	RW	0x00 (0 _{dec})
8000:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
8000:12	User scale gain	Gain of the user scaling The gain has a fixed-point representation with a factor of 2 ⁻¹⁶ . The value 65536 (0x00010000) corresponds to a gain value of 1 Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
8000:13	Limit 1	First limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
8000:14	Limit 2	Second limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
8000:15	Filter settings	This object determines the basic digital filter settings. 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
8000:17	User calibration offset	User calibration offset	INT16	RW	0x0000 (0 _{dec})
8000:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
8000:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Typ: K -270°C to 1372°C 1: Typ: J -210°C to 1200°C 2: Typ: L -50°C to 900°C 3: Typ: E -270°C to 1000°C 4: Typ: T -270°C to 400°C 5: Typ: N -270°C bis 1300°C 6: Typ: U -50°C to 600°C 7: Typ: B 200°C to 1820°C 8: Typ: R -50°C to 1768°C 9: Typ: S -50°C to 1768°C 10: Typ: C 0°C to 2329°C 100: ± 30 mV (1 µV resolution) 101: ± 60 mV (2 µV resolution) 102: ± 75 mV (4 µV resolution)	UINT16	RW	0x0000 (0 _{dec})

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

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

5.9.2.3 EL3311 - Configuration data (vendor-specific)

Index 800F TC Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
800F:0	TC Vendor data	Max. Subindex	UINT8	RW	0x05 (5 _{dec})
800F:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT16	RW	0x0000 (0 _{dec})
800F:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:05	CJ Offset 1/256°C	Offset Coldjunction (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.2.4 EL3311 - Input data

Index 6000 TC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
6000:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
6000:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x6000:07])	BOOLEAN	RO	0x00 (FALSE)
6000:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
6000:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
6000:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
6000:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
6000:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
6000:11	Value	Analog input value (resolution: see Configuration data index 0x8000:02)	INT16	RO	0x0000 (0 _{dec})

5.9.2.5 EL3311 - Output data

Index 7000 TC Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
7000:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C ▶ 258], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.2.6 EL3311 - Information and diagnostic data

Index 800E TC Internal data

Index (hex)	Name	Meaning	Data type	Flags	Default
800E:0	TC Internal data	Maximum subindex	UINT8	RO	0x06 (6 _{dec})
800E:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
800E:03	CJ temperature	Cold junction temperature (resolution [1/10]°C)	INT16	RO	0x0000 (0 _{dec})
800E:04	CJ voltage	Cold junction voltage (resolution 1 µV)	INT16	RO	0x0000 (0 _{dec})
800E:06	TC Voltage		REAL32	RO	0x00000000 (0.0)

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	0x0001 (1 _{dec})

Index F008 Code word

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

5.9.2.7 EL3311 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 1600 RxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RxPDO-Map	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (TC Outputs), entry 0x11 (CJCompensation))	UINT32	RW	0x7000:11, 16

Index 1A00 TxPDO-Map

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	TxPDO-MapCh.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9 _{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x01 (Underrange))	UINT32	RW	0x6000:01, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x02 (Overrange))	UINT32	RW	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x03 (Limit 1))	UINT32	RW	0x6000:03, 2
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x05 (Limit 2))	UINT32	RW	0x6000:05, 2
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x07 (Error))	UINT32	RW	0x6000:07, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A00:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x0F (TxPDO State))	UINT32	RW	0x6000:0F, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (TxPDO-ParCh.1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x6000:10, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x11 (Value))	UINT32	RW	0x6000:11, 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	0x01 (1 _{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1601

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1 _{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0 _{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0 _{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 263], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0 _{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 263	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 263 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 263	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 263	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 263	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 263	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 263	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 263	BOOLEAN	RO	0x00 (0 _{dec})

5.9.3 EL3312 - Object description and parameterization

5.9.3.1 EL3312 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 1$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x19 (25 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: Signed presentation, 0.1°C/digit (default) 1: Absolute value with MSB as sign (signed amount representation), 0.1°C/digit 2: High resolution, 0.01°C/digit	UINT8	RW	0x00 (0 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 1: no Cold junction compensation is not active 2: Extern process data [1/10°C] Cold junction compensation takes place via the process data	UINT8	RW	0x00 (0 _{dec})
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:12	User scale gain	Gain of the user scaling The gain has a fixed-point representation with a factor of 2^{-16} . The value 65536 (0x00010000) corresponds to a gain value of 1 Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:15	Filter settings	This object determines the basic digital filter settings. 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 calibration offset	INT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Typ: K -270°C to 1372°C 1: Typ: J -210°C to 1200°C 2: Typ: L -50°C to 900°C 3: Typ: E -270°C to 1000°C 4: Typ: T -270°C to 400°C 5: Typ: N -270°C bis 1300°C 6: Typ: U -50°C to 600°C 7: Typ: B 200°C to 1820°C 8: Typ: R -50°C to 1768°C 9: Typ: S -50°C to 1768°C 10: Typ: C 0°C to 2329°C 100: ± 30 mV (1 µV resolution) 101: ± 60 mV (2 µV resolution) 102: ± 75 mV (4 µV resolution)	UINT16	RW	0x0000 (0 _{dec})

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

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

5.9.3.3 EL3312 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for 0 ≤ n ≤ 1)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x05 (5 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT16	RW	0x0000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:05	CJ Offset 1/256°C	Offset Coldjunction (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.3.4 EL3312 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for 0 ≤ n ≤ 1)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT16	RO	0x0000 (0 _{dec})

5.9.3.5 EL3312 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 1$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C ▶ 264), comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.3.6 EL3312 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 1$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x06 (6 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	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)	INT16	RO	0x0000 (0 _{dec})
80nE:06	TC Voltage		REAL32	RO	0x00000000 (0.0)

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	0x0002 (2 _{dec})

Index F008 Code word

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

5.9.3.7 EL3312 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 2 (0 ≤ n ≤ 1))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 2 (0 ≤ n ≤ 1))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch.n+1	PDO Mapping TxPDO	UINT8	RW	0x09 (9 _{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 (object 0x60n0 (TC Inputs Ch.n+1), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO State))	UINT32	RW	0x60n0:0F, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TxPDO-ParCh.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 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 (für Ch. 1 - 2 ($1 \leq n \leq 2$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n_{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 2 ($1 \leq n \leq 2$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n_{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0_{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775_{dec}) 0xC001 (EL3318)
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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 269], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 269	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 269 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 269	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 269	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 269	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 269	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 269	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 269	BOOLEAN	RO	0x00 (0 _{dec})

5.9.4 EL3314 - Object description and parameterization

5.9.4.1 EL3314 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x19 (25 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: Signed presentation, 0.1 °C/digit (default) 1: Absolute value with MSB as sign (signed amount representation), 0.1 °C/digit 2: High resolution, 0.01 °C/digit	UINT8	RW	0x00 (0 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 1: no Cold junction compensation is not active 2: Extern process data [1/10 °C] Cold junction compensation takes place via the process data	UINT8	RW	0x00 (0 _{dec})
80n0:0E	Disable wire break detection	0: Wire break detection is enabled 1: Wire break detection is disabled	BOOLEAN	RW	0x00 (FALSE)
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:12	User scale gain	Gain of the user scaling The gain has a fixed-point representation with a factor of 2 ⁻¹⁶ . The value 65536 (0x00010000) corresponds to a gain value of 1. Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1 °C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1 °C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:15	Filter settings	This object determines the basic digital filter settings. 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 calibration offset	INT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -270°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2329°C 100: ± 30 mV (1 µV resolution) 101: ± 60 mV (2 µV resolution) 102: ± 75 mV (4 µV resolution)	UINT16	RW	0x0000 (0 _{dec})

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

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

5.9.4.3 EL3314 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x05 (5 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT16	RW	0x0000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:05	CJ Offset 1/256°C	Offset Coldjunction (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.4.4 EL3314 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT16	RO	0x0000 (0 _{dec})

5.9.4.5 EL3314 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10 °C) (index 0x80n0:0C ▶ 270], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.4.6 EL3314 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x06 (6 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	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)	INT16	RO	0x0000 (0 _{dec})
80nE:06	TC Voltage		REAL32	RO	0x00000000 (0.0)

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	0x0004 (4 _{dec})

Index F008 Code word

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

5.9.4.7 EL3314 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch. n+1	PDO Mapping TxPDO	UINT8	RW	0x09 (9 _{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 (object 0x60n0 (TC Inputs Ch.n+1), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO State))	UINT32	RW	0x60n0:0F, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TxPDO-Par Ch.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 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 (für Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n_{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n_{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0_{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775_{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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 275], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 275	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 275 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 275	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 275	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 275	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 275	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 275	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 275	BOOLEAN	RO	0x00 (0 _{dec})

5.9.5 EL3314-0002 - Object description and parameterization

5.9.5.1 EL3314-0002 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x1A (26 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: 0.1°C/digit 2: 0.01°C/digit (default) 3: 0.001°C/digit	UINT8	RW	0x02 (2 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 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)	UINT8	RW	0x00 (0 _{dec})
80n0:0E	Disable wire break detection	0: Wire break detection is enabled 1: Wire break detection is disabled	BOOLEAN	RW	0x00 (FALSE)
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
8000:12	User scale gain	Gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16} . The value 1 corresponds to 65536 (0x00010000) Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT32	RW	0x00000000 (0 _{dec})
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT32	RW	0x00000000 (0 _{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:15	Filter settings	This object determines the basic digital filter settings. 0: 2.5 Hz 1: 5 Hz 2: 10 Hz 3: 16.6 Hz 4: 20 Hz 5: 50 Hz 6: 60 Hz 7: 100 Hz 8: 200 Hz 9: 400 Hz 10: 800 Hz 11: 1000 Hz 12: 2000 Hz 13: 4000 Hz 20: 50/60 Hz	UINT16	RW	0x0014 (20 _{dec})
80n0:17	User calibration offset	User calibration offset	UINT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -270°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2329°C 100: ± 78 mV 1 µV resolution) 103: ± 2.5 V 1 µV resolution) 250: no evaluation	UINT16	RW	0x0000 (0 _{dec})
80n0:1A	MC filter	The terminal has an optional additional software filter in the microcontroller (MC), which can be parameterized via this setting 0: Inactive 1: IIR 1 2: IIR 2 3: IIR 3 4: IIR 4 5: FIR 4 6: FIR 8 7: FIR 16 8: FIR 32	INT16	RW	0x0000 (0 _{dec})

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

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

5.9.5.3 EL3314-0002 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x05 (5 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT32	RW	0x00B43B00 (11811584 _{dec})
80nF:03	Calibration offset 2,5 V	Offset 2.5 V-Measurement (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})
80nF:04	Calibration offset 2,5 V	Gain 2.5 V-Measurement (vendor calibration)	UINT32	RW	0xD0121300 (3490845440 _{dec})
80nF:05	CJ Offset 1/256°C	Offset Coldjunction (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.5.4 EL3314-0002 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT32	RO	0x00000000 (0 _{dec})

5.9.5.5 EL3314-0002 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C ▶ 276], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.5.6 EL3314-0002 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x04 (4 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
80nE:03	CJ temperature 1/100°C	Cold junction temperature (resolution [1/100]°C)	INT16	RO	0x0000 (0 _{dec})
80nE:04	CJ voltage 10nV	Cold junction voltage (resolution 10 nV)	INT32	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	0x0004 (4 _{dec})

Index F008 Code word

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

5.9.5.7 EL3314-0002 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch.n+1	PDO Mapping TxPDO	UINT8	RW	0x09 (9 _{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 (object 0x60n0 (TC Inputs Ch.n+1), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO State))	UINT32	RW	0x60n0:0F, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TxPDO-Par Ch.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 32

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 (für Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n_{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n_{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0_{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775_{dec}) 0xC001 (EL3318)
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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 282], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 282	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 282 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 282	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 282	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 282	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 282	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 282	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 282	BOOLEAN	RO	0x00 (0 _{dec})

5.9.6 EL3314-00x0 - Object description and parameterization

5.9.6.1 EL3314-00x0 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x1A (26 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: 0.1°C/digit 2: 0.01°C/digit (default) 3: 0.001°C/digit	UINT8	RW	0x02 (2 _{dec})
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 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)	UINT8	RW	0x00 (0 _{dec})
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT32	RW	0x00000000 (0 _{dec})
8000:12	User scale gain	Gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16} . The value 1 corresponds to 65536 (0x00010000) Adjustable values: -2147483648...2147483647	INT32	RW	0x01000000 (16777216 _{dec})
80n0:15	Filter settings	This object determines the basic digital filter settings. 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})
80n0:17	User calibration offset	User calibration offset	INT32	RW	0x00000000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	INT32	RW	0x01000000 (16777216 _{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -270°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2329°C 104: ± 78 mV (10 nV resolution)	UINT16	RW	0x0000 (0 _{dec})
80n0:1A	MC filter	The terminal has an optional additional software filter in the microcontroller (MC), which can be parameterized via this setting 0: Inactive 1: IIR 1 2: IIR 2 3: IIR 3 4: IIR 4 5: FIR 4 6: FIR 8 7: FIR 16 8: FIR 32	UINT16	RW	0x0000 (0 _{dec})

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

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

5.9.6.3 EL3314-00x0 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x03 (3 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT32	RW	0x286BEE00 (678161920 _{dec})
80nF:03	CJ Offset 1/256 °C	Cold junction offset (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.6.4 EL3314-00x0 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT32	RO	0x00000000 (0 _{dec})

5.9.6.5 EL3314-00x0 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C ▶ 283], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.6.6 EL3314-00x0 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x04 (4 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
80nE:03	CJ temperature 1/100°C	Cold junction temperature (resolution [1/100]°C)	INT16	RO	0x0000 (0 _{dec})
80nE:04	CJ voltage 10nV	Cold junction voltage (resolution 10 nV)	INT32	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	0x0004 (4 _{dec})

Index F008 Code word

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

5.9.6.7 EL3314-00x0 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch.n+1	PDO Mapping TxPDO	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 (TxPDO-Par 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, 32

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 (für Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n_{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n_{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0_{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775_{dec}) 0xC001 (EL3318)
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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 288], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 288	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 288 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 288	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 288	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 288	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 288	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 288	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 288	BOOLEAN	RO	0x00 (0 _{dec})

5.9.7 EL3314-0090 - Object description and parameterization

5.9.7.1 EL3314-0090 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x19 (25 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: Signed presentation, 0.1 °C/digit (default) 1: Absolute value with MSB as sign (signed amount representation), 0.1 °C/digit 2: High resolution, 0.01 °C/digit	UINT8	RW	0x00 (0 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 1: no Cold junction compensation is not active 2: Extern process data [1/10 °C] Cold junction compensation takes place via the process data	UINT8	RW	0x00 (0 _{dec})
80n0:0E	Disable wire break detection	0: Wire break detection is enabled 1: Wire break detection is disabled	BOOLEAN	RW	0x00 (FALSE)
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:12	User scale gain	Gain of the user scaling The gain has a fixed-point representation with a factor of 2^{-16} . The value 65536 (0x00010000) corresponds to a gain value of 1. Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1 °C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1 °C) Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:15	Filter settings	This object determines the basic digital filter settings. 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 calibration offset	INT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -270°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2329°C 100: ± 30 mV (1 µV resolution) 101: ± 60 mV (2 µV resolution) 102: ± 75 mV (4 µV resolution)	UINT16	RW	0x0000 (0 _{dec})

Index 8040 TSC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8040:0	TSC Settings ▶ 250	Max. subindex	UINT8	RW	0x02 (2 _{dec})
8040:01	Address	TwinSAFE SC Address	UINT16	RW	0x0000 (0 _{dec})
8040:02	Connection Mode	97039: TwinSAFE SC CRC1 master 153375: TwinSAFE SC CRC2 master 204693: TwinSAFE SC CRC3 master 283633: TwinSAFE SC CRC4 master 389589: TwinSAFE SC CRC5 master 419387: TwinSAFE SC CRC6 master 506061: TwinSAFE SC CRC7 master 582077: TwinSAFE SC CRC8 master	UINT32	RW	0x00017B0F (97039 _{dec})

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

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

5.9.7.3 EL3314-0090 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for 0 ≤ n ≤ 3)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x04 (4 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT16	RW	0x0000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:03	Calibration offset CJ	Cold junction offset [Pt1000] (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:04	Calibration gain CJ	Cold junction gain [Pt1000] (vendor calibration)	INT32	RW	0x0000 (0 _{dec})

5.9.7.4 EL3314-0090 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT16	RO	0x0000 (0 _{dec})

Index 6040 TSC Slave Frame Elements (only EL3314-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
6040:0	TSC Slave Frame Elements [► 250]	Max. subindex	UINT8	RO	0x06 (7 _{dec})
6040:01	TSC__Slave Cmd	reserved	UINT8	RO	0x00 (0 _{dec})
6040:02	TSC__Slave ConnID	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:03	TSC__Slave CRC_0	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:04	TSC__Slave CRC_1	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:05	TSC__Slave CRC_2	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:06	TSC__Slave CRC_3	reserved	UINT16	RO	0x0000 (0 _{dec})

5.9.7.5 EL3314-0090 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10 °C) (index 0x80n0:0C [► 289] , comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

Index 7040 TSC Master Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
7040:0	TSC Master Frame Elements	Max. subindex	UINT8	RO	0x03 (3 _{dec})
7040:01	TSC__Master Cmd	reserved	UINT8	RO	0x00 (0 _{dec})
7040:02	TSC__Master ConnID	reserved	UINT16	RO	0x0000 (0 _{dec})
7040:03	TSC__Master CRC_0	reserved	UINT16	RO	0x0000 (0 _{dec})

5.9.7.6 EL3314-0090 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x06 (6 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
80nE:02	ADC raw value PT1000	ADC raw value PT1000	UINT32	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)	INT16	RO	0x0000 (0 _{dec})
80nE:05	CJ resistor	Cold junction resistance (PT1000 temperature sensor) (resolution 1/10 Ohm)	REAL32	RO	0x00000000 (0.0)

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	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	0x0004 (5 _{dec})

Index F008 Code word

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

5.9.7.7 EL3314-0090 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch. n+1	PDO Mapping TxPDO	UINT8	RW	0x09 (9 _{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 (object 0x60n0 (TC Inputs Ch.n+1), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO State))	UINT32	RW	0x60n0:0F, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TxPDO-Par Ch.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 16

Index 1604 TSC RxPDO-Map Master Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1604:0	TSC RxPDO-Map Master Message	PDO Mapping RxPDO	UINT8	RO	0x04 (4 _{dec})
1604:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (TSC Master Frame Elements), entry 0x01 (TSC__Master Cmd))	UINT32	RO	0x7040:01, 8
1604:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1604:03	SubIndex 003	3. PDO Mapping entry (object 0x7040 (TSC Master Frame Elements), entry 0x03 (TSC__Master CRC_0))	UINT32	RO	0x7040:03, 16
1604:04	SubIndex 004	4. PDO Mapping entry (object 0x7040 (TSC Master Frame Elements), entry 0x02 (TSC__Master ConnID))	UINT32	RO	0x7040:02, 16

Index 1A04 TSC TxPDO-Map Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	TSC TxPDO-Map Slave Message	PDO Mapping TxPDO	UINT8	RW	0x0A (10 _{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x01 (TSC__Slave Cmd))	USINT8	RW	0x6040:01, 8
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x11 (Value))	INT16	RW	0x6000:11, 16
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x03 (TSC__Slave CRC_0))	UINT16	RW	0x6040:03, 16
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (TC Inputs Ch.2), entry 0x11 (Value))	INT16	RW	0x6010:11, 16
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x04 (TSC__Slave CRC_1))	UINT16	RW	0x6040:04, 16
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6020 (TC Inputs Ch.3), entry 0x11 (Value))	INT16	RW	0x6020:11, 16
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x05 (TSC__Slave CRC_2))	UINT16	RW	0x6040:05, 16
1A04:08	SubIndex 008	8. PDO Mapping entry (object 0x6030 (TC Inputs Ch.4), entry 0x11 (Value))	INT16	RW	0x6030:11, 16
1A04:09	SubIndex 009	9. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x06 (TSC__Slave CRC_3))	UINT16	RW	0x6040:06, 16
1A04:0A	SubIndex 010	10. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x02 (TSC__Slave ConnID))	UINT16	RW	0x6040:02, 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 (für Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n _{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 4 ($1 \leq n \leq 4$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n _{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0 _{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0 _{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775 _{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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 296], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0 _{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ▶ 296	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ▶ 296 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
1C33:05	Minimum cycle time	as 0x1C32:05 ▶ 296	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ▶ 296	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ▶ 296	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ▶ 296	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ▶ 296	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ▶ 296	BOOLEAN	RO	0x00 (0 _{dec})

5.9.8 EL3314-0092 - object description and parameterization

5.9.8.1 EL3314-0092 - configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x1A (26 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: 0.1°C/digit 2: 0.01°C/digit (default) 3: 0.001°C/digit	UINT8	RW	0x02 (2 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:07	Enable limit 1	Limit 1 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:08	Enable limit 2	Limit 2 enabled	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 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)	UINT8	RW	0x00 (0 _{dec})
80n0:0E	Disable wire break detection	0: Wire break detection is enabled 1: Wire break detection is disabled	BOOLEAN	RW	0x00 (FALSE)
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
8000:12	User scale gain	Gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16} . The value 1 corresponds to 65536 (0x00010000) Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:13	Limit 1	First limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT32	RW	0x00000000 (0 _{dec})
80n0:14	Limit 2	Second limit value for setting the status bits (resolution 0.1°C) Adjustable values: -32768...32767	INT32	RW	0x00000000 (0 _{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:15	Filter settings	This object determines the basic digital filter settings. 0: 2.5 Hz 1: 5 Hz 2: 10 Hz 3: 16.6 Hz 4: 20 Hz 5: 50 Hz 6: 60 Hz 7: 100 Hz 8: 200 Hz 9: 400 Hz 10: 800 Hz 11: 1000 Hz 12: 2000 Hz 13: 4000 Hz 20: 50/60 Hz	UINT16	RW	0x0014 (20 _{dec})
80n0:17	User calibration offset	User calibration offset	UINT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -270°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2329°C 100: ± 78 mV 1 µV resolution) 103: ± 2.5 V 1 µV resolution) 250: no evaluation	UINT16	RW	0x0000 (0 _{dec})
80n0:1A	MC filter	The terminal has an optional additional software filter in the microcontroller (MC), which can be parameterized via this setting 0: Inactive 1: IIR 1 2: IIR 2 3: IIR 3 4: IIR 4 5: FIR 4 6: FIR 8 7: FIR 16 8: FIR 32	INT16	RW	0x0000 (0 _{dec})

Index 8040 TSC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8040:0	TSC Settings ▶ 250	Max. Subindex	UINT8	RW	0x02 (2 _{dec})
8040:01	Address	TwinSAFE SC address	UINT16	RW	0x0000 (0 _{dec})
8040:02	Connection Mode	Selection of TwinSAFE SC CRC: 97039: TwinSAFE SC CRC1 master 153375: TwinSAFE SC CRC2 master 204693: TwinSAFE SC CRC3 master 283633: TwinSAFE SC CRC4 master 389589: TwinSAFE SC CRC5 master 419387: TwinSAFE SC CRC6 master 506061: TwinSAFE SC CRC7 master 582077: TwinSAFE SC CRC8 master	UINT32	RW	0x00017B0F (97039 _{dec})

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

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

5.9.8.3 EL3314-0092 - configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x05 (5 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT32	RW	0x00B43B00 (11811584 _{dec})
80nF:03	Calibration offset 2,5 V	Offset 2.5 V-Measurement (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})
80nF:04	Calibration offset 2,5 V	Gain 2.5 V-Measurement (vendor calibration)	UINT32	RW	0xD0121300 (3490845440 _{dec})
80nF:05	CJ Offset 1/256°C	Offset Coldjunction (vendor calibration)	INT32	RW	0x00000000 (0 _{dec})

5.9.8.4 EL3314-0092 - input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 3$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:03	Limit 1	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:05	Limit 2	Limit value monitoring 0: not activated 1: limit range exceeded 2: limit range undershot	BIT2	RO	0x0 (0 _{dec})
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT32	RO	0x00000000 (0 _{dec})

Index 6040 TSC Slave Frame Elements (EL3314-0092 only)

Index (hex)	Name	Meaning	Data type	Flags	Default
6040:0	TSC Slave Frame Elements [► 250]	Max. Subindex	UINT8	RO	0x0A (10 _{dec})
6040:01	TSC__Slave Cmd	reserved	UINT8	RO	0x00 (0 _{dec})
6040:02	TSC__Slave ConnID	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:03	TSC__Slave CRC_0	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:04	TSC__Slave CRC_1	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:05	TSC__Slave CRC_2	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:06	TSC__Slave CRC_3	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:07	TSC__Slave CRC_4	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:08	TSC__Slave CRC_5	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:09	TSC__Slave CRC_6	reserved	UINT16	RO	0x0000 (0 _{dec})
6040:0A	TSC__Slave CRC_7	reserved	UINT16	RO	0x0000 (0 _{dec})

5.9.8.5 EL3314-0092 - output data**Index 70n0 TC Outputs Ch.(n+1) (for 0 ≤ n ≤ 3)**

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10°C) (index 0x80n0:0C [► 276], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

Index 7040 TSC Master Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
7040:0	TSC Master Frame Elements	Max. subindex	UINT8	RO	0x03 (3 _{dec})
7040:01	TSC__Master Cmd	reserved	UINT8	RO	0x00 (0 _{dec})
7040:02	TSC__Master ConnID	reserved	UINT16	RO	0x0000 (0 _{dec})
7040:03	TSC__Master CRC_0	reserved	UINT16	RO	0x0000 (0 _{dec})

5.9.8.6 EL3314-0092 - information and diagnostic data**Index 80nE TC Internal data Ch.(n+1) (for 0 ≤ n ≤ 3)**

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x04 (4 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
80nE:03	CJ temperature 1/100°C	Cold junction temperature (resolution [1/100]°C)	INT16	RO	0x0000 (0 _{dec})
80nE:04	CJ voltage 10nV	Cold junction voltage (resolution 10 nV)	INT32	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	Index distance	Index distance of the objects of the individual channels	UINT16	RO	0x0010 (16 _{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0005 (5 _{dec})

Index F008 Code word

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

5.9.8.7 EL3314-0092 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 4 (0 ≤ n ≤ 3))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 4 ($0 \leq n \leq 3$))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch.n+1	PDO Mapping TxPDO	UINT8	RW	0x09 (9 _{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 (object 0x60n0 (TC Inputs Ch.n+1), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x07 (Error))	UINT32	RW	0x60n0:07, 1
1A0n:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x0F (TxPDO State))	UINT32	RW	0x60n0:0F, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (TxPDO-Par Ch.n+1), entry 0x10 (TxPDO-Toggle))	UINT32	RW	0x60n0:10, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (TC Inputs Ch.n+1), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 32

Index 1A04 TSC TxPDO-Map Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	TSC TxPDO-Map Slave Message	PDO Mapping TxPDO	UINT8	RW	0x12 (18 _{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x01 (TSC__Slave Cmd))	USINT8	RW	0x6040:01, 8
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (TC Inputs Ch.1), entry 0x11 (Value))	INT16	RW	0x6000:11, 16
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x03 (TSC__Slave CRC_0))	UINT16	RW	0x6040:03, 16
1A04:04	SubIndex 004	4. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x04 (TSC__Slave CRC_1))	UINT16	RW	0x6040:04, 16
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (TC Inputs Ch.2), entry 0x11 (Value))	INT16	RW	0x6010:11, 16
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x05 (TSC__Slave CRC_2))	UINT16	RW	0x6040:05, 16
1A04:08	SubIndex 008	8. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A04:09	SubIndex 009	9. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x06 (TSC__Slave CRC_3))	UINT16	RW	0x6040:06, 16
1A04:0A	SubIndex 010	10. PDO Mapping entry (object 0x6020 (TC Inputs Ch.3), entry 0x11 (Value))	INT16	RW	0x6020:11, 16
1A04:0B	SubIndex 011	11. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x07 (TSC__Slave CRC_4))	UINT16	RW	0x6040:07, 16
1A04:0C	SubIndex 012	12. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A04:0D	SubIndex 013	13. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x08 (TSC__Slave CRC_5))	UINT16	RW	0x6040:08, 16
1A04:0E	SubIndex 014	14. PDO Mapping entry (object 0x6030 (TC Inputs Ch.4), entry 0x11 (Value))	INT16	RW	0x6030:11, 16
1A04:0F	SubIndex 015	15. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x09 (TSC__Slave CRC_6))	UINT16	RW	0x6040:09, 16
1A04:10	SubIndex 016	16. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A04:11	SubIndex 017	17. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x0A (TSC__Slave CRC_7))	UINT16	RW	0x6040:0A, 16
1A04:12	SubIndex 018	18. PDO Mapping entry (object 0x6040 (TSC Slave Frame Elements), entry 0x02 (TSC__Slave ConnID))	UINT16	RW	0x6040:02, 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 (für Ch. 1 - 4 (1 ≤ n ≤ 4))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n _{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 4 (1 ≤ n ≤ 4))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n _{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0 _{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0 _{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 305], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0 _{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ► 305]	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ► 305] or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 ► 305]	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ► 305]	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ► 305]	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ► 305]	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ► 305]	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ► 305]	BOOLEAN	RO	0x00 (0 _{dec})

5.9.9 EL3318 - Object description and parameterization

5.9.9.1 EL3318 - Configuration data

Index 80n0 TC Settings Ch.(n+1) (for $0 \leq n \leq 7$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	TC Settings	Max. Subindex	UINT8	RW	0x19 (25 _{dec})
80n0:01	Enable user scale	User scaling is active.	BOOLEAN	RW	0x00 (FALSE)
80n0:02	Presentation	0: Signed presentation, 0.1°C/digit (default) 1: Absolute value with MSB as sign (signed amount representation), 0.1°C/digit 2: High resolution, 0.01°C/digit	UINT8	RW	0x00 (0 _{dec})
80n0:05	Siemens bits	The S5 bits are shown in the three low-order bits as status display.	BOOLEAN	RW	0x00 (FALSE)
80n0:06	Enable filter	This setting generally activates the basic filters in object 0x80n0:15. In the EL33xx these are technically realized in the ADC and can therefore not be switched off, even if they are set to "disabled" in the object.	BOOLEAN	RW	0x00 (FALSE)
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (FALSE)
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (TRUE)
80n0:0C	Coldjunction compensation	0: internal (default) 1: no Cold junction compensation is not active 2: Extern process data [1/10°C] Cold junction compensation takes place via the process data	UINT8	RW	0x00 (0 _{dec})
80n0:0E	Disable wire break detection	0: Wire break detection is enabled 1: Wire break detection is disabled	BOOLEAN	RW	0x00 (FALSE)
80n0:11	User scale offset	User scaling offset Adjustable values: -32768...32767	INT16	RW	0x0000 (0 _{dec})
80n0:12	User scale gain	Gain of the user scaling The gain has a fixed-point representation with a factor of 2^{-16} . The value 65536 (0x00010000) corresponds to a gain value of 1 Adjustable values: -2147483648...2147483647	INT32	RW	0x00010000 (65536 _{dec})
80n0:15	Filter settings	This object determines the basic digital filter settings. 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})
80n0:17	User calibration offset	User calibration offset	INT16	RW	0x0000 (0 _{dec})
80n0:18	User calibration gain	User calibration gain	UINT16	RW	0xFFFF (65535 _{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:19	TC element	Thermocouple (Implemented temperature range) or measured variable 0: Type: K -200°C to 1372°C 1: Type: J -210°C to 1200°C 2: Type: L -50°C to 900°C 3: Type: E -270°C to 1000°C 4: Type: T -270°C to 400°C 5: Type: N -270°C to 1300°C 6: Type: U -50°C to 600°C 7: Type: B 200°C to 1820°C 8: Type: R -50°C to 1768°C 9: Type: S -50°C to 1768°C 10: Type: C 0°C to 2320°C 100: ± 30 mV (1 µV resolution) 101: ± 60 mV (2 µV resolution) 102: ± 75 mV (4 µV resolution)	UINT16	RW	0x0000 (0 _{dec})

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

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

5.9.9.3 EL3318 - Configuration data (vendor-specific)

Index 80nF TC Vendor data Ch.(n+1) (for $0 \leq n \leq 7$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	TC Vendor data	Maximum subindex	UINT8	RW	0x03 (3 _{dec})
80nF:01	Calibration offset TC	Thermocouple offset (vendor calibration)	INT16	RW	0x0000 (0 _{dec})
80nF:02	Calibration gain TC	Thermocouple gain (vendor calibration)	UINT16	RW	0x0000 (0 _{dec})
80nF:03	CJOffset	Cold junction offset [Pt1000] (vendor calibration)	INT16	RW	0x0000 (0 _{dec})

5.9.9.4 EL3318 - Input data

Index 60n0 TC Inputs Ch.(n+1) (for $0 \leq n \leq 7$)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	TC Inputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (FALSE)
60n0:02	Overrange	Measuring range exceeded. ("wire breakage" together with "error" [index 0x60n0:07])	BOOLEAN	RO	0x00 (FALSE)
60n0:07	Error	The error bit is set if the value is invalid (wire breakage, overrange, underrange).	BOOLEAN	RO	0x00 (FALSE)
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (FALSE)
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (FALSE)
60n0:11	Value	Analog input value (resolution: see Configuration data index 0x80n0:02)	INT16	RO	0x0000 (0 _{dec})

5.9.9.5 EL3318 - Output data

Index 70n0 TC Outputs Ch.(n+1) (for $0 \leq n \leq 7$)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	TC Outputs	Maximum subindex	UINT8	RO	0x11 (17 _{dec})
70n0:11	CJCompensation	Temperature of the cold junction (resolution in 1/10 °C) (index 0x80n0:0C [► 306], comparison via the process data)	INT16	RO	0x0000 (0 _{dec})

5.9.9.6 EL3318 - Information and diagnostic data

Index 80nE TC Internal data Ch.(n+1) (for $0 \leq n \leq 7$)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	TC Internal data	Maximum subindex	UINT8	RO	0x03 (3 _{dec})
80nE:01	ADC raw value TC	ADC raw value thermocouple	UINT32	RO	0x00000000 (0 _{dec})
80nE:03	CJ temperature	Cold junction temperature (resolution [1/100]°C)	INT16	RO	0x0000 (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	Index distance	Index distance of the objects of the individual channels	UINT16	RO	0x0010 (16 _{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0008 (8 _{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 Profile List	Maximum subindex	UINT8	RW	0x08 (8 _{dec})
F010:01	SubIndex 001	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:02	SubIndex 002	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:03	SubIndex 003	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:04	SubIndex 004	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:05	SubIndex 005	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:06	SubIndex 006	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:07	SubIndex 007	TC Profile	UINT32	RW	0x0000014A (330 _{dec})
F010:08	SubIndex 008	TC Profile	UINT32	RW	0x0000014A (330 _{dec})

5.9.9.7 EL3318 - 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
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	[]

Index 1008 Device name

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

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	[]

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	[terminal-specific]
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	[terminal-specific]
1018:04	Serial number	Serial number of the EtherCAT slave; 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	0x00000000 (0 _{dec})

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 RxPDO-Map (for Ch. 1 - 8 (0 ≤ n ≤ 7))

Index (hex)	Name	Meaning	Data type	Flags	Default
160n:0	RxPDO-Map Ch. n+1	PDO Mapping RxPDO	UINT8	RW	0x01 (1 _{dec})
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 TxPDO-Map (for Ch. 1 - 8 (0 ≤ n ≤ 7))

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0n:0	TxPDO-Map Ch.n+1	PDO Mapping TxPDO	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 (TxPDO-ParCh.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 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 (für Ch. 1 - 8 (1 ≤ n ≤ 8))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x0n (n _{dec})
1C12:0n	Subindex 00n	n. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x160n

Index 1C13 TxPDO assign (for Ch. 1 - 8 (1 ≤ n ≤ 8))

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x0n (n _{dec})
1C13:0n	Subindex 00n	n. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A0n

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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 2 Event 2: DC-Mode - Synchron with SYNC0 Event 3: DC-Mode - Synchron with SYNC1 Event 	UINT16	RW	0x0000 (0 _{dec})
1C32:02	Cycle time	Cycle time (in ns): <ul style="list-style-type: none"> Free Run: Cycle time of the local timer Synchron 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 output of the outputs (in ns, DC mode only)	UINT32	RW	0x00000000 (0 _{dec})
1C32:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0 = 1: free run is supported Bit 1 = 1: Synchron with SM 2 event is supported Bit 3:2 = 10: DC mode is supported Bit 5:4 = 01: Output shift with SYNC1 event (only DC mode) 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})
1C32:08	Command	<ul style="list-style-type: none"> 0: Measurement of the local cycle time is stopped 1: Measurement of the local cycle time is started <p>The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06 [► 312], 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset</p>	UINT16	RW	0x0000 (0 _{dec})
1C32:09	Delay time	Time between SYNC1 event and output 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: <ul style="list-style-type: none"> 0: Free Run 1: Synchron with SM 3 event (no outputs available) 2: DC - Synchron with SYNC0 Event 3: DC - Synchron with SYNC1 Event 34: Synchron with SM 2 event (outputs available) 	UINT16	RW	0x0000 (0 _{dec})
1C33:02	Cycle time	as 0x1C32:02 ► 312	UINT32	RW	0x00000000 (0 _{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0 _{dec})
1C33:04	Sync modes supported	Supported synchronization modes: <ul style="list-style-type: none"> Bit 0: free run is supported Bit 1: Synchron with SM 2 Event is supported (outputs available) Bit 1: Synchron with SM 3 Event is supported (no outputs available) Bit 3:2 = 10: DC mode is supported Bit 5:4 = 10: input shift through local event (outputs available) Bit 5:4 = 101: input shift with SYNC1 event (no outputs available) Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 ► 312 or 0x1C33:08) 	UINT16	RO	0x8007 (32775 _{dec}) 0xC001 (EL3318)
1C33:05	Minimum cycle time	as 0x1C32:05 ► 312	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, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:08	Command	as 0x1C32:08 ► 312	UINT16	RW	0x0000 (0 _{dec})
1C33:09	Delay time	Time 0x1 between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0 _{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 ► 312	UINT16	RO	0x0000 (0 _{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 ► 312	UINT16	RO	0x0000 (0 _{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 ► 312	UINT16	RO	0x0000 (0 _{dec})
1C33:20	Sync error	as 0x1C32:32 ► 312	BOOLEAN	RO	0x00 (0 _{dec})

6 Appendix

6.1 Sample program for individual temperature calculation in the PLC

The terminals from the EL331x-xxxx series are used for the convenient measurement of temperatures with thermocouples. For this purpose they are equipped with various conversion tables for different types of thermocouples as well as an internal cold junction measurement. However, it is possible that a type of thermocouple might be used that is not stored in the firmware. In this case the EL331x offers the following method:

- Measure the thermocouple voltage at the terminal in the **voltage mode** of the EL331x
- Measure the temperature of the internal cold junction (CJ) in the terminal. This is offered in the CoE for each channel.
- Offset the two values in the controller/PLC in consideration of the desired linearization curve/table for the temperature at the place of measurement.

This calculation method, called cold junction compensation (CJC), corresponds approximately to that which is stored in the terminal for the implemented types.

The sample program implements such a procedure and produces a temperature value that takes into account the channel-wise cold junction temperature from the CoE. By way of example the terminal is continually switched between voltage and temperature measurement in the type K, thus enabling a comparison of the two temperature values. A recording of the measured values from channel 1 of the EL3314 on a type K thermocouple with the TwinCAT Scope is illustrated below (units 0.1 °C):

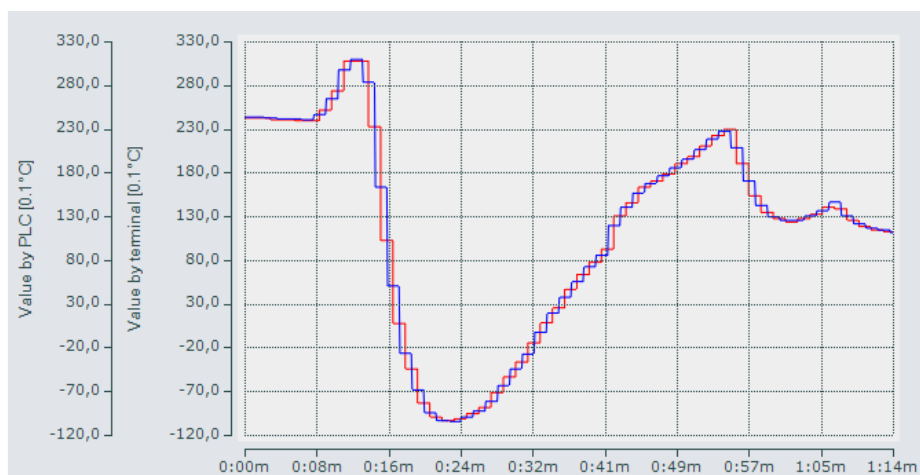


Fig. 174: Blue: temperature values from the PLC calculation; red: PDO values in the temperature measurement range

Notes:

- the EL331x-xxxx also offers a third way of determining temperature - via an externally measured cold junction. See chapter "Operation with an external cold junction" [► 247] in this documentation.
- The sample program operates with a sampling points table with 10 entries for a type K thermocouple. The values must be adjusted accordingly if a different thermocouple is used. The entries in the field variable "aTCElement" are to be made in μV and the temperature values from -30 °C to $+60\text{ °C}$ allocated in 10° steps. The assignment of the value for "nBuffer_INT" in nState =14 in MAIN must also be adjusted (e.g. 5 for type N thermocouple).
- The sample program contains a variable "stUserNetId" in the function block "FB_COE_ACCESS" in which the AMS-Net-ID of the configuration to be used is to be entered. It is required among other things for reading the cold junction temperatures. If the terminal is not located in the first position after the coupler, then the entry for the variable "nUserSlaveAddr" must also be adjusted.

- After starting the program the terminal is set to the "NoCoEStorage" state so that the continuous CoE access for switching between the temperature and voltage measurement modes does not lead in the long run to damage to the terminal's internal EEPROM. This switching is not necessary if the EL331x only ever operates in voltage measurement mode in real use.
- Note that the EL331x-xxxx approximates the characteristic curve via a second-degree polynomial and thus produces more precise temperature values than the calculation by the sample program, which merely carries out a linear interpolation between the sampling points.

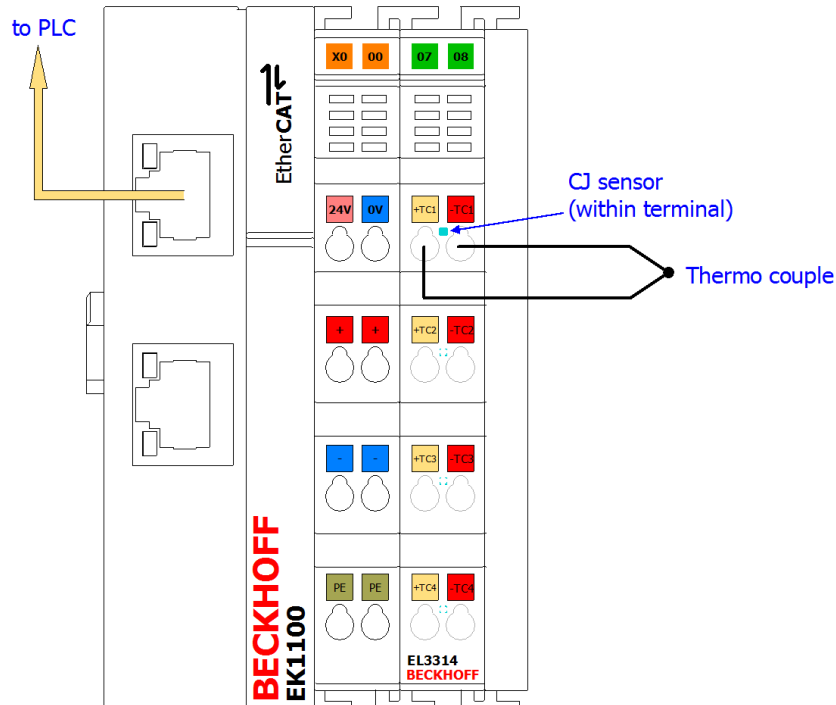


Fig. 175: Structure of the sample program for "separate temperature calculation with CJC in the PLC"

Download: <https://infosys.beckhoff.com/content/1033/el331x/Resources/5273816971.zip>

Preparations for starting the sample programs (tnzip file / TwinCAT 3)

- Click on the download button to save the Zip archive locally on your hard disk, then unzip the *.tnzip archive file in a temporary folder.

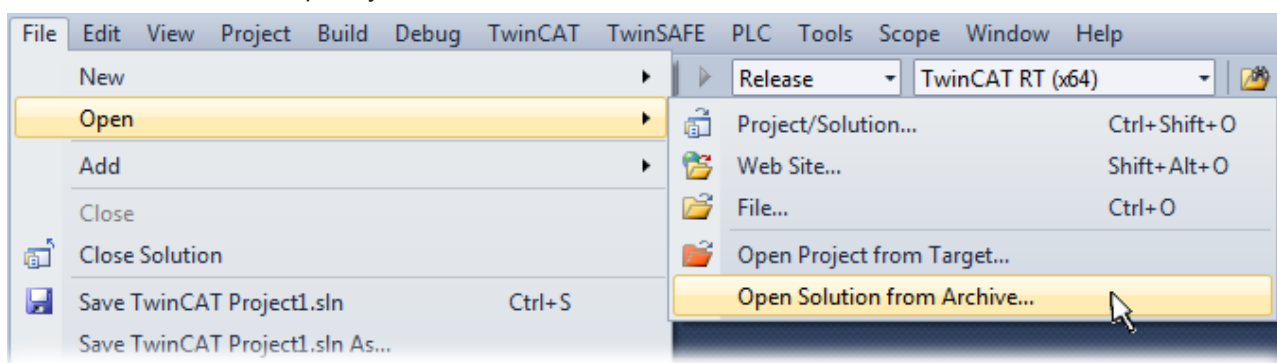


Fig. 176: Opening the *.tnzip archive

- Select the .tnzip file (sample program).
- A further selection window opens. Select the destination directory for storing the project.
- For a description of the general PLC commissioning procedure and starting the program please refer to the terminal documentation or the EtherCAT system documentation.

Extract from the sample program:

Deklarationsteil:

```
// THIS CODE IS ONLY AN EXAMPLE - YOU HAVE TO CHECK APTITUDE FOR YOUR APPLICATION
PROGRAM MAIN
VAR

  nBuffer_INT          : INT;          // Buffer for reading or writing values from/to CoE objects
  aTCElement          : ARRAY[0..9] OF REAL := // Type K  $\mu$ V entries in 10°C Steps:
    [-1156, -778, -392, 0, 397, 798, 1203, 1612, 2023, 2436];
  nTabIndex            : INT;          // Index of node in table

  nT_start             : INT := -300; // -30°C for 0.1°C resolution
  nT_ResTab            : REAL := 100; // 10°C resolution of table (for 0.1°C resolution of values)

  // Variables for calculation:
  // -----
  nDiff_U_node2node    : REAL;        // Voltage difference of two nodes
  nDiff_U_node2U_TC    : REAL;        // Voltage difference of node and U TC
  nSlope               : REAL;        // Slope for 1st interpolation (temperature to voltage)
  nResidual            : REAL;        // Residual value for interpolation
  nRelation            : REAL;        // Relation for 2nd interpolation (voltage to temperature)
  // =====
  nU_TC               : REAL;        // Voltage of temperature inkl. CJC
  nT_CJ               : REAL;        // Cold junction temperature
  nU_CJ               : REAL;        // Corresponding voltage of CJ
  nT_Result           : INT;        // Resulting Temperatur (resolution 0.1°C)
END_VAR
```

Ausführungsteil (nState=100):

```
// Cold junction temperature by CoE:
nT_CJ := INT_TO_REAL(nBuffer_INT);
// 1. Convert temperature to voltage:
// =====
// Determinate index of table:
nTabIndex := TRUNC_INT((nT_CJ - nT_start)/nT_ResTab);

// Calculate difference of two values with real value between them:
nDiff_U_node2node := (aTCElement[nTabIndex+1]-aTCElement[nTabIndex]);

// Get residual value of real value with integer value:
nResidual := nT_CJ - (nTabIndex * nT_ResTab + nT_start);

// Calculate slope nSlope = DY / DX:
nSlope := nDiff_U_node2node/nT_ResTab;

// Calculate interpolated voltage of the cold junction (m*x+b):
nU_CJ := nSlope * nResidual + aTCElement[nTabIndex];
// =====

// 2. Add this value to the PDO value:
nU_TC := INT_TO_REAL(nTC_Inputs_Value) + nU_CJ;
// =====

// 3. Convert calculated voltage to temperature:
// =====
// Search index of higher target node:
nTabIndex := 0;
// Loop as long U TC is greater than a node:
WHILE nU_TC > aTCElement[nTabIndex] DO
  nTabIndex := nTabIndex + 1;
END_WHILE
// Loop ended with resulting nTabIndex

IF nTabIndex = 0 THEN
  // Temperature is below first table entry: end here
  nT_Result := nT_start;
ELSE
  // Voltage difference between U TC and lower target node
  nDiff_U_node2U_TC := nU_TC - aTCElement[nTabIndex-1];

  // Voltage difference between two target nodes with U_TC nested between them:
  nDiff_U_node2node := aTCElement[nTabIndex]-aTCElement[nTabIndex-1];

  // Relation of the two differencies:
  nRelation := nDiff_U_node2U_TC/nDiff_U_node2node;

  // Resulting temperature in 0.1°C resolution:
  nT_Result := REAL_TO_INT(nT_start + (nRelation+nTabIndex-1) * nT_ResTab);
END_IF
```

6.2 Firmware compatibility

Beckhoff EtherCAT devices are delivered with the latest available firmware version. Firmware and hardware must be compatible; not every combination ensures compatibility. The overview below shows the hardware versions on which a firmware can be operated.

Note

- The newest possible firmware for the respective hardware should be implemented
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Observe the notes on the firmware update in the EtherCAT System Manual in chapter "Firmware Update". If a device is set to BOOTSTRAP mode for firmware update, it may not check whether the new firmware is suitable during download.

This may result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

EL3311			
Hardware (HW)	Firmware	Revision no.	Date of release
00	01	EL3311-0000-0016	2008/03
01	02	EL3311-0000-0017	2010/01
	03	EL3311-0000-0018	2010/06
02- 13	04		2010/07
		EL3311-0000-0019	2012/09
	05		2013/06
			2013/06
		EL3311-0000-0020	2014/07
		EL3311-0000-0021	2015/01
		EL3311-0000-0022	2016/02
		EL3311-0000-0023	2016/10
14	10*	EL3311-0000-0024	2022/08
15**	11*	EL3311-0000-0025	2026-06

EL3312			
Hardware (HW)	Firmware	Revision no.	Date of release
00	01	EL3312-0000-0016	2008/03
01	02	EL3312-0000-0017	2010/01
	03	EL3314-0000-0018	2010/06
02 - 12	04		2010/07
			2012/07
	05	EL3312-0000-0019	2012/08
			2013/06
		EL3312-0000-0020	2014/07
		EL3312-0000-0021	2015/01
		EL3312-0000-0022	2016/01
		EL3312-0000-0023	2016/10
13 - 14*	10*	EL3312-0000-0024	2024/02

EL3314			
Hardware (HW)	Firmware	Revision no.	Date of release
00 - 02	01	EL3314-0000-0016	2009/08
	02	EL3314-0000-0017	2010/01
	03	EL3314-0000-0018	2010/06
03 - 13	04		2010/07
	05	EL3314-0000-0019	2012/07
	06		2013/06
		EL3314-0000-0020	2014/07
		EL3314-0000-0021	2015/01
		EL3314-0000-0022	2016/01
		EL3314-0000-0023	2016/10
	07	EL3314-0000-0024	2018/09
14 - 18*	10*	EL3314-0000-0025	2024/02

EL3314-0002			
Hardware (HW)	Firmware	Revision no.	Date of release
00 - 05*	01	EL3314-0002-0016	2018/05
	02		2019/03
	03*		2024/02

EL3314-0010			
Hardware (HW)	Firmware	Revision no.	Date of release
00 - 07*	00	EL3314-0010-0016	2012/07
	01	EL3314-0010-0017	2012/08
	02	EL3314-0010-0018	2012/12
		EL3314-0010-0019	2014/07
	03	EL3314-0010-0020	2016/09
		EL3314-0010-0021	2019/05
	04*		2024/02

EL3314-0030			
Hardware (HW)	Firmware	Revision no.	Date of release
00*	03	EL3314-0030-0021	2019/05
	04*	EL3314-0030-0021	2024/02

EL3314-0090			
Hardware (HW)	Firmware	Revision no.	Date of release
10 - 16	00	EL3314-0090-0016	2016/05
	01		2017/02
	02	EL3314-0090-0017	2017/12
	03		2018/09
	10*	EL3314-0090-0018	2024/02

EL3314-0092			
Hardware (HW)	Firmware	Revision no.	Date of release
00*	01*	EL3314-0092-0016	2024/02

EL3318			
Hardware (HW)	Firmware	Revision no.	Date of release
00 - 12	01	EL3318-0000-0016	2012/02
		EL3318-0000-0017	2012/08
	02		2013/06
		EL3318-0000-0018	2014/07
		EL3318-0000-0019	2015/01
		EL3318-0000-0020	2016/06
	03	EL3318-0000-0021	2018/01
		EL3318-0000-0022	2020/02
	04		2021/11
13*	10*	EL3318-0000-0023	2024/02

*) This is the current compatible firmware/hardware version at the time of the preparing this documentation.
Check on the Beckhoff website whether more up-to-date [documentation](#) is available.

6.3 Support and Service

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

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