BECKHOFF New Automation Technology

Documentation | EN

EL32xx

Analog Input Terminals RTD (Pt100, Pt1000, ...)



2025-09-01 | Version: 7.5.0

Table of contents

1 Overview Analog Input Terminals Pt100 (RTD) 7

2 Foreword 8

2.1 Notes on the documentation 8
2.2 Guide through documentation 9
2.3 Safety instructions 10
2.4 Documentation issue status 11
2.5 Version identification of EtherCAT devices 12
2.5.1 General notes on marking 12
2.5.2 Version identification of EL terminals 13
2.5.3 Beckhoff Identification Code (BIC) 14
2.5.4 Electronic access to the BIC (eBIC) 16

3 Product description 18

3.1 EL3201 18
3.1.1 Introduction 18
3.1.2 Technical data 19
3.1.3 Pin assignment, display and diagnosis 20
3.2 EL3201-0010, EL3201-0020, EL3201-0030 22
3.2.1 Introduction 22
3.2.2 Technical data 23
3.2.3 Pin assignment, display and diagnosis 24
3.3 EL3202 26
3.3.1 Introduction 26
3.3.2 Technical data 27
3.3.3 Pin assignment, display and diagnosis 28
3.4 EL3202-0010, EL3202-0020, EL3202-0030 30
3.4.1 Introduction 30
3.4.2 Technical data 31
3.4.3 Pin assignment, display and diagnosis 32
3.5 EL3204 34
3.5.1 Introduction 34
3.5.2 Technical data 35
3.5.3 Pin assignment, display and diagnosis 36
3.6 EL3204-0200 38
3.6.1 Introduction 38
3.6.2 Technical data 39
3.6.3 Pin assignment, display and diagnosis 40
3.7 EL3208 42
3.7.1 Introduction 42
3.7.2 Technical data 43
3.7.3 Pin assignment, display and diagnosis 44
3.8 EL3208-0010 46
3.8.1 Introduction 46
3.8.2 Technical data 47
3.8.3 Pin assignment, display and diagnosis 48

3.9 EL3214 ... 50
3.9.1 Introduction ... 50
3.9.2 Technical data ... 51
3.9.3 Pin assignment, display and diagnosis ... 52
3.10 EL3214-0090 ... 54
3.10.1 Introduction ... 54
3.10.2 Technical data ... 55
3.10.3 Pin assignment, display and diagnosis ... 56
3.11 EL3218 ... 58
3.11.1 Introduction ... 58
3.11.2 Technical data ... 59
3.11.3 Pin assignment, display and diagnosis ... 60
3.12 RTD measurement in EL32xx ... 62
3.13 Connection of analog RTD signal lines ... 64
3.14 Note on Beckhoff calibration certificates ... 67
3.15 Start ... 69

4 Basics communication ... 70
4.1 EtherCAT basics ... 70
4.2 EtherCAT cabling – wire-bound ... 70
4.3 General notes for setting the watchdog ... 72
4.4 EtherCAT State Machine ... 73
4.5 CoE Interface ... 75
4.6 Distributed Clock ... 80

5 Installation ... 81
5.1 Safety instructions ... 81
5.2 Environmental conditions ... 82
5.3 Transport / storage ... 83
5.4 Control cabinet / terminal box ... 84
5.5 Instructions for ESD protection ... 85
5.6 Explosion protection ... 86
5.6.1 ATEX - Special conditions (standard temperature range) ... 86
5.6.2 ATEX - Special conditions (extended temperature range) ... 87
5.6.3 IECEx - Special conditions ... 88
5.6.4 Continuative documentation for ATEX and IECEx ... 88
5.6.5 cFMus - Special conditions ... 89
5.6.6 Continuative documentation for cFMus ... 90
5.7 UL notice ... 91
5.8 Installation on mounting rails ... 92
5.9 Installation instructions for enhanced mechanical load capacity ... 95
5.10 Positioning of passive Terminals ... 96
5.11 Installation positions ... 97
5.12 Connection ... 99
5.12.1 Connection system ... 99
5.12.2 Wiring ... 101
5.12.3 Shielding ... 102

5.13 Note - power supply ... 103
5.14 Disposal ... 104

6 Commissioning ... 105
6.1 TwinCAT Quick Start ... 105
6.1.1 TwinCAT 2 ... 108
6.1.2 TwinCAT 3 ... 118
6.2 TwinCAT Development Environment ... 131
6.2.1 Installation of the TwinCAT real-time driver ... 132
6.2.2 Notes regarding ESI device description ... 138
6.2.3 TwinCAT ESI Updater ... 142
6.2.4 Distinction between Online and Offline ... 142
6.2.5 OFFLINE configuration creation ... 143
6.2.6 ONLINE configuration creation ... 148
6.2.7 EtherCAT subscriber configuration ... 156
6.2.8 Import/Export of EtherCAT devices with SCI and XTI ... 166
6.3 General Commissioning Instructions for an EtherCAT Slave ... 172
6.4 EL32xx settings ... 180
6.4.1 Basic settings ... 184
6.4.2 Further settings (optional) ... 186
6.5 Process data ... 193
6.6 Status word ... 195
6.7 Settings and application notes for EL3201/2-0010/-0020/-0030 ... 200
6.8 Settings and application notes for EL3204-0200 ... 202
6.8.1 Programmed characteristic sensor curves ... 203
6.8.2 Freely programmable characteristic curves ... 204
6.8.3 Sample implementation of an NTC sensor ... 207
6.8.4 Sample implementation of a PTC sensor ... 209
6.9 Settings and application notes for EL3208-0010 ... 211
6.10 TwinSAFE SC ... 211
6.10.1 TwinSAFE SC - operating principle ... 211
6.10.2 TwinSAFE SC - configuration ... 211
6.11 TwinSAFE SC process data EL3214-0090 ... 216
6.12 CoE object descriptions ... 217
6.12.1 Object description EL3201 ... 217
6.12.2 Object description EL3201-0010, EL3201-0020, EL3201-0030 ... 225
6.12.3 Object description EL3202 ... 233
6.12.4 Object description EL3202-0010, EL3202-0020, EL3202-0030 ... 241
6.12.5 Object description EL3204 ... 249
6.12.6 Object description EL3204-0200 ... 259
6.12.7 Object description EL3208 ... 268
6.12.8 Object description EL3208-0010 ... 275
6.12.9 Object description EL3214 ... 284
6.12.10 Object description EL3214-0090 ... 292
6.12.11 Object description EL3218 ... 301

7 Appendix ... 309

7.1 EtherCAT AL Status Codes 309
7.2 Firmware compatibility 310
7.3 Firmware Update EL/ES/EM/ELM/EP/EPP/ERPxxxx 313
7.3.1 Device description ESI file/XML 314
7.3.2 Firmware explanation 317
7.3.3 Updating controller firmware *.efw 318
7.3.4 FPGA firmware *.rbf 320
7.3.5 Simultaneous updating of several EtherCAT devices 324
7.4 Restoring the delivery state 325
7.5 Support and Service 327

1 Overview Analog Input Terminals Pt100 (RTD)

EL3201 [▶ 18]	1 Channel Input Terminals Pt100 (RTD)
EL3201-0010/0020/0030 [▶ 22]	1 Channel Input Terminals Pt100 (RTD), high precision / with certificate
EL3202 [▶ 26]	2 Channel Input Terminals Pt100 (RTD)
EL3202-0010/0020/0030 [▶ 30]	2 Channel Input Terminals Pt100 (RTD), high precision / with certificate
EL3204 [▶ 34]	4 Channel Input Terminals Pt100 (RTD)
EL3204-0200 [▶ 38]	4 Channel Input Terminal for RTD up to 240 kΩ, NTC 20 k, 16 bit
EL3214 [▶ 50]	4 Channel HD Input Terminal Pt100 for 3-wire connection
EL3214-0090 [▶ 54]	4 Channel HD Input Terminal Pt100, 3-wire connection, TwinSAFE Single Channel
EL3208 [▶ 42]	8 Channel HD Input Terminal Pt100 (RTD)
EL3208-0010 [▶ 46]	8 Channel HD input terminal PT1000, Ni1000 (RTD); NTC sensors, potentiometer
EL3218 [▶ 58]	8 Channel analog HD input terminal for Pt100 (RTD) 2/3-wire connection

2 Foreword

2.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

Beckhoff®, ATRO®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, MX-System®, Safety over EtherCAT®, TC/BSD®, TwinCAT®, TwinCAT/BSD®, TwinSAFE®, XFC®, XPlanar® and XTS® are registered trademarks of and licensed by Beckhoff Automation GmbH.

Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.



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

Copyright

© Beckhoff Automation GmbH & Co. KG, Germany.
The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization are prohibited.
Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

Third-party brands

Trademarks of third parties may be used in this documentation. You can find the trademark notices here:
https://www.beckhoff.com/trademarks

2.2 Guide through documentation

NOTICE



Further components of documentation

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

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
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

2.3 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.

2.4 Documentation issue status

Version	Comment
7.5.0	• Update chapter "Technical data" • Update chapter "Commissioning” • Update revision status • Structural update
7.4.0	• Update chapter "Technical data" • Structural update
7.3.0	• Update chapter "Technical data" • Structural update
7.2.0	• Structural update
7.1	• Update chapter "Commissioning” • Structural update
7.0	• Update chapter "Commissioning” • Structural update
6.9	• Structural update
6.8	• Update chapter "Pin assignment, display and diagnosis” • Structural update
6.7	• Update chapter "Commissioning” • Update chapter "Technical data" • Structural update
6.6	• Update chapter "Introduction" • Update chapter "Technical data" • Structural update
6.5	• Update chapter "Technical data" • Update chapter "Basics of RTD technology" • Update chapter "RTD measurement in EL32xx" • Chapter "Similar products" inserted • Update chapter "EL32xx settings" • Chapter "Process data" inserted • Update chapter "Object description and parameterization" • Update revision status • Structural update
6.4	• Chapter "Note on power supply" amended • Update chapter "Object description and parameterization" • Update chapter "Technical data" • Update revision status • Structural update
6.3	• Update chapter "Introduction" • Update chapter "Technical data" • Update chapter "Connection, display and diagnostics" • Structural update
6.2	• Update chapter "Introduction" • Structural update
6.1	• Update chapter "Introduction" • Update chapter "LEDs and connection" • Update chapter "Ratiometric voltage measurement" • Structural update • Update revision status
6.0	• Update chapter "Introduction" • Chapter "Commissioning: self-heating of RTD sensors" amended
0.1 - 5.9	*archived*

2.5 Version identification of EtherCAT devices

2.5.1 General notes on marking

Designation

A Beckhoff EtherCAT device has a 14-digit designation, made up of

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal 12 mm, non-pluggable 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 mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
  - family key (EL, EP, CU, ES, KL, CX, etc.)
  - type (3314)
  - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown 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.

2.5.2 Version identification of EL terminals

The serial number/ data 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 of a batch.

Structure of the serial number: **KK YY FF HH**	Example with serial number 12 06 3A 02:
KK - week of production (CW, calendar week)	12 - production week 12
YY - year of production	06 - production year 2006
FF - firmware version	3A - firmware version 3A
HH - hardware version	02 - hardware version 02



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

2.5.3 Beckhoff Identification Code (BIC)

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

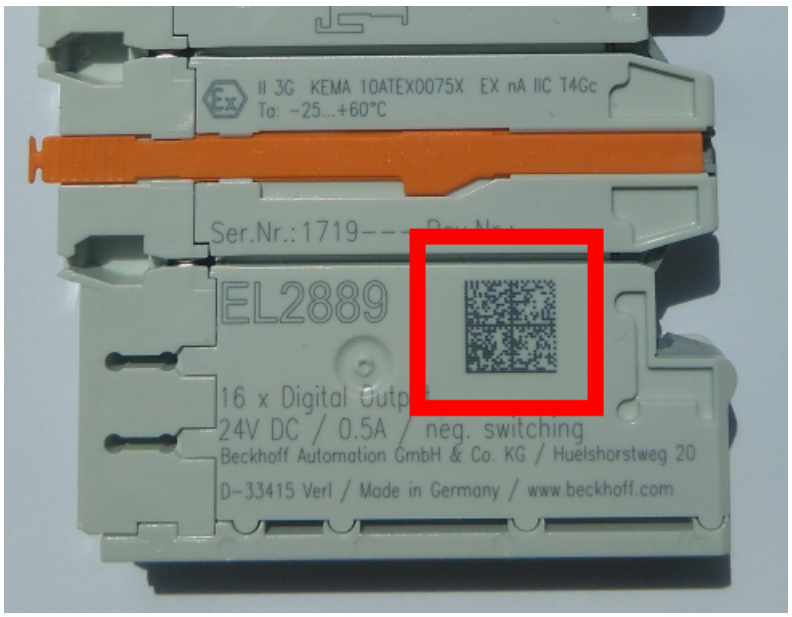


Fig. 2: BIC as data matrix code (DMC, code scheme ECC200)

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

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

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

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

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

Following information is possible, positions 1 to 4 are always present, the other according to need of production:

Position	Type of information	Explanation	Data identifier	Number of digits incl. 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: Present-day serial number system, e.g. with safety products	51S	12	**51S**678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	12	**30P**F971, 2*K183
...					

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

Structure of the BIC

Example of composite information from positions 1 to 4 and with the above given example value on position 6. The data identifiers are highlighted in bold font:

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

Accordingly as 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, position 2). The BTN is a unique serial number consisting of eight characters that will replace all other serial number systems at Beckhoff in the long term (e.g. batch designations on IO components, previous serial number range for safety products, etc.). The BTN will also be introduced step by step, so it may happen that the BTN is not yet coded in the BIC.

NOTICE

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

2.5.4 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.

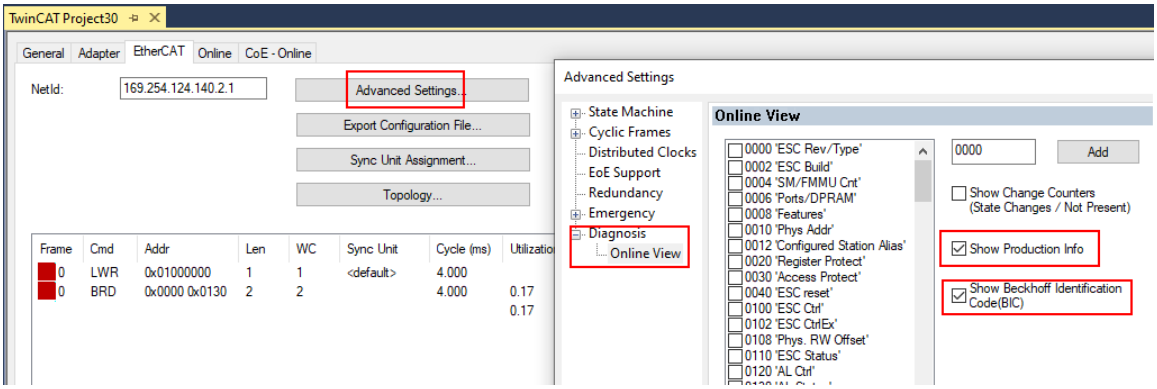
EtherCAT devices (IP20, IP67)

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.

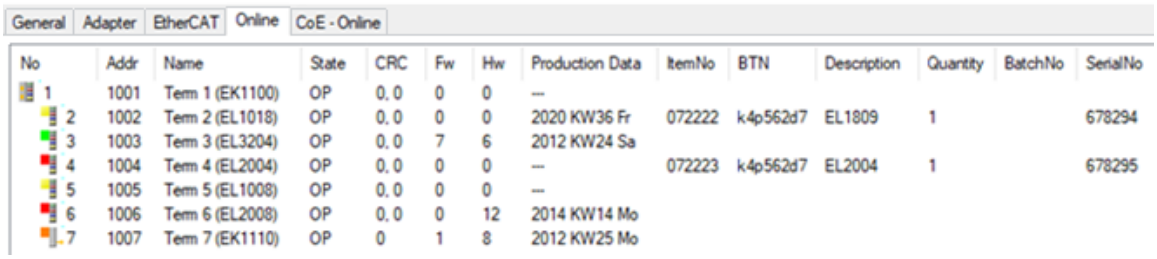
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

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

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

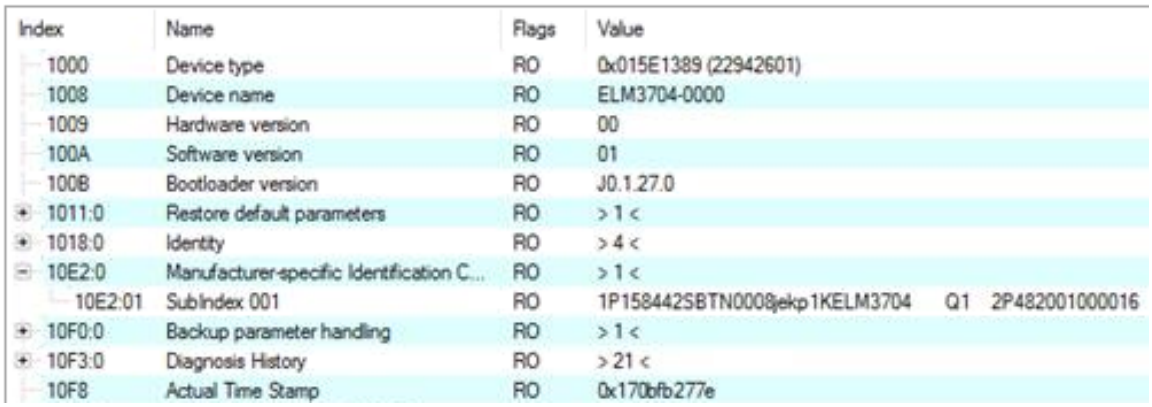


  - The BTN and its contents are then displayed:



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

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



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

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

PROFIBUS, PROFINET, and DeviceNet devices

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

3 Product description

3.1 EL3201

3.1.1 Introduction

1-channel analog input, temperature, RTD (Pt100), 16 bit

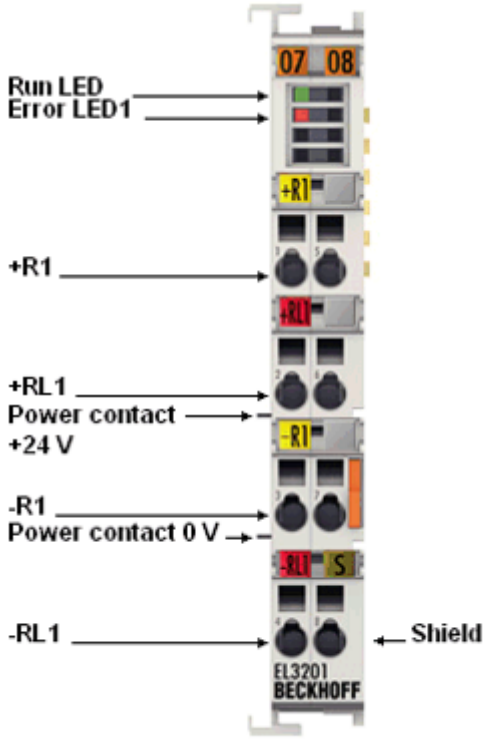


Fig. 4: EL3201

The analog input terminal EL3201 allows the direct connection of one resistance sensor.

The measured resistance value can either be output directly in ohm or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3201 can operate sensors in 3- and 4-wire technology, for 2-wire connection an external bridge is necessary.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 19]
- Pin assignment, display and diagnosis [▶ 20]
- Object description EL3201 [▶ 217]

3.1.2 Technical data

Technical data	EL3201
Number of inputs	1
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 310] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-, 3-, 4-wire
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Simultaneous
Ground reference	Single-ended
Conversion time	Approx. 4... 500 ms (configurable), depending on configuration and filter setting approx. 24 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Support NoCoEStorage [▶ 76]	Yes
Measuring error	for Pt sensors: < ±0.5°C at ambient temperature 0°C... +55°C < ±1.5°C in extended temperature range
Width in the process image	Max. 4 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA, CCC ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 91]

*) 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

3.1.3 Pin assignment, display and diagnosis

EL3201

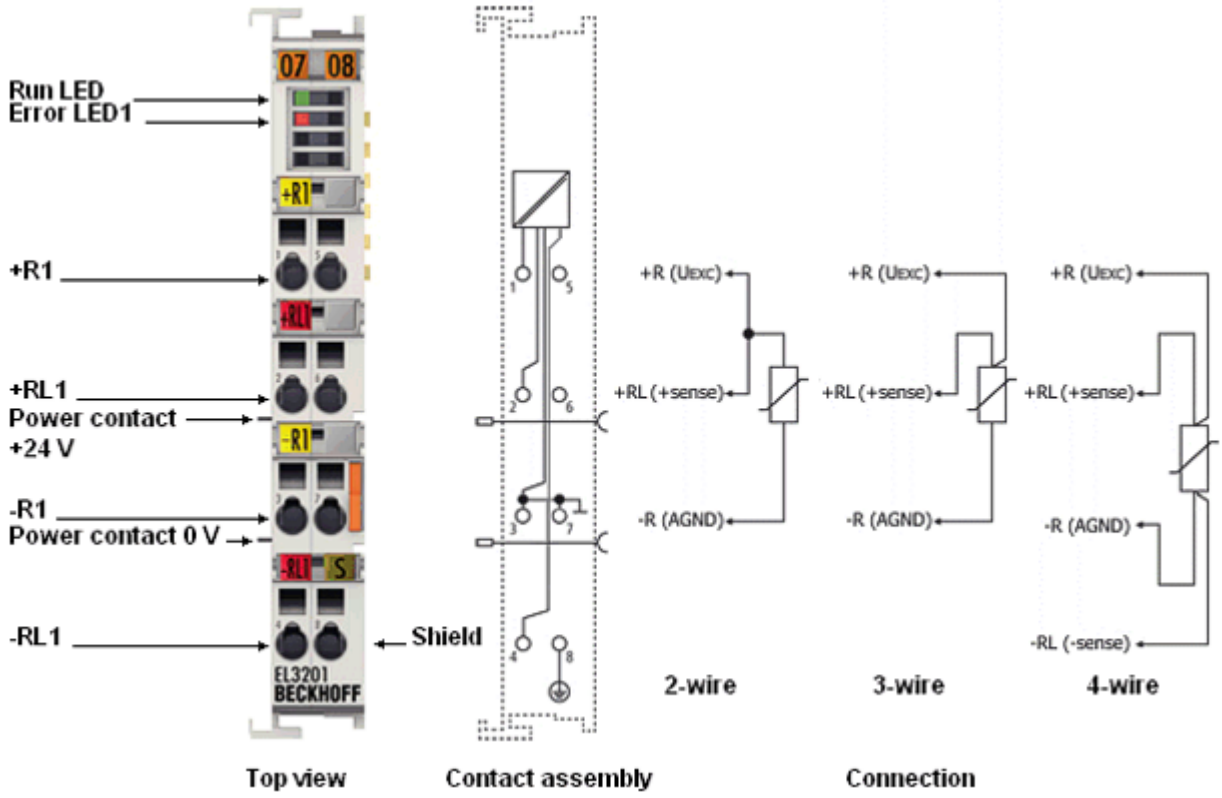


Fig. 5: EL3201 pin assignment

Two-wire connection EL3201

If the EL3201 is operated with a two-wire connection, the inputs +R and +RL must be bridged by the user.

EL3201 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
n. c.	5	not used
n. c.	6	not used
-R1	7	Input -R1, current-carrying
Shield	8	Shield

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3201 - 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 or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	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
ERROR1	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.2 EL3201-0010, EL3201-0020, EL3201-0030

3.2.1 Introduction

1-channel analog input, temperature, RTD (Pt100), 16 bit, high-precision

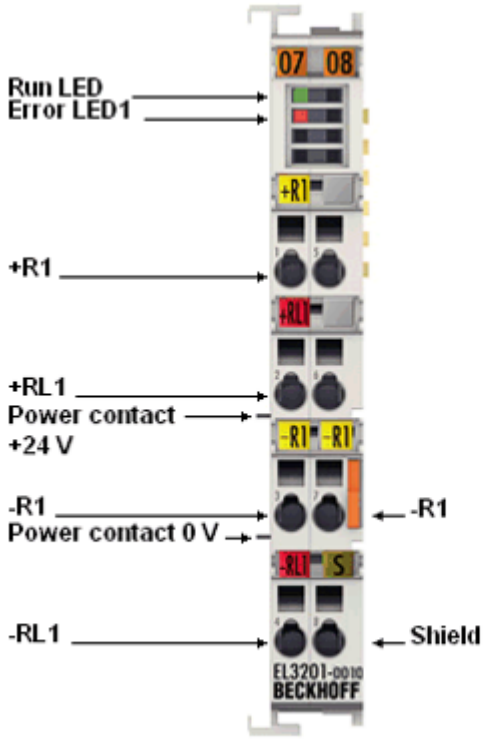


Fig. 6: EL3201-0010/0020/0030

The EL3201-0010 is the high precision version of the EL3201.

The analog input terminal EL3201-0010 allows the direct connection of a resistance sensor.

The measured resistance value can either be output directly in ohm or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3201-00x0 can currently operate sensors in 4-wire technology, external bridges must be set for 2- and 3-wire sensors. However, the intended operation for achieving the best accuracy is the 4-wire operation.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

The EL3201-0010 is also available as a calibrated version with a factory calibration certificate [▶ 67] (EL3201-0020) or optionally with a DAkkS or ISO 17025 certificate [▶ 67] (EL3201-0030) from an accredited service provider in cooperation with Beckhoff.

Also see about this

- Technical data [▶ 23]
- Pin assignment, display and diagnosis [▶ 24]
- Object description EL3201-0010, EL3201-0020, EL3201-0030 [▶ 225]

3.2.2 Technical data

Technical data	EL3201-0010	EL3201-0020/0030
Number of inputs	1	
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 310] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e. g. for potentiometer connection)	
Connection technology	4-wire	
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors) High-precision measurement only for Pt100 sensors, Measuring range -200...+320°C, see Note [▶ 200]!	
Resolution (default)	0.01°C per digit	
Sampling type	Simultaneous	
Ground reference	Single-ended	
Conversion time	Approx. 4.. 500 ms (configurable), depending on configuration and filter setting approx. 24 ms, preset	
ADC conversion method	ΔΣ (Delta-Sigma)	
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA	
Sensor supply	Continuous current (not switched)	
Measuring error	for Pt100 sensors, 4-wire connection technology, measuring range -200 to 320°C, 50 Hz filter, according to the local mains frequency (example: EU/China: 50 Hz, North America: 60 Hz): < ±0.1°C at ambient temperature of 40°C < ±0.3°C in operating temperature range < ±1.5°C (extended temperature range, EL3201-0010) Note: other sensor cases according to CoE can be used with reduced accuracy (e.g. Pt1000, 3-wire connection etc.)	
Support NoCoEStorage [▶ 76]	Yes	
Width in the process image	Max. 4 bytes input	
Power supply for the electronics	via the E-bus	
Current consumption via E-bus	typ. 190 mA	
Electrical isolation	500 V (E-bus/field voltage)	
Configuration	via TwinCAT System Manager	
Weight	Approx. 60 g	
Permissible ambient temperature range during operation	-25°C... +60°C	
Permissible ambient temperature range during storage	-40°C... +85°C	
Permissible relative air humidity	95%, no condensation	
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715	
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4	
Protection rating	IP20	
Installation position	Any	
Identification / approval*)	CE, EAC, UKCA, CCC ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 91]	

*) 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

Also see about this

- Installation instructions for enhanced mechanical load capacity [▶ 95]

3.2.3 Pin assignment, display and diagnosis

EL3201-00x0

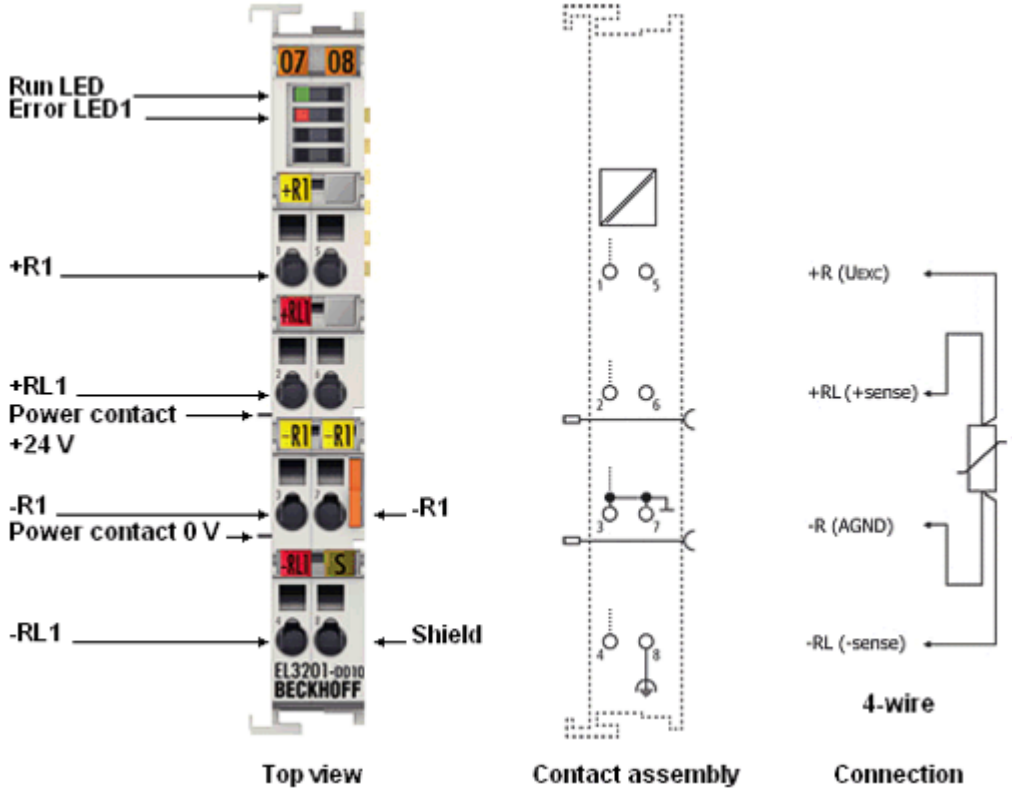


Fig. 7: EL3201-00x0 pin assignment

Four-wire connection

The EL3201-0010/0020/0030 high-precision terminals may be operated as intended only using the 4-wire connection technique!

EL3201-00x0 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
n. c.	5	not used
n. c.	6	not used
-R1	7	Input -R1, current-carrying
Shield	8	Shield

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3201-00x0 - 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 or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	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
ERROR1	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.3 EL3202

3.3.1 Introduction

2-channel analog input, temperature, RTD (Pt100), 16 bit

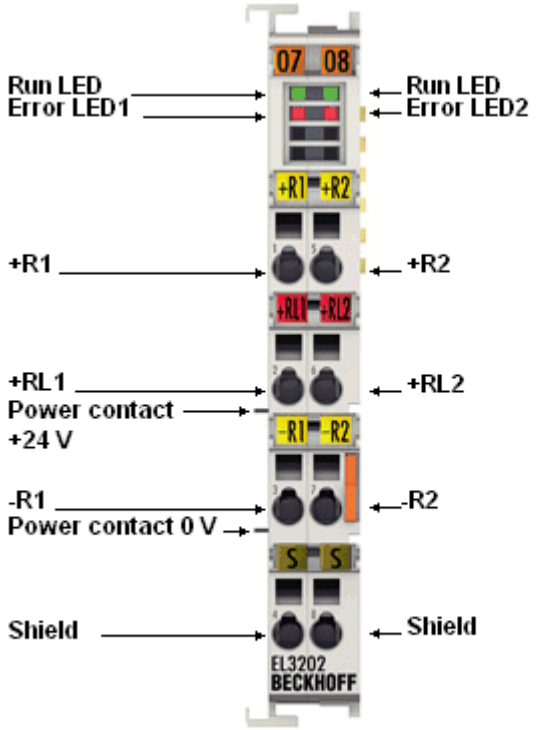


Fig. 8: EL3202

The EL3202 analog input terminal allows direct connection of two resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3202 can operate sensors in 3-wire technology, for 2-wire connection an external bridge is necessary.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 27]
- Pin assignment, display and diagnosis [▶ 28]
- Object description EL3202 [▶ 233]

3.3.2 Technical data

Technical data	EL3202
Number of inputs	2
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 310] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e. g. for potentiometer connection)
Connection technology	2-, 3-wire
Temperature range	Range-dependent: -200…+850°C (Pt sensors); -60…+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Single-ended
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	for Pt sensors: < ±0.5°C at ambient temperature 0°C... +55°C < ±1.5°C in extended temperature range
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 8 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA, CCC ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 91]

*) 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

3.3.3 Pin assignment, display and diagnosis

EL3202

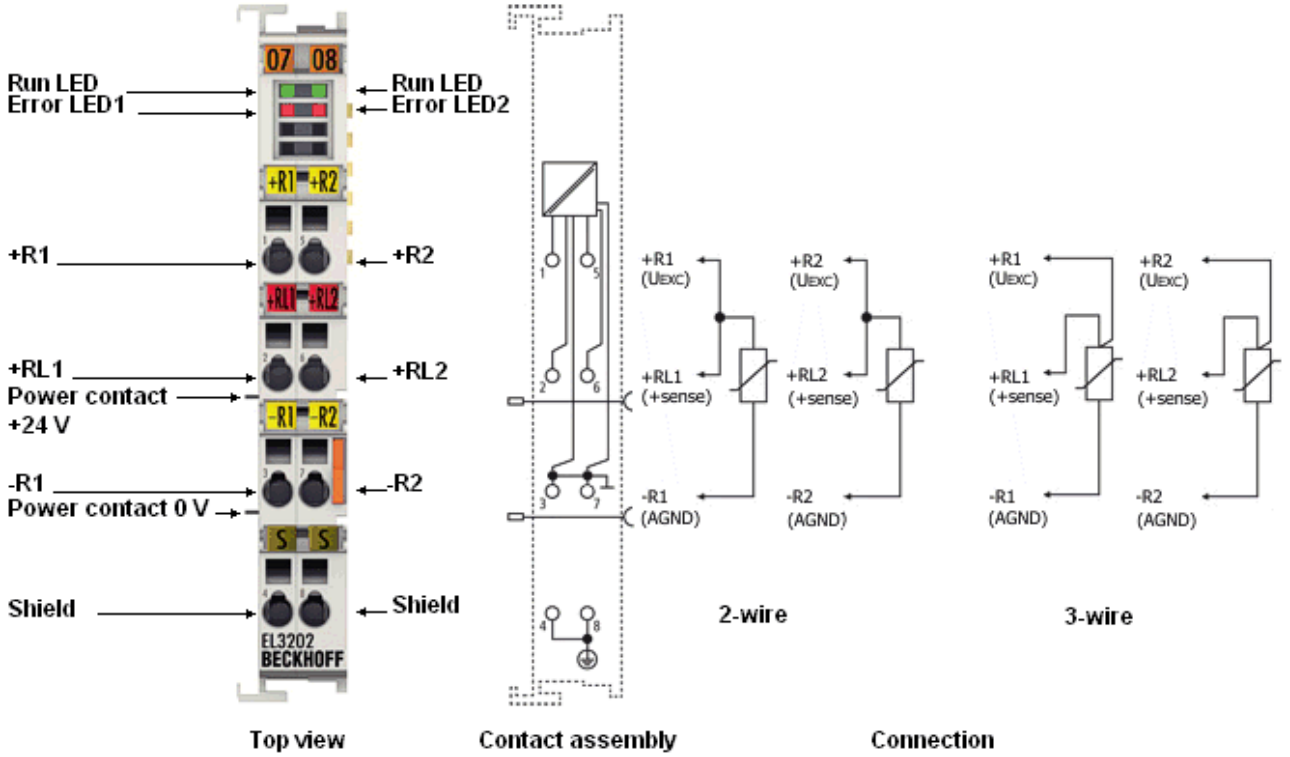


Fig. 9: EL3202 pin assignment

Two-wire connection EL3202

If the EJ3202 is operated in 2-wire connection, the +R and +RL inputs must be bridged by the user.

EL3202 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
Shield	4	Shield (internally connected to terminal point 8)
+R2	5	Input +R2, current-carrying
+RL2	6	Input +RL2, de-energized sense line
-R2	7	Input -R2, current-carrying
Shield	8	Shield (internally connected to terminal point 4)

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3202 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1, ERROR2	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve	

3.4 EL3202-0010, EL3202-0020, EL3202-0030

3.4.1 Introduction

2-channel analog input, temperature, RTD (Pt100), 16 bit, high-precision

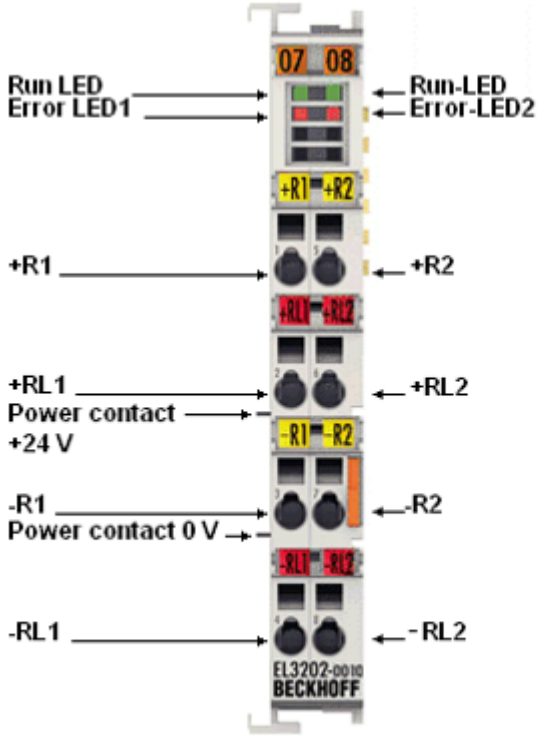


Fig. 10: EL3202-0010/0020/0030

The EL3202-0010 is the high-precision version of the EL3202.

The analog input terminal EL3202-0010 allows the direct connection of two resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be performed in the terminal according to various sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types, etc.).

The EL3202-00x0 can currently operate sensors in 4-wire technology, external bridges must be set for 2- and 3-wire sensors. However, 4-wire operation is the intended mode for achieving the best accuracy.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

The EL3202-0010 is also available as a calibrated variant with a factory calibration certificate [▶ 67] (EL3202-0020) or optionally with a DAkkS or ISO 17025 certificate [▶ 67] (EL3202-0030) from an accredited service provider in cooperation with Beckhoff.

Also see about this

- Technical data [▶ 23]
- Pin assignment, display and diagnosis [▶ 24]
- Object description EL3202-0010, EL3202-0020, EL3202-0030 [▶ 241]

3.4.2 Technical data

Technical data	EL3202-0010	EL3202-0020/0030
Number of inputs	2	
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 310] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)	
Connection technology	4-wire	
Temperature range	Range-dependent: -200...+850°C (Pt sensors) -60...+250°C (Ni sensors) High-precision measurement only for Pt100 sensors, Measuring range -200...+320°C, see Note [▶ 200]!	
Resolution (default)	0.01°C per digit	
Sampling type	Multiplex	
Ground reference	Single-ended	
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset	
ADC conversion method	ΔΣ (Delta-Sigma)	
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA	
Sensor supply	Continuous current (not switched)	
Measuring error	for Pt100 sensors, 4-wire connection technology, measuring range -200 to 320°C, 50 Hz filter, according to the local mains frequency (example: EU/China: 50 Hz, North America: 60 Hz): < ±0.1°C at ambient temperature of 40°C < ±0.3°C in operating temperature range < ±1.5°C (extended temperature range, EL3201-0010) Note: other sensor cases according to CoE can be used with reduced accuracy (e.g. Pt1000, 3-wire connection etc.)	
Support NoCoEStorage [▶ 76]	Yes	
Width in the process image	Max. 8 bytes input	
Power supply for the electronics	via the E-bus	
Current consumption via E-bus	typ. 190 mA	
Electrical isolation	500 V (E-bus/field voltage)	
Configuration	via TwinCAT System Manager	
Weight	Approx. 60 g	
Permissible ambient temperature range during operation	-25°C... +60°C	
Permissible ambient temperature range during storage	-40°C... +85°C	
Permissible relative air humidity	95%, no condensation	
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715	
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27	
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4	
Protection rating	IP20	
Installation position	Any	
Identification / approval*)	CE, EAC, UKCA, CCC ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 91]	

*) 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

3.4.3 Pin assignment, display and diagnosis

EL3202-00x0

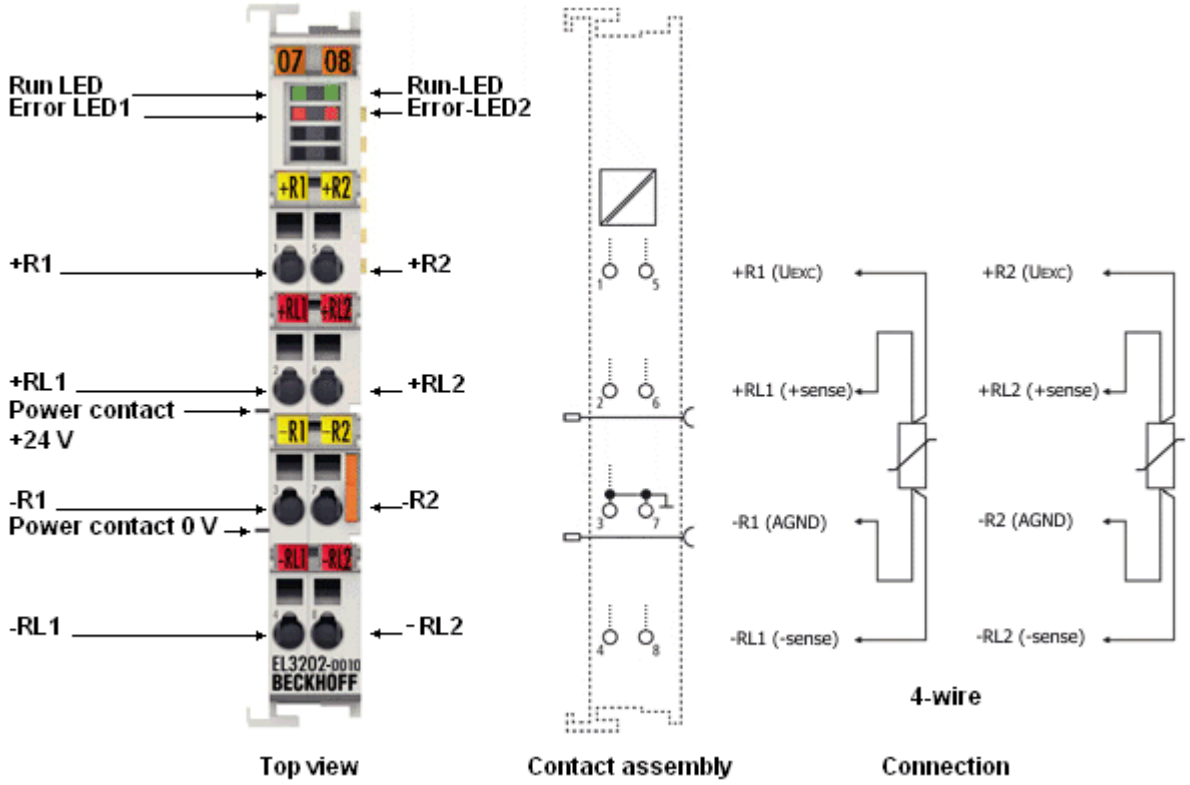


Fig. 11: EL3202-0010/0020/0030 pin assignment

Four-wire connection

The EL3202-0010/0020/0030 high-precision terminals may be operated as intended only using the 4-wire connection technique!

EL3202-00x0 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+RL1	2	Input +RL1, de-energized sense line
-R1	3	Input -R1, current-carrying
-RL1	4	Input -RL1, de-energized sense line
+R2	5	Input +R2, current-carrying
+RL2	6	Input +RL2, de-energized sense line
-R2	7	Input -R2, current-carrying
-RL2	8	Input -RL2, de-energized sense line

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3202-00x0 - 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 or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	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
ERROR1, ERROR2	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve	

3.5 EL3204

3.5.1 Introduction

4-channel analog input, temperature, RTD (Pt100), 16 bit

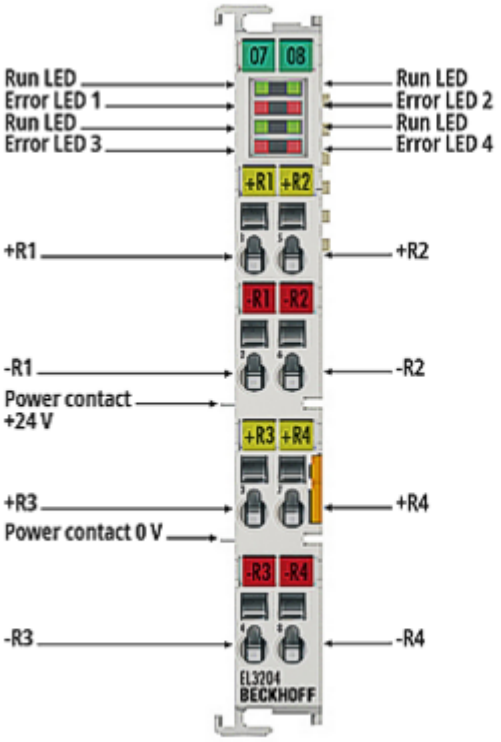


Fig. 12: EL3204

The EL3204 analog input terminal allows direct connection of four resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be performed in the terminal according to various sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types, etc.).

The EL3204 can operate sensors in 2-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 35]
- Pin assignment, display and diagnosis [▶ 36]
- Object description EL3204 [▶ 249]

3.5.2 Technical data

Technical data	EL3204
Number of inputs	4
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY from firmware 06 [▶ 310] resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-wire
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Single-ended
Conversion time	Approx. 800 ms.. 2 ms (configurable), depending on configuration and filter setting approx. 85 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.5°C for Pt sensors < ±1.5°C (extended temperature range)
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 16 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 190 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA, CCC ATEX [▶ 87], IECEx [▶ 88], cFMus [▶ 89], cULus [▶ 91]

*) 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

3.5.3 Pin assignment, display and diagnosis

EL3204

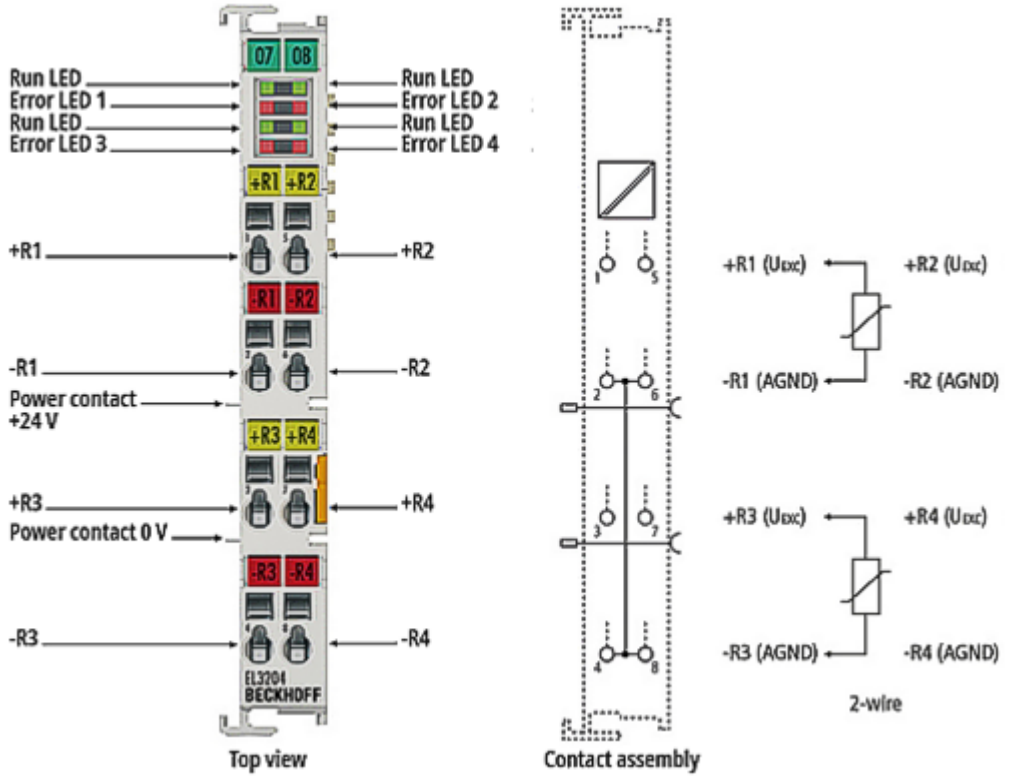


Fig. 13: EL3204 pin assignment

EL3204 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
-R1	2	Input -R1, current-carrying
+R3	3	Input +R3, current-carrying
-R3	4	Input -R3, current-carrying
+R2	5	Input +R2, current-carrying
-R2	6	Input -R2, current-carrying
+R4	7	Input +R4, current-carrying
-R4	8	Input -R4, current-carrying

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3204 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1 - 4	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve.	

3.6 EL3204-0200

3.6.1 Introduction

4-channel analog input, temperature, RTD/NTC, 16 bit

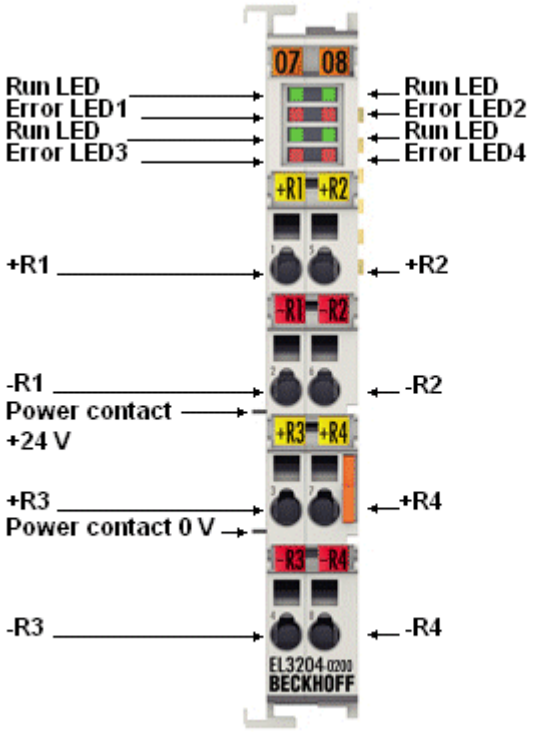


Fig. 14: EL3204-0200

The EL3204-0200 analog input terminal allows the direct connection of four resistance sensors up to 240 kΩ in the 2-wire connection, so that a significantly increased measuring range is available compared to the EL320x-0000 and thus the use of high-resistance NTC sensors is possible.

The measured resistance value can either be output directly in ohms or immediately transformed into a temperature in the terminal. In the second case, the conversion from resistance to temperature can be performed either according to selectable characteristic curves (Pt1000, Ni1000, various NTC types), conversion formulas with specific material parameters (e.g. according to IEC 60751, Steinhart-Hart equation, B parameter equation) or according to a freely programmable conversion table.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 39]
- Pin assignment, display and diagnosis [▶ 40]
- Object description EL3204-0200 [▶ 259]

3.6.2 Technical data

Technical data	EL3204-0200
Number of inputs	4
Sensor types	any RTD within the range 0 Ω...240 kΩ
Connection technology	2-wire
Temperature range	Range-dependent
Resolution (default)	Default: 0.1°C per digit for temperature measurement
Sampling type	Multiplex
Ground reference	Differential
Conversion time	Approx. 4 ms.. 500 ms (configurable), depending on configuration and filter setting approx. 24 ms, preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.03 mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.3% from measuring range end value 240 kΩ equivalent to < ±720 Ω
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 16 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 150 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C ... +60°C
Permissible ambient temperature range during storage	-40°C ... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA, CCC DNV, ATEX [▶ 87], IECEx [▶ 88], cULus [▶ 91]

*) 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

3.6.3 Pin assignment, display and diagnosis

EL3204-0200

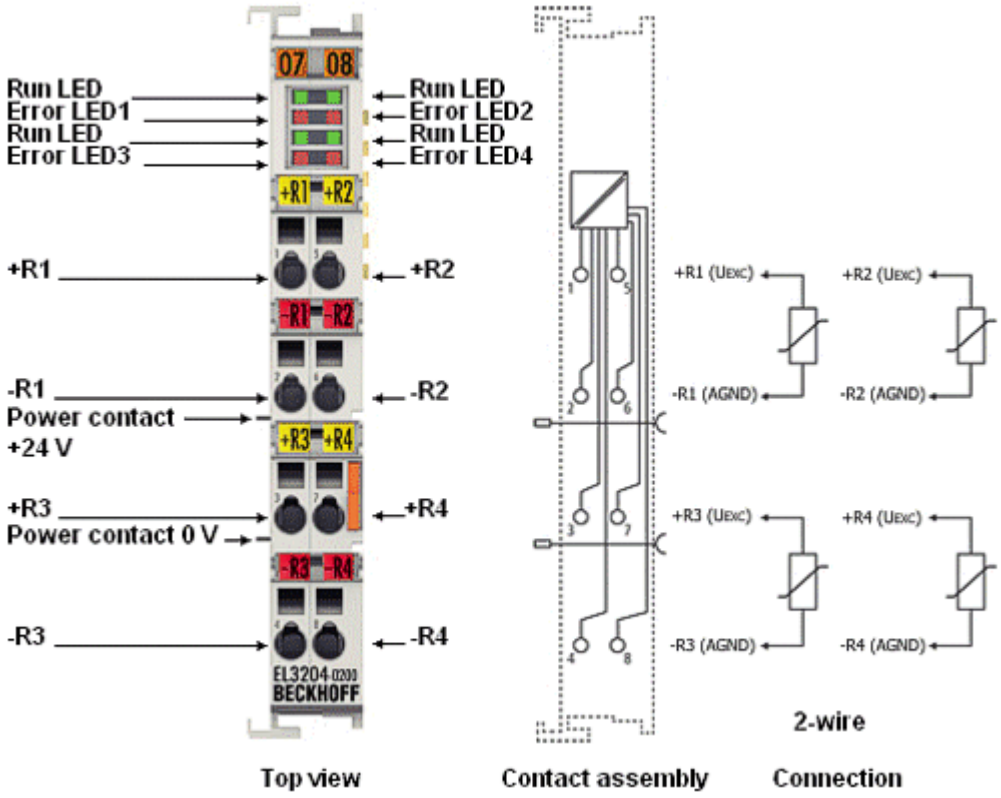


Fig. 15: EL3204-0200 pin assignment

EL3204-0200 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
-R1	2	Input -R1, current-carrying
+R3	3	Input +R3, current-carrying
-R3	4	Input -R3, current-carrying
+R2	5	Input +R2, current-carrying
-R2	6	Input -R2, current-carrying
+R4	7	Input +R4, current-carrying
-R4	8	Input -R4, current-carrying

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3204-0200 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1 - 4	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve.	

3.7 EL3208

3.7.1 Introduction

8-channel analog input, temperature, RTD (Pt100), 16 bit

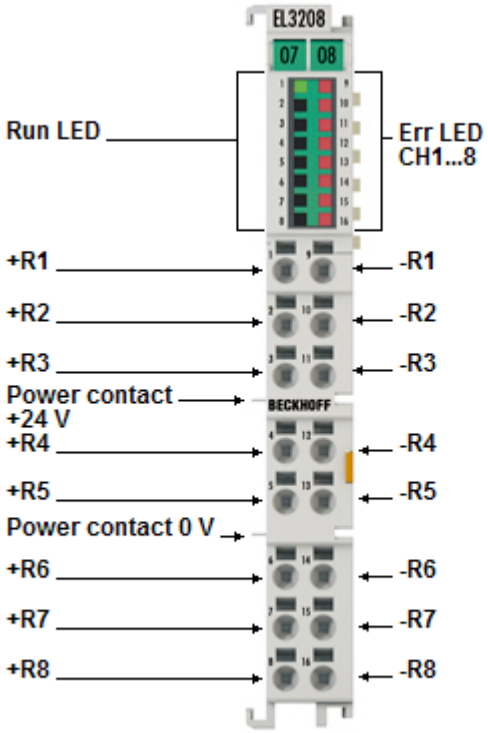


Fig. 16: EL3208

The analog input terminal EL3208 allows the direct connection of eight resistance sensors on 12 mm width (high density housing).

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3208 can operate sensors in 2-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 43]
- Pin assignment, display and diagnosis [▶ 44]
- Object description EL3208 [▶ 268]

3.7.2 Technical data

Technical data	EL3208
Number of inputs	8
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY, resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-wire
Input filter limit range	typ. 1 kHz
Measuring range	-200…+850°C (PT sensors); -60…+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Single-ended
Conversion time	Approx. 3 ms.. 1600 ms (configurable), depending on configuration and filter setting
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.5°C for Pt sensors < ±1.5°C (extended temperature range)
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 32 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 140 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA cULus [▶ 91]

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

3.7.3 Pin assignment, display and diagnosis

EL3208

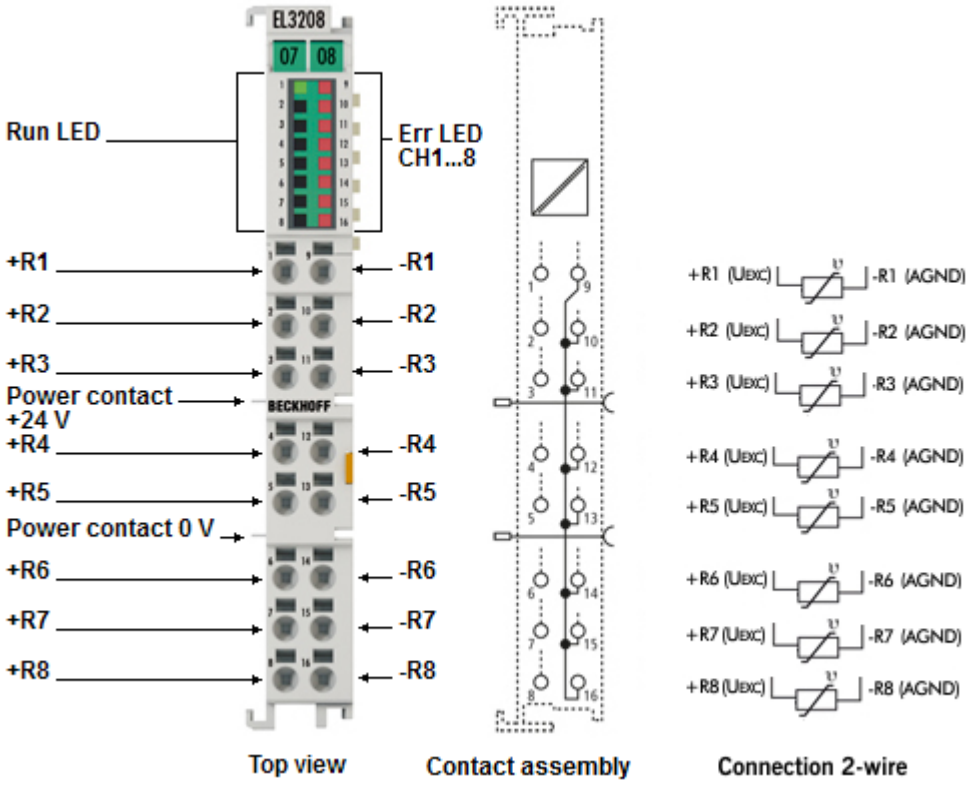


Fig. 17: EL3208 pin assignment

EL3208 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+R2	2	Input +R2, current-carrying
+R3	3	Input +R3, current-carrying
+R4	4	Input +R4, current-carrying
+R5	5	Input -R5, current-carrying
+R6	6	Input +R6, current-carrying
+R7	7	Input +R7, current-carrying
+R8	8	Input +R8, current-carrying
-R1	9	Input -R1, current-carrying
-R2	10	Input -R2, current-carrying
-R3	11	Input -R3, current-carrying
-R4	12	Input -R4, current-carrying
-R5	13	Input -R5, current-carrying
-R6	14	Input -R6, current-carrying
-R7	15	Input -R7, current-carrying
-R8	16	Input -R8, current-carrying

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3208 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1 - 8	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve.	

3.8 EL3208-0010

3.8.1 Introduction

8-channel analog input, temperature, RTD (Pt1000, NTC), 16 bit

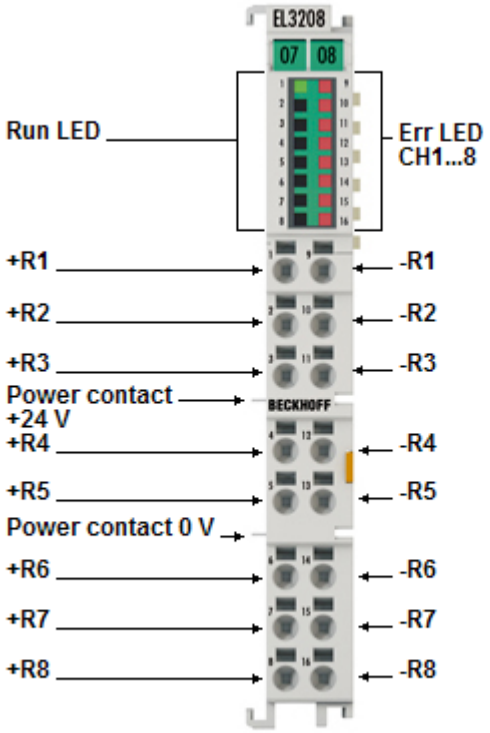


Fig. 18: EL3208-0010

The analog input terminal EL3208-0010 allows the direct connection of eight resistance sensors on 12 mm width (high density housing).

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt1000, Ni1000, NTC and others).

The EL3208-0010 can operate sensors in 2-wire technology.

The EtherCAT Terminals indicate their measuring capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 47]
- Pin assignment, display and diagnosis [▶ 48]
- Object description EL3208-0010 [▶ 275]

3.8.2 Technical data

Technical data	EL3208-0010
Number of inputs	8
Connection technology	2-wire
Sensor types	Pt1000 (default), Ni1000, NTC 1.8k / 2.2k / 3k / 5k / 10k / 20k / 100k: typ. -50...+150°C (sensor dependent) Resistance measurement (poti) 0 ... 4 / 6.5 / 65 / 655 / 1310 kΩ
Input filter limit range	typ. 1 kHz
Resolution (default)	RTD: 0.01°C for Digit R: 0.0625 / 0.1 / 1 / 10 / 20 Ω for Digit
Sampling type	multiplex
Ground reference	Single-ended
Conversion time	approx. 1 s (configurable), depending on configuration and filter setting
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	multiplex (switched in sequence)
Measuring error / uncertainty	with Pt/Ni sensors and 25°C ambient temperature: -50 ... -20°C: ±1.5°C -20 ... +60°C: ±0.25°C (corresponding to 921 ... 1232 Ω: ±0.975 Ω) +60 ... +150°C: ±1.5°C
Support NoCoEStorage [▶ 76]	yes
Width in the process image	max. 32 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 95 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	approx. 60 g
Permissible ambient temperature range during operation	-25°C ... +60°C
Permissible ambient temperature range during storage	-40°C ... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	on 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	any
Identification / approval*)	CE, EAC, UKCA cULus [▶ 91]

*) 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

3.8.3 Pin assignment, display and diagnosis

EL3208-0010

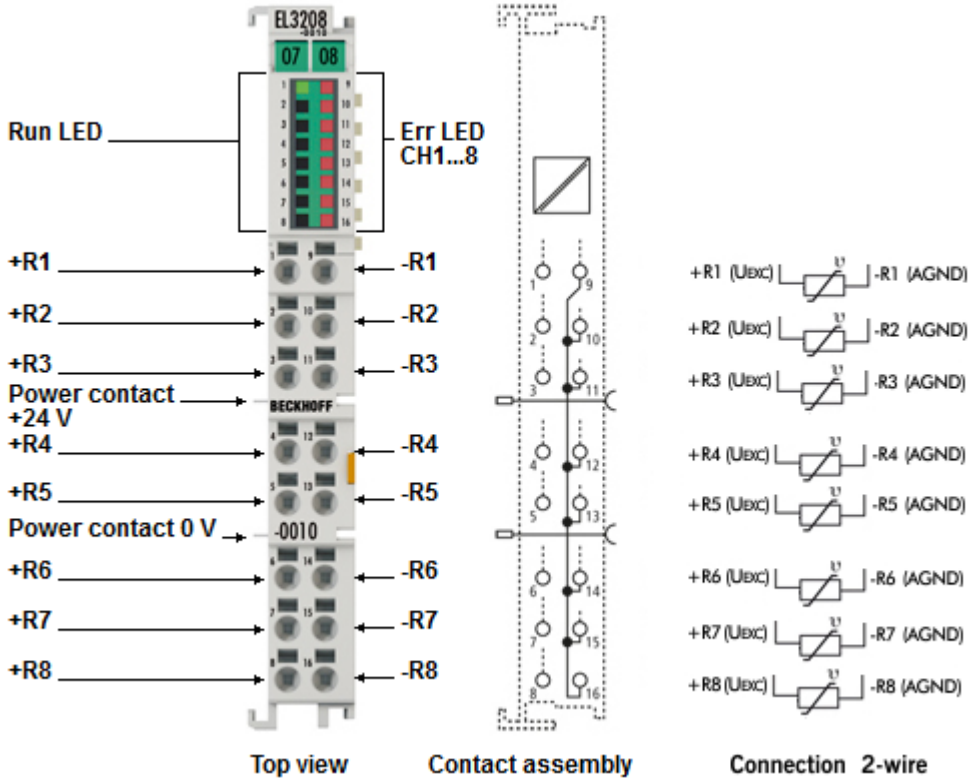


Fig. 19: EL3208-0010 pin assignment

EL3208-0010 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
+R2	2	Input +R2, current-carrying
+R3	3	Input +R3, current-carrying
+R4	4	Input +R4, current-carrying
+R5	5	Input -R5, current-carrying
+R6	6	Input +R6, current-carrying
+R7	7	Input +R7, current-carrying
+R8	8	Input +R8, current-carrying
-R1	9	Input -R1, current-carrying
-R2	10	Input -R2, current-carrying
-R3	11	Input -R3, current-carrying
-R4	12	Input -R4, current-carrying
-R5	13	Input -R5, current-carrying
-R6	14	Input -R6, current-carrying
-R7	15	Input -R7, current-carrying
-R8	16	Input -R8, current-carrying

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3208-0010 - 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 or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	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
ERROR1 - 8	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve.	

3.9 EL3214

3.9.1 Introduction

4-channel analog input, temperature, RTD (Pt100), 16 bit, 3-wire connection

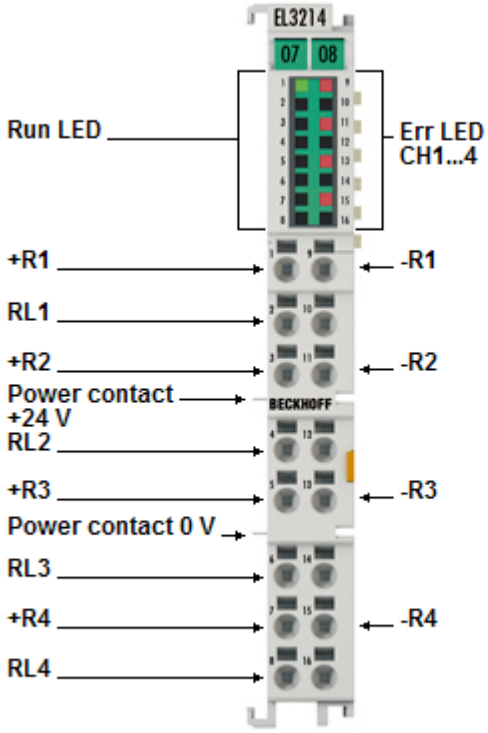


Fig. 20: EL3214

The analog input terminal EL3214 allows the direct connection of four resistance sensors in 3-wire technology on 12 mm width (high density housing).

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3214 can operate sensors in 2- and 3-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 51]
- Pin assignment, display and diagnosis [▶ 52]
- Object description EL3214 [▶ 284]

3.9.2 Technical data

Technical data	EL3214
Number of inputs	4
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY, resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	3-wire
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Differential
Conversion time	Approx. 5 ms .. 1600 ms (configurable), depending on configuration and filter setting
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Measuring error	< ±0.5°C for Pt sensors, 4 x 3-wire connection < ±1.5°C (extended temperature range)
Support NoCoEStorage [▶ 76]	Yes
Width in the process image	Max. 16 bytes input
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 140 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA DNV, cULus [▶ 91]

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

3.9.3 Pin assignment, display and diagnosis

EL3214

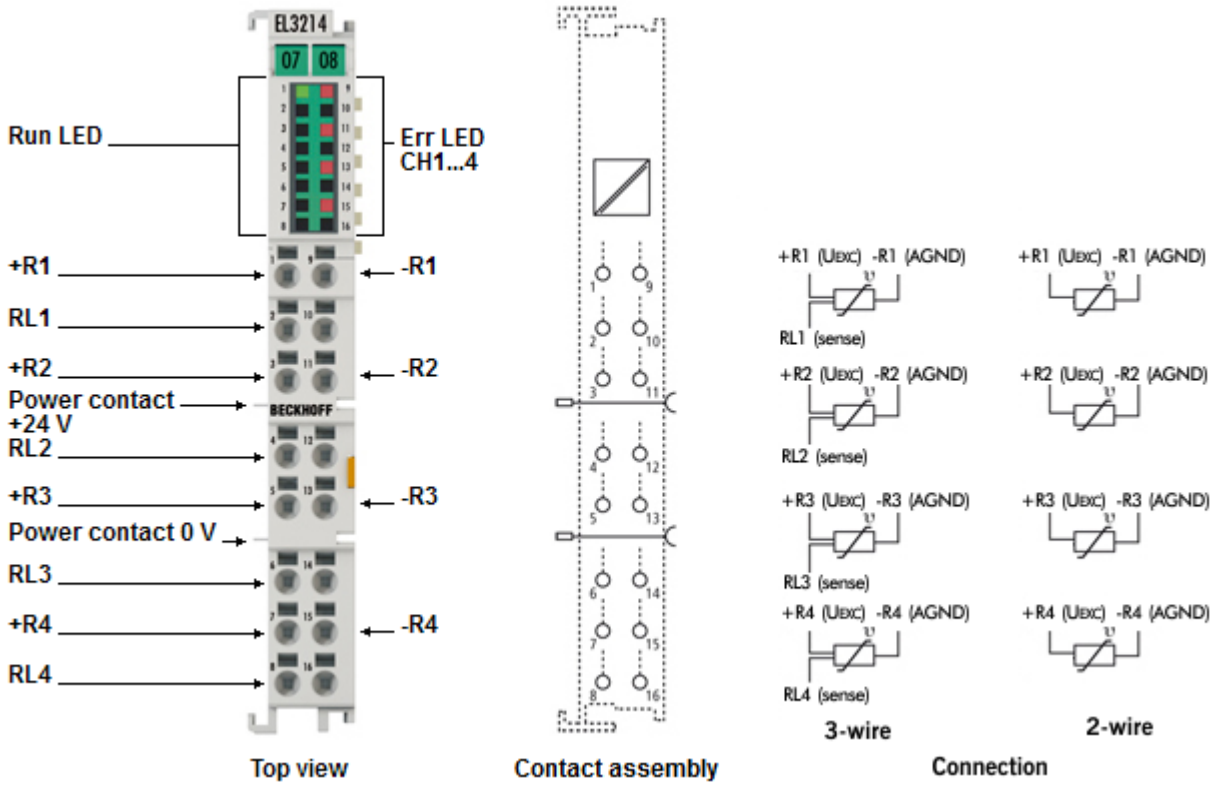


Fig. 21: EL3214 pin assignment

EL3214 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
RL1	2	Input RL1, de-energized sense line
+R2	3	Input +R2, current-carrying
RL2	4	Input RL2, de-energized sense line
+R3	5	Input +R3, current-carrying
RL3	6	Input RL3, de-energized sense line
+R4	7	Input +R4, current-carrying
RL4	8	Input RL4, de-energized sense line
-R1	9	Input -R1, current-carrying
n. c.	10	not used
-R2	11	Input -R2, current-carrying
n. c.	12	not used
-R3	13	Input -R3, current-carrying
n. c.	14	not used
-R4	15	Input -R4, current-carrying
n. c.	16	not used

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3214 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1 - 4	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve.	

3.10 EL3214-0090

3.10.1 Introduction

4-channel analog input, temperature, RTD (Pt100), 16 bit, 3-wire connection, TwinSAFE SC

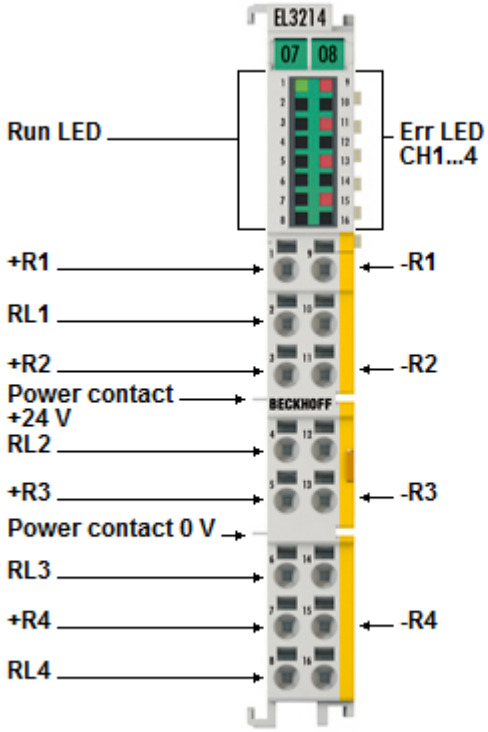


Fig. 22: EL3214-0090

The EL3214-0090 is the TwinSAFE-SC [▶ 211] version of the EL3214.

The EL3214-0090 analog input terminal allows direct connection of four resistance sensors.

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3214-0090 can operate sensors in 2- and 3-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

The EL3214-0090 supports TwinSAFE single channel technology. With the aid of the TwinSAFE SC technology (TwinSAFE Single Channel) it is possible to make use of standard signals for safety tasks in any network or fieldbus. To do this, EtherCAT I/Os from the areas of analog input, position measurement or communication (4…20 mA, incremental encoder, IO-Link, etc.) are extended by the TwinSAFE SC function. The properties typical for the signals and the standard functions of the I/O components are retained. TwinSAFE SC I/Os differ optically from standard I/Os by a yellow stripe on the front of the housing.

The TwinSAFE SC technology enables communication via a TwinSAFE protocol. These connections can be distinguished from the usual secure communication via Safety over EtherCAT.

The data from the TwinSAFE SC components is fed via a TwinSAFE protocol to the TwinSAFE Logic, where it can be used in the context of safety-relevant applications. Detailed examples confirmed/calculated by the TÜV SÜD for the correct application of the TwinSAFE SC components and the respective normative classifications can be found in the TwinSAFE application manual.

Also see about this

- Technical data [▶ 55]
- Pin assignment, display and diagnosis [▶ 56]
- Object description EL3214-0090 [▶ 292]

3.10.2 Technical data

Technical data	EL3214-0090
Number of inputs	4
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000 KT/KTY, resistance measurement 10 Ω...1 kΩ or 10 Ω...4 kΩ (e.g. for potentiometer connection)
Connection technology	2-wire (from firmware 02), 3-wire
Input filter cut-off frequency	typ. 1 kHz
Temperature range	Range-dependent: -200...+850°C (Pt sensors); -60...+250°C (Ni sensors)
Resolution (default)	0.1°C per digit
Sampling type	Multiplex
Ground reference	Differential
Conversion time	Approx. 170 ms (preset)
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current (depending on the sensor element and temperature)	typ. < 0.5 mA
Sensor supply	Continuous current (not switched)
Support NoCoEStorage [▶ 76]	Yes
Measuring error	< ±0.5°C for Pt sensors, 4 x 3-wire connection < ±1.5°C (extended temperature range)
MTBF (55°C)	> 890,000 h
Power supply for the electronics	via the E-bus
Current consumption via E-bus	typ. 140 mA
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 60 g
Permissible ambient temperature range during operation	-25°C... +60°C
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Identification / approval*)	CE, EAC, UKCA cULus [▶ 91]

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

3.10.3 Pin assignment, display and diagnosis

EL3214-0090

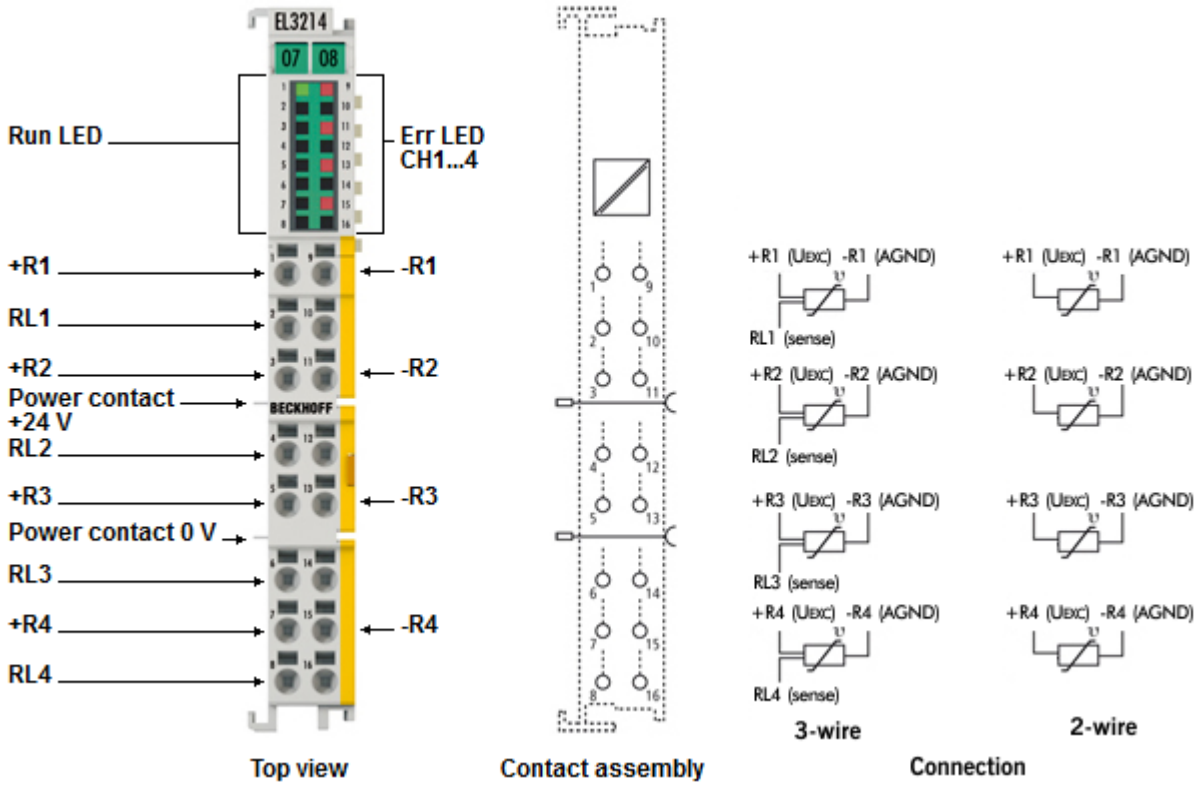


Fig. 23: EL3214-0090 pin assignment

EL3214-0090 – pin assignment

Terminal point	No.	Comment
+R1	1	Input +R1, current-carrying
RL1	2	Input RL1, de-energized sense line
+R2	3	Input +R2, current-carrying
RL2	4	Input RL2, de-energized sense line
+R3	5	Input +R3, current-carrying
RL3	6	Input RL3, de-energized sense line
+R4	7	Input +R4, current-carrying
RL4	8	Input RL4, de-energized sense line
-R1	9	Input -R1, current-carrying
n. c.	10	not used
-R2	11	Input -R2, current-carrying
n. c.	12	not used
-R3	13	Input -R3, current-carrying
n. c.	14	not used
-R4	15	Input -R4, current-carrying
n. c.	16	not used

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3214-0090 - 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 or **BOOTSTRAP** = function for firmware updates of the terminal
		flashing	State of the EtherCAT state machine: **PREOP** = function for mailbox communication and different standard-settings set
		Single flash	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
ERROR1 - 4	red	Short circuit or wire breakage. The resistance is in the invalid range of the characteristic curve.	

3.11 EL3218

3.11.1 Introduction

8-channel analog input, temperature, RTD (Pt100), 16 bit, 3-wire connection

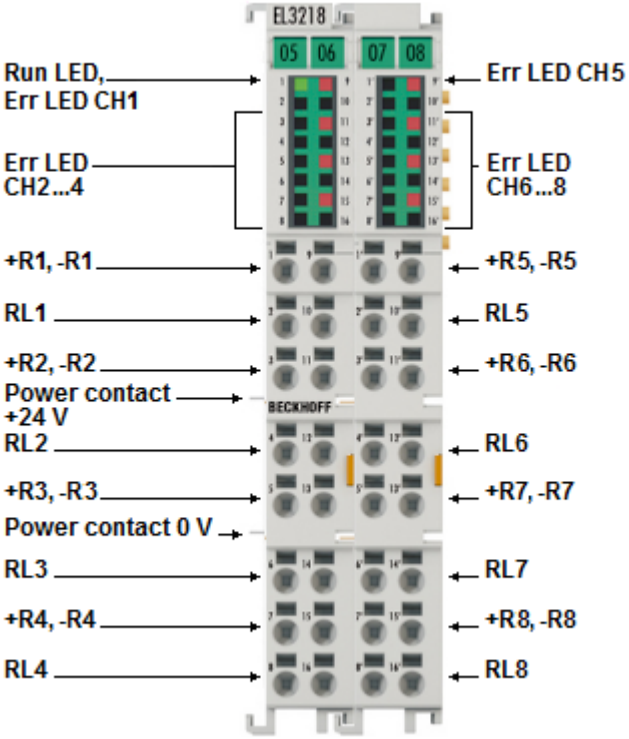


Fig. 24: EL3218

The analog input terminal EL3218 allows the direct connection of eight resistance sensors in 3-wire technology on 24 mm width (high density housing).

The measured resistance value can either be output directly in ohms or transformed into a temperature. If the temperature at the measuring point is of interest, the conversion from resistance to temperature can be done in the terminal according to different sensor characteristics (Pt100, Pt1000, Ni120, Ni1000, KTY types and others).

The EL3218 can operate sensors in 2- and 3-wire technology.

The EtherCAT Terminals indicate their measurement capability via LEDs and status bits in the EtherCAT process image.

Also see about this

- Technical data [▶ 59]
- Pin assignment, display and diagnosis [▶ 60]
- Object description EL3218 [▶ 301]

3.11.2 Technical data

Technical data	EL3218
Number of inputs	8
Connection technology	2 or 3-wire (adjustable)
Distributed clocks	-
Input filter cut-off frequency	typ. 1 kHz
Sensor types	Pt100, Pt200, Pt500, Pt1000, Ni100, Ni120, Ni1000, resistance measurement (e. g. potentiometer connection, 10 Ω...1/4 kΩ), KTY sensors (types see documentation)
Measuring range/ temperature range	-200…+850°C (PT sensors); -60…+250°C (Ni sensors)
Resolution	0.1°C or 0.01°C per digit
Sampling type	Multiplex
Ground reference	Differential
Conversion time	Approx. 170 ms preset
ADC conversion method	ΔΣ (Delta-Sigma)
Measuring current	< 0.5 mA (load-dependent)
Sensor supply	Continuous current (not switched)
Support NoCoEStorage [▶ 76]	Yes
Measuring error	< ±0.5°C with Pt sensors, 8 x 3-wire connection < ±1.5°C (extended temperature range)
Width in the process image	max. 32 bytes input
Power supply for the electronics	via the E-bus
Current consumption Power contacts	-
Current consumption via E-bus	typ. 120 mA
Special features	Integrated digital filter, limit value monitoring, variable connection technology
Electrical isolation	500 V (E-bus/field voltage)
Configuration	via TwinCAT System Manager
Weight	Approx. 95 g
Permissible ambient temperature range during operation	-25°C ... +60°C
Permissible ambient temperature range during storage	-40°C ... +85°C
Permissible relative air humidity	95%, no condensation
Dimensions (W x H x D)	Approx. 30 mm x 100 mm x 70 mm (width aligned: 24 mm)
Assembly [▶ 92]	On 35 mm mounting rail in compliance with EN 60715
Enhanced mechanical load capacity	Yes, see also Installation instructions for terminals with enhanced mechanical load capacity [▶ 95]
Vibration / shock resistance	In accordance with EN 60068-2-6 / EN 60068-2-27
EMC immunity / emission	In accordance with EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Installation position	Any
Marking/Approval*)	CE, EAC, UKCA cULus [▶ 91]

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

3.11.3 Pin assignment, display and diagnosis

EL3218

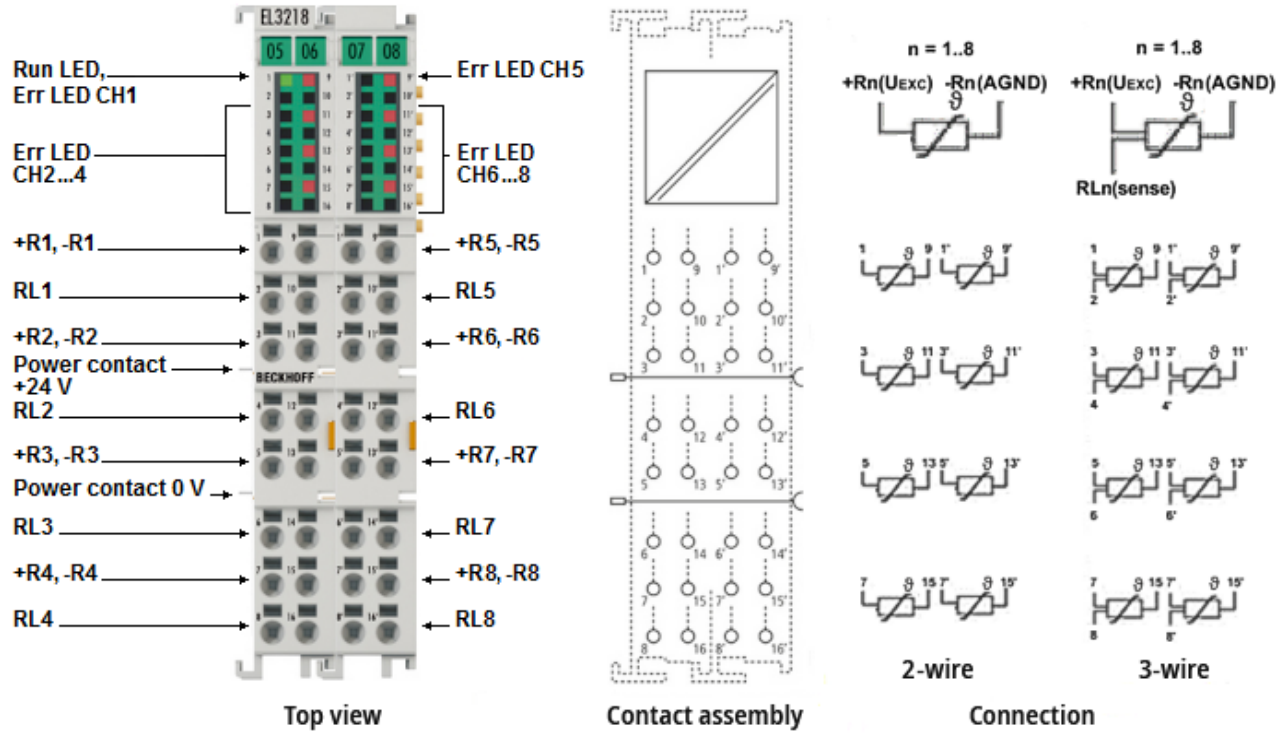


Fig. 25: EL3218 pin assignment

EL3218 – pin assignment

Terminal points 1 – 16 (left side)			Terminal points 1' – 16' (right side)		
Terminal point	**No.**	**Comment**	**Terminal point**	**No.**	**Comment**
+R1	1	Input +R1, current-carrying	+R5	1‘	Input -R5, current-carrying
RL1	2	Input RL1, de-energized sense line	RL5	2‘	Input RL5, de-energized sense line
+R2	3	Input +R2, current-carrying	+R6	3‘	Input +R6, current-carrying
RL2	4	Input RL2, de-energized sense line	RL6	4‘	Input RL6, de-energized sense line
+R3	5	Input +R3, current-carrying	+R7	5‘	Input +R7, current-carrying
RL3	6	Input RL3, de-energized sense line	RL7	6‘	Input RL7, de-energized sense line
+R4	7	Input +R4, current-carrying	+R8	7‘	Input +R8, current-carrying
RL4	8	Input RL4, de-energized sense line	RL8	8‘	Input RL8, de-energized sense line
-R1	9	Input -R1, current-carrying	-R5	9‘	Input -R5, current-carrying
n. c.	10	not used	n. c.	10‘	not used
-R2	11	Input -R2, current-carrying	-R6	11‘	Input -R6, current-carrying
n. c.	12	not used	n. c.	12‘	not used
-R3	13	Input -R3, current-carrying	-R7	13‘	Input -R7, current-carrying
n. c.	14	not used	n. c.	14‘	not used
-R4	15	Input -R4, current-carrying	-R8	15‘	Input -R8, current-carrying
n. c.	16	not used	n. c.	16‘	not used

NOTICE

Increased measurement uncertainty with signal bundling of the AGND line

In this terminal, the AGND contacts (signal return line -R) are connected in the terminal.
If the connection lines are to be reduced on the system side, one line instead of n lines can be used for all n RTD sensors at this terminal.
However, since each channel individually permanently drives its measuring current (some 100 µA, see explanations chapter "RTD measurement in EL32xx [▶ 62]"), all n RTD currents then flow via one line, there is an n-fold increase in voltage drop there, which is also recorded by the ratiometric voltage measurement in the terminal.
The result is the same as for long lines. If RTD sensors are to be connected in this way, a system-side check and, if necessary, compensation using WireCalibration CoE 0x80n0:1B (convert voltage drop to apparent line resistance for this purpose) or UserScale 0x80n0:11/12 is recommended.
Since the line resistances are temperature-dependent and the measuring current depends on the RTD resistance, however, such a static "compensation" cannot achieve the measurement uncertainty as in operation with two lines connected short.

Connection of analog RTD signal lines

To ensure that the analog signals can be measured with as little interference as possible, also observe the notes in the chapter "Connection of analog RTD signal lines [▶ 64]".

EL3218 – 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 or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = 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
ERROR1 - 8	red	Short circuit or wire break. The resistance value is in the invalid range of the characteristic curve.	

3.12 RTD measurement in EL32xx

NOTICE

Further documentation for I/O components with analog in and outputs

Also pay attention to the further documentation:

I/O Analog Manual
Notes on I/O components with analog inputs and outputs,

which is available in the Beckhoff Information-System and for download on the Beckhoff website www.beckhoff.com on the respective product pages!

The content includes the basics of sensor technology and information on analog measured values.

The EL32xx-xxxx series analog input terminals offer the option to take a resistance measurement, as well as the evaluation of a resistance sensor by computational transformation R→T. Common characteristic curves are implemented in the terminal for directly converting the resistance value into a temperature (see IO Analog Manual chapter Overview of implemented RTD transformations). In addition, resolutions, output formats and scaling can be adjusted depending on the device.

The analog input terminals of the EL32xx-xxxx series measure the connected resistance directly ratiometrically by voltage comparison and convert this into a temperature if required. This is performed as shown in the diagram in the following figure:

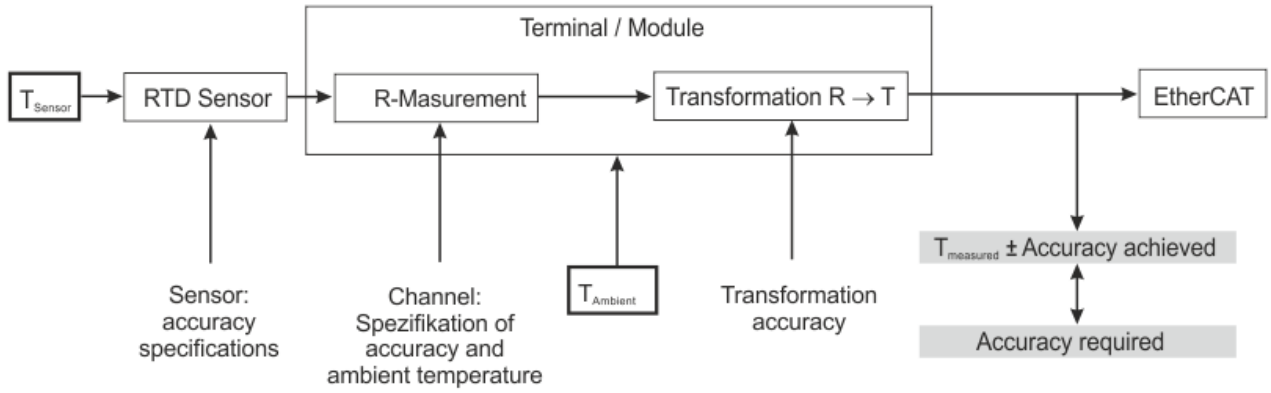


Fig. 26: Representation of the measurement of the resistance and calculation of the temperature

R measurement

The measurement is performed ratiometrically:

A constant voltage of 2.5 V is fed through a known reference resistor $R_{reference}$ and through the sensor R_{sensor}. The size of the reference resistor is 5 kΩ (except EL3024-0200: $R_{reference}$ = 120 kΩ).

By voltage comparison of $U_{R, Reference}$ and $U_{R, Sensor}$, the sensor resistance R_{sensor} can be determined.

The measuring current at the sensor is thus dependent on the sensor resistance R_{sensor}, which must be taken into account when considering any sensor self-heating.

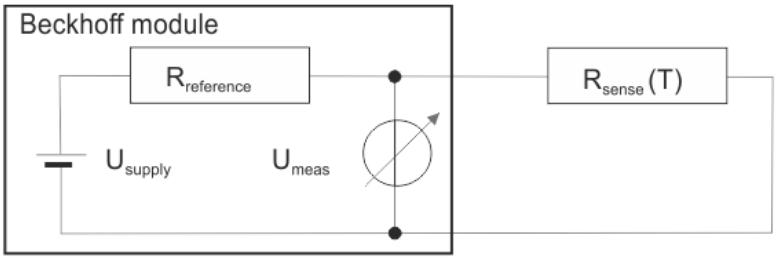


Fig. 27: Circuit diagram for direct resistance measurement

Terminal families

- **EL320x:**
  - Terminals switchable for operation in 2/3/4-wire technology (depending on version)
- **EL321x:**
  - Terminals preferred for operation in 3-wire technology
  - Operation in 2-wire technology is possible depending on the version (see information in the technical data), but is not recommended due to the lower measuring accuracy (see IO Analog Manual, chapter Connection techniques and supply line resistance compensation).

Additional notes

- Special characteristic curves that are not included in the CoE transformations, e. g. Pt375, can be acquired via the freely parameterizable EL3204-0200
- Due to the measuring principle, an RTD sensor may not be connected in parallel to several input channels.
- To improve measuring accuracy, the empirically determined supply line resistance in the CoE can be made known to the firmware in two-wire mode.
- Connection of resistance sensors
  - EL32xx: in the range 0... 4096 Ω
  - EL3204-0200: up to 240 kΩ
  - EL3692: 0...10 Ω
    The EL3692 is recommended for measurements in the range 0...10 Ω, since the measuring range of 1 or 4 kΩ is only poorly utilized with the EL32xx terminals and the measurement uncertainty (specified in $\%_{FSV}$) becomes relatively high
- Additional transition resistances are to be expected with the ES32xx connector variants. In case of doubt, the EL32xx variant is preferable.
- Resolution
  - Default setting: temperature measurement in 1 digit = 0.1°C
  - Increased resolution: 1 digit = 0.01°C
    The resolution is increased purely computationally in the firmware, the ADC resolution does not increase. Measured value jumps of > 0.01°C are to be expected.
  - For resistance measurement
    - 1/64 Ω (0 Ω... 1024 Ω)
    - 1/16 Ω (0 Ω... 4096 Ω)

Notes on connection in two-wire operation and on characteristic curves of KT/KTY sensors

Terminals	For operation with two-wire technology	Characteristic curves for KT/KTY sensors
EL3201-xxxx	the +R and +RL inputs must be bridged by the user.	are implemented from firmware 06 and can be selected via the CoE directory.
EL3202-xxxx		
EL3204	-	
EL3214	the +R and +RL inputs must be bridged by the user.	-
EL3218	the sensor must be connected between +R and -R without an external bridge to RL.	-

3.13 Connection of analog RTD signal lines

The RTD input terminals of the EL32xx series measure the analog resistance of the sensor. The voltage drop at the sensor (including the line resistances, depending on the connection technology) is equivalent to the sensor resistance and therefore a measure for the sensor temperature, if the characteristic sensor curve is known. The following procedure serves for connecting analog signal cables in order to ensure error-free measurement of the analog signals.

Measures

- Sensor cable to be used
  - Tightly twisted
  - Shielded copper braid
  - Use low-impedance cable, particularly for 2-wire connection
- Keep the sensor and sensor cables free from external potential.
  On no account should the GND connections (3/7 for EL3201, EL3202) be connected with other potentials.
- The resistor for the RTD sensor (e.g. 100 or 1000 Ω nominal) should be chosen based on the ratio between sensor resistance and line resistance, taking account of the connection type (2/3/4-wire).

Shielding measures

Shielding measures

Due to the complexity in the "EMC" area, there is no generally applicable guideline, but only technical measures in accordance with the state of the art, which can sometimes contradict each other. These must be checked for feasibility and effectiveness, taking into account the plant specifications, and applied by the plant installer following assessment.
The following notes on shielding are to be understood as technical suggestions that have proven themselves from time to time in practical use.

- It must be checked in each case which measures can be applied, depending on the installation and plant.
- The effectiveness of each measure must be checked individually. The formal transferability of measures to other types of plant is in general not possible.
- Priority is to be given to typical national or general normative specifications.

A shielding approach is described below that in many cases improves the measurement quality. The suggested measures must be checked for feasibility and effectiveness in the actual plant.

- Apply the shield with a low resistance and enveloping the cable by 360°
- at the entry point into the control cabinet, the shield should be earthed conductively
- the shield should be earthed again at the terminal
  - at the terminal connection point, if present
  - if no terminal connection point is available, earth the shield as close to the terminal as possible.
  - to avoid ground loops the shield can be undone after entry into the control cabinet.
    A capacitive connection to the terminal shield contact is possible.
  - avoid unshielded cable lengths of > 50 cm!

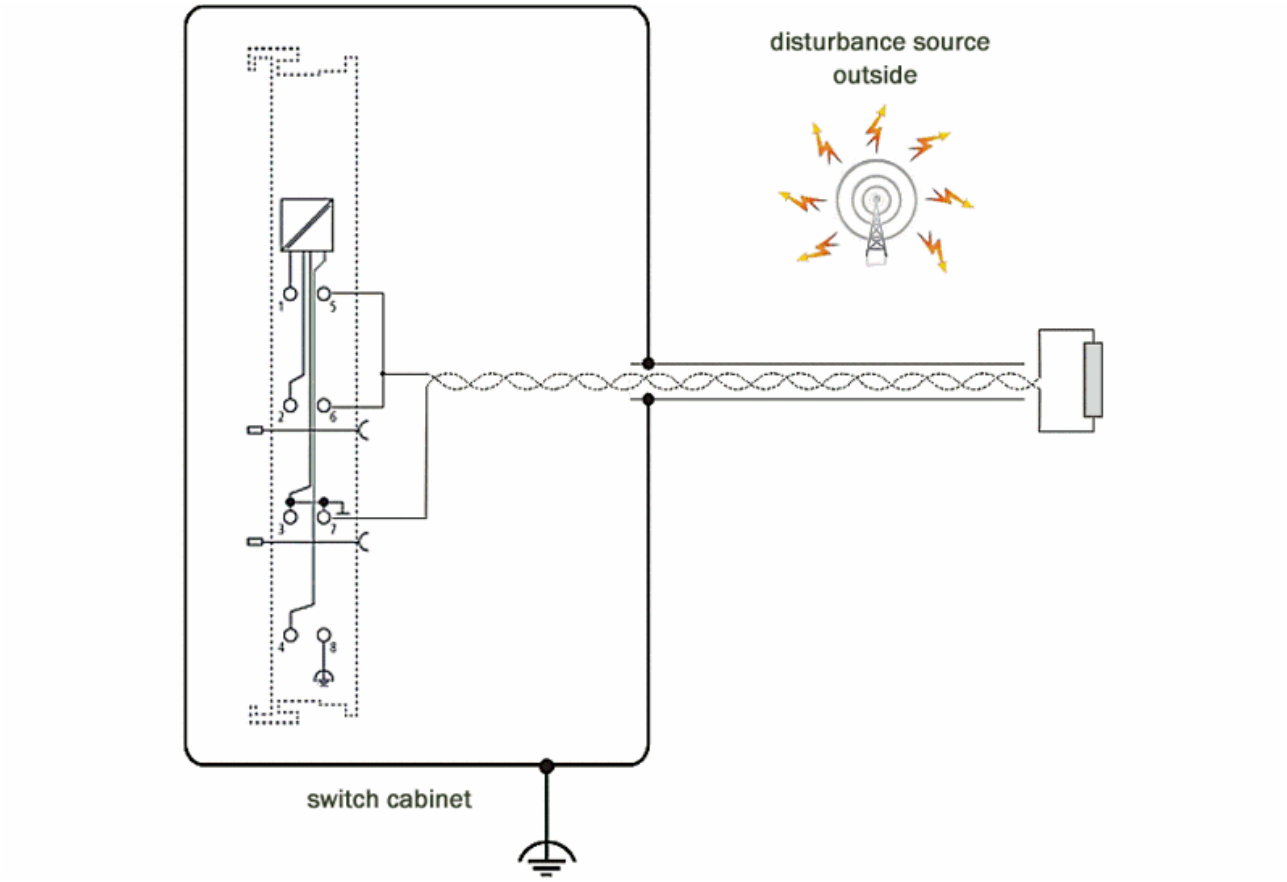


Fig. 28: Example of EL3202 shield connection with shield contact, in the case of potential interference sources inside the control cabinet

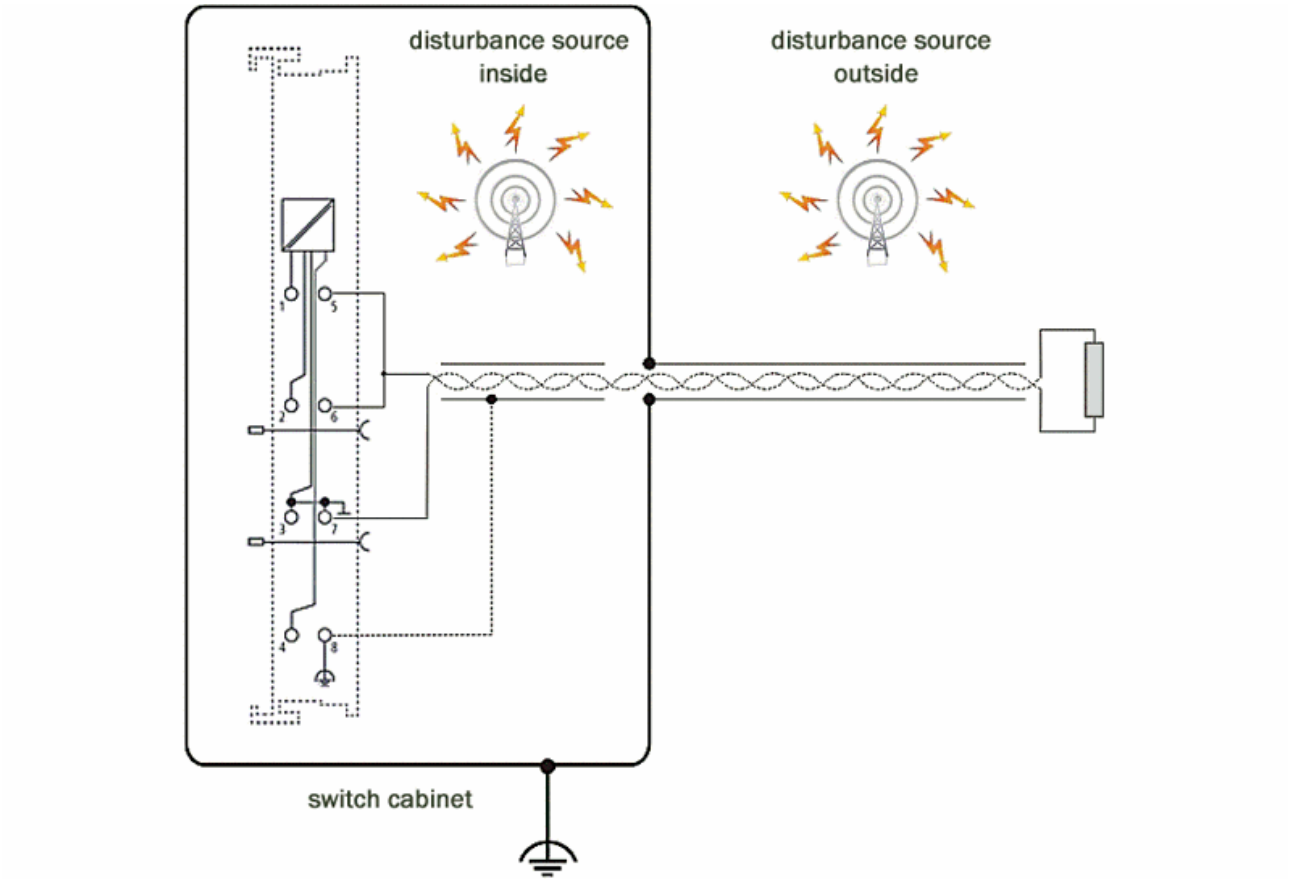


Fig. 29: Example of EL3202 shield connection with shield contact, in the case of potential interference sources inside and outside the control cabinet

3.14 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. 30: 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.

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*.

3.15 Start

For commissioning:

- Install the EL32xx as described in section Installation [▶ 81].
- Configure the EL32xx in TwinCAT as described in section Commissioning [▶ 105].

4 Basics communication

4.1 EtherCAT basics

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

4.2 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.

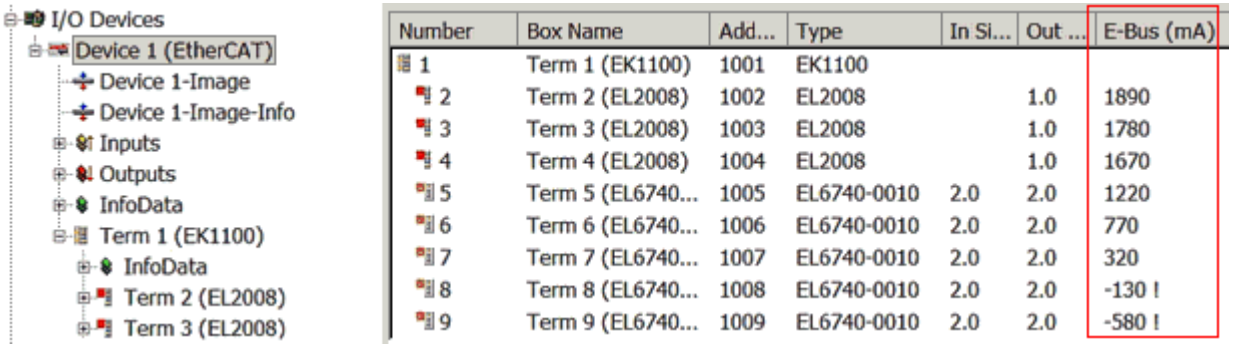


Fig. 31: System manager current calculation

NOTICE

Malfunction possible!

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

4.3 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:

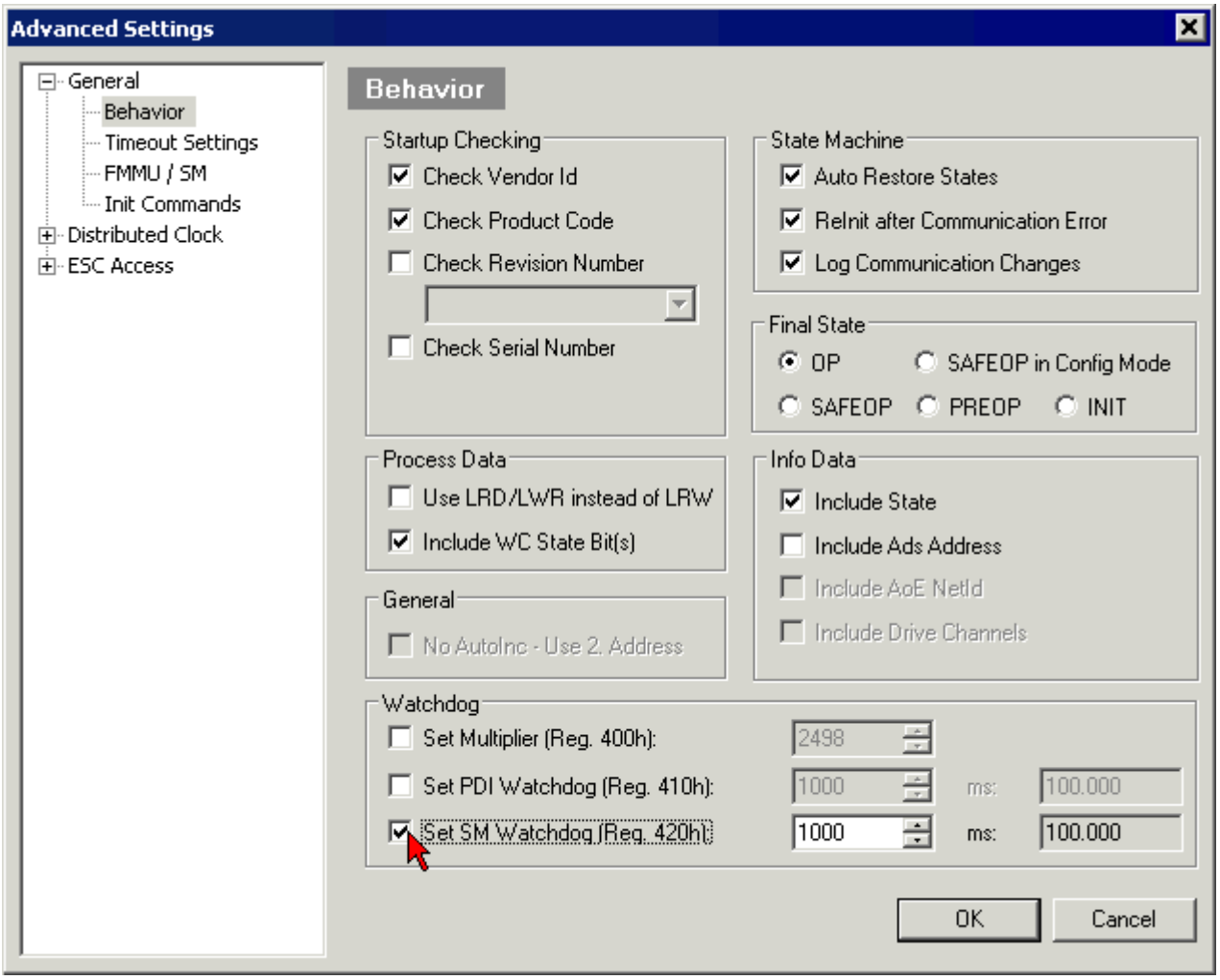


Fig. 32: eEtherCAT tab -> Advanced Settings -> Behavior -> Watchdog

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 (SyncManager Watchdog)

The SyncManager 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 SyncManager 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 (µC) 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 MHz * (Watchdog multiplier + 2)] * 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.

4.4 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.

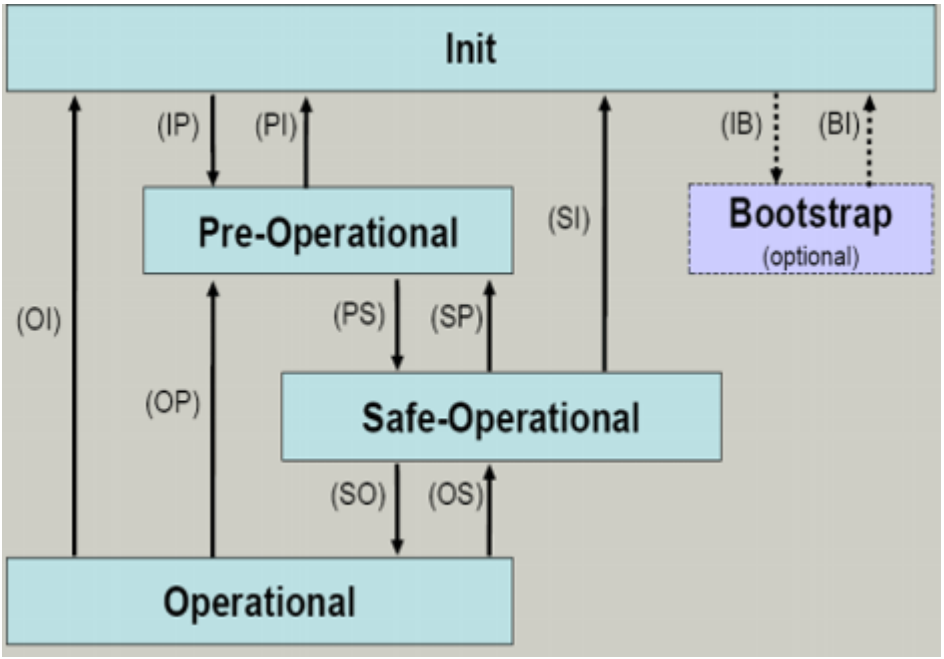


Fig. 33: States of the EtherCAT State Machine

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

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.

4.5 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

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:

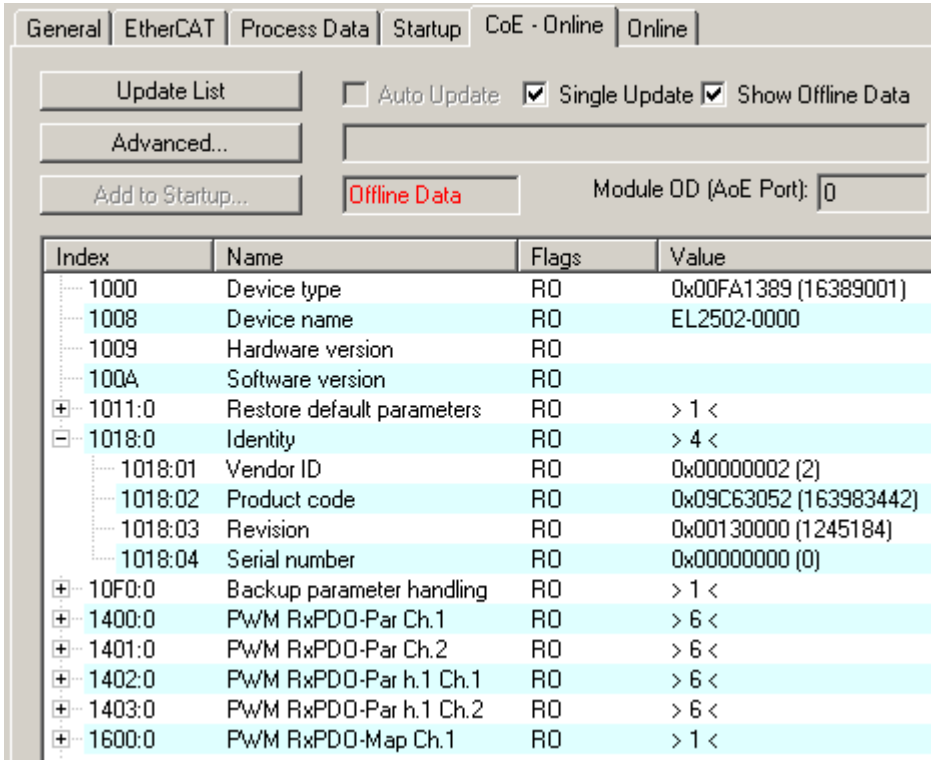


Fig. 34: “CoE Online” tab

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.

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.

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.

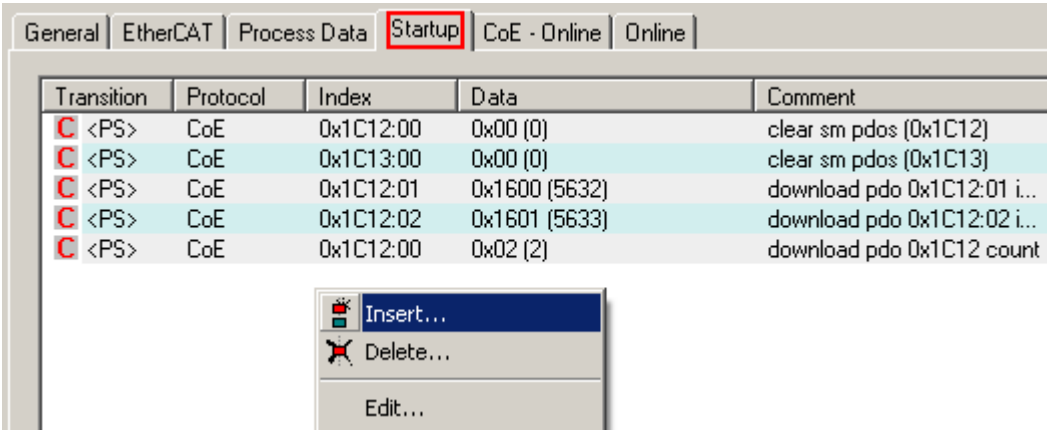


Fig. 35: Startup list in the TwinCAT System Manager

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.

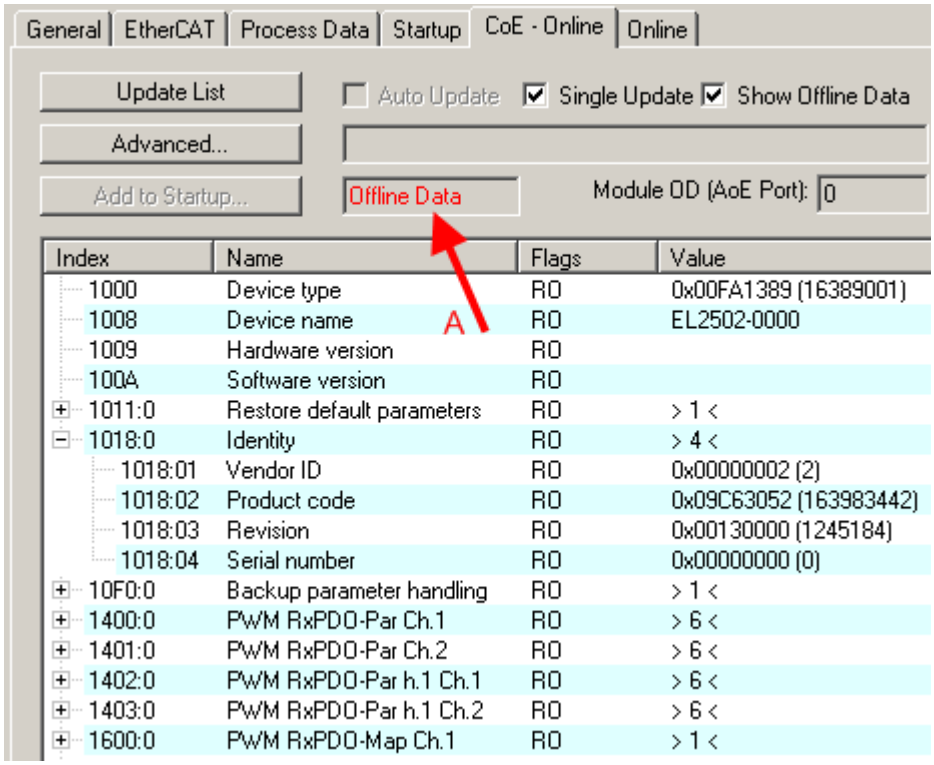


Fig. 36: Offline list

- 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.

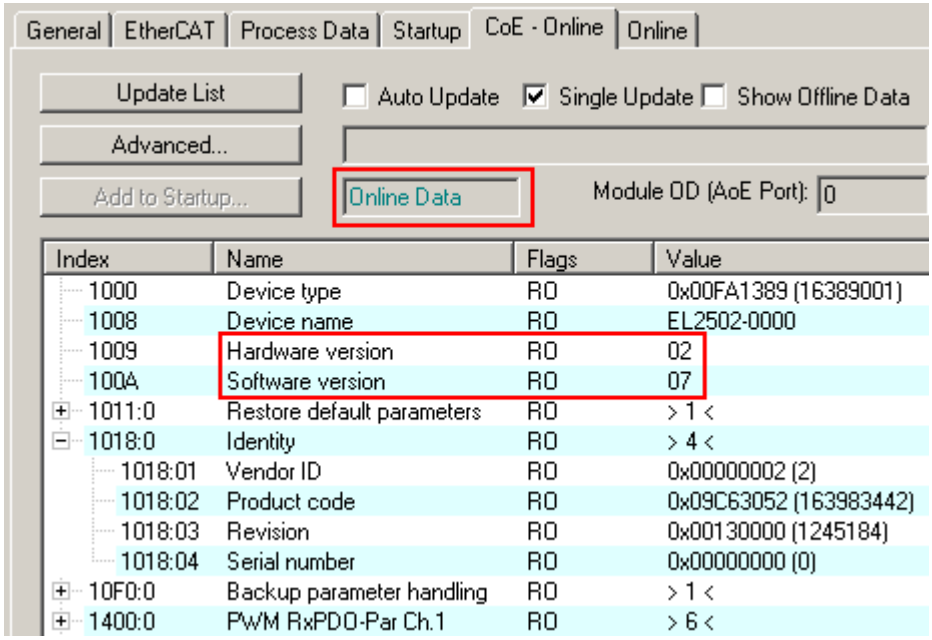


Fig. 37: Online list

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.

4.6 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.

5 Installation

5.1 Safety instructions

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

5.2 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 environments[1]
- 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.

5.3 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).

5.4 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.

5.5 Instructions for ESD protection

NOTICE

Destruction of the devices by electrostatic discharge possible!

The devices contain components at risk from electrostatic discharge caused by improper handling.

- When handling the components, ensure that there is no electrostatic discharge; also avoid touching the spring contacts directly (see illustration).
- Contact with highly insulating materials (synthetic fibers, plastic films, etc.) should be avoided when handling components at the same time.
- When handling the components, ensure that the environment (workplace, packaging and persons) is properly earthed.
- Each bus station must be terminated on the right-hand side with the EL9011 or EL9012 end cap to ensure the degree of protection and ESD protection.

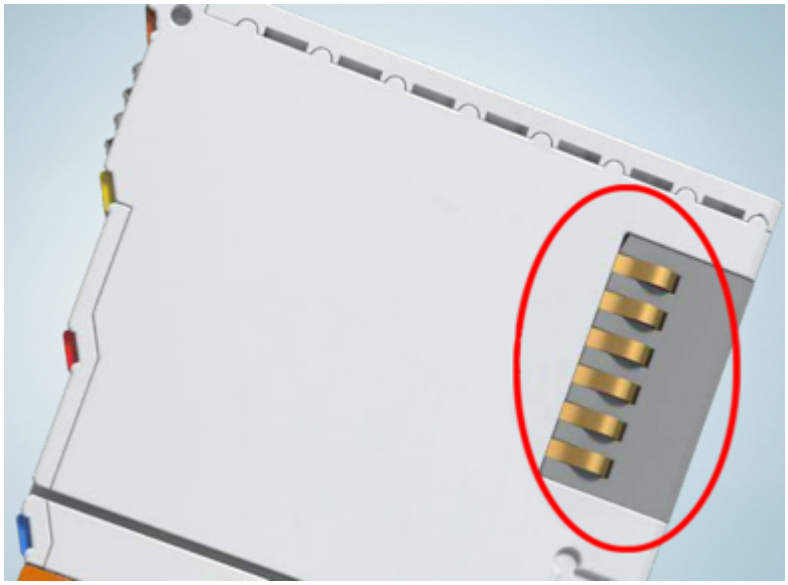


Fig. 38: Spring contacts of the Beckhoff I/O components

5.6 Explosion protection

5.6.1 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

5.6.2 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

5.6.3 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

5.6.4 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!

5.6.5 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**

5.6.6 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!

5.7 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:



5.8 Installation on mounting rails

⚠ WARNING

Risk of electric shock and damage of device!

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

The Bus Terminal system and is designed for mounting in a control cabinet or terminal box.

Assembly

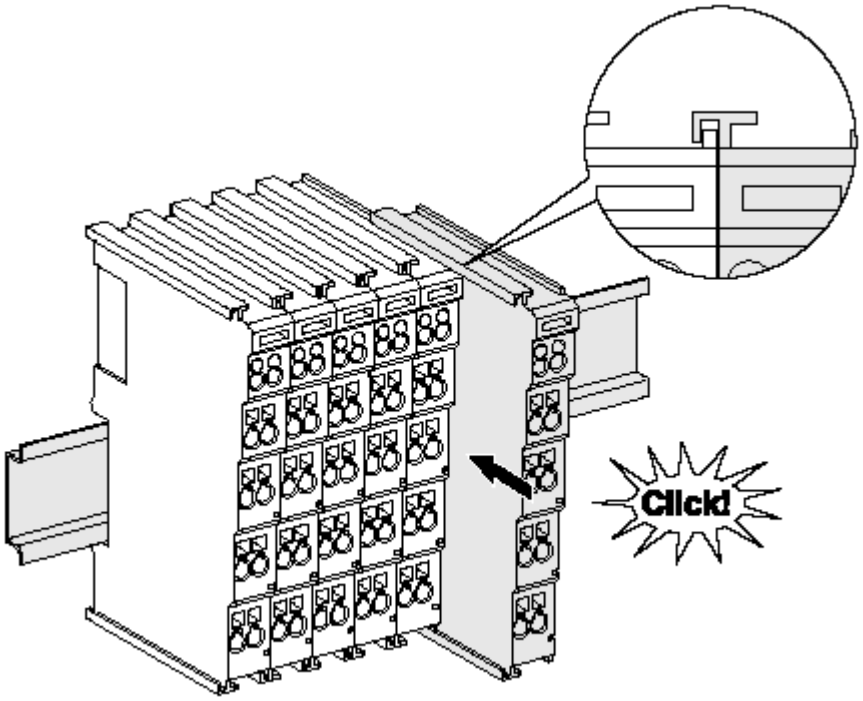


Fig. 39: Attaching on mounting rail

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

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. Join the components with tongue and groove and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.
   If the terminals are clipped onto the mounting rail first and then pushed together without tongue and groove, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

Fixing of mounting rails

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

NOTICE

Ground the mounting rail!

Ensure that the mounting rail is sufficiently grounded.

Connections within a bus terminal block

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

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

Power Contacts

During the design of a bus terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts. Power Feed Terminals (EL91xx, EL92xx or KL91xx, KL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

Power contact ⏚

The power contact labeled ⏚ (earthing connection according to IEC 60417-5017, British English: earth, American English: ground) can be used as grounding. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

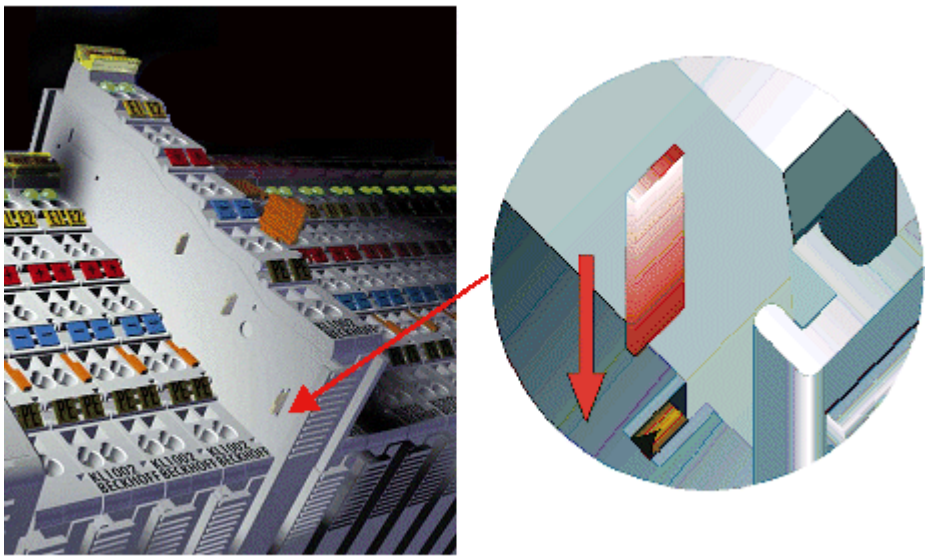


Fig. 40: Power contact on left side

⚠ WARNING

Risk of electric shock!

The power contact labeled ⏚ must not be used for other potentials!

NOTICE

Possible damage of the device

Note that, for reasons of electromagnetic compatibility, the earthing contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the earthing line during insulation testing of a consumer with a nominal voltage of 230 V). For insulation testing, disconnect the earthing supply line at the Bus Coupler or the Power Feed Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

Disassembly

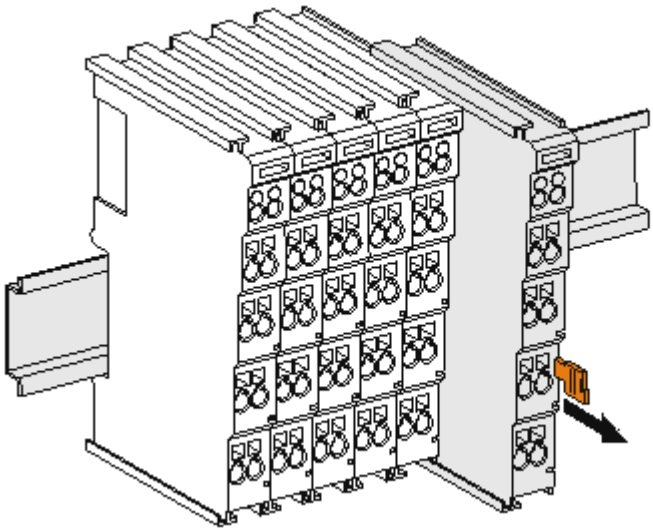


Fig. 41: Disassembling of terminal

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

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

5.9 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.

5.10 Positioning of passive Terminals

Hint for positioning of passive terminals in the bus terminal block

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

Examples for positioning of passive terminals (highlighted)

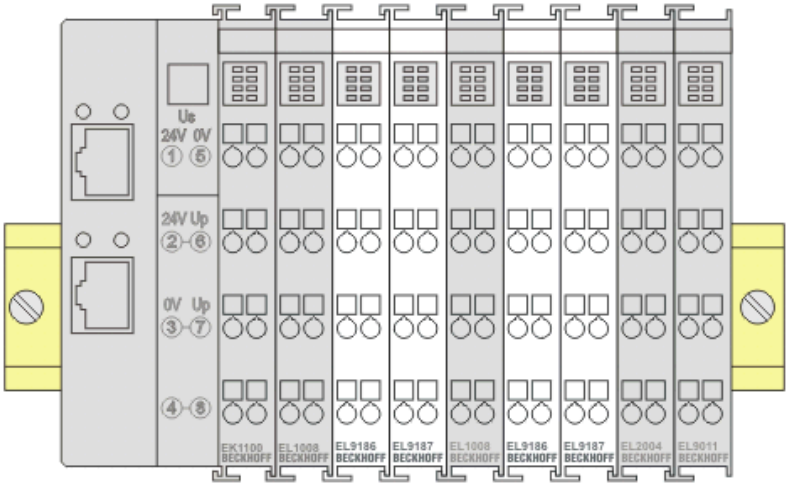


Fig. 42: Correct positioning

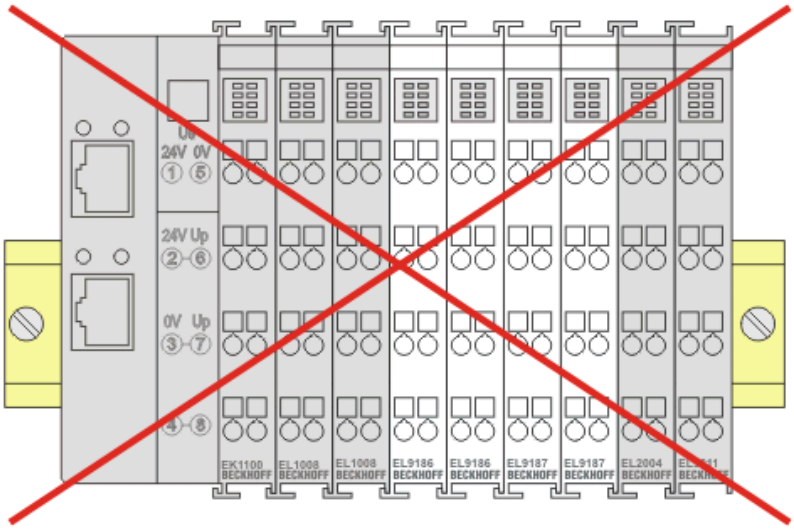


Fig. 43: Incorrect positioning

5.11 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.

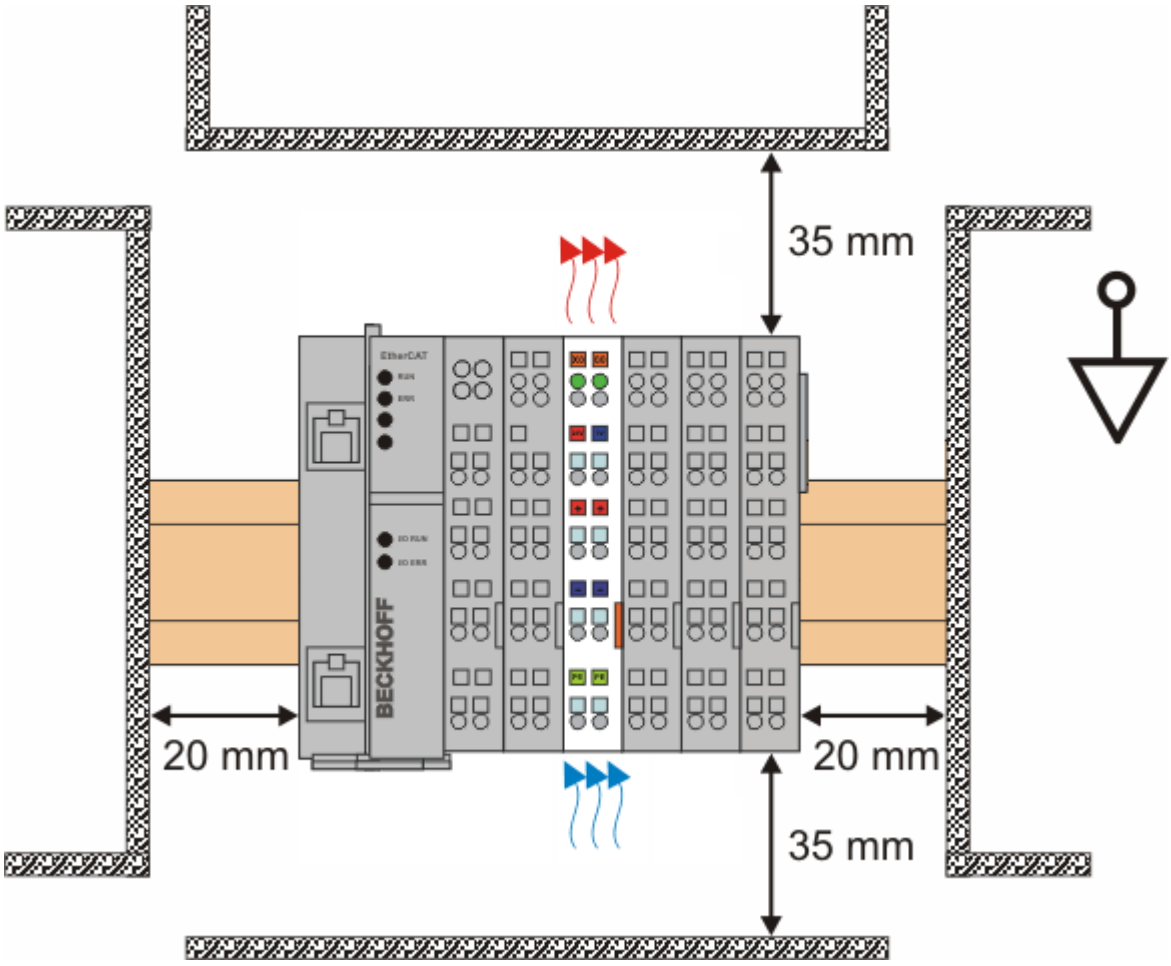


Fig. 44: Recommended distances for standard installation position

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

Other installation positions

All other installation positions are characterized by different spatial arrangement of the mounting rail - see Fig “Other installation positions”.

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

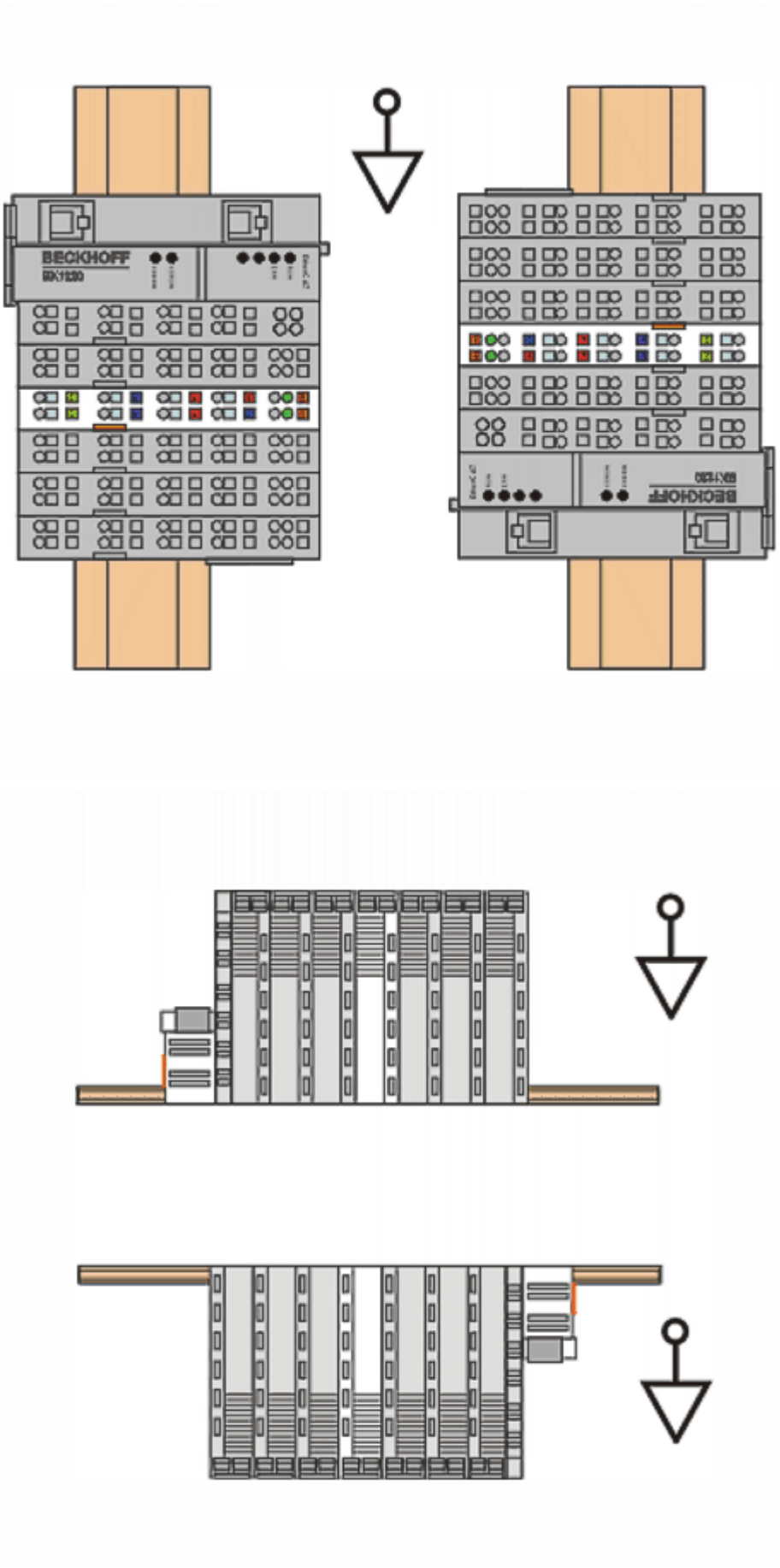


Fig. 45: Other installation positions

5.12 Connection

5.12.1 Connection system

⚠ WARNING

Risk of electric shock and damage of device!

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

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)

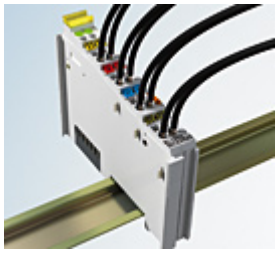


Fig. 46: Standard wiring

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

Pluggable wiring (ESxxxx / KSxxxx)

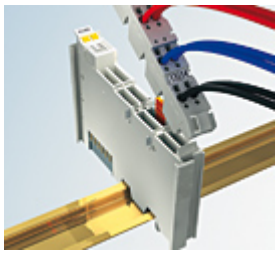


Fig. 47: Pluggable wiring

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. 48: 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 [▶ 102]!

5.12.2 Wiring

⚠ WARNING

Risk of electric shock and damage of device!

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

Terminals for standard wiring ELxxxx/KLxxxx and for pluggable wiring ESxxxx/KSxxxx

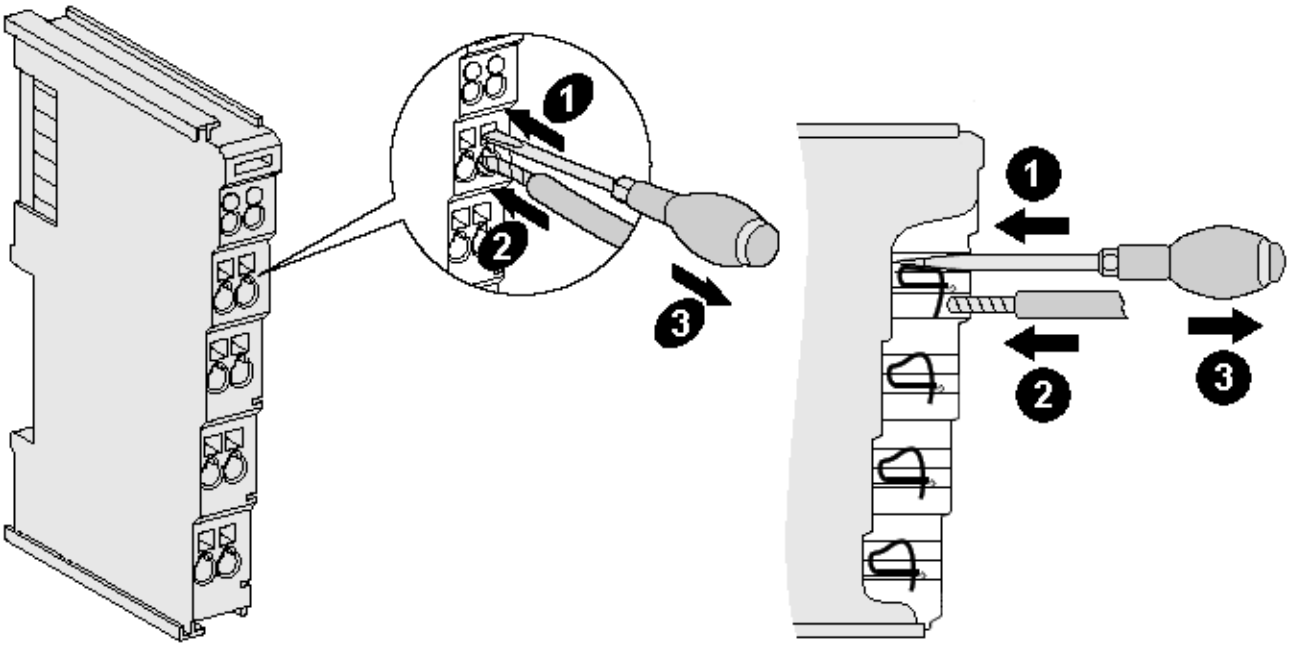


Fig. 49: Connecting a cable on a terminal point

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 mm²	0.08 ... 2.5 mm²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm²	0.14 ... 1.5 mm²
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 100]) 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 mm²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm²
Wire size width (ultrasonically compacted [ultrasonically welded] strands)	only 1.5 mm² (see notice [▶ 100])
Wire stripping length	8 ... 9 mm

5.12.3 Shielding

Shielding

Encoder, analog sensors and actuators should always be connected with shielded, twisted paired wires.

5.13 Note - 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.

5.14 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.

6 Commissioning

6.1 TwinCAT Quick Start

TwinCAT is a development environment for real-time control including a multi PLC system, NC axis control, programming and operation. The whole system is mapped through this environment and enables access to a programming environment (including compilation) for the controller. Individual digital or analog inputs or outputs can also be read or written directly, in order to verify their functionality, for example.

For further information, please refer to http://infosys.beckhoff.com:

- **EtherCAT System Manual:**
  Fieldbus Components → EtherCAT Terminals → EtherCAT System Documentation → Setup in the TwinCAT System Manager
- **TwinCAT 2** → TwinCAT System Manager → I/O Configuration
- In particular, for TwinCAT – driver installation:
  Fieldbus components → Fieldbus Cards and Switches → FC900x – PCI Cards for Ethernet → Installation

Devices contain the relevant terminals for the actual configuration. All configuration data can be entered directly via editor functions (offline) or via the `scan function (online):

- **“offline”**: The configuration can be customized by adding and positioning individual components. These can be selected from a directory and configured.
  - The procedure for the offline mode can be found under http://infosys.beckhoff.com:
    TwinCAT 2 → TwinCAT System Manager → IO Configuration → Add an I/O device
- **“online”**: The existing hardware configuration is read
  - See also http://infosys.beckhoff.com:
    Fieldbus components → Fieldbus Cards and Switches → FC900x – PCI Cards for Ethernet → Installation → Searching for devices

The following relationship is envisaged between the user PC and individual control elements:

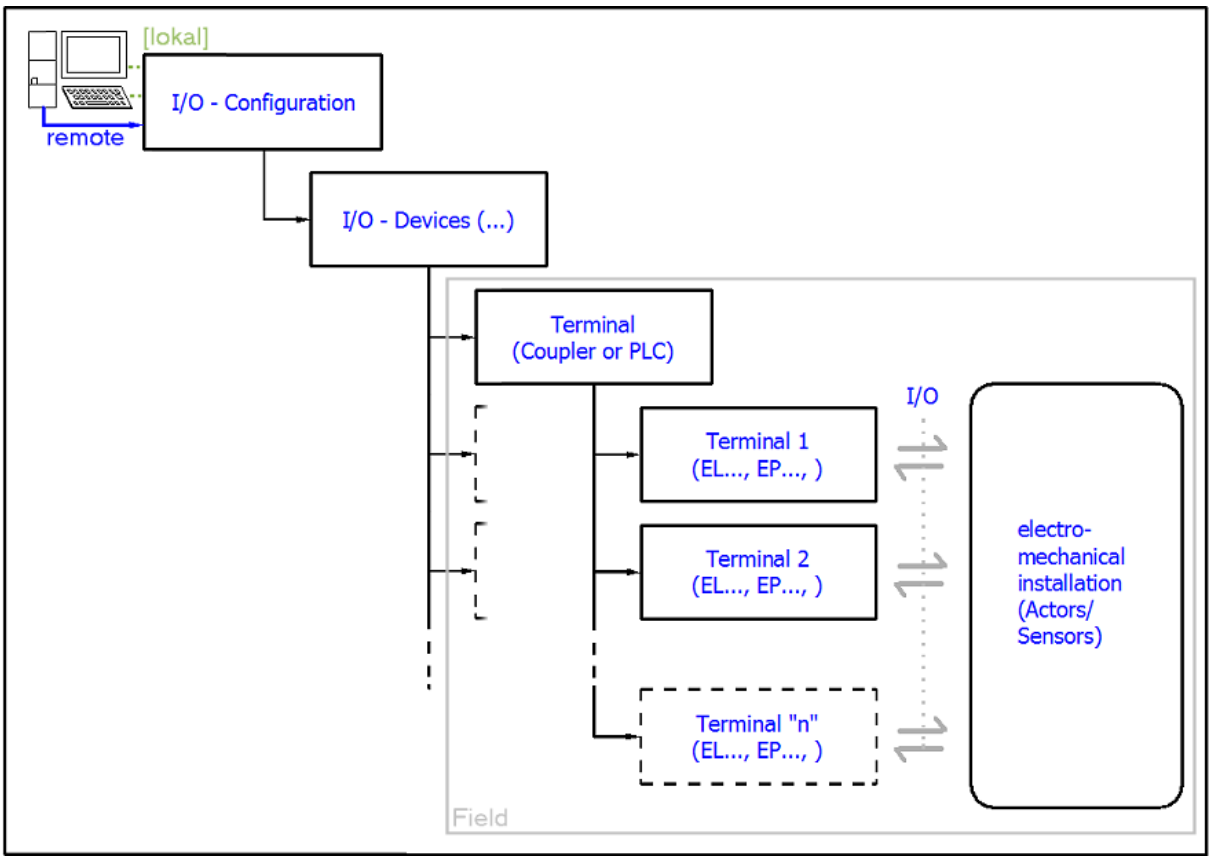


Fig. 50: Relationship between user side (commissioning) and installation

Insertion of certain components (I/O device, terminal, box...) by users functions the same way as in TwinCAT 2 and TwinCAT 3. The descriptions below relate solely to the online procedure.

Example configuration (actual configuration)

Based on the following example configuration, the subsequent subsections describe the procedure for TwinCAT 2 and TwinCAT 3:

- **CX2040** control system (PLC) including **CX2100-0004** power supply unit
- Connected to CX2040 on the right (E-bus):
  EL1004 (4-channel digital input terminal 24 V_{DC})
- Linked via the X001 port (RJ-45): **EK1100** EtherCAT Coupler
- Connected to the EK1100 EtherCAT Coupler on the right (E-bus):
  EL2008 (8-channel digital output terminal 24 V_{DC}; 0.5 A)
- (Optional via X000: a link to an external PC for the user interface)

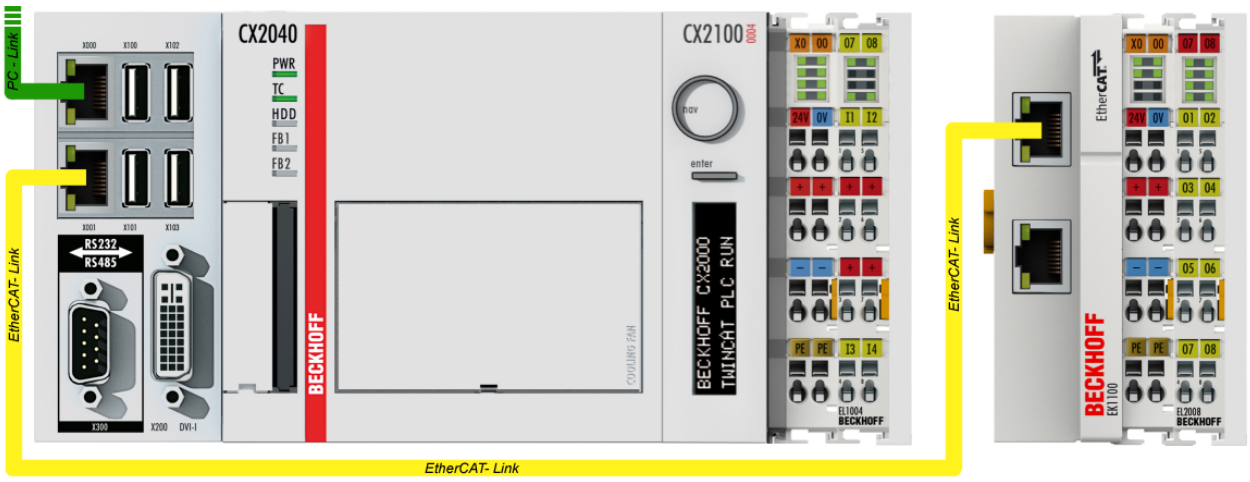


Fig. 51: Control configuration with Embedded PC, input (EL1004) and output (EL2008)

Note that all combinations of a configuration are possible; for example, the EL1004 terminal could also be connected after the coupler, or the EL2008 terminal could additionally be connected to the CX2040 on the right, in which case the EK1100 coupler wouldn't be necessary.

6.1.1 TwinCAT 2

Startup

TwinCAT 2 basically uses two user interfaces: the TwinCAT System Manager for communication with the electromechanical components and TwinCAT PLC Control for the development and compilation of a controller. The starting point is the TwinCAT System Manager.

After successful installation of the TwinCAT system on the PC to be used for development, the TwinCAT 2 System Manager displays the following user interface after startup:

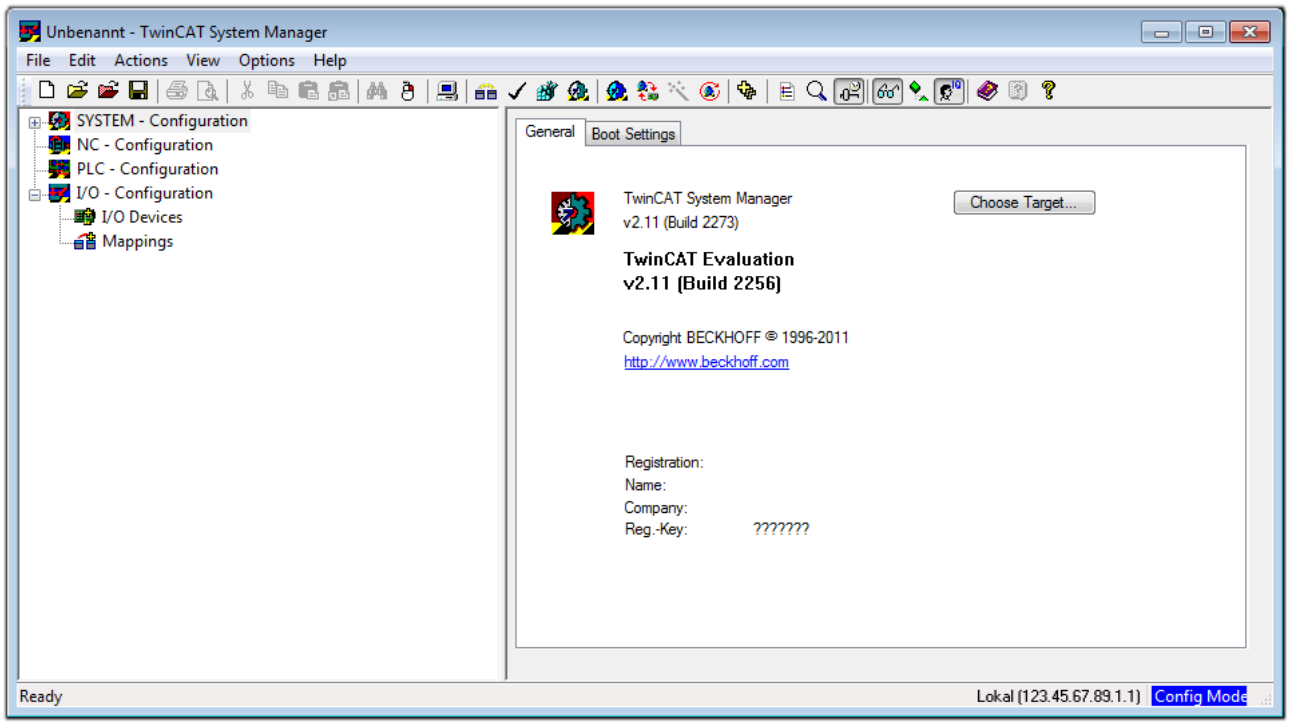


Fig. 52: Initial TwinCAT 2 user interface

Generally, TwinCAT can be used in local or remote mode. Once the TwinCAT system, including the user interface (standard) is installed on the respective PLC, TwinCAT can be used in local mode and thus the next step is “Insert Device [▶ 110]”.

If the intention is to address the TwinCAT runtime environment installed on a PLC remotely from another system used as a development environment, the target system must be made known first. In the menu under “Actions” → “Choose Target System...”, the following window is opened for this via the symbol “  ” or the “F8” key:

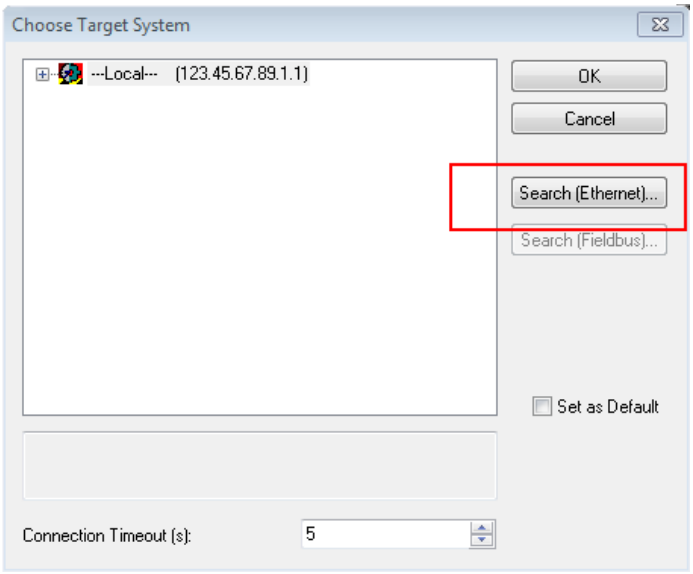


Fig. 53: Selection of the target system

Use “Search (Ethernet)...” to enter the target system. Thus another dialog opens to either:

- enter the known computer name after “Enter Host Name / IP:” (as shown in red)
- perform a “Broadcast Search” (if the exact computer name is not known)
- enter the known computer – IP or AmsNetID

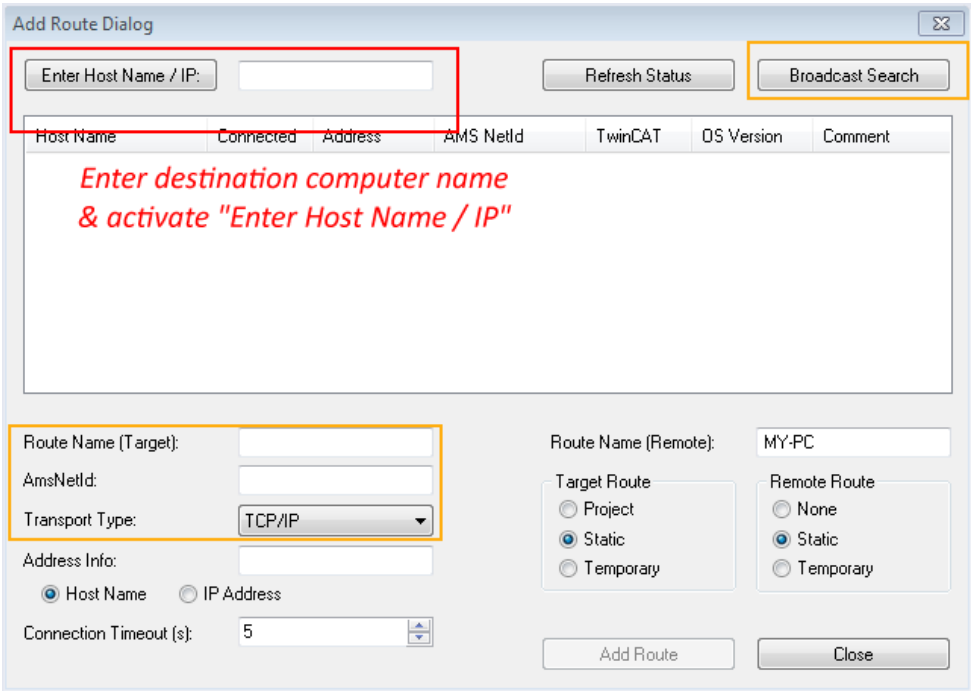
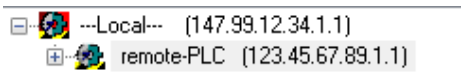


Fig. 54: specify the PLC for access by the TwinCAT System Manager: selection of the target system

Once the target system has been entered, it is available for selection as follows (a correct password may have to be entered before this):



After confirmation with “OK”, the target system can be accessed via the System Manager.

Adding devices

In the configuration tree of the TwinCAT 2 System Manager user interface on the left, select “I/O Devices” and then right-click to open a context menu and select “Scan Devices…”, or start the action in the menu bar via  . The TwinCAT System Manager may first have to be set to “Config Mode” via  or via the menu
“Actions” → “Set/Reset TwinCAT to Config Mode…” (Shift + F4).

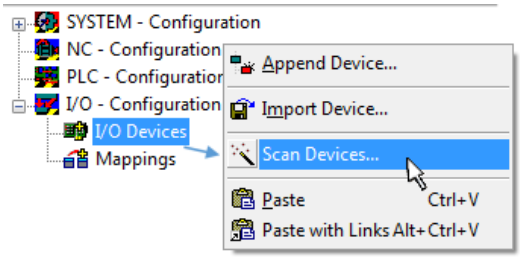


Fig. 55: Select “Scan Devices...”

Confirm the warning message, which follows, and select the “EtherCAT” devices in the dialog:

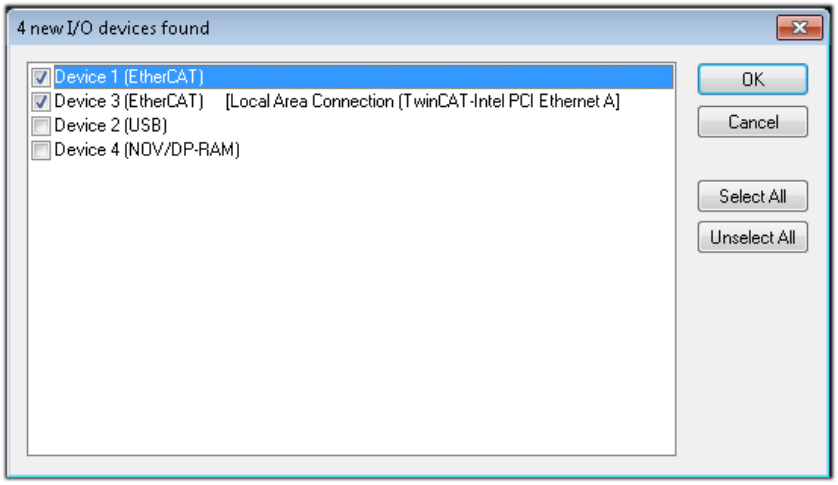


Fig. 56: Automatic detection of I/O devices: selection of the devices to be integrated

Confirm the message “Find new boxes”, in order to determine the terminals connected to the devices. “Free Run” enables manipulation of input and output values in “Config Mode” and should also be acknowledged.

Based on the example configuration [▶ 106] described at the beginning of this section, the result is as follows:

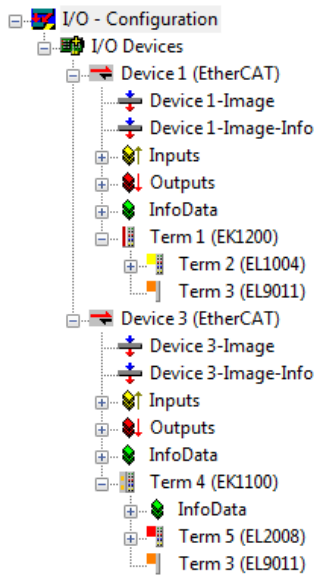


Fig. 57: Mapping of the configuration in the TwinCAT 2 System Manager

The whole process consists of two stages, which can also be performed separately (first determine the devices, then determine the connected elements such as boxes, terminals, etc.). A scan (search function) can also be initiated by selecting “Device ...” from the context menu, which then only reads the elements below which are present in the configuration:

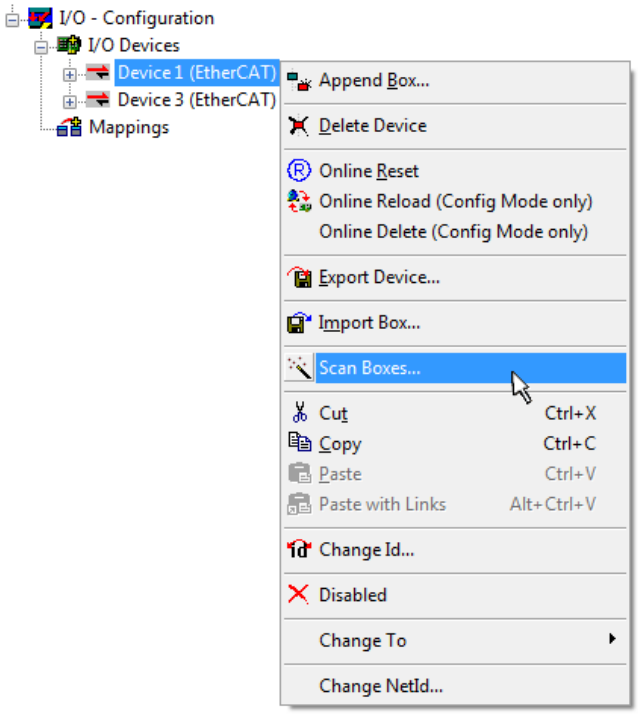


Fig. 58: Reading of individual terminals connected to a device

This functionality is useful if the actual configuration is modified at short notice.

Programming and integrating the PLC

TwinCAT PLC Control is the development environment for generating the controller in different program environments: TwinCAT PLC Control supports all languages described in IEC 61131-3. There are two text-based languages and three graphical languages.

- **Text-based languages**
  - Instruction List (IL)
  - Structured Text (ST)

- **Graphical languages**
  - Function Block Diagram (FBD)
  - Ladder Diagram (LD)
  - The Continuous Function Chart Editor (CFC)
  - Sequential Function Chart (SFC)

The following section refers solely to Structured Text (ST).

After starting TwinCAT PLC Control, the following user interface is shown for an initial project:

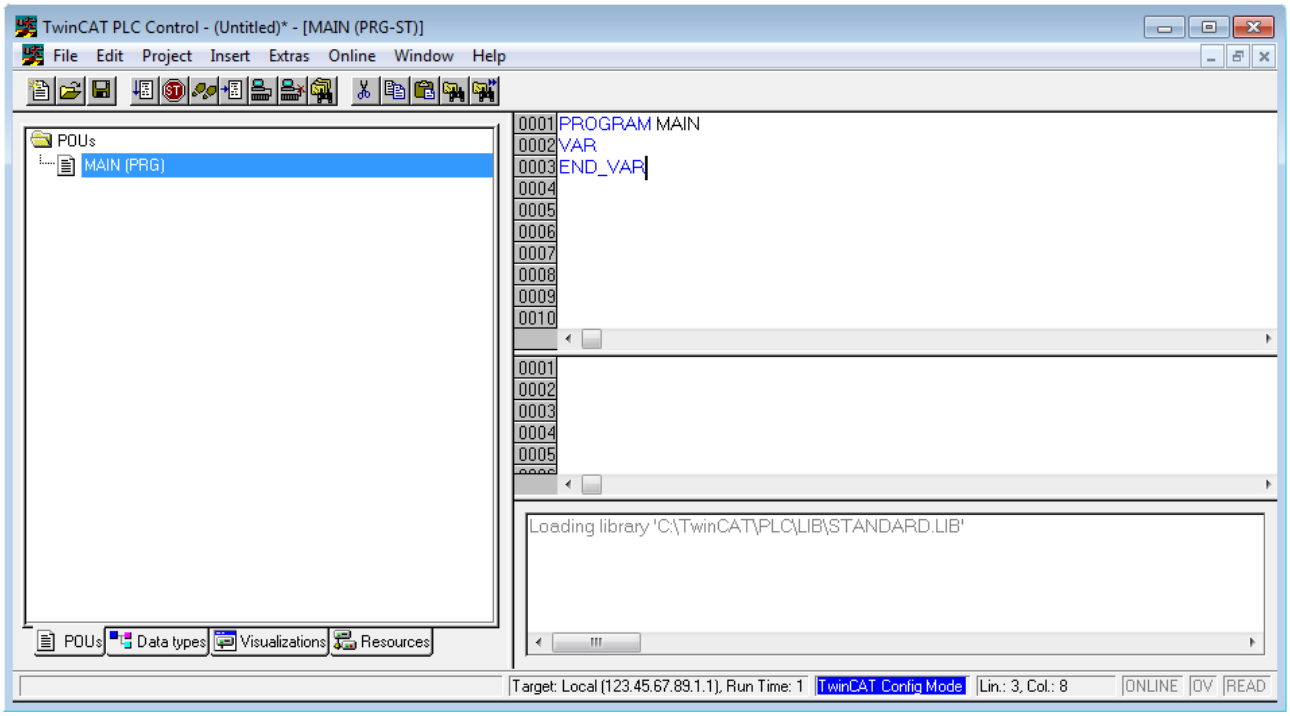


Fig. 59: TwinCAT PLC Control after startup

Example variables and an example program have been created and stored under the name “PLC_example.pro”:

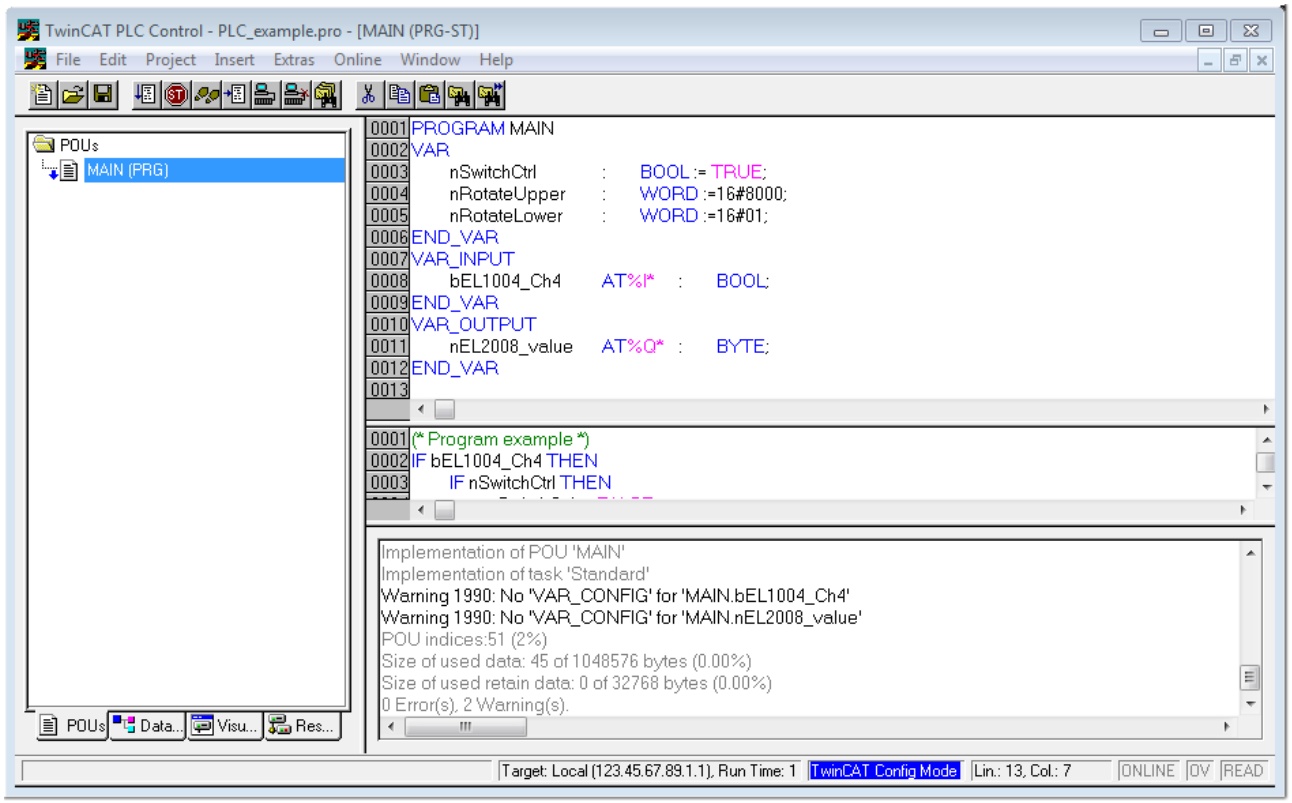


Fig. 60: Example program with variables after a compile process (without variable integration)

Warning 1990 (missing “VAR_CONFIG”) after a compile process indicates that the variables defined as external (with the ID “AT%I*” or “AT%Q*”) have not been assigned. After successful compilation, TwinCAT PLC Control creates a “*.tpy” file in the directory in which the project was stored. This file (“*.tpy”) contains variable assignments and is not known to the System Manager, hence the warning. Once the System Manager has been notified, the warning no longer appears.

First, integrate the TwinCAT PLC Control project in the **System Manager**. This is performed via the context menu of the PLC configuration (right-click) and selecting “Append PLC Project…”:

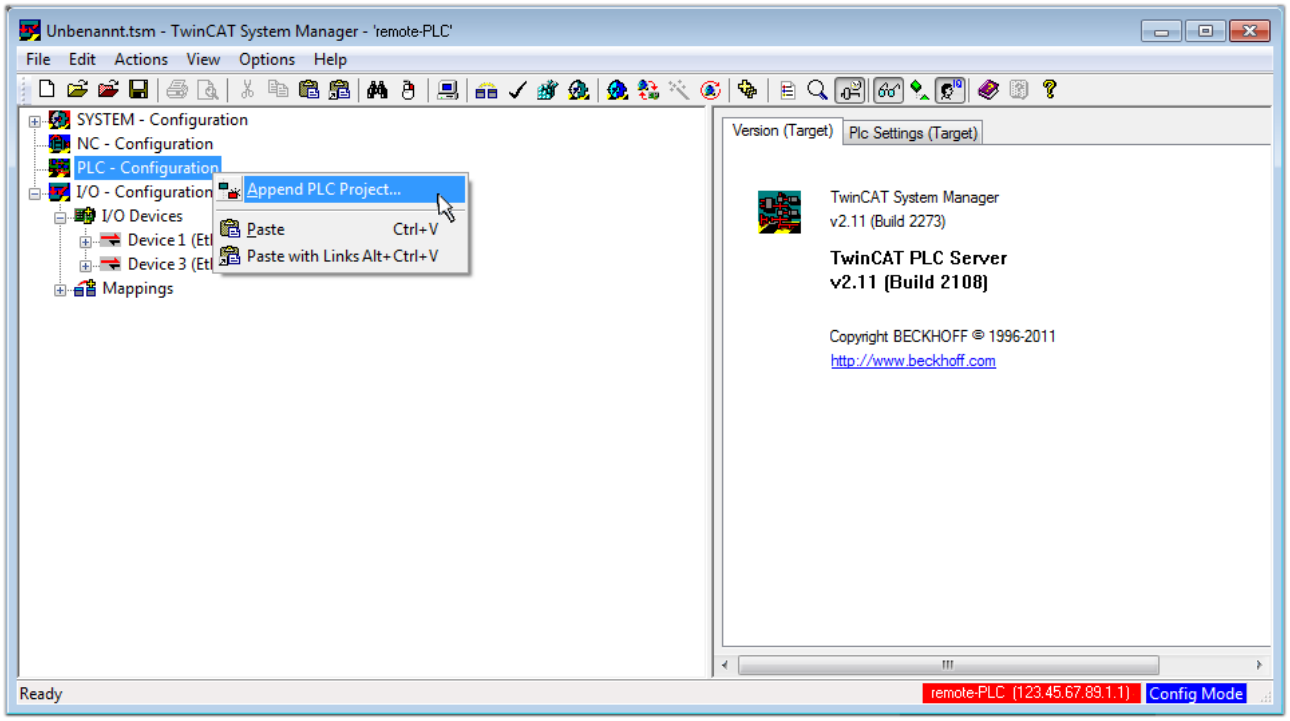


Fig. 61: Appending the TwinCAT PLC Control project

Select the PLC configuration “PLC_example.tpy” in the browser window that opens. The project including the two variables identified with “AT” are then integrated in the configuration tree of the System Manager:

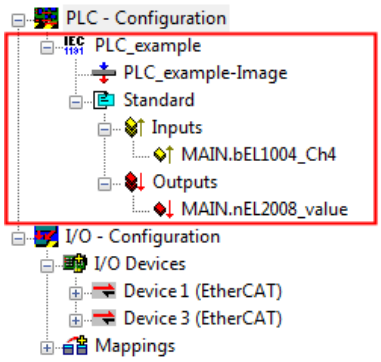


Fig. 62: PLC project integrated in the PLC configuration of the System Manager

The two variables “bEL1004_Ch4” and “nEL2008_value” can now be assigned to certain process objects of the I/O configuration.

Assigning variables

Open a window for selecting a suitable process object (PDO) via the context menu of a variable of the integrated project “PLC_example” and via “Modify Link...” “Standard”:

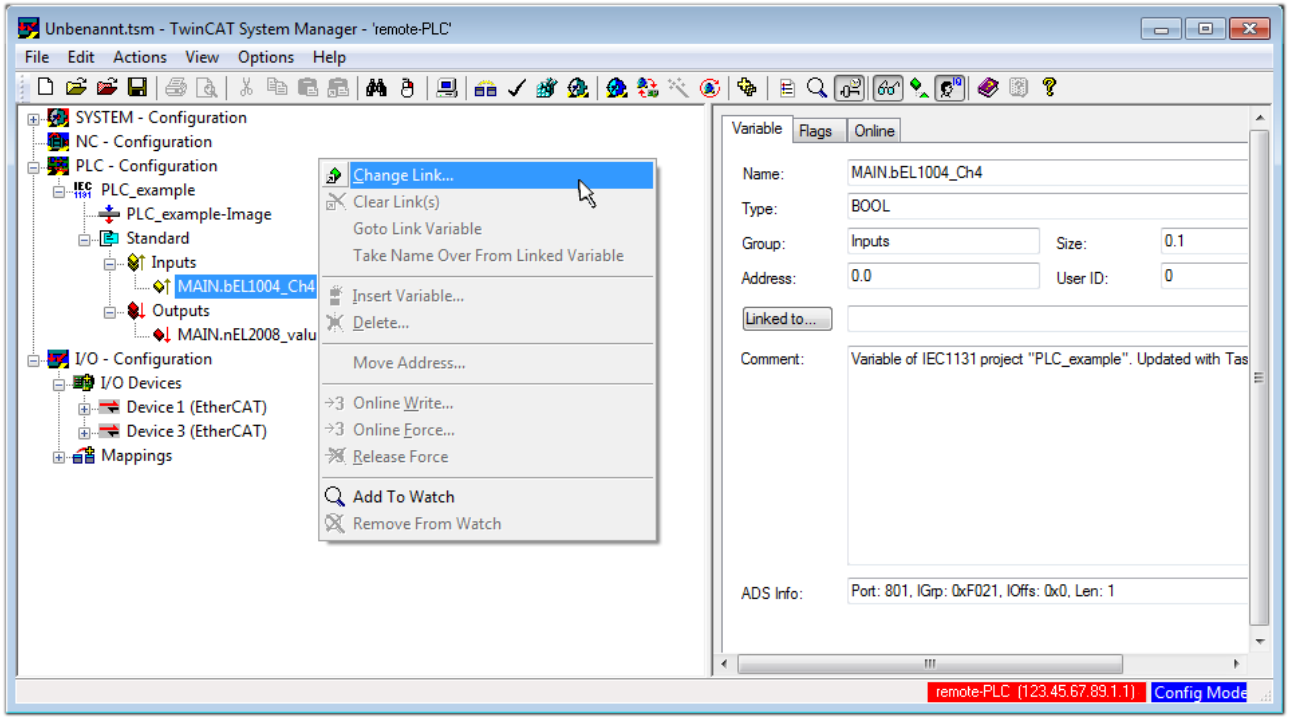


Fig. 63: Creating the links between PLC variables and process objects

In the window that opens, the process object for the “bEL1004_Ch4” BOOL-type variable can be selected from the PLC configuration tree:

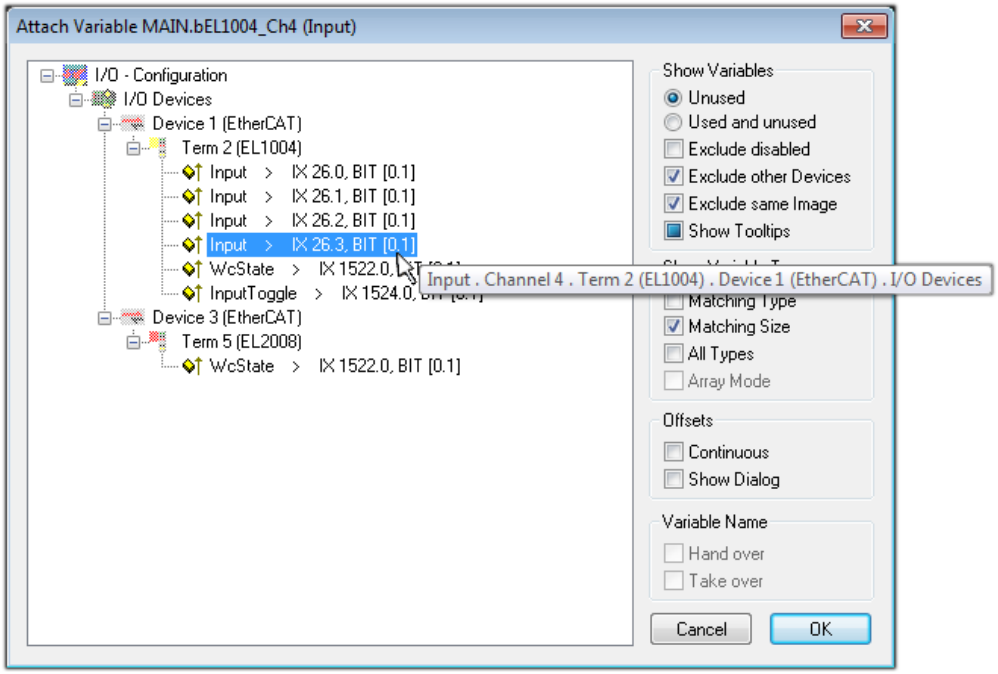


Fig. 64: Selecting BOOL-type PDO

According to the default setting, only certain PDO objects are now available for selection. In this example, the input of channel 4 of the EL1004 terminal is selected for linking. In contrast, the checkbox “All types” must be ticked to create the link for the output variables, in order to allocate a set of eight separate output bits to a byte variable in this case. The following diagram shows the whole process:

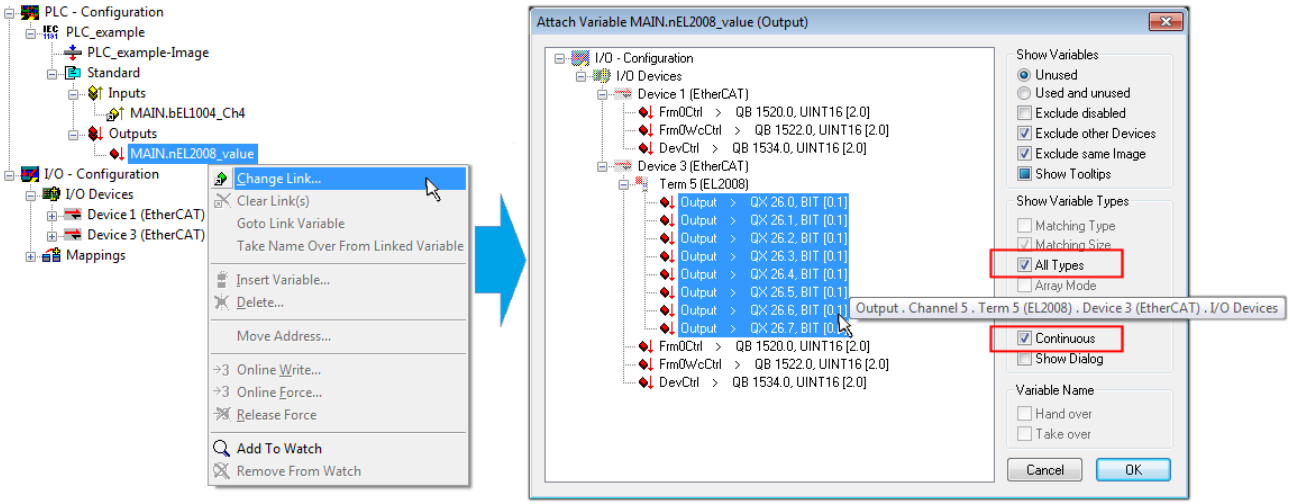


Fig. 65: Selecting several PDOs simultaneously: activate “Continuous” and “All types”

Note that the “Continuous” checkbox was also activated. This is designed to allocate the bits contained in the byte of the “nEL2008_value” variable sequentially to all eight selected output bits of the EL2008 Terminal. It is thus possible to subsequently address all eight outputs of the terminal in the program with a byte corresponding to bit 0 for channel 1 to bit 7 for channel 8 of the PLC. A special symbol ( ) on the yellow or red object of the variable indicates that a link exists. The links can also be checked by selecting “Goto Link Variable” from the context menu of a variable. The opposite linked object, in this case the PDO, is automatically selected:

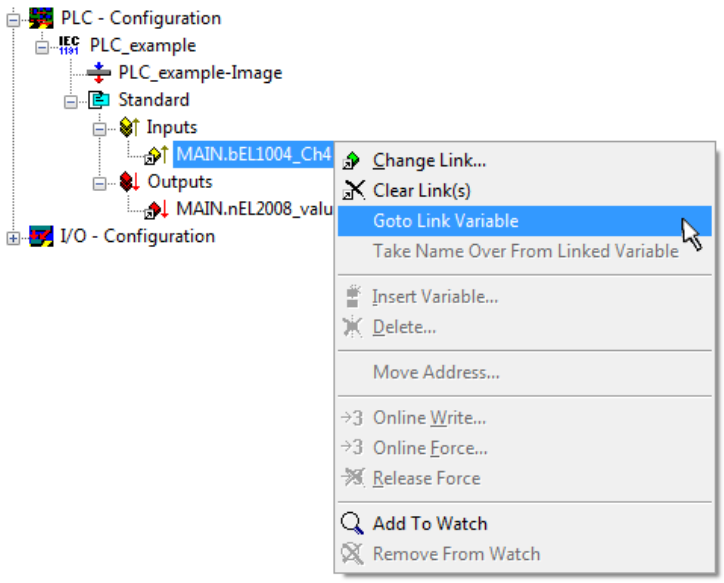
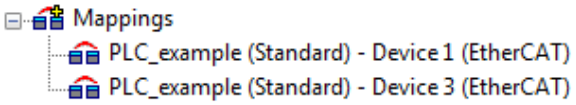


Fig. 66: Application of a “Goto Link Variable”, using “MAIN.bEL1004_Ch4” as an example

The process of assigning variables to the PDO is completed via the menu option “Actions” → “Create assignment”, or via  .

This can be visualized in the configuration:



The process of creating links can also be performed in the opposite direction, i.e. starting with individual PDOs to a variable. However, in this example, it would not be possible to select all output bits for the EL2008, since the terminal only makes individual digital outputs available. If a terminal has a byte, word, integer or similar PDO, it is also possible to allocate this to a set of bit-standardized variables. Here, too, a “Goto Link Variable” can be executed in the other direction, so that the respective PLC instance can then be selected.

Activation of the configuration

The allocation of PDO to PLC variables has now established the connection from the controller to the inputs and outputs of the terminals. The configuration can now be activated. First, the configuration can be verified via  (or via “Actions” → “Check Configuration”). If no error is present, the configuration can be activated via  (or via “Actions” → “Activate Configuration…”) to transfer the System Manager settings to the runtime system. Confirm the messages “Old configurations will be overwritten!” and “Restart TwinCAT system in Run mode” with “OK”.

A few seconds later, the real-time status 

is displayed at the bottom right in the System Manager. The PLC system can then be started as described below.

Starting the controller

Starting from a remote system, the PLC control has to be linked with the embedded PC over the Ethernet via “Online” → “Choose Runtime System…”:

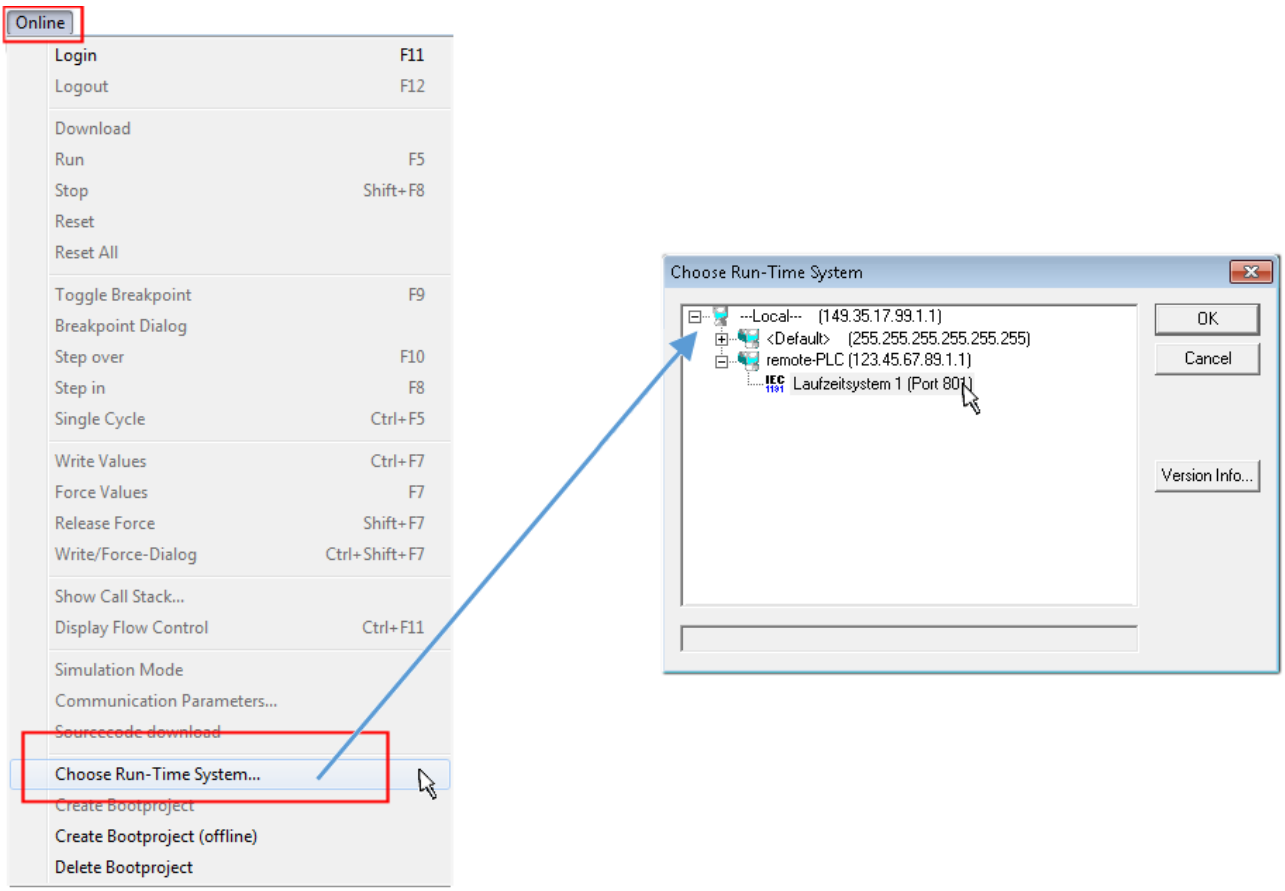


Fig. 67: Choose target system (remote)

In this example, “Runtime system 1 (port 801)” is selected and confirmed. Link the PLC with the real-time system via the menu option “Online” → “Login”, the F11 key or by clicking on the symbol . The control program can then be loaded for execution. This results in the message “No program on the controller! Should the new program be loaded?”, which should be confirmed with “Yes”. The runtime environment is ready for the program start:

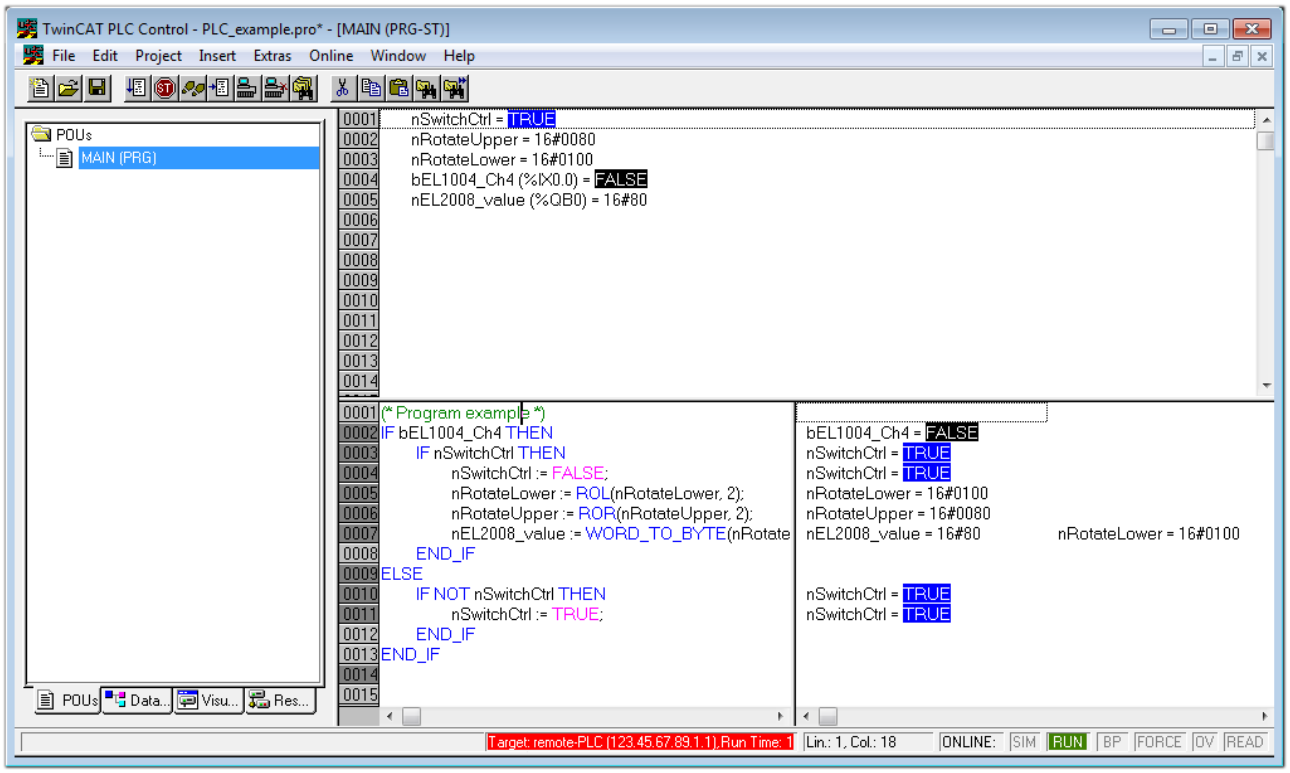


Fig. 68: PLC Control logged in, ready for program startup

The PLC can now be started via “Online” → “Run”, F5 key or .

6.1.2 TwinCAT 3

Startup

TwinCAT 3 makes the development environment areas available all together, with Microsoft Visual Studio: after startup, the project folder explorer appears on the left in the general window area (see “TwinCAT System Manager” of TwinCAT 2) for communication with the electromechanical components.

After successful installation of the TwinCAT system on the PC to be used for development, TwinCAT 3 (shell) displays the following user interface after startup:

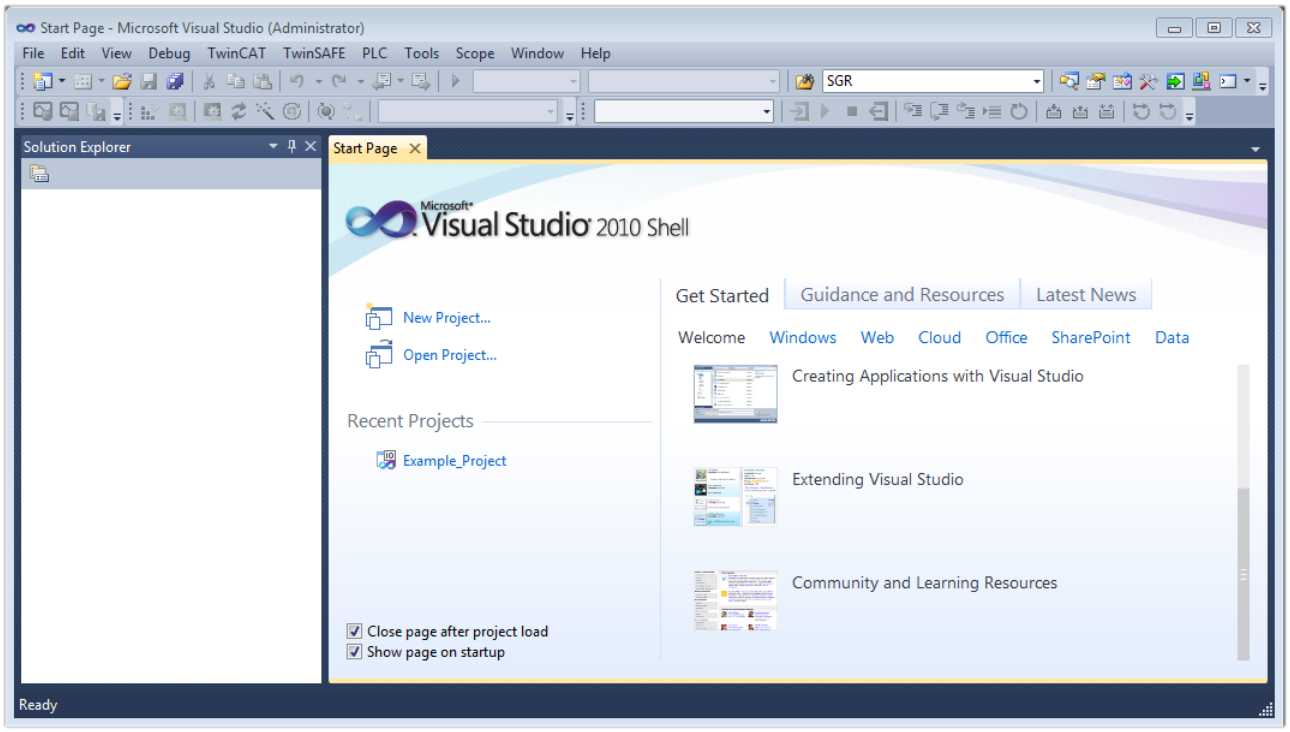


Fig. 69: Initial TwinCAT 3 user interface

First create a new project via  New TwinCAT Project... (or under “File”→“New”→ “Project…”). In the following dialog, make the corresponding entries as required (as shown in the diagram):

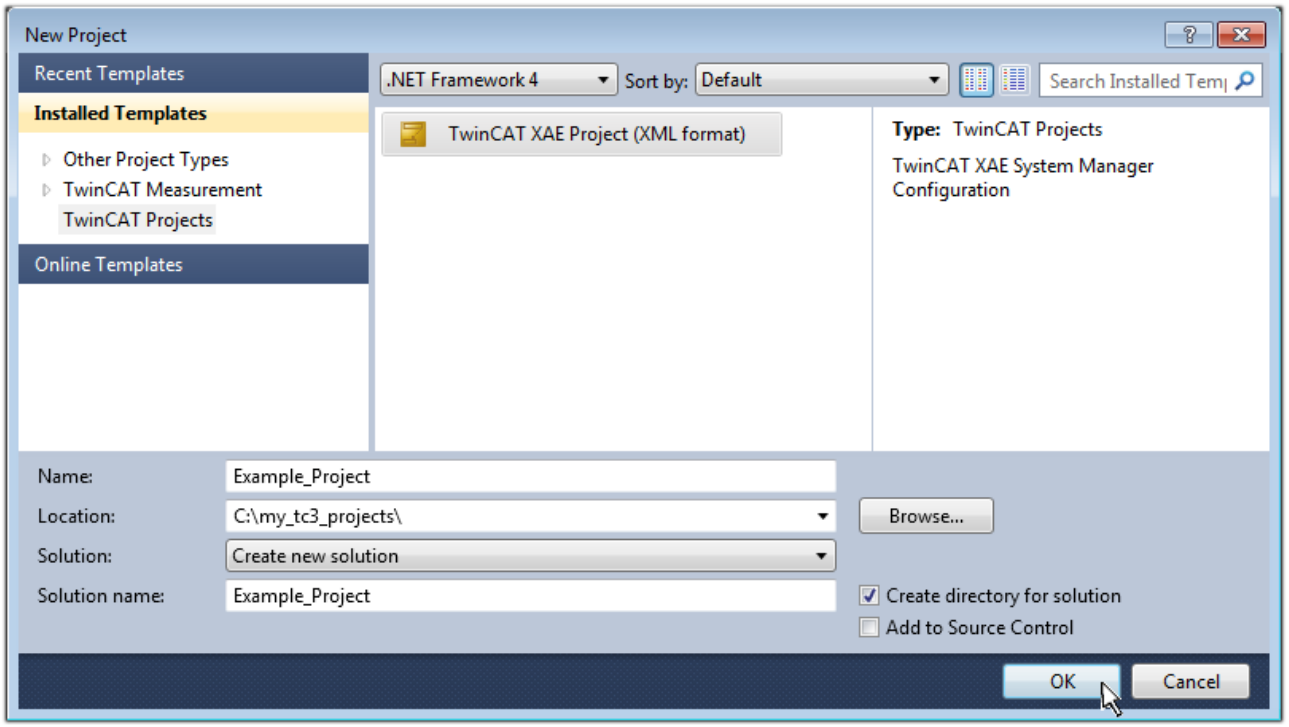


Fig. 70: Create new TwinCAT 3 project

The new project is then available in the project folder explorer:

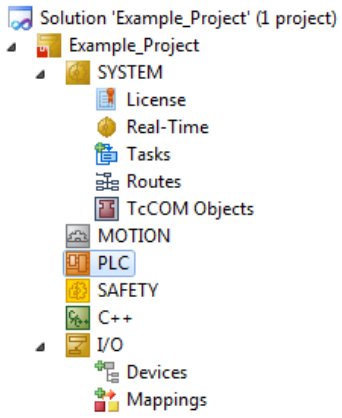
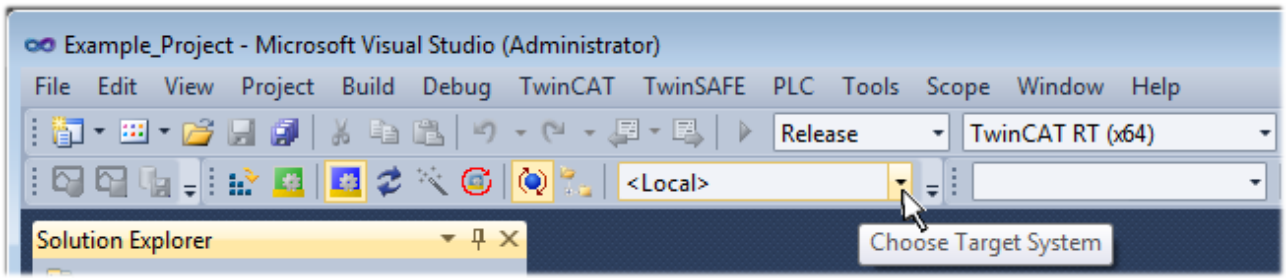


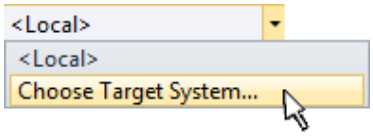
Fig. 71: New TwinCAT 3 project in the project folder explorer

Generally, TwinCAT can be used in local or remote mode. Once the TwinCAT system including the user interface (standard) is installed on the respective PLC (locally), TwinCAT can be used in local mode and the process can be continued with the next step, "Insert Device [▶ 121]".

If the intention is to address the TwinCAT runtime environment installed on a PLC remotely from another system used as a development environment, the target system must be made known first. Via the symbol in the menu bar:



expand the pull-down menu:



and open the following window:

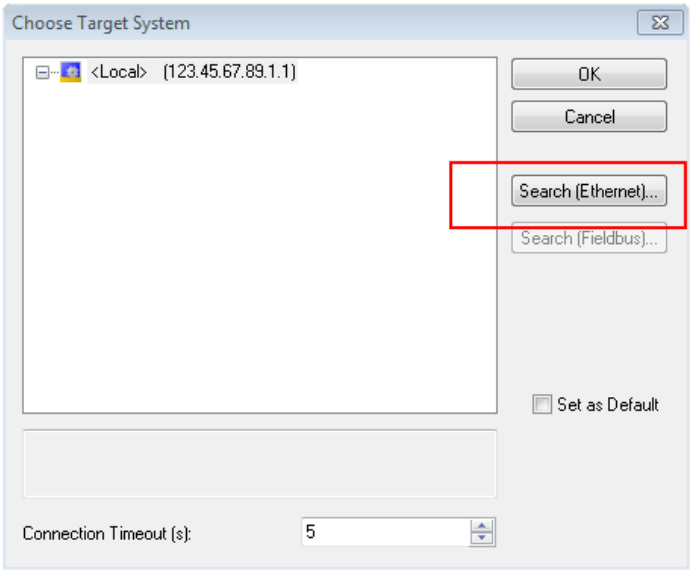


Fig. 72: Selection dialog: Choose the target system

Use “Search (Ethernet)...” to enter the target system. Thus another dialog opens to either:

- enter the known computer name after “Enter Host Name / IP:” (as shown in red)
- perform a “Broadcast Search” (if the exact computer name is not known)
- enter the known computer – IP or AmsNetID

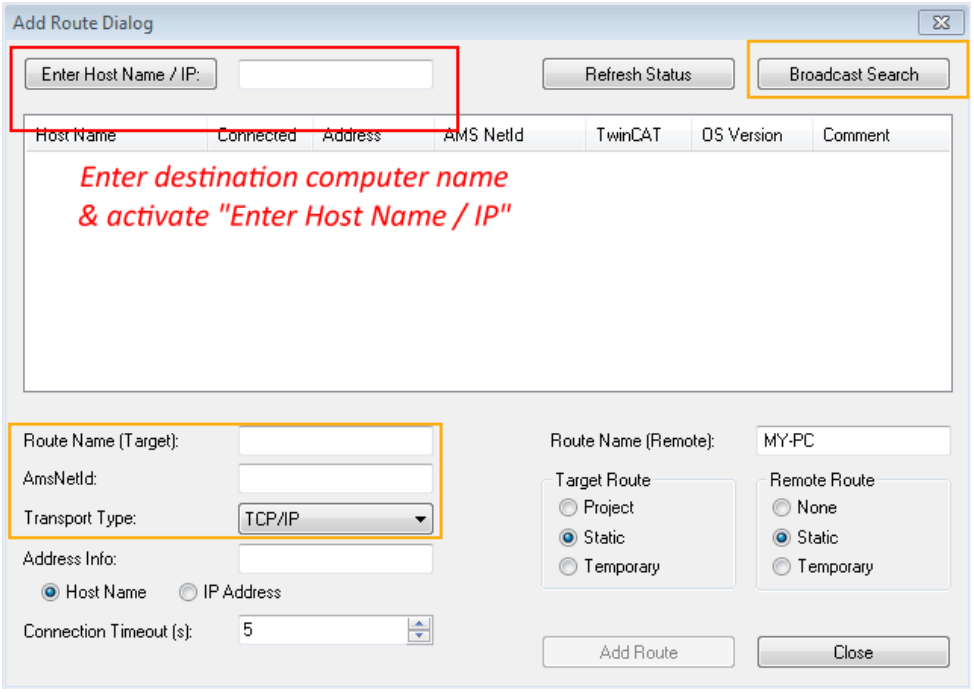
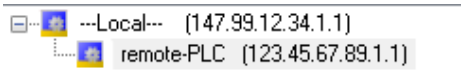


Fig. 73: specify the PLC for access by the TwinCAT System Manager: selection of the target system

Once the target system has been entered, it is available for selection as follows (the correct password may have to be entered beforehand):



After confirmation with “OK” the target system can be accessed via the Visual Studio shell.

Adding devices

In the project folder explorer on the left of the Visual Studio shell user interface, select “Devices” within the element “I/O”, then right-click to open a context menu and select “Scan” or start the action via  in the menu bar. The TwinCAT System Manager may first have to be set to “Config mode” via  or via the menu “TwinCAT” → “Restart TwinCAT (Config Mode)”.

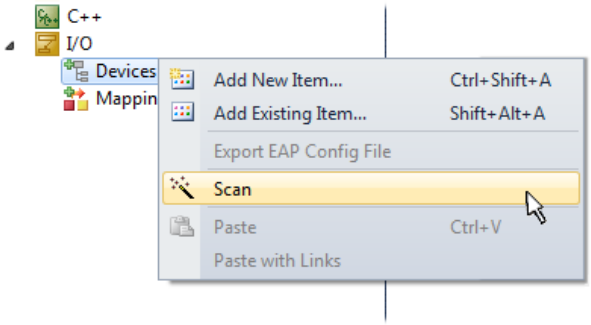


Fig. 74: Select “Scan”

Confirm the warning message, which follows, and select the “EtherCAT” devices in the dialog:

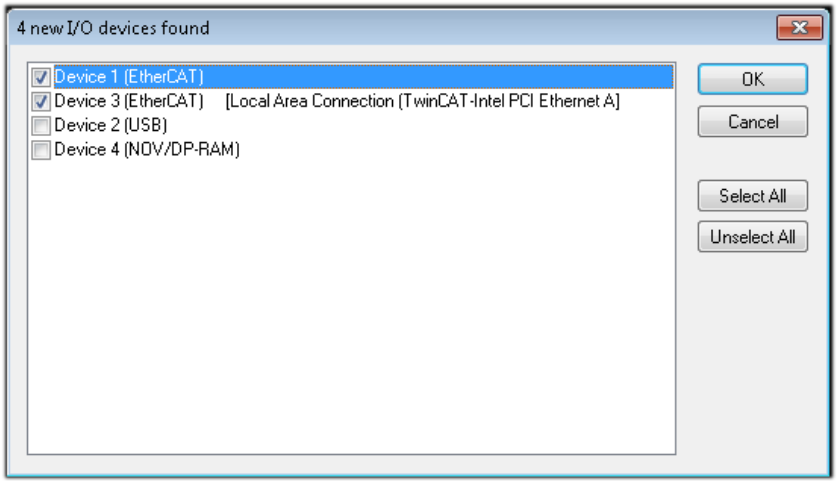


Fig. 75: Automatic detection of I/O devices: selection of the devices to be integrated

Confirm the message “Find new boxes”, in order to determine the terminals connected to the devices. “Free Run” enables manipulation of input and output values in “Config Mode” and should also be acknowledged.

Based on the example configuration [▶ 106] described at the beginning of this section, the result is as follows:

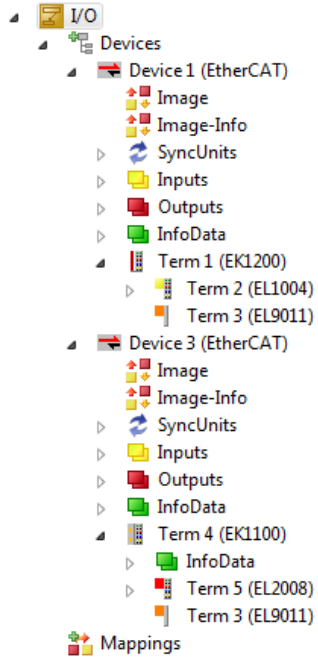


Fig. 76: Mapping of the configuration in VS shell of the TwinCAT 3 environment

The whole process consists of two stages, which can also be performed separately (first determine the devices, then determine the connected elements such as boxes, terminals, etc.). A scan (search function) can also be initiated by selecting “Device ...” from the context menu, which then only reads the elements below which are present in the configuration:

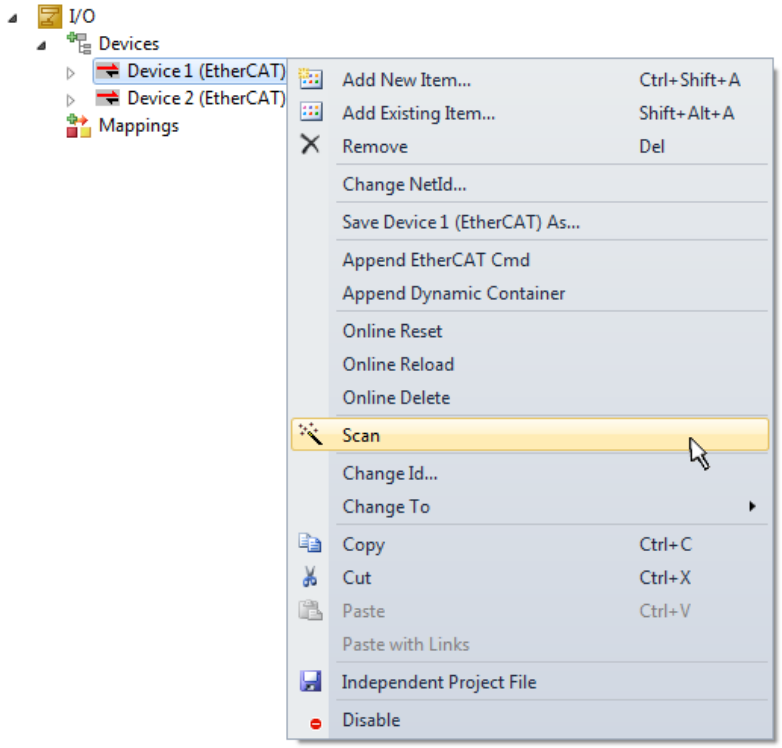


Fig. 77: Reading of individual terminals connected to a device

This functionality is useful if the actual configuration is modified at short notice.

Programming the PLC

TwinCAT PLC Control is the development environment for generating the controller in different program environments: TwinCAT PLC Control supports all languages described in IEC 61131-3. There are two text-based languages and three graphical languages.

- **Text-based languages**
  - Instruction List (IL)
  - Structured Text (ST)
- **Graphical languages**
  - Function Block Diagram (FBD)
  - Ladder Diagram (LD)
  - The Continuous Function Chart Editor (CFC)
  - Sequential Function Chart (SFC)

The following section refers solely to Structured Text (ST).

In order to create a programming environment, a PLC subproject is added to the example project via the context menu of the “PLC” in the project folder explorer by selecting “Add New Item….”:

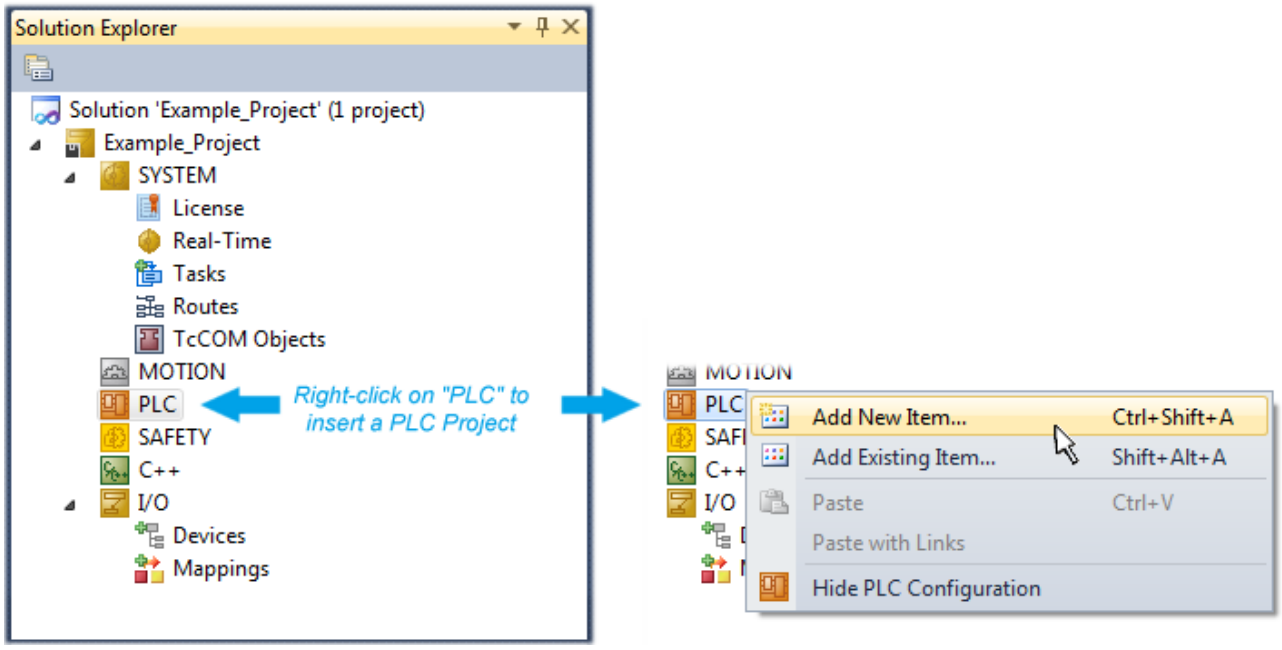


Fig. 78: Adding the programming environment in “PLC”

In the dialog that opens, select “Standard PLC project” and enter “PLC_example” as project name, for example, and select a corresponding directory:

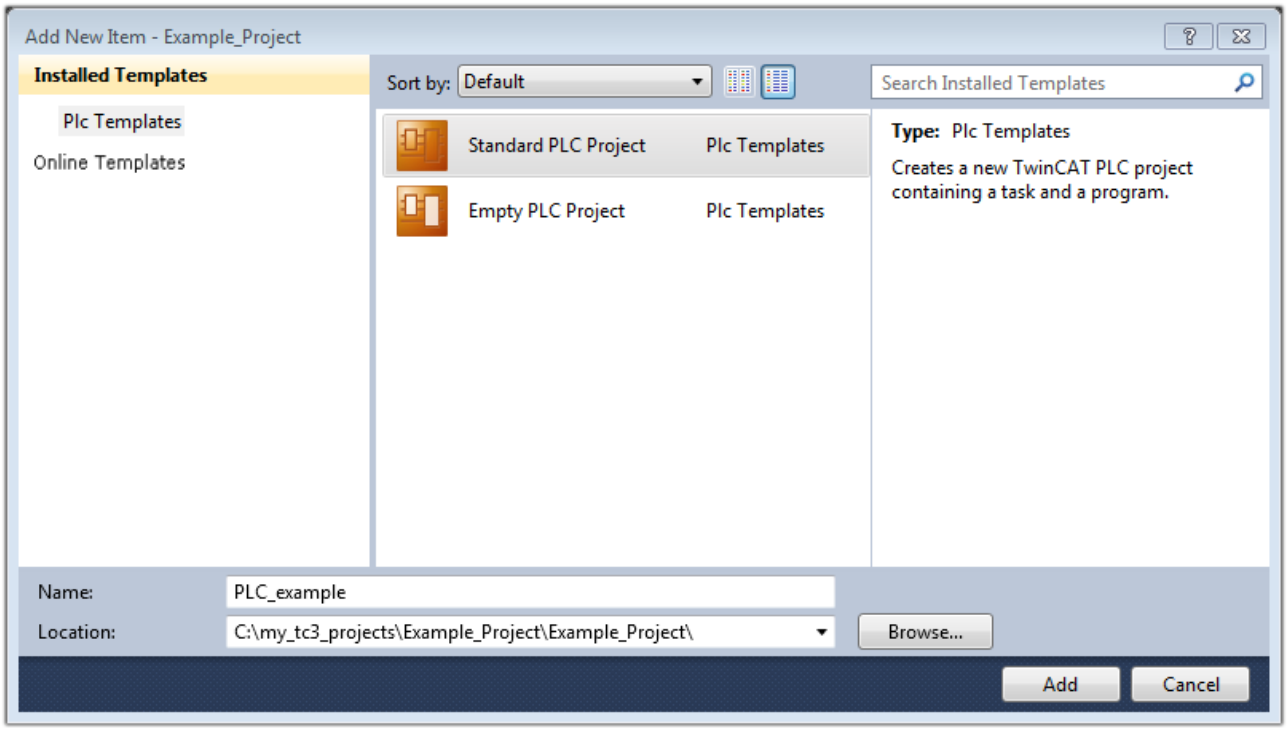


Fig. 79: Specifying the name and directory for the PLC programming environment

The “Main” program, which already exists due to selecting “Standard PLC project”, can be opened by double-clicking on “PLC_example_project” in “POUs”. The following user interface is shown for an initial project:

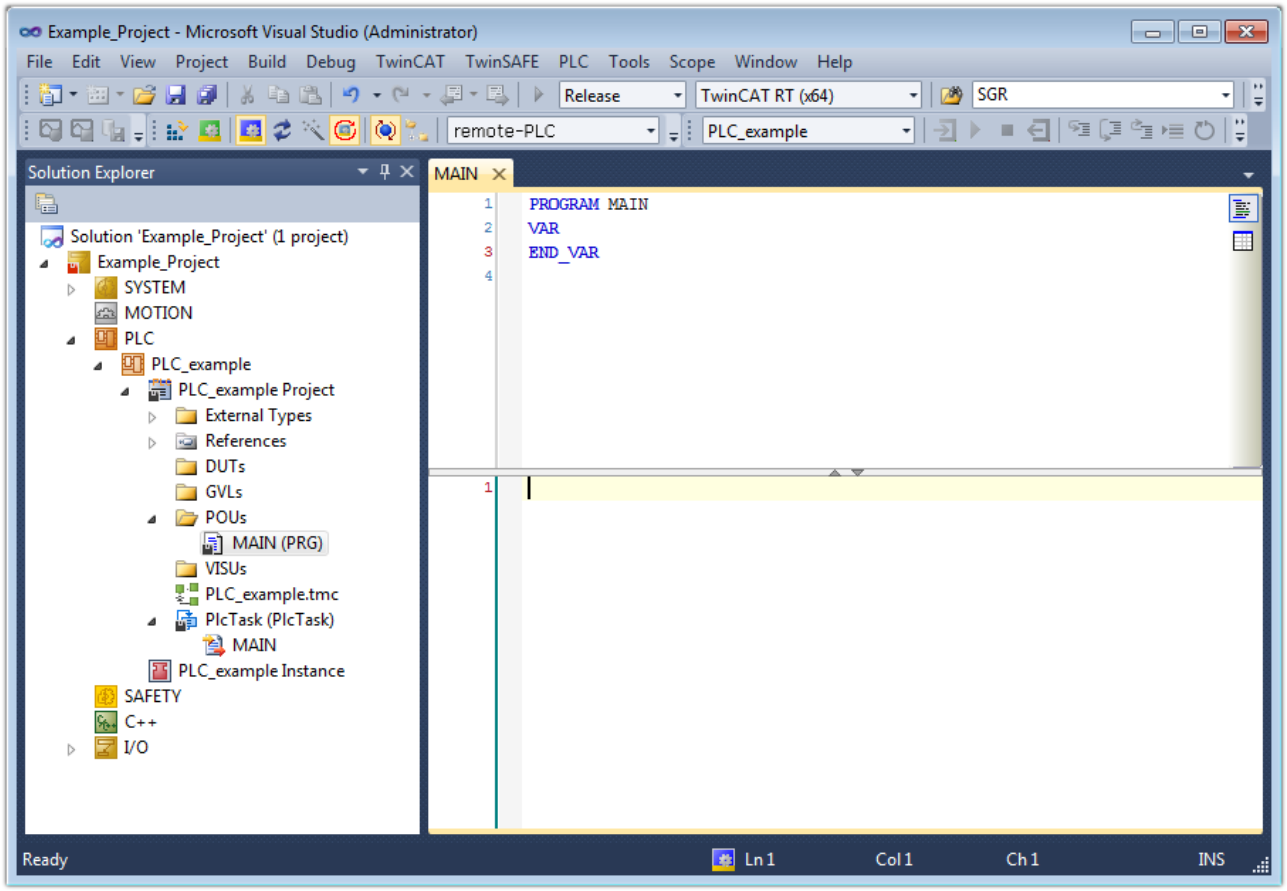


Fig. 80: Initial “Main” program for the standard PLC project

Now example variables and an example program have been created for the next stage of the process:

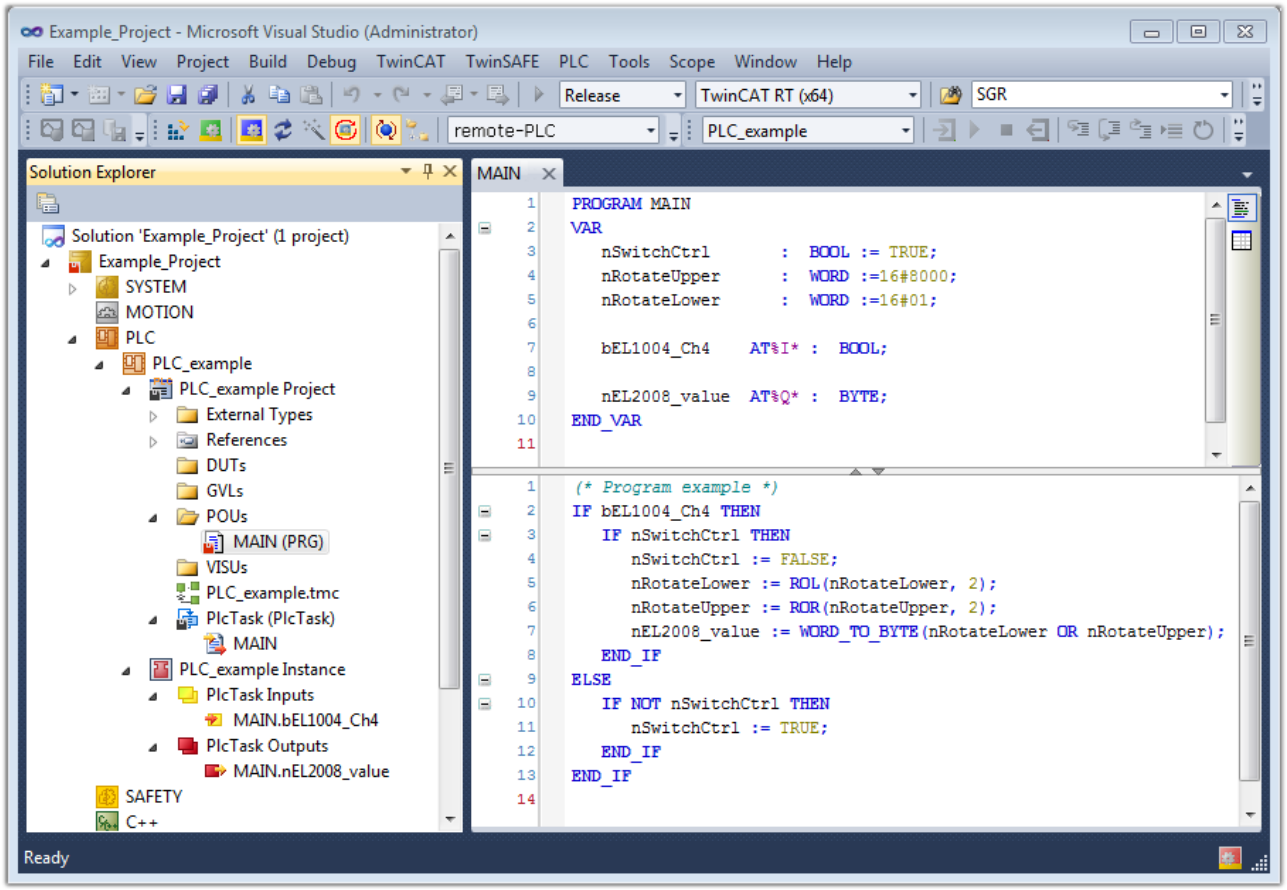


Fig. 81: Example program with variables after a compile process (without variable integration)

The control program is now created as a project folder, followed by the compile process:

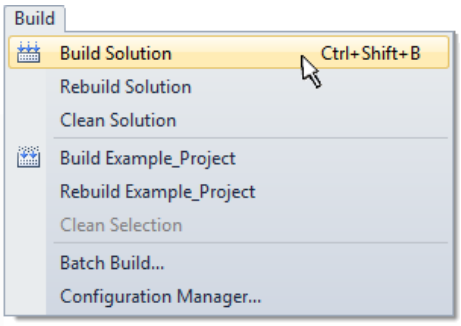
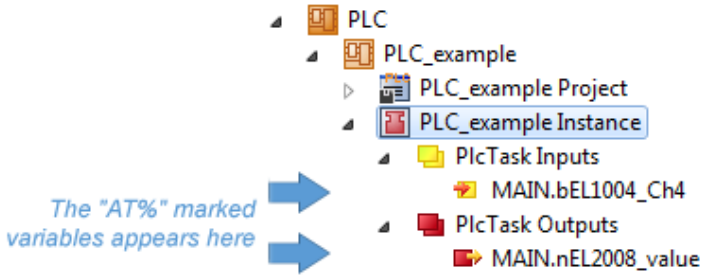


Fig. 82: Start program compilation

The following variables, identified in the ST/PLC program with “AT%”, are then available under “Assignments” in the project folder explorer:



Assigning variables

Via the menu of an instance – variables in the “PLC” context, use the “Modify Link…” option to open a window to select a suitable process object (PDO) for linking:

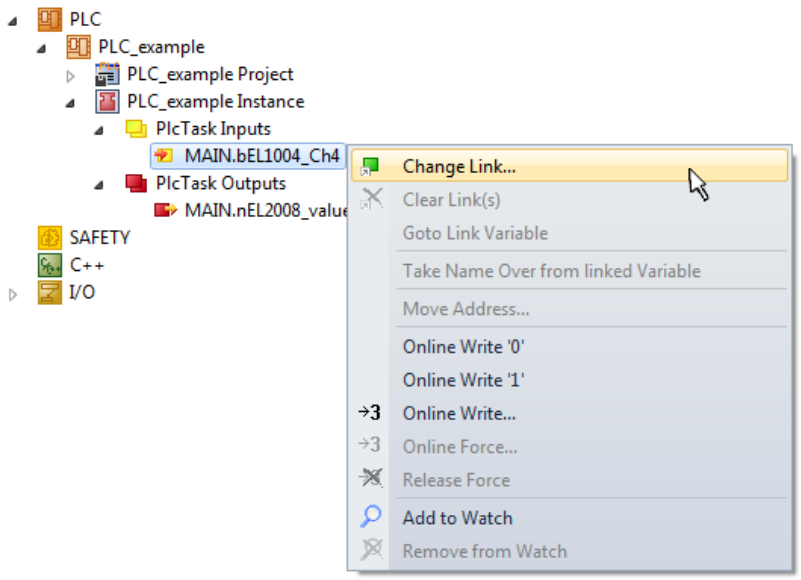


Fig. 83: Creating the links between PLC variables and process objects

In the window that opens, the process object for the “bEL1004_Ch4” BOOL-type variable can be selected from the PLC configuration tree:

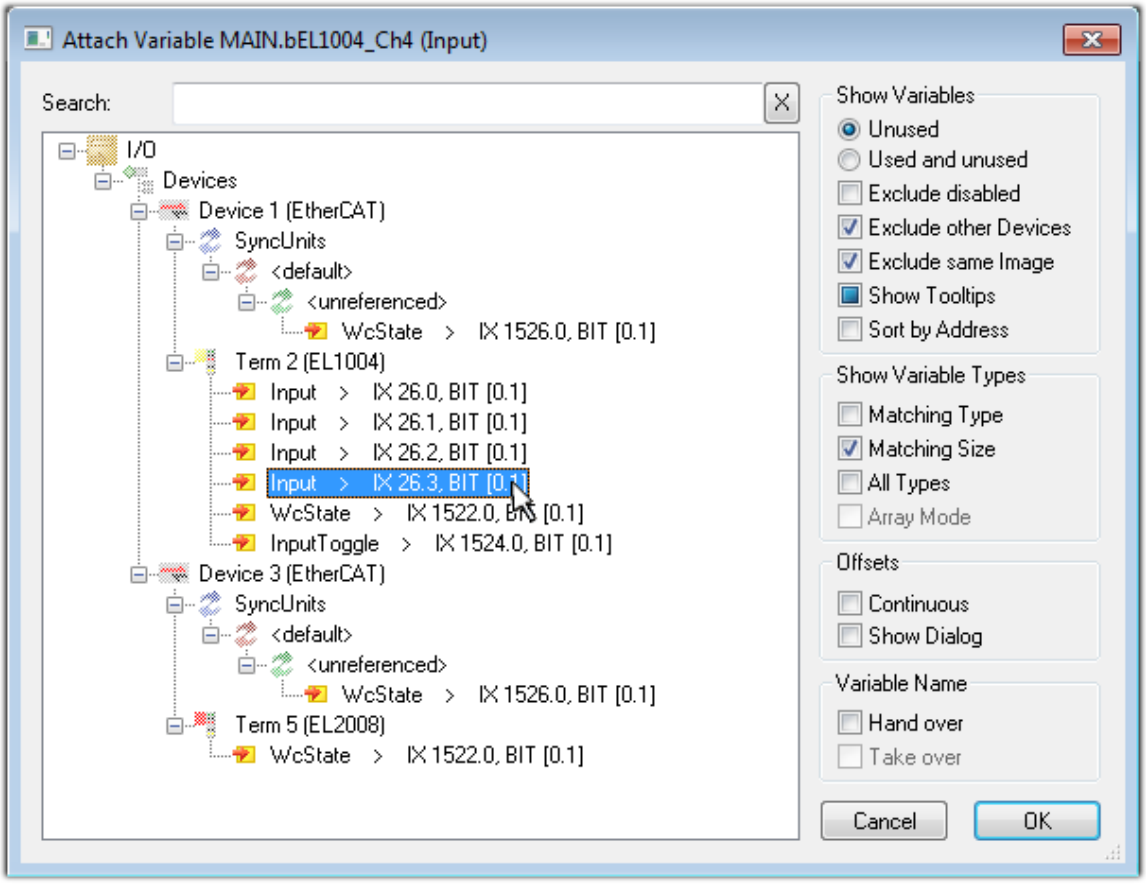


Fig. 84: Selecting BOOL-type PDO

According to the default setting, only certain PDO objects are now available for selection. In this example, the input of channel 4 of the EL1004 terminal is selected for linking. In contrast, the checkbox “All types” must be ticked to create the link for the output variables, in order to allocate a set of eight separate output bits to a byte variable in this case. The following diagram shows the whole process:

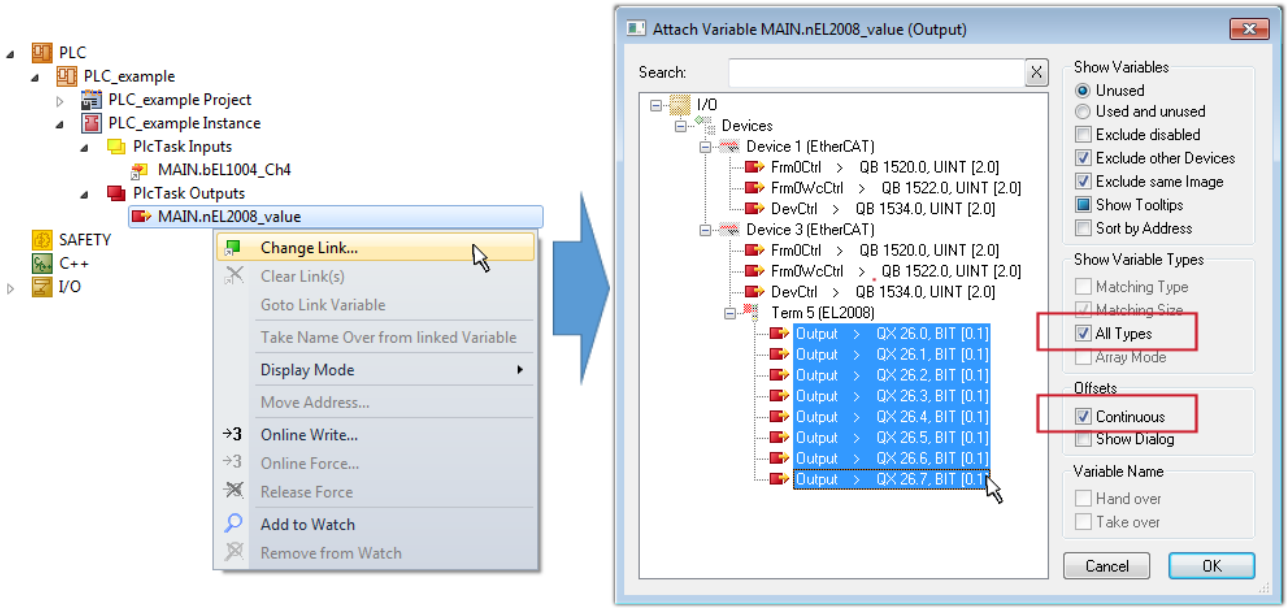


Fig. 85: Selecting several PDOs simultaneously: activate “Continuous” and “All types”

Note that the “Continuous” checkbox was also activated. This is designed to allocate the bits contained in the byte of the “nEL2008_value” variable sequentially to all eight selected output bits of the EL2008 Terminal. It is thus possible to subsequently address all eight outputs of the terminal in the program with a byte corresponding to bit 0 for channel 1 to bit 7 for channel 8 of the PLC. A special symbol ( ) on the yellow or red object of the variable indicates that a link exists. The links can also be checked by selecting “Goto Link Variable” from the context menu of a variable. The opposite linked object, in this case the PDO, is automatically selected:

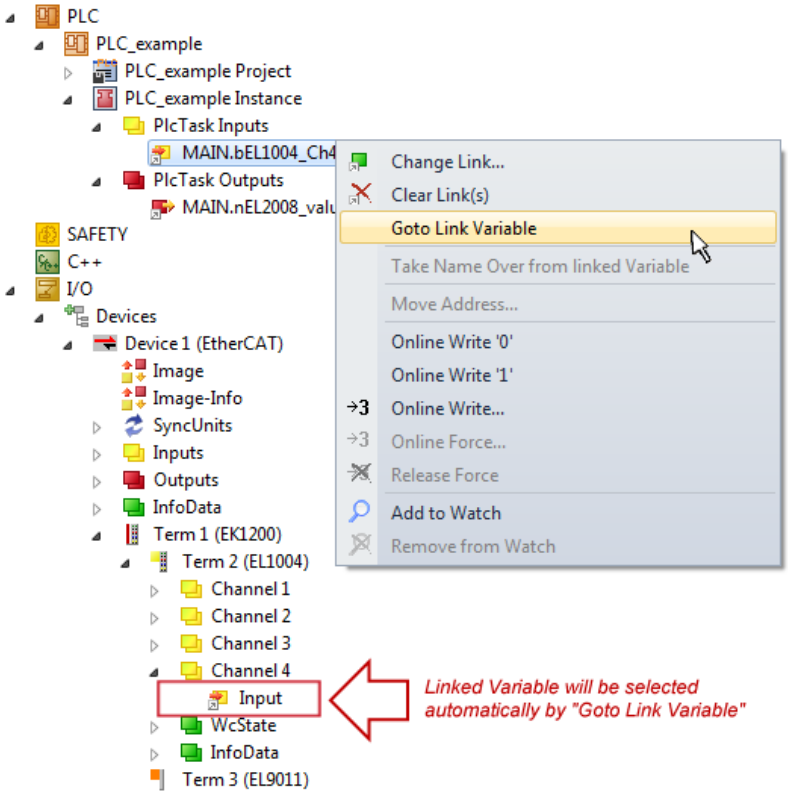


Fig. 86: Application of a “Goto Link Variable”, using “MAIN.bEL1004_Ch4” as an example

The process of creating links can also be performed in the opposite direction, i.e. starting with individual PDOs to a variable. However, in this example, it would not be possible to select all output bits for the EL2008, since the terminal only makes individual digital outputs available. If a terminal has a byte, word,

integer or similar PDO, it is also possible to allocate this to a set of bit-standardized variables. Here, too, a “Goto Link Variable” can be executed in the other direction, so that the respective PLC instance can then be selected.

Note on type of variable assignment

The following type of variable assignment can only be used from TwinCAT version V3.1.4024.4 onwards and is only available for terminals with a microcontroller.

In TwinCAT, a structure can be created from the mapped process data of a terminal. An instance of this structure can then be created in the PLC, so it is possible to access the process data directly from the PLC without having to declare own variables.

The procedure for the EL3001 1-channel analog input terminal -10...+10 V is shown as an example.

1. First, the required process data must be selected in the “Process data” tab in TwinCAT.
2. After that, the PLC data type must be generated in the “PLC” tab via the check box.
3. The data type in the “Data Type” field can then be copied using the “Copy” button.

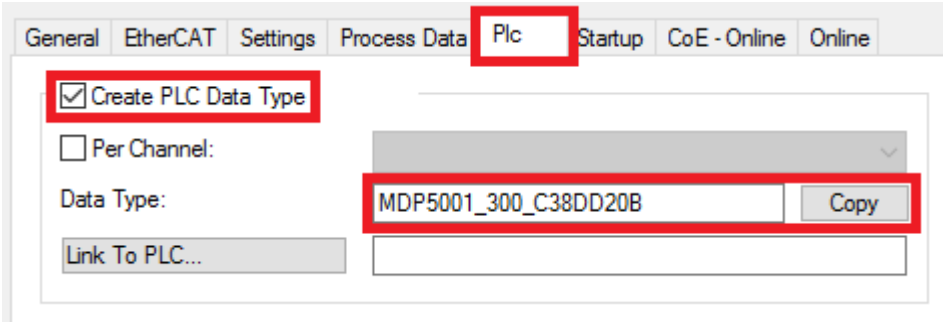


Fig. 87: Creating a PLC data type

4. An instance of the data structure of the copied data type must then be created in the PLC.

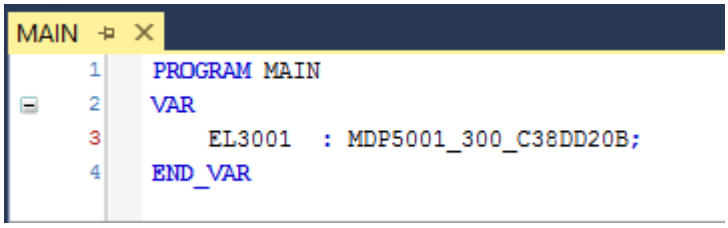


Fig. 88: Instance_of_struct

5. Then the project folder must be created. This can be done either via the key combination “CTRL + Shift + B” or via the “Build” tab in TwinCAT.
6. The structure in the “PLC” tab of the terminal must then be linked to the created instance.

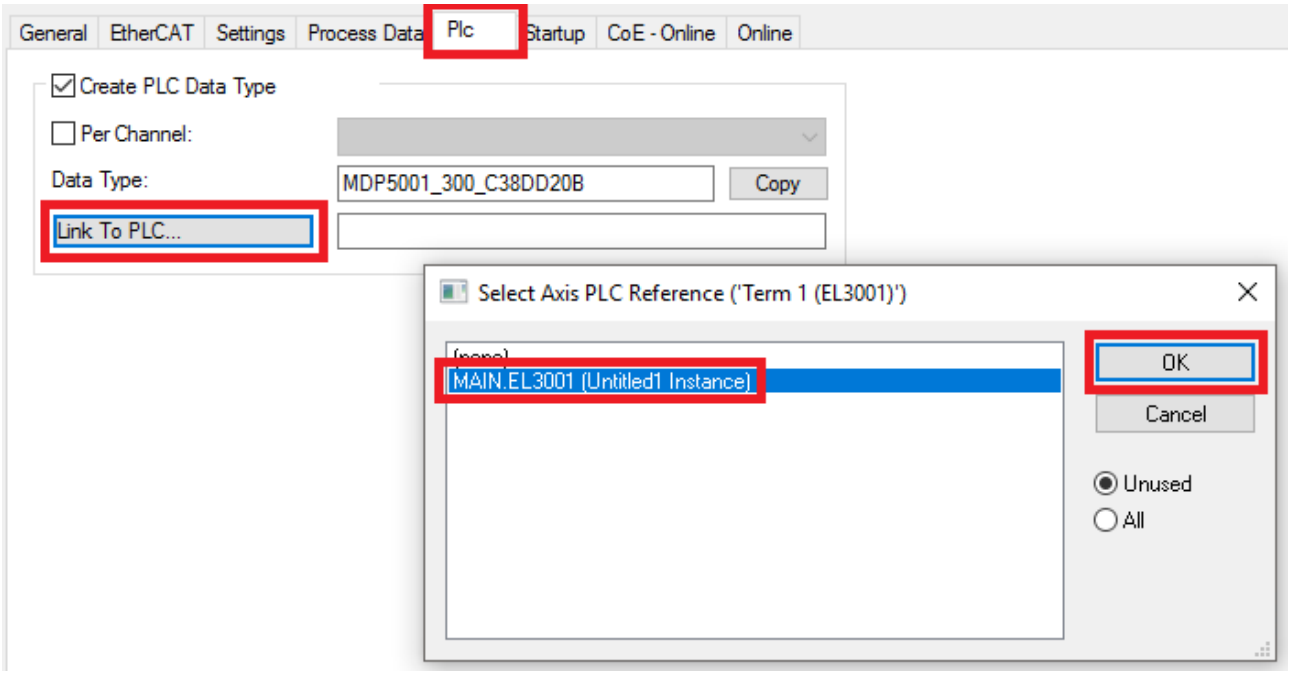


Fig. 89: Linking the structure

7. In the PLC, the process data can then be read or written via the structure in the program code.

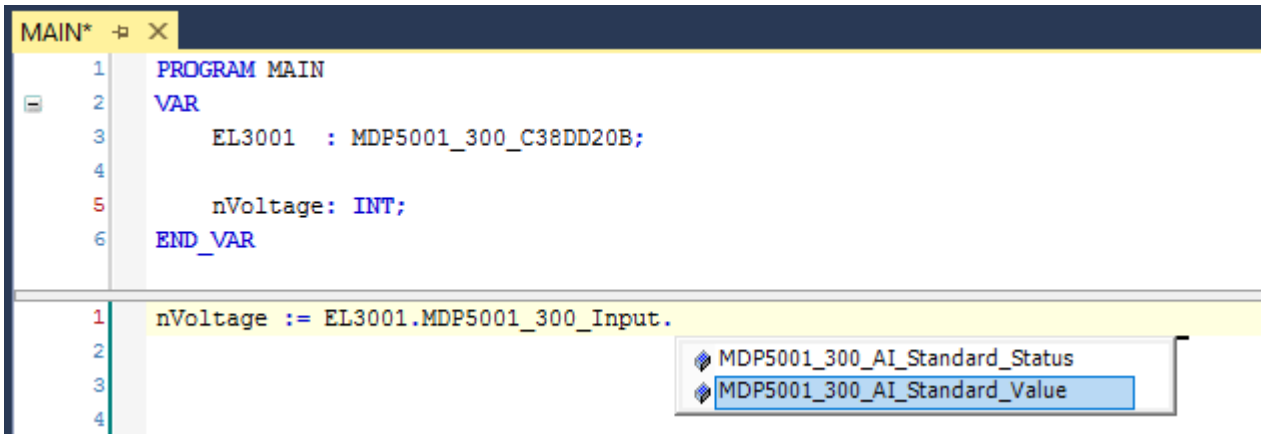
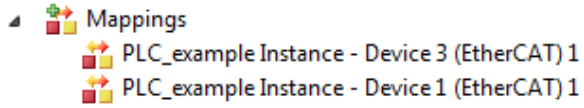


Fig. 90: Reading a variable from the structure of the process data

Activation of the configuration

The allocation of PDO to PLC variables has now established the connection from the controller to the inputs and outputs of the terminals. The configuration can now be activated with  or via the menu under “TwinCAT” in order to transfer the settings of the development environment to the runtime system. Confirm the messages “Old configurations will be overwritten!” and “Restart TwinCAT system in Run mode” with “OK”. The corresponding assignments can be seen in the project folder explorer:



A few seconds later, the corresponding status of the Run mode is displayed in the form of a rotating symbol  at the bottom right of the VS shell development environment. The PLC system can then be started as described below.

Starting the controller

Select the menu option “PLC” → “Login” or click on  to link the PLC with the real-time system and load the control program for execution. This results in the message ”*No program on the controller! Should the new program be loaded?*”, which should be acknowledged with “Yes”. The runtime environment is ready for the program to be started by clicking on symbol , the “F5” key or via “PLC” in the menu, by selecting “Start”. The started programming environment shows the runtime values of individual variables:

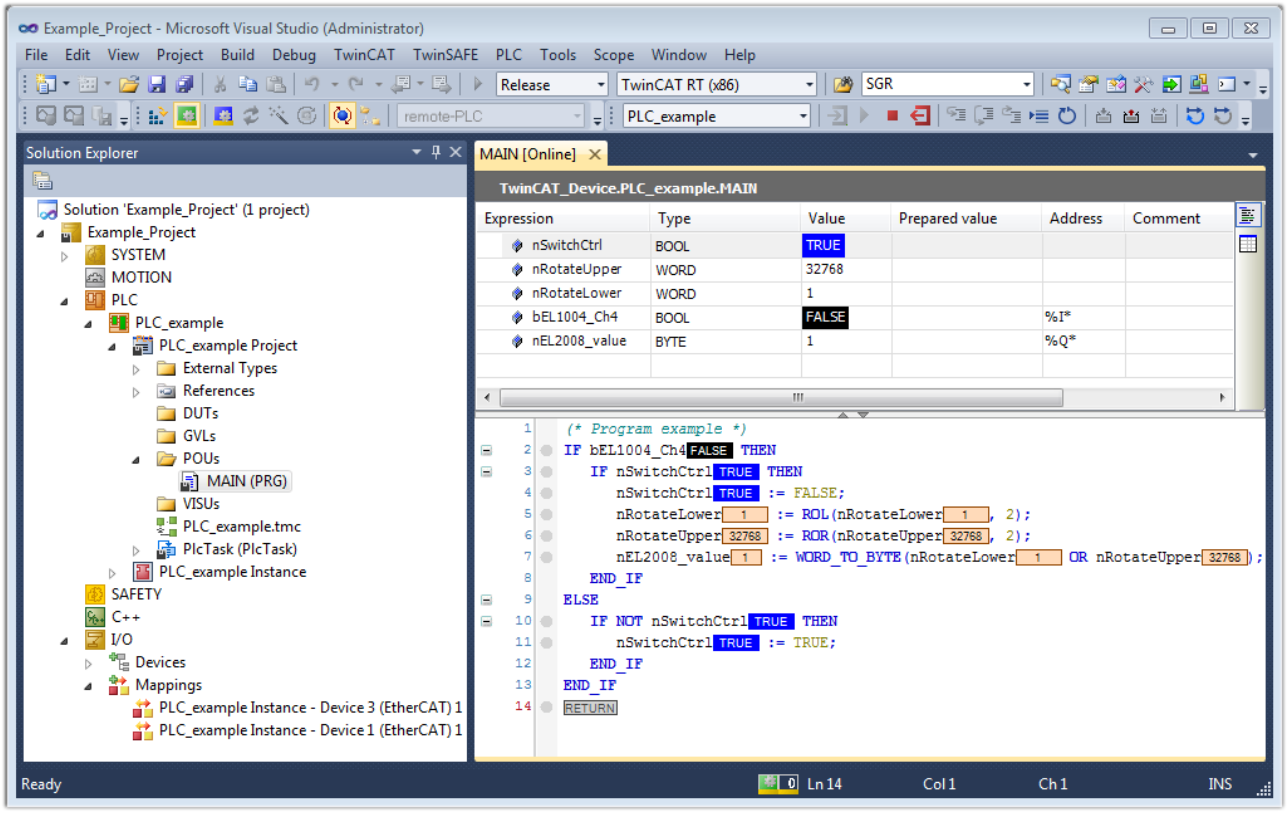


Fig. 91: TwinCAT 3 development environment (VS shell): logged-in, after program startup

The two operator control elements for stopping  and logout  result in the required action (also, “Shift + F5” can be used for stop, or both actions can be selected via the PLC menu).

6.2 TwinCAT Development Environment

The Software for automation TwinCAT (The Windows Control and Automation Technology) will be distinguished into:

- TwinCAT 2: System Manager (Configuration) and PLC Control (Programming)
- TwinCAT 3: Enhancement of TwinCAT 2 (Programming and Configuration takes place via a common Development Environment)

Details:

- **TwinCAT 2:**
  - Connects I/O devices to tasks in a variable-oriented manner
  - Connects tasks to tasks in a variable-oriented manner
  - Supports units at the bit level
  - Supports synchronous or asynchronous relationships
  - Exchange of consistent data areas and process images

- Datalink on NT - Programs by open Microsoft Standards (OLE, OCX, ActiveX, DCOM+, etc.)
- Integration of IEC 61131-3-Software-SPS, Software- NC and Software-CNC within Windows NT/ 2000/XP/Vista, Windows 7, NT/XP Embedded, CE
- Interconnection to all common fieldbusses
- More...

Additional features:

- **TwinCAT 3** (eXtended Automation)**:**
  - Visual Studio® integration
  - Choice of the programming language
  - Supports object orientated extension of IEC 61131-3
  - Usage of C/C++ as programming language for real time applications
  - Connection to MATLAB®/Simulink®
  - Open interface for expandability
  - Flexible run-time environment
  - Active support of multi-core- and 64 bit operating system
  - Automatic code generation and project creation with the TwinCAT Automation Interface
  - More...

Within the following sections commissioning of the TwinCAT Development Environment on a PC System for the control and also the basically functions of unique control elements will be explained.

Please see further information to TwinCAT 2 and TwinCAT 3 at http://infosys.beckhoff.com.

6.2.1 Installation of the TwinCAT real-time driver

In order to assign real-time capability to a standard Ethernet port of an IPC controller, the Beckhoff real-time driver has to be installed on this port under Windows.

This can be done in several ways.

A: Via the TwinCAT Adapter dialog

In the System Manager call up the TwinCAT overview of the local network interfaces via Options → Show Real Time Ethernet Compatible Devices.

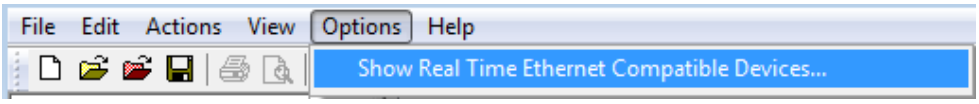


Fig. 92: System Manager “Options” (TwinCAT 2)

This have to be called up by the menu “TwinCAT” within the TwinCAT 3 environment:

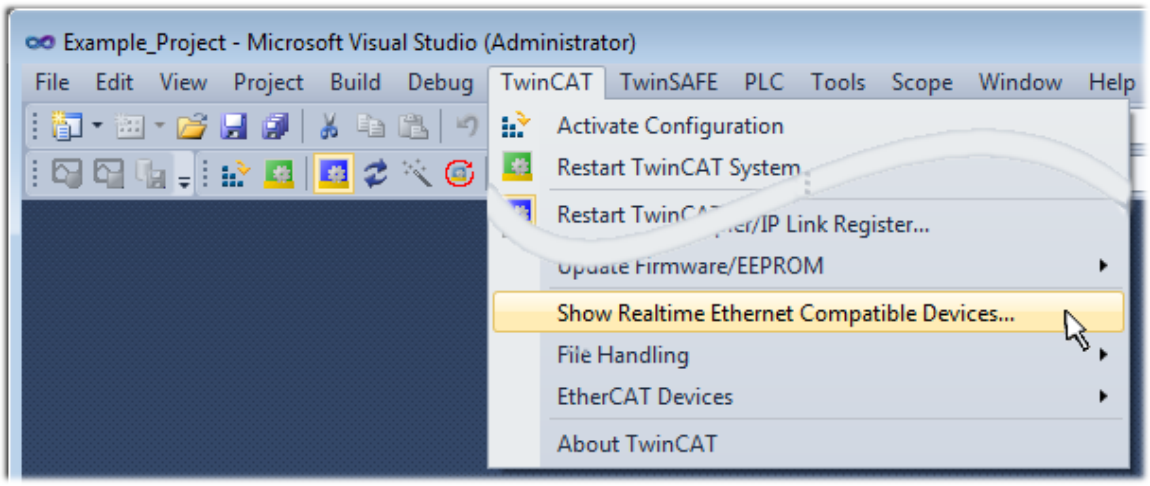


Fig. 93: Call up under VS Shell (TwinCAT 3)

B: Via TcRteInstall.exe in the TwinCAT directory

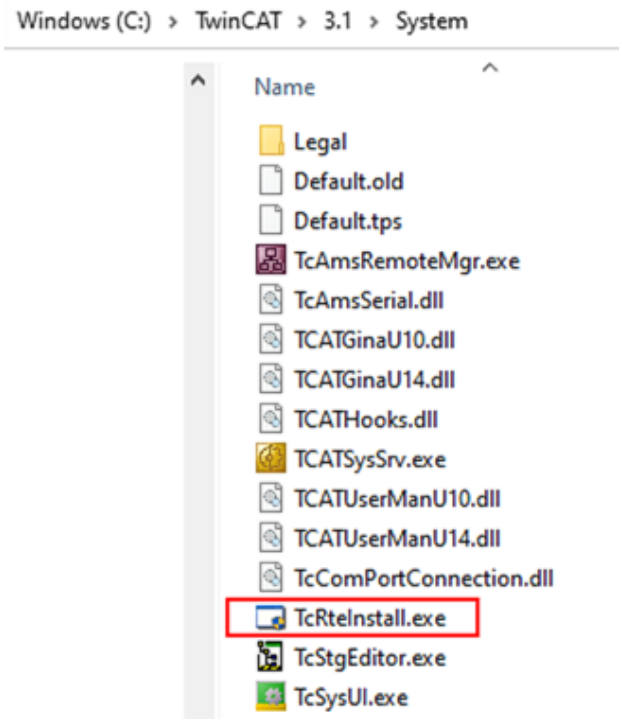


Fig. 94: TcRteInstall in the TwinCAT directory

In both cases, the following dialog appears:

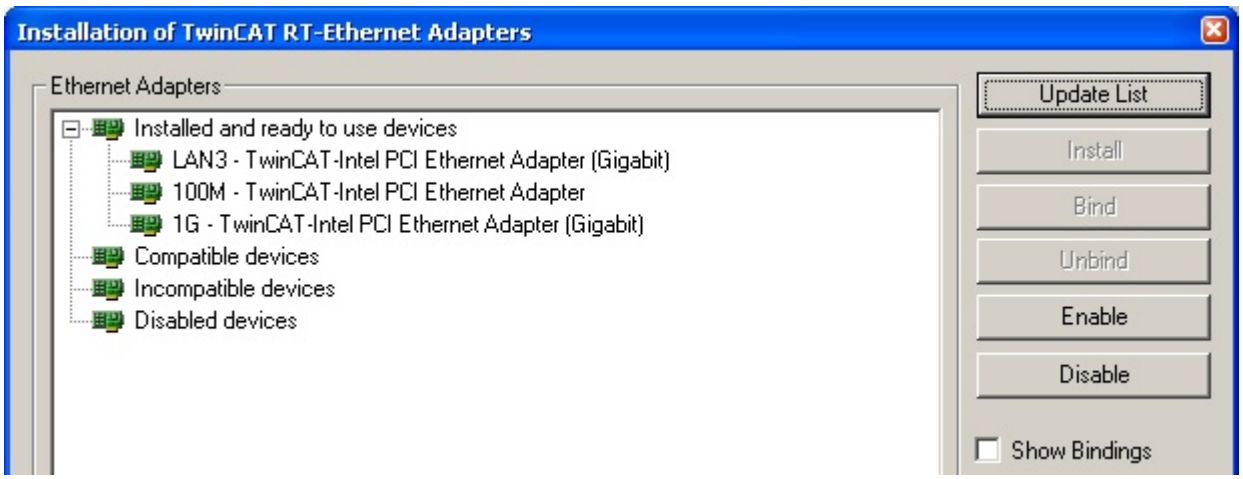


Fig. 95: Overview of network interfaces

Interfaces listed under “Compatible devices” can be assigned a driver via the “Install” button. A driver should only be installed on compatible devices.

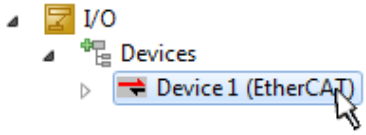
A Windows warning regarding the unsigned driver can be ignored.

Alternatively an EtherCAT-device can be inserted first of all as described in chapter Offline configuration creation, section “Creating the EtherCAT device” [▶ 143] in order to view the compatible ethernet ports via its EtherCAT properties (tab “Adapter”, button “Compatible Devices…”):



Fig. 96: EtherCAT device properties (TwinCAT 2): click on “Compatible Devices…” of tab “Adapter”

TwinCAT 3: the properties of the EtherCAT device can be opened by double click on “Device .. (EtherCAT)” within the Solution Explorer under “I/O”:



After the installation the driver appears activated in the Windows overview for the network interface (Windows Start → System Properties → Network)

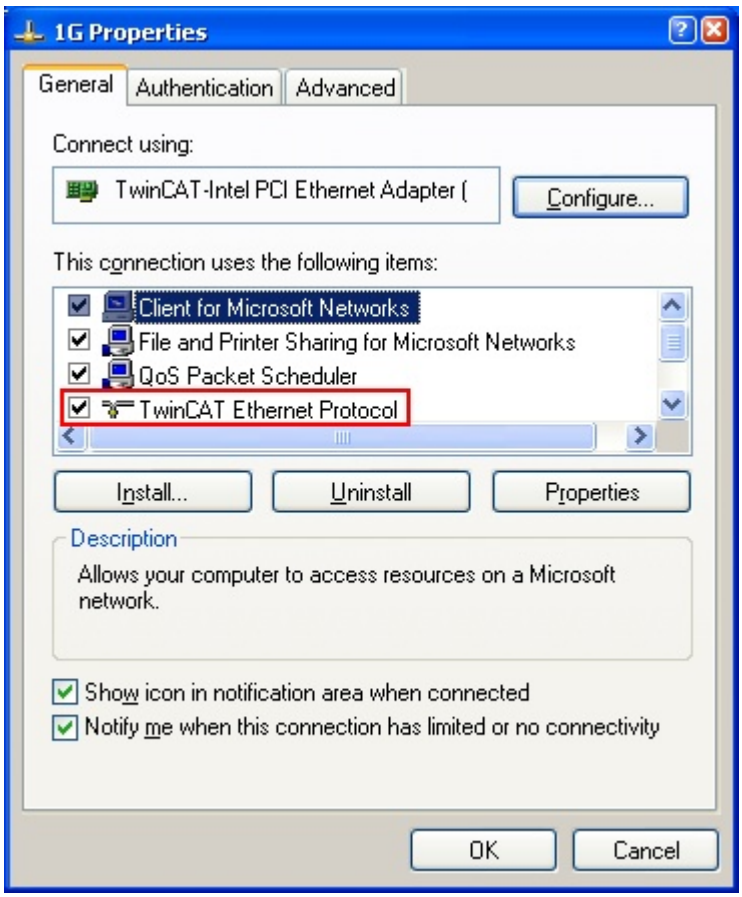


Fig. 97: Windows properties of the network interface

A correct setting of the driver could be:

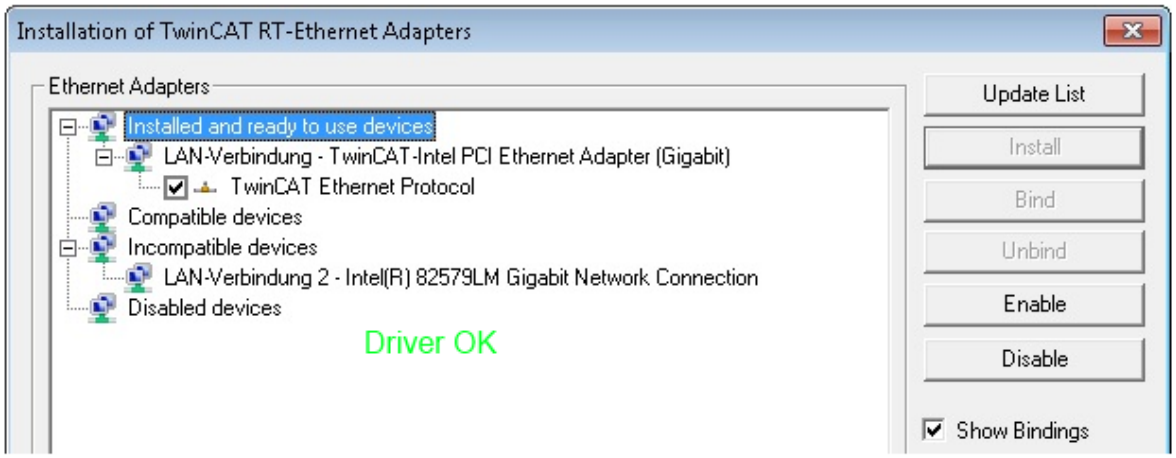
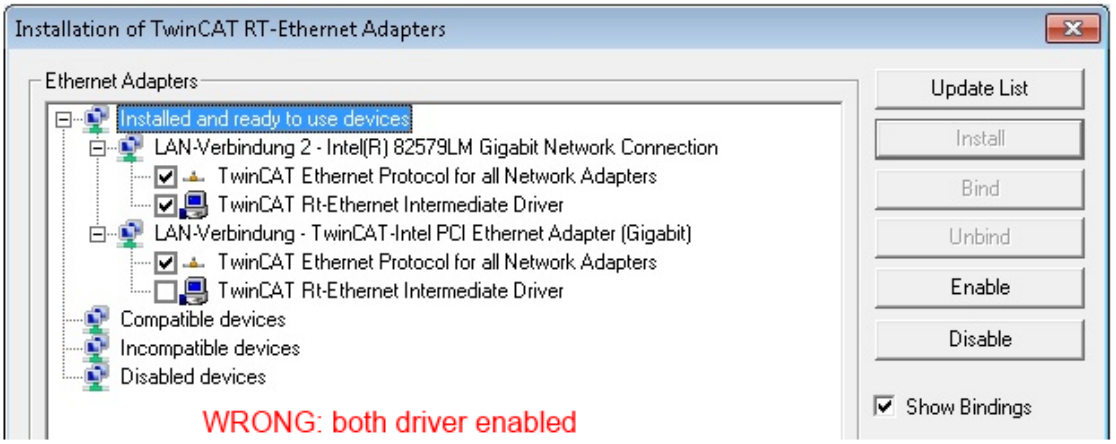
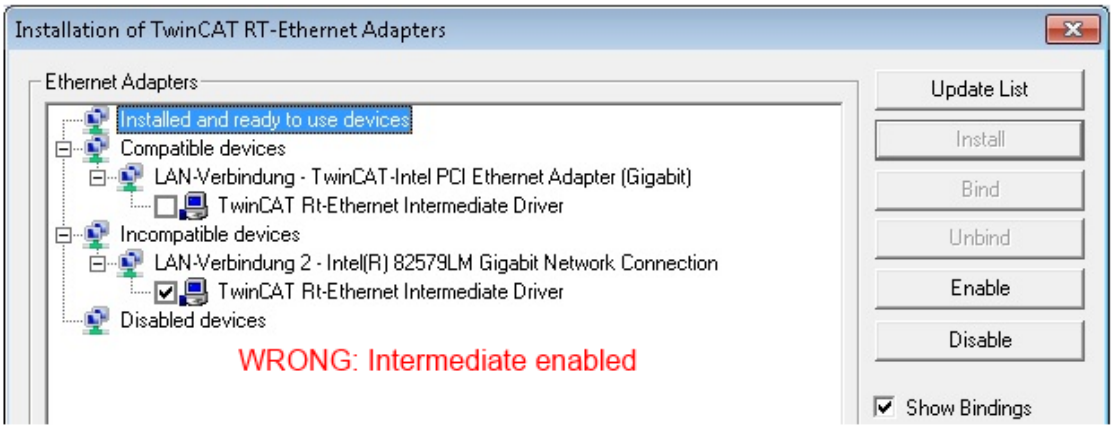
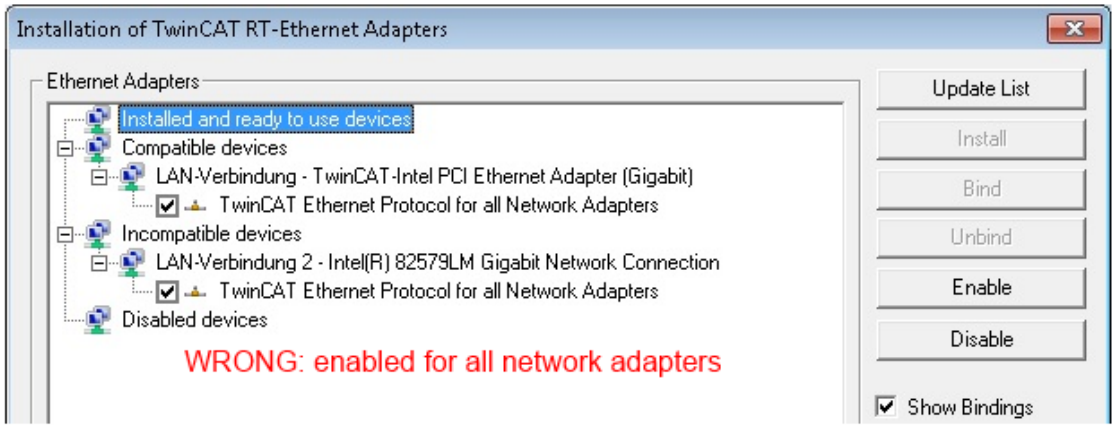


Fig. 98: Exemplary correct driver setting for the Ethernet port

Other possible settings have to be avoided:







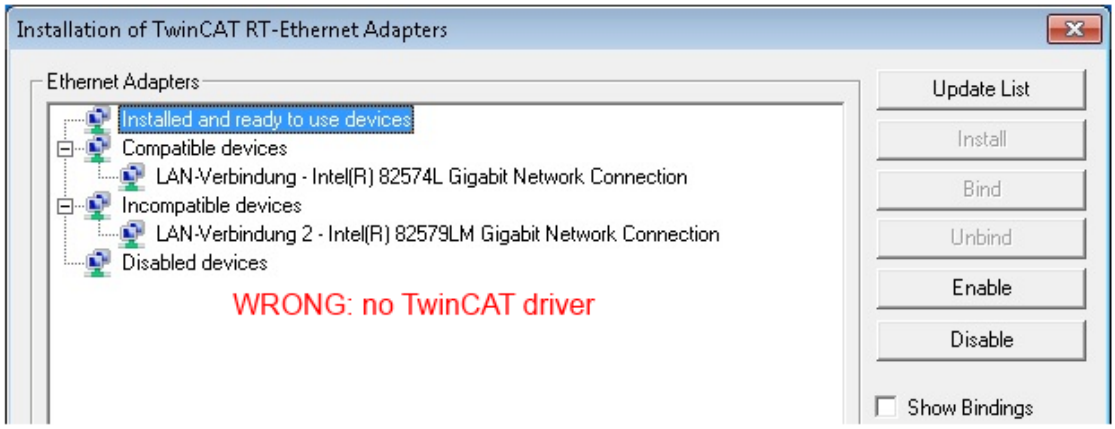


Fig. 99: Incorrect driver settings for the Ethernet port

IP address of the port used

IP address/DHCP

In most cases an Ethernet port that is configured as an EtherCAT device will not transport general IP packets. For this reason and in cases where an EL6601 or similar devices are used it is useful to specify a fixed IP address for this port via the “Internet Protocol TCP/IP” driver setting and to disable DHCP. In this way the delay associated with the DHCP client for the Ethernet port assigning itself a default IP address in the absence of a DHCP server is avoided. A suitable address space is 192.168.x.x, for example.

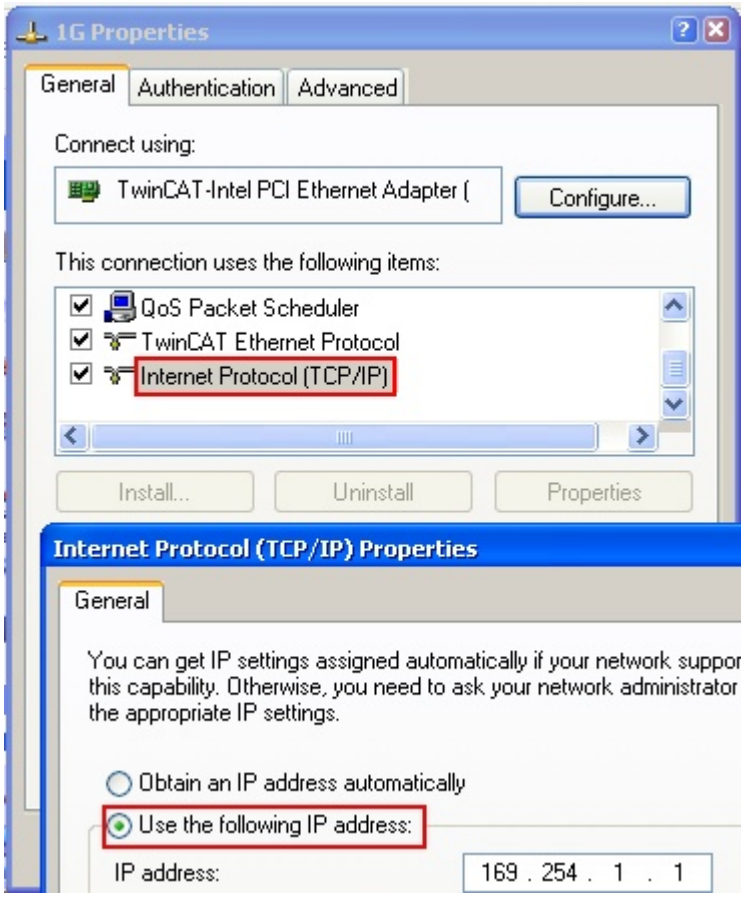


Fig. 100: TCP/IP setting for the Ethernet port

6.2.2 Notes regarding ESI device description

Installation of the latest ESI device description

The TwinCAT EtherCAT master/System Manager needs the device description files for the devices to be used in order to generate the configuration in online or offline mode. The device descriptions are contained in the so-called ESI files (EtherCAT Slave Information) in XML format. These files can be requested from the respective manufacturer and are made available for download. An *.xml file may contain several device descriptions.

The ESI files for Beckhoff EtherCAT devices are available on the Beckhoff website.

The ESI files should be stored in the TwinCAT installation directory.

Default settings:

- **TwinCAT 2**: C:\TwinCAT\IO\EtherCAT
- **TwinCAT 3**: C:\TwinCAT\3.1\Config\Io\EtherCAT

The files are read (once) when a new System Manager window is opened, if they have changed since the last time the System Manager window was opened.

A TwinCAT installation includes the set of Beckhoff ESI files that was current at the time when the TwinCAT build was created.

For TwinCAT 2.11/TwinCAT 3 and higher, the ESI directory can be updated from the System Manager, if the programming PC is connected to the Internet; by

- **TwinCAT 2**: Option → “Update EtherCAT Device Descriptions”
- **TwinCAT 3**: TwinCAT → EtherCAT Devices → “Update Device Descriptions (via ETG Website)…”

The TwinCAT ESI Updater [▶ 142] is available for this purpose.

ESI

The *.xml files are associated with *.xsd files, which describe the structure of the ESI XML files. To update the ESI device descriptions, both file types should therefore be updated.

Device differentiation

EtherCAT devices/slaves are distinguished by four properties, which determine the full device identifier. For example, the device identifier EL2521-0025-1018 consists of:

- family key “EL”
- name “2521”
- type “0025”
- and revision “1018”

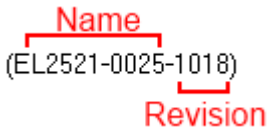


Fig. 101: Identifier structure

The order identifier consisting of name + type (here: EL2521-0025) describes the device function. The revision indicates the technical progress and is managed by Beckhoff. In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation. Each revision has its own ESI description. See further notes [▶ 12].

Online description

If the EtherCAT configuration is created online through scanning of real devices (see section Online setup) and no ESI descriptions are available for a slave (specified by name and revision) that was found, the System Manager asks whether the description stored in the device should be used. In any case, the System Manager needs this information for setting up the cyclic and acyclic communication with the slave correctly.

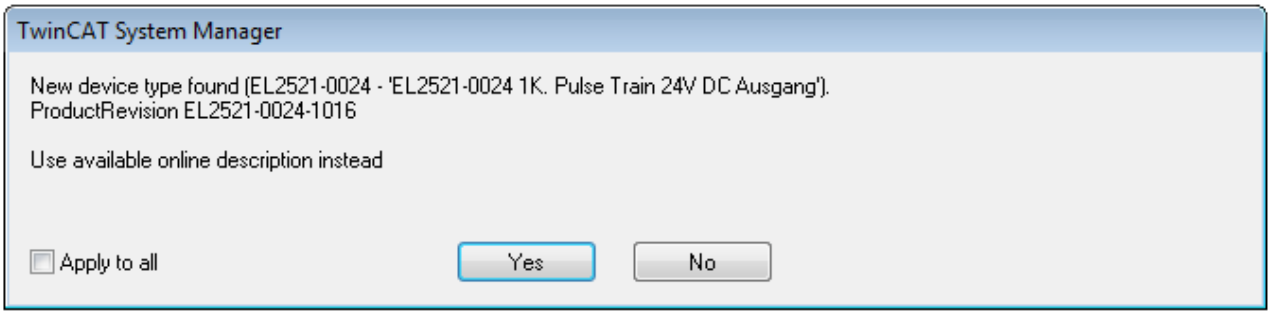


Fig. 102: OnlineDescription information window (TwinCAT 2)

In TwinCAT 3 a similar window appears, which also offers the Web update:

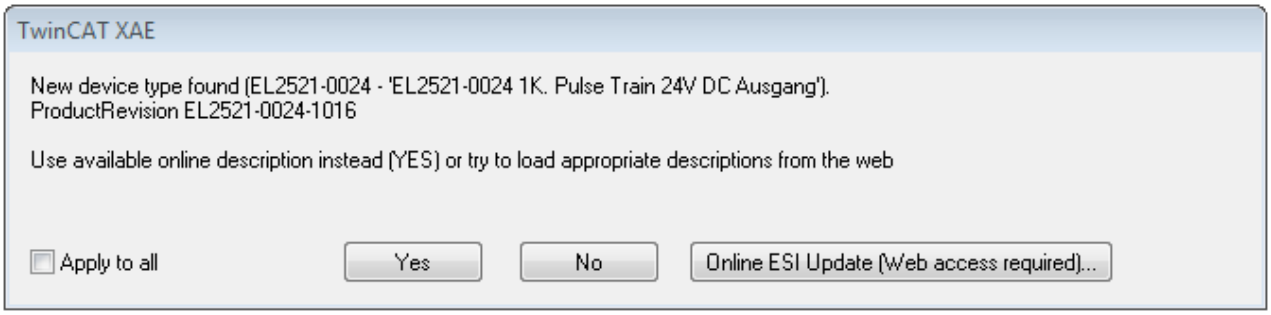


Fig. 103: Information window OnlineDescription (TwinCAT 3)

If possible, the *Yes* is to be rejected and the required ESI is to be requested from the device manufacturer. After installation of the XML/XSD file the configuration process should be repeated.

NOTICE

Changing the "usual" configuration through a scan

✓ If a scan discovers a device that is not yet known to TwinCAT, distinction has to be made between two cases. Taking the example here of the EL2521-0000 in the revision 1019

a) no ESI is present for the EL2521-0000 device at all, either for the revision 1019 or for an older revision. The ESI must then be requested from the manufacturer (in this case Beckhoff).

b) an ESI is present for the EL2521-0000 device, but only in an older revision, e.g. 1018 or 1017. In this case an in-house check should first be performed to determine whether the spare parts stock allows the integration of the increased revision into the configuration at all. A new/higher revision usually also brings along new features. If these are not to be used, work can continue without reservations with the previous revision 1018 in the configuration. This is also stated by the Beckhoff compatibility rule.

Refer in particular to the chapter "General notes on the use of Beckhoff EtherCAT IO components" and for manual configuration to the chapter "Offline configuration creation [▶ 143]".

If the OnlineDescription is used regardless, the System Manager reads a copy of the device description from the EEPROM in the EtherCAT slave. In complex slaves the size of the EEPROM may not be sufficient for the complete ESI, in which case the ESI would be *incomplete* in the configurator. Therefore it's recommended using an offline ESI file with priority in such a case.

The System Manager creates for online recorded device descriptions a new file "OnlineDescription0000...xml" in its ESI directory, which contains all ESI descriptions that were read online.

OnlineDescriptionCache00000002.xml

Fig. 104: File OnlineDescription.xml created by the System Manager

Is a slave desired to be added manually to the configuration at a later stage, online created slaves are indicated by a prepended symbol “>” in the selection list (see Figure *Indication of an online recorded ESI of EL2521 as an example)*.

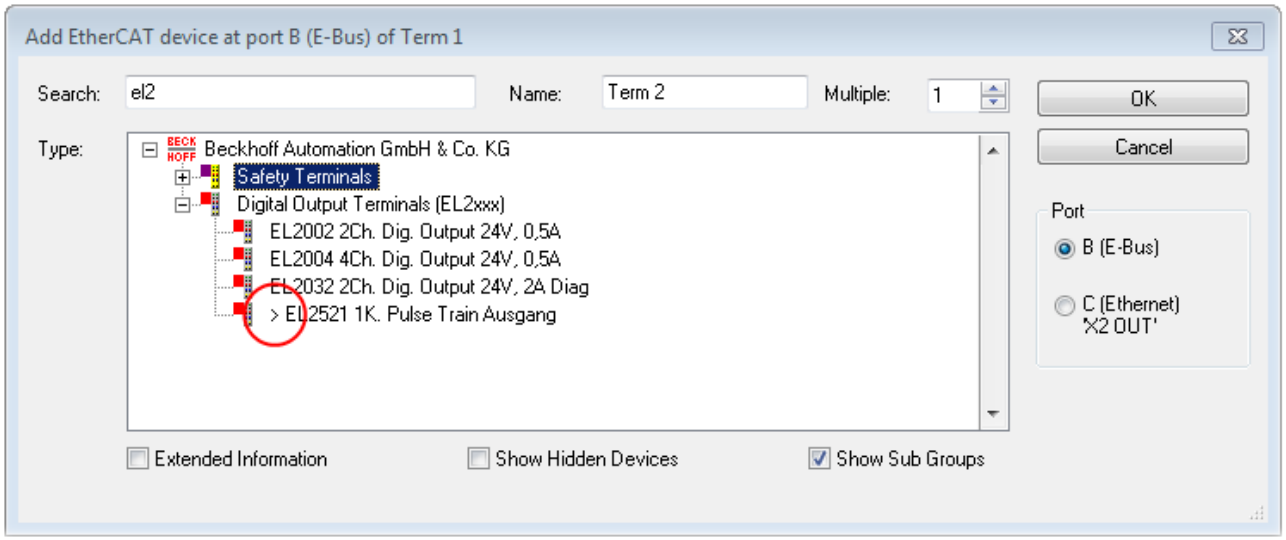


Fig. 105: Indication of an online recorded ESI of EL2521 as an example

If such ESI files are used and the manufacturer's files become available later, the file OnlineDescription.xml should be deleted as follows:

- close all System Manager windows
- restart TwinCAT in Config mode
- delete “OnlineDescription0000...xml”
- restart TwinCAT System Manager

This file should not be visible after this procedure, if necessary press <F5> to update

OnlineDescription for TwinCAT 3.x

In addition to the file described above “OnlineDescription0000...xml”, a so called EtherCAT cache with new discovered devices is created by TwinCAT 3.x, e.g. under Windows 7:

C:\User\[USERNAME]\AppData\Roaming\Beckhoff\TwinCAT3\Components\Base\EtherCATCache.xml

(Please note the language settings of the OS!)
You have to delete this file, too.

Faulty ESI file

If an ESI file is faulty and the System Manager is unable to read it, the System Manager brings up an information window.

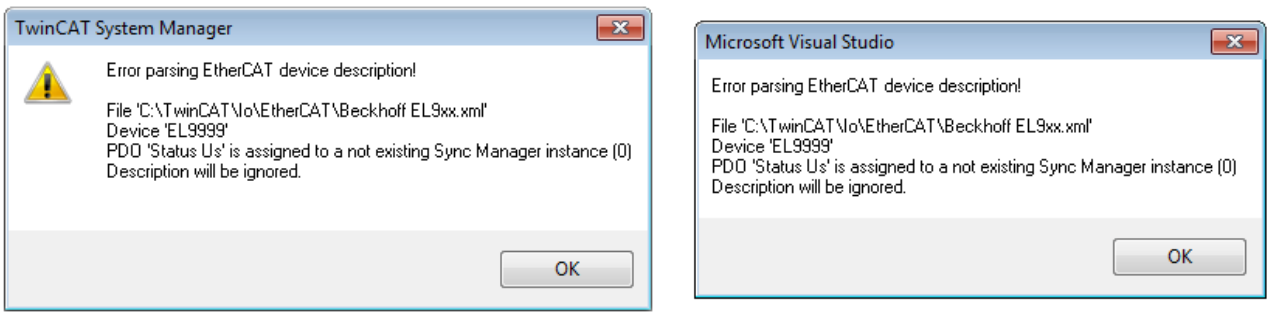


Fig. 106: Information window for faulty ESI file (left: TwinCAT 2; right: TwinCAT 3)

Reasons may include:

- Structure of the *.xml does not correspond to the associated *.xsd file → check your schematics
- Contents cannot be translated into a device description → contact the file manufacturer

6.2.3 TwinCAT ESI Updater

For TwinCAT 2.11 and higher, the System Manager can search for current Beckhoff ESI files automatically, if an online connection is available:

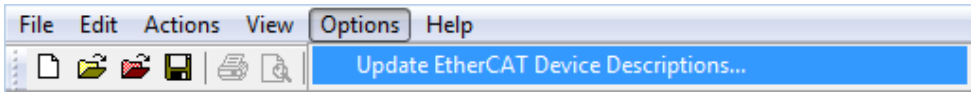


Fig. 107: Using the ESI Updater (>= TwinCAT 2.11)

The call up takes place under:
“Options” → “Update EtherCAT Device Descriptions”

Selection under TwinCAT 3:

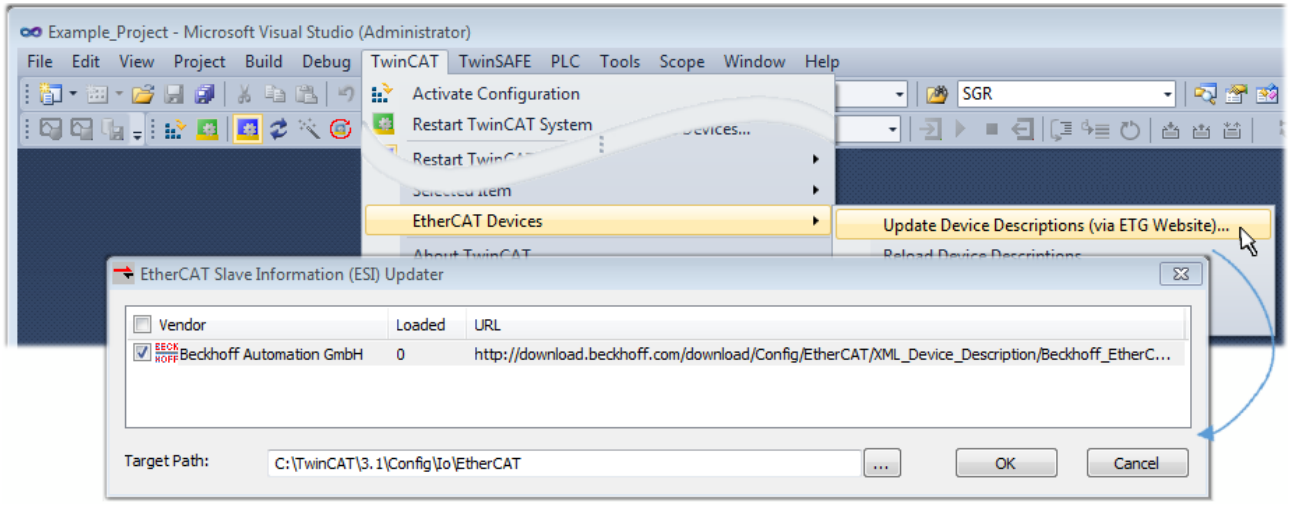


Fig. 108: Using the ESI Updater (TwinCAT 3)

The ESI Updater (TwinCAT 3) is a convenient option for automatic downloading of ESI data provided by EtherCAT manufacturers via the Internet into the TwinCAT directory (ESI = EtherCAT slave information). TwinCAT accesses the central ESI ULR directory list stored at ETG; the entries can then be viewed in the Updater dialog, although they cannot be changed there.

The call up takes place under:
“TwinCAT” → “EtherCAT Devices” → “Update Device Description (via ETG Website)…”.

6.2.4 Distinction between Online and Offline

The distinction between online and offline refers to the presence of the actual I/O environment (drives, terminals, EJ-modules). If the configuration is to be prepared in advance of the system configuration as a programming system, e.g. on a laptop, this is only possible in “Offline configuration” mode. In this case all components have to be entered manually in the configuration, e.g. based on the electrical design.

If the designed control system is already connected to the EtherCAT system and all components are energised and the infrastructure is ready for operation, the TwinCAT configuration can simply be generated through “scanning” from the runtime system. This is referred to as online configuration.

In any case, during each startup the EtherCAT master checks whether the slaves it finds match the configuration. This test can be parameterised in the extended slave settings. Refer to note “Installation of the latest ESI-XML device description” [▶ 138].

For preparation of a configuration:

- the real EtherCAT hardware (devices, couplers, drives) must be present and installed
- the devices/modules must be connected via EtherCAT cables or in the terminal/ module strand in the same way as they are intended to be used later
- the devices/modules be connected to the power supply and ready for communication

- TwinCAT must be in CONFIG mode on the target system.

The online scan process consists of:

- detecting the EtherCAT device [▶ 148] (Ethernet port at the IPC)
- detecting the connected EtherCAT devices [▶ 149]. This step can be carried out independent of the preceding step
- troubleshooting [▶ 152]

The scan with existing configuration [▶ 153] can also be carried out for comparison.

6.2.5 OFFLINE configuration creation

Creating the EtherCAT device

Create an EtherCAT device in an empty System Manager window.

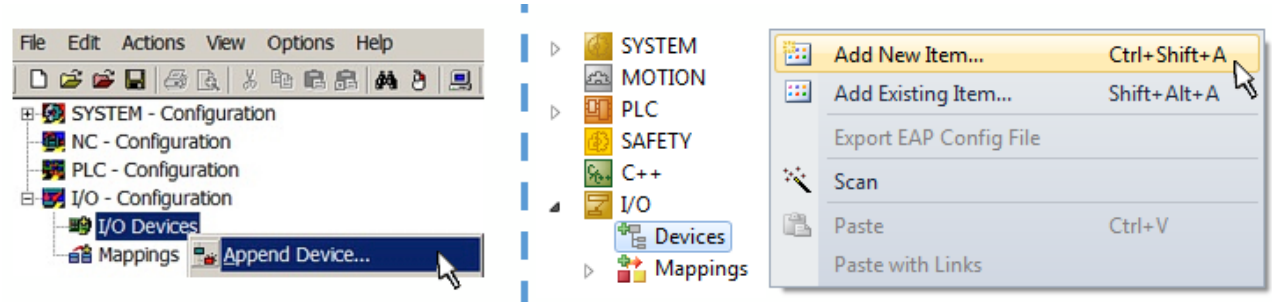


Fig. 109: Append EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)

Select type “EtherCAT” for an EtherCAT I/O application with EtherCAT slaves. For the present publisher/subscriber service in combination with an EL6601/EL6614 terminal select “EtherCAT Automation Protocol via EL6601”.

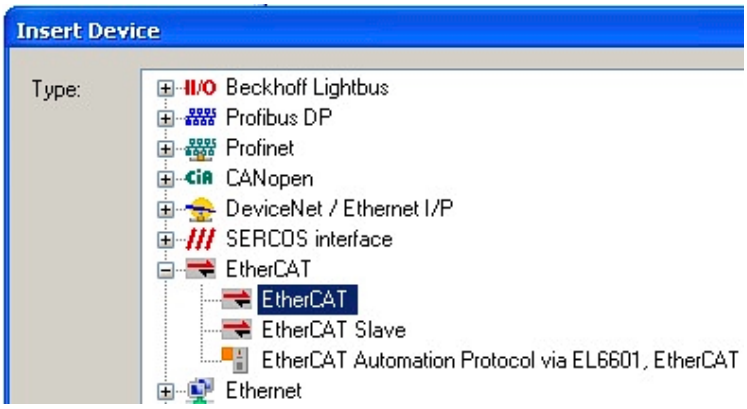


Fig. 110: Selecting the EtherCAT connection (TwinCAT 2.11, TwinCAT 3)

Then assign a real Ethernet port to this virtual device in the runtime system.

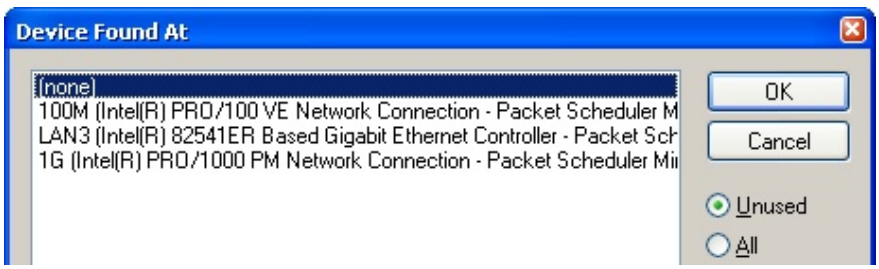


Fig. 111: Selecting the Ethernet port

This query may appear automatically when the EtherCAT device is created, or the assignment can be set/ modified later in the properties dialog; see Fig. “EtherCAT device properties (TwinCAT 2)”.

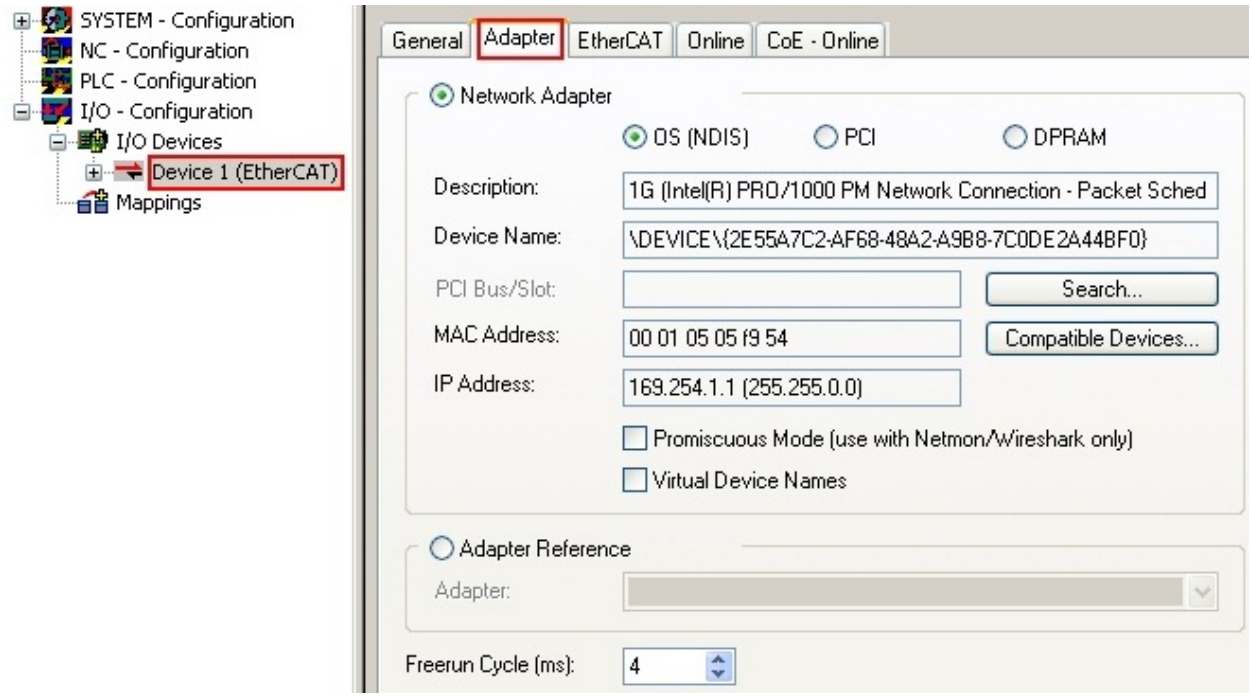
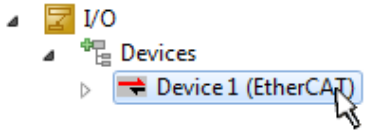


Fig. 112: EtherCAT device properties (TwinCAT 2)

TwinCAT 3: the properties of the EtherCAT device can be opened by double click on “Device .. (EtherCAT)” within the Solution Explorer under “I/O”:



Selecting the Ethernet port

Ethernet ports can only be selected for EtherCAT devices for which the TwinCAT real-time driver is installed. This has to be done separately for each port. Please refer to the respective installation page [▶ 132].

Defining EtherCAT slaves

Further devices can be appended by right-clicking on a device in the configuration tree.

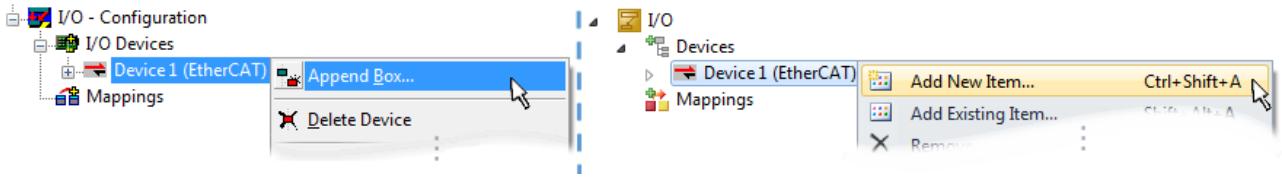


Fig. 113: Appending EtherCAT devices (left: TwinCAT 2; right: TwinCAT 3)

The dialog for selecting a new device opens. Only devices for which ESI files are available are displayed.

Only devices are offered for selection that can be appended to the previously selected device. Therefore, the physical layer available for this port is also displayed (Fig. “Selection dialog for new EtherCAT device”, A). In the case of cable-based Fast-Ethernet physical layer with PHY transfer, then also only cable-based devices are available, as shown in Fig. “Selection dialog for new EtherCAT device”. If the preceding device has several free ports (e.g. EK1122 or EK1100), the required port can be selected on the right-hand side (A).

Overview of physical layer

- “Ethernet”: cable-based 100BASE-TX: couplers, box modules, devices with RJ45/M8/M12 connector

- “E-Bus”: LVDS “terminal bus”, EtherCAT plug-in modules (EJ), EtherCAT terminals (EL/ES), various modular modules

The search field facilitates finding specific devices (since TwinCAT 2.11 or TwinCAT 3).

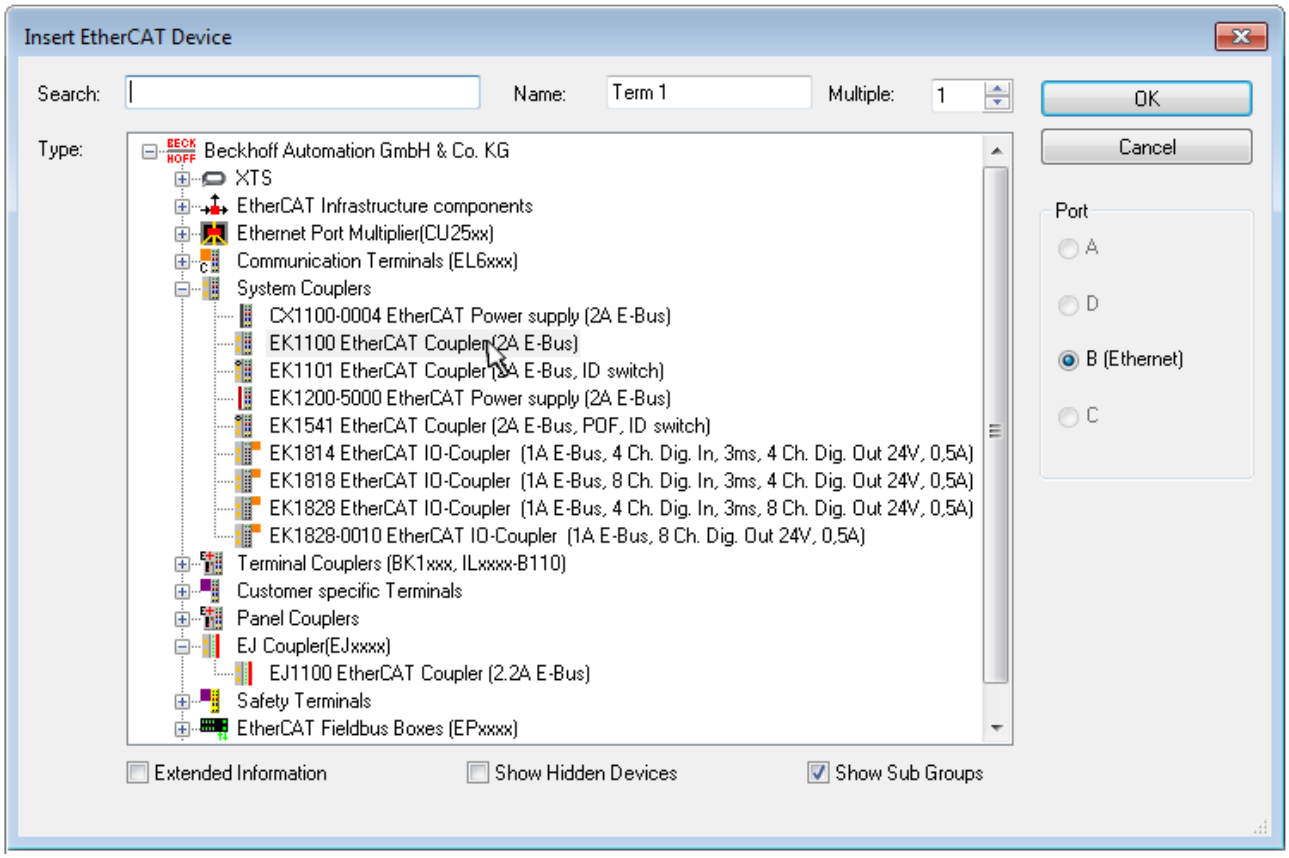


Fig. 114: Selection dialog for new EtherCAT device

By default, only the name/device type is used as selection criterion. For selecting a specific revision of the device, the revision can be displayed as “Extended Information”.

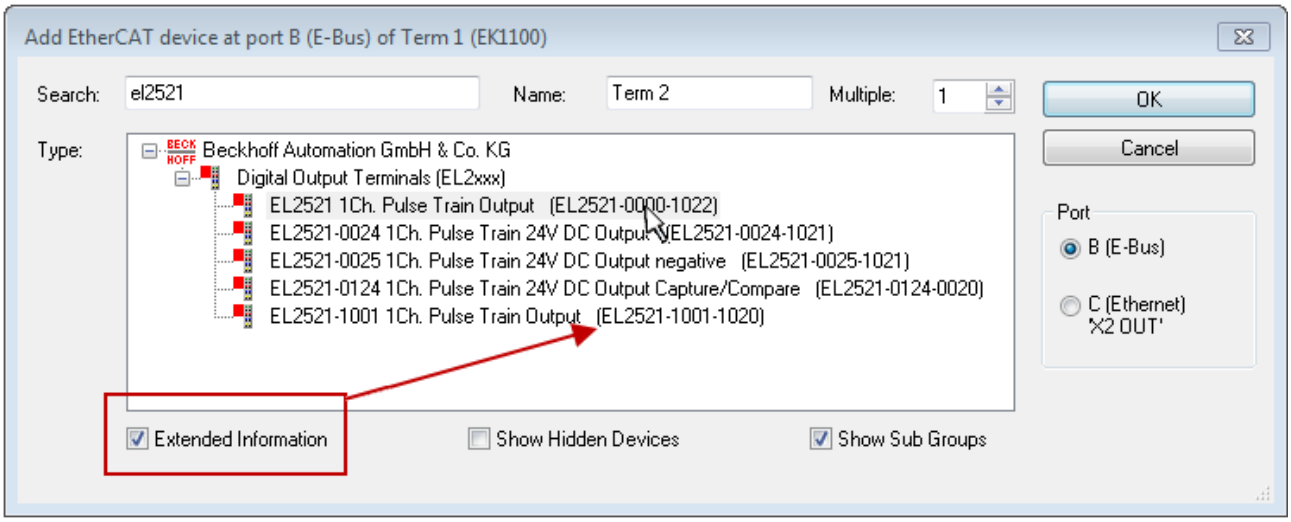


Fig. 115: Display of device revision

In many cases several device revisions were created for historic or functional reasons, e.g. through technological advancement. For simplification purposes (see Fig. “Selection dialog for new EtherCAT device”) only the last (i.e. highest) revision and therefore the latest state of production is displayed in the selection dialog for Beckhoff devices. To show all device revisions available in the system as ESI descriptions tick the “Show Hidden Devices” check box, see Fig. “Display of previous revisions”.

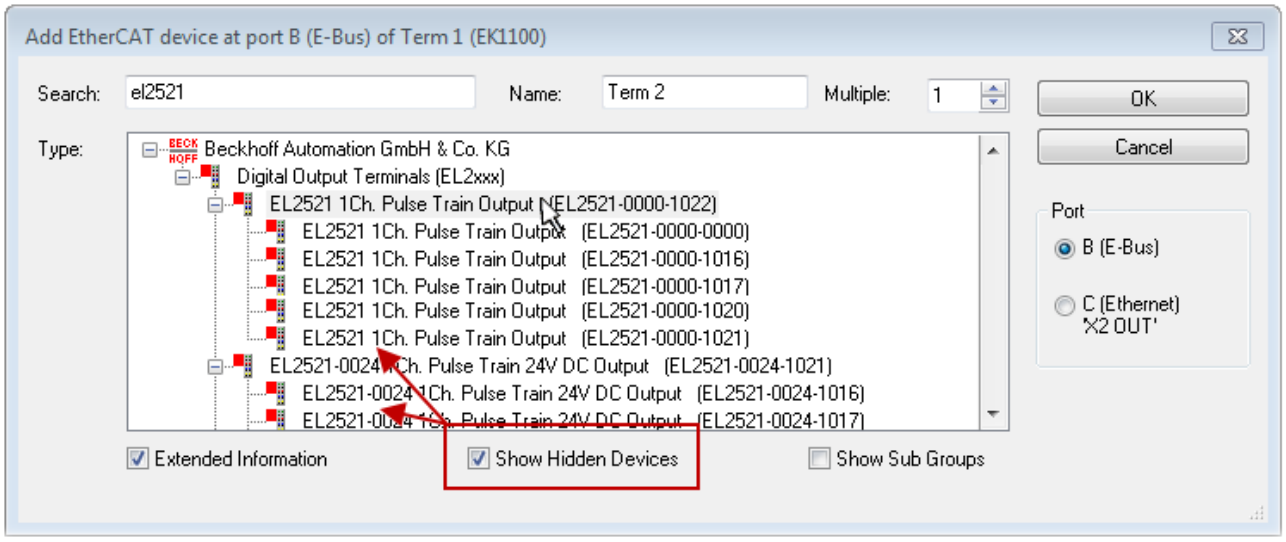


Fig. 116: Display of previous revisions

Device selection based on revision, compatibility

The ESI description also defines the process image, the communication type between master and slave/device and the device functions, if applicable. The physical device (firmware, if available) has to support the communication queries/settings of the master. This is backward compatible, i.e. newer devices (higher revision) should be supported if the EtherCAT master addresses them as an older revision. The following compatibility rule of thumb is to be assumed for Beckhoff EtherCAT Terminals/ Boxes/ EJ-modules:

device revision in the system >= device revision in the configuration

This also enables subsequent replacement of devices without changing the configuration (different specifications are possible for drives).

Example

If an EL2521-0025-**1018** is specified in the configuration, an EL2521-0025-**1018** or higher (-**1019**, -**1020**) can be used in practice.

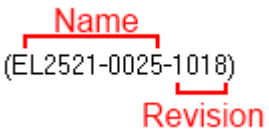


Fig. 117: Name/revision of the terminal

If current ESI descriptions are available in the TwinCAT system, the last revision offered in the selection dialog matches the Beckhoff state of production. It is recommended to use the last device revision when creating a new configuration, if current Beckhoff devices are used in the real application. Older revisions should only be used if older devices from stock are to be used in the application.

In this case the process image of the device is shown in the configuration tree and can be parameterized as follows: linking with the task, CoE/DC settings, plug-in definition, startup settings, ...

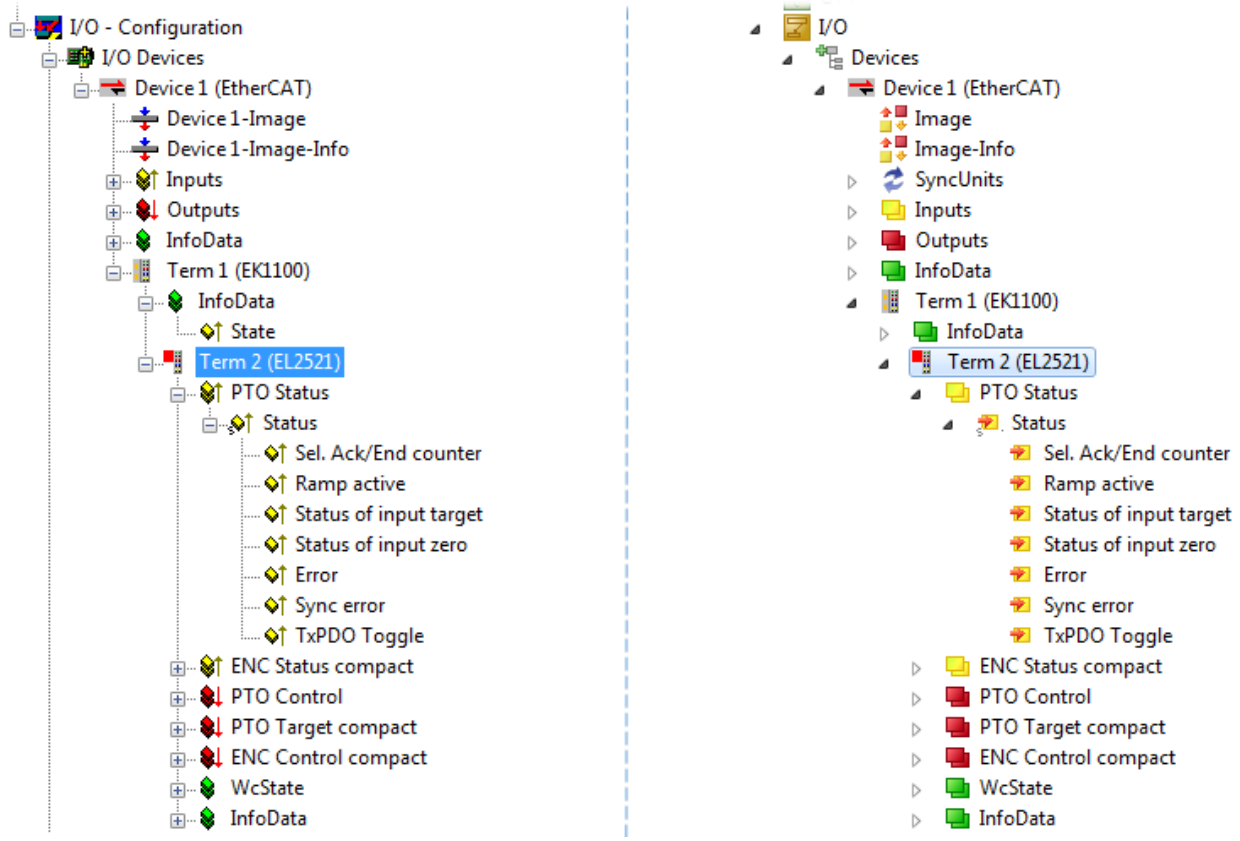


Fig. 118: EtherCAT terminal in the TwinCAT tree (left: TwinCAT 2; right: TwinCAT 3)

6.2.6 ONLINE configuration creation

Detecting/scanning of the EtherCAT device

The online device search can be used if the TwinCAT system is in CONFIG mode. This can be indicated by a symbol right below in the information bar:

- on TwinCAT 2 by a blue display “Config Mode” within the System Manager window: Config Mode .
- on TwinCAT 3 within the user interface of the development environment by a symbol .

TwinCAT can be set into this mode:

- TwinCAT 2: by selection of in the Menubar or by “Actions” → “Set/Reset TwinCAT to Config Mode…”
- TwinCAT 3: by selection of in the Menubar or by “TwinCAT” → “Restart TwinCAT (Config Mode)”

Online scanning in Config mode

The online search is not available in RUN mode (production operation). Note the differentiation between TwinCAT programming system and TwinCAT target system.

The TwinCAT 2 icon ( ) or TwinCAT 3 icon ( ) within the Windows-Taskbar always shows the TwinCAT mode of the local IPC. Compared to that, the System Manager window of TwinCAT 2 or the user interface of TwinCAT 3 indicates the state of the target system.

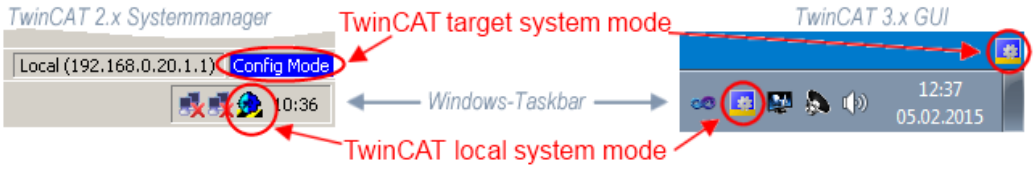


Fig. 119: Differentiation local/target system (left: TwinCAT 2; right: TwinCAT 3)

Right-clicking on “I/O Devices” in the configuration tree opens the search dialog.

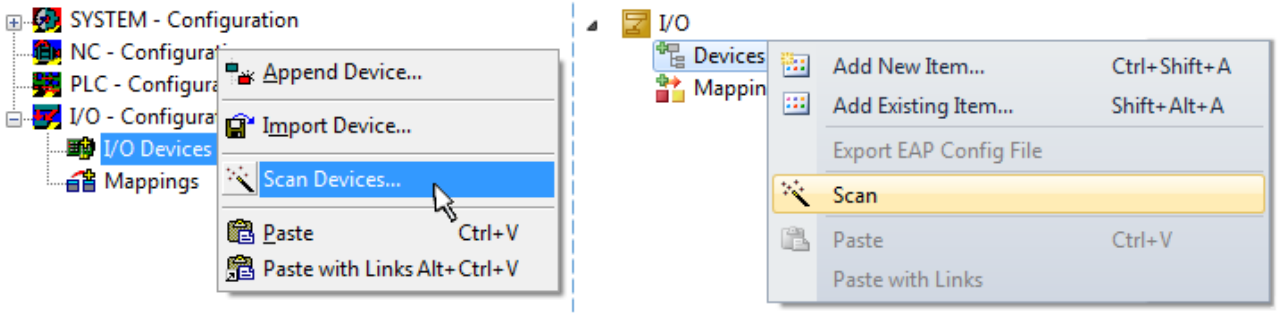


Fig. 120: Scan Devices (left: TwinCAT 2; right: TwinCAT 3)

This scan mode attempts to find not only EtherCAT devices (or Ethernet ports that are usable as such), but also NOVRAM, fieldbus cards, SMB etc. However, not all devices can be found automatically.

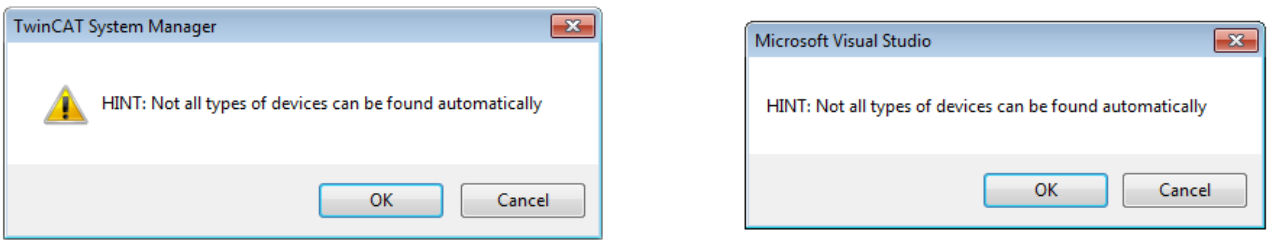


Fig. 121: Note for automatic device scan (left: TwinCAT 2; right: TwinCAT 3)

Ethernet ports with installed TwinCAT real-time driver are shown as “RT Ethernet” devices. An EtherCAT frame is sent to these ports for testing purposes. If the scan agent detects from the response that an EtherCAT slave is connected, the port is immediately shown as an “EtherCAT Device” .

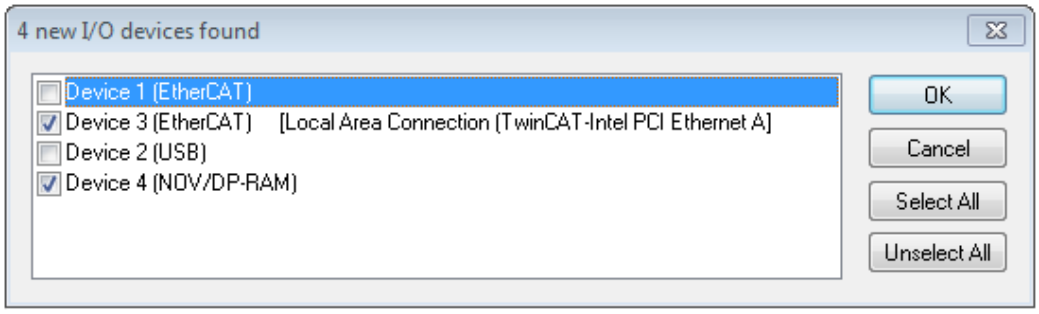


Fig. 122: Detected Ethernet devices

Via respective checkboxes devices can be selected (as illustrated in Fig. “Detected Ethernet devices” e.g. Device 3 and Device 4 were chosen). After confirmation with “OK” a device scan is suggested for all selected devices, see Fig.: “Scan query after automatic creation of an EtherCAT device”.

Selecting the Ethernet port

Ethernet ports can only be selected for EtherCAT devices for which the TwinCAT real-time driver is installed. This has to be done separately for each port. Please refer to the respective installation page [▶ 132].

Detecting/Scanning the EtherCAT devices

Online scan functionality

During a scan the master queries the identity information of the EtherCAT slaves from the slave EEPROM. The name and revision are used for determining the type. The respective devices are located in the stored ESI data and integrated in the configuration tree in the default state defined there.

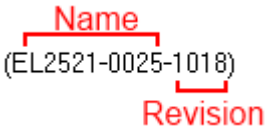


Fig. 123: Example default state

NOTICE

Slave scanning in practice in series machine production

The scanning function should be used with care. It is a practical and fast tool for creating an initial configuration as a basis for commissioning. In series machine production or reproduction of the plant, however, the function should no longer be used for the creation of the configuration, but if necessary for comparison [▶ 153] with the defined initial configuration.Background: since Beckhoff occasionally increases the revision version of the delivered products for product maintenance reasons, a configuration can be created by such a scan which (with an identical machine construction) is identical according to the device list; however, the respective device revision may differ from the initial configuration.

Example:

Company A builds the prototype of a machine B, which is to be produced in series later on. To do this the prototype is built, a scan of the IO devices is performed in TwinCAT and the initial configuration “B.tsm” is created. The EL2521-0025 EtherCAT terminal with the revision 1018 is located somewhere. It is thus built into the TwinCAT configuration in this way:

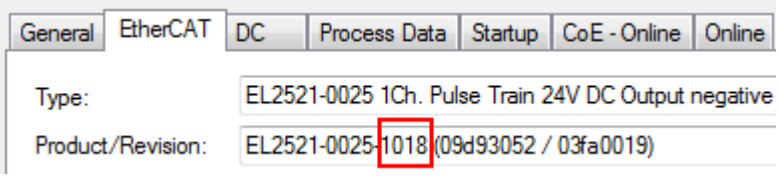


Fig. 124: Installing EthetCAT terminal with revision -1018

Likewise, during the prototype test phase, the functions and properties of this terminal are tested by the programmers/commissioning engineers and used if necessary, i.e. addressed from the PLC “B.pro” or the NC. (the same applies correspondingly to the TwinCAT 3 solution files).

The prototype development is now completed and series production of machine B starts, for which Beckhoff continues to supply the EL2521-0025-0018. If the commissioning engineers of the series machine production department always carry out a scan, a B configuration with the identical contents results again for each machine. Likewise, A might create spare parts stores worldwide for the coming series-produced machines with EL2521-0025-1018 terminals.

After some time Beckhoff extends the EL2521-0025 by a new feature C. Therefore the FW is changed, outwardly recognizable by a higher FW version and **a new revision -1019**. Nevertheless the new device naturally supports functions and interfaces of the predecessor version(s); an adaptation of “B.tsm” or even “B.pro” is therefore unnecessary. The series-produced machines can continue to be built with “B.tsm” and “B.pro”; it makes sense to perform a comparative scan [▶ 153] against the initial configuration “B.tsm” in order to check the built machine.

However, if the series machine production department now doesn’t use “B.tsm”, but instead carries out a scan to create the productive configuration, the revision **-1019** is automatically detected and built into the configuration:

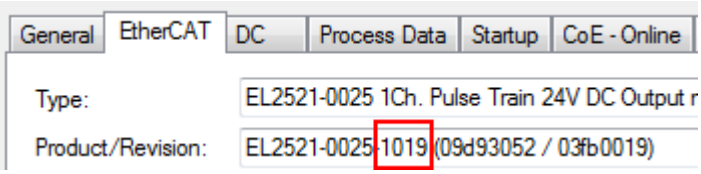


Fig. 125: Detection of EtherCAT terminal with revision -1019

This is usually not noticed by the commissioning engineers. TwinCAT cannot signal anything either, since a new configuration is essentially created. According to the compatibility rule, however, this means that no EL2521-0025-**1018** should be built into this machine as a spare part (even if this nevertheless works in the vast majority of cases).

In addition, it could be the case that, due to the development accompanying production in company A, the new feature C of the EL2521-0025-1019 (for example, an improved analog filter or an additional process data for the diagnosis) is discovered and used without in-house consultation. The previous stock of spare part devices are then no longer to be used for the new configuration “B2.tsm” created in this way. Þ if series machine production is established, the scan should only be performed for informative purposes for comparison with a defined initial configuration. Changes are to be made with care!

If an EtherCAT device was created in the configuration (manually or through a scan), the I/O field can be scanned for devices/slaves.



Fig. 126: Scan query after automatic creation of an EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)

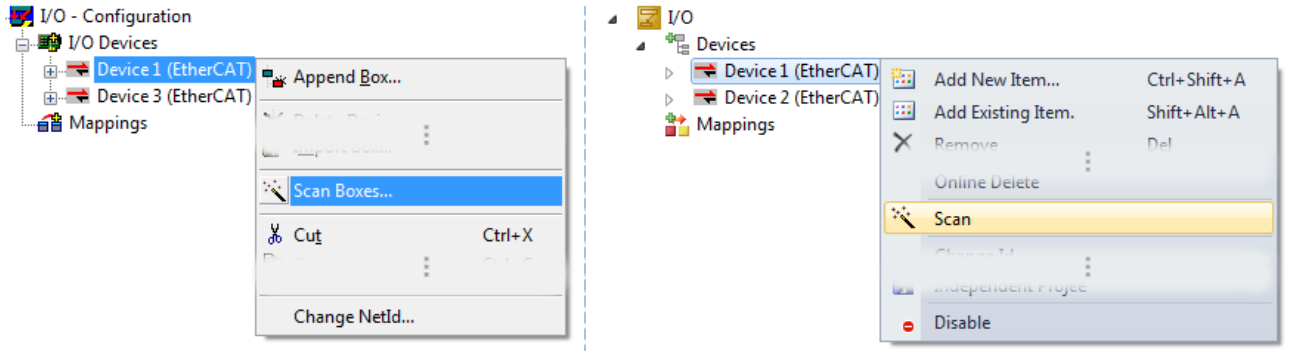


Fig. 127: Manual scanning for devices on a specified EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)

In the System Manager (TwinCAT 2) or the User Interface (TwinCAT 3) the scan process can be monitored via the progress bar at the bottom in the status bar.

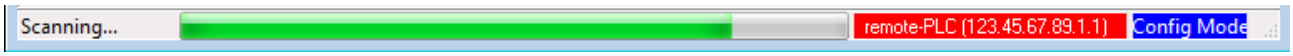


Fig. 128: *Scan progressexemplary by TwinCAT 2*

The configuration is established and can then be switched to online state (OPERATIONAL).



Fig. 129: Config/FreeRun query (left: TwinCAT 2; right: TwinCAT 3)

In Config/FreeRun mode the System Manager display alternates between blue and red, and the EtherCAT device continues to operate with the idling cycle time of 4 ms (default setting), even without active task (NC, PLC).

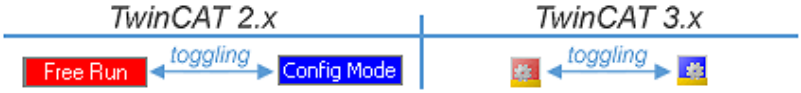


Fig. 130: Displaying of “Free Run” and “Config Mode” toggling right below in the status bar



Fig. 131: TwinCAT can also be switched to this state by using a button (left: TwinCAT 2; right: TwinCAT 3)

The EtherCAT system should then be in a functional cyclic state, as shown in Fig. *Online display example*.

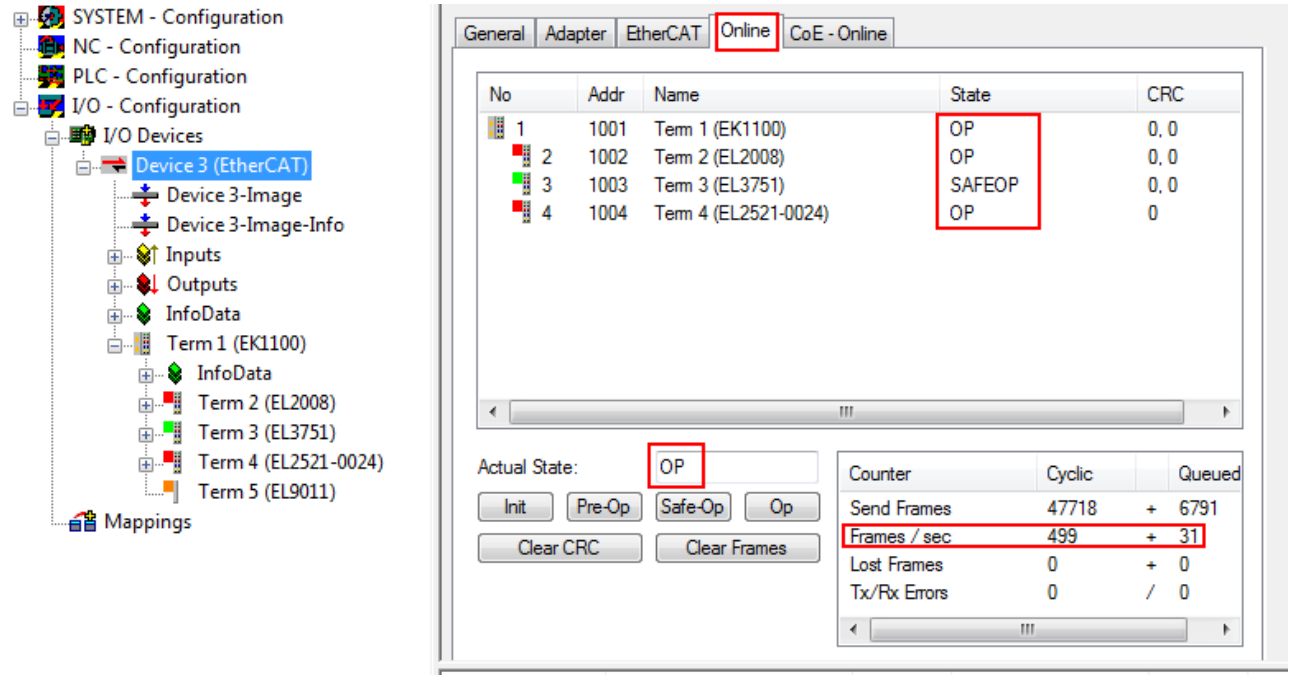


Fig. 132: Online display example

Please note:

- all slaves should be in OP state
- the EtherCAT master should be in “Actual State” OP
- “frames/sec” should match the cycle time taking into account the sent number of frames
- no excessive “LostFrames” or CRC errors should occur

The configuration is now complete. It can be modified as described under manual procedure [▶ 143].

Troubleshooting

Various effects may occur during scanning.

- An **unknown device** is detected, i.e. an EtherCAT slave for which no ESI XML description is available. In this case the System Manager offers to read any ESI that may be stored in the device. This case is described in the chapter “Notes regarding ESI device description”.
- **Device are not detected properly**
  Possible reasons include:
  - faulty data links, resulting in data loss during the scan
  - slave has invalid device description

  The connections and devices should be checked in a targeted manner, e.g. via the emergency scan. Then re-run the scan.

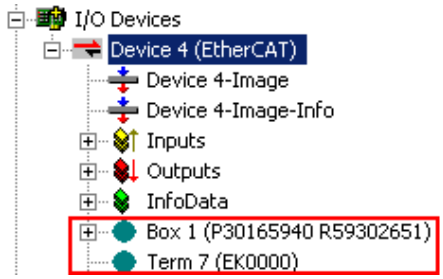


Fig. 133: Faulty identification

In the System Manager such devices may be set up as EK0000 or unknown devices. Operation is not possible or meaningful.

Scan over existing Configuration

NOTICE

Change of the configuration after comparison

With this scan (TwinCAT 2.11 or 3.1) only the device properties vendor (manufacturer), device name and revision are compared at present! A “ChangeTo” or “Copy” should only be carried out with care, taking into consideration the Beckhoff IO compatibility rule (see above). The device configuration is then replaced by the revision found; this can affect the supported process data and functions.

If a scan is initiated for an existing configuration, the actual I/O environment may match the configuration exactly or it may differ. This enables the configuration to be compared.



Fig. 134: Identical configuration (left: TwinCAT 2; right: TwinCAT 3)

If differences are detected, they are shown in the correction dialog, so that the user can modify the configuration as required.

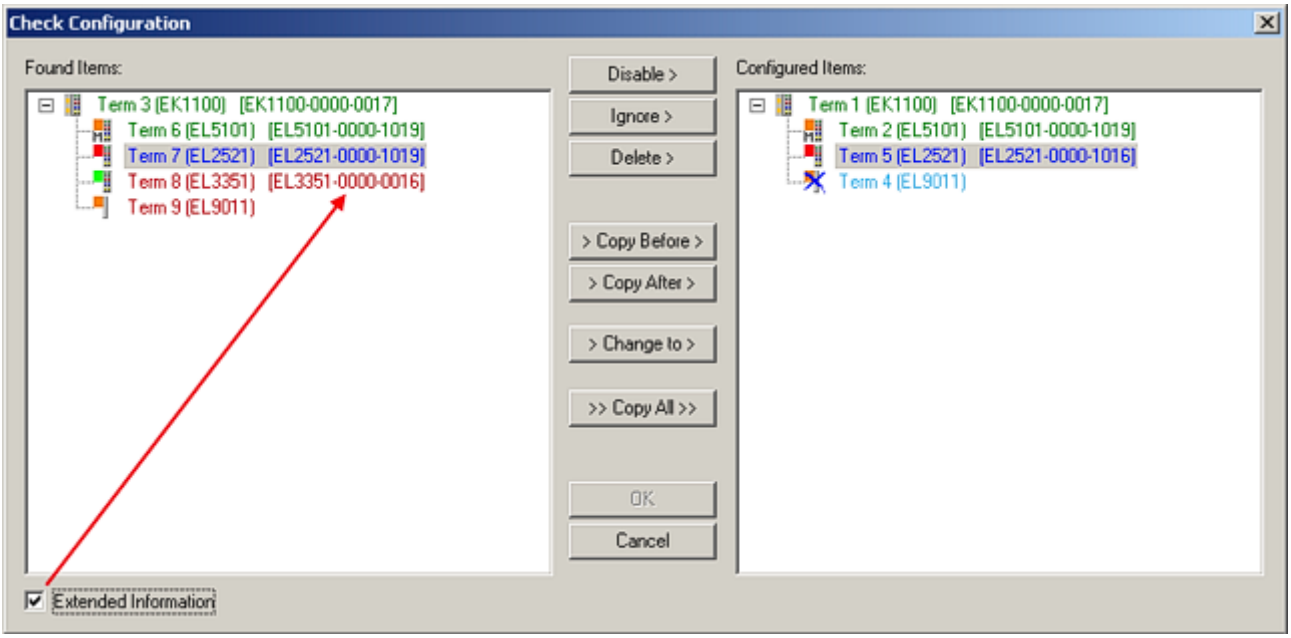


Fig. 135: Correction dialog

It is advisable to tick the “Extended Information” check box to reveal differences in the revision.

Color	Explanation
green	This EtherCAT slave matches the entry on the other side. Both type and revision match.
blue	This EtherCAT slave is present on the other side, but in a different revision. This other revision can have other default values for the process data as well as other/additional functions. If the found revision is higher than the configured revision, the slave may be used provided compatibility issues are taken into account. If the found revision is lower than the configured revision, it is likely that the slave cannot be used. The found device may not support all functions that the master expects based on the higher revision number.
light blue	This EtherCAT slave is ignored (“Ignore” button)
red	• This EtherCAT slave is not present on the other side. • It is present, but in a different revision, which also differs in its properties from the one specified. The compatibility principle then also applies here: if the found revision is higher than the configured revision, use is possible provided compatibility issues are taken into account, since the successor devices should support the functions of the predecessor devices. If the found revision is lower than the configured revision, it is likely that the slave cannot be used. The found device may not support all functions that the master expects based on the higher revision number.

Device selection based on revision, compatibility

The ESI description also defines the process image, the communication type between master and slave/device and the device functions, if applicable. The physical device (firmware, if available) has to support the communication queries/settings of the master. This is backward compatible, i.e. newer devices (higher revision) should be supported if the EtherCAT master addresses them as an older revision. The following compatibility rule of thumb is to be assumed for Beckhoff EtherCAT Terminals/ Boxes/ EJ-modules:

device revision in the system >= device revision in the configuration

This also enables subsequent replacement of devices without changing the configuration (different specifications are possible for drives).

Example

If an EL2521-0025-**1018** is specified in the configuration, an EL2521-0025-**1018** or higher (-**1019**, -**1020**) can be used in practice.

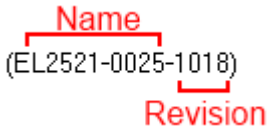


Fig. 136: Name/revision of the terminal

If current ESI descriptions are available in the TwinCAT system, the last revision offered in the selection dialog matches the Beckhoff state of production. It is recommended to use the last device revision when creating a new configuration, if current Beckhoff devices are used in the real application. Older revisions should only be used if older devices from stock are to be used in the application.

In this case the process image of the device is shown in the configuration tree and can be parameterized as follows: linking with the task, CoE/DC settings, plug-in definition, startup settings, ...

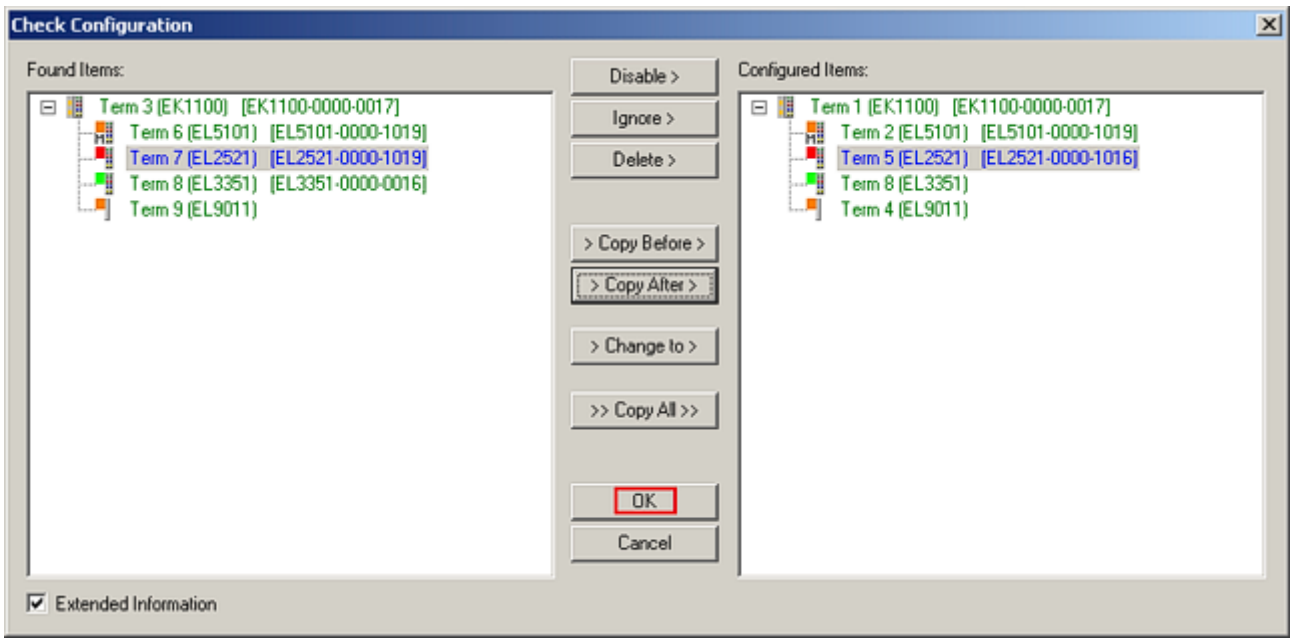


Fig. 137: Correction dialog with modifications

Once all modifications have been saved or accepted, click “OK” to transfer them to the real *.tsm configuration.

Change to Compatible Type

TwinCAT offers a function *Change to Compatible Type…* for the exchange of a device whilst retaining the links in the task.

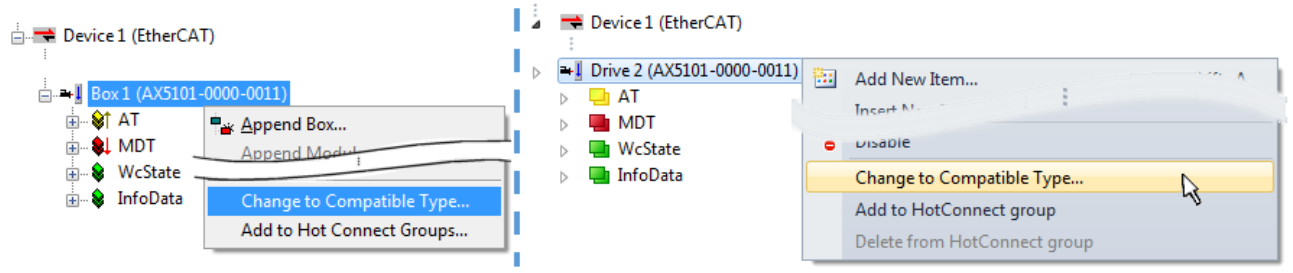


Fig. 138: Dialog “Change to Compatible Type…” (left: TwinCAT 2; right: TwinCAT 3)

The following elements in the ESI of an EtherCAT device are compared by TwinCAT and assumed to be the same in order to decide whether a device is indicated as "compatible":

- Physics (e.g. RJ45, Ebus...)
- FMMU (additional ones are allowed)
- SyncManager (SM, additional ones are allowed)
- EoE (attributes MAC, IP)
- CoE (attributes SdoInfo, PdoAssign, PdoConfig, PdoUpload, CompleteAccess)
- FoE
- PDO (process data: Sequence, SyncUnit SU, SyncManager SM, EntryCount, Ent-ry.Datatype)

This function is preferably to be used on AX5000 devices.

Change to Alternative Type

The TwinCAT System Manager offers a function for the exchange of a device: Change to Alternative Type

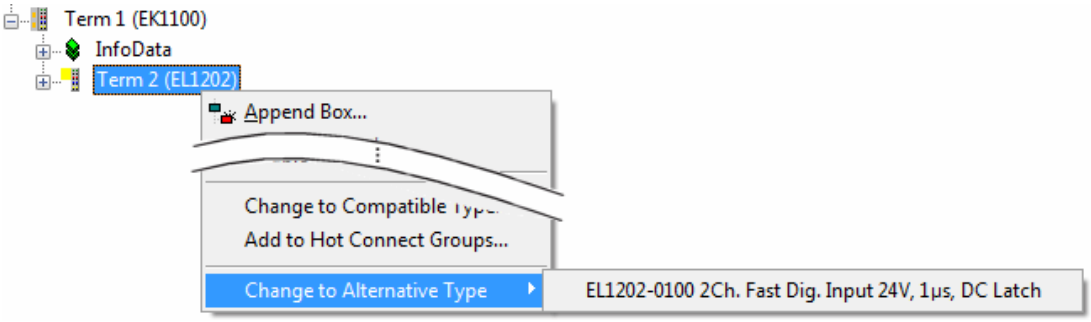


Fig. 139: TwinCAT 2 Dialog Change to Alternative Type

If called, the System Manager searches in the procured device ESI (in this example: EL1202-0000) for details of compatible devices contained there. The configuration is changed and the ESI-EEPROM is overwritten at the same time – therefore this process is possible only in the online state (ConfigMode).

6.2.7 EtherCAT subscriber configuration

In the left-hand window of the TwinCAT 2 System Manager or the Solution Explorer of the TwinCAT 3 Development Environment respectively, click on the element of the terminal within the tree you wish to configure (in the example: EL3751 Terminal 3).

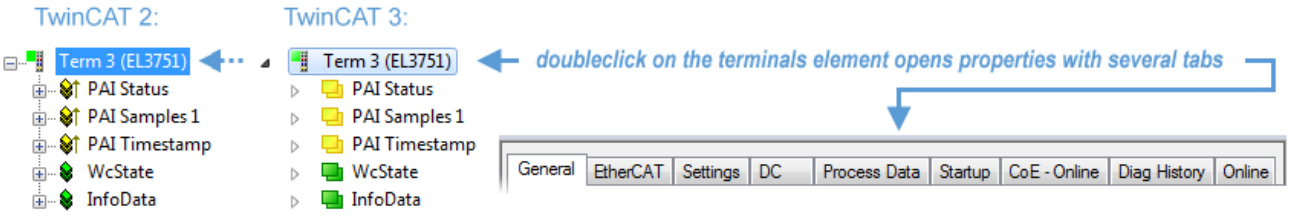


Fig. 140: Branch element as terminal EL3751

In the right-hand window of the TwinCAT System Manager (TwinCAT 2) or the Development Environment (TwinCAT 3), various tabs are now available for configuring the terminal. And yet the dimension of complexity of a subscriber determines which tabs are provided. Thus as illustrated in the example above the terminal EL3751 provides many setup options and also a respective number of tabs are available. On the contrary by the terminal EL1004 for example the tabs “General”, “EtherCAT”, “Process Data” and “Online“ are available only. Several terminals, as for instance the EL6695 provide special functions by a tab with its own terminal name, so “EL6695” in this case. A specific tab “Settings” by terminals with a wide range of setup options will be provided also (e.g. EL3751).

“General” tab

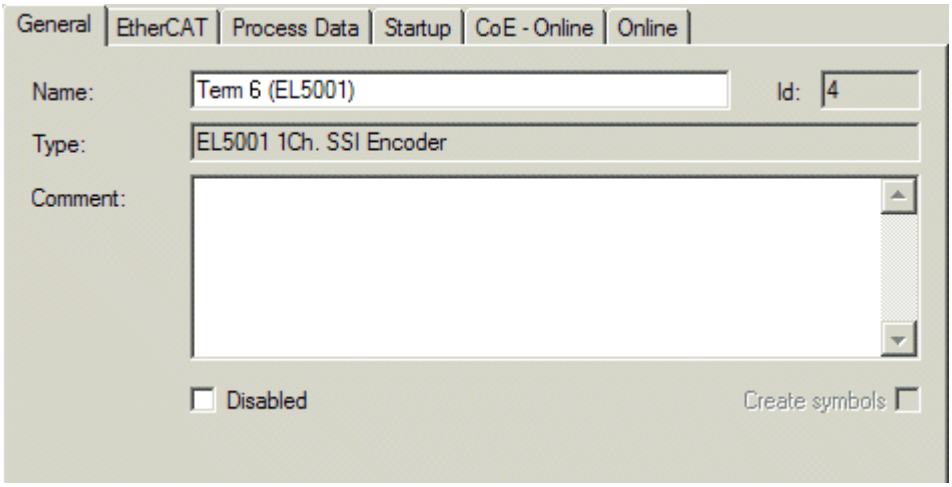


Fig. 141: “General” tab

Name	Name of the EtherCAT device
Id	Number of the EtherCAT device
Type	EtherCAT device type
Comment	Here you can add a comment (e.g. regarding the system).
Disabled	Here you can deactivate the EtherCAT device.
Create symbols	Access to this EtherCAT slave via ADS is only available if this control box is activated.

“EtherCAT” tab

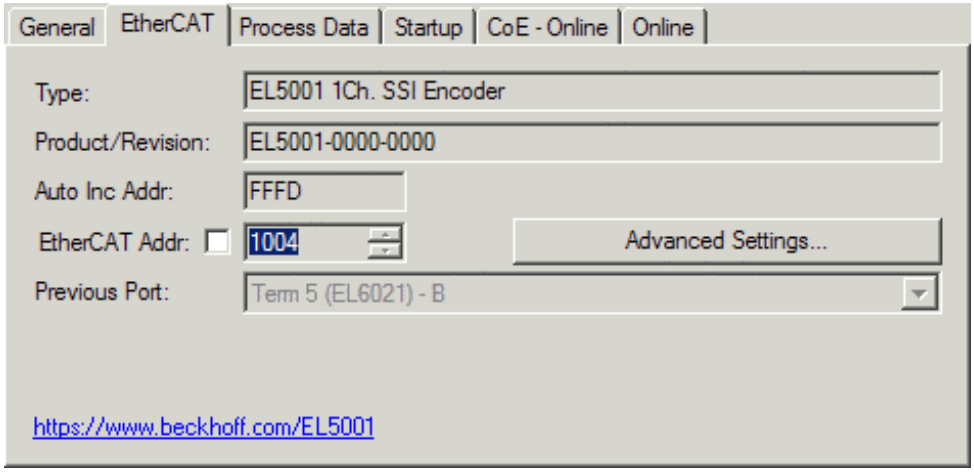


Fig. 142: “EtherCAT” tab

Type	EtherCAT device type
Product/Revision	Product and revision number of the EtherCAT device
Auto Inc Addr.	Auto increment address of the EtherCAT device. The auto increment address can be used for addressing each EtherCAT device in the communication ring through its physical position. Auto increment addressing is used during the start-up phase when the EtherCAT master allocates addresses to the EtherCAT devices. With auto increment addressing the first EtherCAT slave in the ring has the address 0000_{hex}. For each further slave the address is decremented by 1 ($FFFF_{hex}$, $FFFE_{hex}$ etc.).
EtherCAT Addr.	Fixed address of an EtherCAT slave. This address is allocated by the EtherCAT master during the start-up phase. Tick the control box to the left of the input field in order to modify the default value.
Previous Port	Name and port of the EtherCAT device to which this device is connected. If it is possible to connect this device with another one without changing the order of the EtherCAT devices in the communication ring, then this combination field is activated and the EtherCAT device to which this device is to be connected can be selected.
Advanced Settings	This button opens the dialogs for advanced settings.

The link at the bottom of the tab points to the product page for this EtherCAT device on the web.

“Process Data” tab

Indicates the configuration of the process data. The input and output data of the EtherCAT slave are represented as CANopen process data objects (**P**rocess **D**ata **O**bjects, PDOs). The user can select a PDO via PDO assignment and modify the content of the individual PDO via this dialog, if the EtherCAT slave supports this function.

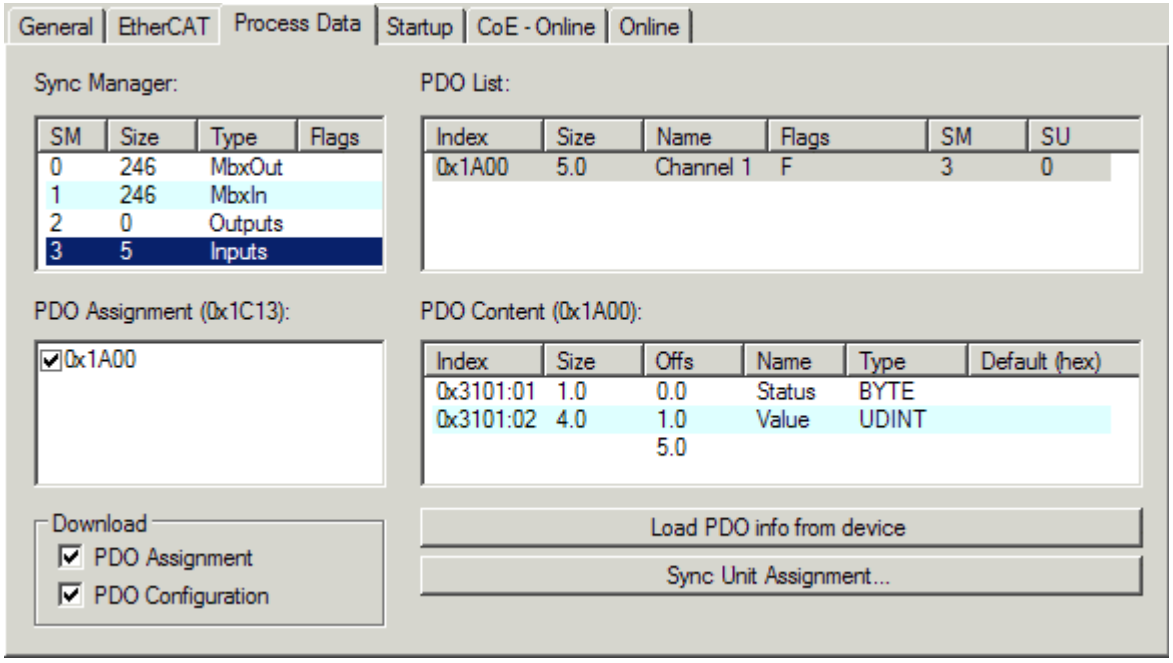


Fig. 143: “Process Data” tab

The process data (PDOs) transferred by an EtherCAT slave during each cycle are user data which the application expects to be updated cyclically or which are sent to the slave. To this end the EtherCAT master (Beckhoff TwinCAT) parameterizes each EtherCAT slave during the start-up phase to define which process data (size in bits/bytes, source location, transmission type) it wants to transfer to or from this slave. Incorrect configuration can prevent successful start-up of the slave.

For Beckhoff EtherCAT EL, ES, EM, EJ and EP slaves the following applies in general:

- The input/output process data supported by the device are defined by the manufacturer in the ESI/XML description. The TwinCAT EtherCAT Master uses the ESI description to configure the slave correctly.
- The process data can be modified in the System Manager. See the device documentation.
  Examples of modifications include: mask out a channel, displaying additional cyclic information, 16-bit display instead of 8-bit data size, etc.
- In so-called “intelligent” EtherCAT devices the process data information is also stored in the CoE directory. Any changes in the CoE directory that lead to different PDO settings prevent successful startup of the slave. It is not advisable to deviate from the designated process data, because the device firmware (if available) is adapted to these PDO combinations.

If the device documentation allows modification of process data, proceed as follows (see Figure *Configuring the process data*).

- A: select the device to configure
- B: in the “Process Data” tab select Input or Output under SyncManager (C)
- D: the PDOs can be selected or deselected
- H: the new process data are visible as linkable variables in the System Manager
  The new process data are active once the configuration has been activated and TwinCAT has been restarted (or the EtherCAT master has been restarted)
- E: if a slave supports this, Input and Output PDO can be modified simultaneously by selecting a so-called PDO record (“predefined PDO settings”).

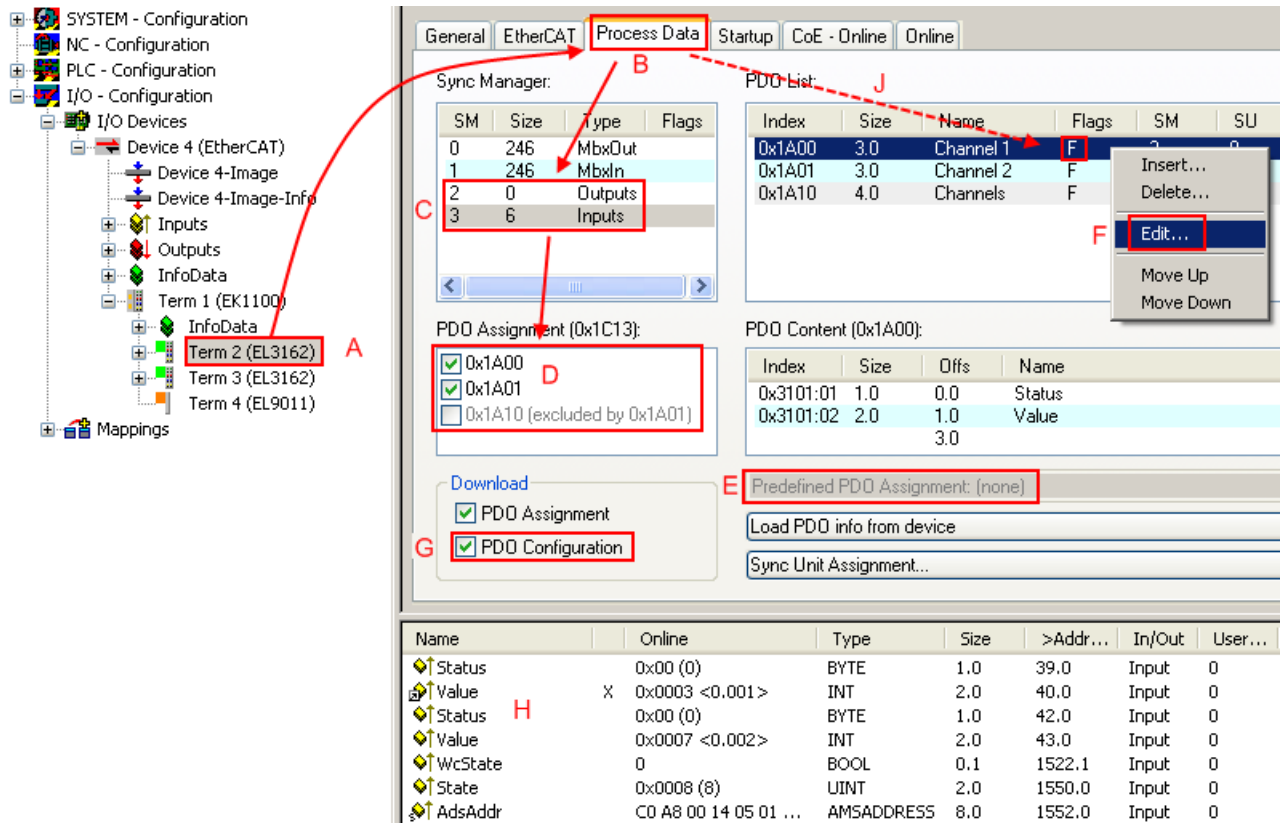


Fig. 144: Configuring the process data

Manual modification of the process data

According to the ESI description, a PDO can be identified as “fixed” with the flag “F” in the PDO overview (Fig. *Configuring the process data*, J). The configuration of such PDOs cannot be changed, even if TwinCAT offers the associated dialog (“Edit”). In particular, CoE content cannot be displayed as cyclic process data. This generally also applies in cases where a device supports download of the PDO configuration, “G”. In case of incorrect configuration the EtherCAT slave usually refuses to start and change to OP state. The System Manager displays an “invalid SM cfg” logger message: This error message (“invalid SM IN cfg” or “invalid SM OUT cfg”) also indicates the reason for the failed start.

A detailed description [▶ 164] can be found at the end of this section.

“Startup” tab

The *Startup* tab is displayed if the EtherCAT slave has a mailbox and supports the *CANopen over EtherCAT* (CoE) or *Servo drive over EtherCAT* protocol. This tab indicates which download requests are sent to the mailbox during startup. It is also possible to add new mailbox requests to the list display. The download requests are sent to the slave in the same order as they are shown in the list.

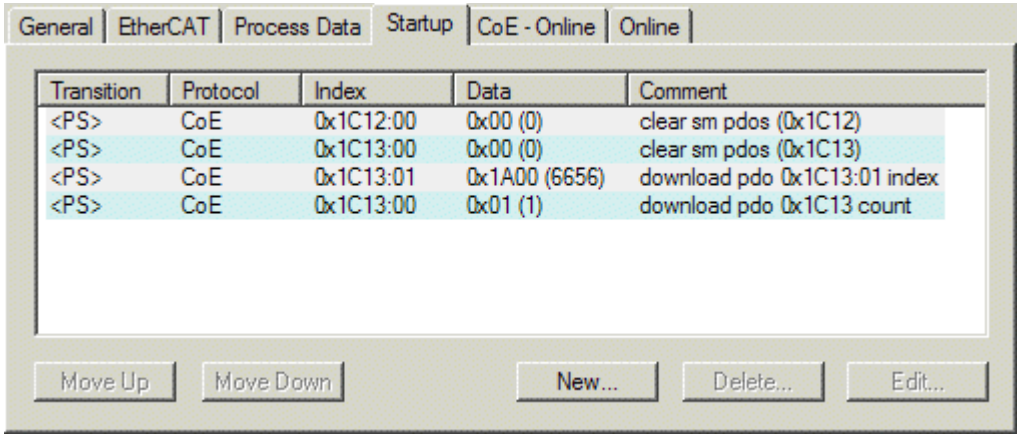


Fig. 145: “Startup” tab

Column	Description
Transition	Transition to which the request is sent. This can either be • the transition from pre-operational to safe-operational (PS), or • the transition from safe-operational to operational (SO). If the transition is enclosed in “<>” (e.g. <PS>), the mailbox request is fixed and cannot be modified or deleted by the user.
Protocol	Type of mailbox protocol
Index	Index of the object
Data	Date on which this object is to be downloaded.
Comment	Description of the request to be sent to the mailbox

Move Up	This button moves the selected request up by one position in the list.
Move Down	This button moves the selected request down by one position in the list.
New	This button adds a new mailbox download request to be sent during startup.
Delete	This button deletes the selected entry.
Edit	This button edits an existing request.

“CoE - Online” tab

The additional *CoE - Online* tab is displayed if the EtherCAT slave supports the *CANopen over EtherCAT* (CoE) protocol. This dialog lists the content of the object list of the slave (SDO upload) and enables the user to modify the content of an object from this list. Details for the objects of the individual EtherCAT devices can be found in the device-specific object descriptions.

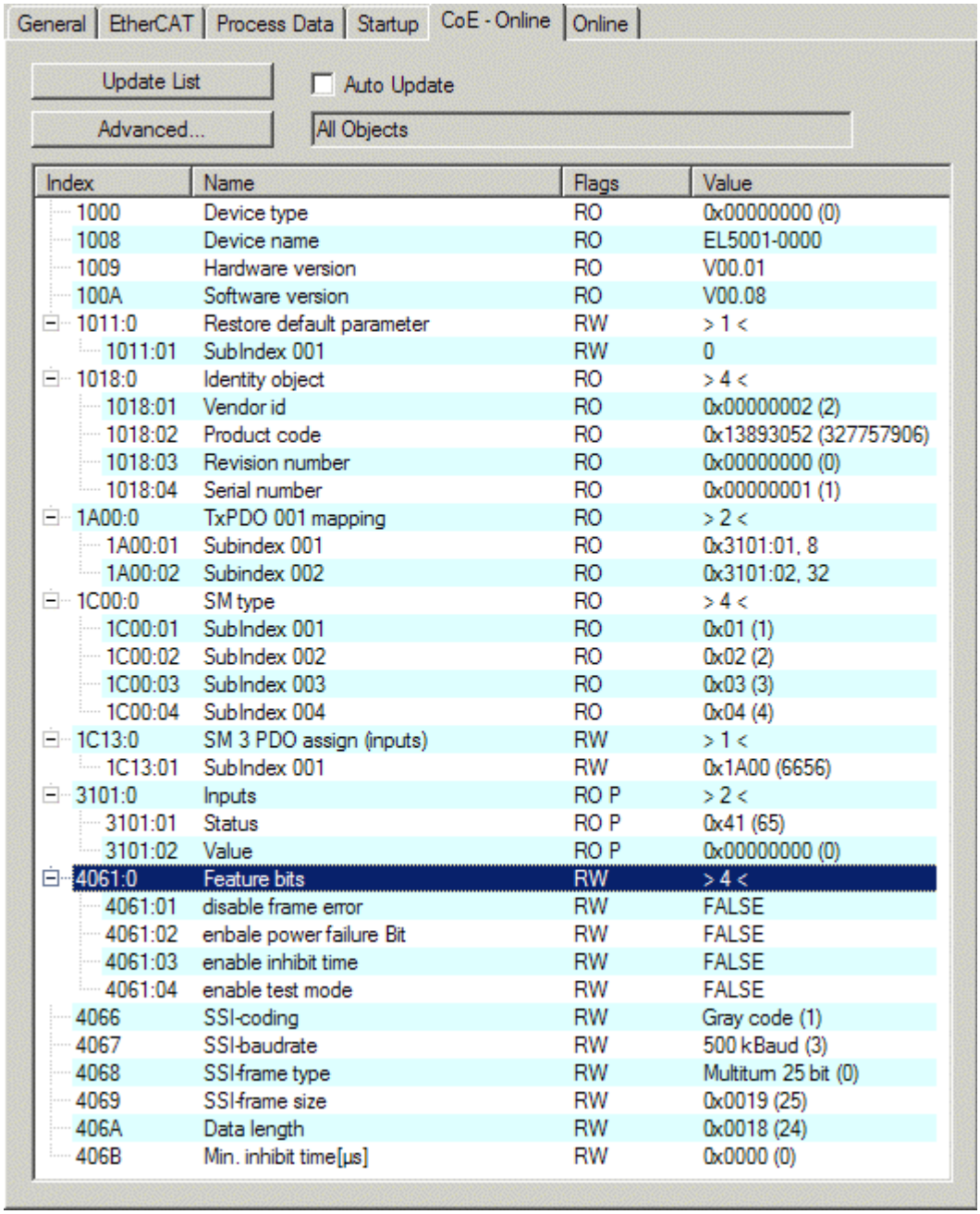


Fig. 146: “CoE - Online” tab

Object list display

Column	Description	
Index	Index and sub-index of the object	
Name	Name of the object	
Flags	RW	The object can be read, and data can be written to the object (read/write)
	RO	The object can be read, but no data can be written to the object (read only)
	P	An additional P identifies the object as a process data object.
Value	Value of the object	

Update List The *Update list* button updates all objects in the displayed list

Auto Update If this check box is selected, the content of the objects is updated automatically.

Advanced The *Advanced* button opens the *Advanced Settings* dialog. Here you can specify which objects are displayed in the list.

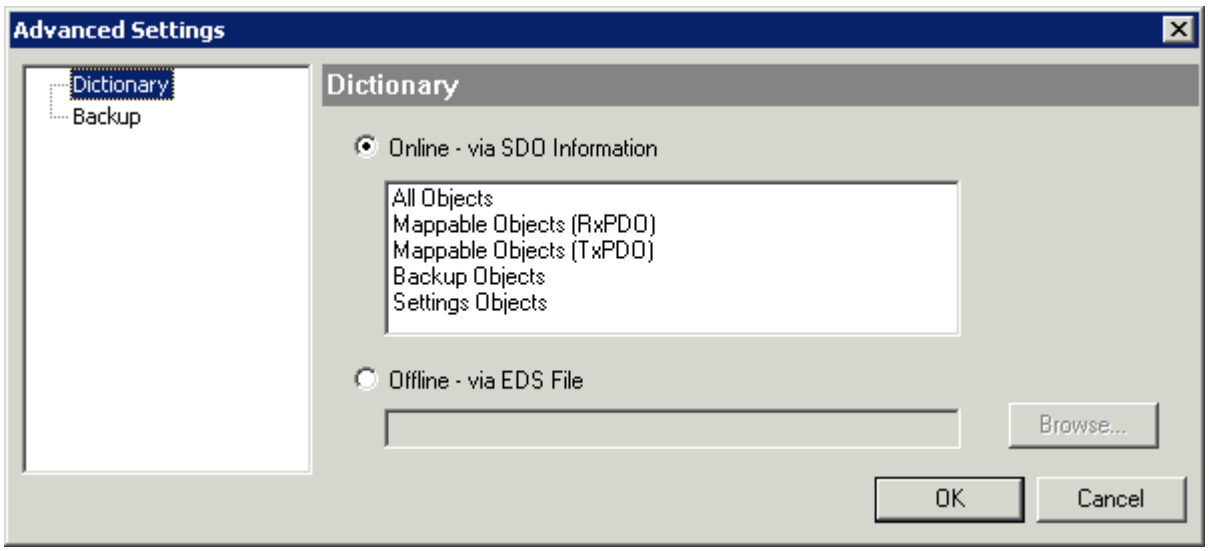


Fig. 147: Dialog “Advanced settings”

Online - via SDO Information	If this option button is selected, the list of the objects included in the object list of the slave is uploaded from the slave via SDO information. The list below can be used to specify which object types are to be uploaded.
Offline - via EDS File	If this option button is selected, the list of the objects included in the object list is read from an EDS file provided by the user.

“Online” tab

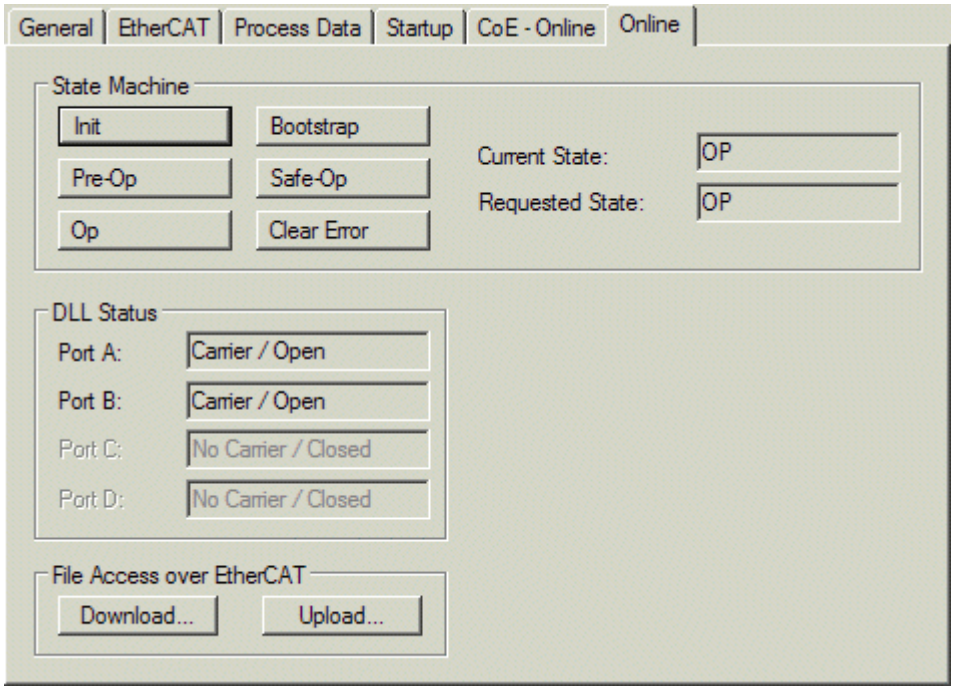


Fig. 148: “Online” tab

State Machine

Init	This button attempts to set the EtherCAT device to the *Init* state.
Pre-Op	This button attempts to set the EtherCAT device to the *pre-operational* state.
Op	This button attempts to set the EtherCAT device to the *operational* state.
Bootstrap	This button attempts to set the EtherCAT device to the *Bootstrap* state.
Safe-Op	This button attempts to set the EtherCAT device to the *safe-operational* state.
Clear Error	This button attempts to delete the fault display. If an EtherCAT slave fails during change of state it sets an error flag. Example: An EtherCAT slave is in PREOP state (pre-operational). The master now requests the SAFEOP state (safe-operational). If the slave fails during change of state it sets the error flag. The current state is now displayed as ERR PREOP. When the *Clear Error* button is pressed the error flag is cleared, and the current state is displayed as PREOP again.
Current State	Indicates the current state of the EtherCAT device.
Requested State	Indicates the state requested for the EtherCAT device.

DLL Status

Indicates the DLL status (data link layer status) of the individual ports of the EtherCAT slave. The DLL status can have four different states:

Status	Description
No Carrier / Open	No carrier signal is available at the port, but the port is open.
No Carrier / Closed	No carrier signal is available at the port, and the port is closed.
Carrier / Open	A carrier signal is available at the port, and the port is open.
Carrier / Closed	A carrier signal is available at the port, but the port is closed.

File Access over EtherCAT

Download	With this button a file can be written to the EtherCAT device.
Upload	With this button a file can be read from the EtherCAT device.

“DC” tab (Distributed Clocks)

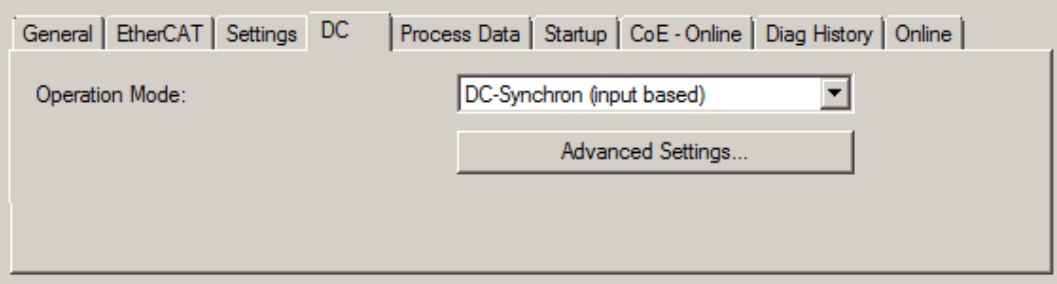


Fig. 149: “DC” tab (Distributed Clocks)

Operation Mode	Options (optional): • FreeRun • SM-Synchron • DC-Synchron (Input based) • DC-Synchron
Advanced Settings…	Advanced settings for readjustment of the real time determinant TwinCAT-clock

Detailed information to Distributed Clocks is specified on http://infosys.beckhoff.com:

Fieldbus Components → EtherCAT Terminals → EtherCAT System documentation → EtherCAT basics → Distributed Clocks

6.2.7.1 Detailed description of Process Data tab

Sync Manager

Lists the configuration of the Sync Manager (SM).
If the EtherCAT device has a mailbox, SM0 is used for the mailbox output (MbxOut) and SM1 for the mailbox input (MbxIn).
SM2 is used for the output process data (outputs) and SM3 (inputs) for the input process data.

If an input is selected, the corresponding PDO assignment is displayed in the *PDO Assignment* list below.

PDO Assignment

PDO assignment of the selected Sync Manager. All PDOs defined for this Sync Manager type are listed here:

- If the output Sync Manager (outputs) is selected in the Sync Manager list, all RxPDOs are displayed.
- If the input Sync Manager (inputs) is selected in the Sync Manager list, all TxPDOs are displayed.

The selected entries are the PDOs involved in the process data transfer. In the tree diagram of the System Manager these PDOs are displayed as variables of the EtherCAT device. The name of the variable is identical to the *Name* parameter of the PDO, as displayed in the PDO list. If an entry in the PDO assignment list is deactivated (not selected and greyed out), this indicates that the input is excluded from the PDO assignment. In order to be able to select a greyed out PDO, the currently selected PDO has to be deselected first.

Activation of PDO assignment

✓ If you have changed the PDO assignment, in order to activate the new PDO assignment,

a) the EtherCAT slave has to run through the PS status transition cycle (from pre-operational to safe-operational) once (see Online tab [▶ 162]),

b) and the System Manager has to reload the EtherCAT slaves

( button for TwinCAT 2 or  button for TwinCAT 3)

PDO list

List of all PDOs supported by this EtherCAT device. The content of the selected PDOs is displayed in the *PDO Content* list. The PDO configuration can be modified by double-clicking on an entry.

Column	Description	
Index	PDO index.	
Size	Size of the PDO in bytes.	
Name	Name of the PDO. If this PDO is assigned to a Sync Manager, it appears as a variable of the slave with this parameter as the name.	
Flags	F	Fixed content: The content of this PDO is fixed and cannot be changed by the System Manager.
	M	Mandatory PDO. This PDO is mandatory and must therefore be assigned to a Sync Manager! Consequently, this PDO cannot be deleted from the *PDO Assignment* list
SM	Sync Manager to which this PDO is assigned. If this entry is empty, this PDO does not take part in the process data traffic.	
SU	Sync unit to which this PDO is assigned.	

PDO Content

Indicates the content of the PDO. If flag F (fixed content) of the PDO is not set the content can be modified.

Download

If the device is intelligent and has a mailbox, the configuration of the PDO and the PDO assignments can be downloaded to the device. This is an optional feature that is not supported by all EtherCAT slaves.

PDO Assignment

If this check box is selected, the PDO assignment that is configured in the PDO Assignment list is downloaded to the device on startup. The required commands to be sent to the device can be viewed in the Startup [▶ 159] tab.

PDO Configuration

If this check box is selected, the configuration of the respective PDOs (as shown in the PDO list and the PDO Content display) is downloaded to the EtherCAT slave.

6.2.8 Import/Export of EtherCAT devices with SCI and XTI

SCI and XTI Export/Import – Handling of user-defined modified EtherCAT slaves

6.2.8.1 Basic principles

An EtherCAT slave is basically parameterized through the following elements:

- Cyclic process data (PDO)
- Synchronization (Distributed Clocks, FreeRun, SM-Synchron)
- CoE parameters (acyclic object dictionary)

Note: Not all three elements may be present, depending on the slave.

For a better understanding of the export/import function, let's consider the usual procedure for IO configuration:

- The user/programmer processes the IO configuration in the TwinCAT system environment. This involves all input/output devices such as drives that are connected to the fieldbuses used.
  Note: In the following sections, only EtherCAT configurations in the TwinCAT system environment are considered.
- For example, the user manually adds devices to a configuration or performs a scan on the online system.
- This results in the IO system configuration.
- On insertion, the slave appears in the system configuration in the default configuration provided by the vendor, consisting of default PDO, default synchronization method and CoE StartUp parameter as defined in the ESI (XML device description).
- If necessary, elements of the slave configuration can be changed, e.g. the PDO configuration or the synchronization method, based on the respective device documentation.

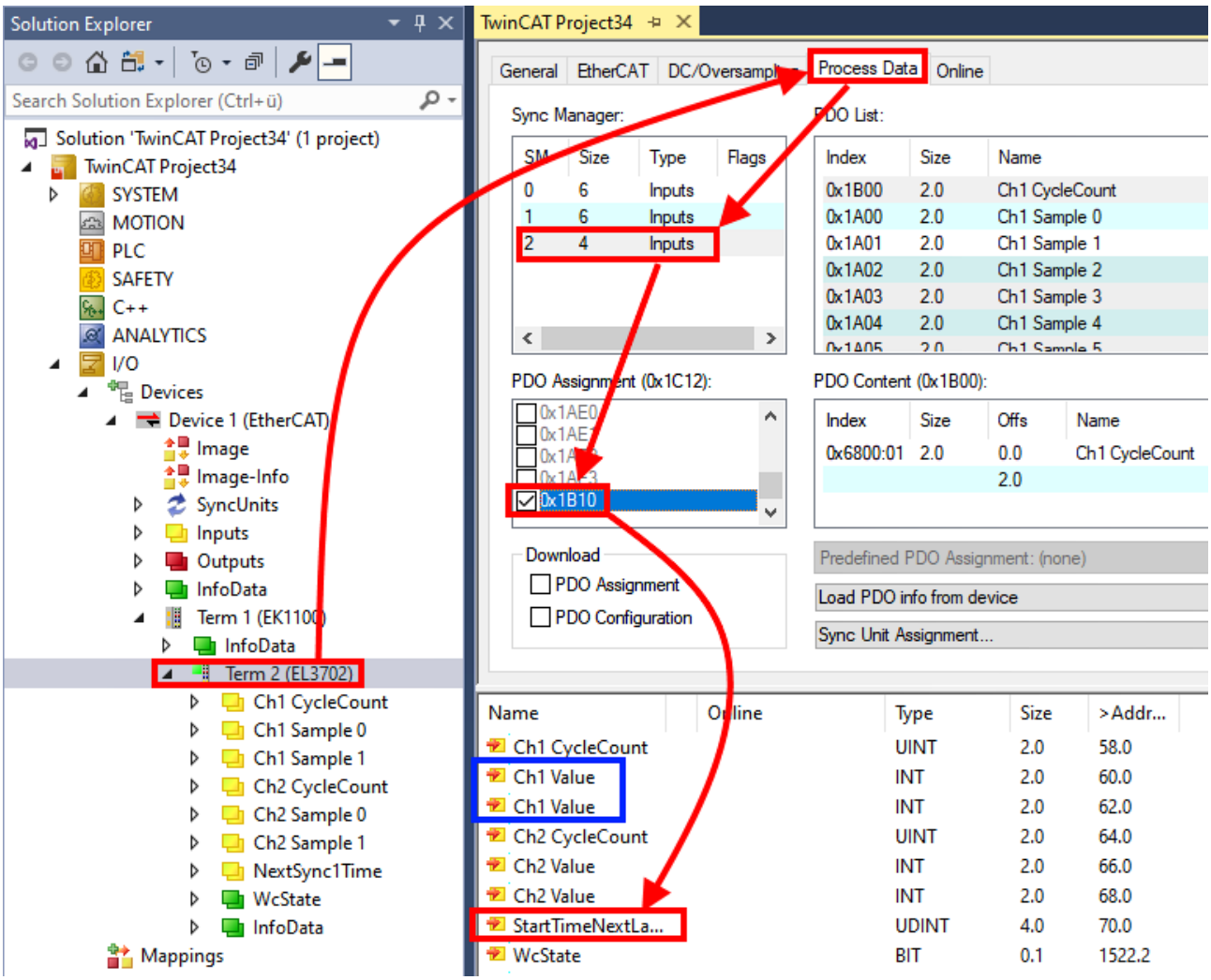
It may become necessary to reuse the modified slave in other projects in this way, without having to make equivalent configuration changes to the slave again. To accomplish this, proceed as follows:

- Export the slave configuration from the project,
- Store and transport as a file,
- Import into another EtherCAT project.

TwinCAT offers two methods for this purpose:

- within the TwinCAT environment: Export/Import as **xti** file or
- outside, i.e. beyond the TwinCAT limits: Export/Import as **sci** file.

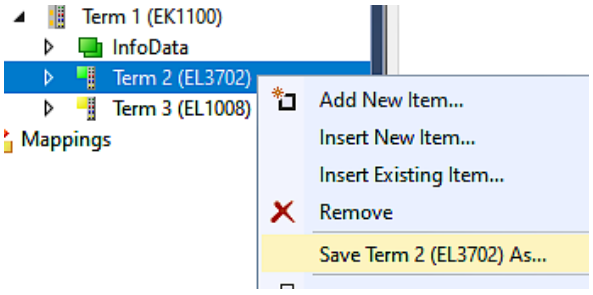
An example is provided below for illustration purposes: an EL3702 terminal with standard setting is switched to 2-fold oversampling (blue) and the optional PDO "StartTimeNextLatch" is added (red):



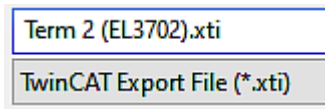
The two methods for exporting and importing the modified terminal referred to above are demonstrated below.

6.2.8.2 Procedure within TwinCAT with xti files

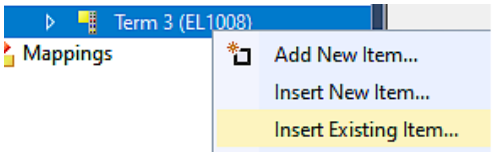
Each IO device can be exported/saved individually:



The xti file can be stored:



and imported again in another TwinCAT system via "Insert Existing item":



6.2.8.3 Procedure within and outside TwinCAT with sci file

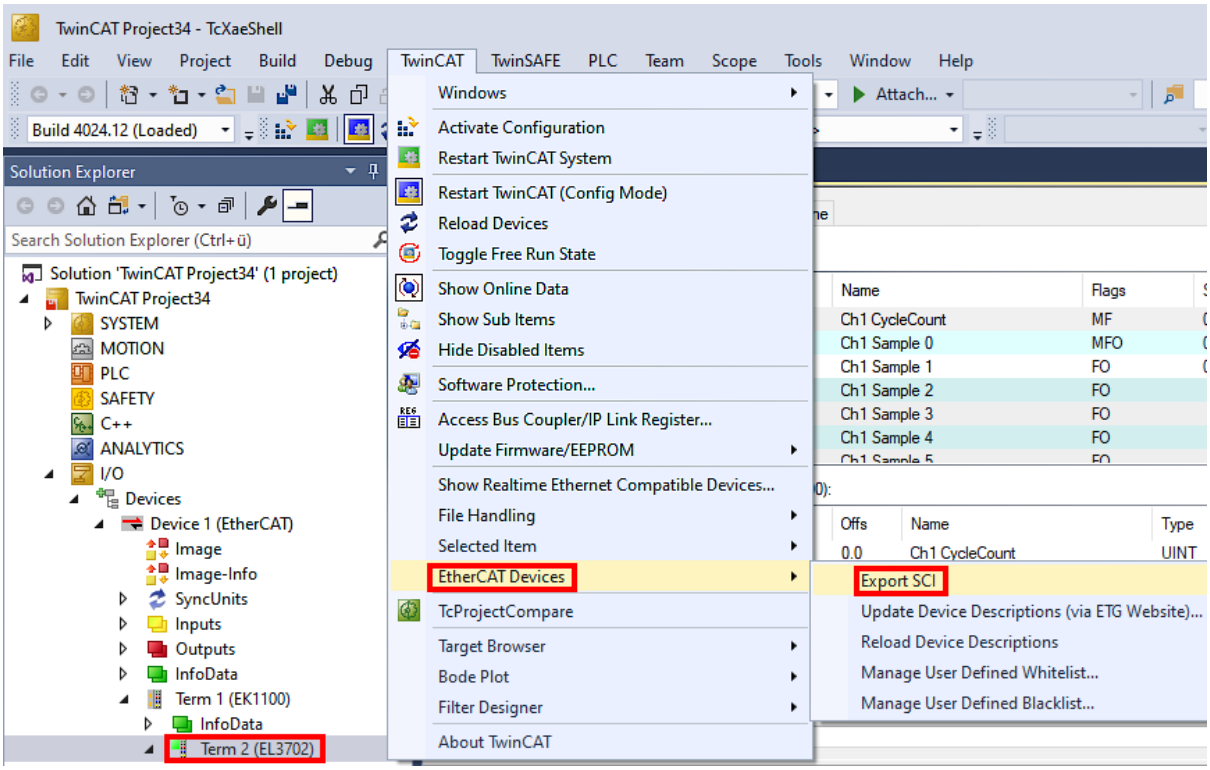
Note regarding availability (2021/01)

The SCI method is available from TwinCAT 3.1 build 4024.14.

The Slave Configuration Information (SCI) describes a specific complete configuration for an EtherCAT slave (terminal, box, drive...) based on the setting options of the device description file (ESI, EtherCAT Slave Information). That is, it includes PDO, CoE, synchronization.

Export:

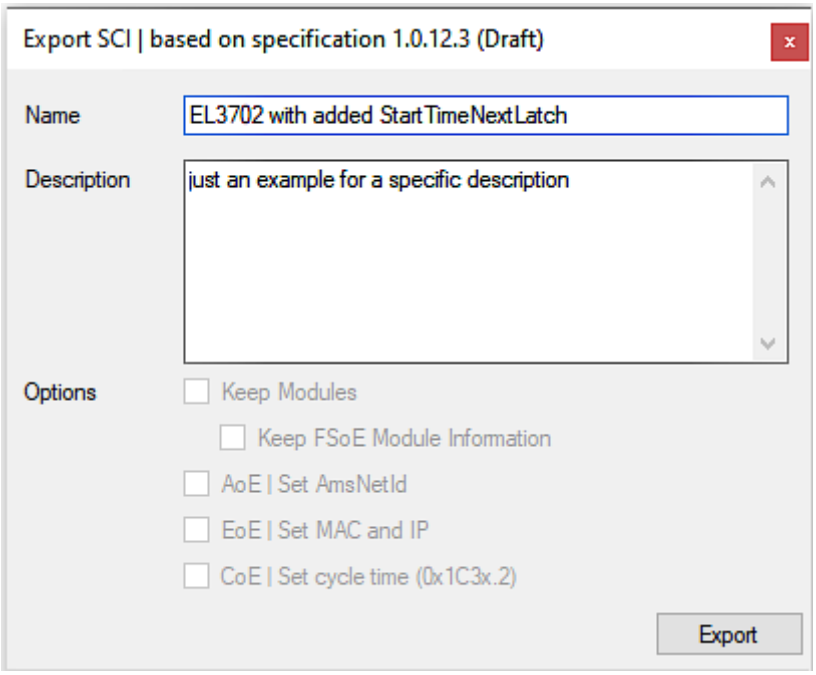
- select a single device via the menu (multiple selection is also possible):
  TwinCAT → EtherCAT Devices → Export SCI.



- If TwinCAT is offline (i.e. if there is no connection to an actual running controller) a warning message may appear, because after executing the function the system attempts to reload the EtherCAT segment. However, in this case this is not relevant for the result and can be acknowledged by clicking OK:



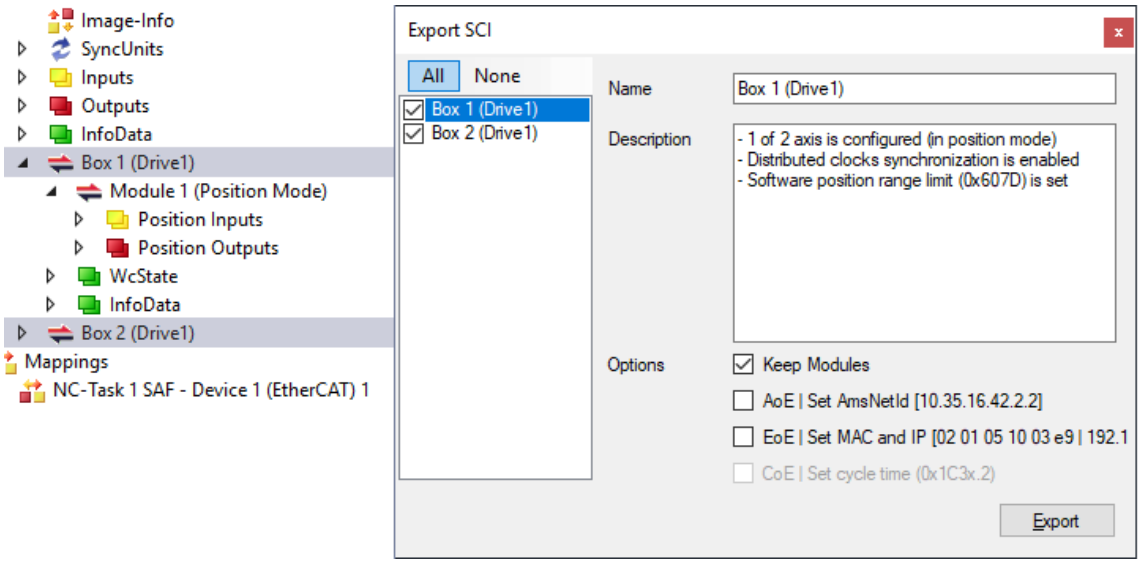
- A description may also be provided:



- Explanation of the dialog box:

Name		Name of the SCI, assigned by the user.
Description		Description of the slave configuration for the use case, assigned by the user.
Options	Keep modules	If a slave supports modules/slots, the user can decide whether these are to be exported or whether the module and device data are to be combined during export.
	AoE | Set AmsNetId	The configured AmsNetId is exported. Usually this is network-dependent and cannot always be determined in advance.
	EoE | Set MAC and IP	The configured virtual MAC and IP addresses are stored in the SCI. Usually these are network-dependent and cannot always be determined in advance.
	CoE | Set cycle time(0x1C3x.2)	The configured cycle time is exported. Usually this is network-dependent and cannot always be determined in advance.
ESI		Reference to the original ESI file.
Export		Save SCI file.

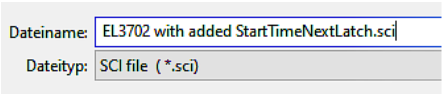
- A list view is available for multiple selections (*Export multiple SCI files)*:



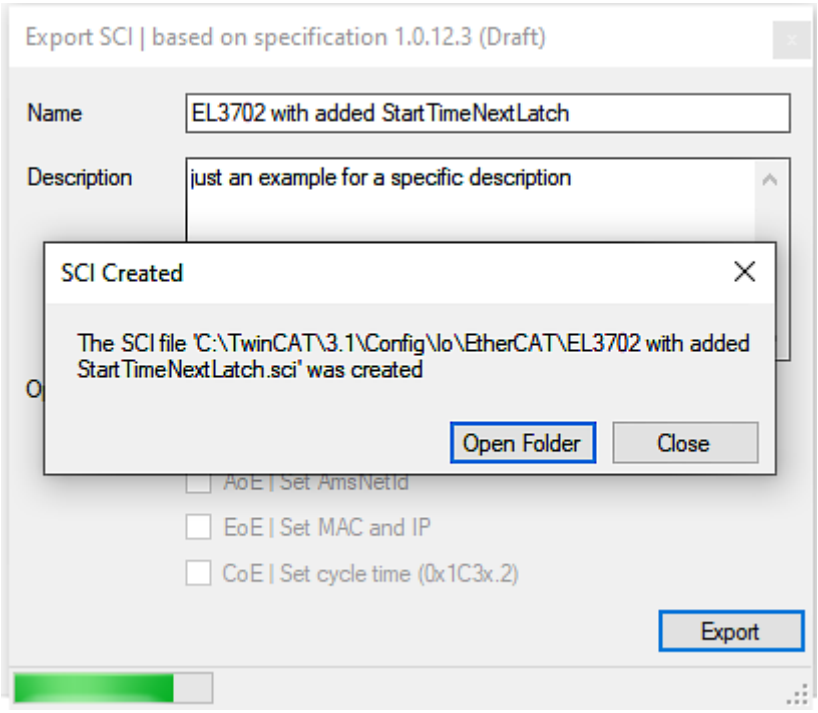
- Selection of the slaves to be exported:
  - All:
    All slaves are selected for export.

- None:
  All slaves are deselected.

- The sci file can be saved locally:

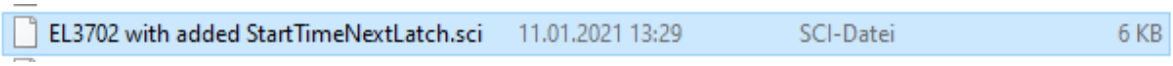


- The export takes place:

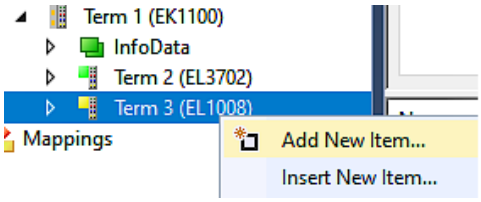


Import

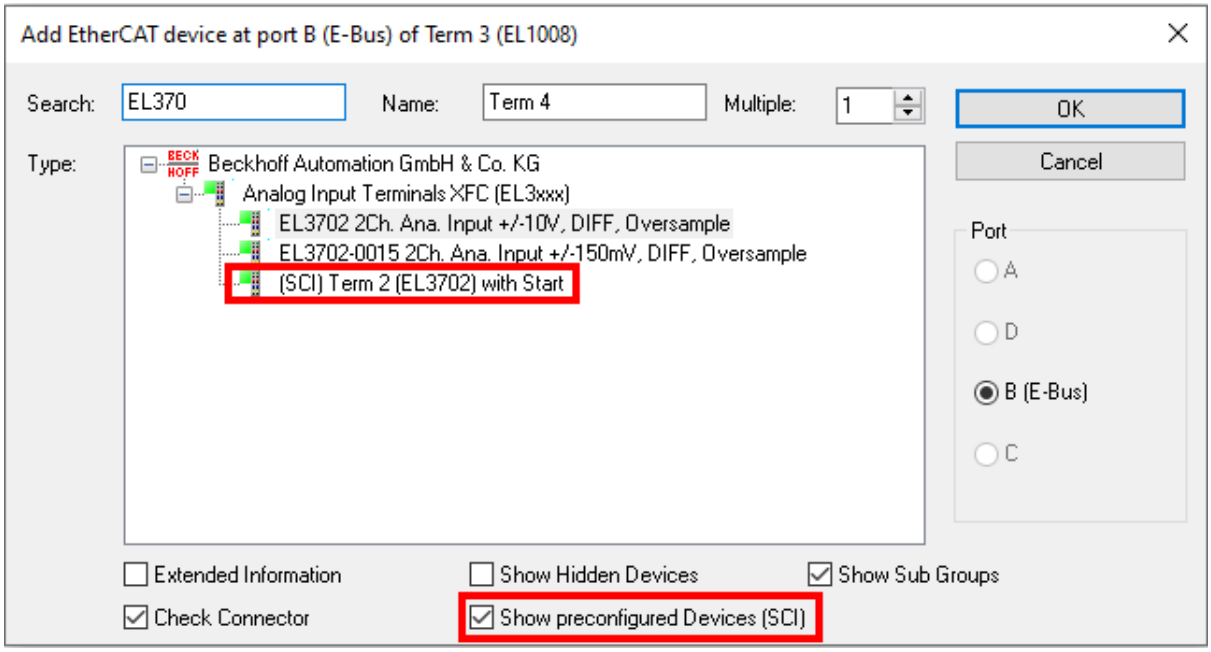
- An sci description can be inserted manually into the TwinCAT configuration like any normal Beckhoff device description.
- The sci file must be located in the TwinCAT ESI path, usually under:
  C:\TwinCAT\3.1\Config\Io\EtherCAT



- Open the selection dialog:

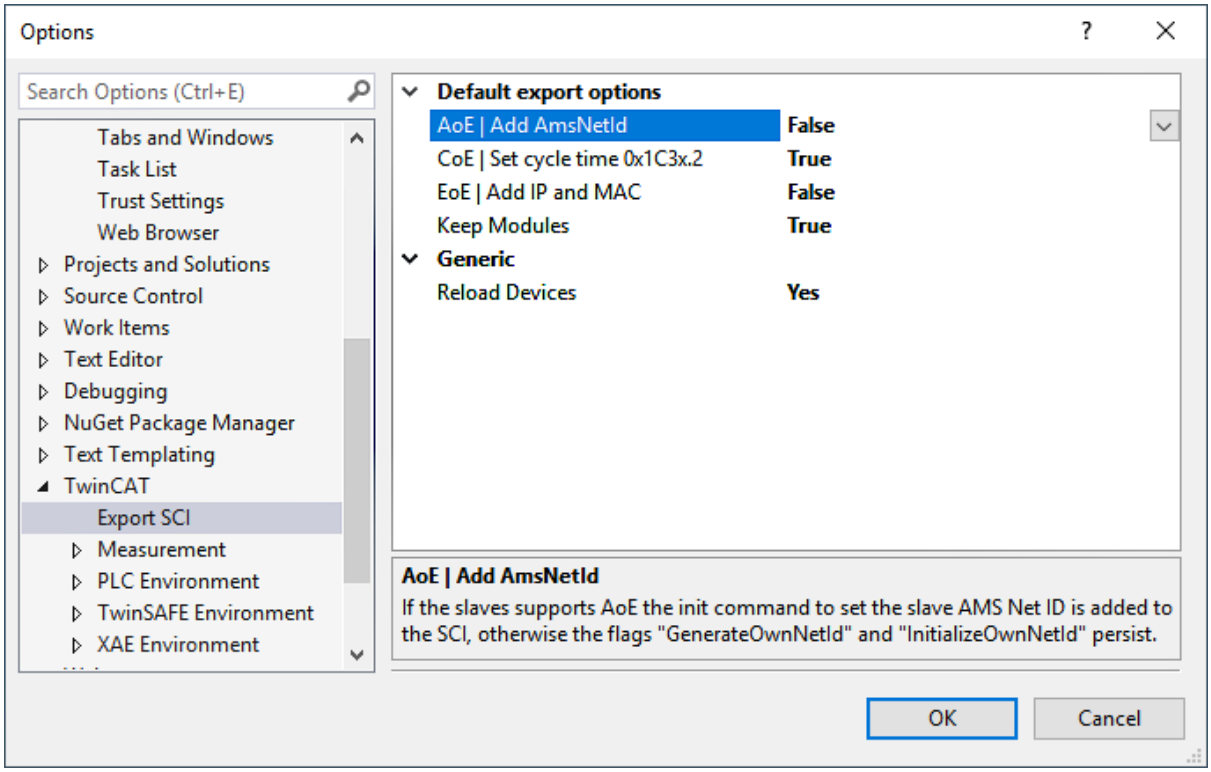


- Display SCI devices and select and insert the desired device:



Additional Notes

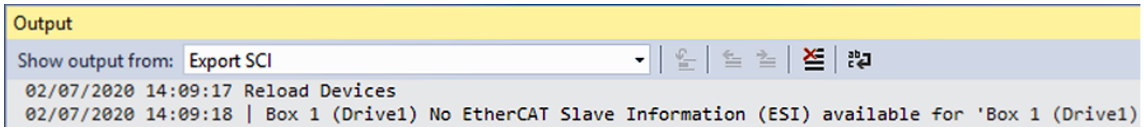
- Settings for the SCI function can be made via the general Options dialog (Tools → Options → TwinCAT → Export SCI):



Explanation of the settings:

Default export options	AoE | Set AmsNetId	Default setting whether the configured AmsNetId is exported.
	CoE | Set cycle time(0x1C3x.2)	Default setting whether the configured cycle time is exported.
	EoE | Set MAC and IP	Default setting whether the configured MAC and IP addresses are exported.
	Keep modules	Default setting whether the modules persist.
Generic	Reload Devices	Setting whether the Reload Devices command is executed before the SCI export. This is strongly recommended to ensure a consistent slave configuration.

SCI error messages are displayed in the TwinCAT logger output window if required:



6.3 General Commissioning Instructions for an EtherCAT Slave

This summary briefly deals with a number of aspects of EtherCAT Slave operation under TwinCAT. More detailed information on this may be found in the corresponding sections of, for instance, the EtherCAT System Documentation.

Diagnosis in real time: WorkingCounter, EtherCAT State and Status

Generally speaking an EtherCAT Slave provides a variety of diagnostic information that can be used by the controlling task.

This diagnostic information relates to differing levels of communication. It therefore has a variety of sources, and is also updated at various times.

Any application that relies on I/O data from a fieldbus being correct and up to date must make diagnostic access to the corresponding underlying layers. EtherCAT and the TwinCAT System Manager offer comprehensive diagnostic elements of this kind. Those diagnostic elements that are helpful to the controlling task for diagnosis that is accurate for the current cycle when in operation (not during commissioning) are discussed below.

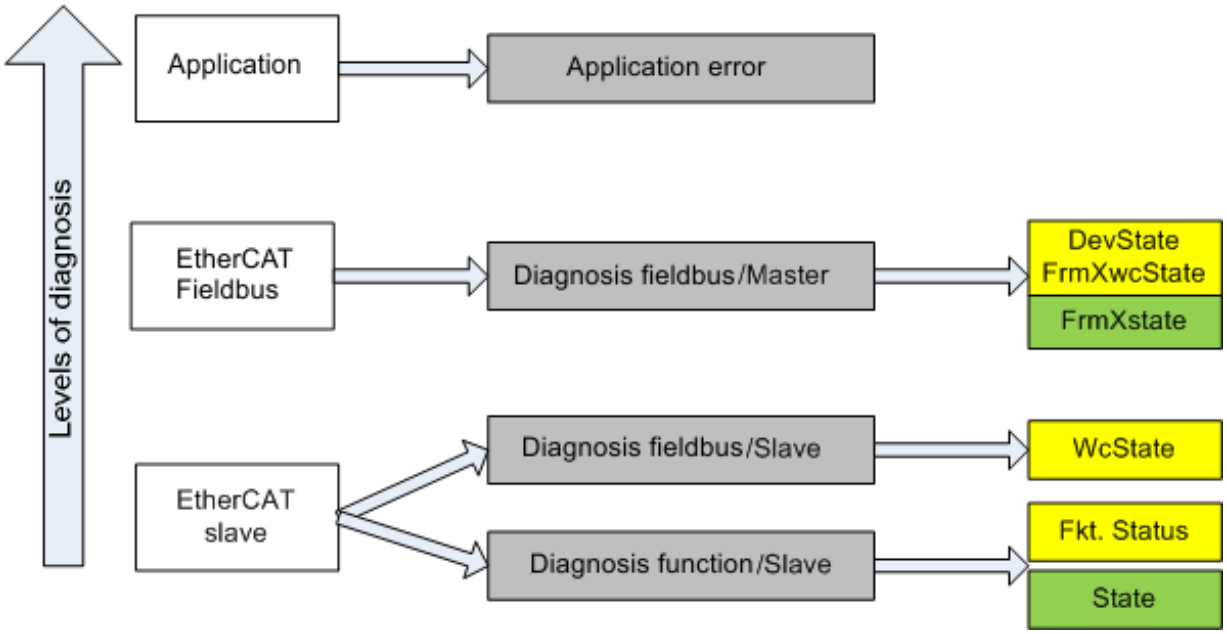


Fig. 150: Selection of the diagnostic information of an EtherCAT Slave

In general, an EtherCAT Slave offers

- communication diagnosis typical for a slave (diagnosis of successful participation in the exchange of process data, and correct operating mode)
  This diagnosis is the same for all slaves.

  as well as
- function diagnosis typical for a channel (device-dependent)
  See the corresponding device documentation

The colors in Fig. *Selection of the diagnostic information of an EtherCAT Slave* also correspond to the variable colors in the System Manager, see Fig. *Basic EtherCAT Slave Diagnosis in the PLC*.

Colour	Meaning
yellow	Input variables from the Slave to the EtherCAT Master, updated in every cycle
red	Output variables from the Slave to the EtherCAT Master, updated in every cycle
green	Information variables for the EtherCAT Master that are updated acyclically. This means that it is possible that in any particular cycle they do not represent the latest possible status. It is therefore useful to read such variables through ADS.

Fig. *Basic EtherCAT Slave Diagnosis in the PLC* shows an example of an implementation of basic EtherCAT Slave Diagnosis. A Beckhoff EL3102 (2-channel analogue input terminal) is used here, as it offers both the communication diagnosis typical of a slave and the functional diagnosis that is specific to a channel. Structures are created as input variables in the PLC, each corresponding to the process image.

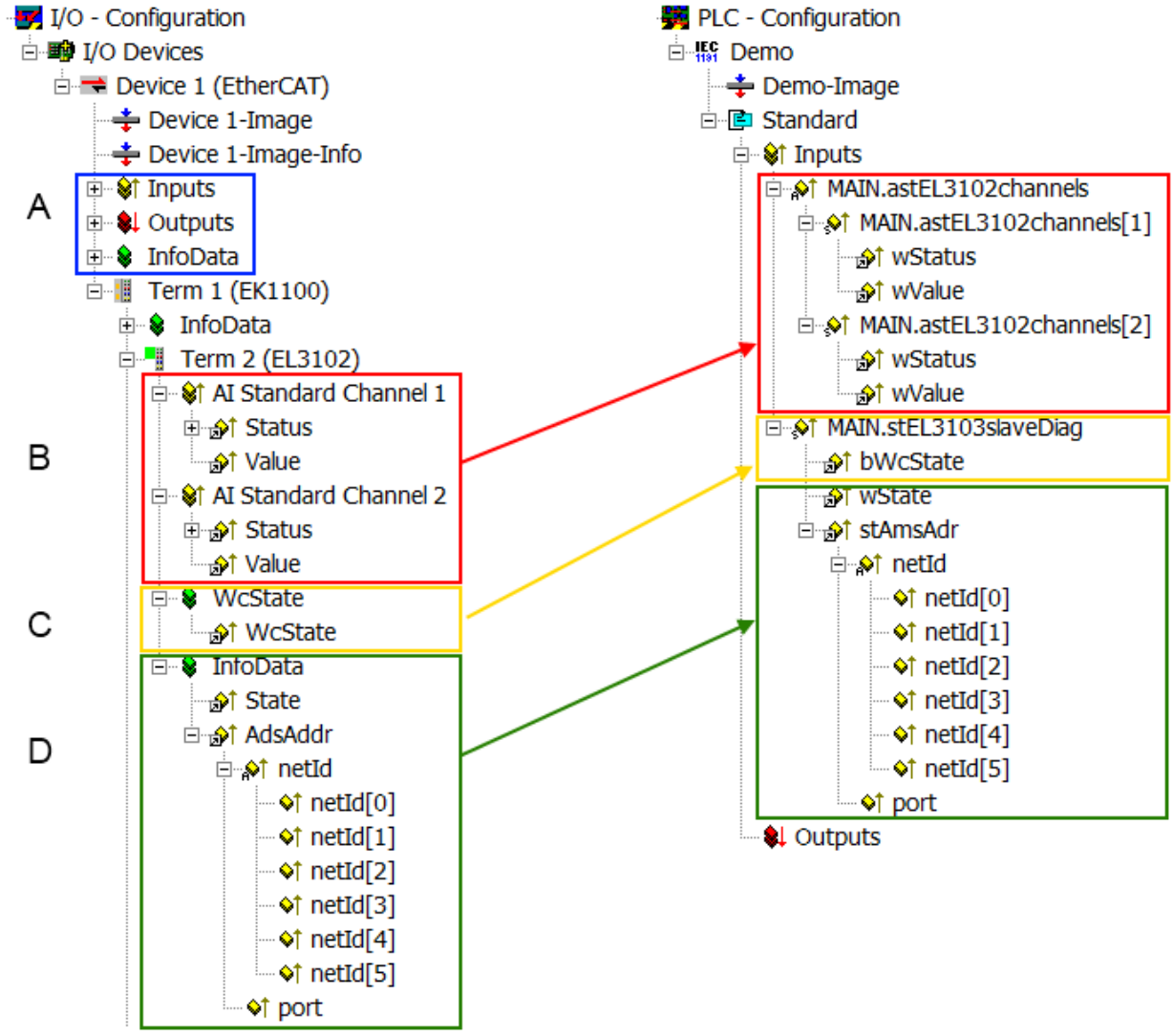


Fig. 151: Basic EtherCAT Slave Diagnosis in the PLC

The following aspects are covered here:

Code	Function	Implementation	Application/evaluation
A	The EtherCAT Master's diagnostic information updated cyclically (yellow) or provided acyclically (green).		At least the DevState is to be evaluated for the most recent cycle in the PLC. The EtherCAT Master's diagnostic information offers many more possibilities than are treated in the EtherCAT System Documentation. A few keywords: • CoE in the Master for communication with/through the Slaves • Functions from *TcEtherCAT.lib* • Perform an OnlineScan
B	In the example chosen (EL3102) the EL3102 comprises two analogue input channels that transmit a single function status for the most recent cycle.	Status • the bit significations may be found in the device documentation • other devices may supply more information, or none that is typical of a slave	In order for the higher-level PLC task (or corresponding control applications) to be able to rely on correct data, the function status must be evaluated there. Such information is therefore provided with the process data for the most recent cycle.
C	For every EtherCAT Slave that has cyclic process data, the Master displays, using what is known as a WorkingCounter, whether the slave is participating successfully and without error in the cyclic exchange of process data. This important, elementary information is therefore provided for the most recent cycle in the System Manager 1. at the EtherCAT Slave, and, with identical contents 2. as a collective variable at the EtherCAT Master (see Point A) for linking.	WcState (Working Counter) 0: valid real-time communication in the last cycle 1: invalid real-time communication This may possibly have effects on the process data of other Slaves that are located in the same SyncUnit	In order for the higher-level PLC task (or corresponding control applications) to be able to rely on correct data, the communication status of the EtherCAT Slave must be evaluated there. Such information is therefore provided with the process data for the most recent cycle.
D	Diagnostic information of the EtherCAT Master which, while it is represented at the slave for linking, is actually determined by the Master for the Slave concerned and represented there. This information cannot be characterized as real-time, because it • is only rarely/never changed, except when the system starts up • is itself determined acyclically (e.g. EtherCAT Status)	State current Status (INIT..OP) of the Slave. The Slave must be in OP (=8) when operating normally. *AdsAddr* The ADS address is useful for communicating from the PLC/task via ADS with the EtherCAT Slave, e.g. for reading/writing to the CoE. The AMS-NetID of a slave corresponds to the AMS-NetID of the EtherCAT Master; communication with the individual Slave is possible via the *port* (= EtherCAT address).	Information variables for the EtherCAT Master that are updated acyclically. This means that it is possible that in any particular cycle they do not represent the latest possible status. It is therefore possible to read such variables through ADS.

NOTICE

Diagnostic information

It is strongly recommended that the diagnostic information made available is evaluated so that the application can react accordingly.

CoE Parameter Directory

The CoE parameter directory (CanOpen-over-EtherCAT) is used to manage the set values for the slave concerned. Changes may, in some circumstances, have to be made here when commissioning a relatively complex EtherCAT Slave. It can be accessed through the TwinCAT System Manager, see Fig. *EL3102, CoE directory*:

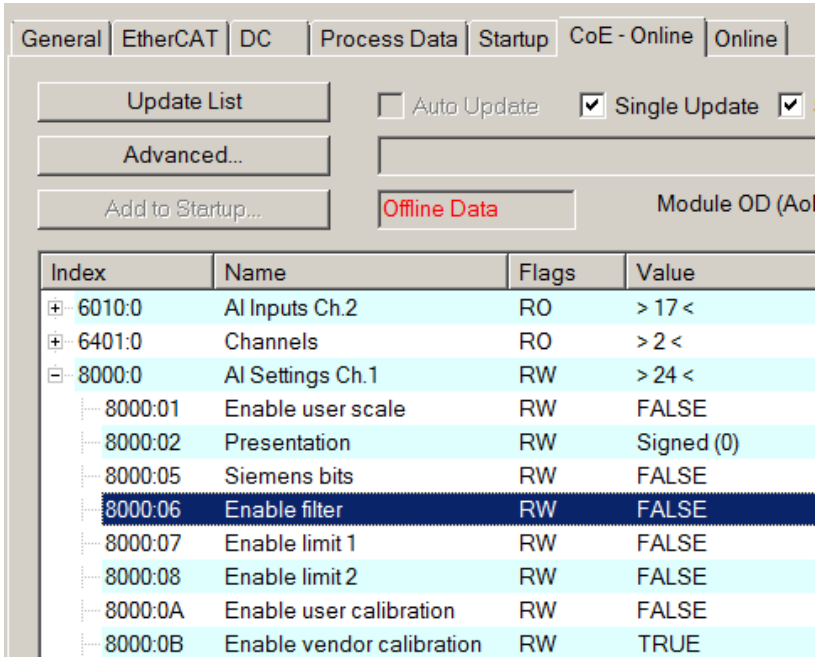


Fig. 152: EL3102, CoE directory

EtherCAT System Documentation

The comprehensive description in the EtherCAT System Documentation (EtherCAT Basics --> CoE Interface) must be observed!

A few brief extracts:

- Whether changes in the online directory are saved locally in the slave depends on the device. EL terminals (except the EL66xx) are able to save in this way.
- The user must manage the changes to the StartUp list.

Commissioning aid in the TwinCAT System Manager

Commissioning interfaces are being introduced as part of an ongoing process for EL/EP EtherCAT devices. These are available in TwinCAT System Managers from TwinCAT 2.11R2 and above. They are integrated into the System Manager through appropriately extended ESI configuration files.

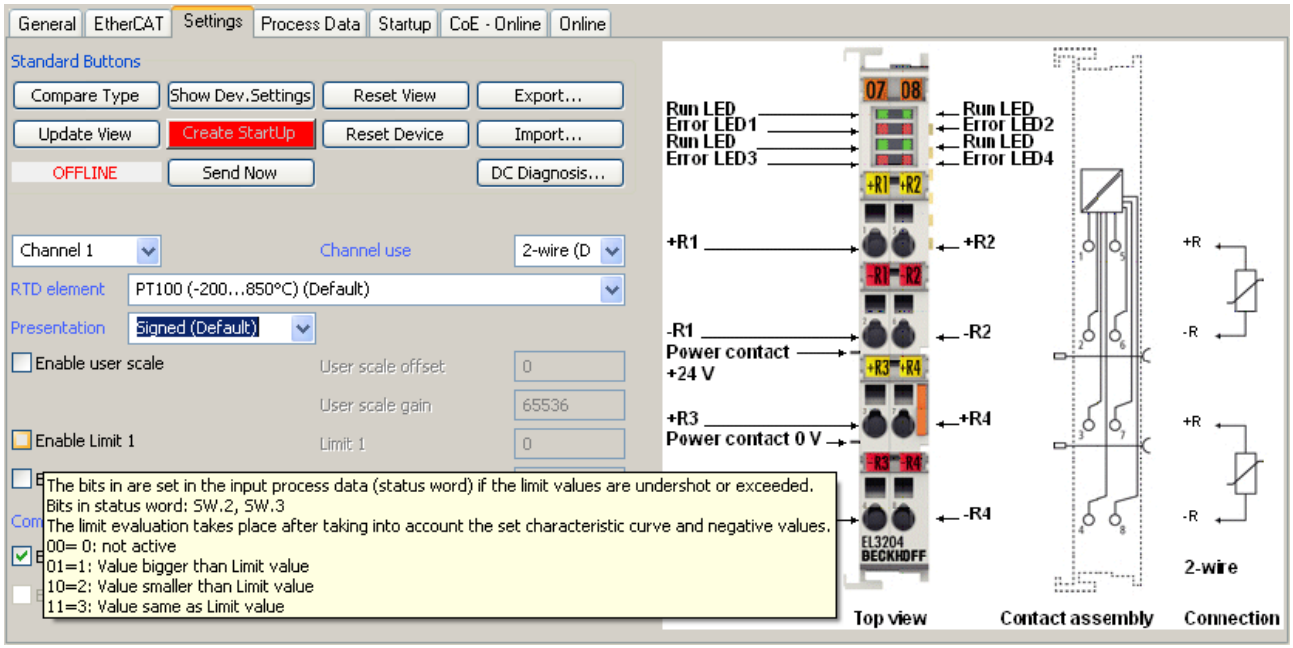


Fig. 153: Example of commissioning aid for a EL3204

This commissioning process simultaneously manages

- CoE Parameter Directory
- DC/FreeRun mode
- the available process data records (PDO)

Although the “Process Data”, “DC”, “Startup” and “CoE-Online” that used to be necessary for this are still displayed, it is recommended that, if the commissioning aid is used, the automatically generated settings are not changed by it.

The commissioning tool does not cover every possible application of an EL/EP device. If the available setting options are not adequate, the user can make the DC, PDO and CoE settings manually, as in the past.

EtherCAT State: automatic default behaviour of the TwinCAT System Manager and manual operation

After the operating power is switched on, an EtherCAT Slave must go through the following statuses

- INIT
- PREOP
- SAFEOP
- OP

to ensure sound operation. The EtherCAT Master directs these statuses in accordance with the initialization routines that are defined for commissioning the device by the ES/XML and user settings (Distributed Clocks (DC), PDO, CoE). See also the section on "Principles of Communication, EtherCAT State Machine [▶ 73]" in this connection. Depending how much configuration has to be done, and on the overall communication, booting can take up to a few seconds.

The EtherCAT Master itself must go through these routines when starting, until it has reached at least the OP target state.

The target state wanted by the user, and which is brought about automatically at start-up by TwinCAT, can be set in the System Manager. As soon as TwinCAT reaches the status RUN, the TwinCAT EtherCAT Master will approach the target states.

Standard setting

The advanced settings of the EtherCAT Master are set as standard:

- EtherCAT Master: OP
- Slaves: OP
  This setting applies equally to all Slaves.

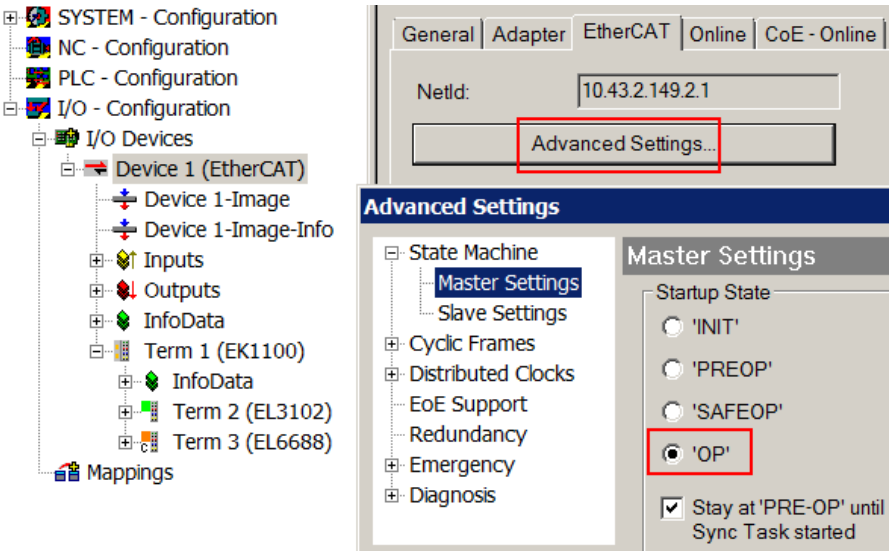


Fig. 154: Default behaviour of the System Manager

In addition, the target state of any particular Slave can be set in the “Advanced Settings” dialogue; the standard setting is again OP.

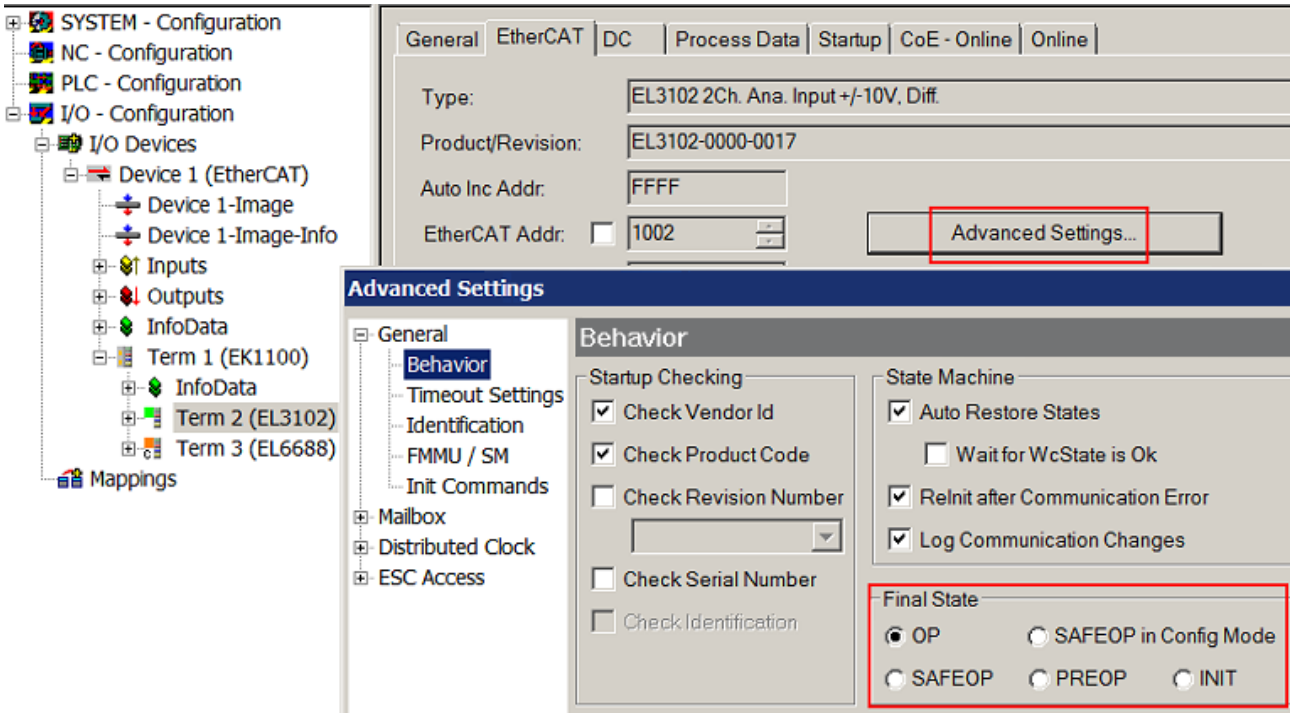


Fig. 155: Default target state in the Slave

Manual Control

There are particular reasons why it may be appropriate to control the states from the application/task/PLC. For instance:

- for diagnostic reasons
- to induce a controlled restart of axes
- because a change in the times involved in starting is desirable

In that case it is appropriate in the PLC application to use the PLC function blocks from the *TcEtherCAT.lib*, which is available as standard, and to work through the states in a controlled manner using, for instance, *FB_EcSetMasterState*.

It is then useful to put the settings in the EtherCAT Master to INIT for master and slave.

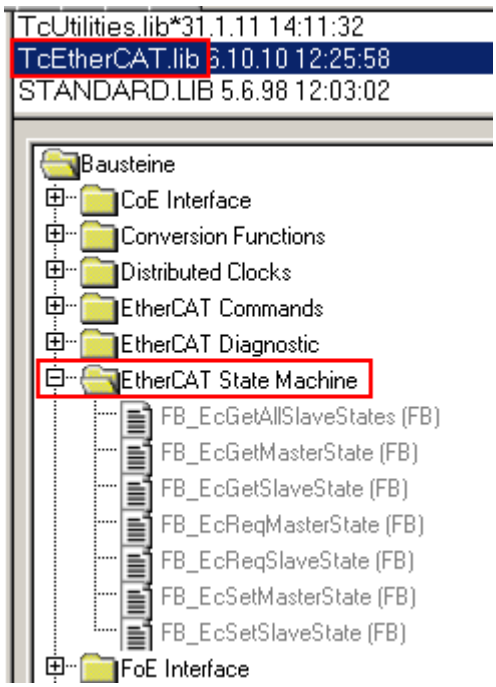


Fig. 156: PLC function blocks

Note regarding E-Bus current

EL/ES terminals are placed on the DIN rail at a coupler on the terminal strand. 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. 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 as a column value. 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.

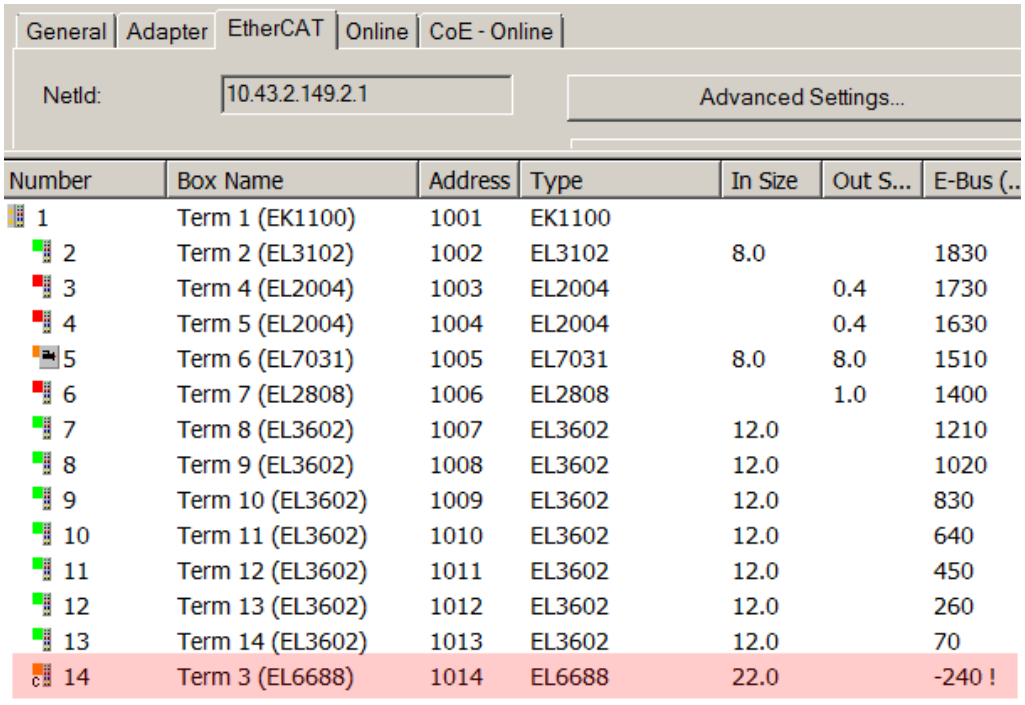


Fig. 157: Illegally exceeding the E-Bus current

From TwinCAT 2.11 and above, a warning message “E-Bus Power of Terminal...” is output in the logger window when such a configuration is activated:

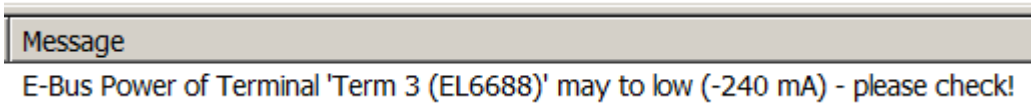


Fig. 158: Warning message for exceeding E-Bus current

NOTICE

Caution! Malfunction possible!

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

6.4 EL32xx settings

The following chapters list the necessary and optional settings for taking temperature or resistance measurements with the EL32xx:

Basic settings [▶ 184]	• Sensor type 0x80n00:19 • Connection method 0x80n0:1A
Further settings [▶ 186] (optional)	• PDO presentation 0x80n00:02 • Compensation of the supply line resistance 0x80n0:1B • User scaling 0x80n00:01 • Calibration and calculation of process data: user calibration 0x80n00:18/17 and manufacturer calibration 0x80nF • Siemens bits 0x80n00:05 • Notch filter 0x80n00:06 and conversion times (not for EL3214, EL3208 and EL3218) • Limit 1 0x80n00:13, Limit 2 0x80n00:14 (not for EL3214, EL3208 and EL3218)

NOTICE

Mixed operation of low-impedance and high-impedance sensors within a terminal operating in multiplex mode must be avoided!

Due to large differences in resistance between the sensor types, mixed operation of low-impedance sensors, e.g. Pt/Ni, and high-impedance sensors, e.g. NTC, within a terminal should be avoided if the terminal operates in multiplex mode, i.e. channels are read in successively by an ADC. In this case, larger measuring errors can occur for the low-resistance sensors.
Alternatively, 1-channel or simultaneously operating devices (each channel has its own ADC) should be used, since no changeover processes occur here.

NOTICE



RTD basics

The RTD basics in chapter "Basics of RTD technology" of the IO Analog Manual and "RTD measurement in EL32xx [▶ 62]" must be observed.

Overarching orientation is provided by the data flow, the successive processing steps from the ADC converter to the process data output to EtherCAT:

Data flow

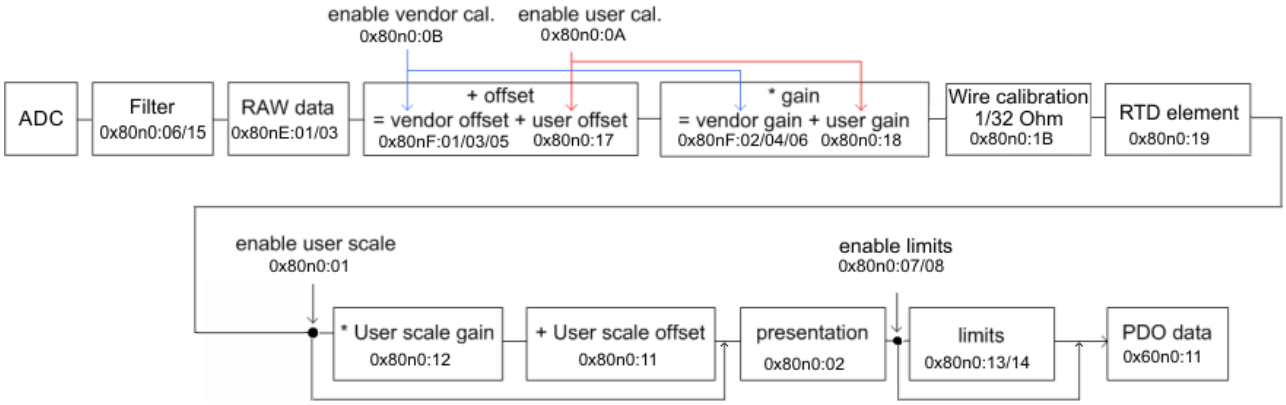


Fig. 159: Data diagram

- The terminal permanently records measured values and puts the filtered raw values X_{ADC} of the A/D converter into the ADC raw value object 0x80nE:01.
- After each acquisition of the analog signal, the correction calculation is performed with the calibration values, measured value after calibration:
  $Y_{calibrated}$ = ((ADC raw data / 8) - Calibration offset) * Calibration gain * 2^{-18}
- optional: Wire calibration
- optional: Transformation RTD element R [Ohm] -> T [°C]

- If user scaling is activated (0x80n0:01 = TRUE) the measured value is calculated including user scaling: $Y_{scaled} = (Y_{calibrated} * A_W * 2^{-16}) + B_W$
  Otherwise $Y_{scaled} = Y_{calibrated}$
- Application "Presentation
- optional: limit evaluation
- Measured value output to EtherCAT

Changes of the slave parameters in the CoE directory

The CoE parameters may have to be changed in the "CoE online" tab of the EtherCAT slave during commissioning.

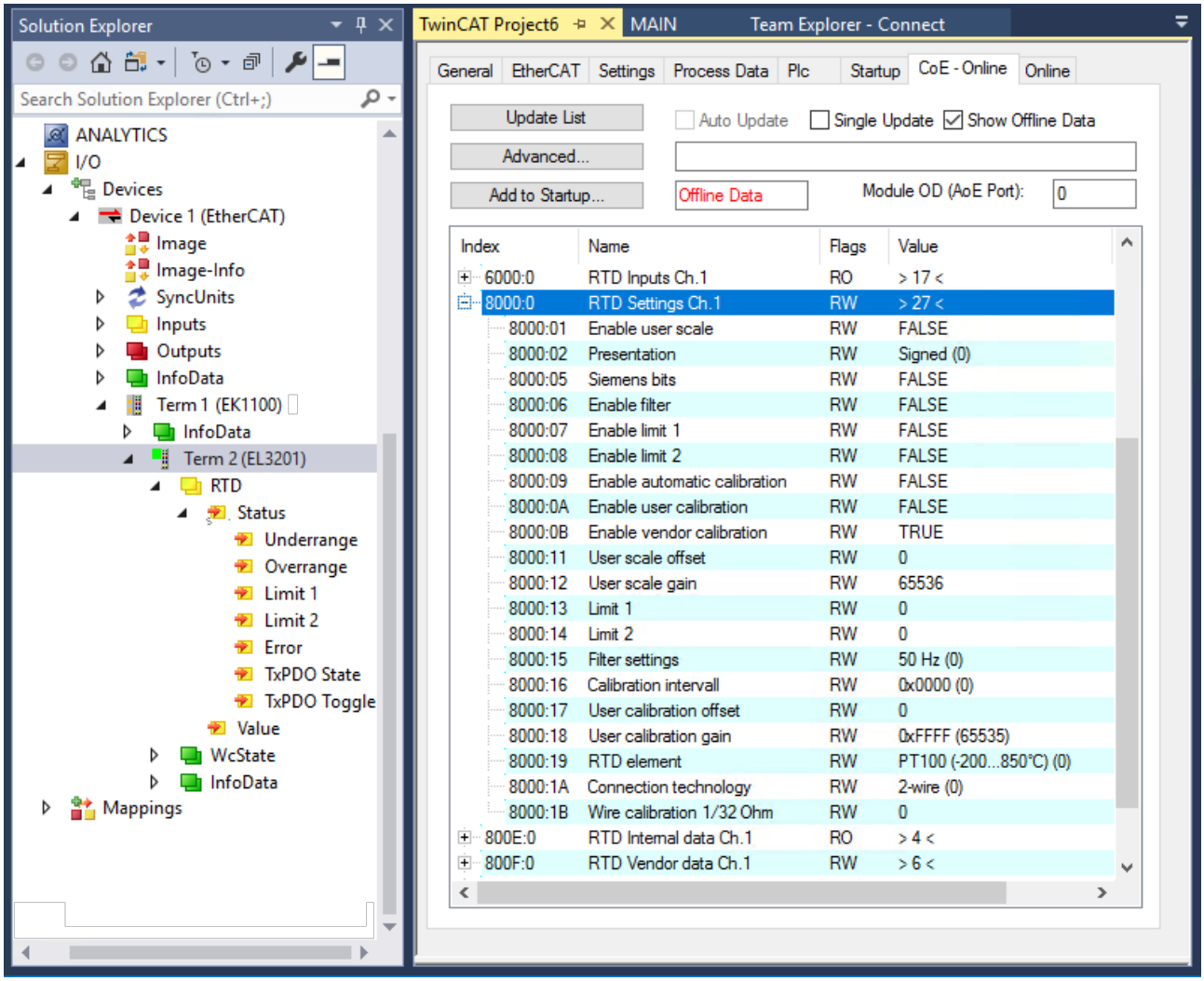


Fig. 160: Accessing the CoE parameters in TwinCAT System Manager, EL3201

For detailed information on settings and operation modes, please read the following chapters on Basic settings [▶ 184] and "Further settings (optional) [▶ 186]".

Reset the terminal

If an EL32xx which was already configured in use is to be put into operation, it is recommended that the settings in the CoE be reset to the factory settings if necessary (see chapter "Restoring the delivery state [▶ 325]")

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)

6.4.1 Basic settings

Depending on the measuring task, it is essential to set the measuring type and connection method.

6.4.1.1 Measuring type: CoE 0x80n00:19 "RTD element"

When measuring temperature via RTD sensors, the measuring device (here: the EL32xx terminal) measures the sensor resistance electrically and transforms it into a temperature in the firmware. As an example, the relationship between the temperature and the resistance of a Pt100 and Pt1000 sensor is shown below:

Temperature	Pt1000 typical resistance, approx.	Pt100 typical resistance, approx.
850°C	3.9 kΩ	390 Ω
320°C	2.2 kΩ	220 Ω
-200°C	180 Ω	18 Ω

Further characteristic sensor curves are available from the sensor manufacturers. Extensive background information is provided by chapter "Basics of RTD technology" of the IO Analog Manual.

CoE 0x80n00:19 "RTD element"

A large number of different R -> T transformations can be selected in the firmware (see also chapter "Overview of implemented RTD transformations" of the IO Analog Manual). The terminal then outputs the converted temperature value:

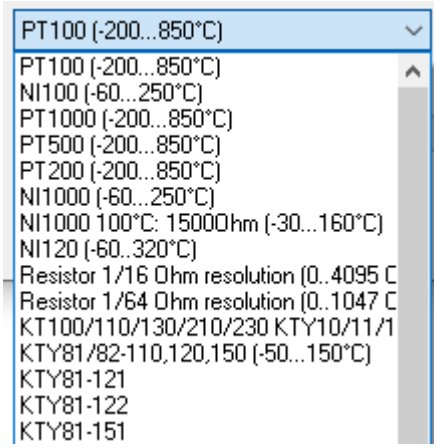


Fig. 161: Selection of R->T transformation in CoE 0x080n00:19 "RTD element"

Alternatively, a direct resistance output can be selected:

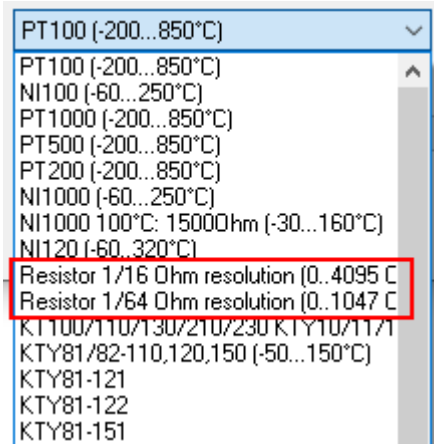


Fig. 162: Selection of resistance output in CoE 0x080n00:19 "RTD element

6.4.1.2 Connection method: CoE 0x08n0:1A "Connection Technology"

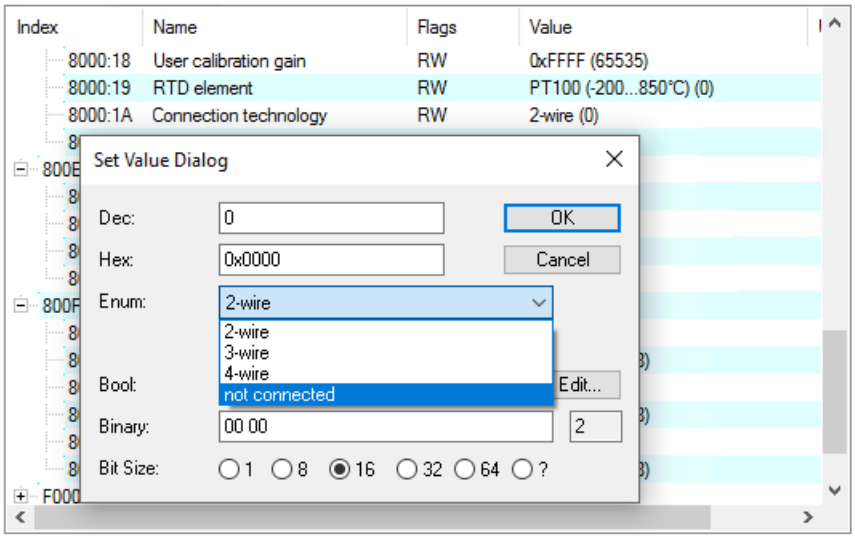


Fig. 163: "Connection technology" selection dialog using the EL3201 as an example

2-, 3- or 4-wire connection of the sensor can be selected here depending on the terminal type. Basically, the lowest measurement uncertainty (colloquially: lowest measuring error) can be achieved with a 4-wire connection (if available), since supply line resistances are actively deducted.
With "not connected" (if present) the respective channel is completely disabled, the conversion time of the EL32xx is shortened accordingly.

The number of connection wires of the sensor and the terminal setting in CoE 0x80n0:1A should match! This is the only way to assure that the capabilities of the sensor and measuring device are used in the best possible way. Otherwise you have to work with wire jumpers (sensor has less lines than are possible in the measuring device) or double assignment (sensor has more lines than are possible in the measuring device). This increases the measurement uncertainty. Here are a few (bad) examples:

- 4-wire sensor and 2-wire terminal:
  The added value of the 4-wire sense measurement cannot be exploited, the complex 4-wire sensor is operated as an uncompensated 2-wire sensor, either the sense lines of the RTD are not connected at all or are also plugged into the 2-wire contacts.
- 2-wire sensor and 4-wire terminal:
  External wire jumpers must be plugged into the terminal to trick the terminal into believing that it is a 4-wire sensor, the 4-wire capability of the terminal cannot be exploited.

6.4.2 Further settings (optional)

Further settings are possible if required and are described in the following chapters.

6.4.2.1 PDO presentation, 0x80n00:02

Index 0x80n00:02 "Presentation" offers the possibility to change the digital presentation of the measured value in the 16-bit value. Three value presentations are possible in the 16-bit PDO:

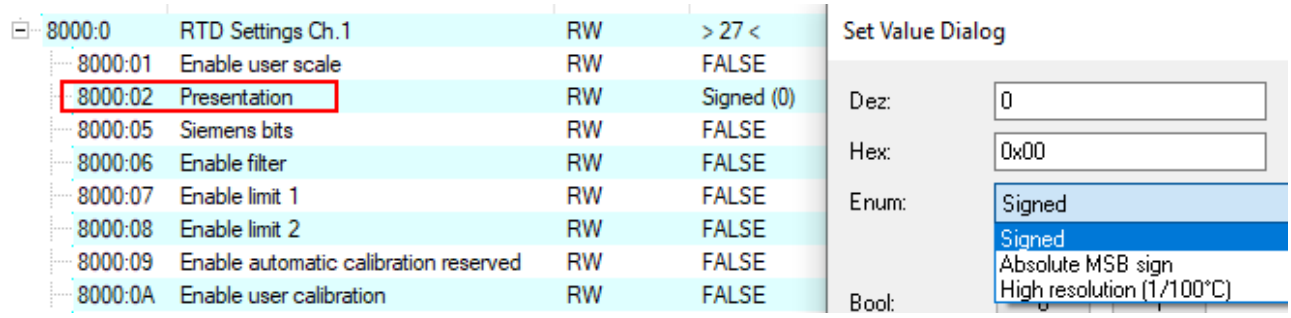
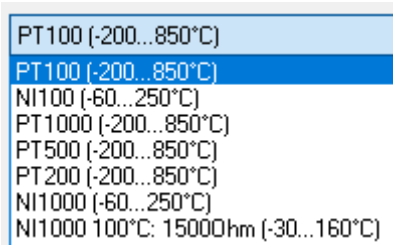


Fig. 164: Setting the presentation of the measured value in 0x8000:02 "Settings"

- **Signed (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 RTD transformation).



  Example:
  - $1000\ 0000\ 0000\ 0000_{bin} = 0x8000_{hex} = -\ 32768_{dec}$
  - $1111\ 1111\ 1111\ 1110_{bin} = 0xFFFE_{hex} = -\ 2_{dec}$
  - $1111\ 1111\ 1111\ 1111_{bin} = 0xFFFF_{hex} = -\ 1_{dec}$
  - $0000\ 0000\ 0000\ 0001_{bin} = 0x0001_{hex} = +1_{dec}$
  - $0000\ 0000\ 0000\ 0010_{bin} = 0x0002_{hex} = +2_{dec}$
  - $0111\ 1111\ 1111\ 1111_{bin} = 0x7FFF_{hex} = +32767_{dec}$
- **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, but can be extended by user scaling [▶ 218]).
  The achievable accuracy is not increased by the more detailed presentation! However, the additional decimal place can be useful for control tasks, where the internal ADC resolution limits the resolution.

Measured value and process data output

Measured value	Output (hexadecimal)	Output (signed integer, decimal)	In 1/10°C, corresponds to	In 1/100°C, corresponds to
-250.0°C	0xF63C	-2500	-250°C	-25°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	100°C

- **Absolute value with MSB as sign:**
  The measured value with resolution 1 bit = 1/10°C is output signed in the signed amount presentation. Maximum presentation 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:
  - $1111\ 1111\ 1111\ 1111_{bin} = 0xFFFF_{hex} = -\ 32767_{dec}$
  - $1000\ 0000\ 0000\ 0010_{bin} = 0x8002_{hex} = -\ 2_{dec}$
  - $1000\ 0000\ 0000\ 0001_{bin} = 0x8001_{hex} = -\ 1_{dec}$
  - $0000\ 0000\ 0000\ 0001_{bin} = 0x0001_{hex} = +1_{dec}$
  - $0000\ 0000\ 0000\ 0010_{bin} = 0x0002_{hex} = +2_{dec}$
  - $0111\ 1111\ 1111\ 1111_{bin} = 0x7FFF_{hex} = +32767_{dec}$

Presentation note on the "Resistance measurement" operation mode

In "Resistance Measurement" mode, the measured value is always displayed unsigned, irrespective of the "Presentation" setting (object 0x80n00:02), as 0..0xFFFF with the respective value.

1/16 Ω -> ~62 mΩ/digit

1/64 Ω -> ~15 mΩ/digit

6.4.2.2 Compensation of the supply line resistance, 0x80n0:1B

When measuring resistance with the two-wire technique, the firmware can take the line resistance into account, provided it is made known to it. For this purpose, the separately measured static supply line resistance can be entered in the CoE object 0x80n0:1B "Wire calibration 1/32 ohm". It is then taken into account in the firmware. (unit [1/32 Ω]). An example of the calculation can be found in the chapter "Basics of RTD technology" of the IO Analog Manual.

However, line changes occurring after commissioning (temperature change, corrosion) are not detected in this way! The use of 3- or 4-wire connection technology is recommended for this purpose.

6.4.2.3 Measured value calculation: calibration, adjustment, scaling

As can be seen in the data flow [▶ 180], the measured value can be manipulated computationally in two places:

- In the calibration object
  - The manufacturer calibration takes place in the manufacturer part (password protected). The Beckhoff adjustment on the production side ensures that the channel complies with the device specification.
  - In the user part, the user can enter their own gain/offset values.
- In the scaling object

User scaling, index 0x80n00:01

The user scaling is enabled via index 0x80n00:01, the parameterization via indices

- 0x80n00:11 offset user scaling
- 0x80n00:12 gain user scaling

User calibration, index 0x80n00:18, 0x80n00:17

The user calibration is enabled via index 0x80n0:0A, the parameterization via indices

- 0x80n00:17 user offset calibration
- 0x80n00:18 user gain calibration

Manufacturer calibration, index 0x80xF

The manufacturer calibration is enabled via index 0x80n0:0B.
Beckhoff reserves the right to parameterize via the device-specific indices of object 0x80nF (see CoE object directory [▶ 217]) (see Note Producer Codeword [▶ 188]).

Producer codeword

Beckhoff reserves the right to perform basic adjustment of the terminals. The producer codeword is therefore not public.

6.4.2.4 Siemens bits, 0x80n00:05

If this bit is set, status displays are superimposed on the lowest three bits. In the error case "overrange" or "underrange", bit 0 is set.

6.4.2.5 Notch filter

The EL32xx terminals are equipped with a digital filter. The filter performs a notch filter function and determines the conversion time of the terminal. It is parameterized via the index 0x8000:15. The higher the filter frequency, the faster the conversion time.

Notch filter means that the filter has zeros (notches) in the frequency response at the specified filter frequency and multiples thereof, i.e. it masks these frequencies. In order to filter out 50 Hz, therefore, the 50 or the 10 Hz filter can be used. Since all frequencies lower than the notch frequency usually have to be measured, however, the "50 Hz" setting is to be used in this case.

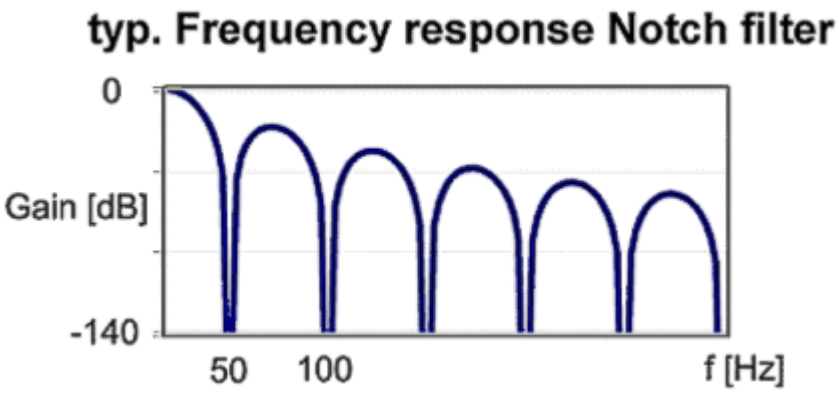


Fig. 165: Typical frequency response of a notch filter set to 50 Hz

Index 0x80n00:06

The filter function is always active even if the bit is not set, since this is obligatory for the measurement process! The firmware filter can therefore not be switched off.

Details on the conversion time

- The conversion time depends on the *number of active channels, number of measurements (2/4-wire), filter time, const. computing time*
- The conversion time for the 2-wire measurement is about twice as long as for the 4-wire measurement
- The resistance measurement corresponds to a 4-wire measurement
- The process data *TxPDO Toggle* changes its state if a new measured value is present

The filter characteristics are set via index 0x8000:15

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1). The corresponding indices 0x8010:15 of the EL3202 or 0x8010:15, 0x8020:15, 0x8030:15 of the EL3204 have no parameterization function.

Switching off the unused channels of multi-channel terminals

Unused channels should be switched off by "not connected" if filter frequencies are ≥ 1 kHz (optimization of conversion times)!
The channel concerned is completely disabled and the conversion time of the EL32xx is correspondingly shortened.

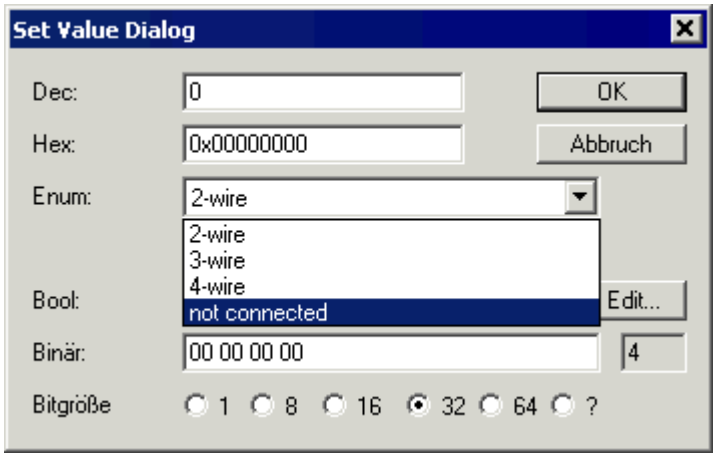


Fig. 166: Set Value Dialog

By means of a double click on the corresponding object 0x80n0:1A, the respective channels can be switched off in the Set Value Dialog by selecting the "Enum" value "not connected" (see fig. *"Set Value Dialog"*).

Interference from equipment

When operating the fast analog EL320x 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 that separate power supply units be used for the terminals and the interference-causing devices.
- The integrated filter of the terminal (see index 0x80n00:06) should be switched on as an additional measure.

Typical conversion times

EL3201, EL3201-0010, EL3201-0020, EL3201-0030

Filter frequency	Conversion time (update time)
5 Hz	205 ms
10 Hz	105 ms
50 Hz	25 ms
60 Hz	21 ms
100 Hz	15 ms
500 Hz	5 ms
1000 Hz	4 ms
2000 Hz	4 ms
3750 Hz	4 ms
7500 Hz	4 ms
15000 Hz	4 ms
30000 Hz	4 ms
Conversion times in relation to the filter frequencies, 4-wire measurement	

EL3202

Filter frequency	Conversion time (update time)
5 Hz	807 ms
10 Hz	410 ms
50 Hz	88 ms
60 Hz	75 ms
100 Hz	46 ms
500 Hz	13 ms
1000 Hz	10 ms
2000 Hz	7 ms
3750 Hz	6 ms
7500 Hz	5 ms
15000 Hz	5 ms
30000 Hz	5 ms
Conversion times in relation to the filter frequencies, 3-wire measurement	

EL3202-0010, EL3202-0020, EL3202-0030

Filter frequency	Conversion time (update time)	
	4-wire update rate	3-wire update rate
5 Hz	410 ms	610 ms
10 Hz	210 ms	310 ms
50 Hz	47 ms	67 ms
60 Hz	40 ms	57 ms
100 Hz	25 ms	35 ms
500 Hz	7 ms	10 ms
1000 Hz	5 ms	7 ms
2000 Hz	4 ms	5 ms
3750 Hz	4 ms	5 ms
7500 Hz	4 ms	5 ms
15000 Hz	4 ms	5 ms
30000 Hz	4 ms	5 ms

EL3204

Filter frequency	Conversion time (update time)
5 Hz	800 ms
10 Hz	400 ms
50 Hz	82 ms (21 ms / 1 channel)
60 Hz	70 ms
100 Hz	43 ms
500 Hz	11 ms
1000 Hz	7 ms
2000 Hz	6.5 ms (2 ms / 1 channel)
3750 Hz	6 ms
7500 Hz	6 ms
15000 Hz	6 ms
30000 Hz	6 ms
Conversion times in relation to the filter frequencies, 4-wire measurement	

EL3208

Filter frequency	Conversion time (update time)	
	1 channel active	8 channels active
5 Hz	201 ms	1600 ms
10 Hz	101 ms	807 ms
50 Hz	22 ms	171 ms
60 Hz	18 ms	145 ms
100 Hz	12 ms	92 ms
500 Hz	4 ms	29 ms
1000 Hz	3 ms	20 ms
2000 Hz	3 ms	20 ms
3750 Hz	3 ms	20 ms
7500 Hz	3 ms	20 ms
15000 Hz	3 ms	20 ms
30000 Hz	3 ms	20 ms
Conversion times in relation to the filter frequencies, 2-wire measurement		

EL3214 and EL3218

Filter frequency	Conversion time (update time)	
	1 channel active	4 channels active
5 Hz	402 ms	1607 ms
10 Hz	203 ms	811 ms
50 Hz	44 ms	175 ms
60 Hz	37 ms	148 ms
100 Hz	24 ms	95 ms
500 Hz	8 ms	32 ms
1000 Hz	6 ms	24 ms
2000 Hz	6 ms	22 ms
3750 Hz	5 ms	21 ms
7500 Hz	5 ms	20 ms
Conversion times in relation to the filter frequencies, 3-wire measurement		

6.4.2.6 Limit 1 0x80n00:13, Limit 2 0x80n00:14 (not for EL3214, EL3208 and EL3218)

The limit function is enabled via the indices 0x80n00:07 "Enable limit 1" and Index 0x80n00:08 "Enable limit 2".

With the indices 0x80n00:13 "Limit 1" and 0x80n00:14 "Limit 2", a value range can be set, which is continuously compared with the current measured value. When the "Limits" limit values are not met/ exceeded, the corresponding bits in the PDO status are set.

The limit evaluation takes place after taking into account the set characteristic curve and negative values, s. data flow diagram [▶ 180].

Limit [2 Bit] Interpretation (default), Index 0x60n00:03, 0x60n00:05:

0x00, 0: not active
0x01, 1: value is greater than limit value
0x10, 2: value is less than limit value
0x11, 3: value is equal to limit value

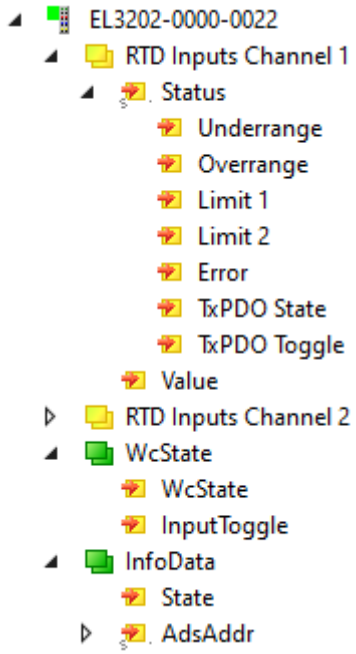
6.5 Process data

EtherCAT process data PDO (process data objects)

The EL32xx-xxxx provide a default process image consisting of

- per channel
  - Status: 16 bit
    Content: see chapter Status word [▶ 195]
  - Value: 16 bit measured value
    Presentation: see chapter "PDO presentation [▶ 186]"
- Device information (real-time, i.e. updated cyclically)
  See also chapter “General Commissioning Instructions for an EtherCAT Slave [▶ 172]”
  - WcState: 1 bit
    TRUE: terminal has not transferred any valid values to EtherCAT in this cycle, measured values of the terminal may not be used.
    Cause: either the terminal itself or another device in the same SyncUnit is not participating in the EtherCAT data exchange, rectify fault.
  - InputToggle: 1 bit
    Bit change indicates new process data
- Device information (non-realtime)
  - State: EtherCAT state of the device INIT – PreOP – SafeOP – OP, BOOTSTRAP
  - ADS address in the AMS Net ID system: for read/write access from the controller

Taking the example here of the EL3202, rev. 0022 (version 2022):



It is strongly recommended that the channel and device diagnostics be evaluated on the application side so that measured values do not continue to be not processed incorrectly, although the RTD terminal has already declared that it is incapable of measurement.

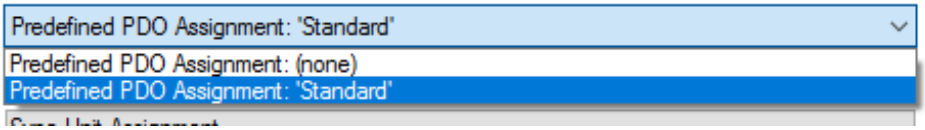
SyncManager

SM3, PDO assignment 0x1C13, for 0 ≤ n ≤ 7 (ch. 1 - 8) (depending on number of channels)				
Index	**Index of excluded PDOs**	**Size (byte.bit)**	**Name**	**PDO content**
0x1A0n (default)	-	4.0	RTD Inputs Channel 1 - 8	Index 0x60n00:01 - Underrange Index 0x60n00:02 - Overrange Index 0x60n00:03 - Limit 1* Index 0x60n00:05 - Limit 2* Index 0x6000:07 - Error Index 0x180n:07 - TxPDO Status Index 0x180n:09 - TxPDO Toggle Index 0x60n00:11 - Value

*) not for EL3214, EL3208 and EL3218

Process data preselection (predefined PDOs)

Since the EL32xx only have the standard process image, there are no selectable Predefined PDO:

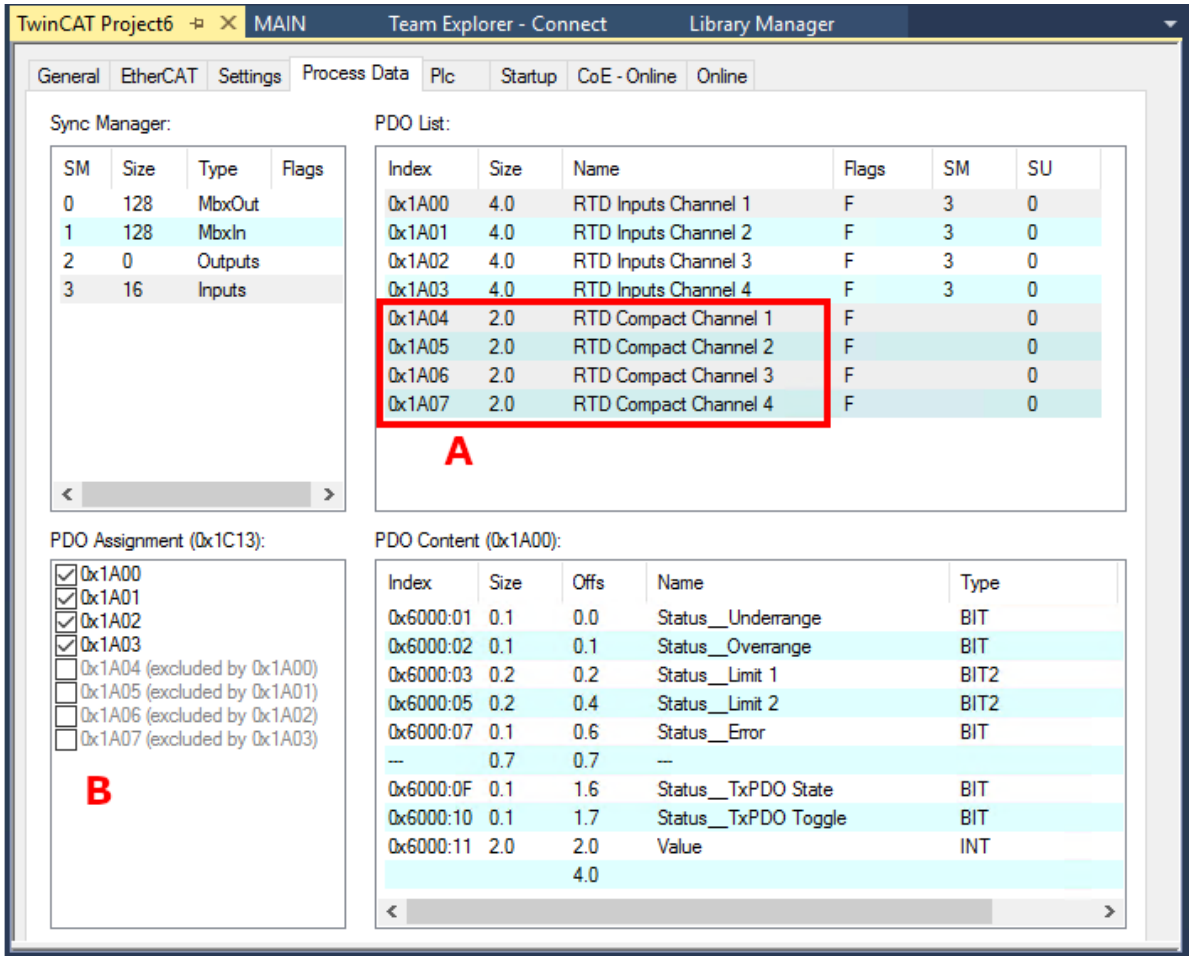


Compact process image

Function available from EL3204 FW10

To save process data width, the 16-bit status can be excluded from transmission. Since no diagnostic information can be evaluated after this, this operation is not recommended.

EL3204 example: in the TwinCAT EtherCAT configuration, select the PDO objects 0x1A04 ... 0x1A07 (A) in the PDO assignment 0x1C13 (B) instead of the standard PDO 0x1A00...0x1A03.



6.6 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**: value below measuring range
- **Overrange**: value above measuring range ("Wire break" together with "Error")
- **Limit 1 (depending on terminal type):** Limit value monitoring 0: ok, 1: limit range exceeded, 2: limit range undershot
- **Limit 2 (depending on terminal type):** Limit value monitoring 0: ok, 1: limit range exceeded, 2: limit range undershot
- **Error**: the error bit is set if the process data is invalid (wire 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 *"EL32xx-0000-0016 process image in the TwinCAT 2.11 representation"*.
Each item of status information is transmitted as a single, linkable process data.

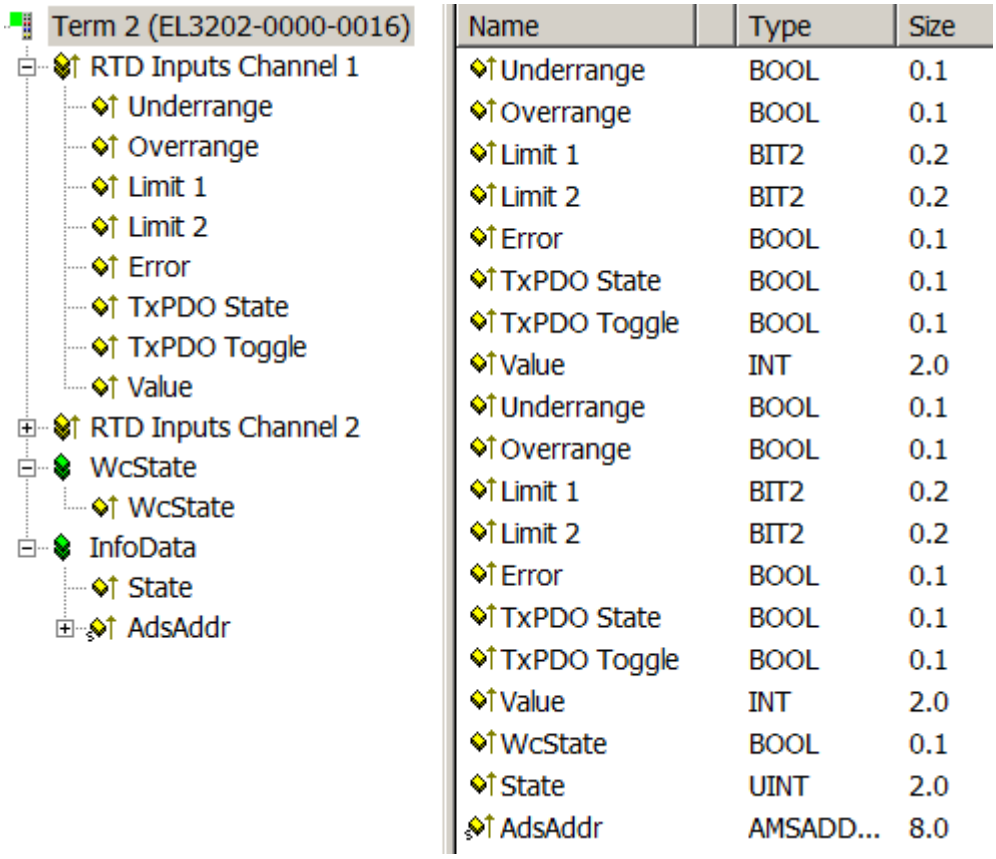


Fig. 167: EL32xx-0000-0016 process image in the TwinCAT 2.11 representation

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.

Status word

Bit	SW.15	SW.14	SW.13	SW.12	SW.11	SW.10	SW.9	SW.8	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.

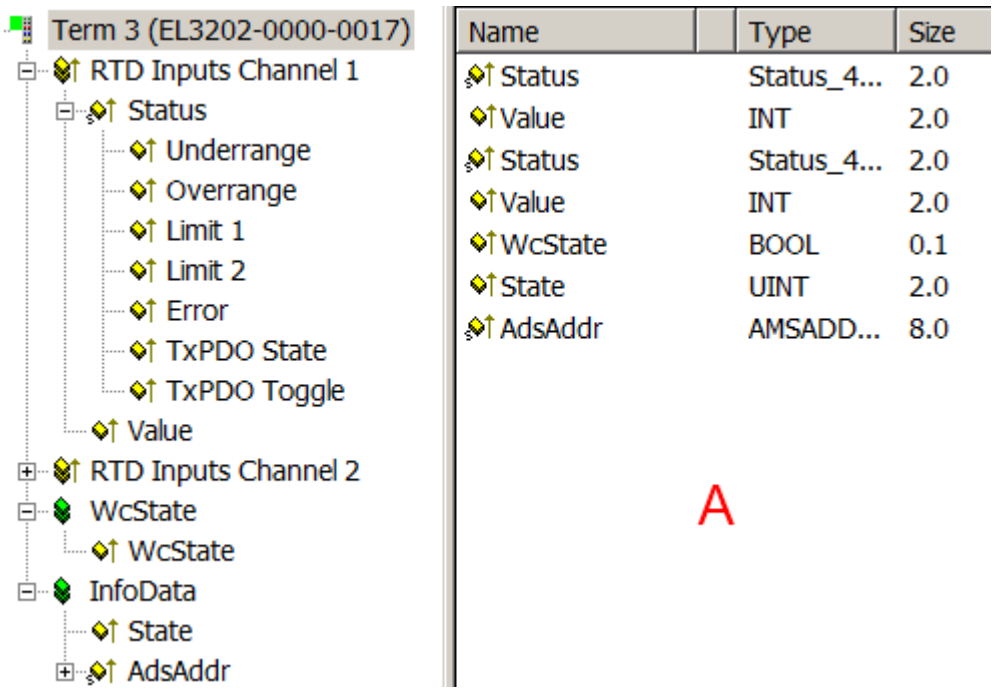


Fig. 168: EL32xx-0000-0017 process image in the TwinCAT 2.11 representation

The individual items of information can also be displayed in the overview window (A) on the right. By clicking on the button



in the menu bar the information can also be displayed there.

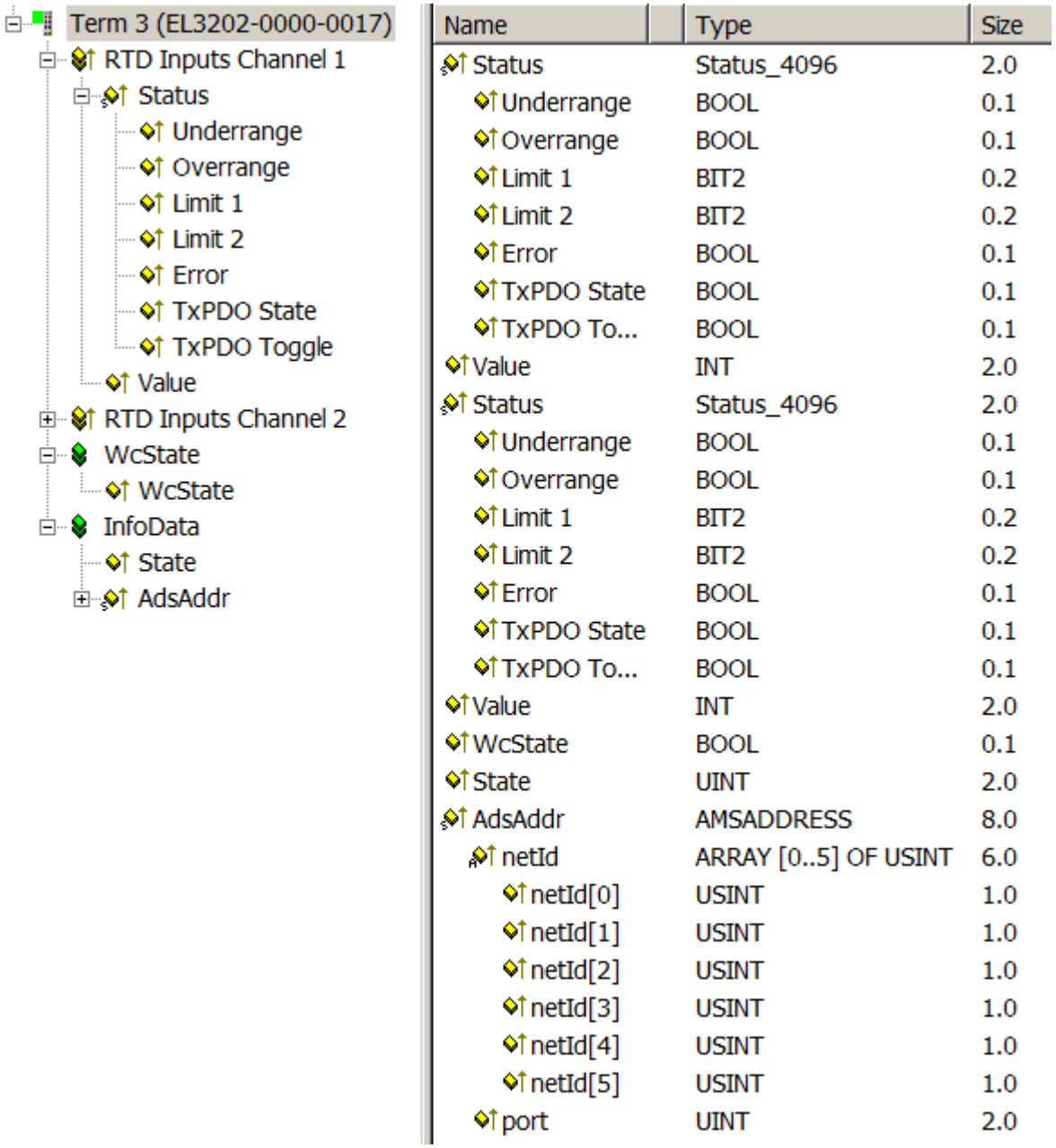


Fig. 169: Consolidated process image in the extended representation under TwinCAT 2.11

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__".

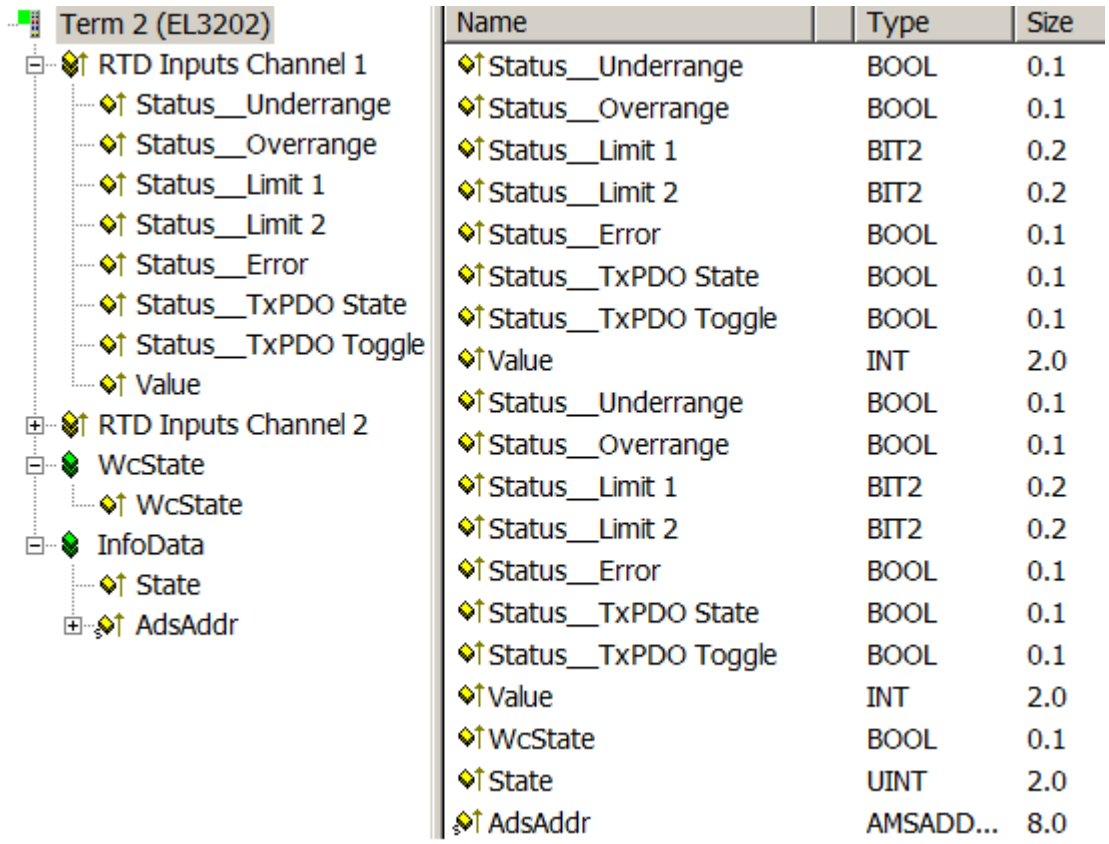


Fig. 170: Consolidated process image represented under TwinCAT 2.10

- 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.

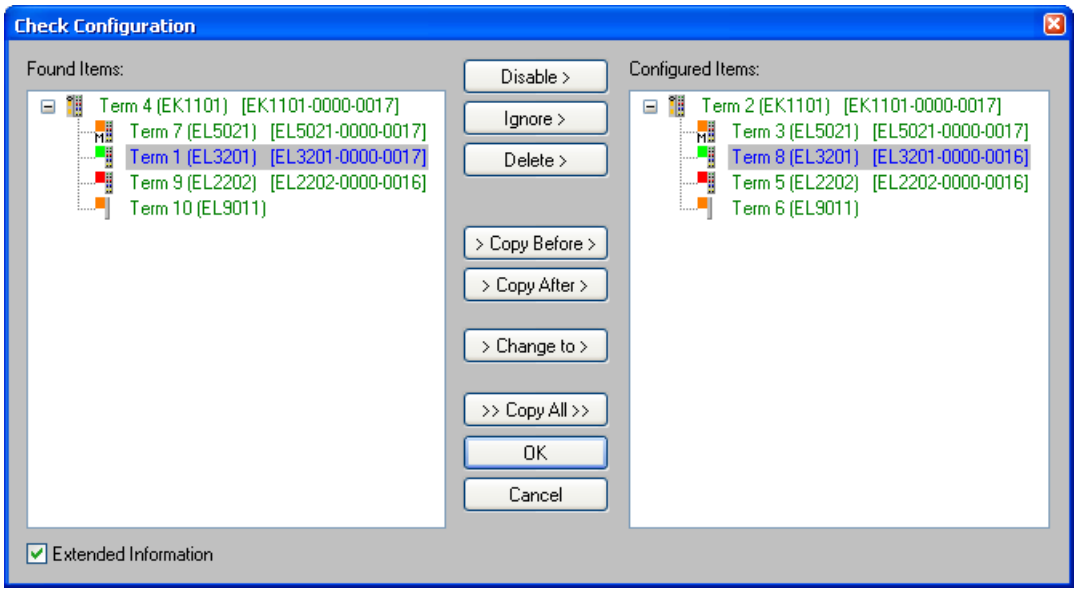


Fig. 171: Typical result after scanning an EtherCAT system

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.

6.7 Settings and application notes for EL3201/2-0010/-0020/-0030

Commissioning EL32xx-xxxx

The basic EL32xx-xxxx notes in chapter "EL32xx settings [▶ 180]" must be observed.

The EL3201/EL3202 series is designed for temperature or resistance measurement

- version -0010 offers enhanced measurement precision
- version -0020 is the factory calibrated version of the EL32xx-0010
- version -0030 is the variant with external calibration certificate of the EL32xx-0010

Notes regarding EL3201/2-0010/-0020/-0030 series (high-precision)

Due to special features in hardware and firmware, the mentioned terminals are able to measure the resistance value and thus, if necessary, the temperature with high accuracy. Please note:

Increased accuracy EL320x-0010/-0020/-0030

In the case of the high-precision terminals the settings in the object 0x80n0 / RTD-Settings may not be changed! The high-precision resistance measurement/temperature measurement can only be performed in the range 10... 220 ohm, this corresponds to a Pt100 measuring range of -200 ... 320°C.

In order to be able to display the high accuracy, the 0.01°C/digit presentation is preset. The increased accuracy of the EL320x-00x0 is therefore only valid for the following settings:

• Resistance measurement or Pt100 characteristic curve (0.00385 Ω/Ω/°C, IEC60751 characteristic curve Pt385) – other characteristic curve without guarantee!
• Ambient temperature: see table of technical data
• 4-wire connection technology
• Measuring range -200 to 320°C
• 50/60 Hz filter

Temperatures or resistances outside the above-mentioned range cannot be measured with high accuracy. If these basic values are not maintained, the high-precision terminal behaves like a terminal with standard accuracy.

To ensure that the measurements are also carried out with the desired increased accuracy in the long term, regular checking of the measuring accuracy is recommended, e. g. annually. Ageing effects or environmental influences can then be compensated by recalibration (user calibration).

Default/factory setting

CoE Index	EL32xx-0000 (standard accuracy)	EL320x-0010/-0020/-0030 (increased accuracy)
0x80n0:1A (connection technology)	• 2-wire connection • All channels enabled **for EL3214 and EL3218:** • 3-wire connection • All channels enabled	• 4-wire connection The connection type is not detected automatically. • All channels enabled
0x80n00:19 (RTD element)	• Pt100 (-200 … 850°C)	• Pt100 Measurements take place in a reduced measuring range of -200 ... 320°C or an equivalent resistance range. ◦ The type label "Pt100 (-200 ... 850°C)" indicates the usual measuring range of a Pt100 element
0x80n00:02 (Presentation)	• Signed The temperature is displayed with 1/10°C per digit (signed).	• HighResolution The temperature is displayed with 1/100°C per digit (signed).
0x80n00:07/08 (Enable Limit 1/2) if present	• FALSE Limits disabled **for EL3214 and EL3218:** • No limit function available	• FALSE Limits disabled
0x8000:15 (Filter settings)	• 50 Hz Filter enabled	• 50 Hz Filter enabled

Area of application

EL32xx-0000 (standard accuracy)	EL320x-0010/-0020/-0030 (increased accuracy)
The terminal is calibrated in the measuring range "1/16 Ω" (10 Ω ... 4 kΩ) and can be used in this resistance range. It provides a normal measurement uncertainty in a wide ambient temperature range, see specification.	The high-precision version is calibrated in the measuring range "1/64 Ω" (10 Ω ... 1 kΩ) and over a measuring range of 18 ... 220 Ω and should only be used in this range or for Pt100 measurements. It provides a comparatively lower measurement uncertainty in the temperature range of a standard switch cabinet environment, see specification.

6.8 Settings and application notes for EL3204-0200

The EL3204-0200 differs from the EL3204-0000 (standard type) in terms of an

- extended measuring range 0 ... 240 kΩ
- additional linearizations/characteristic sensor curves
  - programmed characteristic sensor curves match the measuring range
  - freely programmable according to sampling points table
  - parameterizable formulas according to IEC 60751, Steinhart-Hart equation and B-parameter equation

NOTICE

Changes in the CoE directory, in the case of exchange

So that, in the case of exchanging an EtherCAT device, the CoE parameters are set correctly in the new device, CoE changes on the customer side must be entered in the start-up list.

Changes in the CoE directory, program access

The CoE parameters can also be read and written during operation (insofar as it makes sense) by the PLC using corresponding control commands. For details, see the corresponding articles in the Beckhoff Information System, for example.
Notice: The CoE parameters should be written in status PreOp or SafeOp, after which the slave should be switched to status OP.

Measuring range

The specified terminal precision refers to the full-scale value for the resistance measurement.

It is not advisable to use the terminal in the range 0 to 10 Ω, due to the relatively low (relative) measuring accuracy in this range. Specialized resistance measurement terminals such as the EL3692 with 4-wire measurement are to be used for such measurements.

Notes regarding accuracy

In addition to the accuracy in terminal resistance measurement, the measurement result is influenced by further factors, as described below:

- Measuring error of the measuring sensor used
- Measuring error of the terminal: < +/- 0.3% of full-scale value (240 kΩ for resistance measurement); < +/- 0.5°C for Pt sensors
- Implementation of the calculation parameters in the firmware, e.g. number of sampling points, accuracy of the calculated parameters,...

⇨ We recommend verifying the settings against a calibrated temperature source.

6.8.1 Programmed characteristic sensor curves

Direct resistance measurement

The EL3204-0200 can be used for direct resistance measurement in three measuring ranges (n = channel 0 ... 3).

CoE 0x80n00:19 setting	Measuring range	Resolution/digit
0x101	0 ...6,553.5 Ω	0.1 Ω
0x102	0 ...65,535 Ω	1 Ω
0x103	0 ...240,000 Ω	10 Ω

Note: the way in which the EL3204-0200 measures is electrically the same with these three settings. Only the displayed resolution is changed in the firmware. The full scale value is therefore 240 kΩ for all three measurements.

Fixed sensor curves

Further programmed sensor curves in the defined measuring range can be selected individually in the CoE entry 0x80n00:19 for each channel (n = channel 0... 3).

Type	Resistance range	Implemented temperature range	Resolution/digit
Pt1000 (0.00385 Ω/Ω/°C, IEC60751 characteristic curve Pt385) (PTC)	~180... ~ 3,900 Ω	-200°C to 850°C	0.1°C
Ni1000 (PTC)	~700... ~ 2,300 Ω	-60°C to 250°C	0.1°C
Ni1000 TK1500 (at 100°C: 1500 Ω) (PTC)		-30 to 160°C	0.1°C
NTC 5k (0°C: 16325 Ω)	~167,000... ~ 340 Ω	-40...100°C	0.1°C
NTC 10k (0°C: 32650 Ω)	~176,000... ~ 180 Ω	-30...150°C	0.1°C
NTC 10k (0°C: 29490 Ω)	~135,000... ~ 240 Ω	-30...150°C	0.1°C
NTC 10k (0°C: 27280 Ω, same as KL3204-0030)	~190,000... ~ 760 Ω	-40...110°C	0.1°C
NTC 20k (0°C: 70200 Ω)	~221,000... ~ 270 Ω	-20...150°C	0.1°C
FeT (0°C: 2226 Ω)	~1,900... ~ 3,900 Ω	-30...150°C	0.1°C

6.8.2 Freely programmable characteristic curves

To connect a resisitive sensor with a characteristic curve that is known to the application side but not implemented in the EL32xx-xxxx, the characteristic curve can be entered in the terminal via one of four different options.
Each linearization and each NTC/PTC characteristic curve can be implemented within the measuring range. The suitability of the different implementation procedures depends on the sensor type.

CoE entry in 0x80n00:19	Characteristic curve type	PTC sensors (e.g. Pt100, Pt1000, Ni100, Ni1000,...)	NTC sensors (NTC 5k, NTC 10k, ...)
0x110	RTD table/sampling points table	X	X
0x111	B-parameter equation	-	X
0x112	DIN EN 60751 equation	X (standard for Pt sensors)	-
0x113	Steinhart-Hart equation	-	X

Select the procedure for the channel in CoE entry 0x80n00:19. Please note that for each procedure only one parameter set can be stored in the terminal, which is then available for all channels.

Example: two sensors are connected to channels 1 and 2. Both are to be linearized with the B-parameter equation. The two sensors have to be "identical", since it is not possible to specify different sets of B-parameters for channels 1 and 2. The same applies to the lookup table.

6.8.2.1 Lookup table (0x80n00:19, Entry 0x110)

The required characteristic curve for a PTC or NTC sensor can be stored as a table in CoE 0x8001. It can either be loaded directly from the PLC into the CoE, or the user can enter it in the startup list for the terminal as an XML file. The entries from the TwinCAT startup list are automatically written to the terminal whenever EtherCAT starts.

In general, the lookup table has the following structure: a temperature is assigned to the corresponding resistance. The temperature increment must be constant. Linearization is performed between these steps. A maximum of 100 interpolation points with a maximum measuring range of 0...240 kΩ are permitted.
The exact structure of the lookup table is explained in the CoE overview rand additionally in a sample file (https://infosys.beckhoff.com/content/1033/el32xx/Resources/1525761547.zip) for a Pt1000 sensor.
The sample file illustrates the structure of an XML file to be imported. An Excel file (Excel 2010 format) for creating an XML file is also included. Explanations on how to use the Excel file can be taken from the attached description.

The XML file can be imported directly via the Startup field and activated via “Activate configuration”.

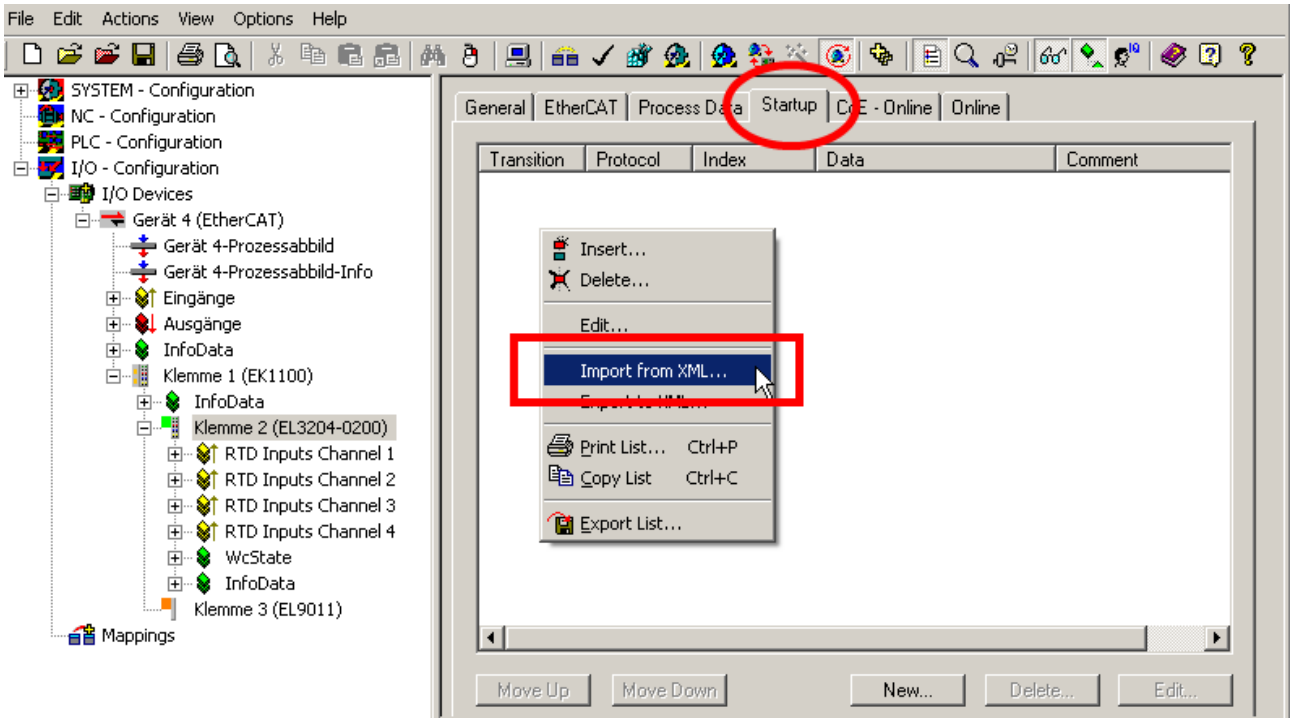


Fig. 172: Importing the XML file

6.8.2.2 B-parameter equation (0x80n00:19, entry 0x111)

The B-parameter equation can be used for NTC sensors (thermistors), i.e. RTD elements with negative coefficient k.

$$R_T = R(T) = A \cdot e^{\frac{B}{T}} = R_{T_0} \cdot e^{B\left(\frac{1}{T}-\frac{1}{T_0}\right)}$$

Here the coefficient R_{T0} indicates the resistance at the temperature T_0, the B-parameter can be taken from the information provided by the sensor manufacturer, or it can be determined by measuring the resistance at two known temperatures.
The following sample file (https://infosys.beckhoff.com/content/1033/el32xx/Resources/1525763723.zip) can be used to calculate the B-parameter. Enter the calculated parameters in the CoE directory 0x8002.

	A	B	D
1	To solve the B-Parameter Equation 2 resistor parameters at 2 defined		
2	temperatures are required:		
3			
4		**Temperatur [°C]**	**Resistance [Ω]**
5	Value 1	25	10000
6	Value 2	85	1450
7			
8	**CoE Index**	**Name**	**CoE Value**
9	8002:0	RTD B-Parameter Equation	
10	8002:01	Min Temperature	-50
11	8002:02	Max Temperature	110
12	8002:03	Rn	10000
13	8002:04	Tn	25
14	8002:05	B-Parameter	3437

Fig. 173: Table for calculating the B-parameter

6.8.2.3 Programmable according to DIN 60751 for Pt sensors (0x80n00:19, entry 0x112)

IEC 751 (and the German version DIN EN 60751) defines the electrical properties of platinum temperature sensors. The characteristic curve is described as follows:

for temperatures -200.. 0°C:

$$R(T) = R_0(1 + AT + BT^2 + C(T - 100°C)T^3)$$

for temperatures 0.. 850°C:

$$R(T) = R_0(1 + AT + BT^2)$$

With the parameters:

$$A = 3.9083 \times 10^{-3}\ °C^{-1}$$
$$B = -5.775 \times 10^{-7}\ °C^{-2}$$
$$C = -4.183 \times 10^{-12}\ °C^{-4}$$

The parameter R_0 indicates the resistance in Ω of the platinum sensor at T = 0°C. The sensors are qualified according to these designations, thus they are termed Pt100 if R_0=100 Ω at T=0°C.
The parameters A, B and C defined in the standard are already stored in the CoE directory 0x8003:yy. The Pt sensor is specified via parameter 0x8003:03, which corresponds to R_0.

6.8.2.4 Steinhart-Hart equation (0x80n00:19, entry 0x113)

The Steinhart-Hart equation can be used for NTC sensors (thermistors), i.e. RTD elements with negative coefficient k.

$$\frac{1}{T} = C_1 + C_2 \ln(R) + C_4(\ln(R))^3$$

The coefficients C_1, C_2 and C_4 can either be taken directly from the manufacturer data or calculated.
A sample file (https://infosys.beckhoff.com/content/1033/el32xx/Resources/1525765899.zip) is available for calculating the Steinhart-Hart parameters. For determining the parameters the resistance values at three known temperatures are required. These can either be taken from the manufacturer data or measured directly at the sensor. Enter the calculated parameters in the CoE directory 0x8004. In most cases the parameter C_3 is close to zero, i.e. negligible. It is therefore not used in the sample file calculation.

EL3204-0200_Steinhart-Hart.xlsx

	A	B	D
1	To solve the Steinhart-Hart Equation 3 resistor parameters at 3 defined		
2	temperatures are required:		
3		**Temperatur [°C]**	**Resistance [Ω]**
4	Value 1	0	27280
5	Value 2	25	10000
6	Value 3	85	1450
7			
8	**CoE Index**	**Name**	**CoE Value**
9	8004:0	RTD Steinhart-Hart Equation	
10	8004:01	Min Temperature	-50
11	8004:02	Max Temperature	110
12	8004:03	C1	8,84E-04
13	8004:04	C2	2,52E-04
14	8004:05	C3	0,00E+00
15	8004:06	C4	1,90E-07

Fig. 174: Table for calculating the Steinhart-Hart parameters

6.8.3 Sample implementation of an NTC sensor

The procedure below illustrates the implementation of an NTC sensor whose characteristic curve is not already stored in the EL3204-0200 terminal based on three methods, i.e. RTD table [▶ 207], B-parameter equation [▶ 208] and Steinhart-Hart equation [▶ 208].
An NTC030WP00 sensor is used in the example.

In this case the manufacturer provides a table with temperature and corresponding resistance values and the following sensor characteristics: NTC 10 kΩ +/- 1% at 25°C, Beta 3435.

Example for the implementation of an NTC sensor with the RTD lookup table

The general procedure is described in chapter Lookup table [▶ 204]. This example illustrates some special cases. An example XML file (https://infosys.beckhoff.com/content/1033/el32xx/Resources/1525768075.zip) for the NTC030WP00 sensor is available for download.

<table>
<tr><th colspan="2">Description</th><th>Problem</th><th colspan="2">Approach</th></tr>
<tr><td colspan="2">The table covers the temperature range -50°C...110°C, in 1°C steps</td><td>Total number of interpolation points 160.
Currently, 100 interpolation points can be entered using the RTD table.</td><td colspan="2">1. Limit the measuring range to correspond to 100 interpolation points in total
2. Increase the step size, e.g. implement a table with 5°C steps. The step size should not be too large, since NTC sensors have an exponential characteristic curve (i.e. not linear as with the PTC sensors).</td></tr>
<tr><td colspan="2">Resistance values in the temperature range -50°C... -44°C are between 330 kΩ... 240 kΩ</td><td>Measured values at low temperatures exceed the total measuring range of 240 kΩ</td><td colspan="2">1. Check whether the measuring range is required
2. Select an alternative sensor with lower resistance values at low temperatures.</td></tr>
<tr><td colspan="2">The range of -40°C... 110°C should be mapped in 2°C steps.
In addition to the table the following settings are implemented in CoE 0x8001:</td><td rowspan="6">Errors occur with default settings of the conversion factor 10: measuring range was not observed. Adjust the unit of the resistance values to the conversion factor</td><td colspan="2">Comply with the measuring range. For the range 0... 240 kΩ, a conversion factor of 100 should be entered in 0x8001:04. The resistance values should then be specified in 1/10 Ω.
The ranges are defined as follows:</td></tr>
<tr><td>0x8001:01 Distance in Degrees</td><td>2</td><td colspan="2" rowspan="5"></td></tr>
<tr><td>0x8001:02 Amount of Entries</td><td>75</td></tr>
<tr><td>0x8001:03 Start Temperature</td><td>-40</td></tr>
<tr><td>0x8001:04 Conversion Factor</td><td>10</td></tr>
<tr><td>0x8001:05 Value 1</td><td>188500</td></tr>
<tr><td colspan="2"></td><td>Conversion Factor 0x8001:04</td><td>Measuring range</td></tr>
<tr><td colspan="2"></td><td>1</td><td>0.. 6,533.5 Ω</td></tr>
<tr><td colspan="2"></td><td>10</td><td>0..65,535.0 Ω</td></tr>
<tr><td colspan="2"></td><td>100</td><td>0..240,000.0 Ω</td></tr>
</table>

Example of NTC sensor implementation with B-parameter equation

The B-parameter (Beta 3435) and the parameters R_n (10 kΩ) and T_n (25°C) can be taken from the manufacturer's data and entered directly in the CoE directory 0x8002.

CoE Entry	Entry
0x8002:01 Min Temperature	-40
0x8002:02 Max Temperature	110
0x8002:03 Rn	10000
0x8002:04 Tn	25
0x8002:05 B-Parameter	3435

If one compares the implementation of the table and the B-parameter equation, as shown in the diagram [▶ 208] below, it becomes clear that the B-parameter equation is only valid in a limited range (large deviations at low temperatures). If the whole temperature range is required, it is preferable to use the Steinhart-Hart equation for the implementation.

Example for the implementation of an NTC sensor with Steinhart-Hart equation

The Steinhart-Hart parameters can be calculated based on the sample file. The required resistance values at three defined temperatures (e.g. 0°C, 25°C and 85°C) can be taken from the manufacturer's table or measured directly at the sensor.

CoE Entry	Entry
0x8004:01 Min Temperature	-40
0x8004:02 Max Temperature	110
0x8004:03 C1	8.8424E-4
0x8004:04 C2	2.5202E-4
0x8002:04 C3	0
0x8002:04 C4	1.9018E-7

Comparison of the implementation via Steinhart-Hart and B-parameter equation

The diagram shows that the implementation via the Steinhart-Hart equation gains values closer to those from the manufacturer's table than the implementation via the B-parameter equation. If a manufacturer's table is available, this method is always preferable.

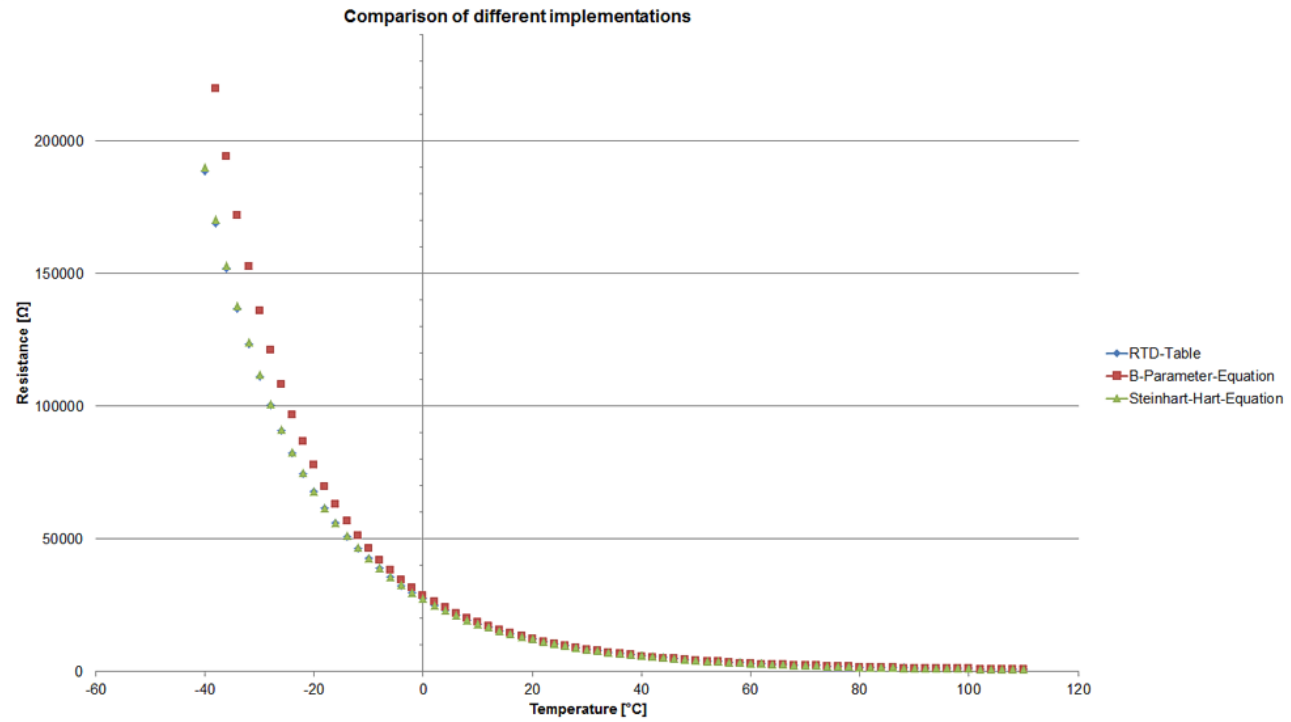


Fig. 175: Comparison of implementation via B-parameters and Steinhart-Hart parameters

6.8.4 Sample implementation of a PTC sensor

The example below illustrates the implementation of a PTC sensor, in particular a platinum sensor (Pt sensor), based on the RTD table [▶ 209] and according to DIN EN 60751 [▶ 209].

Example for the implementation of a PTC sensor with the RTD lookup table

The general procedure is explained in chapter Lookup table [▶ 204]. The example describes the implementation of table for a Pt500 sensor.

<table>
<tr><th>Description</th><th>Problem</th><th colspan="2">Approach</th></tr>
<tr><td>For Pt sensors, tables with several 100 entries in 1°C steps are available.</td><td>Total number of interpolation points is exceeded.
Currently, 100 interpolation points can be entered using the RTD table.</td><td colspan="2">1. Limit the measuring range to correspond to 100 interpolation points in total
2. Increase the step size, e.g. implement a table with 5°C or 10°C steps. Since the Pt sensor curves are almost linear, an increment value only has a small effect on the measuring accuracy. This is in contrast to NTC sensors, where the curve is exponential and a smaller increment is therefore preferable.</td></tr>
<tr><td rowspan="5">The manufacturer tables contain universal values</td><td rowspan="5">The table values should be adjusted to the specific sensor type</td><td colspan="2">For different Pt sensors, the table entries have to be multiplied with the R_0 value. R_0 indicates the resistance at 0°C. The sensor designation is based on the temperature value.</td></tr>
<tr><td>Pt sensor</td><td>R_0 (resistance at 0°C)</td></tr>
<tr><td>Pt100</td><td>100</td></tr>
<tr><td>Pt500</td><td>500</td></tr>
<tr><td>Pt1000</td><td>1000</td></tr>
</table>

For the Pt500 sensor, the following CoE entries can be selected and edited with the following XML file (https://infosys.beckhoff.com/content/1033/el32xx/Resources/1525770251.zip):

CoE Entry	Entry
0x8001:01 Distance in Degrees	10
0x8001:02 Amount of Entries	60
0x8001:03 Start Temperature	-40
0x8001:04 Conversion Factor	10
0x8001:05 Value 1	4247
0x8001:0x further table entries	.....

Example for the implementation of a PTC sensor, programmable according to DIN 60751 for Pt sensors

The implementation according to DIN EN 60751 is described in the section Programmable according to DIN 60751 for Pt sensors [▶ 206]. The parameters A, B, C are already stored in the CoE. Only the temperature range and the R_0 parameter for the specific sensor need to be added. R_0 indicates the resistance at 0°C. The sensor designation is based on the temperature value. The CoE entry has to be adjusted for the specific sensor.

Pt sensor	CoE Entry 0x8003:03
Pt100	100
Pt200	200
Pt500	500
Pt1000	1000

Comparison of implementation via RTD table and according to DIN EN 60751

If we now compare the course of the resistance values as a function of temperature, by the RTD table and according to DIN EN 60751, it becomes clear that both implementation methods provide almost the same result. Due to the easier implementation, the parameterization according to DIN 60571 is preferable.

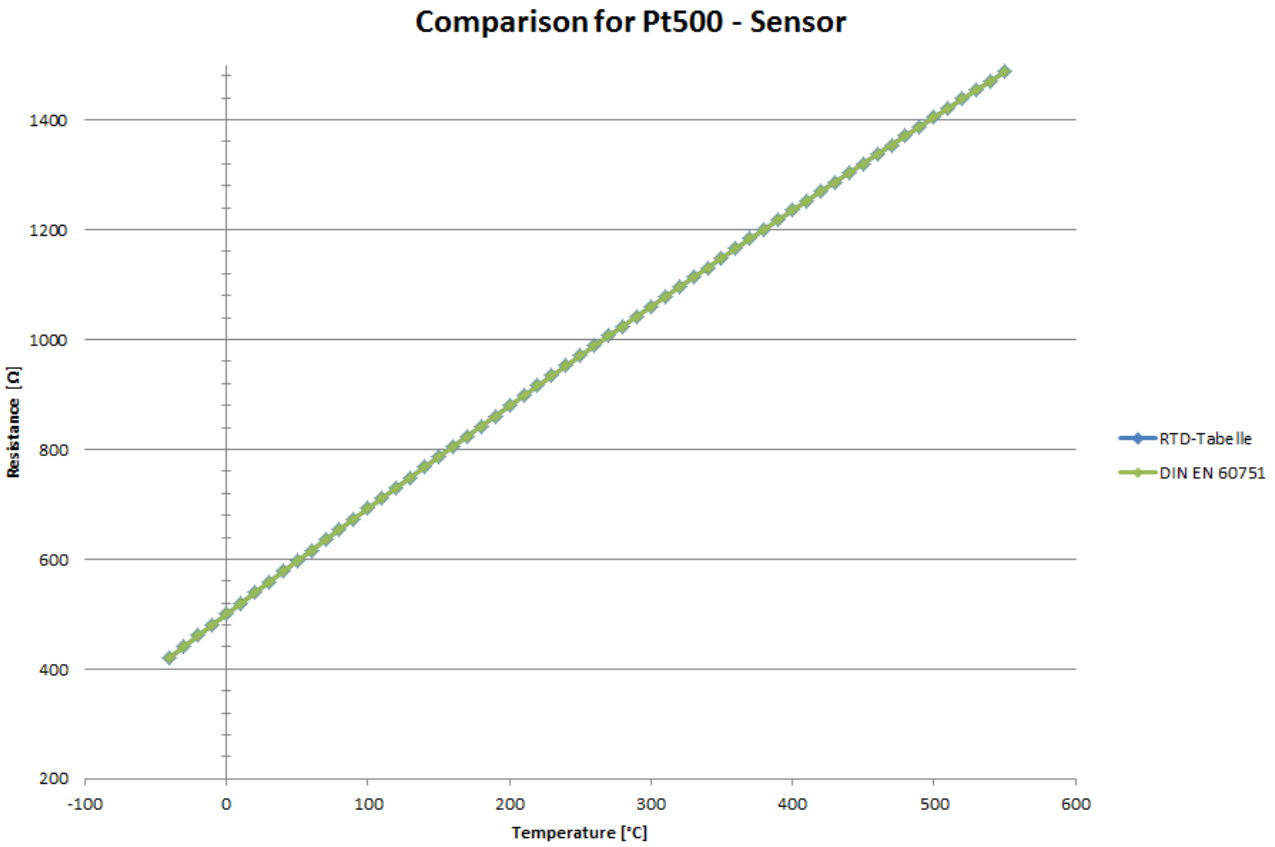


Fig. 176: Comparison of Pt500 sensor implementation

6.9 Settings and application notes for EL3208-0010

The EL3208-0010 is designed for multi-channel RTD measurements in the range -50 ... +150°C. In order to be able to offer 8 channels on 12 mm, it supports 2-wire measurement.
To ensure that unavoidable lead resistances are of little consequence, sensors R20°C >> 100 Ohm are implemented here. A side effect of this design is the measurement capability for resistors up to 1.3 MΩ.

Like all EL32xx terminals, it has two evaluation options:

- Measurement of the resistance, transformation according to choice and output as temperature [°C]. The terminal automatically selects the appropriate electrical measuring range.
  - Pt500/1000, Ni1000
  - Various NTC (up to max. 1.3 MΩ)
  - B-parameter equation (up to max. 1.3 MΩ)

    The temperature output of this terminal is limited to approx. -50 ... +150°C depending on the sensor, for range limits see in the CoE overview [▶ 276].
- -Measurement of resistance and output as resistance [Ω].
  - 4 measuring ranges (called "potentiometer [poti]") with
    Resolution 0.1 Ω / digit: Measuring range 0 ... 6,553.5 Ω
    Resolution 1 Ω / digit: Measuring range 0 ... 65,535 Ω
    Resolution 10 Ω / digit: Measuring range 0 ... 655,350 Ω
    Resolution 20 Ω / digit: Measuring range 0 ... 1,310,700 Ω

    Note: the INT-PDO Value is to be interpreted in these modes as unsigned 16bit UINT with 0 ... 65535 digits.
  - 1 Measuring range "1/16 Ohm" with
    Resolution 0.0625 Ω / digit: Measuring range 0 ... 2,000 Ω

    Note: the INT-PDO Value is to be interpreted in these modes as unsigned 16bit UINT with 0 ... 65535 digits.

6.10 TwinSAFE SC

6.10.1 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.

6.10.2 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.

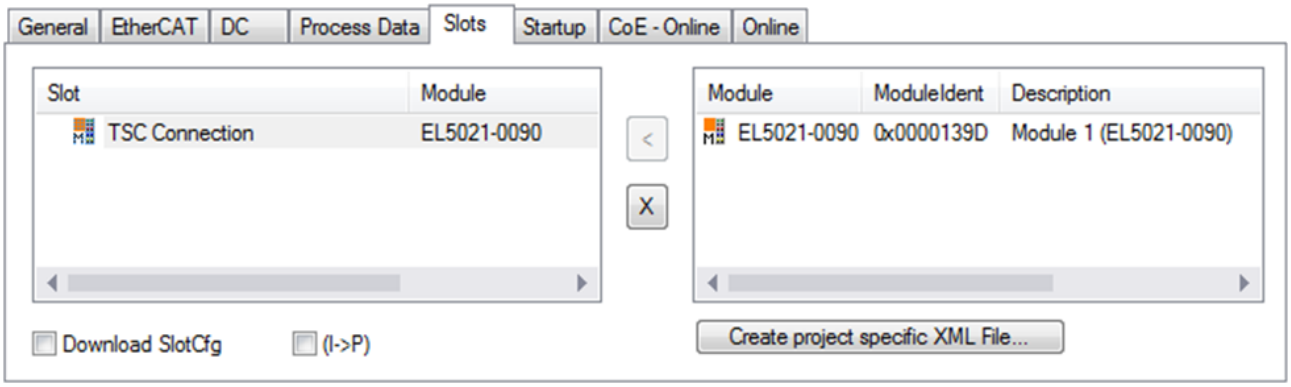


Fig. 177: Adding the TwinSAFE SC process data under the component, e.g. EL5021-0090

Additional process data with the ID TSC Inputs, TSC Outputs are generated (TSC - TwinSAFE Single Channel).

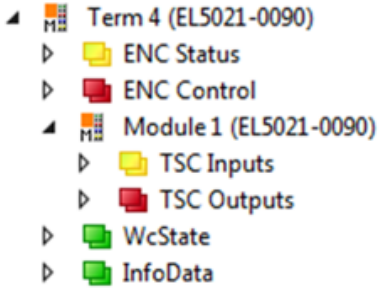


Fig. 178: TwinSAFE SC component process data, example EL5021-0090

A TwinSAFE SC connection is added by adding an alias devices in the safety project and selecting TSC (*TwinSAFE Single Channel*)

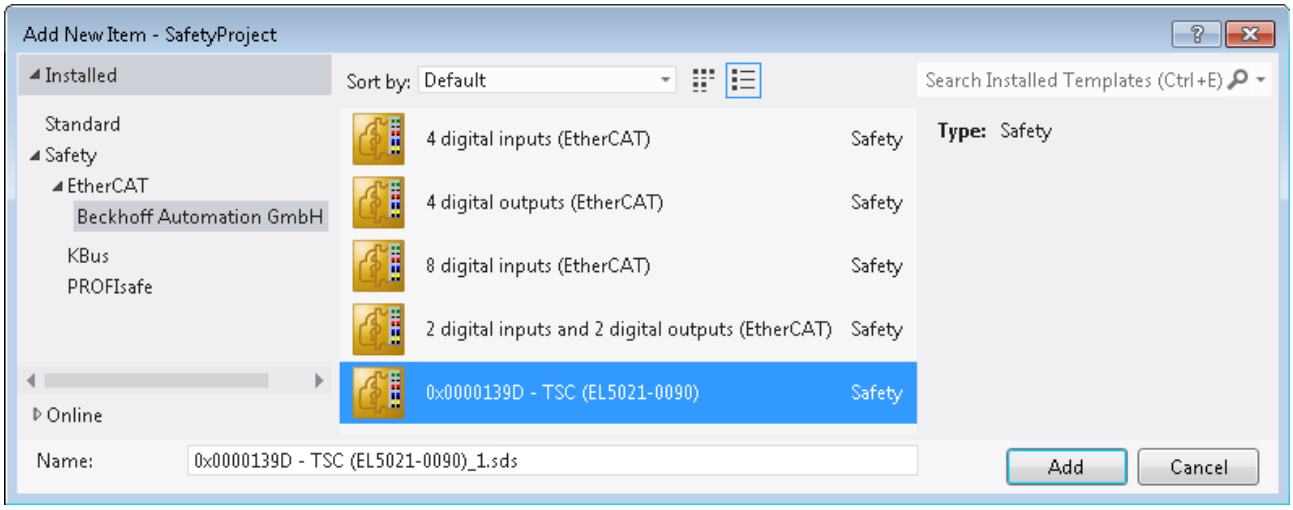


Fig. 179: Adding a TwinSAFE SC connection

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.

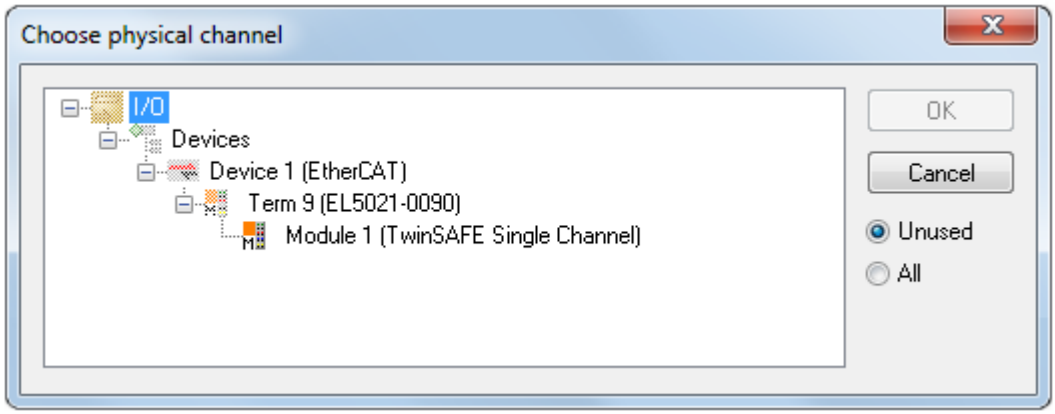


Fig. 180: Creating a link to TwinSAFE SC terminal

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

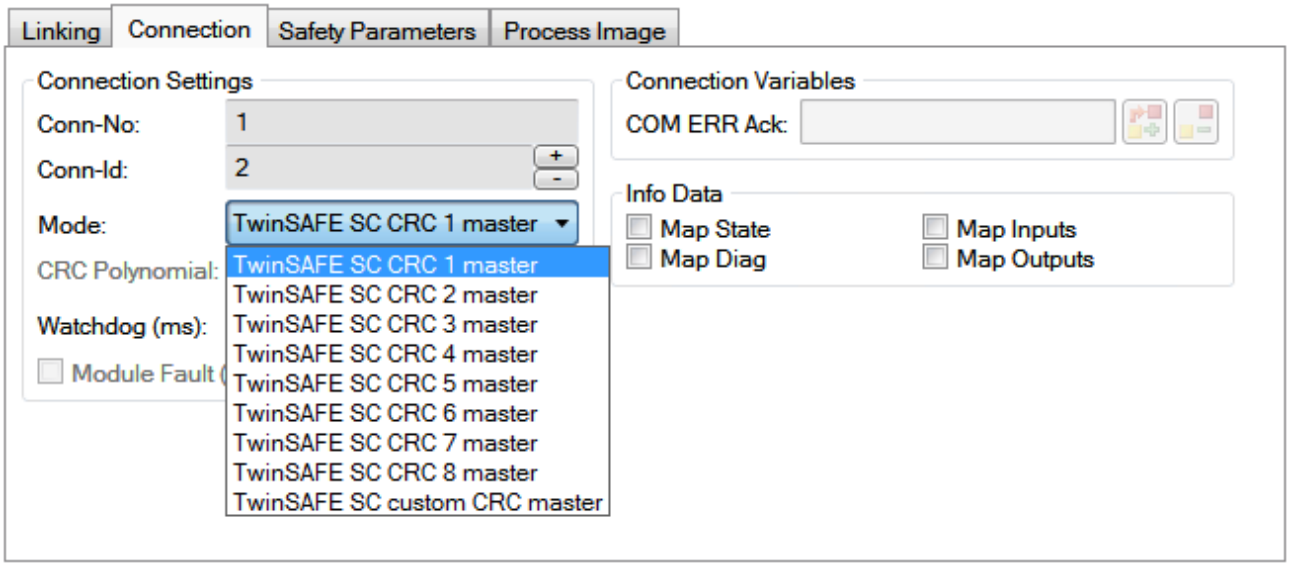


Fig. 181: Selecting a free CRC

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.

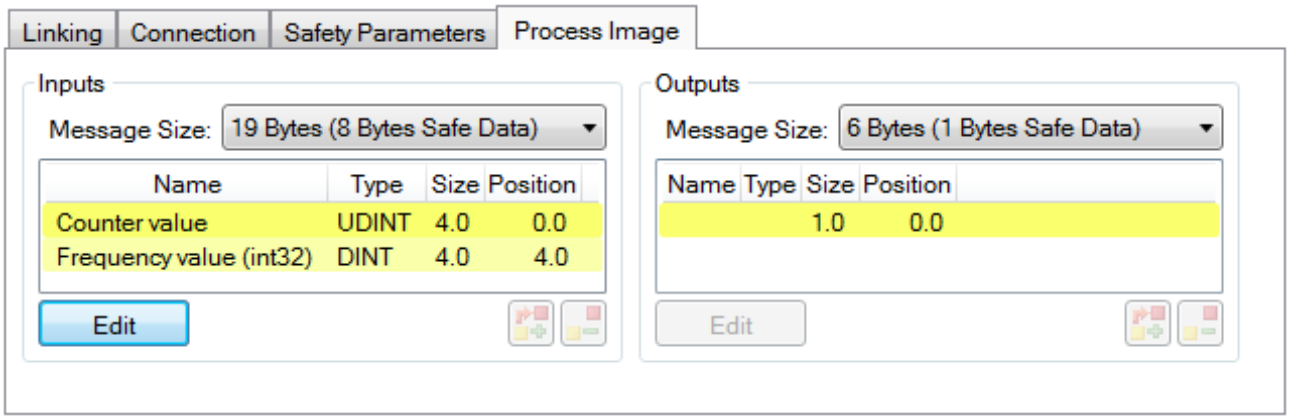


Fig. 182: Selecting the process data size and the process data

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)*.

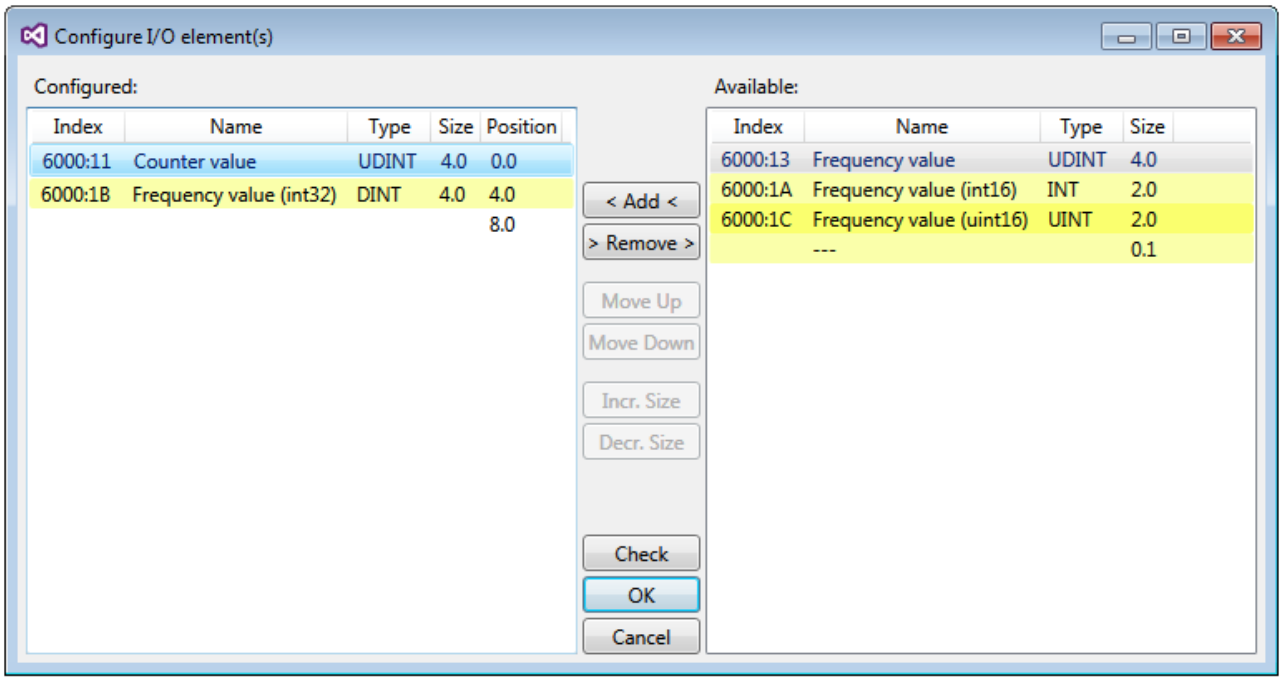


Fig. 183: Selection of the process data

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. 184: 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

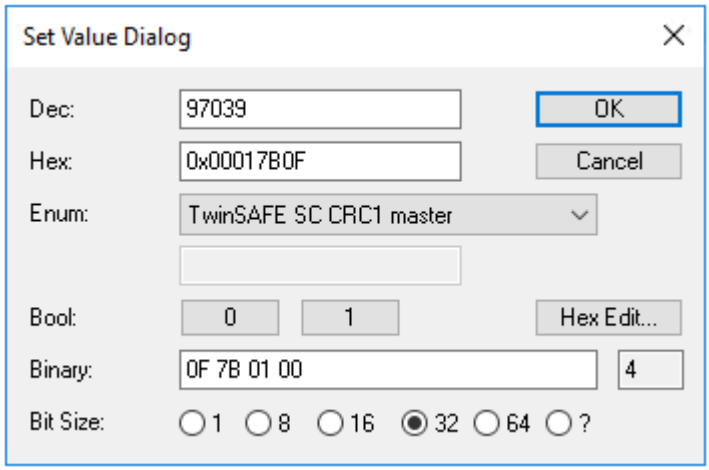


Fig. 185: Entering the safety address and the CRC

TwinSAFE SC connections

If several TwinSAFE SC connections are used within a configuration, a different CRC must be selected for each TwinSAFE SC connection.

6.11 TwinSAFE SC process data EL3214-0090

The EL3214-0090 transmits the following process data to the TwinSAFE logic:

Index (hex)	Name	Type	Size
6000:11	RTD Module 1.Value	INT	2.0
6010:11	RTD Module 2.Value	INT	2.0
6020:11	RTD Module 3.Value	INT	2.0
6030:11	RTD Module 4.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.

6.12 CoE object descriptions

6.12.1 Object description EL3201

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 217] and profile-specific objects [▶ 222] required during commissioning
- Objects for indicating internal settings [▶ 219] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 8000 RTD settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
8000:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C)	BIT3	RW	0x00 (0_{dec})
8000:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x6000:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
8000:06	Enable filter [▶ 188]	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
8000:07	Enable limit 1 [▶ 192]	The status bits are set in relation to Limit 1.	BOOLEAN	RW	0x00 (0_{dec})
8000:08	Enable limit 2 [▶ 192]	The status bits are set in relation to Limit 2.	BOOLEAN	RW	0x00 (0_{dec})
8000:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	0x00 (0_{dec})
8000:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
8000:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
8000:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
8000:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
8000:13	Limit 1 [▶ 192]	First limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
8000:14	Limit 2 [▶ 192]	Second limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
8000:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x8000:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
8000:16	Calibration interval	Interval of cyclic calibration	INT16	RW	0x0000 (0_{dec})
8000:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
8000:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:19	RTD element [▶ 184]	RTD element 0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!	UINT16	RW	0x0000 (0_{dec})
8000:1A	Connection technology	Connection technology 0: 2-wire 1: 3-wire 2: 4-wire 3: not connected	UINT16	RW	0x0000 (0_{dec})
8000:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1A00 TxPDO Map

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A00:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x01 (Underrange))	UINT32	RW	0x6000:01, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x02 (Overrange))	UINT32	RW	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x03 (Limit 1))	UINT32	RW	0x6000:03, 2
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x05 (Limit 2))	UINT32	RW	0x6000:05, 2
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (RTD 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 0x1800 (TxPDO-Par Ch.1), entry 0x07 (TxPDO-State))	UINT32	RW	0x1800:07, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x1800 (TxPDO-Par Ch.1), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x1800:09, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x11 (Value))	UINT32	RW	0x6000:11, 16

Index 1C00 Sync manager type

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

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 6000 RTD Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default value
6000:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
6000:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
6000:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x6000:07 [▶ 223]]) is set	BOOLEAN	RO	0x00 (0_{dec})
6000:03	Limit 1	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
6000:05	Limit 2	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
6000:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
6000:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6000:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nE RTD Internal data

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 800F RTD Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default value
800F:0	RTD Vendor data	Maximum subindex	UINT8	RO	0x06 (6_{dec})
800F:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
800F:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})
800F:03	Calibration offset RL	Manufacturer calibration offset (input RL)	INT16	RW	0x0000 (0_{dec})
800F:04	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	0x9E50 (40528_{dec})
800F:05	Calibration offset 4-wire	Manufacturer calibration offset (4-wire connection technology)	INT16	RW	0x0000 (0_{dec})
800F:06	Calibration gain 4-wire	Manufacturer calibration gain (4-wire connection technology)	UINT16	RW	0x9E50 (40528_{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 distance 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.2 Object description EL3201-0010, EL3201-0020, EL3201-0030

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal is parameterized via the CoE – Online tab (double-click on the respective object) or via the Process Data tab (assignment of PDOs). Please note the following general CoE information when using/manipulating the CoE parameters: – Keep a startup list in case components have to be replaced – Differentiation between online/offline dictionary, existence of current XML description – Use "CoE reload" for resetting changes

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 225] and profile-specific objects [▶ 230] required during commissioning
- Objects for indicating internal settings [▶ 227] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 8000 RTD settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
8000:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x02 (2_{dec})
8000:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x6000:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
8000:06	Enable filter [▶ 188]	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
8000:07	Enable limit 1 [▶ 192]	The status bits are set in relation to Limit 1.	BOOLEAN	RW	0x00 (0_{dec})
8000:08	Enable limit 2 [▶ 192]	The status bits are set in relation to Limit 2.	BOOLEAN	RW	0x00 (0_{dec})
8000:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	0x00 (0_{dec})
8000:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
8000:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
8000:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
8000:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
8000:13	Limit 1 [▶ 192]	First limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
8000:14	Limit 2 [▶ 192]	Second limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
8000:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x8000:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
8000:16	Calibration interval	Interval of cyclic calibration	INT16	RW	0x0000 (0_{dec})
8000:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
8000:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:19	RTD element [▶ 184]	RTD element 0: Pt100 (for high-precision terminals see note [▶ 200])! 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!	UINT16	RW	0x0000 (0_{dec})
8000:1A	Connection technology	Connection technology 0: 2-wire bridged/4-wire 1: 3-wire 2: 4-wire 3: not connected 4: 2-wire unbridged	UINT16	RW	0x0000 (0_{dec})
8000:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1A00 TxPDO Map

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A00:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x01 (Underrange))	UINT32	RW	0x6000:01, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x02 (Overrange))	UINT32	RW	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x03 (Limit 1))	UINT32	RW	0x6000:03, 2
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x05 (Limit 2))	UINT32	RW	0x6000:05, 2
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (RTD 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 0x1800 (TxPDO-Par Ch.1), entry 0x07 (TxPDO-State))	UINT32	RW	0x1800:07, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x1800 (TxPDO-Par Ch.1), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x1800:09, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1), entry 0x11 (Value))	UINT32	RW	0x6000:11, 16

Index 1C00 Sync manager type

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

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 6000 RTD Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default value
6000:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
6000:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
6000:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x6000:07 [▶ 231]]) is set	BOOLEAN	RO	0x00 (0_{dec})
6000:03	Limit 1	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
6000:05	Limit 2	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
6000:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
6000:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6000:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nE RTD Internal data

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 800F RTD Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default value
800F:0	RTD Vendor data	Maximum subindex	UINT8	RO	0x06 (6_{dec})
800F:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
800F:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})
800F:03	Calibration offset RL	Manufacturer calibration offset (input RL)	INT16	RW	0x0000 (0_{dec})
800F:04	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	0x9E50 (40528_{dec})
800F:05	Calibration offset 4-wire	Manufacturer calibration offset (4-wire connection technology)	INT16	RW	0x0000 (0_{dec})
800F:06	Calibration gain 4-wire	Manufacturer calibration gain (4-wire connection technology)	UINT16	RW	0x9E50 (40528_{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 distance 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.3 Object description EL3202

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 233] and profile-specific objects [▶ 238] required during commissioning
- Objects for indicating internal settings [▶ 235] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 1 (Ch. 1 – 2)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding index 0x8010:15 of the EL3202 has no parameterization function!

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n00:06	Enable filter [▶ 188]	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
80n00:07	Enable limit 1 [▶ 192]	The status bits are set in relation to Limit 1.	BOOLEAN	RW	0x00 (0_{dec})
80n00:08	Enable limit 2 [▶ 192]	The status bits are set in relation to Limit 2.	BOOLEAN	RW	0x00 (0_{dec})
80n00:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:13	Limit 1 [▶ 192]	First limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:14	Limit 2 [▶ 192]	Second limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 (for high-precision terminals see note [▶ 200]! 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!		RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection 1: 3-wire connection 2: 4-wire connection [default for EL320x-00x0 high-precision terminals, see note [▶ 200]! 3: not connected	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1A0n TxPDO Map for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x02 (Overrange))	UINT32	RW	0x60n0:02, 1
1A0n:03	SubIndex 003	3. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x02 (2_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 239]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:03	Limit 1	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:05	Limit 2	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nE RTD Internal data for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 80nF RTD Vendor data for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	0x06 (6_{dec})
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})
80nF:03	Calibration offset RL	Manufacturer calibration offset (input RL)	INT16	RW	0x0000 (0_{dec})
80nF:04	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	0x9E50 (40528_{dec})
80nF:05	Calibration offset 4-wire	Manufacturer calibration offset (4-wire connection technology)	INT16	RW	0x0000 (0_{dec})
80nF:06	Calibration gain 4-wire	Manufacturer calibration gain (4-wire connection technology)	UINT16	RW	0x9E50 (40528_{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 distance 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.4 Object description EL3202-0010, EL3202-0020, EL3202-0030

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal is parameterized via the CoE – Online tab (double-click on the respective object) or via the Process Data tab (assignment of PDOs). Please note the following general CoE information when using/manipulating the CoE parameters: – Keep a startup list in case components have to be replaced – Differentiation between online/offline dictionary, existence of current XML description – Use "CoE reload" for resetting changes

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 241] and profile-specific objects [▶ 246] required during commissioning
- Objects for indicating internal settings [▶ 243] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 1 (Ch. 1 – 2)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding index 0x8010:15 of the EL3202 has no parameterization function!

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n00:06	Enable filter [▶ 188]	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
80n00:07	Enable limit 1 [▶ 192]	The status bits are set in relation to Limit 1.	BOOLEAN	RW	0x00 (0_{dec})
80n00:08	Enable limit 2 [▶ 192]	The status bits are set in relation to Limit 2.	BOOLEAN	RW	0x00 (0_{dec})
80n00:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:13	Limit 1 [▶ 192]	First limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:14	Limit 2 [▶ 192]	Second limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 (for high-precision terminals see note [▶ 200]! 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!		RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection 1: 3-wire connection 2: 4-wire connection [default for EL320x-00x0 high-precision terminals, see note [▶ 200]! 3: not connected	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1A0n TxPDO Map for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x02 (Overrange))	UINT32	RW	0x60n0:02, 1
1A0n:03	SubIndex 003	3. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x02 (2_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 247]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:03	Limit 1	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:05	Limit 2	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nF RTD Vendor data for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	0x06 (6_{dec})
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})
80nF:03	Calibration offset RL	Manufacturer calibration offset (input RL)	INT16	RW	0x0000 (0_{dec})
80nF:04	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	0x9E50 (40528_{dec})
80nF:05	Calibration offset 4-wire	Manufacturer calibration offset (4-wire connection technology)	INT16	RW	0x0000 (0_{dec})
80nF:06	Calibration gain 4-wire	Manufacturer calibration gain (4-wire connection technology)	UINT16	RW	0x9E50 (40528_{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 distance 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

Index 80nE RTD Internal data for 0 ≤ n ≤ 1 (Ch. 1 - 2)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

6.12.5 Object description EL3204

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal is parameterized via the CoE – Online tab (double-click on the respective object) or via the Process Data tab (assignment of PDOs). Please note the following general CoE information when using/manipulating the CoE parameters: – Keep a startup list in case components have to be replaced – Differentiation between online/offline dictionary, existence of current XML description – Use "CoE reload" for resetting changes

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 249] and profile-specific objects [▶ 256] required during commissioning
- Objects for indicating internal settings [▶ 251] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 3 (Ch. 1 – 4)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n00:15 of the EL3204 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n00:06	Enable filter [▶ 188]	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
80n00:07	Enable limit 1 [▶ 192]	The status bits are set in relation to Limit 1.	BOOLEAN	RW	0x00 (0_{dec})
80n00:08	Enable limit 2 [▶ 192]	The status bits are set in relation to Limit 2.	BOOLEAN	RW	0x00 (0_{dec})
80n00:09	Enable automatic calibration	A calibration is cyclically started. (optional)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:13	Limit 1 [▶ 192]	First limit value for setting the status bits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:14	Limit 2 [▶ 192]	Second limit value for setting the statusbits (resolution 0.1°C)	INT16	RW	0x0000 (0_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:16	Calibration interval reserved	Interval of cyclic calibration (Serves only for compatibility, no configuration for EL3204)			

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!	UINT16	RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection 3: not connected	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10E2 Manufacturer-specific Identification Code

Index (hex)	Name	Meaning	Data type	Flags	Default
10E2:0*	Manufacturer-specific identification code		UINT8	RO	0x01 (1_{dec})
10E2:01*	SubIndex 001		STRING	RO	

*) EL3204 from FW10, Rev. -0022

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 1800 RTD TxPDO-Par Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	RTD TxPDO-Par Ch.1	PDO parameter TxPDO 1	UINT8	RO	0x06 (6_{dec})
1800:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 1	OCTET STRING[2]	RO	04 1A

Index 1801 RTD TxPDO-Par Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	RTD TxPDO-Par Ch. 2	PDO parameter TxPDO 2	UINT8	RO	0x06 (6_{dec})
1801:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 2	OCTET STRING[2]	RO	05 1A

Index 1802 RTD TxPDO-Par Ch. 3

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	RTD TxPDO-Par Ch. 3	PDO parameter TxPDO 3	UINT8	RO	0x06 (6_{dec})
1802:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 3	OCTET STRING[2]	RO	06 1A

Index 1803 RTD TxPDO-Par Ch. 4

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	RTD TxPDO-Par Ch. 4	PDO parameter TxPDO 4	UINT8	RO	0x06 (6_{dec})
1803:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 4	OCTET STRING[2]	RO	07 1A

Index 1804 RTD TxPDO-Par Compact Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	RTD TxPDO-Par Compact Ch. 1	PDO parameter TxPDO 5	UINT8	RO	0x06 (6_{dec})
1804:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 5	OCTET STRING[2]	RO	00 1A

Index 1805 RTD TxPDO-Par Compact Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
1805:0	RTD TxPDO-Par Compact Ch. 2	PDO parameter TxPDO 6	UINT8	RO	0x06 (6_{dec})
1805:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 6	OCTET STRING[2]	RO	01 1A

Index 1806 RTD TxPDO-Par Compact Ch. 3

Index (hex)	Name	Meaning	Data type	Flags	Default
1806:0	RTD TxPDO-Par Compact Ch. 3	PDO parameter TxPDO 7	UINT8	RO	0x06 (6_{dec})
1806:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 7	OCTET STRING[2]	RO	02 1A

Index 1807 RTD TxPDO-Par Compact Ch. 4

Index (hex)	Name	Meaning	Data type	Flags	Default
1807:0	RTD TxPDO-Par Compact Ch. 4	PDO parameter TxPDO 8	UINT8	RO	0x06 (6_{dec})
1807:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that may not be transferred together with TxPDO 8	OCTET STRING[2]	RO	03 1A

Index 1A0n TxPDO Map for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x02 (Overrange))	UINT32	RW	0x60n0:02, 1
1A0n:03	SubIndex 003	3. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x03 (Limit 1))	UINT32	RW	0x60n0:03, 2
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x05 (Limit 2))	UINT32	RW	0x60n0:05, 2
1A0n:05	SubIndex 005	5. PDO Mapping entry (object 0x60n0 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:09	SubIndex 009	9. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 16

Index 1A04 TxPDO-Map Compact Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	TxPDO-Map Compact Ch.1	PDO Mapping TxPDO 5	UINT8	RW	0x01 (1_{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RTD Inputs Ch.1]), entry 0x11 (Value))	UINT32	RW	0x6000:01, 16

Index 1A05 TxPDO-Map Compact Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	TxPDO-Map Compact Ch.2	PDO Mapping TxPDO 6	UINT8	RW	0x01 (1_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (RTD Inputs Ch.2), entry 0x11 (Value))	UINT32	RW	0x6010:01, 16

Index 1A06 TxPDO-Map Compact Ch. 3

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	TxPDO-Map Compact Ch.3	PDO Mapping TxPDO 7	UINT8	RW	0x01 (1_{dec})
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (RTD Inputs Ch.3), entry 0x11 (Value))	UINT32	RW	0x6020:01, 16

Index 1A07 TxPDO-Map Compact Ch. 4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	TxPDO-Map Compact Ch.4	PDO Mapping TxPDO 8	UINT8	RW	0x01 (1_{dec})
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (RTD Inputs Ch.4), entry 0x11 (Value))	UINT32	RW	0x6030:01, 16

Index 1C00 Sync manager type

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

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs für 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 257]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:03*	Limit 1	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:05*	Limit 2	Limit value monitoring 0: not active 1: Value is larger than the limit value 2: Value is smaller than the limit value 3: Value is equal to the limit value	BIT2	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nE RTD Internal data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 80nF RTD Manufacturer data für 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	RTD Manufacturer data	Maximum subindex	UINT8	RO	0x06 (6_{dec})
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	0x0000 (0_{dec})
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	0x9E50 (40528_{dec})
80nF:03	Calibration offset RL	Manufacturer calibration offset (input RL)	INT16	RW	0x0000 (0_{dec})
80nF:04	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	0x9E50 (40528_{dec})
80nF:05	Calibration offset 4-wire	Manufacturer calibration offset (4-wire connection technology)	INT16	RW	0x0000 (0_{dec})
80nF:06	Calibration gain 4-wire	Manufacturer calibration gain (4-wire connection technology)	UINT16	RW	0x9E50 (40528_{dec})
80nF:07*	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	0x0000 (0_{dec})
80nF:08*	Calibration gain Pt1000	Manufacturer calibration gain Pt1000	UINT16	RW	0x9E50 (40528_{dec})

*) from FW10, rev. -0022

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 distance 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.6 Object description EL3204-0200

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 259] and profile-specific objects required during commissioning
- Objects for indicating internal settings (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 3 (Ch. 1 - 4)

The filter properties are set only via index 0x8000:15

The filter frequencies are set for all channels of the EL3204-0200 terminals centrally via index 0x8000:15 (channel 1). The corresponding indices 0x80n0:15 have no parameterization function!

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n0:01	Enable user scale	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
80n0:02	Process data Presentation	permitted values 0: Signed 1: Absolute MSB sign 2: High resolution (1/100°C)	BIT3	RW	0x00 (0_{dec})
80n0:05	Siemens bits	The S5 bits are superimposed on the three low-order bits (value 0x60n0:11 [▶ 267]) Bit 0 = 1 (“overrange” or “underrange”) Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:06	Enable filter	Enable filter, which makes PLC-cycle-synchronous data exchange unnecessary	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
80n0:11	User scale offset	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n0:12	User scale gain	This is the user scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n0:15	Filter settings	This object determines the digital filter settings, if it is active via Enable filter (index 0x80n0:06 [▶ 260]). The possible settings are sequentially numbered. permitted values: 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 offset calibration	INT16	RW	0x0000 (0_{dec})
80n0:18	User calibration gain	User gain compensation	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n0:19	RTD element	permitted values: 0: Pt1000 (-200...850°C) 2: Ni1000 100 °C (TK5000, at 100 °C 1500 Ohm, -30 to 160 °C) 3: Ni1000 (-60...250°C) 4: NTC 5k (0°C: 16325 Ohm, -40...100°C) 5: NTC 10k (0°C: 32650 Ohm, -30...150°C) 6: NTC 10k (0°C: 29490 Ohm, -30...150°C) 7: NTC 10k (0°C: 27280 Ohm, -40...110°C, as for KL3204-0030) 8: NTC 20k (0°C: 70200 Ohm, -20...150°C) 9: Fet (-30...150°C) 101: Resolution 1/10 Ohm (0 to 6553.5 Ohm) 102: Resolution 1/10 Ohm (0 to 65535 Ohm) 103: Resolution 1/10 Ohm (0 to 240 kOhm) 110: RTD table (for further parameters see 0x80n1 [▶ 262]) 111: B-parameter equation (for further parameters see 0x80n2 [▶ 262]) 112: DIN IEC 60751 equation (for further parameters see 0x80n3 [▶ 263]) 113: Steinhart-Hart equation (for further parameters see 0x80n4 [▶ 263])	UINT16	RW	0x0000 (0_{dec})
80n0:1A	Connection technology	permitted values 0: Two-wire connection 3: n. c. (channel deactivated)	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration	Offset value for the calibration of the supply lines [1/10] Ohm	INT16	RW	0x0000 (0_{dec})

Index 80n1 RTD Table

The standard values in the following table show by way of example the conversion values of a Pt1000 within the range from 0 °C to 140 °C with a resolution of 1/10 Ohm

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n1:0	RTD Table	The sensor characteristic can be programmed with this table	UINT8	RO	105
80n1:01	Distance in Degrees	The value set describes the distance of the entries in °C	UINT16	RW	10
80n1:02	Amount of Entries	The value entered describes the number of entries with which the dependence on distance in °C, start temperature of the measuring range and final temperature are displayed according to the equation below Final temperature = start temperature + ((number of entries -1) * distance in °C)	UINT16	RW	15
80n1:03	Start Temperature	The value entered describes the start of the measuring range Standard value 0 °C	INT16	RW	0
80n1:04	Conversion Factor	1 = 1/10 Ohm per digit in the table entries 10 = 1 Ohm per digit in the table entries 100 = 10 Ohm per digit in the table entries	UINT16	RW	1
80n1:05	Value 1		UINT16	RW	0x2710 (10000_{dec})
80n1:06	Value 2		UINT16	RW	0x2896 (10390_{dec})
80n1:07	Value 3		UINT16	RW	0x2A1B (10779_{dec})
80n1:08	Value 4		UINT16	RW	0x2B9F (11167_{dec})
80n1:09	Value 5		UINT16	RW	0x2D22 (11554_{dec})
80n1:0A	Value 6		UINT16	RW	0x2EA3 (11939_{dec})
80n1:0B	Value 7		UINT16	RW	0x3024 (12324_{dec})
80n1:0C	Value 8		UINT16	RW	0x31A3 (12707_{dec})
80n1:0D	Value 9		UINT16	RW	0x3321 (13089_{dec})
80n1:0E	Value 10		UINT16	RW	0x349E (13470_{dec})
80n1:0F	Value 11		UINT16	RW	0x361A (13850_{dec})
80n1:10	Value 12		UINT16	RW	0x3795 (14229_{dec})
80n1:11	Value 13		UINT16	RW	0x390E (14606_{dec})
80n1:13	Value 14		UINT16	RW	0x3A87 (14983_{dec})
80n1:14	Value 15		UINT16	RW	0x3BFE (15358_{dec})
80n1:15	Value 16		UINT16	RW	0x0000 (0_{dec})
…	…		…	…	…
80n1:69	Value 100		UINT16	RW	0x0000 (0_{dec})

Index 80n2 RTD B-parameter equation for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n2:0	RTD B-Parameter Equation		UINT8	RO	0x05 (5_{dec})
80n2:01	Min Temperature	Start of the measuring range in °C.	INT16	RW	-30
80n2:02	Max Temperature	End of the measuring range in °C.	INT16	RW	150
80n2:03	Rn	Resistance value at Tn. In most cases = 25 °C.	INT16	RW	1000
80n2:04	Tn	Reference temperature for Rn [°C]	INT16	RW	25
80n2:05	B-parameter	B-parameter [Kelvin]	REAL32	RW	3710

Index 80n3 RTD DIN EN 60751 equation for 0 ≤ n ≤ 3 (Ch. 1 - 4) 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n3:0	RTD DIN EN 60751 equation	Standard parameter for Pt1000 within the range 0 to 850°C.	UINT8	RO	0x06 (6_{dec})
80n3:01	Min Temperature	Start of the measuring range in °C.	INT16	RW	0
80n3:02	Max Temperature	End of the measuring range in °C.	INT16	RW	850
80n3:03	R0	see equation [▶ 206]	UINT16	RW	1000
80n3:04	A parameter	see equation [▶ 206]	REAL32	RW	3.908E-3
80n3:05	B parameter	see equation [▶ 206]	REAL32	RW	-5.775E-7
80n3:06	C parameter	see equation [▶ 206]	REAL32	RW	-4.183E-12

Index 80n4 RTD Steinhart-Hart equation for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80n4:0	RTD Steinhart Hart Equation	Standard values for an NTC10K with 32650 Ohm at 0 °C: C1 default = 1.12119E-03 C2 default = 2.35346E-04 C3 default = 0 C4 default = 8.34620E-08	UINT8	RO	0x06 (6_{dec})
80n4:01	Min Temperature	Start of the measuring range in °C.	INT16	RW	-30
80n4:02	Max Temperature	End of the measuring range in °C.	INT16	RW	150
80n4:03	C1	see equation [▶ 204]	REAL32	RW	1.1211E-03
80n4:04	C2	see equation [▶ 204]	REAL32	RW	2.35346E-04
80n4:05	C3	see equation [▶ 204]	REAL32	RW	0
80n4:06	C4	see equation [▶ 204]	REAL32	RW	8.24620E-08

Complete overview

Standard objects

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

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default value
1000:0	Device type	Device type of the EtherCAT slave: the Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x01401389 (20976521_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default value
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EL3204-0200

Index 1009 Hardware version

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

Index 100A Software version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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 ($_{2dec}$)
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x0C843052 (209989714_{dec})
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	0x00000000 (0_{dec})
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 value
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 180n RTD TxPDO-Par for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
180n:0	RTD TxPDO-Par	PDO parameter TxPDO 1	UINT8	RO	0x09 (9_{dec})
180n:06	Exclude TxPDOs	This entry specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 1	OCTET-STRING[0]	RO	
180n:07	TxPDO State	The TxPDO state is set if it was not possible to correctly read in the associated input data	BOOLEAN	RO	0x00 (0_{dec})
180n:09	TxPDO Toggle	The TxPDO toggle is toggled with each update the corresponding input data	BOOLEAN	RO	0x00 (0_{dec})

Index 1A0n RTD TxPDO-Map 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	RTD TxPDO-Map	PDO Mapping TxPDO 1	UINT8	RO	0x08 (8_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.1), entry 0x01 (Underrange))	UINT32	RO	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.1), entry 0x02 (Overrange))	UINT32	RO	0x60n0:02, 1
1A0n:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1A0n:04	SubIndex 004	4. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.1), entry 0x07 (Error))	UINT32	RO	0x60n0:07, 1
1A0n:05	SubIndex 005	5. PDO Mapping entry (7 bits align)	UINT32	RO	0x00n0:00, 7
1A0n:06	SubIndex 006	6. PDO Mapping entry (object 0x180n (RTD TxPDO-Par Ch.1), entry 0x07 (TxPDO State))	UINT32	RO	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (RTD TxPDO-Par Ch.1), entry 0x09 (TxPDO Toggle))	UINT32	RO	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.1), entry 0x11 (Value))	UINT32	RO	0x60n0:11, 16

Index 1C00 Sync manager type

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

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RO	0x04 (4_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RO	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RO	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RO	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RO	0x1A03 (6659_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 1C33:08)	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Maximum delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs for 0 ≤ n ≤ 3 (Ch. 1 – 4)

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

Index 80nE RTD Internal Data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal Data	Max. subindex	UINT8	RO	
80nE:01	ADC raw value	ADC raw value.	INT32	RO	
80nE:02	Resistor (1/10 Ohm)	resulting measured resistance	UINT32	RO	

Index 80nF RTD Vendor Data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor Data	Max. subindex	UINT8	RO	0x03 (3_{dec})
80nF:01	Calibration offset	Calibration offset	INT32	RW	0x00000DAC (3500_{dec})
80nF:02	Calibration gain	Gain value for measuring range 0 to 5000 Ohm	UINT16	RW	0x3D68 (15720_{dec})
80nF:03	Calibration gain ext.	Gain value for measuring range 5 to 240 kOhm	UINT16	RW	0x05A0 (1440_{dec})

Index F000 Modular device profile

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RW	0x04 (4_{dec})
F010:01	SubIndex 001	Analog Input Profile for RTD	UINT32	RW	0x00000140 (320_{dec})
F010:02	SubIndex 002	Analog Input Profile for RTD	UINT32	RW	0x00000140 (320_{dec})
F010:03	SubIndex 003	Analog Input Profile for RTD	UINT32	RW	0x00000140 (320_{dec})
F010:04	SubIndex 004	Analog Input Profile for RTD	UINT32	RW	0x00000140 (320_{dec})

6.12.7 Object description EL3208

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 268] and profile-specific objects [▶ 273] required during commissioning
- Objects for indicating internal settings [▶ 270] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 7 (Ch. 1 – 8)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n00:15 of the EL3208 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n0:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n0:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n0:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (“Value” 0x60n0:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n0:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n0:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n0:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via “Enable “filter (index 0x80n0:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n0:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n0:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!		RW	0x0002 (2_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD 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 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C32:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A05 (6661_{dec})
1C13:07	Subindex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:08	Subindex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A07 (6663_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 274]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	-
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	-
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	-
80nF:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
80nF:04	Calibration gain Pt1000	Manufacturer calibration gain Pt000)	UINT16	RW	-

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	0x0008 (8_{dec})

Index F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.8 Object description EL3208-0010

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 275] and profile-specific objects [▶ 281] required during commissioning
- Objects for indicating internal settings [▶ 278] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 7 (Ch. 1 – 8)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n0:15 of the EL3208-0010 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n0:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n0:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n0:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (“Value” 0x60n0:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n0:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n0:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via “Enable filter” (index 0x80n0:06). The possible settings are sequentially numbered. 0: 50/60 Hz 120 ms 1: 4 ms 2: 8 ms 3: 16 ms 4: 32 ms 5: 40 ms 6: 48 ms 7: 60 ms 8: 101 ms 9: 120 ms 10: 50/60 Hz 11: 160 ms 12: 200 ms 13: 240 ms 14: 320 ms 15: 480 ms	UINT16	RW	0x0000 (0_{dec})
80n0:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n0:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		2: Pt1000 -50°C to 150°C 3: Pt500 -50°C to 150°C 5: Ni1000 -50°C to 150°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30°C to 150°C) 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 50: NTC1K8 -40°C to 130°C $R_{0^\circ C}$=4940 ohm 51: NTC1K8 TK -30°C to 150°C $R_{0^\circ C}$=5200 ohm 52: NTC2K2 -50°C to 130°C $R_{0^\circ C}$=7373 ohm 53: NTC3K -30°C to 80°C $R_{0^\circ C}$=9822 ohm 54: NTC5K -40°C to 100°C $R_{0^\circ C}$=9822 ohm 55: NTC10K -30°C to 150°C $R_{0^\circ C}$=32650 ohm 56: NTC10K PRE -30°C to 150°C $R_{0^\circ C}$=29490 ohm 57: NTC10k 3204 -40°C to 110°C $R_{0^\circ C}$=27080 ohm 58: NTC10k Type 2 -50°C to 130°C $R_{0^\circ C}$=32770 ohm 59: NTC10k Type 3 -50°C to 130°C $R_{0^\circ C}$=29588 ohm 60: NTC10K Dale -50°C to 130°C $R_{0^\circ C}$=32660 ohm 61: NTC10K 3A221 -40°C to 130°C $R_{0^\circ C}$=32639 ohm 62: NTC20K -20 to 150°C $R_{0^\circ C}$=70200 ohm 99: B-parameter equation 100: potentiometer 0.1 ohm 0..5k 101: potentiometer 1 ohm res 102: potentiometer 10 ohm res 103: potentiometer 20 ohm res 200: NTC100K $R_{0^\circ C}$=3266 kΩ	UINT16	RW	0x0002 (2_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Index 8002 B-Parameter Equation

Index (hex)	Name	Meaning	Data type	Flags	Default value
8002:0	B_parameter Equation	Max. subindex	UINT8	RO	0x05 (5_{dec})
8002:01	Min Temperature		UINT16	RW	- 50
8002:02	Max Temperature		UINT16	RW	150
8002:03	Rn 10 Ohm res.		UINT16	RW	1000
8002:04	Tn		UINT16	RW	25
8002:05	B-Parameter		UINT32	RO	3710.000000

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD 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 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C32:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A05 (6661_{dec})
1C13:07	Subindex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:08	Subindex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A07 (6663_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 282]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	RTD Vendor data	Max. subindex	UINT8	RO	-
80nF:01	Calibration offset	Vendor offset calibration	INT16	RW	-
80nF:02	Calibration gain	Vendor gain calibration	UINT16	RW	-
80nF:03	Calibration offset NTC1	Vendor offset calibration NTC1	INT16	RW	-
80nF:04	Calibration gain NTC1	Vendor gain calibration NTC1	UINT16	RW	-
80nF:05	Calibration offset NTC2	Vendor offset calibration NTC2	INT16	RW	-
80nF:06	Calibration gain NTC2	Vendor gain calibration NTC2	UINT16	RW	-
80nF:07	RefA_5k	Extended vendor calibration reference resistor 5k	UINT16	RW	-
80nF:08	RefC_5k	Extended vendor calibration reference resistor 5k	UINT16	RW	-
80nF:09	RefA_35k	Extended vendor calibration reference resistor 35k	UINT16	RW	-
80nF:0A	RefC_35k	Extended vendor calibration reference resistor 35k	UINT16	RW	-

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	0x0008 (8_{dec})

Index F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.9 Object description EL3214

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal is parameterized via the CoE – Online tab (double-click on the respective object) or via the Process Data tab (assignment of PDOs). Please note the following general CoE information when using/manipulating the CoE parameters: – Keep a startup list in case components have to be replaced – Differentiation between online/offline dictionary, existence of current XML description – Use "CoE reload" for resetting changes

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 284] and profile-specific objects [▶ 289] required during commissioning
- Objects for indicating internal settings [▶ 286] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 3 (Ch. 1 – 4)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n00:15 of the EL3214-00x0 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!	UINT16	RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: Two-wire connection 1: Three-wire connection	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1A0n TxPDO Map for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD 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 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 290]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 80nE RTD Internal data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 80nF RTD Vendor data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	-
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	-
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	-
80nF:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
80nF:04	Calibration gain Pt1000	Manufacturer calibration gain Pt1000)	UINT16	RW	-
80nF:05	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-
80nF:06	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default value
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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.10 Object description EL3214-0090

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 292] and profile-specific objects [▶ 298] required during commissioning
- Objects for indicating internal settings [▶ 294] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80n0 RTD settings for 0 ≤ n ≤ 3 (Ch. 1 – 4)

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n00:15 of the EL3214-00x0 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!	UINT16	RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: Two-wire connection (EL3214-0090 from firmware 02) 1: Three-wire connection	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Index 8040 TSC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default value
8040:0	TSC Settings [▶ 211]	Max. ubindex	UINT8	RO	0x02 (2_{dec})
8040:01	Address	TwinSAFE SC Address	UINT16	RW	0x0000 (0_{dec})
8040:02	Connection Mode	Selection of TwinSAFE SC CRC	UINT32	RO	0x00000000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

Index 1604 TSC RxPDO-Map Master Message

Index (hex)	Name	Meaning	Data type	Flags	Default value
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 1A0n TxPDO Map for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD 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 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x11 (Value))	UINT32	RW	0x60n0:11, 16

Index 1A04 TSC TxPDO-Map Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default value
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 (ENC Inputs), entry 0x11 (Counter 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 (ENC Inputs), entry 0x11 (Counter 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 (ENC Inputs), entry 0x11 (Counter 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 (ENC Inputs), entry 0x11 (Counter 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

Index 60n0 RTD Inputs for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 299]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

Index 6040 TSC Slave Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default value
6040:0	TSC Slave Frame Elements [▶ 211]	Max. subindex	UINT8	RO	0x06 (6_{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})

Index 7040 TSC Master Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

Index 80nE RTD Internal data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

Index 80nF RTD Vendor data for 0 ≤ n ≤ 3 (Ch. 1 - 4)

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	-
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	-
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	-
80nF:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
80nF:04	Calibration gain Pt1000	Manufacturer calibration gain Pt1000)	UINT16	RW	-
80nF:05	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-
80nF:06	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-

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 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 value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

6.12.11 Object description EL3218

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The terminal 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 information 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

Relevant objects

The object description refers to the analog input terminals for Pt100 (RTD) in 1 to 8 channel versions. Observe the indices with regard to the objects relevant for the respective terminal (channel dependent).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization [▶ 301] and profile-specific objects [▶ 306] required during commissioning
- Objects for indicating internal settings [▶ 303] (may be fixed)

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

Objects for commissioning

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default value
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})

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

The filter properties are set via index 0x8000:15 only

The filter frequencies are set centrally for all channels of the EL32xx terminals via index 0x8000:15 (channel 1).
The corresponding indices 0x80n00:15 of the EL3218 have no parameterization function.

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	RTD Settings	Maximum subindex	UINT8	RO	0x1B (27_{dec})
80n00:01	Enable user scale [▶ 188]	User scaling is active.	BOOLEAN	RW	0x00 (0_{dec})
80n00:02	Presentation [▶ 186]	0: Signed presentation 1: Absolute value with MSB as sign Signed amount representation 2: High resolution (1/100°C) [default for EL3201/2-00x0 high-precision terminals, see note [▶ 200]!	BIT3	RW	0x00 (0_{dec})
80n00:05	Siemens bits [▶ 188]	The S5 bits are shown in the three low-order bits (value 0x60n00:11) Bit 0 = 1 ("Overange" or "Underrange") Bit 1 (not used) Bit 2 (not used)	BOOLEAN	RW	0x00 (0_{dec})
80n0:0A	Enable user calibration [▶ 188]	Enabling of user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable manufacturer calibration [▶ 188]	Enabling of the manufacturer calibration	BOOLEAN	RW	0x01 (1_{dec})
80n00:11	User scale offset [▶ 188]	User scaling offset	INT16	RW	0x0000 (0_{dec})
80n00:12	User scale gain [▶ 188]	This is the gain of the user scaling. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n00:15	Filter settings [▶ 188]	This object determines the digital filter settings, if it is activated via Enable filter (index 0x80n00:06). The possible settings are sequentially numbered. 0: 50 Hz 1: 60 Hz 2: 100 Hz 3: 500 Hz 4: 1 kHz 5: 2 kHz 6: 3.75 kHz 7: 7.5 kHz 8: 15 kHz 9: 30 kHz 10: 5 Hz 11: 10 Hz	UINT16	RW	0x0000 (0_{dec})
80n00:17	User calibration offset [▶ 188]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n00:18	User calibration gain [▶ 188]	User calibration gain	UINT16	RW	0xFFFF (65535_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n00:19	RTD element [▶ 184]	RTD element	UINT16	RW	0x0000 (0_{dec})
		0: Pt100 1: Ni100 -60°C to 250°C 2: Pt1000 -200°C to 850°C 3: Pt500 -200°C to 850°C 4: Pt200 -200°C to 850°C 5: Ni1000 -60°C to 250°C 6: Ni1000 TK5000, 100°C: 1500 ohm (-30 to 160°C) 7: Ni120 -60°C to 320°C 8: Output in ohm Resolution 1/16 ohm (0 .. 4096 ohm)*** 9: Output in ohm Resolution 1/64 ohm (0 .. 1024 ohm)*** 10-32: KT100/110/130/210/230 KTY10/11/13/16/19 KTY81/82-110,120,150 (-50...150°C) KTY81-121 KTY81-122 KTY81-151 KTY81-152 KTY81/82-210,220,250 KTY81-221 KTY81-222 KTY81-251 KTY81-252 KTY83-110,120,150 (-50...175°C) KTY83-121 KTY83-122 KTY83-151 KTY83-152 KTY84-130,150 (-40...300°C) KTY84-151 KTY21/23-6 (-50...150°C) KTY1x-5 KTY1x-7 KTY21/23-5 KTY21/23-7 ***) please observe further notes [▶ 63] in chapter "RTD measurement in EL32xx"!		RW	0x0000 (0_{dec})
80n0:1A	Connection technology	Connection technology 0: 2-wire connection 1: 3-wire connection	UINT16	RW	0x0000 (0_{dec})
80n0:1B	Wire calibration 1/32 ohm [▶ 187]	Calibration of the supply lines	INT16	RW	0x0000 (0_{dec})

Complete overview

Standard objects (0x1000-0x1FFF)

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

Index 1000 Device type

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

Index 1008 Device name

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

Index 1009 Hardware version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	( )
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	( )
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	( )

Index 10F0 Backup parameter handling

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
1A0n:0	TxPDO Map Ch.1	PDO Mapping TxPDO 1	UINT8	RW	0x09 (9_{dec})
1A0n:01	SubIndex 001	1. PDO Mapping entry (object 0x60n0 (RTD Inputs Ch.[n+1]), entry 0x01 (Underrange))	UINT32	RW	0x60n0:01, 1
1A0n:02	SubIndex 002	2. PDO Mapping entry (object 0x60n0 (RTD 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 (RTD 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 0x180n (TxPDO-Par Ch.[n+1]), entry 0x07 (TxPDO-State))	UINT32	RW	0x180n:07, 1
1A0n:07	SubIndex 007	7. PDO Mapping entry (object 0x180n (TxPDO-Par Ch.[n+1]), entry 0x09 (TxPDO-Toggle))	UINT32	RW	0x180n:09, 1
1A0n:08	SubIndex 008	8. PDO Mapping entry (object 0x60n0 (RTD 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 value
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 value
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x00 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A02 (6658_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A03 (6659_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C32:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A05 (6661_{dec})
1C13:07	Subindex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:08	Subindex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A07 (6663_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default value
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RW	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C33:08)	UINT16	RO	0x8007 (32775_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Profile-specific objects (0x6000-0xFFFF)

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

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
60n0:0	RTD Inputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	The measuring range is undershot.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	The measuring range is overshot. (“open circuit” detection if “error” [index 0x60n0:07 [▶ 307]]) is set	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	The error bit is set if the data is invalid.	BOOLEAN	RO	0x00 (0_{dec})
60n0:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	The analog input data	INT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nE:0	RTD Internal data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
80nE:01	ADC raw value 1	ADC raw value 1	INT32	RO	0x00000000 (0_{dec})
80nE:02	Resistor 1	Resistance 1 (measured value of resistance sensor, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})
80nE:03	ADC raw value 2 (RL)	ADC raw value 2 (RL)	INT32	RO	0x00000000 (0_{dec})
80nE:04	Resistor 2 (RL)	Resistance 2 (RL) (measured value of the supply line, resolution 1/32 Ohm)	UINT16	RO	0x0000 (0_{dec})

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

Index (hex)	Name	Meaning	Data type	Flags	Default value
80nF:0	RTD Vendor data	Maximum subindex	UINT8	RO	-
80nF:01	Calibration offset	Manufacturer calibration offset	INT16	RW	-
80nF:02	Calibration gain	Manufacturer calibration gain	UINT16	RW	-
80nF:03	Calibration offset Pt1000	Manufacturer calibration offset Pt1000	INT16	RW	-
80nF:04	Calibration gain Pt1000	Manufacturer calibration gain Pt1000)	UINT16	RW	-
80nF:05	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-
80nF:06	Calibration gain RL	Manufacturer calibration gain (input RL)	UINT16	RW	-

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default value
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	0x0008 (8_{dec})

Index F008 Code word

Index (hex)	Name	Meaning	Data type	Flags	Default value
F008:0	Code word [▶ 188]	currently reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list [for {n=1} (1-channel) to {n=1,..,n=8} (8-channel)]

Index (hex)	Name	Meaning	Data type	Flags	Default value
F010:0	Module list	Maximum subindex	UINT8	RO	0x08 (n_{dec})
F010:0n	Subindex 00n	Profile 320	INT32	RO	0x00000140 (320_{dec})

7 Appendix

7.1 EtherCAT AL Status Codes

For detailed information please refer to the EtherCAT system description.

7.2 Firmware compatibility

Beckhoff EtherCAT devices are delivered with the latest available firmware version. Compatibility of firmware and hardware is mandatory; not every combination ensures compatibility. The overview below shows the hardware versions on which a firmware can be operated.

Note

- It is recommended to use the newest possible firmware for the respective hardware
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Pay attention to the instructions for firmware updates on the separate page [▶ 313].
If a device is placed in BOOTSTRAP mode for a firmware update, it does not check when downloading whether the new firmware is suitable.
This can result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

EL3201			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 02	03	EL3201-0000-0016	2008/03
	04		2009/04
	05		2009/05
02	06	EL3201-0000-0017	2010/04
03 - 12*	07*		2010/06
		EL3201-0000-0018	2012/06
		EL3201-0000-0019	2012/07
		EL3201-0000-0020	2014/07
		EL3201-0000-0021	2015/01
		EL3201-0000-0022	2016/01

EL3201-0010			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 02	03	EL3201-0010-0016	2008/11
	04		2009/04
	05		2009/05
02	06	EL3201-0010-0017	2010/04
03 - 13*	07*		2010/06
		EL3201-0010-0018	2012/06
		EL3201-0010-0019	2012/07
		EL3201-0010-0020	2014/07
		EL3201-0010-0021	2015/01
		EL3201-0010-0022	2016/02

EL3201-0020			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 02	03	EL3201-0020-0016	2008/11
	04		2009/04
	05		2009/05
02	06	EL3201-0020-0017	2010/04
03 - 12*	07*		2010/06
		EL3201-0020-0018	2012/06
		EL3201-0020-0019	2012/07
		EL3201-0020-0020	2014/07
		EL3201-0020-0021	2015/01
		EL3201-0020-0022	2016/02

EL3202			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 02	03	EL3202-0000-0016	2008/03
	04		2009/04
	05		2009/05
03 - 15*	06	EL3202-0000-0017	2010/04
	07*		2010/06
		EL3202-0000-0018	2012/06
		EL3202-0000-0019	2012/07
		EL3202-0000-0020	2014/07
		EL3202-0000-0021	2015/01
		EL3202-0000-0022	2016/01

EL3202-0010			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 01	05	EL3202-0010-0016	2009/07
	06	EL3202-0010-0017	2010/04
01 - 11*	07		2010/06
	08		2010/10
	09		2011/07
	10		2011/09
		EL3202-0010-0018	2012/06
		EL3202-0010-0019	2012/07
		EL3202-0010-0020	2014/07
		EL3202-0010-0021	2015/01
		EL3202-0010-0022	2016/01
	11*		2021/07

EL3202-0020			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
01 - 11*	09	EL3202-0020-0017	2011/02
	10		2011/09
		EL3202-0020-0018	2012/06
		EL3202-0020-0019	2012/07
		EL3202-0020-0020	2014/07
		EL3202-0020-0021	2015/01
		EL3202-0020-0022	2016/01
	11*		2021/07

EL3204			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 02	03	EL3204-0000-0016	2008/03
	04		2009/04
	05		2009/05
03 - 12	06	EL3204-0000-0017	2010/04
	07		2011/06
		EL3204-0000-0018	2012/07
		EL3204-0000-0019	2014/07
		EL3204-0000-0020	2015/01
		EL3204-0000-0021	2016/01
13 – 14*	10	EL3204-0000-0022	2022/08

EL3204-0200			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 04*	01	EL3204-0200-0016	2013/08
	02*	EL3204-0200-0017	2014/04
		EL3204-0200-0018	2016/02

EL3208			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 06	01	EL3208-0000-0017	2014/04
		EL3208-0000-0018	2016/02
07*	10*	EL3208-0000-0019	2023/06

EL3208-0010			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 05*	01	EL3208-0010-0016	2018/09
	02*		2023/05

EL3214			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 – 04	01	EL3214-0000-0016	2015/01
		EL3214-0000-0017	2017/06
01	02		2020/11
05 – 07*	10	EL3214-0000-0018	2023/06
	11*		2024/11

EL3214-0090			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 – 04	01	EL3214-0090-0016	2017/02
	02		2018/09
05 – 07*	10*	EL3214-0090-0017	2024/07

EL3218			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
01 – 02*	01	EL3218-0000-0016	2020/02
	02	EL3218-0000-0017	2021/07
	03*		2025/04

*) This is the current compatible firmware/hardware version at the time of the preparing this documentation. Check on the Beckhoff web page whether more up-to-date documentation is available.

7.3 Firmware Update EL/ES/EM/ELM/EP/EPP/ERPxxxx

This section describes the device update for Beckhoff EtherCAT slaves from the EL/ES, ELM, EM, EK, EP, EPP and ERP series. A firmware update should only be carried out after consultation with Beckhoff support.

NOTICE

Only use TwinCAT 3 software!

A firmware update of Beckhoff IO devices must only be performed with a TwinCAT 3 installation. It is recommended to build as up-to-date as possible, available for free download on the Beckhoff website.

To update the firmware, TwinCAT can be operated in the so-called FreeRun mode, a paid license is not required.

The device to be updated can usually remain in the installation location, but TwinCAT has to be operated in the FreeRun. Please make sure that EtherCAT communication is trouble-free (no LostFrames etc.).

Other EtherCAT master software, such as the EtherCAT Configurator, should not be used, as they may not support the complexities of updating firmware, EEPROM and other device components.

Storage locations

An EtherCAT slave stores operating data in up to three locations:

- Each EtherCAT slave has a device description, consisting of identity (name, product code), timing specifications, communication settings, etc.
  This device description (ESI; EtherCAT Slave Information) can be downloaded from the Beckhoff website in the download area as a zip file and used in EtherCAT masters for offline configuration, e.g. in TwinCAT.
  Above all, each EtherCAT slave carries its device description (ESI) electronically readable in a local memory chip, the so-called **ESI EEPROM**. When the slave is switched on, this description is loaded locally in the slave and informs it of its communication configuration; on the other hand, the EtherCAT master can identify the slave in this way and, among other things, set up the EtherCAT communication accordingly.

NOTICE

Application-specific writing of the ESI-EEPROM

The ESI is developed by the device manufacturer according to ETG standard and released for the corresponding product.
- Meaning for the ESI file: Modification on the application side (i.e. by the user) is not permitted.
- Meaning for the ESI EEPROM: Even if a writeability is technically given, the ESI parts in the EEPROM and possibly still existing free memory areas must not be changed beyond the normal update process. Especially for cyclic memory processes (operating hours counter etc.), dedicated memory products such as EL6080 or IPC's own NOVRAM must be used.

- Depending on functionality and performance EtherCAT slaves have one or several local controllers for processing I/O data. The corresponding program is the so-called **firmware** in *.efw format.
- In some EtherCAT slaves the EtherCAT communication may also be integrated in these controllers. In this case the controller is usually a so-called **FPGA** chip with *.rbf firmware.

Customers can access the data via the EtherCAT fieldbus and its communication mechanisms. Acyclic mailbox communication or register access to the ESC is used for updating or reading of these data.

The TwinCAT System Manager offers mechanisms for programming all three parts with new data, if the slave is set up for this purpose. Generally the slave does not check whether the new data are suitable, i.e. it may no longer be able to operate if the data are unsuitable.

Simplified update by bundle firmware

The update using so-called **bundle firmware** is more convenient: in this case the controller firmware and the ESI description are combined in a *.efw file; during the update both the firmware and the ESI are changed in the terminal. For this to happen it is necessary

- for the firmware to be in a packed format: recognizable by the file name, which also contains the revision number, e.g. ELxxxx-xxxx_REV0016_SW01.efw

- for password=1 to be entered in the download dialog. If password=0 (default setting) only the firmware update is carried out, without an ESI update.
- for the device to support this function. The function usually cannot be retrofitted; it is a component of many new developments from year of manufacture 2016.

Following the update, its success should be verified

- ESI/Revision: e.g. by means of an online scan in TwinCAT ConfigMode/FreeRun – this is a convenient way to determine the revision
- Firmware: e.g. by looking in the online CoE of the device

NOTICE

Risk of damage to the device!

✓ Note the following when downloading new device files

a) Firmware downloads to an EtherCAT device must not be interrupted

b) Flawless EtherCAT communication must be ensured. CRC errors or LostFrames must be avoided.

c) The power supply must adequately dimensioned. The signal level must meet the specification.

⇨ In the event of malfunctions during the update process the EtherCAT device may become unusable and require re-commissioning by the manufacturer.

7.3.1 Device description ESI file/XML

NOTICE

Attention regarding update of the ESI description/EEPROM

Some slaves have stored calibration and configuration data from the production in the EEPROM. These are irretrievably overwritten during an update.

The ESI device description is stored locally on the slave and loaded on start-up. Each device description has a unique identifier consisting of slave name (9 characters/digits) and a revision number (4 digits). Each slave configured in the System Manager shows its identifier in the EtherCAT tab:

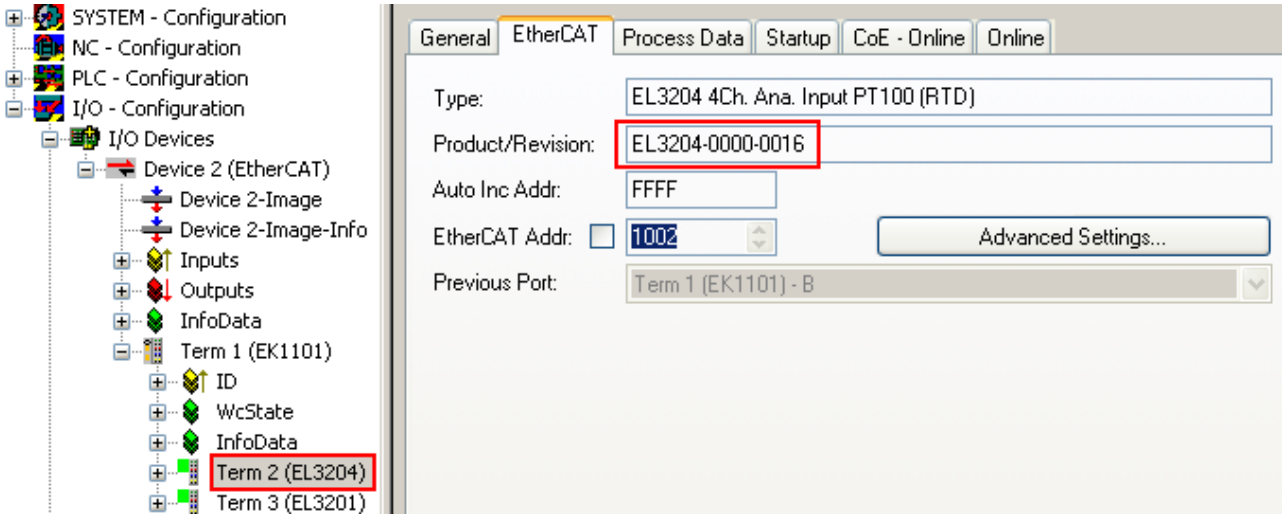


Fig. 186: Device identifier consisting of name EL3204-0000 and revision -0016

The configured identifier must be compatible with the actual device description used as hardware, i.e. the description which the slave has loaded on start-up (in this case EL3204). Normally the configured revision must be the same or lower than that actually present in the terminal network.

For further information on this, please refer to the EtherCAT system documentation.

Update of XML/ESI description

The device revision is closely linked to the firmware and hardware used. Incompatible combinations lead to malfunctions or even final shutdown of the device. Corresponding updates should only be carried out in consultation with Beckhoff support.

Display of ESI slave identifier

The simplest way to ascertain compliance of configured and actual device description is to scan the EtherCAT boxes in TwinCAT mode Config/FreeRun:

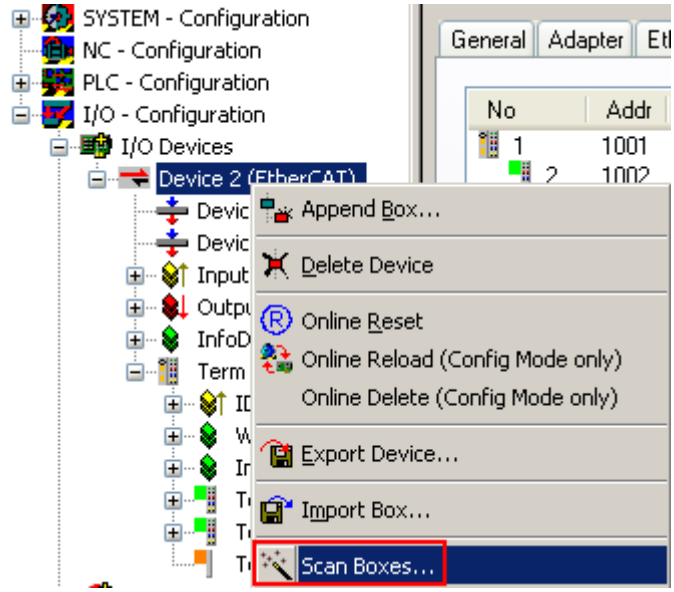


Fig. 187: Scan the subordinate field by right-clicking on the EtherCAT device

If the found field matches the configured field, the display shows



Fig. 188: Configuration is identical

otherwise a change dialog appears for entering the actual data in the configuration.

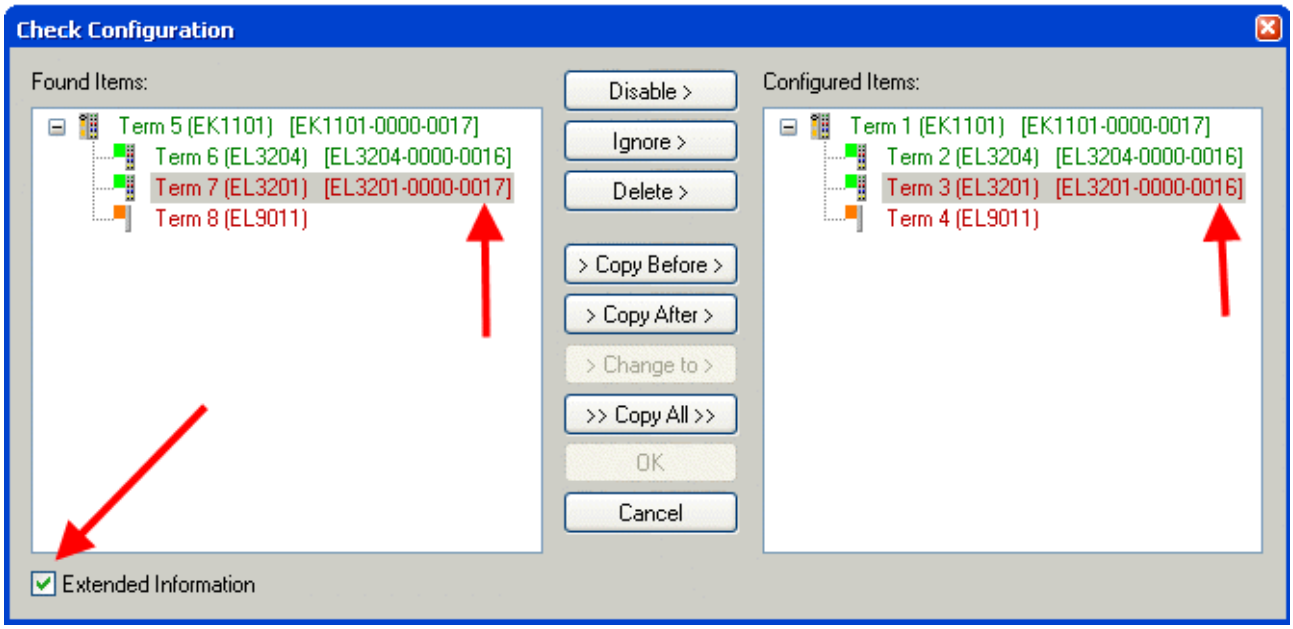


Fig. 189: Change dialog

In this example in Fig. *Change dialog*, an EL3201-0000-**0017** was found, while an EL3201-0000-**0016** was configured. In this case the configuration can be adapted with the *Copy Before* button. The *Extended Information* checkbox must be set in order to display the revision.

Changing the ESI slave identifier

The ESI/EEPROM identifier can be updated as follows under TwinCAT:

- Trouble-free EtherCAT communication must be established with the slave.
- The state of the slave is irrelevant.
- Right-clicking on the slave in the online display opens the *EEPROM Update* dialog, Fig. *EEPROM Update*

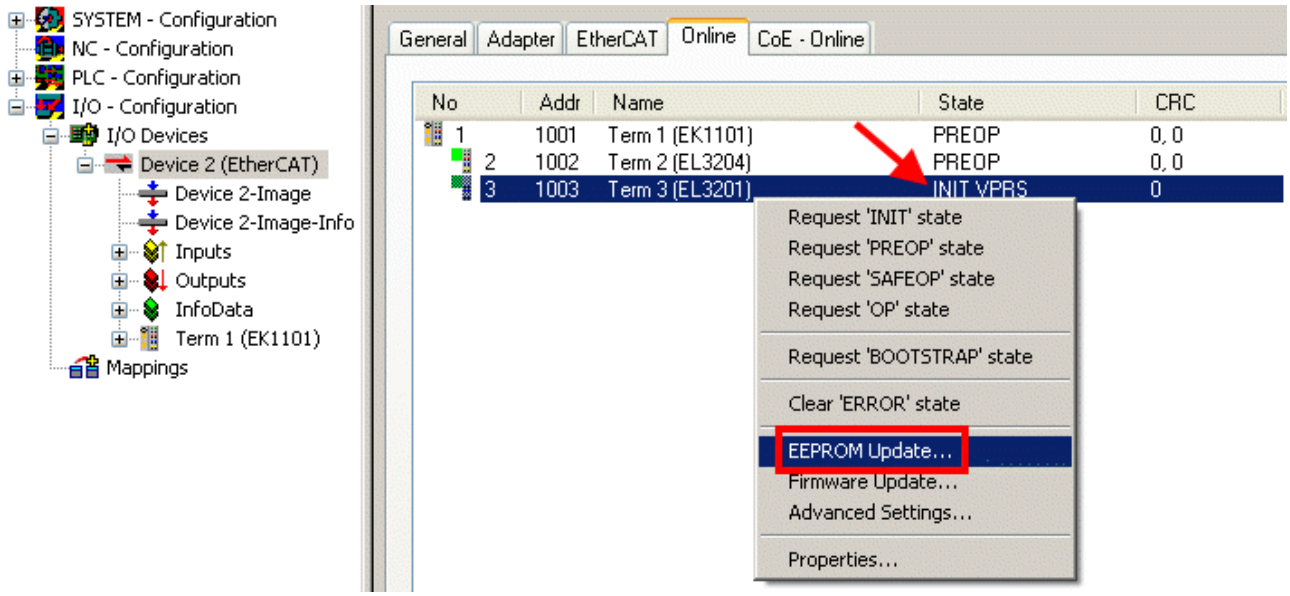


Fig. 190: EEPROM Update

The new ESI description is selected in the following dialog, see Fig. *Selecting the new ESI.* The checkbox *Show Hidden Devices* also displays older, normally hidden versions of a slave.

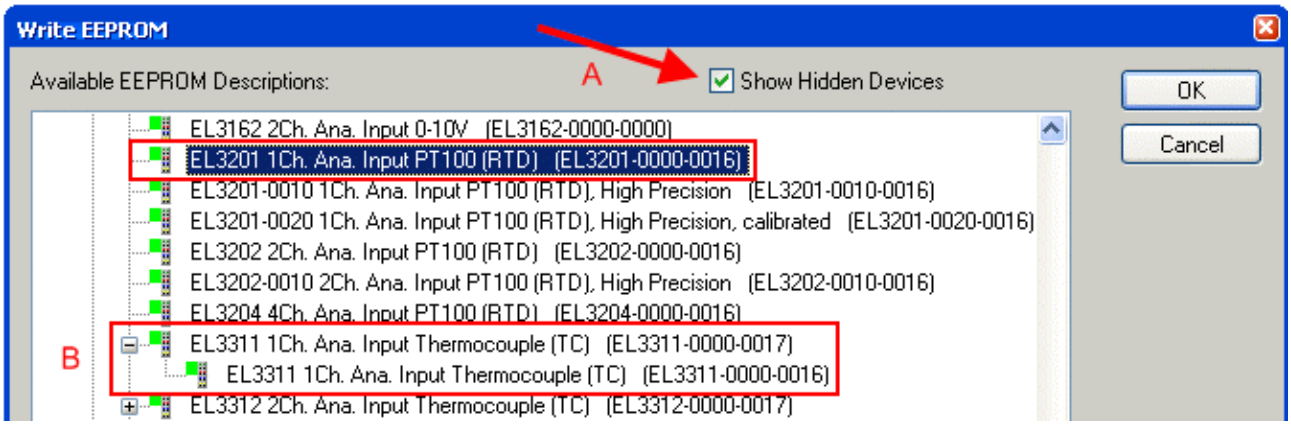


Fig. 191: Selecting the new ESI

A progress bar in the System Manager shows the progress. Data are first written, then verified.

The change only takes effect after a restart.

Most EtherCAT devices read a modified ESI description immediately or after startup from the INIT. Some communication settings such as distributed clocks are only read during power-on. The EtherCAT slave therefore has to be switched off briefly in order for the change to take effect.

7.3.2 Firmware explanation

Determining the firmware version

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager shows the version of the controller firmware if the master can access the slave online. Click on the E-Bus Terminal whose controller firmware you want to check (in the example terminal 2 (EL3204)) and select the tab *CoE Online* (CAN over EtherCAT).

CoE Online and Offline CoE

Two CoE directories are available:
• **online**: This is offered in the EtherCAT slave by the controller, if the EtherCAT slave supports this. This CoE directory can only be displayed if a slave is connected and operational.
• **offline**: The EtherCAT Slave Information ESI/XML may contain the default content of the CoE. This CoE directory can only be displayed if it is included in the ESI (e.g. “Beckhoff EL5xxx.xml”).

The Advanced button must be used for switching between the two views.

In Fig. *Display of EL3204 firmware version* the firmware version of the selected EL3204 is shown as 03 in CoE entry 0x100A.

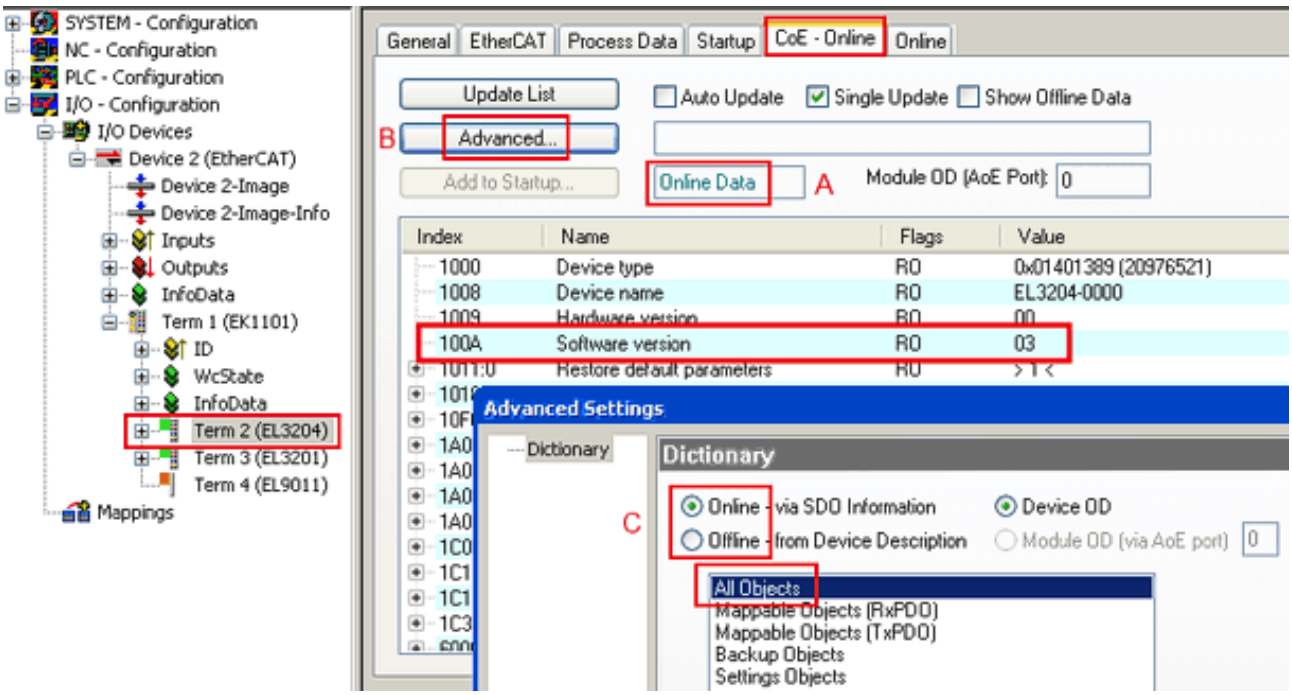


Fig. 192: Display of EL3204 firmware version

In (A) TwinCAT 2.11 shows that the Online CoE directory is currently displayed. If this is not the case, the Online directory can be loaded via the *Online* option in Advanced Settings (B) and double-clicking on *AllObjects*.

7.3.3 Updating controller firmware *.efw

CoE directory

The Online CoE directory is managed by the controller and stored in a dedicated EEPROM, which is generally not changed during a firmware update.

Switch to the *Online* tab to update the controller firmware of a slave, see Fig. *Firmware Update.*

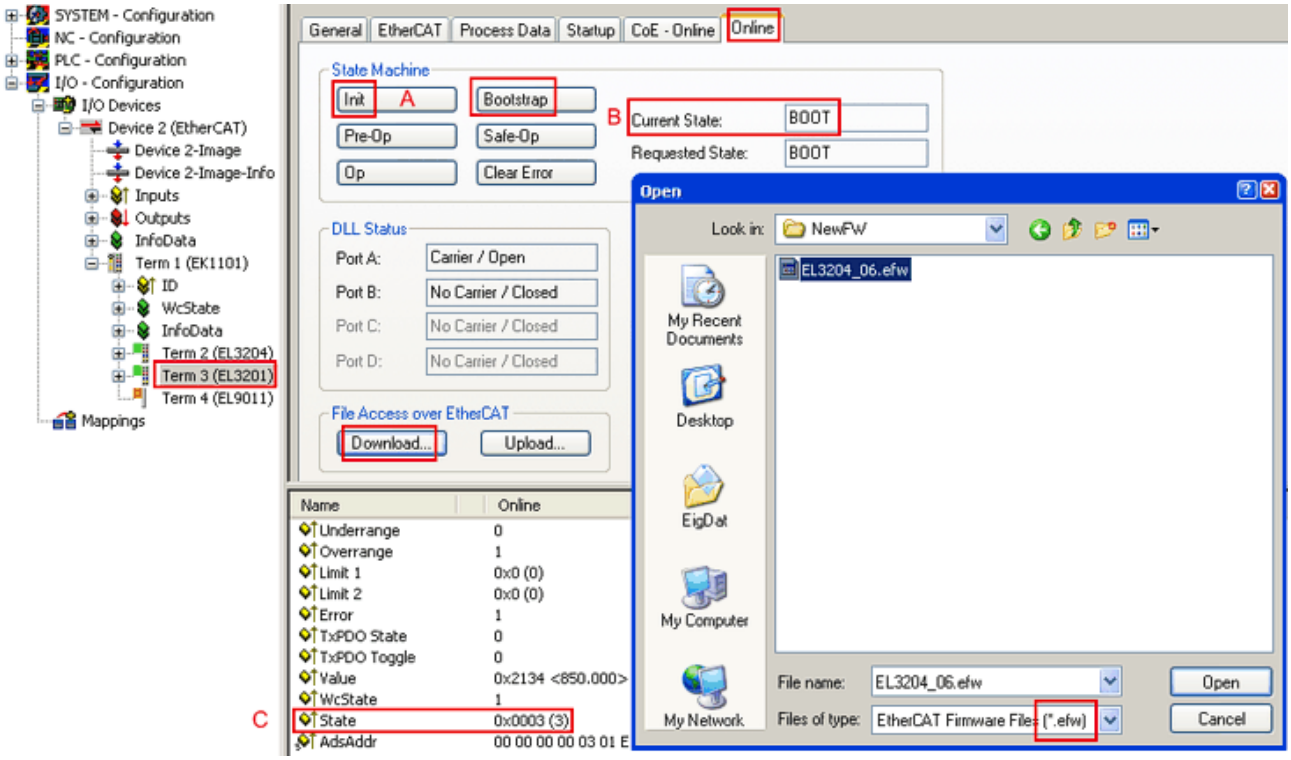
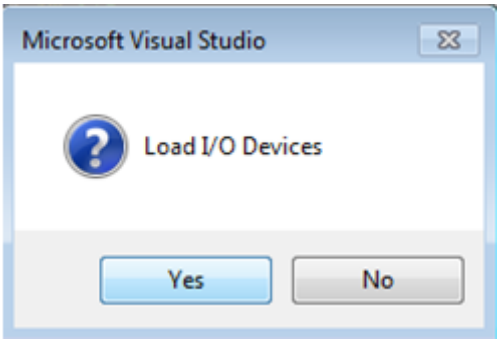
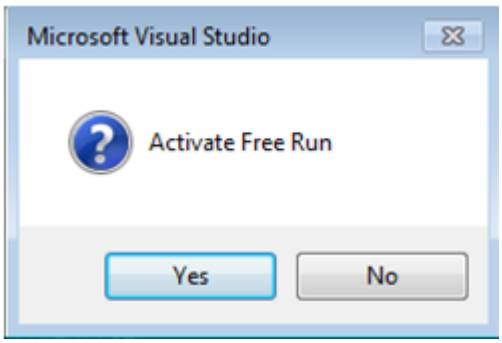


Fig. 193: Firmware Update

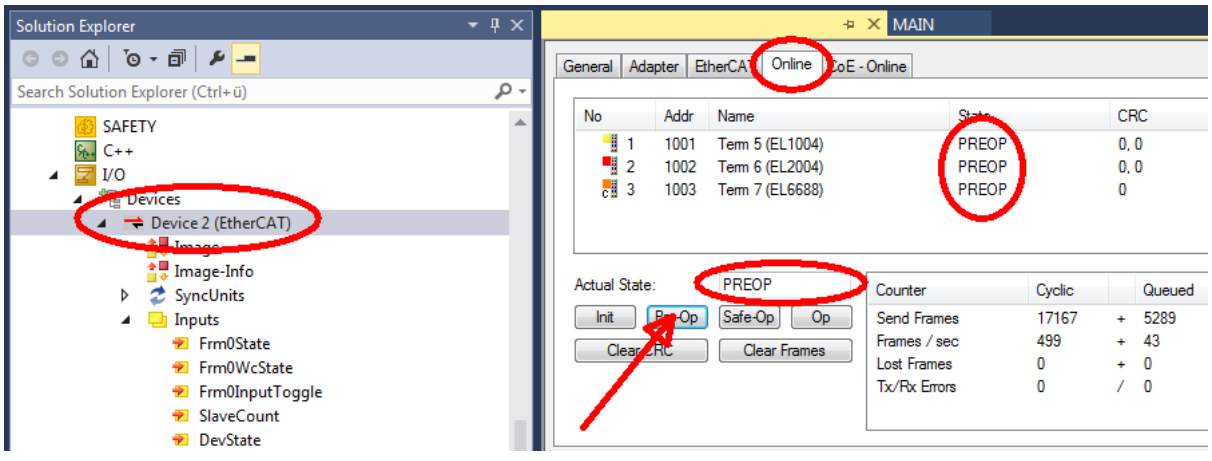
Proceed as follows, unless instructed otherwise by Beckhoff support. Valid for TwinCAT 2 and 3 as EtherCAT master.

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time >= 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.



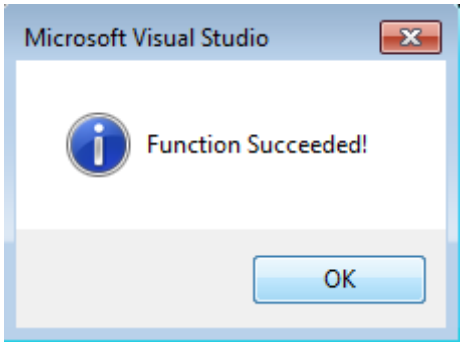


- Switch EtherCAT Master to PreOP



- Switch slave to INIT (A)
- Switch slave to BOOTSTRAP

- Check the current status (B, C)
- Download the new *efw file (wait until it ends). A password will not be necessary usually.



- After the download switch to INIT, then PreOP
- Switch off the slave briefly (don't pull under voltage!)
- Check within CoE 0x100A, if the FW status was correctly overtaken.

7.3.4 FPGA firmware *.rbf

If an FPGA chip deals with the EtherCAT communication an update may be accomplished via an *.rbf file.

- Controller firmware for processing I/O signals
- FPGA firmware for EtherCAT communication (only for terminals with FPGA)

The firmware version number included in the terminal serial number contains both firmware components. If one of these firmware components is modified this version number is updated.

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager indicates the FPGA firmware version. Click on the Ethernet card of your EtherCAT strand (Device 2 in the example) and select the *Online* tab.

The *Reg:0002* column indicates the firmware version of the individual EtherCAT devices in hexadecimal and decimal representation.

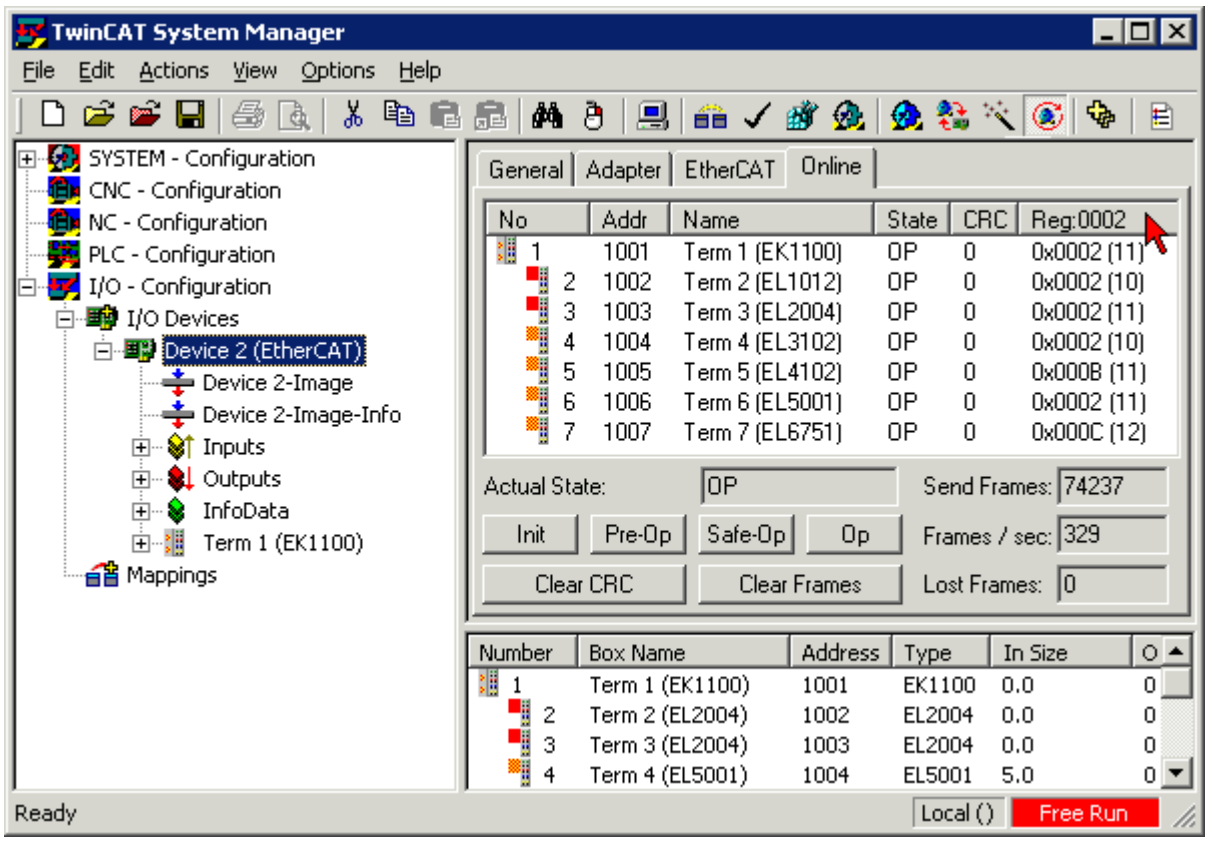


Fig. 194: FPGA firmware version definition

If the column *Reg:0002* is not displayed, right-click the table header and select *Properties* in the context menu.

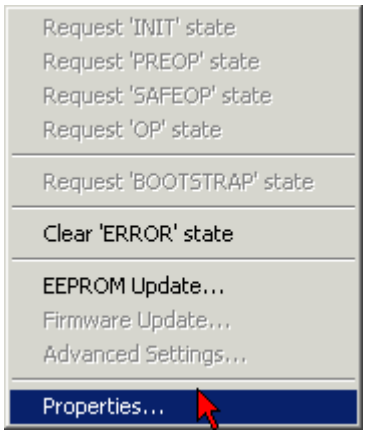


Fig. 195: Context menu *Properties*

The *Advanced Settings* dialog appears where the columns to be displayed can be selected. Under *Diagnosis/***Online View** select the *'0002 ETxxxx Build'* check box in order to activate the FPGA firmware version display.

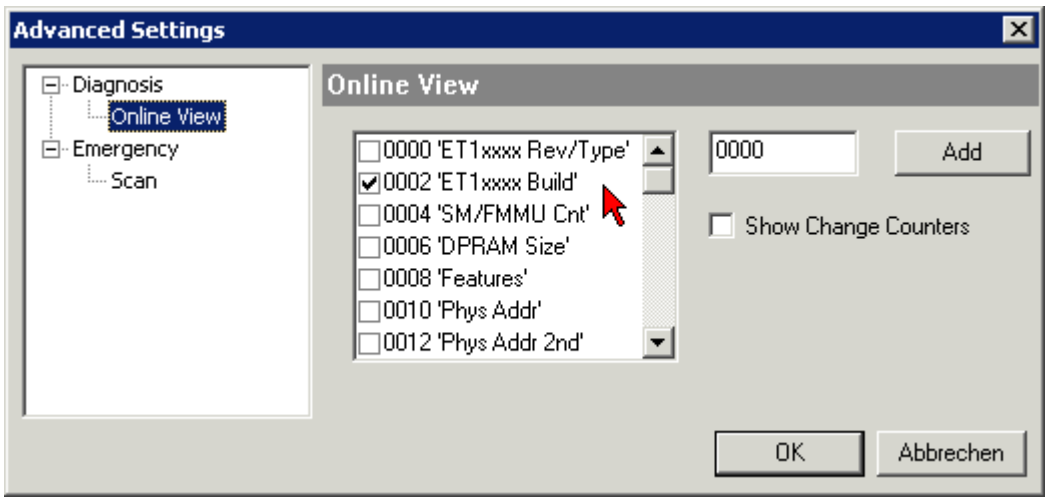


Fig. 196: Dialog *Advanced Settings*

Update

For updating the FPGA firmware

- of an EtherCAT coupler the coupler must have FPGA firmware version 11 or higher;
- of an E-Bus Terminal the terminal must have FPGA firmware version 10 or higher.

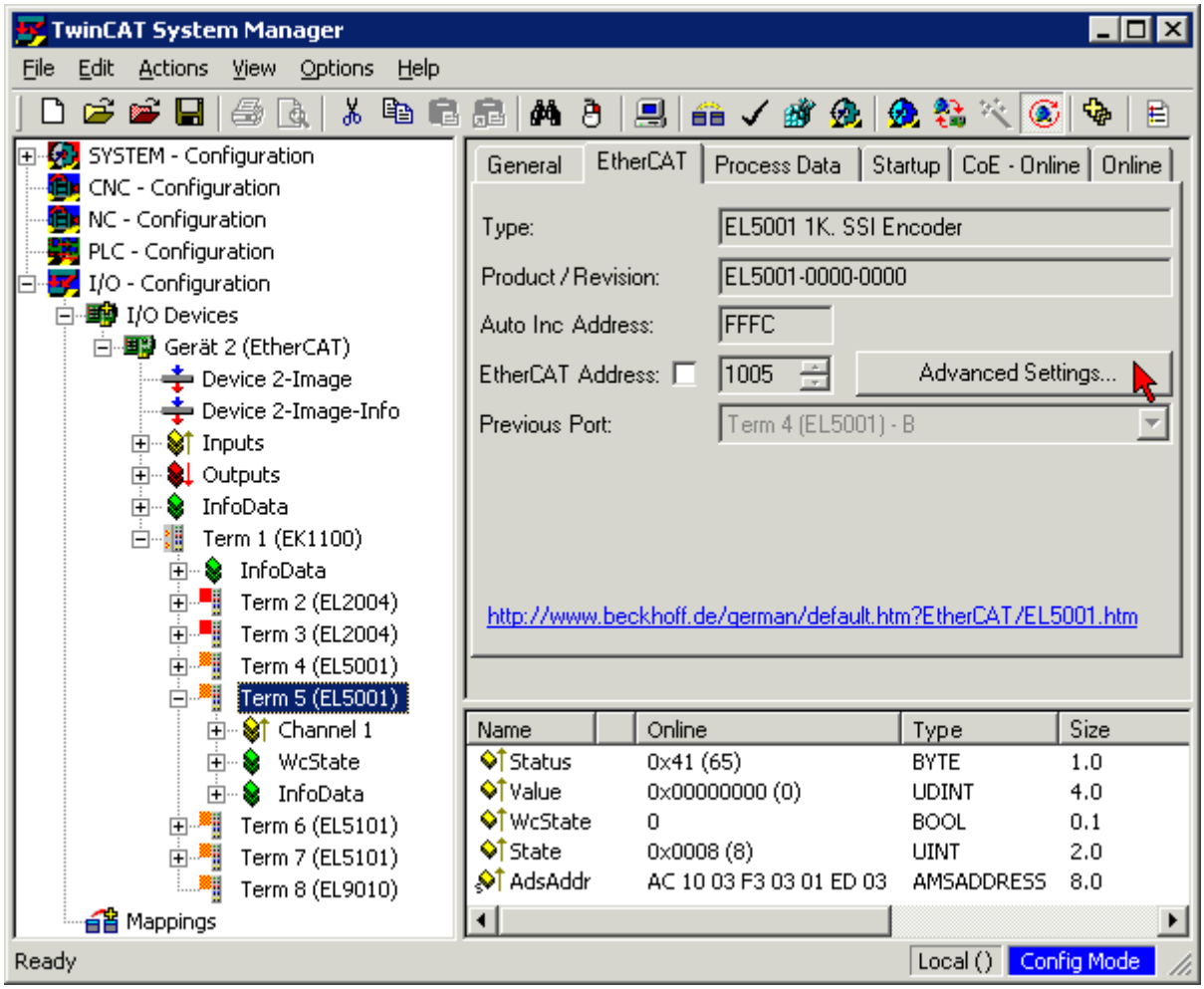
Older firmware versions can only be updated by the manufacturer!

Updating an EtherCAT device

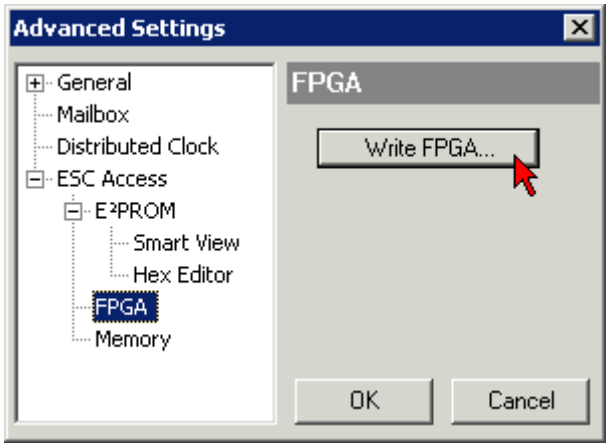
The following sequence order have to be met if no other specifications are given (e.g. by the Beckhoff support):

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time >= 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.

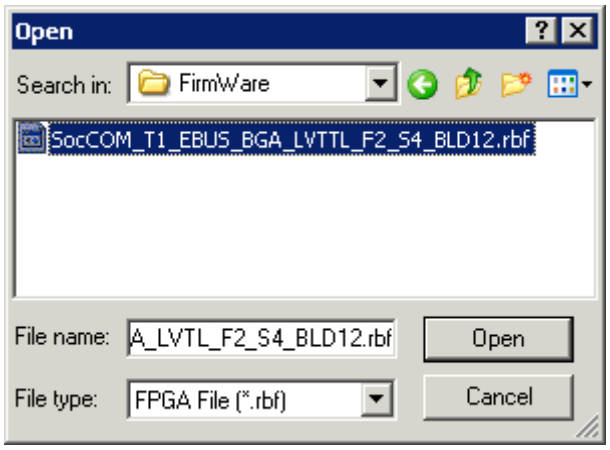
- In the TwinCAT System Manager select the terminal for which the FPGA firmware is to be updated (in the example: Terminal 5: EL5001) and
  click the *Advanced Settings* button in the *EtherCAT* tab:



- The *Advanced Settings* dialog appears. Under *ESC Access/E²PROM*/FPGA click on *Write FPGA* button:



- Select the file (*.rbf) with the new FPGA firmware, and transfer it to the EtherCAT device:



- Wait until download ends
- Switch slave current less for a short time (don't pull under voltage!). In order to activate the new FPGA firmware a restart (switching the power supply off and on again) of the EtherCAT device is required.
- Check the new FPGA status

NOTICE

Risk of damage to the device!

A download of firmware to an EtherCAT device must not be interrupted in any case! If you interrupt this process by switching off power supply or disconnecting the Ethernet link, the EtherCAT device can only be recommissioned by the manufacturer!

7.3.5 Simultaneous updating of several EtherCAT devices

The firmware and ESI descriptions of several devices can be updated simultaneously, provided the devices have the same firmware file/ESI.

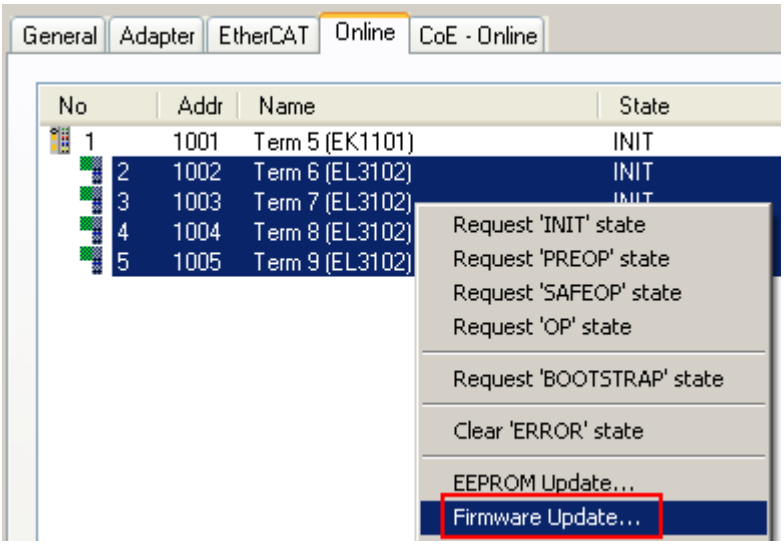


Fig. 197: Multiple selection and firmware update

Select the required slaves and carry out the firmware update in BOOTSTRAP mode as described above.

7.4 Restoring the delivery state

To restore the delivery state (factory settings) of CoE objects for EtherCAT devices (“slaves”), the CoE object *Restore default parameters*, SubIndex 001 can be used via EtherCAT master (e.g. TwinCAT) (see Fig. *Selecting the Restore default parameters PDO*).

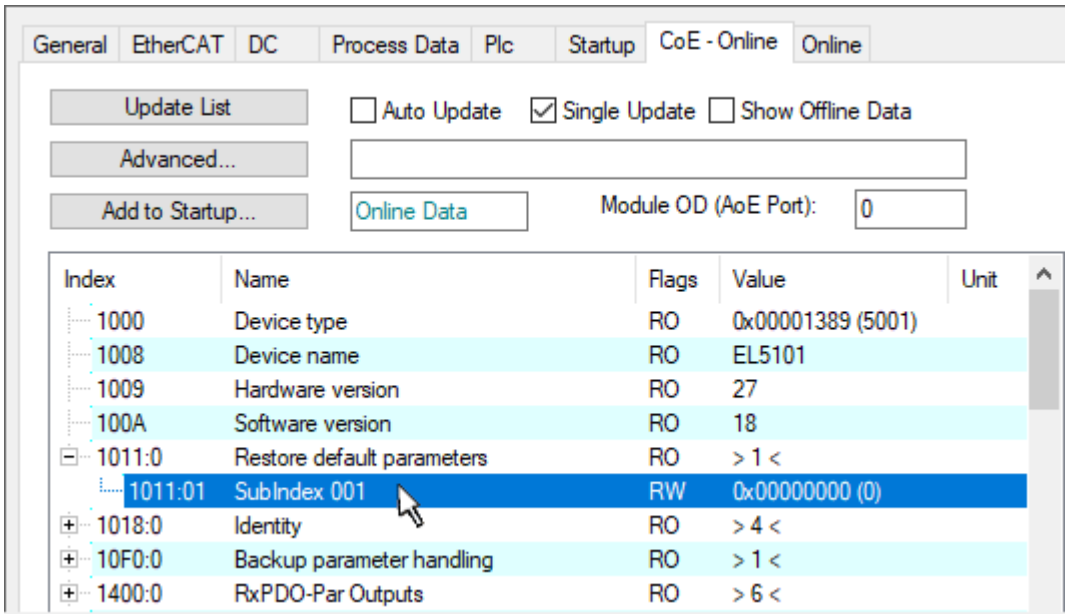


Fig. 198: Selecting the *Restore default parameters* PDO

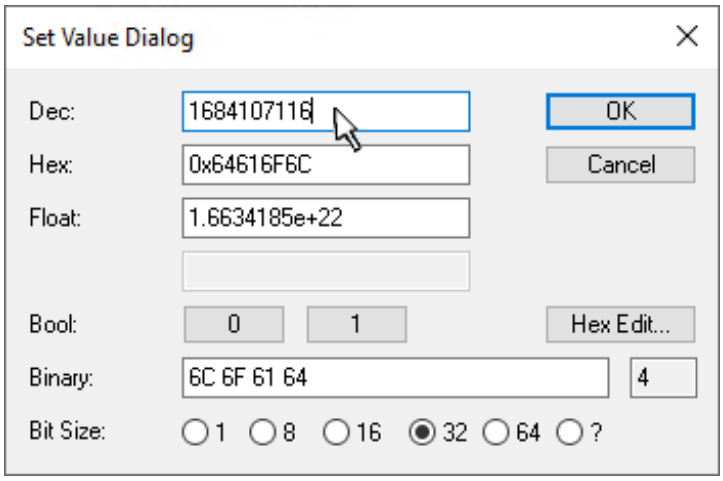


Fig. 199: Entering a restore value in the Set Value dialog

Double-click on *SubIndex 001* to enter the Set Value dialog. Enter the reset value **1684107116** in field *Dec* or the value **0x64616F6C** in field *Hex* (ASCII: “load”) and confirm with *OK* (Fig. *Entering a restore value in the Set Value dialog*).

- All changeable entries in the slave are reset to the default values.
- The values can only be successfully restored if the reset is directly applied to the online CoE, i.e. to the slave. No values can be changed in the offline CoE.
- TwinCAT must be in the RUN or CONFIG/Freerun state for this; that means EtherCAT data exchange takes place. Ensure error-free EtherCAT transmission.
- No separate confirmation takes place due to the reset. A changeable object can be manipulated beforehand for the purposes of checking.
- This reset procedure can also be adopted as the first entry in the startup list of the slave, e.g. in the state transition PREOP->SAFEOP or, as in Fig. *CoE reset as a startup entry*, in SAFEOP->OP.

All backup objects are reset to the delivery state.

Alternative restore value

In some older terminals (FW creation approx. before 2007) the backup objects can be switched with an alternative restore value: Decimal value: 1819238756, Hexadecimal value: 0x6C6F6164.

An incorrect entry for the restore value has no effect.

7.5 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Support

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

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

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com
web:	www.beckhoff.com/support

Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
e-mail:	service@beckhoff.com
web:	www.beckhoff.com/service

Headquarters Germany

Beckhoff Automation GmbH & Co. KG

Hülshorstweg 20
33415 Verl
Germany

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

Trademark statements

Beckhoff®, ATRO®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, MX-System®, Safety over EtherCAT®, TC/BSD®, TwinCAT®, TwinCAT/BSD®, TwinSAFE®, XFC®, XPlanar® and XTS® are registered and licensed trademarks of Beckhoff Automation GmbH.

Third-party trademark statements

DeviceNet and EtherNet/IP are trademarks of ODVA, Inc.

DSP System Toolbox, Embedded Coder, MATLAB, MATLAB Coder, MATLAB Compiler, MathWorks, Predictive Maintenance Toolbox, Simscape, Simscape™ Multibody™, Simulink, Simulink Coder, Stateflow and ThingSpeak are registered trademarks of The MathWorks, Inc.

Microsoft, Microsoft Azure, Microsoft Edge, PowerShell, Visual Studio, Windows and Xbox are trademarks of the Microsoft group of companies.

More Information:
www.beckhoff.com/EL3xxx

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