BECKHOFF New Automation Technology

Documentation | EN

EL73x2

2 channel DC motor output stage

EtherCAT.

1 Product overview 2 channel DC motor output stage

EL7332 [▶ 16]

2 channel DC motor output stage; 24 V_{DC}; 1.0 A

EL7342 [▶ 17]

2 channel DC motor output stage; 48 V_{DC}; 3.5 A

table of contents

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.
It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

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

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Patent Pending

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

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2.2 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Description of instructions

In this documentation the following instructions are used.
These instructions must be read carefully and followed without fail!

⚠ **DANGER**
Serious risk of injury!
Failure to follow this safety instruction directly endangers the life and health of persons.

⚠ **WARNING**
Risk of injury!
Failure to follow this safety instruction endangers the life and health of persons.

⚠ **CAUTION**
Personal injuries!
Failure to follow this safety instruction can lead to injuries to persons.

NOTE
Damage to environment/equipment or data loss
Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.

ⓘ **Tip or pointer**

This symbol indicates information that contributes to better understanding.

2.3   Documentation issue status

Version	Comment
3.6	• Update chapter "Version identification of EtherCAT devices" • Update chapter "Technical data " • Update chapter "Mounting and wiring" • Update revision status • Update structure
3.5	• Update chapter "Product overview" • Update chapter "EL7342 - LEDs and connection" • Update revision status • Update structure
3.4	• Note for fuse protection of the supply voltage added • Update revision status • Update structure
3.3	• Update chapter "Technical data " • Update structure • Update revision status
3.2	• Update chapter "Technical data " • Update structure • Update revision status
3.1	• Update chapter "Notes on the documentation" • Correction of Technical data • Update chapter "TwinCAT 2.1x" -> "TwinCAT Development Environment" and "TwinCAT Quick Start" • Addenda section "Download revision" • Update structure • Update revision status
3.0	• First publication in PDF format • Update structure

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Version	Comment
2.9	• Update chapter "Technical data"
	• Addenda chapter "Installation instructions for enhanced mechanical load capacity"
	• Update structure
	• Update revision status
2.8	• Update chapter "Object description"
2.7	• Update chapter "Object description"
	• Update chapter "Technical data"
	• Update chapter "Firmware status"
2.6	• Update chapter "Object description"
	• Update chapter "Technical data"
	• Update chapter "Positioning Interface"
	• Update chapter "Chopper operation"
	• Update chapter "Process data"
	• Update structure
2.5	• Update chapter "Object description"
	• Update structure
2.4	• Update chapter "Chopper operation"
2.3	• Update Technical data
2.2	• Update Technical data
2.1	• Update chapter "Positioning Interface"
2.0	• Addenda chapter "TwinCAT 2.1x"
	• Update structure
1.1	• Addenda Technical data
1.0	• 1st public issue, Addenda Technical data
0.3	• Addenda Technical data
0.2	• Addenda
0.1	• Provisional documentation for EL7342

2.4 Version identification of EtherCAT devices

2.4.1 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. *"EL5021 EL terminal, standard IP20 IO device with batch number and revision ID (since 2014/01)"*.

- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

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2.4.2   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**

KK - week of production (CW, calendar week)
YY - year of production
FF - firmware version
HH - hardware version

Example with serial number 12 06 3A 02:

12 - production week 12
06 - production year 2006
3A - firmware version 3A
02 - hardware version 02

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

2.4.3   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.
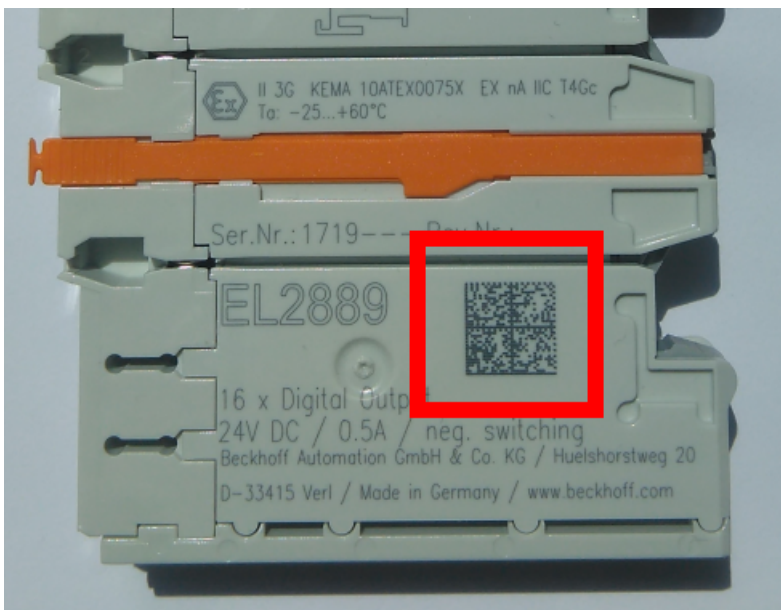
Fig. 2: BIC as data matrix code (DMC, code scheme ECC200)

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:

Posi-tion	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	1P072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	SBTN	12	SBTNk4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	1KEL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	Q1
5	Batch number	Optional: Year and week of production	2P	14	2P401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	51S678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	32	30PF971, 2*K183
...					

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

Structure of the BIC

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

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

Accordingly as DMC:

Fig. 3: Example DMC **1P**072222**S**BTNk4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

An important component of the BIC is the Beckhoff Traceability Number (BTN, 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.

NOTE

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

2.4.4 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.

Decisive for the electronic readout is the interface via which the product can be electronically addressed.

K-bus devices (IP20, IP67)

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

EtherCAT devices (IP20, IP67)

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

The eBIC is also stored in the ESI-EEPROM. The eBIC was introduced into the Beckhoff I/O production (terminals, boxes) from 2020; widespread implementation is expected in 2021.

The user can electronically access the eBIC (if existent) 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 checkbox "Show Beckhoff Identification Code (BIC)" under
    EtherCAT → Advanced Settings → Diagnostics:
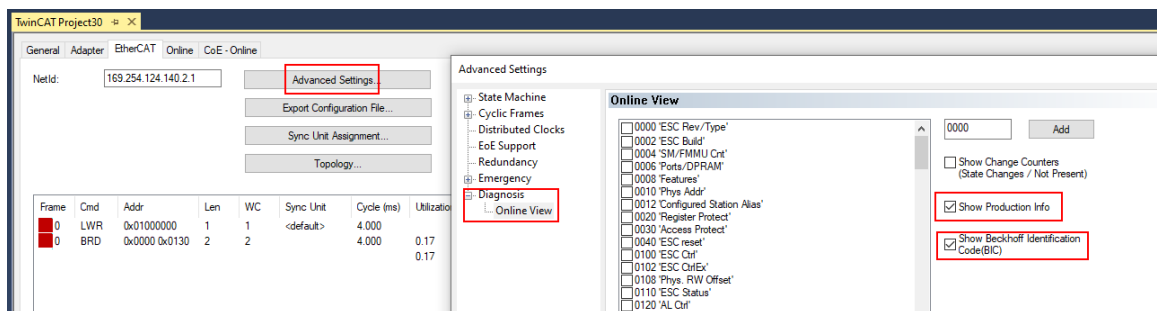
  - The BTN and its contents are then displayed:

  - Note: as can be seen in the illustration, the production data HW version, FW version and production date, which have been programmed since 2012, can also be displayed with "Show Production Info".

- ◦ From TwinCAT 3.1. build 4024.24 the functions *FB_EcReadBIC* and *FB_EcReadBTN* for reading into the PLC and further eBIC auxiliary functions are available in the Tc2_EtherCAT Library from v3.3.19.0.
- • In the case of EtherCAT devices with CoE directory, the object 0x10E2:01 can additionally by used to display the device's own eBIC; the PLC can also simply access the information here:
  - ◦ The device must be in 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 introduced into stock products in the course of a necessary firmware revision.
  - ◦ From TwinCAT 3.1. build 4024.24 the functions *FB_EcCoEReadBIC* and *FB_EcCoEReadBTN* for reading into the PLC and further eBIC auxiliary functions are available in the Tc2_EtherCAT Library from v3.3.19.0.
- • Note: in the case of electronic further 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 additionally written as a category in the ESI-EEPROM during the device production. The structure of the ESI content is largely dictated by the ETG specifications, therefore the additional vendor-specific content is stored with the help of a category according to ETG.2010. ID 03 indicates to all EtherCAT masters that they must not overwrite these data in case of an update or restore the data after an ESI update.
  The structure follows the content of the BIC, see there. This results in a memory requirement of approx. 50..200 bytes in the EEPROM.
- • 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 with 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/DeviceNet... Devices

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

3 Product description

3.1 EL7332 - Introduction
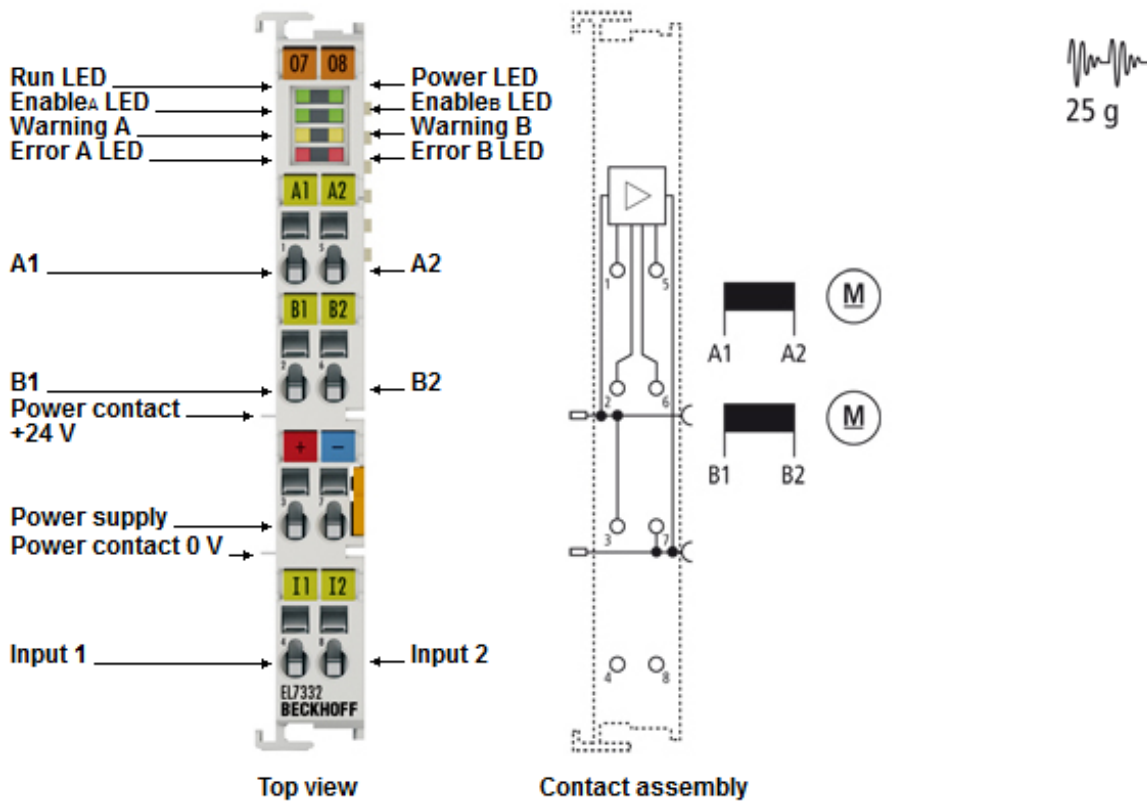
Fig. 4: EL7332

2 channel DC motor output stage 24 V, 1.0 A

The EL7332 EtherCAT Terminal enables direct operation of two DC motors. It is galvanically isolated from the E-bus. The speed is preset by a 16 bit value from the automation device. The output stage is protected against overload and short-circuit. The EtherCAT Terminal contains two channels whose signal state is indicated by LEDs. The LEDs enable quick local diagnosis.

Quick links

- EtherCAT basics
- Technology EL73x2 [▶ 20]
- Settings in the CoE register [▶ 129]
- NC settings [▶ 134]
- CoE object description and parameterization [▶ 165]

3.2   EL7342 - Introduction
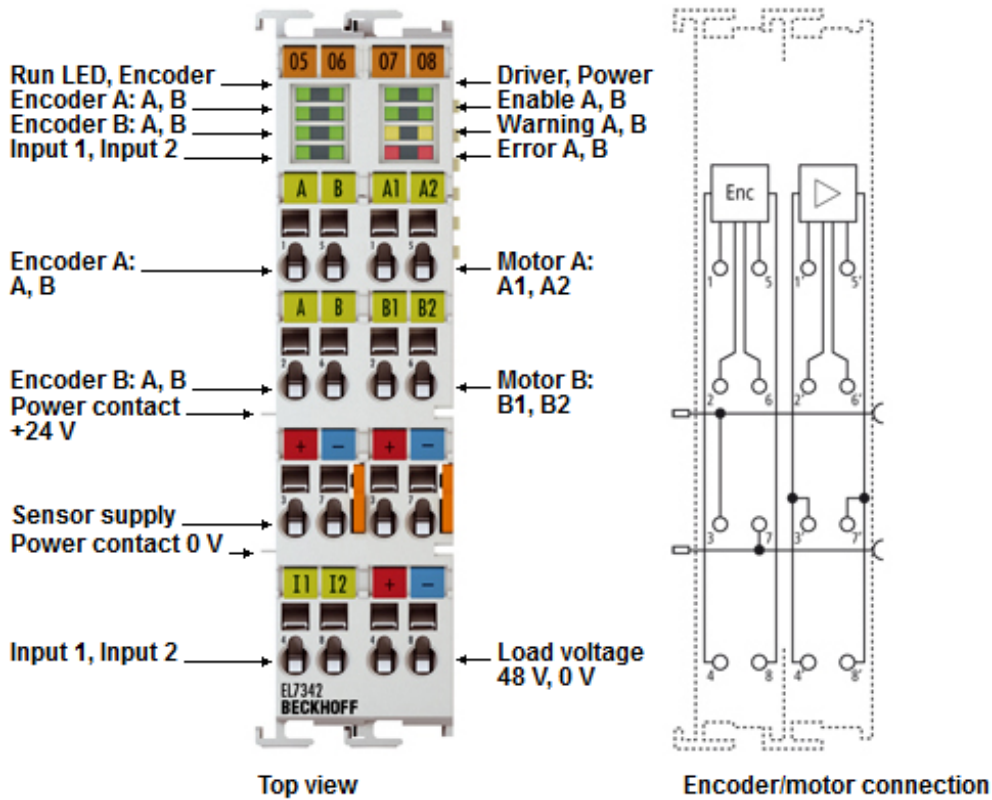
Fig. 5: EL7342

2 channel DC motor output stage 48 V$_{DC}$, 3.5 A

The EL7342 EtherCAT Terminal enables direct operation of two DC motors. It is galvanically isolated from the E-bus. The speed and position are preset by a 16 bit value from the automation device. Connection of an incremental encoder enables a simple servo axis to be realized. The output stage is protected against overload and short-circuit. The EtherCAT Terminal contains two channels whose signal state is indicated by LEDs. The LEDs enable quick local diagnosis.

Quick links

- EtherCAT basics
- Technology EL73x2 [▶ 20]
- Settings in the CoE register [▶ 129]
- NC settings [▶ 134]
- CoE object description and parameterization [▶ 203]

3.3 EL73x2 - Technical data

Technical data	EL7332	EL7342
Number of channels	2 DC motors, 2 digital inputs	2 DC motors, 2 digital inputs Encoder input
Rated load voltage	24 V_{DC} (-15%/+20%)	8 … 48 V_{DC}
Load type	DC brush motors, inductive	
Output current without fan cartridge ZB8610	2 x 1.0 A (overload- and short-circuit-proof)	2 x 3.5 A (overload- and short-circuit-proof)
Output current with fan cartridge ZB8610	2 x 3.0 A (overload- and short-circuit-proof)	2 x 6.5 A (overload- and short-circuit-proof)
PWM clock frequency	30 kHz with 180° phase shift each	
Duty factor	0 … 100 % (voltage-controlled)	
Distributed Clocks	yes	
Control resolution	max. 10 bits current, 16 bits speed	
Supply voltage for electronic	via E-bus and power contacts	
Electrical isolation	500 V (E-bus/field voltage)	
Current consumption via E-bus	typ. 140 mA	
Current consumption power contacts	typ. 40 mA + motor current	typ. 70 mA
Current consumption sensor supply	-	typ. 20 mA
Encoder/input signal	Signal voltage "0": -3 V ... 1.5 V	
	Signal voltage "1": 2.5 V ... 24 V	
Nominal voltage of encoder signals	5 ... 24 V, 5 mA, single ended	
Pulse frequency	-	400,000 increments/s, 4-fold evaluation

Environmental conditions	EL7332	EL7342
permissible ambient temperature range during operation	0°C ... + 55°C (aligned in horizontal installation position, see note [▶ 42])	
permissible ambient temperature range during storage	-25°C ... + 85°C	
permissible relative humidity	95 %, no condensation	

General data	EL7332	EL7342
Weight	approx. 50 g	approx. 90 g
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)	approx. 27 mm x 100 mm x 70 mm (width aligned: 24 mm)
Mounting [▶ 33]	on 35 mm mounting rail conforms to EN 60715	
Installation position	without fan cartridge ZB8610: standard installing position with fan cartridge ZB8610: standard installing position, other installing positions (example 1 and 2) see notice [▶ 42]	

Standards and approvals	EL7332	EL7342
Vibration/shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27, see also installation instructions for terminals with increased mechanical load capacity [▶ 36]	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4 according to IEC/EN 61800-3	
EMC category	Category C3 - standard Category C2, C1 - auxiliary filter required	
Protection class	IP20	
Approvals / markings*	CE, EAC, UKCA, cULus [▶ 45]	

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

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3.4   Technology

The EL7332 and EL7342 2-channel DC motor terminals integrate a compact Motion Control solution up to 200 W in a compact design.

DC motor

DC motors can replace the considerably more expensive servo motors in many applications if they are operated with an intelligent controller. Since its speed is proportional to the voltage, the DC motor is easy to control in comparison with other motors.

Two DC motor output stages for optimum use

A DC motor can be integrated very simply into the control system using the EL7332 and EL7342 EtherCAT Terminals. All parameters are adjustable via the fieldbus. The DC motor output stages for EtherCAT unite a small, compact design with an extensive area of application. Two DC motors can be directly driven by the output stages. The EL7342 additionally possess an integrated feedback system for incremental encoders.

The velocity can be adjusted in simple fashion via the process data with the EL7332 and EL7342 EtherCAT Terminals. The integrated compensation of the internal resistance keeps the motor at the desired speed for load changes. The speed is preset by a 16 bit value from the automation device. Thus a simple drive task can be solved using a simple controller.
The EtherCAT Terminal contains two channels whose signal state is indicated by LEDs. This enables fast local diagnosis.

Areas of application

Two areas of application are particularly well supported by the output stages:

1. A simple controller with inexpensive processor power and low demands on the cycle time.

By the use of the integrated travel distance control, the terminal can perform positioning drives independently without the use of NC. Nothing further is required apart from a DC motor and an EtherCAT terminal.

2. High-end positioning with integration in TwinCAT NC.

In connection with the EtherCAT DC Motor Terminal, a DC motor is controlled under TwinCAT analogous to a servo terminal. No further changes are necessary.

For demanding positioning tasks a closed speed control loop with a feedback system is needed. The EL7342 EtherCAT terminal enables an incremental encoder to be connected.
The control loop can be closed either by the EtherCAT terminal itself or by the higher-level controller.
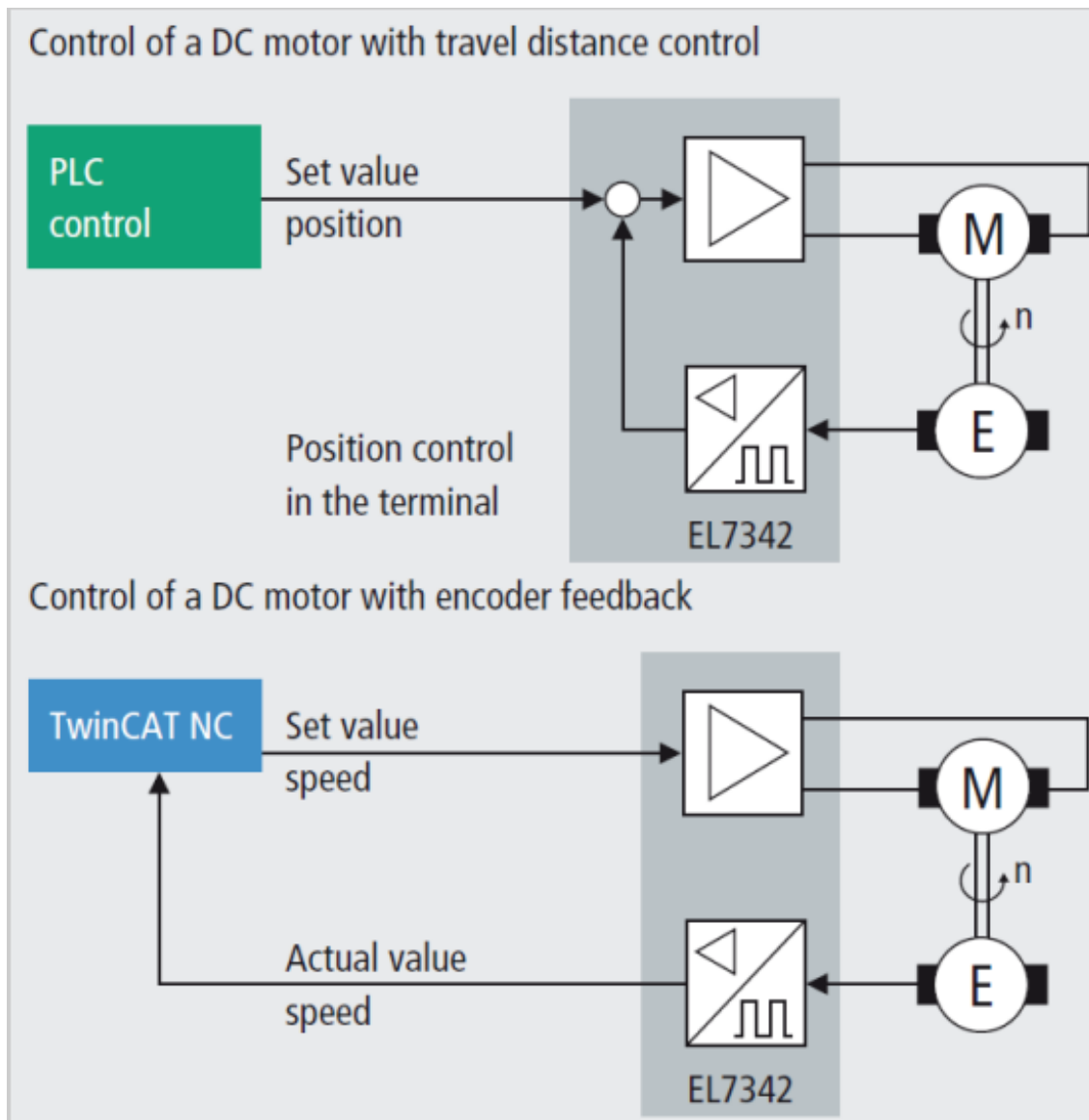
Fig. 6: Possibilities to implement control loops using the EL7342

The peak current may briefly significantly exceed the nominal current and in this way makes the whole drive system very dynamic. In such dynamic applications, negative acceleration causes the feedback of energy, which lead to voltage peaks at the power supply unit. The EL9570 buffer capacitor terminal protects from the effects of overvoltage, in that it absorbs some of the energy. If the voltage exceeds the capacity of the terminal, it dissipates the excess energy via an externally connected resistor.

3.5   Start

For commissioning:

- Install the EL73x2 as described in section <u>Mounting and wiring</u> [▶ 32].
- Configure the EL73x2 in TwinCAT as described in section <u>Commissioning</u> [▶ 78].

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.

> **ℹ 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.

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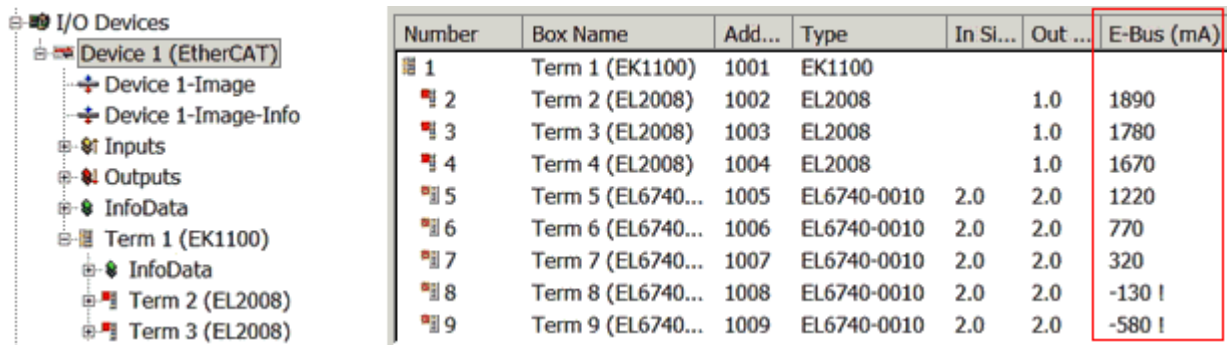
Fig. 7: System manager current calculation

NOTE
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

ELxxxx terminals are equipped with a safety feature (watchdog) that switches off the outputs after a specifiable time e.g. in the event of an interruption of the process data traffic, depending on the device and settings, e.g. in OFF state.

The EtherCAT slave controller (ESC) features two watchdogs:

- SM watchdog (default: 100 ms)
- PDI watchdog (default: 100 ms)

SM watchdog (SyncManager Watchdog)

The SyncManager watchdog is reset after each successful EtherCAT process data communication with the terminal. If no EtherCAT process data communication takes place with the terminal for longer than the set and activated SM watchdog time, e.g. in the event of a line interruption, the watchdog is triggered and the outputs are set to FALSE. The OP state of the terminal is unaffected. The watchdog is only reset after a successful EtherCAT process data access. Set the monitoring time as described below.

The SyncManager watchdog monitors correct and timely process data communication with the ESC from the EtherCAT side.

PDI watchdog (Process Data Watchdog)

If no PDI communication with the EtherCAT slave controller (ESC) takes place for longer than the set and activated PDI watchdog time, this watchdog is triggered.
PDI (Process Data Interface) is the internal interface between the ESC and local processors in the EtherCAT slave, for example. The PDI watchdog can be used to monitor this communication for failure.

The PDI watchdog monitors correct and timely process data communication with the ESC from the application side.

The settings of the SM- and PDI-watchdog must be done for each slave separately in the TwinCAT System Manager.
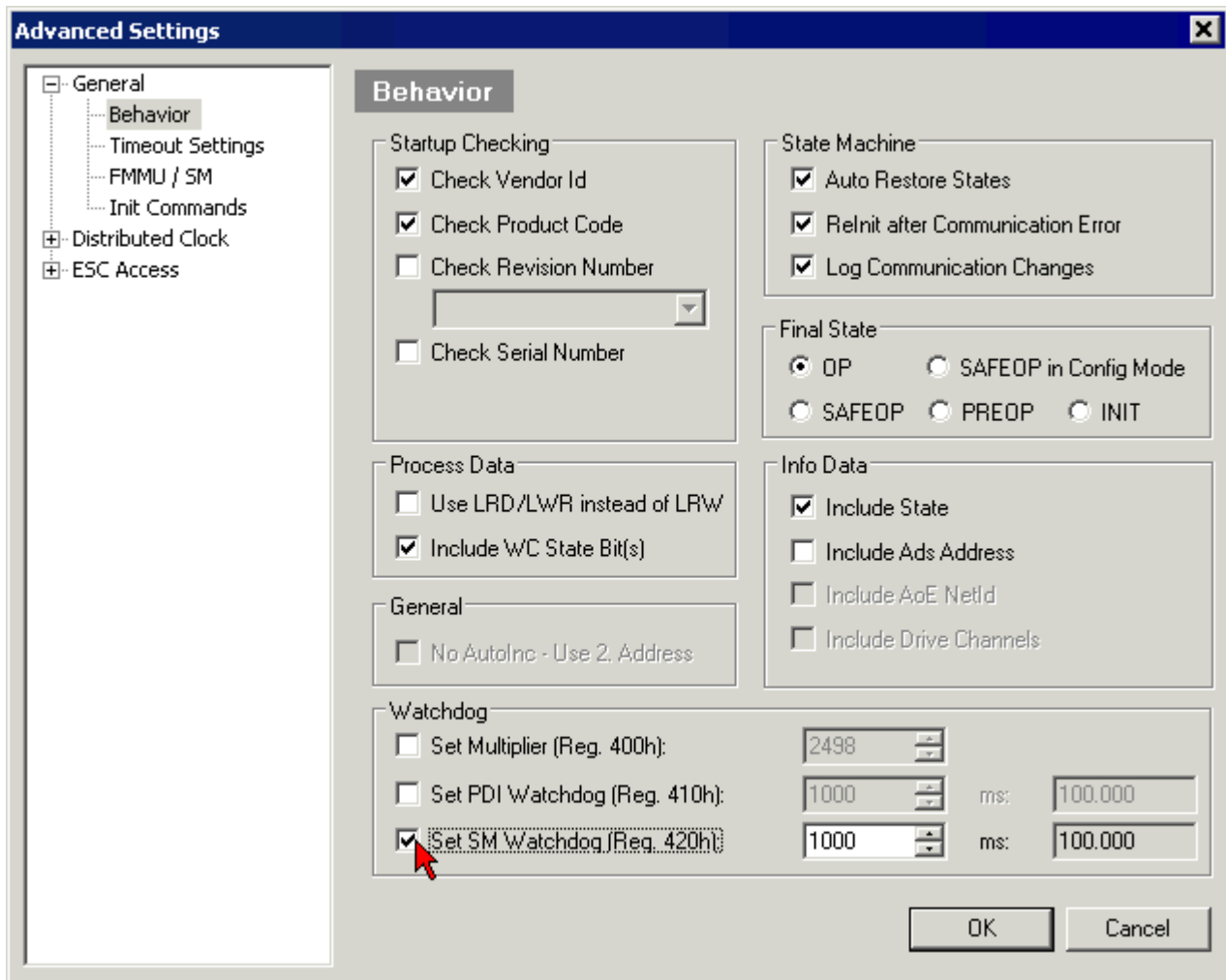
Fig. 8: EtherCAT tab -> Advanced Settings -> Behavior -> Watchdog

Notes:

- the multiplier is valid for both watchdogs.
- each watchdog has its own timer setting, the outcome of this in summary with the multiplier is a resulting time.
- Important: the multiplier/timer setting is only loaded into the slave at the start up, if the checkbox is activated.
  If the checkbox is not activated, nothing is downloaded and the ESC settings remain unchanged.

Multiplier

Both watchdogs receive their pulses from the local terminal cycle, divided by the watchdog multiplier:

1/25 MHz * (watchdog multiplier + 2) = 100 µs (for default setting of 2498 for the multiplier)

The standard setting of 1000 for the SM watchdog corresponds to a release time of 100 ms.

The value in multiplier + 2 corresponds to the number of basic 40 ns ticks representing a watchdog tick. The multiplier can be modified in order to adjust the watchdog time over a larger range.

Example "Set SM watchdog"

This checkbox enables manual setting of the watchdog times. If the outputs are set and the EtherCAT communication is interrupted, the SM watchdog is triggered after the set time and the outputs are erased. This setting can be used for adapting a terminal to a slower EtherCAT master or long cycle times. The default SM watchdog setting is 100 ms. The setting range is 0...65535. Together with a multiplier with a range of 1...65535 this covers a watchdog period between 0...~170 seconds.

Calculation

Multiplier = 2498 → watchdog base time = 1 / 25 MHz * (2498 + 2) = 0.0001 seconds = 100 µs
SM watchdog = 10000 → 10000 * 100 µs = 1 second watchdog monitoring time

⚠ **CAUTION**
Undefined state possible!
The function for switching off of the SM watchdog via SM watchdog = 0 is only implemented in terminals from version -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 and
- Operational
- Boot

The regular state of each EtherCAT slave after bootup is the OP state.
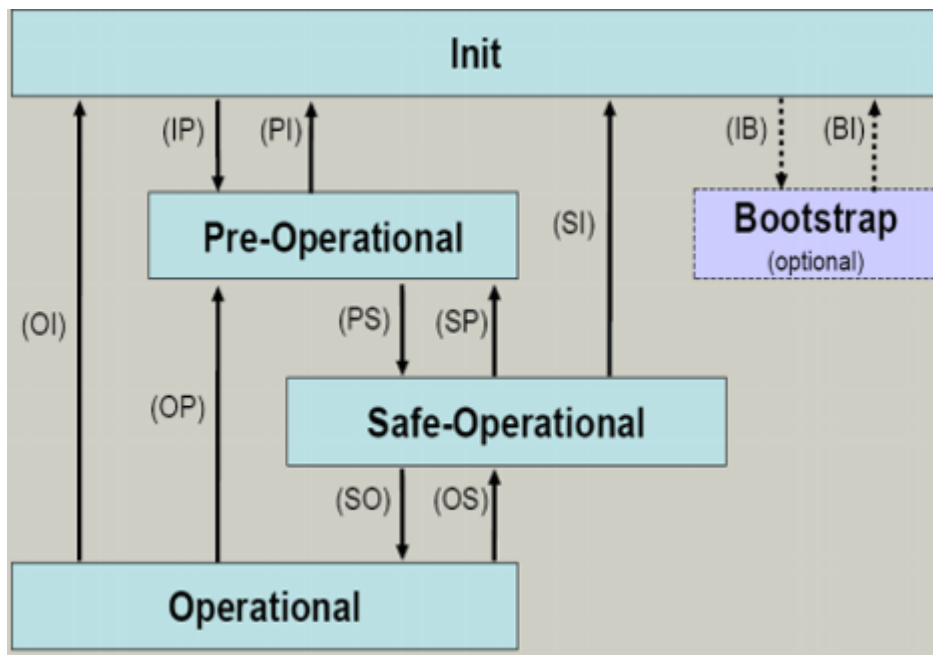
Fig. 9: States of the EtherCAT State Machine

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 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 DP-RAM areas of the EtherCAT slave controller (ECSC).

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

> ● **Outputs in SAFEOP state**
>
> **ℹ** The default set watchdog [▶ 23] monitoring sets the outputs of the module in a safe state - depending on the settings in SAFEOP and OP - e.g. in OFF state. If this is prevented by deactivation of the watchdog monitoring in the module, the outputs can be switched or set also in the SAFEOP state.

Operational (Op)

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

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

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)) 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 read 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 parameter 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 ("input" from the perspective of the EtherCAT master)
- 0x7000: Output PDOs ("output" from the perspective of the EtherCAT master)

● **Availability**

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

If a device has a CoE list, it is shown in the TwinCAT System Manager as a separate tab with a listing of the elements:
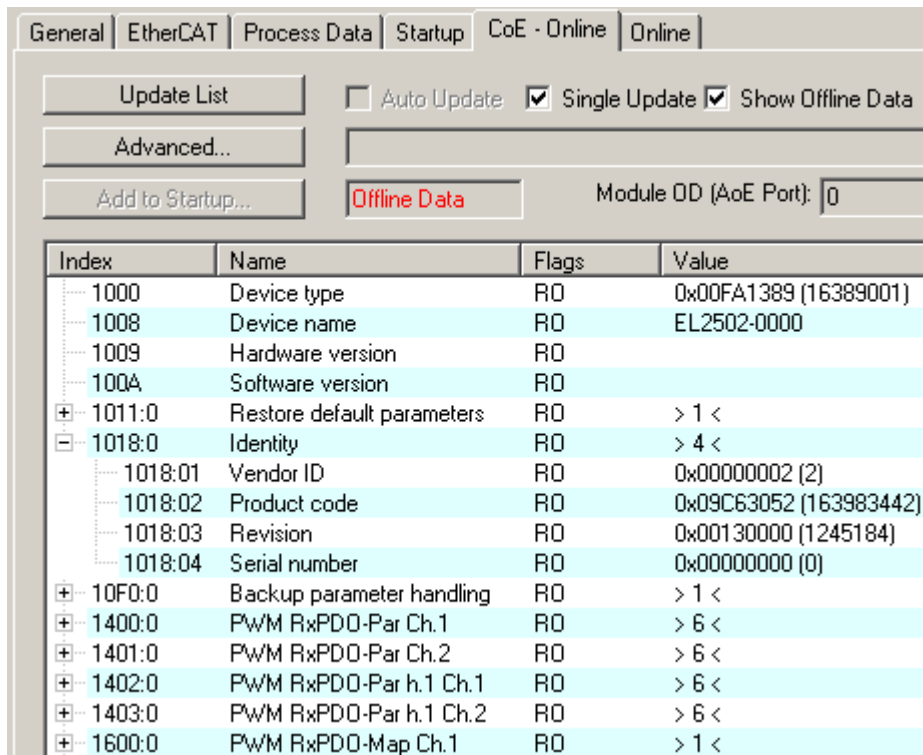
Fig. 10: "CoE Online" tab

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

Data management and function "NoCoeStorage"

Some parameters, particularly the setting parameters of the slave, are configurable and writeable. This can be done in write or read mode

- via the System Manager (Fig. "CoE Online" tab) by clicking
  This is useful for commissioning of the system/slaves. Click on the row of the index to be parameterized and enter a value in the "SetValue" dialog.

- from the control system/PLC via ADS, e.g. through blocks from the TcEtherCAT.lib library
  This is recommended for modifications while the system is running or if no System Manager or operating staff are available.

ℹ **Data management**

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

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

- If the function is supported: the function is activated by entering the code word 0x12345678 once in CoE 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.

- Function is not supported: continuous changing of CoE values is not permissible in view of the lifetime limit.

ℹ **Startup list**

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

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

Recommended approach for manual modification of CoE parameters

- Make the required change in the System Manager
  The values are stored locally in the EtherCAT slave

- If the value is to be stored permanently, enter it in the Startup list.
  The order of the Startup entries is usually irrelevant.
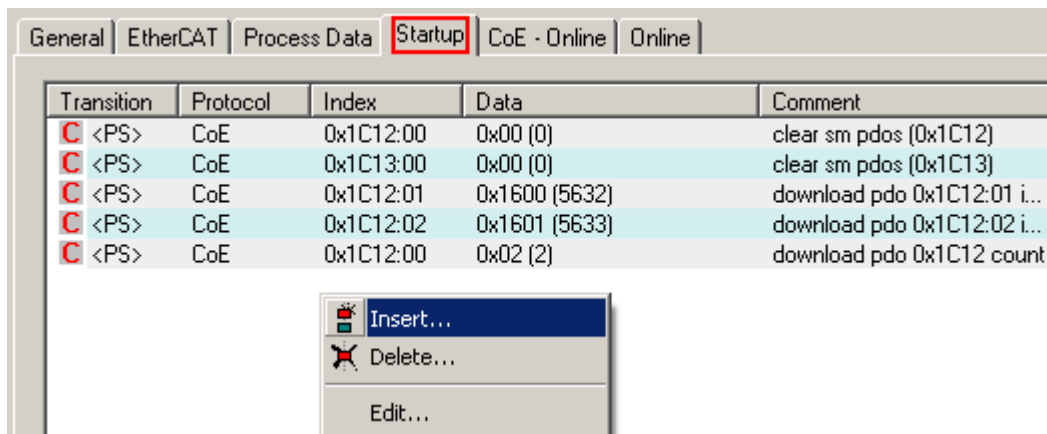
Fig. 11: Startup list in the TwinCAT System Manager

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

Online/offline list

While working with the TwinCAT System Manager, a distinction has to be made whether the EtherCAT device is "available", i.e. switched on and linked via EtherCAT and therefore **online**, or whether a configuration is created **offline** without connected slaves.

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** is shown in red.
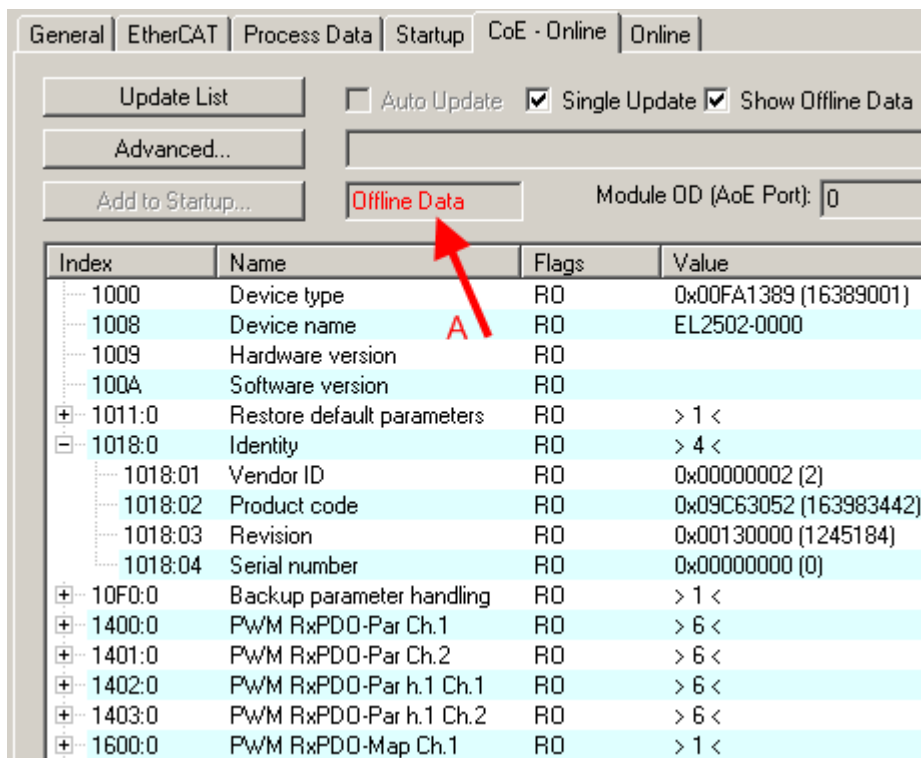
Fig. 12: Offline list

- 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 version of the equipment according to the electronic information is displayed
  - ◦ **Online** is shown in green.
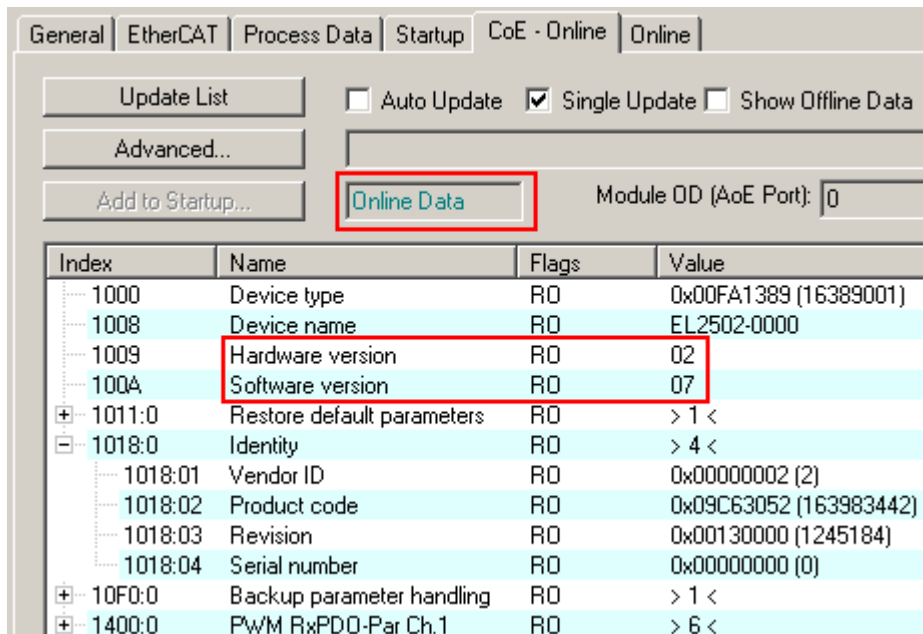
Fig. 13: Online list

Channel-based order

The CoE list is available in EtherCAT devices that usually feature several functionally equivalent channels. For example, a 4-channel analog 0...10 V 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 $16_{dec}/10_{hex}$ 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.

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5 Mounting and wiring

5.1 Instructions for ESD protection

NOTE
Destruction of the devices by electrostatic discharge possible! The devices contain components at risk from electrostatic discharge caused by improper handling. • Please ensure you are electrostatically discharged and avoid touching the contacts of the device directly. • Avoid contact with highly insulating materials (synthetic fibers, plastic film etc.). • Surroundings (working place, packaging and personnel) should by grounded probably, when handling with the devices. • Each assembly must be terminated at the right hand end with an <u>EL9011</u> or <u>EL9012</u> bus end cap, to ensure the protection class and ESD protection.
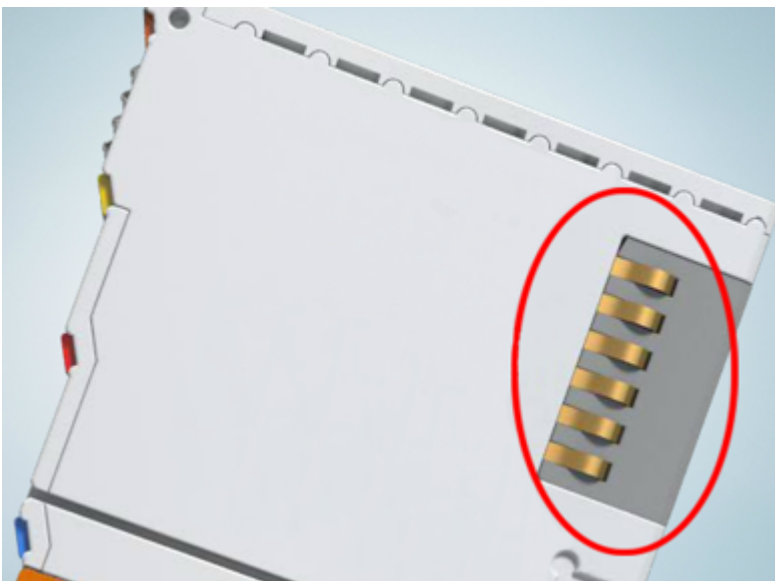
Fig. 14: Spring contacts of the Beckhoff I/O components

5.2   Installation on mounting rails

⚠ WARNING
Risk of electric shock and damage of device! Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the bus terminals!

Assembly
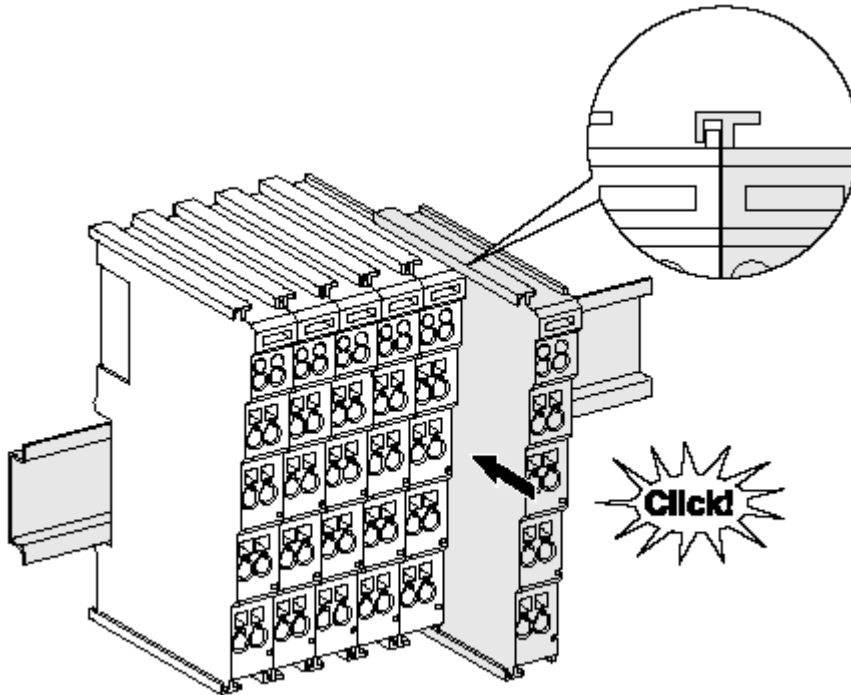
Fig. 15: Attaching on mounting rail

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).

Disassembly
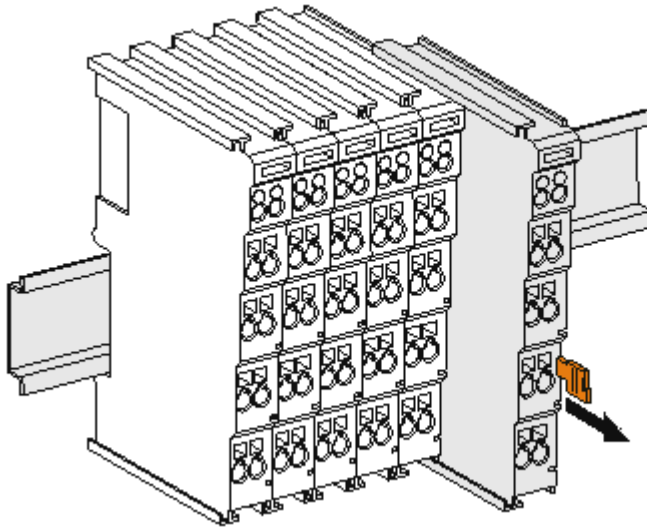
Fig. 16: Disassembling of terminal

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

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

Connections within a bus terminal block

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

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

> **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 (KL91xx, KL92xx or EL91xx, EL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labeled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.
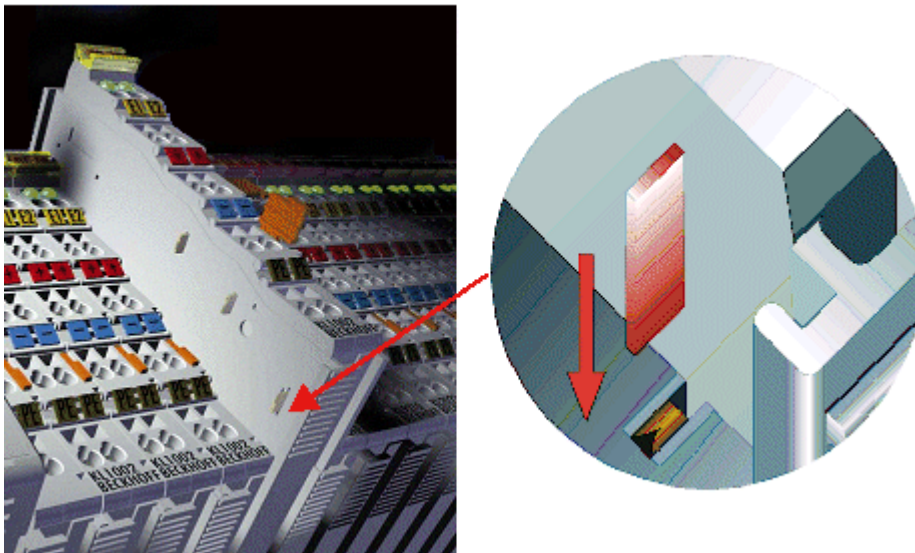
Fig. 17: Power contact on left side

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

⚠ **WARNING**
Risk of electric shock!
The PE power contact must not be used for other potentials!

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5.3 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

For terminals with enhanced mechanical load capacity, the following additional installation instructions 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 with) or 32 terminals (24 mm mounting with)
- 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.

5.4 Connection

5.4.1 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. 18: Standard wiring

The terminals of ELxxxx and KLxxxx series have been tried and tested for years.
They feature integrated screwless spring force technology for fast and simple assembly.

Pluggable wiring (ESxxxx / KSxxxx)

Fig. 19: 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.

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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 mm^2 and 2.5 mm^2 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. 20: High Density Terminals

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

i	**Wiring HD Terminals** The High Density Terminals of the ELx8xx and KLx8xx series doesn't support pluggable wiring.

Ultrasonically "bonded" (ultrasonically welded) conductors

i	**Ultrasonically "bonded" conductors** It is also possible to connect the Standard and High Density Terminals with ultrasonically "bonded" (ultrasonically welded) conductors. In this case, please note the tables concerning the wire-size width [▶ 39]!

5.4.2   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
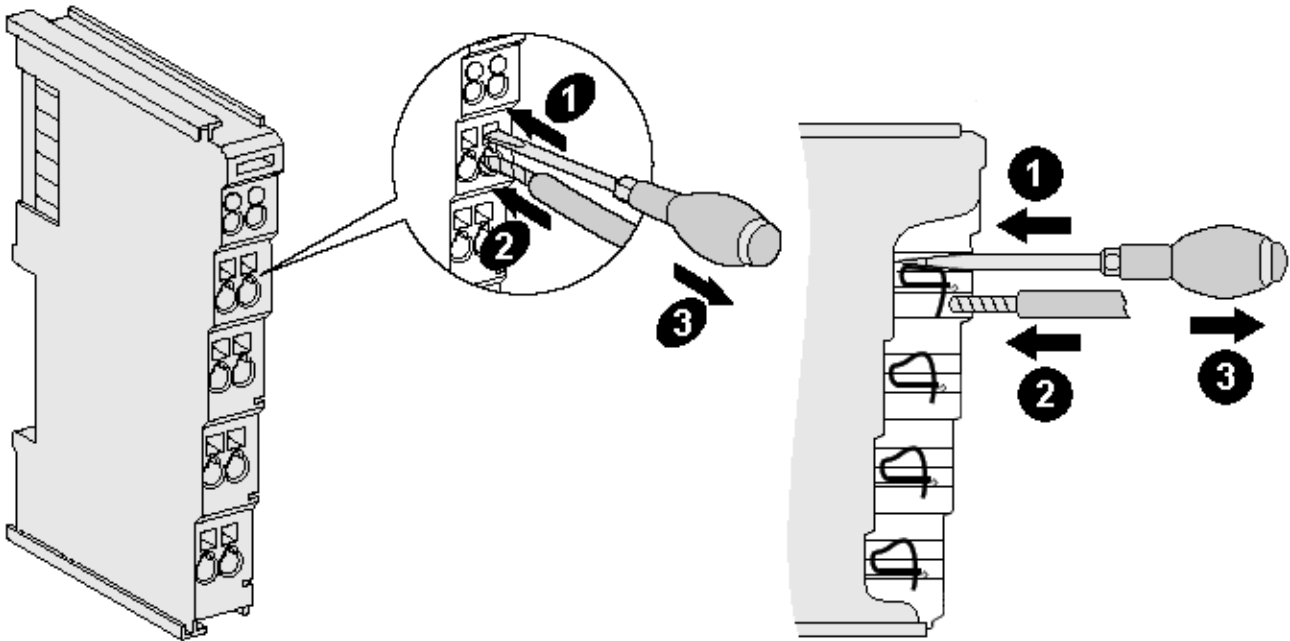
Fig. 21: Connecting a cable on a terminal point

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

1. Open a terminal point by pushing a screwdriver straight against the stop into the square opening above the terminal point. Do not turn the screwdriver or move it alternately (don't toggle).
2. The wire can now be inserted into the round terminal opening without any force.
3. The terminal point closes automatically when the pressure is released, holding the wire securely and permanently.

See the following table for the suitable wire size width.

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width (single core wires)	0.08 ... 2.5 mm^2	0.08 ... 2.5 mm^2
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm^2	0.08 ... 2.5 mm^2
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm^2	0.14 ... 1.5 mm^2
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 38]) with 16 terminal points

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

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm^2
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm^2
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm^2
Wire size width (ultrasonically "bonded" conductors)	only 1.5 mm^2 (see notice [▶ 38])
Wire stripping length	8 ... 9 mm

5.4.3   Shielding

ℹ **Shielding**

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

5.5 Positioning of passive Terminals

ℹ 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)
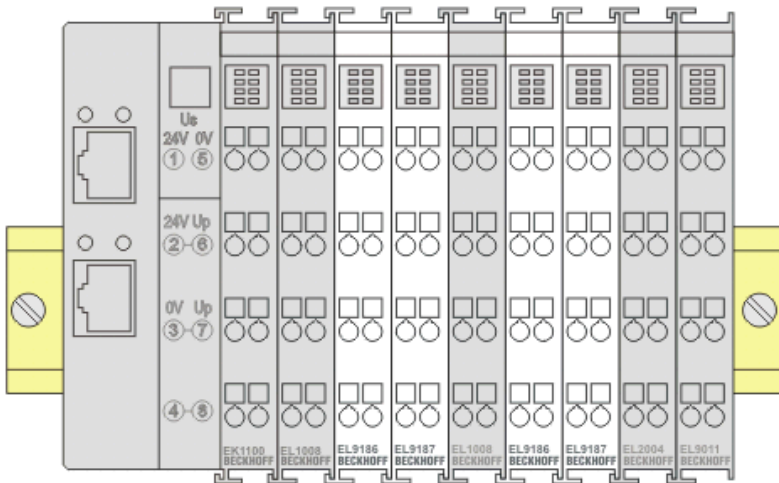
Fig. 22: Correct positioning
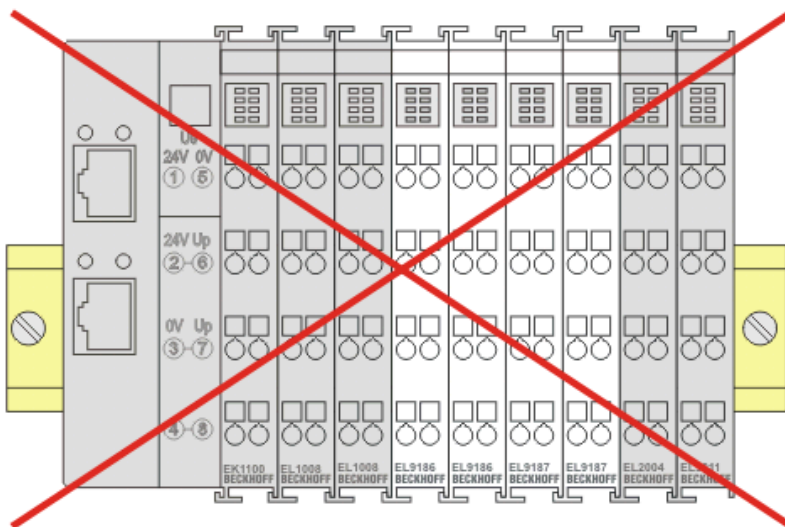
Fig. 23: Incorrect positioning

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5.6 Installation position for operation with or without fan

NOTE
Constraints regarding installation position and operating temperature range
When installing the terminals ensure that an adequate spacing is maintained between other components above and below the terminal in order to guarantee adequate ventilation!

Prescribed installation position for operation without fan

The prescribed 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 of installation position for operating without fan*").

The terminals are ventilated from below, which enables optimum cooling of the electronics through convection.
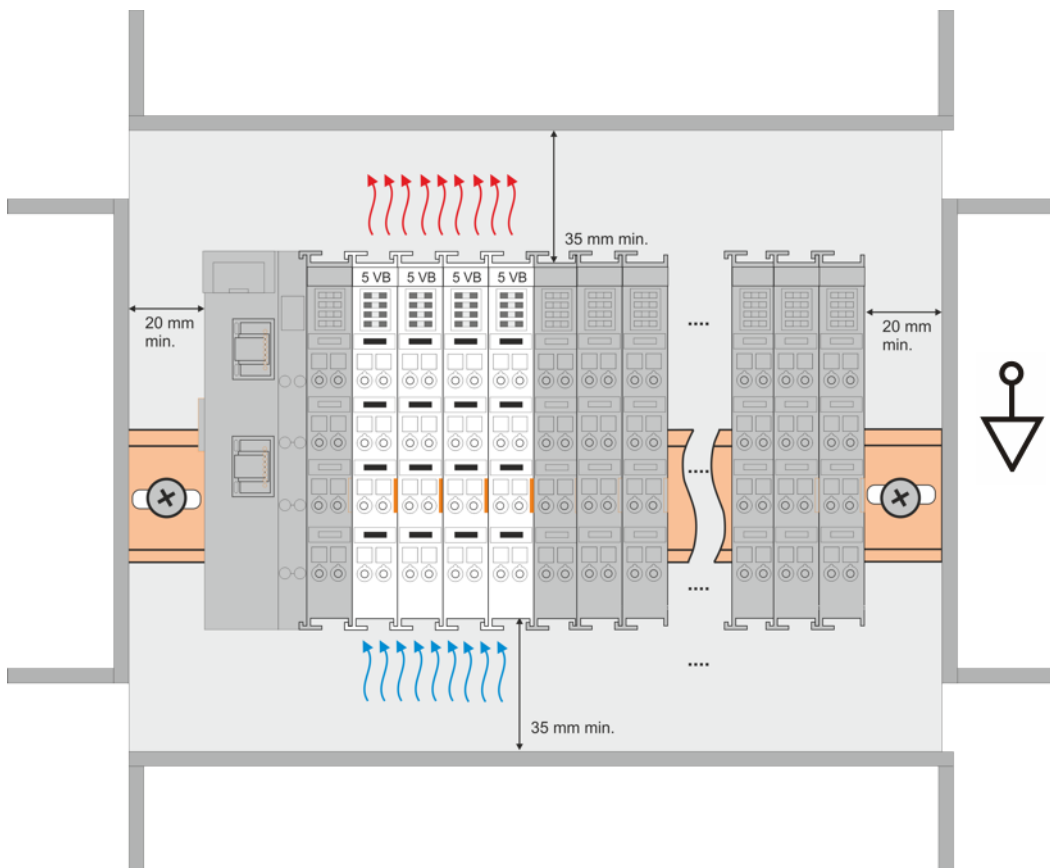
Fig. 24: Recommended distances of installation position for operating without fan

Compliance with the distances shown in Fig. "*Recommended distances of installation position for operating without fan*" is recommended.

For further information regarding the operation without fan refer to the Technical Data of the terminal.

Standard installation position for operation with fan

The standard installation position for operation with fan 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 installation position for operation with fan*).
The terminals are ventilated fan supported (e.g. with underlined fan cartridge ZB8610) from below.
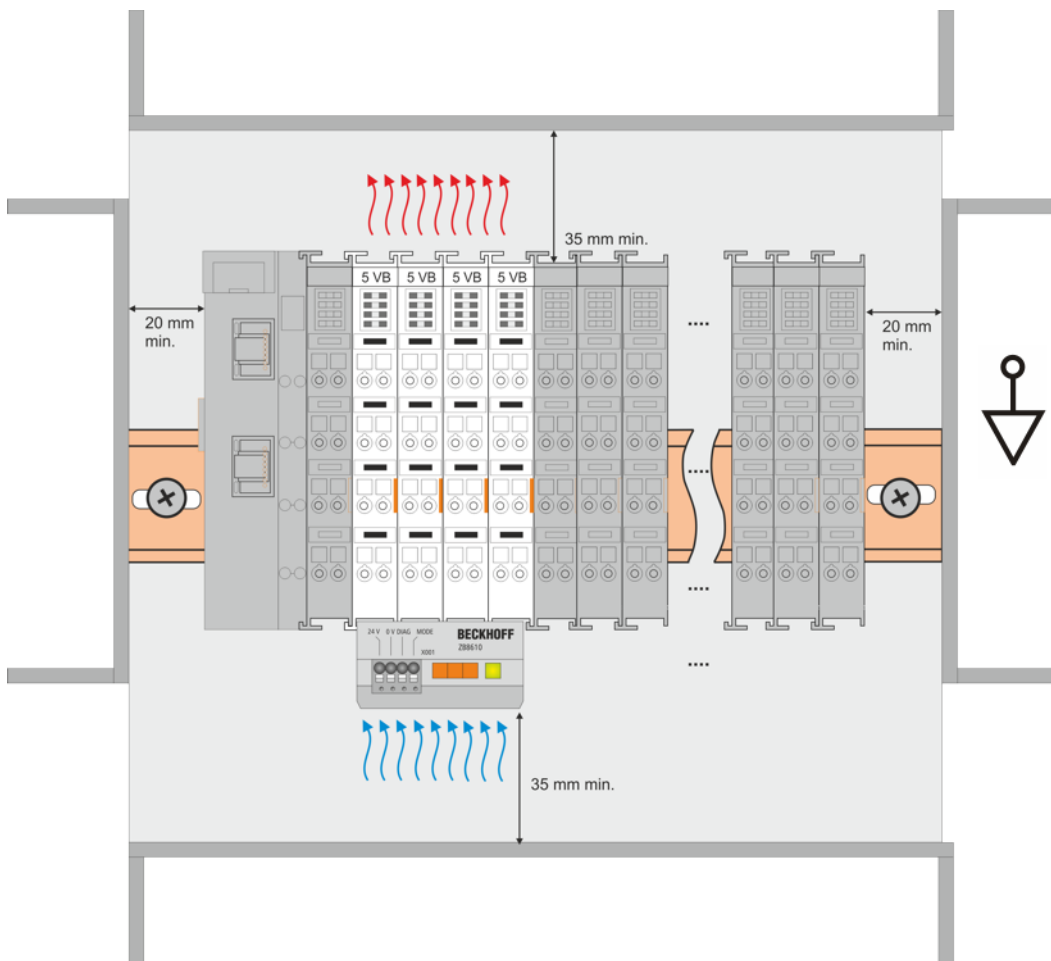
Fig. 25: Recommended distances for installation position for operation with fan

Other installation positions

Due to the enforced effect of the fan on the ventilation of the terminals, other installation positions (see Fig. "*Other installation positions, example 1 + 2*") may be permitted where appropriate.

See corresponding notes in the Technical Data of the terminal.
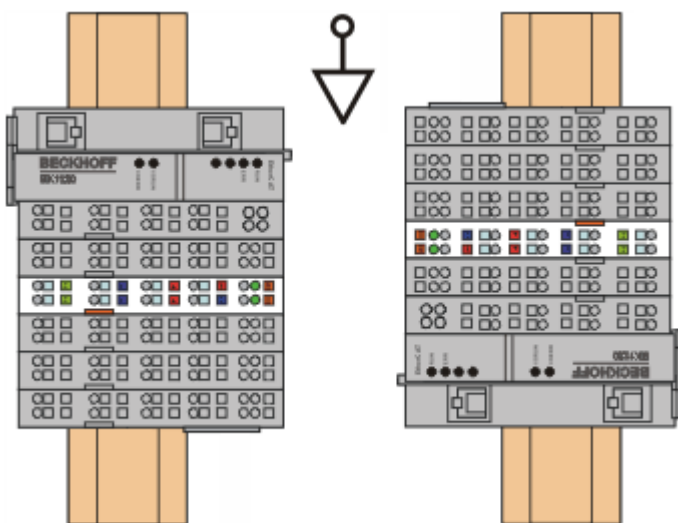
Fig. 26: Other installation positions, example 1

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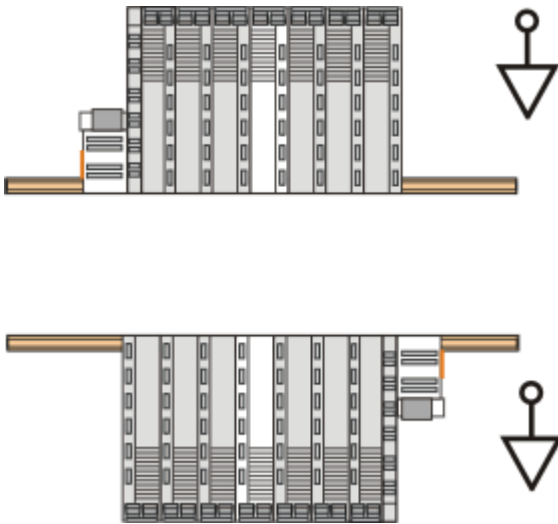
Fig. 27: Other installation positions, example 2

5.7 UL notice - Compact Motion

⚠ **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.

⚠ **CAUTION**
Notes on motion devices • *Motor overtemperature* Motor overtemperature sensing is not provided by the drive. • *Application for compact motion devices* The modules are intended for use only within Beckhoff's Programmable Controller system Listed in File E172151. • *Galvanic isolation from the supply* The modules are intended for operation within circuits not connected directly to the supply mains (galvanically isolated from the supply, i.e. on transformer secondary). • *Requirement for environmental conditions* For use in Pollution Degree 2 Environment only.

Basic principles

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

5.8 EL7332 - LEDs and connection

⚠ WARNING
Risk of injury through electric shock and damage to the device!
Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.
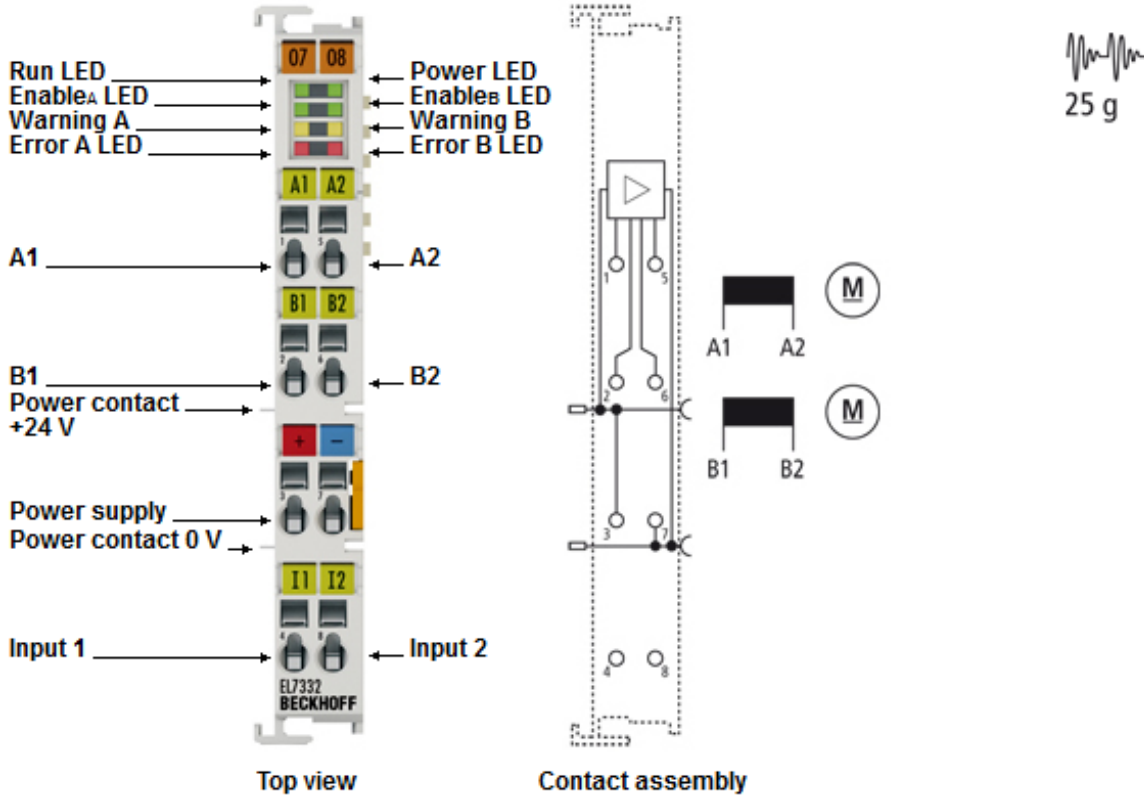
Fig. 28: EL7332 LEDs and connection

NOTE
Fuse protection of the supply voltage
The electrical protection of the load voltage must be selected in such a way that the maximum flowing current is limited to 3 times the rated current (max. 1 second)!

EL7332 - Connection

Terminal point	Name	Description
1	A1	Motor A, motor winding A1
2	B1	Motor B, motor winding B1
3	24 V	Motor supply feed (maximum +24 V_{DC})
4	Input 1	Digital input 1 (+24 V_{DC})
5	A2	Motor A, motor winding A2
6	B2	Motor B, motor winding B2
7	Power Motor 0 V	Motor supply feed (0 V_{DC})
8	Input 2	Digital input 2 (+24 V_{DC})

EL7332 - LEDs
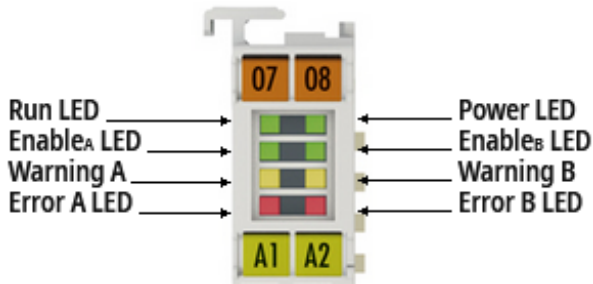
Fig. 29: EL7332 - LEDs

LED	Color	Meaning	
Run	green	This LED indicates the terminal's operating state.	
		off	State of the EtherCAT State Machine: INIT = terminal initialization
		flashing	State of the EtherCAT State Machine: PREOP = function of mailbox communication and variant standard settings
		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
		flickering	State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates
Enable A	green	off	The motor control (motor A) is blocked or EL7332 is not ready for operation.
		on	The motor control (motor A) is activated or EL7332 is ready for operation.
Enable B	green	off	The motor control (motor B) is blocked or EL7332 is not ready for operation.
		on	The motor control (motor B) is activated or EL7332 is ready for operation.
Warning A/B	yellow	off	no defect
		on	Configuration error, e.g.: Motor power supply not connected 80 °C temperature exceeded …
Error A	red	off	no defect
		on	Configuration error of output stage A, e.g.: 100°C temperature exceeded Short circuit Open load / broken wire ...
Error B	red	off	no defect
		on	Configuration error of output stage B, e.g.: 100°C temperature exceeded Short circuit Open load / broken wire ...

BECKHOFF

5.9 EL7342 - LEDs and connection

⚠ WARNING
Risk of injury through electric shock and damage to the device!
Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.

Fig. 30: EL7342 LEDs and connection (left-hand section of the housing)

NOTE
Fuse protection of the supply voltage
The electrical protection of the load voltage must be selected in such a way that the maximum flowing current is limited to 3 times the rated current (max. 1 second)!

EL7342 - Connection (left-hand section of the housing)

Terminal point	Name	Description
1	Enc. A, A	Encoder A-input A
2	Enc. B, A	Encoder B-input B
3	Power Encoder +24 V	+ 24 V, encoder supply (from positive power contact)
4	Input 1	Digital input 1 (+24 V_{DC}) or Digital latch input for motor A.
5	Enc. A, B	Encoder A-input B
6	Enc. B, B	Encoder B-input B
7	Power Encoder 0 V	0 V, encoder supply (from negative power contact)
8	Input 2	Digital input 2 (+24 V_{DC}) or Digital latch input for motor B.
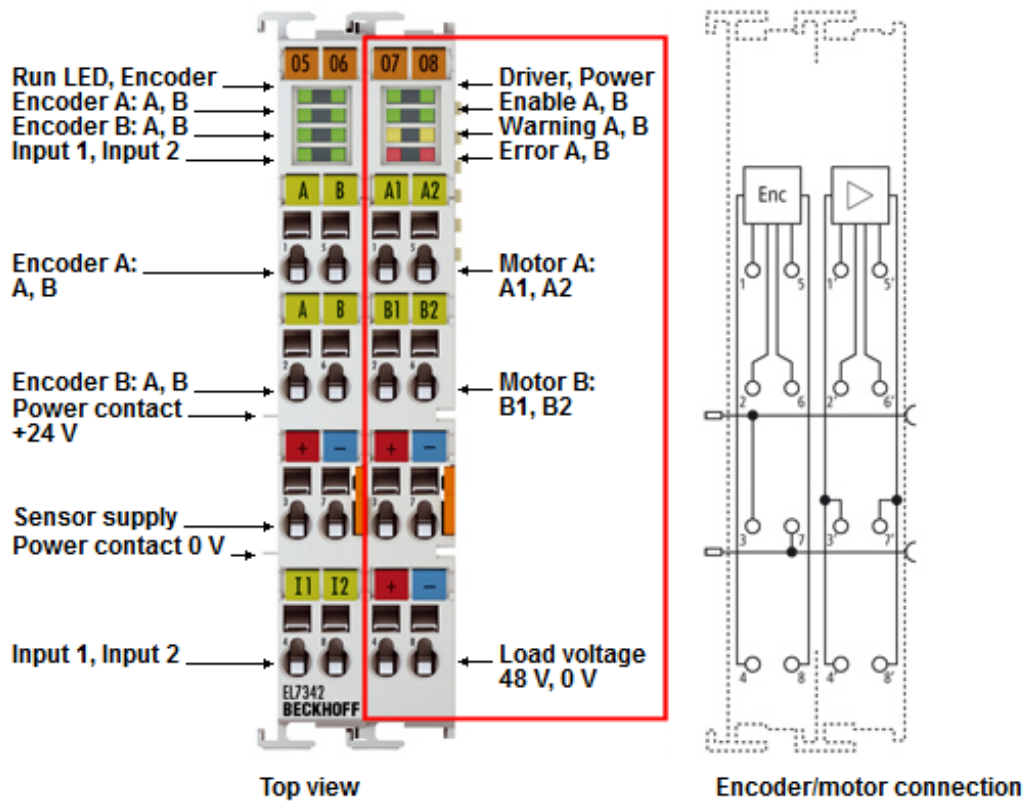
Fig. 31: EL7342 - Connection (right -hand section of the housing)

EL7342 - Connection (right-hand section of the housing)

Terminal point	Name	Description
1'	A1	Motor A, motor winding A1
2'	B1	Motor B, motor winding B1
3'	Power Motor +48 V	Motor supply feed (maximum +48 V_{DC})
4'	Power Motor +48 V	Motor supply feed (maximum +48 V_{DC})
5'	A2	Motor A, motor winding A2
6'	B2	Motor B, motor winding B2
7'	Power Motor 0 V	Motor supply feed (0 V)
8'	Power Motor 0 V	Motor supply feed (0 V)

Fig. 32: EL7342 - LEDs

EL7342 - LEDs (left prism)

LED	Color	Meaning		
Run	green	This LED indicates the terminal's operating state.		
		off	State of the EtherCAT State Machine: INIT = terminal initialization	
		flashing	State of the EtherCAT State Machine: PREOP = function of mailbox communication and variant standard settings	
		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	
		flickering	State of the EtherCAT State Machine: BOOTSTRAP = function for terminal firmware updates	
Enc. A A	green	on	Signal at encoder A - input A.	
Enc. A B	green	on	Signal at encoder A - input B.	
Enc. B A	green	on	Signal at encoder B - input A.	
Enc. B B	green	on	Signal at encoder B - input B.	
Input 1	green	on	Signal at digital input 1.	
Input 2	green	on	Signal at digital input 2.	

EL7342 - LEDs (right prism)

LED	Color	Meaning	
Motor Power	green	off	Supply voltage (48 V_{DC}) not present or motor control is blocked (index is not set).
		on	Supply voltage (48 V_{DC}) present.
Enable A	green	off	The motor control (motor A) is blocked or EL7342 is not ready for operation.
		on	The motor control (motor A) is activated or EL7342 is ready for operation.
Enable B	green	off	The motor control (motor B) is blocked or EL7342 is not ready for operation.
		on	The motor control (motor B) is activated or EL7342 is ready for operation.
Warning A/B	yellow	off	no defect
		on	Configuration error, e.g.: Motor power supply not connected 80 °C temperature exceeded ...
Error A	red	off	no defect
		on	Configuration error of output stage A, e.g.: 100°C temperature exceeded Short circuit Open load / broken wire ...
Error B	red	off	no defect
		on	Configuration error of output stage B, e.g.: 100°C temperature exceeded Short circuit Open load / broken wire ...

5.10   Disposal

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

6   Commissioning

6.1   TwinCAT Quick Start

TwinCAT is a development environment for real-time control including 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 Systemmanual:**
  Fieldbus Components → EtherCAT Terminals → EtherCAT System Documentation → Setup in the TwinCAT System Manager
- **TwinCAT 2** → TwinCAT System Manager → I/O - Configuration
- In particular, TwinCAT driver installation:
  Fieldbus components → Fieldbus Cards and Switches → FC900x – PCI Cards for Ethernet → Installation

Devices contain the 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 offline mode can be found under http://infosys.beckhoff.com:
    TwinCAT 2 → TwinCAT System Manager → IO - Configuration → Adding 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 from user PC to the individual control elements:
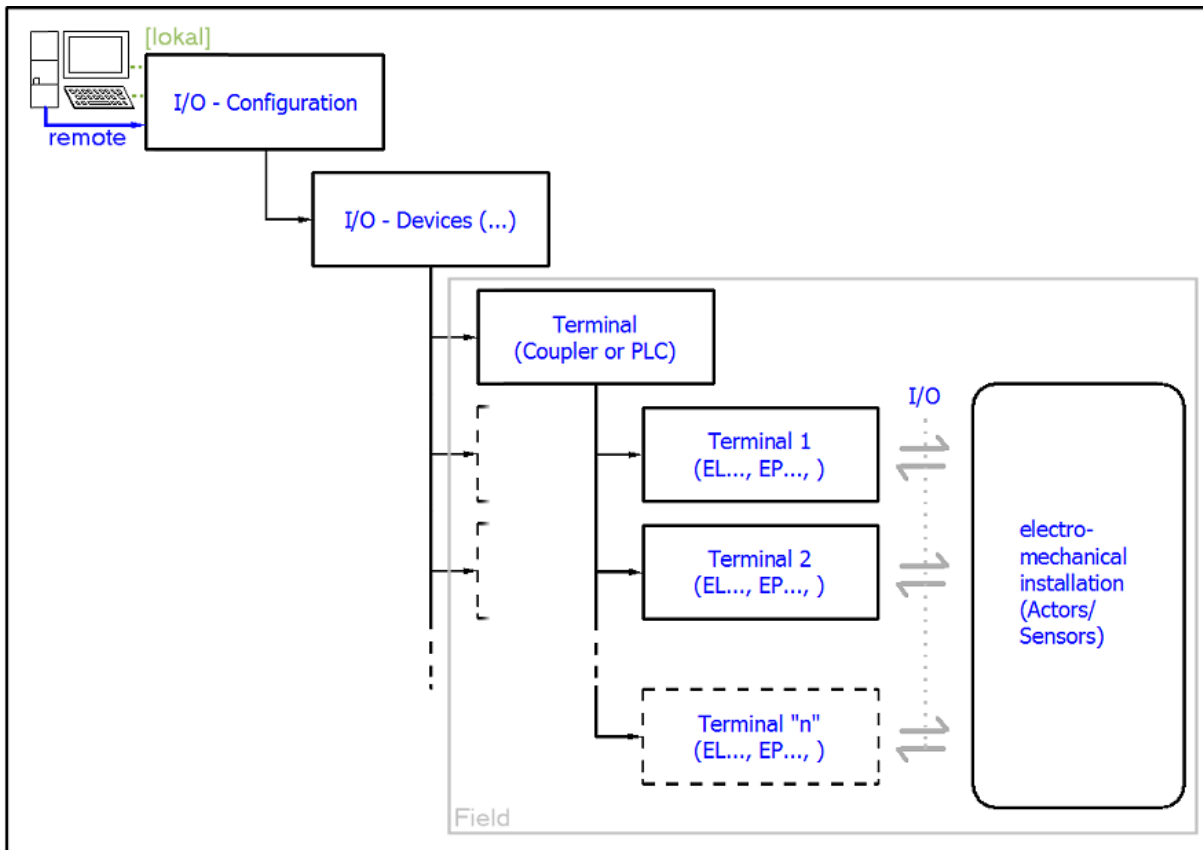
Fig. 33: Relationship between user side (commissioning) and installation

The user inserting of certain components (I/O device, terminal, box...) is the same in TwinCAT 2 and TwinCAT 3. The descriptions below relate to the online procedure.

Sample configuration (actual configuration)

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

- Control system (PLC) **CX2040** including **CX2100-0004** power supply unit
- Connected to the 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)

BECKHOFF
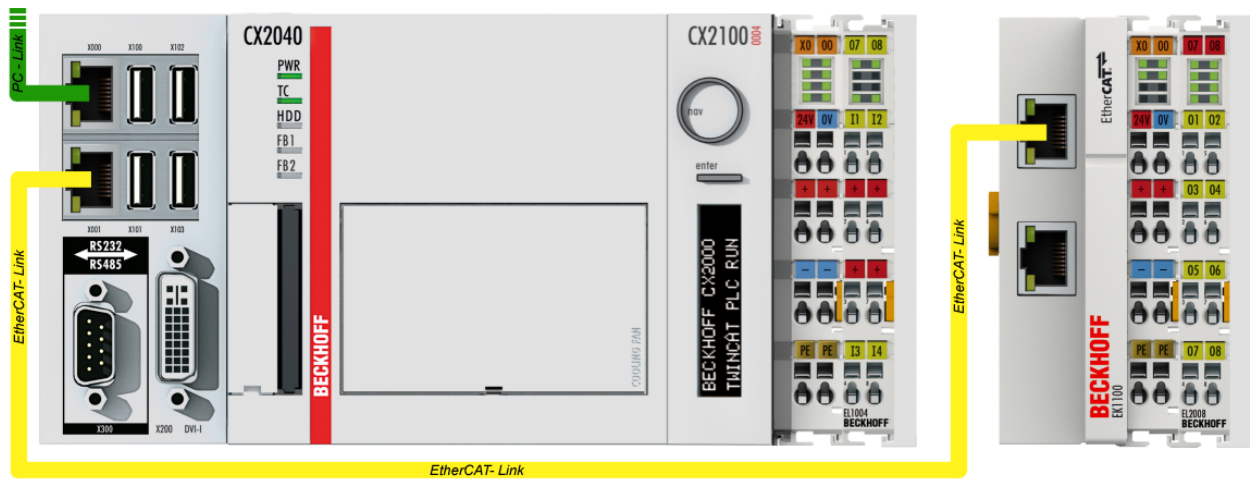
Fig. 34: Control configuration with Embedded PC, input (EL1004) and output (EL2008)

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 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:
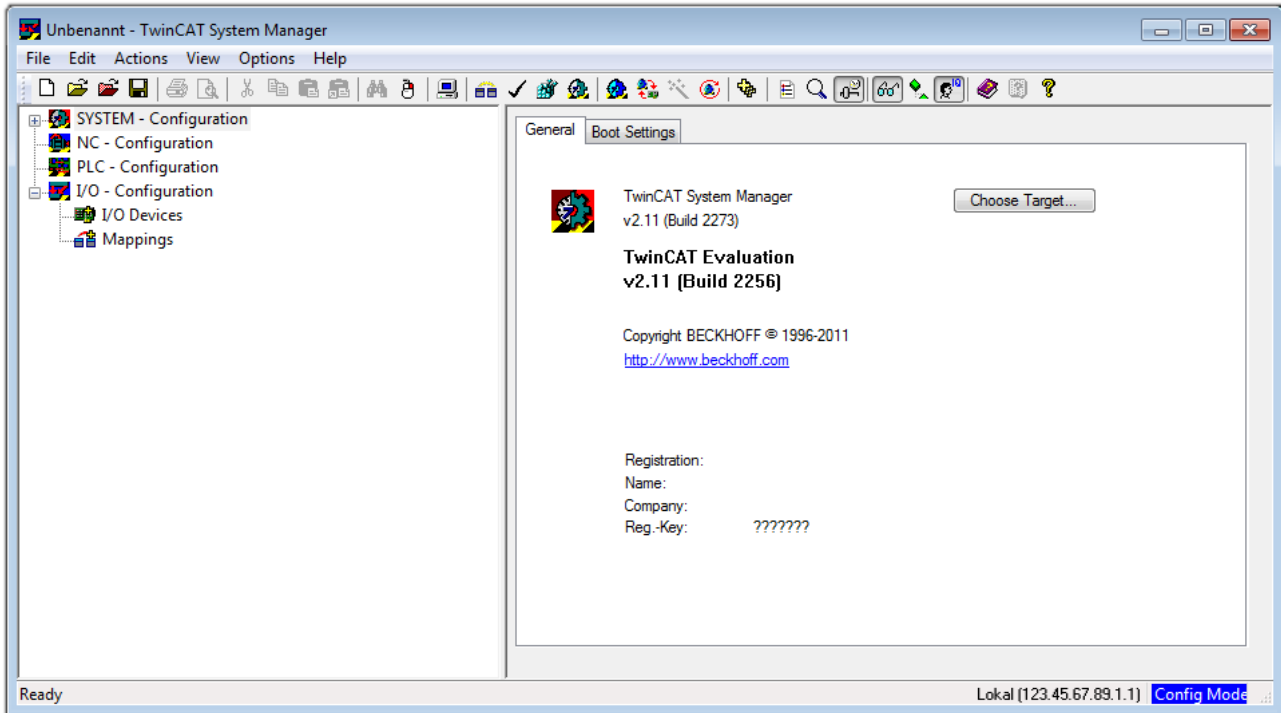
Fig. 35: Initial TwinCAT 2 user interface

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 thereby the next step is "Insert Device [▶ 57]".

If the intention is to address the TwinCAT runtime environment installed on a PLC as development environment remotely from another system, the target system must be made known first. In the menu under

"Actions" → "Choose Target System...", via the symbol " 🖳 " or the "F8" key, open the following window:
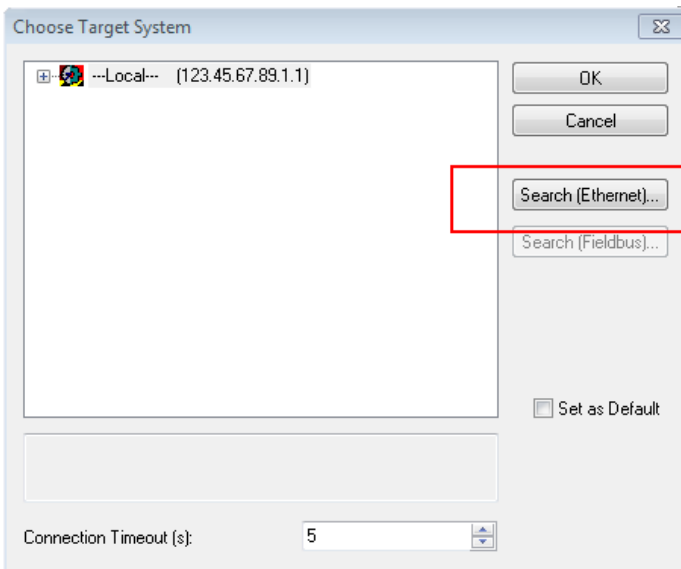
Fig. 36: Selection of the target system

Use "Search (Ethernet)..." to enter the target system. Thus a next 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.
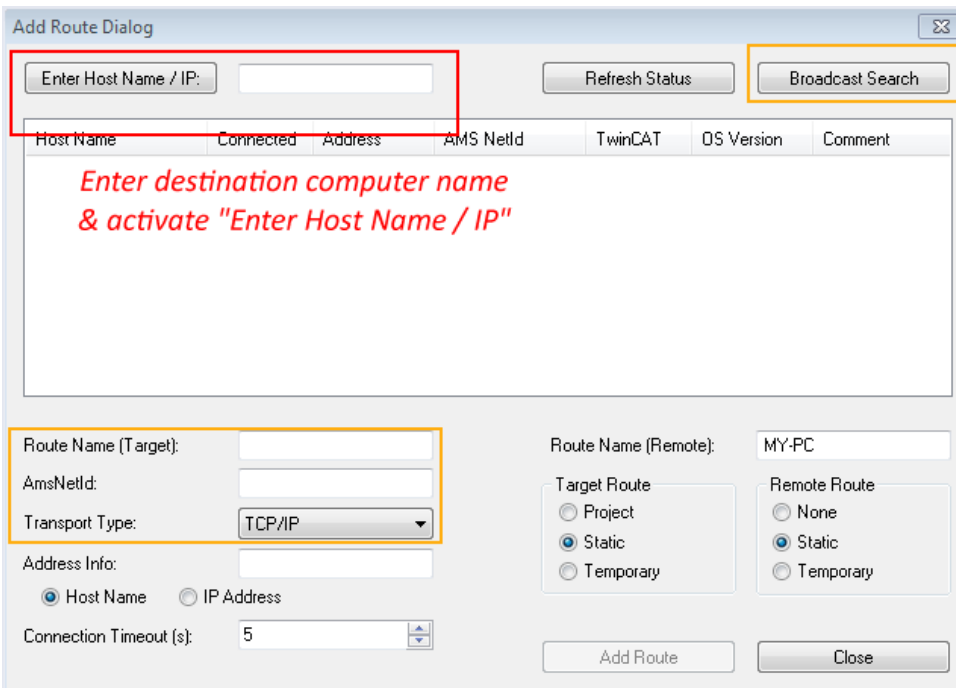
Fig. 37: Specify the PLC for access by the TwinCAT System Manager: selection of the target system

Once the target system has been entered, it is available for selection as follows (a password may have to be entered):
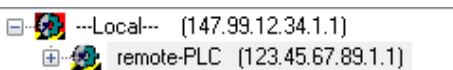
After confirmation with "OK" the target system can be accessed via the System Manager.

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 ![icon] . The TwinCAT System Manager may first have to be set to "Config mode" via ![icon] or via menu "Actions" → "Set/Reset TwinCAT to Config Mode…" (Shift + F4).
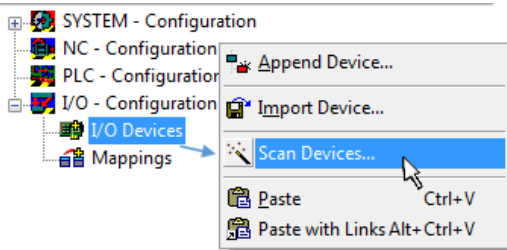
Fig. 38: Select "Scan Devices..."

Confirm the warning message, which follows, and select "EtherCAT" in the dialog:
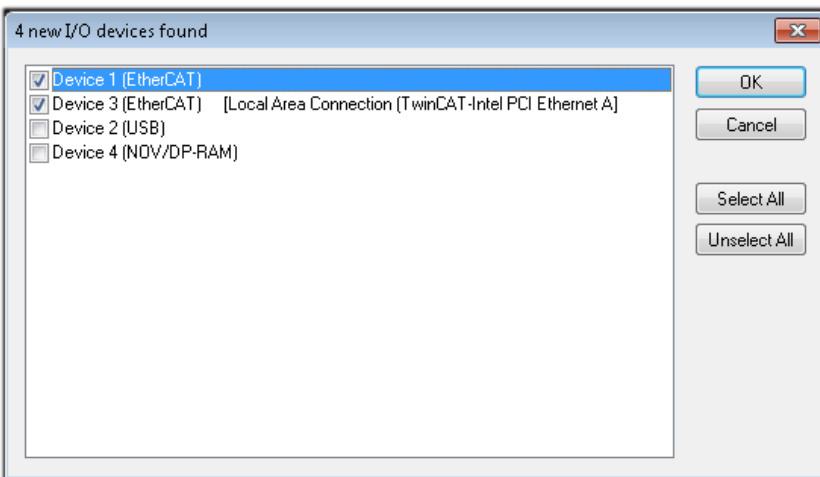
Fig. 39: Automatic detection of I/O devices: selection the devices to be integrated

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 sample configuration [▶ 53] described at the beginning of this section, the result is as follows:
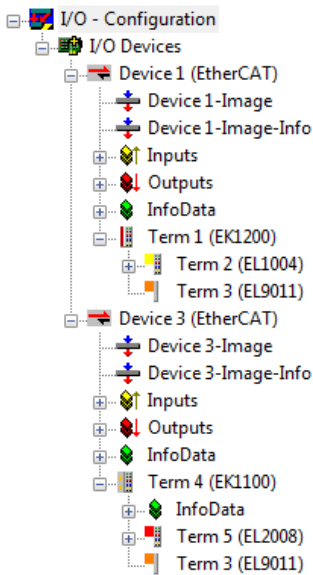
Fig. 40: Mapping of the configuration in the TwinCAT 2 System Manager

The whole process consists of two stages, which may be performed separately (first determine the devices, then determine the connected elements such as boxes, terminals, etc.). A scan can also be initiated by selecting "Device ..." from the context menu, which then reads the elements present in the configuration below:
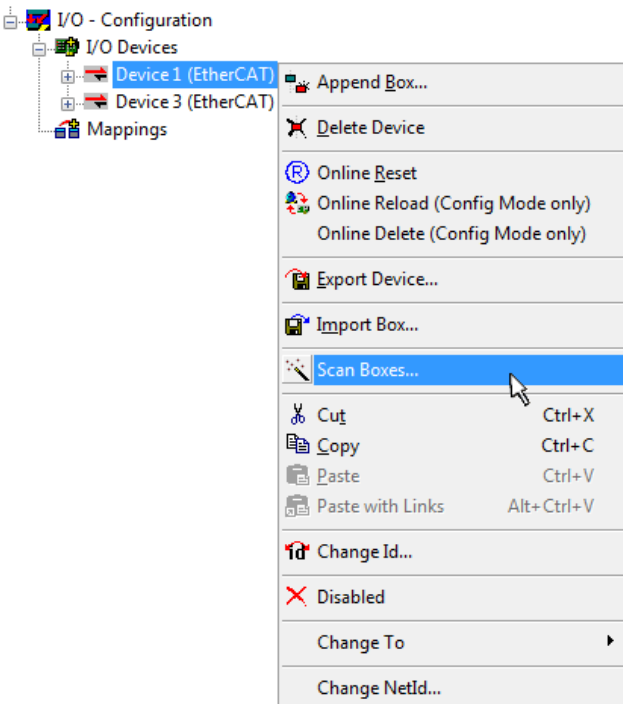
Fig. 41: Reading of individual terminals connected to a device

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 the creation of 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 to Structured Text (ST).

After starting TwinCAT PLC Control, the following user interface is shown for an initial project:
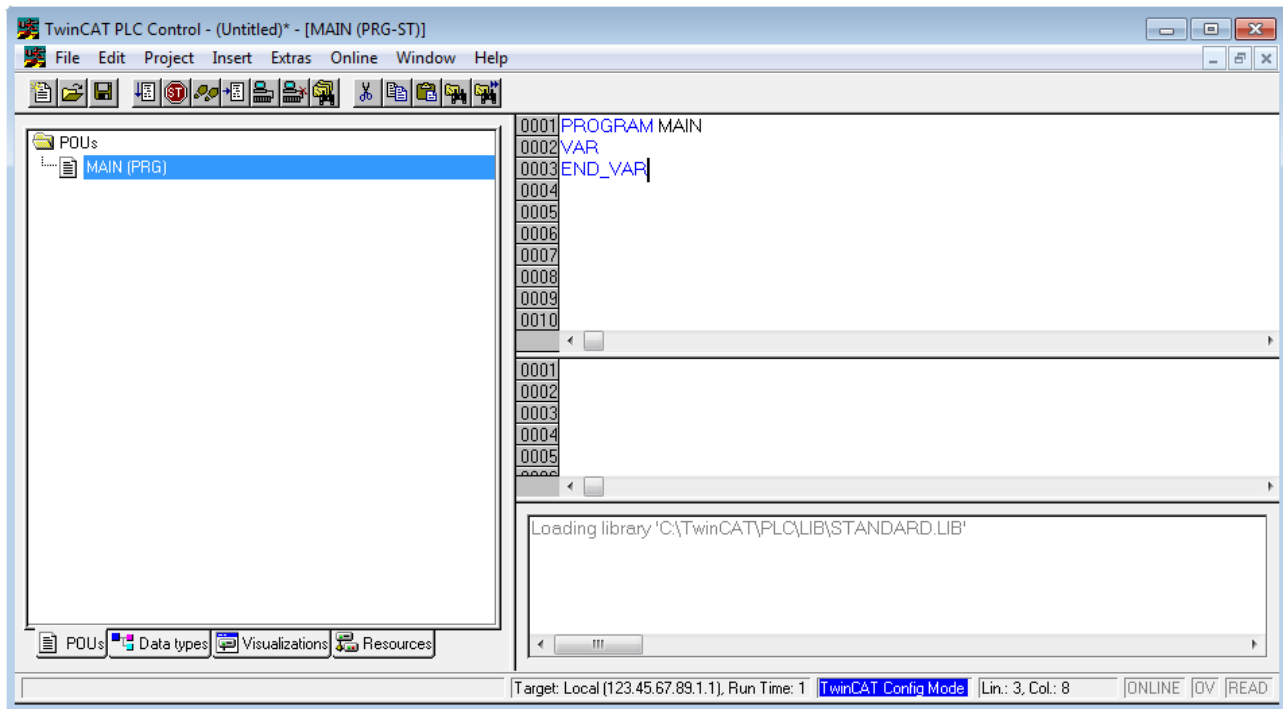
Fig. 42: TwinCAT PLC Control after startup

Sample variables and a sample program have been created and stored under the name "PLC_example.pro":
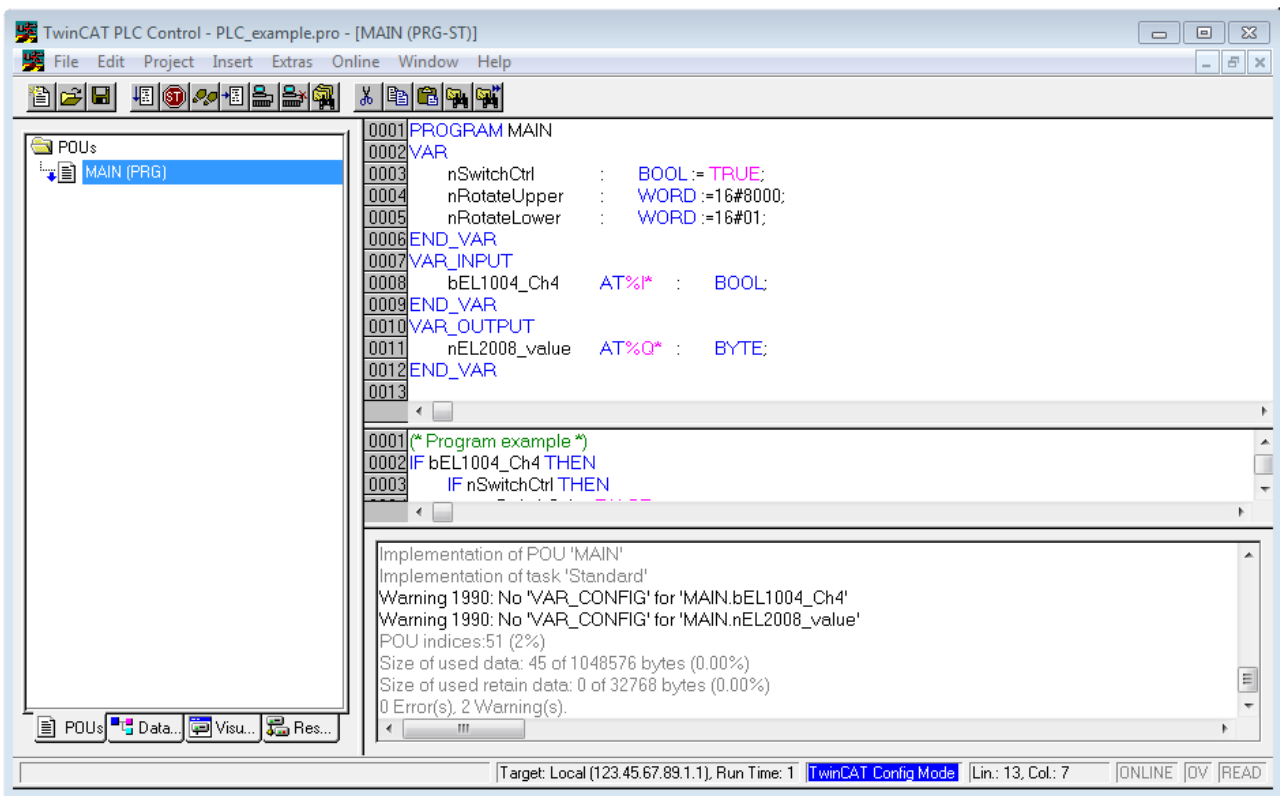
Fig. 43: Sample program with variables after a compile process (without variable integration)

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** via the context menu of the PLC configuration; right-click and select "Append PLC Project…":
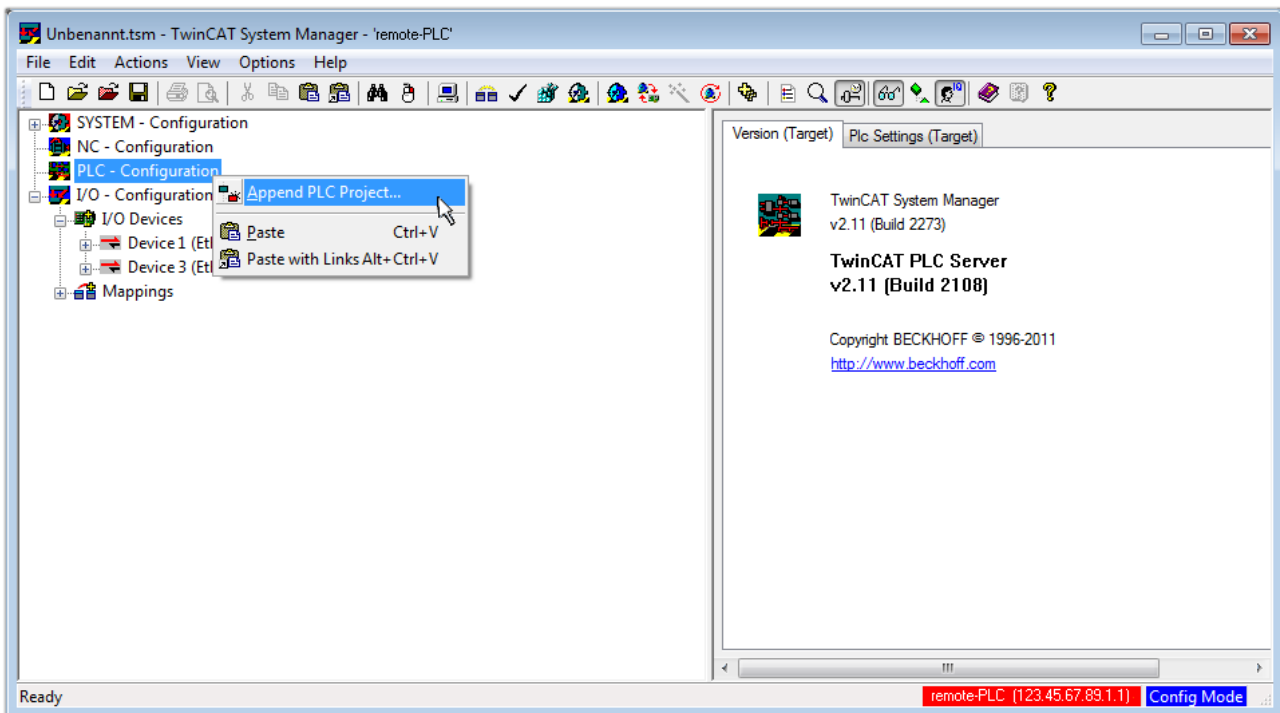
Fig. 44: Appending the TwinCAT PLC Control project

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:
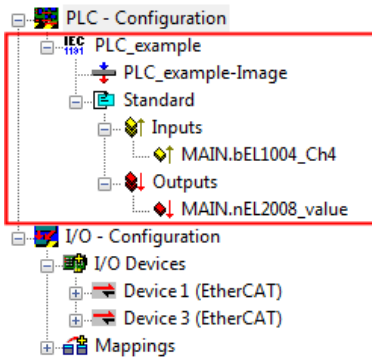
Fig. 45: PLC project integrated in the PLC configuration of the System Manager

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":
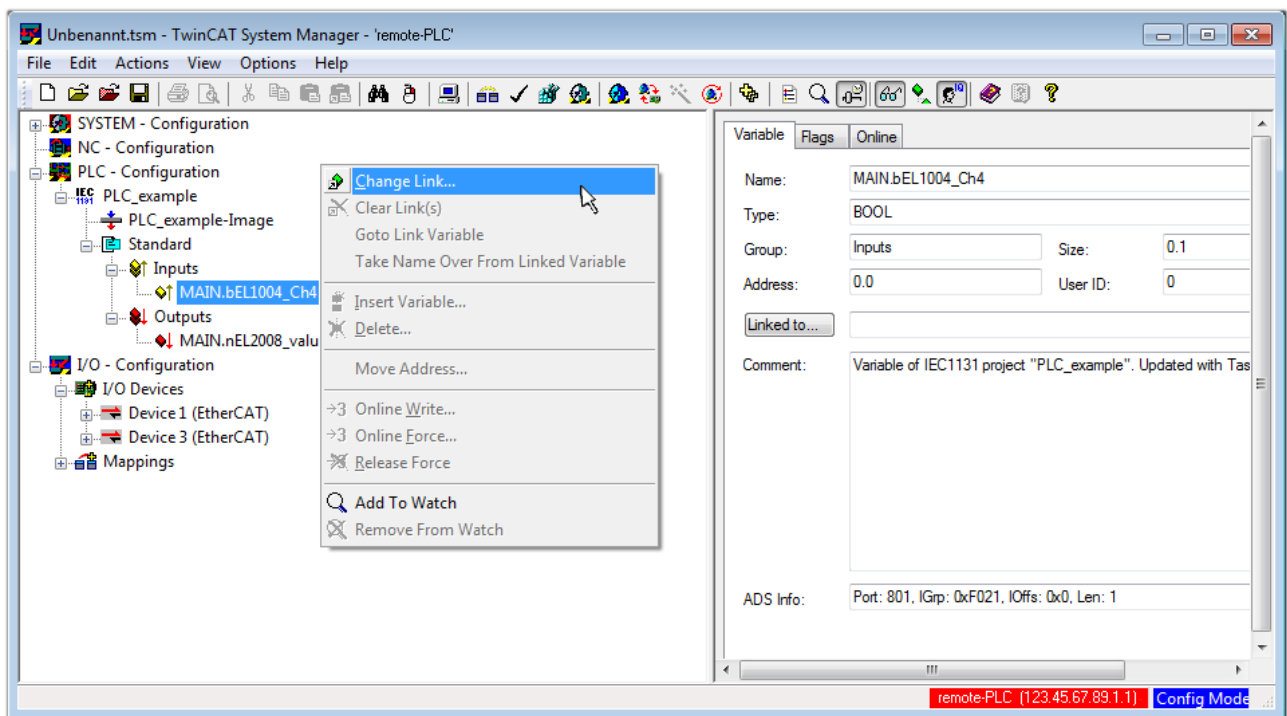
Fig. 46: Creating the links between PLC variables and process objects

In the window that opens, the process object for the variable "bEL1004_Ch4" of type BOOL can be selected from the PLC configuration tree:
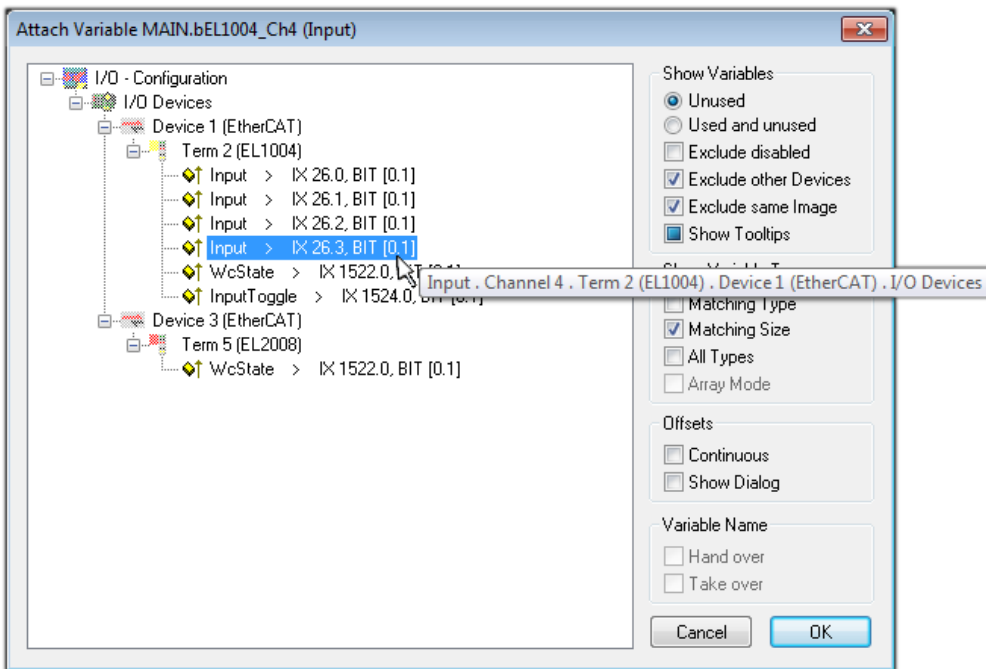
Fig. 47: Selecting PDO of type BOOL

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

Fig. 48: 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 variable "nEL2008_value" sequentially to all eight selected output bits of the EL2008 terminal. In this way it is 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 ( ) at the yellow or red object of the variable indicates that a link exists. The links can also be checked by selecting a "Goto Link Variable" from the context menu of a variable. The object opposite, in this case the PDO, is automatically selected:

Fig. 49: Application of a "Goto Link" variable, using "MAIN.bEL1004_Ch4" as a sample

The process of assigning variables to the PDO is completed via the menu selection "Actions" → "Generate

Mappings", key Ctrl+M or by clicking on the symbol ![symbol] in the menu.

This can be visualized in the configuration:
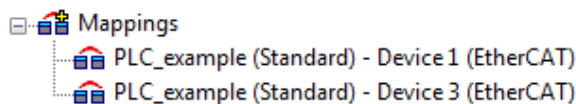
The process of creating links can also take place in the opposite direction, i.e. starting with individual PDOs to variable. However, in this example it would then not be possible to select all output bits for the EL2008, since the terminal only makes individual digital outputs available. If a terminal has a byte, word, integer or similar PDO, it is possible to allocate this a set of bit-standardized variables (type "BOOL"). Here, too, a "Goto Link Variable" from the context menu of a PDO 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 ![checkmark] (or via "Actions" → "Check Configuration"). If no error is present, the configuration can be

activated via ![icon] (or via "Actions" → "Activate Configuration…") to transfer the System Manager settings to the runtime system. Confirm the messages "Old configurations are overwritten!" and "Restart TwinCAT system in Run mode" with "OK".

A few seconds later the real-time status ![RTime 0%] 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 Ethernet via "Online" → "Choose Run-Time System…":
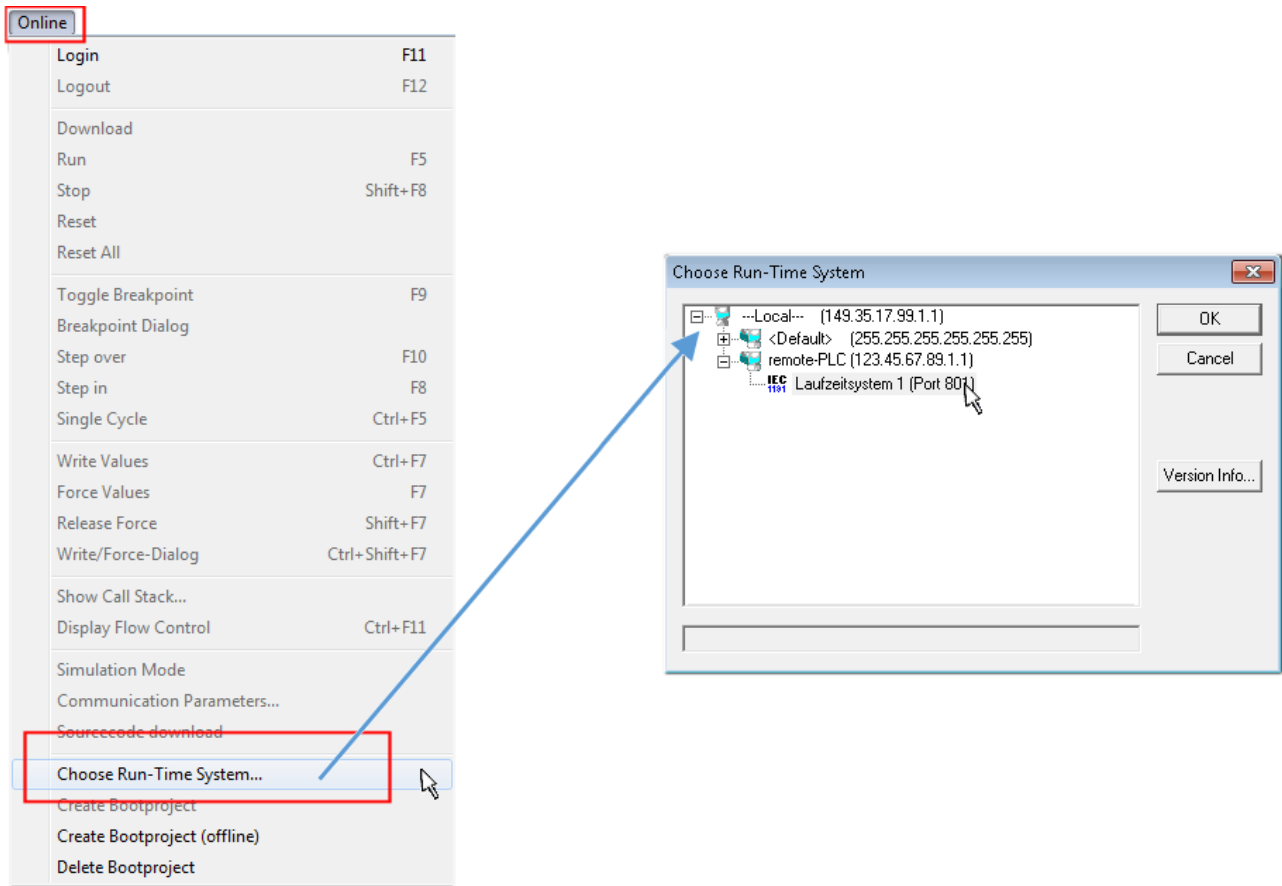
Fig. 50: Choose target system (remote)

In this sample "Runtime system 1 (port 801)" is selected and confirmed. Link the PLC with the real-time

system via 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 acknowledged with "Yes". The runtime environment is ready for the program start:

Fig. 51: PLC Control logged in, ready for program startup
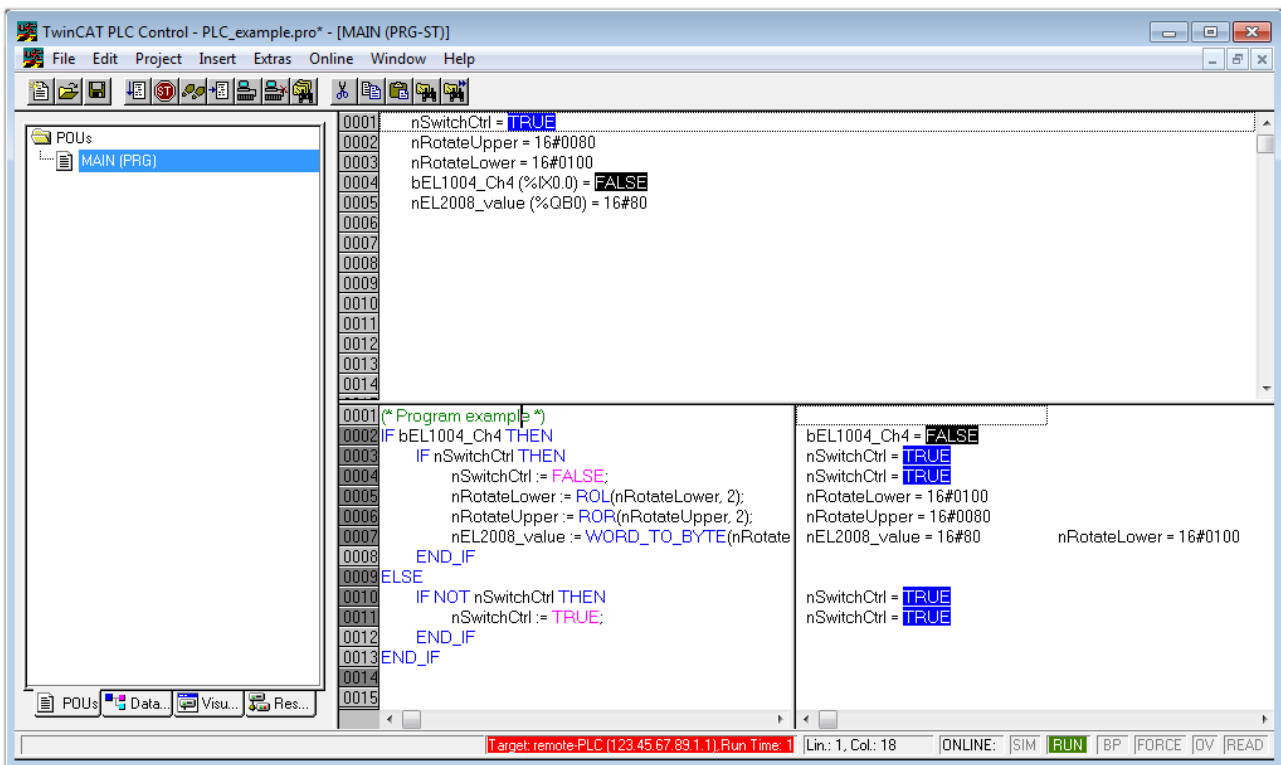
The PLC can now be started via "Online" → "Run", F5 key or .

6.1.2   TwinCAT 3

Startup

TwinCAT makes the development environment areas available together with Microsoft Visual Studio: after startup, the project folder explorer appears on the left in the general window area (cf. "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:

BECKHOFF

Fig. 52: 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):
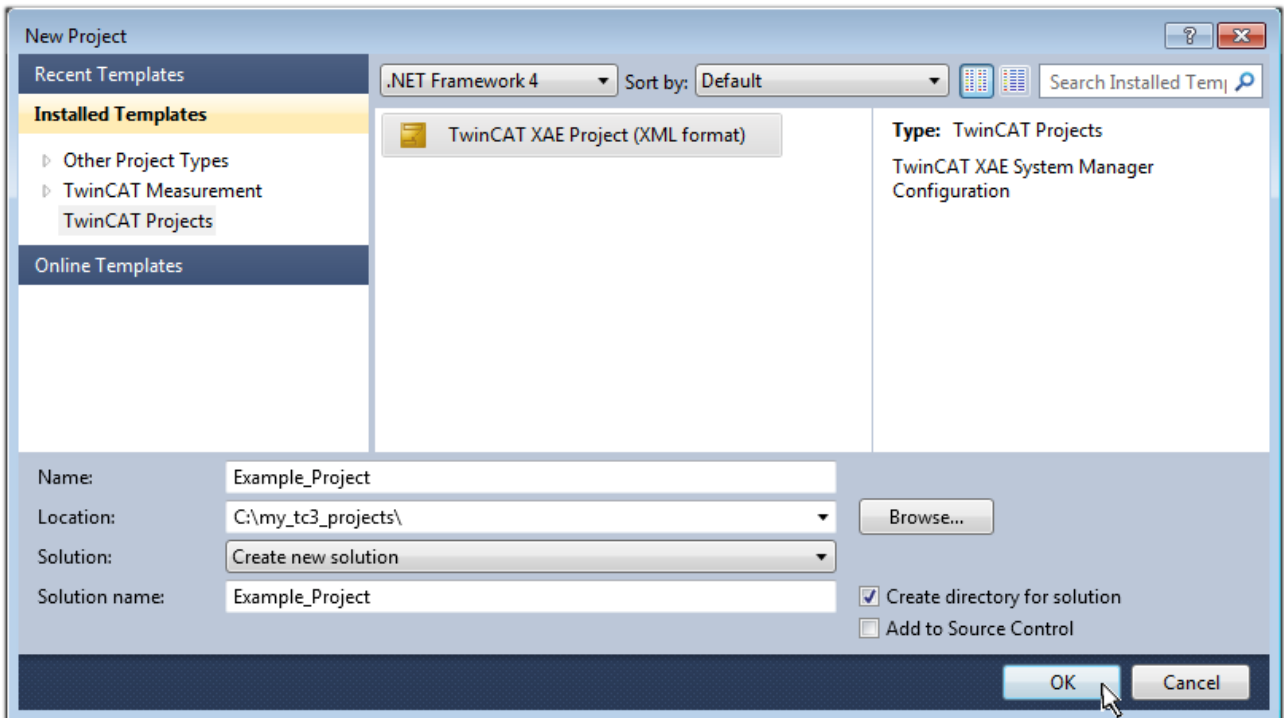
Fig. 53: Create new TwinCAT project

The new project is then available in the project folder explorer:
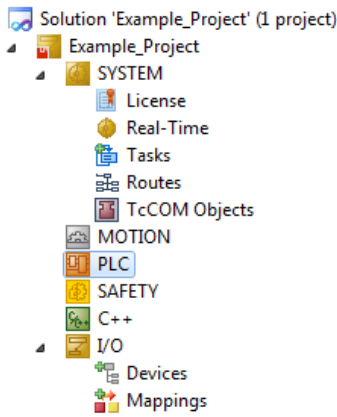
Fig. 54: New TwinCAT3 project in the project folder explorer

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, TwinCAT can be used in local mode and thereby the next step is "Insert Device [▶ 68]".

If the intention is to address the TwinCAT runtime environment installed on a PLC as development environment remotely from another system, the target system must be made known first. Via the symbol in the menu bar:
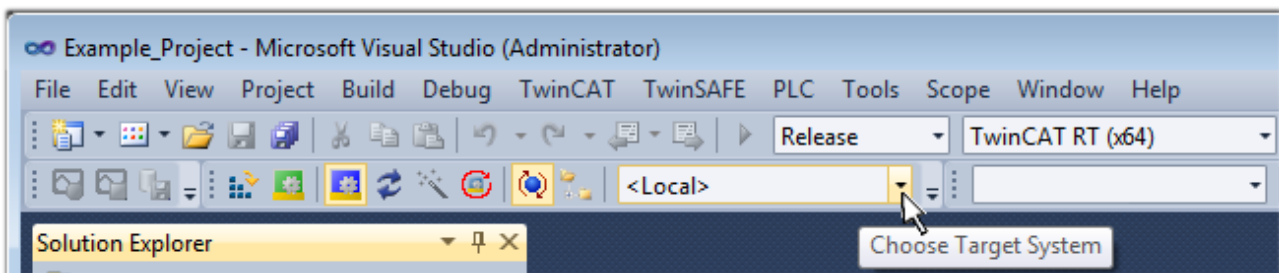
expand the pull-down menu:
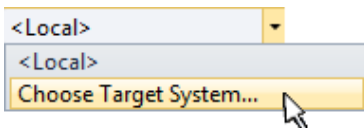
and open the following window:
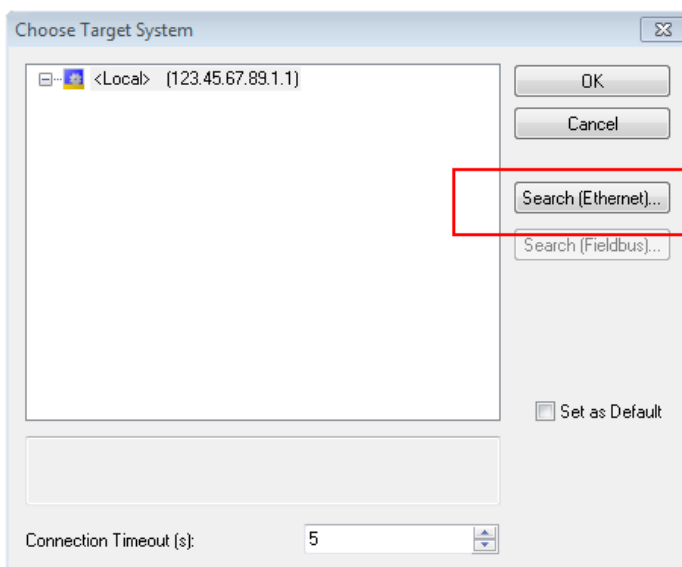
Fig. 55: Selection dialog: Choose the target system

Use "Search (Ethernet)..." to enter the target system. Thus a next 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.
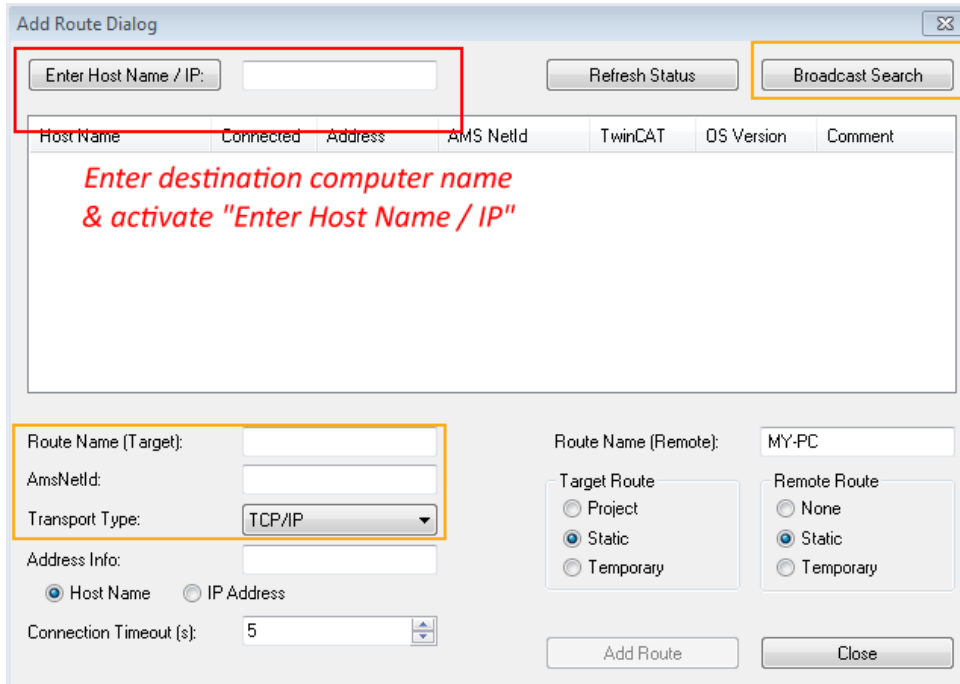
Fig. 56: Specify the PLC for access by the TwinCAT System Manager: selection of the target system

Once the target system has been entered, it is available for selection as follows (a password may have to be entered):
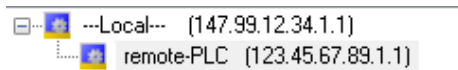
After confirmation with "OK" the target system can be accessed via the Visual Studio shell.

Adding devices

In the project folder explorer of the Visual Studio shell user interface on the left, select "Devices" within

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)".
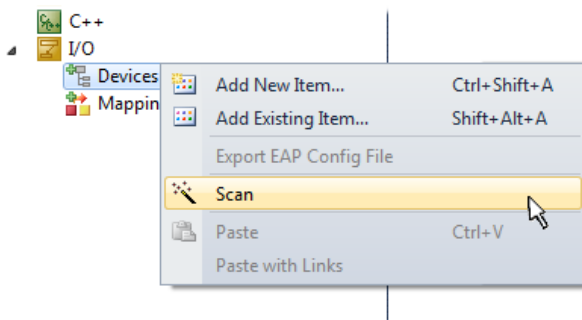
Fig. 57: Select "Scan"

Confirm the warning message, which follows, and select "EtherCAT" in the dialog:
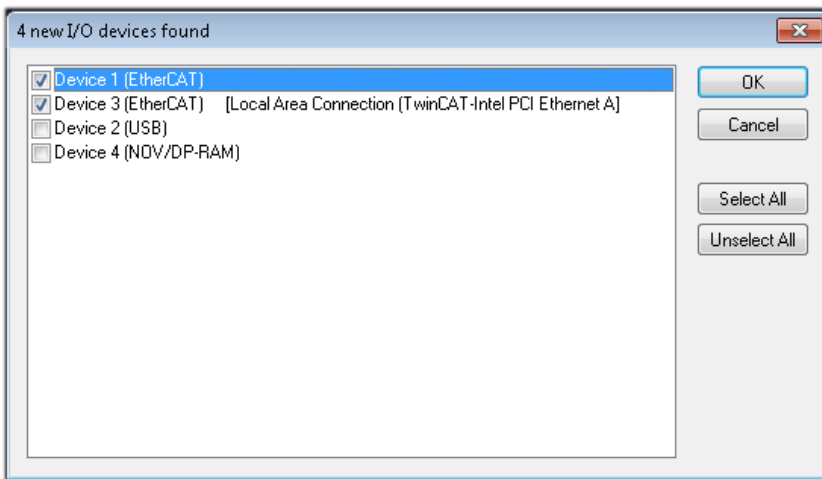
Fig. 58: Automatic detection of I/O devices: selection the devices to be integrated

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 sample configuration [▶ 53] described at the beginning of this section, the result is as follows:
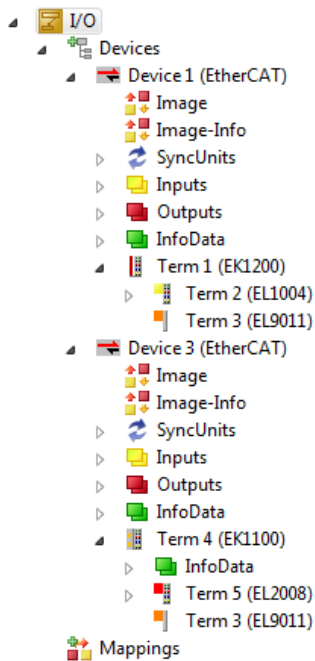
Fig. 59: Mapping of the configuration in VS shell of the TwinCAT3 environment

The whole process consists of two stages, which may be performed separately (first determine the devices, then determine the connected elements such as boxes, terminals, etc.). A scan can also be initiated by selecting "Device ..." from the context menu, which then reads the elements present in the configuration below:
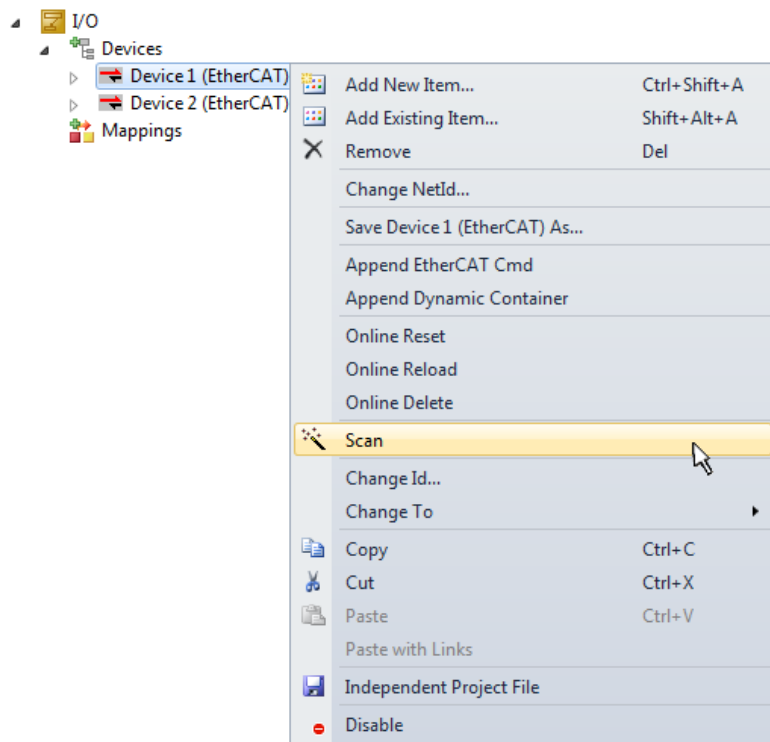
Fig. 60: Reading of individual terminals connected to a device

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

Programming the PLC

TwinCAT PLC Control is the development environment for the creation of 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 to Structured Text (ST).

In order to create a programming environment, a PLC subproject is added to the project sample via the context menu of "PLC" in the project folder explorer by selecting "Add New Item….":
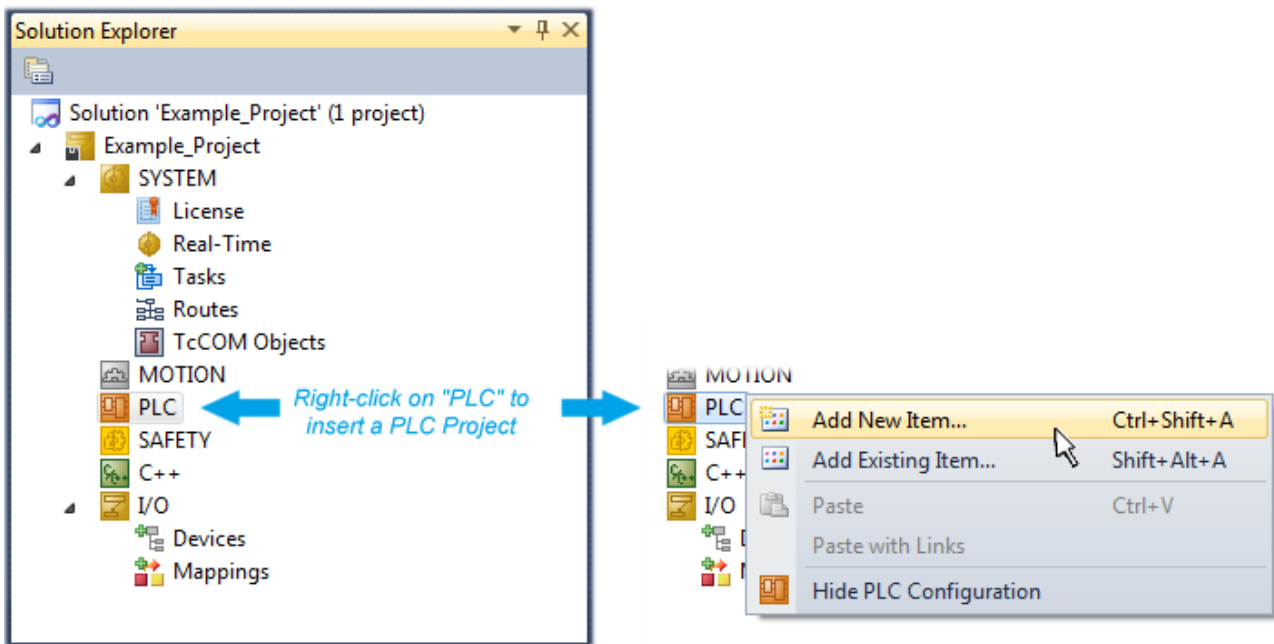
Fig. 61: Adding the programming environment in "PLC"

In the dialog that opens select "Standard PLC project" and enter "PLC_example" as project name, for example, and select a corresponding directory:
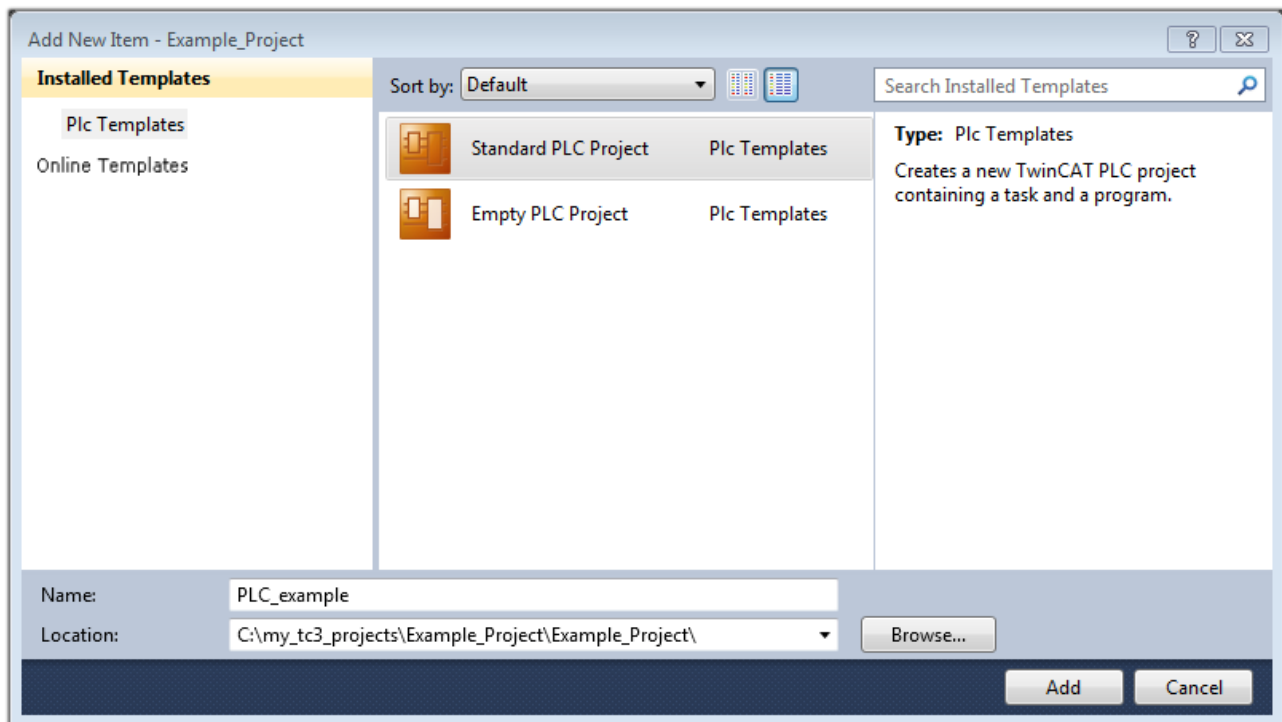
Fig. 62: Specifying the name and directory for the PLC programming environment

The "Main" program, which already exists by 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:

BECKHOFF
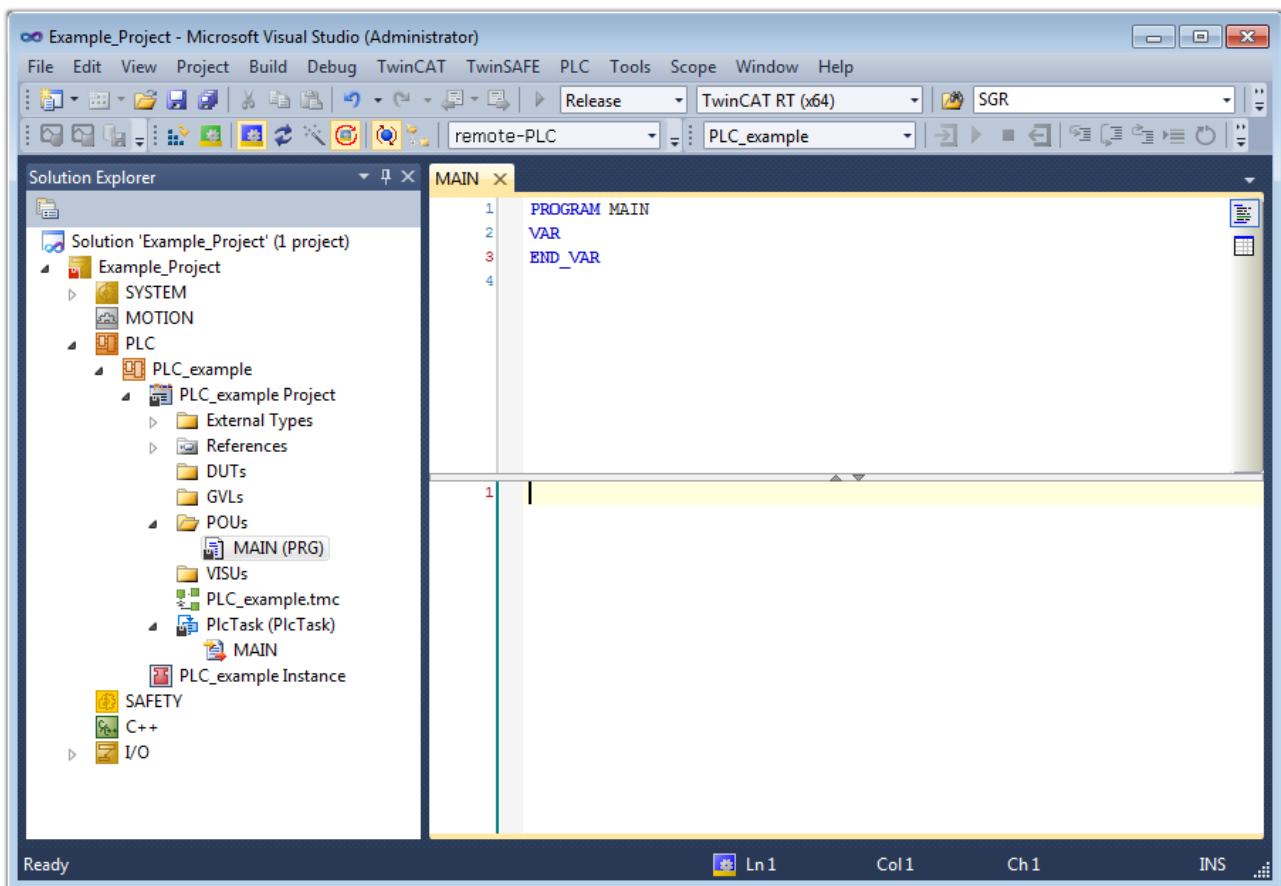
Fig. 63: Initial "Main" program of the standard PLC project

To continue, sample variables and a sample program have now been created:
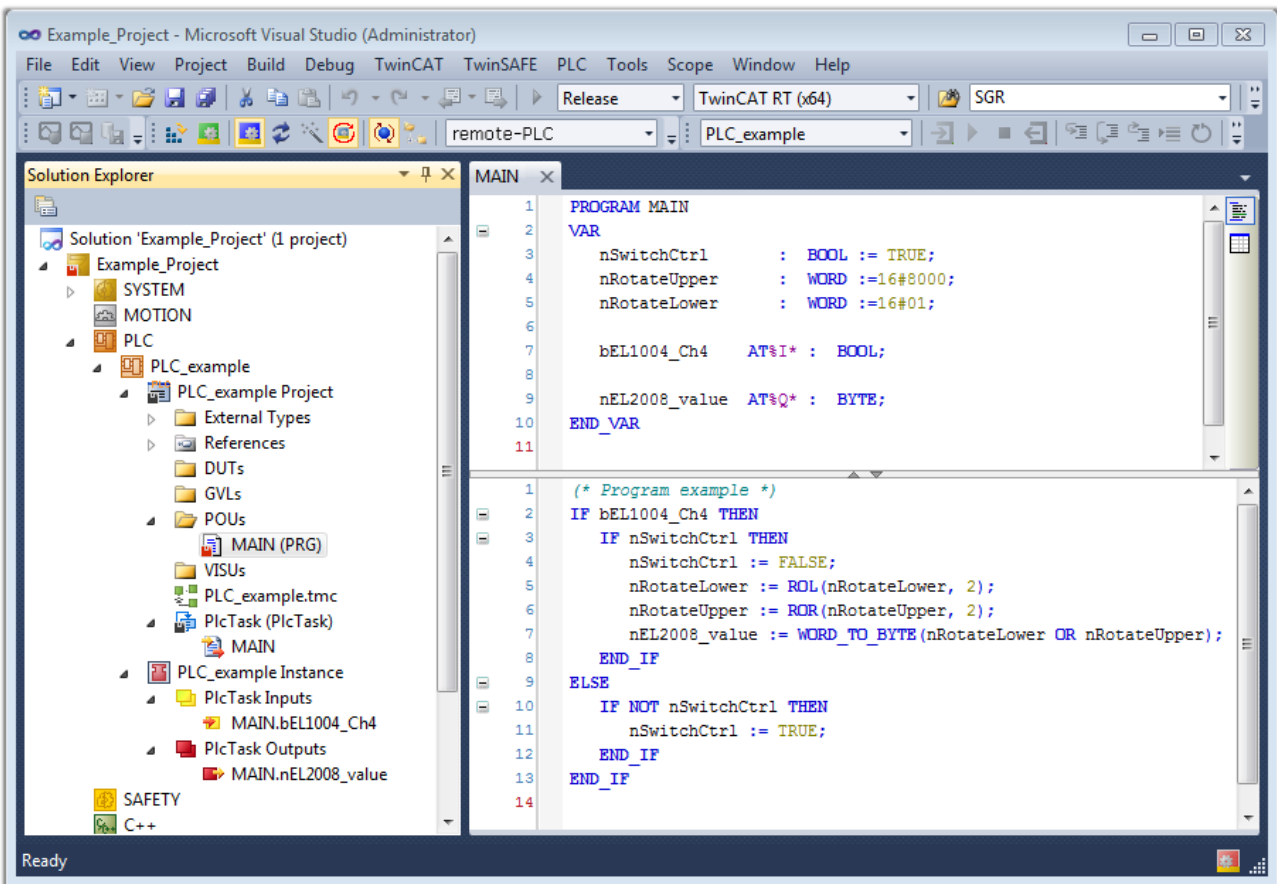
Fig. 64: Sample program with variables after a compile process (without variable integration)

The control program is now created as a project folder, followed by the compile process:
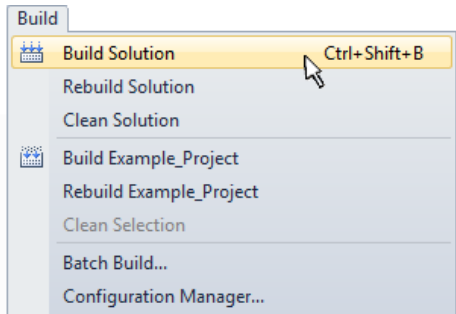
Fig. 65: Start program compilation

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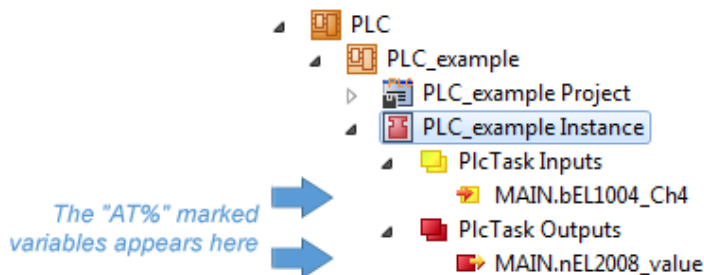
Assigning variables

Via the menu of an instance - variables in the "PLC" context, use the "Modify Link…" option to open a window for selecting a suitable process object (PDO) for linking:
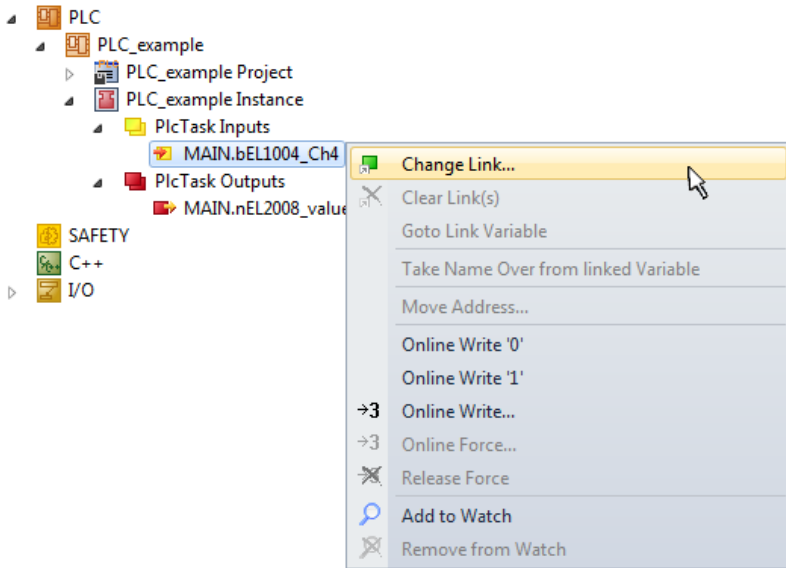
Fig. 66: Creating the links between PLC variables and process objects

In the window that opens, the process object for the variable "bEL1004_Ch4" of type BOOL can be selected from the PLC configuration tree:
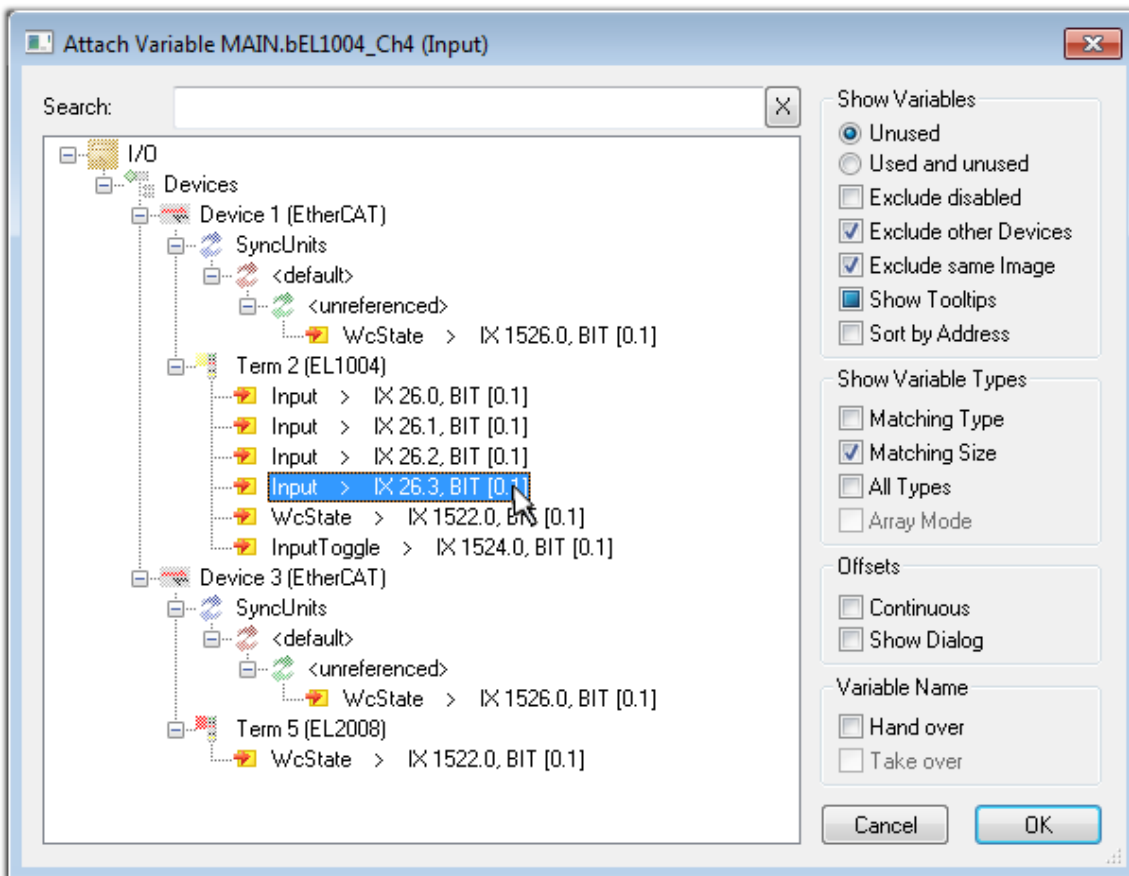
Fig. 67: Selecting PDO of type BOOL

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

Fig. 68: 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 variable "nEL2008_value" sequentially to all eight selected output bits of the EL2008 terminal. In this way it is 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 (▣) at the yellow or red object of the variable indicates that a link exists. The links can also be checked by selecting a "Goto Link Variable" from the context menu of a variable. The object opposite, in this case the PDO, is automatically selected:

Fig. 69: Application of a "Goto Link" variable, using "MAIN.bEL1004_Ch4" as a sample

The process of creating links can also take place in the opposite direction, i.e. starting with individual PDOs to variable. However, in this example it would then 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 possible to allocate this a set of bit-standardized variables (type "BOOL"). Here, too, a "Goto Link Variable" from the context menu of a PDO can be executed in the other direction, so that the respective PLC instance can then be selected.

> ● **Note on the type of variable assignment**
>
> **i** 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 it is possible to create a structure 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 tab "PLC" via the check box.
3. The data type in the "Data Type" field can then be copied using the "Copy" button.
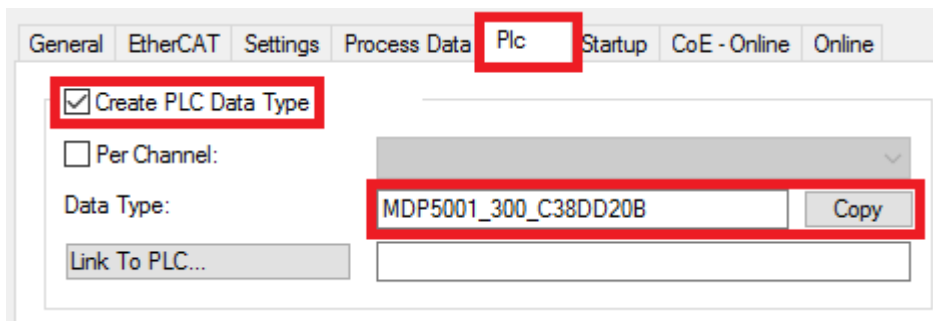
Fig. 70: Creating a PLC data type

4. An instance of the data structure of the copied data type must then be created in the PLC.
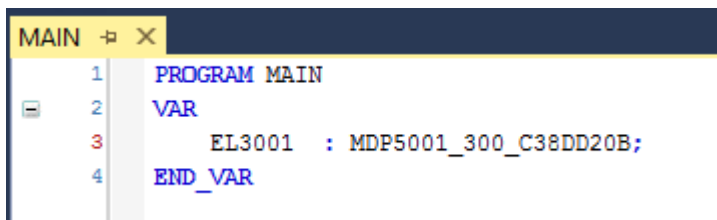
Fig. 71: Instance_of_struct

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.
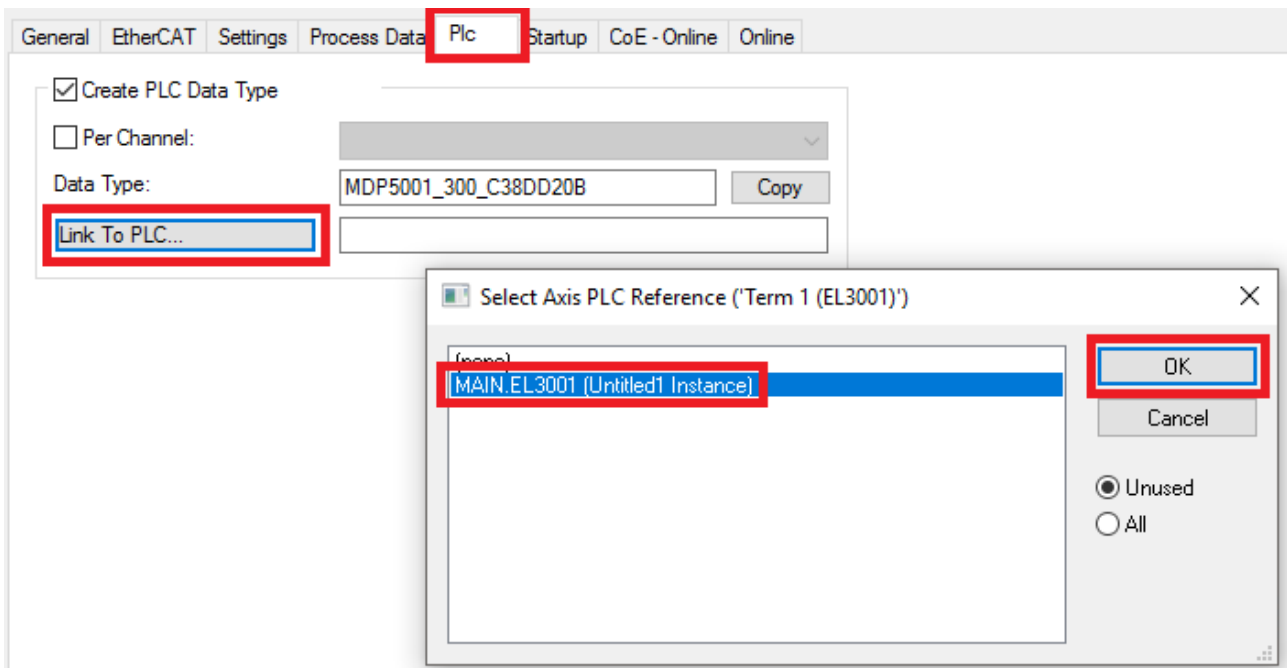
Fig. 72: Linking the structure

7. In the PLC the process data can then be read or written via the structure in the program code.
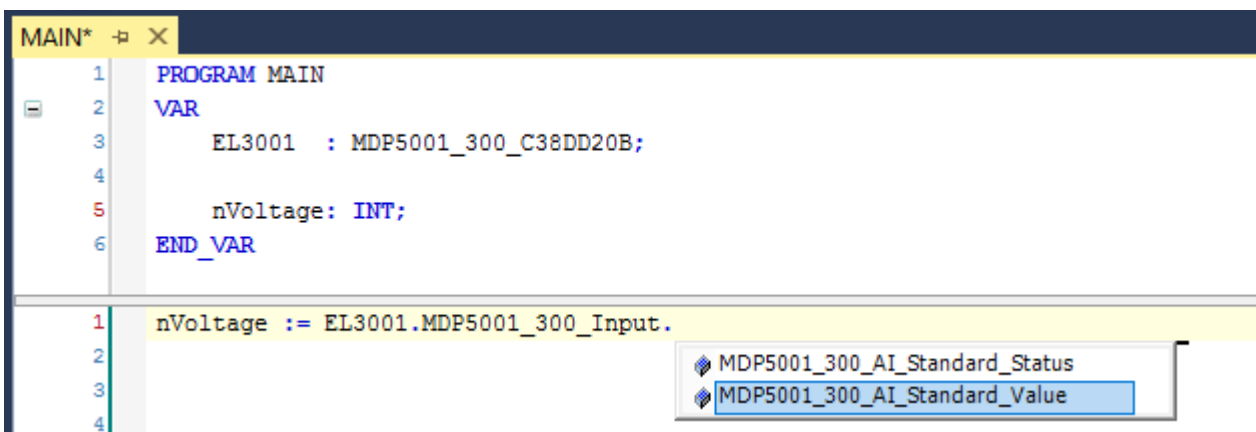
Fig. 73: Reading a variable from the structure of the process data

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 settings of the development environment to the runtime system. Confirm the messages "Old configurations are overwritten!" and "Restart TwinCAT system in Run mode" with "OK". The corresponding assignments can be seen in the project folder explorer:
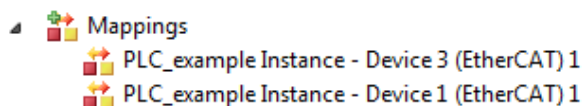
A few seconds later the corresponding status of the Run mode is displayed in the form of a rotating symbol

 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

program start by click on symbol , the "F5" key or via "PLC" in the menu selecting "Start". The started programming environment shows the runtime values of individual variables:
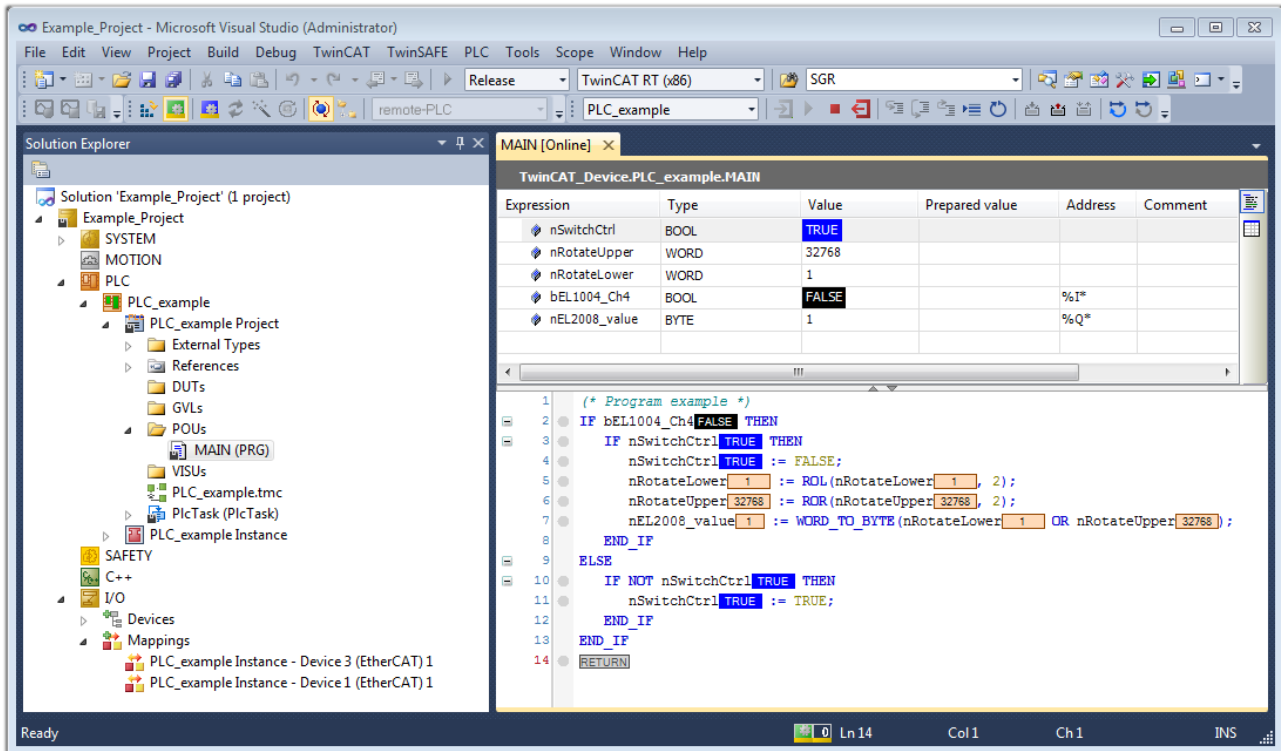
Fig. 74: TwinCAT development environment (VS shell): logged-in, after program startup

The two operator control elements for stopping and logout result in the required action (accordingly also for stop "Shift + F5", 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) & 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-Operatingsystem

  - 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.
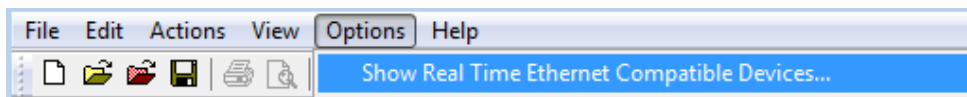
Fig. 75: System Manager "Options" (TwinCAT 2)

This have to be called up by the menu "TwinCAT" within the TwinCAT 3 environment:
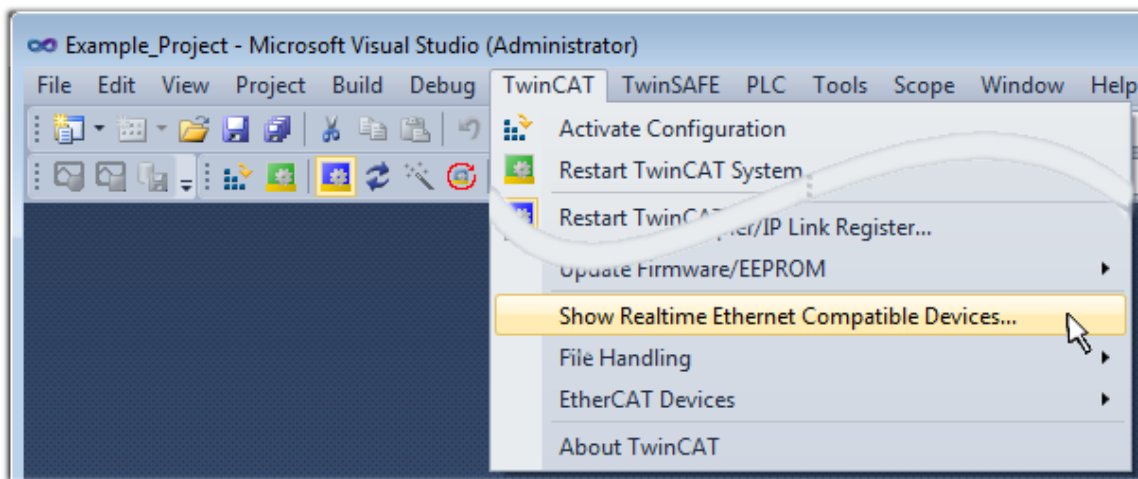
Fig. 76: Call up under VS Shell (TwinCAT 3)

B: Via TcRteInstall.exe in the TwinCAT directory
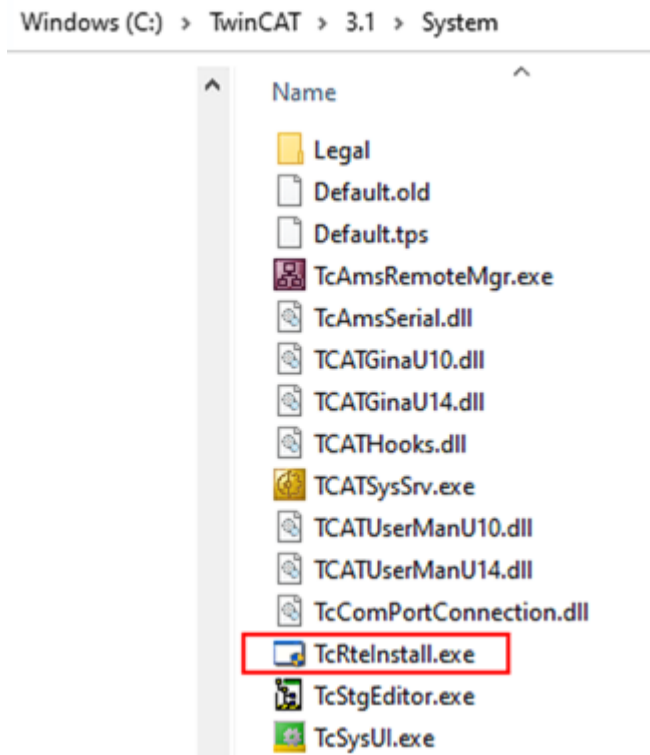
Fig. 77: TcRteInstall in the TwinCAT directory

In both cases, the following dialog appears:
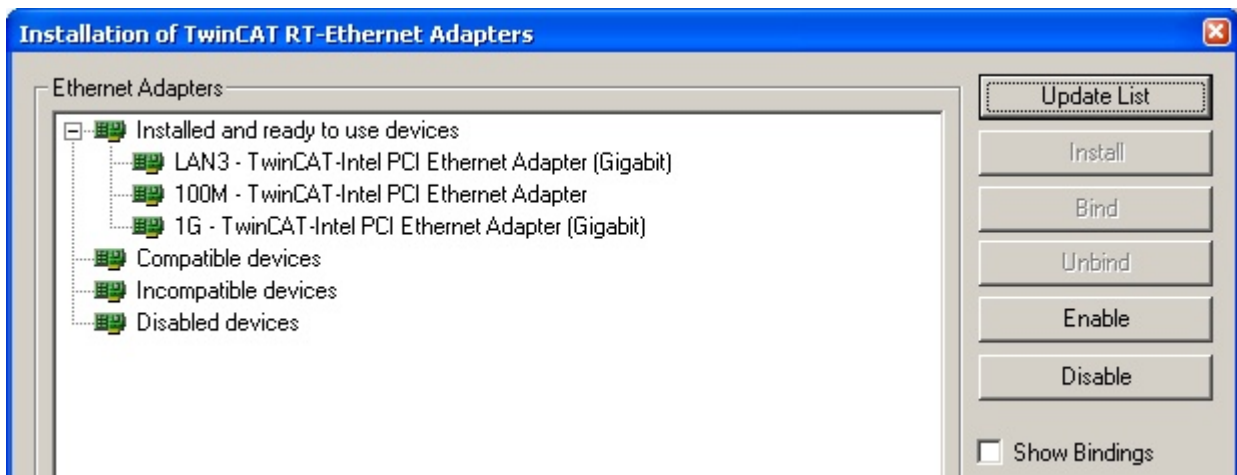
Fig. 78: Overview of network interfaces

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" [▶ 90] in order to view the compatible ethernet ports via its EtherCAT properties (tab "Adapter", button "Compatible Devices…"):

Fig. 79: EtherCAT device properties(TwinCAT 2): click on "Compatible Devices…" of tab "Adapte""

TwinCAT 3: the properties of the EtherCAT device can be opened by double click on "Device .. (EtherCAT)" within the Solution Explorer under "I/O":
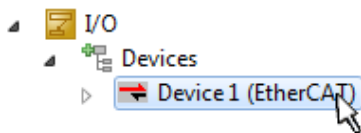
After the installation the driver appears activated in the Windows overview for the network interface (Windows Start → System Properties → Network)

BECKHOFF
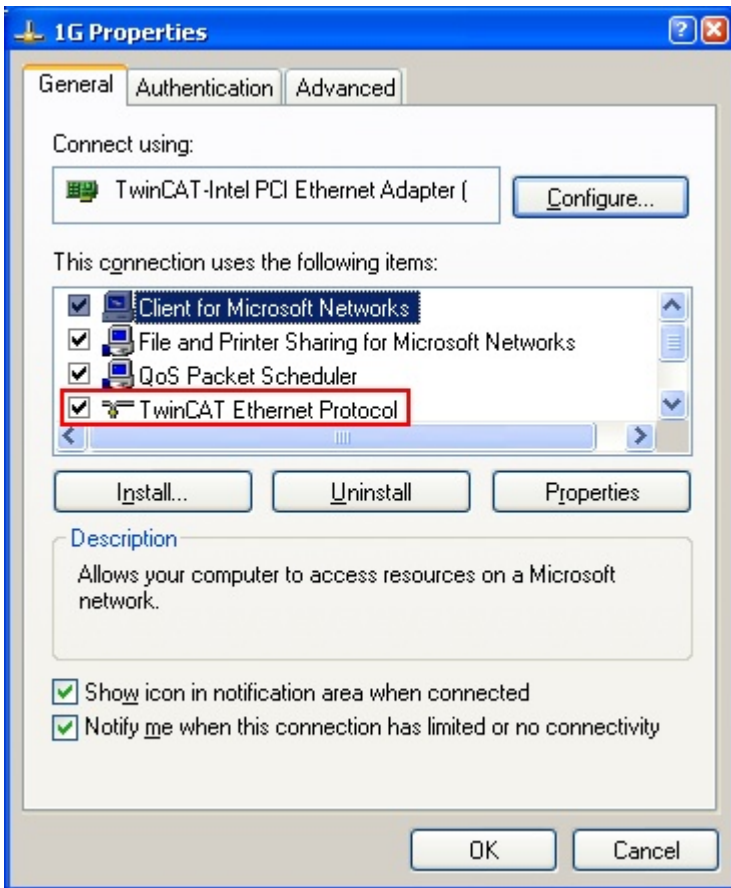
Fig. 80: Windows properties of the network interface

A correct setting of the driver could be:
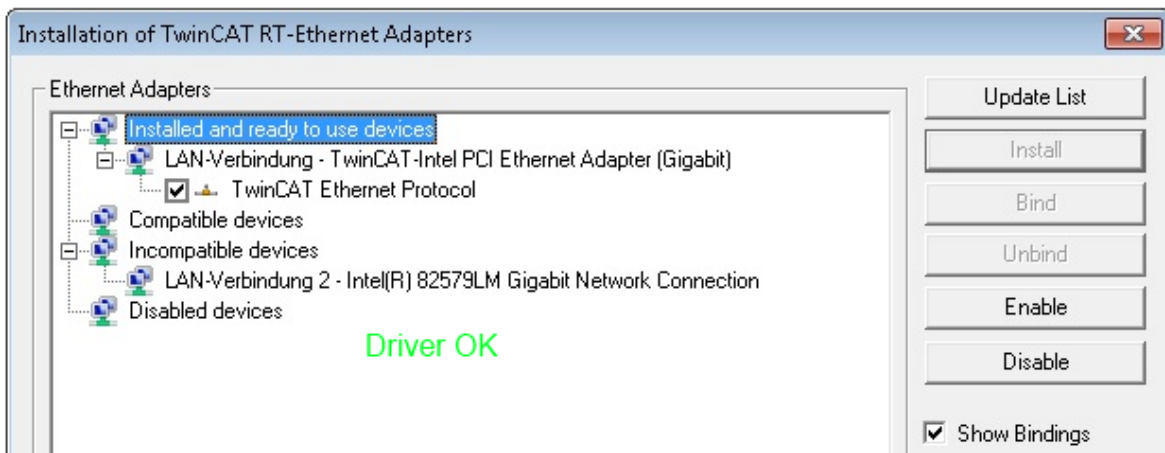
Fig. 81: Exemplary correct driver setting for the Ethernet port

Other possible settings have to be avoided:
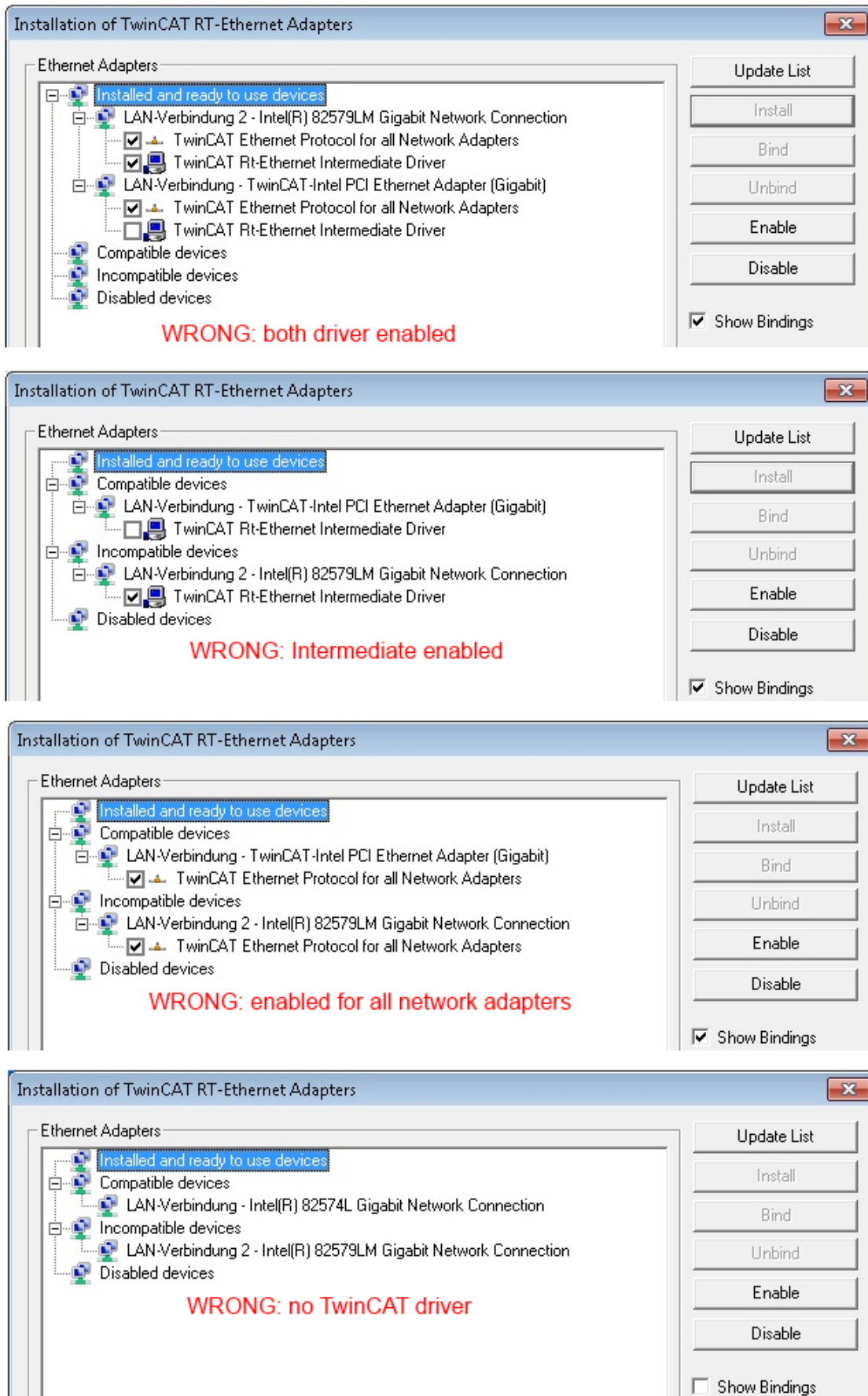
Fig. 82: Incorrect driver settings for the Ethernet port

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.
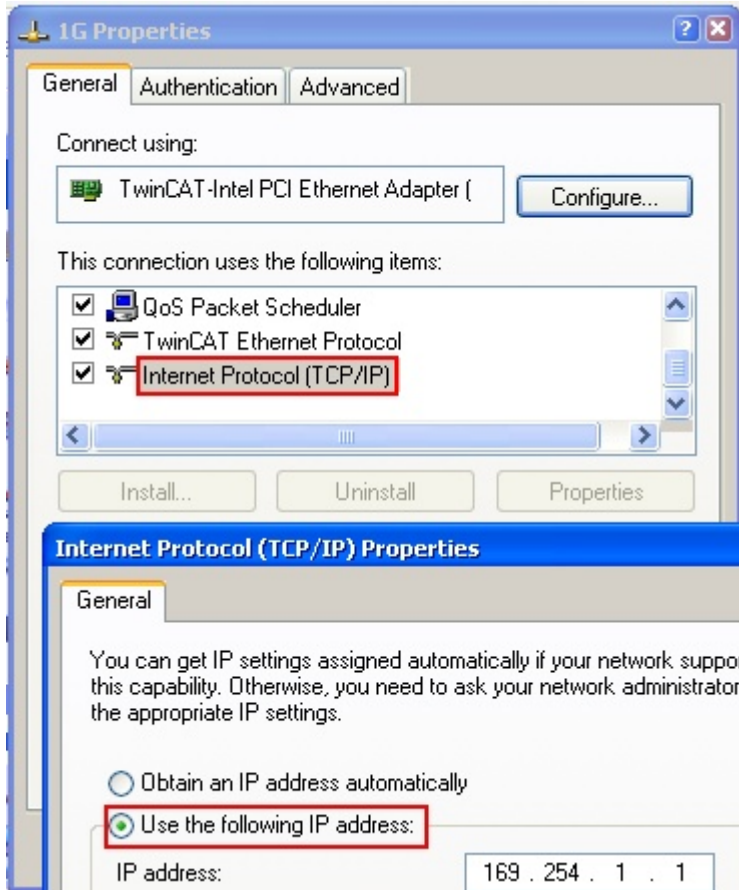
Fig. 83: TCP/IP setting for the Ethernet port

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 [▶ 89] 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"
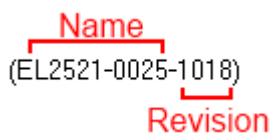
Fig. 84: Identifier structure

The order identifier consisting of name + type (here: EL2521-0010) 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 [▶ 11].

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.
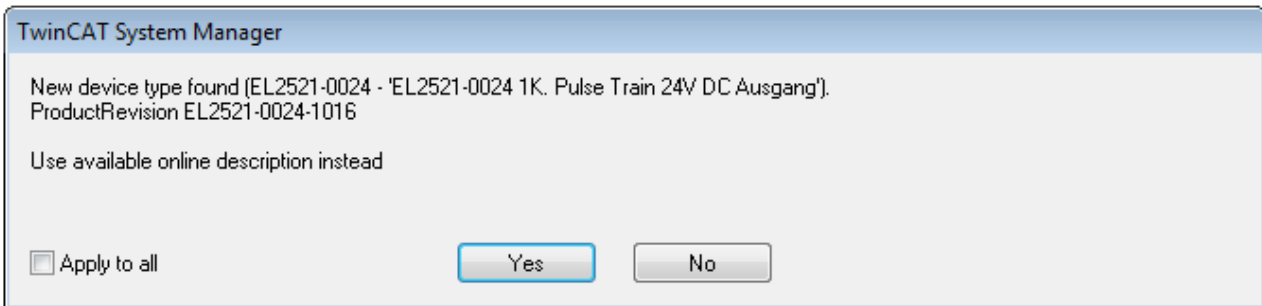
Fig. 85: OnlineDescription information window (TwinCAT 2)

In TwinCAT 3 a similar window appears, which also offers the Web update:
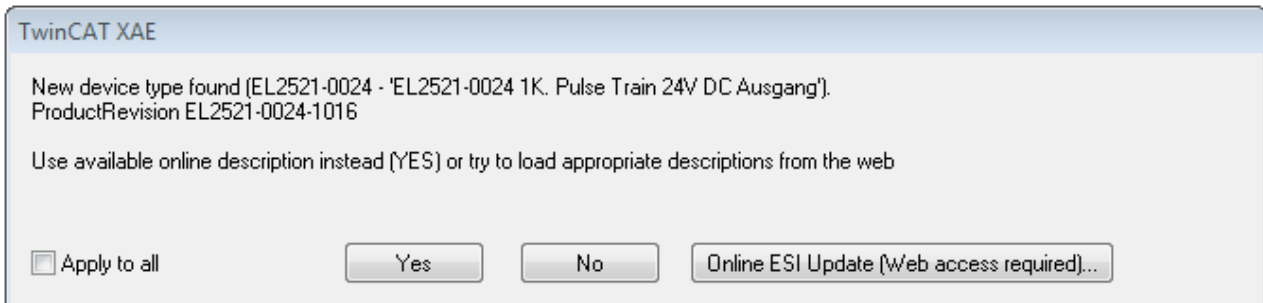
Fig. 86: Information window OnlineDescription (TwinCAT 3)

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.

NOTE
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 [▶ 90]".

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. 87: 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*).
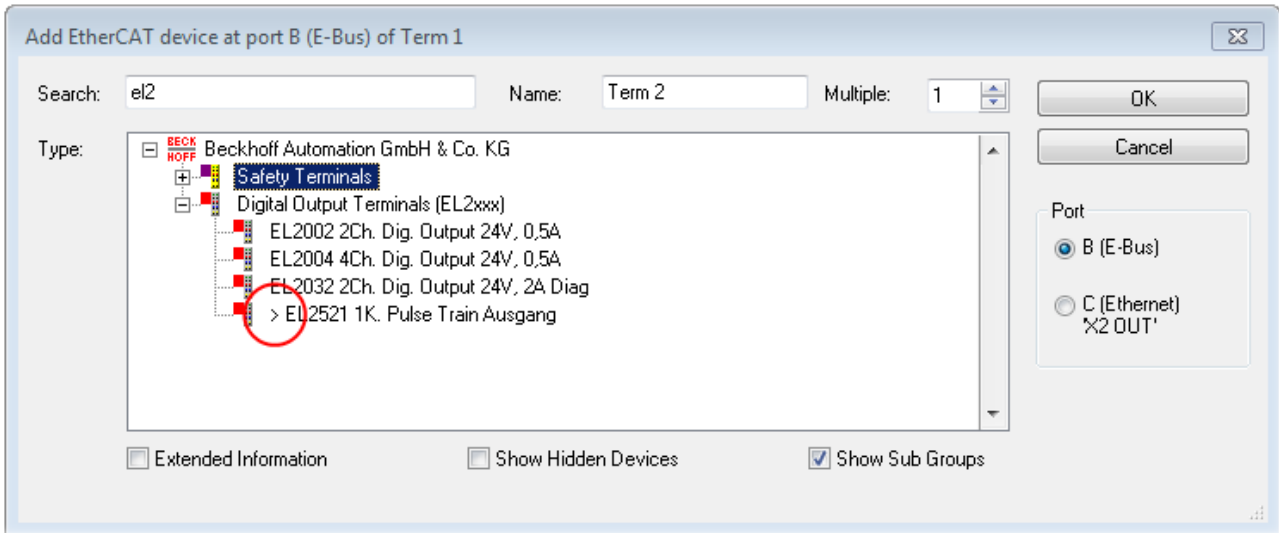
Fig. 88: Indication of an online recorded ESI of EL2521 as an example

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

---

ℹ   **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.
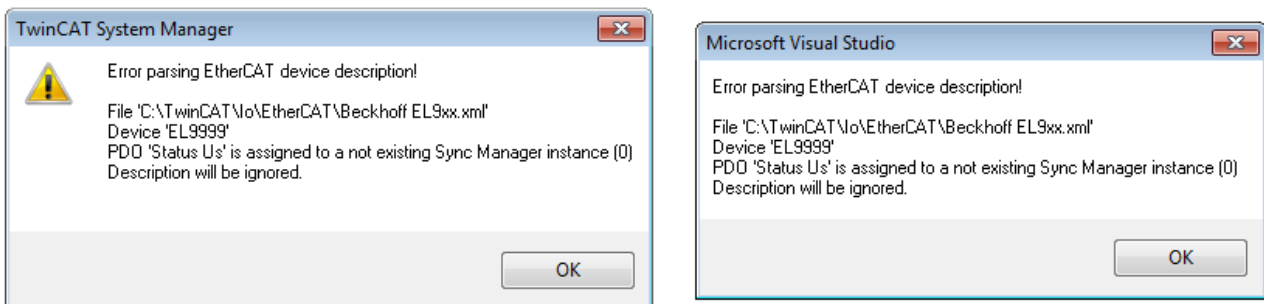
Fig. 89: Information window for faulty ESI file (left: TwinCAT 2; right: TwinCAT 3)

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:
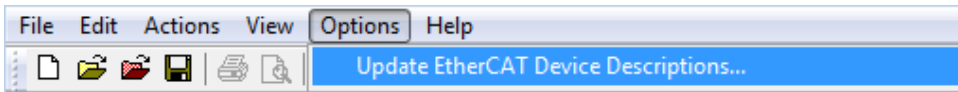
Fig. 90: Using the ESI Updater (>= TwinCAT 2.11)

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

Selection under TwinCAT 3:
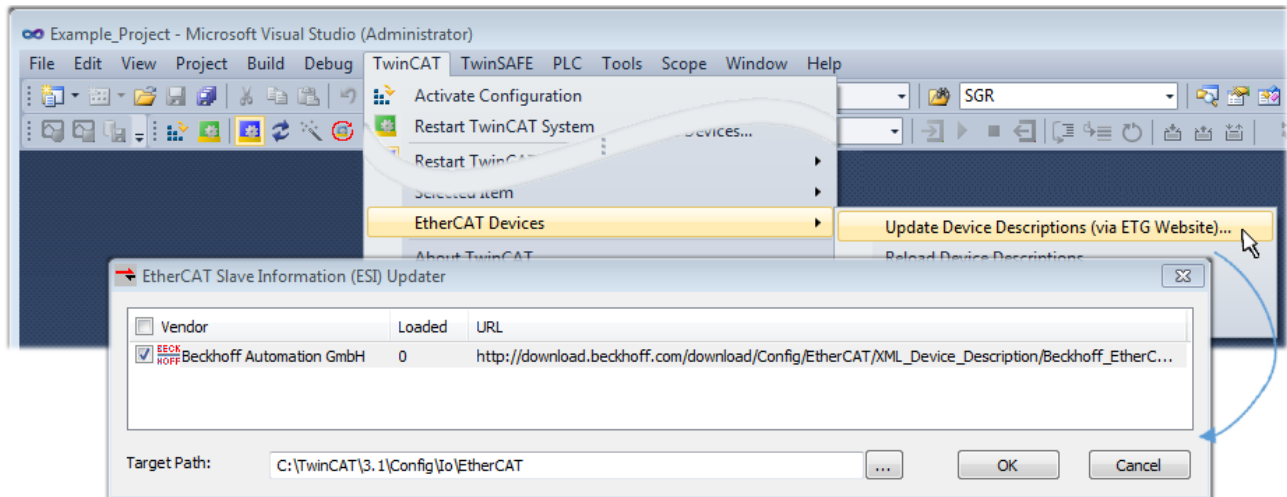
Fig. 91: Using the ESI Updater (TwinCAT 3)

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" [▶ 85].

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 [▶ 95] (Ethernet port at the IPC)
- detecting the connected EtherCAT devices [▶ 96]. This step can be carried out independent of the preceding step
- troubleshooting [▶ 99]

The scan with existing configuration [▶ 100] 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.
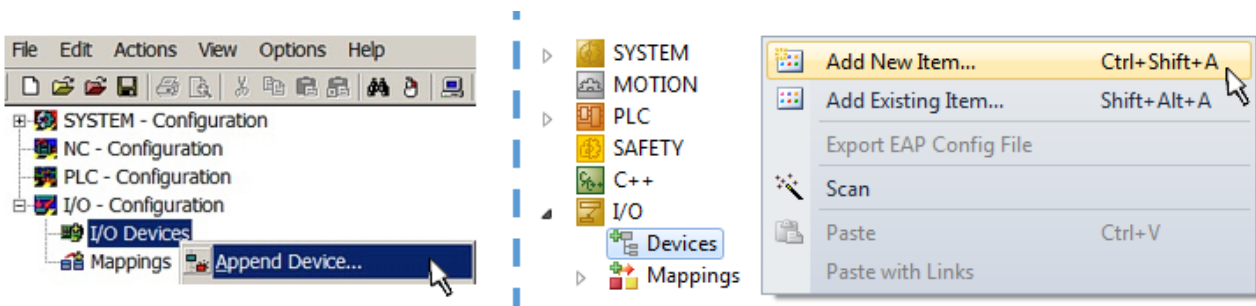
Fig. 92: Append EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)

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".
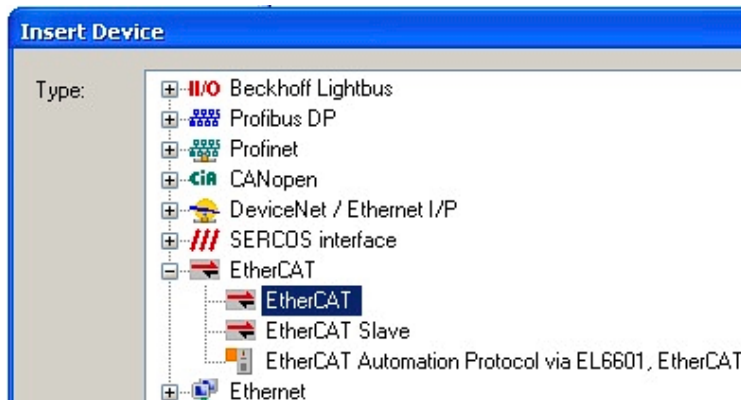
Fig. 93: Selecting the EtherCAT connection (TwinCAT 2.11, TwinCAT 3)

Then assign a real Ethernet port to this virtual device in the runtime system.
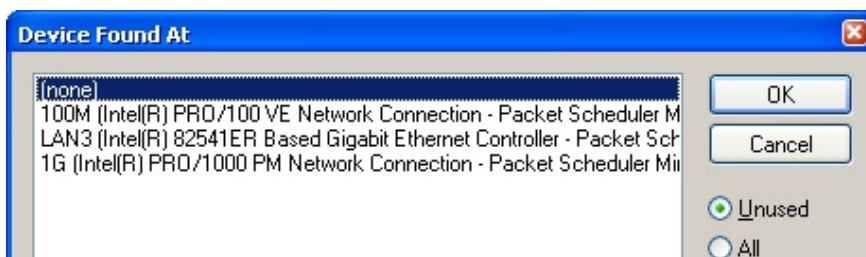
Fig. 94: Selecting the Ethernet port

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)".
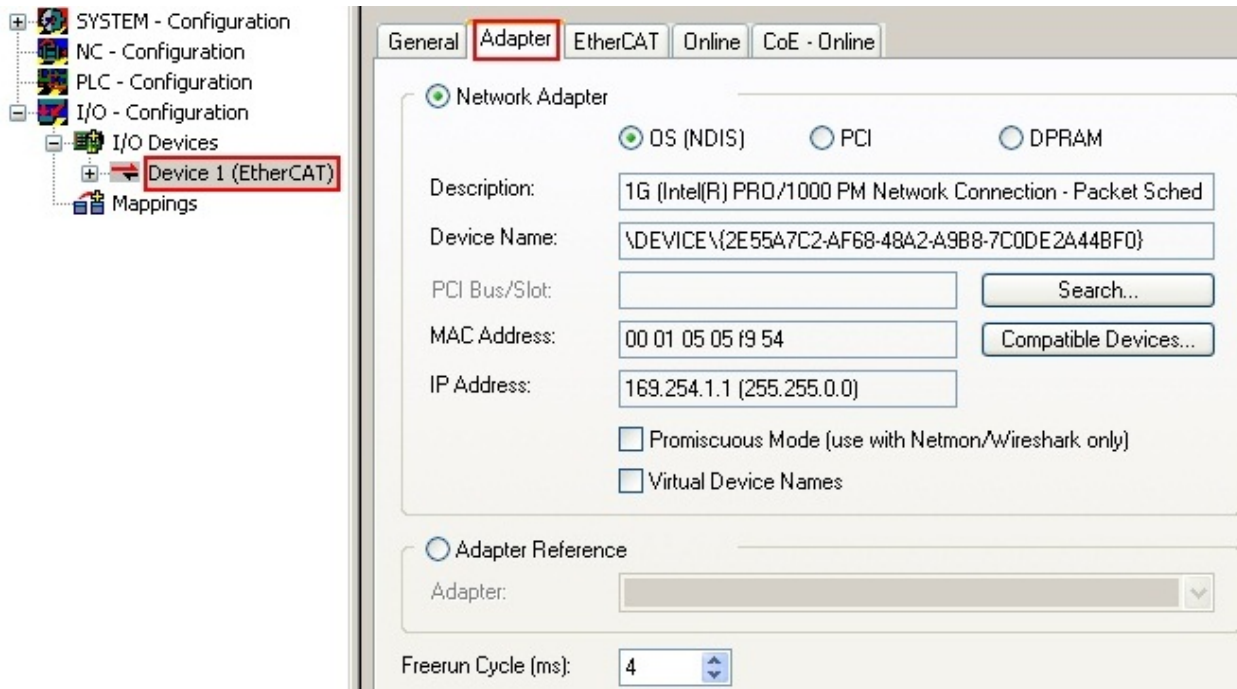
Fig. 95: EtherCAT device properties (TwinCAT 2)

TwinCAT 3: the properties of the EtherCAT device can be opened by double click on "Device .. (EtherCAT)" within the Solution Explorer under "I/O":
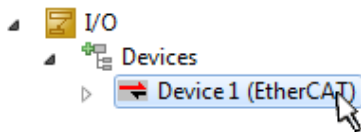
● **Selecting the Ethernet port**

i 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 [▶ 79].

Defining EtherCAT slaves

Further devices can be appended by right-clicking on a device in the configuration tree.
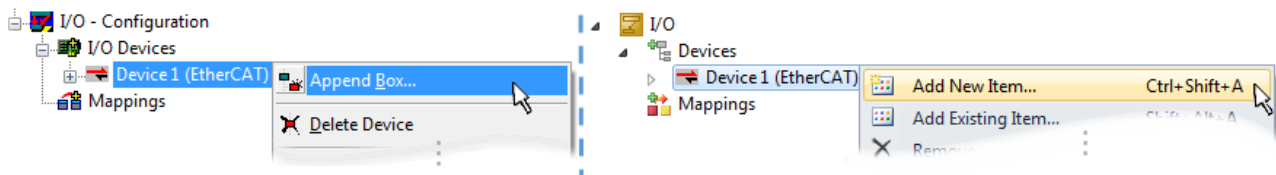
Fig. 96: Appending EtherCAT devices (left: TwinCAT 2; right: TwinCAT 3)

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: EK couplers, EP boxes, devices with RJ45/M8/M12 connector

- "E-Bus": LVDS "terminal bus", "EJ-module": EL/ES terminals, various modular modules

The search field facilitates finding specific devices (since TwinCAT 2.11 or TwinCAT 3).
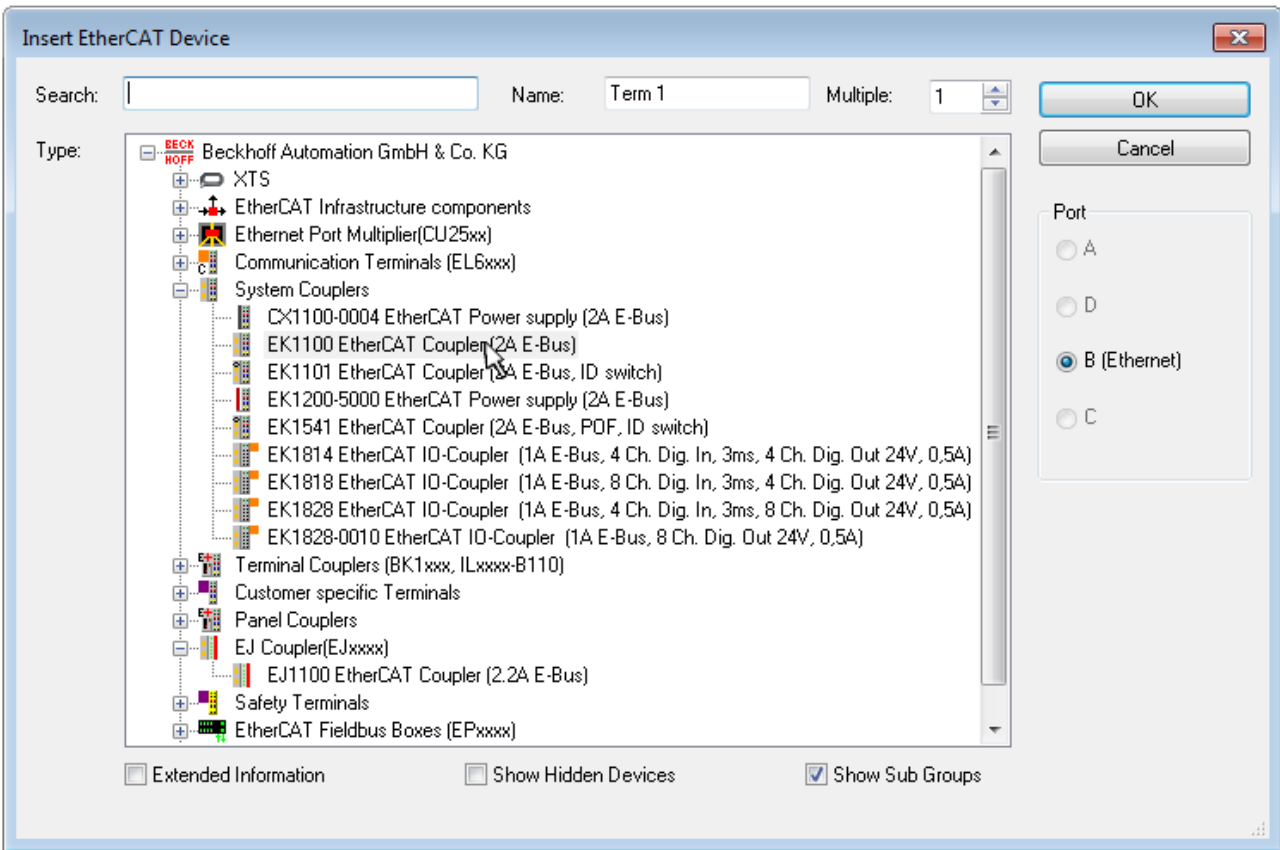
Fig. 97: Selection dialog for new EtherCAT device

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".
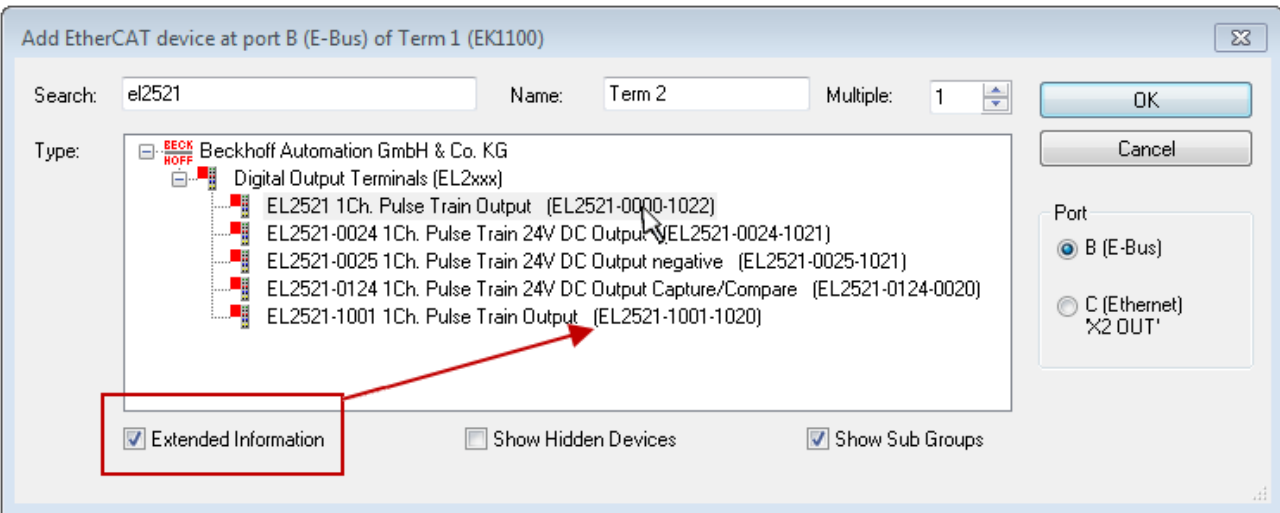
Fig. 98: Display of device revision

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. 99: 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. 100: 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, ...

BECKHOFF
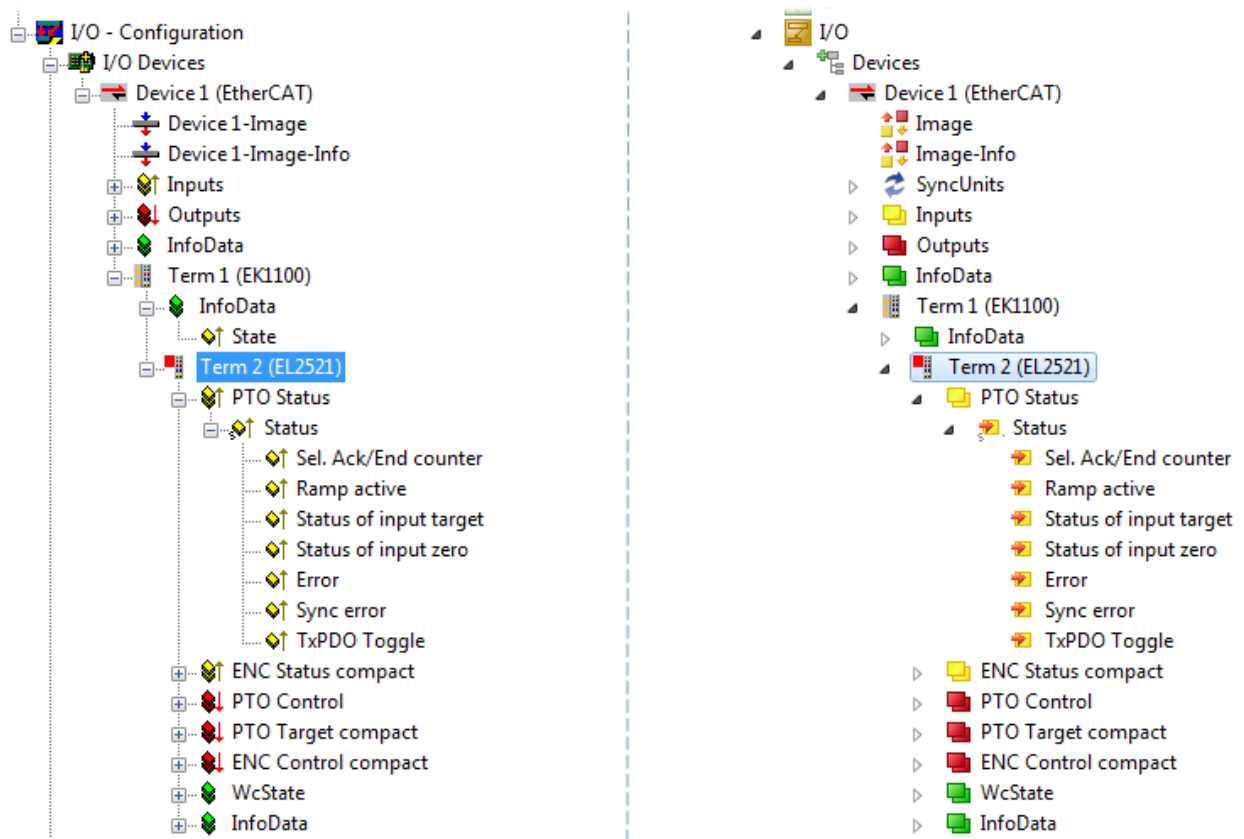
Fig. 101: EtherCAT terminal in the TwinCAT tree (left: TwinCAT 2; right: TwinCAT 3)

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.
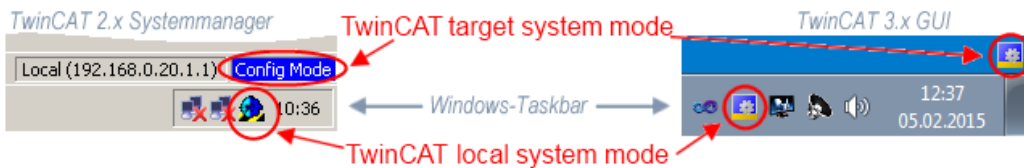
Fig. 102: Differentiation local/target system (left: TwinCAT 2; right: TwinCAT 3)

Right-clicking on "I/O Devices" in the configuration tree opens the search dialog.
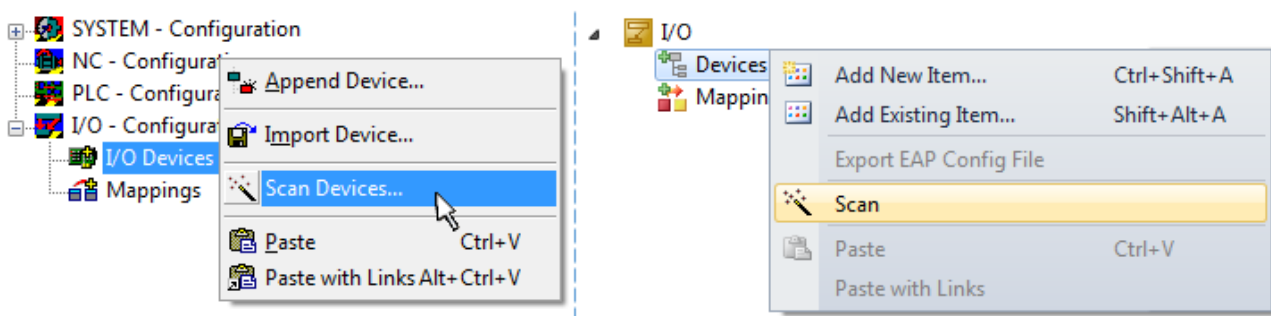
Fig. 103: Scan Devices (left: TwinCAT 2; right: TwinCAT 3)

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.
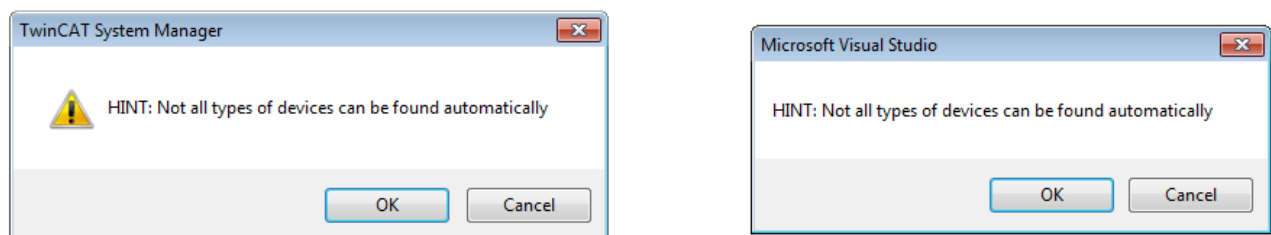
Fig. 104: Note for automatic device scan (left: TwinCAT 2; right: TwinCAT 3)

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" .
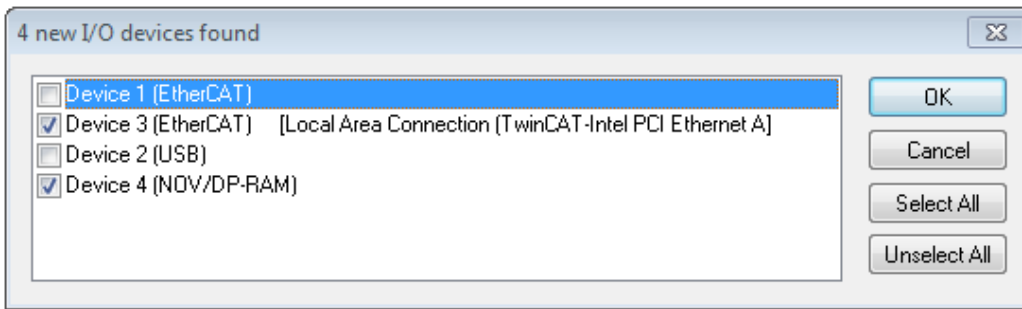
Fig. 105: Detected Ethernet devices

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".

i **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 [▶ 79].

Detecting/Scanning the EtherCAT devices

i **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. 106: Example default state

NOTE
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 [▶ 100] 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:
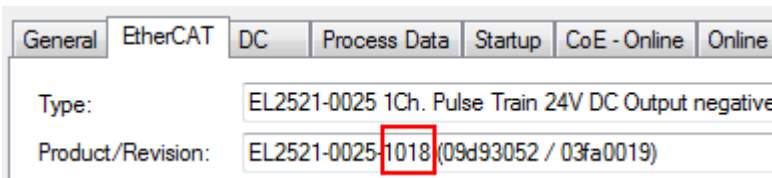
Fig. 107: Installing EthetCAT terminal with revision -1018

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 <u>comparative scan [▶ 100]</u> 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:
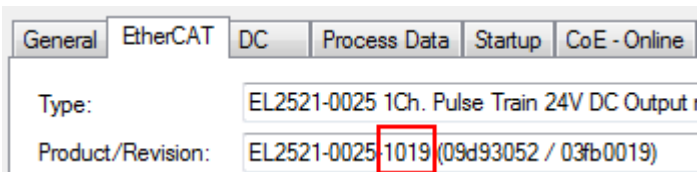
Fig. 108: Detection of EtherCAT terminal with revision -1019

This is usually not noticed by the commissioning engineers. TwinCAT cannot signal anything either, since virtually a new configuration is 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.
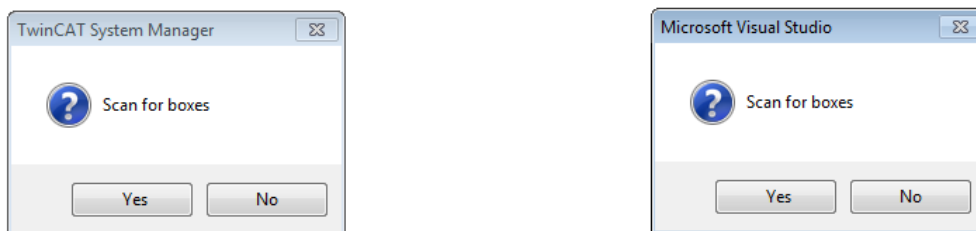
Fig. 109: Scan query after automatic creation of an EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)
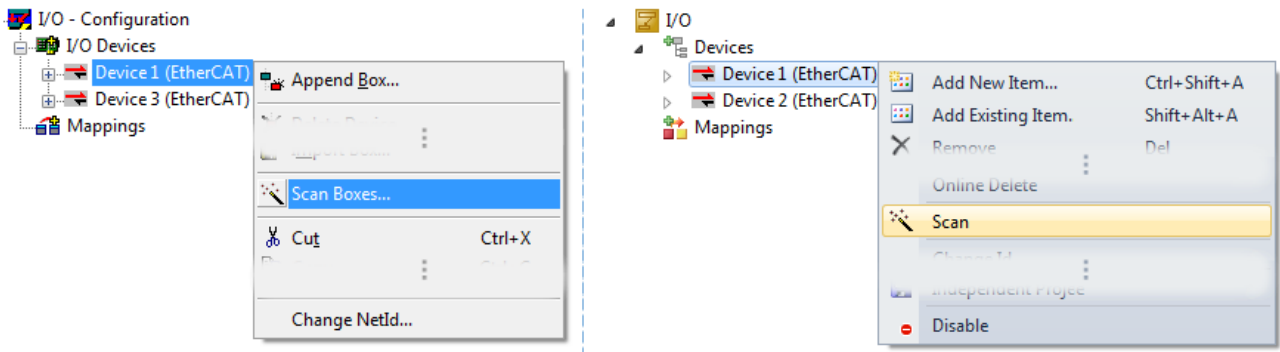
Fig. 110: Manual triggering of a device scan on a specified EtherCAT device (left: TwinCAT 2; right: TwinCAT 3)

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.
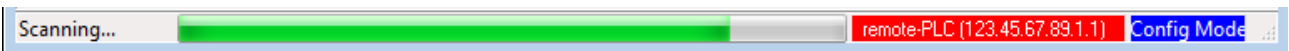
Fig. 111: *Scan progressexemplary by TwinCAT 2*

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

Fig. 112: 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. 113: Displaying of "Free Run" and "Config Mode" toggling right below in the status bar

Fig. 114: 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*.
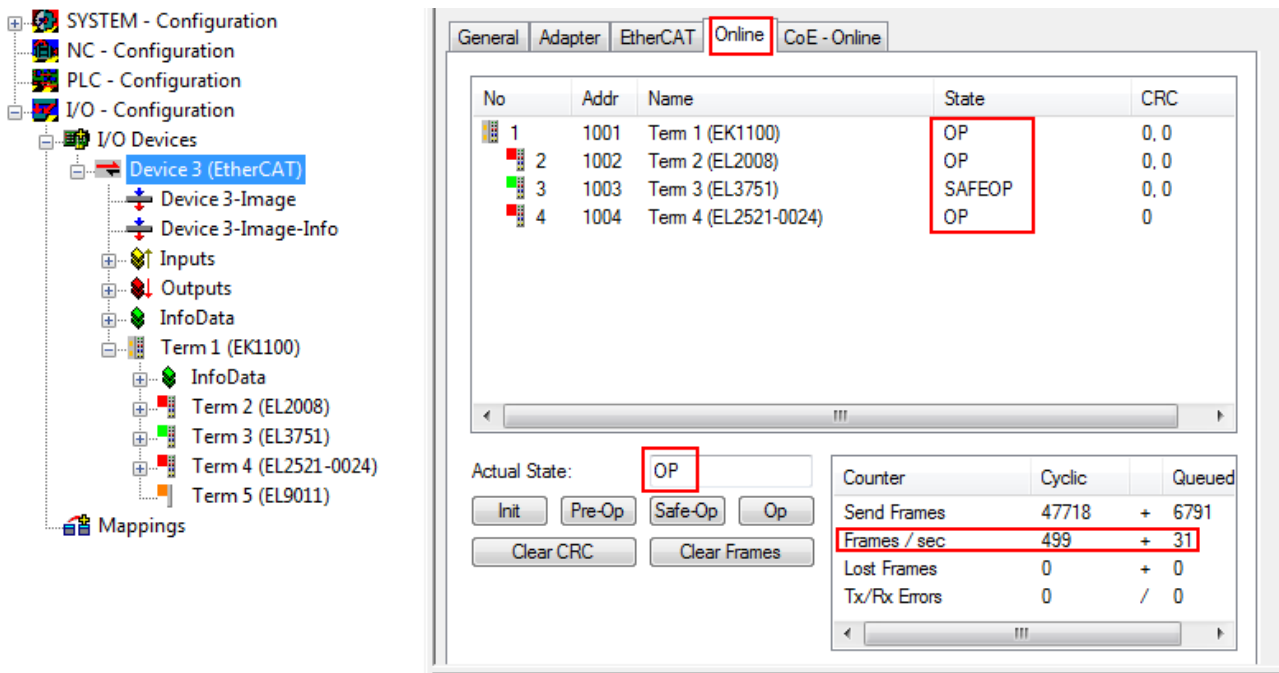
Fig. 115: Online display example

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 [▶ 90].

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.
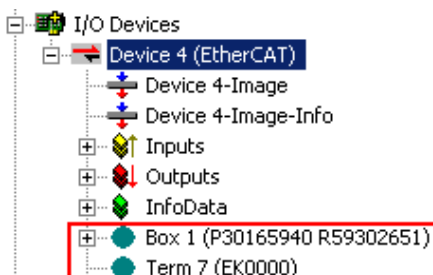
Fig. 116: Faulty identification

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

BECKHOFF

Scan over existing Configuration

NOTE
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. 117: 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.
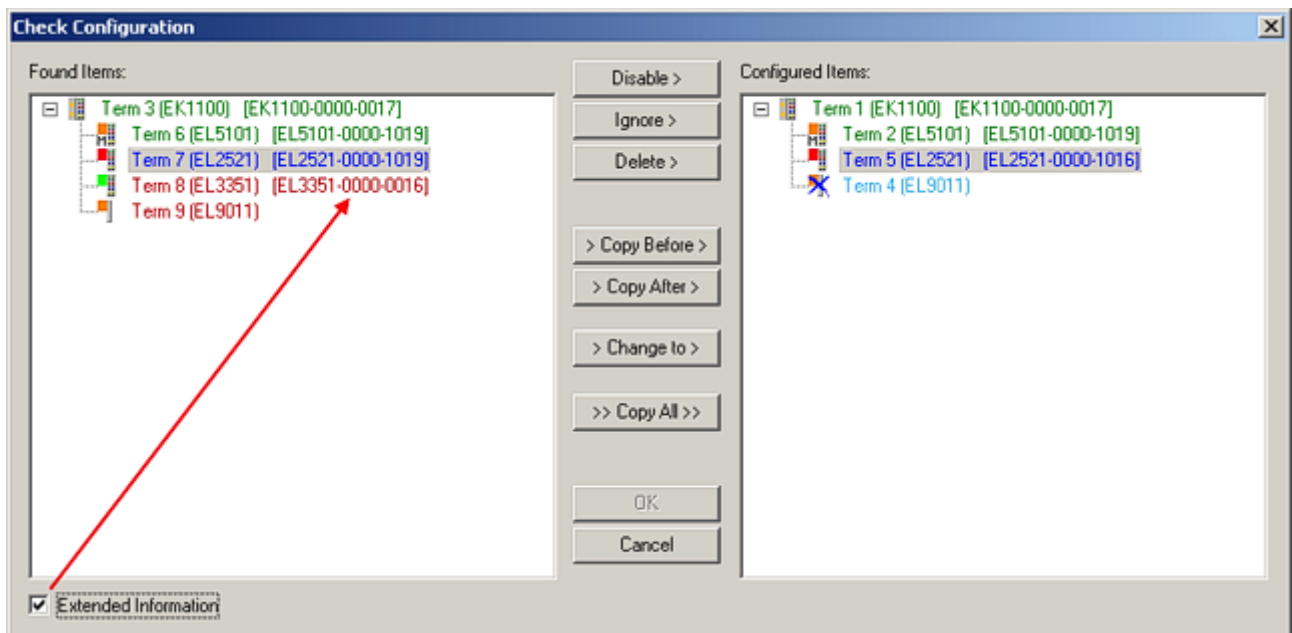
Fig. 118: Correction dialog

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.

Name
(EL2521-0025-1018)
Revision

Fig. 119: 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, ...
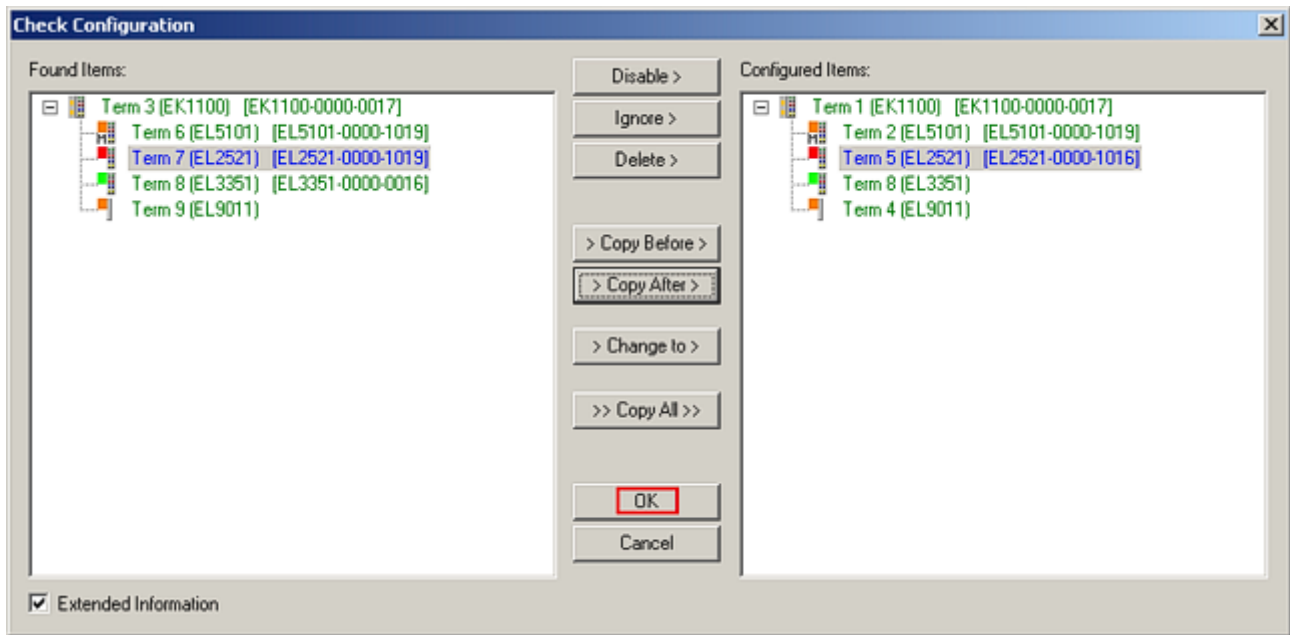
Fig. 120: Correction dialog with modifications

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.
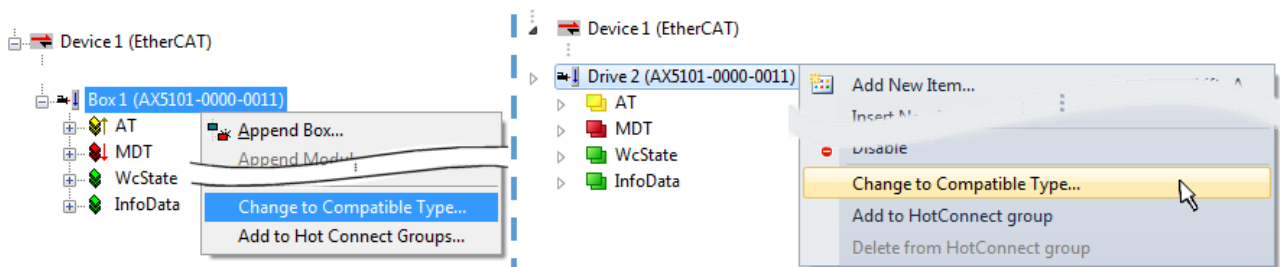
Fig. 121: Dialog "Change to Compatible Type…" (left: TwinCAT 2; right: TwinCAT 3)

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
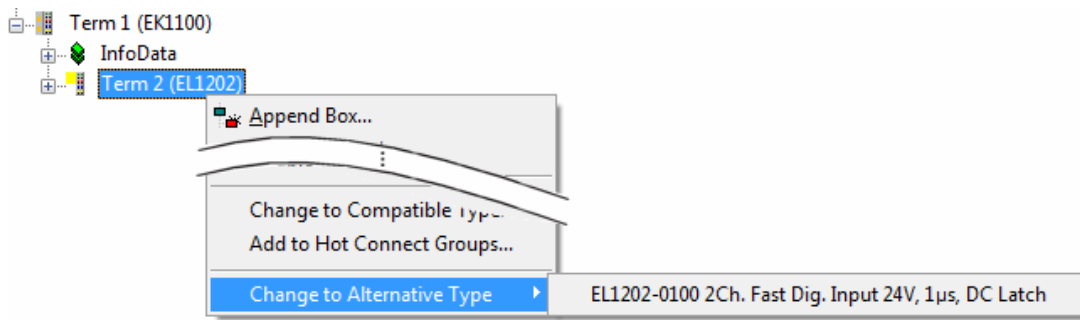
Fig. 122: TwinCAT 2 Dialog Change to Alternative Type

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).
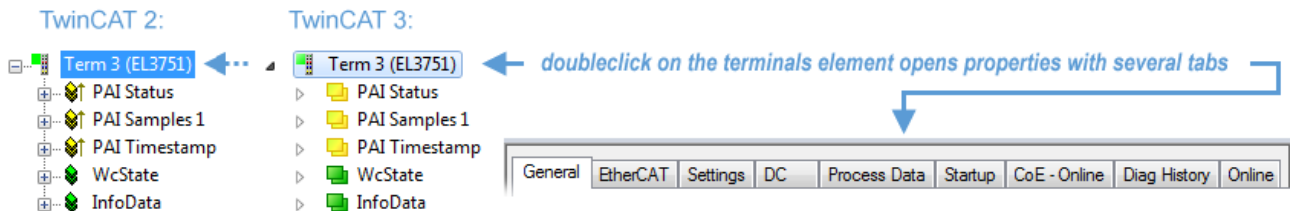
Fig. 123: Branch element as terminal EL3751

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
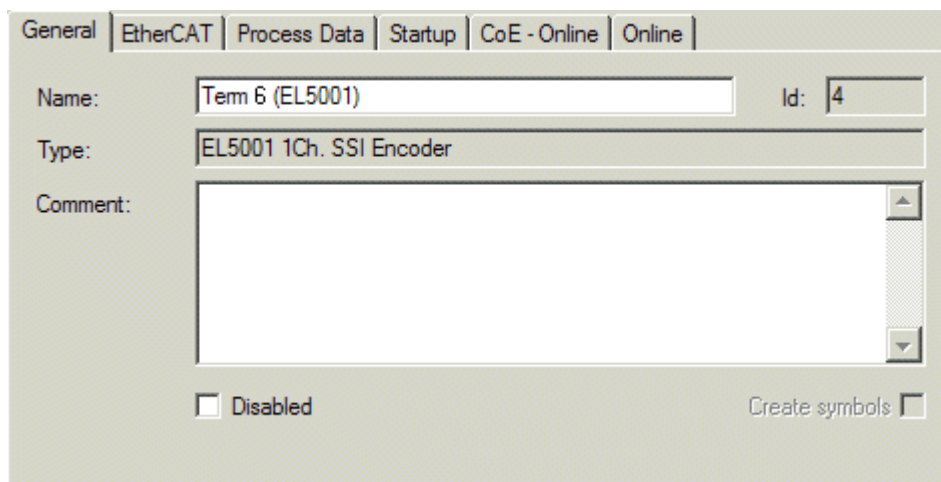
Fig. 124: "General" tab

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. 125: "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.
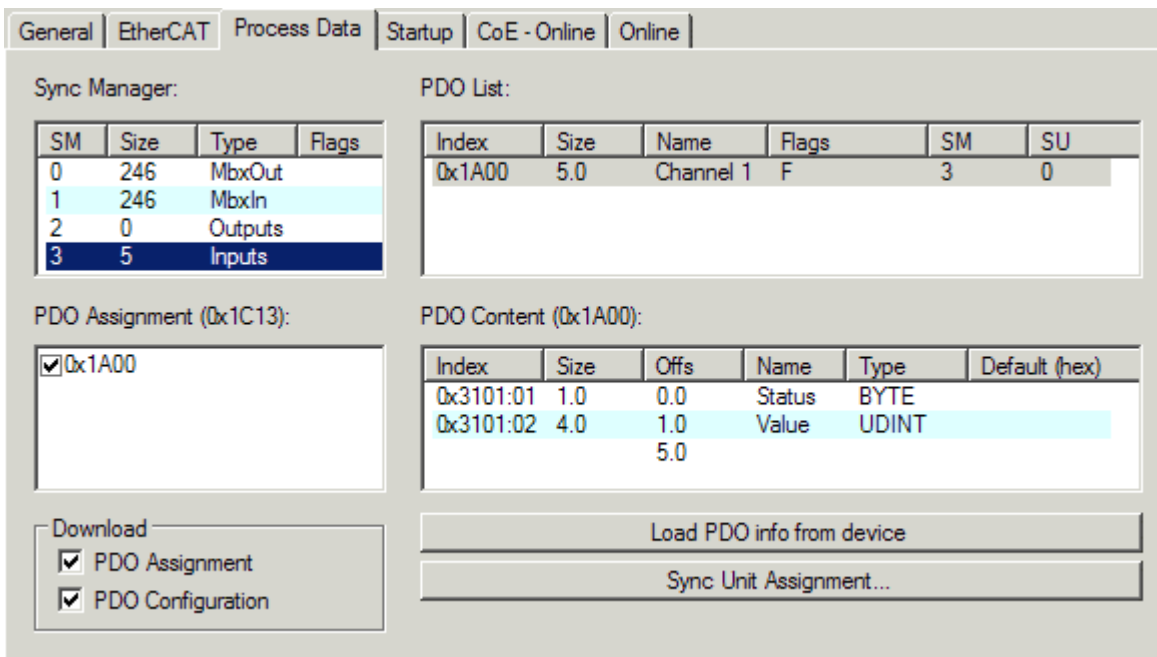
Fig. 126: "Process Data" tab

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").
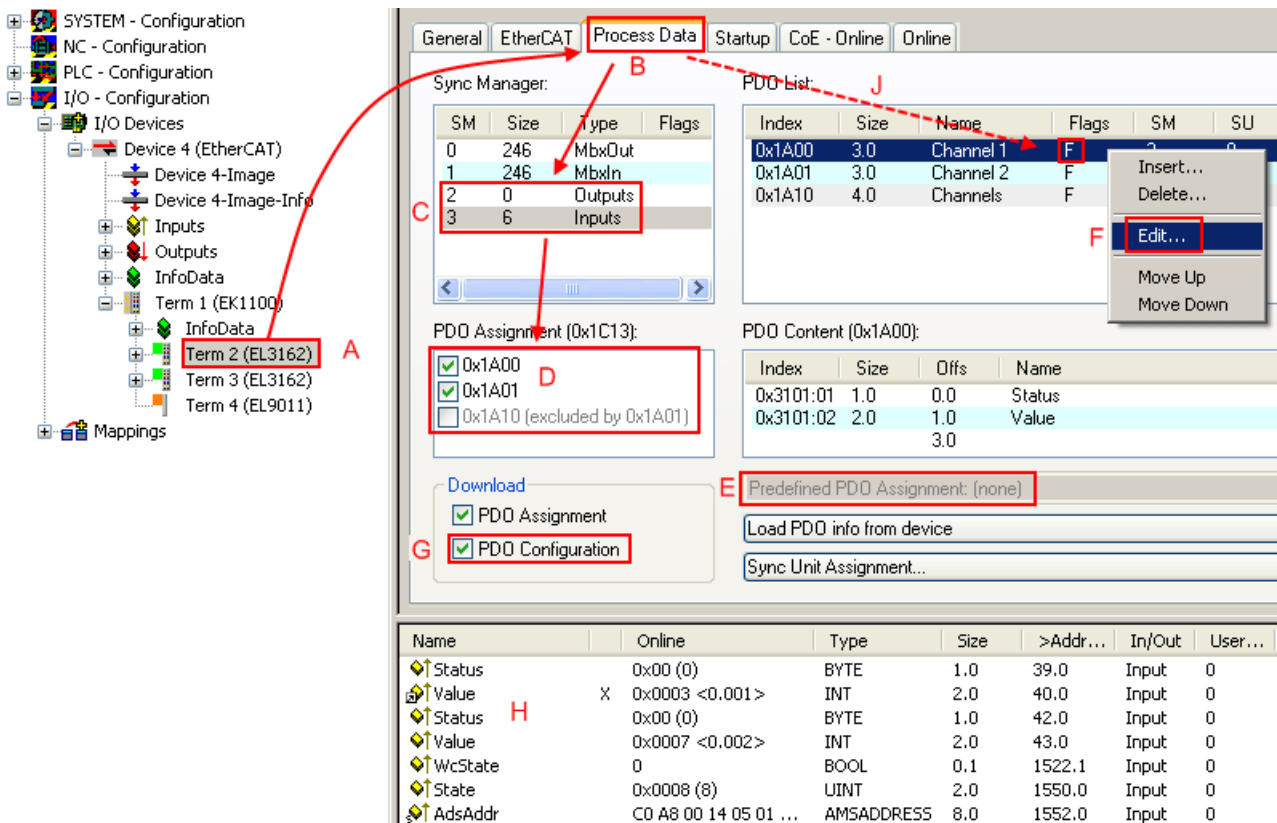
Fig. 127: Configuring the process data

ⓘ **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 [▶ 111] 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.
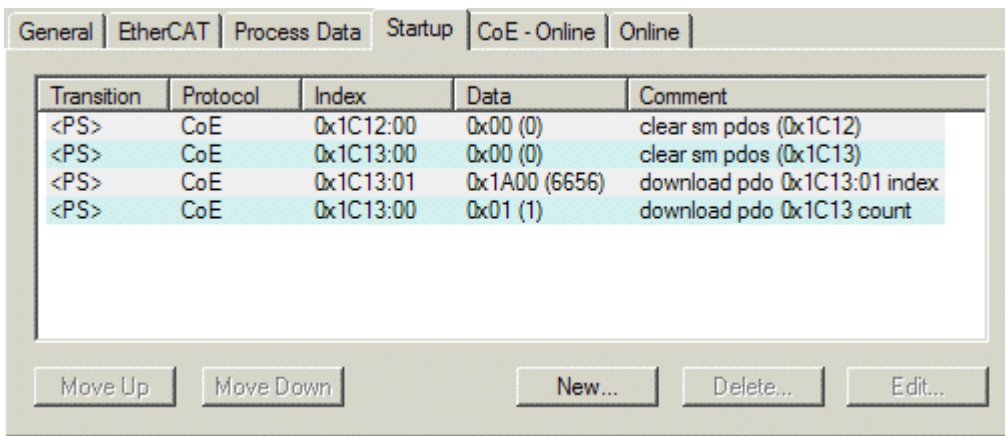
Fig. 128: "Startup" tab

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.

BECKHOFF
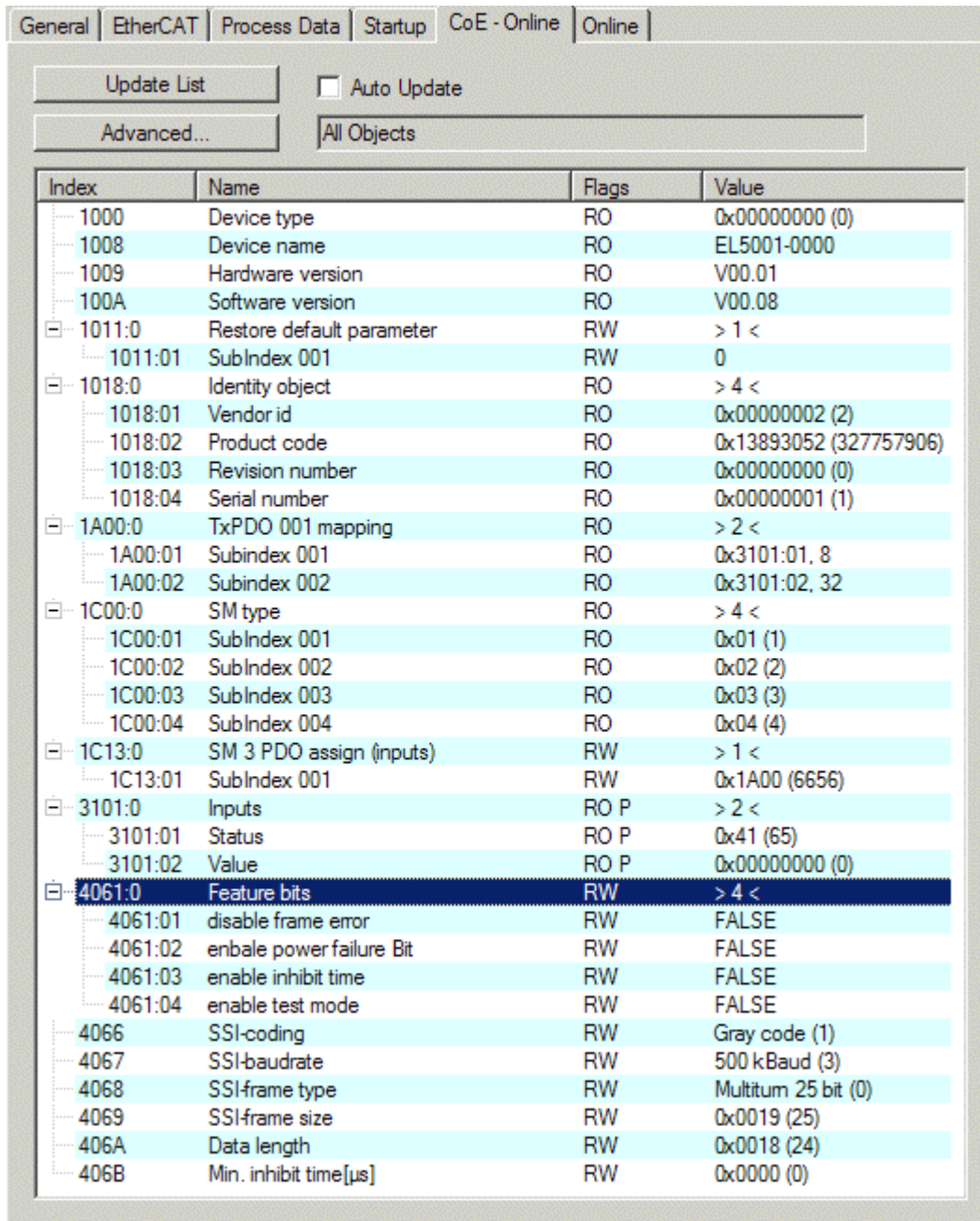
Fig. 129: "CoE - Online" tab

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.
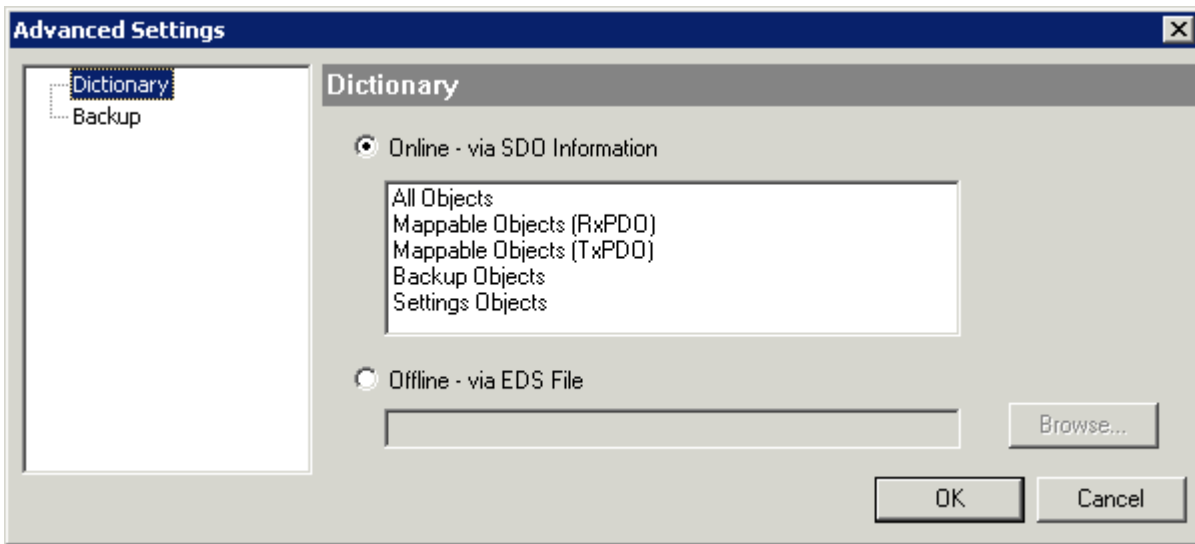
Fig. 130: Dialog "Advanced settings"

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
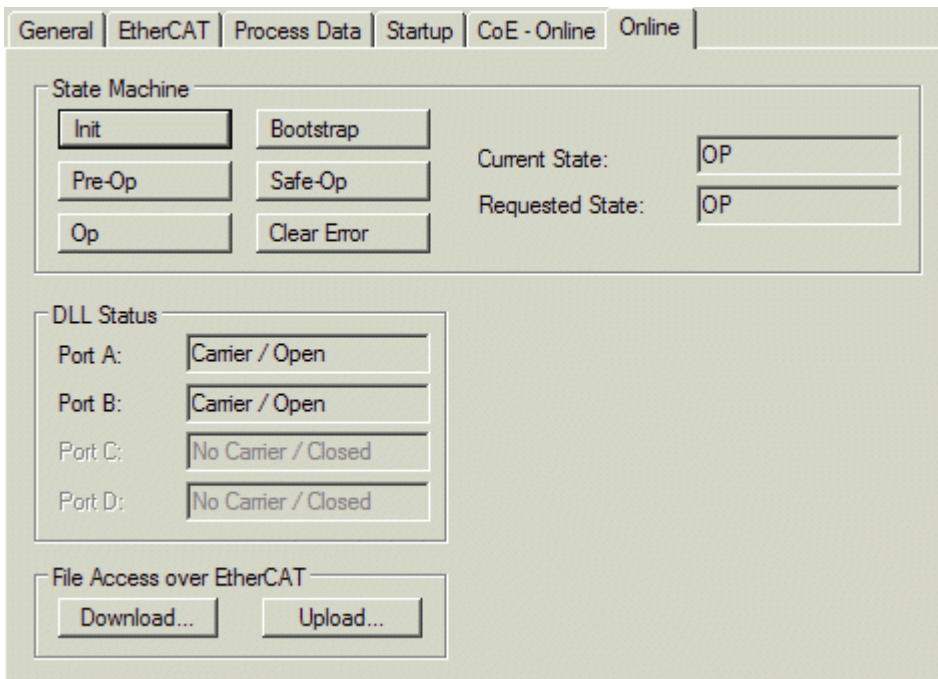
Fig. 131: "Online" tab

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)
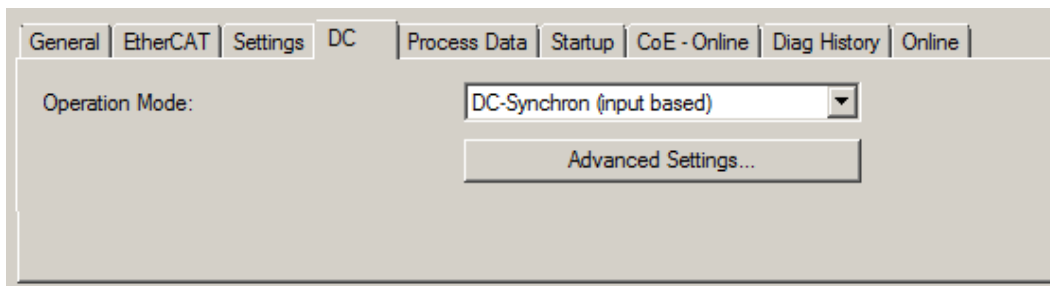
Fig. 132: "DC" tab (Distributed Clocks)

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 Download revision

ℹ **Download revision in Start-up list**

Several terminals / modules generate the entry from object 0xF081:01 in the Start-up list automatically (see fig. "Download revision in Start-up list").

The object 0xF081:01 (Download revision) describes the revision of the terminal / module, e.g. 0x0018000*A* for EL7201-00*10*-00**24**, and is necessary to ensure compatibility.

Please note, that you must not delete this entry from the Start-up list!

	General	EtherCAT	Drive Manager	DC	Process Data	Startup	CoE - Online	Diag History	Online

Transition	Protocol	Index	Data	Comment
C <PS>	CoE	0x1C12 C 0	02 00 00 16 01 16	download pdo 0x1C12 index
C <PS>	CoE	0x1C13 C 0	02 00 00 1A 01 1A	download pdo 0x1C13 index
C IP	CoE	0xF081:01	0x0018000A (1572874)	

Fig. 133: Download revision in Start-up list

6.2.7.2 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.

ℹ **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 <u>Online tab [▶ 109]</u>),

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 [▶ 106] 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.

6.3 General Notes - EtherCAT Slave Application

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.
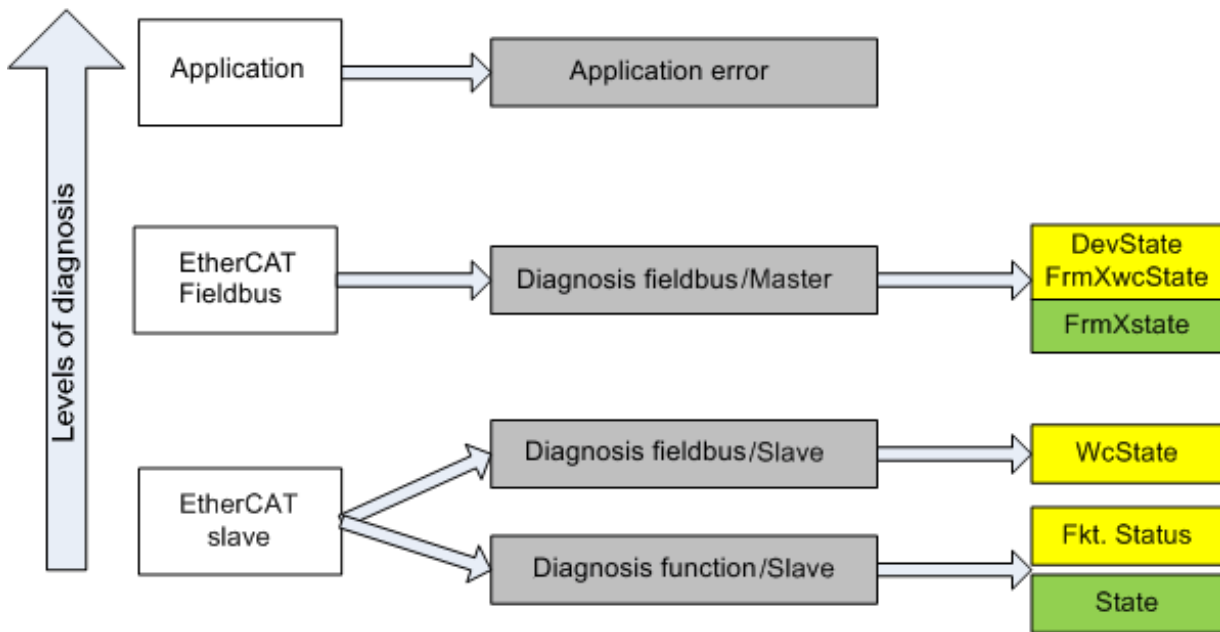
Fig. 134: Selection of the diagnostic information of an EtherCAT Slave

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.
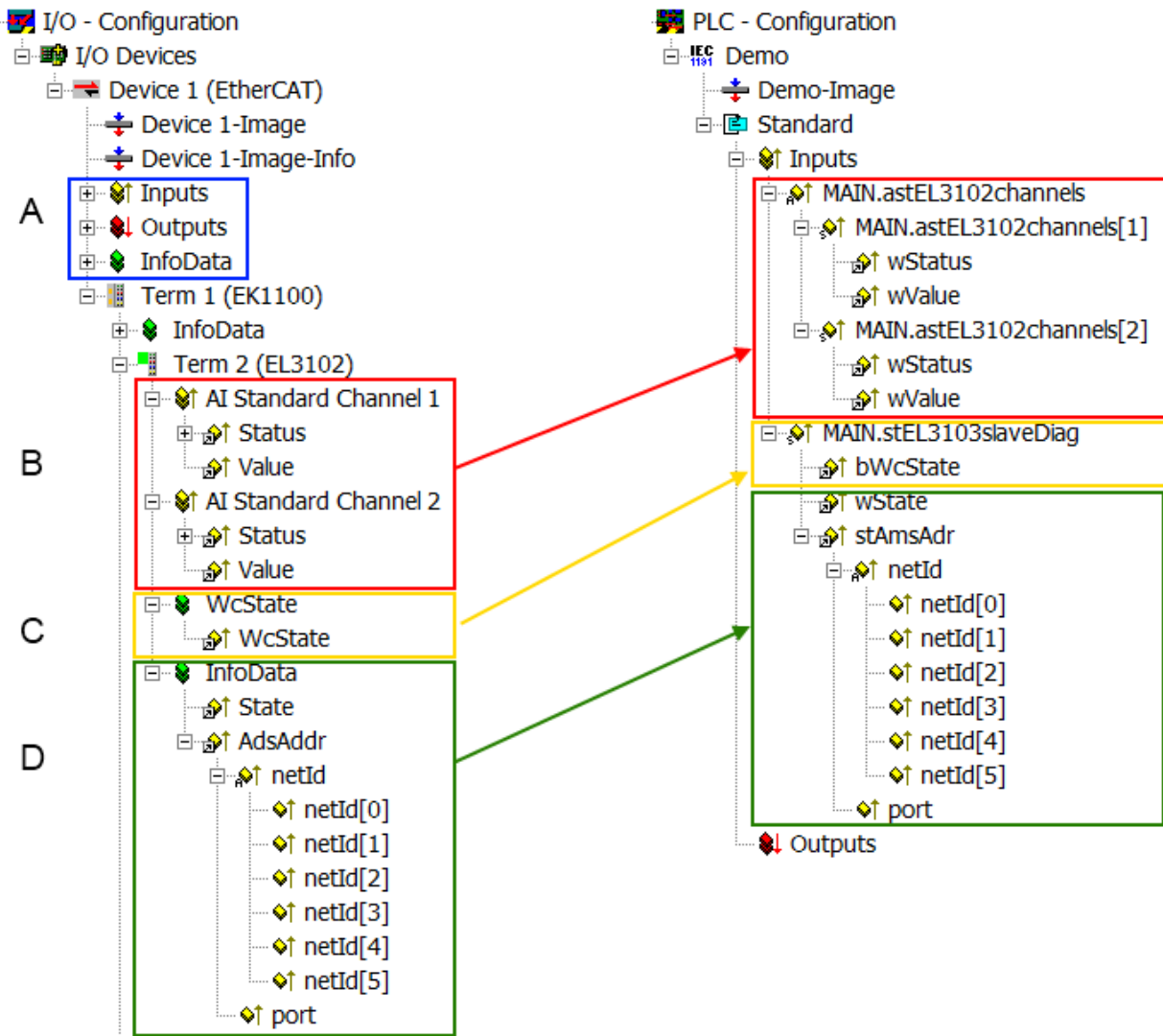
Fig. 135: Basic EtherCAT Slave Diagnosis in the PLC

The following aspects are covered here:

Code	Function	Implementation	Application/evaluation
A	The EtherCAT Master's diagnostic information updated acyclically (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.

> **NOTE**
>
> **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*:
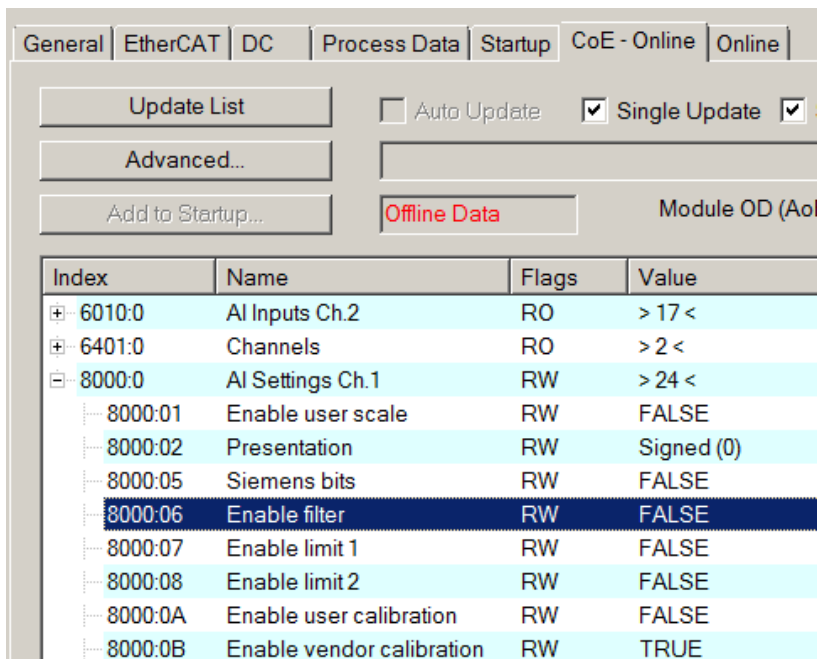
Fig. 136: EL3102, CoE directory

ℹ️ **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.
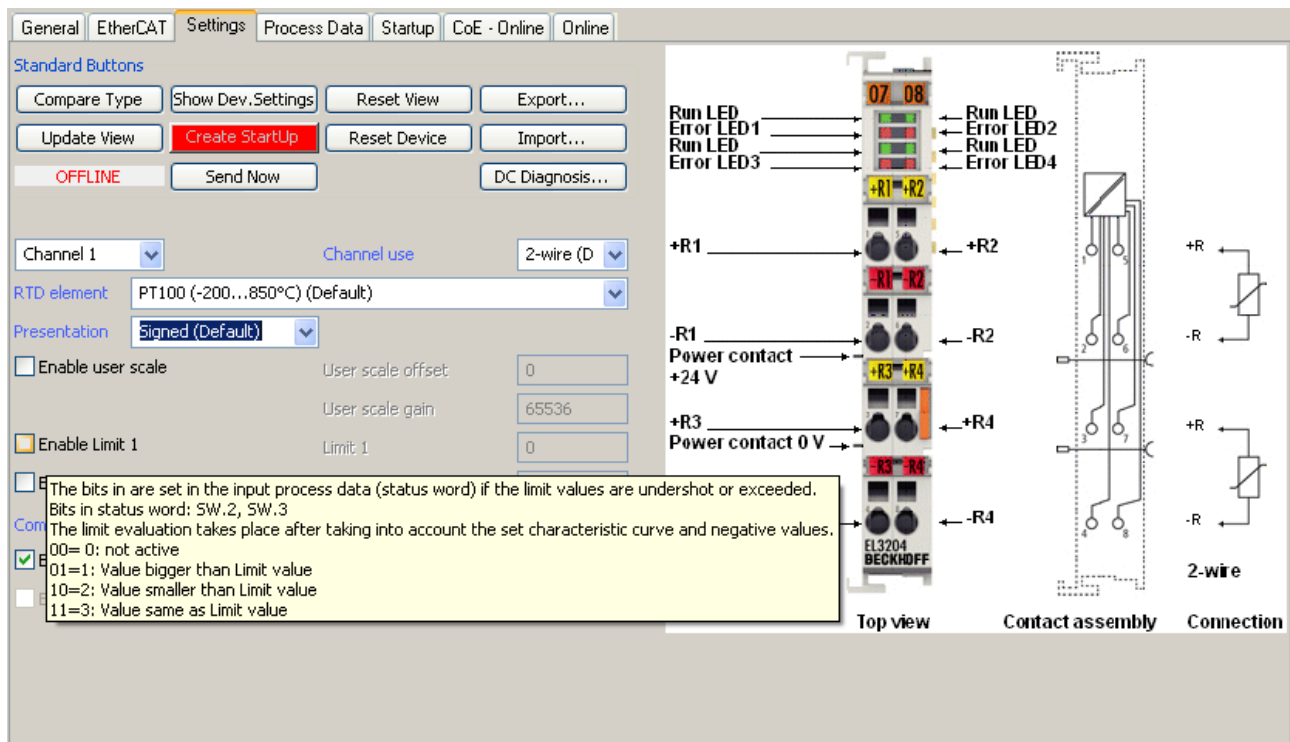
Fig. 137: Example of commissioning aid for a EL3204

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 [▶ 25]" 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.
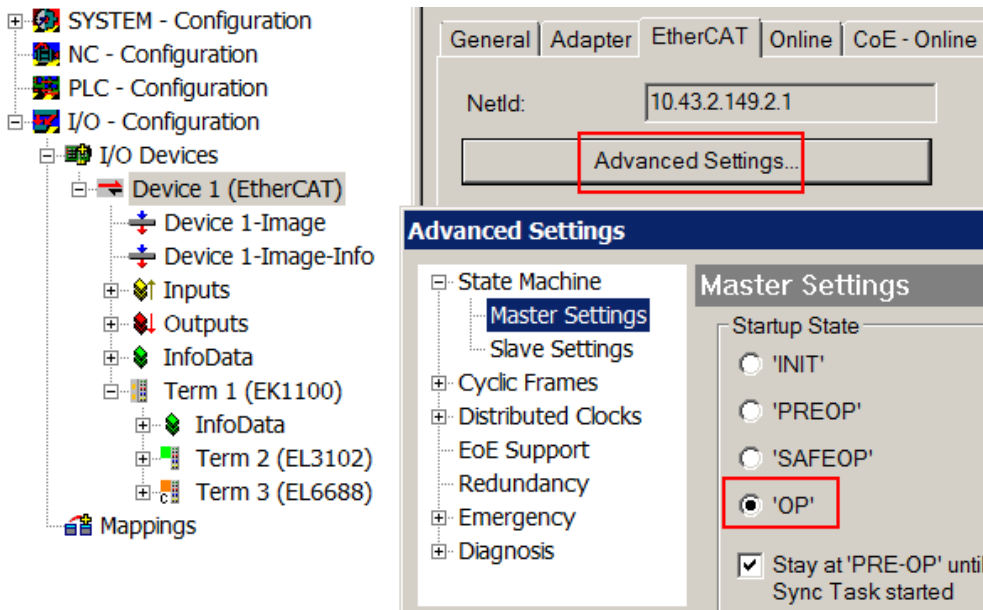
Fig. 138: Default behaviour of the System Manager

In addition, the target state of any particular Slave can be set in the "Advanced Settings" dialogue; the standard setting is again OP.
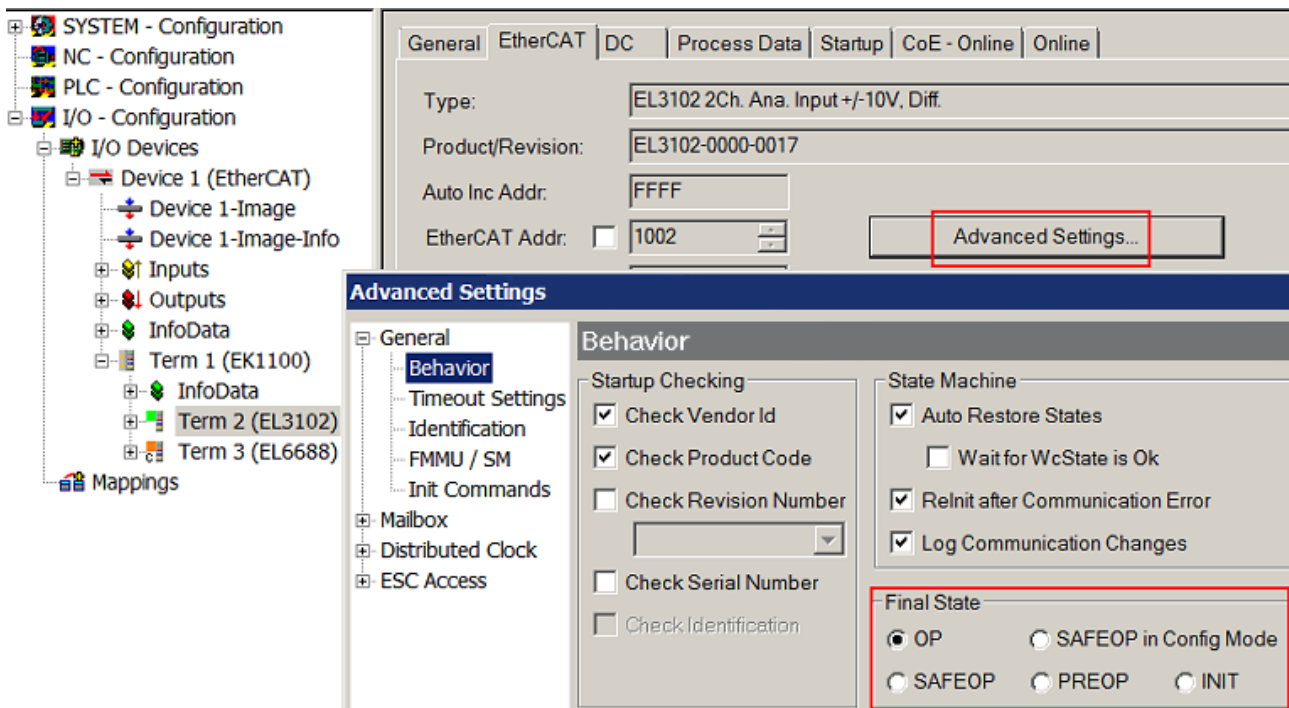
Fig. 139: Default target state in the Slave

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.
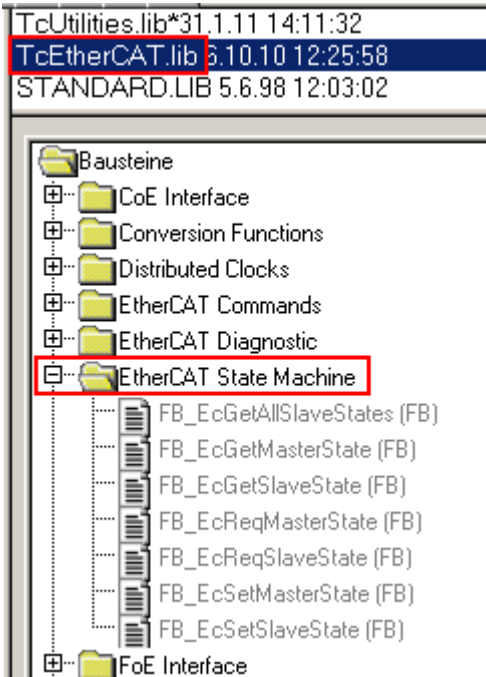
Fig. 140: PLC function blocks

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.

BECKHOFF

Number	Box Name	Address	Type	In Size	Out S...	E-Bus (..
1	Term 1 (EK1100)	1001	EK1100			
2	Term 2 (EL3102)	1002	EL3102	8.0		1830
3	Term 4 (EL2004)	1003	EL2004		0.4	1730
4	Term 5 (EL2004)	1004	EL2004		0.4	1630
5	Term 6 (EL7031)	1005	EL7031	8.0	8.0	1510
6	Term 7 (EL2808)	1006	EL2808		1.0	1400
7	Term 8 (EL3602)	1007	EL3602	12.0		1210
8	Term 9 (EL3602)	1008	EL3602	12.0		1020
9	Term 10 (EL3602)	1009	EL3602	12.0		830
10	Term 11 (EL3602)	1010	EL3602	12.0		640
11	Term 12 (EL3602)	1011	EL3602	12.0		450
12	Term 13 (EL3602)	1012	EL3602	12.0		260
13	Term 14 (EL3602)	1013	EL3602	12.0		70
14	Term 3 (EL6688)	1014	EL6688	22.0		-240 !

NetId: 10.43.2.149.2.1

Advanced Settings...

General | Adapter | EtherCAT | Online | CoE - Online

Fig. 141: 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:

Message

E-Bus Power of Terminal 'Term 3 (EL6688)' may to low (-240 mA) - please check!
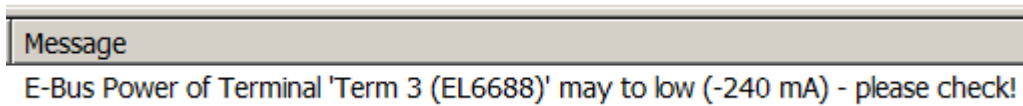
Fig. 142: Warning message for exceeding E-Bus current

NOTE
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   Integration into the NC configuration (manually)

(Master: TwinCAT 2.11)

ⓘ   **EtherCAT XML Device Description**

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

Integration into the NC can be accomplished as follows:

- The terminal must already have been added manually under I/O devices or have been scanned in by the system (see chapter Configuration set-up in TwinCAT).

- First add a new task. Right-click on NC configuration and select "Append Task..." (see Fig. *Adding a new task*).

- Rename the task if required and confirm with OK.
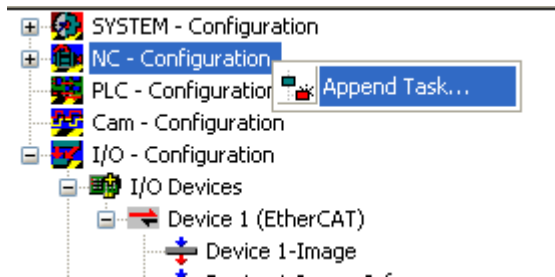
Fig. 143: *Adding a new task*

- Right-click on *Axes*, then add a new axis (see Fig. *Adding a new axis*).
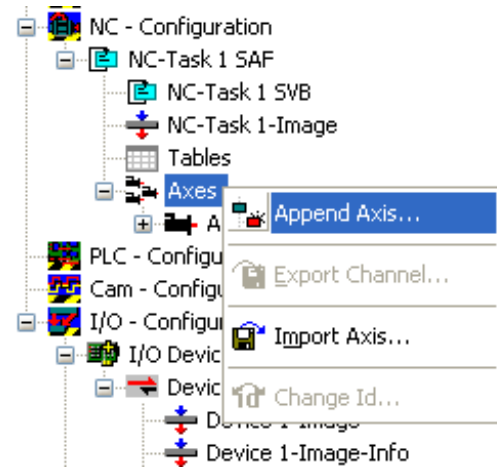
Fig. 144: Adding a new axis

- Select Continuous Axis type and confirm with OK (see Fig. *Selecting and confirming the axis type*).
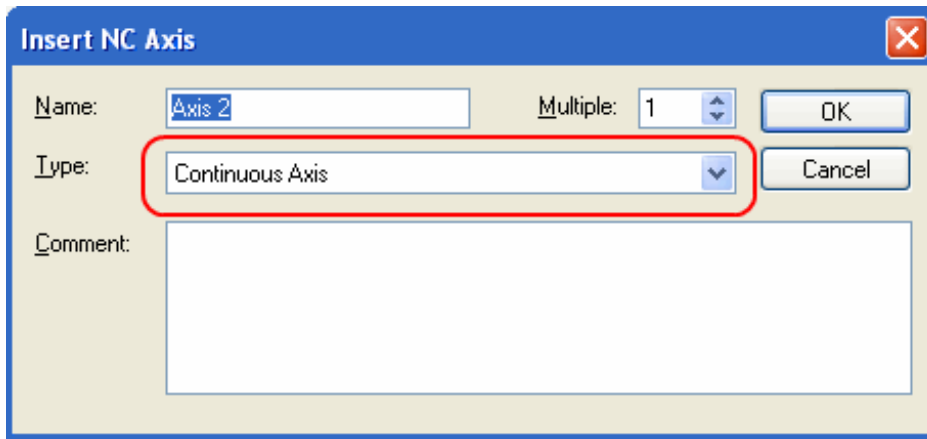
Fig. 145: Selecting and confirming the axis type

- Left-click your axis to select it. Under the S*ettings* tab select "Link To..." (see Fig. *Linking the axis with the terminal*).
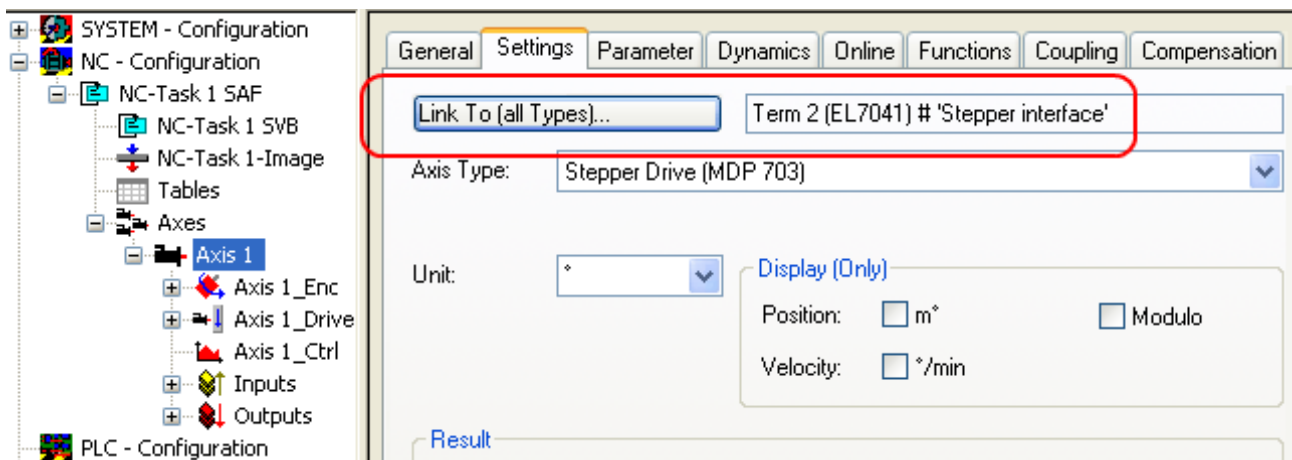
Linking the axis with the terminal

- Select the right terminal (DC Drive (MDP 733)) and confirm with OK. Note that each terminal can drive two motors. Select the channel that you have connected.
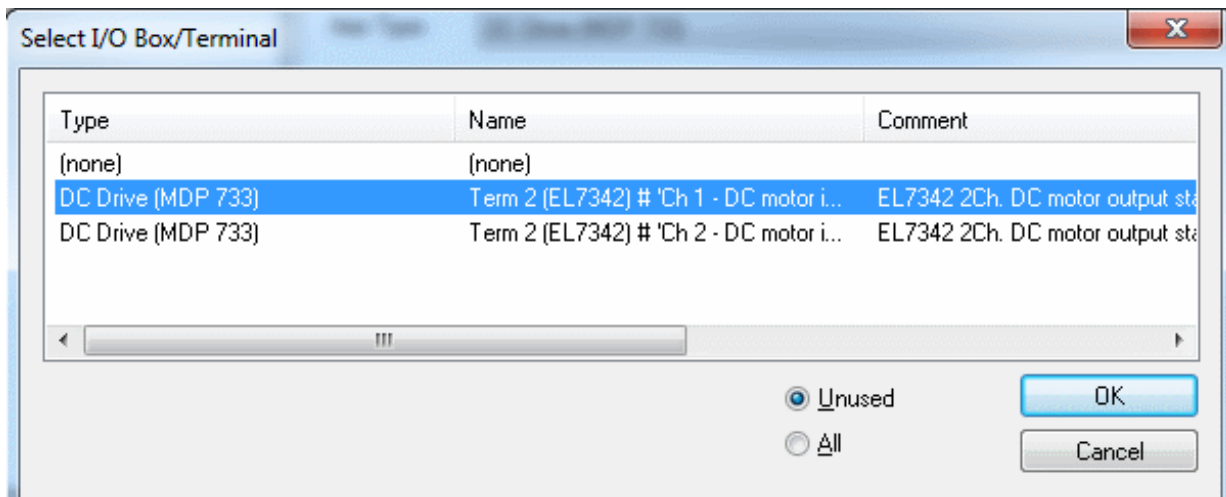
Selecting the right terminal

- All main links between the NC configuration and the terminal are set automatically (see Fig. "*Automatic linking of all main variables*")

Name		Type	Size	>Addr...	In/Out	User ID	Linked to
Status		Status_4096	2.0	26.0	Input	0	
Counter value	X	UINT	2.0	28.0	Input	0	nInData1[0] . nInData1 . ...
Latch value	X	UINT	2.0	30.0	Input	0	nInData2[0] . nInData2 . ...
Status		Status_4096	2.0	32.0	Input	0	
Counter value		UINT	2.0	34.0	Input	0	
Latch value		UINT	2.0	36.0	Input	0	
Status		Status_4097	2.0	38.0	Input	0	
Status		Status_4097	2.0	40.0	Input	0	
WcState	X	BOOL	0.1	1522.0	Input	0	nStatus4, nStatus4
State		UINT	2.0	1550.0	Input	0	
AdsAddr		AMSADDR...	8.0	1552.0	Input	0	
Control		Control_40...	2.0	26.0	Output	0	
Set counter value	X	UINT	2.0	28.0	Output	0	nOutData1[0] . nOutDat...
Control		Control_40...	2.0	30.0	Output	0	
Set counter value		UINT	2.0	32.0	Output	0	
Control		Control_40...	2.0	34.0	Output	0	
Velocity	X	INT	2.0	36.0	Output	0	nOutData2[0] . nOutDat...
Control		Control_40...	2.0	38.0	Output	0	
Velocity		INT	2.0	40.0	Output	0	

Fig. 146: Automatic linking of all main variables

Several parameters have to be set before the motor can be started up. The values can be found in chapter
Configuration of the main parameters [▶ 129].
Please set these parameters before continuing with the motor commissioning procedure.

6.5 Process data

6.5.1 Sync Manager (SM)

Sync Manager (SM) The extent of the process data that is made available can be changed through the "Process data" tab (EL7342 as example, see following Fig.).

Fig. 147: Process Data tab SM2, EL7342 (default)

Fig. 148: Process Data tab SM3, EL7342 (default)

6.5.2   PDO Assignment

- In order to configure the process data, select the desired Sync Manager (SM2 and SM3 can be edited) in the upper left-hand "Sync Manager" box (see fig.).
- The process data assigned to this Sync Manager can then be switched on or off in the "PDO Assignment" box underneath.
- Restarting the EtherCAT system, or reloading the configuration in configuration mode (F4), causes the EtherCAT communication to restart, and the process data is transferred from the terminal.

Default PDO assignment of the sync managers, EL7342

Index	Index of excluded PDOs	Size (byte.bit)	Name	PDO content Index - name
SM2, PDO assignment 0x1C12, default				
0x1600	0x1601	4.0	ENC Control compact Ch. 1	0x7000:02 [▶ 216] - Enable Latch extern on positive edge 0x7000:03 [▶ 216] - Set counter 0x7000:04 [▶ 216] - Enable Latch extern on negative edge 0x7000:11 [▶ 216] - Set counter value (16-bit)
0x1602	0x1603	4.0	ENC Control compact Ch. 2	0x7010:02 [▶ 216] - Enable Latch extern on positive edge 0x7010:03 [▶ 216] - Set counter 0x7010:04 [▶ 216] - Enable Latch extern on negative edge 0x7010:11 [▶ 216] - Set counter value (16-bit)
0x1604	-	2.0	DCM control Ch. 1	0x7020:01 [▶ 216] - Enable 0x7020:02 [▶ 216] - Reset 0x7020:03 [▶ 216] - Reduce torque
0x1606	0x1605 0x160A 0x160B	2.0	DCM velocity Ch. 1	0x7020:21 [▶ 216] - Velocity
0x1607	-	2.0	DCM control Ch. 2	0x7030:01 [▶ 216] - Enable 0x7030:02 [▶ 216] - Reset 0x7030:03 [▶ 216] - Reduce torque
0x1609	0x1608 0x160C 0x160D	2.0	DCM velocity Ch. 2	0x7030:21 [▶ 216] - Velocity

SM3, PDO Assignment 0x1C13, default

Index	Index of excluded PDOs	Size (byte.bit)	Name	PDO content
0x1A00	0x1A01	6.0	ENC Status compact Ch. 1	0x6000:02 [▶ 213] - Latch extern valid 0x6000:03 [▶ 213] - Set counter done 0x6000:04 [▶ 213] - Counter underflow 0x6000:05 [▶ 213] - Counter overflow 0x6000:08 [▶ 213] - Extrapolation stall 0x6000:09 [▶ 213] - Status of input A 0x6000:0A [▶ 213] - Status of input B 0x6000:0D [▶ 213] - Status of extern latch 0x6000:0E [▶ 213] - Sync error 0x6000:10 [▶ 213] - TxPDO Toggle 0x6000:11 [▶ 213] - Counter value (16-Bit) 0x6000:12 [▶ 213] - Latch value (16-Bit)
0x1A03	0x1A04	6.0	ENC Status compact Ch. 2	0x6010:02 [▶ 214] - Latch extern valid 0x6010:03 [▶ 214] - Set counter done 0x6010:04 [▶ 214] - Counter underflow 0x6010:05 [▶ 214] - Counter overflow 0x6010:08 [▶ 214] - Extrapolation stall 0x6010:09 [▶ 214] - Status of input A 0x6010:0A [▶ 214] - Status of input B 0x6010:0D [▶ 214] - Status of extern latch 0x6010:0E [▶ 214] - Sync error 0x6010:10 [▶ 214] - TxPDO Toggle 0x6010:11 [▶ 214] - Counter value (16-Bit) 0x6010:12 [▶ 214] - Latch value (16-Bit)
0x1A06	-	2.0	DCM Status Ch. 1	0x6020:01 [▶ 214] - Ready to enable 0x6020:02 [▶ 214] - Ready 0x6020:03 [▶ 214] - Warning 0x6020:04 [▶ 214] - Error 0x6020:05 [▶ 214] - Moving positive 0x6020:06 [▶ 214] - Moving negative 0x6020:07 [▶ 214] - Torque reduced 0x6020:0C [▶ 214] - Digital input 1 0x6020:0D [▶ 214] - Digital input 2 0x6020:0E [▶ 214] - Sync error 0x6020:10 [▶ 214] - TxPDO Toggle
0x1A08	-	2.0	POS Status	0x6030:01 [▶ 215] - Ready to enable 0x6030:02 [▶ 215] - Ready 0x6030:03 [▶ 215] - Warning 0x6030:04 [▶ 215] - Error 0x6030:05 [▶ 215] - Moving positive 0x6030:06 [▶ 215] - Moving negative 0x6030:07 [▶ 215] - Torque reduced 0x6030:0C [▶ 215] - Digital input 1 0x6030:0D [▶ 215] - Digital input 2 0x6030:0E [▶ 215] - Sync error 0x6030:10 [▶ 215] - TxPDO Toggle

6.5.3 Predefined PDO Assignment

The "Predefined PDO Assignment" enables a simplified selection of the process data. The desired function is selected on the lower part of the "Process Data" tab. As a result, all necessary PDOs are automatically activated and the unnecessary PDOs are deactivated.

Five PDO assignments are available:

Name	SM2, PDO assignment	SM3, PDO assignment
Velocity control compact	0x1600 0x1602 0x1604 0x1606 0x1607 0x1609	0x1A00 0x1A03 0x1A06 0x1A08
Velocity control	0x1601 0x1603 0x1604 0x1606 0x1607 0x1609	0x1A01 0x1A04 0x1A06 0x1A08
Position control	0x1601 0x1603 0x1604 0x1605 0x1607 0x1608	0x1A01 0x1A04 0x1A06 0x1A08
Positioning interface compact	0x1601 0x1603 0x1604 0x1607 0x160A 0x160C	0x1A01 0x1A04 0x1A06 0x1A08 0x1A0A 0x1A0C
Positioning interface	0x1601 0x1603 0x1604 0x1607 0x160B 0x160D	0x1A01 0x1A04 0x1A06 0x1A08 0x1A0B 0x1A0D
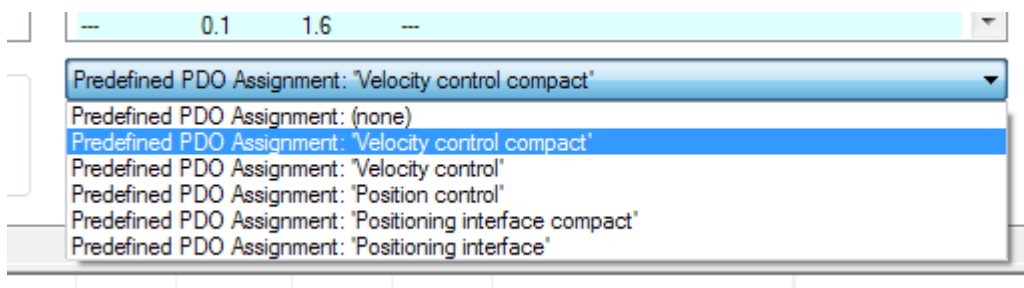
Fig. 149: Process data tab - Predefined PDO Assignment, EL7342

6.6 Settings in the CoE register

The data given here exemplary for a DC motor type GR42X25 from the company Dunkermotoren. For other motors the values may vary, depending on the application.

6.6.1 Adaptation of current and voltage

NOTE
The motor may overheat!
In order to prevent overheating of the connected motor it is important to adapt the current and voltage output from the stepper interface to the motor.

To this end set the index 0x8020:02 [▶ 205] "Nominal current" and 0x8020:03 [▶ 205] "Nominal voltage" in the CoE register to suitable values (see Fig. "*Adaptation of current and voltage*"). In addition, you should also adapt the "Maximal current" in the index 0x8020:01 [▶ 205] and the coil resistance of the motor in the index 0x8020:04 [▶ 205] "Motor coil resistance" to the connected motor.
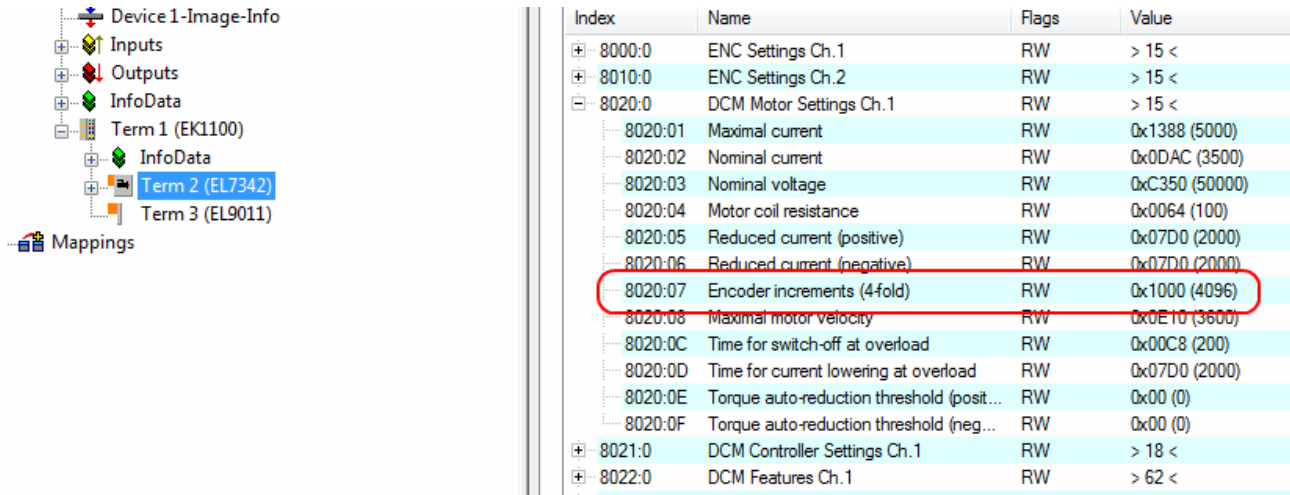
Reducedcurrent can be set in index 0x8020:05 [▶ 205] and 0x8020:06 [▶ 205]. This reduces the coil current when at a standstill (and therefore the power dissipation). Please note that the torque is also reduced.

Fig. 150: Adaptation of current and voltage

6.6.2 Adaptation of the encoder data

Different encoders are available with a different number of increments. You must specify the number of increments of your encoder in the index 0x8020:07 [▶ 205] "Encoder increments" (see fig. *Adaptation of the encoder data*). In our example an encoder with 1024 increments is used, corresponding to 4096 increments in the case of quadruple evaluation. The number of increments of your encoder can be found in the data sheet for the encoder.

Fig. 151: Adaptation of the encoder data

6.6.3 Adaptation of the maximal velocity

The maximal velocity with which your DC motor can drive must be entered in the index 0x8020:08 [▶ 205] "Maximal motor velocity" (see fig. *Adaptation of the maximal velocity*). You can take this parameter from the name plate on the motor and write it 1:1 into the index. In the example the motor has a maximal velocity of 3600 revolutions per minute.

Fig. 152: Adaptation of the maximal velocity

6.6.4   Selection of the operating mode

You can select the operating mode in the index <u>0x8022:01 [▶ 206]</u> "Operation mode". It is recommended that you select the operation mode "Automatic" (Fig. *Setting the operation mode*) and then set the suitable operation mode for your application on the Process Data tab. Further information on this can be found in the chapter "Process Data".
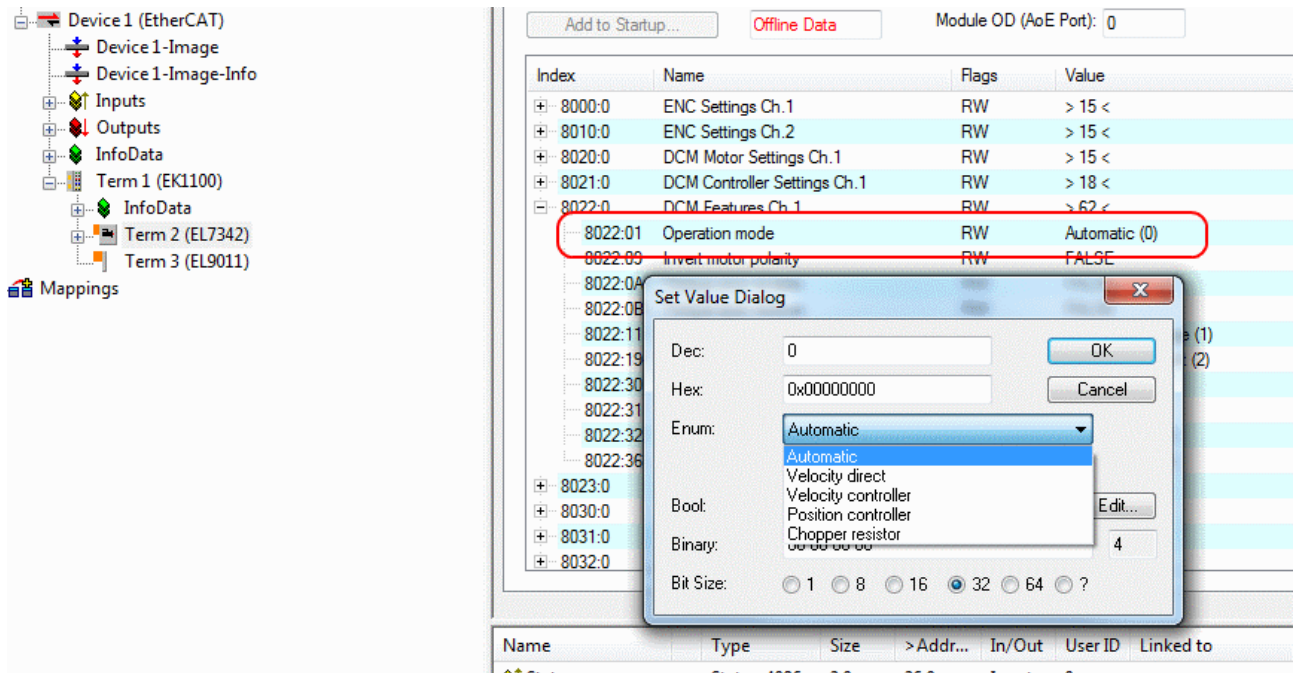
Fig. 153: Setting the operation mode

6.6.5 Select info data

There is a possibility in the index <u>0x8022:11 [▶ 206]</u> "Select info data 1" and <u>0x8022:19 [▶ 206]</u> "Select info data 2", to select two parameters that can be displayed in the process data (see fig. *Selection of additional information data*). The following parameters can be selected

- Status word
- Motor coil voltage
- Motor coil current
- Current limit
- Control error
- Duty cycle
- Motor velocity
- Overload time
- Internal temperature
- Control voltage
- Motor supply voltage
- Status word (drive controller)
- State (drive controller)

These two parameters must be activated in the process data afterwards. Please refer to the "Process Data" section for details of how to activate the parameters.
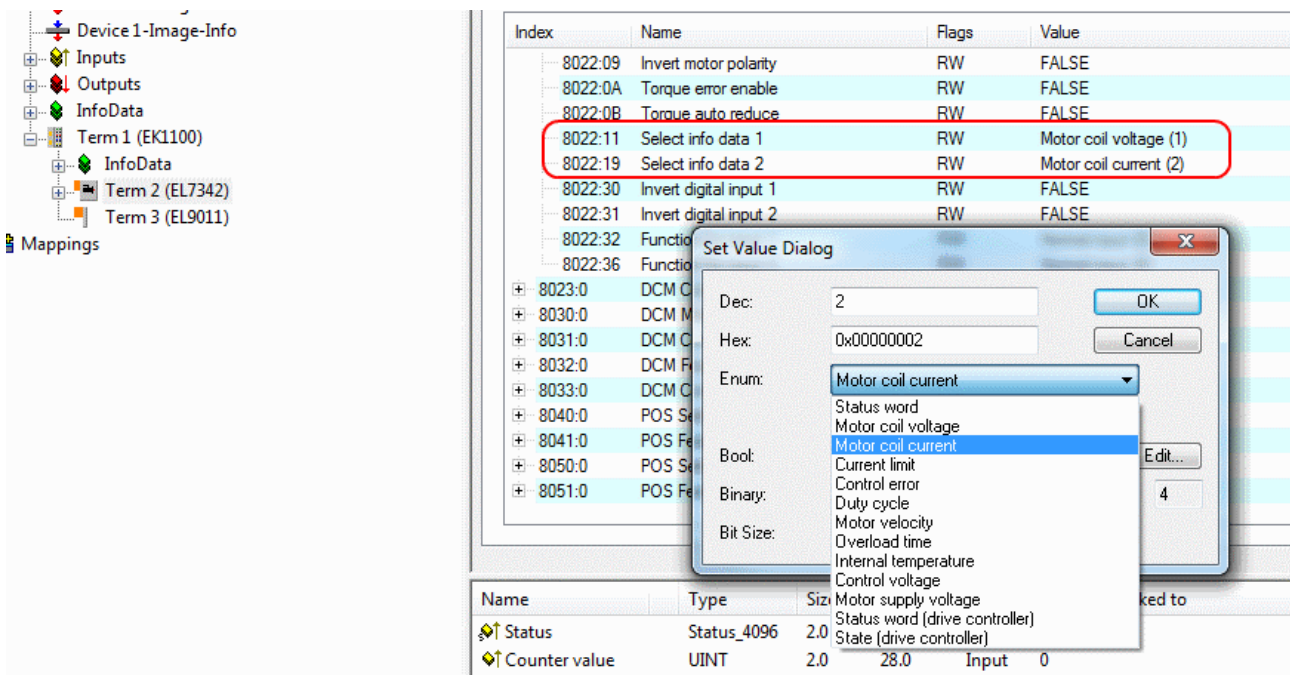
Fig. 154: Selection of additional information data

6.6.6   KA factor

The K_A factor can be used to adapt the current during the acceleration phases. The current increase is calculated as follows.

Current increase in mA = speed difference x K_A / 1000

The steeper the speed ramp, the higher the current increase.
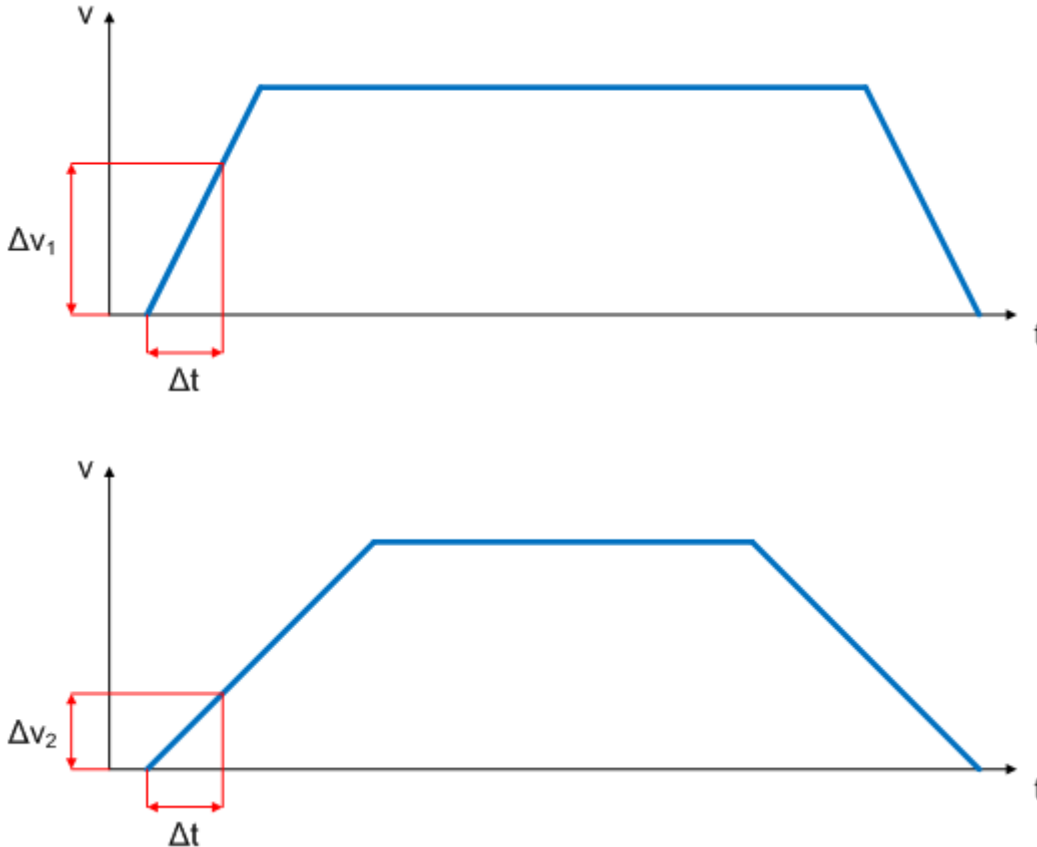
Fig. 155: Speed ramps

This value can be set in index 0x8023:07 [▶ 207] "Ka factor (velo./pos.)" (see Fig. *Setting the KA factor*).

Fig. 156: Setting the K_A factor

6.7 NC settings

The specified data apply to a DC Motor GR42X25 of the Company "Dunker Motoren" and are intended as an example. For other motors the values may vary, depending on the application.

6.7.1 Reference velocity selection

The maximum velocity is calculated based on the maximum motor speed (name plate) and the distance, in revolutions per second.

v_{max} = (maximum motor speed x 360°) / 60 sec.
= ((3,600 revolutions / min.) x 360°) / 60 sec.
= 21,600 revolutions / sec.

Parameter	Value
- Velocities:	
Reference Velocity	25570.0
Maximum Velocity	2000.0
Manual Velocity (Fast)	600.0
Manual Velocity (Slow)	100.0
Calibration Velocity (towards plc cam)	30.0
Calibration Velocity (off plc cam)	30.0
Jog Increment (Forward)	5.0
Jog Increment (Backward)	5.0
+ Dynamics:	

Fig. 157: Adjusting the reference velocity

This is a theoretical value that is quite close to the practical value, although the value may vary, depending on the load. To determine the actual value set the K_v factor to 0 and determine the final reference velocity empirically. To this end move the motor using the keys F1 - F4 and compare the *actual velocity* and the *setpoint velocity*. These values should be almost identical. If the *actual velocity* is greater, increase the reference velocity slightly. If the *Actual velocity* is smaller than the *Setpoint velocity*, reduce the reference velocity slightly. This empirical exercise should only be carried out once the other parameters have been set. In our case the reference velocity is 25,570 revolutions / sec. Finally, adjust the *maximum allowed velocity*.

6.7.2   Dead time compensation

Dead time compensation

The dead time compensation can be adjusted on the *Time Compensation* tab of *Axis1_ENC*.
It should theoretically be 3 cycles of the NC cycle time, although in practice 4 cycles are preferable.
Therefore, the settings of the parameters *Time Compensation Mode Encoder* should be ‚ON (with velocity)'
and *Encoder Delay in Cycles* '4'.

Fig. 158: Dead time compensation parameter

6.7.3   Scaling factor

The scaling factor can be changed by selecting "Axis 1_Enc" and tab "Parameter" in the NC (see *Setting the Scaling Factor*). The value can be calculated with the formulas specified below.

Fig. 159: *Setting the Scaling Factor*

Calculation of the scaling factor

SF = distance per revolution / (increments x 4) = 360° / (1024 x 4) = 0.087890625 ° / INC

6.7.4   Position lag monitoring

The position lag monitoring function checks whether the current position lag of an axis has exceeded the limit value. The position lag is the difference between the set value (control value) and the actual value reported back. If the terminal parameters are set inadequately, the position lag monitoring function may report an error when the axis is moved. During commissioning it may therefore be advisable to increase the limits of the *Position lag monitoring* slightly.

NOTE
ATTENTION: Damage to equipment, machines and peripheral components possible!
Setting the position lag monitoring parameters too high may result in damage to equipment, machines and peripheral components.

Fig. 160: Lag monitoring

6.7.5   KV factors

In the NC two proportional factors K_v can be set under "Axis 1_Ctrl " in tab "Parameter". First select the position controller *Type* with two P constants (with K_A) under the "NC Controller" tab. The two P constants are for the *Standstill* range and for the *Moving* range (see Fig. *Setting the proportional factor KV*). The factors can be used to set the start-up torque and the braking torque to a different value than the drive torque. The threshold value can be set directly below (Position control: Velocity threshold V dyn) between 0.0 (0%) and 1.0 (100%). Fig. *Velocity ramp with KV factor limit values* shows a speed ramp with thresholds of 50%. The K_v factor for Standstill (t_1 and t_3) can be different than the Kv factor for Moving (t_2). The factor at standstill should always be greater than the factor during motion.
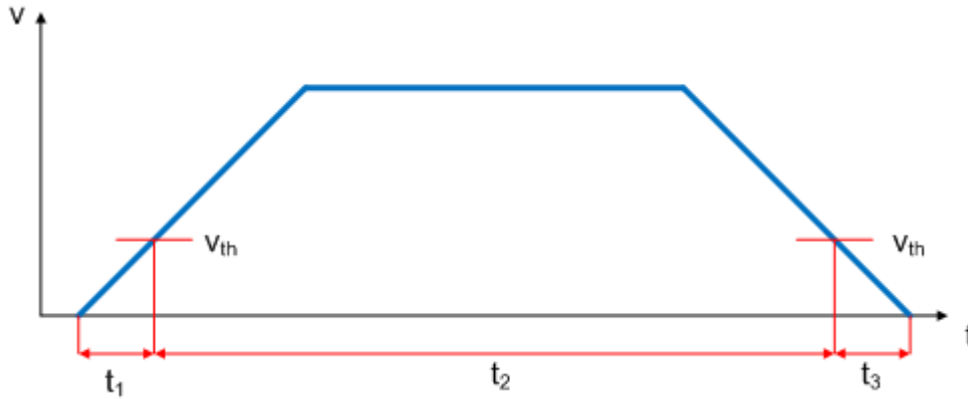
Fig. 161: Speed ramp with K_v factor limit values

Fig. 162: *Setting the proportional factor K_v*

6.8   Commissioning the motor with the NC

- Once the parameters are set, the motor is basically ready for operation. Individual further parameters have to be adapted to the respective application.
- To commission the axis, activate the configuration (Ctrl+Shift+F4), select the axis, select tab Online and enable the axis under Set.
- Set all tick marks and set Override to 100% (see Fig. *Enabling an axis*). The axis can then be moved.
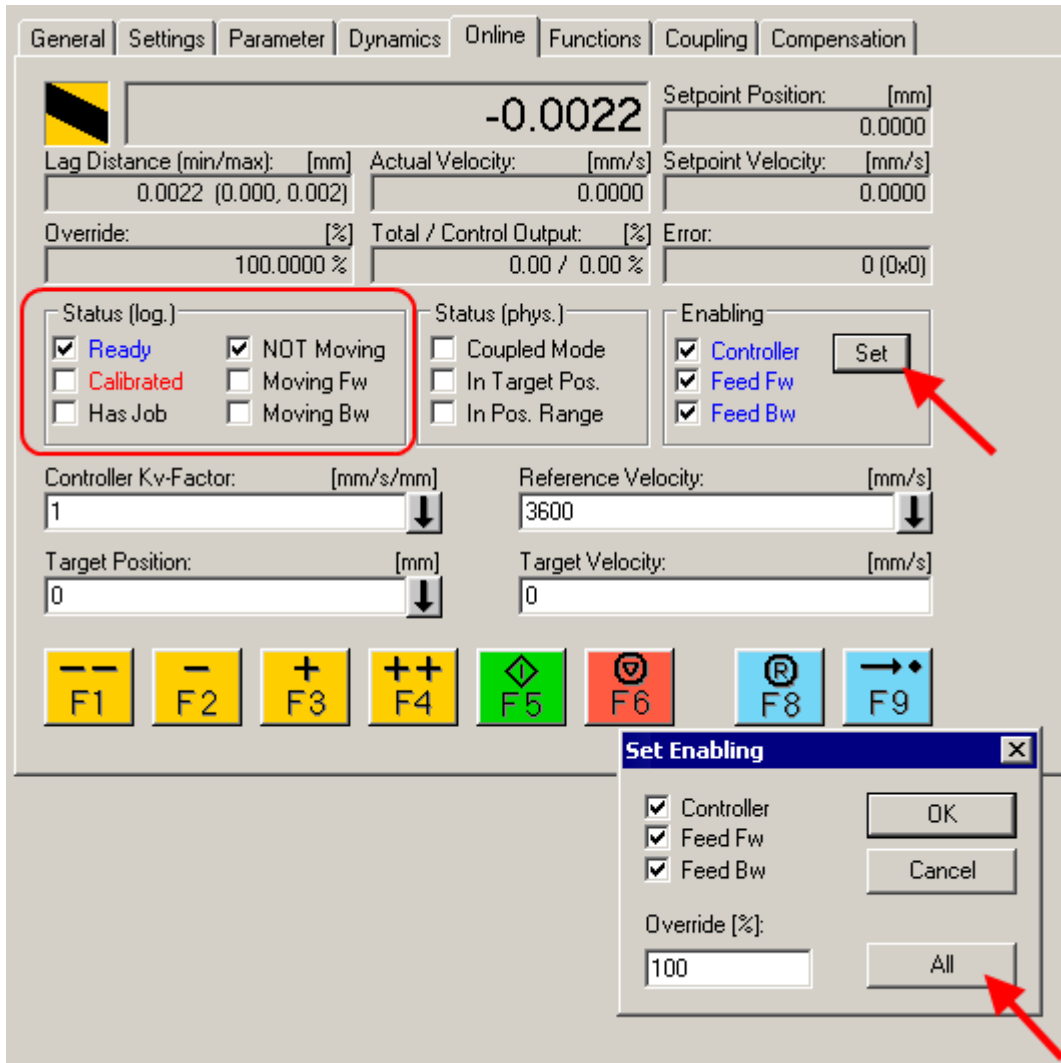
Fig. 163: Enabling an axis

You can now move the axis with the function keys F1, F2 (Backward) or F3, F4 (Forward).
You can adjust the Kv factor in order to approach a suitable factor. Set the value to 0 initially in order to set the correct reference velocity. For calculating the reference velocity please refer to section "Selecting the reference velocity [▶ 134]". The calculation provides a relatively precise value, although the value may have to be corrected slightly. To this end move the motor with a Kv factor of 0 until the actual velocity matches the setpoint velocity.

Alternatively you can control the axis via the "Functions" tab. An example is provided below.

- Select as *Reversing Sequence* as the start type.
- Enter the required *Target Position1*, e.g. 5000°.
- Enter the required Target Velocity, e.g. 2000°/s.
- Enter the required Target Position2, e.g. 0°.
- Enter the required *Idle Time*, e.g. 1 s.
- Select Start.
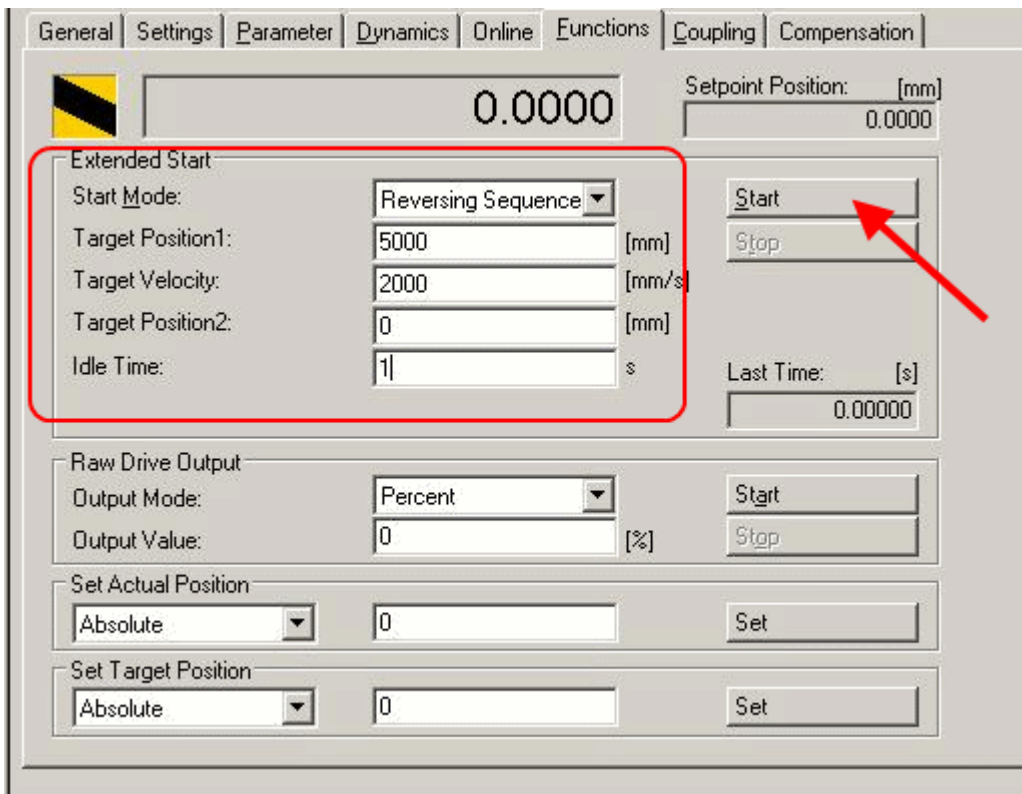
Enabling an axis

The motor now turns to position 1, remains there for 1 seconds and returns to position 2. This is repeated until Stop is pressed.

6.9 Operating modes

6.9.1 Overview

The operating modes *Automatic*, *Velocity direct*, *Position controller*, *Path control* and *Brake resistor* are supported.

Automatic

In preparation!

Velocity, direct

This mode is intended for the cyclic velocity interface of a numeric controller (NC). In this mode, the NC specifies a set velocity. Ramps for start-up and deceleration of the motor are also controlled by the NC.

Position controller

Refer to the Positioning Interface [▶ 142] section for information about this operating mode!

Travel distance control

In preparation!

Brake resistor

Refer to the Chopper operation [▶ 140] section for information about this operating mode!

6.9.2 Chopper operation

You can connect a brake resistor (chopper) instead of a DC motor to a channel of the EL7332/EL7342 and activate the operating mode *Brake resistor* (EL7332, index 0x8022:01 [▶ 167] or 0x8032:01 [▶ 169]; EL7342, index 0x8022:01 [▶ 206] or 0x8032:01 [▶ 209]) for this channel.

The motor must actively brake for positioning tasks. The mechanical energy is thereby converted back into electrical energy. Small quantities of energy are taken up by a capacitor in the EL7332/EL7342. Further storage capacities, for example in the power supply, can also take up energy. The feedback leads in each case to a voltage increase.

In order to avoid overvoltage, a brake resistor can be connected to the EL7332/EL7342 in order to dissipate the excess energy in the form of heat. As soon as the voltage reaches 110% of the nominal voltage (EL7332, index 0x8020:03 [▶ 166] or 0x8030:03 [▶ 168]; EL7342, 0x8020:03 [▶ 205] or 0x8030:03 [▶ 207]), e.g. 55 V for the EL7342, the correctly adjusted output stage drives a fast-clocked current through the brake resistor (see diagram).
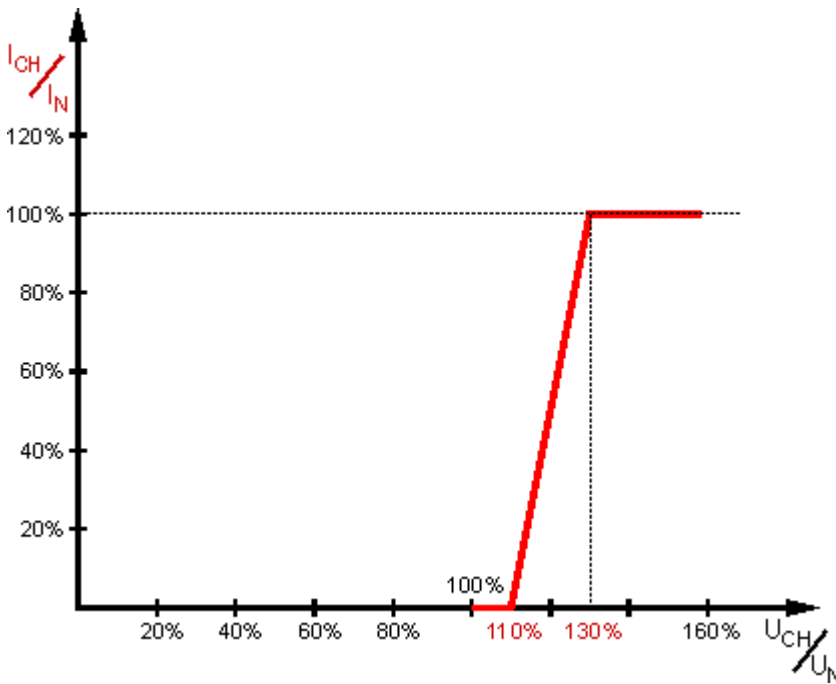
Fig. 164: I_{CH}/I_N. - U_{CH}/U_N characteristic curve

U_{CH}/U_N	20%	40%	60%	80%	**100%**	**110%**	**130%**	160%
U_{CH} at U_N = 50 V	10 V	20 V	30 V	40 V	**50 V**	**55 V**	**65 V**	80 V
U_{CH} at U_N = 24 V	4,8 V	9,6 V	14,4 V	19,2 V	**24 V**	**25,2 V**	**31,2 V**	38,4 V

NOTE

Dimensioning of the brake resistor

The brake resistor should be dimensioned such that it can withstand the expected heat development without damage!

A brake resistance of 10 Ω is recommended for EL7342, which results in a pulse current of approx. 5.5 A to 6.5 A. The maximum expected continuous power is 125 W. However, the value typically lies significantly below that.

Power estimation

$P_N = I_N^2 \times R$

$P_N = (5A)^2 \times 10\ \Omega$

$P_N = 250\ W$

A maximum duty cycle of 50 % is possible. This results in a maximum continuous power of 125 W.

A motor efficiency of 80 % is usual in practice.
The motor thus converts 80 % of the rated electrical power into kinetic energy when accelerating. Conversely, when braking, the motor (as a generator) converts 80 % of the kinetic energy into electrical power.

This results in a practical brake power of:

$P_{CH} = P_N/2 \times 80/100 \times 80/100$

$P_{CH} = 125W \times 80/100 \times 80/100$

$P_{CH} = 80\ W$

6.9.3 Basic principles: "Positioning Interface"

The "*Positioning interface*" offers the user a possibility to implement travel commands directly on the terminal.

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Predefined PDO Assignment

The "Predefined PDO Assignment [▶ 128]" enables a simplified selection of the process data. Select the function "*Positioning interface*" or "*Positioning interface compact*" in the lower part of the Process data tab. As a result, all necessary PDOs are automatically activated and the unnecessary PDOs are deactivated.
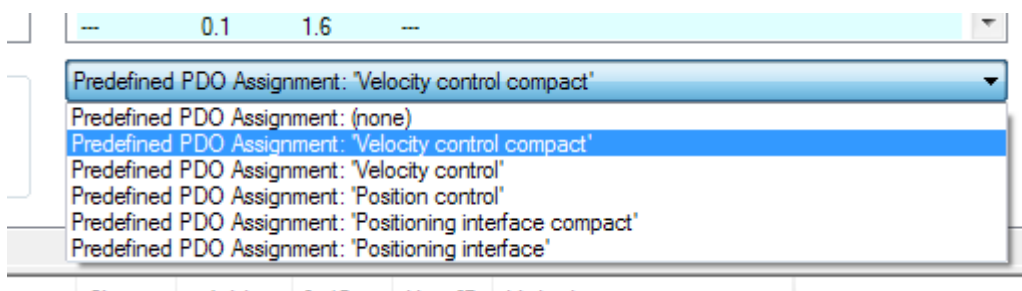
Fig. 165: Predefined PDO Assignment

Parameter set

Two objects are at the user's disposal in the CoE for the configuration – the "POS Settings" (Index 0x8040 [▶ 210]) and the "POS Features" (Index 0x8041 [▶ 211]).

Index	Name	Flags	Value
8040:0	POS Settings Ch.1	RW	> 16 <
8040:01	Velocity min.	RW	100
8040:02	Velocity max.	RW	10000
8040:03	Acceleration pos.	RW	0x03E8 (1000)
8040:04	Acceleration neg.	RW	0x03E8 (1000)
8040:05	Deceleration pos.	RW	0x03E8 (1000)
8040:06	Deceleration neg.	RW	0x03E8 (1000)
8040:07	Emergency deceleration	RW	0x0064 (100)
8040:08	Calibration position	RW	0x00000000 (0)
8040:09	Calibration velocity (towards plc cam)	RW	100
8040:0A	Calibration Velocity (off plc cam)	RW	10
8040:0B	Target window	RW	0x000A (10)
8040:0C	In-Target timeout	RW	0x03E8 (1000)
8040:0D	Dead time compensation	RW	50
8040:0E	Modulo factor	RW	0x00000000 (0)
8040:0F	Modulo tolerance window	RW	0x00000000 (0)
8040:10	Position lag max.	RW	0x0000 (0)
8041:0	POS Features Ch.1	RW	> 22 <
8041:01	Start type	RW	Absolute (1)
8041:11	Time information	RW	Elapsed time (0)
8041:13	Invert calibration cam search direction	RW	TRUE
8041:14	Invert sync impulse search direction	RW	FALSE
8041:15	Emergency stop on position lag error	RW	FALSE
8041:16	Enhanced diag history	RW	FALSE

Fig. 166: Settings objects in the CoE

- **POS Settings**:
  - **Velocity min.:**
    For reasons of performance when ramping down to the target position, the terminal needs a safety margin of 0.5%. That means that, depending on the maximum velocity reached and the configured deceleration, the time is calculated at which the deceleration ramp begins. In order to always reach the destination reliably, 0.5% is subtracted from the position determined. If the deceleration ramp has ended and the destination has not yet been reached, the terminal drives at the velocity "Velocity min." to the destination. It must be configured in such a way that the motor is able to stop abruptly and without a step loss at this velocity.
  - **Velocity max.:**
    The maximum velocity with which the motor drives during a travel command.
  - **Acceleration pos.:**
    Acceleration time in the positive direction of rotation.
    The 5 parameters for acceleration are given in ms. With a setting of 1000, the terminal accelerates the motor from 0 to 100% in 1000 ms. At a speed of 50% the acceleration time is linearly reduced to half accordingly.
  - **Acceleration neg.:**
    Acceleration time in the negative direction of rotation.
  - **Deceleration pos.:**
    Deceleration time in the positive direction of rotation.
  - **Deceleration neg.:**
    Deceleration time in the negative direction of rotation.

- ◦ **Emergency deceleration:**
  Emergency deceleration time (both directions of rotation). If "Emergency stop" is set in the appropriate PDO, the motor is stopped within this time.

- ◦ **Calibration position:**
  The current counter value is loaded with this value after calibration.

- ◦ **Calibration velocity (towards plc cam):**
  Velocity with which the motor travels towards the cam during calibration.

- ◦ **Calibration velocity (off plc cam):**
  Velocity with which the motor travels away from the cam during calibration.

- ◦ **Target window:**
  Target window of the travel distance control. "In-Target" is set if the motor comes to a stop within this target window.

- ◦ **In-Target timeout:**
  "In-Target" is not set if the motor is not within the target window after the expiry of the travel distance control after this set time. This condition can be recognized only by checking the falling edge of "Busy".

- ◦ **Dead time compensation:**
  Compensation of the internal propagation delays. This parameter does not have to be changed with standard applications.

- ◦ **Modulo factor:**
  The "Modulo factor" is referred to for the calculation of the target position and the direction of rotation in the modulo operating modes. It refers to the controlled system.

- ◦ **Modulo tolerance window:**
  Tolerance window for the determination of the start condition of the modulo operating modes.

- ◦ **Position lag max.:**
  Max. permitted position lag [▶ 136], for explanation refer to "NC settings [▶ 134]"

- • **POS Features:**

  - ◦ **Start type:**
    The "Start type" specifies the type of calculation used to determine the target position (see below [▶ 148]).

  - ◦ **Time information:**
    The meaning of the "Actual drive time" displayed is configured by this parameter. At present this value cannot be changed, since there are no further selection options. The elapsed time of the travel command is displayed.

  - ◦ **Invert calibration cam search direction:**
    In relation to a positive direction of rotation, the direction of the search for the calibration cam is configured here (travel towards the cam).

  - ◦ **Invert sync impulse search direction:**
    In relation to a positive direction of rotation, the direction of the search is configured here in accordance with the HW sync pulse (travel away from the cam).

  - ◦ **Emergency stop on position lag error:**
    Triggers an emergency stop if the maximum following error is exceeded.

  - ◦ **Enhanced diag history:**
    Provides detailed messages about the status of the positioning interface in the Diag History.

Information and diagnostic data

Via the information and diagnostic data, the user can obtain a more exact statement about which error occurred during a travel command.

Index	Name	Flags	Value
⊟ 9040:0	POS Info data Ch.1	RO	
9040:01	Status word	RO	---
9040:03	State (drive controller)	RO	---
9040:04	Actual position lag	RO	---
⊞ 9050:0	POS Info data Ch.2	RO	
⊞ A020:0	DCM Diag data Ch.1	RO	
⊞ A030:0	DCM Diag data Ch.2	RO	
⊟ A040:0	POS Diag data Ch.1	RO	
A040:01	Command rejected	RO	---
A040:02	Command aborted	RO	---
A040:03	Target overrun	RO	---
A040:04	Target timeout	RO	---
A040:05	Position lag	RO	---
A040:06	Emergency stop	RO	---

Fig. 167: Diagnostic objects in the CoE

- **POS Info data:**
  - **Status word:**
    The "Status word" reflects the status bits used in *Index 0xA040* in a data word, in order to be able to process them more simply in the PLC. The positions of the bits correspond to the number of the subindex-1.
    Bit 0: Command rejected
    Bit 1: Command aborted
    Bit 2: Target overrun
  - **State (drive controller):**
    The current status of the internal state machine is displayed here (see below [▶ 148]).
  - **Actual position lag:**
    Current position lag, see NC settings [▶ 136]
- **POS Diag data:**
  - **Command rejected:**
    A dynamic change of the target position is not accepted each time by the terminal, since this is then not possible. The new command is rejected in this case and indicated by the setting of this bit.
    These 3 diagnostic bits are transmitted synchronously to the controller by setting "*Warning*" in the PDO.
  - **Command aborted:**
    The current travel command is prematurely aborted due to an internal error or by an "Emergency stop".
  - **Target overrun:**
    In the case of a dynamic change of the target position, the change may take place at a relatively late point in time. The consequence of this may be that a change in the direction of rotation is necessary and that the new target position may be overrun. "Target overrun" is set if this occurs.
  - **Target timeout:**
    The motor did not reach the target window (8040:0B [▶ 210], 8050:0B [▶ 211]) within the configured time (0x8040:0C [▶ 210], 0x8050:0C [▶ 211]) after the end of the travel command.
  - **Position lag:**
    The position lag was exceeded. The position lag monitoring is deactivated if "Position lag max." = 0. If a value is entered in "Position lag max.", then this value is compared with "Actual position lag". As soon as "Actual position lag" exceeds "Position lag max.", "Position lag" = 1 is set and a PDO warning is output.

◦ **Emergency stop:**
An emergency stop was triggered (automatic or manual).

States of the internal state machine

The state (drive controller) (Index 0x9040:03 [▶ 219], 0x9050:03 [▶ 219]) provides information about the current state of the internal state machine. For diagnostic purposes this can be read out by the PLC for the propagation delay. The internal cycle works constantly with 250 µs. A connected PLC cycle is very probably slower (e.g. 1 ms). For this reason it may be the case that some states are not visible at all in the PLC, since these will sometimes run through only one internal cycle.

States of the internal state machine

Name	ID	Description
INIT	0x0000	Initialization/preparation for the next travel command
IDLE	0x0001	Wait for the next travel command
START	0x0010	The new command is evaluated and the corresponding calculations are performed
ACCEL	0x0011	Acceleration phase
CONST	0x0012	Constant phase
DECEL	0x0013	Deceleration phase
EMCY	0x0040	An "*Emergency stop"* has been triggered
STOP	0x0041	The motor has stopped
CALI_START	0x0100	Start of a calibration command
CALI_GO_CAM	0x0110	The motor is being driven towards the cam
CALI_ON_CAM	0x0111	The cam has been reached
CALI_GO_SYNC	0x0120	The motor is being driven in the direction of the HW sync pulse
CALI_LEAVE_CAM	0x0121	The motor is being driven away from the cam
CALI_STOP	0x0130	End of the calibration phase
CALIBRATED	0x0140	The motor is calibrated
NOT_CALIBRATED	0x0141	The motor is not calibrated
PRE_TARGET	0x1000	The set position has been reached; the position controller "pulls" the motor further into the target; "*In-Target timeout*" is started here
TARGET	0x1001	The motor has reached the target window within the timeout
TARGET_RESTART	0x1002	A dynamic change of the target position is processed here
END	0x2000	End of the positioning phase
WARNING	0x4000	A warning state occurred during the travel command; this is processed here
ERROR	0x8000	An error state occurred during the travel command; this is processed here
UNDEFINED	0xFFFF	Undefined state (can occur, for example, if the driver stage has no control voltage)

Standard sequence of a travel command

The "normally" sequence of a travel command is shown in the following flow diagram.
Coarse distinction is made between these four stages:

Startup

Test the system and the ready status of the motor.

Start positioning

Write all variables and calculate the desired target position with the appropriate "*Start type*". Subsequently, start the travel command.

Evaluate status

Monitor the terminal state and, if necessary, dynamically change the target position.

Error handling

In case of error, procure the necessary information from the CoE and evaluate it.
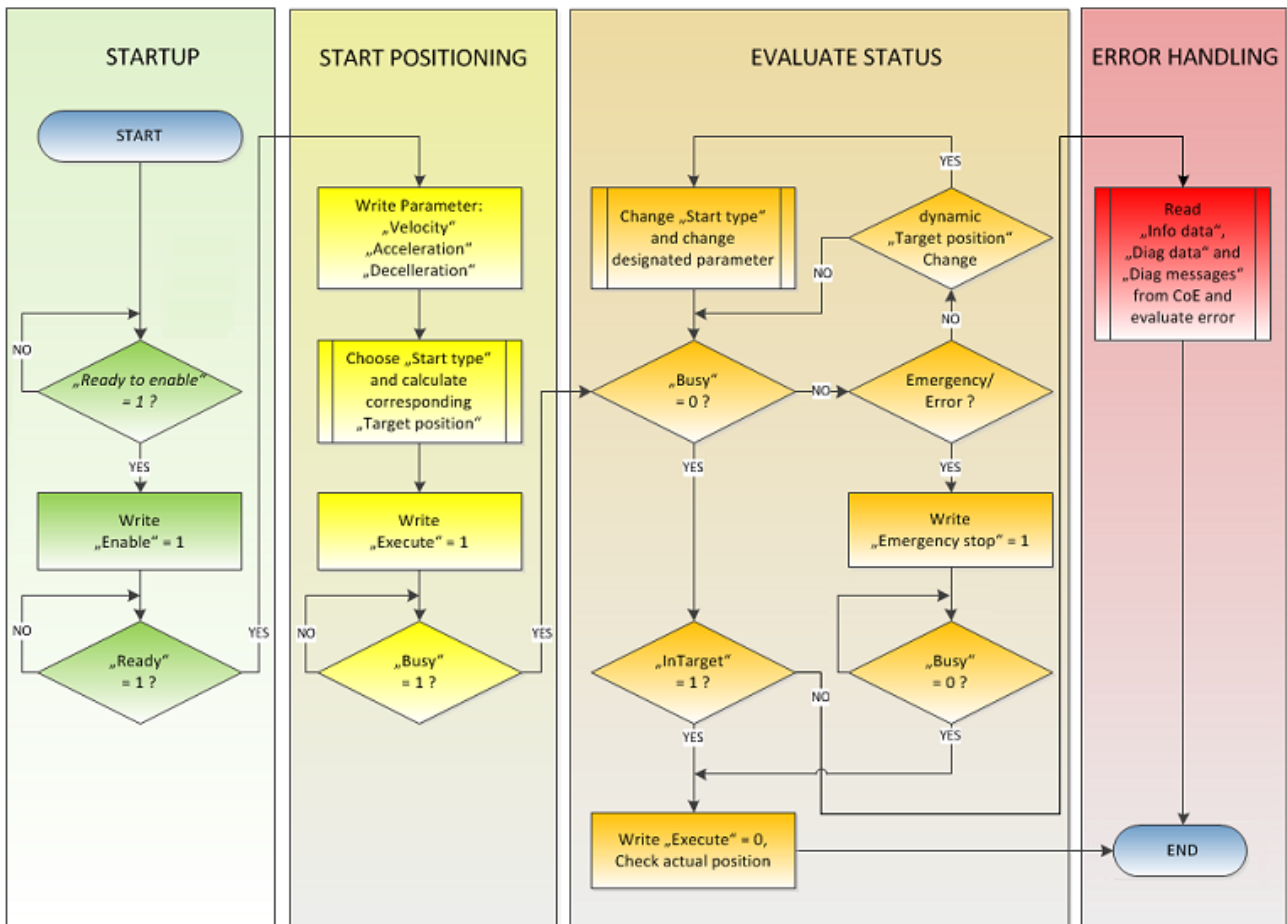
Fig. 168: Flow diagram for a travel command

Start types

The "*Positioning interface*" offers different types of positioning. The following table contains all commands supported; these are divided into four groups.

Supported "Start types" of the "Positioning interface"

Name	Command	Group	Description
ABSOLUTE	0x0001	Standard [▶ 149]	Absolute positioning to a specified target position
RELATIVE	0x0002		Relative positioning to a calculated target position; a specified position difference is added to the current position
ENDLESS_PLUS	0x0003		Endless travel in the positive direction of rotation (direct specification of a speed)
ENDLESS_MINUS	0x0004		Endless travel in the negative direction of rotation (direct specification of a speed)
ADDITIVE	0x0006		Additive positioning to a calculated target position; a specified position difference is added to the last target position
ABSOLUTE_CHANGE	0x1001	Standard Ext. [▶ 150]	Dynamic change of the target position during a travel command to a new absolute position
RELATIVE_CHANGE	0x1002		Dynamic change of the target position during a travel command to a new relative position (the current changing position value is used here also)
ADDITIVE_CHANGE	0x1006		Dynamic change of the target position during a travel command to a new additive position (the last target position is used here)
MODULO_SHORT	0x0105	Modulo [▶ 152]	Modulo positioning along the shortest path to the modulo position (positive or negative), calculated by the "*Modulo factor*" (Index 0x8040:0E [▶ 210])
MODULO_SHORT_EXT	0x0115		Modulo positioning along the shortest path to the modulo position; the "*Modulo tolerance window*" (Index 0x8040:0F [▶ 210])
MODULO_PLUS	0x0405		Modulo positioning in the positive direction of rotation to the calculated modulo position
MODULO_PLUS_EXT	0x0415		Modulo positioning in the positive direction of rotation to the calculated modulo position; the "*Modulo tolerance window*" is ignored
MODULO_MINUS	0x0305		Modulo positioning in the negative direction of rotation to the calculated modulo position
MODULO_MINUS_EXT	0x0315		Modulo positioning in the negative direction of rotation to the calculated modulo position; the "*Modulo tolerance window*" is ignored
MODULO_CURRENT	0x0405		Modulo positioning in the last direction of rotation to the calculated modulo position
MODULO_CURRENT_EXT	0x0415		Modulo positioning in the last direction of rotation to the calculated modulo position; the "*Modulo tolerance window*" is ignored
CALI_PLC_CAM	0x6000	Calibration [▶ 151]	Start a calibration with cam (digital inputs)
CALI_HW_SYNC	0x6100		start a calibration with cam and HW sync pulse (C-track)
SET_CALIBRATION	0x6E00		Manually set the terminal to "*Calibrated*"
SET_CALIBRATION_AUTO	0x6E01		Automatically set the terminal to "*Calibrated*" on the first rising edge on "*Enable*"
CLEAR_CALIBRATION	0x6F00		Manually delete the calibration

ABSOLUTE:

The absolute positioning represents the simplest positioning case. A position B is specified and travelled to from the start point A.
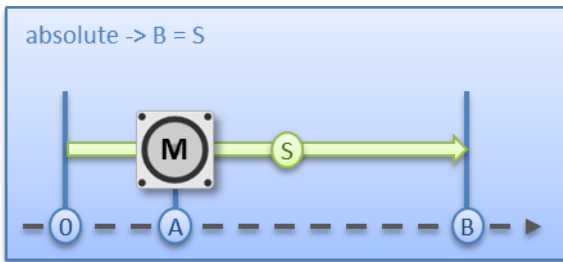
Fig. 169: Absolute positioning

RELATIVE:

In relative positioning, the user specifies a position delta S, which is added to the current position A, producing the target position B.
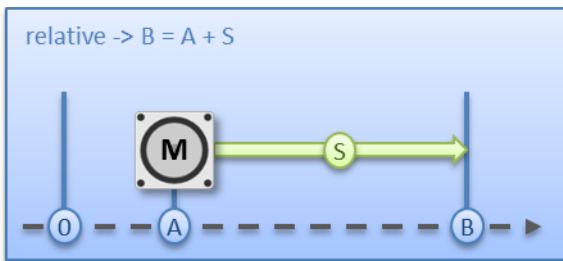
Fig. 170: Relative positioning

ENDLESS_PLUS / ENDLESS_MINUS:

The two start types "*ENDLESS_PLUS*" and "*ENDLESS_MINUS*" offer the possibility in the "*Positioning interface*" to specify a direct motor velocity in order to travel endlessly in the positive or negative direction with the specified accelerations.
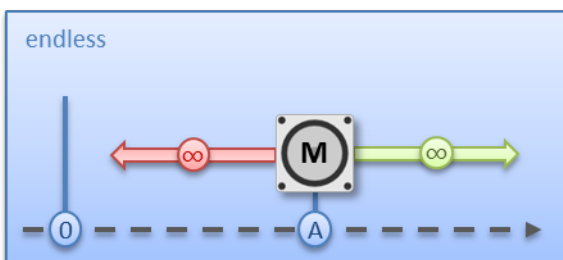
Fig. 171: Endless travel

ADDITIVE:

For additive positioning, the position delta S specified by the user is added to the target position E used for the last travel command in order to calculate the target position B.

This kind of positioning resembles the relative positioning, but there is a difference. If the last travel command was completed successfully, the new target position is the same. If there was an error, however, be it that the motor entered a stall state or an "*Emergency stop*" was triggered, the current position is arbitrary and not foreseeable. The user now has the advantage that he can use the last target position for the calculation of the following target position.
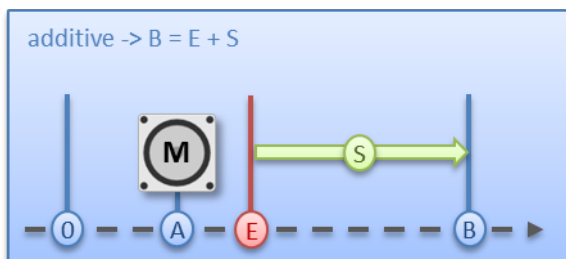
Fig. 172: Additive positioning

ABSOLUTE_CHANGE / RELATIVE_CHANGE / ADDITIVE_CHANGE:

These three kinds of positioning are completely identical to those described above. The important difference thereby is that the user uses these commands during an active travel command in order to dynamically specify a new target position.

The same rules and conditions apply as to the "normal" start types. "*ABSOLUTE_CHANGE*" and "*ADDITIVE_CHANGE*" are unique in the calculation of the target position i.e. in absolute positioning an absolute position is specified and in additive positioning a position delta is added to the momentarily active target position.

NOTE
Caution when using the "RELATIVE_CHANGE" positioning
The change by means of "RELATIVE_CHANGE" must be used with caution, since the current position of the motor is also used here as the start position. Due to propagation delays in the system, the position indicated in the PDO never corresponds to the actual position of the motor! Therefore a difference to the desired target position always results in the calculation of the transferred position delta.

ⓘ **Time of the change of the target position**

A change of the target position cannot take place at an arbitrary point in time. If the calculation of the output parameters shows that the new target position cannot be readily reached, the command is rejected by the terminal and the "Command rejected [▶ 145]" bit is set. This is the case, for example, at standstill (since the terminal expects a standard positioning here) and in the acceleration phase (since at this point the braking time cannot be calculated yet).

CALI_PLC_CAM / CALI_HW_SYNC / SET_CALIBRATION / SET_CALIBRATION_AUTO / CLEAR_CALIBRATION:

The simplest calibration case is calibration by cam only (connected to one digital input).

Here, the motor travels in the

1st step with velocity 1 (Index 0x8040:09 [▶ 210]) in direction 1 (Index 0x8041:13 [▶ 211]) towards the cam.

Subsequently, in the 2nd step, it travels with velocity 2 (Index 0x8040:0A [▶ 210]) in direction 2 (Index 0x8041:14 [▶ 211]) away from the cam.

After the "*In-Target timeout*" (Index 0x8040:0C [▶ 210]) has elapsed, the calibration position (Index 0x8040:08 [▶ 210]) is taken on by the terminal as the current position.

NOTE
Observe the switching hysteresis of the cam switch
With this simple calibration it must be noted that the position detection of the cam is only exact to a certain degree. The digital inputs are not interrupt-controlled and are "only" polled. The internal propagation delays may therefore result in a system-related position difference.
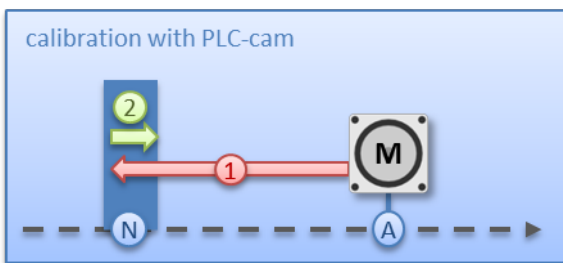
Fig. 173: Calibration with cam

For a more precise calibration, an HW sync pulse (C-track) is used in addition to the cam. This calibration proceeds in exactly the same way as described above, up to the point at which the motor travels away from the cam. The travel is not stopped immediately; instead, the sync pulse is awaited. Subsequently, the "*In-Target timeout*" runs down again and the calibration position is taken on by the terminal as the current position.
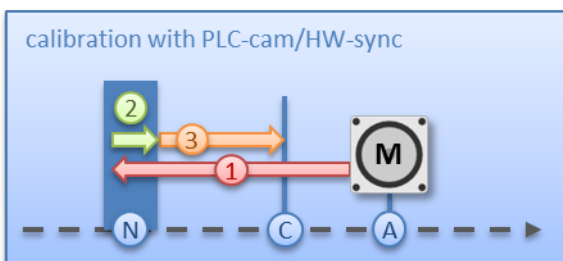
Fig. 174: Calibration with cam and C-track

If calibration by hardware is not possible due to the circumstances of the application, the user can also set the "*Calibrated*" bit manually or automatically. The manual setting or deletion takes place with the commands "*SET_CALIBRATION*" and "*CLEAR_CALIBRATION*".

It is simpler, however, if the standard start types (Index 0x8041:01 [▶ 211]) are set to "*SET_CALIBRATION_AUTO*". The "*Calibrated*" bit will now be set automatically by the first rising edge on "*Enable*". The command is conceived only for this purpose; therefore, it does not make sense to use it via the synchronous data exchange.

MODULO:

The modulo position of the axis is a piece of additional information about the absolute axis position. Modulo positioning represents the required target position in a different way. Contrary to the standard types of positioning, it must be noted in the case of modulo positioning that the desired target position can be interpreted differently.

The modulo positioning refers in principle to the "*Modulo factor*" (Index 0x8040:0E [▶ 210]), which can be set in the CoE. In the following examples, a rotary axis with a "*Modulo factor*" equivalent to 360 degrees is assumed.

The "*Modulo tolerance window*" (Index 0x8040:0F [▶ 210]) defines a position window around the current modulo target position of the axis. The window width is twice the specified value (set position ± tolerance value). A detailed description of the tolerance window is provided below.

The positioning of an axis is always referenced to its current actual position. The actual position of an axis is normally the target position of the last travel command. Under certain circumstances (incorrect positioning due to the axis stalling, or a very coarse resolution of the connected encoder), however, a position not expected by the user may arise. If this possibility is not considered, subsequent positioning may lead to unexpected behavior.
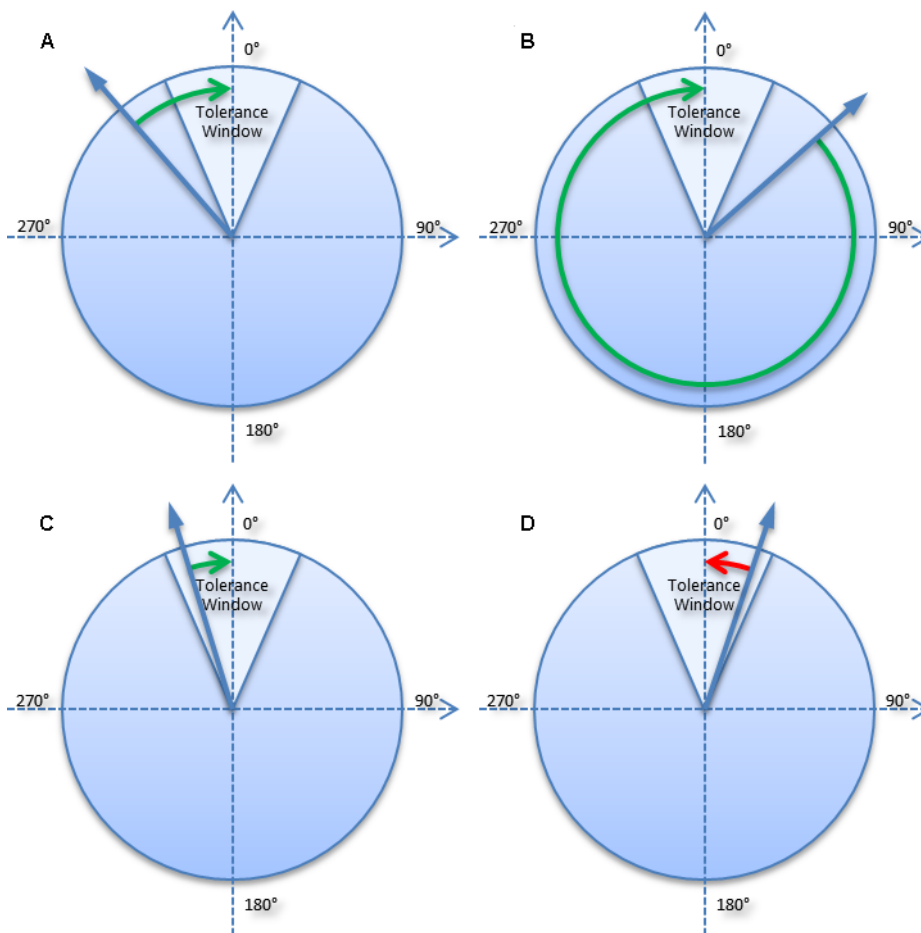
Fig. 175: Effect of the modulo tolerance window - modulo target position 0° in positive direction

Example:

An axis is positioned to 0°, with the result that subsequently the actual position of the axis is exactly 0°. A further modulo travel command to 360° in *positive direction* results in a full turn, with the subsequent modulo position of the axis of once again being exactly 0°.
If the axis comes to a stop somewhere in front of or behind the target position for mechanical reasons, the next travel command does not behave as one would expect.

- If the actual position lies slightly below 0° (see fig. *Effect of the modulo tolerance window - modulo target position 0° in positive direction* **A**), a new travel command to 0° in the *positive direction* leads only to a minimal movement. The deviation that arose beforehand is compensated and the position is subsequently exactly 0° once more.

- If the position lies slightly above 0° (see fig. *Effect of the modulo tolerance window - modulo target position 0° in positive direction* **B**), however, the same travel command leads to a full revolution in order to reach the exact position of 0° again. This problem occurs if complete turns by 360° or multiples of 360° were initiated. For positioning to an angle that is significantly different from the current modulo position, the travel command is unambiguous.

In order to solve the problem, a "*Modulo tolerance window*" (Index 0x8040:0F [▶ 210]) can be parameterized. This ensures that small deviations from the position that are within the window do not lead to different axis behavior. If, for example, a window of 1° is parameterized, in the case described above the axis will behave identically, as long the actual position is between 359° and 1°.

- If the position exceeds 0° by less than 1° (see fig. *Effect of the modulo tolerance window - modulo target position 0° in positive direction* **D**), the axis is re-positioned in *positive direction* at a modulo start. In both cases, a target position of 0° therefore leads to minimum movement to exactly 0°. A target position of 360° leads to a full turn in both cases.

For values that are within the window range, the modulo tolerance window can therefore lead to movements against the specified direction. For small windows this is usually not a problem, because system deviations between set and actual position are compensated in both directions. This means that the tolerance window may also be used for axes that may only be moved in one direction due to their construction.

Modulo positioning by less than one turn

Modulo positioning from a starting position to a non-identical target position is unambiguous and requires no special consideration.

- A modulo target position in the range [0 ≤; position < 360] reaches the required target in less than one whole turn.

- No motion occurs if target position and starting position are identical.

- Target positions of more than 360 ° lead to one or more full turns before the axis travels to the required target position.

For a movement from 270° to 0°, a modulo target position of 0° (not 360°) should therefore be specified, because 360° is outside the basic range and would lead to an additional turn.

The modulo positioning distinguishes between three direction specifications: *positive direction*, *negative direction* and *along the shortest path* (*MODULO_PLUS, MODULO_MINUS, MODULO_SHORT*).
For positioning along the shortest path, target positions of more than 360° are not sensible, because the movement towards the target is always direct. In contrast to positive or negative direction, it is therefore not possible to carry out several turns before the axis moves to the target.

NOTE
Only basic periods of less than 360° are permitted
For modulo positioning with start type "MODULO_SHORT", only modulo target positions within the basic period (e.g. less than 360°) are permitted, otherwise an error is returned.

● **Positioning without the modulo tolerance window**

ℹ The "Modulo tolerance window" (Index 0 Index 0x8040:0F) is always taken into account in the "normal" types of modulo positioning. However, this is less desirable in some situations. In order to eliminate this "disadvantage", the comparable start types "MODULO_SHORT_EXT", "MODULO_PLUS_EXT", "MODULO_MINUS_EXT" and "MODULO_CURRENT_EXT" can be used, which ignore the modulo tolerance window.

The following tables show some positioning examples.

Examples of modulo positioning with less than one revolution

Modulo start type	Absolute start position	Modulo target position	Relative travel path	Absolute end position	Modulo end position
MODULO_PLUS	90°	0°	270°	360°	0°
MODULO_PLUS	90°	360°	630°	720°	0°
MODULO_PLUS	90°	720°	990°	1080°	0°
MODULO_MINUS	90°	0°	-90°	0°	0°
MODULO_MINUS	90°	360°	-450°	-360°	0°
MODULO_MINUS	90°	720°	-810°	-720°	0°
MODULO_SHORT	90°	0°	-90°	0°	0°

Modulo positioning with full turns

In principle, modulo positioning by one or full turns are no different than positioning to an angle that differs from the starting position. No motion occurs if target position and starting position are identical. For a full turn, 360° has to be added to the starting position. The behavior described in the <u>example [▶ 152]</u> shows that special attention must be paid to positionings with whole revolutions. The following table shows positioning examples for a starting position of approximately 90°. The modulo tolerance window (TF) is set to 1° here. Special cases for which the starting position is outside this window are identified.

Examples of modulo positioning with whole revolutions

Modulo start type	Absolute start position	Modulo target position	Relative travel path	Absolute end position	Modulo end position	Note
MODULO_PLUS	90.00°	90.00°	0.00°	90.00°	90.00°	
MODULO_PLUS	90.90°	90.00°	-0.90°	90.00°	90.00°	
MODULO_PLUS	91.10°	90.00°	358.90°	450.00°	90.00°	outside TF
MODULO_PLUS	89.10°	90.00°	0.90°	90.00°	90.00°	
MODULO_PLUS	88.90°	90.00°	1.10°	90.00°	90.00°	outside TF
MODULO_PLUS	90.00°	450.00	360.00°	450.00°	90.00°	
MODULO_PLUS	90.90°	450.00°	359.10°	450.00°	90.00°	
MODULO_PLUS	91.10°	450.00°	718.90°	810.00°	90.00°	outside TF
MODULO_PLUS	89.10°	450.00°	360.90°	450.00°	90.00°	
MODULO_PLUS	88.90°	450.00°	361.10°	450.00°	90.00°	outside TF
MODULO_PLUS	90.00°	810.00	720.00°	810.00°	90.00°	
MODULO_PLUS	90.90°	810.00	719.10°	810.00°	90.00°	
MODULO_PLUS	91.10°	810.00	1078.90°	1170.00°	90.00°	outside TF
MODULO_PLUS	89.10°	810.00	720.90°	810.00°	90.00°	
MODULO_PLUS	88.90°	810.00	721.10°	810.00°	90.00°	outside TF
MODULO_MINUS	90.00°	90.00°	0.00°	90.00°	90.00°	
MODULO_MINUS	90.90°	90.00°	-0.90°	90.00°	90.00°	
MODULO_MINUS	91.10°	90.00°	-1.10°	90.00°	90.00°	outside TF
MODULO_MINUS	89.10°	90.00°	0.90°	90.00°	90.00°	
MODULO_MINUS	88.90°	90.00°	-358.90°	-270.00°	90.00°	outside TF
MODULO_MINUS	90.00°	450.00°	-360.00°	-270.00°	90.00°	
MODULO_MINUS	90.90°	450.00°	-360.90°	-270.00°	90.00°	
MODULO_MINUS	91.10°	450.00°	-361.10°	-270.00°	90.00°	outside TF
MODULO_MINUS	89.10°	450.00°	-359.10°	-270.00°	90.00°	
MODULO_MINUS	88.90°	450.00°	-718.90°	-630.00°	90.00°	outside TF
MODULO_MINUS	90.00°	810.00°	-720.00°	-630.00°	90.00°	
MODULO_MINUS	90.90°	810.00°	-720.90°	-630.00°	90.00°	
MODULO_MINUS	91.10°	810.00°	-721.10°	-630.00°	90.00°	outside TF
MODULO_MINUS	89.10°	810.00°	-719.10°	-630.00°	90.00°	
MODULO_MINUS	88.90°	810.00°	-1078.90°	-990.00°	90.00°	outside TF

Examples of two travel commands with a dynamic change of the target position

Without overrun of the target position

Time	POS Outputs	POS Inputs	Description
t1:	Execute = 1 Target position = 200000 Velocity = 2000 Start type = 0x0001 Acceleration = 1000 Deceleration = 1000	Busy = 1 Accelerate = 1	- Specification of the first parameter - Start of the acceleration phase
t2:		Accelerate = 0	- End of the acceleration phase
t3:	Target position = 100000 Velocity = 1500 Start type = 0x1001 Acceleration = 2000 Deceleration = 2000		- Change of the parameters - Activation by new start types
t4:		Decelerate = 1	- Start of the deceleration phase
t5:	Execute = 0	Busy = 0 In-Target = 1 Decelerate = 0	- End of the deceleration phase - Motor is at the new target position
t6 - t9:			- Absolute travel back to the start position 0
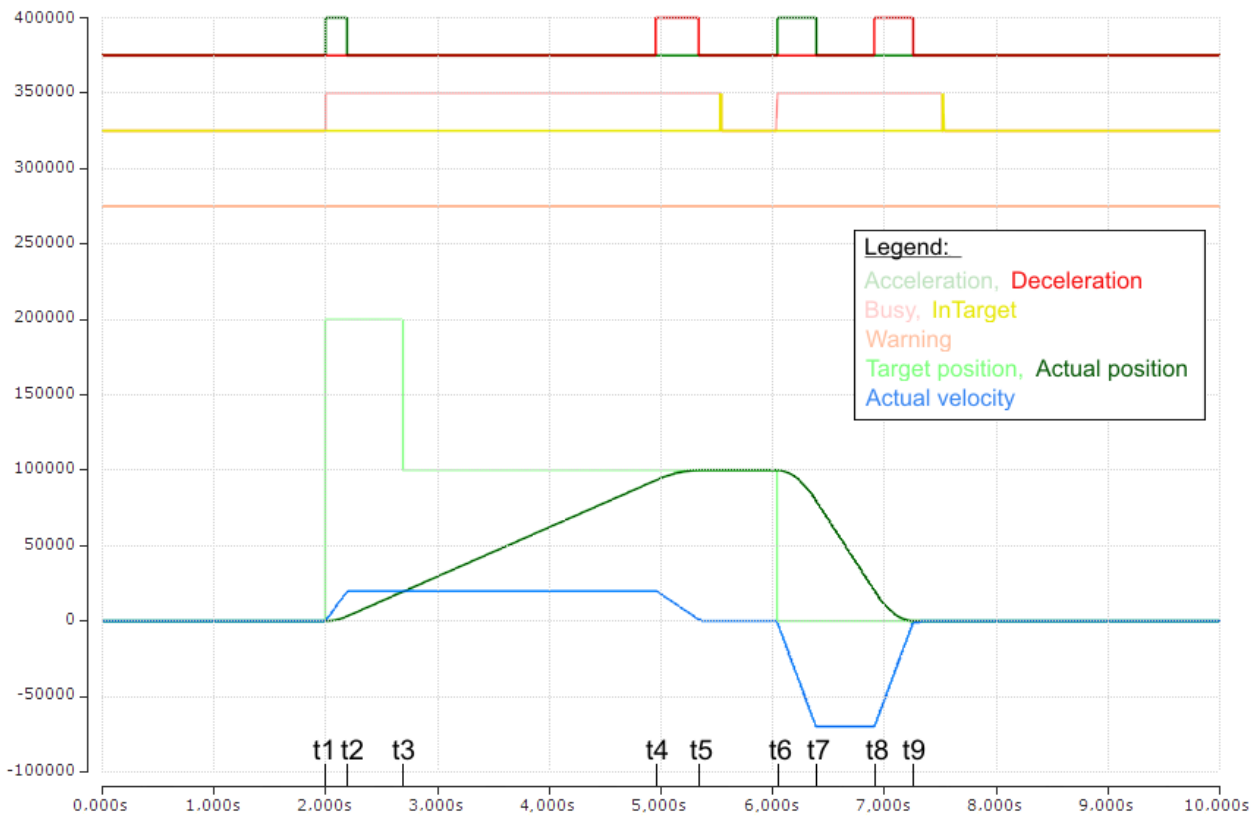
Fig. 176: Scope recording of a travel command with a dynamic change of the target position, without overrunning the target position
(The axis scaling refers only to the positions, not to the speed or the status bits)

With overrun of the target position

Time	POS Outputs	POS Inputs	Description
t1:	Execute = 1 Target position = 200000 Velocity = 5000 Start type = 0x0001 Acceleration = 3000 Deceleration = 5000	Busy = 1 Accelerate = 1	- Specification of the 1st parameter - Start of the 1st acceleration phase
t2:		Accelerate = 0	- End of the 1st acceleration phase
t3:	Target position = 100000 Velocity = 1500 Start type = 0x1001 Acceleration = 1000 Deceleration = 2000	Warning = 1 Decelerate = 1	- Change of the parameters - Activation by new start types - Warning of overrunning the target position - Start of the 1st deceleration phase
t4:		Accelerate = 1 Decelerate = 0	- End of the 1st deceleration phase - Start of the 2nd acceleration phase in the opposite direction
t5:		Accelerate = 0 Decelerate = 1	- End of the 2nd acceleration phase - Start of the 2nd deceleration phase
t6:	Execute = 0	Busy = 0 In-Target = 1 Decelerate = 0	- End of the 2nd deceleration phase - Motor is at the new target position
t7 - t10:			- Absolute travel back to the start position 0
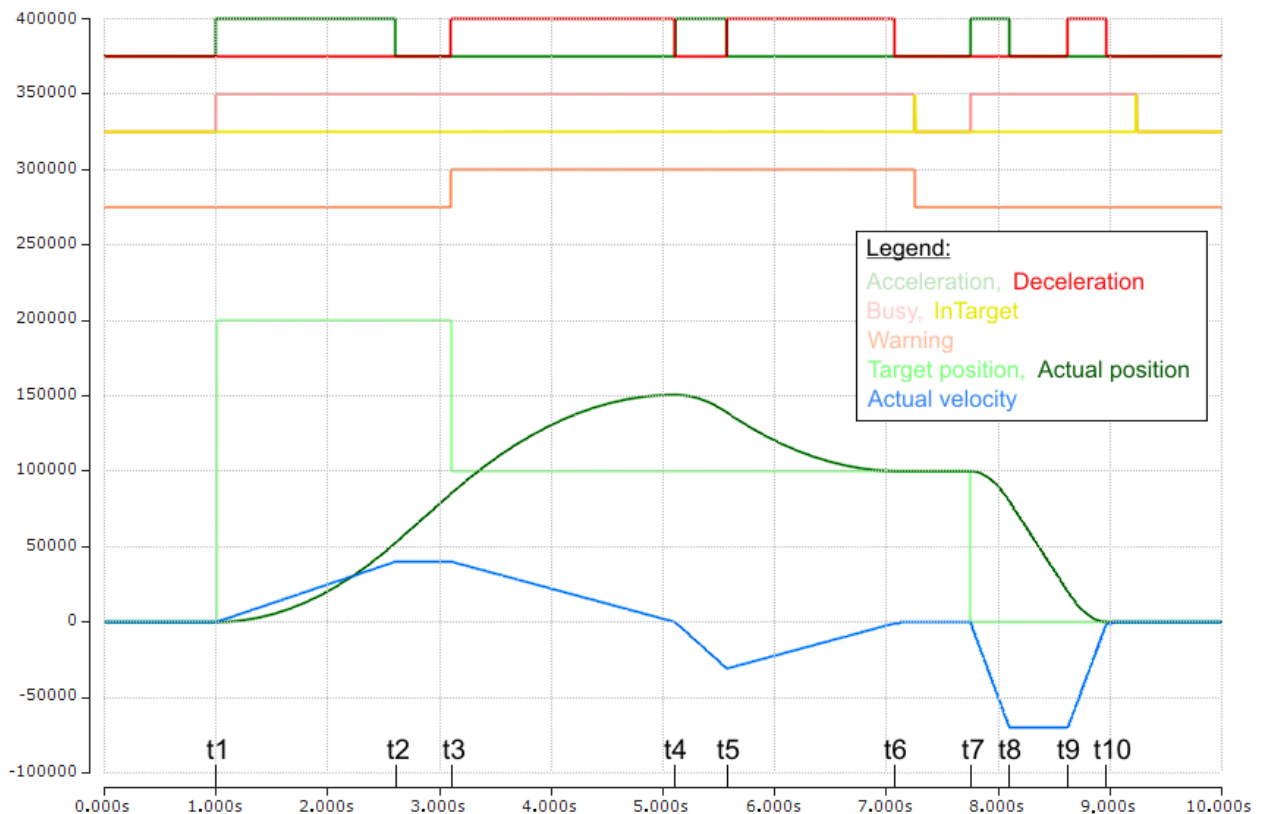
Fig. 177: Scope recording of a travel command with a dynamic change of the target position, with overrunning of the final target position
(The axis scaling refers only to the positions, not to the speed or the status bits)

6.10 Samples commissioning

6.10.1 EL73x2 - Application example: chopper operation

⚠ WARNING
Risk of injury through electric shock and damage to the device!
Bring the Bus Terminals system into a safe, de-energized state before starting mounting, disassembly or wiring of the Bus Terminals.

Brake resistor

The brake resistor connected to channel 2 of the second EL7342 uses the brake energy of the motors connected to the other three channels.
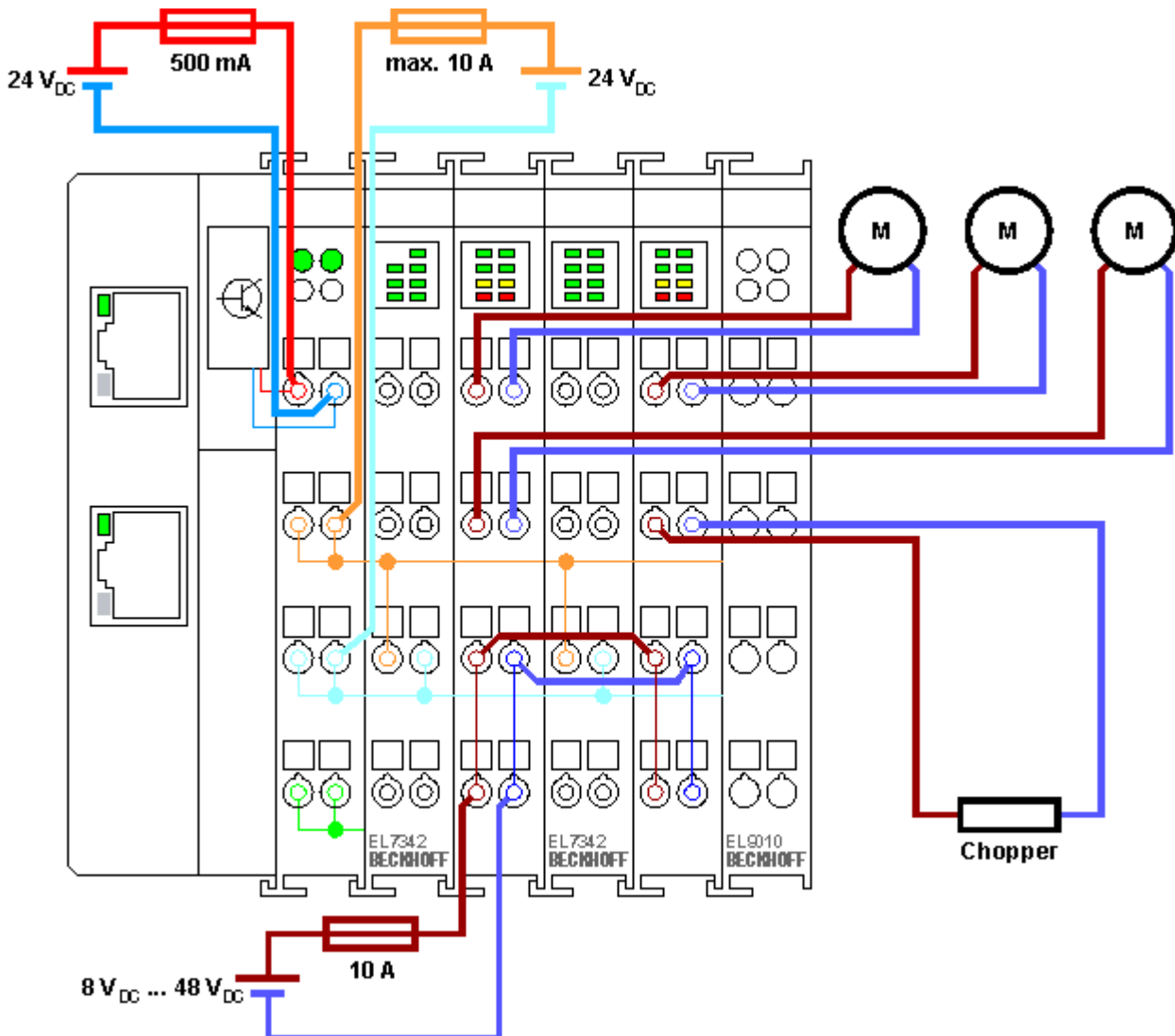
Fig. 178: Connection example Brake resistor

NOTE
Dimensioning of the brake resistor
The brake resistor should be dimensioned such that it can withstand the expected heat development without damage (refer also to the Chopper operation [▶ 140] section)!

6.10.2   Program example: motor controller with visualization

ℹ **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.

💾 Download (https://infosys.beckhoff.com/content/1033/el73x2/Resources/zip/2050399883.zip)

Used Master: TwinCAT 2.11 (for older versions the control loop has to be programmed manually; in this case it is already implemented in the NC).
This application example demonstrates movement of a motor to any position or in continuous mode with the aid of visualization. The velocity, the starting acceleration and the deceleration can be specified.

The example program consists of two files. On the one hand the PLC file and on the other System Manager file.

First open the PLC file and compile it so that you have the *.tpy file available that is required for the System Manager.

Please note that you may have to adjust the target platform in the PLC program (default: PC or CX 8x86). If required, you can select the target platform under *Resources -> Controller configuration*.
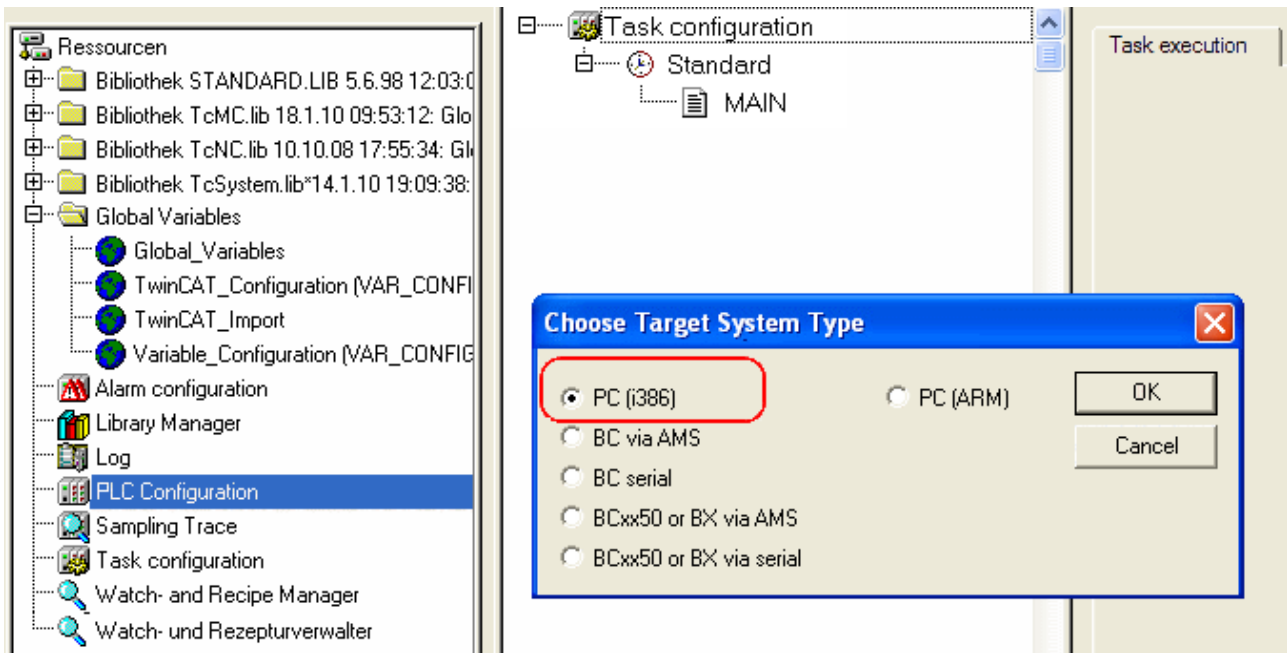
Fig. 179: Selection of the target platform

Please note the following for the System Manager file:

- Start the System Manager in Config mode.
- Please ensure that the I/O configuration matches your actual configuration. In the sample program only one EL7342 is integrated. If further terminals are connected you have to add them or re-scan your configuration.
- You have to adjust the MAC address. To do this click on your EtherCAT device, then select the Adapter tab and click on Search after the MAC address (see Fig. *Selection of adapter*). Select the right adapter.

BECKHOFF
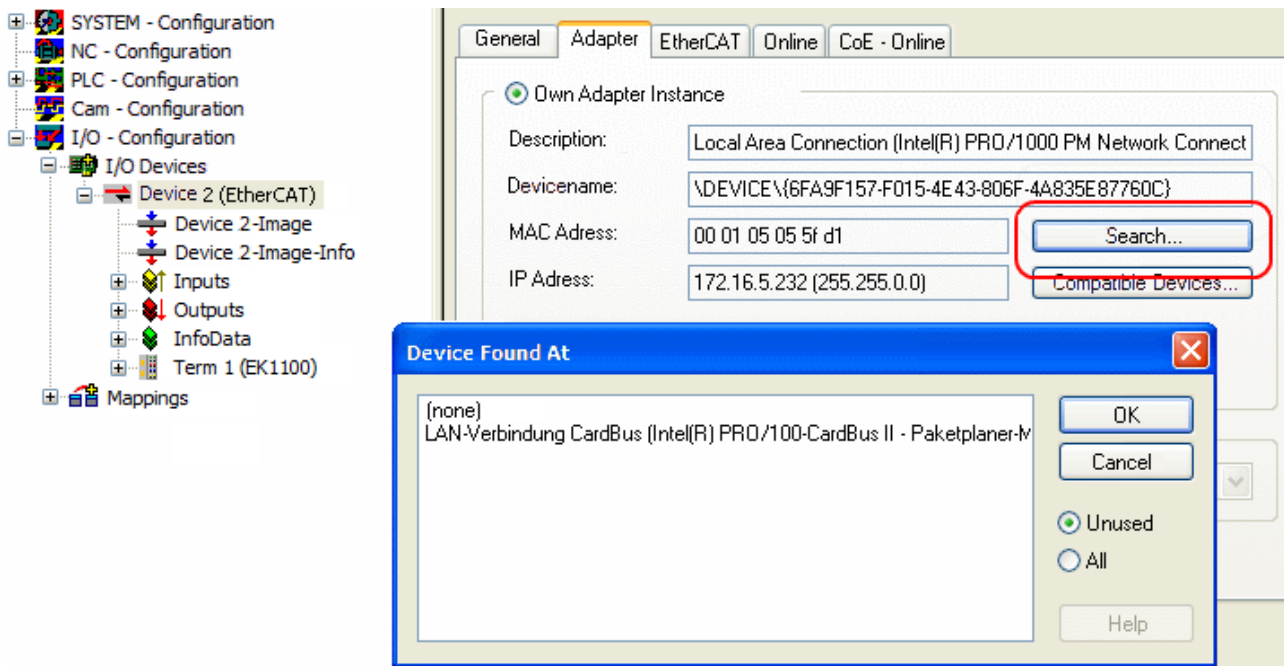
Fig. 180: Selection of adapter

- In the PLC configuration you have to adjust the path for the PLC program. Click on the appended PLC program and select the tab IEC1131 (see Fig. *Changing path of the PLC program*). Select Change and enter the correct path.
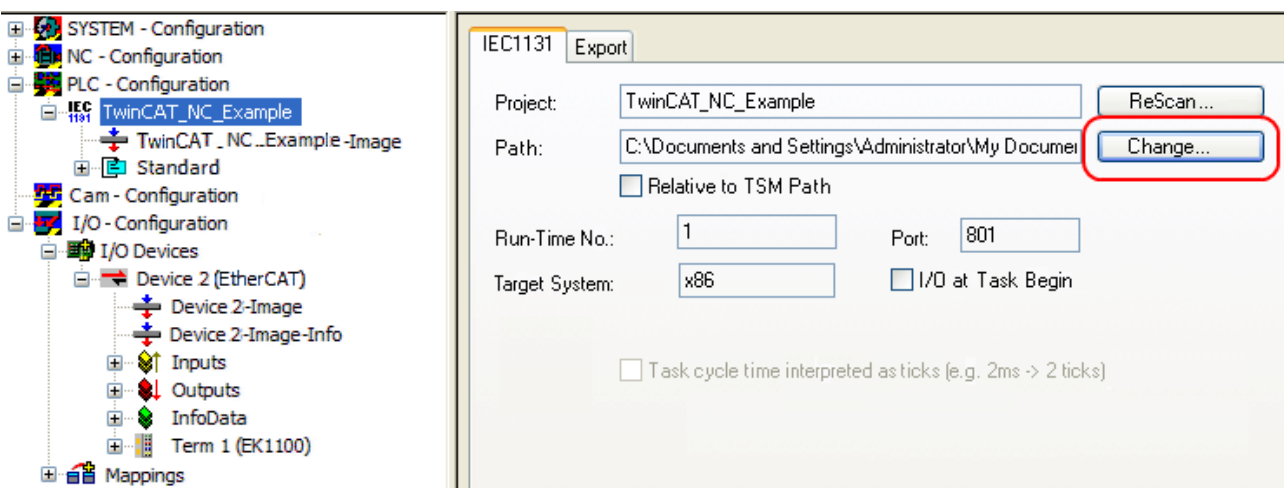
Fig. 181: Changing path of the PLC program

- Under NC configuration an EL7041 is already linked to the NC. To change the link or add additional devices proceed as described under "".

The PLC program is configured as follows. The libraries TcMC.lib and TcNC.lib must be integrated (see Fig. *Required libraries*).
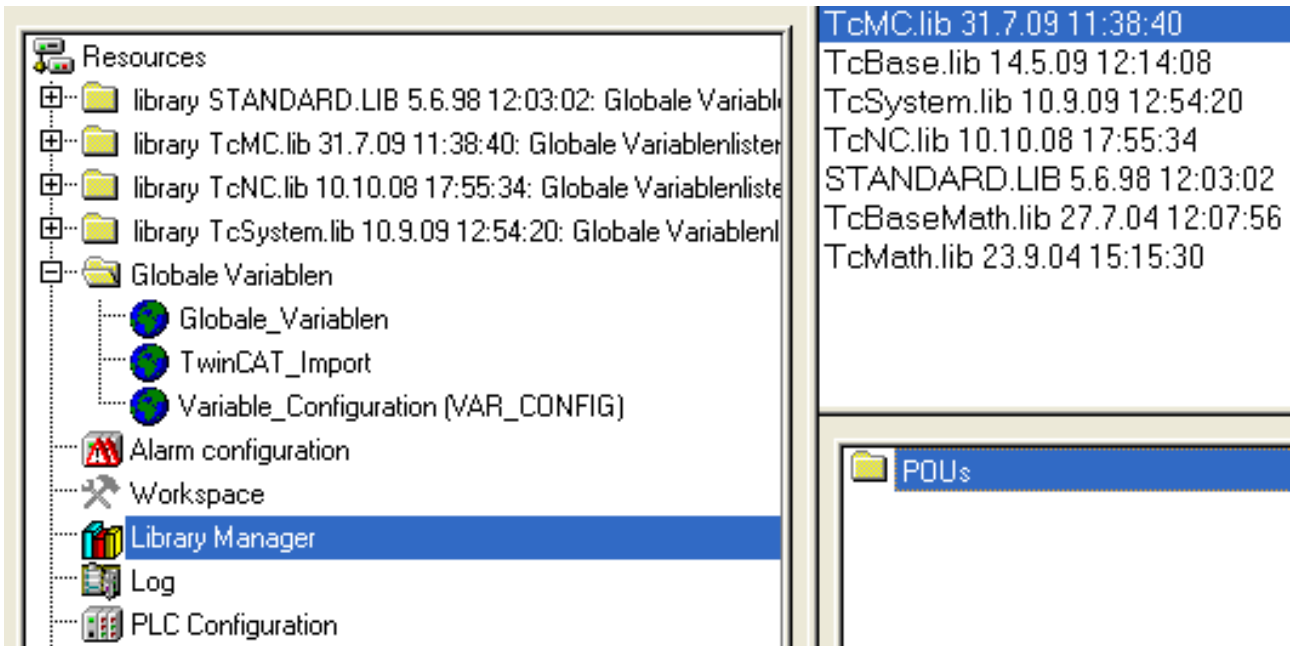
Fig. 182: Required libraries

Once this is done, certain global variables are declared (see Fig. *Global variables*). The data types PLCTONC_AXLESTRUCT and NCTOPLC_AXLESTRUCT deal with the communication between the PLC and the NC.
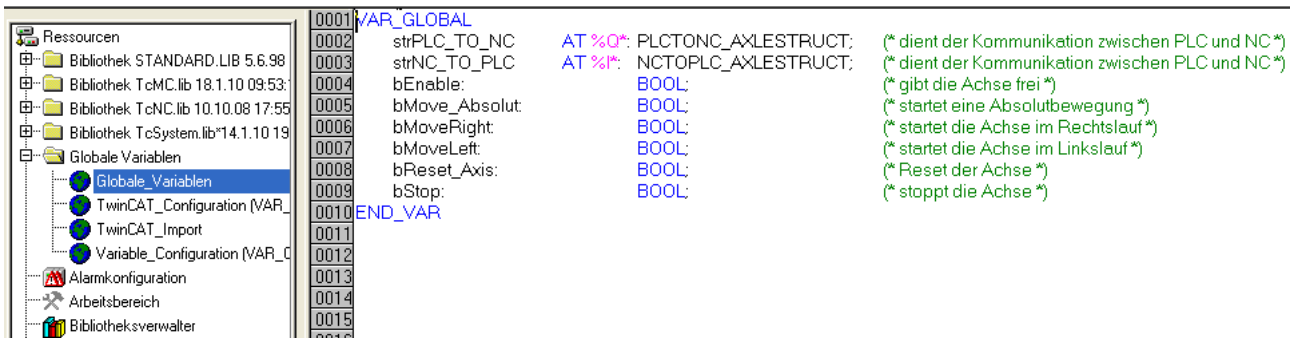
Fig. 183: Global variables

Once the global variables have been declared, programming can commence. Start with declaring local variables (see Fig. *Local variables*).
MC_Direction is an enumeration type that specifies the direction of travel for the block MC_MoveVelocity, which in turn initiates continuous travel of the motor.
An axis reset is carried out with the function block MC_Reset. Absolute positioning is carried out with the function block MC_MoveAbsolute. The current axis position can be read with the function block MC_ActualPosition.
MC_Power enables the axis; MC_Stop is required for stopping the axis.

Fig. 184: Local variables

The program can then be programmed as follows (see Fig. *Program code*):

```
Bausteine
  MAIN (PRG)
```

```
0001 (* Freigabesignale werden gesetzt *)
0002 fbPower_Axis_1(
0003      Enable             :=    bEnable,
0004      Enable_Positive    :=    bEnable,
0005      Enable_Negative :=      bEnable,
0006      Override           :=    100.000,
0007      AxisRefIn          :=    strNC_TO_PLC,
0008      AxisRefOut         :=    strPLC_TO_NC,
0009      Status             => ,
0010      Error              => ,  ErrorID         => );
0011
0012 (* Überprüft, ob die Achse bereit ist *)
0013 bAxis_Ready := AxisIsReady(strNC_TO_PLC.nStateDWord );
0014
0015 (* Reset der Achse *)
0016 fbReset_Axis(
0017      Execute  :=    bReset_Axis,
0018      Axis     :=    strNC_TO_PLC,
0019      Done     =>    bReset_Done,
0020      Error    => ,   ErrorID  =>  );
0021
0022 (* Führt eine Absolutbewegung durch *)
0023 fbMoveAbsolute_Axis_1(
0024      Execute            :=    bMove_Absolut,
0025      Position           :=    lrPosition_Drive_to,
0026      Velocity           :=    lrVelocity_Move_Ab_Axis_1 ,
0027      Acceleration       :=    lrAcc_Axis_1,
0028      Deceleration       :=    lrDecel_Axis_1,
0029      Jerk               :=    lrJerk_Axis_1 ,
0030      Axis               :=    strNC_TO_PLC,
0031      Done               =>    bMove_Absolut_Done ,
0032      CommandAborted =>       bMove_Absolut_Aborted ,
0033      Error              => ,   ErrorID         =>  );
0034
0035 IF fbMoveAbsolute_Axis_1.Done THEN
0036      bMove_Absolut := FALSE;
0037 END_IF
0038
0039 (* Führt eine Endlosbewegung durch *)
0040 IF bMoveRight THEN
0041      Direction := MC_Positive_Direction;
0042 ELSIF bMoveLeft THEN
0043      Direction := MC_Negative_Direction;
0044 END_IF
0045
0046 fbMoveVelocity_Axis_1(
0047      Execute            :=    bMoveRight OR bMoveLeft,
0048      Velocity           :=    1000,
0049      Acceleration       :=    lrAcc_Axis_1,
0050      Deceleration       :=    lrDecel_Axis_1,
0051      Jerk               :=    ,
0052      Direction          :=    Direction,
0053      Axis               :=    strNC_TO_PLC,
0054      InVelocity         => ,
0055      CommandAborted =>    ,
0056      Error              => ,   ErrorId         =>  );
0057
0058 IF bMove_Absolut OR bMoveLeft OR bMoveRight THEN
0059      bStop := FALSE;
0060 ELSE
0061      bStop := TRUE;
0062 END_IF
0063
0064 (* Stoppt die Achse *)
0065 fbStop(
0066      Execute        :=    bStop,
0067      Deceleration  :=     500,
0068      Jerk           :=    ,
0069      Axis           :=    strNC_TO_PLC,
0070      Done           => ,
0071      Error          => ,   ErrorId      =>  );
0072
0073 (* Auslesen der aktuellen Position *)
0074 fbReadActualPosition_1(
0075      Enable  :=    TRUE ,
0076      Axis    :=    strNC_TO_PLC,
0077      Done    => ,
0078      Error   => ,
0079      ErrorID => ,
0080      Position =>  lrActual_Position);
0081
```

Fig. 185: Program code

The motor can then be operated with the aid of the following visualization (see Fig. *Visualization*).

Press *Enable* to enable the axis. You now have the choice. You can press the *Left* or *Right* button in *free run mode* and the motor will turn at the velocity defined in *fbMoveVelocity_Axis_1* in the selected direction. Or you can specify in *Absolute mode velocity*, *acceleration*, *deceleration* and the *position* to be driven to and start the drive with *Start Job*. If no values are entered for *acceleration* and *deceleration* the default value of the NC is used.
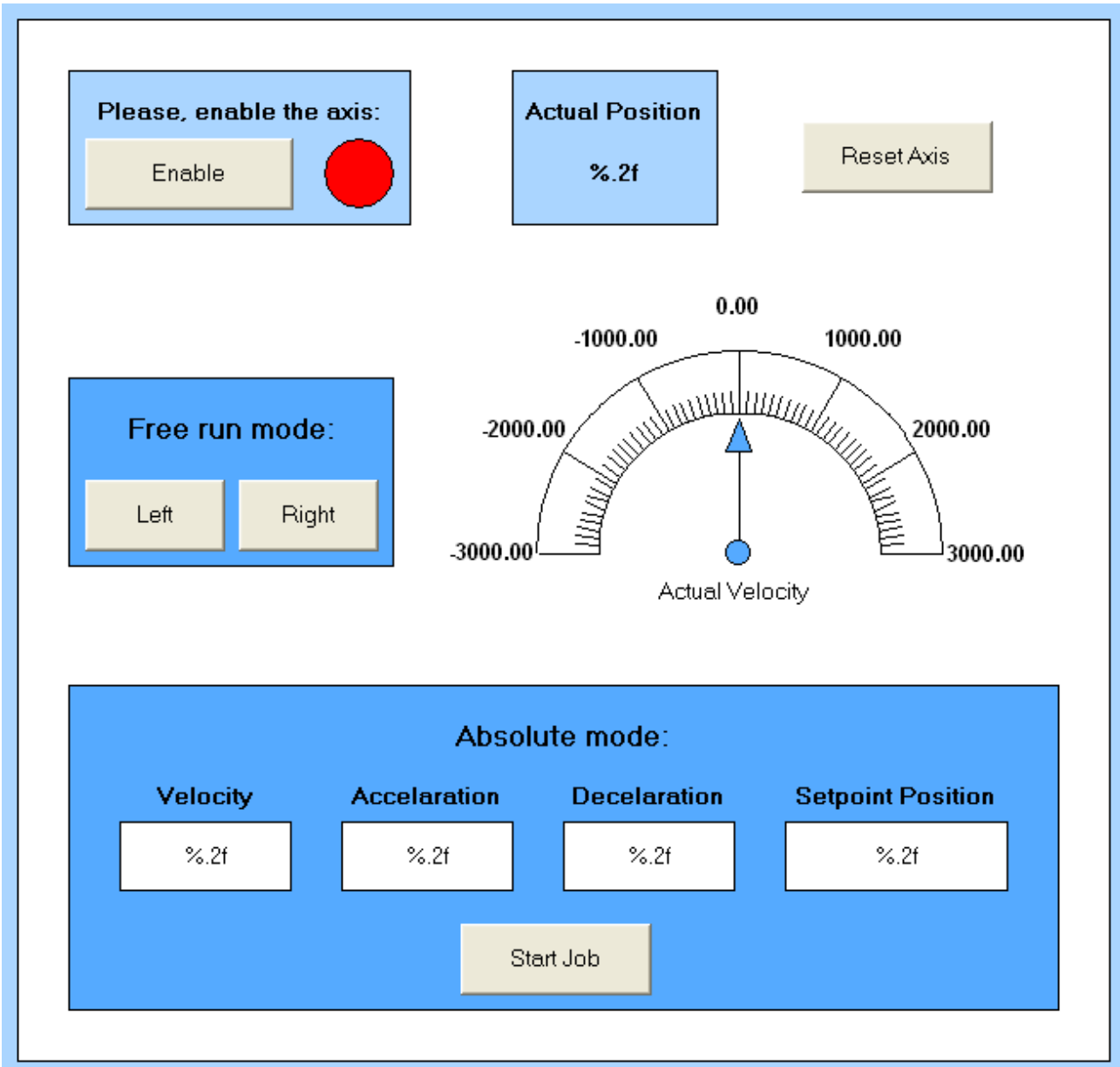
Fig. 186: Visualization

Information on function blocks and data types

Further information on the function blocks and data types used can be found in the Beckhoff Information System.

7   EL7332- Object description and parameterization

7.1   Note regarding CoE objects compatibility

i   **CoE objects with different hardware/software versions**

Due to the continual further development of the EL7332, depending on the firmware and hardware as well as the revision level, the following must be observed:

► Object dictionary valid up to firmware 05 / revision status -0019 [▶ 165]

► Object dictionary valid from firmware 06 / revision status -0020 [▶ 180]

The terminals with the newer firmware/revision status are downwardly compatible, i.e. a "new" terminal can be operated with an "old" TwinCAT configuration; it is mapped internally to the new object dictionary.

7.2   up to firmware 05 / revision status -0019

i   **Parameterization**

The terminal is parameterized via the CoE - Online tab (double-click on the respective object) or via the Process Data tab (allocation of PDOs).

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization during commissioning:
  - Restore object [▶ 165]
  - Configuration data [▶ 166]
  - Command object [▶ 170]
- Profile-specific objects:
  - Input data [▶ 170]
  - Output data [▶ 171]
  - Information and diagnosis data (channel specific) [▶ 172]
  - Configuration data (vendor-specific) [▶ 173]
  - Information and diagnosis data (device-specific) [▶ 174]
- Standard objects [▶ 174]

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

7.2.1   Restore object

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters [▶ 255]	Restore default parameters	UINT8	RO	0x01 (1$_{dec}$)
1011:01	SubIndex 001	If this object is set to **"0x64616F6C"** in the set value dialog, all backup objects are reset to their delivery state.	UINT32	RW	0x00000000 (0$_{dec}$)

7.2.2 Configuration data

Index 8020 DCM Motor Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8020:0	DCM Motor Settings Ch.1	Max. Subindex	UINT8	RO	0x0F (15_{dec})
8020:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x0960 (2400_{dec})
8020:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x05DC (1500_{dec})
8020:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0x5DC0 (24000_{dec})
8020:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100_{dec})
8020:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500_{dec})
8020:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500_{dec})
8020:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200_{dec})
8020:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000_{dec})
8020:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})
8020:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})

Index 8021 DCM Controller Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8021:0	DCM Controller Settings Ch.1	Max. Subindex	UINT8	RO	0x12 (18_{dec})
8021:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200_{dec})
8021:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2_{dec})
8021:03	Inner window (curr.)	Inner window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})
8021:05	Outer window (curr.)	Outer window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})
8021:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0_{dec})
8021:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0_{dec})
8021:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0_{dec})

Index 8022 DCM Features Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8022:0	DCM Features Ch.1	Max. Subindex	UINT8	RO	0x3E (62$_{dec}$)
8022:01	Operation mode	Operation mode: 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller 4 - 14: reserved 15: Chopper resistor Existing overvoltage (10% > nominal voltage 0x8020:03 [▶ 166]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8022:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8020:0C [▶ 166])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8020:0D [▶ 166] - 0x8020:0F [▶ 166])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle 6: reserved 7: Motor velocity 8: Overload time 9 - 100: reserved 101: Internal temperature 102: reserved 103: Control voltage 104: Motor supply voltage 105 - 149: reserved 150: Status word (drive controller) 151: State (drive controller) …: reserved	UINT8	RW	0x01 (1$_{dec}$)
8022:19	Select info data 2	Selection "Info data 2" see subindex 0x8022:11 [▶ 167]	UINT8	RW	0x02 (2$_{dec}$)
8022:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:32	Function for input 1	Function of digital input 1 0: Normal input 1: Hardware enable …:reserved	BIT4	RW	0x00 (0$_{dec}$)
8022:36	Function for input 2	Function of digital input 2 see subindex 0x8022:32 [▶ 167]	BIT4	RW	0x00 (0$_{dec}$)

Index 8030 DCM Motor Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8030:0	DCM Motor Settings Ch.2	Max. Subindex	UINT8	RO	0x0F (15$_{dec}$)
8030:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x0960 (2400$_{dec}$)
8030:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x05DC (1500$_{dec}$)
8030:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0x5DC0 (24000$_{dec}$)
8030:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100$_{dec}$)
8030:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8030:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8030:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200$_{dec}$)
8030:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000$_{dec}$)
8030:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8030:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)

Index 8031 DCM Controller Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8031:0	DCM Controller Settings Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
8031:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200$_{dec}$)
8031:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2$_{dec}$)
8031:03	Inner window (curr.)	Inner window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8031:05	Outer window (curr.)	Outer window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8031:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8031:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0$_{dec}$)
8031:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8032 DCM Features Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8032:0	DCM Features Ch.1	Max. Subindex	UINT8	RO	0x3E (62$_{dec}$)
8032:01	Operation mode	Operation mode 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller 4 - 14: reserved 15: Chopper resistor Existing overvoltage (10 % > nominal voltage 0x8030:03 [▶ 168]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8032:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8030:0C [▶ 168])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8030:0D [▶ 168] - 0x8030:0F [▶ 168])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle 6: reserved 7: Motor velocity 8: Overload time 9 - 100: reserved 101: Internal temperature 102: reserved 103: Control voltage 104: Motor supply voltage 105 - 149: reserved 150: Status word (drive controller) 151: State (drive controller) …: reserved	UINT8	RW	0x01 (1$_{dec}$)
8032:19	Select info data 2	Selection "Info data 2" see subindex 0x8032:11 [▶ 169]	UINT8	RW	0x02 (2$_{dec}$)
8032:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:32	Function for input 1	Function of digital input 1 Function of digital input 1 0: Normal input 1: Hardware enable …:reserved	BIT4	RW	0x00 (0$_{dec}$)
8032:36	Function for input 2	Function of digital input 2 see subindex 0x8032:32 [▶ 169]	BIT4	RW	0x00 (0$_{dec}$)

7.2.3 Command object

Index FB00 DCM Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	DCM Command	Max. Subindex	UINT8	RO	0x03 (3$_{dec}$)
FB00:01	Request	0x1000 Clear diag history: Clear the Diag History	OCTET-STRING[2]	RW	{0}
		0x1100 Get build number: Read out the build number			
		0x1101 Get build date: Read out the build date			
		0x1102 Get build time: Read out the build time			
		0x8000 software reset: Perform a software reset (hardware is re-initialized with the current CoE configuration; this otherwise happens only during the transition to INIT)			
FB00:02	Status	0: Finished, no error, no response Command terminated without error and without response	UINT8	RO	0x00 (0$_{dec}$)
		1: Finished, no error, response Command terminated without error and with response			
		2: Finished, error, no response Command terminated with error and without response			
		3: Finished, error, response Command terminated with error and with response			
		255: Executing Command is being executed			
FB00:03	Response	dependent on the request	OCTET-STRING[4]	RO	{0}

7.2.4 Input data

Index 6000 DCM Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	DCM Inputs Ch.1	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6000:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:03	Warning	A warning has occurred (see index 0xA000 [▶ 172])	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:04	Error	An error has occurred (see index 0xA000 [▶ 172])	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	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	Info data 1	Synchronous information (selection via subindex 0x8022:11 [▶ 167])	UINT16	RO	0x0000 (0$_{dec}$)
6000:12	Info data 2	Synchronous information (selection via subindex 0x8022:19 [▶ 167])	UINT16	RO	0x0000 (0$_{dec}$)

Index 6010 DCM Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	DCM Inputs Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6010:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:03	Warning	A warning has occurred (see index 0xA010 [▶ 173])	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:04	Error	An error has occurred (see index 0xA010 [▶ 173])	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:11	Info data 1	Synchronous information (selection via subindex 0x8032:11 [▶ 169])	UINT16	RO	0x0000 (0$_{dec}$)
6010:12	Info data 2	Synchronous information (selection via subindex 0x8032:19 [▶ 169])	UINT16	RO	0x0000 (0$_{dec}$)

7.2.5 Output data

Index 7000 DCM Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	DCM Outputs Ch.1	Max. Subindex	UINT8	RO	0x21 (33$_{dec}$)
7000:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8020:05 [▶ 166] / 0x8020:06 [▶ 166])	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0$_{dec}$)

Index 7010 DCM Outputs Ch.2

Index	Name	Meaning	Data type	Flags	Default
7010:0	DCM Outputs Ch.2	Max. Subindex	UINT8	RO	0x21 (33$_{dec}$)
7010:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8030:05 [▶ 168] / 0x8030:06 [▶ 168])	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0$_{dec}$)

7.2.6 Information and diagnosis data (channel specific)

Index 9000 DCM Info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
9000:0	DCM Info data Ch.1	Max. Subindex	UINT8	RO	0x09 (9_{dec})
9000:01	Status word	Status word (see Index App0)	UINT16	RO	0x0000 (0_{dec})
9000:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0_{dec})
9000:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0_{dec})
9000:04	Current limit	Present current limit	UINT16	RO	0x0000 (0_{dec})
9000:05	Control error	Present control error	INT16	RO	0x0000 (0_{dec})
9000:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0_{dec})
9000:09	Overload time	Time since overload	UINT16	RO	0x0000 (0_{dec})

Index 9010 DCM Info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
9010:0	DCM Info data Ch.2	Max. Subindex	UINT8	RO	0x09 (9_{dec})
9010:01	Status word	Status word (see Index App0)	UINT16	RO	0x0000 (0_{dec})
9010:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0_{dec})
9010:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0_{dec})
9010:04	Current limit	Present current limit	UINT16	RO	0x0000 (0_{dec})
9010:05	Control error	Present control error	INT16	RO	0x0000 (0_{dec})
9010:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0_{dec})
9010:09	Overload time	Time since overload	UINT16	RO	0x0000 (0_{dec})

Index A000 DCM Diag data Ch.1

Index (hex)	Name	Meaning		Data type	Flags	Default
A000:0	DCM Diag data Ch.1	Max. Subindex		UINT8	RO	0x11 (17_{dec})
A000:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0_{dec})
A000:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0_{dec})
A000:03	Torque overload	Present motor current exceeds the nominal current (see 0x8020:02 [▶ 166])	Warning (0x8pp2:0A = 0) / Error (0x8pp2:0A = 1)	BOOLEAN	RO	0x00 (0_{dec})
A000:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0_{dec})
A000:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8020:03) [▶ 166]	Error	BOOLEAN	RO	0x00 (0_{dec})
A000:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0_{dec})
A000:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0_{dec})
A000:09	Misc error	• initialization failed or • internal temperature of the terminal exceeds 100°C (see 0xF80F:05) or • motor current exceeds the nominal current (see 0x8022:0A [▶ 167])	Error	BOOLEAN	RO	0x00 (0_{dec})
A000:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8022:01 [▶ 167])		BIT4	RO	0x00 (0_{dec})

Index A010 DCM Diag data Ch.2

Index (hex)	Name	Meaning		Data type	Flags	Default
A010:0	DCM Diag data Ch.2	Max. Subindex		UINT8	RO	0x11 (17$_{dec}$)
A010:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:03	Torque overload	Present motor current exceeds the nominal current (see 8030:02 [▶ 168])	Warning (0x8032:0A = 0) / Error (0x8032:0A = 1)	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8030:03) [▶ 168]	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:09	Misc error	initialization failed or internal temperature of the terminal exceeds 100 °C (see 0xF80F:05) or motor current exceeds the nominal current (see 0x8032:0A [▶ 169])	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A010:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8032:01 [▶ 169])		BIT4	RO	0x00 (0$_{dec}$)

7.2.7   Configuration data (vendor-specific)

Index F80F DCM Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
F80F:0	DCM Vendor data	Max. Subindex	UINT8	RO	0x06 (6$_{dec}$)
F80F:01	PWM Frequency	DC link frequency (**unit:** 1 Hz)	UINT16	RW	0x7530 (30000$_{dec}$)
F80F:02	Deadtime	Dead time for pulse width modulation	UINT16	RW	0x0505 (1285$_{dec}$)
F80F:03	Deadtime space	Duty cycle limitation	UINT16	RW	0x0009 (9$_{dec}$)
F80F:04	Warning temperature	Threshold of the temperature warning (**unit:** 1 °C)	INT8	RW	0x50 (80$_{dec}$)
F80F:05	Switch off temperature	Switch-off temperature (**unit:** 1 °C)	INT8	RW	0x64 (100$_{dec}$)
F80F:06	Analog trigger point	Trigger point for AD conversion	UINT16	RW	0x000A (10$_{dec}$)

7.2.8 Information and diagnosis data (device-specific)

Index F900 DCM Info data

Index (hex)	Name	Meaning	Data type	Flags	Default
F900:0	DCM Info data	Max. Subindex	UINT8	RO	0x06 (6$_{dec}$)
F900:01	Software version (driver)	Software version of the driver card	STRING	RO	
F900:02	Internal temperature	Internal terminal temperature (**unit:** 1 °C)	INT8	RO	0x00 (0$_{dec}$)
F900:04	Control voltage	Control voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0$_{dec}$)
F900:05	Motor supply voltage	Load voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0$_{dec}$)
F900:06	Cycle time	Measured cycle time (**unit:** 1 µs)	UINT16	RO	0x0000 (0$_{dec}$)

7.2.9 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
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	0x02DD1389 (48042889$_{dec}$)

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EL7332

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	01

Index 100A Software version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4$_{dec}$)
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2$_{dec}$)
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x1CA43052 (480522322$_{dec}$)
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	0x00100000 (1048576$_{dec}$)
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
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 1401 DCM RxPDO-Par Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	DCM RxPDO-Par Velocity Ch.1	PDO Parameter RxPDO 2	UINT8	RO	0x06 (6$_{dec}$)
1401:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 2	OCTET-STRING[6]	RO	05 16 0A 16 0B 16

Index 1403 DCM RxPDO-Par Velocity Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1403:0	DCM RxPDO-Par Velocity Ch.2	PDO Parameter RxPDO 4	UINT8	RO	0x06 (6$_{dec}$)
1403:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 4	OCTET-STRING[6]	RO	07 16 0C 16 0D 16

Index 1600 DCM RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	DCM RxPDO-Map Control Ch.1	PDO Mapping RxPDO 1	UINT8	RO	0x05 (5$_{dec}$)
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x01 (Enable))	UINT32	RO	0x7000:01, 1
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x02 (Reset))	UINT32	RO	0x7000:02, 1
1600:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x03 (Reduce torque))	UINT32	RO	0x7000:03, 1
1600:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1600:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1601 DCM RxPDO-Map Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	DCM RxPDO-Map Velocity Ch.1	PDO Mapping RxPDO 2	UINT8	RO	0x01 (1$_{dec}$)
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x7000:21, 16

Index 1602 DCM RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	DCM RxPDO-Map Control Ch.2	PDO Mapping RxPDO 3	UINT8	RO	0x05 (5$_{dec}$)
1602:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x01 (Enable))	UINT32	RO	0x7010:01, 1
1602:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x02 (Reset))	UINT32	RO	0x7010:02, 1
1602:03	SubIndex 003	3. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x03 (Reduce torque))	UINT32	RO	0x7010:03, 1
1602:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1602:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1603 DCM RxPDO-Map Velocity Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	DCM RxPDO-Map Velocity Ch.2	PDO Mapping RxPDO 4	UINT8	RO	0x01 (1$_{dec}$)
1603:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x21 (Velocity))	UINT32	RO	0x7010:21, 16

Index 1A00 DCM TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	DCM TxPDO-Map Status Ch.1	PDO Mapping TxPDO 1	UINT8	RO	0x0E (14$_{dec}$)
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x01 (Ready to enable))	UINT32	RO	0x6000:01, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x02 (Ready))	UINT32	RO	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x03 (Warning))	UINT32	RO	0x6000:03, 1
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x04 (Error))	UINT32	RO	0x6000:04, 1
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x05 (Moving positive))	UINT32	RO	0x6000:05, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x06 (Moving negative))	UINT32	RO	0x6000:06, 1
1A00:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x07 (Torque reduced))	UINT32	RO	0x6000:07, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A00:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x0C (Digital input 1))	UINT32	RO	0x6000:0C, 1
1A00:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x0D (Digital input 2))	UINT32	RO	0x6000:0D, 1
1A00:0C	SubIndex 012	12. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A00:0D	SubIndex 013	13. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A00:0E	SubIndex 014	14. PDO Mapping entry (object 0x1800, entry 0x09)	UINT32	RO	0x1800:09, 1

Index 1A01 DCM TxPDO-Map Synchron info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	DCM TxPDO-Map Synchron info data Ch.1	PDO Mapping TxPDO 2	UINT8	RO	0x02 (2$_{dec}$)
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x11 (Info data 1))	UINT32	RO	0x6000:11, 16
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (DCM Inputs Ch.1), entry 0x12 (Info data 2))	UINT32	RO	0x6000:12, 16

Index 1A02 DCM TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	DCM TxPDO-Map Status Ch.2	PDO Mapping TxPDO 3	UINT8	RO	0x0E (14$_{dec}$)
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x01 (Ready to enable))	UINT32	RO	0x6010:01, 1
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x02 (Ready))	UINT32	RO	0x6010:02, 1
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x03 (Warning))	UINT32	RO	0x6010:03, 1
1A02:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x04 (Error))	UINT32	RO	0x6010:04, 1
1A02:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x05 (Moving positive))	UINT32	RO	0x6010:05, 1
1A02:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x06 (Moving negative))	UINT32	RO	0x6010:06, 1
1A02:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x07 (Torque reduced))	UINT32	RO	0x6010:07, 1
1A02:08	SubIndex 008	8. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A02:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A02:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x0C (Digital input 1))	UINT32	RO	0x6010:0C, 1
1A02:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x0D (Digital input 2))	UINT32	RO	0x6010:0D, 1
1A02:0C	SubIndex 012	12. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A02:0D	SubIndex 013	13. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A02:0E	SubIndex 014	14. PDO Mapping entry (object 0x1802, entry 0x09)	UINT32	RO	0x1802:09, 1

Index 1A03 DCM TxPDO-Map Synchron info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	DCM TxPDO-Map Synchron info data Ch.2	PDO Mapping TxPDO 4	UINT8	RO	0x02 (2$_{dec}$)
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x11 (Info data 1))	UINT32	RO	0x6010:11, 16
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (DCM Inputs Ch.2), entry 0x12 (Info data 2))	UINT32	RO	0x6010:12, 16

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x04 (4$_{dec}$)
1C12:01	SubIndex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632$_{dec}$)
1C12:02	SubIndex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1601 (5633$_{dec}$)
1C12:03	SubIndex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1602 (5634$_{dec}$)
1C12:04	SubIndex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1603 (5635$_{dec}$)

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
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	0x1A02 (6658_{dec})
1C13:03	SubIndex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:04	SubIndex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 2 event • 2: DC-Mode - Synchronous with SYNC0 Event • 3: DC-Mode - Synchronous with SYNC1 event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchron with SM 2 Event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchron with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0xC007 (49159_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x0001E848 (125000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 1C32:03, 1C32:05, 1C32:06, 1C32:09, 0x1C33:03 [▶ 179], 0x1C33:06 [▶ 178], 0x1C33:09 [▶ 179] are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 178]	UINT32	RW	0x000F4240 (1000000_{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 0x1C32:08 [▶ 178] or 0x1C33:08)	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	as 1C32:05 [▶ 178]	UINT32	RO	0x0001E848 (125000_{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	as 0x1C32:08 [▶ 178]	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	as 0x1C32:11 [▶ 178]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 178]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 178]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 178]	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index 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
F008:0	Code word	reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Max. Subindex	UINT8	RW	0x02 (2_{dec})
F010:01	SubIndex 001	Profile number of the DC motor interface	UINT32	RW	0x000002DD (733_{dec})
F010:02	SubIndex 002	Profile number of the DC motor interface	UINT32	RW	0x000002DD (733_{dec})

7.3 as from firmware 06 /revision status -0020

ℹ **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.

ℹ **Parameterization via the CoE list (CAN over EtherCAT)**

The EtherCAT device is parameterized via the CoE-Online tab [▶ 107] (double-click on the respective object) or via the Process Data tab [▶ 104](allocation of PDOs). Please note the following general CoE notes [▶ 26] when using/manipulating the CoE parameters:

- Keep a startup list if components have to be replaced
- Differentiation between online/offline dictionary, existence of current XML description
- use "CoE reload" for resetting changes

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization during commissioning:
  - Restore object [▶ 180]
  - Configuration data [▶ 181]
- Profile-specific objects:
  - Input data [▶ 185]
  - Output data [▶ 186]
  - Information and diagnosis data (channel specific) [▶ 187]
  - Configuration data (vendor-specific) [▶ 189]
  - Information and diagnosis data (device-specific) [▶ 190]
- Standard objects [▶ 190]

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

7.3.1 Restore object

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters [▶ 255]	Restore default parameters	UINT8	RO	0x01 (1_{dec})
1011:01	SubIndex 001	If this object is set to **"0x64616F6C"** in the set value dialog, all backup objects are reset to their delivery state.	UINT32	RW	0x00000000 (0_{dec})

7.3.2 Configuration data

Index 8020 DCM Motor Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8020:0	DCM Motor Settings Ch.1	Max. Subindex	UINT8	RO	0x0F (15$_{dec}$)
8020:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x0960 (2400$_{dec}$)
8020:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x05DC (1500$_{dec}$)
8020:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0x5DC0 (24000$_{dec}$)
8020:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100$_{dec}$)
8020:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8020:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8020:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200$_{dec}$)
8020:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000$_{dec}$)
8020:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8020:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)

Index 8021 DCM Controller Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8021:0	DCM Controller Settings Ch.1	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
8021:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200$_{dec}$)
8021:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2$_{dec}$)
8021:03	Inner window (curr.)	Inner window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8021:05	Outer window (curr.)	Outer window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8021:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8021:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0$_{dec}$)
8021:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8022 DCM Features Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8022:0	DCM Features Ch.1	Max. Subindex	UINT8	RO	0x36 (54$_{dec}$)
8022:01	Operation mode	Operation mode 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller …: reserved 15: Chopper resistor Existing overvoltage (10% > nominal voltage 0x8020:03 [▶ 181]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8022:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8020:0C [▶ 181])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8020:0D [▶ 181] – 0x8020:0F [▶ 181])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle ....: reserved 7: Motor velocity 8: Overload time ...: reserved 101: Internal temperature ...: reserved 103: Control voltage 104: Motor supply voltage ...: reserved 150: Status word (drive controller) 151: State (drive controller) ...: reserved	UINT8	RW	0x01 (1$_{dec}$)
8022:19	Select info data 2	Selection "Info data 2" see subindex 0x8022:11 [▶ 182]	UINT8	RW	0x02 (2$_{dec}$)
8022:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:32	Function for input 1	Function of digital input 1 0: Normal input 1: Hardware enable …: reserved	BIT4	RW	0x00 (0$_{dec}$)
8022:36	Function for input 2	Function of digital input 2 see subindex 0x8022:32 [▶ 182]	BIT4	RW	0x00 (0$_{dec}$)

Index 8030 DCM Motor Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8030:0	DCM Motor Settings Ch.2	Max. Subindex	UINT8	RO	0x0F (15$_{dec}$)
8030:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x0960 (2400$_{dec}$)
8030:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x05DC (1500$_{dec}$)
8030:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0x5DC0 (24000$_{dec}$)
8030:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100$_{dec}$)
8030:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8030:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x01F4 (500$_{dec}$)
8030:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200$_{dec}$)
8030:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000$_{dec}$)
8030:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8030:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)

Index 8031 DCM Controller Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8031:0	DCM Controller Settings Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
8031:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200$_{dec}$)
8031:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2$_{dec}$)
8031:03	Inner window (curr.)	Inner window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8031:05	Outer window (curr.)	Outer window for the I component (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8031:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8031:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0$_{dec}$)
8031:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8032 DCM Features Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8032:0	DCM Features Ch.1	Max. Subindex	UINT8	RO	0x36 (54$_{dec}$)
8032:01	Operation mode	Operation mode 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller …: reserved 15: Chopper resistor Existing overvoltage (10% > nominal voltage 0x8030:03 [▶ 183]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8032:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8030:0C [▶ 183])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8030:0D [▶ 183] - 0x8030:0F [▶ 183])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle ....: reserved 7: Motor velocity 8: Overload time ...: reserved 101: Internal temperature ...: reserved 103: Control voltage 104: Motor supply voltage ...: reserved 150: Status word (drive controller) 151: State (drive controller) ...: reserved	UINT8	RW	0x01 (1$_{dec}$)
8032:19	Select info data 2	Selection "Info data 2" see subindex 0x8032:11 [▶ 184]	UINT8	RW	0x02 (2$_{dec}$)
8032:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:32	Function for input 1	Function of digital input 1 0: Normal input 1: Hardware enable …: reserved	BIT4	RW	0x00 (0$_{dec}$)
8032:36	Function for input 2	Function of digital input 2 see subindex 0x8032:32 [▶ 184]	BIT4	RW	0x00 (0$_{dec}$)

7.3.3 Command object

Index FB00 DCM Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	DCM Command	Command interface	UINT8	RO	0x03 (3$_{dec}$)
FB00:01	Request	0x8000: Software reset, hardware is re-initialized with the current CoE configuration (this otherwise happens only during the transition to INIT)	OCTET-STRING[2]	RW	{0}
FB00:02	Status	0x8000: 0x01 if a reset has taken place	UINT8	RO	0x00 (0$_{dec}$)
FB00:03	Response	0x8000: not used	OCTET-STRING[4]	RO	{0}

7.3.4 Input data

Index 6000 CNT Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	CNT Inputs Ch.1	Max. Subindex	UINT8	RO	0x11 (17$_{dec}$)
6000:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:04	Counter inhibited	Counter underflow	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:06	Status of input clock	Status of the clock input	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	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	Counter value	Counter value	UINT32	RO	0x00000000 (0$_{dec}$)

Index 6010 CNT Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	CNT Inputs Ch.2	Max. Subindex	UINT8	RO	0x11 (17$_{dec}$)
6010:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:04	Counter inhibited	Counter underflow	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:06	Status of input clock	Status of the clock input	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:11	Counter value	Counter value	UINT32	RO	0x00000000 (0$_{dec}$)

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Index 6020 DCM Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	DCM Inputs Ch.1	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6020:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:03	Warning	A warning has occurred (see index 0xA020 [▶ 188])	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:04	Error	An error has occurred (see index 0xA020 [▶ 188])	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:11	Info data 1	Synchronous information (selection via subindex 0x8022:11 [▶ 182])	UINT16	RO	0x0000 (0$_{dec}$)
6020:12	Info data 2	Synchronous information (selection via subindex 0x8022:19 [▶ 182])	UINT16	RO	0x0000 (0$_{dec}$)

Index 6030 DCM Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6030:0	DCM Inputs Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6030:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:03	Warning	A warning has occurred (see index 0xA030 [▶ 188])	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:04	Error	An error has occurred (see index 0xA030 [▶ 189])	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:11	Info data 1	Synchronous information (selection via subindex 0x8032:11 [▶ 184])	UINT16	RO	0x0000 (0$_{dec}$)
6030:12	Info data 2	Synchronous information (selection via subindex 0x8032:19 [▶ 184])	UINT16	RO	0x0000 (0$_{dec}$)

7.3.5 Output data

Index 7000 CNT Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	CNT Outputs Ch.1	Max. subindex	UINT8	RO	0x11 (17$_{dec}$)
7000:03	Set counter	Set counter value with "Set counter value".	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:04	Inhibit counter	The counter is stopped as long as this bit is active. The previous counter state is retained.	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:11	Set counter value	This is the counter value to be set via "Set counter".	UINT32	RO	0x00000000 (0$_{dec}$)

Index 7010 CNT Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	CNT Outputs Ch.1	Max. subindex	UINT8	RO	0x11 (17_{dec})
7010:03	Set counter	Set counter value with "Set counter value".	BOOLEAN	RO	0x00 (0_{dec})
7010:04	Inhibit counter	The counter is stopped as long as this bit is active. The previous counter state is retained.	BOOLEAN	RO	0x00 (0_{dec})
7010:11	Set counter value	This is the counter value to be set via "Set counter".	UINT32	RO	0x00000000 (0_{dec})

Index 7020 DCM Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7020:0	DCM Outputs Ch.1	Max. Subindex	UINT8	RO	0x21 (33_{dec})
7020:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0_{dec})
7020:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0_{dec})
7020:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8020:05 [▶ 181] / 0x8020:06 [▶ 181])	BOOLEAN	RO	0x00 (0_{dec})
7020:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0_{dec})

Index 7030 DCM Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	DCM Outputs Ch.2	Max. Subindex	UINT8	RO	0x21 (33_{dec})
7030:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0_{dec})
7030:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0_{dec})
7030:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8030:05 [▶ 183] / 0x8030:06 [▶ 183])	BOOLEAN	RO	0x00 (0_{dec})
7030:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0_{dec})

7.3.6   Information and diagnosis data (channel specific)

Index 9020 DCM Info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
9020:0	DCM Info data Ch.1	Max. Subindex	UINT8	RO	0x09 (9_{dec})
9020:01	Status word	Status word (see Index 0xApp0)	UINT16	RO	0x0000 (0_{dec})
9020:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0_{dec})
9020:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0_{dec})
9020:04	Current limit	Present current limit	UINT16	RO	0x0000 (0_{dec})
9020:05	Control error	Present control error	INT16	RO	0x0000 (0_{dec})
9020:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0_{dec})
9020:09	Overload time	Time since overload	UINT16	RO	0x0000 (0_{dec})

Index 9030 DCM Info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
9030:0	DCM Info data Ch.2	Max. Subindex	UINT8	RO	0x09 (9_{dec})
9030:01	Status word	Status word (see Index 0xApp0)	UINT16	RO	0x0000 (0_{dec})
9030:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0_{dec})
9030:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0_{dec})
9030:04	Current limit	Present current limit	UINT16	RO	0x0000 (0_{dec})
9030:05	Control error	Present control error	INT16	RO	0x0000 (0_{dec})
9030:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0_{dec})
9030:09	Overload time	Time since overload	UINT16	RO	0x0000 (0_{dec})

Index A020 DCM Diag data Ch.1

Index (hex)	Name	Meaning		Data type	Flags	Default
A020:0	DCM Diag data Ch.1	Max. Subindex		UINT8	RO	0x11 (17$_{dec}$)
A020:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:03	Torque overload	Present motor current exceeds the nominal current (see 0x8020:02 [▶ 181])	Warning (0x8pp2:0A = 0) / Error (0x8pp2:0A = 1)	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8020:03) [▶ 181]	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:09	Misc error	• initialization failed or • internal temperature of the terminal exceeds 100 °C (see 0xF80F:05) or • motor current exceeds the nominal current (see 0x8022:0A [▶ 182])	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8022:01 [▶ 182])		BIT4	RO	0x00 (0$_{dec}$)

Index A030 DCM Diag data Ch.2

Index (hex)	Name	Meaning		Data type	Flags	Default
A030:0	DCM Diag data Ch.2	Max. Subindex		UINT8	RO	0x11 (17$_{dec}$)
A030:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:03	Torque overload	Present motor current exceeds the nominal current (see 0x8030:02 [▶ 183])	Warning (0x8032:0A = 0) / Error (0x8032:0A = 1)	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8030:03) [▶ 183]	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:09	Misc error	• initialization failed or • internal temperature of the terminal exceeds 100 °C (see 0xF80F:05) or • motor current exceeds the nominal current (see 0x8032:0A [▶ 184])	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8032:01 [▶ 184])		BIT4	RO	0x00 (0$_{dec}$)

7.3.7 Configuration data (vendor-specific)

Index F80F DCM Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
F80F:0	DCM Vendor data	Max. Subindex	UINT8	RO	0x06 (6$_{dec}$)
F80F:01	PWM Frequency	DC link frequency (**unit:** 1 Hz)	UINT16	RW	0x7530 (30000$_{dec}$)
F80F:02	Deadtime	Dead time for pulse width modulation	UINT16	RW	0x0505 (1285$_{dec}$)
F80F:03	Deadtime space	Duty cycle limitation	UINT16	RW	0x0009 (9$_{dec}$)
F80F:04	Warning temperature	Threshold of the temperature warning (**unit:** 1 °C)	INT8	RW	0x50 (80$_{dec}$)
F80F:05	Switch off temperature	Switch-off temperature (**unit:** 1 °C)	INT8	RW	0x64 (100$_{dec}$)
F80F:06	Analog trigger point	Trigger point for AD conversion	UINT16	RW	0x000A (10$_{dec}$)

7.3.8 Information and diagnosis data (device-specific)

Index 10F3 Diagnosis History

Index (hex)	Name	Meaning	Data type	Flags	Default
10F3:0	Diagnosis History	Maximum subindex	UINT8	RO	0x37 (55_{dec})
10F3:01	Maximum Messages	Maximum number of stored messages A maximum of 50 messages can be stored	UINT8	RO	0x00 (0_{dec})
10F3:02	Newest Message	Subindex of the latest message	UINT8	RO	0x00 (0_{dec})
10F3:03	Newest Acknowledged Message	Subindex of the last confirmed message	UINT8	RW	0x00 (0_{dec})
10F3:04	New Messages Available	Indicates that a new message is available.	BOOLEAN	RO	0x00 (0_{dec})
10F3:05	Flags	not used	UINT16	RW	0x0000 (0_{dec})
10F3:06	Diagnosis Message 001	Message 1	OCTET-STRING[28]	RO	{0}
...	...		...	...	…
10F3:37	Diagnosis Message 050	Message 50	OCTET-STRING[28]	RO	{0}

Index 10F8 Actual Time Stamp

Index (hex)	Name	Meaning	Data type	Flags	Default
10F8:0	Actual Time Stamp	Time stamp	UINT64	RO	

Index F900 DCM Info data

Index (hex)	Name	Meaning	Data type	Flags	Default
F900:0	DCM Info data	Max. Subindex	UINT8	RO	0x06 (6_{dec})
F900:01	Software version (driver)	Software version of the driver card	STRING	RO	
F900:02	Internal temperature	Internal terminal temperature (**unit:** 1 °C)	INT8	RO	0x00 (0_{dec})
F900:04	Control voltage	Control voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0_{dec})
F900:05	Motor supply voltage	Load voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0_{dec})
F900:06	Cycle time	Measured cycle time (**unit:** 1 µs)	UINT16	RO	0x0000 (0_{dec})

Index FB40 Memory interface

Index (hex)	Name	Meaning	Data type	Flags	Default
FB40:0	Memory interface	Maximum subindex	UINT8	RO	0x03 (3_{dec})
FB40:01	Address	reserved	UINT32	RW	0x00000000 (0_{dec})
FB40:02	Length	reserved	UINT16	RW	0x0000 (0_{dec})
FB40:03	Data	reserved	OCTET-STRING[8]	RW	{0}

7.3.9 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
1000:0	Device type	Device type of the EtherCAT slave: the Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EL7332

Index 1009 Hardware version

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

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	08

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x1CA43052 (480522322_{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	0x00100000 (1048576_{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
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 1400 CNT RxPDO-Par Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1400:0	CNT RxPDO-Par Control compact Ch.1	PDO Parameter RxPDO 1	UINT8	RO	0x06 (6_{dec})
1400:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 1	OCTET-STRING[2]	RO	01 16

Index 1401 CNT RxPDO-Par Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	CNT RxPDO-Par Control Ch.1	PDO Parameter RxPDO 2	UINT8	RO	0x06 (6_{dec})
1401:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 2	OCTET-STRING[2]	RO	00 16

Index 1402 CNT RxPDO-Par Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1402:0	CNT RxPDO-Par Control compact Ch.2	PDO Parameter RxPDO 3	UINT8	RO	0x06 (6_{dec})
1402:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 3	OCTET-STRING[2]	RO	03 16

Index 1403 CNT RxPDO-Par Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1403:0	CNT RxPDO-Par Control Ch.2	PDO Parameter RxPDO 4	UINT8	RO	0x06 (6$_{dec}$)
1403:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 4	OCTET-STRING[2]	RO	02 16

Index 1600 CNT RxPDO-Map Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	CNT RxPDO-Map Control compact Ch.1	PDO Mapping RxPDO 1	UINT8	RO	0x06 (6$_{dec}$)
1600:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 2
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x02 (Enable latch extern on positive edge))	UINT32	RO	0x7000:03, 1
1600:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x03 (Set counter))	UINT32	RO	0x7000:04, 1
1600:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x04 (Enable latch extern on negative edge))	UINT32	RO	0x0000:00, 4
1600:05	SubIndex 005	5. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 8
1600:06	SubIndex 006	6. PDO Mapping entry (object 0x7000 (CNT Outputs Ch.1), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 16

Index 1600 DCM RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	DCM RxPDO-Map Control Ch.1	PDO Mapping RxPDO 1	UINT8	RO	0x05 (5$_{dec}$)
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x01 (Enable))	UINT32	RO	0x7000:01, 1
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x02 (Reset))	UINT32	RO	0x7000:02, 1
1600:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x03 (Reduce torque))	UINT32	RO	0x7000:03, 1
1600:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1600:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1601 CNT RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	CNT RxPDO-Map Control Ch.1	PDO Mapping RxPDO 2	UINT8	RO	0x06 (6$_{dec}$)
1601:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 2
1601:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (CNT Outputs Ch.1), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (CNT Outputs Ch.1), entry 0x04 (Inhibit counter))	UINT32	RO	0x7000:04, 1
1601:04	SubIndex 004	4. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1601:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:06	SubIndex 006	6. PDO Mapping entry (object 0x7000 (CNT Outputs Ch.1), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 32

Index 1601 DCM RxPDO-Map Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	DCM RxPDO-Map Velocity Ch.1	PDO Mapping RxPDO 2	UINT8	RO	0x01 (1$_{dec}$)
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x7000:21, 16

Index 1602 CNT RxPDO-Map Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	CNT RxPDO-Map Control compact Ch.2	PDO Mapping RxPDO 3	UINT8	RO	0x06 (6$_{dec}$)
1602:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (DCM Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x0000:00, 2
1602:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x02 (Reset))	UINT32	RO	0x7010:03, 1
1602:03	SubIndex 003	3. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x03 (Reduce torque))	UINT32	RO	0x7010:04, 1
1602:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 4
1602:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1602:06	SubIndex 006	6. PDO Mapping entry (object 0x7010 (CNT Outputs Ch.2), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 16

Index 1603 CNT RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	CNT RxPDO-Map Control Ch.2	PDO Mapping RxPDO 4	UINT8	RO	0x06 (6$_{dec}$)
1603:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (DCM Outputs Ch.2), entry 0x01 (Enable))	UINT32	RO	0x0000:00, 2
1603:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (CNT Outputs Ch.2), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1603:03	SubIndex 003	3. PDO Mapping entry (object 0x7010 (CNT Outputs Ch.2), entry 0x04 (Inhibit counter))	UINT32	RO	0x7010:04, 1
1603:04	SubIndex 004	4. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1603:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1603:06	SubIndex 006	6. PDO Mapping entry (object 0x7010 (CNT Outputs Ch.2), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 32

Index 1604 DCM RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1604:0	DCM RxPDO-Map Control Ch.1	PDO Mapping RxPDO 5	UINT8	RO	0x05 (5$_{dec}$)
1604:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x01 (Enable))	UINT32	RO	0x7020:01, 1
1604:02	SubIndex 002	2. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x02 (Reset))	UINT32	RO	0x7020:02, 1
1604:03	SubIndex 003	3. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x03 (Reduce torque))	UINT32	RO	0x7020:03, 1
1604:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1604:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1605 DCM RxPDO-Map Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1605:0	DCM RxPDO-Map Velocity Ch.1	PDO Mapping RxPDO 6	UINT8	RO	0x01 (1$_{dec}$)
1605:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x7020:21, 16

Index 1606 DCM RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1606:0	DCM RxPDO-Map Control Ch.2	PDO Mapping RxPDO 7	UINT8	RO	0x05 (5$_{dec}$)
1606:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x01 (Enable))	UINT32	RO	0x7030:01, 1
1606:02	SubIndex 002	2. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x02 (Reset))	UINT32	RO	0x7030:02, 1
1606:03	SubIndex 003	3. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x03 (Reduce torque))	UINT32	RO	0x7030:03, 1
1606:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1606:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1607 DCM RxPDO-Map Velocity Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1607:0	DCM RxPDO-Map Velocity Ch.2	PDO Mapping RxPDO 8	UINT8	RO	0x01 (1$_{dec}$)
1607:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x21 (Velocity))	UINT32	RO	0x7030:21, 16

Index 1800 CNT TxPDO-Par Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	CNT TxPDO-Par Status compact Ch.1	PDO Parameter TxPDO 1	UINT8	RO	0x06 (6$_{dec}$)
1800:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 1	OCTET-STRING[2]	RO	01 1A

Index 1801 CNT TxPDO-Par Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	CNT TxPDO-Par Status Ch.1	PDO Parameter TxPDO 2	UINT8	RO	0x06 (6$_{dec}$)
1801:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 2	OCTET-STRING[2]	RO	00 1A

Index 1802 CNT TxPDO-Par Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	CNT TxPDO-Par Status compact Ch.2	PDO Parameter TxPDO 3	UINT8	RO	0x06 (6$_{dec}$)
1802:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 3	OCTET-STRING[2]	RO	03 1A

Index 1803 CNT TxPDO-Par Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	CNT TxPDO-Par Status Ch.2	PDO Parameter TxPDO 4	UINT8	RO	0x06 (6$_{dec}$)
1803:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 4	OCTET-STRING[2]	RO	02 1A

Index 1A00 CNT TxPDO-Map Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	CNT TxPDO-Map Status compact Ch.1	PDO Mapping TxPDO 1	UINT8	RO	0x0B (11$_{dec}$)
1A00:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x04 (Counter inhibited))	UINT32	RO	0x6000:04, 1
1A00:04	SubIndex 004	4. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x06 (Status of input clock))	UINT32	RO	0x6000:06, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A00:07	SubIndex 007	7. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x0E (Sync error))	UINT32	RO	0x6000:0E, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1
1A00:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 1

Index 1A01 CNT TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	CNT TxPDO-Map Status Ch.1	PDO Mapping TxPDO 2	UINT8	RO	0x0B (11$_{dec}$)
1A01:01	SubIndex 001	1. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 2
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x02 (Set counter done))	UINT32	RO	0x6000:03, 1
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x04 (Counter inhibited))	UINT32	RO	0x6000:04, 1
1A01:04	SubIndex 004	4. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A01:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x06 (Status of input clock))	UINT32	RO	0x6000:06, 1
1A01:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A01:07	SubIndex 007	7. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1A01:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x0E (Sync error))	UINT32	RO	0x6000:0E, 1
1A01:09	SubIndex 009	9. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A01:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1
1A01:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (CNT Inputs Ch.1), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A02 CNT TxPDO-Map Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	CNT TxPDO-Map Status compact Ch.2	PDO Mapping TxPDO 3	UINT8	RO	0x0B (11$_{dec}$)
1A02:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x04 (Counter inhibited))	UINT32	RO	0x6010:04, 1
1A02:04	SubIndex 004	4. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A02:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x06 (Status of input clock))	UINT32	RO	0x6010:06, 1
1A02:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A02:07	SubIndex 007	7. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1A02:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A02:09	SubIndex 009	9. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A02:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A02:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 16

Index 1A03 CNT TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	CNT TxPDO-Map Status Ch.2	PDO Mapping TxPDO 4	UINT8	RO	0x0B (11$_{dec}$)
1A03:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x04 (Counter inhibited))	UINT32	RO	0x6010:04, 1
1A03:04	SubIndex 004	4. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x06 (Status of input clock))	UINT32	RO	0x6010:06, 1
1A03:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A03:07	SubIndex 007	7. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1A03:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A03:09	SubIndex 009	9. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A03:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (CNT Inputs Ch.2), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32

Index 1A04 DCM TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	DCM TxPDO-Map Status Ch.1	PDO Mapping TxPDO 5	UINT8	RO	0x0E (14$_{dec}$)
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x01 (Ready to enable))	UINT32	RO	0x6020:01, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x02 (Ready))	UINT32	RO	0x6020:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x03 (Warning))	UINT32	RO	0x6020:03, 1
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x04 (Error))	UINT32	RO	0x6020:04, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x05 (Moving positive))	UINT32	RO	0x6020:05, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x06 (Moving negative))	UINT32	RO	0x6020:06, 1
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x07 (Torque reduced))	UINT32	RO	0x6020:07, 1
1A04:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A04:0A	SubIndex 010	10. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x0C (Digital input 1))	UINT32	RO	0x6020:0C, 1
1A04:0B	SubIndex 011	11. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x0D (Digital input 2))	UINT32	RO	0x6020:0D, 1
1A04:0C	SubIndex 012	12. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x0E (Sync error))	UINT32	RO	0x6020:0E, 1
1A04:0D	SubIndex 013	13. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:0E	SubIndex 014	14. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6020:10, 1

Index 1A05 DCM TxPDO-Map Synchron info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	DCM TxPDO-Map Synchron info data Ch.1	PDO Mapping TxPDO 6	UINT8	RO	0x02 (2$_{dec}$)
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x11 (Info data 1))	UINT32	RO	0x6020:11, 16
1A05:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x12 (Info data 2))	UINT32	RO	0x6020:12, 16

Index 1A06 DCM TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	DCM TxPDO-Map Status Ch.2	PDO Mapping TxPDO 7	UINT8	RO	0x0E (14$_{dec}$)
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x01 (Ready to enable))	UINT32	RO	0x6030:01, 1
1A06:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x02 (Ready))	UINT32	RO	0x6030:02, 1
1A06:03	SubIndex 003	3. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x03 (Warning))	UINT32	RO	0x6030:03, 1
1A06:04	SubIndex 004	4. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x04 (Error))	UINT32	RO	0x6030:04, 1
1A06:05	SubIndex 005	5. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x05 (Moving positive))	UINT32	RO	0x6030:05, 1
1A06:06	SubIndex 006	6. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x06 (Moving negative))	UINT32	RO	0x6030:06, 1
1A06:07	SubIndex 007	7. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x07 (Torque reduced))	UINT32	RO	0x6030:07, 1
1A06:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A06:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A06:0A	SubIndex 010	10. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x0C (Digital input 1))	UINT32	RO	0x6030:0C, 1
1A06:0B	SubIndex 011	11. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x0D (Digital input 2))	UINT32	RO	0x6030:0D, 1
1A06:0C	SubIndex 012	12. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x0E (Sync error))	UINT32	RO	0x6030:0E, 1
1A06:0D	SubIndex 013	13. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A06:0E	SubIndex 014	14. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6030:10, 1

Index 1A07 DCM TxPDO-Map Synchron info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	DCM TxPDO-Map Synchron info data Ch.2	PDO Mapping TxPDO 8	UINT8	RO	0x02 (2$_{dec}$)
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x11 (Info data 1))	UINT32	RO	0x6030:11, 16
1A07:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x12 (Info data 2))	UINT32	RO	0x6030:12, 16

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x06 (6_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1602 (5634_{dec})
1C12:03	Subindex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1604 (5636_{dec})
1C12:04	Subindex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1605 (5637_{dec})
1C12:05	Subindex 005	5. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1606 (5638_{dec})
1C12:06	Subindex 006	6. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1607 (5639_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x04 (4_{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	0x1A02 (6658_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A04 (6660_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchron with SM 2 Event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchron with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0x0C07 (3079_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x0001E848 (125000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 1C32:03, 1C32:05, 1C32:06, 1C32:09, 0x1C33:03 [▶ 201], 0x1C33:06 [▶ 200], 0x1C33:09 [▶ 201] are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 200]	UINT32	RW	0x000F4240 (1000000_{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 0x1C32:08 [▶ 200] or 0x1C33:08)	UINT16	RO	0x0C07 (3079_{dec})
1C33:05	Minimum cycle time	as 1C32:05 [▶ 200]	UINT32	RO	0x0001E848 (125000_{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	as 0x1C32:08 [▶ 200]	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	as 0x1C32:11 [▶ 200]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 200]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 200]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 200]	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index 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
F008:0	Code word	reserved	UINT32	RW	0x00000000 (0_{dec})

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Max. Subindex	UINT8	RW	0x04 (4_{dec})
F010:01	SubIndex 001	Profile number CNT	UINT32	RW	0x00000096 (150_{dec})
F010:02	SubIndex 002	Profile number CNT	UINT32	RW	0x00000096 (150_{dec})
F010:03	SubIndex 003	Profile number DCM	UINT32	RW	0x000002DD (733_{dec})
F010:04	SubIndex 004	Profile number DCM	UINT32	RW	0x000002DD (733_{dec})

8   EL7342 - Object description and parameterization

ⓘ   **EtherCAT XML Device Description**

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

ⓘ   **Parameterization via the CoE list (CAN over EtherCAT)**

The EtherCAT device is parameterized via the CoE-Online tab [▶ 107] (double-click on the respective object) or via the Process Data tab [▶ 104](allocation of PDOs). Please note the following general CoE notes [▶ 26] when using/manipulating the CoE parameters:

- Keep a startup list if components have to be replaced
- Differentiation between online/offline dictionary, existence of current XML description
- use "CoE reload" for resetting changes

Introduction

The CoE overview contains objects for different intended applications:

- Objects required for parameterization during commissioning:
  - Restore object [▶ 203]
  - Configuration data [▶ 204]
  - Command object [▶ 212]
- Profile-specific objects:
  - Input data [▶ 213]
  - Output data [▶ 216]
  - Information and diagnosis data (channel specific) [▶ 219]
  - Configuration data (vendor-specific) [▶ 221]
  - Information and diagnosis data (device-specific) [▶ 222]
- Standard objects [▶ 222]

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

8.1   Restore object

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters [▶ 255]	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$_{dec}$)

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8.2 Configuration data

Index 8000 ENC Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	ENC Settings Ch.1	Max. Subindex	UINT8	RO	0x0E (14$_{dec}$)
8000:08	Disable filter	0: Activates the input filter (inputs A, /A, B, /B, C, /C only) 1: Deactivates the input filter If a filter is activated a signal edge must be present for at least 2.4 µs in order to be counted as an increment.	BOOLEAN	RW	0x00 (0$_{dec}$)
8000:0A	Enable micro increments	If activated, the terminal interpolates micro-increments between the integral encoder increments in DC mode. The lower 8 bits of the counter value are used in each case for the display. A 32-bit counter thus becomes a 24 +8 bit counter, a 16-bit counter becomes a 8 +8 bit counter.	BOOLEAN	RW	0x00 (0$_{dec}$)
8000:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8010 ENC Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	ENC Settings Ch.2	Max. Subindex	UINT8	RO	0x0E (14$_{dec}$)
8010:08	Disable filter	0: Activates the input filter (inputs A, /A, B, /B, C, /C only) 1: Deactivates the input filter If a filter is activated a signal edge must be present for at least 2.4 µs in order to be counted as an increment.	BOOLEAN	RW	0x00 (0$_{dec}$)
8010:0A	Enable micro increments	If activated, the terminal interpolates micro-increments between the integral encoder increments in DC mode. The lower 8 bits of the counter value are used in each case for the display. A 32-bit counter thus becomes a 24 +8 bit counter, a 16-bit counter becomes a 8 + 8 bit counter.	BOOLEAN	RW	0x00 (0$_{dec}$)
8010:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8020 DCM Motor Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8020:0	DCM Motor Settings Ch.1	Max. Subindex	UINT8	RO	0x0F (15$_{dec}$)
8020:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x1388 (5000$_{dec}$)
8020:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x0DAC (3500$_{dec}$)
8020:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0xC350 (50000$_{dec}$)
8020:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100$_{dec}$)
8020:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x07D0 (2000$_{dec}$)
8020:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x07D0 (2000$_{dec}$)
8020:07	Encoder increments (4-fold)	Number of encoder increments per revolution with quadruple evaluation	UINT16	RW	0x0000 (0$_{dec}$)
8020:08	Maximal motor velocity	Nominal speed of the motor at the nominal voltage (**unit:** 1 rpm)	UINT16	RW	0x0000 (0$_{dec}$)
8020:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200$_{dec}$)
8020:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000$_{dec}$)
8020:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)
8020:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0$_{dec}$)

Index 8021 DCM Controller Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8021:0	DCM Controller Settings Ch.1	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
8021:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200$_{dec}$)
8021:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2$_{dec}$)
8021:03	Inner window (curr.)	Inner window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8021:05	Outer window (curr.)	Outer window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8021:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8021:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0$_{dec}$)
8021:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8022 DCM Features Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8022:0	DCM Features Ch.1	Max. Subindex	UINT8	RO	0x36 (54$_{dec}$)
8022:01	Operation mode	Operation mode 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller ...: reserved 15: Chopper resistor Existing overvoltage (10 % > nominal voltage 0x8020:03 [▶ 205]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8022:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8020:0C [▶ 205])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8020:0D [▶ 205] - 0x8020:0F [▶ 205])	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle ....: reserved 7: Motor velocity 8: Overload time ...: reserved 101: Internal temperature ...: reserved 103: Control voltage 104: Motor supply voltage ...: reserved 150: Status word (drive controller) 151: State (drive controller) ...: reserved	UINT8	RW	0x01 (1$_{dec}$)
8022:19	Select info data 2	Selection "Info data 2" see subindex 0x8022:11 [▶ 206]	UINT8	RW	0x02 (2$_{dec}$)
8022:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8022:32	Function for input 1	Function of digital input 1 0: Normal input 1: Hardware enable …: reserved	BIT4	RW	0x00 (0$_{dec}$)
8022:36	Function for input 2	Function of digital input 2 see subindex 0x8022:32 [▶ 206]	BIT4	RW	0x00 (0$_{dec}$)

Index 8023 DCM Controller Settings 2 Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8023:0	DCM Controller Settings 2 Ch.1	Max. Subindex	UINT8	RO	0x08 (8_{dec})
8023:01	Kp factor (velo./pos.)	Kp control factor of the velocity/position controller	UINT16	RW	0x00C8 (200_{dec})
8023:02	Ki factor (velo./pos.)	Ki control factor of the velocity/position controller	UINT16	RW	0x0002 (2_{dec})
8023:03	Inner window (velo./pos.)	Inner window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0_{dec})
8023:05	Outer window (velo./pos.)	Outer window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0_{dec})
8023:06	Filter cut off frequency (velo./pos.)	Limit frequency of the velocity/position controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0_{dec})
8023:07	Ka factor (velo./pos.)	Ka control factor of the velocity/position controller	UINT16	RW	0x0000 (0_{dec})
8023:08	Kd factor (velo./pos.)	Kd control factor of the velocity/position controller	UINT16	RW	0x0014 (20_{dec})

Index 8030 DCM Motor Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8030:0	DCM Motor Settings Ch.2	Max. Subindex	UINT8	RO	0x0F (15_{dec})
8030:01	Maximal current	Maximum permanent motor coil current (**unit:** 1 mA)	UINT16	RW	0x1388 (5000_{dec})
8030:02	Nominal current	Motor nominal current (**unit:** 1 mA)	UINT16	RW	0x0DAC (3500_{dec})
8030:03	Nominal voltage	Nominal voltage (supply voltage) of the motor (**unit:** 1 mV)	UINT16	RW	0xC350 (50000_{dec})
8030:04	Motor coil resistance	Internal resistance of the motor (**unit:** 0.01 ohm)	UINT16	RW	0x0064 (100_{dec})
8030:05	Reduced current (positive)	Reduced torque in positive direction of rotation (**unit:** 1 mA)	UINT16	RW	0x07D0 (2000_{dec})
8030:06	Reduced current (negative)	Reduced torque in negative direction of rotation (**unit:** 1 mA)	UINT16	RW	0x07D0 (2000_{dec})
8030:07	Encoder increments (4-fold)	Number of encoder increments per revolution with quadruple evaluation	UINT16	RW	0x0000 (0_{dec})
8030:08	Maximal motor velocity	Rated motor velocity at nominal voltage (**unit:** 1 rpm)	UINT16	RW	0x0000 (0_{dec})
8030:0C	Time for switch-off at overload	Time for switch-off at overload (**unit:** 1 ms)	UINT16	RW	0x00C8 (200_{dec})
8030:0D	Time for current lowering at overload	Time for current lowering at overload (from max. current to nominal current, **unit:** 1 ms)	UINT16	RW	0x07D0 (2000_{dec})
8030:0E	Torque auto-reduction threshold (positive)	Process data threshold for automatic torque reduction in the positive direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})
8030:0F	Torque auto-reduction threshold (negative)	Process data threshold for automatic torque reduction in the negative direction of rotation (**unit:** 1 %)	UINT8	RW	0x00 (0_{dec})

Index 8031 DCM Controller Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8031:0	DCM Controller Settings Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
8031:01	Kp factor (curr.)	Kp control factor of the current controller	UINT16	RW	0x00C8 (200$_{dec}$)
8031:02	Ki factor (curr.)	Ki control factor of the current controller	UINT16	RW	0x0002 (2$_{dec}$)
8031:03	Inner window (curr.)	Inner window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8031:05	Outer window (curr.)	Outer window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8031:06	Filter cut off frequency (curr.)	Limit frequency of the current controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8031:11	Voltage adjustment enable	Activates the compensation of voltage fluctuations (only in the operating mode "Direct velocity")	BOOLEAN	RW	0x00 (0$_{dec}$)
8031:12	Current adjustment enable	Activates the R x I compensation	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8032 DCM Features Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8032:0	DCM Features Ch.2	Max. Subindex	UINT8	RO	0x36 (54$_{dec}$)
8032:01	Operation mode	Operation mode 0: Automatic 1: Velocity direct 2: Velocity controller 3: Position controller ...: reserved 15: Chopper resistor Existing overvoltage (10% > nominal voltage 0x8030:03 [▶ 207]) is reduced via connected chopper resistor.	BIT4	RW	0x00 (0$_{dec}$)
8032:09	Invert motor polarity	Inverts the direction of rotation of the motor	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0A	Torque error enable	Activates the automatic overload cut-off (see also subindex 0x8030:0C [▶ 207])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:0B	Torque auto reduce	Activates the automatic torque reduction (see also subindex 0x8030:0D [▶ 207] – 0x8030:0F [▶ 207])	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:11	Select info data 1	Selection "Info data 1" 0: Status word 1: Motor coil voltage 2: Motor coil current 3: Current limit 4: Control error 5: Duty cycle ....: reserved 7: Motor velocity 8: Overload time ...: reserved 101: Internal temperature ...: reserved 103: Control voltage 104: Motor supply voltage ...: reserved 150: Status word (drive controller) 151: State (drive controller) ...: reserved	UINT8	RW	0x01 (1$_{dec}$)
8032:19	Select info data 2	Selection "Info data 2" see subindex 0x8032:11 [▶ 209]	UINT8	RW	0x02 (2$_{dec}$)
8032:30	Invert digital input 1	Inversion of digital input 1	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:31	Invert digital input 2	Inversion of digital input 2	BOOLEAN	RW	0x00 (0$_{dec}$)
8032:32	Function for input 1	Function of digital input 1 0: Normal input 1: Hardware enable ...: reserved	BIT4	RW	0x00 (0$_{dec}$)
8032:36	Function for input 2	Function of digital input 2 see subindex 0x8032:32 [▶ 209]	BIT4	RW	0x00 (0$_{dec}$)

Index 8033 DCM Controller Settings 2 Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8033:0	DCM Controller Settings 2 Ch.2	Max. Subindex	UINT8	RO	0x08 (8$_{dec}$)
8033:01	Kp factor (velo./pos.)	Kp control factor of the velocity/position controller	UINT16	RW	0x00C8 (200$_{dec}$)
8033:02	Ki factor (velo./pos.)	Ki control factor of the velocity/position controller	UINT16	RW	0x0002 (2$_{dec}$)
8033:03	Inner window (velo./pos.)	Inner window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8033:05	Outer window (velo./pos.)	Outer window for the I component (**unit:** 1%)	UINT8	RW	0x00 (0$_{dec}$)
8033:06	Filter cut off frequency (velo./pos.)	Limit frequency of the velocity/position controller (**unit:** 1 Hz)	UINT16	RW	0x0000 (0$_{dec}$)
8033:07	Ka factor (velo./pos.)	Ka control factor of the velocity/position controller	UINT16	RW	0x0000 (0$_{dec}$)
8033:08	Kd factor (velo./pos.)	Kd control factor of the velocity/position controller	UINT16	RW	0x0014(20$_{dec}$)

Index 8040 POS Settings Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8040:0	POS Settings Ch.1	Max. Subindex	UINT8	RO	0x10 (16$_{dec}$)
8040:01	Velocity min.	Minimum set velocity (range: 0-10000)	INT16	RW	0x0064 (100$_{dec}$)
8040:02	Velocity max.	Maximum set velocity (range: 0-10000)	INT16	RW	0x2710 (10000$_{dec}$)
8040:03	Acceleration pos.	Acceleration time in positive direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8040:04	Acceleration neg.	Acceleration time in negative direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8040:05	Deceleration pos.	Deceleration time in positive direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8040:06	Deceleration neg.	Deceleration time in negative direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8040:07	Emergency deceleration	Emergency deceleration time (both directions of rotation, **unit:** 1 ms)	UINT16	RW	0x0064 (100$_{dec}$)
8040:08	Calibration position	Calibration position	UINT32	RW	0x00000000 (0$_{dec}$)
8040:09	Calibration velocity (towards plc cam)	Calibration velocity towards the cam (range: 0-10000)	INT16	RW	0x03E8 (1000$_{dec}$)
8040:0A	Calibration Velocity (off plc cam)	Calibration velocity away from the cam (range: 0-10000)	INT16	RW	0x0064 (100$_{dec}$)
8040:0B	Target window	Target window	UINT16	RW	0x000A (10$_{dec}$)
8040:0C	In-Target timeout	Timeout at target position (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8040:0D	Dead time compensation	Dead time compensation (**unit:** 1 μs)	INT16	RW	0x0064 (100$_{dec}$)
8040:0E	Modulo factor	Modulo factor/position	UINT32	RW	0x00000000 (0$_{dec}$)
8040:0F	Modulo tolerance window	Tolerance window for modulo positioning	UINT32	RW	0x00000000 (0$_{dec}$)
8040:10	Position lag max.	Max. permitted position lag	UINT16	RW	0x0000 (0$_{dec}$)

Index 8041 POS Features Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
8041:0	POS Features Ch.1		UINT8	RO	0x16 (22$_{dec}$)
8041:01	Start type	Standard start type	UINT16	RW	0x0001 (1$_{dec}$)
8041:11	Time information	Time information in subindex 0x6pp0: 22 ("Actual drive time") 0: Elapsed time current drive time since start of the travel command ...: reserved	BIT2	RW	0x00 (0$_{dec}$)
8041:13	Invert calibration cam search direction	Inversion of the direction of rotation towards the cam	BOOLEAN	RW	0x01 (1$_{dec}$)
8041:14	Invert sync impulse search direction	Inversion of the direction of rotation away from the cam	BOOLEAN	RW	0x00 (0$_{dec}$)
8041:15	Emergency stop on position lag error	- Lag error monitoring has triggered - an emergency stop is triggered as soon as "Position lag" = 1. The "Misc Error" is set to 1 and a PDO error is generated.	BOOLEAN	RW	0x00 (0$_{dec}$)
8041:16	Enhanced diag history	TRUE: Additional messages are output during the travel command (each change of the state machine (index 0x9040:03 [▶ 219]))	BOOLEAN	RW	0x00 (0$_{dec}$)

Index 8050 POS Settings Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8050:0	POS Settings Ch.2	Max. Subindex	UINT8	RO	0x10 (16$_{dec}$)
8050:01	Velocity min.	Minimum set velocity (range: 0-10000)	INT16	RW	0x0064 (100$_{dec}$)
8050:02	Velocity max.	Maximum set velocity (range: 0-10000)	INT16	RW	0x2710 (10000$_{dec}$)
8050:03	Acceleration pos.	Acceleration time in positive direction of rotation (**unit**: 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8050:04	Acceleration neg.	Acceleration time in negative direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8050:05	Deceleration pos.	Deceleration time in positive direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8050:06	Deceleration neg.	Deceleration time in negative direction of rotation (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8050:07	Emergency Deceleration	Emergency deceleration time (both directions of rotation, **unit:** 1 ms)	UINT16	RW	0x0064 (100$_{dec}$)
8050:08	Calibration position	Calibration position	UINT32	RW	0x00000000 (0$_{dec}$)
8050:09	Calibration velocity (towards plc cam)	Calibration velocity towards the cam (range: 0-10000)	INT16	RW	0x03E8 (1000$_{dec}$)
8050:0A	Calibration Velocity (off plc cam)	Calibration velocity away from the cam (range: 0-10000)	INT16	RW	0x0064 (100$_{dec}$)
8050:0B	Target window	Target window	UINT16	RW	0x000A (10$_{dec}$)
8050:0C	In-Target timeout	Timeout at target position (**unit:** 1 ms)	UINT16	RW	0x03E8 (1000$_{dec}$)
8050:0D	Dead time compensation	Dead time compensation (**unit:** 1 µs)	INT16	RW	0x0064 (100$_{dec}$)
8050:0E	Modulo factor	Modulo factor/position	UINT32	RW	0x00000000 (0$_{dec}$)
8050:0F	Modulo tolerance window	Tolerance window for modulo positioning	UINT32	RW	0x00000000 (0$_{dec}$)
8050:10	Position lag max.	Max. permitted position lag	UINT16	RW	0x0000 (0$_{dec}$)

Index 8051 POS Features Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
8051:0	POS Features Ch.2	Max. Subindex	UINT8	RO	0x16 (22$_{dec}$)
8051:01	Start type	Standard start type	UINT16	RW	0x0001 (1$_{dec}$)
8051:11	Time information	Time information in subindex 0x6pp0: 22 ("Actual drive time") 0: Elapsed time current drive time since start of the travel command ...: reserved	BIT2	RW	0x00 (0$_{dec}$)
8051:13	Invert calibration cam search direction	Inversion of the direction of rotation towards the cam	BOOLEAN	RW	0x01 (1$_{dec}$)
8051:14	Invert sync impulse search direction	Inversion of the direction of rotation away from the cam	BOOLEAN	RW	0x00 (0$_{dec}$)
8051:15	Emergency stop on position lag error	• Lag error monitoring has triggered • an emergency stop is triggered as soon as "Position lag" = 1. The "Misc Error" is set to 1 and a PDO error is generated.	BOOLEAN	RW	0x00 (0$_{dec}$)
8051:16	Enhanced diag history	TRUE: Additional messages are output during the travel command (each change of the state machine (index 0x9050:03 [▶ 219]))	BOOLEAN	RW	0x00 (0$_{dec}$)

8.3   Command object

Index FB00 DCM Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	DCM Command	Max. Subindex	UINT8	RO	0x03 (3$_{dec}$)
FB00:01	Request	0x1000 Clear diag history Clear the Diag History 0x1100 Get build number: Read out the build number 0x1101 Get build date Read out the build date 0x1102 Get build time Read out the build time 0x8000 Software reset Perform a software reset (hardware is re-initialized with the current CoE configuration; this otherwise happens only during the transition to INIT)	OCTET-STRING[2]	RW	{0}
FB00:02	Status	0: Finished, no error, no response Command terminated without error and without response	UINT8	RO	0x00 (0$_{dec}$)
		1: Finished, no error, response Command terminated without error and with response			
		2: Finished, error, no response Command terminated with error and without response			
		3: Finished, error, response Command terminated with error and with response			
		255: Executing Command is being executed			
FB00:03	Response	dependent on the request	OCTET-STRING[4]	RO	{0}

8.4   Input data

Index 6000 ENC Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	ENC Inputs Ch.1	Max. Subindex	UINT8	RO	0x16 (22$_{dec}$)
6000:02	Latch extern valid	The counter value was locked via the external latch. The data with the index 0x6000:12 [▶ 213] correspond to the latched value with the bit set. In order to re-activate the latch input, index 0x7000:02 [▶ 216] or object index 0x7000:04 [▶ 216] must first be cancelled and then set again.	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:04	Counter underflow	Counter underflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:05	Counter overflow	Counter overflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:08	Extrapolation stall	The extrapolated part of the counter is invalid.	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:09	Status of input A	Status of input A	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0A	Status of input B	Status of input B	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0D	Status of extern latch	Status of the extern latch input	BOOLEAN	RO	0x00 (0$_{dec}$)
6000:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle. This means a SYNC signal was triggered in the terminal, although no new process data were available (0=OK, 1=NOK).	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	Counter value	Counter value	UINT32	RO	0x00000000 (0$_{dec}$)
6000:12	Latch value	Latch value	UINT32	RO	0x00000000 (0$_{dec}$)
6000:16	Timestamp	Timestamp of the last counter change	UINT32	RO	0x00000000 (0$_{dec}$)

Index 6010 ENC Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	ENC Inputs Ch.2	Max. Subindex	UINT8	RO	0x16 (22$_{dec}$)
6010:02	Latch extern valid	The counter value was locked via the external latch. The data with the index 0x6010:12 [▶ 214] correspond to the latched value with the bit set. In order to re-activate the latch input, index 0x7010:02 [▶ 216] or object index 0x7010:04 [▶ 216] must first be cancelled and then set again.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:04	Counter underflow	Counter underflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:05	Counter overflow	Counter overflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:08	Extrapolation stall	The extrapolated part of the counter is invalid	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:09	Status of input A	Status of input A	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0A	Status of input B	Status of input B	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0D	Status of extern latch	Status of the extern latch input	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle. This means a SYNC signal was triggered in the terminal, although no new process data were available (0=OK, 1=NOK).	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6010:11	Counter value	Counter value	UINT32	RO	0x00000000 (0$_{dec}$)
6010:12	Latch value	Latch value	UINT32	RO	0x00000000 (0$_{dec}$)
6010:16	Timestamp	Timestamp of the last counter change	UINT32	RO	0x00000000 (0$_{dec}$)

Index 6020 DCM Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	DCM Inputs Ch.1	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6020:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:03	Warning	A warning has occurred (see index 0xA020 [▶ 220])	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:04	Error	An error has occurred (see index 0xA020 [▶ 220])	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6020:11	Info data 1	Synchronous information (selection via subindex 0x8022:11 [▶ 206])	UINT16	RO	0x0000 (0$_{dec}$)
6020:12	Info data 2	Synchronous information (selection via subindex 0x8022:19 [▶ 206])	UINT16	RO	0x0000 (0$_{dec}$)

Index 6030 DCM Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6030:0	DCM Inputs Ch.2	Max. Subindex	UINT8	RO	0x12 (18$_{dec}$)
6030:01	Ready to enable	Driver stage is ready for enabling	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:02	Ready	Driver stage is ready for operation	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:03	Warning	A warning has occurred (see index 0xA030 [▶ 220])	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:04	Error	An error has occurred (see index 0xA030 [▶ 220])	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:05	Moving positive	Driver stage is activated in positive direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:06	Moving negative	Driver stage is activated in negative direction	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:07	Torque reduced	Reduced torque is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0C	Digital input 1	Digital input 1	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0D	Digital input 2	Digital input 2	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:0E	Sync error	The Sync error bit is only required for DC mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0$_{dec}$)
6030:11	Info data 1	Synchronous information (selection via subindex 0x8032:11 [▶ 209])	UINT16	RO	0x0000 (0$_{dec}$)
6030:12	Info data 2	Synchronous information (selection via subindex 0x8032:19 [▶ 209])	UINT16	RO	0x0000 (0$_{dec}$)

Index 6040 POS Inputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
6040:0	POS Inputs Ch.1	Max. Subindex	UINT8	RO	0x22 (34$_{dec}$)
6040:01	Busy	A current travel command is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:02	In-Target	Motor has arrived at target	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:03	Warning	A warning has occurred	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:04	Error	an error has occurred	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:05	Calibrated	Motor is calibrated	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:06	Accelerate	Motor is in the acceleration phase	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:07	Decelerate	Motor is in the deceleration phase	BOOLEAN	RO	0x00 (0$_{dec}$)
6040:11	Actual position	Current target position of the travel command generator	UINT32	RO	0x00007FFF (32767$_{dec}$)
6040:21	Actual velocity	Current set velocity of the travel command generator	INT16	RO	0x0000 (0$_{dec}$)
6040:22	Actual drive time	Travel command time information (see subindex 0x8pp1:11)	UINT32	RO	0x00000000 (0$_{dec}$)

Index 6050 POS Inputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
6050:0	POS Inputs Ch.2	Max. Subindex	UINT8	RO	0x22 (34$_{dec}$)
6050:01	Busy	A current travel command is active	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:02	In-Target	Motor has arrived at target	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:03	Warning	A warning has occurred	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:04	Error	an error has occurred	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:05	Calibrated	Motor is calibrated	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:06	Accelerate	Motor is in the acceleration phase	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:07	Decelerate	Motor is in the deceleration phase	BOOLEAN	RO	0x00 (0$_{dec}$)
6050:11	Actual position	Current target position of the travel command generator	UINT32	RO	0x00007FFF (32767$_{dec}$)
6050:21	Actual velocity	Current set velocity of the travel command generator	INT16	RO	0x0000 (0$_{dec}$)
6050:22	Actual drive time	Travel command time information (see subindex 0x8pp1:11)	UINT32	RO	0x00000000 (0$_{dec}$)

8.5 Output data

Index 7000 ENC Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	ENC Outputs Ch.1	Max. Subindex	UINT8	RO	0x11 (17$_{dec}$)
7000:02	Enable latch extern on positive edge	Activate external latch with positive edge.	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:03	Set counter	Set counter	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:04	Enable latch extern on negative edge	Activate external latch with negative edge.	BOOLEAN	RO	0x00 (0$_{dec}$)
7000:11	Set counter value	The counter value to be set via "Set counter" (index 0x7000:03).	UINT32	RO	0x00000000 (0$_{dec}$)

Index 7010 ENC Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	ENC Outputs Ch.2	Max. Subindex	UINT8	RO	0x11 (17$_{dec}$)
7010:02	Enable latch extern on positive edge	Activate external latch with positive edge.	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:03	Set counter	Set counter	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:04	Enable latch extern on negative edge	Activate external latch with negative edge.	BOOLEAN	RO	0x00 (0$_{dec}$)
7010:11	Set counter value	The counter value to be set via "Set counter" (index 0x7010:03).	UINT32	RO	0x00000000 (0$_{dec}$)

Index 7020 DCM Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7020:0	DCM Outputs Ch.1	Max. Subindex	UINT8	RO	0x21 (33$_{dec}$)
7020:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0$_{dec}$)
7020:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7020:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8020:05 [▶ 205] / 0x8020:06 [▶ 205])	BOOLEAN	RO	0x00 (0$_{dec}$)
7020:11	Position	Set position specification	UINT32	RO	0x00000000 (0$_{dec}$)
7020:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0$_{dec}$)

Index 7030 DCM Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	DCM Outputs Ch.2	Max. Subindex	UINT8	RO	0x21 (33$_{dec}$)
7030:01	Enable	Activates the output stage	BOOLEAN	RO	0x00 (0$_{dec}$)
7030:02	Reset	All errors that may have occurred are reset by setting this bit (rising edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7030:03	Reduce torque	Reduced torque (coil current) is active (see subindex 0x8030:05 [▶ 207] / 0x8030:06 [▶ 207])	BOOLEAN	RO	0x00 (0$_{dec}$)
7030:11	Position	Set position specification	UINT32	RO	0x00000000 (0$_{dec}$)
7030:21	Velocity	Set velocity specification	INT16	RO	0x0000 (0$_{dec}$)

Index 7040 POS Outputs Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
7040:0	POS Outputs Ch.1	Max. Subindex	UINT8	RO	0x24 (36_{dec})
7040:01	Execute	Start travel command (rising edge), or prematurely abort travel command (falling edge)	BOOLEAN	RO	0x00 (0_{dec})
7040:02	Emergency stop	Prematurely abort travel command with an emergency ramp (rising edge)	BOOLEAN	RO	0x00 (0_{dec})
7040:11	Target position	Specification of the target position	UINT32	RO	0x00007FFF (32767_{dec})
7040:21	Velocity	Specification of the maximum set velocity	INT16	RO	0x0000 (0_{dec})
7040:22	Start type	Specification of the start types	UINT16	RO	0x0000 (0_{dec})
		0x0000 Idle No travel command is being executed			
		0x0001 Absolute Absolute target position			
		0x0002 Relative Target position relative to the start position			
		0x0003 Endless plus Endless driving in positive direction of rotation			
		0x0004 Endless minus Endless driving in negative direction of rotation			
		0x0105 Modulo short Shortest distance to the next modulo position			
		0x0115 Modulo short extended Shortest distance to the next modulo position (without modulo window)			
		0x0205 Modulo plus Drive in positive direction of rotation to the next modulo position			
		0x0215 Modulo plus extended Drive in positive direction of rotation to the next modulo position (without modulo window)			
		0x0305 Modulo minus Drive in negative direction of rotation to the next modulo position			
		0x0315 Modulo minus extended Drive in negative direction of rotation to the next modulo position (without modulo window)			
		0x0405 Modulo current Drive in the last implemented direction of rotation to the next modulo position			
		0x0415 Modulo current extended Drive in the last implemented direction of rotation to the next modulo position (without modulo window)			
		0x0006 Additive New target position relative/additive to the last target position			
		0x6000 Calibration, Plc cam Calibration with cam			
		0x6100 Calibration, Hw sync Calibration with cam and C-track			
		0x6E00 Calibration, set manual Set calibration manually			
		0x6E01 Calibration, set manual auto Set calibration automatically			
		0x6F00 Calibration, clear manual Clear calibration manually			
7040:23	Acceleration	Acceleration specification	UINT16	RO	0x0000 (0_{dec})
7040:24	Deceleration	Deceleration specification	UINT16	RO	0x0000 (0_{dec})

Index 7050 POS Outputs Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
7050:0	POS Outputs Ch.2	Max. Subindex	UINT8	RO	0x24 (36$_{dec}$)
7050:01	Execute	Start travel command (rising edge), or prematurely abort travel command (falling edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7050:02	Emergency Stop	Prematurely abort travel command with an emergency ramp (rising edge)	BOOLEAN	RO	0x00 (0$_{dec}$)
7050:11	Target position	Specification of the target position	UINT32	RO	0x00007FFF (32767$_{dec}$)
7050:21	Velocity	Specification of the maximum set velocity	INT16	RO	0x0000 (0$_{dec}$)
7050:22	Start type	Specification of the start types 0x0000 Idle No travel command is being executed 0x0001 Absolute Absolute target position 0x0002 Relative Target position relative to the start position 0x0003 Endless plus Endless driving in positive direction of rotation 0x0004 Endless minus Endless driving in negative direction of rotation 0x0105 Modulo short Shortest distance to the next modulo position 0x0115 Modulo short extended Shortest distance to the next modulo position (without modulo window) 0x0205 Modulo plus Drive in positive direction of rotation to the next modulo position 0x0215 Modulo plus extended Drive in positive direction of rotation to the next modulo position (without modulo window) 0x0305 Modulo minus Drive in negative direction of rotation to the next modulo position 0x0315 Modulo minus extended Drive in negative direction of rotation to the next modulo position (without modulo window) 0x0405 Modulo current Drive in the last implemented direction of rotation to the next modulo position 0x0415 Modulo current extended Drive in the last implemented direction of rotation to the next modulo position (without modulo window) 0x0006 Additive New target position relative/additive to the last target position 0x6000 Calibration, Plc cam Calibration with cam 0x6100 Calibration, Hw sync Calibration with cam and C-track 0x6E00 Calibration, set manual Set calibration manually 0x6E01 Calibration, set manual auto Set calibration automatically 0x6F00 Calibration, clear manual Clear calibration manually	UINT16	RO	0x0000 (0$_{dec}$)
7050:23	Acceleration	Acceleration specification	UINT16	RO	0x0000 (0$_{dec}$)
7050:24	Deceleration	Deceleration specification	UINT16	RO	0x0000 (0$_{dec}$)

8.6 Information and diagnosis data (channel specific)

Index 9020 DCM Info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
9020:0	DCM Info data Ch.1	Max. Subindex	UINT8	RO	0x09 (9$_{dec}$)
9020:01	Status word	Status word (see Index 0xApp0)	UINT16	RO	0x0000 (0$_{dec}$)
9020:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0$_{dec}$)
9020:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0$_{dec}$)
9020:04	Current limit	Present current limit	UINT16	RO	0x0000 (0$_{dec}$)
9020:05	Control error	Present control error	INT16	RO	0x0000 (0$_{dec}$)
9020:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0$_{dec}$)
9020:08	Motor velocity	Present motor velocity	INT16	RO	0x0000 (0$_{dec}$)
9020:09	Overload time	Time since overload	UINT16	RO	0x0000 (0$_{dec}$)

Index 9030 DCM Info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
9030:0	DCM Info data Ch.2	Max. Subindex	UINT8	RO	0x09 (9$_{dec}$)
9030:01	Status word	Status word (see Index 0xApp0)	UINT16	RO	0x0000 (0$_{dec}$)
9030:02	Motor coil voltage	Present coil voltage	UINT16	RO	0x0000 (0$_{dec}$)
9030:03	Motor coil current	Present coil current	INT16	RO	0x0000 (0$_{dec}$)
9030:04	Current limit	Present current limit	UINT16	RO	0x0000 (0$_{dec}$)
9030:05	Control error	Present control error	INT16	RO	0x0000 (0$_{dec}$)
9030:06	Duty cycle	Present Duty-Cycle	INT8	RO	0x00 (0$_{dec}$)
9030:08	Motor velocity	Present motor velocity	INT16	RO	0x0000 (0$_{dec}$)
9030:09	Overload time	Time since overload	UINT16	RO	0x0000 (0$_{dec}$)

Index 9040 POS Info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
9040:0	POS Info data Ch.1	Max. Subindex	UINT8	RO	0x04 (4$_{dec}$)
9040:01	Status word	Status word	UINT16		0x0000 (0$_{dec}$)
9040:03	State (drive controller)	Current step of the internal state machine	UINT16	RO	0xFFFF (65535$_{dec}$)
9040:04	Actual position lag	Current position lag	UINT16		0x0000 (0$_{dec}$)

Index 9050 POS Info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
9050:0	POS Info data Ch.2	Max. Subindex	UINT8	RO	0x04 (4$_{dec}$)
9050:01	Status word	Status word	UINT16	RO	0x0000 (0$_{dec}$)
9050:03	State (drive controller)	Current step of the internal state machine	UINT16	RO	0xFFFF (65535$_{dec}$)
9050:04	Actual position lag	Current position lag	UINT16	RO	0x0000 (0$_{dec}$)

Index A020 DCM Diag data Ch.1

Index (hex)	Name	Meaning		Data type	Flags	Default
A020:0	DCM Diag data Ch.1	Max. Subindex		UINT8	RO	0x11 (17$_{dec}$)
A020:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:03	Torque overload	Present motor current exceeds the nominal current (see 0x8020:02 [▶ 205])	Warning (0x8022:0A = 0) / Error (0x8022:0A = 1)	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8020:03 [▶ 205]	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:09	Misc error	• initialization failed or • internal temperature of the terminal exceeds 100 °C (see 0xF80F:05) or • motor current exceeds the nominal current (see 0x8022:0A [▶ 206])	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:0A	Configuration	CoE change has not yet been adopted into the current configuration.	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A020:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8022:01 [▶ 206])		BIT4	RO	0x00 (0$_{dec}$)

Index A030 DCM Diag data Ch.2

Index (hex)	Name	Meaning		Data type	Flags	Default
A030:0	DCM Diag data Ch.1	Max. Subindex		UINT8	RO	0x11 (17$_{dec}$)
A030:01	Saturated	Driver stage operates with maximum duty cycle	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:02	Over temperature	Internal terminal temperature is greater than 80 °C	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:03	Torque overload	Present motor current exceeds the nominal current (see 0x8030:02 [▶ 207])	Warning (0x8032:0A = 0) / Error (0x8032:0A = 1)	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:04	Under voltage	Supply voltage less than 7 V	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:05	Over voltage	Supply voltage 10 % higher than the nominal voltage (see 0x8030:03 [▶ 207]	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:06	Short circuit	Short circuit in the driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:08	No control power	No power supply to driver stage	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:09	Misc error	• initialization failed or • internal temperature of the terminal exceeds 100 °C (see 0xF80F:05) or • motor current exceeds the nominal current (see 0x8032:0A [▶ 209])	Error	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:0A	Configuration	CoE change has not yet been adopted into the current configuration.	Warning	BOOLEAN	RO	0x00 (0$_{dec}$)
A030:11	Actual operation mode	Present operating mode (in the case of automatic detection of operating mode, see 0x8032:01 [▶ 209])		BIT4	RO	0x00 (0$_{dec}$)

Index A040 POS Diag data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
A040:0	POS Diag data Ch.1	Max. Subindex	UINT8	RO	0x6 (6_{dec})
A040:01	Command rejected	Travel command was rejected	BOOLEAN	RO	0x00 (0_{dec})
A040:02	Command aborted	Travel command was aborted	BOOLEAN	RO	0x00 (0_{dec})
A040:03	Target overrun	Target position was overrun in the opposite direction	BOOLEAN	RO	0x00 (0_{dec})
A040:04	Target timeout	The motor did not reach the target window (0x8040:0B [▶ 210]) within the configured time (0x8040:0C [▶ 210]) after the end of the travel command.	BOOLEAN	RO	0x00 (0_{dec})
A040:05	Position lag	Position lag exceeded • The position lag monitoring is deactivated if "Position lag max." = 0. • If a value is entered in "Position lag max.", then this value is compared with "Actual position lag". As soon as "Actual position lag" exceeds "Position lag max.", "Position lag" = 1 is set and a PDO warning is output.	BOOLEAN	RO	0x00 (0_{dec})
A040:06	Emergency stop	An emergency stop was triggered (automatic or manual).	BOOLEAN	RO	0x00 (0_{dec})

Index A050 POS Diag data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
A050:0	POS Diag data Ch.2	Max. Subindex	UINT8	RO	0x6 (6_{dec})
A050:01	Command rejected	Travel command was rejected	BOOLEAN	RO	0x00 (0_{dec})
A050:02	Command aborted	Travel command was aborted	BOOLEAN	RO	0x00 (0_{dec})
A050:03	Target overrun	Target position was overrun in the opposite direction	BOOLEAN	RO	0x00 (0_{dec})
A050:04	Target timeout	The motor did not reach the target window (0x8050:0B [▶ 211]) within the configured time (0x8050:0C [▶ 211]) after the end of the travel command.	BOOLEAN	RO	0x00 (0_{dec})
A050:05	Position lag	Position lag exceeded • The position lag monitoring is deactivated if "Position lag max." = 0. • If a value is entered in "Position lag max.", then this value is compared with "Actual position lag". As soon as "Actual position lag" exceeds "Position lag max.", "Position lag" = 1 is set and a PDO warning is output.	BOOLEAN	RO	0x00 (0_{dec})
A050:06	Emergency stop	An emergency stop was triggered (automatic or manual).	BOOLEAN	RO	0x00 (0_{dec})

8.7 Configuration data (vendor-specific)

Index F80F DCM Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
F80F:0	DCM Vendor data	Max. Subindex	UINT8	RO	0x06 (6_{dec})
F80F:01	PWM Frequency	DC link frequency (**unit**: 1 Hz)	UINT16	RW	0x7530 (30000_{dec})
F80F:02	Deadtime	Dead time for pulse width modulation	UINT16	RW	0x0102 (258_{dec})
F80F:03	Deadtime space	Duty cycle limitation	UINT16	RW	0x0009 (9_{dec})
F80F:04	Warning temperature	Threshold of the temperature warning (**unit**: 1 °C)	INT8	RW	0x50 (80_{dec})
F80F:05	Switch off temperature	Switch-off temperature (**unit**: 1 °C)	INT8	RW	0x64 (100_{dec})
F80F:06	Analog trigger point	Trigger point for AD conversion	UINT16	RW	0x000A (10_{dec})

8.8   Information and diagnosis data (device-specific)

Index F900 DCM Info data

Index (hex)	Name	Meaning	Data type	Flags	Default
F900:0	DCM Info data	Max. Subindex	UINT8	RO	0x06 (6_{dec})
F900:01	Software version (driver)	Software version of the driver card	STRING	RO	
F900:02	Internal temperature	Internal terminal temperature (**unit:** 1 °C)	INT8	RO	0x00 (0_{dec})
F900:04	Control voltage	Control voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0_{dec})
F900:05	Motor supply voltage	Load voltage (**unit:** 1 mV)	UINT16	RO	0x0000 (0_{dec})
F900:06	Cycle time	Measured cycle time (**unit:** 1 µs)	UINT16	RO	0x0000 (0_{dec})

8.9   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
1000:0	Device type	Device type of the EtherCAT slave: the Lo-Word contains the CoE profile used (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EL7342

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	02

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	03

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x1CAE3052 (481177682_{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	0x00100000 (1048576_{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
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 1400 ENC RxPDO-Par Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1400:0	ENC RxPDO-Par Control compact Ch.1	PDO Parameter RxPDO 1	UINT8	RO	0x06 (6_{dec})
1400:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 1	OCTET-STRING[6]	RO	01 16 00 00 00 00

Index 1401 ENC RxPDO-Par Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	ENC RxPDO-Par Control Ch.1	PDO Parameter RxPDO 2	UINT8	RO	0x06 (6_{dec})
1401:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 2	OCTET-STRING[6]	RO	00 16 00 00 00 00

Index 1402 ENC RxPDO-Par Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1402:0	ENC RxPDO-Par Control compact Ch.2	PDO Parameter RxPDO 3	UINT8	RO	0x06 (6_{dec})
1402:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 3	OCTET-STRING[6]	RO	03 16 00 00 00 00

Index 1403 ENC RxPDO-Par Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1403:0	ENC RxPDO-Par Control Ch.2	PDO Parameter RxPDO 4	UINT8	RO	0x06 (6_{dec})
1403:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 4	OCTET-STRING[6]	RO	02 16 00 00 00 00

Index 1405 DCM RxPDO-Par Position Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1405:0	DCM RxPDO-Par Position Ch.1	PDO Parameter RxPDO 6	UINT8	RO	0x06 (6_{dec})
1405:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 6	OCTET-STRING[6]	RO	06 16 0A 16 0B 16

Index 1406 DCM RxPDO-Par Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1406:0	DCM RxPDO-Par Velocity Ch.1	PDO Parameter RxPDO 7	UINT8	RO	0x06 (6_{dec})
1406:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with Rx-PDO 7	OCTET-STRING[6]	RO	05 16 0A 16 0B 16

Index 1408 DCM RxPDO-Par Position Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1408:0	DCM RxPDO-Par Position Ch.2	PDO Parameter RxPDO 9	UINT8	RO	0x06 (6$_{dec}$)
1408:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 9	OCTET-STRING[6]	RO	09 16 0C 16 0D 16

Index 1409 DCM RxPDO-Par Velocity Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1409:0	DCM RxPDO-Par Velocity Ch.2	PDO Parameter RxPDO 10	UINT8	RO	0x06 (6$_{dec}$)
1409:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 10	OCTET-STRING[6]	RO	08 16 0C 16 0D 16

Index 140A POS RxPDO-Par Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
140A:0	POS RxPDO-Par Control compact Ch.1	PDO Parameter RxPDO 11	UINT8	RO	0x06 (6$_{dec}$)
140A:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 11	OCTET-STRING[6]	RO	05 16 06 16 0B 16

Index 140B POS RxPDO-Par Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
140B:0	POS RxPDO-Par Control Ch.1	PDO Parameter RxPDO 12	UINT8	RO	0x06 (6$_{dec}$)
140B:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 12	OCTET-STRING[6]	RO	05 16 06 16 0A 16

Index 140C POS RxPDO-Par Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
140C:0	POS RxPDO-Par Control compact Ch.2	PDO Parameter RxPDO 13	UINT8	RO	0x06 (6$_{dec}$)
140C:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 13	OCTET-STRING[6]	RO	08 16 09 16 0D 16

Index 140D POS RxPDO-Par Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
140D:0	POS RxPDO-Par Control Ch.2	PDO Parameter RxPDO 14	UINT8	RO	0x06 (6$_{dec}$)
140D:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 14	OCTET-STRING[6]	RO	08 16 09 16 0C 16

Index 1600 ENC RxPDO-Map Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	ENC RxPDO-Map Control compact Ch.1	PDO Mapping RxPDO 1	UINT8	RO	0x07 (7$_{dec}$)
1600:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x02 (Enable latch extern on positive edge))	UINT32	RO	0x7000:02, 1
1600:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1600:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x04 (Enable latch extern on negative edge))	UINT32	RO	0x7000:04, 1
1600:05	SubIndex 005	5. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1600:06	SubIndex 006	6. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1600:07	SubIndex 007	7. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 16

Index 1601 ENC RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	ENC RxPDO-Map Control Ch.1	PDO Mapping RxPDO 2	UINT8	RO	0x07 (7$_{dec}$)
1601:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1601:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x02 (Enable latch extern on positive edge))	UINT32	RO	0x7000:02, 1
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1601:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x04 (Enable latch extern on negative edge))	UINT32	RO	0x7000:04, 1
1601:05	SubIndex 005	5. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1601:06	SubIndex 006	6. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:07	SubIndex 007	7. PDO Mapping entry (object 0x7000 (ENC Outputs Ch.1), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 32

Index 1602 ENC RxPDO-Map Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	ENC RxPDO-Map Control compact Ch.2	PDO Mapping RxPDO 3	UINT8	RO	0x07 (7$_{dec}$)
1602:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1602:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x02 (Enable latch extern on positive edge))	UINT32	RO	0x7010:02, 1
1602:03	SubIndex 003	3. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1602:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x04 (Enable latch extern on negative edge))	UINT32	RO	0x7010:04, 1
1602:05	SubIndex 005	5. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1602:06	SubIndex 006	6. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1602:07	SubIndex 007	7. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 16

Index 1603 ENC RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	ENC RxPDO-Map Control Ch.2	PDO Mapping RxPDO 4	UINT8	RO	0x07 (7$_{dec}$)
1603:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1603:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x02 (Enable latch extern on positive edge))	UINT32	RO	0x7010:02, 1
1603:03	SubIndex 003	3. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1603:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x04 (Enable latch extern on negative edge))	UINT32	RO	0x7010:04, 1
1603:05	SubIndex 005	5. PDO Mapping entry (4 bits align)	UINT32	RO	0x0000:00, 4
1603:06	SubIndex 006	6. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1603:07	SubIndex 007	7. PDO Mapping entry (object 0x7010 (ENC Outputs Ch.2), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 32

Index 1604 DCM RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1604:0	DCM RxPDO-Map Control Ch.1	PDO Mapping RxPDO 5	UINT8	RO	0x05 (5$_{dec}$)
1604:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x01 (Enable))	UINT32	RO	0x7020:01, 1
1604:02	SubIndex 002	2. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x02 (Reset))	UINT32	RO	0x7020:02, 1
1604:03	SubIndex 003	3. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x03 (Reduce torque))	UINT32	RO	0x7020:03, 1
1604:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1604:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1605 DCM RxPDO-Map Position Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1605:0	DCM RxPDO-Map Position Ch.1	PDO Mapping RxPDO 6	UINT8	RO	0x01 (1$_{dec}$)
1605:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x11 (Position))	UINT32	RO	0x7020:11, 32

Index 1606 DCM RxPDO-Map Velocity Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1606:0	DCM RxPDO-Map Velocity Ch.1	PDO Mapping RxPDO 7	UINT8	RO	0x01 (1$_{dec}$)
1606:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (DCM Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x7020:21, 16

Index 1607 DCM RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1607:0	DCM RxPDO-Map Control Ch.2	PDO Mapping RxPDO 8	UINT8	RO	0x05 (5$_{dec}$)
1607:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x01 (Enable))	UINT32	RO	0x7030:01, 1
1607:02	SubIndex 002	2. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x02 (Reset))	UINT32	RO	0x7030:02, 1
1607:03	SubIndex 003	3. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x03 (Reduce torque))	UINT32	RO	0x7030:03, 1
1607:04	SubIndex 004	4. PDO Mapping entry (5 bits align)	UINT32	RO	0x0000:00, 5
1607:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1608 DCM RxPDO-Map Position Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1608:0	DCM RxPDO-Map Position Ch.2	PDO Mapping RxPDO 9	UINT8	RO	0x01 (1$_{dec}$)
1608:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x11 (Position))	UINT32	RO	0x7030:11, 32

Index 1609 DCM RxPDO-Map Velocity Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1609:0	DCM RxPDO-Map Velocity Ch.2	PDO Mapping RxPDO 10	UINT8	RO	0x01 (1$_{dec}$)
1609:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (DCM Outputs Ch.2), entry 0x21 (Velocity))	UINT32	RO	0x7030:21, 16

Index 160A POS RxPDO-Map Control compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
160A:0	POS RxPDO-Map Control compact Ch.1	PDO Mapping RxPDO 11	UINT8	RO	0x05 (5$_{dec}$)
160A:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x01 (Execute))	UINT32	RO	0x7040:01, 1
160A:02	SubIndex 002	2. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x02 (Emergency stop))	UINT32	RO	0x7040:02, 1
160A:03	SubIndex 003	3. PDO Mapping entry (6 bits align)	UINT32	RO	0x0000:00, 6
160A:04	SubIndex 004	4. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
160A:05	SubIndex 005	5. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x11 (Target position))	UINT32	RO	0x7040:11, 32

Index 160B POS RxPDO-Map Control Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
160B:0	POS RxPDO-Map Control Ch.1	PDO Mapping RxPDO 12	UINT8	RO	0x09 (9$_{dec}$)
160B:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x01 (Execute))	UINT32	RO	0x7040:01, 1
160B:02	SubIndex 002	2. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x02 (Emergency stop))	UINT32	RO	0x7040:02, 1
160B:03	SubIndex 003	3. PDO Mapping entry (6 bits align)	UINT32	RO	0x0000:00, 6
160B:04	SubIndex 004	4. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
160B:05	SubIndex 005	5. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x11 (Target position))	UINT32	RO	0x7040:11, 32
160B:06	SubIndex 006	6. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x21 (Velocity))	UINT32	RO	0x7040:21, 16
160B:07	SubIndex 007	7. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x22 (Start type))	UINT32	RO	0x7040:22, 16
160B:08	SubIndex 008	8. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x23 (Acceleration))	UINT32	RO	0x7040:23, 16
160B:09	SubIndex 009	9. PDO Mapping entry (object 0x7040 (POS Outputs Ch.1), entry 0x24 (Deceleration))	UINT32	RO	0x7040:24, 16

Index 160C POS RxPDO-Map Control compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
160C:0	POS RxPDO-Map Control compact Ch.2	PDO Mapping RxPDO 13	UINT8	RO	0x05 (5$_{dec}$)
160C:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x01 (Execute))	UINT32	RO	0x7050:01, 1
160C:02	SubIndex 002	2. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x02 (Emergency stop))	UINT32	RO	0x7050:02, 1
160C:03	SubIndex 003	3. PDO Mapping entry (6 bits align)	UINT32	RO	0x0000:00, 6
160C:04	SubIndex 004	4. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
160C:05	SubIndex 005	5. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x11 (Target position))	UINT32	RO	0x7050:11, 32

Index 160D POS RxPDO-Map Control Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
160D:0	POS RxPDO-Map Control Ch.2	PDO Mapping RxPDO 14	UINT8	RO	0x09 (9$_{dec}$)
160D:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x01 (Execute))	UINT32	RO	0x7050:01, 1
160D:02	SubIndex 002	2. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x02 (Emergency stop))	UINT32	RO	0x7050:02, 1
160D:03	SubIndex 003	3. PDO Mapping entry (6 bits align)	UINT32	RO	0x0000:00, 6
160D:04	SubIndex 004	4. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
160D:05	SubIndex 005	5. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x11 (Target position))	UINT32	RO	0x7050:11, 32
160D:06	SubIndex 006	6. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x21 (Velocity))	UINT32	RO	0x7050:21, 16
160D:07	SubIndex 007	7. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x22 (Start type))	UINT32	RO	0x7050:22, 16
160D:08	SubIndex 008	8. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x23 (Acceleration))	UINT32	RO	0x7050:23, 16
160D:09	SubIndex 009	9. PDO Mapping entry (object 0x7050 (POS Outputs Ch.2), entry 0x24 (Deceleration))	UINT32	RO	0x7050:24, 16

Index 1800 ENC TxPDO-Par Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	ENC TxPDO-Par Status compact Ch.1	PDO Parameter TxPDO 1	UINT8	RO	0x09 (9$_{dec}$)
1800:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 1	OCTET-STRING[2]	RO	01 1A
1800:09	TxPDO Toggle	The TxPDO toggle is toggled with each update the corresponding input data	BOOLEAN	RO	0x00 (0$_{dec}$)

Index 1801 ENC TxPDO-Par Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	ENC TxPDO-Par Status Ch.1	PDO Parameter TxPDO 2	UINT8	RO	0x09 (9$_{dec}$)
1801:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 2	OCTET-STRING[2]	RO	00 1A
1801:09	TxPDO Toggle	The TxPDO toggle is toggled with each update the corresponding input data	BOOLEAN	RO	0x00 (0$_{dec}$)

Index 1803 ENC TxPDO-Par Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	ENC TxPDO-Par Status compact Ch.2	PDO Parameter TxPDO 4	UINT8	RO	0x09 (9$_{dec}$)
1803:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 4	OCTET-STRING[2]	RO	04 1A
1803:09	TxPDO Toggle	The TxPDO toggle is toggled with each update the corresponding input data	BOOLEAN	RO	0x00 (0$_{dec}$)

Index 1804 ENC TxPDO-Par Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	ENC TxPDO-Par Status Ch.2	PDO Parameter TxPDO 5	UINT8	RO	0x09 (9$_{dec}$)
1804:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 5	OCTET-STRING[2]	RO	03 1A
1804:09	TxPDO Toggle	The TxPDO toggle is toggled with each update the corresponding input data	BOOLEAN	RO	0x00 (0$_{dec}$)

Index 180A POS TxPDO-Par Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
180A:0	POS TxPDO-Par Status compact Ch.1	PDO Parameter TxPDO 11	UINT8	RO	0x06 (6$_{dec}$)
180A:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 11	OCTET-STRING[2]	RO	0B 1A

Index 180B POS TxPDO-Par Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
180B:0	POS TxPDO-Par Status Ch.1	PDO Parameter TxPDO 12	UINT8	RO	0x06 (6$_{dec}$)
180B:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 12	OCTET-STRING[2]	RO	0A 1A

Index 180C POS TxPDO-Par Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
180C:0	POS TxPDO-Par Status compact Ch.2	PDO Parameter TxPDO 13	UINT8	RO	0x06 (6$_{dec}$)
180C:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 13	OCTET-STRING[2]	RO	0D 1A

Index 180D POS TxPDO-Par Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
180D:0	POS TxPDO-Par Status Ch.2	PDO Parameter TxPDO 14	UINT8	RO	0x06 (6$_{dec}$)
180D:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 14	OCTET-STRING[2]	RO	0C 1A

Index 1A00 ENC TxPDO-Map Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	ENC TxPDO-Map Status compact Ch.1	PDO Mapping TxPDO 1	UINT8	RO	0x11 (17$_{dec}$)
1A00:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x02 (Latch extern valid))	UINT32	RO	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x04 (Counter underflow))	UINT32	RO	0x6000:04, 1
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x05 (Counter overflow))	UINT32	RO	0x6000:05, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A00:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6000:08, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x09 (Status of input A))	UINT32	RO	0x6000:09, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x0A (Status of input B))	UINT32	RO	0x6000:0A, 1
1A00:0A	SubIndex 010	10. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:0B	SubIndex 011	11. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:0C	SubIndex 012	12. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x0D (Status of extern latch))	UINT32	RO	0x6000:0D, 1
1A00:0D	SubIndex 013	13. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A00:0E	SubIndex 014	14. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:0F	SubIndex 015	15. PDO Mapping entry (object 0x1800 (ENC TxPDO-Par Status compact Ch.1), entry 0x09 (TxPDO Toggle))	UINT32	RO	0x1800:09, 1
1A00:10	SubIndex 016	16. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 16
1A00:11	SubIndex 017	17. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x12 (Latch value))	UINT32	RO	0x6000:12, 16

Index 1A01 ENC TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	ENC TxPDO-Map Status Ch.1	PDO Mapping TxPDO 2	UINT8	RO	0x11 (17$_{dec}$)
1A01:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x02 (Latch extern valid))	UINT32	RO	0x6000:02, 1
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x04 (Counter underflow))	UINT32	RO	0x6000:04, 1
1A01:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x05 (Counter overflow))	UINT32	RO	0x6000:05, 1
1A01:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A01:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6000:08, 1
1A01:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x09 (Status of input A))	UINT32	RO	0x6000:09, 1
1A01:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x0A (Status of input B))	UINT32	RO	0x6000:0A, 1
1A01:0A	SubIndex 010	10. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A01:0B	SubIndex 011	11. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A01:0C	SubIndex 012	12. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x0D (Status of extern latch))	UINT32	RO	0x6000:0D, 1
1A01:0D	SubIndex 013	13. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A01:0E	SubIndex 014	14. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A01:0F	SubIndex 015	15. PDO Mapping entry (object 0x1801 (ENC TxPDO-Par Status Ch.1), entry 0x09 (TxPDO Toggle))	UINT32	RO	0x1801:09, 1
1A01:10	SubIndex 016	16. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
1A01:11	SubIndex 017	17. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x12 (Latch value))	UINT32	RO	0x6000:12, 32

Index 1A02 ENC TxPDO-Map Timest. compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	ENC TxPDO-Map Timest. compact Ch.1	PDO Mapping TxPDO 3	UINT8	RO	0x01 (1$_{dec}$)
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs Ch.1), entry 0x16 (Timestamp))	UINT32	RO	0x6000:16, 32

Index 1A03 ENC TxPDO-Map Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	ENC TxPDO-Map Status compact Ch.2	PDO Mapping TxPDO 4	UINT8	RO	0x11 (17$_{dec}$)
1A03:01	SubIndex 001	1. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A03:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A03:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A03:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A03:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A03:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A03:0A	SubIndex 010	10. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:0B	SubIndex 011	11. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A03:0D	SubIndex 013	13. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A03:0E	SubIndex 014	14. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A03:0F	SubIndex 015	15. PDO Mapping entry (object 0x1803 (ENC TxPDO-Par Status compact Ch.2), entry 0x09 (TxPDO Toggle))	UINT32	RO	0x1803:09, 1
1A03:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 16
1A03:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 16

Index 1A04 ENC TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	ENC TxPDO-Map Status Ch.2	PDO Mapping TxPDO 5	UINT8	RO	0x11 (17$_{dec}$)
1A04:01	SubIndex 001	1. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A04:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A04:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A04:0A	SubIndex 010	10. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:0B	SubIndex 011	11. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A04:0D	SubIndex 013	13. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A04:0E	SubIndex 014	14. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A04:0F	SubIndex 015	15. PDO Mapping entry (object 0x1804 (ENC TxPDO-Par Status Ch.2), entry 0x09 (TxPDO Toggle))	UINT32	RO	0x1804:09, 1
1A04:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32
1A04:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 32

Index 1A05 ENC TxPDO-Map Timest. compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	ENC TxPDO-Map Timest. compact Ch.2	PDO Mapping TxPDO 6	UINT8	RO	0x01 (1$_{dec}$)
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs Ch.2), entry 0x16 (Timestamp))	UINT32	RO	0x6010:16, 32

Index 1A06 DCM TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	DCM TxPDO-Map Status Ch.1	PDO Mapping TxPDO 7	UINT8	RO	0x0E (14$_{dec}$)
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x01 (Ready to enable))	UINT32	RO	0x6020:01, 1
1A06:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x02 (Ready))	UINT32	RO	0x6020:02, 1
1A06:03	SubIndex 003	3. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x03 (Warning))	UINT32	RO	0x6020:03, 1
1A06:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x04 (Error))	UINT32	RO	0x6020:04, 1
1A06:05	SubIndex 005	5. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x05 (Moving positive))	UINT32	RO	0x6020:05, 1
1A06:06	SubIndex 006	6. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x06 (Moving negative))	UINT32	RO	0x6020:06, 1
1A06:07	SubIndex 007	7. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x07 (Torque reduced))	UINT32	RO	0x6020:07, 1
1A06:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A06:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A06:0A	SubIndex 010	10. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x0C (Digital input 1))	UINT32	RO	0x6020:0C, 1
1A06:0B	SubIndex 011	11. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x0D (Digital input 2))	UINT32	RO	0x6020:0D, 1
1A06:0C	SubIndex 012	12. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A06:0D	SubIndex 013	13. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A06:0E	SubIndex 014	14. PDO Mapping entry (object 0x1806, entry 0x09)	UINT32	RO	0x1806:09, 1

Index 1A07 DCM TxPDO-Map Synchron info data Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	DCM TxPDO-Map Synchron info data Ch.1	PDO Mapping TxPDO 8	UINT8	RO	0x02 (2$_{dec}$)
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x11 (Info data 1))	UINT32	RO	0x6020:11, 16
1A07:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (DCM Inputs Ch.1), entry 0x12 (Info data 2))	UINT32	RO	0x6020:12, 16

Index 1A08 DCM TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A08:0	DCM TxPDO-Map Status Ch.2	PDO Mapping TxPDO 9	UINT8	RO	0x0E (14$_{dec}$)
1A08:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x01 (Ready to enable))	UINT32	RO	0x6030:01, 1
1A08:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x02 (Ready))	UINT32	RO	0x6030:02, 1
1A08:03	SubIndex 003	3. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x03 (Warning))	UINT32	RO	0x6030:03, 1
1A08:04	SubIndex 004	4. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x04 (Error))	UINT32	RO	0x6030:04, 1
1A08:05	SubIndex 005	5. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x05 (Moving positive))	UINT32	RO	0x6030:05, 1
1A08:06	SubIndex 006	6. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x06 (Moving negative))	UINT32	RO	0x6030:06, 1
1A08:07	SubIndex 007	7. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x07 (Torque reduced))	UINT32	RO	0x6030:07, 1
1A08:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A08:09	SubIndex 009	9. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A08:0A	SubIndex 010	10. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x0C (Digital input 1))	UINT32	RO	0x6030:0C, 1
1A08:0B	SubIndex 011	11. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x0D (Digital input 2))	UINT32	RO	0x6030:0D, 1
1A08:0C	SubIndex 012	12. PDO Mapping entry (object 0x1C32 (SM output parameter), entry 0x20 (Sync error))	UINT32	RO	0x1C32:20, 1
1A08:0D	SubIndex 013	13. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A08:0E	SubIndex 014	14. PDO Mapping entry (object 0x1808, entry 0x09)	UINT32	RO	0x1808:09, 1

Index 1A09 DCM TxPDO-Map Synchron info data Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A09:0	DCM TxPDO-Map Synchron info data Ch.2	PDO Mapping TxPDO 10	UINT8	RO	0x02 (2$_{dec}$)
1A09:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x11 (Info data 1))	UINT32	RO	0x6030:11, 16
1A09:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (DCM Inputs Ch.2), entry 0x12 (Info data 2))	UINT32	RO	0x6030:12, 16

Index 1A0A POS TxPDO-Map Status compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0A:0	POS TxPDO-Map Status compact Ch.1	PDO Mapping TxPDO 11	UINT8	RO	0x09 (9$_{dec}$)
1A0A:01	SubIndex 001	1. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x01 (Busy))	UINT32	RO	0x6040:01, 1
1A0A:02	SubIndex 002	2. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x02 (In-Target))	UINT32	RO	0x6040:02, 1
1A0A:03	SubIndex 003	3. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x03 (Warning))	UINT32	RO	0x6040:03, 1
1A0A:04	SubIndex 004	4. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x04 (Error))	UINT32	RO	0x6040:04, 1
1A0A:05	SubIndex 005	5. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x05 (Calibrated))	UINT32	RO	0x6040:05, 1
1A0A:06	SubIndex 006	6. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x06 (Accelerate))	UINT32	RO	0x6040:06, 1
1A0A:07	SubIndex 007	7. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x07 (Decelerate))	UINT32	RO	0x6040:07, 1
1A0A:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A0A:09	SubIndex 009	9. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1A0B POS TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0B:0	POS TxPDO-Map Status Ch.1	PDO Mapping TxPDO 12	UINT8	RO	0x0C (12$_{dec}$)
1A0B:01	SubIndex 001	1. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x01 (Busy))	UINT32	RO	0x6040:01, 1
1A0B:02	SubIndex 002	2. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x02 (In-Target))	UINT32	RO	0x6040:02, 1
1A0B:03	SubIndex 003	3. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x03 (Warning))	UINT32	RO	0x6040:03, 1
1A0B:04	SubIndex 004	4. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x04 (Error))	UINT32	RO	0x6040:04, 1
1A0B:05	SubIndex 005	5. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x05 (Calibrated))	UINT32	RO	0x6040:05, 1
1A0B:06	SubIndex 006	6. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x06 (Accelerate))	UINT32	RO	0x6040:06, 1
1A0B:07	SubIndex 007	7. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x07 (Decelerate))	UINT32	RO	0x6040:07, 1
1A0B:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A0B:09	SubIndex 009	9. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A0B:0A	SubIndex 010	10. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x11 (Actual position))	UINT32	RO	0x6040:11, 32
1A0B:0B	SubIndex 011	11. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x21 (Actual velocity))	UINT32	RO	0x6040:21, 16
1A0B:0C	SubIndex 012	12. PDO Mapping entry (object 0x6040 (POS Inputs Ch.1), entry 0x22 (Actual drive time))	UINT32	RO	0x6040:22, 32

Index 1A0C POS TxPDO-Map Status compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0C:0	POS TxPDO-Map Status compact Ch.2	PDO Mapping TxPDO 13	UINT8	RO	0x09 (9$_{dec}$)
1A0C:01	SubIndex 001	1. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x01 (Busy))	UINT32	RO	0x6050:01, 1
1A0C:02	SubIndex 002	2. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x02 (In-Target))	UINT32	RO	0x6050:02, 1
1A0C:03	SubIndex 003	3. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x03 (Warning))	UINT32	RO	0x6050:03, 1
1A0C:04	SubIndex 004	4. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x04 (Error))	UINT32	RO	0x6050:04, 1
1A0C:05	SubIndex 005	5. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x05 (Calibrated))	UINT32	RO	0x6050:05, 1
1A0C:06	SubIndex 006	6. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x06 (Accelerate))	UINT32	RO	0x6050:06, 1
1A0C:07	SubIndex 007	7. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x07 (Decelerate))	UINT32	RO	0x6050:07, 1
1A0C:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A0C:09	SubIndex 009	9. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1A0D POS TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A0D:0	POS TxPDO-Map Status Ch.2	PDO Mapping TxPDO 14	UINT8	RO	0x0C (12$_{dec}$)
1A0D:01	SubIndex 001	1. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x01 (Busy))	UINT32	RO	0x6050:01, 1
1A0D:02	SubIndex 002	2. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x02 (In-Target))	UINT32	RO	0x6050:02, 1
1A0D:03	SubIndex 003	3. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x03 (Warning))	UINT32	RO	0x6050:03, 1
1A0D:04	SubIndex 004	4. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x04 (Error))	UINT32	RO	0x6050:04, 1
1A0D:05	SubIndex 005	5. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x05 (Calibrated))	UINT32	RO	0x6050:05, 1
1A0D:06	SubIndex 006	6. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x06 (Accelerate))	UINT32	RO	0x6050:06, 1
1A0D:07	SubIndex 007	7. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x07 (Decelerate))	UINT32	RO	0x6050:07, 1
1A0D:08	SubIndex 008	8. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A0D:09	SubIndex 009	9. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A0D:0A	SubIndex 010	10. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x11 (Actual position))	UINT32	RO	0x6050:11, 32
1A0D:0B	SubIndex 011	11. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x21 (Actual velocity))	UINT32	RO	0x6050:21, 16
1A0D:0C	SubIndex 012	12. PDO Mapping entry (object 0x6050 (POS Inputs Ch.2), entry 0x22 (Actual drive time))	UINT32	RO	0x6050:22, 32

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x06 (6$_{dec}$)
1C12:01	SubIndex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632$_{dec}$)
1C12:02	SubIndex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1602 (5634$_{dec}$)
1C12:03	SubIndex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1604 (5636$_{dec}$)
1C12:04	SubIndex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1606 (5638$_{dec}$)
1C12:05	SubIndex 005	5. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1607 (5639$_{dec}$)
1C12:06	SubIndex 006	6. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1609 (5641$_{dec}$)

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x04 (4_{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	0x1A03 (6659_{dec})
1C13:03	SubIndex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A06 (6662_{dec})
1C13:04	SubIndex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A08 (6664_{dec})
1C13:05	SubIndex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C32:06	SubIndex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:07	SubIndex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:08	SubIndex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:09	SubIndex 009	9. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:0A	SubIndex 010	10. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 2 event • 2: DC-Mode - Synchronous with SYNC0 Event • 3: DC-Mode - Synchronous with SYNC1 event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchron with SM 2 Event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchron with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 1C32:08)	UINT16	RO	0xC007 (49159_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x0003D090 (250000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03 [▶ 240], 0x1C33:06, 0x1C33:09 [▶ 240] are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 239]	UINT32	RW	0x000F4240 (1000000_{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 0x1C32:08 [▶ 239] or 0x1C33:08)	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 239]	UINT32	RO	0x0003D090 (250000_{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	as 1C32:08 [▶ 239]	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	as 0x1C32:11 [▶ 239]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 239]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 239]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 239]	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index distance of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0006 (6_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Max. Subindex	UINT8	RW	0x06 (6_{dec})
F010:01	SubIndex 001	Profile number of the encoder interface	UINT32	RW	0x000001FF (511_{dec})
F010:02	SubIndex 002	Profile number of the encoder interface	UINT32	RW	0x000001FF (511_{dec})
F010:03	SubIndex 003	Profile number of the DC motor interface	UINT32	RW	0x000002DD (733_{dec})
F010:04	SubIndex 004	Profile number of the DC motor interface	UINT32	RW	0x000002DD (733_{dec})
F010:05	SubIndex 005	Profile number of the positioning interface	UINT32	RW	0x000002C0 (704_{dec})
F010:06	SubIndex 006	Profile number of the positioning interface	UINT32	RW	0x000002C0 (704_{dec})

9 Appendix

9.1 EtherCAT AL Status Codes

For detailed information please refer to the EtherCAT system description.

9.2 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.

NOTE
Risk of damage to the device!
Pay attention to the instructions for firmware updates on the separate page [▶ 244]. 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!

EL7332			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
01	01	EL7332-0000-0016	2010/07
	02	EL7332-0000-0017	2011/04
	03		2011/08
02 - 14*	04	EL7332-0000-0018	2011/09
	05	EL7332-0000-0019	2011/12
	06	EL7332-0000-0020	2012/02
		EL7332-0000-0021	2012/09
		EL7332-0000-0022	2012/11
	07*	EL7332-0000-0023	2013/01
		EL7332-0000-0024	2016/06

EL7342			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Date of release**
00 - 01	01		2009/12
	02		2009/12
02 - 19*	03	EL7342-0000-0016	2010/07
	04	EL7342-0000-0017	2011/04
	05		2011/08
	06	EL7342-0000-0018	2012/02
		EL7342-0000-0019	2012/07
	07	EL7342-0000-0020	2015/05
		EL7342-0000-0021	2016/02
		EL7342-0000-0022	2017/12
	08	EL7342-0000-0023	2019/04
	09		2019/11
	10*	EL7342-0000-0024	2021/12

*) 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.

9.3 Firmware Update EL/ES/EM/ELM/EPxxxx

This section describes the device update for Beckhoff EtherCAT slaves from the EL/ES, ELM, EM, EK and EP series. A firmware update should only be carried out after consultation with Beckhoff support.

NOTE
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 https://www.beckhoff.com/en-us/.
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:

- 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.

- In addition, each EtherCAT slave has a memory chip, a so-called **ESI-EEPROM**, for storing its own device description (ESI: EtherCAT Slave Information). On power-up this description is loaded and the EtherCAT communication is set up accordingly. The device description is available from the download area of the Beckhoff website at (https://www.beckhoff.com). All ESI files are accessible there as zip files.

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

> **NOTE**
>
> **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.

9.3.1   Device description ESI file/XML

> **NOTE**
>
> **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:
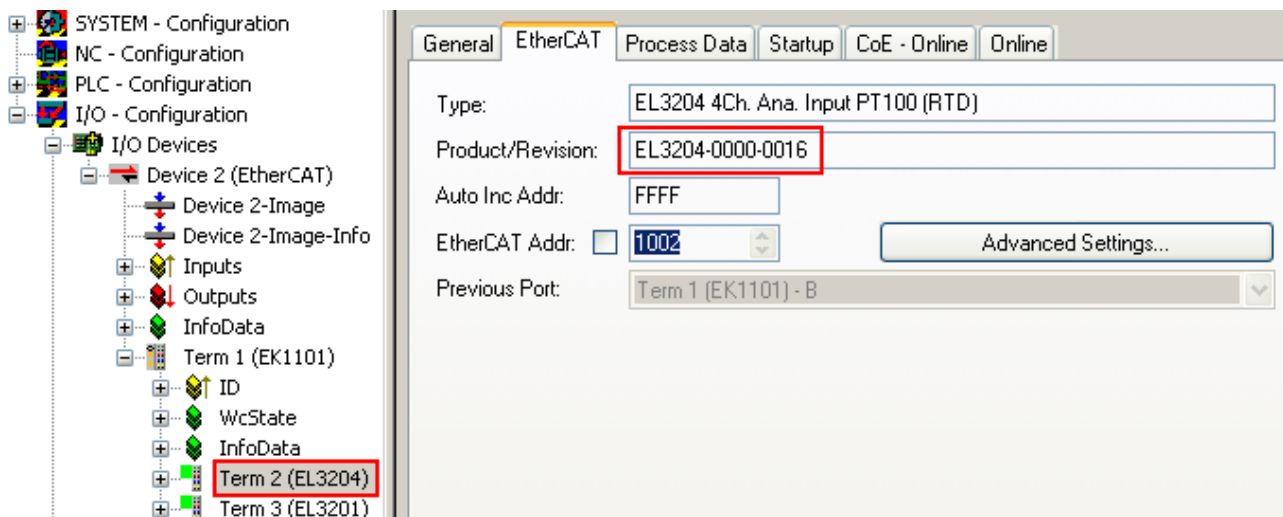
Fig. 187: Device identifier consisting of name EL3204-0000 and revision -0016

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**

ℹ 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:

BECKHOFF
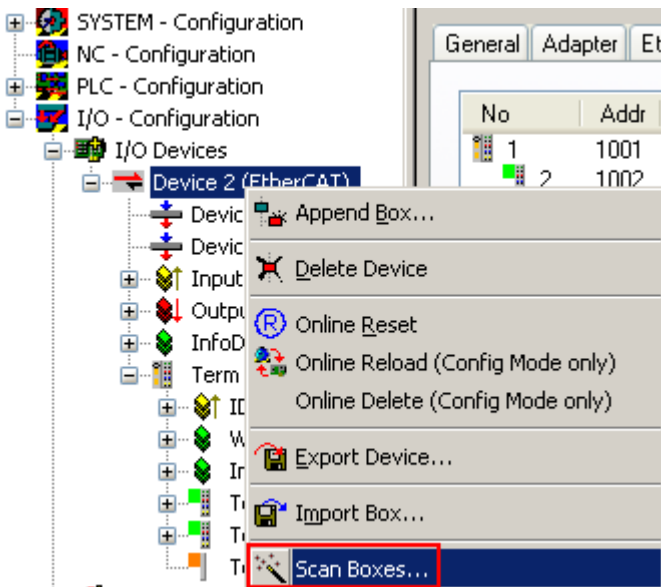
Fig. 188: Scan the subordinate field by right-clicking on the EtherCAT device

If the found field matches the configured field, the display shows

Fig. 189: Configuration is identical

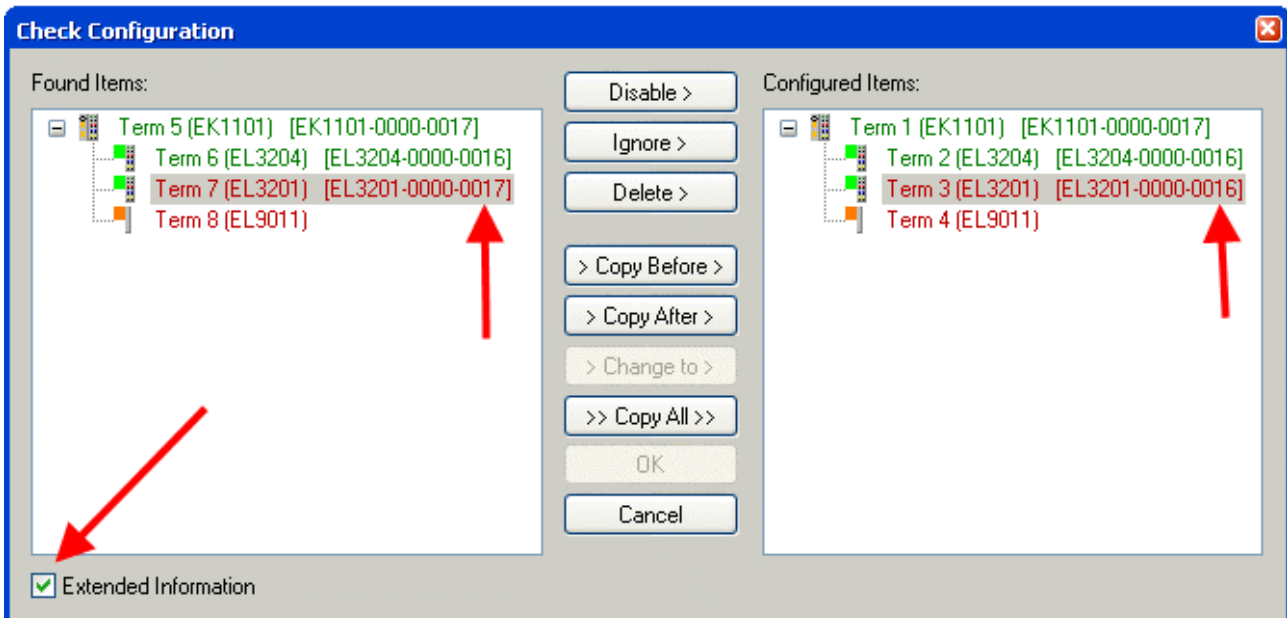otherwise a change dialog appears for entering the actual data in the configuration.

Fig. 190: 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*
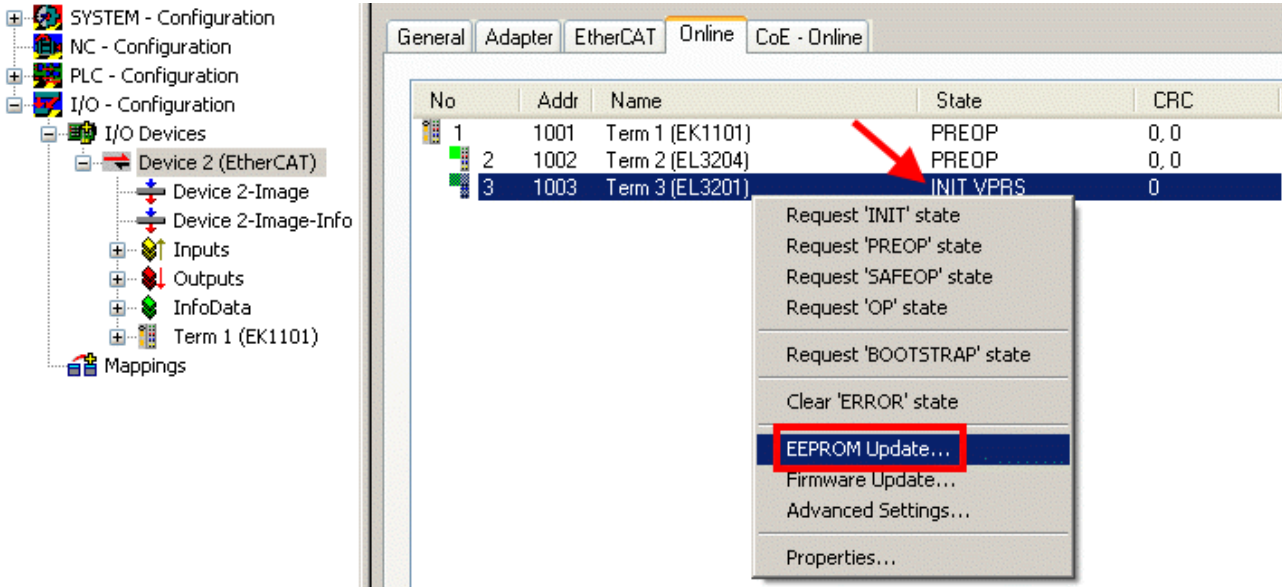
Fig. 191: EEPROM Update

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.
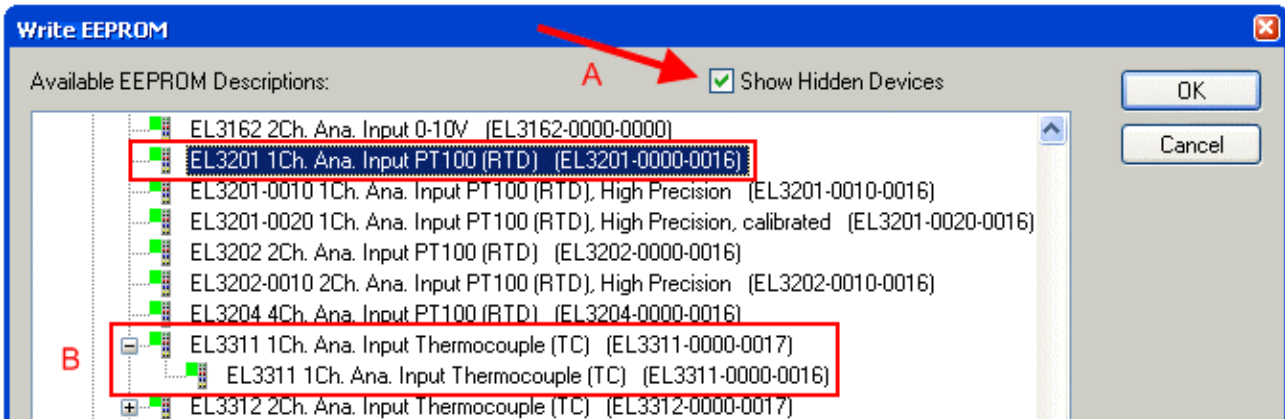
Fig. 192: Selecting the new ESI

A progress bar in the System Manager shows the progress. Data are first written, then verified.

● **The change only takes effect after a restart.**

ℹ 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.

BECKHOFF

9.3.2 Firmware explanation

Determining the firmware version

Determining the version via the 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.
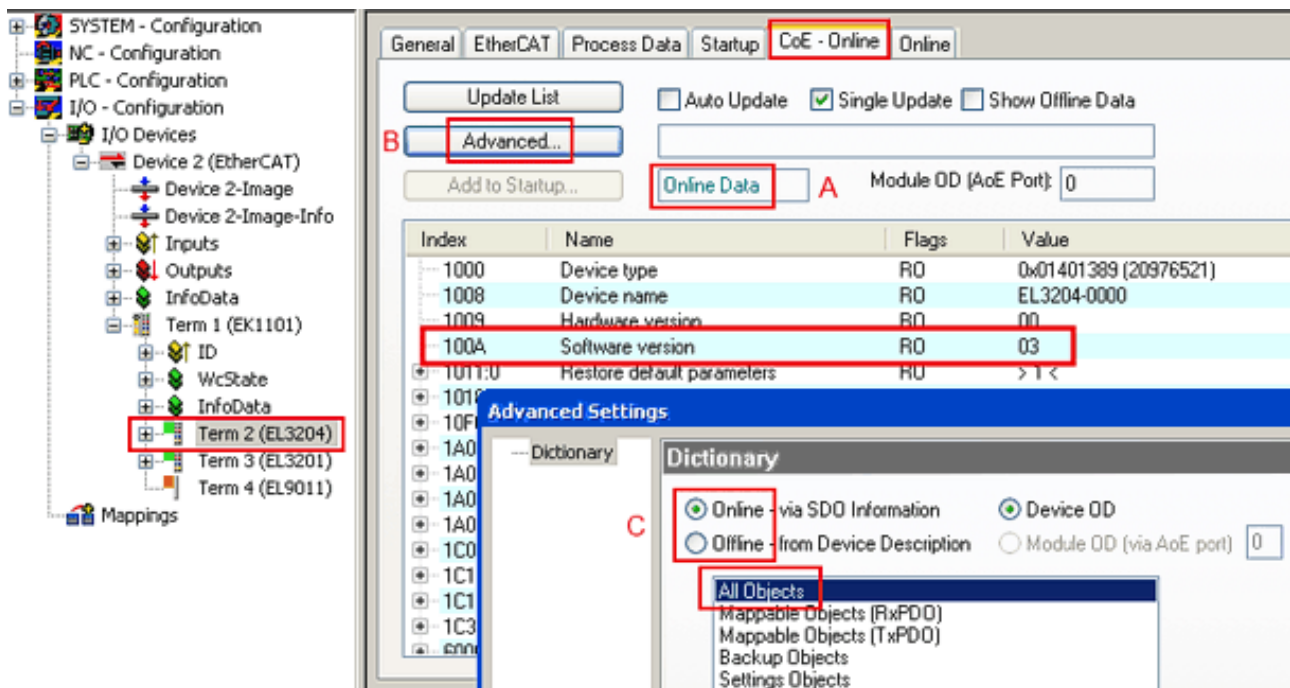
Fig. 193: Display of EL3204 firmware version

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*.

9.3.3 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.*
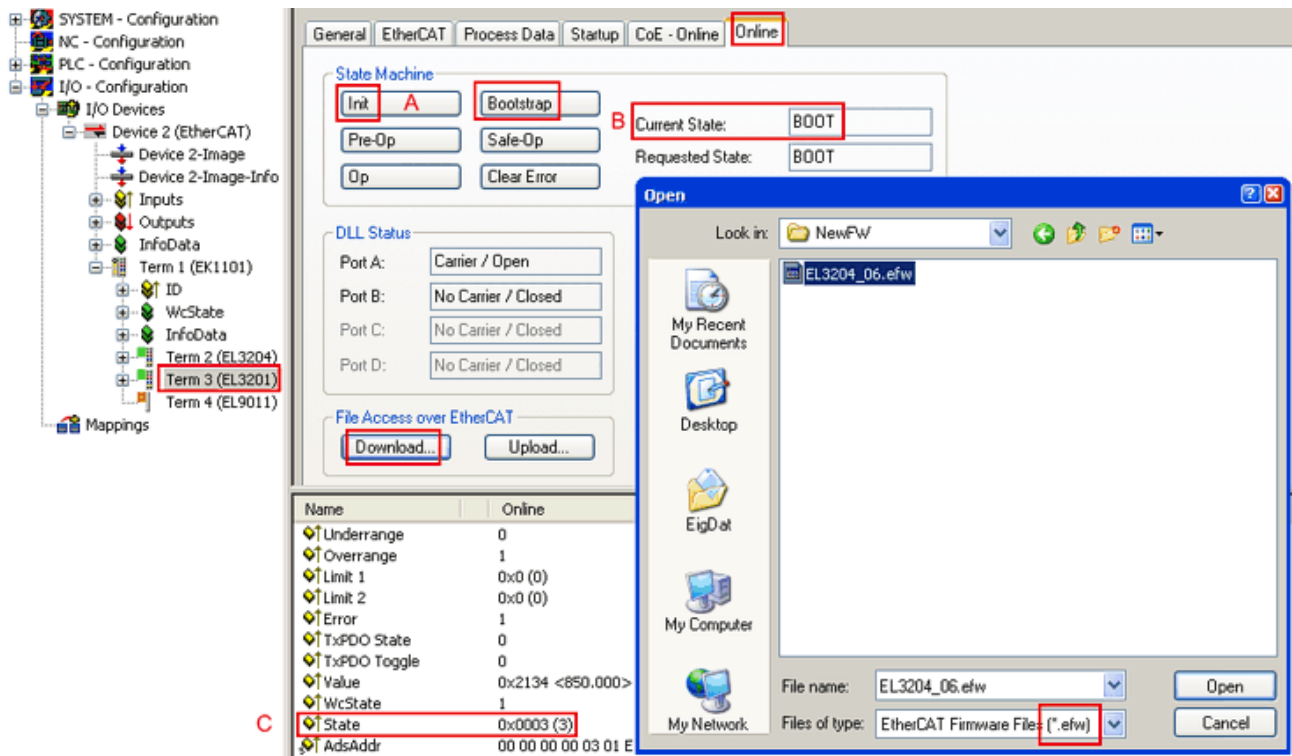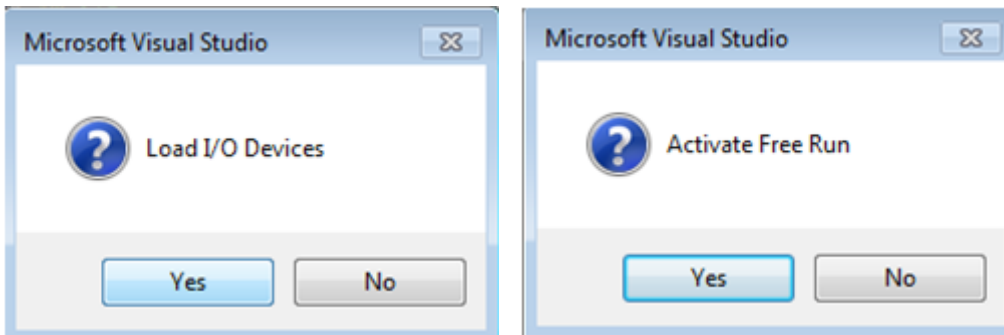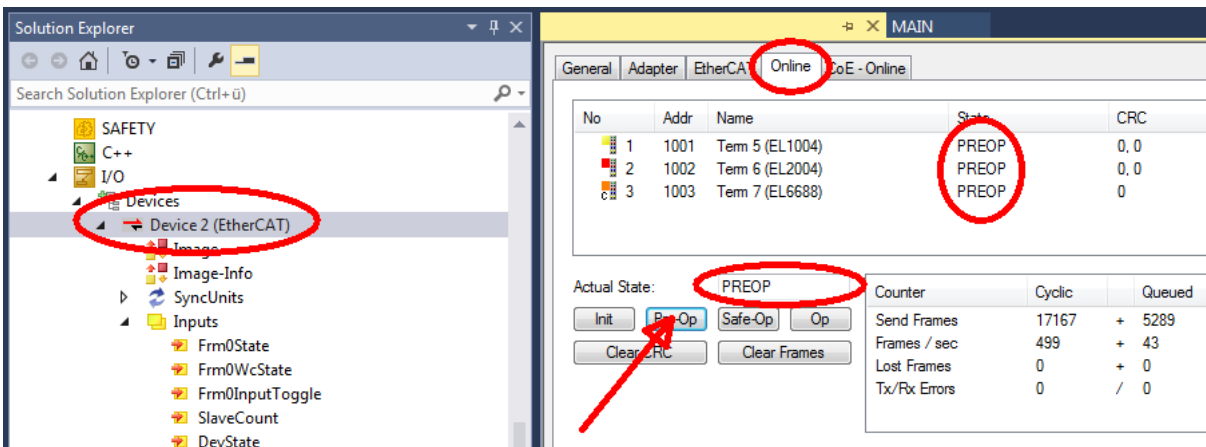
Fig. 194: Firmware Update

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 pass word will not be neccessary 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.

9.3.4   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 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.
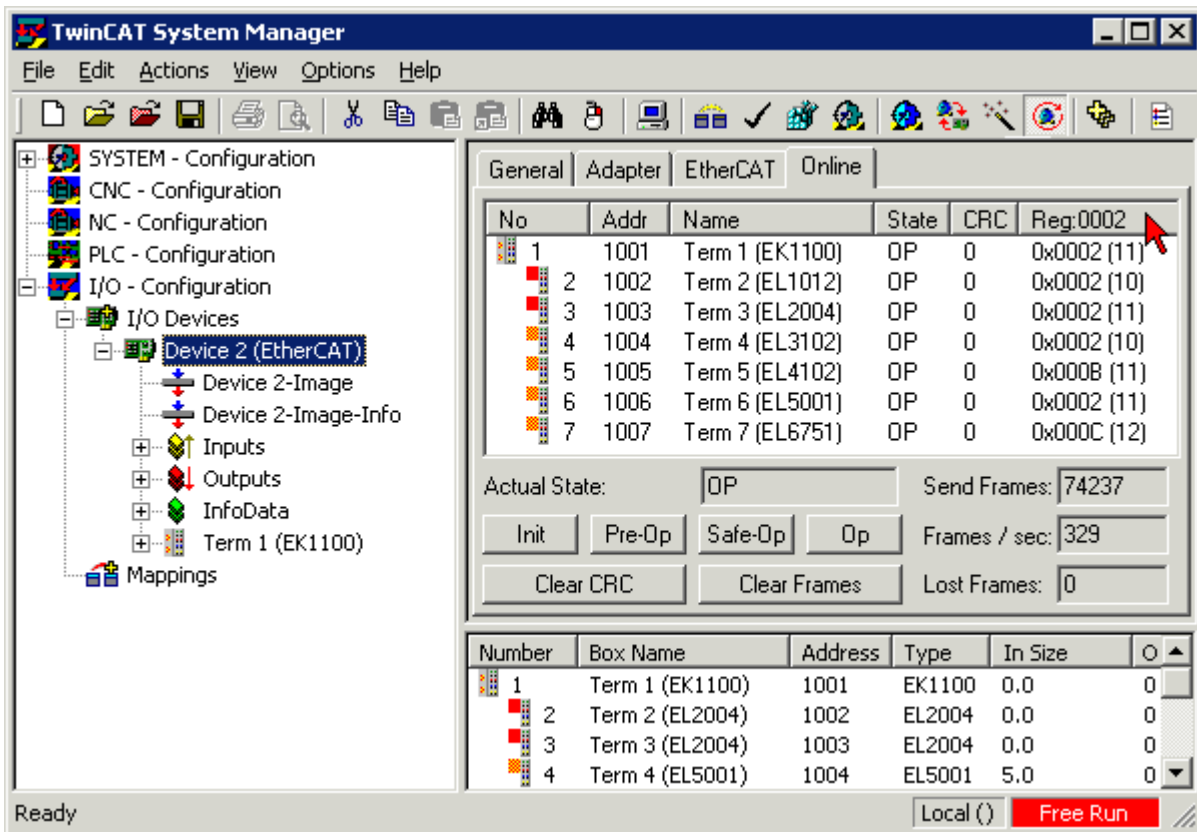
Fig. 195: FPGA firmware version definition

If the column *Reg:0002* is not displayed, right-click the table header and select *Properties* in the context menu.
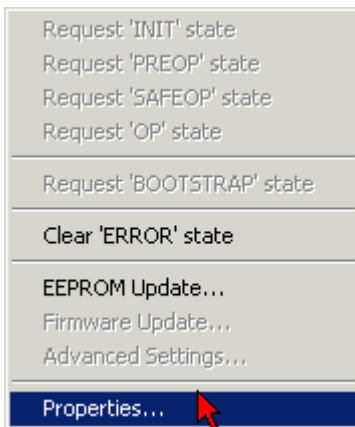

Fig. 196: Context menu *Properties*

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.
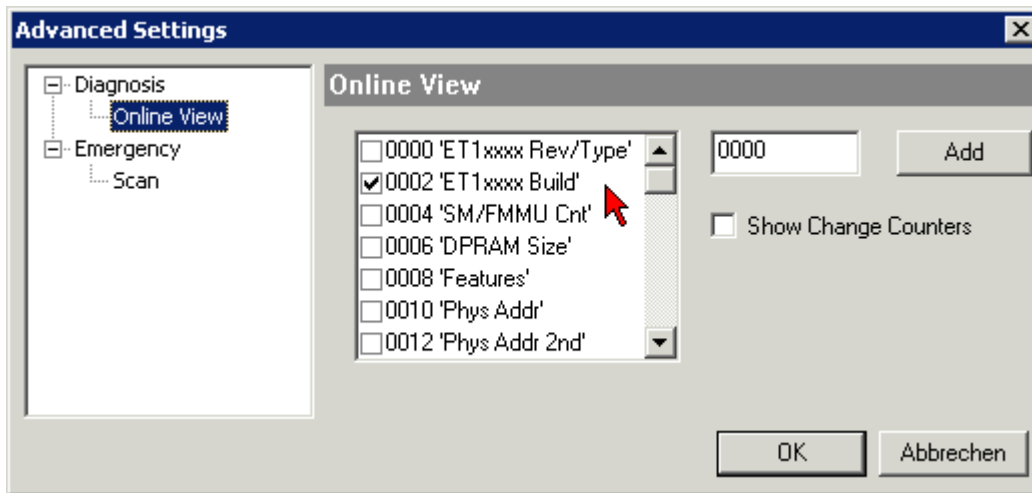
Fig. 197: Dialog *Advanced Settings*

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:
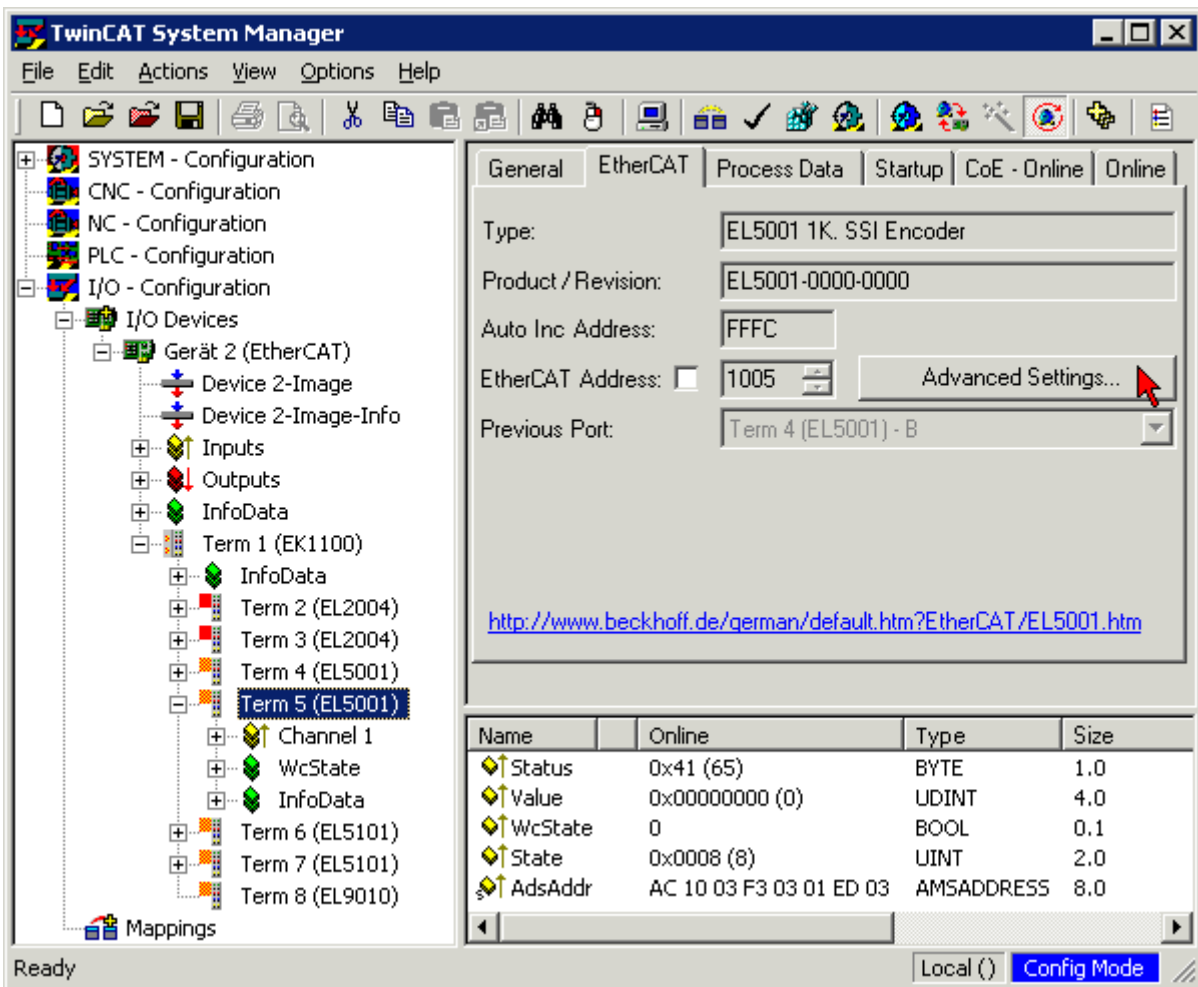
- The *Advanced Settings* dialog appears. Under *ESC Access/E²PROM*/FPGA click on *Write FPGA* button:
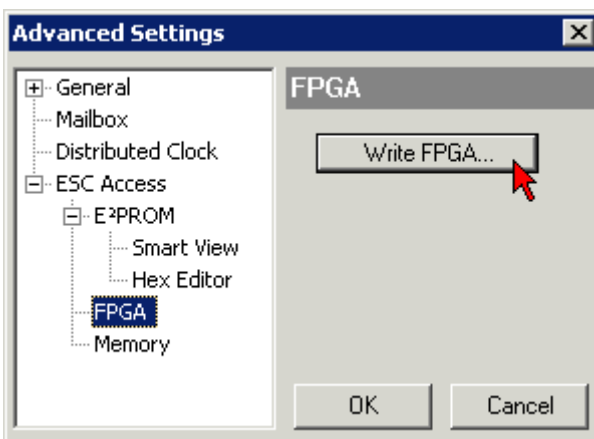
- Select the file (*.rbf) with the new FPGA firmware, and transfer it to the EtherCAT device:
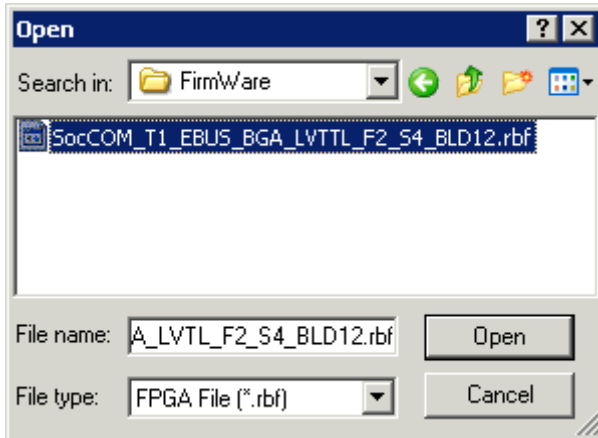
- Wait until download ends
- Switch slave current less for a short time (don't pull under voltage!). In order to activate the new FPGA firmware a restart (switching the power supply off and on again) of the EtherCAT device is required.
- Check the new FPGA status

NOTE
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!

9.3.5 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.
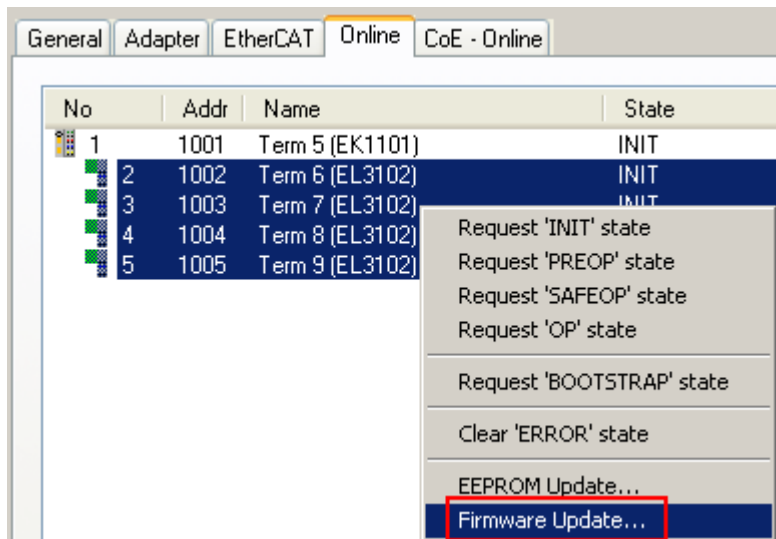

Fig. 198: Multiple selection and firmware update

Select the required slaves and carry out the firmware update in BOOTSTRAP mode as described above.

9.4   Restoring the delivery state

To restore the delivery state (factory settings) for backup objects in ELxxxx terminals, the CoE object Restore default parameters, *SubIndex 001* can be selected in the TwinCAT System Manager (Config mode) (see Fig. *Selecting the Restore default parameters PDO*)
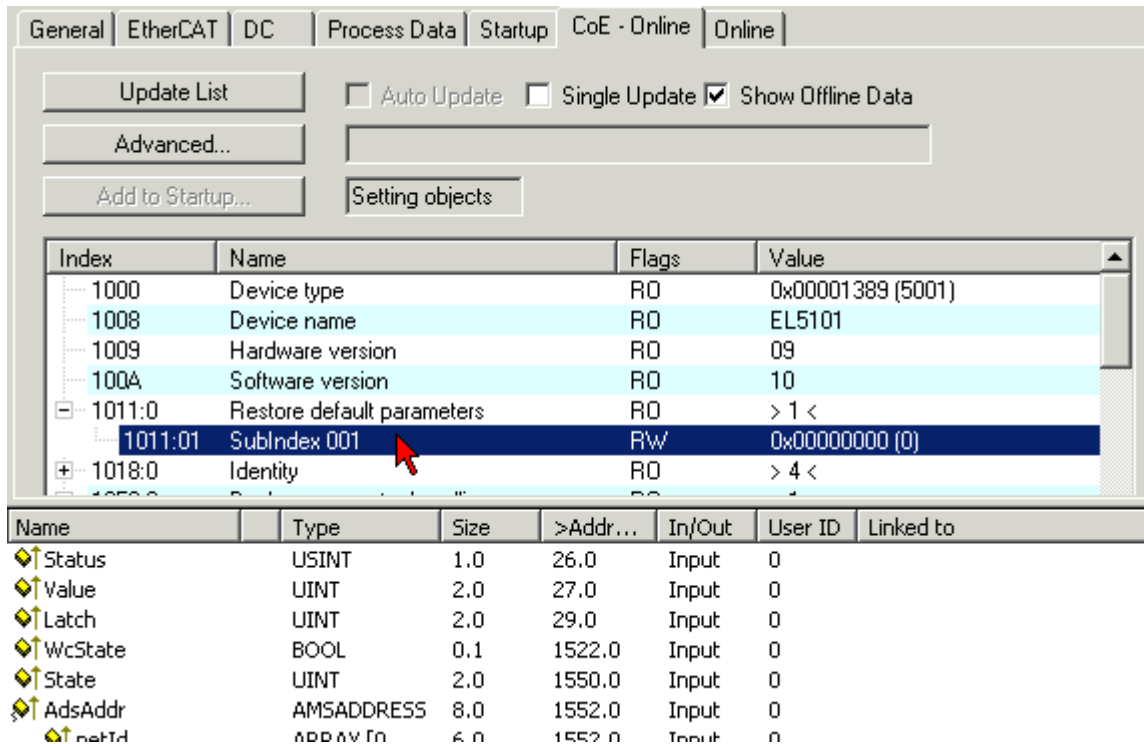

Fig. 199: Selecting the *Restore default parameters* PDO

Double-click on SubIndex 001 to enter the Set Value dialog. Enter the value **1684107116** in field *Dec* or the value **0x64616F6C** in field *Hex* and confirm with *OK* (Fig. *Entering a restore value in the Set Value dialog*). All backup objects are reset to the delivery state.
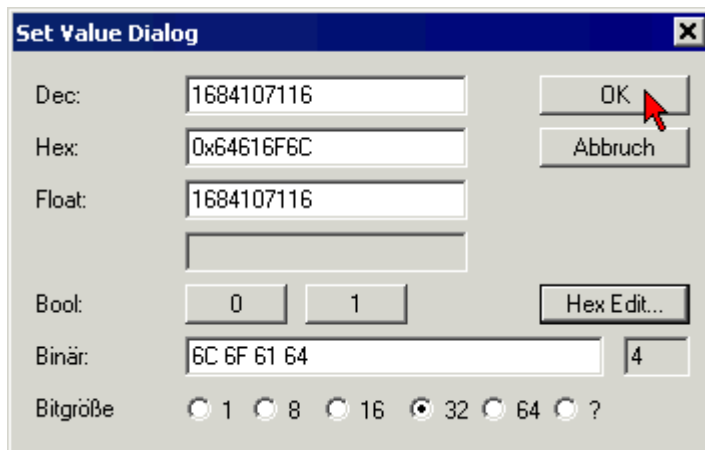

Fig. 200: Entering a restore value in the Set Value dialog

⊙ Alternative restore value

ℹ In some older terminals the backup objects can be switched with an alternative restore value: Decimal value: 1819238756, Hexadecimal value: 0x6C6F6164An incorrect entry for the restore value has no effect.

9.5 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!

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