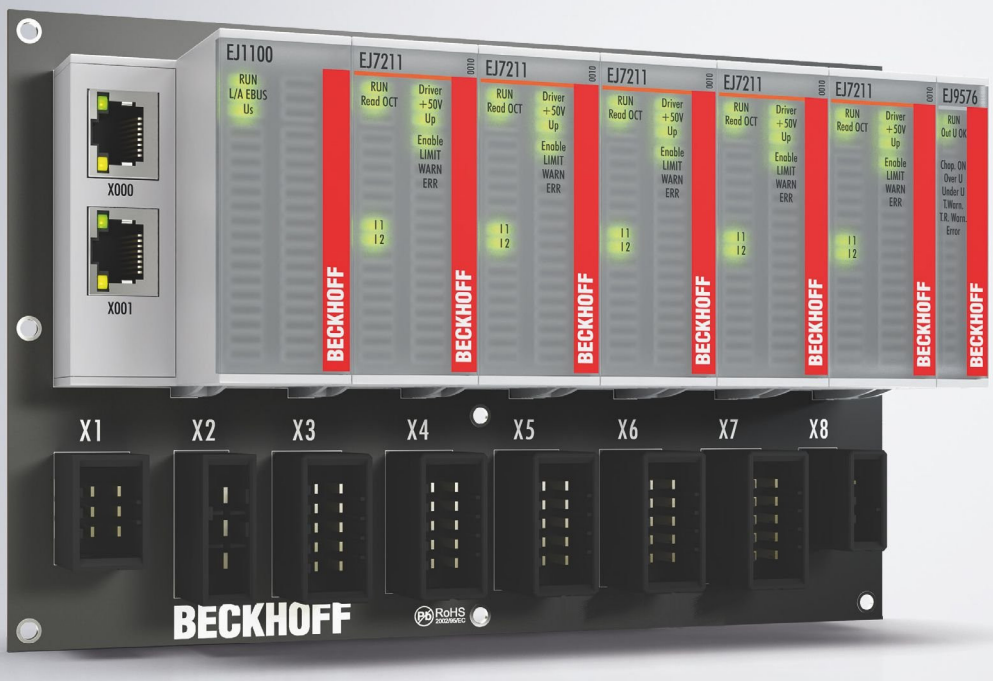
BECKHOFF New Automation Technology

Documentation | EN

EJ5101, EJ5101-0090

Incremental-Encoder-Interface



2025-06-05 | Version: 1.7.0

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1 Foreword

1.1 Product overview

EJ5101 [▶ 17]	1-channel encoder interface, incremental, 5 V_{DC} (DIFF RS422, TTL), 1 MHz
EJ5101-0090 [▶ 23]	1-channel encoder interface, incremental, 5 V_{DC} (DIFF RS422, TTL), 1 MHz, TwinSAFE SC

1.2 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

Trademarks

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https://www.beckhoff.com/trademarks

1.3 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.

1.4 Intended use

⚠ WARNING

Caution - Risk of injury!

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

1.5 Signal distribution board

NOTICE

Signal distribution board

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

1.6 Documentation issue status

Version	Comment
1.7.0	• Update chapter “Foreword” • Update structure
1.6	• EJ5101-0090 added • Update chapter *Connection* • Update chapter *LEDs* • Structural update
1.5	• Update Technical data • Correction in chapter *Interface level* • Update chapter *Installation of EJ modules* • Structural update
1.4	• Update chapter *Marking of EtherCAT plug-in modules* • Update Technical data • Chapter *Disposal* added • Structural update
1.3	• New title page • Update chapter *Connection* • Chapters *Basics communication, TwinCAT Quick Start* , *TwinCAT development environment* and *General Notes - EtherCAT Slave Application* replaced by references in the chapter *Guide through the documentation* • Chapter *EJ5101 - Object description and parameterization* added • Update revision status • Structural update
1.2	• Note *Signal Distribution Board* added • Chapter *Version identification of EtherCAT devices* replaced by *Marking of EtherCAT plug-in modules* • Update Technical data • Update chapter *Connection* • Update revision status
1.1	• *Notes on routing and installation* added
1.0	• First publication EJ5101

1.7 Guide through documentation

NOTICE

Further components of documentation

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

Title	Description
EtherCAT System Documentation (PDF)	• System overview • EtherCAT basics • Cable redundancy • Hot Connect • EtherCAT devices configuration
Design Guide EJ8xxx - Signal distribution board for standard EtherCAT plug-in modules (PDF)	Notes on the design of a signal distribution board for standard EtherCAT plug-in modules. • Requirements for the signal distribution board • Backplane mounting guidelines • Module placement • Routing guidelines
Documentation of the corresponding ELxxxx EtherCAT Terminal (s. note on documentation of ELxxxx) [▶ 45]	• Notes on the principle of operation and • descriptions for configuration and parameterization are transferable to the corresponding EtherCAT plug-in modules
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

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

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

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

1.8 Marking of EtherCAT plug-in modules

Designation

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

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

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

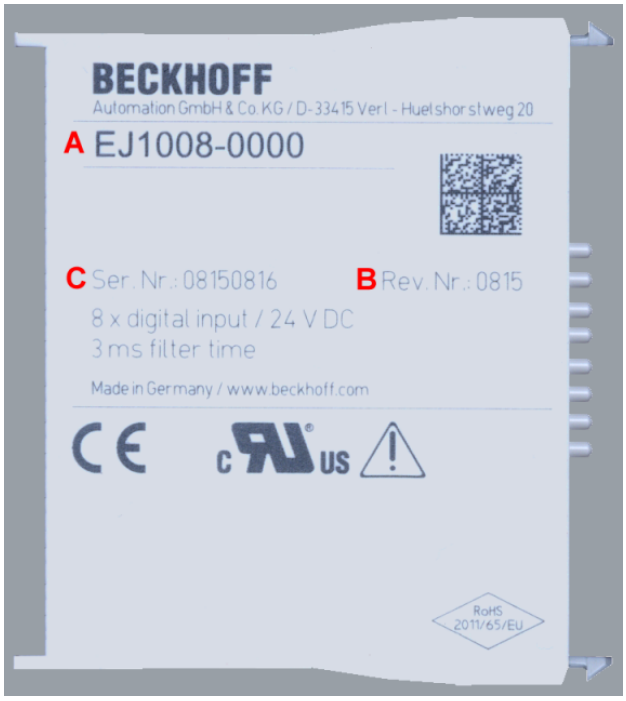


Fig. 1: Order identifier (A), Revision number (B) and serial number (C) using the example of EJ1008

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

Notes

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

Serial number

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

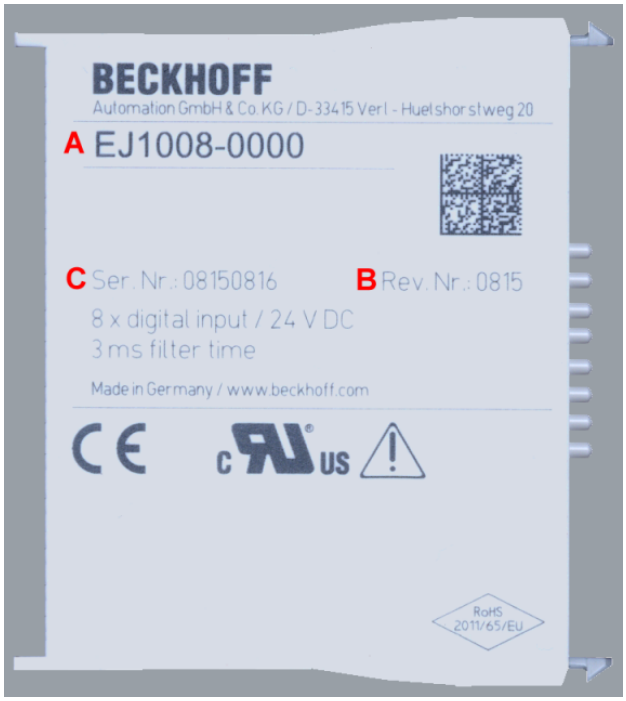


Fig. 2: Order identifier (A), revision number (B) and serial number (C) using the example of EJ1008

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

1.8.1 Beckhoff Identification Code (BIC)

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

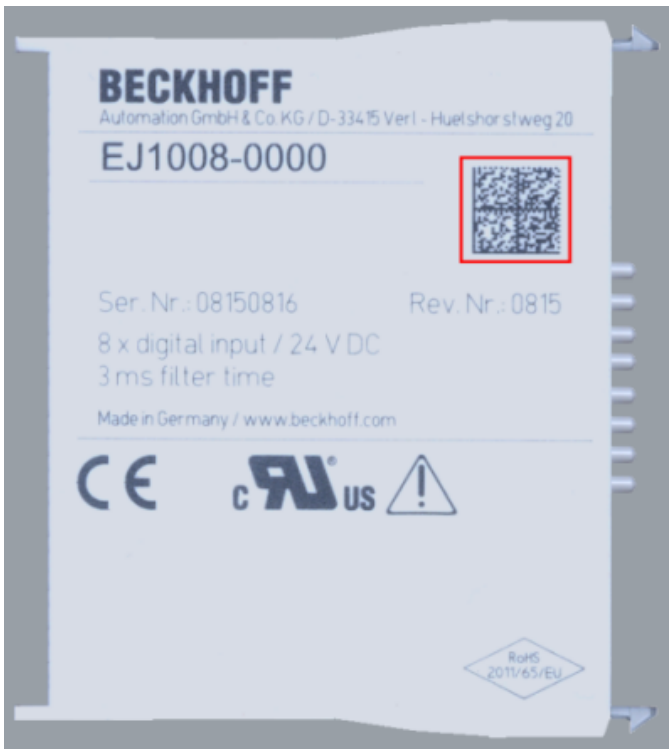


Fig. 3: BIC as data matrix code (DMC, code scheme ECC200)

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

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

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

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

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

The following information is contained:

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

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

Structure of the BIC

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

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

Accordingly as DMC:

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

BTN

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

NOTICE

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

1.8.2 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

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

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

K-bus devices (IP20, IP67)

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

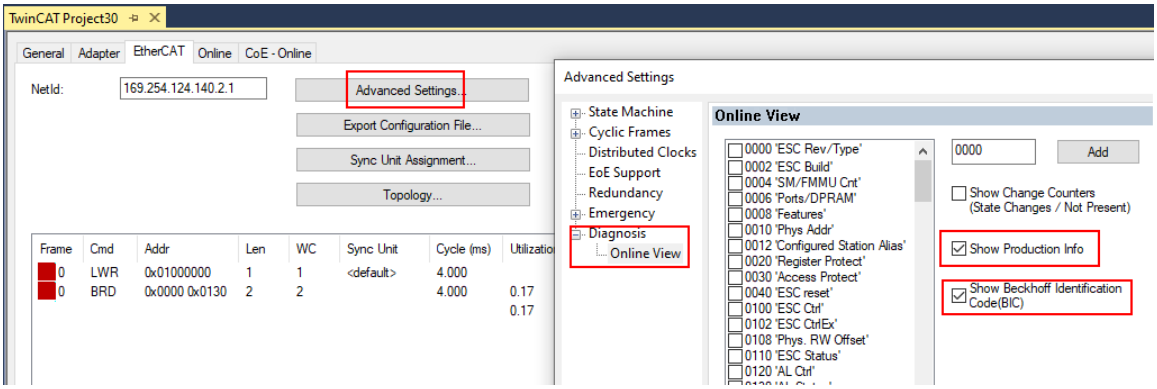
EtherCAT devices (IP20, IP67)

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

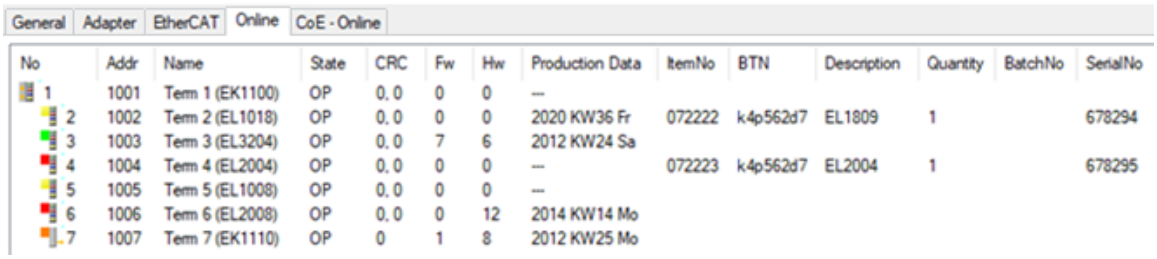
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

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

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

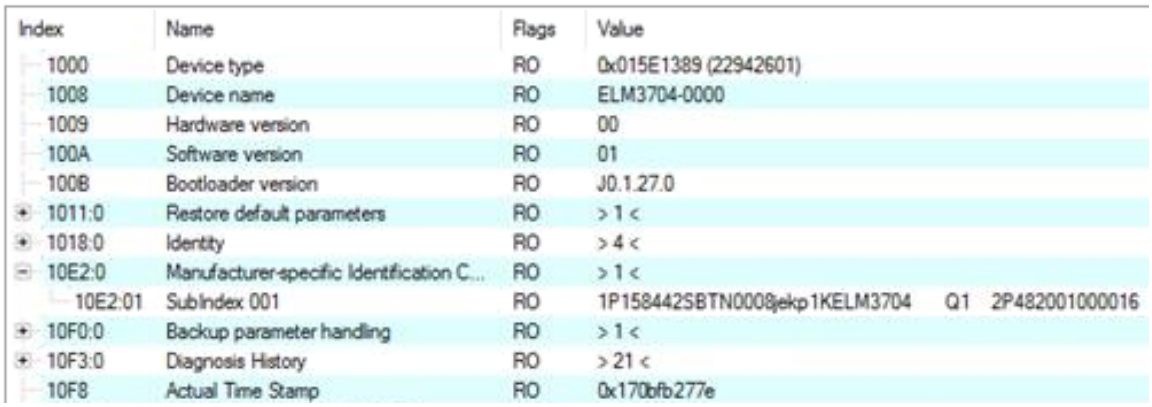


  - The BTN and its contents are then displayed:



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

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



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

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

PROFIBUS, PROFINET, and DeviceNet devices

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

1.8.3 Certificates

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

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

2 System overview

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

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

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

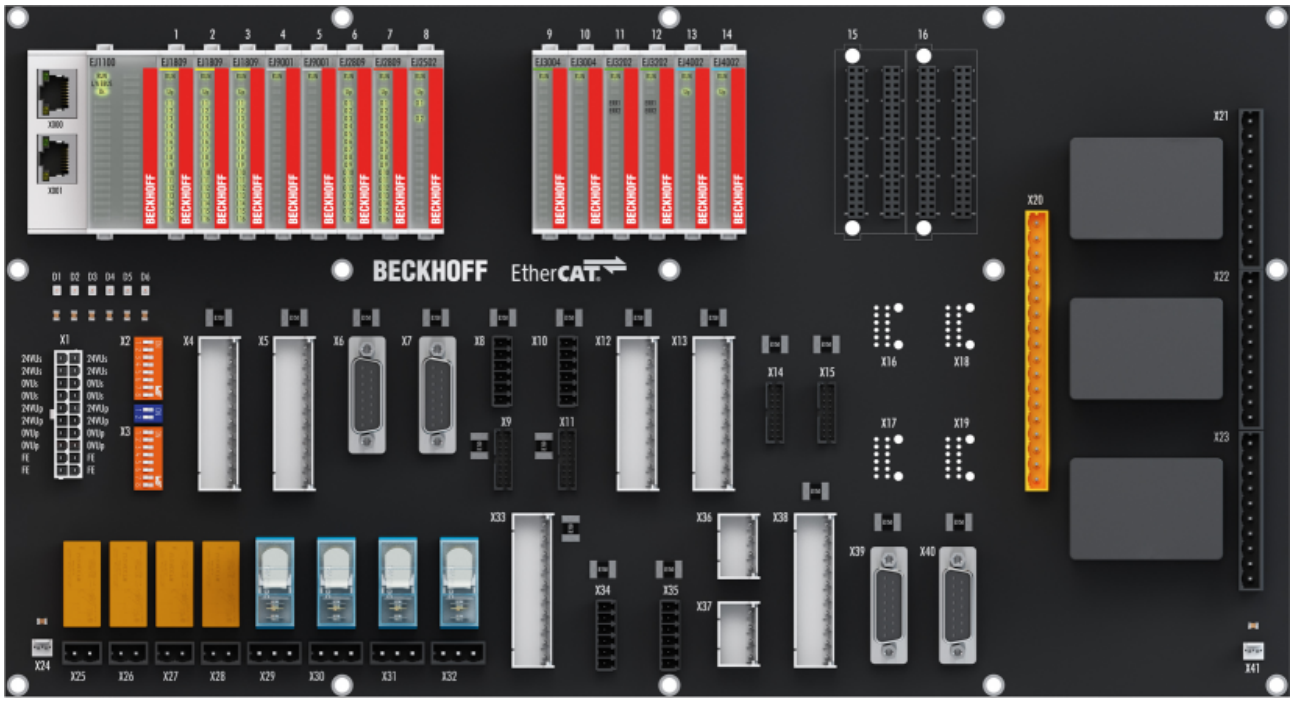


Fig. 6: EJ system sample

Signal distribution board

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

EtherCAT plug-in modules

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

3 EJ5101 - Product description

3.1 Introduction

Fig. 7: EJ5101

Incremental encoder interface

The EJ5101 EtherCAT plug-in module is an interface for the direct connection of incremental encoders with differential inputs (RS422). The connection of single-ended signals (5 V) is possible. Incremental encoders with a fault message output can be connected to the status input of the interface.

A 32/16-bit counter with quadrature decoder as well as a 32/16-bit latch for the zero pulse can be read, set or activated. The EJ5101 can also be operated as a bidirectional counter terminal on channel A.

A period measurement and frequency measurement with a resolution of up to 100 ns is possible.

The gate input allows the counter to be locked at either high or low level. The latch input accepts the counter value with rising or falling edge.

Due to the optional interpolating micro-increment function, the EJ5101 can supply even more precise axis positions for dynamic axes.

The EtherCAT plug-in module EJ5101 supports the distributed clocks function (DC). This enables synchronous reading of the encoder value together with other input data in the EtherCAT system. Optionally, the timestamp of the last-registered increment edge based on the distributed clocks system is output.

3.2 Technical data

Technical data	EJ5101
Technology	Incremental encoder interface
Number of outputs	1
Encoder connection	A, A (inv), B, B (inv), C,C (inv) (RS422, differential inputs [▶ 19]), single-ended connection possible, status input 5 V_{DC}, gate/latch input (24 $V_{DC,}$ both max. 1 MHz permitted)
Input frequency	max. 4 million increments/s with 4-fold evaluation, equivalent to 1 MHz
Power supply	24 V_{DC} (-15%/+20%)
Sensor supply	5 V_{DC}, 0.5 A
Current consumption	20 mA typ. (without sensor)
Current consumption via E-bus	typ. 130 mA
Zero-pulse latch	1 x 16/32-bit switchable
Counter	1 x 16/32-bit switchable
Distributed clocks	yes
Electrical isolation	500 V (E-bus/field voltage)
Permissible ambient temperature range during operation	-25°C ... +60°C (extended temperature range)
Permissible ambient temperature range during storage	-40°C ... +85°C
Permissible relative air humidity	95%, no condensation
Operating altitude	max. 2,000 m
Dimensions (W x H x D)	approx. 24 mm x 66 mm x 55 mm
Weight	approx. 50 g
Mounting	on signal distribution board
Pollution degree	2
Mounting position	Standard [▶ 34]
Position of the coding pins [▶ 37]	2 and 5
Color coding	grey
Vibration/shock resistance	according to EN 60068-2-6/EN 60068-2-27 (with corresponding signal distribution board)
EMC immunity/emission	conforms to EN 61000-6-2 /EN 61000-6-4 (with corresponding signal distribution board)
Protection class	EJ module: IP20 EJ system: dependent on the signal distribution board and housing
Approvals/markings*	CE, EAC, UKCA, UL

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

CE approval

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

Compliance with the common mode range

The differential signal must be in the Common Mode range (<+13.2 V and >-10 V, in relation to GND), levels outside this range can lead to destruction (see interface level). [▶ 19]

3.3 Level on interface

Signal type RS422 (diff. input)

The EJ5101-00xx modules expect the levels according to RS422 in differential mode. The data are transferred without ground reference as voltage difference between two cables (signal A and inverted signal / A). The EtherCAT plug-in module evaluates 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.

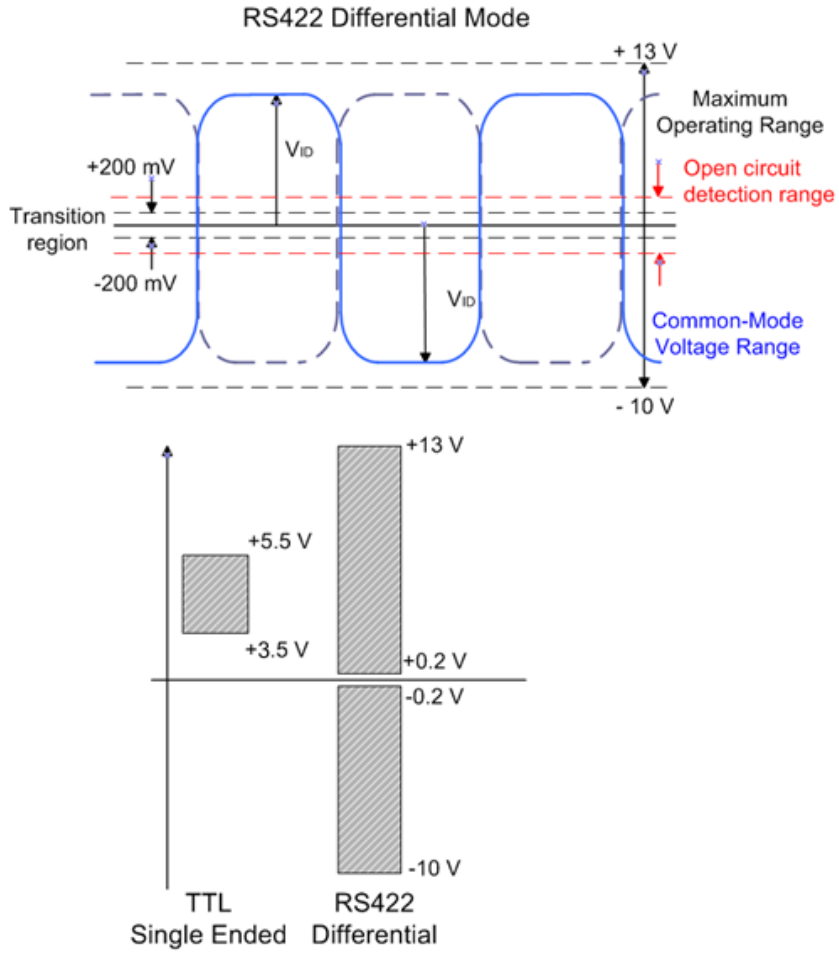


Fig. 8: Level interface

In differential mode, only the voltage difference is evaluated. Thus common-mode interference on the transmission link does not lead to any falsification of the wanted signal, as these interferences act simultaneously on both lines.

Signal type TTL (single-ended)

If the module is only operated in single-ended mode, a nominal level voltage of 3.5 V to 5.5 V is expected.

Wire break detection

Open circuit detection (index 0x8010:0B, 0x8010:0C, 0x8010:0D) is activated for:

- EJ5101 and EJ5101-0090 for typ. -1.5 V > Vid > +1.5 V (subject to change).

3.4 Pinout

EJ5101 Left connector (Encoder)				EJ5101 Right connector (Power supply)				
Pin#		Signal		Pin#		Signal		
1	2	U_{EBUS}	U_{EBUS}	1	2	NC	NC	**E-Bus contacts** The power supply U_{EBUS} is provided by the coupler and supplied from the supply voltage U_S of the EtherCAT coupler.
3	4	GND	GND	3	4	GND	GND	
5	6	RX0+	TX1+	5	6	NC	NC	
7	8	RX0-	TX1-	7	8	NC	NC	
9	10	GND	GND	9	10	GND	GND	
11	12	TX0+	RX1+	11	12	NC	NC	
13	14	TX0-	RX1-	13	14	NC	NC	
15	16	GND	GND	15	16	GND	GND	
17	18	A	B	17	18	NC	NC	**Signals**
19	20	/A	/B	19	20	NC	NC	
21	22	C	NC	21	22	NC	5V_Sensor	
23	24	/C	NC	23	24	NC	GND Sensor	
25	26	NC	NC	25	26	NC	NC	
27	28	NC	NC	27	28	NC	NC	
29	30	DI 1	Latch	29	30	NC	NC	
31	32	NC	Gate	31	32	NC	NC	
33	34	0V Up	0V Up	33	34	0V Up	0V Up	**U_P-Contacts** The peripheral voltage U_P supplies the electronics on the field side.
35	36	0V Up	24V Up	35	36	0V Up	24V Up	
37	38	24V Up	24V Up	37	38	24V Up	24V Up	
39	40	SGND	SGND	39	40	SGND	SGND	

Left connector (Encoder)		Right connector (Power supply)	
Signal	**Description**	**Signal**	**Description**
U_{EBUS}	E-Bus power supply 3.3 V	NC	Do not connect
GND	E-Bus GND signal. Don`t connect with 0V Up!	GND	E-Bus GND signal. Don`t connect with 0V Up!
RXn+	Positive E-Bus receive signal		
RXn-	Negative E-Bus receive signal		
TXn+	Positive E-Bus transmit signal		
TXn-	Negative E-Bus transmit signal		
A	Encoder-Input A	NC	Do not connect
/A	Encoder-Input A		
B	Encoder-Input B		
/B	Encoder-Input B		
C	Encoder-Input C	5V_Sensor	5 V Encoder Supply
/C	Encoder-Input C	GND Sensor	0 V Encoder Supply
DI 1	Digital input 1		
Latch	Latch input		
Gate	Gate input		
0V Up	Field side GND signal	0V Up	Field side GND signal
24V Up	Field side power supply 24 V	24V Up	Field side power supply 24 V
SGND	Shield Ground	SGND	Shield Ground

Fig. 9: EJ5101 - Pinout

The PCB footprint can be downloaded from the Beckhoff homepage

NOTICE

Damage may result!

- The pins labeled "NC" must not be contacted.
- Before installation and commissioning, please also read the chapters Installation of EJ modules [▶ 30] and Commissioning [▶ 45]!

Observe the following instructions in the design phase and during installation!

Notes on routing and installation

- Differential signals (RS422) are transmitted in differential mode. In order to ensure good EMC immunity, shielded twisted-pair cables should also be used for long distances.
  - ⇨ The cable shield should be connected to earth potential at both channel ends and the two end devices should always be at the same reference potential.
  - ⇨ When using externally shielded cables, special care should be taken to avoid damaging or interrupting the shield.
  - ⇨ The shielding should be connected close to the plug.
  - ⇨ Please also observe the corresponding instructions from the sensor manufacturer!
- Observe the guidelines of the Design Guide for EtherCAT plug-in modules to ensure proper forwarding of the differential signals!
- The value of each terminating resistor should be equal to the characteristic cable impedance, typically 120 Ω for EIA-485 or RS-482 standard.
- The routing of the differential signals should be impedance-controlled with typically 120 Ω for EIA-485 or RS-482 standard. The conductor track width should be > 0.2 mm, the maximum current carrying capacity must be observed.

3.5 LEDs

LED No.	EJ5101	
	Left	Right
A	RUN	
B		
C		Up (5V)
1	A	
2	B	
3	C	
4	I 1	
5	Latch	
6	Gate	
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Fig. 10: EJ5101 - LEDs

LEDs (left side)				
LED	**Color**	**Display**	**State**	**Description**
RUN	green	off	Init	State of the EtherCAT State Machine: **INIT** = initialization of the plug-in module
		flashing	Pre-Operational	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	Safe-Operational	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	Operational	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
		flickering	Bootstrap	State of the EtherCAT State Machine: **BOOTSTRAP** = function for Firmware updates of the plug-in module
A	green	on	-	A signal is present at encoder input A.
B	green	on	-	A signal is present at encoder input B.
C	green	on	-	A signal is present at encoder input C.
I 1	red	on	-	Encoder error detection (encoder-specific) Error encoder signal, I1 is LOW
		off	-	Encoder signal OK, I1 is HIGH (connected to GND)
Latch	green	on	-	A signal is present at the latch input.
Gate	green	on	-	A signal is present at the gate input

LEDs (right side)			
LED	**Color**	**Display**	**Meaning**
Up (5V)	green	off	Supply voltage incremental encoder (5 V_{DC}) not available
		on	Supply voltage incremental encoder (5 V_{DC}) available

4 EJ5101-0090 - Product description

4.1 Introduction

Fig. 11: EJ5101-0090

Incremental Encoder Interface

The EJ5101-0090 EtherCAT plug-in module is an interface for the direct connection of incremental encoders with differential inputs (RS422). The connection of single-ended signals (5 V) is possible. Incremental encoders with alarm output can be connected to the status input of the interface.
A 32/16-bit counter with quadrature decoder and a 32/16-bit latch for the zero pulse can be read, set or activated. The EJ5101-0090 module can also be operated as a bidirectional counter terminal on channel A. Interval measurement and frequency measurement with a resolution of up to 100 ns is possible.
The gate input allows the counter to be disabled either at a high or low level. The latch input accepts the counter value with a rising or falling edge.
The optional interpolating microincrements functionality enables the EJ5101-0090 EtherCAT plug-in module to provide even more precise axis positions for dynamic axes.

The EJ5101-0090 EtherCAT plug-in module supports the distributed clocks function (DC). This enables the encoder value to be read in synchronously with other input data in the EtherCAT system. Optionally, the timestamp of the last registered increment edge is output based on the distributed clocks system.

The EJ5101-0090 EtherCAT plug-in module supports the full functionality of the EJ5101 module as well as TwinSAFE SC technology (TwinSAFE Single Channel).

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

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

4.2 Technical data

Encoder	EJ5101-0090
Technology	Incremental encoder interface
Number of outputs	1
Encoder connection	A, A (inv), B, B (inv), C, C (inv) (RS422, differential inputs [▶ 26]), single-ended connection possible, status input 5 V_{DC}, gate/latch input (24 V_{DC}, both max. 1 MHz permitted)
Input frequency	max. 4 million increments/s with 4-fold evaluation, equivalent to 1 MHz
Zero-pulse latch	1 x 16/32-bit switchable
Counter	1 x 16/32-bit switchable

Function and communication	EJ5101-0090
Distributed clocks	yes
Special features	TwinSAFE SC Technology
MTBF (+55 °C)	> 1,300,000 h

Supply and potentials	EJ5101-0090
Power supply	24 V_{DC} (-15%/+20%)
Sensor power supply	5 V_{DC}, 0.5 A
Current consumption	20 mA typ. (without sensor)
Current consumption via E-bus	130 mA typ.
Electrical isolation	500 V (E-bus/field voltage)

Environmental conditions	EJ5101-0090
Permissible ambient temperature range during operation	-25°C... +60°C (extended temperature range)
Permissible ambient temperature range during storage	-40°C... +85°C
Permissible relative air humidity	95%, no condensation
Pollution degree	2
Operating altitude	max. 2,000 m
Vibration/shock resistance	conforms to EN 60068-2-6 /EN 60068-2-27 (with corresponding signal distribution board)
EMC immunity/emission	conforms to EN 61000-6-2 /EN 61000-6-4 (with corresponding signal distribution board)
Protection rating	EJ module: IP20 EJ system: dependent on the signal distribution board and housing

Housing data	EJ5101-0090
Position of the coding pins [▶ 37]	2 and 5
Color coding	gray
Weight	approx. 50 g
Installation position	Standard [▶ 34]
Dimensions (W x H x D)	approx. 24 mm x 66 mm x 55 mm
Mounting	on signal distribution board

Approvals and conformity	EJ5101-0090
Approvals/markings*	CE, UKCA

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

CE approval

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

Compliance with the common mode range

The differential signal must be in the Common Mode range (<+13.2 V and >-10 V, in relation to GND), levels outside this range can lead to destruction (see interface level). [▶ 26]

4.3 Level on interface

Signal type RS422 (diff. input)

The EJ5101-00xx modules expect the levels according to RS422 in differential mode. The data are transferred without ground reference as voltage difference between two cables (signal A and inverted signal / A). The EtherCAT plug-in module evaluates 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.

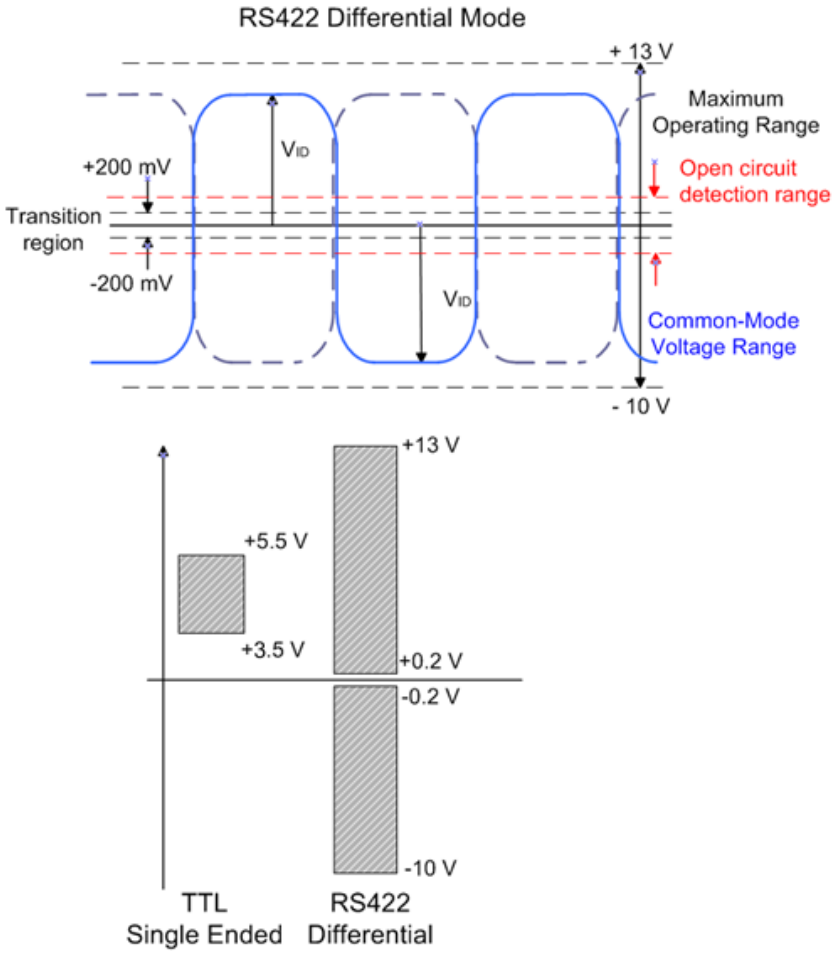


Fig. 12: Level interface

In differential mode, only the voltage difference is evaluated. Thus common-mode interference on the transmission link does not lead to any falsification of the wanted signal, as these interferences act simultaneously on both lines.

Signal type TTL (single-ended)

If the module is only operated in single-ended mode, a nominal level voltage of 3.5 V to 5.5 V is expected.

Wire break detection

Open circuit detection (index 0x8010:0B, 0x8010:0C, 0x8010:0D) is activated for:

- EJ5101 and EJ5101-0090 for typ. -1.5 V > Vid > +1.5 V (subject to change).

4.4 Pinout

EJ5101-0090 Left connector (Encoder)				EJ5101-0090 Right connector (Power supply)				
Pin#		Signal		Pin#		Signal		
1	2	U_{EBUS}	U_{EBUS}	1	2	NC	NC	**E-Bus contacts**
3	4	GND	GND	3	4	GND	GND	
5	6	RX0+	TX1+	5	6	NC	NC	
7	8	RX0-	TX1-	7	8	NC	NC	The power supply U_{EBUS} is provided by the coupler and supplied from the supply voltage U_S of the EtherCAT coupler.
9	10	GND	GND	9	10	GND	GND	
11	12	TX0+	RX1+	11	12	NC	NC	
13	14	TX0-	RX1-	13	14	NC	NC	
15	16	GND	GND	15	16	GND	GND	
17	18	A	B	17	18	NC	NC	**Signals**
19	20	/A	/B	19	20	NC	NC	
21	22	C	NC	21	22	NC	5V_Sensor	
23	24	/C	NC	23	24	NC	GND Sensor	
25	26	NC	NC	25	26	NC	NC	
27	28	NC	NC	27	28	NC	NC	
29	30	DI 1	Latch	29	30	NC	NC	
31	32	NC	Gate	31	32	NC	NC	
33	34	0V Up	0V Up	33	34	0V Up	0V Up	**U_P-Contacts**
35	36	0V Up	24V Up	35	36	0V Up	24V Up	
37	38	24V Up	24V Up	37	38	24V Up	24V Up	The peripheral voltage U_P supplies the electronics on the field side.
39	40	SGND	SGND	39	40	SGND	SGND	

Left connector (Encoder)		Right connector (Power supply)	
Signal	**Description**	**Signal**	**Description**
U_{EBUS}	E-Bus power supply 3.3 V	NC	Do not connect
GND	E-Bus GND signal. Don`t connect with 0V Up!	GND	E-Bus GND signal. Don`t connect with 0V Up!
RXn+	Positive E-Bus receive signal		
RXn-	Negative E-Bus receive signal		
TXn+	Positive E-Bus transmit signal		
TXn-	Negative E-Bus transmit signal		
A	Encoder-Input A	NC	Do not connect
/A	Encoder-Input A		
B	Encoder-Input B		
/B	Encoder-Input B		
C	Encoder-Input C	5V_Sensor	5 V Encoder Supply
/C	Encoder-Input C	GND Sensor	0 V Encoder Supply
DI 1	Digital input 1		
Latch	Latch input		
Gate	Gate input		
0V Up	Field side GND signal	0V Up	Field side GND signal
24V Up	Field side power supply 24 V	24V Up	Field side power supply 24 V
SGND	Shield Ground	SGND	Shield Ground

Fig. 13: EJ5101-0090 – connection

The PCB footprint can be downloaded from the Beckhoff homepage

NOTICE

Damage may result!

- The pins labeled "NC" must not be contacted.
- Before installation and commissioning, please also read the chapters Installation of EJ modules [▶ 30] and Commissioning [▶ 45]!

Observe the following instructions in the design phase and during installation!

Notes on routing and installation

- Differential signals (RS422) are transmitted in differential mode. In order to ensure good EMC immunity, shielded twisted-pair cables should also be used for long distances.
  - ⇨ The cable shield should be connected to earth potential at both channel ends and the two end devices should always be at the same reference potential.
  - ⇨ When using externally shielded cables, special care should be taken to avoid damaging or interrupting the shield.
  - ⇨ The shielding should be connected close to the plug.
  - ⇨ Please also observe the corresponding instructions from the sensor manufacturer!
- Observe the guidelines of the Design Guide for EtherCAT plug-in modules to ensure proper forwarding of the differential signals!
- The value of each terminating resistor should be equal to the characteristic cable impedance, typically 120 Ω for EIA-485 or RS-482 standard.
- The routing of the differential signals should be impedance-controlled with typically 120 Ω for EIA-485 or RS-482 standard. The conductor track width should be > 0.2 mm, the maximum current carrying capacity must be observed.

4.5 LEDs

LED No.	EJ5101-0090	
	Left	Right
A	RUN	
B		
C		Up (5V)
1	A	
2	B	
3	C	
4	I 1	
5	Latch	
6	Gate	
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

Fig. 14: EJ5101-0090 - LEDs

LEDs (left side)				
LED	**Color**	**Display**	**State**	**Description**
RUN	green	off	Init	State of the EtherCAT State Machine: **INIT** = initialization of the plug-in module
		flashing	Pre-Operational	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
		single flash	Safe-Operational	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	Operational	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
		flickering	Bootstrap	State of the EtherCAT State Machine: **BOOTSTRAP** = function for Firmware updates of the plug-in module
A	green	on	-	A signal is present at encoder input A.
B	green	on	-	A signal is present at encoder input B.
C	green	on	-	A signal is present at encoder input C.
I 1	red	on	-	Encoder error detection (encoder-specific) Error encoder signal, I1 is LOW
		off	-	Encoder signal OK, I1 is HIGH (connected to GND)
Latch	green	on	-	A signal is present at the latch input.
Gate	green	on	-	A signal is present at the gate input

LEDs (right side)			
LED	**Color**	**Display**	**Meaning**
Up (5V)	green	off	Supply voltage incremental encoder (5 V_{DC}) not available
		on	Supply voltage incremental encoder (5 V_{DC}) available

5 Installation of EJ modules

5.1 Power supply for the EtherCAT plug-in modules

⚠ WARNING

Power supply from SELV / PELV power supply unit!

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

Notes:

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

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

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

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

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

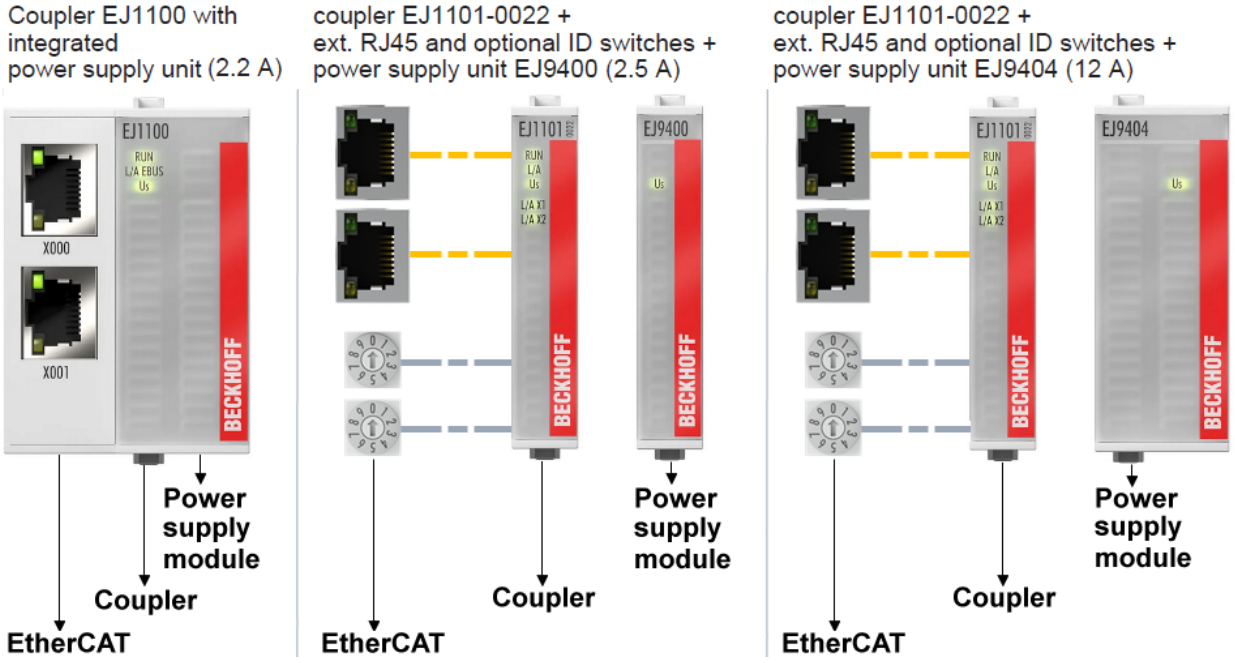


Fig. 15: E-bus power supply with EJ1100 or EJ1101-0022 + EJ940x

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

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

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

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

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

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

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

Fig. 16: PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

5.2 Note on load voltage supply

⚠ WARNING

Load voltage supply

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

5.3 EJxxxx - dimensions

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

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

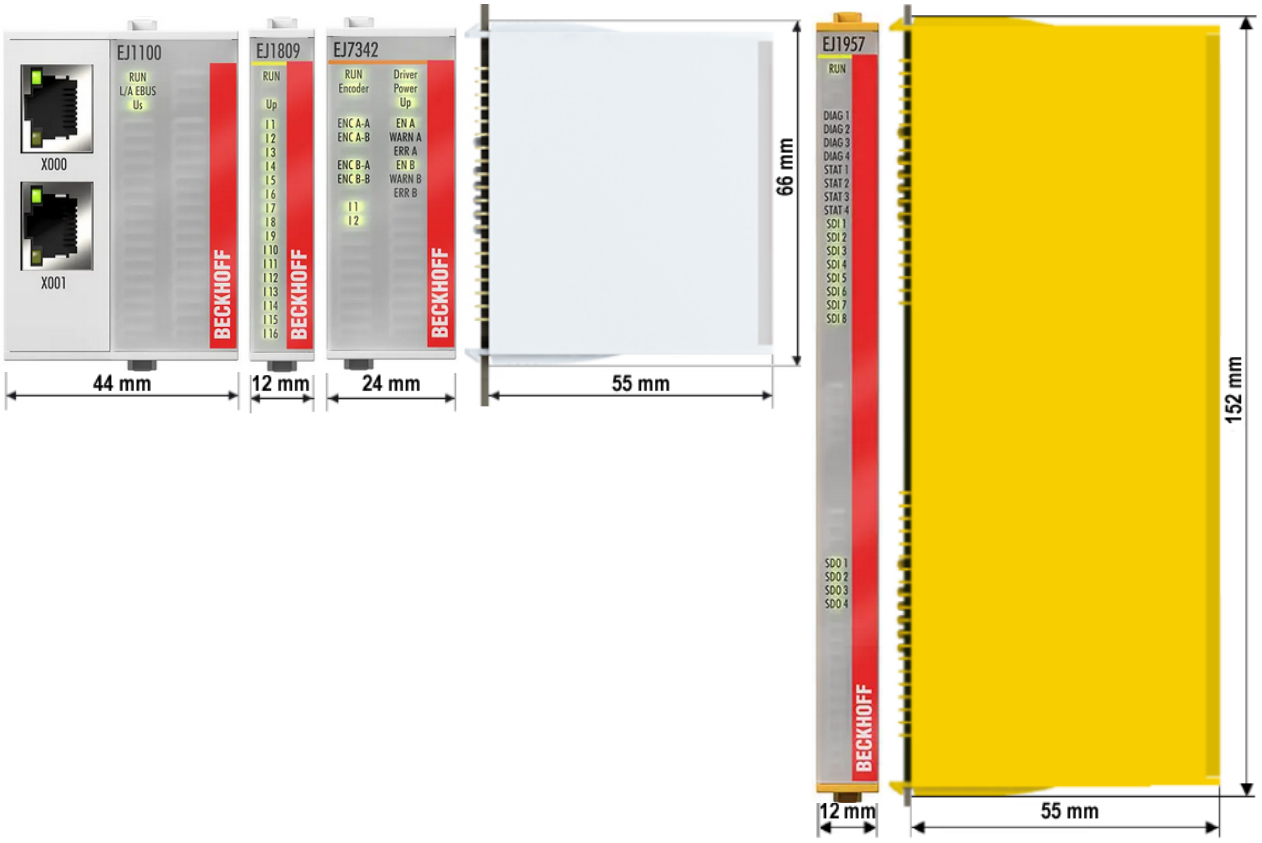


Fig. 17: EJxxxx - Dimensions

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

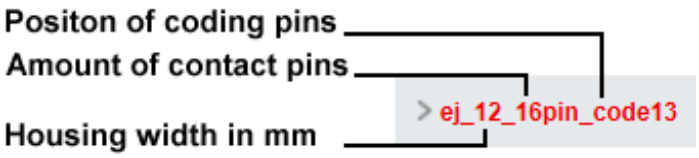


Fig. 18: Naming of the technical drawings

5.4 Installation positions and minimum distances

5.4.1 Minimum distances for ensuring installability

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

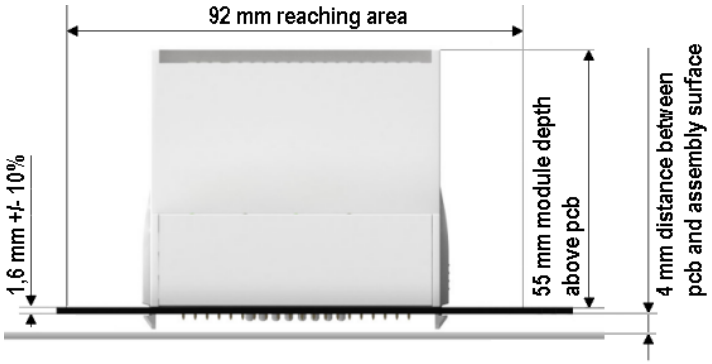


Fig. 19: Mounting distances EJ module - PCB

Observing the reaching area

A minimum reaching area of 92 mm is required for assembly / disassembly, in order to be able to reach the mounting tabs with the fingers.
Adherence to the recommended minimum distances for ventilation (see section Installation position [▶ 34]) ensures an adequate reaching area.

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

5.4.2 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

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

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

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

Optimum installation position (standard)

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

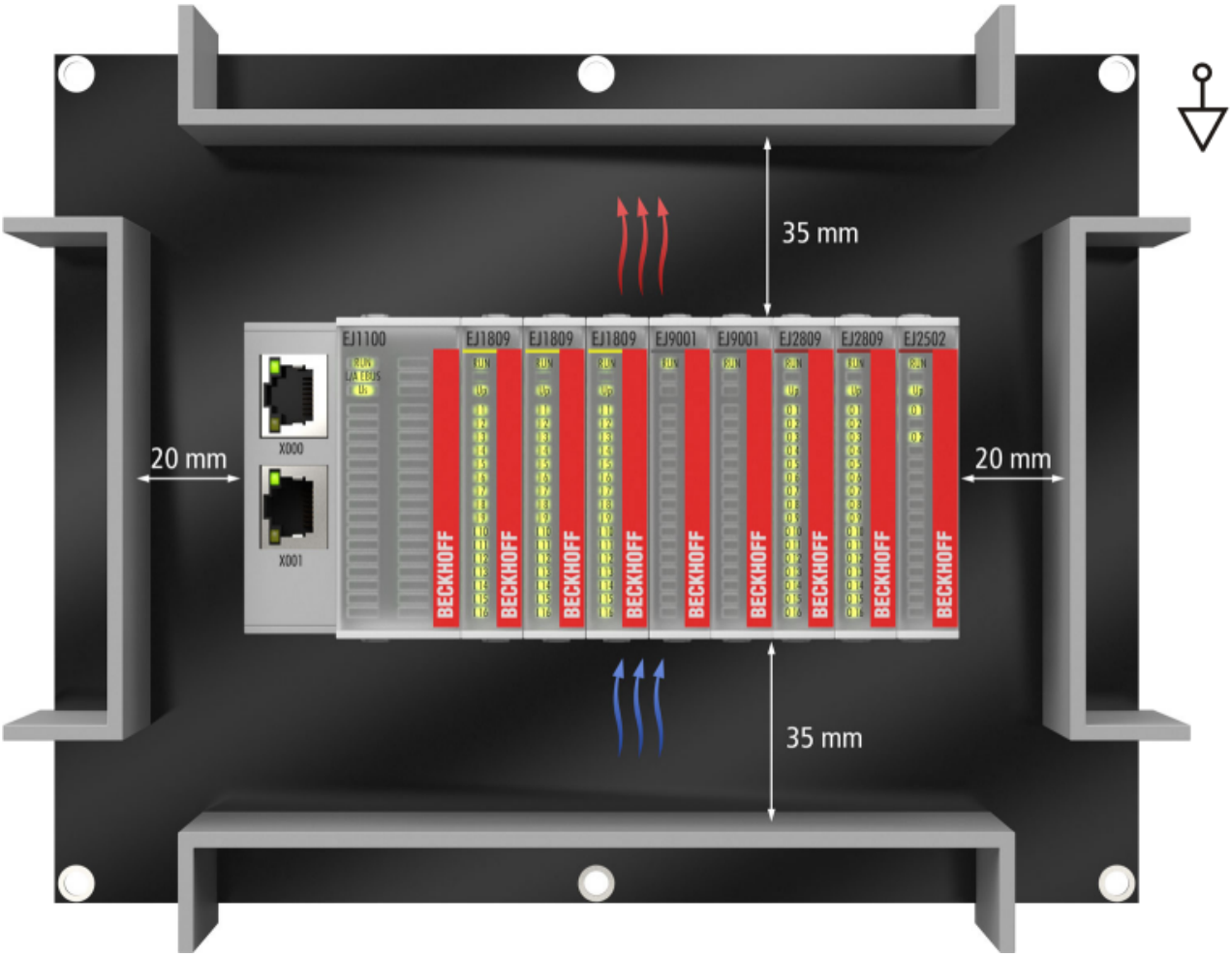


Fig. 20: Recommended distances for standard installation position

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

Other installation positions

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

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

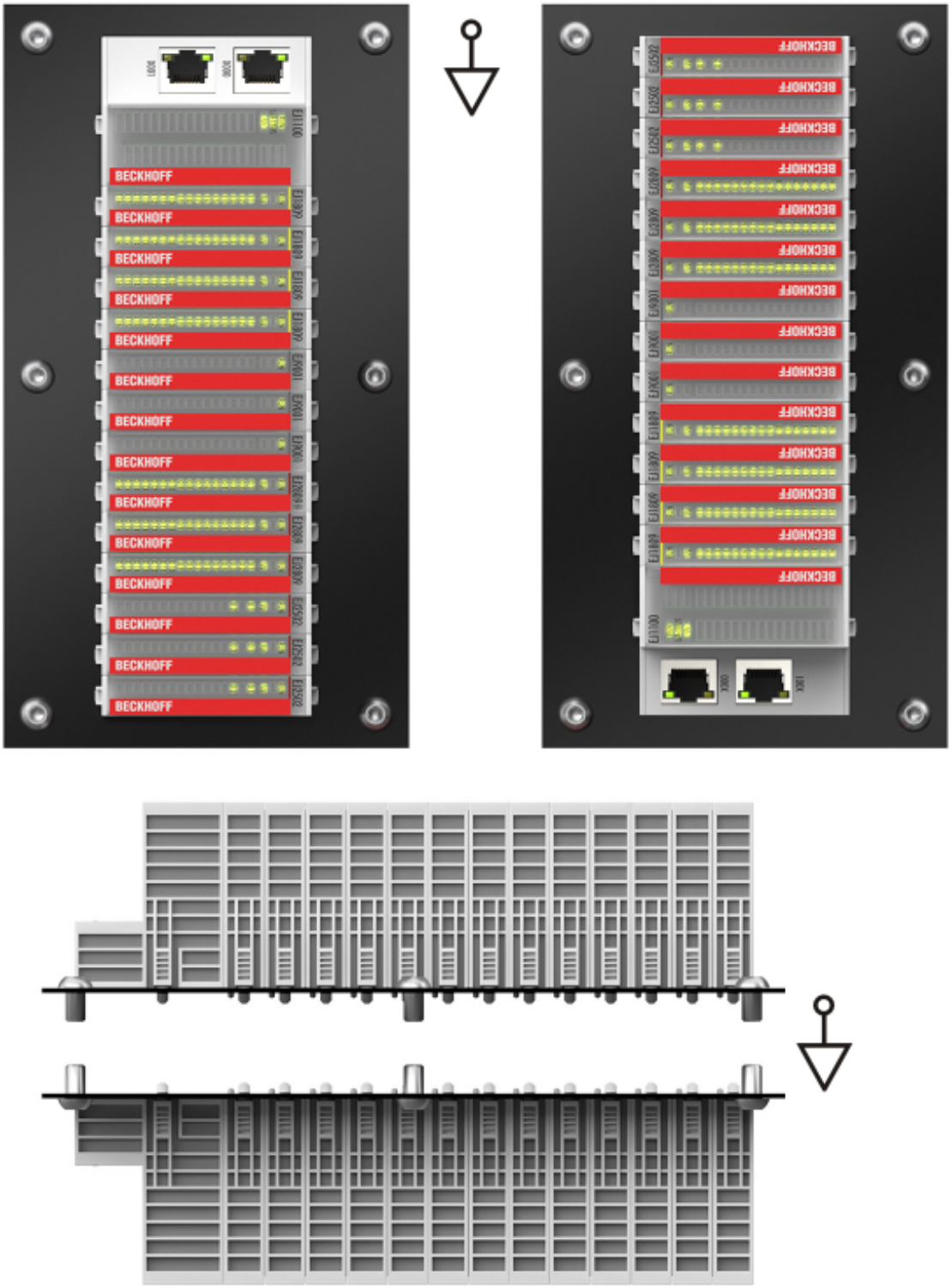


Fig. 21: Other installation positions

5.5 Codings

5.5.1 Color coding

Fig. 22: EJ modules color code; sample: EJ1809

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

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

5.5.2 Mechanical position coding

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

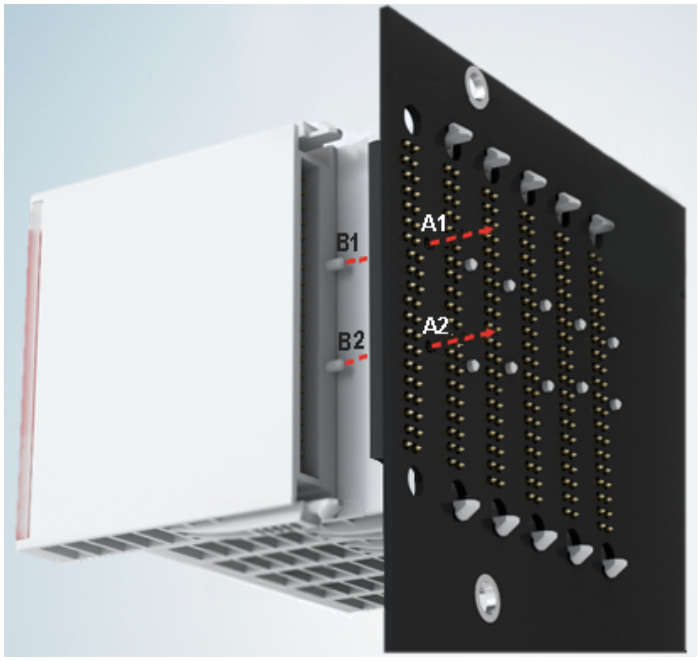


Fig. 23: Mechanical position coding with coding pins (B1 and B2) and coding holes (A1 and A2)

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

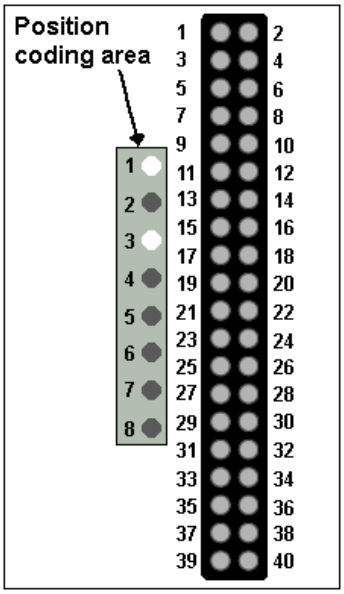


Fig. 24: Pin coding; sample: digital input modules

5.6 Installation on the signal distribution board

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

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

⚠ WARNING

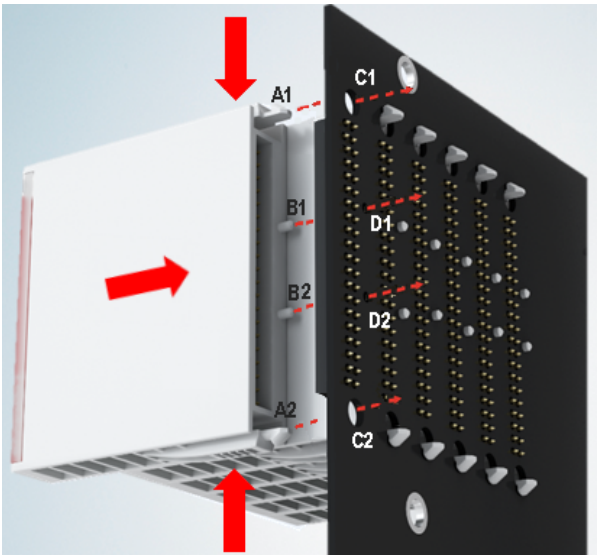
Risk of injury through electric shock and damage to the device!

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

NOTICE

Risk of damage to components through electrostatic discharge!

Observe the regulations for ESD protection.



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

Installation of EJ modules

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

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

NOTICE

Ensure safe latching of the modules on the signal distribution board

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

⇨ loss of quality of the transferred signals,

⇨ increased power dissipation of the contacts,

⇨ impairment of the service life.

5.7 Extension options

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

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

5.7.1 Using placeholder modules for unused slots

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

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

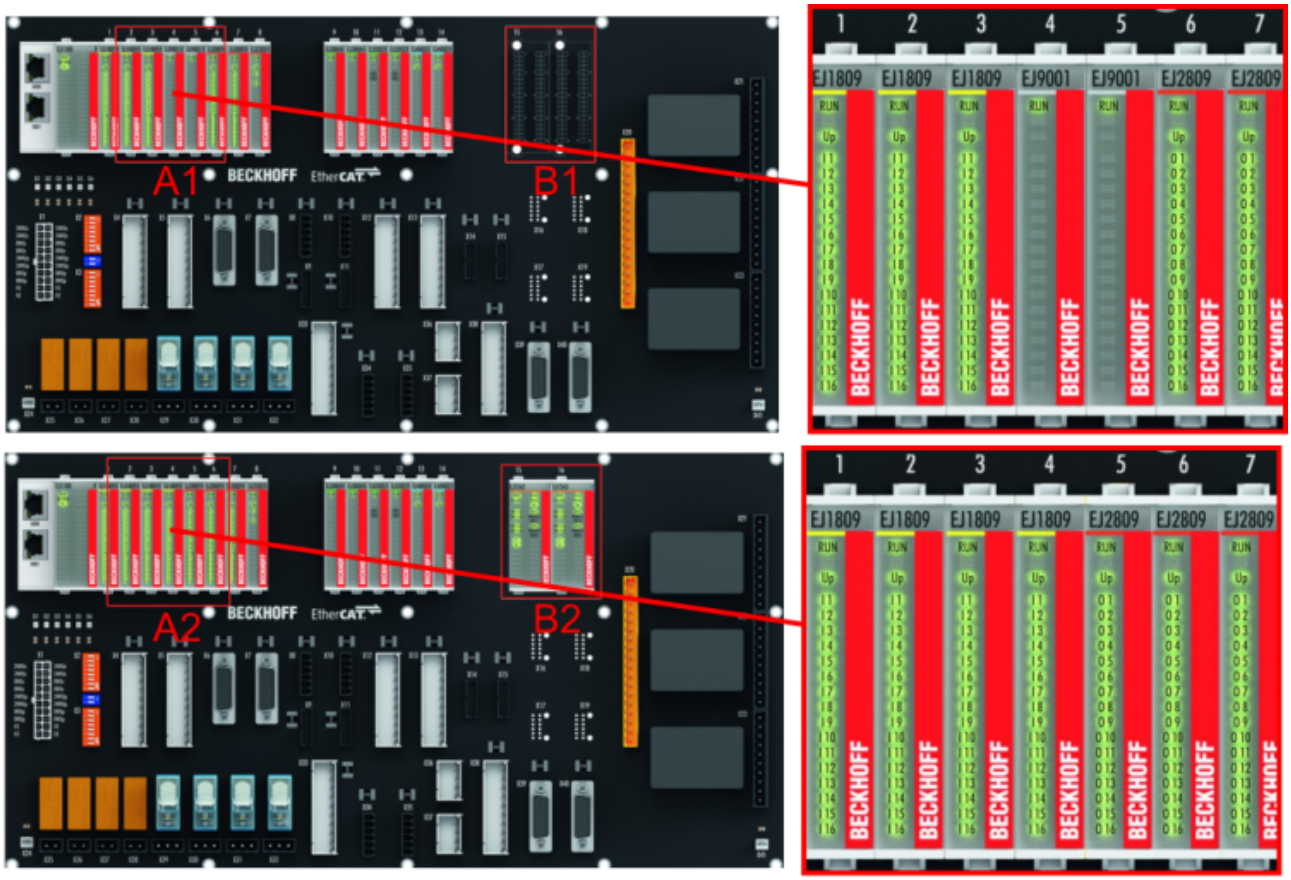


Fig. 25: Sample: Exchanging placeholder modules and assigning reserve slots

E-bus supply

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

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

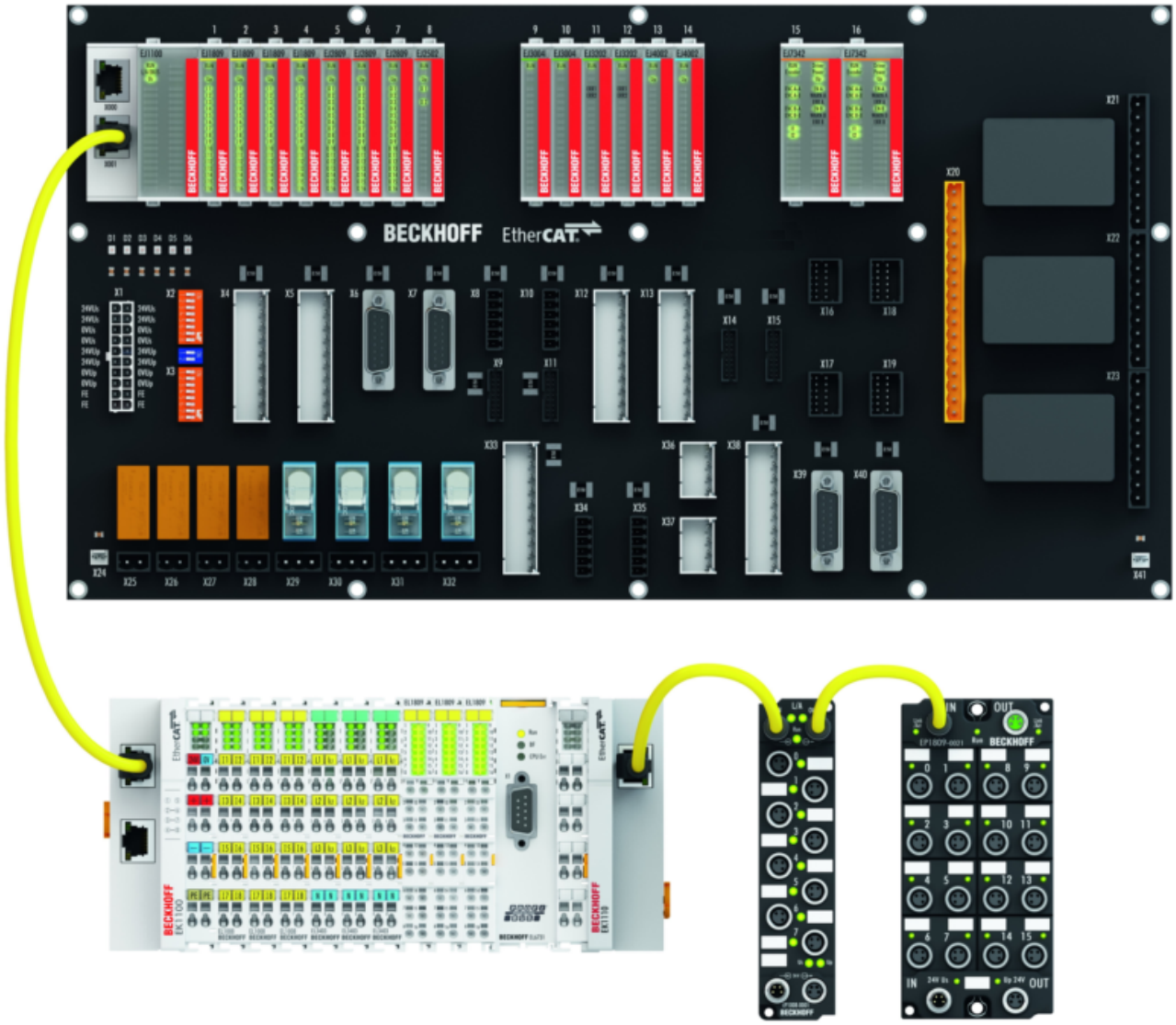


Fig. 26: Example of extension via an Ethernet/EtherCAT connection

5.8 IPC integration

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

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

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

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

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

Fig. 27: Example PCB with Embedded PC, EK1110-0043 and EJxxxx, rear view EK1110-0043

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

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

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

NOTICE

Positioning on the signal distribution board

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

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

Fig. 28: Example for the connection of a C6015 IPC to an EJ system

5.9 Disassembly of the signal distribution board

⚠ WARNING

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

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

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

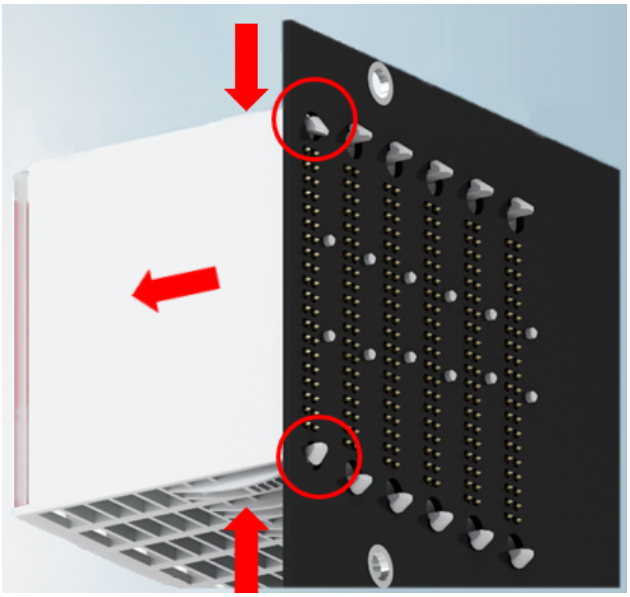


Fig. 29: Disassembly of EJ modules

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

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

5.10 Disposal

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

6 EtherCAT basics

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

7 EJ5101 - Commissioning

7.1 Reference to documentation EL5101

Detailed documentation on the commissioning of the EJ5101-00xx modules is being prepared.

NOTICE

Damage to devices or loss of data

The descriptions and instructions for commissioning the EL5101-00x EtherCAT Terminals can be transferred to the EJ5101-00x EtherCAT plug-in modules.

Before commissioning, read the detailed description of the process data, operation modes and parameterization in the EL5101 documentation.

7.2 EJ5101 - object description and parameterization

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

7.2.1 Restore object

Index 1011 Restore default parameters

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

7.2.2 Configuration data

7.2.2.1 0x8000, 0x8001 - simple operating mode

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	The counter counts up to the *Counter reload value* (0x8001:02) or is loaded with the *Counter reload value* (0x8001:02) in the event of an underflow **Example 360° encoder with set bit:** Moves in positive direction via *Counter reload value*: Reset counter value to 0 Moves in negative direction less than 0: Reset counter value to *Counter reload value*.	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Enable index reset	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	FALSE The module operates in quadrature decoder mode. TRUE The module operates as a counter, counting direction towards input B.	BOOLEAN	RW	0x00 (0_{dec})
8000:04	Enable pos. gate	Gate input responds to positive edge and locks the counter	BOOLEAN	RW	0x01 (1_{dec})
8000:05	Enable neg. gate	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	The value specifies the size of the time window for the variable *Window* (0x6000:06). 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	If *Enable register reload* (0x8000:01) is TRUE, the counter counts up to this value or is loaded with this value in the event of an underflow	UINT16	RW	0xFFFF (65535_{dec})

7.2.2.2 0x8010 - enhanced operating mode

Index 8010 ENC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	ENC Settings	Maximum subindex	UINT8	RO	0x14 (20_{dec})
8010:01	Enable C reset	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8010:02	Enable extern reset	A counter reset is triggered via the external latch input (24 V).	BOOLEAN	RW	0x00 (0_{dec})
8010:03	Enable up/down counter	Enablement of the up/down 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	0: Disable gate 1: Enable pos. gate (gate locks with HIGH signal level) 2: Enable neg. gate (gate locks with LOW signal level)	BIT2	RW	0x01 (1_{dec})
8010:08	Disable filter	0: Activates the input filter (inputs A, /A, B, /B, C, /C only) 1: Deactivates the input filter If a filter is activated a signal edge must be present for at least 2.4 µs in order to be counted as an increment.	BOOLEAN	RW	0x01 (1_{dec})
8010:0A	Enable micro increments	If DC mode is enabled, the module interpolates micro-increments between the integer encoder increments. The lower 8 bits of the *Counter Value* are used in each case for the display. A 32-bit counter thus becomes a 24+8-bit counter, 16-bit counter becomes an 8+8-bit counter.	BOOLEAN	RW	0x00 (0_{dec})
8010:0B	Open circuit detection A	An open circuit on track A is indicated in index 0x6010:07 and as process data. Diagnostics is only possible, if the associated input is wired differentially. A differential voltage of -1.5 V > Vid > 1.5 V (typical, subject to modification) is interpreted as an open circuit.	BOOLEAN	RW	0x01 (1_{dec})
8010:0C	Open circuit detection B	An open circuit on track B is indicated in index 0x6010:07 and as process data. Diagnostics is only possible, if the associated input is wired differentially. A differential voltage of -1.5 V > Vid > 1.5 V (typical, subject to modification) is interpreted as an open circuit.	BOOLEAN	RW	0x01 (1_{dec})
8010:0D	Open circuit detection C	An open circuit on track C is indicated in index 0x6010:07 and as process data. Diagnostics is only possible, if the associated input is wired differentially. A differential voltage of -1.5 V > Vid > 1.5 V (typical, subject to modification) is interpreted as an open circuit.	BOOLEAN	RW	0x00 (0_{dec})
8010:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})
8010:10	Extern reset polarity	0 (fall): the counter is set to 0 with the falling edge 1 (rise): the counter is set to 0 with the rising edge	BIT1	RW	0x01 (1_{dec})
8010:11	Frequency window	This is the minimum time over which the frequency is determined; default value 10 ms [resolution: 1 µs] The number of pulses in the timeframe + the following is measured. The maximum waiting time is *Frequency Wait Time* Index 0x8010:17. The number of pulses is divided by the actual time window size. The determined frequency is output in *Frequency scaling* index 0x6010 [▶ 49]:13 and as a process record. The frequency calculation is carried out locally without distributed clocks function.	UINT16	RW	0x2710 (10000_{dec})
8010:13	Frequency scaling	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 (hex)	Name	Meaning	Data type	Flags	Default
8010:14	Period scaling	Resolution of the period value 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})
8010:15	Frequency resolution	Resolution of the frequency measurement: 100: “0.01 Hz”	UINT16	RW	0x0064 (100_{dec})
8010:16	Period resolution	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 the process record continues to reflect the value according to *Period scaling* index 0x8010:14 (e.g. 100 ns [default]).	UINT16	RW	0x01F4 (500_{dec})
8010:17	Frequency Wait Time	Waiting time [ms] for frequency measurement If the time from *Frequency window* Index 0x8010:11 has expired, the system waits for the next positive edge from track A for the duration specified in *Frequency Wait Time*. This enables the update speed for the *Frequency* process data to be optimized, depending on the expected frequencies. The minimum value to be entered here is twice the period value of the smallest measured frequency. T >= 2* (1 / f_{min}).	UINT16	RW	0x0640 (1600_{dec})

7.2.3 Input data

7.2.3.1 0x6000 - simple operating mode

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	UINT8	RO	0x00 (0_{dec})
6000:02	Value	Counter value	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 time window (*Frequency Window* (index 0x8001 [▶ 46]:01))	UINT16	RO	0x0000 (0_{dec})

7.2.3.2 0x6010 - enhanced operating mode

Index 6010 ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	ENC Inputs	Maximum subindex	UINT8	RO	0x16 (22_{dec})
6010:01	Latch C valid	The counter value was latched with the “C” input. The data in *Latch value* index 0x6010:12 correspond to the latched value with the bit set. To re-enable the latch input, *Enable latch C* index 0x7010 [▶ 50]:01 must be canceled and then reset.	BOOLEAN	RO	0x00 (0_{dec})
6010:02	Latch extern valid	The counter value was locked via the external latch. The data in *Latch value* index 0x6010:12 correspond to the latched value with the bit set. To re-enable the latch input, *Enable latch extern on positive edge* index 0x7010:02 or *Enable latch extern on negative edge* index 0x7010:04 must first be canceled and then reset.	BOOLEAN	RO	0x00 (0_{dec})
6010:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0_{dec})
6010:04	Counter underflow	The counter has passed the zero crossing backwards. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0_{dec})
6010:05	Counter overflow	Counter overflow. Overflow/underflow control is inactive in combination with a reset function (C/external).	BOOLEAN	RO	0x00 (0_{dec})
6010:06	Status of input status	State of the status input (alarm *Input 1*)	BOOLEAN	RO	0x00 (0_{dec})
6010:07	Open circuit	Indicates an open circuit. Configuration via index 0x8010: [▶ 47]0B, 0x8010:0C, 0x8010:0D	BOOLEAN	RO	0x00 (0_{dec})
6010:08	Extrapolation stall	The extrapolated part of the counter is invalid	BOOLEAN	RO	0x00 (0_{dec})
6010:09	Status of input A	Status of input A	BOOLEAN	RO	0x00 (0_{dec})
6010:0A	Status of input B	Status of input B	BOOLEAN	RO	0x00 (0_{dec})
6010:0B	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	Status of the extern latch input	BOOLEAN	RO	0x00 (0_{dec})
6010:0E	Sync Error	The Sync Error bit is only required for the DC mode. It indicates whether a synchronization error occurred in the expired cycle. This means a SYNC signal was triggered in the module, 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	The frequency (setting of the scaling in index 0x8010:13 and resolution in index 0x8010:15)	UINT32	RO	0x00000000 (0_{dec})
6010:14	Period value	The period (setting of the scaling in index 0x8010:14 and the resolution in index 0x8010:16)	UINT32	RO	0x00000000 (0_{dec})
6010:16	Timestamp	Timestamp of the last counter change	UINT64	RO	

7.2.4 Output data

7.2.4.1 0x7000 - simple operating mode

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	Control byte	UINT8	RO	0x00 (0_{dec})
7000:02	Value	The counter value to be set via “CNT_SET” (CB.02).	UINT16	RO	0x0000 (0_{dec})

7.2.4.2 0x7010 - enhanced operating mode

Index 7010 ENC Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7010:01	Enable latch C	Activate latching via input “C”.	BOOLEAN	RO	0x00 (0_{dec})
7010:02	Enable latch extern on positive edge	Activate external latch with positive edge.	BOOLEAN	RO	0x00 (0_{dec})
7010:03	Set counter	Set counter value	BOOLEAN	RO	0x00 (0_{dec})
7010:04	Enable latch extern on negative edge	Activate external latch with negative edge.	BOOLEAN	RO	0x00 (0_{dec})
7010:11	Set counter value	The counter value to be set via *Set counter* (index 0x7010:03).	UINT32	RO	0x00000000 (0_{dec})

7.2.5 Information and diagnostic data / channel-specific

Index A010 ENC diag data (only for enhanced operating mode)

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	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A010:02	Open circuit B	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A010:03	Open circuit C	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})

7.2.6 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 Lo-Word contains the CoE profile used (5001). • The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EJ5101

Index 1009 Hardware version

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

Index 100A Software version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x13ED2852 (334309458_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The Low Word (bit 0-15) indicates the special terminal number. • The High Word (bit 16-31) refers to the device description.	UINT32	RO	0x00000000 (00000000_{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

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

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

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

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

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 1602 ENC RxPDO-Map Control compact

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

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

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

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

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

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

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

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

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.

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

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

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 1A03 ENC TxPDO-Map Status compact

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 (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

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	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x06 (input status))	UINT32	RO	0x6010:06, 1
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A04:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A04:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A04:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A04:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A04:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A04:0D	SubIndex 013	13. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A04:0E	SubIndex 014	14. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A04:0F	SubIndex 015	15. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6010:0F, 1
1A04:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A04:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32
1A04:12	SubIndex 018	18. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 32

Index 1A05 ENC TxPDO-Map Frequency

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

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.

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

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	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:03	SubIndex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchron with SM 2 Event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchron with SM 2 Event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output Shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0xC807 (51207_{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: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32 [▶ 58]:02	UINT32	RW	0x000F4240 (1000000_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: Synchron with SM 2 Event is supported (outputs available) • Bit 1: Synchron 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 or 0x1C33:08)	UINT16	RO	0xC807 (51207_{dec})
1C33:05	Minimum cycle time	as 0x1C32 [▶ 58]:05	UINT32	RO	0x000103C4 (66500_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	as 0x1C32 [▶ 58]:08	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32 [▶ 58]:11	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32 [▶ 58]:12	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32 [▶ 58]:13	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32 [▶ 58]:32	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

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

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	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})

8 EJ5101-0090 - Commissioning

8.1 Reference to documentation EL5101

Detailed documentation on the commissioning of the EJ5101-00xx modules is being prepared.

NOTICE

Damage to devices or loss of data

The descriptions and instructions for commissioning the EL5101-00x EtherCAT Terminals can be transferred to the EJ5101-00x EtherCAT plug-in modules.

Before commissioning, read the detailed description of the process data, operation modes and parameterization in the EL5101 documentation.

8.2 EJ5101-0090 - TwinSAFE SC

8.2.1 TwinSAFE SC

8.2.1.1 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.

8.2.1.2 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.

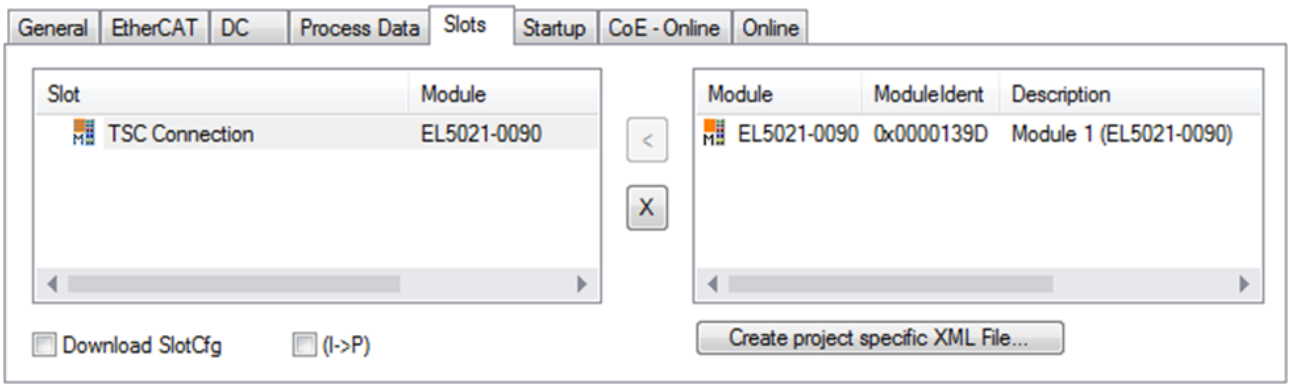


Fig. 30: Adding the TwinSAFE SC process data under the component, e.g. EL5021-0090

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

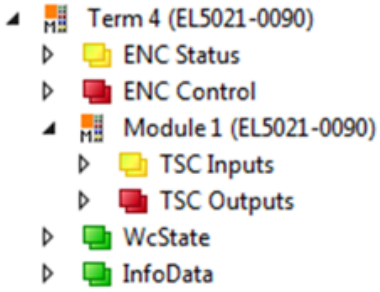


Fig. 31: TwinSAFE SC component process data, example EL5021-0090

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

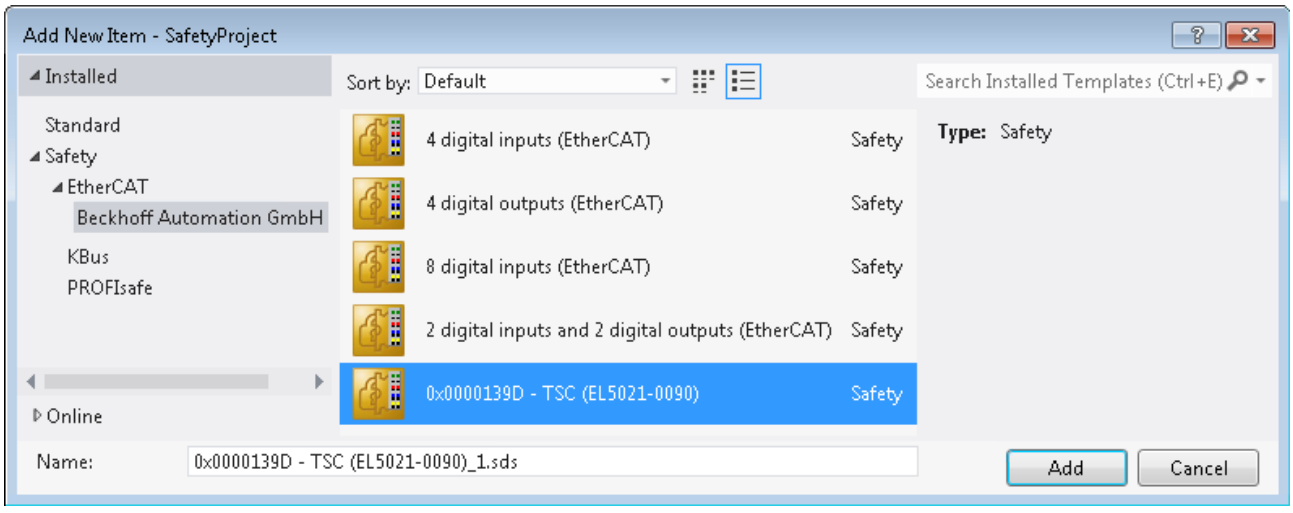


Fig. 32: Adding a TwinSAFE SC connection

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.

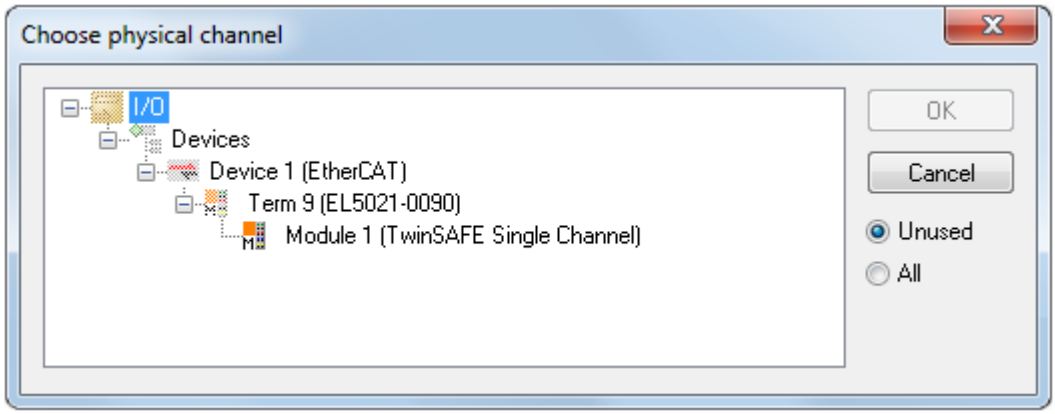


Fig. 33: Creating a link to TwinSAFE SC terminal

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

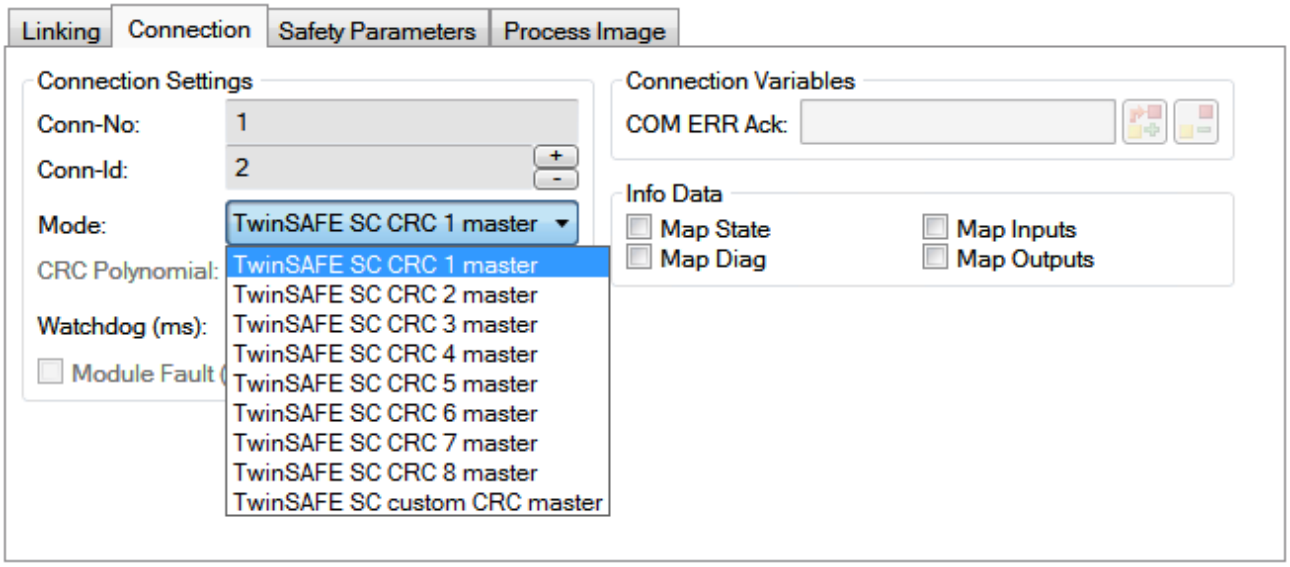


Fig. 34: Selecting a free CRC

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.

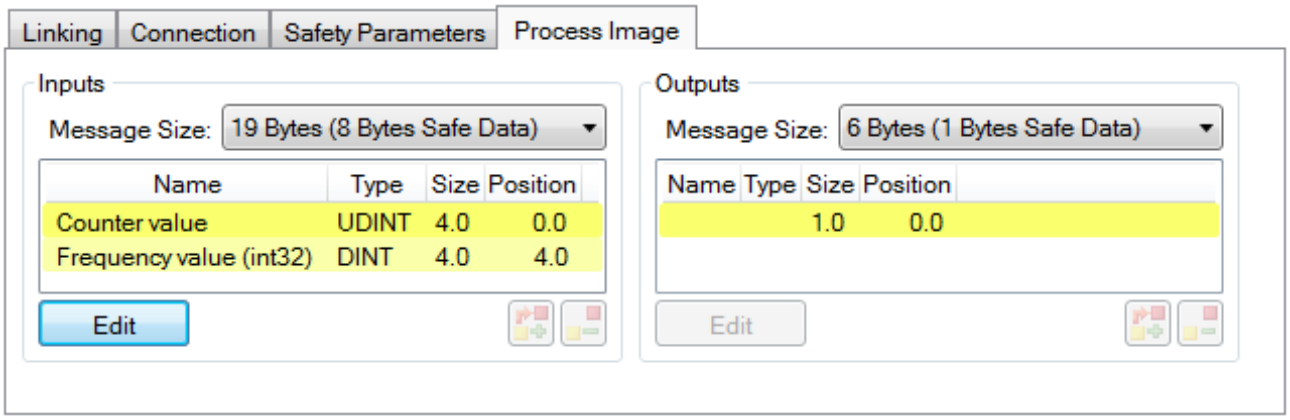


Fig. 35: Selecting the process data size and the process data

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)*.

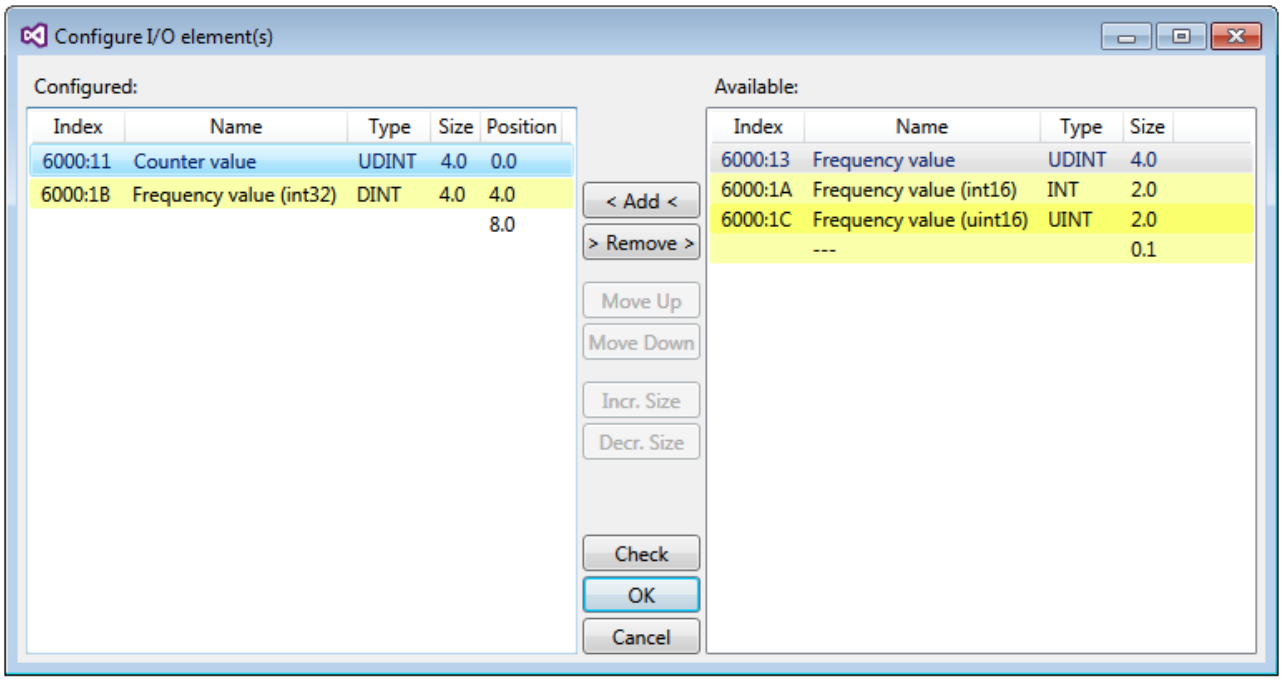


Fig. 36: Selection of the process data

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. 37: 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

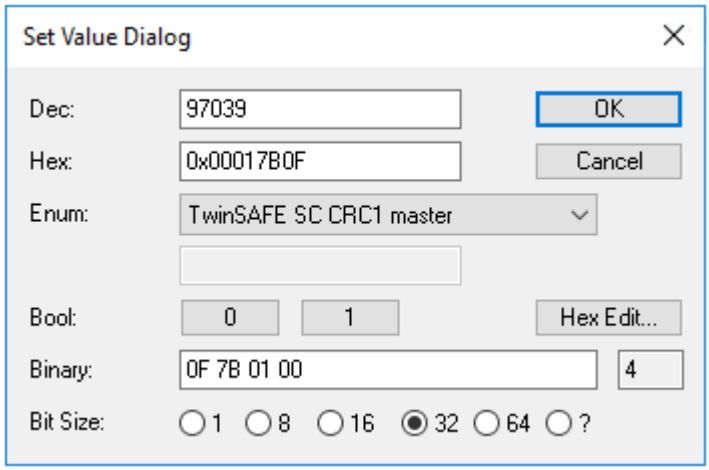


Fig. 38: Entering the safety address and the CRC

TwinSAFE SC connections

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

8.2.2 TwinSAFE SC process data EJ5101-0090

The EJ5101-0090 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 the default value. Further process data can be selected or deselected on the "Process Image" tab in the Safety Editor.

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

TwinSAFE SC objects

The overview of the TwinSAFE SC objects of the EJ5101-0090 can be found in the chapter TwinSAFE Single Channel objects (EJ5101-0090) [▶ 81].

8.3 EJ5101-0090 - object description and parameterization

EtherCAT XML Device Description

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

NOTICE

Parameterization via the CoE list (CAN over EtherCAT)

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

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

8.3.1 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})

8.3.2 Configuration data

8.3.2.1 0x8000, 0x8001 - simple operating mode

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	The counter counts up to the *Counter reload value* (0x8001:02) or is loaded with the *Counter reload value* (0x8001:02) in the event of an underflow **Example 360° encoder with set bit:** Moves in positive direction via *Counter reload value*: Reset counter value to 0 Moves in negative direction less than 0: Reset counter value to *Counter reload value*.	BOOLEAN	RW	0x00 (0_{dec})
8000:02	Enable index reset	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	FALSE The module operates in quadrature decoder mode. TRUE The module operates as a counter, counting direction towards input B.	BOOLEAN	RW	0x00 (0_{dec})
8000:04	Enable pos. gate	Gate input responds to positive edge and locks the counter	BOOLEAN	RW	0x01 (1_{dec})
8000:05	Enable neg. gate	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	The value specifies the size of the time window for the variable *Window* (0x6000:06). 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	If *Enable register reload* (0x8000:01) is TRUE, the counter counts up to this value or is loaded with this value in the event of an underflow	UINT16	RW	0xFFFF (65535_{dec})

8.3.2.2 0x8010 - enhanced operating mode

Index 8010 ENC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8010:0	ENC Settings	Maximum subindex	UINT8	RO	0x21 (33_{dec})
8010:01	Enable C reset	The counter is reset via the C input.	BOOLEAN	RW	0x00 (0_{dec})
8010:02	Enable extern reset	A counter reset is triggered via the external latch input (24 V).	BOOLEAN	RW	0x00 (0_{dec})
8010:03	Enable up/down counter	Enables the up/down counter instead of the encoder when the bit is set. Increments are counted at input A, Input B specifies the counting direction.	BOOLEAN	RW	0x00 (0_{dec})
8010:04	Gate polarity	0: Disable gate 1: Enable pos. gate (gate disables with HIGH level) 2: Enable neg. gate (gate disables with LOW level)	BIT2	RW	0x01 (1_{dec})
8010:08	Disable filter	0: Activates input filter (only inputs A, /A, B, /B, C, /C) 1: Deactivates input filter When the filter is activated, a signal edge must be present for at least 2.4 µs to be counted as an increment.	BOOLEAN	RW	0x01 (1_{dec})
8010:0A	Enable micro increments	If DC mode is enabled, the module interpolates micro-increments between the integer encoder increments. 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	A wire break on the A track is displayed in the index 0x6010:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typ., subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0C	Open circuit detection B	A wire break on the B track is displayed in the index 0x6010:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typ., subject to change) is detected as a wire break.	BOOLEAN	RW	0x01 (1_{dec})
8010:0D	Open circuit detection C	A wire break on the C track is displayed in the index 0x6010:07 and as process data. Diagnosis is only possible if the corresponding input is wired differentially. A differential voltage -1.5 V > Vid > 1.5 V (typ., subject to change) is detected as a wire break.	BOOLEAN	RW	0x00 (0_{dec})
8010:0E	Reversion of rotation	Activates reversion of rotation	BOOLEAN	RW	0x00 (0_{dec})
8010:10	Extern reset polarity	0: (Fall) with the falling edge the counter is set to 0 1: (Rise) with the rising edge the counter is set to 0	BIT1	RW	0x01 (1_{dec})
8010:11	Frequency window	This is the minimum time over which the frequency is determined. Default value 10 ms [resolution: 1 µs] The number of pulses in the timeframe + the following is measured. The maximum waiting time is *Frequency Wait Time* Index 0x8010:17. The number of pulses is then divided by the actual timeframe size.The determined frequency is output in Frequency scaling index 0x6010 [▶ 70]:13 and as the process data.The frequency calculation is performed locally and does not use a distributed clocks function.	UINT16	RW	0x2710 (10000_{dec})
8010:13	Frequency scaling	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 (hex)	Name	Meaning	Data type	Flags	Default
8010:14	Period scaling	Resolution of the period value in the process data: 100: "100 ns" Period duration value is a multiple of 100 ns 500: "500 ns" Period value is a multiple of 500 ns	UINT16	RW	0x0064 (100_{dec})
8010:15	Frequency resolution	Resolution of the frequency measurement: 100: "0.01 Hz"	UINT16	RW	0x0064 (100_{dec})
8010:16	Period resolution	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 the process data continues to reflect the value according to *Period scaling* index 0x8010:14 (e.g. 100 ns [default]).	UINT16	RW	0x01F4 (500_{dec})
8010:17	Frequency Wait Time	Waiting time [ms] for frequency measurement If the time from *Frequency window* index 0x8010:11 has elapsed, the system still waits for the next positive edge from track A for the duration specified in *Frequency Wait Time*. Depending on the expected frequencies, the fastest possible update of the *Frequency* process data can be achieved in this way. The minimum value to be entered here is twice the period value of the smallest measured frequency. T >= 2* (1 / f_{min}).	UINT16	RW	0x0640 (1600_{dec})
8010:21	Enable encoder plausibility check	Activation of plausibility check	BOOLEAN	RW	0x00 (0_{dec})

8.3.3 Input data

8.3.3.1 0x6000 - simple operating mode

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	UINT8	RO	0x00 (0_{dec})
6000:02	Value	Counter value	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 time window (*Frequency Window* (index 0x8001 [▶ 67]:01))	UINT16	RO	0x0000 (0_{dec})

8.3.3.2 0x6010 - enhanced operating mode

Index 6010 ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6010:0	ENC Inputs	Maximum subindex	UINT8	RO	0x1E (30_{dec})
6010:01	Latch C valid	The counter value was latched with the "C" input. The data in *Latch value* index 0x6010:12 corresponds to the latched value with the bit set. To re-enable the latch input, *Enable latch C* index 0x7010 [▶ 71]:01 must first be canceled and then reset.	BOOLEAN	RO	0x00 (0_{dec})
6010:02	Latch extern valid	The counter value was locked via the external latch. The data in *Latch value* index 0x6010:12 corresponds to the latched value with the bit set. To re-enable the latch input, *Enable latch extern on positive edge* index 0x7010:02 or *Enable latch extern on negative edge* index 0x7010:04 must first be canceled and then reset.	BOOLEAN	RO	0x00 (0_{dec})
6010:03	Set counter done	The counter was set.	BOOLEAN	RO	0x00 (0_{dec})
6010:04	Counter underflow	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	Counter overflow. In combination with a reset function (C/external), the underflow/overflow control is ineffective.	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	Indicates a wire break. Configuration via index 0x8010: [▶ 47]0B, 0x8010:0C, 0x8010:0D	BOOLEAN	RO	0x00 (0_{dec})
6010:08	Extrapolation stall	The extrapolated part of the counter is invalid	BOOLEAN	RO	0x00 (0_{dec})
6010:09	Status of input A	Status of input A	BOOLEAN	RO	0x00 (0_{dec})
6010:0A	Status of input B	Status of input B	BOOLEAN	RO	0x00 (0_{dec})
6010:0B	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	Status of the extern latch input	BOOLEAN	RO	0x00 (0_{dec})
6010:0E	Sync Error	The Sync Error bit is only required for the DC mode. It indicates whether a synchronization error has occurred in the cycle that has elapsed. This means that a SYNC signal was triggered in the module, but no new process data was 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	The frequency (setting of the scaling in index 0x8010:13 and resolution in index 0x8010:15)	UINT32	RO	0x00000000 (0_{dec})
6010:14	Period value	The period value (setting of the scaling in index 0x8010:14 and the resolution in index 0x8010:16)	UINT32	RO	0x00000000 (0_{dec})
6010:16	Timestamp	Timestamp of the last counter change	UINT64	RO	
6010:1C	Frequency value	Frequency (16-bit value)	UINT16	RO	0x0000 (0_{dec})
6010:1D	Counter value	Counter (16-bit value)	UINT16	RO	0x0000 (0_{dec})
6010:1E	Period value	Period (16-bit value)	UINT16	RO	0x0000 (0_{dec})

8.3.4 Output data

8.3.4.1 0x7000 - simple operating mode

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	Control byte	UINT8	RO	0x00 (0_{dec})
7000:02	Value	The counter value to be set via “CNT_SET” (CB.02).	UINT16	RO	0x0000 (0_{dec})

8.3.4.2 0x7010 - enhanced operating mode

Index 7010 ENC Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7010:0	ENC Outputs	Maximum subindex	UINT8	RO	0x11 (17_{dec})
7010:01	Enable latch C	Activate latching via input “C”.	BOOLEAN	RO	0x00 (0_{dec})
7010:02	Enable latch extern on positive edge	Activate external latch with positive edge.	BOOLEAN	RO	0x00 (0_{dec})
7010:03	Set counter	Set counter value	BOOLEAN	RO	0x00 (0_{dec})
7010:04	Enable latch extern on negative edge	Activate external latch with negative edge.	BOOLEAN	RO	0x00 (0_{dec})
7010:11	Set counter value	The counter value to be set via *Set counter* (index 0x7010:03).	UINT32	RO	0x00000000 (0_{dec})

8.3.5 Information and diagnostic data / channel-specific

Index A010 ENC diag data (only for enhanced operation mode)

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	Open circuit on track A	BOOLEAN	RO	0x00 (0_{dec})
A010:02	Open circuit B	Open circuit on track B	BOOLEAN	RO	0x00 (0_{dec})
A010:03	Open circuit C	Open circuit on track C	BOOLEAN	RO	0x00 (0_{dec})
A010:13	Encoder plausibility error counter	Number of detected plausibility errors	UINT16	RO	0x0000 (0_{dec})

8.3.6 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 Lo-Word contains the CoE profile used (5001). • The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EJ5101-0090

Index 1009 Hardware version

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

Index 100A Software version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x13ED2852 (334309458_{dec})
1018:03	Revision	Revision number of the EtherCAT slave: • The Low Word (bit 0-15) indicates the special terminal number. • The High Word (bit 16-31) refers to the device description.	UINT32	RO	0x00000000 (00000000_{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

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 10 16

Index 1401 RxPDO-Par outputs word-aligned

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 10 16

Index 1402 ENC RxPDO-Par Control compact

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 00 00

Index 1403 ENC RxPDO-Par Control

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 00 00

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 1602 ENC RxPDO-Map Control compact

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

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

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 10 1A

Index 1801 TxPDO-Par inputs word-aligned

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 10 1A

Index 1802 TxPDO-Par Inputs optional

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 10 1A 00 00

Index 1803 ENC TxPDO-Par Status compact

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 00 00

Index 1804 ENC TxPDO-Par Status

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 00 00

Index 1805 ENC TxPDO-Par Frequency

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 00 00

Index 1806 ENC TxPDO-Par Period

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 00 00

Index 1807 ENC TxPDO-Par Timest.

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 00 00

Index 1808 ENC TxPDO-Par Timest. compact

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 00 00

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 1A03 ENC TxPDO-Map Status compact

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 (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

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	1. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x01 (Latch C valid))	UINT32	RO	0x6010:01, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x02 (Latch extern valid))	UINT32	RO	0x6010:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x03 (Set counter done))	UINT32	RO	0x6010:03, 1
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x04 (Counter underflow))	UINT32	RO	0x6010:04, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x05 (Counter overflow))	UINT32	RO	0x6010:05, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x06 (input status))	UINT32	RO	0x6010:06, 1
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x07 (Open circuit))	UINT32	RO	0x6010:07, 1
1A04:08	SubIndex 008	8. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x08 (Extrapolation stall))	UINT32	RO	0x6010:08, 1
1A04:09	SubIndex 009	9. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x09 (Status of input A))	UINT32	RO	0x6010:09, 1
1A04:0A	SubIndex 010	10. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0A (Status of input B))	UINT32	RO	0x6010:0A, 1
1A04:0B	SubIndex 011	11. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0B (Status of input C))	UINT32	RO	0x6010:0B, 1
1A04:0C	SubIndex 012	12. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0C (Status of input gate))	UINT32	RO	0x6010:0C, 1
1A04:0D	SubIndex 013	13. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0D (Status of extern latch))	UINT32	RO	0x6010:0D, 1
1A04:0E	SubIndex 014	14. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0E (Sync error))	UINT32	RO	0x6010:0E, 1
1A04:0F	SubIndex 015	15. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x0F (TxPDO State))	UINT32	RO	0x6010:0F, 1
1A04:10	SubIndex 016	16. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x10 (TxPDO Toggle))	UINT32	RO	0x6010:10, 1
1A04:11	SubIndex 017	17. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x11 (Counter value))	UINT32	RO	0x6010:11, 32
1A04:12	SubIndex 018	18. PDO Mapping entry (object 0x6010 (ENC Inputs), entry 0x12 (Latch value))	UINT32	RO	0x6010:12, 32

Index 1A05 ENC TxPDO-Map Frequency

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

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.

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

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	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:01	SubIndex 002	2. 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	0x02 (2_{dec})
1C13:01	SubIndex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	SubIndex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 (6672_{dec})
1C13:03	SubIndex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C13:04	SubIndex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: cycle time of the local timer • Synchron with SM 2 Event: cycle time of the master • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: Free Run is supported • Bit 1 = 1: Synchron with SM 2 Event is supported • Bit 2-3 = 01: DC-Mode is supported • Bit 4-5 = 10: Output Shift with SYNC1 Event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	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: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32 [▶ 58]:02	UINT32	RW	0x000F4240 (1000000_{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: Synchron with SM 2 Event is supported (outputs available) • Bit 1: Synchron 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 or 0x1C33:08)	UINT16	RO	0x4807 (18439_{dec})
1C33:05	Minimum cycle time	as 0x1C32 [▶ 58]:05	UINT32	RO	0x000103C4 (66500_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x000103C4 (66500_{dec})
1C33:08	Command	as 0x1C32: [▶ 58]08	UINT16	RW	0x0000 (0_{dec})
1C33:09	Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32 [▶ 58]:11	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32 [▶ 58]:12	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32 [▶ 58]:13	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32 [▶ 58]:32	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the Modular Device Profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index distance of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	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	0x00003B6 (950_{dec})

Index F082 MDP Profile Compatibility

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

8.4 TwinSAFE Single Channel objects (EJ5101-0090)

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	Maximaler 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			

9 Appendix

9.1 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Support

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

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

Hotline:	+49 5246 963 157
e-mail:	support@beckhoff.com
web:	www.beckhoff.com/support

Service

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49 5246 963 460
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