BECKHOFF New Automation Technology

Documentation | EN

EL5101-00xx

EtherCAT Terminals, 1-channel encoder interface, incremental, 5 V DC



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Table of contents

1 Overview Incremental Encoder Interface 7

2 Foreword 8

2.1 Notes on the documentation 8
2.2 Guide through documentation 9
2.3 Safety instructions 10
2.4 Documentation issue status 11

3 EL5101 - Product description 12

3.1 Introduction 12
3.2 Technical data 14
3.3 Start 15

4 EL5101-0010 - Product description 16

4.1 Introduction 16
4.2 Technical data 17
4.3 Start 18

5 EL5101-0011 - Product description 19

5.1 Introduction 19
5.2 Technical data 20
5.3 Start 21

6 EL5101-0090 - Product description 22

6.1 Introduction 22
6.2 Technical data 24
6.3 Start 25

7 Overview EL5101-00xx series 26

8 Incremental encoder basics 27

9 Technical properties 28

9.1 EL5101 - Extended operating mode (from FW14/HW09) 29
9.2 Note on monitoring the process data 29
9.3 EtherCAT cycle time 29
9.4 Inputs 30
9.5 Signal types 32

10 Mounting and wiring 33

10.1 Notes on ESD protection 33
10.2 Mounting rail installation 34
10.3 Usage in potentially explosive areas (ATEX) 37
10.3.1 ATEX - Special conditions (extended temperature range) 37
10.3.2 IECEx - Special conditions 38
10.3.3 Continuative documentation for ATEX and IECEx 38
10.3.4 cFMus - Special conditions 39
10.3.5 Continuative documentation for cFMus 40
10.4 UL notice 41
10.5 Installation instructions for enhanced mechanical load capacity 42
10.6 Connection 43

10.6.1 Connection system ... 43
10.6.2 Wiring ... 45
10.6.3 Shielding ... 46
10.7 Note on power supply ... 46
10.8 Installation positions ... 47
10.9 Positioning of passive terminals ... 50
10.10 EL5101-00x0 - LEDs and Connection ... 51
10.11 EL5101-0011 - LEDs and Connection ... 53
10.12 Disposal ... 55

11 NC configuration ... 56

12 EL5101 - Commissioning ... 59
12.1 Normal operation mode ... 59
12.1.1 Operation modes ... 59
12.1.2 Process data ... 60
12.1.3 Features CoE ... 66
12.1.4 Object description and parameterization - normal operation mode ... 68
12.1.5 Control and status byte ... 74
12.1.6 Single-ended connection for TTL encoder ... 75
12.2 Enhanced operation mode ... 76
12.2.1 Operation modes ... 76
12.2.2 Process data ... 77
12.2.3 Features CoE ... 85
12.2.4 Object description and parameterization - enhanced operation mode ... 90
12.2.5 Single-ended connection for TTL encoder ... 104

13 EL5101-0010 - Commissioning ... 105
13.1 Enhanced operation mode ... 105
13.1.1 Operation modes ... 105
13.1.2 Process data ... 106
13.1.3 Features CoE ... 112
13.1.4 Object description and parameterization - enhanced operation mode ... 116

14 EL5101-0011 - Commissioning ... 128
14.1 Principles of the oversampling function ... 128
14.2 Process data and configuration ... 131
14.3 Object description and parameterization - enhanced operation mode ... 135
14.3.1 Restore object ... 135
14.3.2 Configuration data ... 135
14.3.3 Input data ... 136
14.3.4 Output data ... 136
14.3.5 Information / diagnostic data (channel specific) ... 136
14.3.6 Standard objects ... 137

15 EL5101-0090 - Commissioning ... 148
15.1 TwinSAFE SC ... 148
15.1.1 TwinSAFE SC - operating principle ... 148
15.1.2 TwinSAFE SC - configuration ... 148
15.1.3 TwinSAFE SC process data EL5101-0090 ... 152

15.2 Process data and operation modes ... 152
15.3 Object description and parameterization - normal operation mode ... 153
15.3.1 Restore object ... 153
15.3.2 Configuration data ... 154
15.3.3 Input data ... 154
15.3.4 Output data ... 155
15.3.5 Standard objects ... 155
15.4 Object description and parameterization - enhanced operation mode ... 159
15.4.1 Restore object ... 159
15.4.2 Configuration data ... 160
15.4.3 Input data ... 161
15.4.4 Output data ... 163
15.4.5 Information / diagnostic data (channel specific) ... 163
15.4.6 Standard objects ... 163
15.5 Objects TwinSAFE Single Channel (EL5101-0090) ... 173
16 Appendix ... 176
16.1 EtherCAT AL Status Codes ... 176
16.2 Firmware compatibility ... 176
16.3 Support and Service ... 178

1 Overview Incremental Encoder Interface

This documentation covers the following products:

EL5101 [▶ 12]	EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422, TTL), 1 MHz
EL5101-0010 [▶ 16]	EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422), 5 MHz
EL5101-0011 [▶ 19]	EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422), 5 MHz, oversampling
EL5101-0090 [▶ 22]	EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422, TTL), 1 MHz, TwinSAFE SC

Use the tabular product overview or the product finder to find the right product for your application (https://www.beckhoff.com/IO).

2 Foreword

2.1 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

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https://www.beckhoff.com/trademarks

2.2 Guide through documentation

NOTICE



Further components of documentation

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

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
Application guide TwinSAFE (PDF)	Examples for the calculation of safety parameters for safety functions
Explosion Protection for Terminal Systems (PDF)	Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx
Control Drawing I/O, CX, CPX (PDF)	Connection diagrams and Ex markings (conform to cFMus)
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

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

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

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

2.3 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Signal words

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

Personal injury warnings

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

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

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

Warning of damage to property or environment

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

Information on handling the product



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

2.4 Documentation issue status

From version 5.0	Comment
5.4.0	• Update chapter “Technical data” • Update chapter “Installation and wiring”
5.3.0	• Update chapter “Product description” • Update chapter “Installation positions” • Update revision status • Structural update
5.2.0	• Update chapter “Technical data” • Structural update
5.1	• EL5101, EL5101-0090: Update chapter “Technical data” • EL5101-0011: ◦ Update chapter “Basic oversampling function principles” ◦ Update chapter “Process data and configuration”
5.0	• Update chapter “Technical data” • Update revision status • Structural update
0.1–4.9.0	• Archived

3 EL5101 - Product description

3.1 Introduction

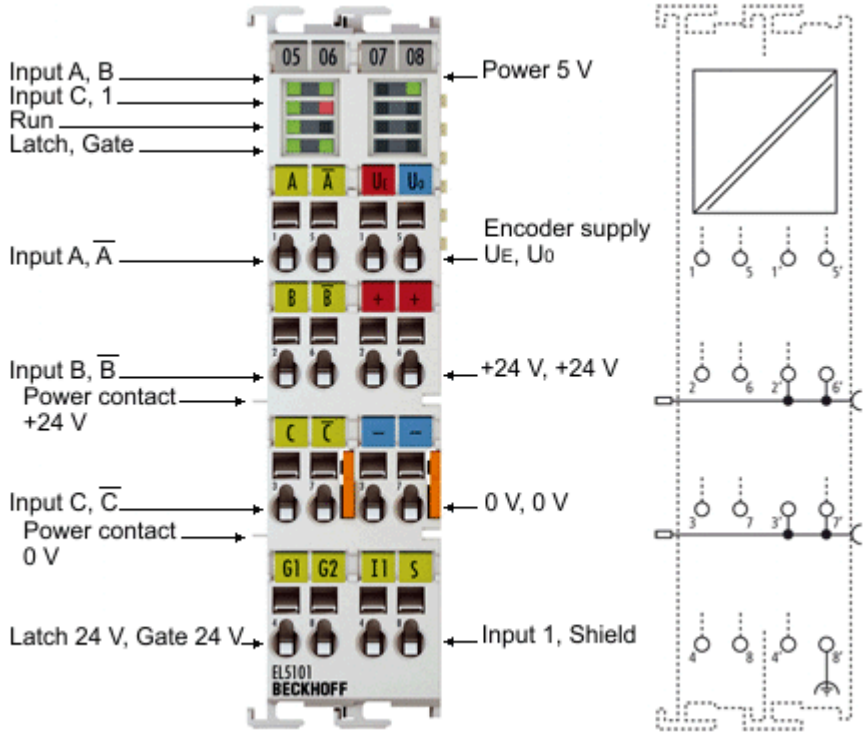


Fig. 1: EL5101

EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422, TTL), 1 MHz

The EL5101 EtherCAT Terminal is an interface for the direct connection of incremental encoders with differential inputs (RS422) or TTL single-ended signals. Input frequencies up to 1 MHz can be evaluated. It is possible to measure a period or frequency with a resolution of 100 ns. The EL5101 can also be used as bidirectional counter on channel A; channel B specifies the count direction.

Two additional 24 V digital inputs are available for saving, locking, and setting the counter value. The gate input allows the locking of the counter, alternatively with a high or low level. The latch input is similarly configurable and evaluates high or low levels.

The alarm output of an encoder can be connected to the negative-triggered status input. The encoders can be supplied with 5 V or 24 V directly via the connection points of the terminal.

In “normal operation mode,” a 16 bit counter and a 16 bit latch for a zero pulse can be read, set, or enabled.

The extended operating mode is available as a result of further development of the EL5101 starting with firmware 14 / hardware 09 [▶ 176]. This can be configured in the TwinCAT System Manager depending on the hardware available. Older EL5101 devices do not support this enhanced operation mode (see table)!

Operation modes of the EL5101	from FW/HW	ESI	Functional description
normal operation mode	03/05	from EL5101-0000-0000	all basic functions as described above
enhanced operation mode	14/09	from EL5101-0000-1018	changes to the normal operation mode • distributed clocks support • microincrements • wire break detection • connection of single-ended signals possible

In “extended operation mode,” a switchable 16/32 bit counter and a 32 bit latch for a zero pulse can be read, set, or enabled.

The EL5101 supports distributed clocks in the enhanced operation mode, i.e. the input data can be recorded synchronously with other data that are also linked to distributed clocks slaves. The accuracy across the system is < 100 ns.

The two operating modes are described separately in the chapter "EL5101 - Commissioning [▶ 59]". During commissioning, you must decide which operation mode to use.

Quick links

- EtherCAT system manual: Chapter on "Basic I/O Configuration"
- EtherCAT system manual, Chapter: "I/O Synchronization Using Distributed Clocks"
- "EL5101 – process data, modes, object description [▶ 59]"
- LEDs and connection [▶ 51]

3.2 Technical data

Encoder	EL5101
Technology	Incremental encoder interface, differential (RS422), single-ended (TTL*), counter, pulse generator
Additional inputs	Gate, latch (24 V DC, both max. 1 MHz permitted), Signal voltage: “0”: -3 V…+5 V (EN 61131-2, type 3) “1”: 11 V…30 V (EN 61131-2, type 3) Status input (max. 5 V DC, potential-free, switching to negative potential)
Encoder connection	A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs) also single-ended connection (5 V ±20%) possible from (hardware 09 [▶ 176])
Encoder operating voltage	5 V DC (-5% to +10%) (generated from the 24 V DC power contacts)
Sensor output current	0.5 A
Counter	16 bit, 16/32 bit switchable (from firmware 14 / hardware 09 [▶ 176])
Zero pulse latch	16 bit, 16/32 bit switchable (from firmware 14 / hardware 09 [▶ 176])
Limit frequency	1 MHz (equals 4 million increments with 4-fold evaluation)
Quadrature decoder	4-fold evaluation

Notice * Signal level see chapter „Signal types” [▶ 32]

Function and communication	EL5101
Distributed clocks	in the extended operation mode (starting with firmware 14 / hardware 09 [▶ 176])
Cycle time	min. 100 µs
Wire break detection to encoder	in the extended operation mode (starting with firmware 14 / hardware 09 [▶ 176])
Bit width in process image	up to 6 bytes outputs, 22 bytes inputs, depends on parameterization
Configuration	via TwinCAT System Manager (see the EtherCAT system manual, chapter “EtherCAT subscriber configuration”)
Special features	• wire break detection • latch and gate functions • period value and frequency measurement • microincrements • timestamping of edges • filter

Supply and potentials	EL5101
Current consumption from the E-bus	typ. 130 mA
Current consumption from the power contacts	0.1 A (excluding sensor load current)
Electrical isolation	500 V (E-bus/field voltage)

Environmental conditions	EL5101
Approved ambient temperature range during operation	-25°C…+60°C
Approved ambient temperature range during storage	-40°C…+85°C
Approved relative air humidity	95%, no condensation

General data	EL5101
Weight	approx. 100 g
Dimensions (W x H x D)	approx. 27 mm x 100 mm x 70 mm (width aligned: 24 mm)
Mounting [▶ 34]	on 35 mm mounting rail conforms to EN 60715
Installation position	variable

Standards and approvals	EL5101
Enhanced mechanical load capacity	yes, see also Installation instructions [▶ 42] for terminals with increased mechanical load capacity
Vibration/shock resistance	according to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Approvals/markings	CE, EAC, UKCA, CCC, cULus [▶ 41] ATEX [▶ 37], IECEx [▶ 38], cFMus [▶ 39]

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

Ex markings

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

3.3 Start

For commissioning:

- install the EL5101 as described in the chapter “Installation and wiring [▶ 33]”
- configure the EL5101 in TwinCAT as described in the chapters “NC configuration [▶ 56]” and “EL5101 – Commissioning [▶ 59]”.

4 EL5101-0010 - Product description

4.1 Introduction

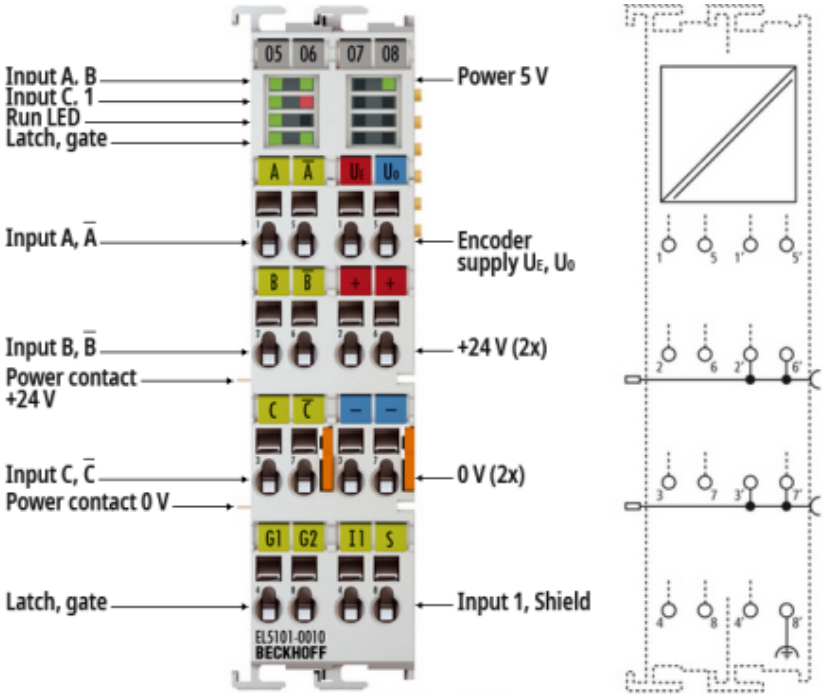


Fig. 2: EL5101-0010

EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422, TTL), 5 MHz

The EL5101-0010 EtherCAT Terminal is an interface for direct connection of incremental encoders with differential inputs (RS422). With a maximum input frequency of up to 5 MHz, it is particularly well-suited for dynamic applications.

The EL5101-0010, with a resolution of 20 million increments per second at 5 MHz and 4-fold evaluation, can only be used in extended operation mode. The microincrement mode is not available for the EL5101-0010.

A switchable 16/32 bit counter with a quadrature decoder and a 32 bit latch for the zero pulse can be read, set or enabled. A period measurement and frequency measurement with a resolution of 100 ns is possible.

Two additional 24 V digital inputs are available for saving, locking, and setting the counter value. The gate input allows the locking of the counter, alternatively with a high or low level. The latch input is similarly configurable and evaluates high or low levels.

The alarm output of an encoder can be connected and evaluated via the negative-triggered status input. The encoders can be supplied with 5 V or 24 V directly via the connection points of the terminal.

The EL5101-0010 supports distributed clocks, i.e. the input data can be synchronously acquired with other data that, similarly distributed, are connected to distributed clocks slaves. The accuracy across the system is < 100 ns.

In addition, a timestamp is available for the last registered incremental edge. The use of encoder profiles allows the process data to be linked to the motion control application quickly and easily.

Quick links

- "EL5101-0010 – process data, modes, object description [▶ 105]"
- LEDs and connection [▶ 51]
- EtherCAT system manual chapter:
  - "Basic I/O configuration"
  - "I/O synchronization via distributed clocks"

4.2 Technical data

Encoder	EL5101-0010
Technology	Incremental encoder interface, differential (RS422)
Additional inputs	gate, latch (24 V DC, both max. 1 MHz permitted), Signal voltage: “0”: -3 V…+5 V (EN 61131-2, type 3) “1”: 11 V…30 V (EN 61131-2, type 3) status input (max. 5 V DC, potential-free, switching to negative potential)
Encoder connection	A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs)
Encoder operating voltage	5 V DC (-5% to +10%) (generated from the 24 V DC power contacts)
Sensor output current	0.5 A
Counter	16 bit, 16/32 bit switchable
Zero pulse latch	16 bit, 16/32 bit switchable
Limit frequency	5 MHz (equals 20 million increments with 4-fold evaluation)
Quadrature decoder	4-fold evaluation

Function and communication	EL5101-0010
Distributed clocks	yes
Cycle time	min. 100 µs
Wire break detection to encoder	yes
Bit width in process image	up to 6 bytes outputs, 22 bytes inputs, depends on parameterization
Configuration	via TwinCAT System Manager (see the EtherCAT system manual, chapter “EtherCAT subscriber configuration”)
Special features	• wire break detection • latch and gate functions • period value and frequency measurement • timestamping of edges • filter • no single-ended operation

Supply and potentials	EL5101-0010
Current consumption from the E-bus	typ. 130 mA
Current consumption from the power contacts	0.1 A (excluding sensor load current)
Electrical isolation	500 V (E-bus/field voltage)

Environmental conditions	EL5101-0010
Approved ambient temperature range during operation	-25°C…+60°C
Approved ambient temperature range during storage	-40°C…+85°C
Approved relative air humidity	95%, no condensation

General data	EL5101-0010
Weight	approx. 100 g
Dimensions (W x H x D)	approx. 27 mm x 100 mm x 70 mm (width aligned: 24 mm)
Mounting [▶ 34]	on 35 mm mounting rail conforms to EN 60715
Installation position	variable

Standards and approvals	EL5101-0010
Enhanced mechanical load capacity	yes, see also Installation instructions [▶ 42] for terminals with increased mechanical load capacity
Vibration/shock resistance	according to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Approvals/markings*	CE, EAC, UKCA, CCC, cULus [▶ 41] ATEX [▶ 37], IECEx [▶ 38], cFMus [▶ 39]

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

Ex markings

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

4.3 Start

For commissioning:

- install the EL5101-0010 as described in the chapter “Installation and wiring [▶ 33]”
- configure the EL5101-0010 in TwinCAT as described in the chapters “NC configuration [▶ 56]” and “EL5101-0010 – Commissioning [▶ 105]”.

5 EL5101-0011 - Product description

5.1 Introduction

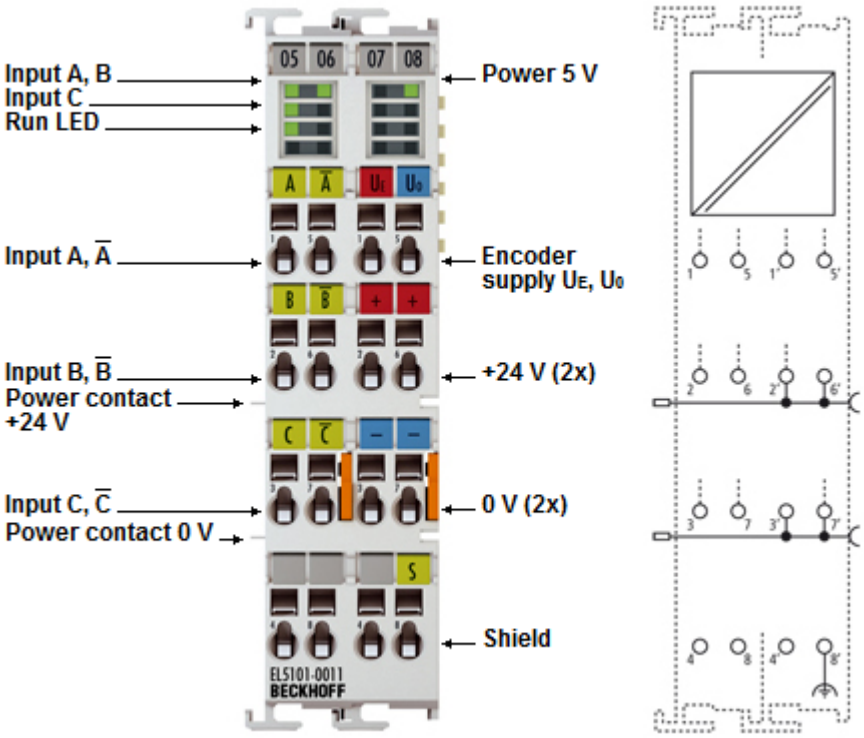


Fig. 3: EL5101-0011

EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422), 5 MHz, oversampling

The EL5101-0011 EtherCAT Terminal is an interface for direct connection of incremental encoders with differential inputs (RS422). A 32 bit counter with quadrature decoder can be read and set.

The EL5101-0011 supports the oversampling principle. Using this method the resolution of the position value can be increased to n times the bus cycle time. The current counter value is thereby read at several configurable and equidistant times between two fieldbus communication cycles with an adjustable whole number multiple (oversampling factor: n) of the bus cycle time. The transfer of a packet of n position values of 32 bits each to the higher-level controller takes place in the next fieldbus communication cycle. The minimum sampling time is 10 µs (maximum sampling frequency 100 ksps). Areas of application of the EL5101-0011 lie in particular in the area of high-resolution position detection.

The EL5101-0011 supports distributed clocks, i.e. the input data can be synchronously acquired with other data that, similarly distributed, are connected to distributed clocks slaves. The system accuracy is < 100 ns.

Quick links

- "EL5101-0011 – process data, modes, object description [▶ 128]"
- LEDs and connection [▶ 53]
- EtherCAT system manual chapter:
  - "Basic I/O configuration"
  - "I/O synchronization via distributed clocks"

5.2 Technical data

Encoder	EL5101-0011
Technology	Incremental encoder interface, differential (RS422)
Additional inputs	-
Encoder connection	A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs)
Encoder operating voltage	5 V DC (-5% to +10%) (generated from the 24 V DC power contacts)
Sensor output current	0.5 A
Counter	32 bit
Zero pulse latch	-
Limit frequency	5 MHz (equals 20 million increments with 4-fold evaluation)
Quadrature decoder	4-fold evaluation

Function and communication	EL5101-0011
Distributed clocks	yes
Oversampling factor	n = 1…100 selectable
Cycle time	min. 500 µs
Conversion time	10 µs/100 ksps
Wire break detection to encoder	yes
Bit width in process image	up to 6 bytes outputs, 22 bytes inputs, depends on parameterization
Configuration	via TwinCAT System Manager (see the EtherCAT system manual, chapter “EtherCAT subscriber configuration”)
Special features	• oversampling • wire break detection • set counter

Supply and potentials	EL5101-0011
Current consumption from the E-bus	typ. 130 mA
Current consumption from the power contacts	0.1 A (excluding sensor load current)
Electrical isolation	500 V (E-bus/field voltage)

Environmental conditions	EL5101-0011
Approved ambient temperature range during operation	-25°C…+60°C
Approved ambient temperature range during storage	-40°C…+85°C
Approved relative air humidity	95%, no condensation

General data	EL5101-0011
Weight	approx. 100 g
Dimensions (W x H x D)	approx. 27 mm x 100 mm x 70 mm (width aligned: 24 mm)
Mounting [▶ 34]	on 35 mm mounting rail conforms to EN 60715
Installation position	variable

Standards and approvals	EL5101-0011
Enhanced mechanical load capacity	yes, see also Installation instructions [▶ 42] for terminals with increased mechanical load capacity
Vibration/shock resistance	according to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2/EN 61000-6-4
Protection rating	IP20
Approvals/markings*	CE, EAC, UKCA, CCC, cULus [▶ 41] ATEX [▶ 37], IECEx [▶ 38], cFMus [▶ 39]

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

Ex markings

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

5.3 Start

For commissioning:

- install the EL5101-0011 as described in the chapter “Installation and wiring [▶ 33]”
- configure the EL5101-0011 in TwinCAT as described in the chapters “NC configuration [▶ 56]” and “EL5101-0011 – Commissioning [▶ 128]”.

6 EL5101-0090 - Product description

6.1 Introduction

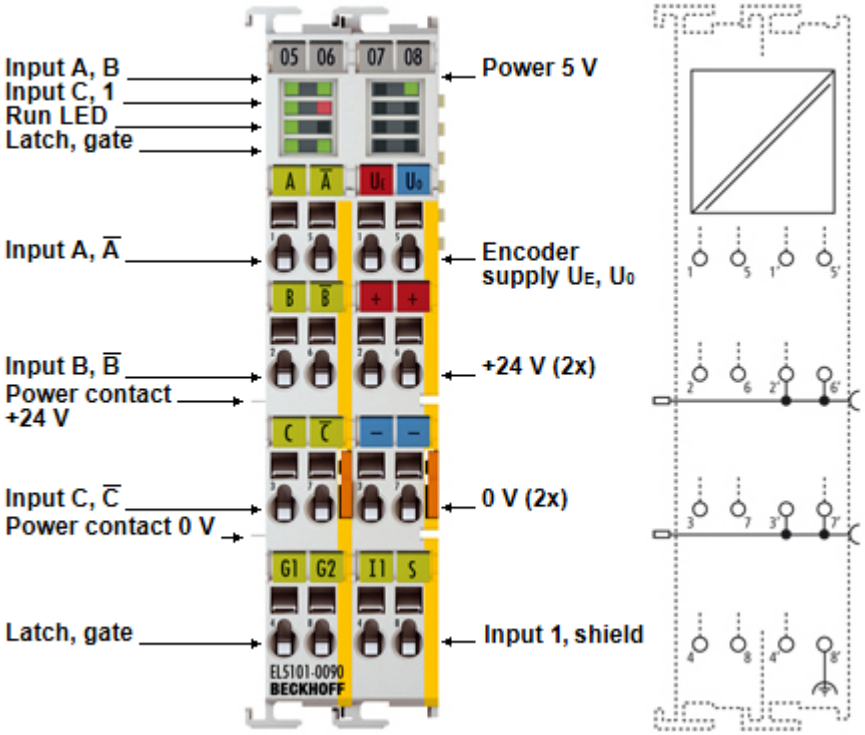


Fig. 4: EL5101-0090

EtherCAT Terminal, 1-channel encoder interface, incremental, 5 V DC (DIFF RS422, TTL), 1 MHz, TwinSAFE SC

The EL5101-0090 EtherCAT Terminal is an interface for the direct connection of incremental encoders with differential inputs (RS422) or TTL single-ended signals. Input frequencies up to 1 MHz can be evaluated. A period measurement and frequency measurement with a resolution of 100 ns is possible. The EL5101-0090 can also be used as bidirectional counter on channel A; channel B specifies the count direction.

Two additional 24 V digital inputs are available for saving, locking, and setting the counter value. The gate input allows the locking of the counter, alternatively with a high or low level. The latch input is similarly configurable and evaluates high or low levels.

The alarm output of an encoder can be connected and evaluated via the negative-triggered status input. The encoders can be supplied with 5 V or 24 V directly via the connection points of the terminal.

In “normal operation mode,” a 16 bit counter and a 16 bit latch for a zero pulse can be read, set, or enabled. In “extended operation mode,” a switchable 16/32 bit counter and a 32 bit latch can be read, set, or enabled for a zero pulse.

Different functions are available in the two operation modes (see the table below)

Operation modes of the EL5101-0090	Functional description
normal operation mode	all basic functions as described above
enhanced operation mode	changes to the normal operation mode • distributed clocks support • microincrements • wire break detection • connection of single-ended signals possible

The EL5101-0090 supports distributed clocks in the “enhanced operation mode”, i.e. the input data can be recorded synchronously with other data that are also linked to distributed clocks slaves. The accuracy across the system is < 100 ns.

The operating modes are described separately in the chapter “EL5101 - Commissioning [▶ 59]”. During commissioning, you must decide which operation mode to use.

In addition to the full functionality of the EL5101, the EL5101-0090 supports TwinSAFE SC (Single Channel) technology. This enables the use of standard signals for safety tasks in any networks or fieldbuses.

Quick links

- “EL5101 – process data, modes, object description [▶ 59]”
- “TwinSAFE SC [▶ 148]”
- “Objects TwinSAFE Single Channel (EL5101-0090) [▶ 173]”
- LEDs and connection [▶ 51]
- EtherCAT system manual chapter:
  - “Basic I/O configuration”
  - “I/O synchronization via distributed clocks”

6.2 Technical data

Encoder	EL5101-0090
Technology	Incremental encoder interface, differential (RS422), single-ended (TTL*), counter, pulse generator
Additional inputs	Gate, latch (24 V DC, both max. 1 MHz permitted), Signal voltage: “0”: -3 V…+5 V (EN 61131-2, type 3) “1”: 11 V…30 V (EN 61131-2, type 3) Status input (max. 5 V DC, potential-free, switching to negative potential)
Encoder connection	A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs) also single-ended connection (5 V ±20%) possible
Encoder operating voltage	5 V DC (-5% to +10%) (generated from the 24 V DC power contacts)
Sensor output current	0.5 A
Counter	16 bit, 16/32 bit switchable
Zero pulse latch	16 bit, 16/32 bit switchable
Limit frequency	1 MHz (equals 4 million increments with 4-fold evaluation)
Quadrature decoder	4-fold evaluation

Notice * Signal level see chapter „Signal types” [▶ 32]

Function and communication	EL5101-0090
Distributed clocks	yes
Cycle time	min. 100 µs
Wire break detection to encoder	yes
Bit width in process image	up to 6 bytes outputs, 22 bytes inputs, depends on parameterization
Configuration	via TwinCAT System Manager (see the EtherCAT system manual, chapter “EtherCAT subscriber configuration”)
Special features	• TwinSAFE SC • wire break detection • latch and gate functions • period value and frequency measurement • microincrements • timestamping of edges • filter

Supply and potentials	EL5101-0090
Current consumption from the E-bus	typ. 130 mA
Current consumption from the power contacts	0.1 A (excluding sensor load current)
Electrical isolation	500 V (E-bus/field voltage)

Environmental conditions	EL5101-0090
Approved ambient temperature range during operation	-25°C…+60°C
Approved ambient temperature range during storage	-40°C…+85°C
Approved relative air humidity	95%, no condensation

General data	EL5101-0090
MTBF (+55°C)	> 790,000 h
Weight	approx. 100 g
Dimensions (W x H x D)	approx. 27 mm x 100 mm x 70 mm (width aligned: 24 mm)
Mounting [▶ 34]	on 35 mm mounting rail conforms to EN 60715
Installation position	variable

Standards and approvals	EL5101-0090
Enhanced mechanical load capacity	yes, see also Installation instructions [▶ 42] for terminals with increased mechanical load capacity
Vibration/shock resistance	according to EN 60068-2-6/EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Protection rating	IP20
Approvals/markings*	CE, EAC, UKCA, CCC, cULus [▶ 41] ATEX [▶ 37], IECEx [▶ 38], cFMus [▶ 39]

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

Ex markings

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

6.3 Start

For commissioning:

- install the EL5101-0090 as described in the chapter “Installation and wiring [▶ 33]”
- configure the EL5101-0090 in TwinCAT as described in the chapters “NC configuration [▶ 56]” and “EL5101-0090 – Commissioning [▶ 148]”.

7 Overview EL5101-00xx series

Technical data	EL5101	EL5101-0090	EL5101-0010	EL5101-0011
Sensor connection	A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs) also single-ended connection (5 V ±20%) possible (EL5101 from hardware 09 [▶ 176])		A, ¬A, B, ¬B, C, ¬C (RS422 differential inputs)	
Additional inputs	gate, latch (24 V DC, both max. 1 MHz permitted), status input (max. 5 V DC, potential-free, switching to negative potential)			-
Encoder operating voltage / Encoder supply	5 V DC (-5% to +10%) (generated from the 24 V DC power contacts)			
Sensor output current	0.5 A			
Counter	16 bit, 16/32 bit switchable (EL5101 from firmware 14 / hardware 09 [▶ 176])			32 bit
Zero pulse latch	16 bit, 16/32 bit switchable (EL5101 from firmware 14 / hardware 09 [▶ 176])			-
Limit frequency	1 MHz (equals 4 million increments with 4-fold evaluation)		5 MHz (equals 20 million increments with 4-fold evaluation)	
Quadrature decoder	4-fold evaluation			
Distributed Clocks	in enhanced operating mode (from firmware 14 / hardware 09 [▶ 176])	yes		
Broken wire detection to sensor	in enhanced operating mode (from firmware 14 / hardware 09 [▶ 176])	yes		
Cycle time	min. 100 µs			min. 500 µs
Conversion time	-			10 µs / 100 kSps
Oversampling factor	-			n = 1..100, adjustable
MTBF (+55°C)	-	> 790,000 h	-	

Functions	EL5101	EL5101-0090	EL5101-0010	EL5101-0011
Gate- and Latch function	yes	yes	yes	no
Micro-increments	in enhanced operating mode (from firmware 14 / hardware 09 [▶ 176])	yes	no	no
Timestamp of edges	in enhanced operating mode (from firmware 14 / hardware 09 [▶ 176])	yes	yes	no
Period and Frequency measurement	yes	yes	yes	no
Up/down counter	yes	yes	no	no
Filter	yes	yes	yes	no
Oversampling	no	no	no	yes
TwinSAFE Single Channel	no	yes	no	no

8 Incremental encoder basics

Incremental encoders divide a 360° rotation of the encoder axis into individual steps (increments) and mark a full revolution by means of a special mark (zero pulse). An RS422 encoder transmits the signal symmetrically as a differential line pair. TTL encoders use single signal lines (single-ended).

The terminal evaluates the 90° phase-shifted square wave signals of an incremental encoder on tracks A and B. The zero pulse is captured on track C. With a differential connection, the inverted signals ($\overline{A}$, $\overline{B}$, $\overline{C}$) are also recorded.

These signals are converted by means of the quadrature decoder and counter into a position value with optional quadruple evaluation. The digital inputs enable latch, reset and set functionalities and thus exact and speed-independent referencing and storage of the counter value.

Encoder type		Incremental signals
RS422 encoder	with zero pulse	A, $\overline{A}$, B, $\overline{B}$, C, $\overline{C}$
RS422 encoder	without zero pulse	A, $\overline{A}$, B, $\overline{B}$
RS422 counter or pulse generator	with zero pulse	A, $\overline{A}$, C, $\overline{C}$; Counting direction specification via track B (B, $\overline{B}$)
RS422 counter or pulse generator	without zero pulse	A, $\overline{A}$; Counting direction specification via track B (B, $\overline{B}$)
TTL encoder	with zero pulse	A, B, C
TTL encoder	without zero pulse	A, B
TTL counter or pulse generator	with zero pulse	A, C; Counting direction specification via B
TTL counter or pulse generator	without zero pulse	A, Counting direction specification via B

The phase position between the signals on track A and track B determines the counting direction.
Forward (cw): Signal on track A leads track B by 90°
Reverse (ccw): Signal on track A lags track B by 90°.

With quadruple evaluation the rising and falling edges on track A and track B are counted.

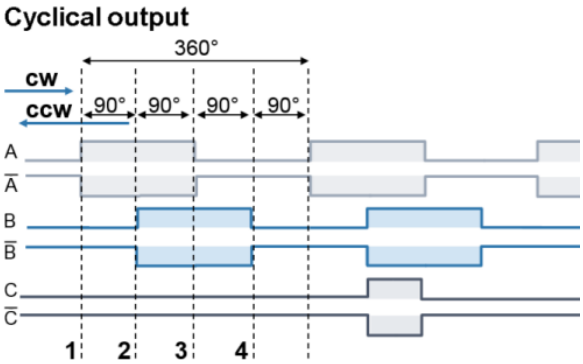


Fig. 5: Incremental signals

Absolute value encoders provide an absolute position value directly after switch-on, which is unambiguous over the entire travel path. With incremental encoders, homing must be performed after switch-on in order to be able to determine an unambiguous position.
Referencing can be carried out, for example, with the aid of referencing cams or using the zero pulse of the encoder.

NOTICE

Differential and single-ended connection

The RS422 signal transmits a differential voltage, which makes the signal less sensitive to interference compared to a single-ended signal.

- If the encoder signal is to be transmitted over longer distances or at higher frequencies, an encoder with RS422 signals is recommended.
- Shielded and twisted pair cables should be used.

9 Technical properties

The EL5101-00xx series incremental encoder interface terminals enable incremental encoders with A/B/C track to be connected to bus couplers or the PLC. The terminals are supplied as a 4-fold quadrature decoder with complementary evaluation of the sensor signals A, B, C. Differential signals according to RS422 (for EL5101 and EL5101-0090 also TTL) are intended as encoder connection.

In addition to the encoder inputs A, B, C, an additional latch input (24 V) and a gate input (24 V) for locking the counter during operation are available (not for EL5101-0011).

If the incremental encoder has an alarm output, it can be connected to the INPUT 1 status input of the EL5101-00x0.

EL5101

In “normal operation mode”, a 16 bit counter with a quadrature decoder and a 16 bit latch can be read, set, or enabled.
In “extended operation mode”, a switchable 16/32 bit counter and a 32 bit latch can be read, set, or enabled. The EL5101 features “extended operation mode” in addition to “normal operation mode” only starting with firmware 14/hardware 09. The differences are explained in the chapter “EL5101 – Enhanced operation mode as of FW14/HW09 [▶ 29]”.

Internal pull-up resistors also allow for 5 V single-ended signals (on the EL5101, starting with hardware version 09 [▶ 176]).

The terminal can optionally be operated as a bidirectional counter terminal on channel A.

EL5101-0010

The EL5101-0010, with a resolution of 20 million increments/s at 5 MHz and 4-fold evaluation, can only be used in “extended operation mode” and can process only differential signals according to RS422 at the encoder connection.

The microincrement mode is not available for the EL5101-0010.

EL5101-0011

The EL5101-0011, with a resolution of 20 million increments/s at 5 MHz and 4-fold evaluation, can only be used in “extended operation mode” and can process only differential signals according to RS422 at the encoder connection.

The microincrement mode is not available for the EL5101-0011.

The EL5101-0011 supports the oversampling principle.

The terminal does not have additional latch and gate inputs.

EL5101-0090

The EL5101-0090 offers the full range of functionalities of the EL5101.

In addition, the EL5101-0090 supports TwinSAFE SC technology.

9.1 EL5101 - Extended operating mode (from FW14/HW09)

Through the further development of the EL5101 an enhanced operating mode is available (from firmware 14 / hardware 09 [▶ 176]), which can be parameterized in the TwinCAT System Manager, depending on the hardware used.

Older EL5101 devices do not support this extended operating mode (see following Table)!

Operating modes EL5101			
Version	**From FW/HW**	**ESI**	**Functional description**
normal operating mode EL5101	03/05	from EL5101-0000-0000	All basic functions as described above
enhanced operating mode EL5101	14/09	from EL5101-0000-1018	Changes to the normal operating mode • Distributed clock support • Micro-increments • Broken wire detection • Connection of single ended signals possible

Compatibility in the case of service

- An EL5101 designed for and used in enhanced operating mode cannot be replaced with an EL5101 with older hardware version (< 09)!
- EL5101-0010 and EL5101-0011 only support the enhanced operating mode and are not exchange-compatible with an EL5101 (hardware version < 09)!

Irrespective of the hardware/firmware version, after integration into a system an EL5101 reports in normal operating mode.

During commissioning the user has to decide with what functionality, i.e. in what operating mode, the EL5101 is to be used. This depends on the required functions and, of course, the hardware version. Hardware older then firmware 14/hardware 09 [▶ 176], for example, will not support enhanced operating mode functions.

Combination of functions from different operating modes is not possible.

Specific settings are described in chapter “EL5101 - Commissioning [▶ 59]”.

9.2 Note on monitoring the process data

Process data monitoring

- **WcState**: if ≠ 0, this EtherCAT device does not take part in the process data traffic
- **State**: if ≠ 8, the EtherCAT device is not in OP (operational) status
- **TxPDO state, SyncError:** if ≠ 0, then no valid process data are available, e.g. caused by broken wire
- **TxPDO Toggle**: if this bit is toggling, a new set of process data is available

9.3 EtherCAT cycle time

- For the EL5101-00x0 a minimum EtherCAT cycle time of > 100 µs is recommended.
- For the EL5101-0011 a minimum EtherCAT cycle time of > 500 µs is recommended.

If a faster cycle time is used, the toggling process data “TxPDO Toggle” must be monitored to determine when new process data is delivered by the EL5101-00xx.

9.4 Inputs

EL5101-00xx input impedance

The signal source must be able to operate the input impedance of the EL5101-00xx (typically 220 Ω, subject to modification) with adequate voltage levels according to RS422.

NOTICE

Fast digital inputs – interference from interfering devices

Please note that the input wiring has very little filtering. It has been optimized for fast signal transmission from the input to the evaluation unit. In other words, rapid level changes/pulses in the µs range and/or high-frequency interference signals from devices (e.g. proportional valves, stepper motor or DC motor output stages) arrive at the evaluation unit almost unfiltered/unattenuated. These interferences can be incorrectly detected as a signal.

- To suppress interference, an additional input filter can be parameterized.
- Furthermore, EMC-compliant cabling and the use of separate power supply units for the terminal and the devices causing interference are recommended.

Gate and latch input (EL5101-00x0)

For gate and latch inputs (24 V) a max. input frequency of 1 MHz is permitted (Subject to modification).

Both inputs are type 3 inputs according to EN 61131-2, with a minimum pulse duration of t_{ON} > 1µs.

Digital input type 3, according to EN 61131-2	Voltage [V]	Input current [mA]
Signal voltage “0 – LOW”	-3 V...+5 V typ.	0 mA...2.6 mA typ.
Signal voltage “1 – HIGH”	11 V...30 V typ.	typ. 3 mA

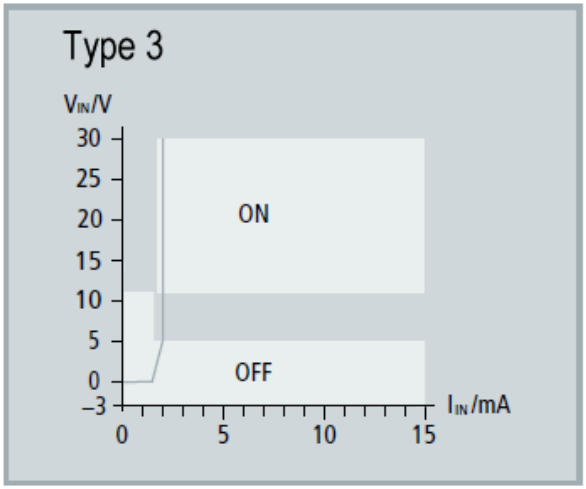


Fig. 6: Characteristic 24 V DC Input type 3

Status input (EL5101-00x0)

The terminal provides a Status Input. The alarm output or status output of an encoder can be connected to this input.

The input is 5 V compatible.

Digital input, 5 V TTL input characteristic	Voltage [V]	Input current [mA]
Signal voltage “0 – LOW”	0 V…+0.8 V	typ. < 1 mA
Signal voltage “1 – HIGH”	+2 V…+5 V	typ. 0 mA

NOTICE

Wiring of the Status Input

In the terminal the Status Input is internally connected to 5 V via a pull-up resistor.

The alarm output or status output of the encoder is usually designed with negative logic. This means that contacting against GND leads to an error bit and the LED display.

External power supply is not recommended. If an external supply is used, the maximum permitted voltage is 5 V against GND.

9.5 Signal types

Signal type RS422 (diff. input)

In differential mode the EL5101-00xx expects the signal levels after RS422. The data are transferred without ground reference as voltage difference between two cables (signal A and inverted signal /A). The terminal analyses differences greater than 200 mV as valid signals. The differential signal must be in the common mode range (<+13.2 V and >-10 V, with respect to GND) (cf. diagram). Signal levels outside this range can lead to destruction.

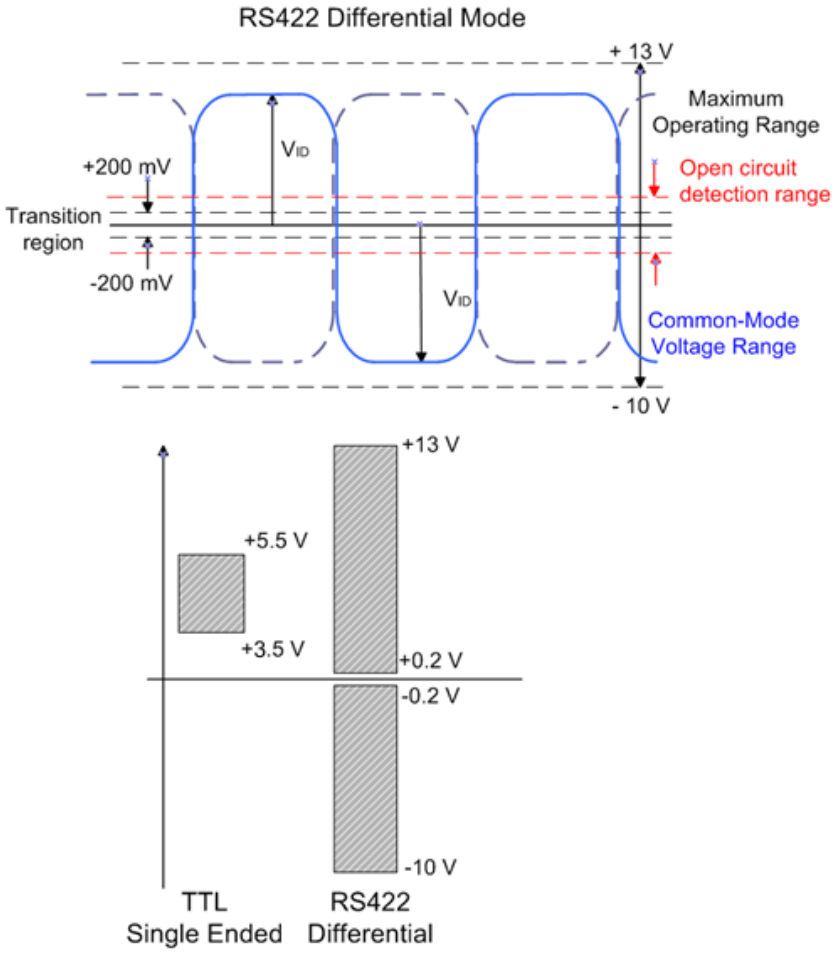


Fig. 7: Level interface

In differential mode only the voltage difference is evaluated, so that common-mode interference on the transmission link does not lead to corruption of the wanted signal, since any interference affects both cables simultaneously.

Signal type TTL (single ended)

If the EL5101 is only operated in single-ended mode, a nominal level voltage between 3.5 V and 5.5 V is expected.

The EL5101-0010 and EL5101-0011 do not support single-ended mode.

Open circuit detection

Open circuit detection (Index 0x80n0:0B, 0x80n0:0C, 0x80n0:0D) is activated:

- for EL5101-0010 and EL5101-0011, in the range -0.475 V > Vid > +0.475 V (typically),
- for EL5101 and EL5101-0090, in the range -1.5 V > Vid > +1.5 V (typically)

(subject to change).

10 Mounting and wiring

10.1 Notes on ESD protection

NOTICE

Devices can be destroyed by electrostatic charging!

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

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

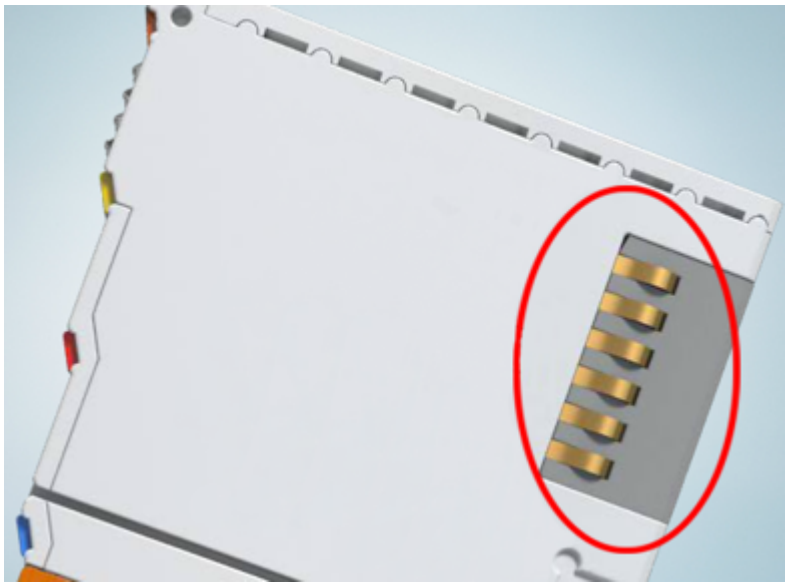


Fig. 8: Spring contacts of Beckhoff I/O components

10.2 Mounting rail installation

⚠ WARNING

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

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

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

Installation

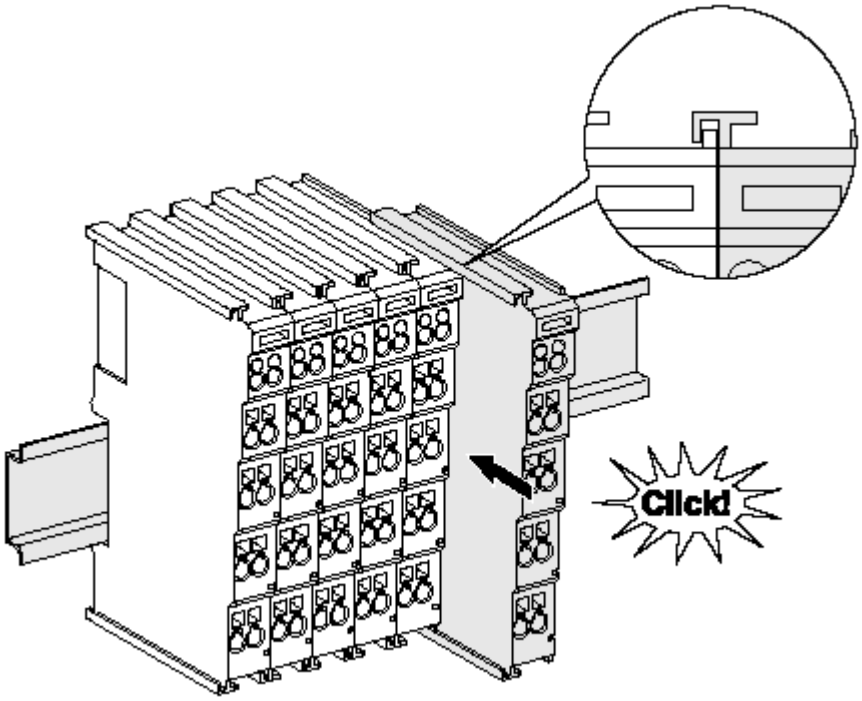


Fig. 9: Installation on the mounting rail

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

1. First attach the fieldbus coupler to the mounting rail.
2. The bus terminals are now attached on the right-hand side of the fieldbus coupler. To do this, connect the components with the slot and key and push the terminals against the mounting rail until the latch audibly engages on the mounting rail.
   If you snap the terminals onto the mounting rail first and then push them next to each other without the slot and key engaging, no functional connection will be established! When correctly assembled, no significant gap should be visible between the housing units.

Fastening the mounting rails

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

NOTICE

Earth the mounting rail!

Make sure the mounting rail is properly earthed.

Connections within a bus terminal block

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

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

Power contacts

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

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

Power contact ⏚

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

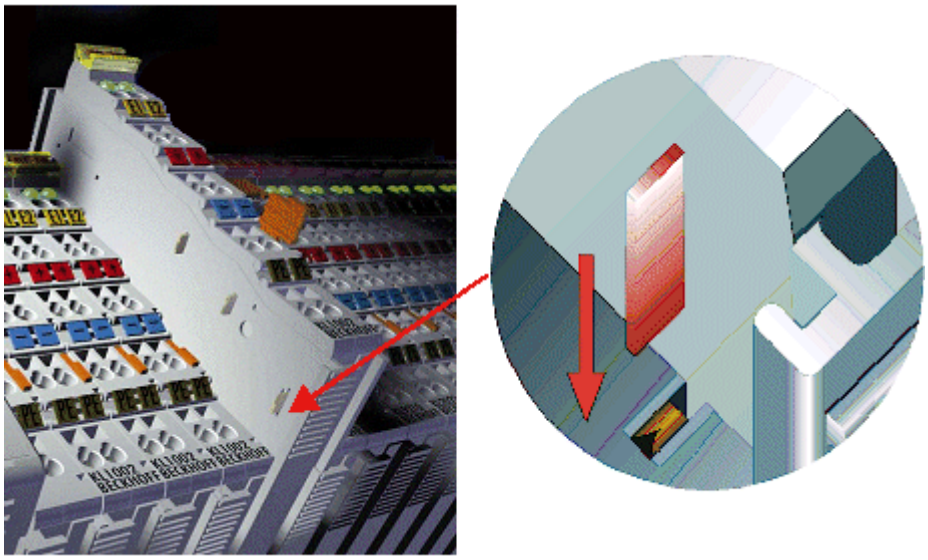


Fig. 10: Power contact on the left

⚠ WARNING

Risk of injury from electric shock!

The power contact marked ⏚ may not be used for other potentials!

NOTICE

Risk of damage to the device

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

Disassembly

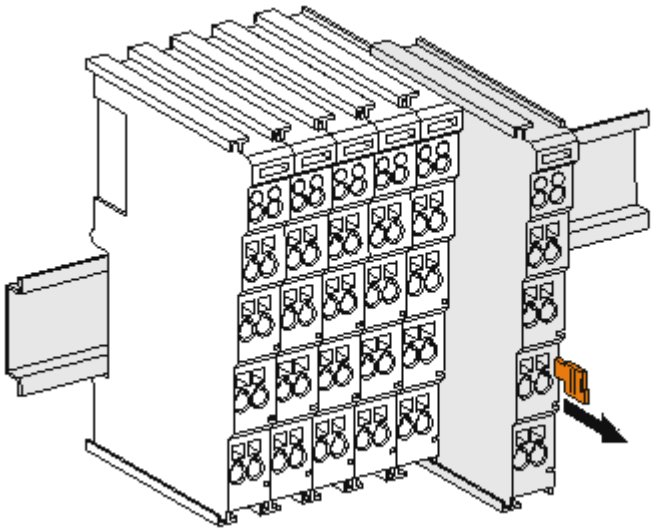


Fig. 11: Removal from mounting rail

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

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

10.3 Usage in potentially explosive areas (ATEX)

10.3.1 ATEX - Special conditions (extended temperature range)

⚠ WARNING

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

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

Standards

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

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

Marking

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



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

10.3.2 IECEx - Special conditions

⚠ WARNING

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

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

Standards

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

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

Marking

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

IECEx DEK 16.0078 X

Ex ec IIC T4 Gc

10.3.3 Continuative documentation for ATEX and IECEx

NOTICE



Continuative documentation about explosion protection according to ATEX and IECEx

Pay also attention to the continuative documentation

Ex. Protection for Terminal Systems
Notes on the use of the Beckhoff terminal systems in hazardous areas according to ATEX and IECEx,

that is available for download within the download area of your product on the Beckhoff homepage www.beckhoff.com!

10.3.4 cFMus - Special conditions

⚠ WARNING

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

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

Standards

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

M20US0111X (US):

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

FM20CA0053X (Canada):

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

Marking

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

FM20US0111X (US):	**Class I, Division 2, Groups A, B, C, D** **Class I, Zone 2, AEx ec IIC T4 Gc**
FM20CA0053X (Canada):	**Class I, Division 2, Groups A, B, C, D** **Ex ec T4 Gc**

10.3.5 Continuative documentation for cFMus

NOTICE	
	**Continuative documentation about explosion protection according to cFMus** Pay also attention to the continuative documentation **Control Drawing I/O, CX, CPX** Connection diagrams and Ex markings, that is available for download within the download area of your product on the Beckhoff homepage www.beckhoff.com!

10.4 UL notice

⚠ CAUTION	
c UL us	**Application** Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.

⚠ CAUTION	
c UL us	**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	
c UL us	**For devices with Ethernet connectors** Not for connection to telecommunication circuits.

Basic principles

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



10.5 Installation instructions for enhanced mechanical load capacity

⚠ WARNING

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

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

Additional checks

The terminals have undergone the following additional tests:

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

Additional installation instructions and notes

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

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

10.6 Connection

10.6.1 Connection system

⚠ WARNING

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

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

Overview

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

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

Standard wiring (ELxxxx / KLxxxx)



Fig. 12: Standard wiring

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

Pluggable wiring (ESxxxx / KSxxxx)

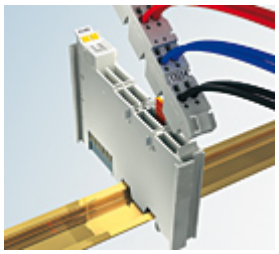


Fig. 13: Pluggable wiring

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

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

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

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

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

High Density Terminals (HD Terminals)



Fig. 14: High Density Terminals

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

Wiring HD Terminals

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

Ultrasonically compacted (ultrasonically welded) strands

Ultrasonically compacted (ultrasonically welded) strands

Ultrasonically compacted (ultrasonically welded) strands can also be connected to the standard and high-density terminals. In this case, please note the tables concerning the wire-size width [▶ 46]!

10.6.2 Wiring

⚠ WARNING

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

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

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

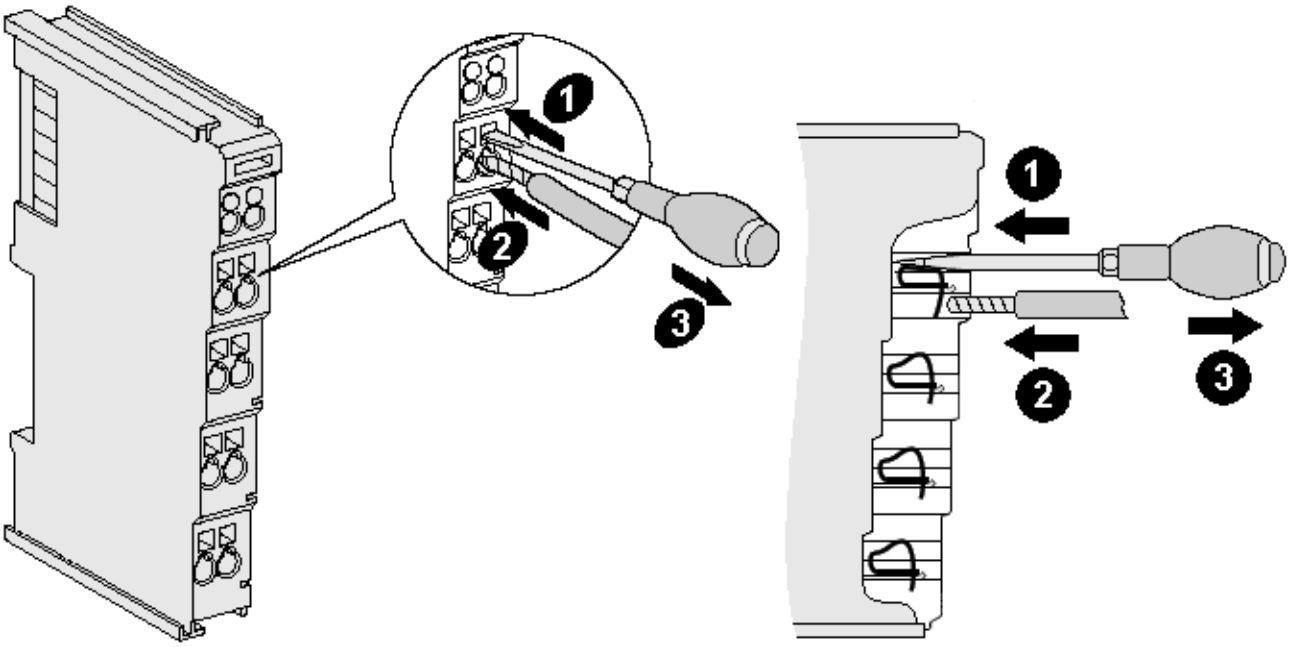


Fig. 15: Connecting a cable on a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the bus terminal. The terminal points are implemented in spring force technology. Connect the cables as follows (see fig. “Connecting a cable on a terminal point”:

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

See the following table for the suitable wire size width:

Terminal housing	ELxxxx, KLxxxx	ESxxxx, KSxxxx
Wire size width (single core wires)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (fine-wire conductors)	0.08 ... 2.5 mm²	0.08 ... 2.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 1.5 mm²	0.14 ... 1.5 mm²
Wire stripping length	8 ... 9 mm	9 ... 10 mm

High Density Terminals (HD Terminals [▶ 44]) with 16/32 terminal points

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

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm²
Wire size width (ultrasonically compacted [ultrasonically welded] strands)	only 1.5 mm² (see notice [▶ 44])
Wire stripping length	8 ... 9 mm

10.6.3 Shielding

Shielding

Encoders, analog sensors, and actuators should always be connected with shielded, pair-wise twisted cables.

10.7 Note on power supply

⚠ WARNING

Power supply from SELV / PELV power supply unit!

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

Notes:

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

10.8 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

- Please refer to the technical data of the device to ascertain whether any restrictions regarding the installation position and/or the operating temperature range have been specified.
- When installing devices with increased heat dissipation, ensure that there is sufficient space above and below the devices during operation to guarantee adequate ventilation!

The installation positions and their names for mounting devices on mounting rails are specified below. The illustration of the devices in the following figures is an example.
The following applies to all installation positions: the reference direction “down” (see arrow) is the direction of the earth's gravitational force.

Horizontal installation (standard installation)

The mounting rail is mounted horizontally on a vertical mounting plate.
The connection level of the devices points to the front.

The devices are ventilated from below, which enables optimum cooling of the electronics through convection. This is therefore also the recommended installation position.

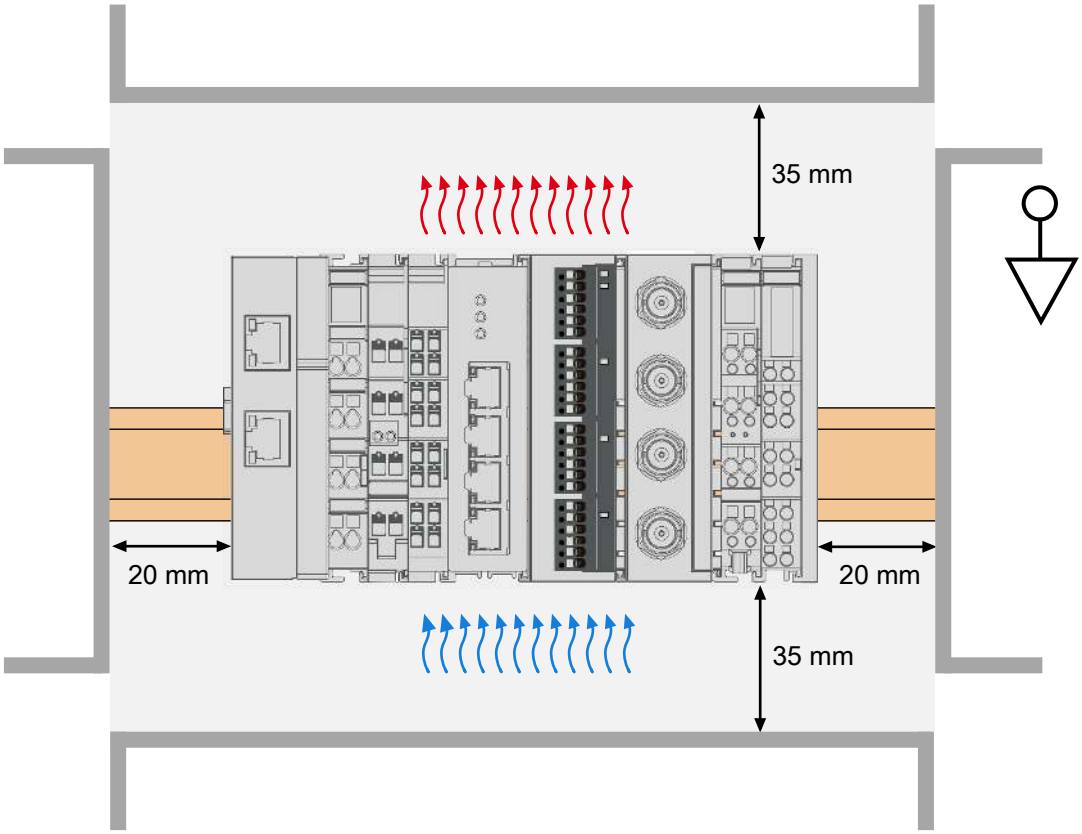


Fig. 16: Recommended minimum distances for standard installation position

NOTICE

Compliance with the minimum distances

Compliance with the minimum distances shown in the figure “Recommended minimum distances for standard installation position” is strongly recommended in all installation positions.

Vertical installation

The mounting rail is mounted vertically on a vertical mounting plate.
The connection level of the devices faces the front.
The devices can be arranged as follows:

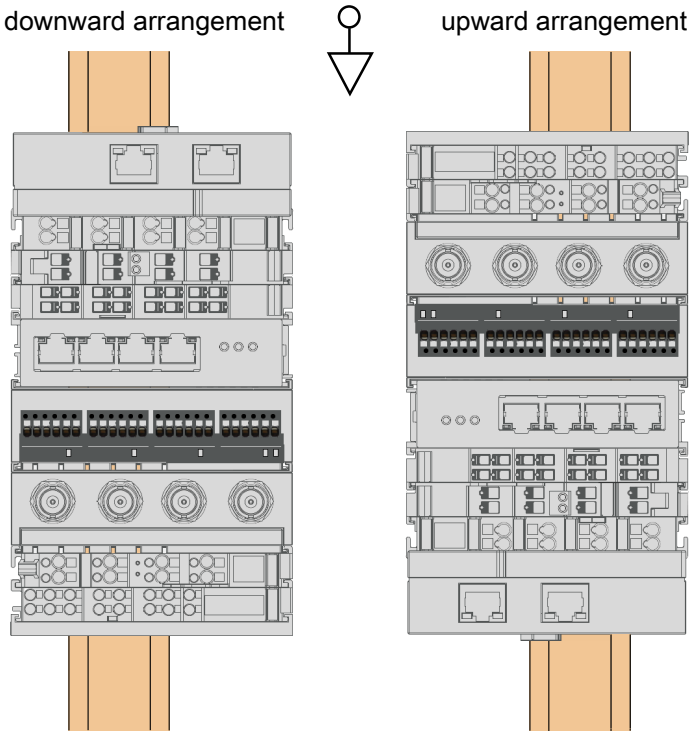


Fig. 17: Installation position: Vertical, downward arrangement (left)/upward arrangement (right)

Flat installation

The mounting rail is mounted on a horizontal mounting plate.
The connection level of the devices points upwards.

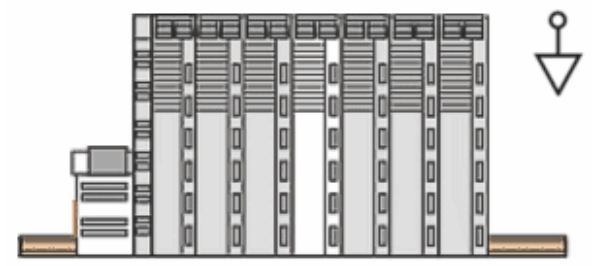


Fig. 18: Flat installation

NOTICE

Danger of sliding off the mounting rail

Particularly in the “vertical” installation position, but also in other installation positions under corresponding mechanical load, the terminal segment may move on the mounting rail. These can lead to undesirable malfunctions.

- If this risk exists, secure the terminal segment with appropriate locking devices, e.g. by clamping it to the mounting rail.

NOTICE

Compliance with the minimum distances

Compliance with the minimum distances shown in the figure “Recommended minimum distances for standard installation position” is strongly recommended in all installation positions.

Installation positions with ZB8610 fan cartridge

If the cooling should or must be increased for the intended application, the ZB8610 fan cartridge can be mounted on the underside of the device. In the horizontal installation position, the devices are ventilated from bottom to top by the fan cartridge. This optimum cooling is further enhanced by convection ventilation (see following figure).

The fan cartridge can be used in any installation position.

Further information on operation with and without a fan can be found in the technical data for the device (e.g. derating, information on installation positions, etc.).

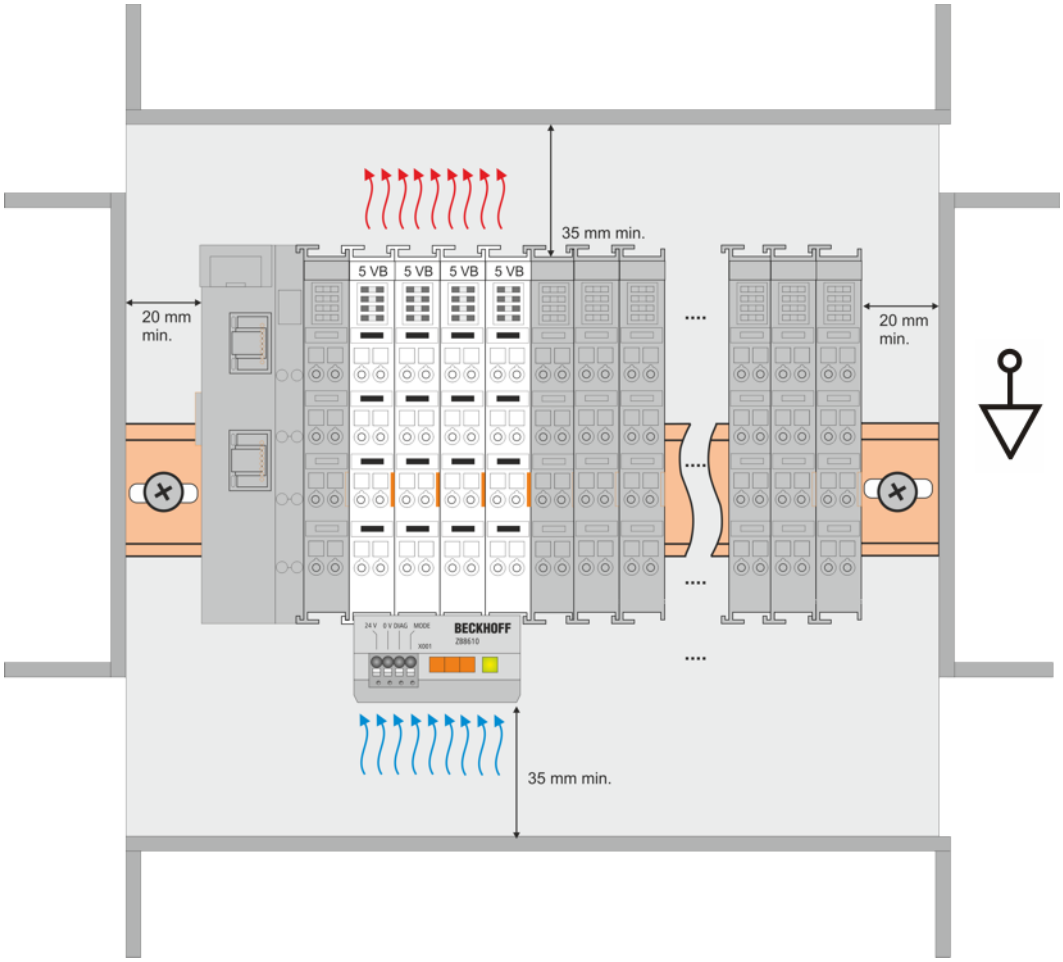


Fig. 19: Recommended minimum distances for operation with fan, using horizontal installation position as an example

NOTICE

Compliance with the minimum distances

Compliance with the minimum distances as shown in the figure “Recommended minimum distances for operation with fan” is strongly recommended.

10.9 Positioning of passive terminals

Note on the placement of passive terminals in the bus terminal block

EtherCAT Terminals that do not take part in active data exchange within the bus terminal block are referred to as passive terminals. These terminals can be recognized because they do not consume power from the E-bus. To ensure optimal data exchange, no more than two passive terminals may be connected directly to each other!

Examples of the placement of passive terminals (highlighted in light color)

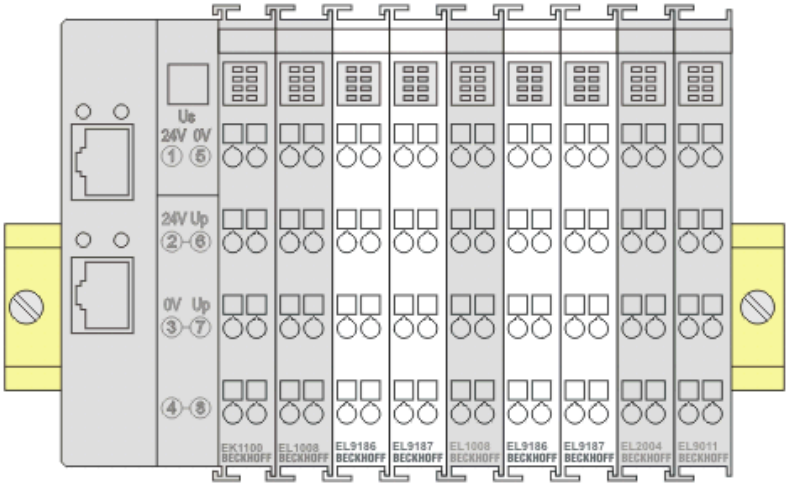


Fig. 20: Proper positioning

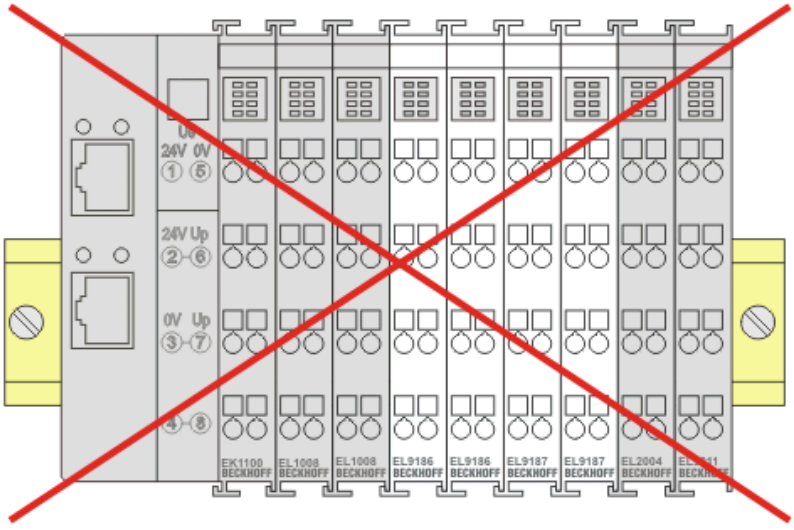


Fig. 21: Incorrect positioning

10.10 EL5101-00x0 - LEDs and Connection

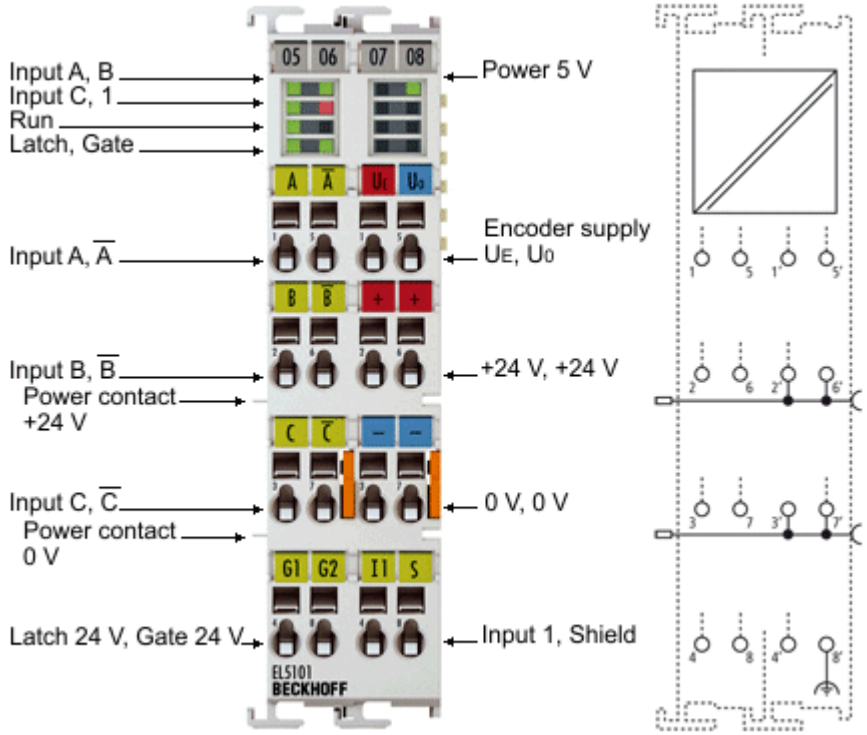


Fig. 22: EL5101

NOTICE

Encoder supply via the terminal

The encoder supply voltage, can be taken from the terminal points 1'(5 V) and 5`(0 V).

NOTICE

Single-ended connection for TTL encoder

For information on the single-ended connection for TTL encoders, please refer to chapter "Single-Ended Connection for TTL Encoders" ("Normal Operating Mode [▶ 75]" or "Enhanced Operating Mode [▶ 104]").

- No Single-ended connection is possible for the terminals EL5101-0010 and EL5101-0011.

Connection		
Terminal point	**No.**	**Comment**
A	1	Encoder input A
B	2	Encoder input B
C	3	Encoder input C
Latch 24 V	4	Latch input
¬A	5	Encoder input A
¬B	6	Encoder input B
¬C	7	Encoder input C
Gate 24 V	8	Gate input
Ue = +5 V	1'	+5 V encoder supply
+24 V	2'	+24 V (internally connected to terminal point 6' and positive power contact)
0 V	3'	0 V (internally connected to terminal point 7' and negative power contact)
Input 1	4'	Status input 1 Alarm input from rotary encoder. Internally connected to 5 V via pull-up resistor. Switching to negative potential, i.e. connection to GND leads to error bit and LED display. If externally supplied (not recommended) 5 V max. against GND is permitted.
Uo = 0 V	5'	0 V encoder supply
+24 V	6'	+24 V (internally connected to terminal point 2' and positive power contact)
0 V	7'	0 V (internally connected to terminal point 3' and negative power contact)
Shield	8'	Shield

LEDs

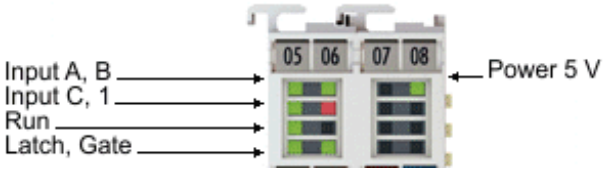


Fig. 23: EL5101-00x0 – LEDs

LED	Color	Meaning	
INPUT A, B, C	green	indicates TRUE level	
INPUT 1	red	lights up when the INPUT1 pin is pulled to GND [INPUT 1 is set to the internal 5 V high level by an internal pull-up (default)]	
LATCH	green	lights up if a signal (+24 V) is connected to the latch input	
GATE	green	lights up if a signal (+24 V) is connected to the gate input	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
POWER 5 V	green	Operating voltage display for incremental encoder power supply	

10.11 EL5101-0011 - LEDs and Connection

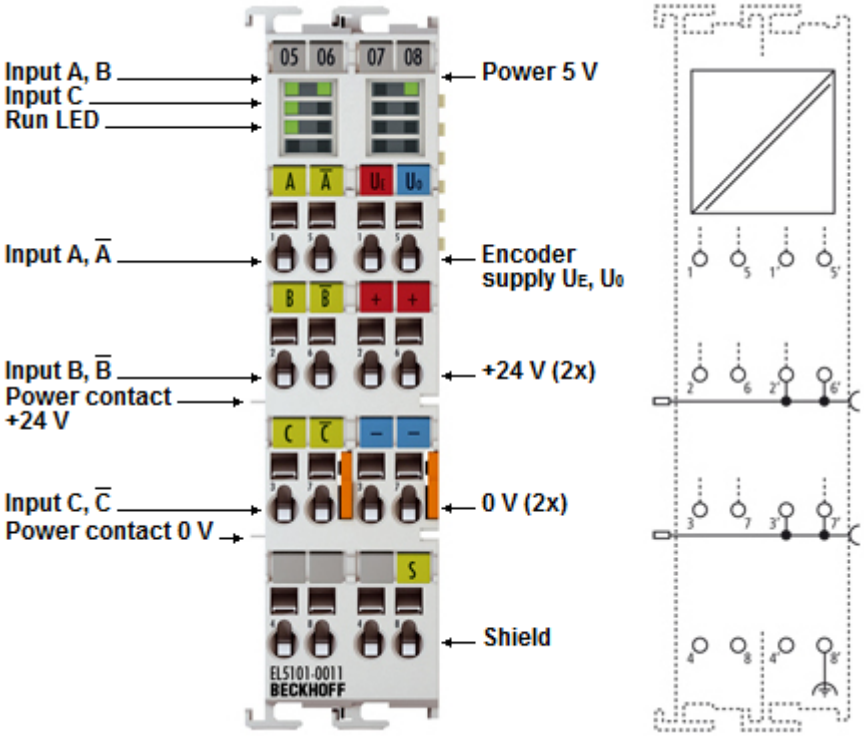


Fig. 24: EL5101-0011

NOTICE

Encoder supply via the terminal

The encoder supply voltage, can be taken from the terminal points 1'(5 V) and 5`(0 V).

NOTICE

Single-ended connection for TTL encoder

For information on the single-ended connection for TTL encoders, please refer to chapter "Single-Ended Connection for TTL Encoders" ("Normal Operating Mode [▶ 75]" or "Enhanced Operating Mode [▶ 104]").

- No Single-ended connection is possible for the terminals EL5101-0010 and EL5101-0011.

Connection		
Terminal point	**No.**	**Comment**
A	1	Encoder input A
B	2	Encoder input B
C	3	Encoder input C
-	4	-
¬A	5	Encoder input A
¬B	6	Encoder input B
¬C	7	Encoder input C
-	8	-
Ue = +5 V	1'	+5 V encoder supply
+24 V	2'	+24 V (internally connected to terminal point 6' and positive power contact)
0 V	3'	0 V (internally connected to terminal point 7' and negative power contact)
-	4'	-
Uo = 0 V	5'	0 V encoder supply
+24 V	6'	+24 V (internally connected to terminal point 2' and positive power contact)
0 V	7'	0 V (internally connected to terminal point 3' and negative power contact)
Shield	8'	Shield

LEDs

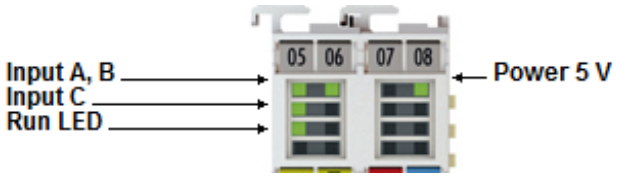


Fig. 25: EL5101-0011 - LEDs

LED	Color	Meaning	
INPUT A, B, C	green	indicates TRUE level	
RUN	green	This LED indicates the terminal's operating state:	
		off	State of the EtherCAT State Machine: **INIT** = initialization of the terminal or **BOOTSTRAP** = function for terminal firmware updates
		flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		Single flash	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
POWER 5 V	green	Operating voltage display for incremental encoder power supply	

10.12 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.

11 NC configuration

NC configuration – for axis configuration and connection of the EL51x1 in the TwinCAT System Manager (Config mode) proceed as follows:

Right-click on *NC Configuration - > Append Task* (Fig. *NC Configuration, Append Task*), enter a name for the task and confirm with *OK* (Fig. *Entering a name for the task and confirming*)

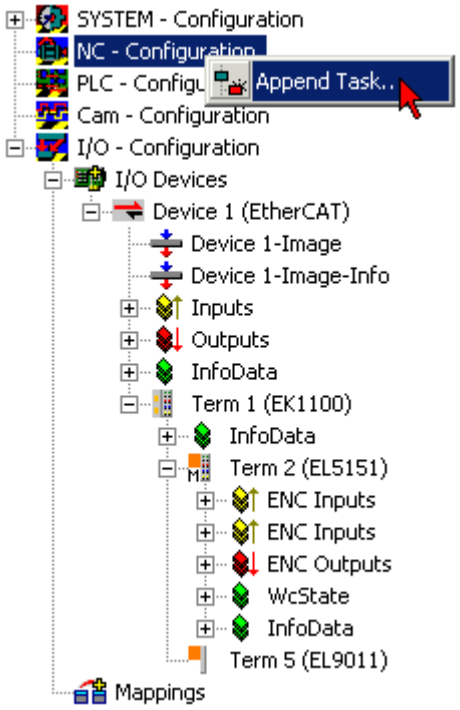


Fig. 26: NC - Configuration, Append Task

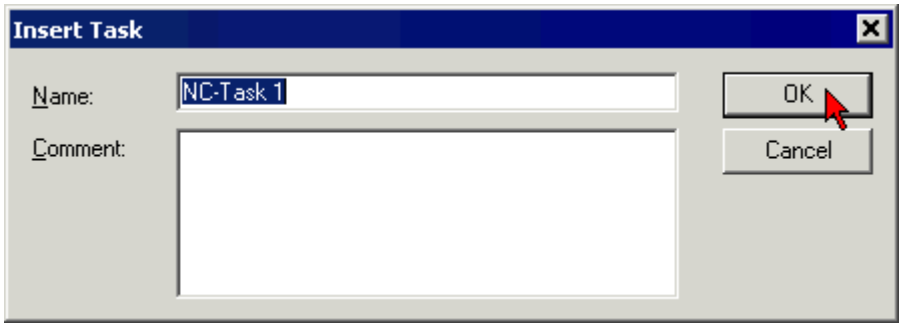


Fig. 27: Entering a name for the task and confirming

Right-click on *Axes - > Append Axis* (Fig. *Insert axis*), enter a name, select a type for the axis and confirm with *OK* (Fig. *Entering a name for the axis and selecting a type*)

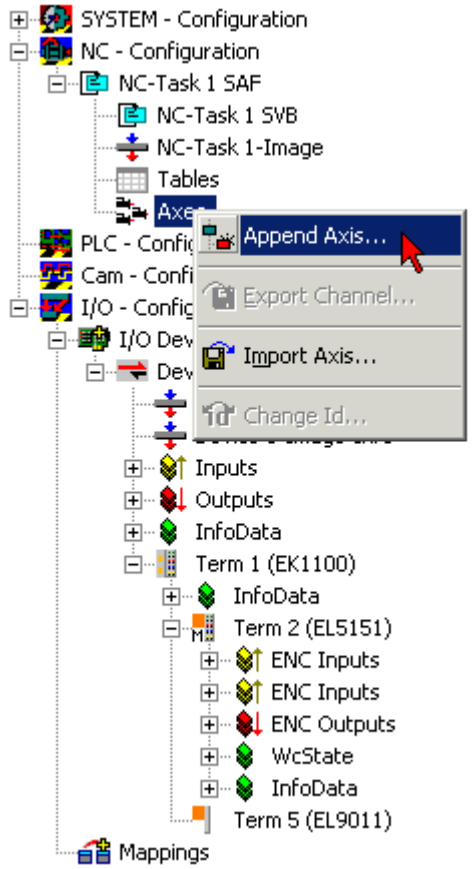


Fig. 28: Insert axis

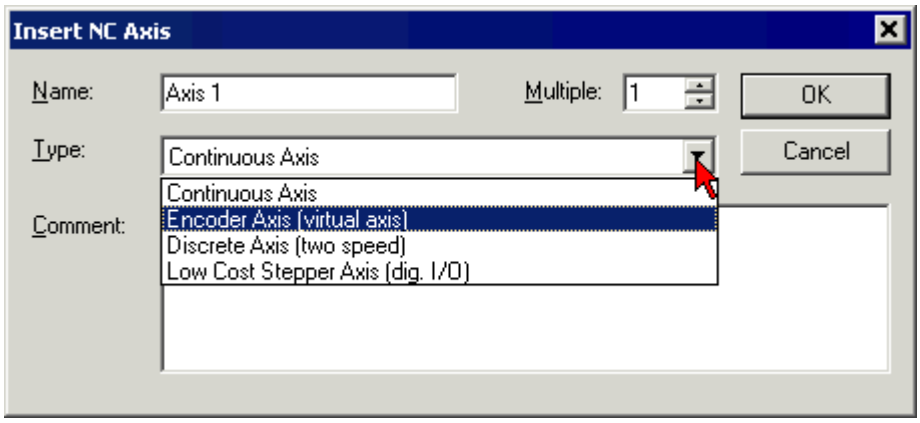


Fig. 29: Entering a name for the axis and selecting a type

On the *NC-Encoder* tab select the *encoder* (KL5101/KL5111/IP5109/EL5101) in the *Type* pull-down menu (Fig. *Selecting the encoder*)

Click on the button *Link To...,* select *Terminal EL51x1* and confirm with *OK* (Fig. *Selecting and confirming an encoder terminal*)

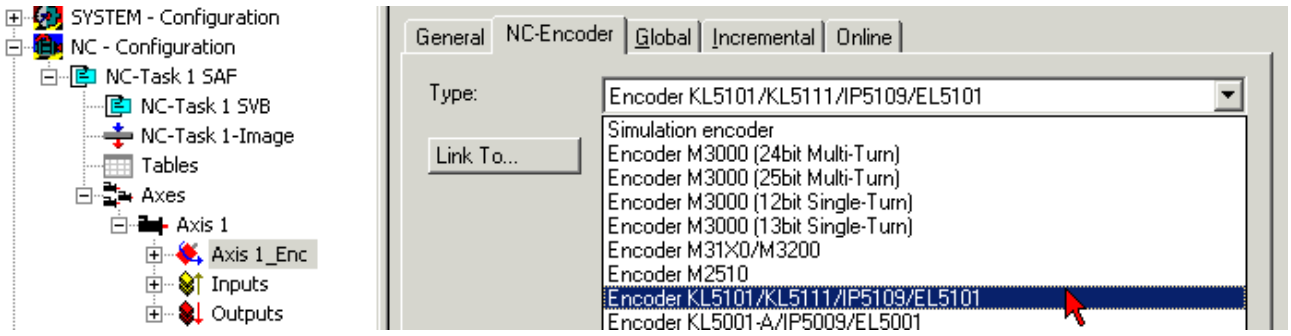


Fig. 30: Selecting the encoder

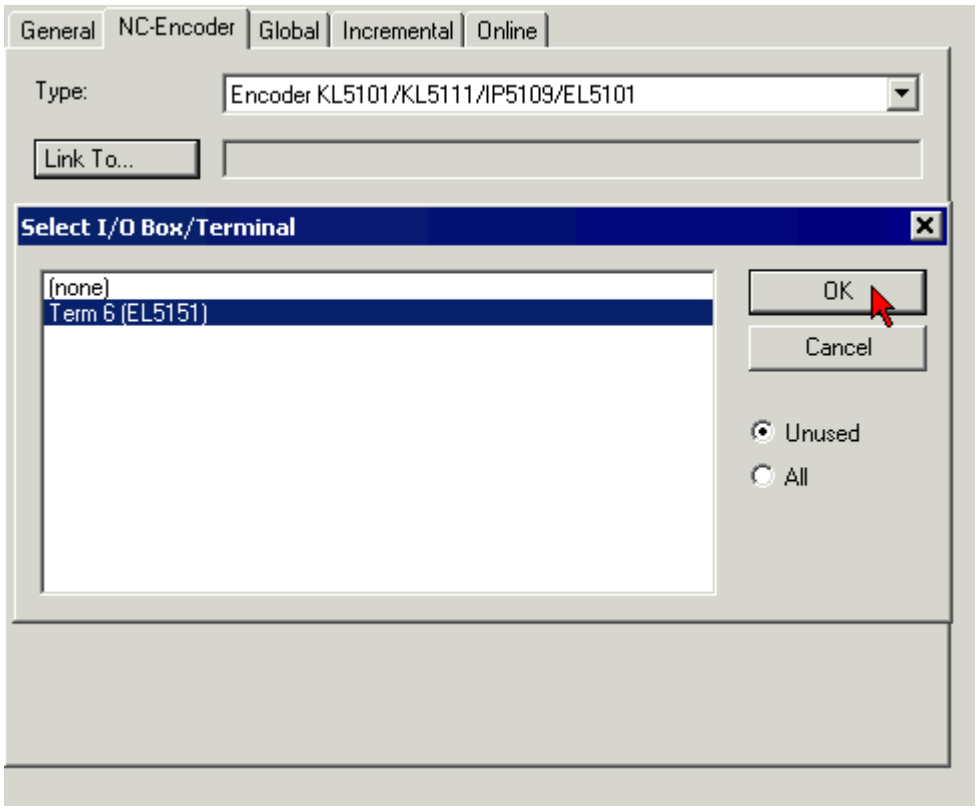


Fig. 31: Selecting and confirming an encoder terminal

The corresponding inputs of the EL51x1 are now linked with the NC task (Fig. *EL51x1 inputs linked with the NC task*)

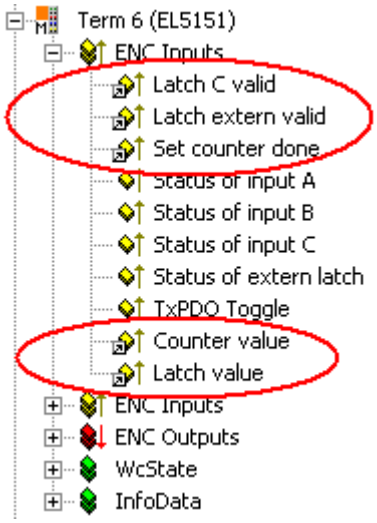


Fig. 32: EL51x1 inputs linked with the NC task

12 EL5101 - Commissioning

12.1 Normal operation mode

12.1.1 Operation modes

In EL5101 “Normal operation mode” the following modes are available:

Mode	DC	Main PDO	Comment	Optional PDO 1	Comment	Features CoE	Comment
1	FreeRun	0x1A00 [▶ 71] + 0x1600 [▶ 71]	16 bit Value/Latch **Byte alignment**	0x1A02 [▶ 71]	**Frequency**: 32-bit **Period**: 16-bit **Window**: 16-bit CoE object 0x8001:02 [▶ 69]: window	0x8000:01 [▶ 69] + 0x8001:02 [▶ 69]	**Register reload** + Reload value
2	"	"	"	"	"	0x8000:02 [▶ 69]	**Index reset**
3	"	"	"	"	"	0x8000:03 [▶ 69], :04 [▶ 69], :05 [▶ 69]	**FWD Cnt** + pos/ neg gate
4	FreeRun	0x1A01 [▶ 71] + 0x1601 [▶ 71]	16 bit Value/Latch **Word alignment**	0x1A02 [▶ 71]	**Frequency**: 32-bit **Period**: 16-bit **Window**: 16-bit CoE object 0x8001:02 [▶ 69]: window	0x8000:01 [▶ 69] + 0x8001:02 [▶ 69]	**Register reload** + Reload value
5	"	"	"	"	"	0x8000:02 [▶ 69]	**Index reset**
6	"	"	"	"	"	0x8000:03 [▶ 69], :04 [▶ 69], :05 [▶ 69]	**FWD Cnt** + pos/ neg gate

Settings other than those listed above may result in irregular process data and error messages in the TwinCAT System Manager logger window.

EL5101 parameterization

- To clear any previous settings, if necessary, perform a CoE reset (see the EtherCAT system manual, chapter “Restoring factory settings”).
- To activate the new operation mode, reload the EtherCAT slaves (button  in the System Manager)

DC (Distributed Clocks)

Describes whether the terminal is operated with distributed clocks support:

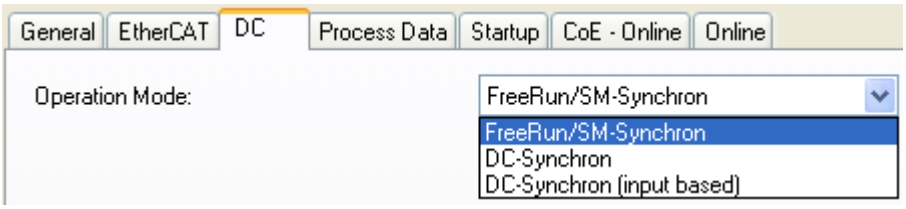


Fig. 33: “DC” tab

Distributed Clocks in normal operating mode

In normal operating mode no DC functions are available.

12.1.2 Process data

Main PDO

Selection of basic process data:

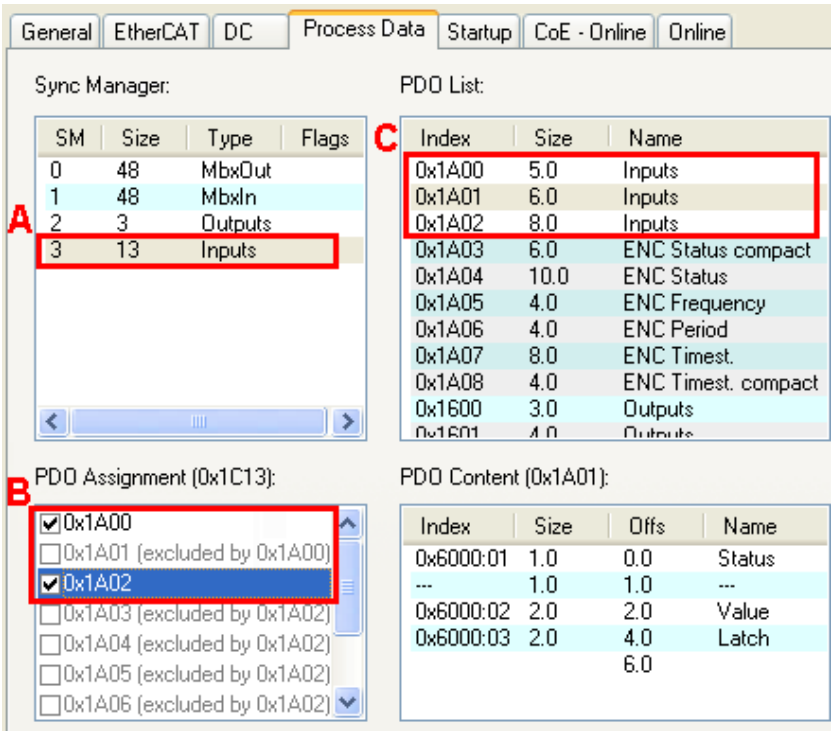


Fig. 34: “Process data” tab
A: Selection of data direction: input or output
B: Selection of (optional) PDOs (process data objects)
C: Explanatory notes for PDOs

- Byte/word alignment: By default the EL5101 is operated in normal operation mode with byte alignment and therefore efficiently few process data. In cases where an EtherCAT master requires the process data in word alignment (filled to 16 bit), PDO 0x1A01 [▶ 71] and 0x1601 [▶ 71] should be used.

Optional PDOs

Optional PDOs, in addition to the main PDO:

- PDO 1 (0x1A02 [▶ 71]):
  - The **frequency** is determined over 10 ms (fixed) as a number of increments.
  - The **period** (time interval between two positive edges of input A) is determined as often as possible in the unit 500 ns/digit. If no increment event occurs for approx.1.6 seconds, the frequency/period is set to 0.
  - **Window**: A user-defined time window can be parameterized via CoE object 0x8001:02 [▶ 69] with the unit 16 µs/digit. During this window time the encoder increments are counted and output in the process record *window*.

Process data description

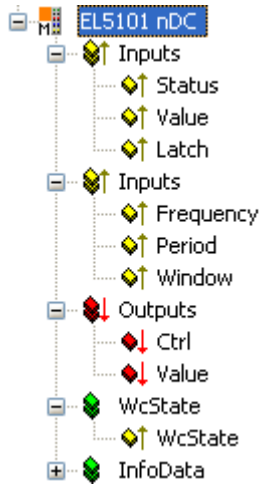


Fig. 35: Process data description

The process data are generated from CoE objects 0x6000 (inputs) [▶ 69] and 0x7000 (outputs) [▶ 70].

- **Status**: Status bits (see section Control and status word [▶ 74])
- **Value**: Encoder position
- **Latch**: Latch position
- **Frequency**: Current calculated frequency
- **Period**: Period of the last possible measurement
  The refresh rate depends on the cycle time and the applied frequency
- **Window**: Number of edges counted during the timeframe
- **Ctrl**: Control bits (see section Control and status word [▶ 74])
- **Value**: Relevant counter value

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

12.1.2.1 Sync Manager (SM)

The scope of the offered process data can be changed via the “Process Data” tab (see illustration below).

1. To configure the process data, select the desired Sync Manager in the upper-left field “Sync Manager” (see the figure below). (SM2 and SM3 can be edited here).
2. The process data assigned to this Sync Manager can then be switched on or off in the “PDO Assignment” box underneath.
3. Restarting the EtherCAT system or reloading the configuration in Config mode (F4), causes the EtherCAT communication to restart, and the process data is transferred from the terminal.

For a detailed description of how to configure the process data, see the “EtherCAT subscriber configuration” chapter in the EtherCAT System Manual.

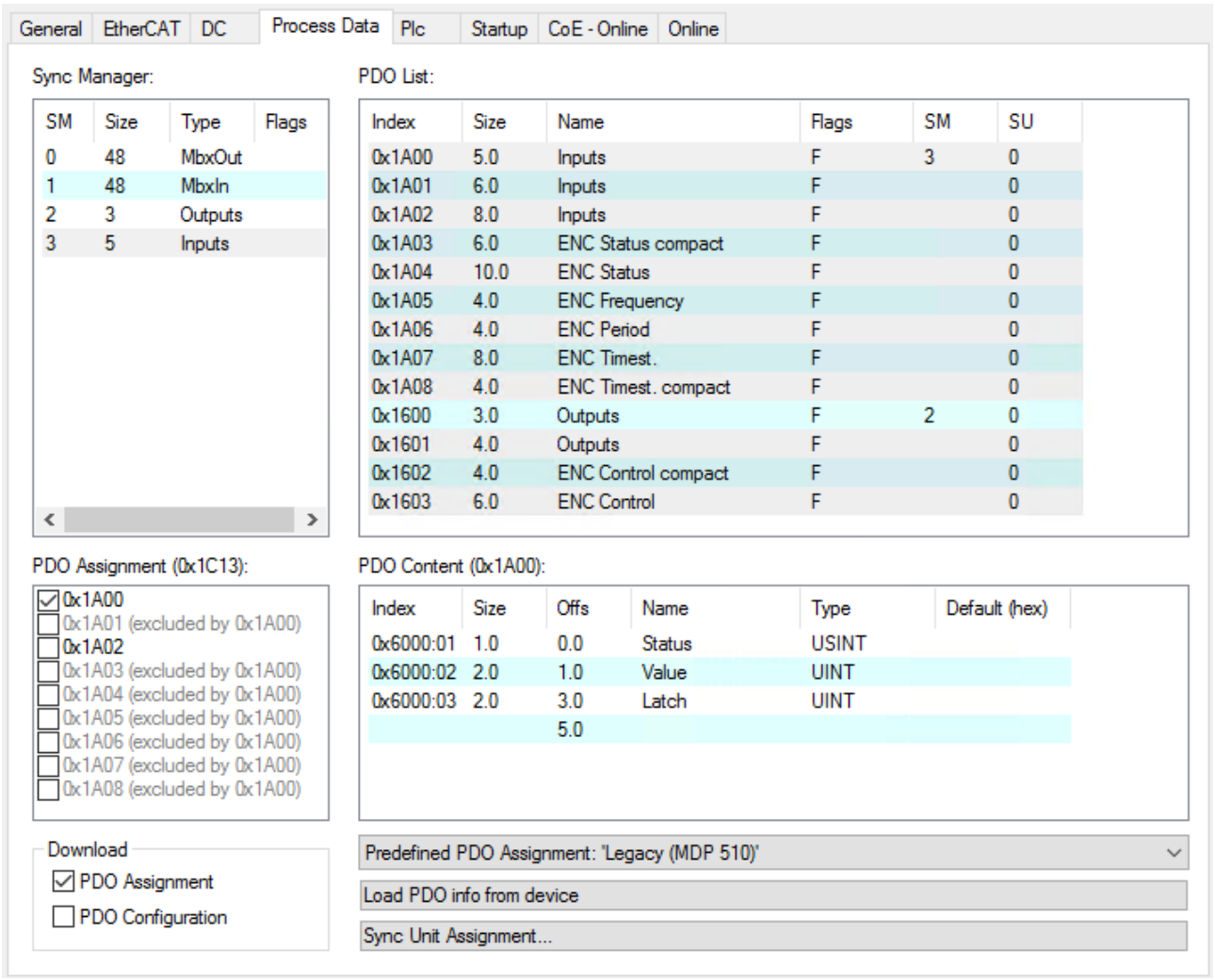


Fig. 36: EL5101 - Process Data tab SM3 (Legacy)

12.1.2.2 PDO assignment

The EL5101 offers different process data objects (PDO) in normal and enhanced operation mode. The PDOs of the two operation modes are mutually exclusive.

In this chapter only the PDOs of the normal operation mode are described. Excluded PDOs of the enhanced operation mode are shown in gray font in the following tables and are described in chapter "Enhanced operation mode". [▶ 79]

12.1.2.2.1 SM3 - Inputs (0x1A00 .. 0x1A02)

0x1A00 - Inputs (5.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6000:01 [▶ 69] - Status (1.0) 0x6000:02 [▶ 69] - Value (2.0) 0x6000:03 [▶ 69] - Latch (2.0)	Objects for normal operation mode: 0x1A01 [▶ 71] - Inputs (6.0) Objects for enhanced mode: 0x1A03 - ENC Status compact (6.0) 0x1A04 - ENC Status (10.0) 0x1A05 - ENC Frequency (4.0) 0x1A06 - ENC Period (4.0) 0x1A07 - ENC Timest. (8.0) 0x1A08 - ENC Timest. compact (4.0)

0x1A01 - Inputs (6.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6000:01 [▶ 69] - Status (1.0) 0x6000:02 [▶ 69] - Value (2.0) 0x6000:03 [▶ 69] - Latch (2.0)	Objects for normal operation mode: 0x1A00 [▶ 98] - Inputs (5.0) Objects for enhanced mode: 0x1A03 - ENC Status compact (6.0) 0x1A04 - ENC Status (10.0) 0x1A05 - ENC Frequency (4.0) 0x1A06 - ENC Period (4.0) 0x1A07 - ENC Timest. (8.0) 0x1A08 - ENC Timest. Compact (4.0)

0x1A02 - Inputs (8.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6000:04 [▶ 69] - Frequency (4.0) 0x6000:05 [▶ 69] - Period (2.0) 0x6000:06 [▶ 69] - Window (2.0)	Objects for enhanced mode: 0x1A03 - ENC Status compact (6.0) 0x1A04 - ENC Status (10.0) 0x1A05 - ENC Frequency (4.0) 0x1A06 - ENC Period (4.0) 0x1A07 - ENC Timest. (8.0) 0x1A08 - ENC Timest. compact (4.0)

12.1.2.2.2 SM2 - Outputs (0x1600 .. 0x1601)

0x1600 - Outputs (3.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7000:01 [▶ 70] - Ctrl (1.0) 0x7000:02 [▶ 70] - Value (2.0)	Objects for normal operation mode: 0x1601 [▶ 71] - Outputs (4.0) Objects for enhanced operation mode: 0x1602 - ENC Control compact (4.0) 0x1603 - ENC Control (6.0)

0x1601 - Outputs (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7000:01 [▶ 70] - Ctrl (1.0) 0x7000:02 [▶ 70] - Value (2.0)	Objects for normal operation mode: 0x1600 [▶ 71] - Outputs (3.0) Objects for enhanced operation mode: 0x1602 - ENC Control compact (4.0) 0x1603 - ENC Control (6.0)

12.1.2.3 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.

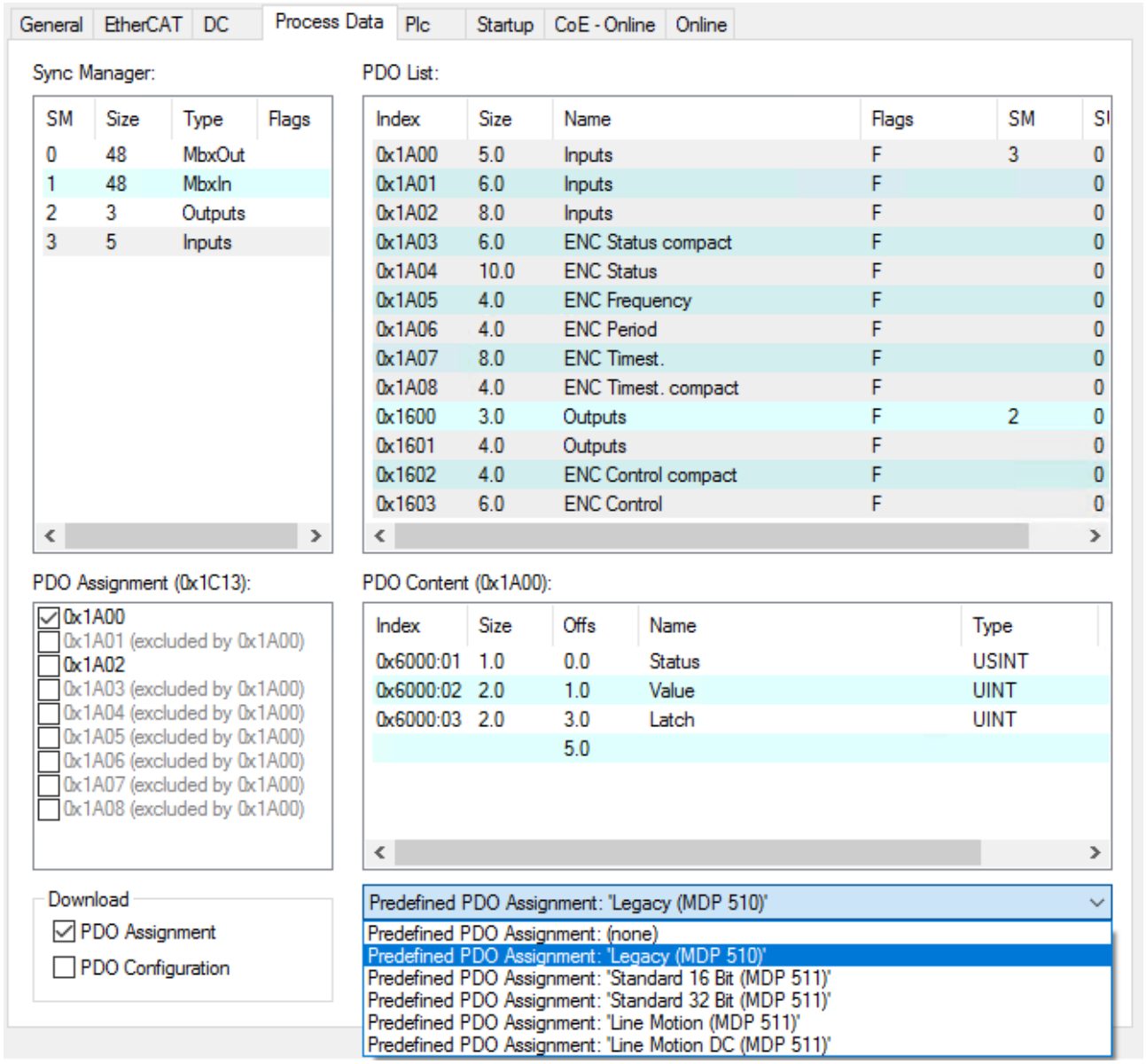


Fig. 37: EL5101 - Process data, Predefined PDO (Legacy (MDP 510))

For the normal operation mode one PDO assignment is available in mode “Legacy”.

Predefined PDO assignment for Legacy mode

Predefined PDO Assignment	PDO Assignment
Legacy (MDP 510)	**SM3:** 0x1A00 [▶ 63] - Inputs (5.0) **SM2:** 0x1600 [▶ 64] - Outpufs (3.0)

12.1.3 Features CoE

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

Depending on the main PDO/optional PDOs further settings can be selected in the CoE (CAN over EtherCAT list).

The following CoE settings from objects 0x8000 [▶ 69] and 0x8001 [▶ 69] are possible and are shown below in their default settings:

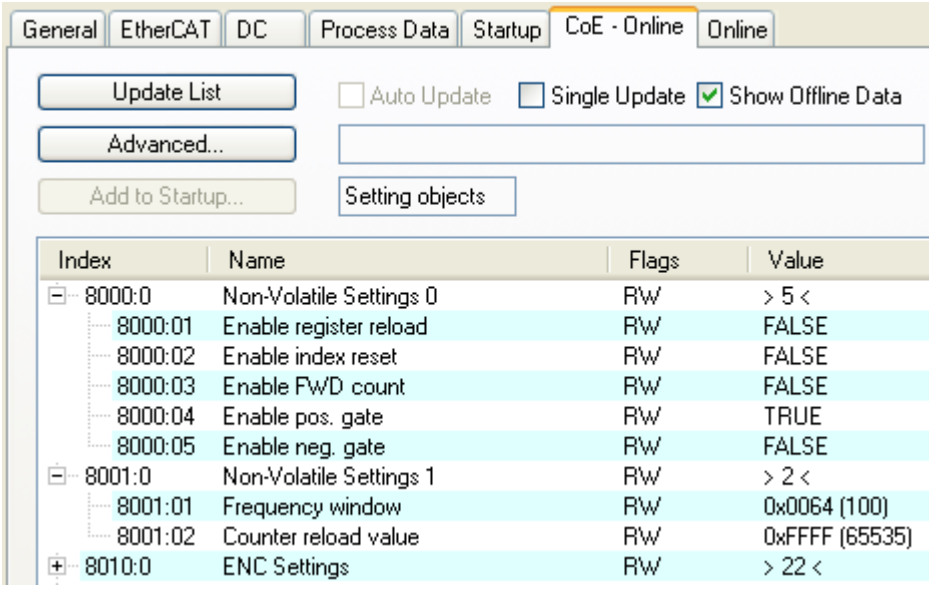


Fig. 38: “CoE-Online” tab

The parameters are described on page object description and parameterization [▶ 68].

“Register Reload”

If “Register Reload” is enabled in CoE object 0x8000:01 [▶ 69], the counter value is set

- to zero in the event of overflow over the value in CoE object 0x8001:02 [▶ 69] and
- to the value in CoE object 0x8001:02 [▶ 69] in the event of underflow below 0.

“Index Reset”

If “Index Reset” is enabled in CoE object 0x8000:02 [▶ 69], input C resets the counter to 0.

“Register Reload” and “Index Reset”

“Register Reload” and “Index Reset” cannot be operated simultaneously.

Forward/backward counter “Enable FWD count”

If “Enable FWD Count” is activated in CoE object 0x8000:03 [▶ 69], the EL5101 operates as counter on channel A. Channel B indicates the counting direction: B = TRUE forward, B = FALSE backward.
The counter can be locked via the gate input (24 V).

- CoE object 0x8000:04 [▶ 69] (TRUE):
  Locking of the counter at the gate input with positive edge (0 V -> +24 V).
- CoE object 0x8000:05 [▶ 69] (TRUE):
  Locking of the counter at the gate input with negative edge (+24 V -> 0 V).

Frequency

- The timeframe for the frequency calculation is set to 10 ms (see Fig. *“Process data”* tab); in addition a variably configurable measuring window is available (parameterization via object 0x8001:01 [▶ 69] , output frequency value in object 0x6000:06 [▶ 69])
- Only the increment edges in the specified time window are counted.
- If no edge change occurs for approx. 1.6 s, any frequency specification is cancelled.
- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- No frequency measurement is possible if the counter is blocked by the gate. In this case the period can be measured regardless.
- If an encoder signal is only present at input A/A and the frequency/period is to be measured, the terminal must be set to “Enable FWD count” in CoE 0x8000:03 [▶ 69].
- A C or external reset restarts the frequency measurement. The last frequency value remains unchanged until a new frequency value is determined.

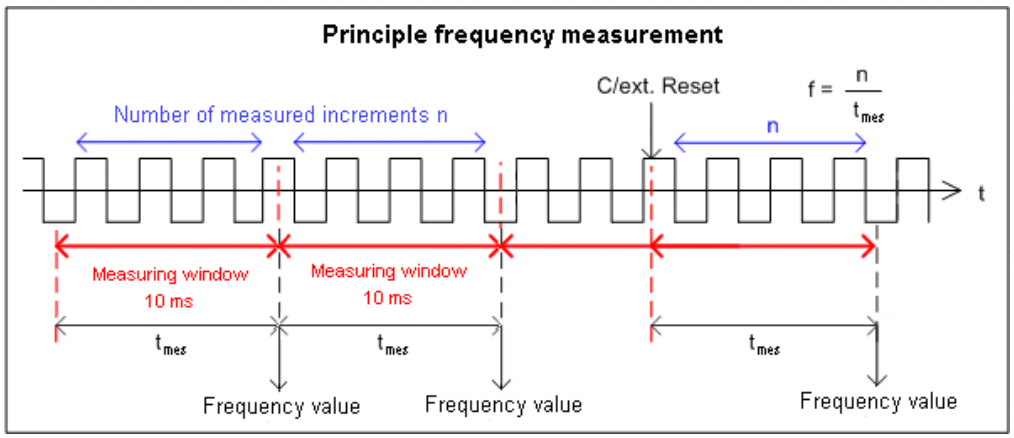


Fig. 39: Frequency measurement principle in normal operation mode

Period calculation

- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- In each cycle the interval between two positive edges of input A is counted with a resolution of 100 ns.
- If no edge change occurs for approx. 1.6 s, any period specification is cancelled.

Frequency and period measurement

From the explanatory notes above it is apparent that the frequency measurement can measure the current axis status (velocity) significantly more accurately than the period measurement. Frequency measurement is therefore preferable, if possible.

Latch

Latch control is implemented via the control and status word [▶ 74].

12.1.4 Object description and parameterization - normal operation mode

EtherCAT XML Device Description

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

NOTICE



Parameterization via the CoE list (CAN over EtherCAT)

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

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

12.1.4.1 Restore object

Index 1011 Restore default parameters

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

12.1.4.2 Configuration data

Index 8000 Non-Volatile Settings 0

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	Non-Volatile Settings 0	Maximum subindex	UINT8	RO	0x05 (5_{dec})
8000:01	Enable register reload [▶ 66]	The counter counts up to the “Counter reload value”, or the “Counter reload value” (0x8001:02 [▶ 69]) is loaded in the event of an underflow. **Example 360° encoder with set bit:** Moves in positive direction via Counter reload value [▶ 69]: Reset counter value to 0. Moves in negative direction less than 0: Reset counter value to Counter reload value [▶ 69].	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Enable index reset [▶ 66]	Activates input C for resetting the counter. **Example 360° encoder with set bit:** Moves in positive direction (signal at input C): Reset counter value to 0 Moves in negative direction (signal at input C): underflow with FFFF, FFFE etc.)	BOOLEAN	RW	0x00 (0_{dec})
8000:03	Enable FWD count [▶ 67]	FALSE The terminal operates in quadrature decoder mode. TRUE The terminal operates as counter, count direction to input B.	BOOLEAN	RW	0x00 (0_{dec})
8000:04	Enable pos. gate [▶ 67]	The gate input responds to positive edge and locks the counter.	BOOLEAN	RW	0x01 (1_{dec})
8000:05	Enable neg. gate [▶ 67]	The gate input responds to negative edge and locks the counter.	BOOLEAN	RW	0x00 (0_{dec})

Index 8001 Non-Volatile Settings 1

Index (hex)	Name	Meaning	Data type	Flags	Default
8001:0	Non-Volatile Settings 1	Maximum subindex	UINT8	RO	0x02 (2_{dec})
8001:01	Frequency window [▶ 67]	The value specifies the size of the time window for the “Window [▶ 69]” variable. resolution: 16 µs; e.g. default value: 16 µs x 100_{dec} = 1.6 ms	UINT16	RW	0x0064 (100_{dec})
8001:02	Counter reload value [▶ 66]	If “Enable register reload [▶ 69]” = TRUE, the counter counts up to this value and is loaded with this value in the event of an underflow.	UINT16	RW	0xFFFF (65535_{dec})

12.1.4.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6000 Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	Inputs	Length of this object	UINT8	RO	0x06 (6_{dec})
6000:01	Status	Status byte [▶ 74]	UINT8	RO	0x00 (0_{dec})
6000:02	Value	meter reading	UINT16	RO	0x0000 (0_{dec})
6000:03	Latch	Latch value	UINT16	RO	0x0000 (0_{dec})
6000:04	Frequency	Frequency value (resolution: 0.01 Hz / digit) [fixed 10 ms measuring window]	UINT32	RO	0x00000000 (0_{dec})
6000:05	Period	Period (resolution 500 ns / digit)	UINT16	RO	0x0000 (0_{dec})
6000:06	Window	Measured value of the variable timeframe (“Frequency window” (0x8001:01 [▶ 69])	UINT16	RO	0x0000 (0_{dec})

12.1.4.4 Output data

Index 7000 Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	Outputs	Length of this object	UINT8	RO	0x02 (2_{dec})
7000:01	Ctrl [▶ 74]	Control byte [▶ 74]	UINT8	RO	0x00 (0_{dec})
7000:02	Value	The counter value to be set via “CNT_SET” (CB.02 [▶ 74]).	UINT16	RO	0x0000 (0_{dec})

12.1.4.5 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 low word contains the CoE profile used (5001). • The high 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	EL5101

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	09

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	10

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x03F90000 (66650112_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave: • Low word ◦ 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 1600 RxPDO-Map Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RxPDO-Map Outputs	PDO Mapping RxPDO 1	UINT8	RO	0x02 (2_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1601 RxPDO-Map Outputs Word-Aligned

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	RxPDO-Map Outputs Word-Aligned	PDO Mapping RxPDO 2	UINT8	RO	0x03 (3_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1601:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1A00 TxPDO-Map Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	TxPDO-Map Inputs	PDO Mapping TxPDO 1	UINT8	RO	0x03 (3_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A01 TxPDO-Map Inputs Word-Aligned

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	TxPDO-Map Inputs Word-Aligned	PDO Mapping TxPDO 2	UINT8	RO	0x04 (4_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A01:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A02 TxPDO-Map Inputs Optional

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	TxPDO-Map Inputs Optional	PDO Mapping TxPDO 3	UINT8	RO	0x03 (3_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x04 (Frequency))	UINT32	RO	0x6000:04, 32
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x05 (Period))	UINT32	RO	0x6000:05, 16
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x06 (Window))	UINT32	RO	0x6000:06, 16

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x01 (1_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:03	SubIndex 003	3rd 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 • Synchronous with SM 2 event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • 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	0x00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only).	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0002 (2_{dec})

Index F008 Code word

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

12.1.5 Control and status byte

Control byte

The control byte (CB) is located in the output process image, and is transmitted from the controller to the terminal.

Bit	CB.7	CB.6	CB.5	CB.4	CB.3	CB.2	CB.1	CB.0
Name	-	-	-	-	EN_LATCH_EXTN	CNT_SET	EN_LATCH_EXTP	EN_LATC

Legend

Bit	Name	Description	
CB.3	EN_LATCH_EXTN	1_{bin}	After the EN_LATCH_EXTN bit becomes active, the counter value is stored in the latch input (index 0x6000:03 [▶ 69]) upon the first external latch pulse with a falling edge. The subsequent pulses have no influence on the latch value. **Please note: A new counter value can be written to the latch input only after the "Latch°valid" bit (LAT_EXT_VAL) in the status byte has a low-level.**
CB.2	CNT_SET	rise	The counter is set with rising edge of CNT_SET to the value specified via the process data (index 0x7000:02 [▶ 70]).
CB.1	EN_LATCH_EXTP	1_{bin}	Once the EN_LATCH_EXTP bit is set, the counter value is stored in the latch input (index 0x6000:03 [▶ 69]) on the rising edge of the first external latch pulse. The subsequent pulses have no influence on the latch value. **Please note: A new counter value can be written to the latch input only after the "Latch°valid" bit (LAT_EXT_VAL) in the status byte has a low-level.**
CB.0	EN_LATC	1_{bin}	The zero point latch (C input) is activated. The counter value is saved upon the first external latch pulse after the EN_LATC bit becomes valid (this takes precedence over EN_LAT_EXTN/ EN_LAT_EXTP). If the bit is set, subsequent pulses have no influence on the latch value. **Please note: Only when the "Latch°valid" bit (LATC_VAL) in the status byte is at a low-level can a new counter value be written to the latch input (the LATC_VAL bit (SB.0) is not cleared by the terminal until the C pulse = LOW).**

Status byte

The status byte (SB) is located in the input process image, and is transmitted from terminal to the controller.

Bit	SB.7	SB.6	SB.5	SB.4	SB.3	SB.2	SB.1	SB.0
Name	-	-	STATUS_INPUT	OVERFLOW	UNDERFLOW	CNTSET_ACC	LAT_EXT_VAL	LATC_VAL

Legend

Bit	Name	Description	
SB.5	STATUS_INPUT	0_{bin}/ 1_{bin}	Indicates the status of INPUT 1
SB.4	OVERFLOW	1_{bin}	This bit is set if the 16-bit counter overflows (65535 to 0). It is reset when the counter exceeds one third of its measuring range (21845 to 21846) or immediately an underflow occurs.
SB.3	UNDERFLOW	1_{bin}	This bit is set if the 16-bit counter underflows (0 to 65535). It is reset when the counter drops below two thirds of its measuring range (43690 to 43689) or immediately an overflow occurs.
SB.2	CNTSET_ACC	1_{bin}	The data for setting the counter (index 0x7000:02 [▶ 70]) is accepted from the terminal.
SB.1	LAT_EXT_VAL	1_{bin}	An external latch pulse has occurred. The data with index 0x6000:03 [▶ 69] match the latched value when the bit is set. To reactivate the latch input EN_LAT_EXTN or EN_LATCH_EXTP (CB.3 or CB.1) has first to be cleared and then to be set once more.
SB.0	LATC_VAL	1_{bin}	A zero point latch has occurred. The data with index 0x6000:03 [▶ 69] match the latched value when the bit is set. In order to reactivate the latch input, it is necessary for EN_LATC (CB.0) first be cleared and then to be set once more.

12.1.6 Single-ended connection for TTL encoder

In addition to encoders with differential RS422 interface, single-ended encoders with TTL interface are also supported. Please note the following:

- Operating mode selection encoder 0x8000:03 [▶ 69] “Enable FWD count” = FALSE.
- The differential inputs (/A, /B, /C) must remain open and must not be connected to ground.

12.2 Enhanced operation mode

12.2.1 Operation modes

In EL5101 “Enhanced operation mode” the following modes are available:

Mode	DC	Main PDO	Comment	Optional PDO 1	Comment	Optional PDO 2	Comment	Features CoE	Comment
7	FreeRun	0x1A04 [▶ 100] + 0x1603 [▶ 96]	Count/Latch in 32 bit	0x1A05 [▶ 100] or 0x1A06 [▶ 100]	Frequency (32 Bit) or Period (32 Bit)	--		0x8010 [▶ 91]:nn	CoE combinations 0x8010 [▶ 91]:nn
8	"	0x1A03 [▶ 99] + 0x1602 [▶ 96]	**compact**: 16 bit count/ latch	"	"	--		"	"
9	DC/DCi	0x1A04 [▶ 100] + 0x1603 [▶ 96]	Count/Latch in 32 bit	"	"	0x1A07 [▶ 100] or 0x1A08 [▶ 101]	64-bit timestamp 32-bit timestamp (compact)	"	"
10	"	0x1A03 [▶ 99] + 0x1602 [▶ 96]	**compact**: 16 bit count/ latch	"	"	"	"	"	"

Settings other than those listed above may result in irregular process data and error messages in the TwinCAT System Manager logger window.

EL5101 parameterization

- To clear any previous settings, if necessary, perform a CoE reset (see the EtherCAT system manual, chapter “Restoring factory settings”).
- To activate the new operation mode, reload the EtherCAT slaves (button  in the System Manager)

DC (Distributed Clocks)

Describes whether the terminal is operated with distributed clocks support:

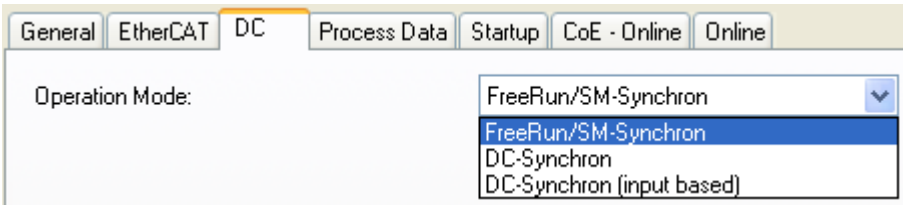


Fig. 40: “DC” tab

- **FreeRun**: the terminal operates frame-triggered. Cyclic operation is started via the SyncManagers of the EtherCAT frame processing.
- **DC-Synchron**: cyclic operation in the terminal is started by the local distributed clock at exact intervals. The start time is chosen such that it coincides with other output slaves in the EtherCAT system.
- **DC-Synchron (input based)**: as DC-Synchron mode, with the cyclic start time chosen such that it coincides with other input slaves in the EtherCAT system.

12.2.2 Process data

Main PDO

Selection of basic process data

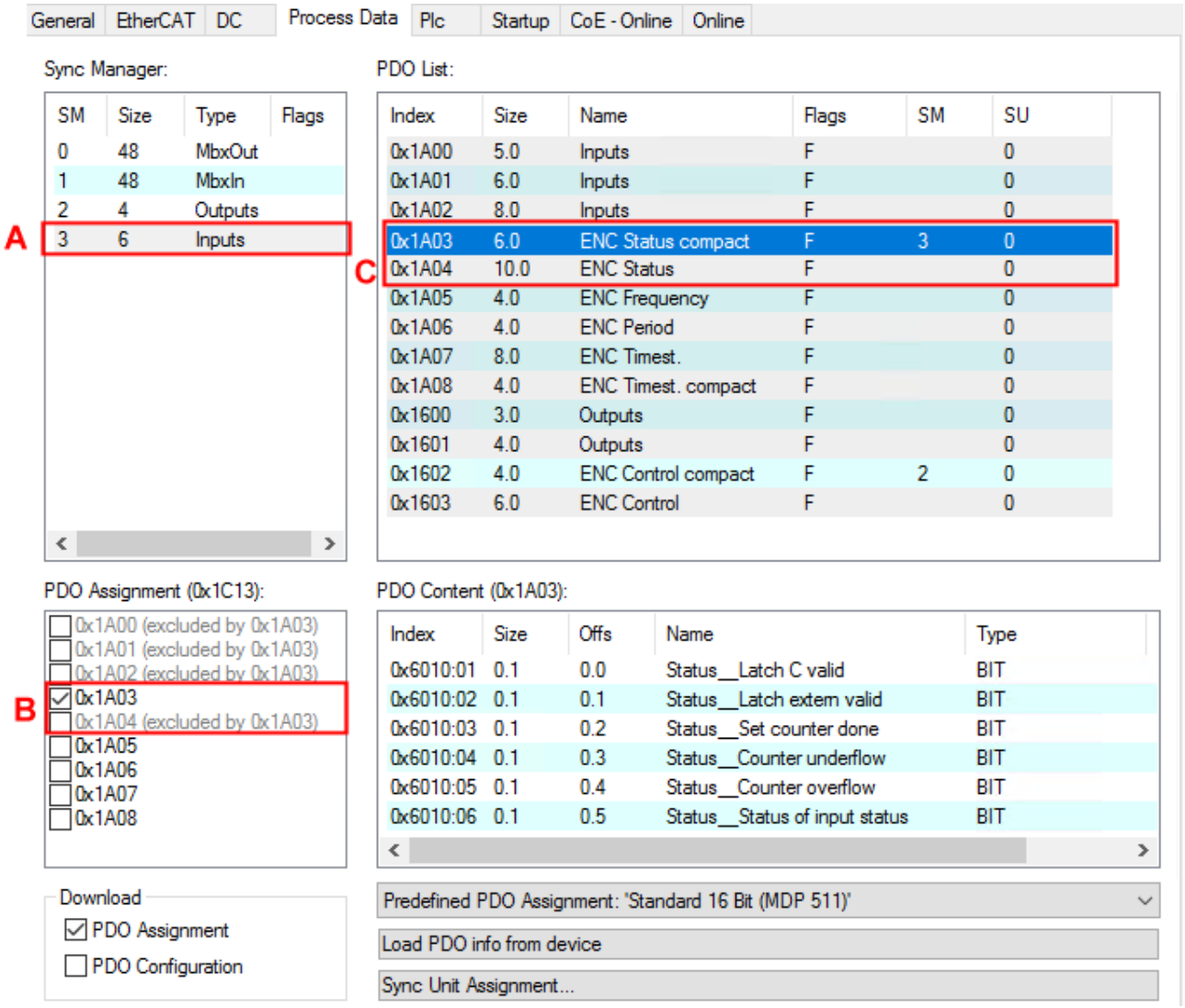


Fig. 41: “Process data” tab
A: Selection of data direction: input or output
B: Selection of (optional) PDOs (process data objects)
C: Explanatory notes for PDOs

compact: The process data can be represented with 16 bits (compact) or with 32 bits.

Optional PDOs

Optional PDOs, in addition to the main PDO:

- PDO 1 (0x1A05 [▶ 100] or 0x1A06 [▶ 100]): The **frequency** or the **period** can be selected as optional PDO 1
- PDO 2 (0x1A07 [▶ 100] or 0x1A08 [▶ 101]): In one of the DC modes a 64 bit or 32 bit **timestamp** can be selected. The timestamp specifies the time of the last registered increment edge, based on the DistributedClocks system.

Process data description

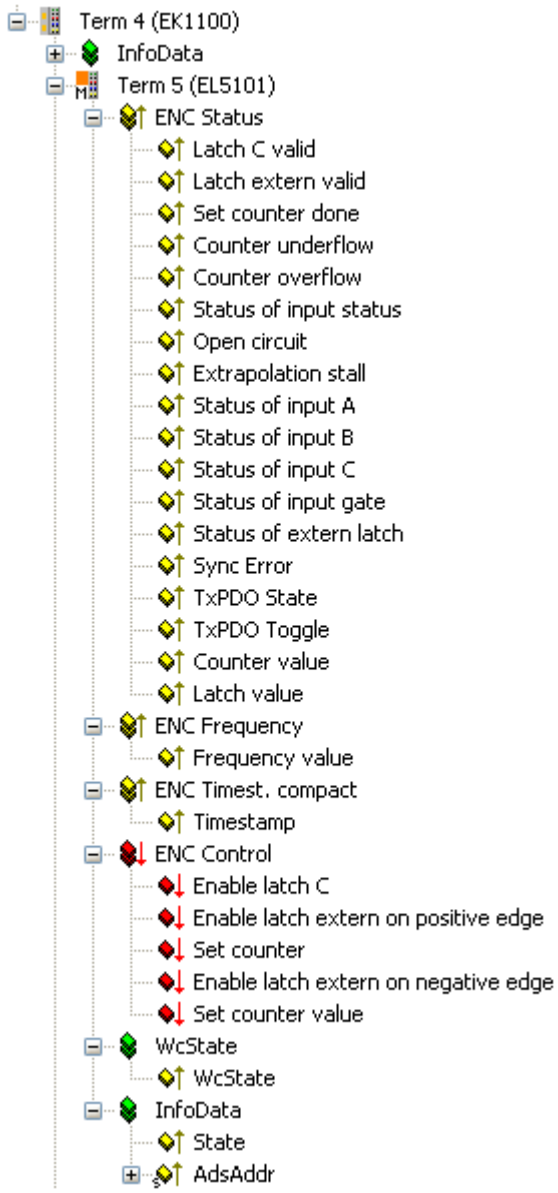


Fig. 42: Process data description

The process data are generated from CoE objects 0x6010 (Inputs) and 0x7010 (Outputs) and are described in chapter “Object description and parameterization [▶ 90]”.

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

12.2.2.1 Sync Manager (SM)

The scope of the offered process data can be changed via the “Process Data” tab (see illustration).

For a detailed description of how to configure the process data, see the “EtherCAT subscriber configuration” chapter in the EtherCAT System Manual.

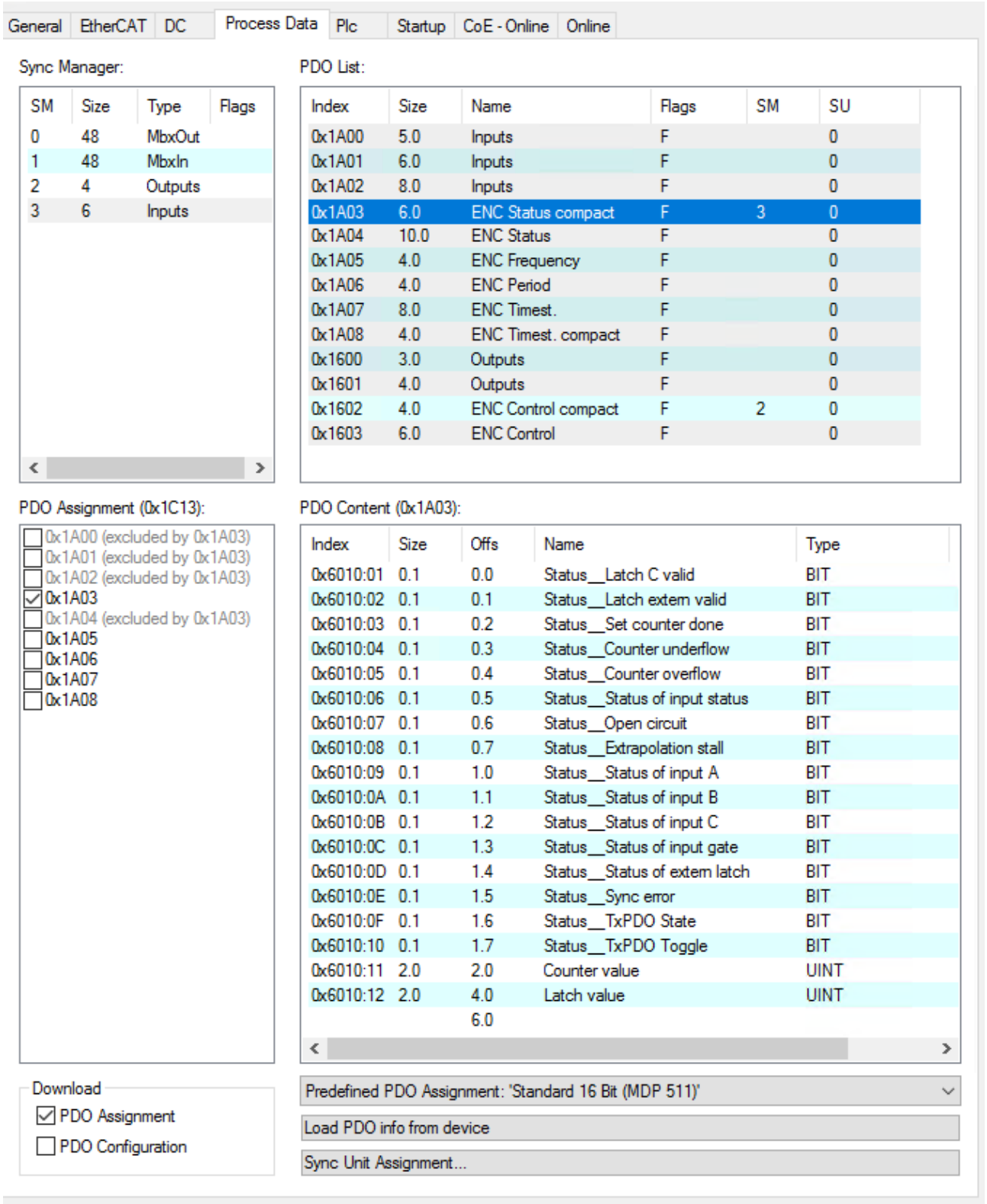


Fig. 43: EL5101 - SM3 Process data tab (Standard 16-bit (MDP511))

12.2.2.2 PDO assignment

The EL5101 offers different process data objects (PDO) in normal and enhanced operation mode. The PDOs of the two operation modes are mutually exclusive.

In this chapter only the PDOs of the enhanced operation mode are described.
Excluded PDOs of the normal operation mode are shown in gray font in the following tables and are described in chapter "Normal operation mode [▶ 62]".

12.2.2.2.1 SM3 - Inputs (0x1A03 .. 0x1A08)

0x1A03 - ENC Status compact (6.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6010:01 [▶ 93] - Status_Latch C valid (0.1) 0x6010:02 [▶ 93] - Status_Latch extern valid (0.1) 0x6010:03 [▶ 93] - Status_Set counter done (0.1) 0x6010:04 [▶ 93] - Status_Counter underflow (0.1) 0x6010:05 [▶ 93] - Status_Counter overflow (0.1) 0x6010:06 [▶ 93] - Status_Status of input status (0.1) 0x6010:07 [▶ 93] - Status_Open circuit (0.1) 0x6010:08 [▶ 93] - Status_Extrapolation stall (0.1) 0x6010:09 [▶ 93] - Status_Status of input A (0.1) 0x6010:0A [▶ 93] - Status_Status of input B (0.1) 0x6010:0B [▶ 93] - Status_Status of input C (0.1) 0x6010:0C [▶ 93] - Status_Status of input gate (0.1) 0x6010:0D [▶ 93] - Status_Status of extern latch (0.1) 0x6010:0E [▶ 93] - Status_Sync error (0.1) 0x6010:0F [▶ 93] - Status_Status TxPDO State (0.1) 0x6010:10 [▶ 93] - Status_Status TxPDO Toggle (0.1) 0x6010:11 [▶ 93] - Counter value (2.0) 0x6010:12 [▶ 93] - Latch value (2.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A04 [▶ 100] - ENC Status (10.0)

0x1A04 - ENC Status (10.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6010:01 [▶ 93] - Status_Latch C valid (0.1) 0x6010:02 [▶ 93] - Status_Latch extern valid (0.1) 0x6010:03 [▶ 93] - Status_Set counter done (0.1) 0x6010:04 [▶ 93] - Status_Counter underflow (0.1) 0x6010:05 [▶ 93] - Status_Counter overflow (0.1) 0x6010:06 [▶ 93] - Status_Status of input status (0.1) 0x6010:07 [▶ 93] - Status_Open circuit (0.1) 0x6010:08 [▶ 93] - Status_Extrapolation stall (0.1) 0x6010:09 [▶ 93] - Status_Status of input A (0.1) 0x6010:0A [▶ 93] - Status_Status of input B (0.1) 0x6010:0B [▶ 93] - Status_Status of input C (0.1) 0x6010:0C [▶ 93] - Status_Status of input gate (0.1) 0x6010:0D [▶ 93] - Status_Status of extern latch (0.1) 0x6010:0E [▶ 93] - Status_Sync error (0.1) 0x6010:0F [▶ 93] - Status_Status TxPDO State (0.1) 0x6010:10 [▶ 93] - Status_Status TxPDO Toggle (0.1) 0x6010:11 [▶ 93] - Counter value (4.0) 0x6010:12 [▶ 93] - Latch value (4.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A03 [▶ 99] - ENC Status compact (6.0)

0x1A05 - ENC Frequency (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6010:13 [▶ 93] - Frequency value (4.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A06 [▶ 100] - ENC Period (4.0)

0x1A06 - ENC Period (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6010:14 [▶ 93] - Period value (4.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A05 [▶ 100] - ENC Frequency (4.0)

0x1A07 - ENC Timest. (8.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6010:16 [▶ 93] - Timestamp (8.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A08 [▶ 101] - ENC Timest. compact (4.0)

0x1A08 - ENC Timest. compact (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6010:16 [▶ 93] - Timestamp (4.0)	Objects for normal operation mode: [▶ 63] 0x1A00 - Inputs (5.0) 0x1A01 - Inputs (6.0) 0x1A02 - Inputs (8.0) Objects for enhanced operation mode: 0x1A07 [▶ 100] - ENC Timest.(8.0)

12.2.2.2.2 SM2 - Outputs (0x1602 .. 0x1603)

0x1602 - ENC Control compact (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7010:01 [▶ 94] - Control_Enable latch C (0.1) 0x7010:02 [▶ 94] - Control_Enable latch extern on positive edge (0.1) 0x7010:03 [▶ 94] - Control_Set counter (0.1) 0x7010:04 [▶ 94] - Control_Enable latch extern on negative edge (0.1) 0x7010:11 [▶ 94] - Set counter value (2.0)	Objects for normal operation mode: [▶ 64] 0x1600 - Outputs (3.0) 0x1601 - Outputs (4.0) Objects for enhanced operation mode: 0x1603 [▶ 96] - ENC Control (6.0)

0x1603 - ENC Control (6.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7010:01 [▶ 94] - Control_Enable latch C (0.1) 0x7010:02 [▶ 94] - Control_Enable latch extern on positive edge (0.1) 0x7010:03 [▶ 94] - Control_Set counter (0.1) 0x7010:04 [▶ 94] - Control_Enable latch extern on negative edge (0.1) 0x7010:11 [▶ 94] - Set counter value (4.0)	Objects for normal operation mode: [▶ 64] 0x1600 - Outputs (3.0) 0x1601 - Outputs (4.0) Objects for enhanced operation mode: 0x1602 [▶ 96] - ENC Control compact (4.0)

12.2.2.3 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.

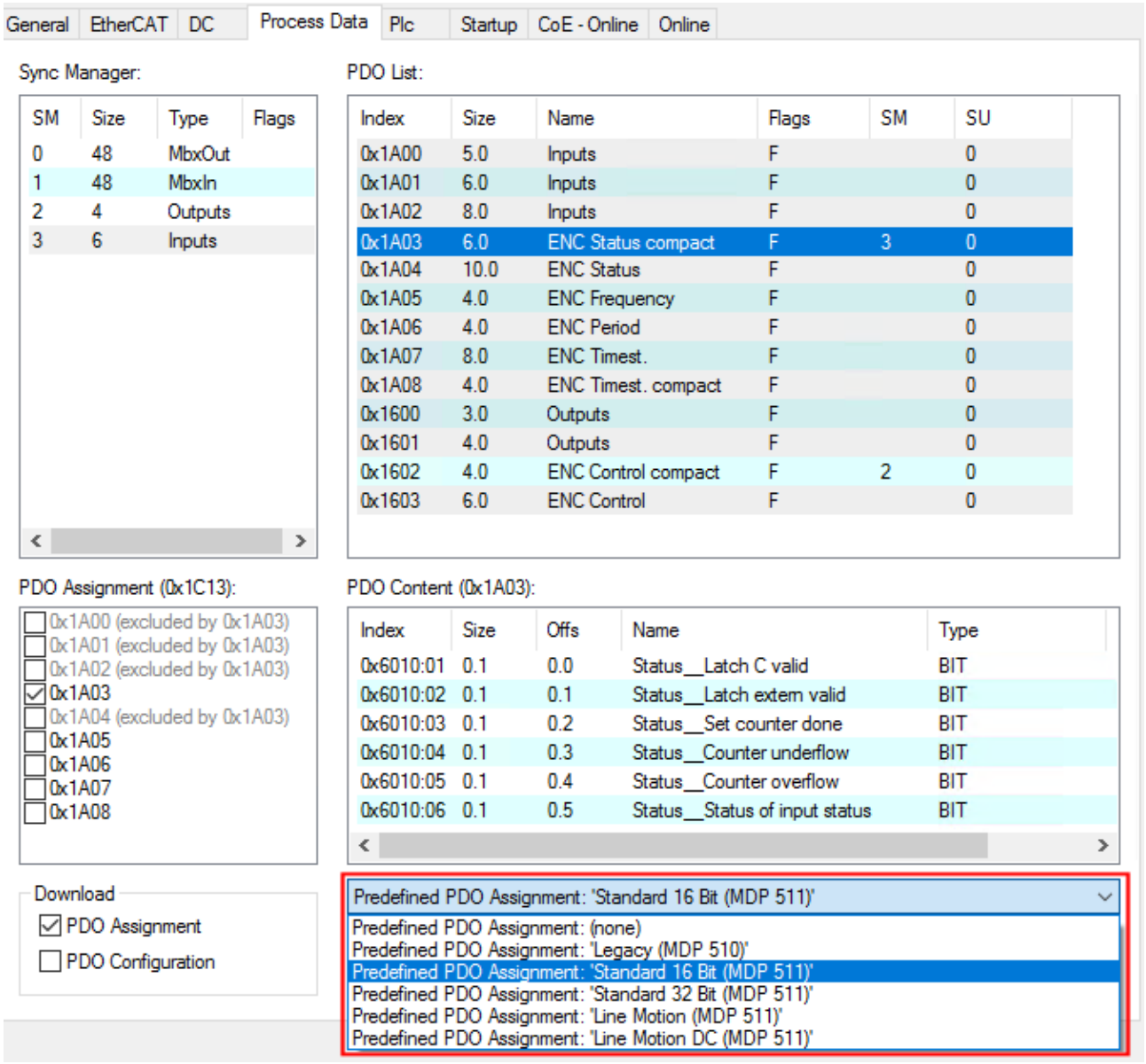


Fig. 44: EL5101 - Process data, Predefined PDO (Default: Standard 16 Bit (MDP 511))

For the enhanced operation mode four PDO assignments are available in modes Standard, and “Line Motion”.

Note on the use of timestamp function

In order to be able to use the timestamp function, the EL5101 must be operated in “DC Synchron” or “DC Synchron (input based)” mode.

Predefined PDO Assignments for “Standard” mode

Predefined PDO Assignment	PDO Assignment
Standard 16 Bit (MDP 511)	**SM3:** 0x1A03 [▶ 99] - ENC Status compact (6.0) **SM2:** 0x1602 [▶ 96] - ENC Control compact (4.0)
Standard 32 Bit (MDP 511)	**SM3:** 0x1A04 [▶ 100] - ENC Status (10.0) **SM2:** 0x1603 [▶ 96] - ENC Control (6.0)

Predefined PDO Assignments for “Line Motion” mode

Predefined PDO Assignment	PDO Assignment
Line Motion (MDP 511)	**SM3:** 0x1A03 [▶ 99] - ENC Status compact (6.0) 0x1A06 [▶ 100] - ENC Period (4.0) **SM2:** 0x1602 [▶ 96] - ENC Control compact (4.0)
Line Motion DC (MDP 511)	**SM3:** 0x1A03 [▶ 99] - ENC Status compact (6.0) 0x1A08 [▶ 101] - ENC Timest. compact (4.0) **SM2:** 0x1602 [▶ 96] - ENC Control compact (4.0)

12.2.3 Features CoE

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

Depending on the main PDO/optional PDOs, further settings can be selected in the CoE list (**C**AN **o**ver **E**therCAT).

The following CoE settings are possible from object 0x8010 [▶ 91] and are shown below in their default settings:

General | EtherCAT | DC | Process Data | Plc | Startup | CoE - Online | Online

Update List | Auto Update | Single Update | Show Offline Data

Advanced...

Add to Startup... | Setting objects | Module OD (AoE Port): 0

Index	Name	Flags	Value	Unit
8001:0	Non-Volatile Settings 1	RW	> 2 <	
8010:0	ENC Settings	RW	> 23 <	
8010:01	Enable C reset	RW	FALSE	
8010:02	Enable extern reset	RW	FALSE	
8010:03	Enable up/down counter	RW	FALSE	
8010:04	Gate polarity	RW	Enable pos. gate (1)	
8010:08	Disable filter	RW	TRUE	
8010:0A	Enable micro increments	RW	FALSE	
8010:0B	Open circuit detection A	RW	TRUE	
8010:0C	Open circuit detection B	RW	TRUE	
8010:0D	Open circuit detection C	RW	FALSE	
8010:0E	Reversion of rotation	RW	FALSE	
8010:10	Extern reset polarity	RW	Rise (1)	
8010:11	Frequency window	RW	0x2710 (10000)	
8010:13	Frequency scaling	RW	0.01Hz (100)	
8010:14	Period scaling	RW	100ns (100)	
8010:15	Frequency resolution	RW	0.01Hz (100)	
8010:16	Period resolution	RW	100ns (100)	
8010:17	Frequency wait time	RW	0x0640 (1600)	
A010:0	ENC Diag data	RO	> 3 <	

Fig. 45: “CoE online” tab

The parameters are described on page Object description and parameterization [▶ 90].

Frequency

- The time window for the frequency calculation and the resolution can be parameterized in CoE objects 0x8010:11 [▶ 91], 0x8010:13 [▶ 91], 0x8010:15 [▶ 91], 0x8010:17 [▶ 91].
- The positive edges of track A are counted within the specified timeframe and the next edge including the time up to it are counted. The waiting time can be set in CoE object 0x8010:17 “Frequency Wait Time” (unit: ms). The default value is 1.6 sec. This is also the maximum value.
- The time window is 10 ms (default), min. 1 µs. With the default setting it is possible to measure frequencies up to approx. 800 kHz. At higher frequencies a smaller value must be selected for the timeframe.
- The time is measured with a resolution of 100 ns.
- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- No frequency measurement is possible if the counter is blocked by the gate. In this case the period can be measured regardless.
- If an encoder signal only is only present at input A/A and the frequency/period is to be measured, the terminal must be set to “Up/Down Counter” in CoE 0x8010:03 [▶ 91].
- A C or external reset restarts the frequency measurement. The last frequency value remains unchanged until a new frequency value is determined.

Frequency measurement

- Basic unit 1 µs: all window sizes

Measurement sequence

- The measurement starts with a positive edge at track A. The current counter value and time (resolution: 100 ns) are stored.
- After the measuring window time has elapsed (index 0x8010:11 [▶ 91]), the system waits for the following rising edge at track A or a maximum of 1.6 sec or the time from 0x8010:17 [▶ 91]
- The frequency is calculated from the edge difference and the actual elapsed time.

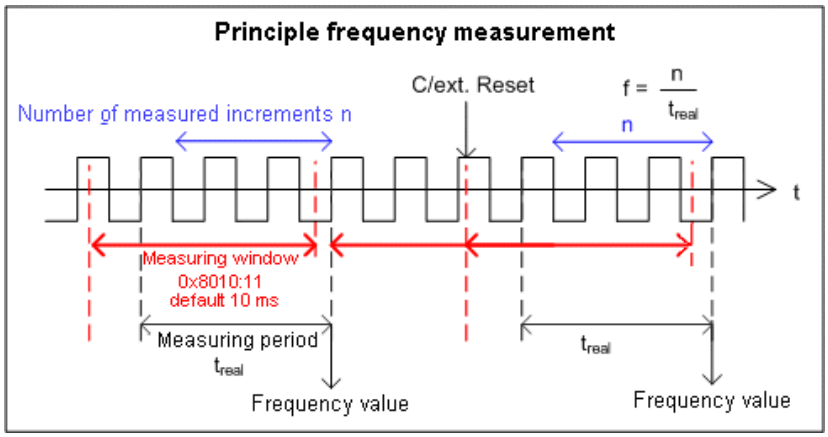


Fig. 46: Frequency measurement principle in enhanced operation mode

Period calculation

- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- In each cycle the interval between two positive edges of input A is counted with a resolution of 100 ns.
- If no edge change occurs for approx. 1.6 s, any period specification is cancelled.

Frequency and period measurement

From the explanatory notes above it is apparent that the frequency measurement can measure the current axis status (velocity) significantly more accurately than the period measurement. Frequency measurement is therefore preferable, if possible.

Latch

- **Activating the latch C input (C) and latching the counter value**
  - Upon the first external latch pulse (positive edge at input C) after setting the bit in the output process data “Enable latch C” (index 0x7010:01) = TRUE, the counter value is saved (this takes precedence over the process data “Enable latch extern on postitive/negative edge” (index 0x7010:02/0x7010:04)).
    Subsequent pulses at the other inputs have no effect on the latch value in the input process data “Latch value” (index 0x6010:12) when the bit is set.

“Latch C valid” bit

Only when the value in the input process data “Latch C valid” (index 0x6010:01) is FALSE can a new counter value be written to the latch input.

- **Activating the external latch input (“gate/latch”) and latching the counter value**
  - If the bit in the process data “Enable latch extern on positive edge” = TRUE (index 0x7010:02), the counter value is stored in the latch input in the input process data “Latch value” (index 0x6010:12) upon the first external latch pulse with a rising edge. The following pulses have no effect on the latch value in the input process data “Latch value” (index 0x6010:12).
  - If the bit in the process data “Enable latch extern on negative edge” = TRUE (index 0x7010:04), the counter value is stored in the latch input in the input process date “Latch value” (index 0x6010:12) upon the first external latch pulse with a falling edge. The following pulses have no effect on the latch value in the input process data “Latch value” (index 0x6010:12).

“Latch extern valid” bit

Only when the value in the input process data “Latch external valid” (index 0x6010:02) is FALSE can a new counter value be written to the latch input.

Reset

- Counter reset (index 0x8010:01 [▶ 91], 0x8010:02 [▶ 91], 0x8010:10 [▶ 91]): For a counter reset via input C set the bit in index 0x8010:01 [▶ 91], for a reset via the external latch input set the bit in index 0x8010:02 [▶ 91].
- The functions “Enable C reset” (0x8010:01 [▶ 91]) and “Enable extern reset” (0x8010:02 [▶ 91]) cannot be activated simultaneously.
- Note for “Extern reset polarity”, index 0x8010:10 [▶ 91]: The edge for setting the counter to zero can be selected via index 0x8010:10 [▶ 91].
  Bit not set: counter is set to zero with falling edge.
  Bit set: counter is set to zero with rising edge.

Up/down counter

- The mode (encoder or up/down counter) is set via the CoE objects (profile-specific objects, tab CoE - Online, index 0x8010:03 [▶ 91] “Enable up/down counter”). Click on the corresponding row of the index to be parameterized, enter 1 in the SetValue dialog and confirm with OK.
- Set the gate polarity accordingly via index 0x8010:04 [▶ 91].
- An additional option for reversing the rotation direction is available by setting the bit in index 0x8010:0E [▶ 91].

Over-/underflow

- When combined with an enabled reset function (C/external), the over/underflow check is disabled.
- The bit in the input process data “Counter underflow” (index 0x6010:04 [▶ 93]) is set when an underflow …00 →…FF occurs. It is reset if 2/3 of the counter range is underrun.
- The bit in the input process data “Counter overflow” (index 0x6010:05 [▶ 93]) is set when an overflow from FF… to 00… occurs. It is reset if 1/3 of the counter range is exceeded.

Wire break detection “Open circuit detection”

- A separate wire break detection can be activated for each of the channels A, B, and C (index 0x8010:0B [▶ 91], 0x8010:0C [▶ 91], 0x8010:0D [▶ 91]).
- Wire break detection is activated for channels A and B by default.
- A differential voltage of typ. -1.5 V > Vid > +1.5 V is detected as a wire break.
- A detected wire break is indicated by setting the bit in the process data “Open circuit” (Index 0x6010:07) to TRUE. A wire break is also indicated separately in indices 0xA010:01 [▶ 94] (track A), 0xA010:02 [▶ 94] (track B), and 0xA010:03 [▶ 94] (track C).
- The bit in the input process data “TxPDO State” also becomes TRUE when a wire break is detected, since the data must be assumed to be invalid.

NOTICE

Wire break detection “Open circuit detection” vs. Single-ended cables (TTL interface)

Due to the nature of the technology, “Wire break detection” does not work with single-ended cables (TTL interface).

Micro-increments

- Works with and without distributed clocks, but is only meaningful in conjunction with one of the DC modes
- By setting the counter value only the integer component can be modified.
- The principle:

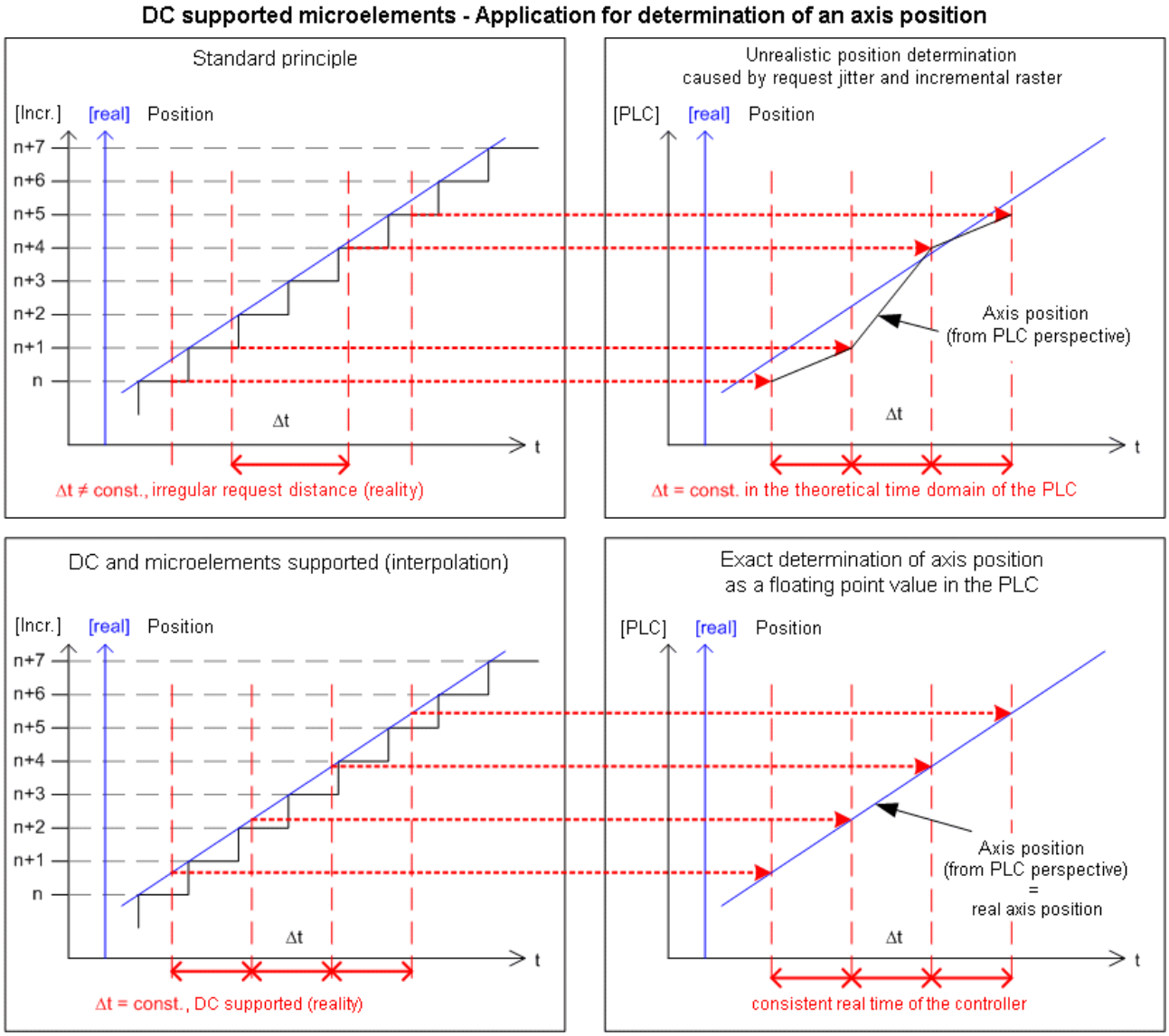


Fig. 47: Frequency measurement principle in enhanced operation mode

The highly constant query cycles (accuracy: 100 ns) of the distributed clocks systems enable the terminal to interpolate axis positions between the counted encoder increments from a certain speed. The interpolation resolution is 8 bit, corresponding to 256 values. A standard encoder with 1,024 bars with 4-fold evaluation and micro-increments thus becomes a high-resolution axis encoder with 4096 * 256 = 1,048,576 bars. Underrunning of the minimum velocity is indicated by the object 0x6010:08 [▶ 93] (extrapolation stall) in the process data.

12.2.4 Object description and parameterization - enhanced operation mode

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

12.2.4.1 Restore object

Index 1011 Restore default parameters

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

12.2.4.2 Configuration data

Index 8010 ENC Settings (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	ENC Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
8010:01	Enable C reset [▶ 87]	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8010:02	Enable extern reset [▶ 87]	A counter reset is triggered via the external latch input (24 V).	BOOLEAN	RW	0x00 (0_{dec})
8010:03	Enable up/down counter [▶ 87]	Enablement of the V/R counter in place of the encoder with the bit set. Increments are counted at input A. Input B specifies the counting direction.	BOOLEAN	RW	0x00 (0_{dec})
8010:04	Gate polarity [▶ 87]	0: Disable gate 1: Enable pos. gate (gate locks with high level) 2: Enable neg. gate (gate locks with low-level)	BIT2	RW	0x01 (1_{dec})
8010:08	Disable filter	0: Activates the input filter (inputs A, /A, B, /B, C, /C only) 1: Disables the input filter When the filter is enabled, a signal edge must last at least 2.4 µs to be counted as an increment.	BOOLEAN	RW	0x01 (1_{dec})
8010:0A	Enable micro increments [▶ 89]	When enabled, the terminal interpolates micro-increments between the integer encoder increments in DC mode. The lower 8 bits of the Counter-Value are used for the display. A 32 bit counter thus becomes a 24+8 bit counter, a 16 bit counter becomes an 8+8 bit counter.	BOOLEAN	RW	0x00 (0_{dec})
8010:0B	Open circuit detection A [▶ 88]	A wire break on track A is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0C	Open circuit detection B [▶ 88]	A wire break on track B is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0D	Open circuit detection C [▶ 88]	A wire break on track C is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x00 (0_{dec})
8010:0E	Reversion of rotation [▶ 87]	Enables reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})
8010:10	Extern reset polarity [▶ 87]	0: Fall (the counter is set to zero with a falling edge) 1: Rise (the counter is set to zero with a rising edge)	BIT1	RW	0x01 (1_{dec})
8010:11	Frequency window [▶ 86]	This is the minimal time used for determining the frequency. Default value: 10 ms [Resolution: 1 µs] The number of pulses in the timeframe plus the next one is measured. The wait will last no longer than “Frequency Wait Time”. The number of pulses is divided by the actual timeframe size. The calculated frequency is output to index 0x6010:13 [▶ 93] and as a process data value. The frequency calculation is performed locally and does not use the distributed clock function.	UINT16	RW	0x2710 (10000_{dec})
8010:13	Frequency scaling [▶ 86]	Scaling of the frequency measurement (must be divided by this value to obtain the unit in Hz): 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})

Index 8010 ENC Settings (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:14	Period scaling [▶ 86]	Resolution of the period value in the process data: 100: The “100 ns” period duration value is a multiple of 100 ns 500: The “500 ns” period duration value is a multiple of 500 ns	UINT16	RW	0x0064 (100_{dec})
8010:15	Frequency resolution [▶ 86]	Resolution of the frequency measurement: 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})
8010:16	Period resolution [▶ 86]	Internal resolution of the interval measurement: 100: “100 ns” Period value is a multiple of 100 ns Internally, the period is calculated with 100 ns resolution. The max. measurable period can then be approx. 1.6 seconds. 500: “500 ns” Period value is a multiple of 500 ns Internally, the period is calculated with 500 ns resolution, the maximum measurable period can be approx. 32.7 ms. The resolution of process data continues to be the value according to index 0x8010:14 [▶ 91] (e.g. 100 ns [default]).	UINT16	RW	0x0064 (100_{dec})
8010:17	Frequency Wait Time [▶ 86]	Waiting time [ms] for frequency measurement Once the time specified in the “Frequency window [▶ 86]” has elapsed, the system waits for the next positive edge from track A. This enables the update speed for the “Frequency” process data to be optimized, depending on the expected frequencies. At least double the period value of the minimum frequency to be measured should be entered here. t >= 2* (1 / f_{min})	UINT16	RW	0x0640 (1600_{dec})

12.2.4.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6010 ENC Inputs (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	ENC Inputs	Maximum subindex	UINT8	RO	0x16 (22_{dec})
6010:01	Latch C valid [▶ 87]	The counter value was latched with the C input. The data in the process data field “Latch value” (index 0x6010:12) corresponds to the latched value when the bit is set. To reactivate the latch input, the bit in the process data “Enable latch C” (index 0x7010:01 [▶ 94]) must first be cleared and then set again.	BOOLEAN	RO	0x00 (0_{dec})
6010:02	Latch extern valid [▶ 87]	The counter value was locked via the external latch. The data in the process data field “Latch value” (index 0x6010:12) corresponds to the latched value when the bit is set. To reactivate the latch input, the bit in the process data “Enable latch extern on positive/ negative edge” (index 0x7010:02 [▶ 94]/0x7010:04 [▶ 94]) must first be cleared 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 [▶ 88]	The counter has crossed the zero crossing backwards. In combination with a reset function (C/external), the underflow/overflow control is ineffective.	BOOLEAN	RO	0x00 (0_{dec})
6010:05	Counter overflow [▶ 88]	Counter overflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0_{dec})
6010:06	Status of input status	State of the status input (alarm “input 1”)	BOOLEAN	RO	0x00 (0_{dec})
6010:07	Open circuit [▶ 88]	Indicates a wire break. Configuration via index 0x8010:0B [▶ 91], 0x8010:0C [▶ 91], 0x8010:0D [▶ 91]	BOOLEAN	RO	0x00 (0_{dec})
6010:08	Extrapolation stall [▶ 89]	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})
6010:0B	Status of input C	Status of input C	BOOLEAN	RO	0x00 (0_{dec})
6010:0C	Status of input gate	The state of the gate input	BOOLEAN	RO	0x00 (0_{dec})
6010:0D	Status of extern latch	State 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})
6010:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	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})
6010:13	Frequency value [▶ 91]	The frequency (setting of the scaling and resolution in index 0x8010:13 [▶ 91] and 0x8010:15 [▶ 91])	UINT32	RO	0x00000000 (0_{dec})
6010:14	Period value [▶ 91]	The period (setting of the scaling and resolution in index 0x8010:14 [▶ 91] and 0x8010:16 [▶ 91])	UINT32	RO	0x00000000 (0_{dec})
6010:16	Timestamp [▶ 77]	Timestamp of the last counter change	UINT64	RO	

12.2.4.4 Output data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 7010 ENC Outputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7010:01	Enable latch C [▶ 87]	Activate latching via input C.	BOOLEAN	RO	0x00 (0_{dec})
7010:02	Enable latch extern on positive edge [▶ 87]	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 [▶ 87]	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 [▶ 94]).	UINT32	RO	0x00000000 (0_{dec})

12.2.4.5 Information / diagnostic data (channel specific)

Index A010 ENC Diag data (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
A010:0	ENC Diag data	Maximum subindex	UINT8	RO	0x03 (3_{dec})
A010:01	Open circuit A [▶ 88]	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A010:02	Open circuit B [▶ 88]	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A010:03	Open circuit C [▶ 88]	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})

12.2.4.6 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 low word contains the CoE profile used (5001). • The high 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	EL5101

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	09

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	10

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave, • Low word ◦ 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 RxPDO-Par Outputs (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1400:0	RxPDO-Par Outputs	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[6]	RO	01 16 02 16 03 16

Index 1401 RxPDO-Par Outputs Word-Aligned (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	RxPDO-Par Outputs Word-Aligned	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[6]	RO	00 16 02 16 03 16

Index 1402 ENC RxPDO-Par Control compact (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1402:0	ENC RxPDO-Par Control compact	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[6]	RO	03 16 00 16 01 16

Index 1403 ENC RxPDO-Par Control (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1403:0	ENC RxPDO-Par Control	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[6]	RO	02 16 00 16 01 16

Index 1600 RxPDO-Map Outputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RxPDO-Map Outputs	PDO Mapping RxPDO 1	UINT8	RO	0x02 (2_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1601 RxPDO-Map Outputs Word-Aligned (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	RxPDO-Map Outputs Word-Aligned	PDO Mapping RxPDO 2	UINT8	RO	0x03 (3_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1601:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1602 ENC RxPDO-Map Control compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	ENC RxPDO-Map Control compact	PDO Mapping RxPDO 3	UINT8	RO	0x07 (7_{dec})
1602:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7010:01, 1
1602:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1602:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 16

Index 1603 ENC RxPDO-Map Control (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	ENC RxPDO-Map Control	PDO Mapping RxPDO 4	UINT8	RO	0x07 (7_{dec})
1603:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7010:01, 1
1603:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1603:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 32

Index 1800 TxPDO-Par Inputs (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	TxPDO-Par Inputs	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[14]	RO	01 1A 03 1A 04 1A 05 1A 06 1A 07 1A 08 1A

Index 1801 TxPDO-Par Inputs Word-Aligned (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	TxPDO-Par Inputs Word-Aligned	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[14]	RO	00 1A 03 1A 04 1A 05 1A 06 1A 07 1A 08 1A

Index 1802 TxPDO-Par Inputs Optional (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	TxPDO-Par Inputs Optional	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[14]	RO	03 1A 04 1A 05 1A 06 1A 07 1A 08 1A 00 00

Index 1803 ENC TxPDO-Par Status compact (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	ENC TxPDO-Par Status compact	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[14]	RO	04 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00

Index 1804 ENC TxPDO-Par Status (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	ENC TxPDO-Par Status	PDO Parameter TxPDO 5	UINT8	RO	0x06 (6_{dec})
1804:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 5.	OCTET-STRING[14]	RO	03 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00

Index 1805 ENC TxPDO-Par Frequency (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1805:0	ENC TxPDO-Par Frequency	PDO Parameter TxPDO 6	UINT8	RO	0x06 (6_{dec})
1805:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 6.	OCTET-STRING[14]	RO	00 1A 01 1A 02 1A 06 1A 00 00 00 00 00 00

Index 1806 ENC TxPDO-Par Period (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1806:0	ENC TxPDO-Par Period	PDO Parameter TxPDO 7	UINT8	RO	0x06 (6_{dec})
1806:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 7.	OCTET-STRING[14]	RO	00 1A 01 1A 02 1A 05 1A 00 00 00 00 00 00

Index 1807 ENC TxPDO-Par Timest. (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1807:0	ENC TxPDO-Par Timest.	PDO Parameter TxPDO 8	UINT8	RO	0x06 (6_{dec})
1807:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 8.	OCTET-STRING[14]	RO	08 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00

Index 1808 ENC TxPDO-Par Timest. compact (EL5101)

Index (hex)	Name	Meaning	Data type	Flags	Default
1808:0	ENC TxPDO-Par Timest. compact	PDO Parameter TxPDO 9	UINT8	RO	0x06 (6_{dec})
1808:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 9.	OCTET-STRING[14]	RO	07 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00

Index 1A00 TxPDO-Map Inputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	TxPDO-Map Inputs	PDO Mapping TxPDO 1	UINT8	RO	0x03 (3_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A01 TxPDO-Map Inputs Word-Aligned (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	TxPDO-Map Inputs Word-Aligned	PDO Mapping TxPDO 2	UINT8	RO	0x04 (4_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A01:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A02 TxPDO-Map Inputs Optional (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	TxPDO-Map Inputs Optional	PDO Mapping TxPDO 3	UINT8	RO	0x03 (3_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x04 (Frequency))	UINT32	RO	0x6000:04, 32
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x05 (Period))	UINT32	RO	0x6000:05, 16
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x06 (Window))	UINT32	RO	0x6000:06, 16

Index 1A03 ENC TxPDO-Map Status compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	ENC TxPDO-Map Status compact	PDO Mapping TxPDO 4	UINT8	RO	0x12 (18_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A03:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A03:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x06 (Status of input status))	UINT32	RO	0x6010:06, 1
1A03:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A03:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A03:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A03:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A03:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A03:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A03:0D	SubIndex 013	13. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A03:0E	SubIndex 014	14. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E: 1
1A03:0F	SubIndex 015	15. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO-State))	UINT32	RO	0x6010:0F, 1
1A03:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO-Toggle))	UINT32	RO	0x6010:10, 1
1A03:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 16
1A03:12	SubIndex 018	18. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 16

Index 1A04 ENC TxPDO-Map Status (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	ENC TxPDO-Map Status	PDO Mapping TxPDO 5	UINT8	RO	0x12 (18_{dec})
1A04:01	SubIndex 001	PDO Mapping entry no. 1 (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A04:02	SubIndex 002	PDO Mapping entry no. 2 (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A04:03	SubIndex 003	PDO Mapping entry no. 3 (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A04:04	SubIndex 004	PDO Mapping entry no. 4 (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A04:05	SubIndex 005	PDO Mapping entry no. 5 (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A04:06	SubIndex 006	PDO Mapping entry no. 6 (object 0x6010 (ENC Inputs), entry 0x06 (input status))	UINT32	RO	0x6010:06, 1
1A04:07	SubIndex 007	PDO Mapping entry no. 7 (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A04:08	SubIndex 008	PDO Mapping entry no. 8 (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A04:09	SubIndex 009	PDO Mapping entry no. 9 (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A04:0A	SubIndex 010	PDO Mapping entry no. 10 (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A04:0B	SubIndex 011	PDO Mapping entry no. 11 (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A04:0C	SubIndex 012	PDO Mapping entry no. 12 (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A04:0D	SubIndex 013	PDO Mapping entry no. 13 (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A04:0E	SubIndex 014	PDO Mapping entry no. 14 (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A04:0F	SubIndex 015	PDO Mapping entry no. 15 (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6010:0F, 1
1A04:10	SubIndex 016	PDO Mapping entry no. 16 (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A04:11	SubIndex 017	PDO Mapping entry no. 17 (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32
1A04:12	SubIndex 018	PDO Mapping entry no. 18 (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 32

Index 1A05 ENC TxPDO-Map Frequency (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	ENC TxPDO-Map Frequency	PDO Mapping TxPDO 6	UINT8	RO	0x01 (1_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x13 (Frequency value))	UINT32	RO	0x6010:13, 32

Index 1A06 ENC TxPDO-Map Period (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	ENC TxPDO-Map Period	PDO Mapping TxPDO 7	UINT8	RO	0x01 (1_{dec})
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x14 (Period value))	UINT32	RO	0x6010:14, 32

Index 1A07 ENC TxPDO-Map Timest. (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	ENC TxPDO-Map Timest.	PDO Mapping TxPDO 8	UINT8	RO	0x01 (1_{dec})
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6010:16, 64

Index 1A08 ENC TxPDO-Map Timest. compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A08:0	ENC TxPDO-Map Timest. compact	PDO Mapping TxPDO 9	UINT8	RO	0x01 (1_{dec})
1A08:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6010:16, 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	0x01 (1_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:03	SubIndex 003	3rd 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 • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • 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	0x00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	With this entry the real required process data provision time can be measured. • 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 [▶ 103], 0x1C33:06, and 0x1C33:09 [▶ 103] are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only).	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 102]	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC mode only)	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 [▶ 102] or 0x1C33:08)	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 102]	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	as 0x1C32:08 [▶ 102]	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 [▶ 102]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 102]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 102]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 102]	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 spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0002 (2_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Maximum subindex	UINT8	RW	0x02 (2_{dec})
F010:01	SubIndex 001	reserved	UINT32	RW	0x000001FE (510_{dec})
F010:02	SubIndex 002	reserved	UINT32	RW	0x000001FF (511_{dec})

12.2.5 Single-ended connection for TTL encoder

In addition to encoders with differential RS422 interface, single-ended encoders with TTL interface are also supported. Please note the following:

- Operating mode selection encoder 0x8010:03 [▶ 91] “Enable up/down counter” = FALSE.
- The differential inputs (/A, /B, /C) must remain open and must not be connected to ground.
- The option to reverse the direction of rotation is given by setting the bit in index 0x8010:0E [▶ 91] “Reversion of rotation” = TRUE.
- The open circuit detection does not work in principle conditionally with single-ended connection.

13 EL5101-0010 - Commissioning

13.1 Enhanced operation mode

13.1.1 Operation modes

In EL5101-0010 “Enhanced operation mode” the following modes are available:

Mode	DC	Main PDO	Comment	Optional PDO 1	Comment	Optional PDO 2	Comment	Features CoE	Comment
7	FreeRun	0x1A00 [▶ 123] + 0x1600 [▶ 121]	Count/Latch in 32 bit	0x1A03 [▶ 124] or 0x1A02 [▶ 124]	Frequency (32 Bit) or Period (32 Bit)	--		0x8000:nn [▶ 117]	CoE combinations 0x8000:nn [▶ 117]
8	"	0x1A01 [▶ 124] + 0x1601 [▶ 122]	**compact**: 16 bit count/ latch	"	"	--		"	"
9	DC/DCi	0x1A00 [▶ 123] + 0x1600 [▶ 121]	Count/Latch in 32 bit	"	"	0x1A04 [▶ 124] or 0x1A05 [▶ 125]	64-bit timestamp 32-bit timestamp (compact)	"	"
10	"	0x1A01 [▶ 124] + 0x1601 [▶ 122]	**compact**: 16 bit count/ latch	"	"	"	"	"	"

Settings other than those listed above may result in irregular process data and error messages in the TwinCAT System Manager logger window.

EL5101 parameterization

- To clear any previous settings, if necessary, perform a CoE reset (see the EtherCAT system manual, chapter “Restoring factory settings”).
- To activate the new operation mode, reload the EtherCAT slaves (button  in the System Manager)

DC (Distributed Clocks)

Describes whether the terminal is operated with distributed clocks support:

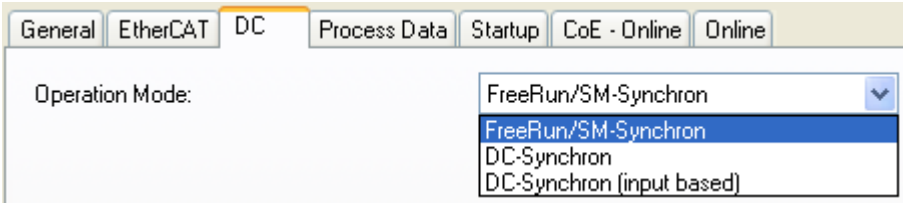


Fig. 48: “DC” tab

- **FreeRun**: the terminal operates frame-triggered. Cyclic operation is started via the SyncManagers of the EtherCAT frame processing.
- **DC-Synchron**: cyclic operation in the terminal is started by the local distributed clock at exact intervals. The start time is chosen such that it coincides with other output slaves in the EtherCAT system.
- **DC-Synchron (input based)**: as DC-Synchron mode, with the cyclic start time chosen such that it coincides with other input slaves in the EtherCAT system.

13.1.2 Process data

Main PDO

Selection of basic process data

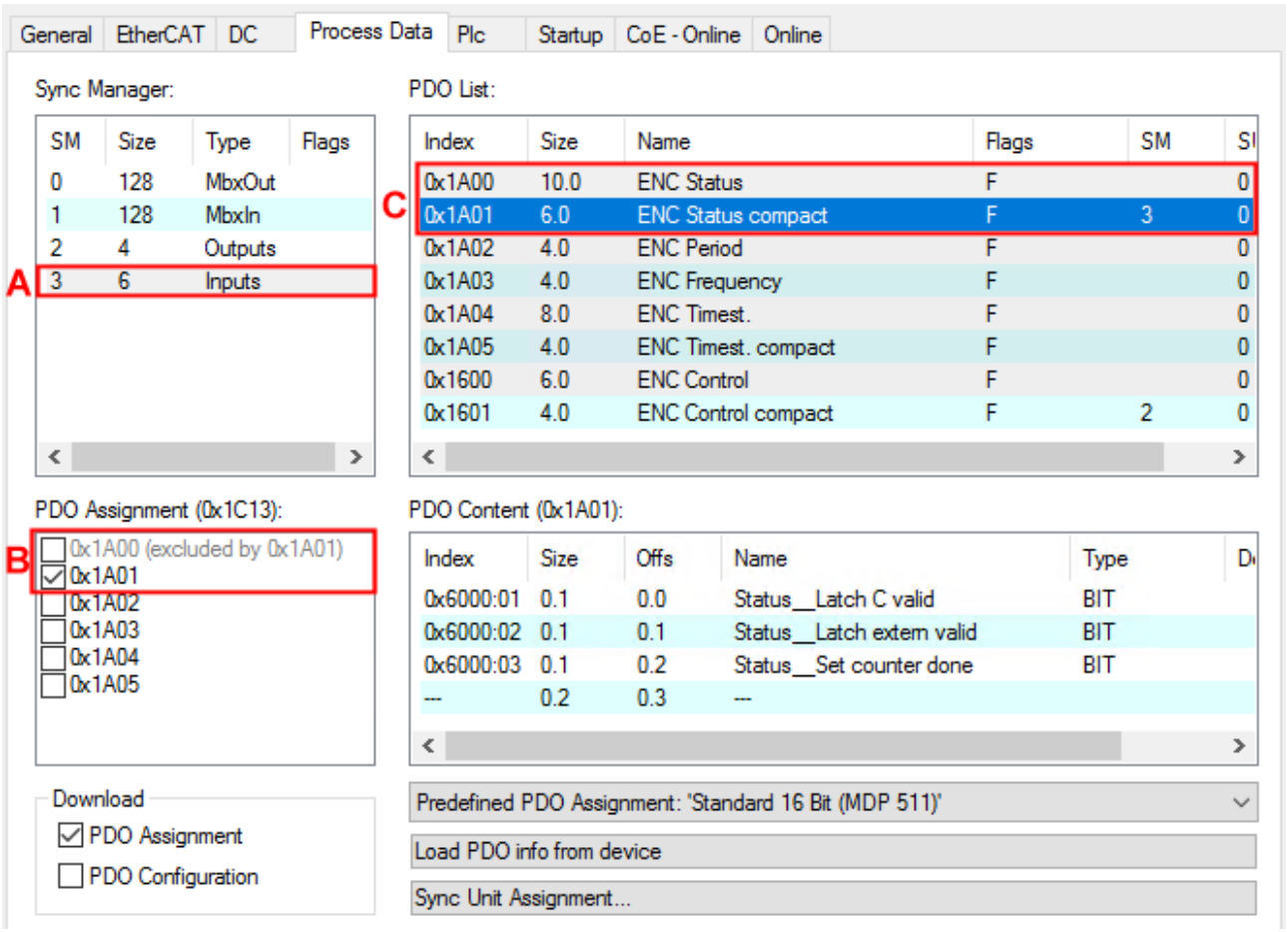


Fig. 49: “Process data” tab
A: Selection of data direction: input or output
B: Selection of (optional) PDOs (process data objects)
C: Explanatory notes for PDOs

compact: The process data can be represented with 16 bits (compact) or with 32 bits.

Optional PDOs

Optional PDOs, in addition to the main PDO:

- PDO 1 (0x1A03 [▶ 124] or 0x1A02 [▶ 124]): The **frequency** or the **period** can be selected as optional PDO 1
- PDO 2 (0x1A05 [▶ 125] or 0x1A04 [▶ 124]): In one of the DC modes a 32 bit or 64 bit **timestamp** can be selected. The timestamp specifies the time of the last registered increment edge, based on the DistributedClocks system.

Process data description

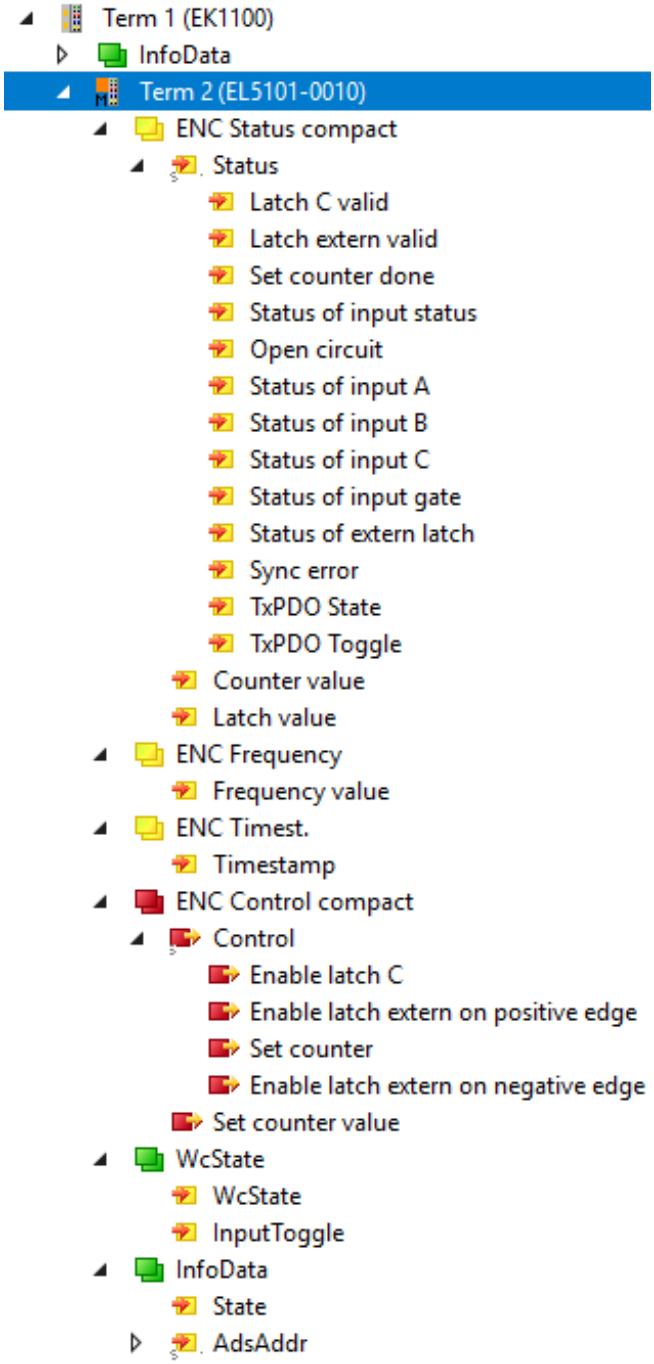


Fig. 50: Process data description

The process data are generated from CoE objects 0x6000 (inputs) and 0x7000 (outputs) and are described in section “Object description and parameterization [▶ 116]”

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

13.1.2.1 Sync Manager (SM)

The scope of the offered process data can be changed via the “Process Data” tab (see illustration below).

For a detailed description of how to configure the process data, see the “EtherCAT subscriber configuration” chapter in the EtherCAT System Manual.

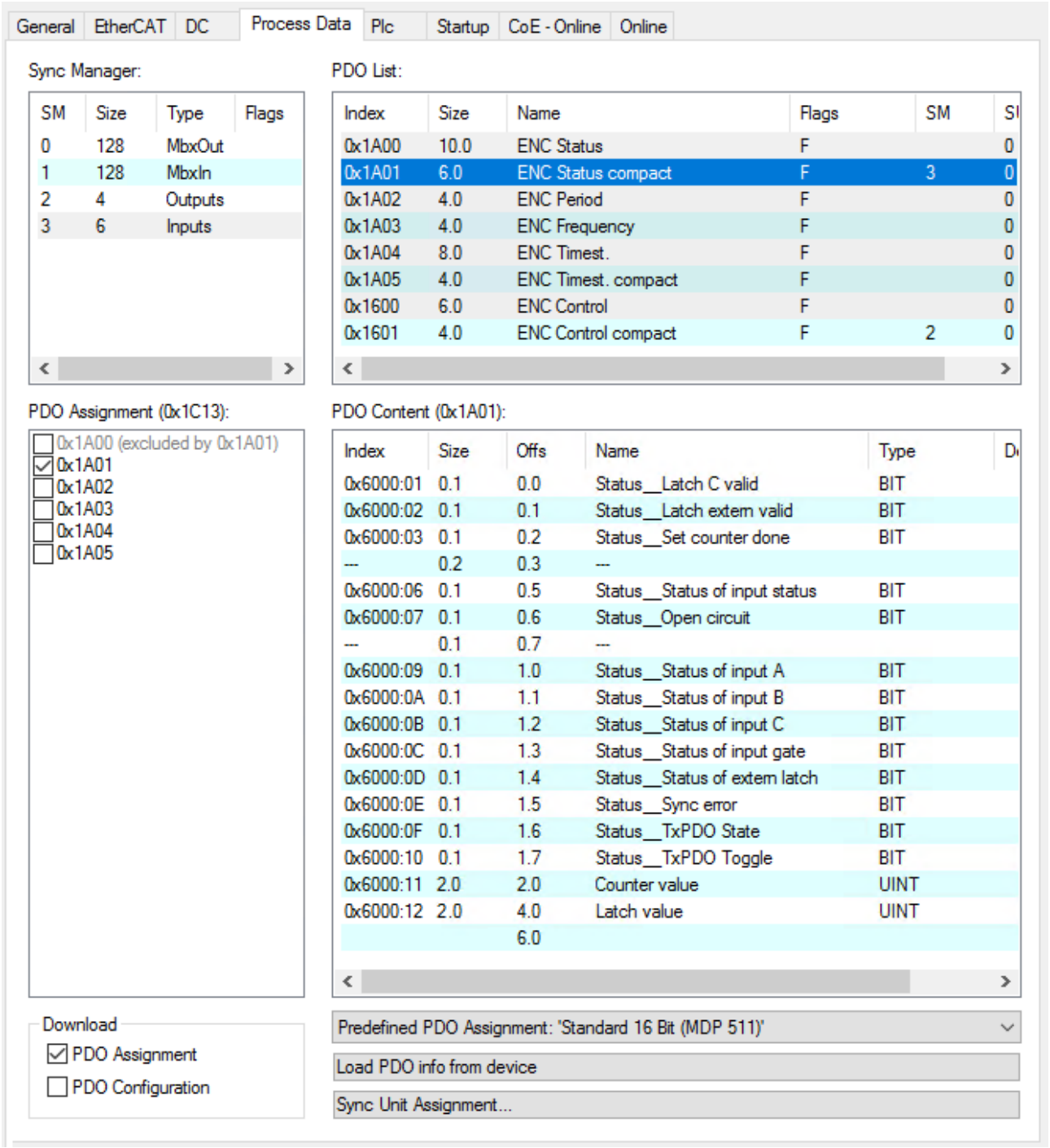


Fig. 51: EL5101-0010 - Process data tab SM3 (default)

13.1.2.2 PDO assignment

This chapter describes the assignment of the Process data objects (PDO) of the EL5101-0010 terminal.

13.1.2.2.1 SM3 - Inputs (0x1A00 .. 0x1A05)

0x1A00 - ENC Status (10.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6000:01 [▶ 119] - Status_Latch C valid (0.1) 0x6000:02 [▶ 119] - Status_Latch extern valid (0.1) 0x6000:03 [▶ 119] - Status_Set counter done (0.1) 0x6000:06 [▶ 119] - Status_Status of input status (0.1) 0x6000:07 [▶ 119] - Status_Open circuit (0.1) 0x6000:09 [▶ 119] - Status_Status of input A (0.1) 0x6000:0A [▶ 119] - Status_Status of input B (0.1) 0x6000:0B [▶ 119] - Status_Status of input C (0.1) 0x6000:0C [▶ 119] - Status_Status of input gate (0.1) 0x6000:0D [▶ 119] - Status_Status of extern latch (0.1) 0x6000:0E [▶ 119] - Status_Sync error (0.1) 0x6000:0F [▶ 119] - Status_Status TxPDO State (0.1) 0x6000:10 [▶ 119] - Status_Status TxPDO Toggle (0.1) 0x6000:11 [▶ 119] - Counter value (4.0) 0x6000:12 [▶ 119] - Latch value (4.0)	0x1A01 [▶ 124] - ENC Status compact (6.0)

0x1A01 - ENC Status compact (6.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x6000:01 [▶ 119] - Status_Latch C valid (0.1) 0x6000:02 [▶ 119] - Status_Latch extern valid (0.1) 0x6000:03 [▶ 119] - Status_Set counter done (0.1) 0x6000:06 [▶ 119] - Status_Status of input status (0.1) 0x6000:07 [▶ 119] - Status_Open circuit (0.1) 0x6000:09 [▶ 119] - Status_Status of input A (0.1) 0x6000:0A [▶ 119] - Status_Status of input B (0.1) 0x6000:0B [▶ 119] - Status_Status of input C (0.1) 0x6000:0C [▶ 119] - Status_Status of input gate (0.1) 0x6000:0D [▶ 119] - Status_Status of extern latch (0.1) 0x6000:0E [▶ 119] - Status_Sync error (0.1) 0x6000:0F [▶ 119] - Status_Status TxPDO State (0.1) 0x6000:10 [▶ 119] - Status_Status TxPDO Toggle (0.1) 0x6000:11 [▶ 119] - Counter value (2.0) 0x6000:12 [▶ 119] - Latch value (2.0)	0x1A00 [▶ 123] - ENC Status (10.0)

0x1A02 - ENC Period (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6000:14 [▶ 119] - Period value (4.0)	0x1A03 [▶ 124] - ENC Frequency (4.0)

0x1A03 - ENC Frequency (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6000:13 [▶ 119] - Frequency value (4.0)	0x1A02 [▶ 124] - ENC Period (4.0)

0x1A04 - ENC Timest. (8.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6000:16 [▶ 119] - Timestamp (8.0)	0x1A05 [▶ 125] - ENC Timest. compact (4.0)

0x1A05 - ENC Timest. compact (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index name size (byte.bit)**
0x6000:16 [▶ 119] - Timestamp (4.0)	0x1A04 [▶ 124] - ENC Timest. (8.0)

13.1.2.2.2 SM2 - Outputs (0x1600 .. 0x1601)

0x1600 - ENC Control (6.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7000:01 [▶ 120] - Control_Enable latch C (0.1) 0x7000:02 [▶ 120] - Control_Enable latch extern on positive edge (0.1) 0x7000:03 [▶ 120] - Control_Set counter (0.1) 0x7000:04 [▶ 120] - Control_Enable latch extern on negative edge (0.1) 0x7000:11 [▶ 120] - Set counter value (4.0)	0x1601 [▶ 122] - ENC Control compact (4.0)

0x1601 - ENC Control compact (4.0)	
Contents **Index - name size (byte.bit)**	**Excluded PDOs** **Index - name size (byte.bit)**
0x7000:01 [▶ 120] - Control_Enable latch C (0.1) 0x7000:02 [▶ 120] - Control_Enable latch extern on positive edge (0.1) 0x7000:03 [▶ 120] - Control_Set counter (0.1) 0x7000:04 [▶ 120] - Control_Enable latch extern on negative edge (0.1) 0x7000:11 [▶ 120] - Set counter value (2.0)	0x1600 [▶ 121] - ENC Control (6.0)

13.1.2.3 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.

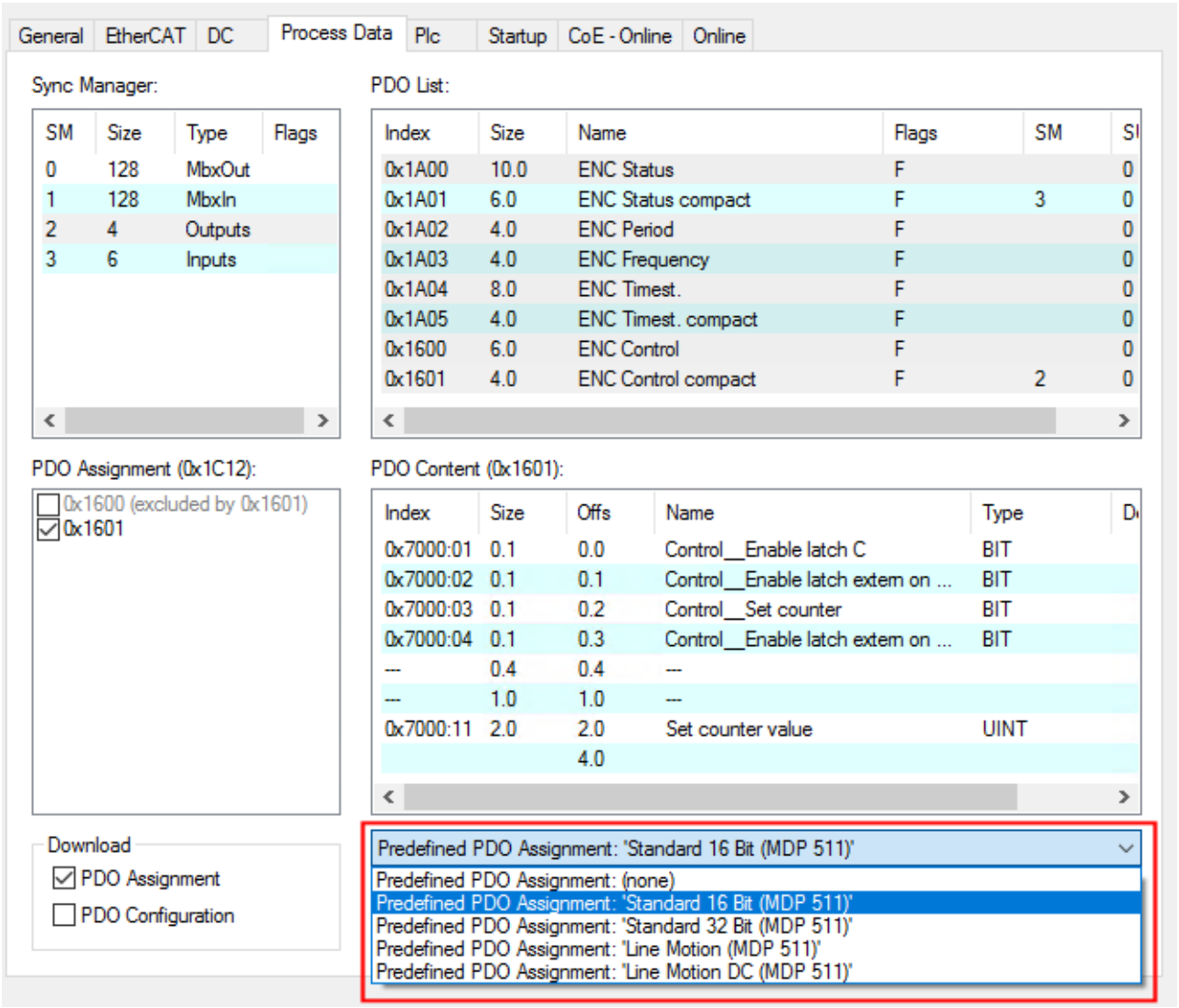


Fig. 52: EL5101-0010 - Process data, Predefined PDO (default: Standard 16 Bit (MDP 511))

Four PDO assignments are available in modes “Standard” and “Line Motion”.

Note on the use of timestamp function

In order to be able to use the timestamp function, the EL5101-0010 must be operated in “DC Synchron” or “DC Synchron (input based)” mode.

Predefined PDO assignments for “Standard” mode

Predefined PDO Assignment	PDO Assignment
Standard 16 Bit (MDP 511)	**SM3:** 0x1A01 [▶ 124] - ENC Status compact (6.0) **SM2:** 0x1601 [▶ 122] - ENC Control compact (4.0)
Standard 32 Bit (MDP 511)	**SM3:** 0x1A00 [▶ 123] - ENC Status (10.0) **SM2:** 0x1600 [▶ 121] - ENC Control (6.0)

Predefined PDO Assignments for “Line Motion” mode

Predefined PDO Assignment	PDO Assignment
Line Motion (MDP 511)	**SM3:** 0x1A01 [▶ 124] - ENC Status compact (6.0) 0x1A02 [▶ 124] - ENC Period (4.0) **SM2:** 0x1601 [▶ 122] - ENC Control compact (4.0)
Line Motion DC (MDP 511)	**SM3:** 0x1A01 [▶ 124] - ENC Status compact (6.0) 0x1A05 [▶ 125] - ENC Timest. Compact (4.0) **SM2:** 0x1601 [▶ 122] - ENC Control compact (4.0)

13.1.3 Features CoE

NOTICE



Parameterization via the CoE list (CAN over EtherCAT)

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

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

Depending on the main PDO/optional PDOs further settings can be selected in the CoE list (CAN over EtherCAT).

The following CoE settings are possible from object 0x8000 [▶ 117] and are shown below in their default settings:

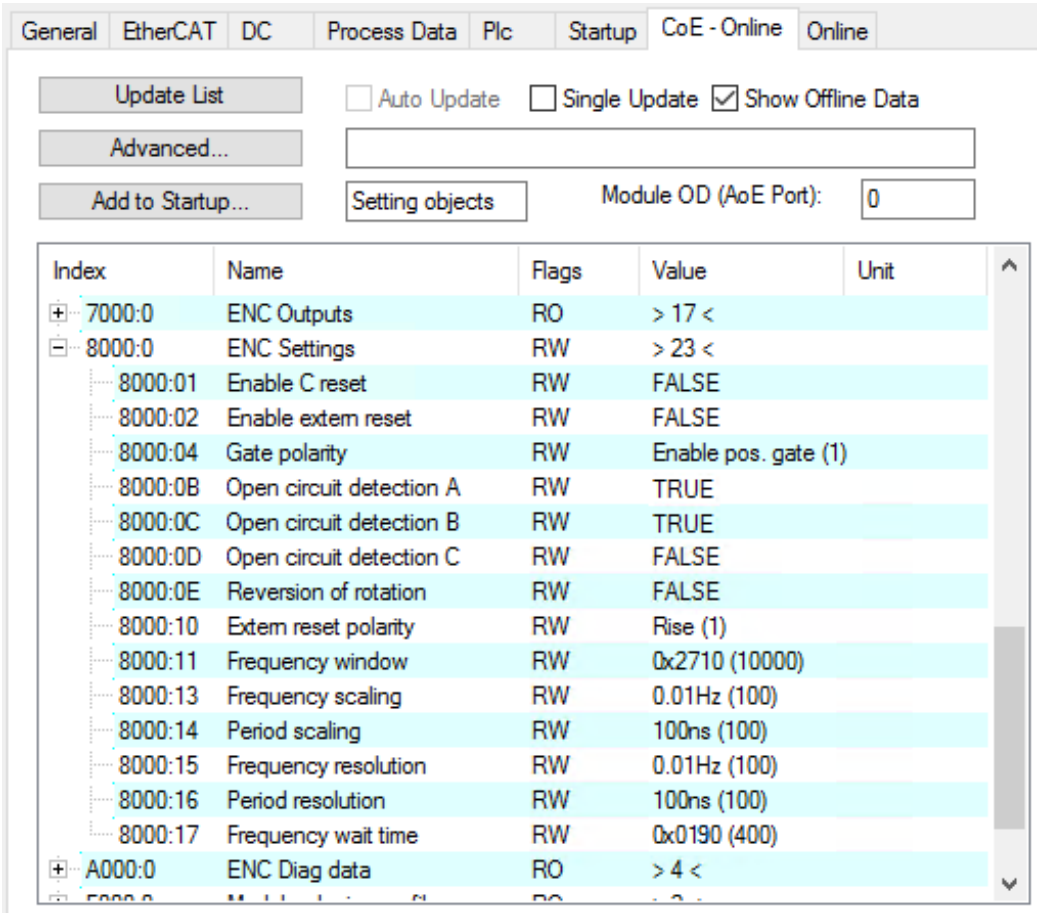


Fig. 53: “CoE online” tab

The parameters are described on page “Object description and parameterization [▶ 116]”.

Frequency

- The time window for the frequency calculation and the resolution can be parameterized in CoE objects 0x8000:11, 0x8000:13, 0x8000:15, 0x8000:17 [▶ 117].
- The positive edges of track A are counted within the specified timeframe and the next edge including the time up to it are counted. The waiting time can be set in CoE object 0x8000:17 [▶ 117] “Frequency Wait Time” (unit: ms). The default value is 1.6 sec. This is also the maximum value.
- The time window is 10 ms (default), min. 1 µs. With the default setting it is possible to measure frequencies up to approx. 800 kHz. At higher frequencies a smaller value must be selected for the timeframe.
- The time is measured with a resolution of 100 ns.
- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- No frequency measurement is possible if the counter is blocked by the gate. In this case the period can be measured regardless.
- A C or external reset restarts the frequency measurement. The last frequency value remains unchanged until a new frequency value is determined.

Frequency measurement

- Basic unit 1 µs: all window sizes

Measurement sequence

- The measurement starts with a positive edge at track A. The current counter value and time (resolution: 100 ns) are stored.
- After the measuring window time has elapsed (index 0x8000:11 [▶ 117]), the system waits for the following rising edge at track A or a maximum of 1.6 sec or the time from 0x8000:17 [▶ 117]
- The frequency is calculated from the edge difference and the actual elapsed time.

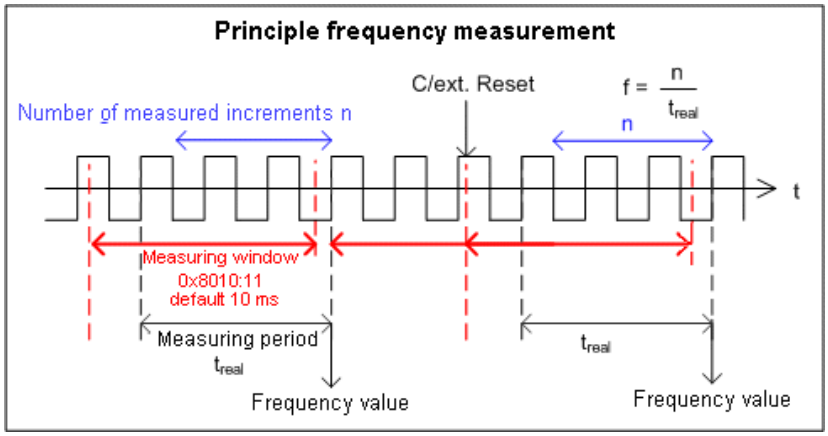


Fig. 54: Frequency measurement principle in enhanced operation mode

Period calculation

- This calculation is carried out in the slave without reference to the distributed clocks system. It is therefore independent of the DC mode.
- In each cycle the interval between two positive edges of input A is counted with a resolution of 100 ns.
- If no edge change occurs for approx. 1.6 s, any period specification is cancelled.

Frequency and period measurement

From the explanatory notes above it is apparent that the frequency measurement can measure the current axis status (velocity) significantly more accurately than the period measurement. Frequency measurement is therefore preferable, if possible.

Latch

- **Activating the latch C input (C) and latching the counter value**
  - Upon the first external latch pulse (positive edge at input C) after a bit has been set in the output process data “Enable latch C” = TRUE (index 0x7000:01), the counter value is saved (this takes precedence over process data “Enable latch extern on positive/negative edge“ (index 0x7000:02/0x7000:04)). When this bit is set, the following pulses at the other inputs have no effect on the latch value in the input process data “Latch value” (index 0x6000:12).

“Latch C valid” bit

Only when the value of the bit in the input process data “Latch C valid” (index 0x6000:01) is FALSE can a new counter value be written to the latch input.

- **Activating the external latch input (“gate/latch”) and latching the counter value**
  - If the bit in process data “Enable latch extern on positive edge” (index 0x7000:02) is set to TRUE, the counter value is stored in the latch input in process data “Latch value” (index 0x6000:12) upon the first external latch pulse with a rising edge. The subsequent pulses have no influence on the latch value in “Process data” (index: 0x6000:12).
  - If the bit in the process data “Enable latch extern on negative edge” (index 0x7000:04) is set to TRUE, the counter value is stored at the latch input (index 0x6000:12) upon the first external latch pulse with a falling edge. The subsequent pulses have no influence on the latch value in “Process data” (index: 0x6000:12).

“Latch extern valid” bit

Only when the value of the bit in the input process data “Latch extern valid” (index 0x6000:02) is FALSE can a new counter value be written to the latch input.

Reset

- Resetting the counter (index 0x8000:01, 0x8000:02, 0x8000:10 [▶ 117]): To reset the counter via input C, set the bit at index 0x8000:01 [▶ 117]; to reset it via the external latch input, set the bit at index 0x8000:02 [▶ 117].
- The “Enable C reset” (0x8000:01 [▶ 117]) and “Enable external reset” (0x8000:02 [▶ 117]) functions cannot be enabled at the same time.
- Note: “Extern reset polarity” index 0x8000:10 [▶ 117]: Using the index 0x8000:10 [▶ 117], you can select the edge to reset the counter to zero.
  - Bit not set: Counter is set to Zero with falling edge.
  - Bit set: Counter is set to Zero with rising edge.

Wire break detection “Open circuit detection”

- A separate wire break detection can be activated for each of the channels A, B, and C (index 0x8000:0B, 0x8000:0C, 0x8000:0D [▶ 117]).
- Wire break detection is activated for channels A and B by default.
- A differential voltage in the range of typ. -0.475 V > Vid > +0.475 V is detected as a wire break.
- A detected wire break is indicated by the process data “Open circuit” (index 0x6000:07) = TRUE. A wire break is also indicated separately in indices 0xA000:01 [▶ 120] (track A), 0xA000:02 [▶ 120] (track B), and 0xA000:03 [▶ 120] (track C).
- The input process data “TxPDO State” also becomes TRUE when a wire break is detected, since the data must be assumed to be invalid.

13.1.4 Object description and parameterization - enhanced operation mode

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

13.1.4.1 Restore object

Index 1011 Restore default parameters

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

13.1.4.2 Configuration data

Index 8000 ENC Settings (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	ENC Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
8000:01	Enable C reset [▶ 115]	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Enable extern reset	A counter reset is triggered via the external latch input (24 V)	BOOLEAN	RW	0x00 (0_{dec})
8000:04	Gate polarity	0: Disable gate 1: Enable pos. gate (gate locks with HIGH level) 2: Enable neg. gate (gate locks with LOW level)	BIT2	RW	0x01 (1_{dec})
8000:0B	Open circuit detection A [▶ 115]	An open circuit on track A is indicated in index 0x6000:07 [▶ 119] and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x01 (1_{dec})
8000:0C	Open circuit detection B [▶ 115]	An open circuit on track B is indicated in index 0x6000:07 [▶ 119] and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x01 (1_{dec})
8000:0D	Open circuit detection C [▶ 115]	An open circuit on track C is indicated in index 0x6000:07 [▶ 119] and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x00 (0_{dec})
8000:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})
8000:10	Extern reset polarity [▶ 115]	0: Fall (the counter is set to zero with a falling edge) 1: Rise (the counter is set to zero with a rising edge)	BIT1	RW	0x01 (1_{dec})
8000:11	Frequency window [▶ 113]	This is the minimum time over which the frequency is determined. Default 10 ms [resolution: 1 µs] The number of pulses in the time window + the following is measured. The maximum waiting time is specified in the “Frequency Wait Time” parameter. The number of pulses is divided by the actual time window size. The determined frequency is output in index 0x6000:13 [▶ 119] and as a process data. The frequency calculation is carried out locally without distributed clocks function.	UINT16	RW	0x2710 (10000_{dec})
8000:13	Frequency scaling [▶ 113]	Scaling of the frequency measurement (must be divided by this value to obtain the unit in Hz): 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})
8000:14	Period scaling [▶ 114]	Resolution of the period in the process data: 100: “100 ns” period value is a multiple of 100 ns 500: “500 ns” period value is a multiple of 500 ns	UINT16	RW	0x0064 (100_{dec})
8000:15	Frequency resolution [▶ 113]	Resolution of the frequency measurement: 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})

Index 8000 ENC Settings (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:16	Period resolution [▶ 114]	Internal resolution of the period measurement: 100: “100 ns” period value is a multiple of 100 ns The period is calculated internally with a resolution of 100 ns. The max. measurable period can then be approx. 1.6 seconds. 500: “500 ns” period value is a multiple of 500 ns Internally the period is calculated with 500 ns resolution. The maximum measurable period is approx. 32.7 ms. The resolution of process data continues to be the value according to index 0x8000:14 [▶ 117] (e.g. 100 ns [default]).	UINT16	RW	0x0064 (100_{dec})
8000:17	Frequency Wait Time [▶ 113]	Waiting time [ms] for frequency measurement Once the time specified in the “Frequency window [▶ 113]” has elapsed, the system waits for the next positive edge from track A. This enables the update speed for the Frequency process data to be optimized, depending on the expected frequencies. At least double the period of the minimum frequency to be measured should be entered here. t >= 2* (1 / f_{min})	UINT16	RW	0x0190 (400_{dec})

13.1.4.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6000 ENC Inputs (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	ENC Inputs	Maximum subindex	UINT8	RO	0x16 (22_{dec})
6000:01	Latch C valid [▶ 115]	The counter value was latched with the C input. The data in the process data field “Latch value” (index 0x6000:12) corresponds to the latched value when the bit is set. To re-enable the latch input, the bit in the output process data “Enable latch C” (index 0x7000:01 [▶ 120]) must first be cleared and then set again.	BOOLEAN	RO	0x00 (0_{dec})
6000:02	Latch extern valid [▶ 115]	The counter value was locked via the external latch. The data in the process data field “Latch value” (index 0x6000:12) corresponds to the latched value when the bit is set. To re-enable the latch input, the bit in the output process data “Enable latch extern on positive/negative edge” (index 0x7000:02 [▶ 120]/ 0x7000:04 [▶ 120]) must first be cleared and then set again.	BOOLEAN	RO	0x00 (0_{dec})
6000:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0_{dec})
6000:06	Status of input status	State of the status input (alarm “input 1”)	BOOLEAN	RO	0x00 (0_{dec})
6000:07	Open circuit [▶ 115]	Indicates a wire break. Configuration via index 0x8000:0B [▶ 117], 0x8000:0C [▶ 117], 0x8000:0D [▶ 117]	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})
6000:0B	Status of input C	Status of input C	BOOLEAN	RO	0x00 (0_{dec})
6000:0C	Status of input gate	The state of the gate input	BOOLEAN	RO	0x00 (0_{dec})
6000:0D	Status of extern latch	The state of the external 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})
6000:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle	The input process data “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})
6000:13	Frequency value [▶ 113]	The frequency (setting of the scaling and resolution in index 0x8000:13 [▶ 117] and 0x8000:15 [▶ 117])	UINT32	RO	0x00000000 (0_{dec})
6000:14	Period value [▶ 117]	The period (setting of the scaling and resolution in index 0x8000:14 [▶ 117] and 0x8000:16 [▶ 117])	UINT32	RO	0x00000000 (0_{dec})
6000:16	Timestamp [▶ 106]	Timestamp of the last counter change	UINT64	RO	

13.1.4.4 Output data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 7000 ENC Outputs (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7000:01	Enable latch C [▶ 115]	Activate latching via input C.	BOOLEAN	RO	0x00 (0_{dec})
7000:02	Enable latch extern on positive edge [▶ 115]	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 [▶ 115]	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 [▶ 120]).	UINT32	RO	0x00000000 (0_{dec})

13.1.4.5 Information / diagnostic data (channel specific)

Index A000 ENC Diag data (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
A000:0	ENC Diag data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
A000:01	Open circuit A [▶ 115]	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A000:02	Open circuit B [▶ 115]	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A000:03	Open circuit C [▶ 115]	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})
A000:04	Field power failure	Field bus voltage error	BOOLEAN	RO	0x00 (0_{dec})

13.1.4.6 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 low word contains the CoE profile used (5001). • The high word contains the module profile according to the modular device profile.	UINT32	RO	0x01FF1389 (33493897_{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	EL5101-0010

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	09

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	10

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave: • Low word ◦ 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 (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1400:0	ENC RxPDO-Par Control	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 ENC RxPDO-Par Control compact (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	ENC RxPDO-Par Control compact	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 1600 ENC RxPDO-Map Control (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	ENC RxPDO-Map Control	PDO Mapping RxPDO 1	UINT8	RO	0x07 (7_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7000:01, 1
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1600:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 32

Index 1601 ENC RxPDO-Map Control compact (EL5101-0010)

Index	Name	Meaning	Data type	Flags	Default
1601:0	ENC RxPDO-Map Control compact	PDO Mapping RxPDO 2	UINT8	RO	0x07 (7_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7000:01, 1
1601:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1601:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 16

Index 1800 ENC TxPDO-Par Status (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	ENC TxPDO-Par Status	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 ENC TxPDO-Par Status compact (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	ENC TxPDO-Par Status compact	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 ENC TxPDO-Par Period (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	ENC TxPDO-Par Period	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 ENC TxPDO-Par Frequency (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	ENC TxPDO-Par Frequency	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 1804 ENC TxPDO-Par Timest. (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	ENC TxPDO-Par Timest.	PDO Parameter TxPDO 5	UINT8	RO	0x06 (6_{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	05 1A

Index 1805 ENC TxPDO-Par Timest. compact (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1805:0	ENC TxPDO-Par Timest. compact	PDO Parameter TxPDO 6	UINT8	RO	0x06 (6_{dec})
1805:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 6.	OCTET-STRING[2]	RO	04 1A

Index 1A00 ENC TxPDO-Map Status (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	ENC TxPDO-Map Status	PDO Mapping TxPDO 1	UINT8	RO	0x11 (17_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6000:01, 1
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6000:02, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A00:04	SubIndex 004	4. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A00:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x06 (Status of input status))	UINT32	RO	0x6000:06, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6000:07, 1
1A00:07	SubIndex 007	7. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6000:09, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6000:0A, 1
1A00:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6000:0B, 1
1A00:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6000:0C, 1
1A00:0C	SubIndex 012	12. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6000:0D, 1
1A00:0D	SubIndex 013	13. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6000:0E, 1
1A00:0E	SubIndex 014	14. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6000:0F, 1
1A00:0F	SubIndex 015	15. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1
1A00:10	SubIndex 016	16. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
1A00:11	SubIndex 017	17. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6000:12, 32

Index 1A01 ENC TxPDO-Map Status compact (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	ENC TxPDO-Map Status compact	PDO Mapping TxPDO 2	UINT8	RO	0x11 (17_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6000:01, 1
1A01:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6000:02, 1
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A01:04	SubIndex 004	4. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A01:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x06 (Status of input status))	UINT32	RO	0x6000:06, 1
1A01:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6000:07, 1
1A01:07	SubIndex 007	7. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A01:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6000:09, 1
1A01:09	SubIndex 009	9. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6000:0A, 1
1A01:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6000:0B, 1
1A01:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6000:0C, 1
1A01:0C	SubIndex 012	12. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6000:0D, 1
1A01:0D	SubIndex 013	13. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6000:0E, 1
1A01:0E	SubIndex 014	14. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6000:0F, 1
1A01:0F	SubIndex 015	15. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1
1A01:10	SubIndex 016	16. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 16
1A01:11	SubIndex 017	17. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6000:12, 16

Index 1A02 ENC TxPDO-Map Period (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	ENC TxPDO-Map Period	PDO Mapping TxPDO 3	UINT8	RO	0x01 (1_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x14 (Period value))	UINT32	RO	0x6000:14, 32

Index 1A03 ENC TxPDO-Map Frequency (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	ENC TxPDO-Map Frequency	PDO Mapping TxPDO 4	UINT8	RO	0x01 (1_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x13 (Frequency value))	UINT32	RO	0x6000:13, 32

Index 1A04 ENC TxPDO-Map Timest. (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	ENC TxPDO-Map Timest.	PDO Mapping TxPDO 5	UINT8	RO	0x01 (1_{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6000:16, 64

Index 1A05 ENC TxPDO-Map Timest. compact (EL5101-0010)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	ENC TxPDO-Map Timest. compact	PDO Mapping TxPDO 6	UINT8	RO	0x01 (1_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6000:16, 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	0x01 (1_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:03	SubIndex 003	3rd 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 • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • 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	0x00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	With this entry the real required process data provision time can be measured. • 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 [▶ 127], 0x1C33:06, and 0x1C33:09 [▶ 127] are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only).	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 126]	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC mode only)	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 [▶ 126] or 0x1C33:08)	UINT16	RO	0xC007 (49159_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 126]	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	as 0x1C32:08 [▶ 126]	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 [▶ 126]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 126]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 126]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 126]	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 spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0001 (1_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Maximum subindex	UINT8	RW	0x01 (1_{dec})
F010:01	SubIndex 001	reserved	UINT32	RW	0x000001FF (511_{dec})

14 EL5101-0011 - Commissioning

14.1 Principles of the oversampling function

The EL5101-0011 EtherCAT Terminal is an interface for direct connection of incremental encoders with differential inputs (RS422). Through the oversampling property the terminal can read the current counter value several times per bus cycle.

Oversampling

A conventional incremental encoder interface terminal reads a counter value with each bus cycle and passes it on to the higher-level controller in the next fieldbus cycle. The EL5101-0011 reads the current counter value at several configurable and equidistant times between two fieldbus communication cycles. The transfer of a packet of x position values of 32 bits each to the higher-level controller takes place in the next fieldbus communication cycle. This procedure is referred to as oversampling.

Distributed Clocks

Oversampling requires a clock generator in the terminal that triggers the individual data sampling events. The local clock in the terminal, referred to as distributed clock, is used for this purpose.

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.

The EL5101-0011 offers 64-bit support.

Sample Oversampling with SYNC0 and SYNC1:

The fieldbus/EtherCAT master is operated with a cycle time (T_{SYNC1}) of 1 ms to match the higher-level PLC cycle time of 1 ms, for example. This means that an EtherCAT frame is sent every 1 ms to the EL5101-0011 to collect the process data. Therefore, the local clock in the terminal triggers an interrupt every 1 ms (1 kHz) in the ESC (EtherCAT Slave Controller) that provides the process data promptly for the collecting EtherCAT frame. This first interrupt is called SYNC1.

The EL5101-0011 is set in the TwinCAT System Manager to an oversampling factor n = 100. This causes the ESC to generate a second interrupt in the terminal with an n-times higher frequency (F_{SYNC0}), in this case 100 kHz or 10 µs period (T_{SYNC0}). This interrupt is called SYNC0. The counter value is read on each SYNC0 signal; the values are stored in succession in a buffer. Generation of the SYNC0 pulse from the local synchronized clock within the distributed clock network ensures that the position values are sampled at highly equidistant intervals with the period of the SYNC1 pulse.



Maximum sampling frequency / minimum cycle time

A sampling time shorter than (T_{SYNC0}) 10 µs is not permissible for the EL5101-0011!
The maximum sample frequency (F_{SYNC0}) for the EL5101-0011 is thus 100 kSps (samples per second).
The cycle time (T_{SYNC1}) may not be shorter than the minimum cycle time of 500 µs with an oversampling factor of n = 50.
Regarding the calculation of SYNC0 from the SYNC1 pulse based on manual specification of an oversampling factor, please note that for T_{SYNC0} only integer values are calculated at nanosecond intervals.
Sample: 187,500 ns are permissible, 333,333.3333 ns are not.

Sample permissible and impermissible oversampling factors:

For T_{SYNC1} = 1 ms oversampling factors such as 1, 2, 5 or 100 are permitted, but not 3! If implausible values are use the terminal will reach the OP state but will not supply any process data.
This may result in a working counter error.
The 32-bit measured values accumulated in the buffer are sent as a packet to the higher-level control system.

Summary:

Symbol	Description	Permissible values	Example (OK)	Example (NOK)
F_{Sync1}	Frequency of the fieldbus/EtherCAT master		F_{Sync1} = 1 kHz	F_{Sync1} = 1 kHz
T_{Sync1}	Cycle time of the fieldbus/EtherCAT master	$T_{Sync1} \geq 500$ µs at n = 50	T_{Sync1} = 1 ms	T_{Sync1} = 1 ms
n	Oversampling factor	n = 0 ... 100	n = 100	n = 3
F_{Sync0}	Sampling frequency ($F_{Sync0} = F_{Sync1} * n$)	$F_{Sync0} \leq 100$ kSps (Samples per second)	F_{Sync0} = 100 kHz	F_{Sync0} = 3 kHz
T_{Sync0}	Sampling time	$T_{Sync0} \geq 10$ µs only integer values are calculated at nanosecond intervals!	T_{Sync0} = 10 µs	T_{Sync0} = 333,333.333 ns

Time-related cooperation with other terminals

The reading of the measured values in the EL5101-0011 is triggered by an interrupt generated by the local clock in the terminal. All local clocks in the supporting EtherCAT slaves are synchronized. This enables EtherCAT slaves (here: terminals) to sample measured values simultaneously (simultaneous interrupt generation), independent of the distance between them. This simultaneity is within the distributed clock precision range of < 100 ns.

Sample for Coordination of two EL5101-0011 terminals with each other:

The EtherCAT master, e.g. Beckhoff TwinCAT, configures both EL5101-0011 terminals such that their SYNC1 pulses occur at the same time.

Assumption: The EtherCAT bus cycle time is 500 µs. The SYNC1 is thus triggered in all EL5101-0011 terminals every 500 µs.

- If both terminals operate with a corresponding oversampling factor (e.g. n = 20), the SYNC0 pulse correlating to SYNC1 will occur simultaneously in all EL5101-0011, in this sample T_{SYNC0} = 25 µs.
- If different oversampling factors are used in the EL5101-0011 terminals employed, their SYNC0 pulses no longer occur simultaneously. The higher-level SYNC1 pulse is retained.

Timestamp of the process data

The EL5101-0011 offers a “timestamp” for each process data block. This process data is already activated as *StartTimeNextLatch* through the activation of 0x1A01 *ENC NextSync1Time* as a 64-bit value in default on the Process data tab (see chapter “Process data [▶ 131]”).
The data block consisting of sample value + timestamp, which is transferred in each cycle, is not related. The relationship is shown in the figure below.

To explain in more detail:

- The sample is based on an oversampling factor n = 100.
- The SYNC0 signal in the terminal fills the internal buffer with 100 position values.
- SYNC1, which triggers the filled buffer to be made available as process data and at the same time fetches the *StartTimeNextLatch* from the local distributed clock, runs synchronous with the cycle time.
- The data array is thereby assembled together with the next SYNC1 Time.
- The next EtherCAT cycle fetches this data.

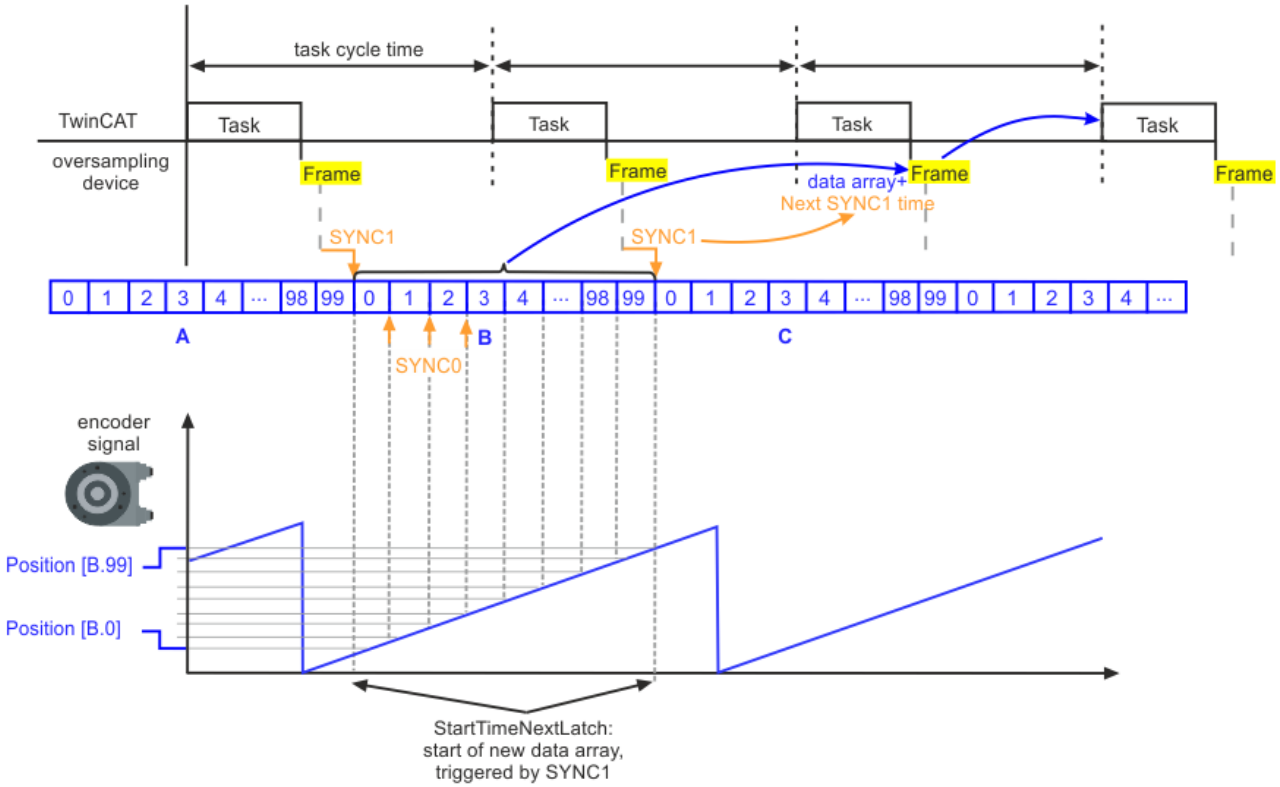


Fig. 55: Temporal relationship between SYNC signals and SyncManager interrupt

14.2 Process data and configuration

The principles for the oversampling function and the mode of operation of the EL5101-0011 with the use of the SYNC0 and SYNC1 pulses are explained in the section “Principles of the oversampling function [▶ 128]”. The setting of the various parameters using the Beckhoff TwinCAT System Manager is described in the following chapter. The EL5101-0011 offers the following process data:

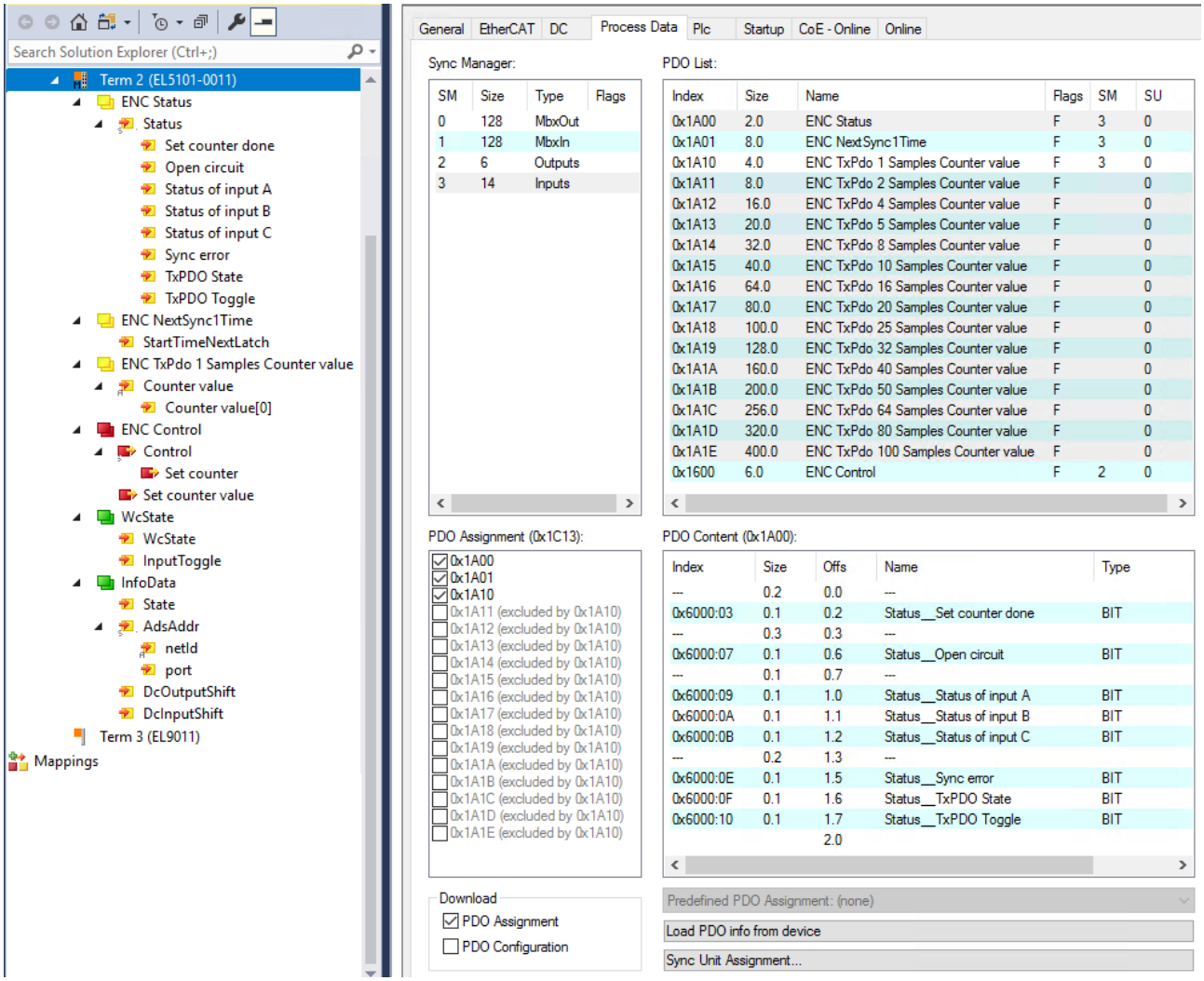


Fig. 56: EL5101-0011 - Process data (default)

Oversampling settings, distributed clocks (DC)

The oversampling factor can be set on the “DC” tab (see figure below). The oversampling factor n is set to 1 in the delivery condition. When an entry is selected in the dialog, the correct sampling ratio at distributed clock level and the correct number of process data to be transferred are set automatically.

Sampling frequency

If an oversampling factor is required that does not appear in the list, the user has to specify the ratio between the SYNC0 pulse and the SYNC1 pulse within the permitted limits, based on the information found in “Principles of the oversampling function [▶ 128]”. Please refer to the note “Maximum sampling frequency / minimum cycle time [▶ 128]”.

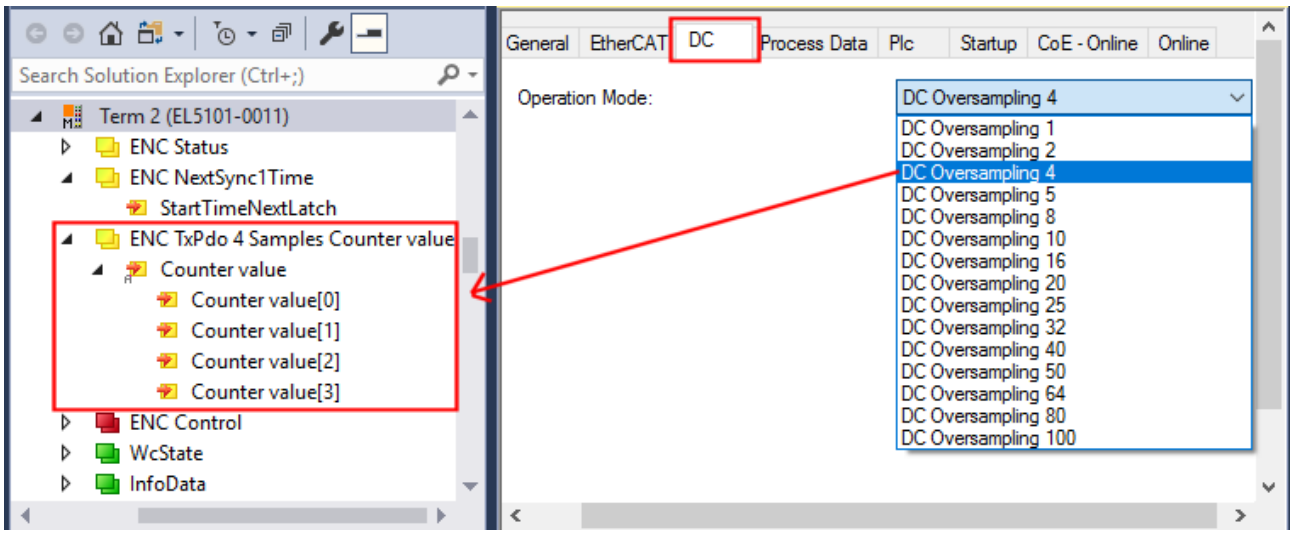


Fig. 57: Setting of the oversampling factor n = 4 and display of the process data to be transferred

Sampling times T_{SYNC0} apply to EL5101-0011:

Oversampling factor	Cycle time T_{SYNC1}				
	500 µs	**1,000 µs**	**2,000 µs**	**5,000 µs**	**10,000 µs**
1	500.00 µs	1,000.00 µs	2,000.00 µs	5,000.00 µs	10,000.00 µs
2	250.00 µs	500.00 µs	1,000.00 µs	2,500.00 µs	5,000.00 µs
4	125.00 µs	250.00 µs	500.00 µs	1,250.00 µs	2,500.00 µs
5	100.00 µs	200.00 µs	400.00 µs	1,000.00 µs	2,000.00 µs
8	62.50 µs	125.00 µs	250.00 µs	625.00 µs	1,250.00 µs
10	50.00 µs	100.00 µs	200.00 µs	500.00 µs	1,000.00 µs
16	31.25 µs	62.50 µs	125.00 µs	312.50 µs	625.00 µs
20	25.00 µs	50.00 µs	100.00 µs	250.00 µs	500.00 µs
25	20.00 µs	40.00 µs	80.00 µs	200.00 µs	400.00 µs
32	15.63 µs	31.25 µs	62.50 µs	156.25 µs	312.50 µs
40	12.50 µs	25.00 µs	50.00 µs	125.00 µs	250.00 µs
50	10.00 µs	20.00 µs	40.00 µs	100.00 µs	200.00 µs
64	Not permissible, because T_{SYNC0} < 10 µs	15.63 µs	31.25 µs	78.125 µs	156.25 µs
80	Not permissible, because T_{SYNC0} < 10 µs	12.50 µs	25.00 µs	62.50 µs	125.00 µs
100	Not permissible, because T_{SYNC0} < 10 µs	10.00 µs	20.00 µs	50.00 µs	100.00 µs

Sampling frequencies F_{SYNC0} apply to EL5101-0011:

Oversampling factor	Cycle time T_{SYNC1}				
	500 µs	**1,000 µs**	**2,000 µs**	**5,000 µs**	**10,000 µs**
1	2.0 kSps	1.0 kSps	0.5 kSps	0.2 kSps	0.1 kSps
2	4.0 kSps	2.0 kSps	1.0 kSps	0.4 kSps	0.2 kSps
4	8.0 kSps	4.0 kSps	2.0 kSps	0.8 kSps	0.4 kSps
5	10.0 kSps	5.0 kSps	2.5 kSps	1.0 kSps	0.5 kSps
8	16.0 kSps	8.0 kSps	4.0 kSps	1.6 kSps	0.8 kSps
10	20.0 kSps	10.0 kSps	5.0 kSps	2.0 kSps	1.0 kSps
16	32.0 kSps	16.0 kSps	8.0 kSps	3.2 kSps	1.6 kSps
20	40.0 kSps	20.0 kSps	10.0 kSps	4.0 kSps	2.0 kSps
25	50.0 kSps	25.0 kSps	12.5 kSps	5.0 kSps	2.5 kSps
32	64.0 kSps	32.0 kSps	16.0 kSps	6.4 kSps	3.2 kSps
40	80.0 kSps	40.0 kSps	20.0 kSps	8.0 kSps	4.0 kSps
50	100.0 kSps	50.0 kSps	25.0 kSps	10.0 kSps	5.0 kSps
64	Not permissible, because F_{SYNC0} > 100 kSps	64.0 kSps	32.0 kSps	12.8 kSps	6.4 kSps
80	Not permissible, because F_{SYNC0} > 100 kSps	80.0 kSps	40.0 kSps	16.0 kSps	8.0 kSps
100	Not permissible, because F_{SYNC0} > 100 kSps	100.0 kSps	50.0 kSps	20.0 kSps	10.0 kSps

“StartTimeNextLatch”

The process data “StartTimeNextLatch” (index 0x1A01) is activated by default.
The “StartTimeNextlatch” process data is 32 bits wide. During each process data cycle the time is specified at which the next SYNC1 pulse and therefore the next block of sample values begins. “StartTimeNextLatch” thus changes in each cycle by the amount of that task cycle time with which this terminal is operated. This time specification is based on the terminal’s local Distributed Clocks time. The terminal maps only the 64-bit distributed clocks time.
In this way all samples can be synchronized with other time data within the EtherCAT bus based on the known oversampling factor.

Sample:

The terminal supplies in the regarded cycle with
cycle time = 1 ms (= 1,000,000 ns) and
oversampling factor n = 20,
a “StartTimeNextLatch” of $503,330,625,067,077,000_{dec}$ and 20 measured values (counter value) of 32 bits each as process data.

The time of measurement of the 5th supplied position value is now to be determined, i.e. the Distributed Clocks time at which the 5th position value was determined.
The currently delivered set of 20 counter values was started at the time:

503,330,625,067,077,000 – 1,000,000 (cycle time) = 503,330,625,066,077,000 ns.
The time interval between the samples is 1.000.000/20 = 50.000 ns.
The 5th position value was thus determined at the time:
503,330,625,066,077,000 + ((5 - 1) * 50,000) = 503,330,625,066,027,000 ns

Special oversampling factor and Shift Time for the SYNC0 pulse

NOTICE

CAUTION! Risk of device damage!

If these settings are changed in the System Manager, no plausibility checks are carried out on the software side.
Correct function of the terminal with all conceivable setting options cannot be guaranteed.

Setting the counter value – referencing:

Since incremental encoders do not provide a unique position specification immediately after power-up, a reference run should be performed.
The reference point can be set manually using the initial process data “Set counter” (index 0x7000:03).

“Set counter” (index 0x7000:03)

- In the process data “Set counter value” (index 0x7000:11), the value to be set as the reference value is written (default: 0).
- The function is enabled by setting the bit in the output process data “Set counter” (index 0x7000:03) to TRUE.
- The value from the process data “Set counter value” (index 0x7000:11) is written to the process data “Counter value” (index 0x6000:11).
- The value of the bit in the process data “Set counter done” (index 0x6000:03) is set to TRUE.
- Only when the value of the “Set counter done” bit (index 0x6000:03) is FALSE can the next reference value be written to the process data “Set counter” (index 0x6000:11) after reactivating the process data “Counter value” (index 0x7000:03).

Wire break detection/Open circuit detection

- A separate wire break detection can be activated for each of the channels A, B, and C (index 0x8000:0B, 0x8000:0C, 0x8000:0D).
- By default, wire break detection is enabled for channels A and B.
- A differential voltage of -0.475 V > Vid >+0.475 V (typical, subject to change) is detected as a wire break.
- A detected wire break is indicated by the process data “Open circuit” (index 0x6000:07) = TRUE. A wire break is also indicated separately in indices 0xA000:01 (track A), 0xA000:02 (track B), and 0xA000:03 (track C).
- The input process data “TxPDO State” also becomes TRUE when a wire break is detected, since the data must be assumed to be invalid.

Further cyclic information

In addition, the following cyclic information is available:

Variable	Meaning
Sync error	In DC mode: Indicates whether a synchronization error 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).
TxPDO State	Indicates whether an error has occurred (= TRUE). If an internal error is detected or an “open circuit” is reported, “TxPDO State” is set to TRUE, since the data must be assumed to be invalid.
DcOutputShift, DcInputShift	In these static variables the System Manager announces the shift time to which this terminal has been set. The value is set once on activating/calculating the configuration and also depends on the customer-specific settings in the extended slave settings. It can be linked to offset calculations in the PLC.
StartTimeNextLatch	See chapter “StartTimeNextLatch [▶ 133]”

14.3 Object description and parameterization - enhanced operation mode

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

14.3.1 Restore object

Index 1011 Restore default parameters

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

14.3.2 Configuration data

Index 8000 ENC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	ENC Settings	Maximum subindex	UINT8	RO	0x0E (14_{dec})
8000:01	Enable C reset	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8000:0B	Open circuit detection A	An open circuit on track A is indicated in index 0x6000:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x01 (1_{dec})
8000:0C	Open circuit detection B	An open circuit on track B is indicated in index 0x6000:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x01 (1_{dec})
8000:0D	Open circuit detection C	An open circuit on track C is indicated in index 0x6000:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -0.475 V > Vid > +0.475 V (typical, subject to change) is detected as a broken wire.	BOOLEAN	RW	0x00 (0_{dec})
8000:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})

14.3.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6000 ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	ENC Inputs	Maximum subindex	UINT8	RO	0x19 (25_{dec})
6000:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0_{dec})
6000:07	Open circuit	Indicates a wire break. Configuration via index 0x8000:0B, 0x8000:0C, 0x8000:0D	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})
6000:0B	Status of input C	Status of input C	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})
6000:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6000:11	Counter value	Counter value	UINT32	RO	0x00000000 (0_{dec})
6000:19	StartTimeNextLatch		UINT64	RO	

14.3.4 Output data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 7000 ENC Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7000:03	Set counter	Set counter value	BOOLEAN	RO	0x00 (0_{dec})
7000:11	Set counter value	The counter value to be set via the process data “Set counter” (index 0x7000:03).	UINT32	RO	0x00000000 (0_{dec})

14.3.5 Information / diagnostic data (channel specific)

Index A000 ENC Diag data

Index (hex)	Name	Meaning	Data type	Flags	Default
A000:0	ENC Diag data	Maximum subindex	UINT8	RO	0x04 (4_{dec})
A000:01	Open circuit A	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A000:02	Open circuit B	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A000:03	Open circuit C	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})
A000:04	Field power failure	Field bus voltage error	BOOLEAN	RO	0x00 (0_{dec})

14.3.6 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 low word contains the CoE profile used (5001). • The high 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	EL5101-0011

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	-

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave: • Low word ◦ The low byte (bit 0–7) of the low word contains the year of production. ◦ The high byte (bit 8–15) of the low word contains the week of production. • The high word (bit 16–31) is 0.	UINT32	RO	0x00000000 (0_{dec})

Index 10F0 Backup parameter handling

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

Index 1600 ENC RxPDO-Map Control

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	ENC RxPDO-Map Control	PDO Mapping RxPDO 1	UINT8	RO	0x04 (4_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (ENC Outputs), entry 0x03 (Set counter))	UINT32	RO	0x7000:03, 1
1600:03	SubIndex 003	3. PDO Mapping entry (13 bits align)	UINT32	RO	0x0000:00, 13
1600:04	SubIndex 004	4. PDO Mapping entry (object 0x7000 (ENC Outputs), entry 0x11 (Set counter value))	UINT32	RO	0x7000:11, 32

Index 1810 ENC TxPDO-Par TxPdo 1 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1810:0	ENC TxPDO-Par TxPdo 1 Samples Counter value	PDO Parameter TxPDO 17	UINT8	RO	0x06 (6_{dec})
1810:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must be transferred together with TxPDO 17.	OCTET-STRING[28]	RO	11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1811 ENC TxPDO-Par TxPdo 2 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1811:0	ENC TxPDO-Par TxPdo 2 Samples Counter value	PDO Parameter TxPDO 18	UINT8	RO	0x06 (6_{dec})
1811:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 18.	OCTET-STRING[28]	RO	10 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1812 ENC TxPDO-Par TxPdo 4 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1812:0	ENC TxPDO-Par TxPdo 4 Samples Counter value	PDO Parameter TxPDO 19	UINT8	RO	0x06 (6_{dec})
1812:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 19.	OCTET-STRING[28]	RO	10 1A 11 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1813 ENC TxPDO-Par TxPdo 5 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1813:0	ENC TxPDO-Par TxPdo 5 Samples Counter value	PDO Parameter TxPDO 20	UINT8	RO	0x06 (6_{dec})
1813:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 20.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1814 ENC TxPDO-Par TxPdo 8 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1814:0	ENC TxPDO-Par TxPdo 8 Samples Counter value	PDO Parameter TxPDO 21	UINT8	RO	0x06 (6_{dec})
1814:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 21.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1815 ENC TxPDO-Par TxPdo 10 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1815:0	ENC TxPDO-Par TxPdo 10 Samples Counter value	PDO Parameter TxPDO 22	UINT8	RO	0x06 (6_{dec})
1815:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 22.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1816 ENC TxPDO-Par TxPdo 16 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1816:0	ENC TxPDO-Par TxPdo 16 Samples Counter value	PDO Parameter TxPDO 23	UINT8	RO	0x06 (6_{dec})
1816:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 23.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1817 ENC TxPDO-Par TxPdo 20 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1817:0	ENC TxPDO-Par TxPdo 20 Samples Counter value	PDO Parameter TxPDO 24	UINT8	RO	0x06 (6_{dec})
1817:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 24.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1818 ENC TxPDO-Par TxPdo 25 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1818:0	ENC TxPDO-Par TxPdo 25 Samples Counter value	PDO Parameter TxPDO 25	UINT8	RO	0x06 (6_{dec})
1818:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 25.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 1819 ENC TxPDO-Par TxPdo 32 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1819:0	ENC TxPDO-Par TxPdo 32 Samples Counter value	PDO Parameter TxPDO 26	UINT8	RO	0x06 (6_{dec})
1819:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 26.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 1A 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 181A ENC TxPDO-Par TxPdo 40 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
181A:0	ENC TxPDO-Par TxPdo 40 Samples Counter value	PDO Parameter TxPDO 27	UINT8	RO	0x06 (6_{dec})
181A:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 27.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1B 1A 1C 1A 1D 1A 1E 1A

Index 181B ENC TxPDO-Par TxPdo 50 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
181B:0	ENC TxPDO-Par TxPdo 50 Samples Counter value	PDO Parameter TxPDO 28	UINT8	RO	0x06 (6_{dec})
181B:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 28.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1C 1A 1D 1A 1E 1A

Index 181C ENC TxPDO-Par TxPdo 64 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
181C:0	ENC TxPDO-Par TxPdo 64 Samples Counter value	PDO Parameter TxPDO 29	UINT8	RO	0x06 (6_{dec})
181C:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 29.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1D 1A 1E 1A

Index 181D ENC TxPDO-Par TxPdo 80 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
181D:0	ENC TxPDO-Par TxPdo 80 Samples Counter value	PDO Parameter TxPDO 30	UINT8	RO	0x06 (6_{dec})
181D:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 30.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1E 1A

Index 181E ENC TxPDO-Par TxPdo 100 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
181E:0	ENC TxPDO-Par TxPdo 100 Samples Counter value	PDO Parameter TxPDO 31	UINT8	RO	0x06 (6_{dec})
181E:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 31.	OCTET-STRING[28]	RO	10 1A 11 1A 12 1A 13 1A 14 1A 15 1A 16 1A 17 1A 18 1A 19 1A 1A 1A 1B 1A 1C 1A 1D 1A

Index 1A00 ENC TxPDO-Map Status

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	ENC TxPDO-Map Status	PDO Mapping TxPDO 1	UINT8	RO	0x0C (12_{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 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6000:03, 1
1A00:03	SubIndex 003	3. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1A00:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6000:07, 1
1A00:05	SubIndex 005	5. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1A00:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6000:09, 1
1A00:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6000:0A, 1
1A00:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6000:0B, 1
1A00:09	SubIndex 009	9. PDO Mapping entry (2 bits align)	UINT32	RO	0x0000:00, 2
1A00:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6000:0E, 1
1A00:0B	SubIndex 011	11. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6000:0F, 1
1A00:0C	SubIndex 012	12. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6000:10, 1

Index 1A01 ENC TxPDO-Map NextSync1Time

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	ENC TxPDO-Map NextSync1Time	PDO Mapping TxPDO 2	UINT8	RO	0x01 (1_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x19 (StartTimeNextLatch))	UINT32	RO	0x6000:19, 64

Index 1A10 ENC TxPDO-Map TxPdo 1 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A10:0	ENC TxPDO-Map TxPdo 1 Samples Counter value	PDO Mapping TxPDO 17	UINT8	RO	0x01 (1_{dec})
1A10:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A11 ENC TxPDO-Map TxPdo 2 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A11:0	ENC TxPDO-Map TxPdo 2 Samples Counter value	PDO Mapping TxPDO 18	UINT8	RO	0x02 (2_{dec})
1A11:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
1A11:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A12 ENC TxPDO-Map TxPdo 4 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A12:0	ENC TxPDO-Map TxPdo 4 Samples Counter value	PDO Mapping TxPDO 19	UINT8	RO	0x04 (4_{dec})
1A12:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A12:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A13 ENC TxPDO-Map TxPdo 5 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A13:0	ENC TxPDO-Map TxPdo 5 Samples Counter value	PDO Mapping TxPDO 20	UINT8	RO	0x05 (5_{dec})
1A13:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A13:05	SubIndex 005	5. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A14 ENC TxPDO-Map TxPdo 8 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A14:0	ENC TxPDO-Map TxPdo 8 Samples Counter value	PDO Mapping TxPDO 21	UINT8	RO	0x08 (8_{dec})
1A14:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A14:08	SubIndex 008	8. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A15 ENC TxPDO-Map TxPdo 10 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A15:0	ENC TxPDO-Map TxPdo 10 Samples Counter value	PDO Mapping TxPDO 22	UINT8	RO	0x0A (10_{dec})
1A15:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A15:0A	SubIndex 010	10. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A16 ENC TxPDO-Map TxPdo 16 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A16:0	ENC TxPDO-Map TxPdo 16 Samples Counter value	PDO Mapping TxPDO 23	UINT8	RO	0x10 (16_{dec})
1A16:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A16:10	SubIndex 016	16. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A17 ENC TxPDO-Map TxPdo 20 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A17:0	ENC TxPDO-Map TxPdo 20 Samples Counter value	PDO Mapping TxPDO 24	UINT8	RO	0x14 (20_{dec})
1A17:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A17:14	SubIndex 020	20. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A18 ENC TxPDO-Map TxPdo 25 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A18:0	ENC TxPDO-Map TxPdo 25 Samples Counter value	PDO Mapping TxPDO 25	UINT8	RO	0x19 (25_{dec})
1A18:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A18:19	SubIndex 025	25. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A19 ENC TxPDO-Map TxPdo 32 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A19:0	ENC TxPDO-Map TxPdo 32 Samples Counter value	PDO Mapping TxPDO 26	UINT8	RO	0x20 (32_{dec})
1A19:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A19:20	SubIndex 032	32. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A1A ENC TxPDO-Map TxPdo 40 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A1A:0	ENC TxPDO-Map TxPdo 40 Samples Counter value	PDO Mapping TxPDO 27	UINT8	RO	0x28 (40_{dec})
1A1A:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A1A:28	SubIndex 040	40. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A1B ENC TxPDO-Map TxPdo 50 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A1B:0	ENC TxPDO-Map TxPdo 50 Samples Counter value	PDO Mapping TxPDO 28	UINT8	RO	0x32 (50_{dec})
1A1B:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A1B:32	SubIndex 050	50. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A1C ENC TxPDO-Map TxPdo 64 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A1C:0	ENC TxPDO-Map TxPdo 64 Samples Counter value	PDO Mapping TxPDO 29	UINT8	RO	0x40 (64_{dec})
1A1C:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A1C:40	SubIndex 064	64. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A1D ENC TxPDO-Map TxPdo 80 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A1D:0	ENC TxPDO-Map TxPdo 80 Samples Counter value	PDO Mapping TxPDO 30	UINT8	RO	0x50 (80_{dec})
1A1D:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A1D:50	SubIndex 080	80. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1A1E ENC TxPDO-Map TxPdo 100 Samples Counter value

Index (hex)	Name	Meaning	Data type	Flags	Default
1A1E:0	ENC TxPDO-Map TxPdo 100 Samples Counter value	PDO Mapping TxPDO 31	UINT8	RO	0x64 (100_{dec})
1A1E:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32
…	…	…	…	…	..
1A1E:64	SubIndex 100	100. PDO Mapping entry (object 0x6000 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6000:11, 32

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x01 (1_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x03 (3_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	SubIndex 003	3rd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 (6672_{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 • Synchronous with SM 2 event: Master cycle time • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x00000000 (0_{dec})
1C32:03	Shift time	Time between SYNC0 event and 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • 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	0x00000000 (0_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	With this entry the real required process data provision time can be measured. • 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 [▶ 146], 0x1C33:06, and 0x1C33:09 [▶ 146] 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: Synchronous with SM 3 event (no outputs available) • 2: DC – Synchronous with SYNC0 event • 3: DC – Synchronous with SYNC1 event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0000 (0_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 145]	UINT32	RW	0x00000000 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC Mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: Free Run is supported • Bit 1: Synchronization with SM 2 event is supported (outputs available) • Bit 1: Synchronization 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 [▶ 145] or 0x1C33:08 [▶ 146])	UINT16	RO	0x0000 (0_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 145]	UINT32	RO	0x00000000 (0_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and the inputs being available for the master (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Min. delay time		UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	as 0x1C32:08 [▶ 145]	UINT16	RW	0x0000 (0_{dec})
1C33:09	Max. delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 [▶ 145]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 145]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 145]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 145]	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 spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0001 (1_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Maximum subindex	UINT8	RW	0x01 (1_{dec})
F010:01	SubIndex 001	Profile 510	UINT32	RW	0x000001FF (511_{dec})

Index F082 MDP Profile Compatibility

Index (hex)	Name	Meaning	Data type	Flags	Default
F082:0	MDP Profile Compatibility	Maximum subindex	UINT8	RO	0x01 (1_{dec})
F082:01	Compatible input cycle counter	-	BOOLEAN	RW	0x00 (0_{dec})

15 EL5101-0090 - Commissioning

The EL5101-0090 supports the full functionality of the EL5101 (please refer to chapter "EL5101 - Commissioning [▶ 59]").

In addition, the EL5101-0090 supports TwinSAFE SC technology.

NOTICE

Further information

For information on commissioning with TwinCAT and EtherCAT basics, please refer to the "EtherCAT system manual".

15.1 TwinSAFE SC

15.1.1 TwinSAFE SC - operating principle

The TwinSAFE SC (Single Channel) technology enables the use of standard signals for safety tasks in any networks of fieldbuses. To do this, EtherCAT Terminals from the areas of analog input, angle/displacement measurement or communication (4…20 mA, incremental encoder, IO-Link, etc.) are extended by the TwinSAFE SC function. The typical signal characteristics and standard functionalities of the I/O components are retained. TwinSAFE SC I/Os have a yellow strip at the front of the housing to distinguish them from standard I/Os.

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

The data of the TwinSAFE SC components are transferred via a TwinSAFE protocol to the TwinSAFE logic, where they can be used in the context of safety-relevant applications. Detailed examples for the correct application of the TwinSAFE SC components and the respective normative classification, which were confirmed/calculated by TÜV SÜD, can be found in the TwinSAFE application manual.

15.1.2 TwinSAFE SC - configuration

The TwinSAFE SC technology enables communication with standard EtherCAT terminals via the Safety over EtherCAT protocol. These connections use another checksum, in order to be able to distinguish between TwinSAFE SC and TwinSAFE. Eight fixed CRCs can be selected, or a free CRC can be entered by the user.

By default the TwinSAFE SC communication channel of the respective TwinSAFE SC component is not enabled. In order to be able to use the data transfer, the corresponding TwinSAFE SC module must first be added under the Slots tab. Only then is it possible to link to a corresponding alias device.

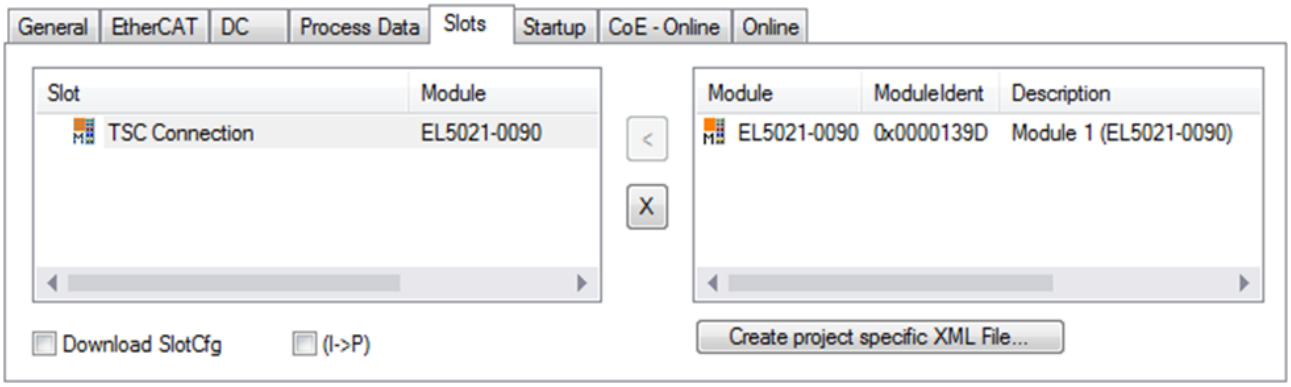


Fig. 58: Adding the TwinSAFE SC process data under the component, e.g. EL5021-0090

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

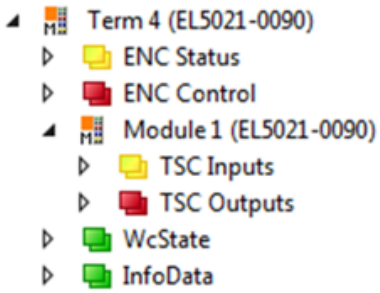


Fig. 59: TwinSAFE SC component process data, example EL5021-0090

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

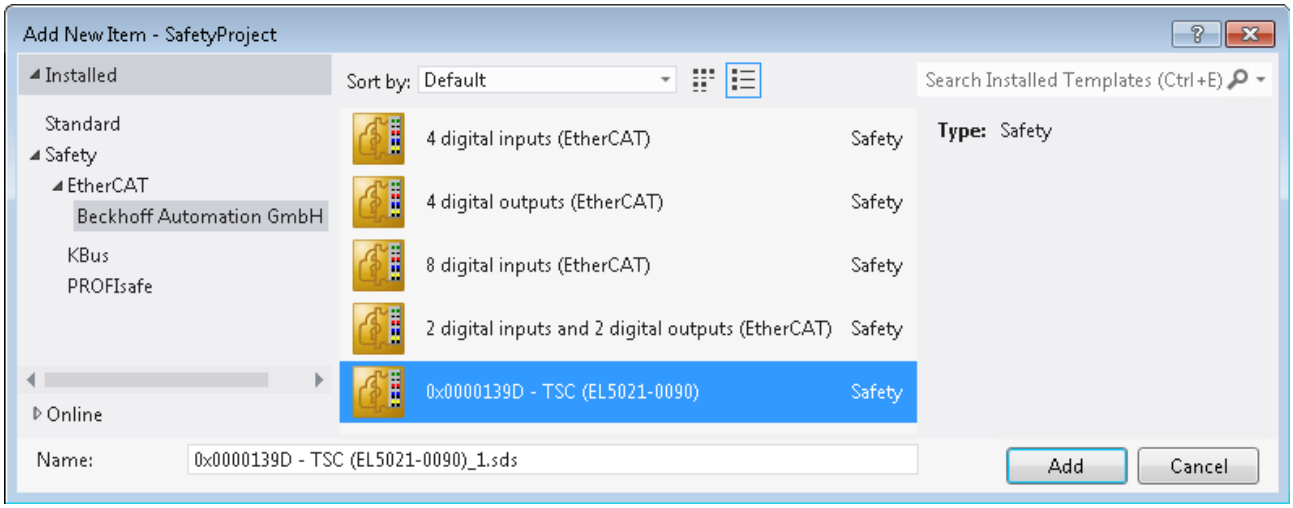


Fig. 60: Adding a TwinSAFE SC connection

After opening the alias device by double-clicking, select the Link button  next to *Physical Device,* in order to create the link to a TwinSAFE SC terminal. Only suitable TwinSAFE SC terminals are offered in the selection dialog.

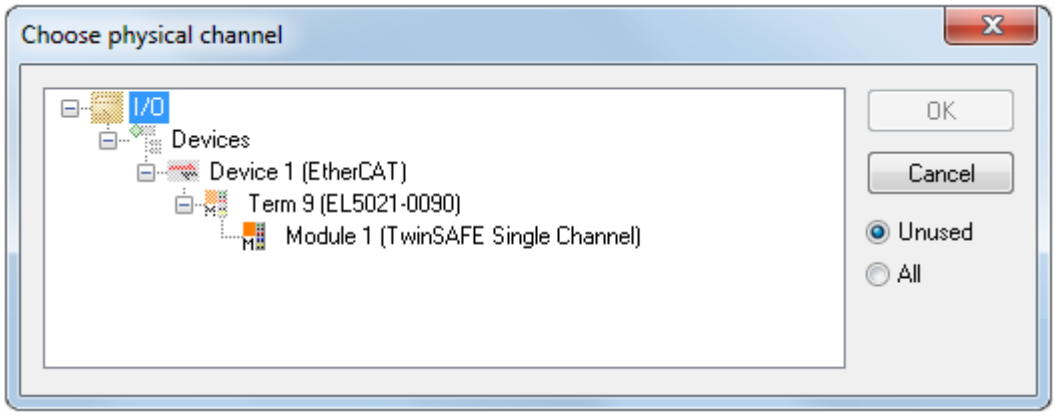


Fig. 61: Creating a link to TwinSAFE SC terminal

The CRC to be used can be selected or a free CRC can be entered under the Connection tab of the alias device.

Entry Mode	Used CRCs
TwinSAFE SC CRC 1 master	0x17B0F
TwinSAFE SC CRC 2 master	0x1571F
TwinSAFE SC CRC 3 master	0x11F95
TwinSAFE SC CRC 4 master	0x153F1
TwinSAFE SC CRC 5 master	0x1F1D5
TwinSAFE SC CRC 6 master	0x1663B
TwinSAFE SC CRC 7 master	0x1B8CD
TwinSAFE SC CRC 8 master	0x1E1BD

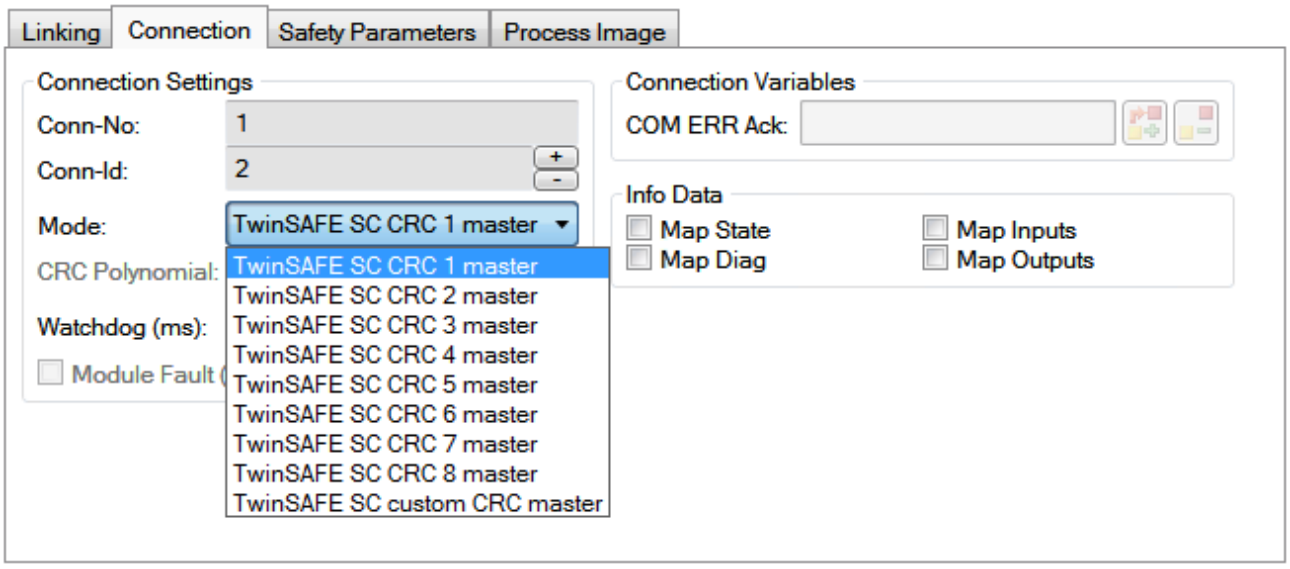


Fig. 62: Selecting a free CRC

These settings must match the settings in the CoE objects of the TwinSAFE SC component.
The TwinSAFE SC component initially makes all available process data available. The *Safety Parameters* tab typically contains no parameters. The process data size and the process data themselves can be selected under the *Process Image* tab.

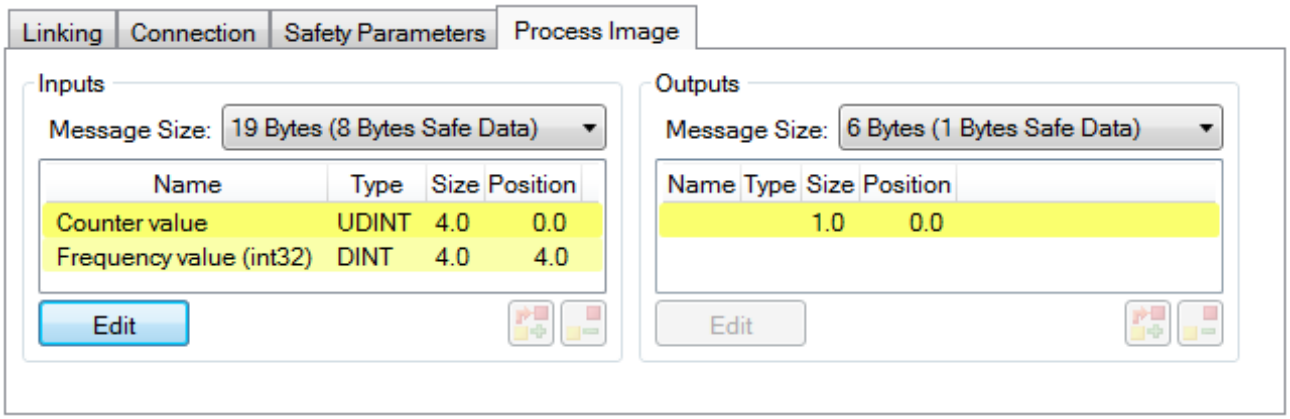


Fig. 63: Selecting the process data size and the process data

The process data (defined in the ESI file) can be adjusted to user requirements by selecting the *Edit* button in the dialog *Configure I/O element(s)*.

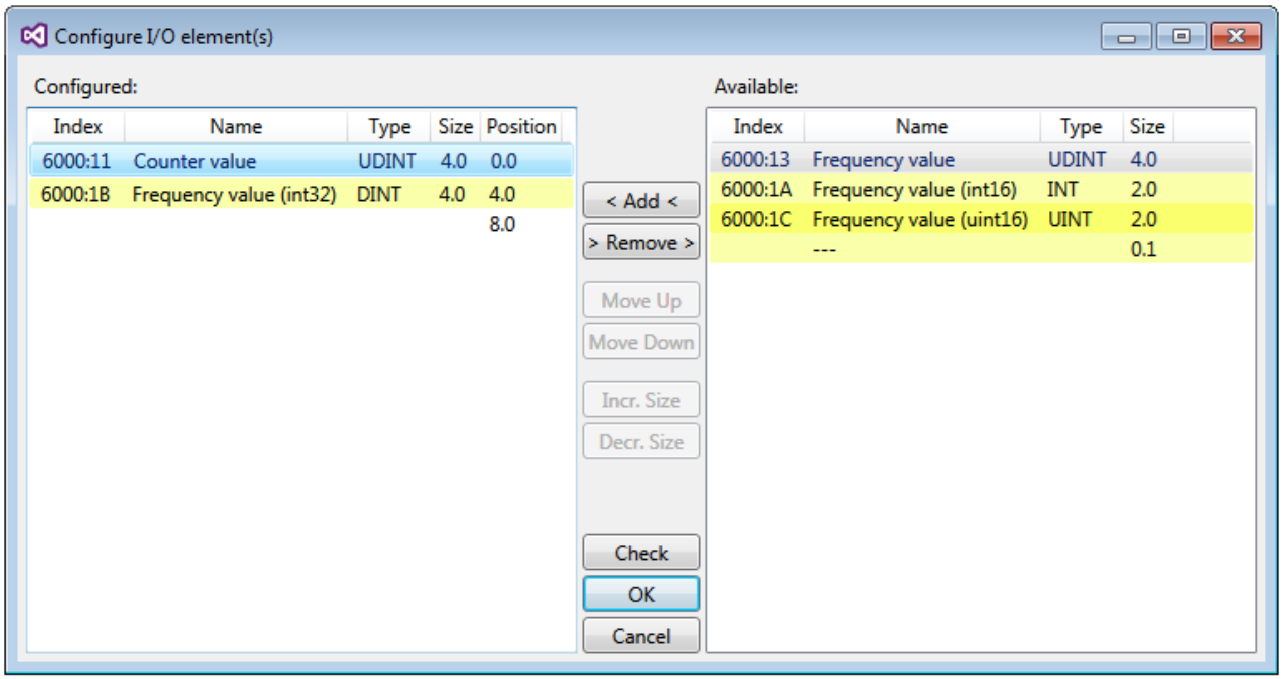


Fig. 64: Selection of the process data

The safety address together with the CRC must be entered on the TwinSAFE SC slave side. This is done via the CoE objects under *TSC settings* of the corresponding TwinSAFE SC component (here, for example, EL5021-0090, 0x8010: 01 and 0x8010: 02). The address set here must also be set in the *alias device* as *FSoE* address under the *Linking* tab.

Under the object 0x80n0:02 Connection Mode the CRC to be used is selected or a free CRC is entered. A total of 8 CRCs are available. A free CRC must start with 0x00ff in the high word.

8010:0	TSC Settings	RW	> 2 <
8010:01	Address	RW	0x0000 (0)
8010:02	Connection Mode	RW	TwinSAFE SC CRC1 master (97039)

Fig. 65: CoE objects 0x8010:01 and 0x8010:02

Object *TSC Settings*

Depending on the terminal, the index designation of the configuration object *TSC Settings* can vary.
Example:
- EL3214-0090 and EL3314-0090, TSC Settings, Index 8040
- EL5021-0090, TSC Settings, Index 8010
- EL6224-0090, TSC Settings, Index 800F

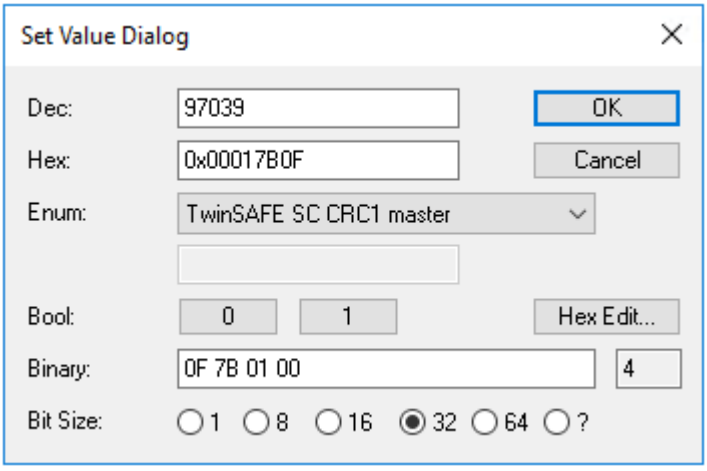


Fig. 66: Entering the safety address and the CRC

TwinSAFE SC connections

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

15.1.3 TwinSAFE SC process data EL5101-0090

The EL5101-0090 transmits the following process data to the TwinSAFE logic:

Index (hex)	Name	Type	Size
6010:1D	Counter value (uint16)	UINT	2.0
6010:11	Counter value	UDINT	4.0
6010:13	Frequency value	UDINT	4.0
6010:14	Period value	UDINT	4.0
6010:1C	Frequency value (uint16)	UINT	2.0
6010:1E	Period value (uint16)	UINT	2.0

The Counter Value (uint16) (0x6010:1D) is transferred as default value. Via the „Process Image“ tab, other data types can be selected or completely deselected in the Safety Editor.

Depending on the TwinCAT 3.1 version, process data can be renamed automatically when linking to the Safety Editor.

TwinSAFE SC Objects

The TwinSAFE SC objects of the EL5101-0090 are listed in chapter “Objects TwinSAFE Single Channel (EL5101-0090) [▶ 173]”.

15.2 Process data and operation modes

Information on process data and operating modes can be found in chapter “EL5101 - Commissioning [▶ 59]”.

15.3 Object description and parameterization - normal operation mode

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

15.3.1 Restore object

Index 1011 Restore default parameters

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

15.3.2 Configuration data

Index 8000 Non-Volatile Settings 0

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	Non-Volatile Settings 0	Maximum subindex	UINT8	RO	0x05 (5_{dec})
8000:01	Enable register reload [▶ 66]	The counter counts up to the “Counter reload value”, or the “Counter reload value” (0x8001:02 [▶ 154]) is loaded in the event of an underflow. **Example 360° encoder with set bit:** Moves in positive direction via Counter reload value [▶ 154]: Reset counter value to 0. Moves in negative direction less than 0: Reset counter value to Counter reload value [▶ 154].	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Enable index reset [▶ 66]	Activates input C for resetting the counter. **Example 360° encoder with set bit:** Moves in positive direction (signal at input C): Reset counter value to 0 Moves in negative direction (signal at input C): underflow with FFFF, FFFE etc.)	BOOLEAN	RW	0x00 (0_{dec})
8000:03	Enable FWD count [▶ 67]	FALSE The terminal operates in quadrature decoder mode. TRUE The terminal operates as counter, count direction to input B.	BOOLEAN	RW	0x00 (0_{dec})
8000:04	Enable pos. gate [▶ 67]	The gate input responds to positive edge and locks the counter.	BOOLEAN	RW	0x01 (1_{dec})
8000:05	Enable neg. gate [▶ 67]	The gate input responds to negative edge and locks the counter.	BOOLEAN	RW	0x00 (0_{dec})

Index 8001 Non-Volatile Settings 1

Index (hex)	Name	Meaning	Data type	Flags	Default
8001:0	Non-Volatile Settings 1	Maximum subindex	UINT8	RO	0x02 (2_{dec})
8001:01	Frequency window [▶ 67]	The value specifies the size of the time window for the “Window [▶ 154]” variable. resolution: 16 µs; e.g. default value: 16 µs x 100_{dec} = 1.6 ms	UINT16	RW	0x0064 (100_{dec})
8001:02	Counter reload value [▶ 66]	If “Enable register reload [▶ 154]” = TRUE, the counter counts up to this value and is loaded with this value in the event of an underflow.	UINT16	RW	0xFFFF (65535_{dec})

15.3.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6000 Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	Inputs	Length of this object	UINT8	RO	0x06 (6_{dec})
6000:01	Status	Status byte [▶ 74]	UINT8	RO	0x00 (0_{dec})
6000:02	Value	meter reading	UINT16	RO	0x0000 (0_{dec})
6000:03	Latch	Latch value	UINT16	RO	0x0000 (0_{dec})
6000:04	Frequency	Frequency value (resolution: 0.01 Hz / digit) [fixed 10 ms measuring window]	UINT32	RO	0x00000000 (0_{dec})
6000:05	Period	Period (resolution 500 ns / digit)	UINT16	RO	0x0000 (0_{dec})
6000:06	Window	Measured value of the variable timeframe (“Frequency window” (0x8001:01 [▶ 154])	UINT16	RO	0x0000 (0_{dec})

15.3.4 Output data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 7000 Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	Outputs	Length of this object	UINT8	RO	0x02 (2_{dec})
7000:01	Ctrl [▶ 74]	Control byte [▶ 74]	UINT8	RO	0x00 (0_{dec})
7000:02	Value	The counter value to be set via “CNT_SET” (CB.02 [▶ 74]).	UINT16	RO	0x0000 (0_{dec})

15.3.5 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 low word contains the CoE profile used (5001). • The high 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	EL5101-0090

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	09

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	10

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave: • Low word ◦ 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 1600 RxPDO-Map Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RxPDO-Map Outputs	PDO Mapping RxPDO 1	UINT8	RO	0x02 (2_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1601 RxPDO-Map Outputs Word-Aligned

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	RxPDO-Map Outputs Word-Aligned	PDO Mapping RxPDO 2	UINT8	RO	0x03 (3_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1601:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1A00 TxPDO-Map Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	TxPDO-Map Inputs	PDO Mapping TxPDO 1	UINT8	RO	0x03 (3_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A01 TxPDO-Map Inputs Word-Aligned

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	TxPDO-Map Inputs Word-Aligned	PDO Mapping TxPDO 2	UINT8	RO	0x04 (4_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A01:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A02 TxPDO-Map Inputs Optional

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	TxPDO-Map Inputs Optional	PDO Mapping TxPDO 3	UINT8	RO	0x03 (3_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x04 (Frequency))	UINT32	RO	0x6000:04, 32
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x05 (Period))	UINT32	RO	0x6000:05, 16
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x06 (Window))	UINT32	RO	0x6000:06, 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	0x02 (2_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	SubIndex 002	2nd allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1610 (5648_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 (6672_{dec})
1C13:03	SubIndex 003	3rd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:04	SubIndex 004	4th 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 • Synchronous 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0x4807 (18439_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000103C4 (66500_{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, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only).	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0003 (3_{dec})

Index F008 Code word

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

15.4 Object description and parameterization - enhanced operation mode

EtherCAT XML Device Description

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

NOTICE



Parameterization via the CoE list (CAN over EtherCAT)

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

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

15.4.1 Restore object

Index 1011 Restore default parameters

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

15.4.2 Configuration data

Index 8010 ENC Settings (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	ENC Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
8010:01	Enable C reset [▶ 87]	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8010:02	Enable extern reset [▶ 87]	A counter reset is triggered via the external latch input (24 V).	BOOLEAN	RW	0x00 (0_{dec})
8010:03	Enable up/down counter [▶ 87]	Enablement of the V/R counter in place of the encoder with the bit set. Increments are counted at input A. Input B specifies the counting direction.	BOOLEAN	RW	0x00 (0_{dec})
8010:04	Gate polarity [▶ 87]	0: Disable gate 1: Enable pos. gate (gate locks with high level) 2: Enable neg. gate (gate locks with low-level)	BIT2	RW	0x01 (1_{dec})
8010:08	Disable filter	0: Activates the input filter (inputs A, /A, B, /B, C, /C only) 1: Disables the input filter When the filter is enabled, a signal edge must last at least 2.4 µs to be counted as an increment.	BOOLEAN	RW	0x01 (1_{dec})
8010:0A	Enable micro increments [▶ 89]	When enabled, the terminal interpolates micro-increments between the integer encoder increments in DC mode. The lower 8 bits of the Counter-Value are used for the display. A 32 bit counter thus becomes a 24+8 bit counter, a 16 bit counter becomes an 8+8 bit counter.	BOOLEAN	RW	0x00 (0_{dec})
8010:0B	Open circuit detection A [▶ 88]	A wire break on track A is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0C	Open circuit detection B [▶ 88]	A wire break on track B is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0D	Open circuit detection C [▶ 88]	A wire break on track C is indicated in index 0x6010:07 [▶ 93] and as process data. Diagnostics are only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typical, subject to change) is detected as a wire break.	BOOLEAN	RW	0x00 (0_{dec})
8010:0E	Reversion of rotation [▶ 87]	Enables reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})
8010:10	Extern reset polarity [▶ 87]	0: Fall (the counter is set to zero with a falling edge) 1: Rise (the counter is set to zero with a rising edge)	BIT1	RW	0x01 (1_{dec})
8010:11	Frequency window [▶ 86]	This is the minimal time used for determining the frequency. Default value: 10 ms [Resolution: 1 µs] The number of pulses in the timeframe plus the next one is measured. The wait will last no longer than “Frequency Wait Time”. The number of pulses is divided by the actual timeframe size. The calculated frequency is output to index 0x6010:13 [▶ 93] and as a process data value. The frequency calculation is performed locally and does not use the distributed clock function.	UINT16	RW	0x2710 (10000_{dec})
8010:13	Frequency scaling [▶ 86]	Scaling of the frequency measurement (must be divided by this value to obtain the unit in Hz): 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})

Index 8010 ENC Settings (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:14	Period scaling [▶ 114]	Resolution of the period value in the process data: 100: The “100 ns” period duration value is a multiple of 100 ns 500: The “500 ns” period duration value is a multiple of 500 ns	UINT16	RW	0x0064 (100_{dec})
8010:15	Frequency resolution [▶ 86]	Resolution of the frequency measurement: 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})
8010:16	Period resolution [▶ 114]	Internal resolution of the interval measurement: 100: “100 ns” Period value is a multiple of 100 ns Internally, the period is calculated with 100 ns resolution. The max. measurable period can then be approx. 1.6 seconds. 500: “500 ns” Period value is a multiple of 500 ns Internally, the period is calculated with 500 ns resolution, the maximum measurable period can be approx. 32.7 ms. The resolution of process data continues to be the value according to index 0x8010:14 [▶ 160] (e.g. 100 ns [default]).	UINT16	RW	0x0064 (100_{dec})
8010:17	Frequency Wait Time [▶ 86]	Waiting time [ms] for frequency measurement Once the time specified in the “Frequency window [▶ 86]” has elapsed, the system waits for the next positive edge from track A. This enables the update speed for the “Frequency” process data to be optimized, depending on the expected frequencies. At least double the period value of the minimum frequency to be measured should be entered here. t >= 2* (1 / f_{min})	UINT16	RW	0x0640 (1600_{dec})

15.4.3 Input data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 6010 ENC Inputs (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	ENC Inputs	Maximum subindex	UINT8	RO	0x1E (30_{dec})
6010:01	Latch C valid [▶ 87]	The counter value was latched with the C input. The data in the input process data “Latch value” (index 0x6010:12) corresponds to the latched value when the bit is set. To re-enable the latch input, the bit in the output process data “Enable latch C” (index 0x7010:01 [▶ 163]) must first be cleared and then set again.	BOOLEAN	RO	0x00 (0_{dec})
6010:02	Latch extern valid [▶ 87]	The counter value was locked via the external latch. The data in the process data field “Latch value” (index 0x6010:12 [▶ 162]) corresponds to the latched value when the bit is set. To re-enable the latch input, the bit in the output process data “Enable latch extern on postitive/ negative edge” (index 0x7010:02 [▶ 163]/0x7010:04 [▶ 163]) must first be cleared 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 [▶ 88]	The counter has crossed the zero crossing backwards. In combination with a reset function (C/external), the underflow/overflow control is ineffective.	BOOLEAN	RO	0x00 (0_{dec})
6010:05	Counter overflow [▶ 88]	Counter overflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0_{dec})
6010:06	Status of input status	State of the status input (alarm “input 1”)	BOOLEAN	RO	0x00 (0_{dec})
6010:07	Open circuit [▶ 88]	Indicates a wire break. Configuration via index 0x8010:0B [▶ 160], 0x8010:0C [▶ 160], 0x8010:0D [▶ 160]	BOOLEAN	RO	0x00 (0_{dec})
6010:08	Extrapolation stall [▶ 89]	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})
6010:0B	Status of input C	Status of input C	BOOLEAN	RO	0x00 (0_{dec})
6010:0C	Status of input gate	The state of the gate input	BOOLEAN	RO	0x00 (0_{dec})
6010:0D	Status of extern latch	State 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 EL5101, although no new process data were available (0 = OK, 1 = NOK).	BOOLEAN	RO	0x00 (0_{dec})
6010:0F	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	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})
6010:13	Frequency value [▶ 160]	The frequency (setting of the scaling and resolution in index 0x8010:13 [▶ 160] and 0x8010:15 [▶ 160])	UINT32	RO	0x00000000 (0_{dec})
6010:14	Period value [▶ 160]	The period (setting of the scaling and resolution in index 0x8010:14 [▶ 160] and 0x8010:16 [▶ 160])	UINT32	RO	0x00000000 (0_{dec})
6010:16	Timestamp [▶ 77]	Timestamp of the last counter change	UINT64	RO	
6010:1C	Frequency value (uint16)	Frequency (16-bit value)	UINT16	RO	0x0000 (0_{dec})
6010:1D	Counter value (uint16)	Counter (16-bit value)	UINT16	RO	0x0000 (0_{dec})
6010:1E	Period value (uint16)	Period (16-bit value)	UINT16	RO	0x0000 (0_{dec})

15.4.4 Output data

Process data can be read via CoE but cannot be set.

In the following descriptions, the corresponding CoE index is always included as a reference in addition to the name of the process data.

- Please note that while the input and output process data (0x6xxx/0x7xxx) can be read via the CoE directory, they cannot be set via the CoE directory!

Index 7010 ENC Outputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7010:01	Enable latch C [▶ 115]	Activate latching via input C.	BOOLEAN	RO	0x00 (0_{dec})
7010:02	Enable latch extern on positive edge [▶ 115]	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 [▶ 115]	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 [▶ 163]).	UINT32	RO	0x00000000 (0_{dec})

15.4.5 Information / diagnostic data (channel specific)

Index A010 ENC Diag data (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
A010:0	ENC Diag data	Maximum subindex	UINT8	RO	0x03 (3_{dec})
A010:01	Open circuit A [▶ 88]	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A010:02	Open circuit B [▶ 88]	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A010:03	Open circuit C [▶ 88]	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})

15.4.6 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 low word contains the CoE profile used (5001). • The high 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	EL5101-0090

Index 1009 Hardware version

Index (hex)	Name	Meaning	Data type	Flags	Default
1009:0	Hardware version	Hardware version of the EtherCAT slave	STRING	RO	09

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	10

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	0x13ED3052 (334311506_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave: • Low word ◦ 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 RxPDO-Par Outputs (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1400:0	RxPDO-Par Outputs	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[8]	RO	01 16 02 16 03 16 10 16

Index 1401 RxPDO-Par Outputs Word-Aligned (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1401:0	RxPDO-Par Outputs Word-Aligned	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[8]	RO	00 16 02 16 03 16 10 16

Index 1402 ENC RxPDO-Par Control compact (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1402:0	ENC RxPDO-Par Control compact	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[8]	RO	03 16 00 16 01 16 00 00

Index 1403 ENC RxPDO-Par Control (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1403:0	ENC RxPDO-Par Control	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[8]	RO	02 16 00 16 01 16 00 00

Index 1600 RxPDO-Map Outputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RxPDO-Map Outputs	PDO Mapping RxPDO 1	UINT8	RO	0x02 (2_{dec})
1600:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1600:02	SubIndex 002	2. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1601 RxPDO-Map Outputs Word-Aligned (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	RxPDO-Map Outputs Word-Aligned	PDO Mapping RxPDO 2	UINT8	RO	0x03 (3_{dec})
1601:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (Outputs), entry 0x01 (Ctrl))	UINT32	RO	0x7000:01, 8
1601:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1601:03	SubIndex 003	3. PDO Mapping entry (object 0x7000 (Outputs), entry 0x02 (Value))	UINT32	RO	0x7000:02, 16

Index 1602 ENC RxPDO-Map Control compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1602:0	ENC RxPDO-Map Control compact	PDO Mapping RxPDO 3	UINT8	RO	0x07 (7_{dec})
1602:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7010:01, 1
1602:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1602:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 16

Index 1603 ENC RxPDO-Map Control (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1603:0	ENC RxPDO-Map Control	PDO Mapping RxPDO 4	UINT8	RO	0x07 (7_{dec})
1603:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (ENC Outputs), entry 0x01 (Enable latch C))	UINT32	RO	0x7010:01, 1
1603:02	SubIndex 002	2. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x03 (Set counter))	UINT32	RO	0x7010:03, 1
1603:04	SubIndex 004	4. PDO Mapping entry (object 0x7010 (ENC Outputs), 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), entry 0x11 (Set counter value))	UINT32	RO	0x7010:11, 32

Index 1800 TxPDO-Par Inputs (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	TxPDO-Par Inputs	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[16]	RO	01 1A 03 1A 04 1A 05 1A 06 1A 07 1A 08 1A 10 1A

Index 1801 TxPDO-Par Inputs Word-Aligned (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	TxPDO-Par Inputs Word-Aligned	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[16]	RO	00 1A 03 1A 04 1A 05 1A 06 1A 07 1A 08 1A 10 1A

Index 1802 TxPDO-Par Inputs Optional (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	TxPDO-Par Inputs Optional	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[16]	RO	03 1A 04 1A 05 1A 06 1A 07 1A 08 1A 00 00

Index 1803 ENC TxPDO-Par Status compact (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	ENC TxPDO-Par Status compact	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[16]	RO	04 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00 00 00

Index 1804 ENC TxPDO-Par Status (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	ENC TxPDO-Par Status	PDO Parameter TxPDO 5	UINT8	RO	0x06 (6_{dec})
1804:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 5.	OCTET-STRING[16]	RO	03 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00 00 00

Index 1805 ENC TxPDO-Par Frequency (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1805:0	ENC TxPDO-Par Frequency	PDO Parameter TxPDO 6	UINT8	RO	0x06 (6_{dec})
1805:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 6.	OCTET-STRING[16]	RO	00 1A 01 1A 02 1A 06 1A 00 00 00 00 00 00 00 00

Index 1806 ENC TxPDO-Par Period (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1806:0	ENC TxPDO-Par Period	PDO Parameter TxPDO 7	UINT8	RO	0x06 (6_{dec})
1806:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 7.	OCTET-STRING[16]	RO	00 1A 01 1A 02 1A 05 1A 00 00 00 00 00 00 00 00

Index 1807 ENC TxPDO-Par Timest. (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1807:0	ENC TxPDO-Par Timest.	PDO Parameter TxPDO 8	UINT8	RO	0x06 (6_{dec})
1807:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 8.	OCTET-STRING[16]	RO	08 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00 00 00

Index 1808 ENC TxPDO-Par Timest. compact (EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1808:0	ENC TxPDO-Par Timest. compact	PDO Parameter TxPDO 9	UINT8	RO	0x06 (6_{dec})
1808:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 9.	OCTET-STRING[16]	RO	07 1A 00 1A 01 1A 02 1A 00 00 00 00 00 00 00 00

Index 1A00 TxPDO-Map Inputs (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	TxPDO-Map Inputs	PDO Mapping TxPDO 1	UINT8	RO	0x03 (3_{dec})
1A00:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A00:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A00:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A01 TxPDO-Map Inputs Word-Aligned (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	TxPDO-Map Inputs Word-Aligned	PDO Mapping TxPDO 2	UINT8	RO	0x04 (4_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x01 (Status))	UINT32	RO	0x6000:01, 8
1A01:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1A01:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x02 (Value))	UINT32	RO	0x6000:02, 16
1A01:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (Inputs), entry 0x03 (Latch))	UINT32	RO	0x6000:03, 16

Index 1A02 TxPDO-Map Inputs Optional (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	TxPDO-Map Inputs Optional	PDO Mapping TxPDO 3	UINT8	RO	0x03 (3_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (Inputs), entry 0x04 (Frequency))	UINT32	RO	0x6000:04, 32
1A02:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (Inputs), entry 0x05 (Period))	UINT32	RO	0x6000:05, 16
1A02:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (Inputs), entry 0x06 (Window))	UINT32	RO	0x6000:06, 16

Index 1A03 ENC TxPDO-Map Status compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	ENC TxPDO-Map Status compact	PDO Mapping TxPDO 4	UINT8	RO	0x12 (18_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A03:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A03:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A03:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A03:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A03:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x06 (Status of input status))	UINT32	RO	0x6010:06, 1
1A03:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A03:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A03:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A03:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A03:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A03:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A03:0D	SubIndex 013	13. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A03:0E	SubIndex 014	14. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E: 1
1A03:0F	SubIndex 015	15. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO-State))	UINT32	RO	0x6010:0F, 1
1A03:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO-Toggle))	UINT32	RO	0x6010:10, 1
1A03:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 16
1A03:12	SubIndex 018	18. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 16

Index 1A04 ENC TxPDO-Map Status (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	ENC TxPDO-Map Status	PDO Mapping TxPDO 5	UINT8	RO	0x12 (18_{dec})
1A04:01	SubIndex 001	PDO Mapping entry no. 1 (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A04:02	SubIndex 002	PDO Mapping entry no. 2 (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A04:03	SubIndex 003	PDO Mapping entry no. 3 (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A04:04	SubIndex 004	PDO Mapping entry no. 4 (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A04:05	SubIndex 005	PDO Mapping entry no. 5 (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A04:06	SubIndex 006	PDO Mapping entry no. 6 (object 0x6010 (ENC Inputs), entry 0x06 (input status))	UINT32	RO	0x6010:06, 1
1A04:07	SubIndex 007	PDO Mapping entry no. 7 (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A04:08	SubIndex 008	PDO Mapping entry no. 8 (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A04:09	SubIndex 009	PDO Mapping entry no. 9 (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A04:0A	SubIndex 010	PDO Mapping entry no. 10 (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A04:0B	SubIndex 011	PDO Mapping entry no. 11 (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A04:0C	SubIndex 012	PDO Mapping entry no. 12 (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A04:0D	SubIndex 013	PDO Mapping entry no. 13 (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A04:0E	SubIndex 014	PDO Mapping entry no. 14 (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A04:0F	SubIndex 015	PDO Mapping entry no. 15 (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6010:0F, 1
1A04:10	SubIndex 016	PDO Mapping entry no. 16 (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A04:11	SubIndex 017	PDO Mapping entry no. 17 (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32
1A04:12	SubIndex 018	PDO Mapping entry no. 18 (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 32

Index 1A05 ENC TxPDO-Map Frequency (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	ENC TxPDO-Map Frequency	PDO Mapping TxPDO 6	UINT8	RO	0x01 (1_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x13 (Frequency value))	UINT32	RO	0x6010:13, 32

Index 1A06 ENC TxPDO-Map Period (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	ENC TxPDO-Map Period	PDO Mapping TxPDO 7	UINT8	RO	0x01 (1_{dec})
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x14 (Period value))	UINT32	RO	0x6010:14, 32

Index 1A07 ENC TxPDO-Map Timest. (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	ENC TxPDO-Map Timest.	PDO Mapping TxPDO 8	UINT8	RO	0x01 (1_{dec})
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6010:16, 64

Index 1A08 ENC TxPDO-Map Timest. compact (EL5101, EL5101-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A08:0	ENC TxPDO-Map Timest. compact	PDO Mapping TxPDO 9	UINT8	RO	0x01 (1_{dec})
1A08:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x16 (Timestamp))	UINT32	RO	0x6010:16, 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	0x02 (2_{dec})
1C12:01	SubIndex 001	1st allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	SubIndex 002	2nd allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1610 (5648_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x01 (1_{dec})
1C13:01	SubIndex 001	1st allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2nd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 (6672_{dec})
1C13:03	SubIndex 003	3rd allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:04	SubIndex 004	4th 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 • Synchronous 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: Synchronous with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output shift with SYNC1 event (DC mode only) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0x4807 (18439_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000103C4 (66500_{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, 0x1C33:06, 0x1C33:09 are updated with the maximum measured values. For a subsequent measurement the measured values are reset.	UINT16	RW	0x0000 (0_{dec})
1C32:09	Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only).	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC – Synchronous with SYNC0 event • 3: DC – Synchronous with SYNC1 event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 171]	UINT32	RW	0x000F4240 (0_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC Mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: Free Run is supported • Bit 1: Synchronization with SM 2 event is supported (outputs available) • Bit 1: Synchronization 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 [▶ 171] or 0x1C33:08)	UINT16	RO	0x4807 (18439_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 171]	UINT32	RO	0x000103C4 (66500_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and the inputs being available for the master (in ns, DC mode only)	UINT32	RO	0x000103C4 (66500_{dec})
1C33:07	Minimum delay time		UINT32	RW	0x0000 (0_{dec})
1C33:08	Command	as 0x1C32:08 [▶ 171]	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 [▶ 171]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 171]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 171]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 171]	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 spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	0x0003 (3_{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	Maximum subindex	UINT8	RW	0x03 (3_{dec})
F010:01	SubIndex 001	reserved	UINT32	RW	0x000001FE (510_{dec})
F010:02	SubIndex 002	reserved	UINT32	RW	0x000001FF (511_{dec})
F010:03	SubIndex 003	reserved	UINT32	RW	0x000003B6 (950_{dec})

Index F082 MDP Profile Compatibility

Index (hex)	Name	Meaning	Data type	Flags	Default
F082:0	Module list	Maximum subindex	UINT8	RW	0x01 (1_{dec})
F082:01	Compatible input cycle counter	reserved	BOOLEAN	RW	0x00 (0_{dec})

15.5 Objects TwinSAFE Single Channel (EL5101-0090)

Index 1410 TSC RxPDO-Par Master Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1410:0	TSC RxPDO-Map Master Message	PDO Parameter RxPDO 17	UINT8	RO	0x06 (6_{dec})
1410:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) which must not be transferred together with this PDO.	OCTET-STRING[8]	RO	00 16 01 16 00 00 00 00

Index 1610 TSC RxPDO-Map Master Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1610:0	TSC RxPDO-Map Master Message	PDO Mapping RxPDO 17	UINT8	RO	0x04 (4_{dec})
1610:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (TSC Master Frame Elements), entry 0x01 (TSC___Master Cmd))	UINT32	RO	0x7020:01, 8
1610:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1610:03	SubIndex 003	3. PDO Mapping entry (object 0x7020 (TSC Master Frame Elements), entry 0x03 (TSC__Master CRC_0))	UINT32	RO	0x7020:03, 16
1610:04	SubIndex 004	4. PDO Mapping entry (object 0x7020 (TSC Master Frame Elements), entry 0x02 (TSC__Master ConnID))	UINT32	RO	0x7020:02, 16

Index 1810 TSC TxPDO-Par Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1810:0	TSC TxPDO-Par Slave Message	PDO Mapping TxPDO 17	UINT8	RO	0x06 (6_{dec})
1810:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) which must not be transferred together with this PDO.	OCTET-STRING[16]	RO	00 1A 01 1A 02 1A 00 00 00 00 00 00 00 00 00 00

Index 1A10 TSC TxPDO-Map Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1A10:0	TSC TxPDO-Map Slave Message	PDO Mapping TxPDO	UINT8	RW	0x14 (20_{dec})
1A10:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x01 (TSC___Slave Cmd))	UINT32	RW	0x6020:01, 8
1A10:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RW	0x6010:11, 16
1A10:03	SubIndex 003	3. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x03 (TSC__Slave CRC_0))	UINT32	RW	0x6020:03, 16
1A10:04	SubIndex 004	4. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A10:05	SubIndex 005	5. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x04 (TSC__Slave CRC_1))	UINT32	RW	0x6020:04, 16
1A10:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x13 (Frequency value))	UINT32	RW	0x6010:13, 16
1A10:07	SubIndex 007	7. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x05 (TSC__Slave CRC_2))	UINT32	RW	0x6020:05, 16
1A10:08	SubIndex 008	8. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A10:09	SubIndex 009	9. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x06 (TSC__Slave CRC_3))	UINT32	RW	0x6020:06, 16
1A10:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x14 (Period value))	UINT32	RW	0x6010:14, 16
1A10:0B	SubIndex 011	11. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x07 (TSC__Slave CRC_4))	UINT32	RW	0x6020:07, 16
1A10:0C	SubIndex 012	12. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A10:0D	SubIndex 013	13. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x08 (TSC__Slave CRC_5))	UINT32	RW	0x6020:08, 16
1A10:0E	SubIndex 014	14. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x1C (Frequency value (uint16)))	UINT32	RW	0x6010:1C, 16
1A10:0F	SubIndex 015	15. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x09 (TSC__Slave CRC_6))	UINT32	RW	0x6020:09, 16
1A10:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x1D (Counter value (uint16)))	UINT32	RW	0x6010:1D, 16
1A10:11	SubIndex 017	17. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x0A (TSC__Slave CRC_7))	UINT32	RW	0x6020:0A, 16
1A10:12	SubIndex 018	18. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x1E (Period value (uint16)))	UINT32	RW	0x6010:1E, 16
1A10:13	SubIndex 019	19. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x0B (TSC__Slave CRC_8))	UINT32	RW	0x6020:0B, 16
1A10:14	SubIndex 020	20. PDO Mapping entry (object 0x6020 (TSC Slave Frame Elements), entry 0x02 (TSC__Slave ConnID))	UINT32	RW	0x6020:02, 16

Index 6020 TSC Slave Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
6020:0	TSC Slave Frame Elements	Max. Subindex	UINT8	RO	0x0B (11_{dec})
6020:01	TSC__Slave Cmd	reserved	UINT8	RO	0x00 (0_{dec})
6020:02	TSC__Slave ConnID	reserved	UINT16	RO	0x0000 (0_{dec})
6020:03	TSC__Slave CRC_0	reserved	UINT16	RO	0x0000 (0_{dec})
6020:04	TSC__Slave CRC_1	reserved	UINT16	RO	0x0000 (0_{dec})
6020:05	TSC__Slave CRC_2	reserved	UINT16	RO	0x0000 (0_{dec})
6020:06	TSC__Slave CRC_3	reserved	UINT16	RO	0x0000 (0_{dec})
6020:07	TSC__Slave CRC_4	reserved	UINT16	RO	0x0000 (0_{dec})
6020:08	TSC__Slave CRC_5	reserved	UINT16	RO	0x0000 (0_{dec})
6020:09	TSC__Slave CRC_6	reserved	UINT16	RO	0x0000 (0_{dec})
6020:0A	TSC__Slave CRC_7	reserved	UINT16	RO	0x0000 (0_{dec})
6020:0B	TSC__Slave CRC_8	reserved	UINT16	RO	0x0000 (0_{dec})

Index 7020 TSC Master Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
7020:0	TSC Master Frame Elements	Max. Subindex	UINT8	RO	0x03 (3_{dec})
7020:01	TSC__Master Cmd	reserved	UINT8	RO	0x00 (0_{dec})
7020:02	TSC__Master ConnID	reserved	UINT16	RO	0x0000 (0_{dec})
7020:03	TSC__Master CRC_0	reserved	UINT16	RO	0x0000 (0_{dec})

Index 8020 TSC Settings

Index (hex)	Name	Meaning		Data type	Flags	Default
8020:0	TSC Settings	Max. Subindex		UINT8	RO	0x02 (2_{dec})
8020:01	Address	TwinSAFE SC Address		UINT16	RO	0x0000 (0_{dec})
8020:02	Connection Mode	Selection of the TwinSAFE SC CRC		UINT32	RO	0x00000000 (0_{dec})
		97039_{dec}	TwinSAFE SC CRC1 master			
		153375_{dec}	TwinSAFE SC CRC2 master			
		20469_{dec}	TwinSAFE SC CRC3 master			
		283633_{dec}	TwinSAFE SC CRC4 master			
		389589_{dec}	TwinSAFE SC CRC5 master			
		419387_{dec}	TwinSAFE SC CRC6 master			
		506061_{dec}	TwinSAFE SC CRC7 master			
		582077_{dec}	TwinSAFE SC CRC8 master			

16 Appendix

16.1 EtherCAT AL Status Codes

For detailed information please refer to the EtherCAT system description.

16.2 Firmware compatibility

Beckhoff EtherCAT devices are delivered with the latest available firmware version. Firmware and hardware must be compatible; not every combination ensures compatibility. The overview below shows the hardware versions on which a firmware can be operated.

Note

- The newest possible firmware for the respective hardware should be implemented
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Observe the notes on the firmware update in the EtherCAT System Manual in chapter "Firmware Update".
If a device is set to BOOTSTRAP mode for firmware update, it may not check whether the new firmware is suitable during download.
This may result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

EL5101			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
07	04		2007/12
08	05		2008/02
07–10	06		2008/03
	07		2008/04
	08		2008/05
	09		2008/05
	10		2008/08
08–17	11	EL5101-0000-1018	2009/01
	12		2009/02
	13		2009/02
	14		2009/02
	15	EL5101-0000-1019	2009/04
	16		2009/09
	17		2009/09
		EL5101-0000-1020	2010/05
		EL5101-0000-1021	2012/06
		EL5101-0000-1022	2012/10
18–33*	18	EL5101-0000-1023	2013/04
		EL5101-0000-1024	2014/11
	19*		2018/11

EL5101-0010			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
00–12	01	EL5101-0010-0016	2010/10
		EL5101-0010-0017	2012/06
		EL5101-0010-0018	2012/10
		EL5101-0010-0019	2014/11
13–17*	02*		2022/04

EL5101-0011			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
07–17*	01*	EL5101-0011-0016	2016/10

EL5101-0090			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
24–25	01	EL5101-0090-0016	2017/10
26–34*	02	EL5101-0090-0017	2018/11
	03*		2020/11

*) This is the current compatible firmware/hardware version at the time of the preparing this documentation. Check on the Beckhoff website whether more up-to-date documentation is available.

16.3 Support and Service

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