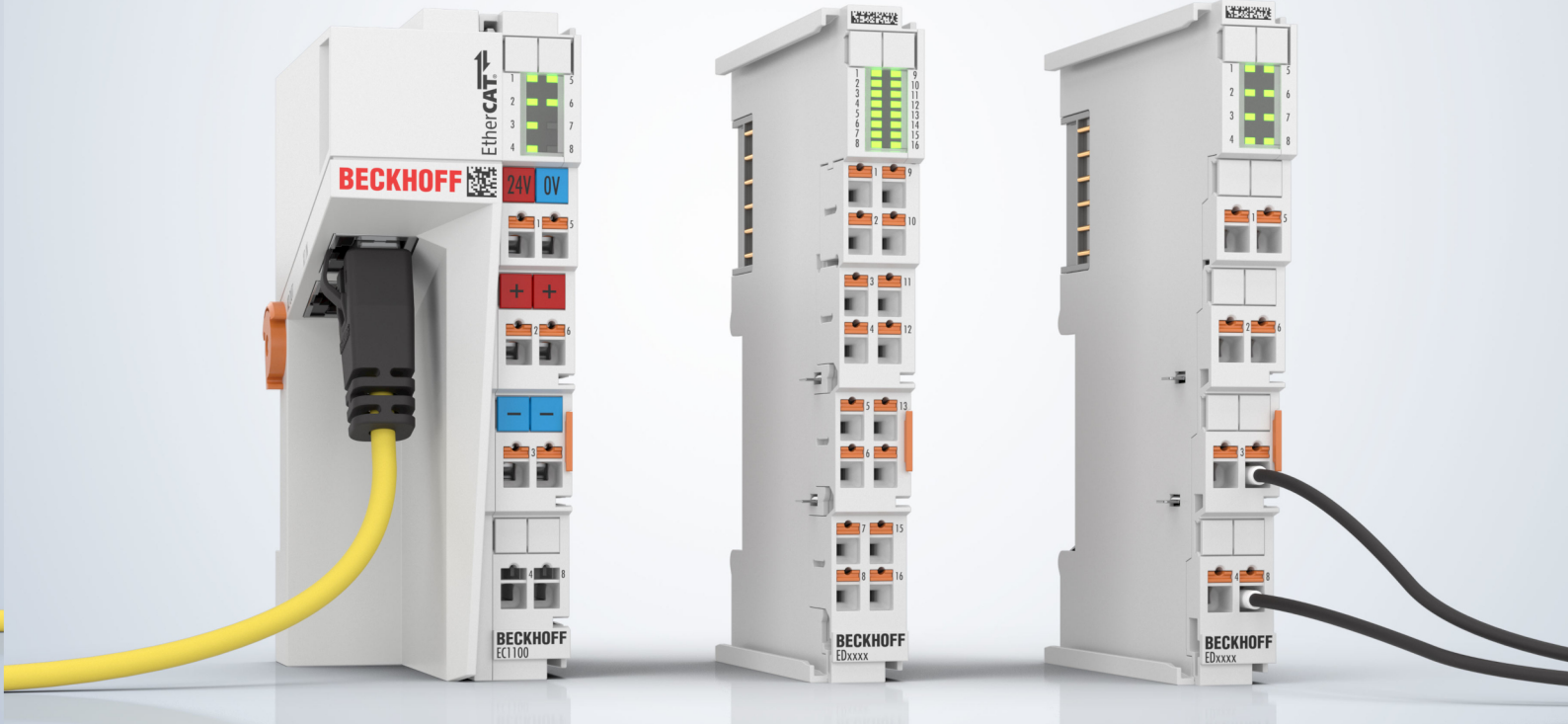
BECKHOFF New Automation Technology

Documentation | EN

ED2504

EtherCAT Terminal, 4-channel PWM output, 5...24 V DC, 1.5 A, push-in, with 4 x digital input



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1 Foreword

1.1 Product overview

This documentation covers the following products:

ED2504 [▶ 9]	EtherCAT Terminal, 4-channel PWM output, 5…24 V DC, 1.5 A, push-in, with 4 x digital inputs

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

1.2 Notes on the documentation

Intended audience

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

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

Disclaimer

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

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

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

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1.3 Guide through documentation

NOTICE

Further components of documentation

This documentation describes device-specific content. It is part of the modular documentation concept for Beckhoff I/O components. For the use and safe operation of the 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
Infrastructure for EtherCAT/Ethernet (PDF)	Technical recommendations and notes for design, implementation and testing
Software Declarations I/O (PDF)	Open source software declarations for Beckhoff I/O components

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

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

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

1.4 Safety instructions

Safety regulations

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

Exclusion of liability

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

Personnel qualification

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

Signal words

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

Personal injury warnings

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

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

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

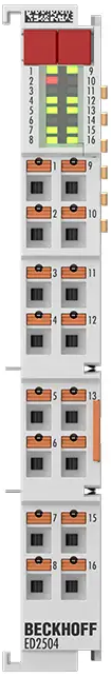
Warning of damage to property or environment

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

Information on handling the product

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

2 Product description



EtherCAT Terminal, 4-channel PWM output, 5…24 V DC, 1.5 A, push-in, with 4 x digital inputs

The ED2504 EtherCAT Terminal offers up to four digital outputs, which are output as pulse-width modulated signals. The output signal can be modulated in both pulse width and frequency within the range of 1 Hz to 64 kHz.
The output level is determined by the external voltage fed in and can be freely selected in the range from 5 V DC to 24 V DC. The outputs are short circuit and overcurrent protected.

Each channel also has a digital input with configurable filter times.
The switching characteristic can be selected as either positive or ground switching (PNP/NPN) for each channel.
The input can be used as a digital input or to enable the PWM output. If the PWM signal is used to control the fan, for example, the additional input can be used for the measurement of rotary speed.

The ED-series EtherCAT Terminals have push-in connection technology which makes wiring easy and tool-free.

2.1 Technical data

General	ED2504
Number of channels | Total	max. 8
Internal communication protocol	EtherCAT
Minimum cycle time	350 µs

Digital output PWM	ED2504
Number of channels	4
Load type	ohmic, inductive
Signal range | Technical	5…24 V DC (+20%) (external supply)
Output current	max. 1.5 A per channel[1)]
Short-circuit proof	yes
Output stage	push-pull
Pulse duration | T_{ON}	typ. > 320 ns
Pulse duration | T_{OFF}	typ. > 320 ns
Duty cycle	0…100%
Resolution	10…16 bit
Output frequency	1 Hz…64 kHz
Reverse polarity protection	yes

[1)] The maximum output current per channel depends on the operating temperature. The following relationship applies:

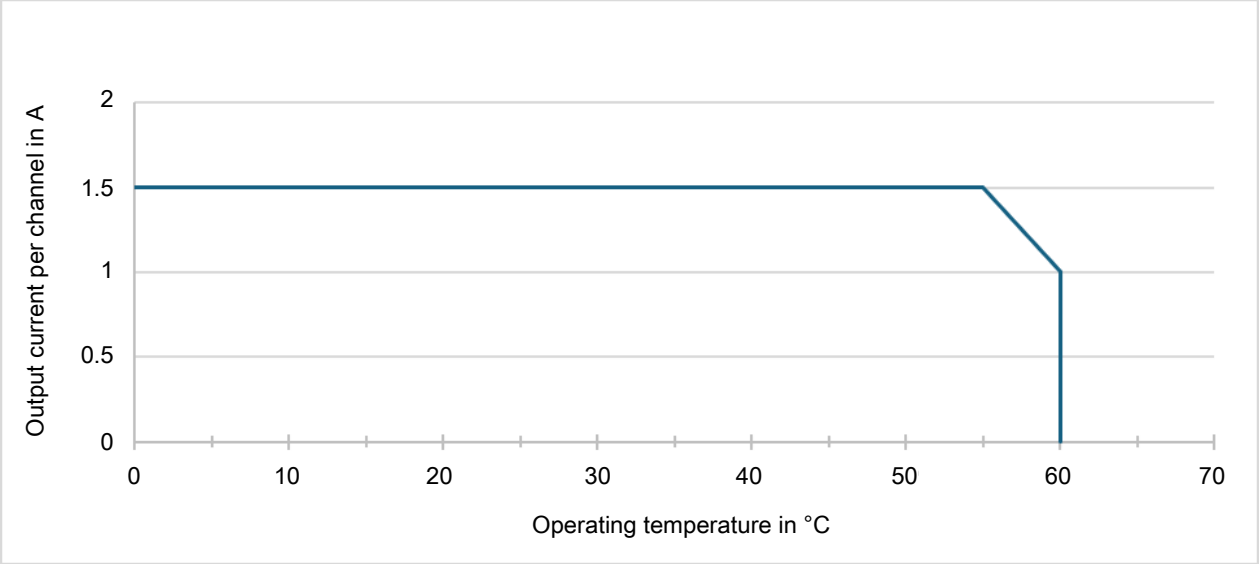


Fig. 1: ED2504 – Dependence of the output current per channel on operating temperature

Digital input Standard digital | Positive switching	ED2504
Number of channels	max. 4
Function	digital input, hardware gate, tacho
Connection technology	1-wire
Signal voltage “0”	-3…+1.5 V DC
Signal voltage “1”	2.7…28 V DC
Input filter	typ. 1 µs, 0.1 ms, 0.5 ms, 1 ms, 3 ms, 10 ms, 20 ms (adjustable)
Input current	typ. 1 mA at 24 V DC
Cable length | Sensor cable	max. 30 m

Digital input Standard digital | Ground switching	ED2504
Number of channels	max. 4
Function	digital input, hardware gate, tacho
Connection technology	1-wire
Signal voltage “0”	2.5…28 V DC
Signal voltage “1”	-3…+1 V DC
Input filter	typ. 1 µs, 0.1 ms, 0.5 ms, 1 ms, 3 ms, 10 ms, 20 ms (adjustable)
Input current	typ. 2 mA at 24 V DC
Cable length | Sensor cable	max. 30 m

XFC	ED2504
Distributed clocks	no
Timestamp	no
Oversampling	no

Supply and electrical isolation	ED2504
Electronics | Supply voltage	via E-bus, via power contacts
E-bus | Current consumption	typ. 100 mA
Power contacts | Input voltage	24 V DC (-15%/+20%)
Power contacts | Current carrying capacity	max. 10 A
Power contacts | Current consumption	typ. 5 mA + load
Power contacts | Output voltage	corresponds to Power contacts | Input voltage
Electrical isolation | Channel/channel	no
Electrical isolation | Channel/bus	functional, 707 V DC (type test)

Environmental conditions	ED2504
Operating temperature	-25…+60°C
Storage temperature	-40…+85°C
Relative humidity	95%, no condensation
Installation position	variable

Standards and approvals	ED2504
Vibration resistance	conforms to EN 60068-2-6
Shock resistance	conforms to EN 60068-2-27
EMC immunity	conforms to EN 61000-6-2
EMC emission	conforms to EN 61000-6-4
Markings*)	CE
Approvals*)	–
*) Real applicable approvals/markings, see name plate on the side (product labeling)	

Housing data	ED-12-16pin
Weight	approx. 60 g
Protection rating	IP20
Material	polycarbonate
Dimensions | Width (single)	15 mm
Dimensions | Width (stacked)	12 mm
Dimensions | Height	100 mm
Dimensions | Depth	65 mm
Installation | Terminal/back wall	DIN rail, 35 mm (EN 60715)
Installation | Terminal/terminal	double slot and key connection
Pluggable wiring level	no
Connection mechanism	push-in
Connection cross-section | Solid wire	0.08…1.5 mm²
Connection cross-section | Stranded wire	0.25…1.5 mm²
Connection cross-section | With ferrule	0.14…0.75 mm²
Connection cross-section AWG | Solid wire	AWG28…16
Connection cross-section AWG | Stranded wire	AWG22…16
Connection cross-section AWG | With ferrule	AWG26…19
Stripping length	8…9 mm
Power contact | "+" (left)	yes
Power contact | "+" (right)	yes
Power contact | "-" (left)	yes
Power contact | "-" (right)	yes
Power contact | "⏚" (left)	no
Power contact | "⏚" (right)	no
Insertion lock for power contact "⏚"	yes

2.2 Connection

⚠ WARNING

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

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

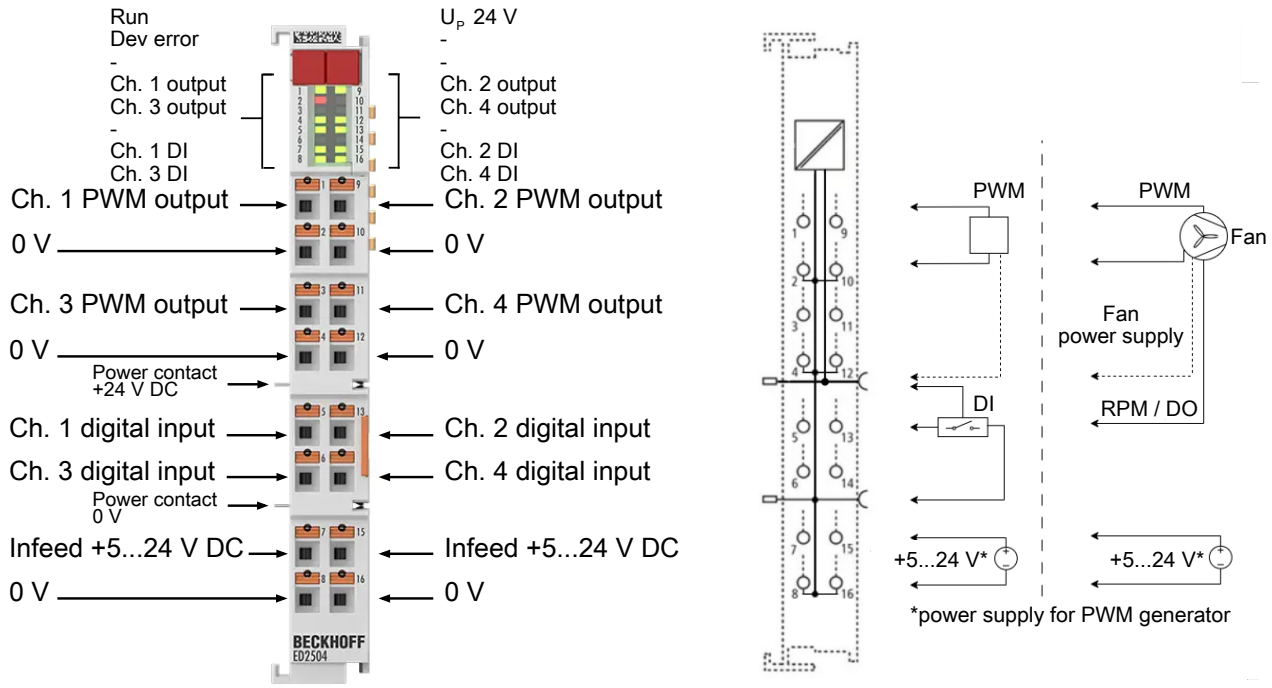


Fig. 2: ED2504

Terminal point		Description
Abbreviation	No.	
Ch 1 output	1	PWM output 1
0 V	2	0 V (internally connected to terminal points 4, 8, 10, 12, 16, and the negative power contact)
Ch 3 output	3	PWM output 3
0 V	4	0 V (internally connected to terminal points 2, 8, 10, 12, 16, and the negative power contact)
Ch 1 DI	5	Digital input 1
Ch 3 DI	6	Digital input 3
Infeed 5…24 V	7	Externally supplied 5…24 V DC power
0 V	8	Ground reference for externally supplied power (internally connected to terminals 2, 4, 10, 12, 16, and the negative power contact)
Ch 2 output	9	PWM output 2
0 V	10	0 V (internally connected to terminal points 2, 4, 8, 12, 16, and the negative power contact)
Ch 4 output	11	PWM output 4
0 V	12	0 V (internally connected to terminal points 2, 4, 8, 10, 16, and the negative power contact)
Ch 2 DI	13	Digital input 2
Ch 4 DI	14	Digital input 4
Infeed 5…24 V	15	Externally supplied 5…24 V DC power
0 V	16	Ground reference for externally supplied power (internally connected to terminals 2, 4, 8, 10, 12, and the negative power contact)

NOTICE

Please note the additional information and instructions

Please follow the instructions below and refer to the information in the technical specifications!

Note on connecting two-wire cables

If you are using two-wire cables, we recommend using a shielded cable for the PWM signal.

Notes on connecting and operating the digital inputs

Sensors with open collector output circuits

A sensor with an open collector output circuit corresponds to the “Input Type”: “Ground Switching (NPN)”.

- In this context, the switching thresholds defined by the manufacturer must be observed to determine whether the input signal should be interpreted as “normally open” or “normally closed”.

Digital input wiring

- 3-wire digital sensors must be used.
- To ensure that the digital input functions properly, the sensor supply and the ground connection must be connected separately.
- 2-wire digital sensors are not supported.

Maximum cable length to the sensor/encoder

- Signal cables to the sensor/encoder over 3 m must be shielded. The shielding must be state-of-the-art and effective.
- The permissible cable length for signal cables is < 30 m.

NOTICE

Fast digital inputs – interference from interfering devices

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

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

2.3 LEDs

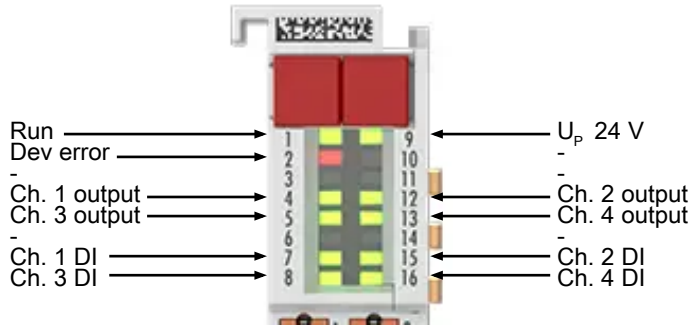


Fig. 3: ED2504 – LEDs

Name	No.	Color	Meaning	
Run	1	green	This LED indicates the terminal's operating state:	
			off	State of the EtherCAT State Machine: **INIT** = initialization of the terminal
			flashing	State of the EtherCAT State Machine: **PREOP** = function for mailbox communication and different default settings set
			Single flash	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
			on	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
			flickering	State of the EtherCAT State Machine: **BOOTSTRAP** = Function for Firmware updates of the terminal
Dev error	2	red	on	Error indicator: An error has occurred, e.g., due to incorrect configuration or undervoltage. For details, see the "Diagnostics [▶ 53]" chapter
Ch. 1 output	4	green	on	PWM output signal is present on channel 1
			off	No output signal
Ch. 3 output	5	green	on	PWM output signal is present on channel 3
			off	No output signal
Ch. 1 DI	7	green	on	An input signal is present at the digital input of channel 1
			off	No input signal at the digital input
Ch. 3 DI	8	green	on	An input signal is present at the digital input of channel 3
			off	No input signal at the digital input
U_P 24 V	9	green	on	24 V peripheral voltage (power contacts) is present.
			off	Peripheral voltage (power contacts) is not present or is below 12 V.
Ch. 2 output	12	green	on	PWM output signal is present on channel 2
			off	No output signal
Ch. 4 output	13	green	on	PWM output signal is present on channel 4
			off	No output signal
Ch. 2 DI	15	green	on	An input signal is present at the digital input of channel 2
			off	No input signal at the digital input
Ch. 4 DI	16	green	on	An input signal is present at the digital input of channel 4
			off	No input signal at the digital input

2.4 Externally supplied power for the output signal

The output voltage level of the PWM outputs depends on the externally supplied voltage at the connection points.

1. The voltage must be supplied via the following terminals:
   - Terminal 7, 15: Externally supplied 5…24 V DC supply
   - Terminal 8, 16: Ground reference for externally supplied power

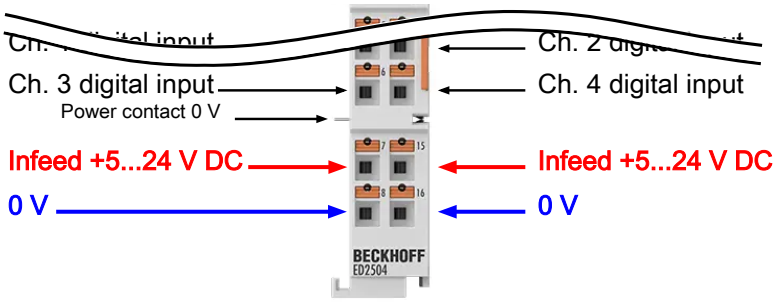


Fig. 4: ED2504 – external power supply

2. Before applying voltage, ensure that all four actuators connected to the PWM outputs are compatible with this voltage range.

The following tolerances apply:

Externally supplied voltage	Tolerance
Min. 5 V DC	–
Max. 24 V DC	up to +20% (up to 28.8 V)

NOTICE

Notes on the externally supplied voltage

- Size the terminal's power supply according to the power requirements of the connected actuators.
- Select power supply cables, power supplies, and actuator cables of appropriate length.
- The switching thresholds of the digital inputs are independent of the external voltage.

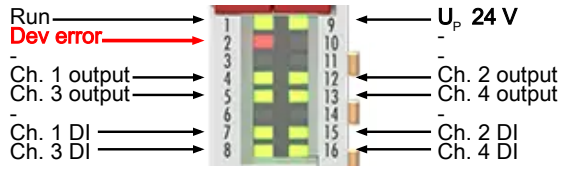
NOTICE

Shared ground reference for external power supply

If the actuators are controlled via the PWM outputs but are not powered by the externally supplied voltage, a common ground connection between the EtherCAT Terminal and the external power supply must be ensured.

Diagnostics of missing or insufficient externally supplied voltage

If there is no external supply voltage or if the voltage is too low, this is indicated by:

LED 2: "Dev error",	Process data	DiagMessages:
"Dev error" lights up red 	Warning bit = TRUE External supply undervoltage	For voltages < 4.75 V: Warning "0x4601 External supply undervoltage"
	Error bit = TRUE External supply undervoltage	for voltages < 4.5 V: Error "0x8601 External supply undervoltage"

3 Mounting and wiring

3.1 Notes on ESD protection

NOTICE

Devices can be destroyed by electrostatic charging!

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

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

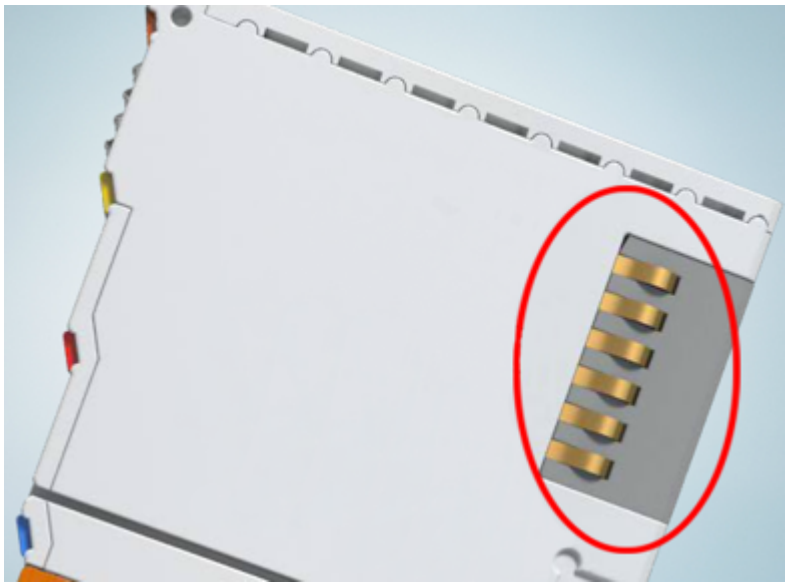


Fig. 5: Spring contacts of Beckhoff I/O components

3.2 Mounting rail installation

⚠ WARNING

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

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

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

Installation

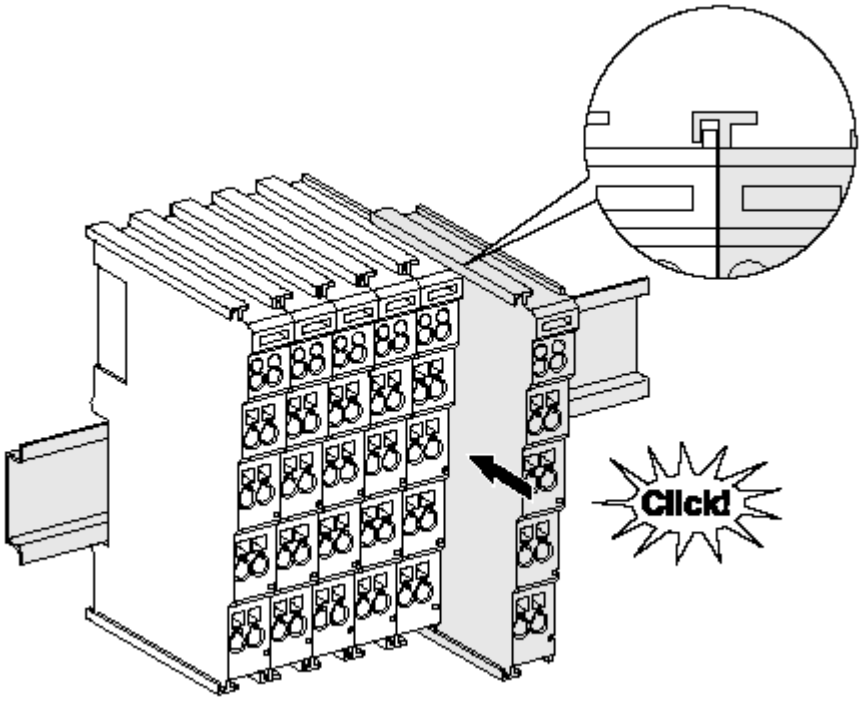


Fig. 6: Installation on the mounting rail

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

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

Fastening the mounting rails

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

NOTICE

Eath the mounting rail!

Make sure the mounting rail is properly earthed.

Connections within a bus terminal block

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

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

Power contacts

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

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

Power contact ⏚

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

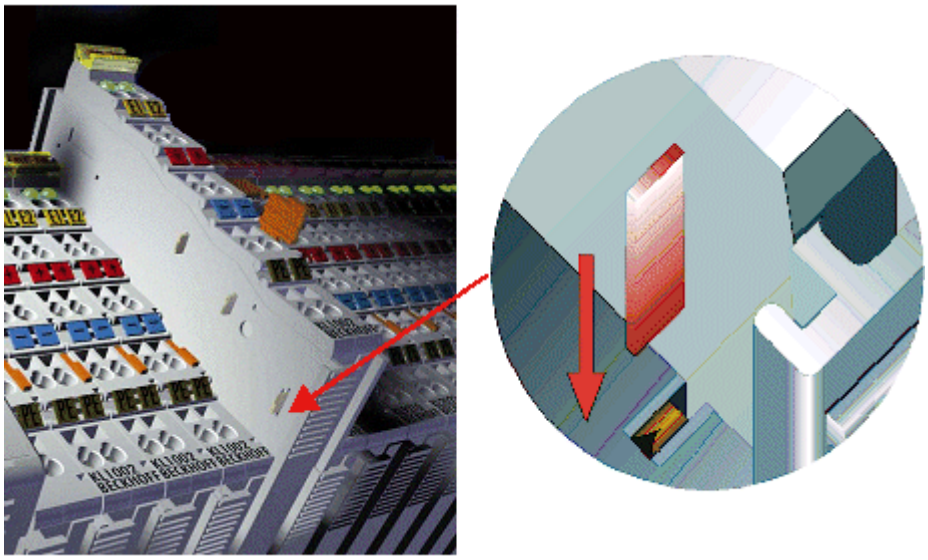


Fig. 7: Power contact on the left

⚠ WARNING

Risk of injury from electric shock!

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

NOTICE

Risk of damage to the device

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

Disassembly

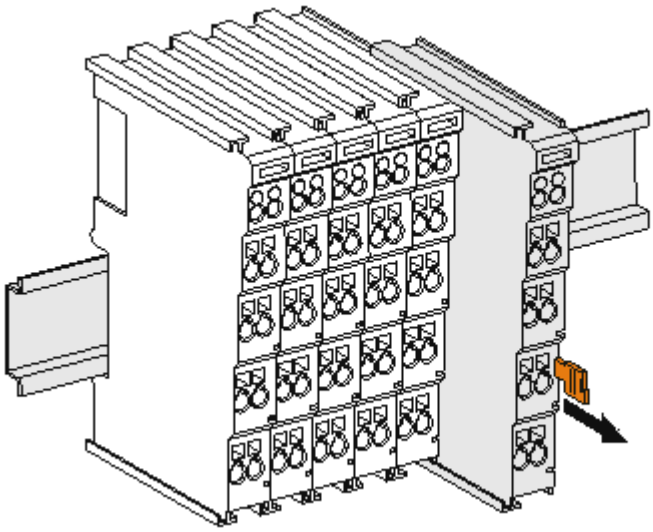


Fig. 8: Removal from mounting rail

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

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

3.3 Positioning of passive terminals

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

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

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

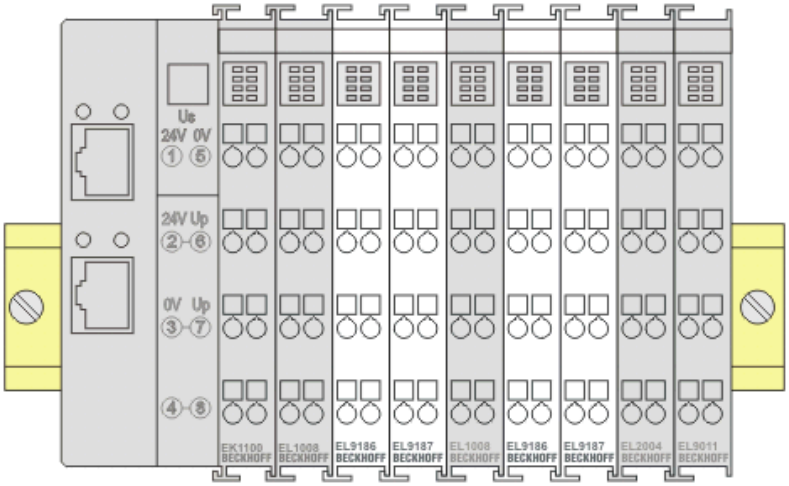


Fig. 9: Proper positioning

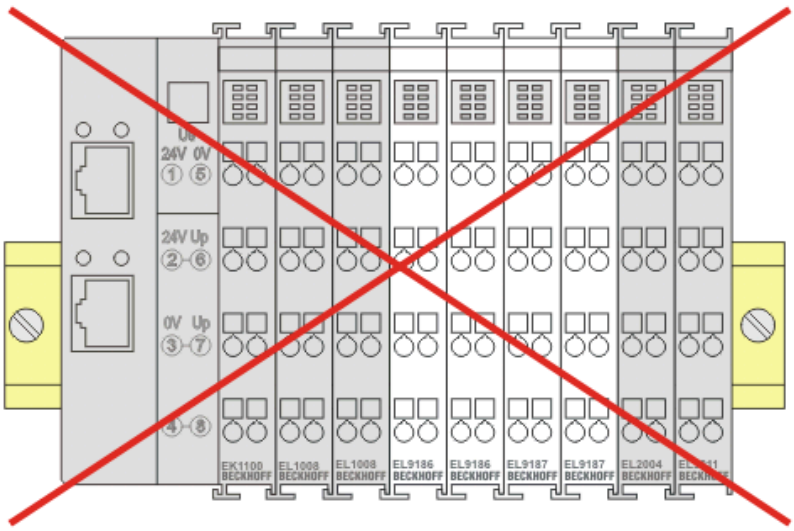


Fig. 10: Incorrect positioning

3.4 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

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

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

Horizontal installation (standard installation)

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

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

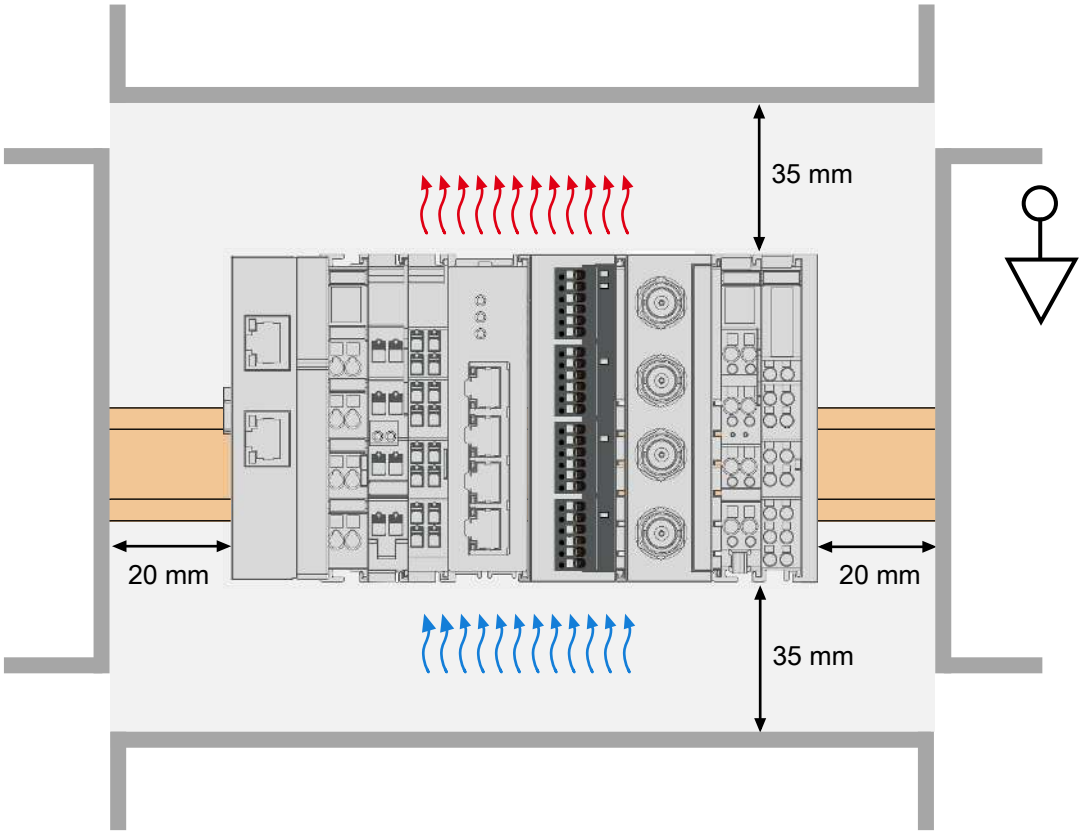


Fig. 11: Recommended minimum distances for standard installation position

NOTICE

Compliance with the minimum distances

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

Vertical installation

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

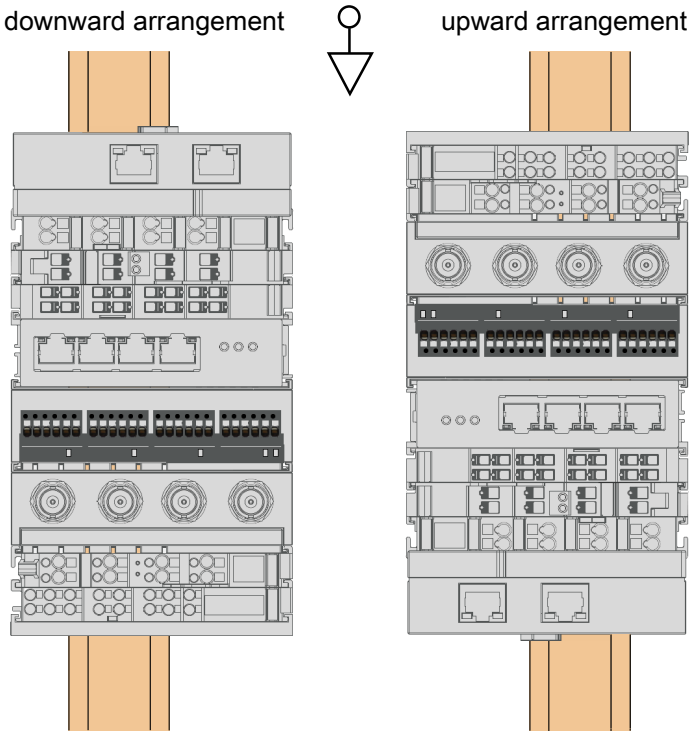


Fig. 12: Installation position: Vertical, downward arrangement (left)/upward arrangement (right)

Flat installation

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

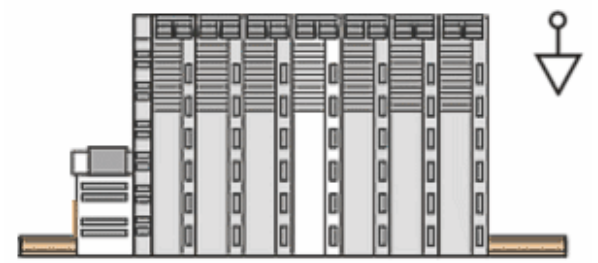


Fig. 13: Flat installation

NOTICE

Danger of sliding off the mounting rail

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

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

NOTICE

Compliance with the minimum distances

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

Installation positions with ZB8610 fan cartridge

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

The fan cartridge can be used in any installation position.

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

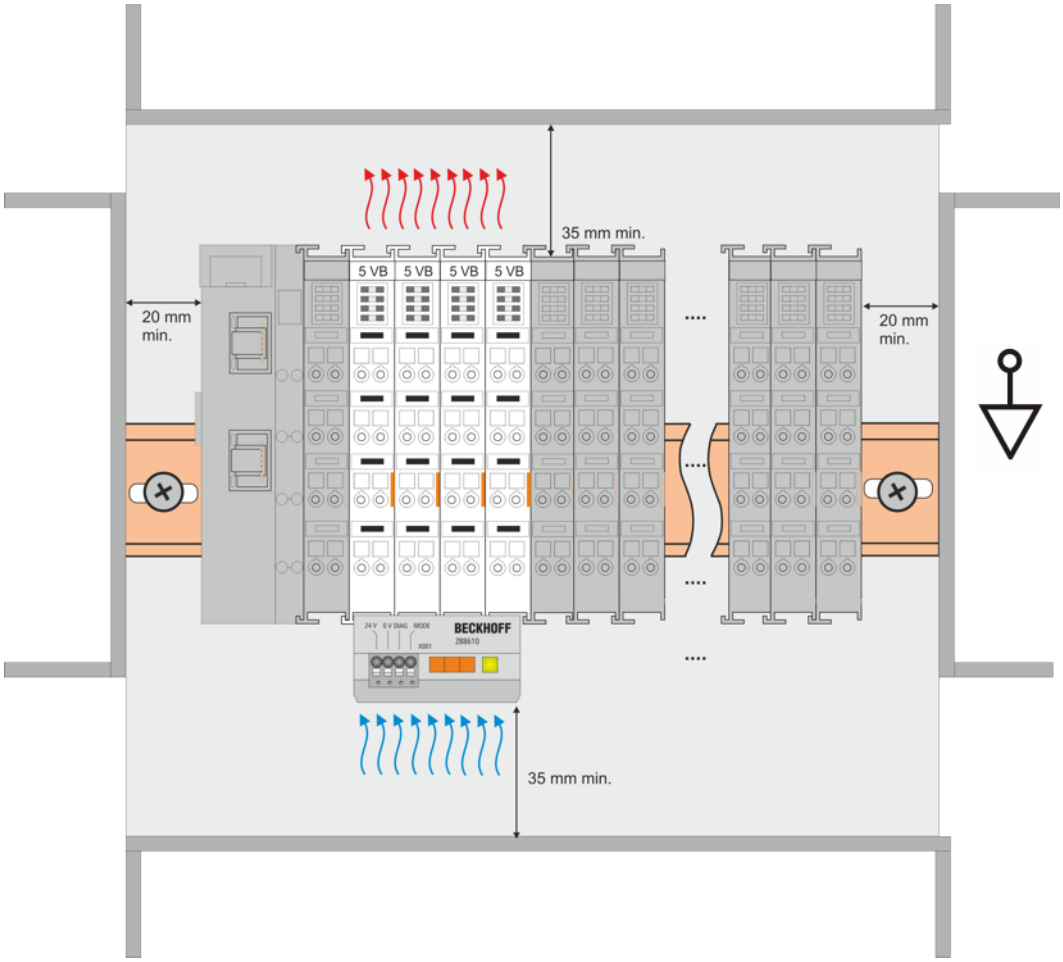


Fig. 14: Recommended minimum distances for operation with fan, using horizontal installation position as an example

NOTICE

Compliance with the minimum distances

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

3.5 Push-in connection technology (EC/ED/EFxxxx)

⚠ WARNING

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

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

In the case of EC/ED/EFxxxx-series Terminals with push-in connection technology, solid conductors fitted with wire end ferrules can be plugged in directly without tools (see "Wiring [▶ 26]" section).

Ultrasonically compacted wires

Ultrasonically compacted (ultrasonically welded) wires can also be connected.

- Please note the information on the connection cross-section in the table housing data in the chapter Technical data of the relevant device!

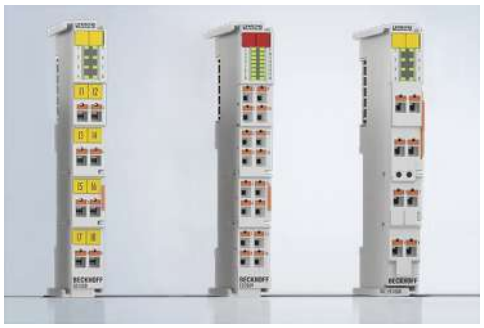


Fig. 15: Tool-free push-in connection; housing types ED-12-8pin, ED-12-16pin, and EF-12-8pin

The following connection options are available for optimum adaptation to the application:

- The EC/EDxxxx-series Terminals contain electronics and the connection level in one housing unit.
- The EFxxxx-series Terminals have a pluggable connection level. For servicing, the pluggable connection level allows the entire wiring to be removed from the top of the housing as a single plug. This reduces the installation time and eliminates the risk of wires being mixed up. The plug is only slightly protruding (for dimensions, see Technical data -> Housing data of the corresponding product). Installation and wiring are carried out as for the EDxxxx-series Terminals.
  Proceed as follows when replacing:
  - Press the unlocking hub and pull the lower part out of the terminal block.
  - Push in the replacement component and plug the connector with the upright wiring back in.

Strain relief of the cable

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

Overview of housing designs

EC/EDxxxx housing designs, contain the electronics and connection level in one housing	EFxxxx housing designs with pluggable wiring level	Description
EC-40-8pin	-	8 connection points on 40 mm
ED-12-8pin	EF-12-8pin	8 connection points on 12 mm
ED-24-2x8pin	EF-24-2x8pin	16 connection points on 24 mm
ED-12-16pin	-	16 connection points on 12 mm
ED-24-2x16pin	-	32 connection points on 24 mm

3.5.1 EC/ED/EFxxxx wiring with push-in connection technology

⚠ WARNING

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

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

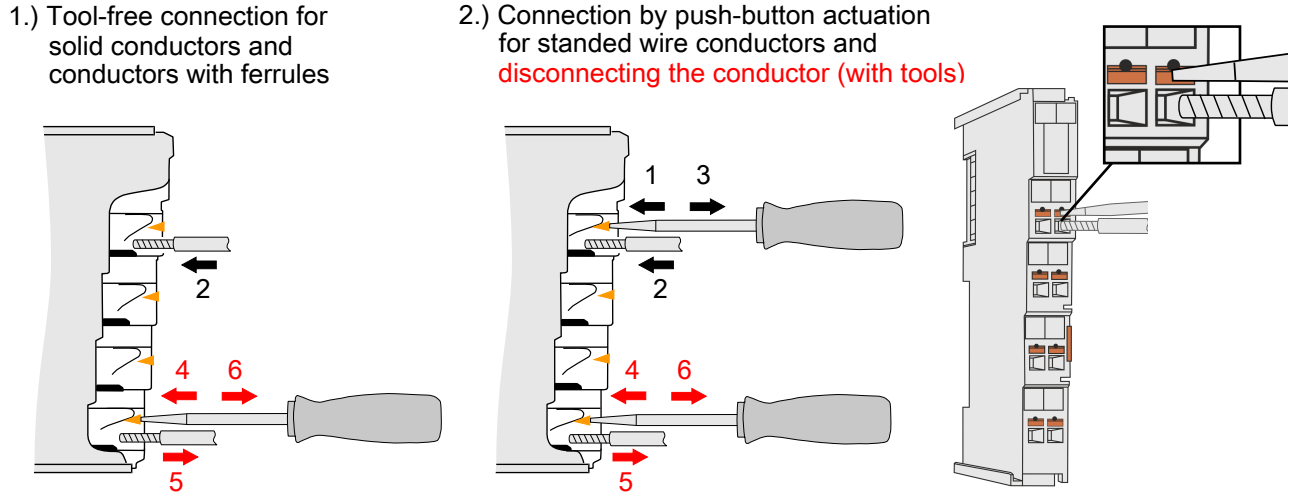


Fig. 16: Connecting and disconnecting the conductors

1. **Connecting solid conductors and conductors with ferrules (Fig. top left, step 2)**
   These can be connected using a direct plug-in technique, without tools.
   - Insert the conductor into the terminal point after stripping the insulation (2)
2. **Connect stranded cables (Fig. top right, steps 1–3)**
   These must be connected via the push-button.
   - Use a screwdriver to press the push-button to open the contact point (1).
   - Then insert the conductor (2).
   - Release the push-button by pulling back the screwdriver to close the terminal point (3).

Disconnect cables (Fig. above steps 4–6)
The release is performed using the push-button for all conductor types.

- Use a screwdriver to press the push-button to unlock the contact (4).
- Then pull out the conductor (5).
- Release the push-button by pulling back the screwdriver to close the terminal point (6).

NOTICE

Observe the permissible connection cross-sections and stripping lengths

The permissible conductor cross-section and stripping length depend on the type of housing, please refer to the housing data in the “Technical data” chapter for the device in question.

3.5.2 Shielding

Shielding

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

3.6 Note on power supply

⚠ WARNING

Power supply from SELV / PELV power supply unit!

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

Notes:

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

3.7 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.

4 Commissioning

The ED2504 EtherCAT Terminal provides four digital outputs, which are pulse-width-modulated signals. The duty cycle and output frequency can be set using either real or integer values.
In addition, each output has a digital input with configurable filter times.
The switching characteristics can be set to either positive or ground switching (PNP/NPN).

Each channel thus consists of a combination of a PWM output and a digital input. These are grouped together in a signal group called “SlotGroup n”. The signal group is configured via the “Slots” tab using the “Modules/slots procedure [▶ 30]”. The number of configurable “ModuleGroups” and the functions available with them are described below.

Overview of slots and ModuleGroups:

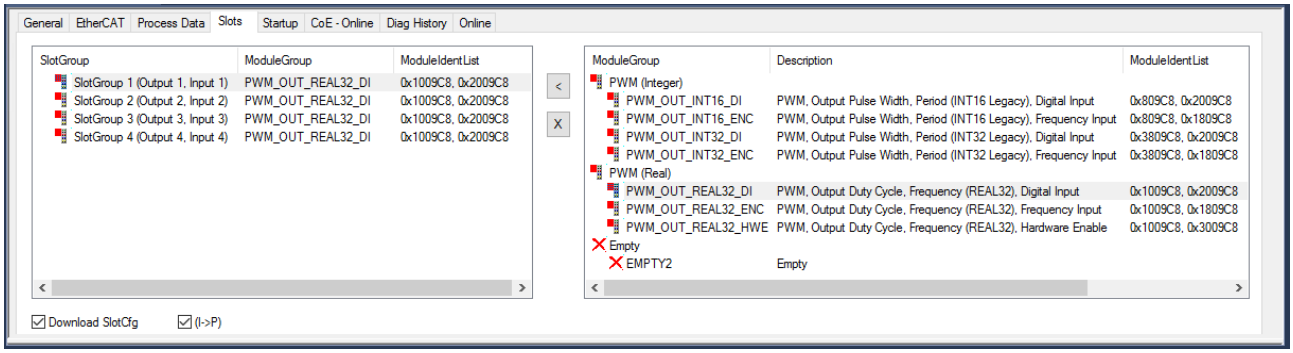


Fig. 17: ED2504 – Assigning SlotGroups and ModuleGroups in the “Slots” tab

The following ModuleGroups are available for each SlotGroup n (Output n, Input n):

“ModuleGroup”		“Description”	ModuleIdent	Description
PWM (Integer)	PWM_OUT_INT16_DI	PWM, Output Pulse Width, Period (INT16 Legacy), Digital Input	0x809C8 [▶ 39], 0x2009C8 [▶ 47]	1x PWM output with adjustable pulse width and period (INT16), 1x digital input
	PWM_OUT_INT16_ENC	PWM, Output Pulse Width, Period (INT16 Legacy), Frequency Input	0x809C8 [▶ 39], 0x1809C8 [▶ 49]	1x PWM output with adjustable pulse width and period (INT16), 1x frequency input
	PWM_OUT_INT32_DI	PWM, Output Pulse Width, Period (INT32 Legacy), Digital Input	0x3809C8, [▶ 39] 0x2009C8 [▶ 47]	1x PWM output with adjustable pulse width and period (INT32), 1x digital input
	PWM_OUT_INT32_ENC	PWM, Output Pulse Width, Period (INT32 Legacy), Frequency Input	0x3809C8 [▶ 39], 0x1809C8 [▶ 49]	1x PWM output with adjustable pulse width and period (INT32), 1x frequency input
PWM (Real)	PWM_OUT_REAL32_DI	PWM, Output Duty Cycle, Frequency (REAL32), Digital Input	0x1009C8 [▶ 31], 0x2009C8 [▶ 49]	1x PWM output with adjustable duty cycle and frequency (REAL32), 1x digital input
	PWM_OUT_REAL32_ENC	PWM, Output Duty Cycle, Frequency (REAL32), Frequency Input	0x1009C8 [▶ 31], 0x1809C8 [▶ 49]	1x PWM output with adjustable duty cycle and frequency (REAL32), 1x frequency input
	PWM_OUT_REAL32_HWE	PWM, Output Duty Cycle, Frequency (REAL32), Hardware Enable	0x1009C8 [▶ 31], 0x3009C8 [▶ 51]	1x PWM output with adjustable duty cycle and frequency (REAL32), 1x hardware enable input
Empty	EMPTY	Empty	–	A port that has no function must be assigned the value “Empty”.

NOTICE

Specifying an invalid module/slot configuration

If invalid module combinations are configured within a SlotGroup, then

- the specification is rejected and
- the following diagnostic message is output: 0x81B5 “Invalid module and slot configuration”.

4.1 Basics of the "Modules/Slots" procedure

The modules/slots procedure enables simplified configuration and parameterization of multifunctional EtherCAT devices. The configuration is carried out in TwinCAT via the "Slots" tab.

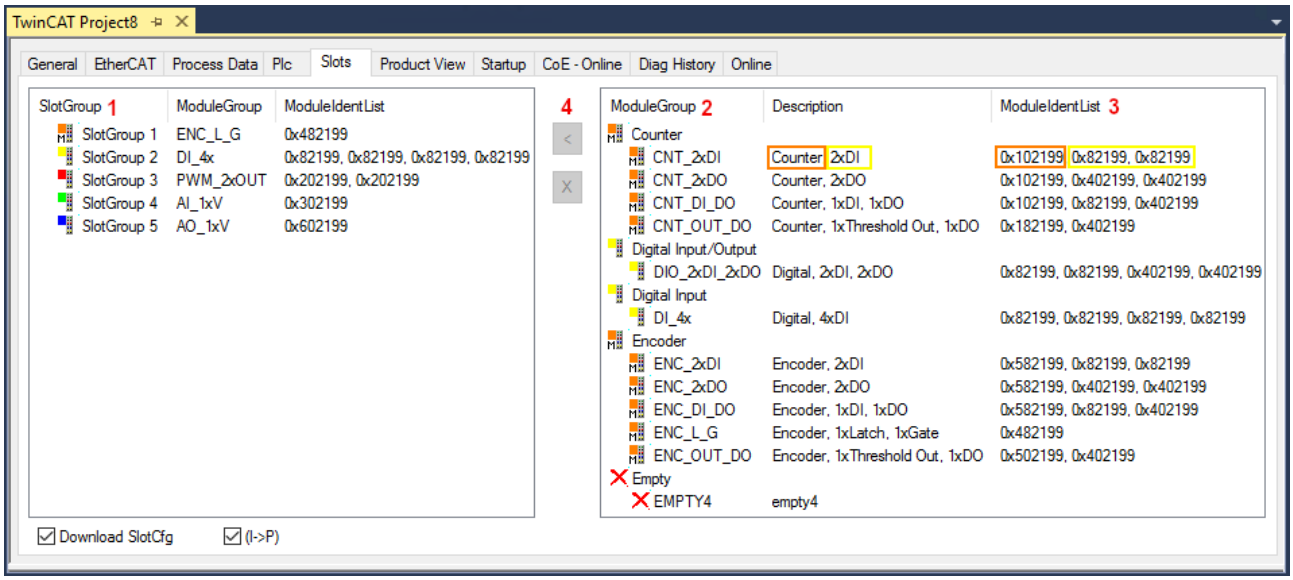


Fig. 18: Configuration in the "Slots" tab using an EL8601-8411 as example

1. The operating mode is defined for each "**SlotGroup**" by assigning a maximum of one "ModuleGroup". When the "SlotGroup" is selected in the left-hand field, the "ModuleGroups" available for this "SlotGroup" with the associated "Modules" are displayed in the right-hand field.
2. **"ModuleGroups"** describe the possible combinations of the individual "Modules". In this way, the configuration of invalid combinations can be excluded. The operation mode of the group is explained in short form in the "Description" section.
3. Each **"Module"** has a defined **"ModuleIdent"** number that is fixed to an operation mode and the corresponding process data and CoE objects.
   In the "ModuleIdentList", all "ModuleIdents" of a "ModuleGroup" are displayed according to the frequency of their use (see Fig. above CNT_2xDI).
4. Each SlotGroup must be assigned exactly one "ModuleGroup" using the **"<" (assign)** and **"X" (remove)** buttons.
   ⇨ The process data and the CoE objects are automatically adjusted according to the selected "ModuleGroup", in the respective SlotGroup.
   ⇨ In the TwinCAT "Product View" tab, the pin assignment is displayed according to the configuration (see chapter Connections in the "Product View" tab).

Notes on configuration with the modules/slots procedure

- The TwinCAT system must be in "ConfigMode"  to perform the configuration.
- If a "SlotGroup" is to be operated without function, the "ModuleGroup" "Empty" must be selected. A "SlotGroup" without an assigned "ModuleGroup" is not allowed.
- If the configuration is changed, the settings in the Setting objects of the changed "ModuleGroups" are reset to the factory settings.
- To reset the product to the delivery state (factory settings), the "PreOP" state is required before the "Restore default parameters" object is used.

4.2 PWM (Real) – ModuleIdent 0x1009C8

The pulse width and frequency of a 5…24 V DC binary signal with a maximum load capacity of 1.5 A can be changed via the digital **p**ulse **w**idth **m**odulation output (PWM).

✓ Prerequisite: A SlotGroup must be assigned a ModuleGroup that contains the ModuleIdent 0x1009C8 “PWM Output Duty Cycle, Frequency”.

1. In “PWM (Real)“” operation mode, the process data are specified as floating-point variables, REAL32 PDO:
   the duty cycle via “PWM Duty Cycle” and
   the frequency via “PWM Frequency”.

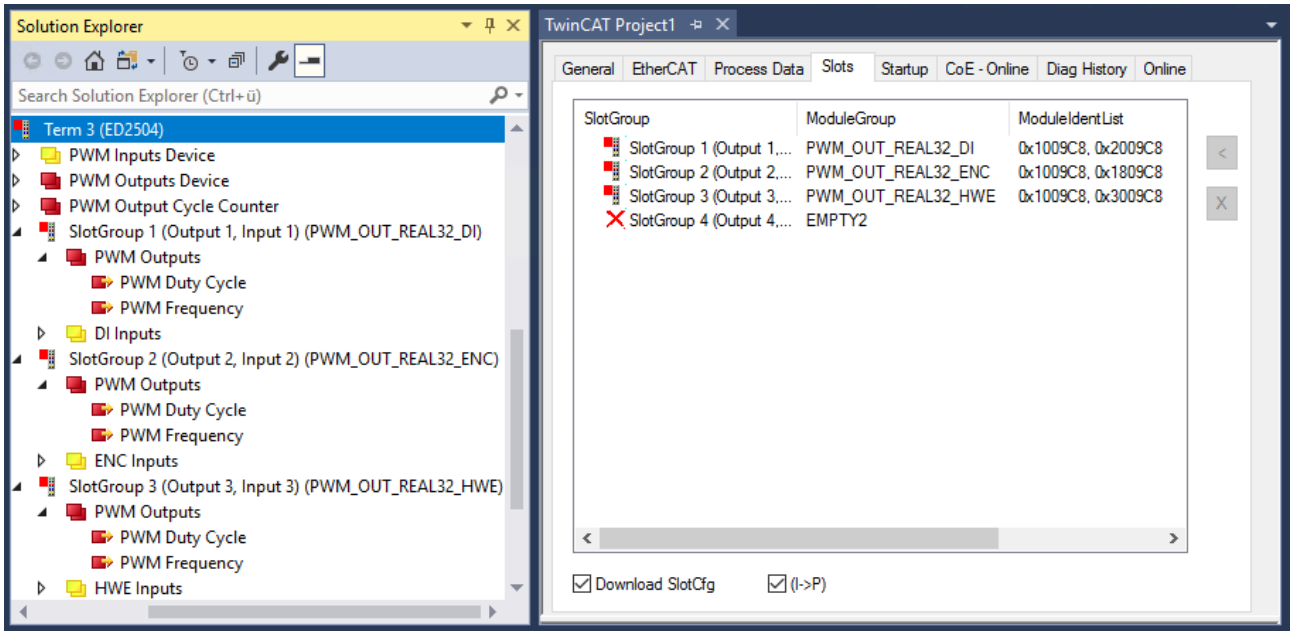


Fig. 19: Module/slot assignment with process data in “PWM (Real)” operation mode

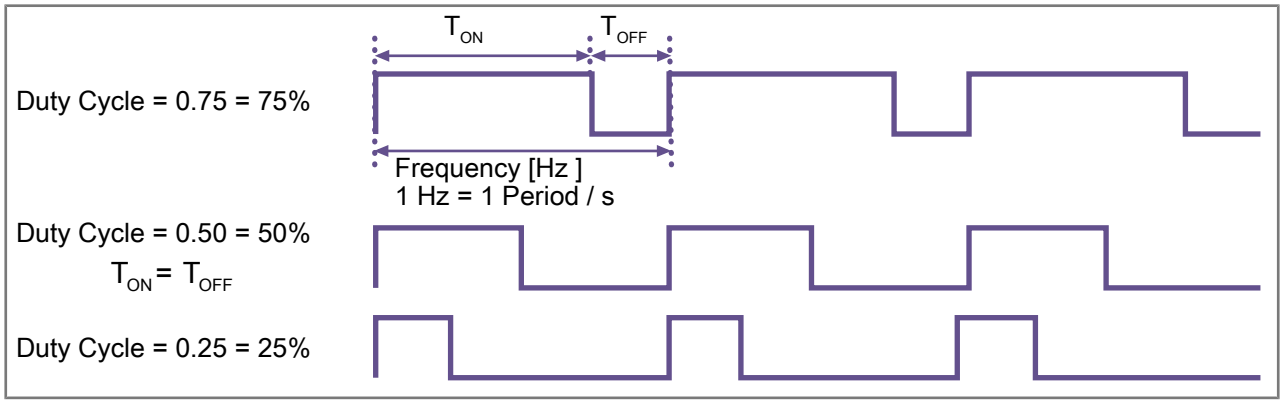


Fig. 20: Setting the duty cycle, shown for 25%, 50%, and 75%

4.2.1 Configuring PWM outputs | ModuleIdent 0x1009C8

The following section describes the parameterization of the PWM outputs.

Changing the duty cycle | “PWM Duty Cycle” process data value

- The duty cycle for the PWM output can be set separately for each channel and adjusted cyclically.
- The value is expressed as [0…100%]. The pulse pause is calculated automatically as the difference from a 100% pulse duration. The following relationships apply:

PWM Duty Cycle	Duty Cycle in %
0.1	10%
0.5	50%
1	100%

Changing the output frequency | “PWM Frequency” process data value

- The output frequency of the PWM signal can be specified in Hz using the “PWM Frequency” process data value and can be changed cyclically.
- The resolution of the output signal depends on the specified frequency or period. This can be read for each channel in index 0x80nE:01, “Timer Resolution”.
- Value range 1 Hz…64,000 Hz

NOTICE

Specifying invalid duty cycle and frequency values

If the specified duty cycle or frequency value is outside the valid output range, then

- the specification is rejected,
- a diagnostic message is output:
  0x461B “Slot group n: Invalid duty cycle written”,
  0x461A “Slot Group n Invalid frequency/period written”,
- the maximum permissible value is output.

Output signal range

The following table shows the valid range of values for the output signal.

Output signal range	
Pulse duration | T_{ON}	typ. > 320 ns
Pulse duration | T_{OFF}	typ. > 320 ns
Output frequency	1 Hz…64 kHz

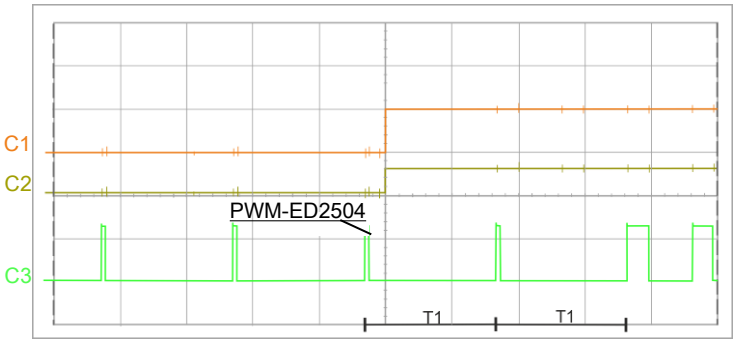
4.2.1.1 Applying new duty cycle and/or frequency values

Two options are available for applying new duty cycle and/or frequency values:

1. **Applying new values in the default setting (see Example 1)**
   In the default setting, new process data specifications for “PWM Duty Cycle” and “PWM Frequency” are applied only after the currently running period has elapsed and one additional full period has passed. This prevents distortion of the output signal, ensuring that no glitches occur.
2. **Applying new values with low latency in 1-channel mode (see Example 2)**
   In 1-channel mode, the cyclic update of new values (“PWM Duty Cycle”, “PWM Frequency”) is supported with low latency. In this case, the value is applied after the currently running period has elapsed; no additional full period is waited for.
   To do this, the following parameterizations are required:
   - ⇨ Select the desired configuration for SlotGroup 1.
   - ⇨ Select an “Empty” module in SlotGroup 2, SlotGroup 3, and SlotGroup 4. As a result, channels 2, 3, and 4 are no longer functional.
   - ⇨ In the CoE directory, set:
     0xF817:01 “Enable Low Latency Output Slot 1” = TRUE.

Example 1: 0xF817:01 “Enable Low Latency Output Slot 1” = FALSE (default)

New process data values (“PWM Duty Cycle”, “PWM Frequency”) are applied once the current period has ended and another period has elapsed.

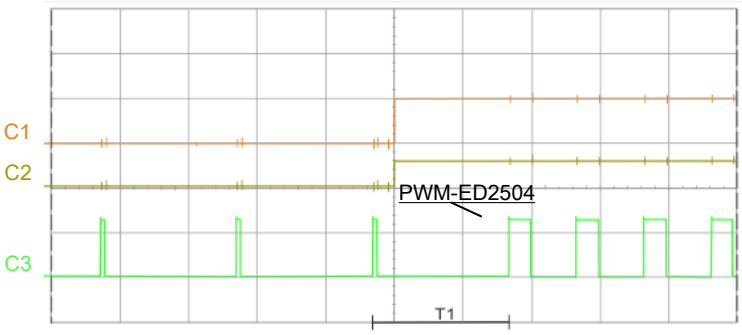


- "PWM Duty Cycle" = new duty cycle value
- "PWM frequency" = new period value
- "Enable Low Latency Output Slot 1" = FALSE

Fig. 21: Diagram “Enable Low Latency Output Slot1” = FALSE (default)

Example 2: “Enable Low Latency Output Slot 1” = TRUE, application with low latency

New process data values (“PWM Duty Cycle”, “PWM Frequency”) are applied immediately after the current period ends.



- "PWM Duty Cycle" = new duty cycle value
- "PWM frequency" = new period value
- "Enable Low Latency Output Slot 1" = TRUE

Fig. 22: Diagram “Enable Low Latency Output Slot1” = TRUE

Legend for the figures in the examples shown above:

C1: Specification of the frequency using the “PWM Frequency” process data value
C2: Specification of the duty cycle using the “PWM Duty Cycle” process data value
C3: PWM signal output on channel 1

4.2.2 Setting the PWM state in the event of a watchdog trigger

The watchdog behavior can be configured for the following cases:

1. in the event of a bus error [▶ 35] via index 0x80n0:05 “Watchdog”
2. in the event of PLC inactivity [▶ 37], via index 0x80n0:0C “Enable Output Cycle Counter Watchdog”

A loss of supply voltages is not a watchdog event

Please note that the loss of supply voltages via the E-bus, the power contacts, and the externally supplied voltage does not represent a watchdog event.

Notes on the switching behavior of the outputs

- **With an inductive load:**
  The switching behavior of the output with inductive loads deviates from the specified switching times due to the inductance of the selected load.
- **In tristate mode:**
  Internal circuit causes a leakage current in tristate mode, which pulls the potential toward ground. This corresponds to a pull-down resistance in the range of typically < 4 kOhm.
- **When switching via a PLC variable**:
  If the output is switched via a PLC variable, the delays caused by the PLC cycle time must also be taken into account in addition to the T_{ON}/T_{OFF}.

⚠ CAUTION

Watchdog settings

Changes to the watchdog settings can lead to unwanted system behavior or damage to devices.

- Observe the information in the chapter “Notes on watchdog settings” in the EtherCAT system documentation before making any changes to the watchdog settings!

4.2.2.1 Watchdog behavior in case of a bus error

The setting in index 0x80n0:05 “Watchdog” defines how the output should assume a safe state in the event of a bus error. The following table shows the available settings.

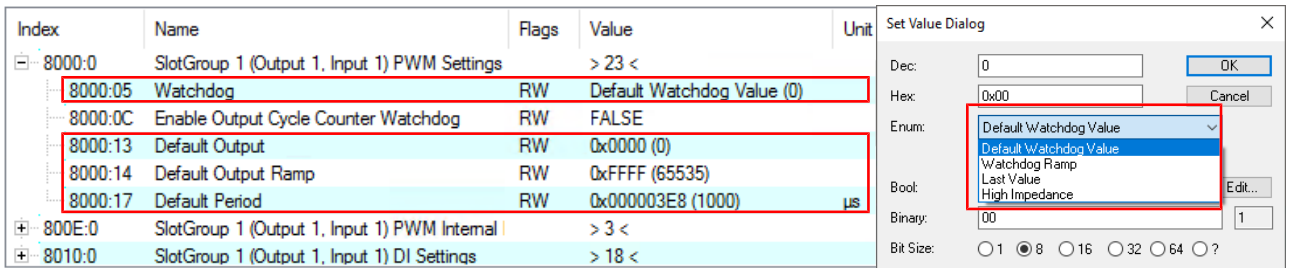


Fig. 23: PWM watchdog settings in case of a bus error

Desired state of the output in the event of a bus error	Specification in 0x80n0:05 “Watchdog” (n = 0 for PWM1, n = 2 for PWM2, n = 4 for PWM3, n = 6 for PWM4)
set to specified value	**0: “Default Watchdog Value” (default setting)** • The duty cycle value specified for the output in the “PWM Duty Cycle” process data value is set to the value defined in index 0x80n0:13 “Default Output”. • The frequency value specified for the output in the “PWM Frequency“” process data value is set to the value defined in index 0x80n0:17 “Default Period”. ***Notice*** **Please note that the values must be specified as integer variables (see the following example).** 0x80n0:13 “Default Output”: 0_{hex} (0_{dec}) corresponds to a 0% duty cycle $7FFF_{hex}$ ($32{,}767_{dec}$) corresponds to a 50% duty cycle $FFFF_{hex}$ ($65{,}535_{dec}$) corresponds to a 100% duty cycle 0x80n0:17 “Default Period”: $3E8_{hex}$ (1000_{dec}) µs corresponds to 1 kHz
set to specified value via ramp [▶ 36]	**1: “Watchdog ramp”** Using the ramp defined in index 0x80n0:14 “Default Output Ramp” (linear change [digit/ms]) • the duty cycle value specified for the output in the “PWM Duty Cycle” process data value is set to the value defined in index 0x80n0:13 “Default Output”. • the frequency value specified for the output in the “PWM Frequency” process data value is switched to the value defined in index 0x80n0:17 “Default Period”.
Retain current value	**2: Last value** The output retains the current state.
Switch to high-resistance (Tristate [▶ 36])	**3: “High impedance”** The output is switched to high-impedance.

NOTICE

Apply watchdog settings for power supply units that can be configured via EtherCAT

- If a power supply unit that can be configured via EtherCAT is used for the external power supply – for example, an EL9501 power supply terminal (0…20 V DC, 0…2 A) – the settings on this power supply unit must also be configured according to the requirements.

⇨ If no external power is supplied in the event of a bus error, no output voltage is generated.

Ramp

You can define the time to reach the default value when the watchdog behavior is set to the value 1 "Watchdog ramp".

$$t = \frac{|n_{current} - n_{default}|}{v_{ramp}}$$

t: time in ms until the default value is reached.

$n_{current}$: the last output value that was received by the controller before the communication interruption.

$n_{default}$: default value (CoE parameter 0x80n0:13).

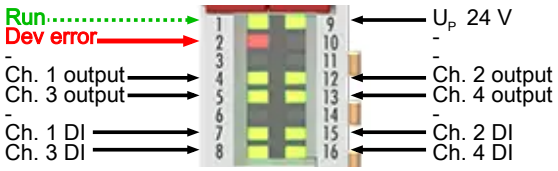
v_{ramp} : ramp velocity in digits/ms (CoE parameter 0x80n0:14).

Tristate

In the event of a bus error, the output can be switched to a tristate state, actively to 24 V and high-impedance. The high-resistance tristate state ensures that the respective output behaves as if it were not connected. This means that the outputs of other outputs/devices connected to this output are not affected. The associated output takes on the same output voltage as the other active devices.

Diagnostics in case of bus error

The triggering of the watchdog event is indicated by:

LED 1: “Run”, LED 2: “Dev error”	Process data	DiagMessages “ ” when communication is resumed
“Run” blinks, “Dev error” lights up red 	–	Text ID: 0x8114 Output Cycle Counter watchdog has triggered Text ID: 0x8105 PD watchdog has triggered

4.2.2.2 Watchdog behavior when the PLC is inactive

The PWM outputs can also adopt the behavior defined in index 0x80n0:05, “Watchdog”, when the PLC is inactive or when there is no communication with the PLC or communication with the PLC is faulty. This is also the case, for example, when the PLC is restarted if the device is already in the OP state but the PLC is not yet providing valid data. Proceed as follows:

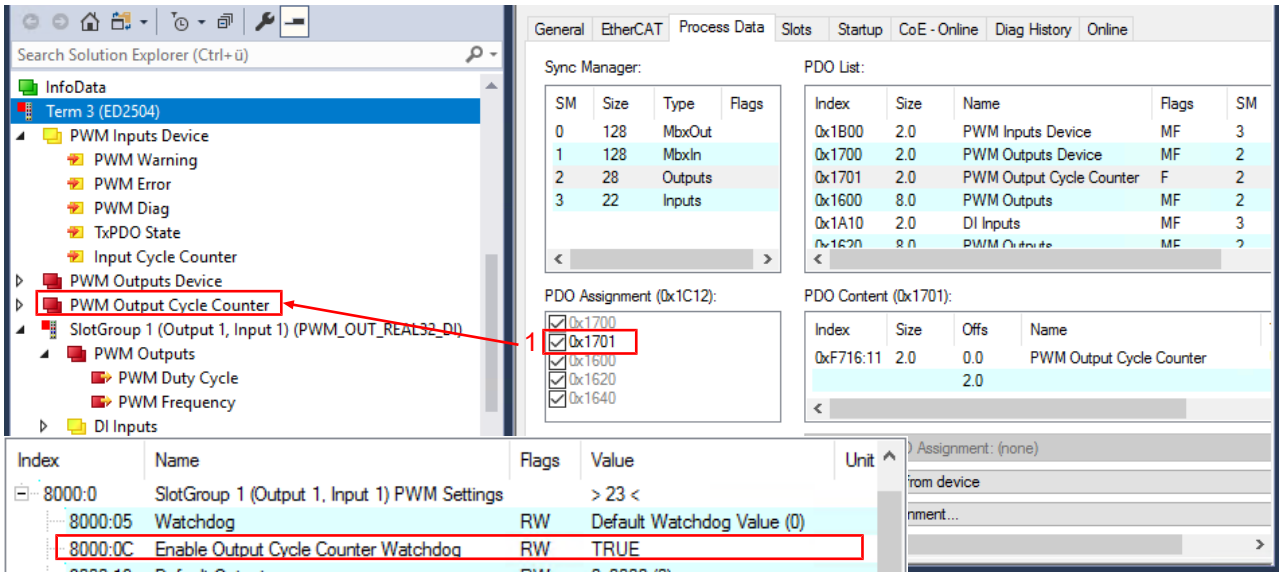


Fig. 24: PWM watchdog settings when the PLC is inactive

1. To enable the optional PDO 0x1701 “PWM Output Cycle Counter”, select SM2 on the “Process Data” tab and enable the PDO in the “PDO Assignment (0x1C12)” field.
   ⇨ The additional PDO “PWM Output Cycle Counter” appears in the output data. It is a 16 bit counter and is available once for the entire device.
2. Cyclic incrementation of the “PWM Output Cycle Counter” process data value
   If this PDO is enabled, the variable must be incremented cyclically by +1 from the control. The variable overflow is handled by the device.
3. Channel-by-channel activation of “Output Cycle Counter” monitoring via the CoE directory
   index 0x80n0:0C “Enable Output Cycle Counter Watchdog” = TRUE
   ⇨ The device is now monitoring the “PWM Output Cycle Counter” counter.
   ⇨ If the object: 0x80n0:0C “Enable Ouput Cycle Counter Watchdog” is set to TRUE without first activating the PDO “PWM Output Cycle Counter”, this is displayed as a warning in the DiagMessages: DiagMessage,
   Text ID: “0x4110 Output Cycle Counter watchdog activated without a mapped PDO”
4. The watchdog event is triggered if there is no change in the counter within the PD watchdog time (default 100 ms).
   ⇨ For all channels with active output cycle counter monitoring (0x80n0:0C = TRUE), the behavior defined for the respective channel at index 0x80n0:05 “Watchdog” (see the chapter “Watchdog behavior in case of a bus error [▶ 35]”).

NOTICE

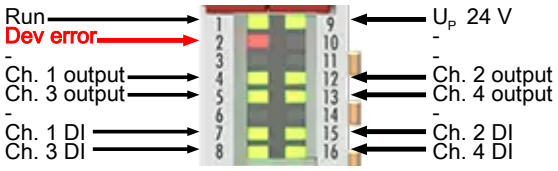
Notes on watchdog behavior when the PLC is inactive

- **Enabling/disabling monitoring**
  Monitoring can be disabled using the object 0x80n0:0C
  “Enable Ouput Cycle Counter Watchdog” = FALSE. This should be used, for example, during maintenance work.
- **Index 0x80n0:05 “Watchdog” = “Last Value (2)” when the PLC is stopped**
  When the PLC is stopped, the output data is set to “0”. This value is valid for the process data of the PWM outputs “PWM Duty Cycle” and “PWM Frequency”. If “Watchdog” = “Last Value (2)” is selected for the watchdog behavior in index 0x80n0:05,

  ⇨ the PWM output drops to 0 in the event of a watchdog.

Diagnostics for an inactive PLC

The triggering of a watchdog event – for example, due to an inactive PLC – is indicated by:

LED 2: “Dev error”	Process data	DiagMessages
“Dev error” lights up red  	The number of events that have occurred can be read from the error counter: 0xFA16:16 “Output Cycle Counter Error”.	Text ID: 0x8114 Output Cycle Counter watchdog has triggered

4.3 PWM (Integer) - ModuleIdent 0x809C8, 0x3809C8

The pulse width and frequency of a 5…24 V DC binary signal with a maximum load capacity of 1.5 A can be changed via the digital **p**ulse **w**idth **m**odulation output (PWM). This operation mode is used in the EL2502 product group and is therefore referred to as the “legacy” operation mode.

✓ Prerequisite: A SlotGroup must be assigned a ModuleGroup that contains the ModuleIdent 0x809C8/0x3809C8 “PWM Output Pulse Width, Period (INT16/32 Legacy)”.

1. In “PWM (Integer)” operation mode, the process data are specified as integer variables, INT16 or INT32-PDO
   ⇨ The pulse width or duty cycle via “PWM Output” and
   ⇨ The period (equal to 1/frequency) via “PWM Period” (INT16) or “PWM Period 1Hz” (INT32)

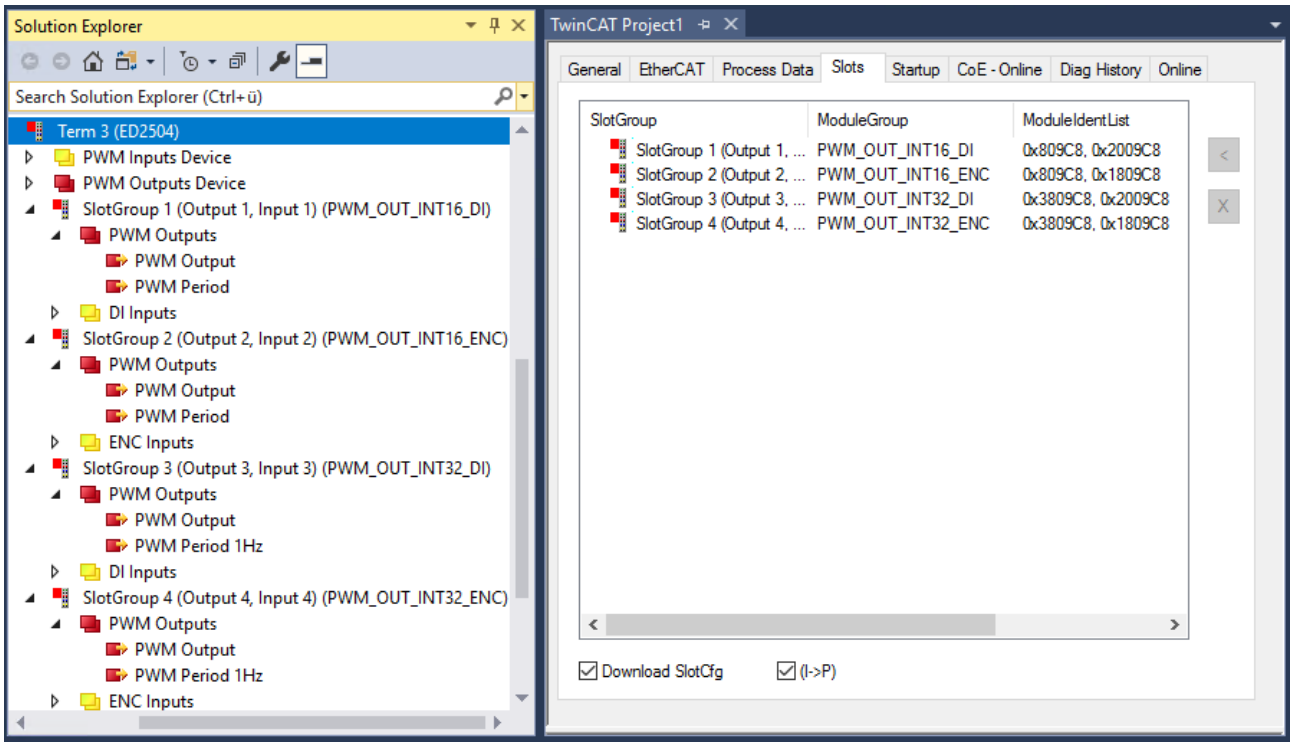


Fig. 25: Module/slot assignment with process data in “PWM (Integer)” operation mode

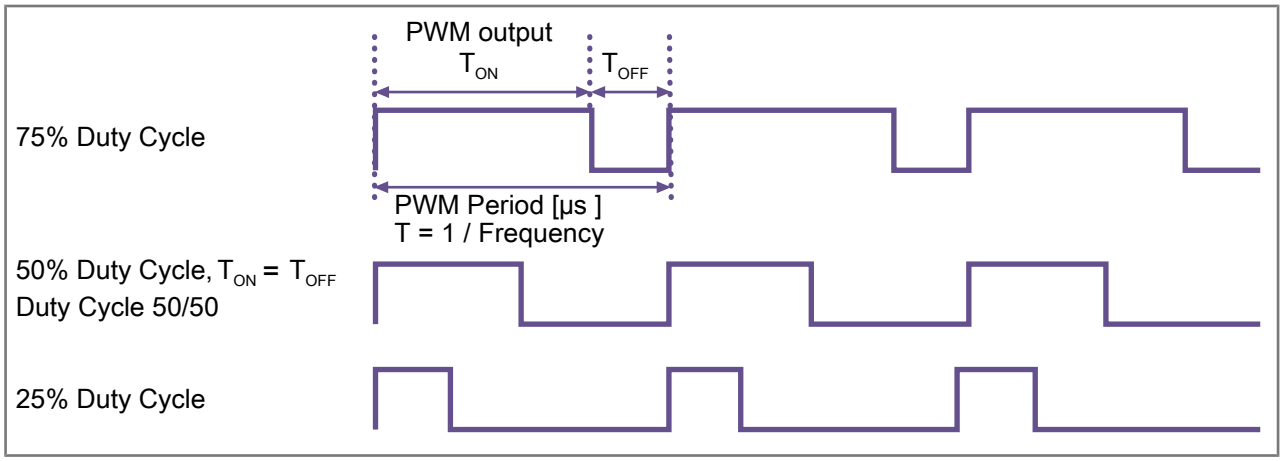


Fig. 26: Setting pulse-pause ratio using the example of duty cycle 25%, 50%, and 75%

4.3.1 Parameterizing PWM outputs | ModuleIdent 0x809C8, 0x3809C8

The outputs can be parameterized as follows by setting the pulse width "PWM output" [▶ 40] and the period value "PWM period" [▶ 41].

4.3.1.1 Specifying the pulse width | "PWM Output" process data value

To change the duty cycle
(T_{ON}/T_{OFF}) [0…100%], the valid value range can be set using the parameters
Presentation [▶ 40] (0x80n0:02) and
User Scale [▶ 40] ("Enable User Scale"/0x80n0:01 "Offset" 0x80n0:11/"Gain" 0x80n0:12)

Index	Name	Flags	Value	Unit
8000:0	SlotGroup 1 (Output 1, Input 1) PWM Settings		> 23 <	
8000:01	Enable User Scale	RW	TRUE	
8000:02	Presentation	RW	Signed Presentation (0)	
8000:05	Watchdog	RW	Default Watchdog Value (0)	
8000:0C	Enable Output Cycle Counter Watchdog	RW	FALSE	
8000:11	Offset	RW	0	
8000:12	Gain	RW	65536	
8000:13	Default Output	RW	0x0000 (0)	
8000:14	Default Output Ramp	RW	0xFFFF (65535)	
8000:17	Default Period	RW	0x000003E8 (1000)	µs

Fig. 27: "PWM output" duty cycle settings

Presentation (0x80n0:02)

Duty cycle	"PWM output"	
	0x80n0:02 "Presentation" = 0: Signed (default)	0x80n0:02 "Presentation" = 1: Unsigned
0%	0_{hex} (0_{dec})	0_{hex} (0_{dec})
50%	$3FFF_{hex}$ ($16,383_{dec}$)	$7FFF_{hex}$ (32767_{dec})
100%	$7FFF_{hex}$ ($32,767_{dec}$)	$FFFF_{hex}$ ($65,535_{dec}$)
(n = 0 for PWM1, n = 2 for PWM2, n = 4 for PWM3, n = 6 for PWM4)		

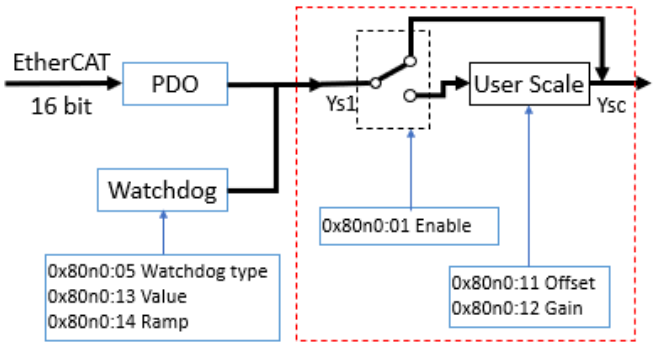
User scaling ("Offset" 0x80n0:11 / "Gain" 0x80n0:12)

- **Value range without user scale in the factory setting (default)**
  User scale is not enabled in the factory setting ("Enable user scale" = FALSE). No further user scale settings (0x80n0:12 "Gain"/0x80n0:11 "Offset") are required.
  Value range: 0 ... $FFFF_{hex}$ (65535_{dec}) for 0 ... 100% duty cycle
- **Set the value range via the user scale (see block diagram)**
  - Enable user scale via index 0x80n0:01 "Enable user scale"
  - Set the desired value range via 0x80n0:11 "Offset" and 0x80n0:12 "Gain".

With:
Gain = 0x80n0:12 "User scale Gain"
Offset = 0x80n0:11 "User scale Offset"

Is the influence of user scale:

active: Ysc = Ys1 * Gain*2^{-16} + Offset
inactive: Ysc = Ys1



4.3.1.2 Specifying the period | “PWM period” process data value

The period of the output can be specified, which corresponds to a frequency setting. The period is specified using the “PWM period” process data value in units of 1 µs.

The resolution of the output signal depends on the specified frequency or period. This can be read for each channel in index 0x80nE:01, “Timer resolution”.

The following table shows the valid range of values based on the selected ModuleIdent.

ModuleIdent	Description	Valid value range for “PWM period”	
0x809C8	PWM, Output Pulse Width, Period (INT16 Legacy)	10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz	$FFFF_{hex}$ ($65,535_{dec}$) 65.565 ms corresponds to 15 Hz
0x3809C8	PWM, Output Pulse Width, Period (INT32 Legacy)	10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz	$F4240_{hex}$ ($1,000,000_{dec}$) 1 s corresponds to 1 Hz

The following table shows examples for setting the period (1/frequency) within the valid value range.

Desired period (frequency)	Setting via the “PWM period” process data value	
1,000,000 µs (1 Hz)	$F4240_{hex}$	$1,000,000_{dec}$
50,000 µs (20 Hz)	$C350_{hex}$	$50,000_{dec}$
10,000 µs (100 Hz)	2710_{hex}	$10,000_{dec}$
1,000 µs (1 kHz)	$03E8_{hex}$	$1,000_{dec}$
16 µs (62.5 kHz)	10_{hex}	16_{dec}

NOTICE

Specifying invalid period values

If the specified period values are outside the valid output range

- the specification is rejected,
- a diagnostic message is output:
  0x461A “Slot Group n: Invalid frequency/period written”,
- the maximum permissible value is output.

4.3.2 Setting the PWM state in the event of a watchdog trigger

The watchdog behavior can be configured for the following cases:

1. in the event of a bus error [▶ 43] via index 0x80n0:05 “Watchdog”
2. in the event of PLC inactivity [▶ 45], via index 0x80n0:0C “Enable Output Cycle Counter Watchdog”

A loss of supply voltages is not a watchdog event

Please note that the loss of supply voltages via the E-bus, the power contacts, and the externally supplied voltage does not represent a watchdog event.

Notes on the switching behavior of the outputs

- **With an inductive load:**
  The switching behavior of the output with inductive loads deviates from the specified switching times due to the inductance of the selected load.
- **In tristate mode:**
  Internal circuit causes a leakage current in tristate mode, which pulls the potential toward ground. This corresponds to a pull-down resistance in the range of typically < 4 kOhm.
- **When switching via a PLC variable**:
  If the output is switched via a PLC variable, the delays caused by the PLC cycle time must also be taken into account in addition to the T_{ON}/T_{OFF}.

⚠ CAUTION

Watchdog settings

Changes to the watchdog settings can lead to unwanted system behavior or damage to devices.

- Observe the information in the chapter “Notes on watchdog settings” in the EtherCAT system documentation before making any changes to the watchdog settings!

4.3.2.1 Watchdog behavior in case of a bus error | Index 0x80n:05 “Watchdog”

The setting in index 0x80n0:05 “Watchdog” defines how the output should assume a safe state in the event of a bus error. The following table shows the available settings.

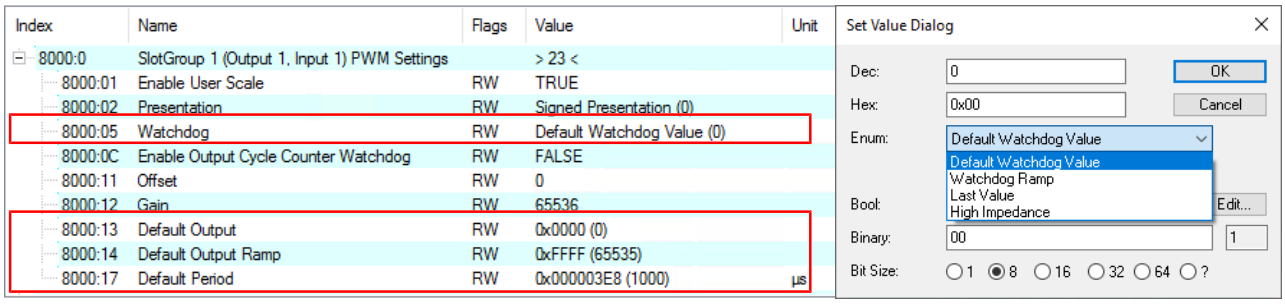


Fig. 28: PWM watchdog settings

Desired state of the output in the event of a bus error	Specification in 0x80n0:05 “Watchdog” (n = 0 for PWM1, n = 2 for PWM2, n = 4 for PWM3, n = 6 for PWM4)
set to specified value	**0: Default watchdog value** • The specified pulse width “PWM Output”” of the output is set to the value defined in index 0x80n0:13 “Default Output”. • The period specified for the “PWM Period” process data value is set to the value defined in index 0x80n0:17 “Default Period”.
set to specified value via ramp [▶ 44]	**1: Watchdog ramp** • The specified pulse width “PWM Output” of the output is switched to the value specified in index 0x80n0:13 “Default Output Ramp” via the ramp defined in index 0x80n0:14 “Default Output” (linear change [digit/ms]). • The period specified for the “PWM Period” process data value is set to the value defined in index 0x80n0:17 “Default Period”.
Retain current value	**2: Last value** The output retains the current state.
Switch to high-resistance (Tristate [▶ 44])	**3: “High impedance”** The output is switched to high-impedance.

NOTICE

Apply watchdog settings for power supply units that can be configured via EtherCAT

- If a power supply unit that can be configured via EtherCAT is used for the external power supply – for example, an EL9501 power supply terminal (0…20 V DC, 0…2 A) – the settings on this power supply unit must also be configured according to the requirements.

⇨ If no external power is supplied in the event of a bus error, no output voltage is generated.

Ramp

You can define the time to reach the default value when the watchdog behavior is set to the value 1 "Watchdog ramp".

$$t = \frac{|n_{current} - n_{default}|}{v_{ramp}}$$

t: time in ms until the default value is reached.

$n_{current}$: the last output value that was received by the controller before the communication interruption.

$n_{default}$: default value (CoE parameter 0x80n0:13).

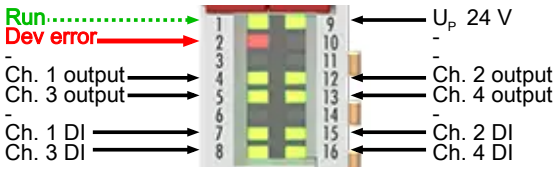
v_{ramp} : ramp velocity in digits/ms (CoE parameter 0x80n0:14).

Tristate

In the event of a bus error, the output can be switched to a tristate state, actively to 24 V and high-impedance. The high-resistance tristate state ensures that the respective output behaves as if it were not connected. This means that the outputs of other outputs/devices connected to this output are not affected. The associated output takes on the same output voltage as the other active devices.

Diagnostics in case of bus error

The triggering of the watchdog event is indicated by:

LED 1: “Run”, LED 2: “Dev error”	Process data	DiagMessages “ ” when communication is resumed
“Run” blinks, “Dev error” lights up red 	–	Text ID: 0x8114 Output Cycle Counter watchdog has triggered Text ID: 0x8105 PD watchdog has triggered

4.3.2.2 Watchdog behavior when the PLC is inactive

The PWM outputs can also adopt the behavior defined in index 0x80n0:05, “Watchdog”, when the PLC is inactive or when there is no communication with the PLC or communication with the PLC is faulty. This is also the case, for example, when the PLC is restarted if the device is already in the OP state but the PLC is not yet providing valid data. Proceed as follows:

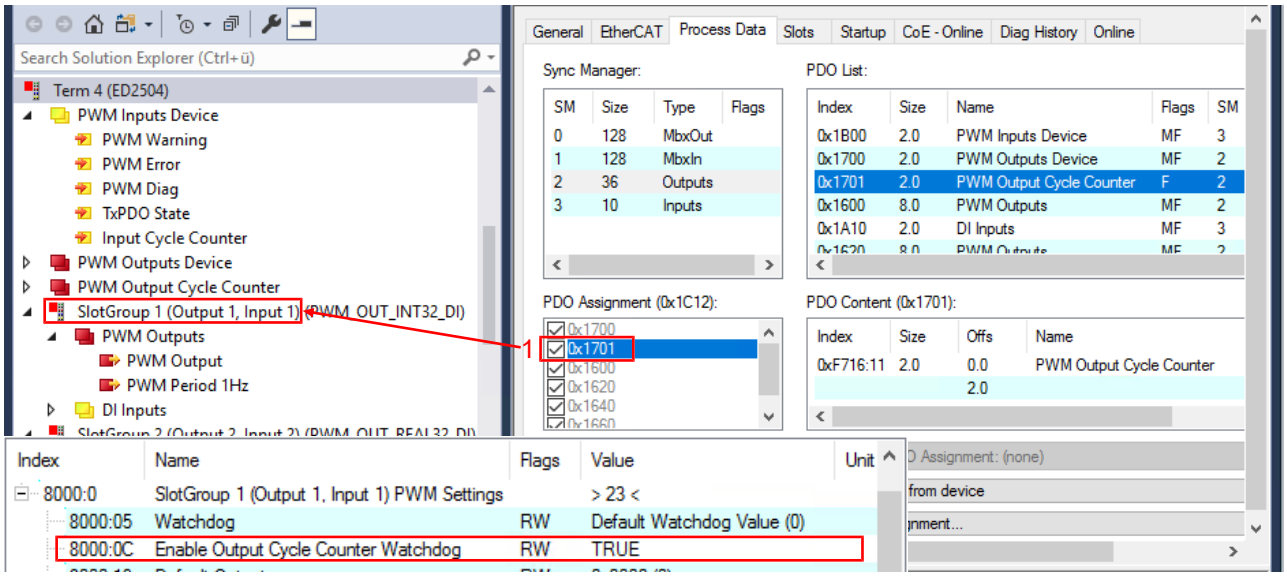


Fig. 29: PWM watchdog settings when the PLC is inactive

1. To enable the optional PDO 0x1701 “PWM Output Cycle Counter”, select SM2 on the “Process Data” tab and enable the PDO in the “PDO Assignment (0x1C12)” field.
   ⇨ The additional PDO “PWM Output Cycle Counter” appears in the output data. It is a 16 bit counter and is available once for the entire device.
2. Cyclic incrementation of the “PWM Output Cycle Counter” process data value
   If this PDO is enabled, the variable must be incremented cyclically by +1 from the control. The variable overflow is handled by the device.
3. Channel-by-channel activation of “Output Cycle Counter” monitoring via the CoE directory index 0x80n0:0C “Enable Output Cycle Counter Watchdog” = TRUE
   ⇨ The device is now monitoring the “PWM Output Cycle Counter” counter.
   ⇨ If the object: 0x80n0:0C “Enable Ouput Cycle Counter Watchdog” is set to TRUE without first activating the PDO “PWM Output Cycle Counter”, this is displayed as a warning in the DiagMessages: DiagMessage,
   Text ID: “0x4110 Output Cycle Counter watchdog activated without a mapped PDO”
4. The watchdog event is triggered if there is no change in the counter within the PD watchdog time (default 100 ms).
   ⇨ For all channels with active output cycle counter monitoring (0x80n0:0C = TRUE), the behavior defined for the respective channel at index 0x80n0:05 “Watchdog” (see the chapter “Watchdog behavior in case of a bus error [▶ 43]”).

NOTICE

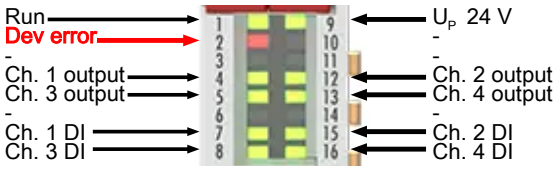
Notes on watchdog behavior when the PLC is inactive

- **Enabling/disabling monitoring**
  Monitoring can be disabled using the object 0x80n0:0C
  “Enable Ouput Cycle Counter Watchdog” = FALSE. This should be used, for example, during maintenance work.
- **Index 0x80n0:05 “Watchdog” = “Last Value (2)” when the PLC is stopped**
  When the PLC is stopped, the output data is set to “0”. This value is valid for the process data of the PWM outputs “PWM Output” and “PWM Period”/“PWM Period 1 Hz”. If “Watchdog” = “Last Value (2)” is selected for the watchdog behavior in index 0x80n0:05,

  ⇨ the PWM output drops to 0 in the event of a watchdog.

Diagnostics for an inactive PLC

The triggering of a watchdog event – for example, due to an inactive PLC – is indicated by:

LED 2: “Dev error”	Process data	DiagMessages
“Dev error” lights up red  	The number of events that have occurred can be read from the error counter: 0xFA16:16 “Output Cycle Counter Error”.	Text ID: 0x8114 Output Cycle Counter watchdog has triggered

4.4 Digital input - ModuleIdent 0x2009C8, 0x1809C8, 0x3009C8

4.4.1 “Digital input” | ModuleIdent 0x2009C8

The binary signal is output via the “Input” process data value.
The digital input module provides the following functions:

- Parameterizable input characteristics (0x80n0:11 “Input Type”)
- Parameterizable filter time (0x80n0:12 “Filter Time”)

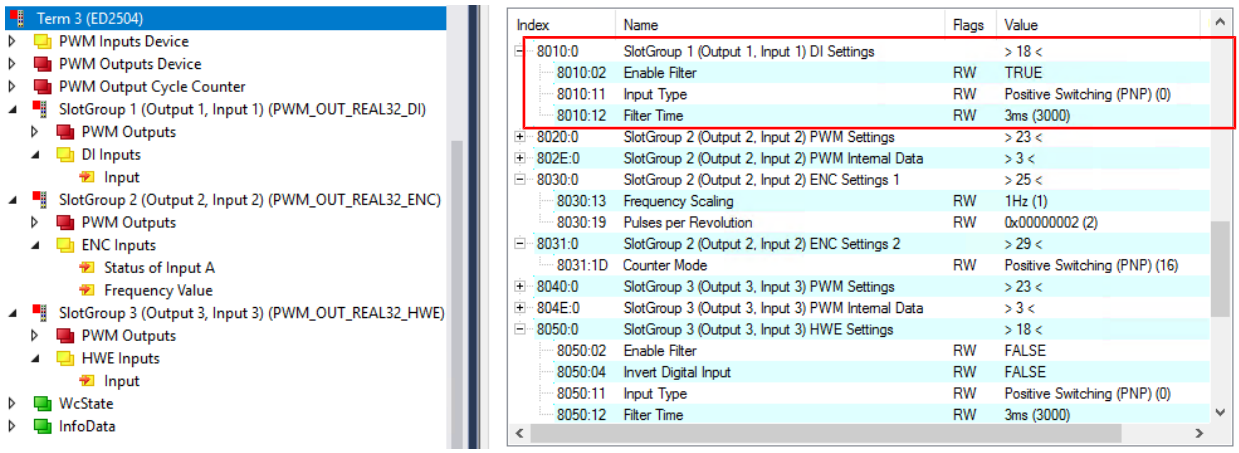


Fig. 30: Digital input settings

Parameterizable input characteristics

The digital input can be interpreted as having either a positive switching or ground switching characteristic. This is defined at 0x80n0:11 “Input Type” (n = 1 for DI 1, n = 3 for DI 2, n = 5 for DI 3, n = 7 for DI 4):

Standard digital | Positive switching	
0x80n0:11 „Input Type“	Positive Switching (PNP)
Signal voltage “0”	-3…+1.5 V DC
Signal voltage “1”	2.7…28 V DC

Standard digital | Ground switching	
0x80n0:11 „Input Type“	Ground Switching (NPN)
Signal voltage “0”	2.5…28 V DC
Signal voltage “1”	-3…+1 V DC
In this operation mode, an additional pull-up resistor is connected to V+.	

Sensors with open collector output circuits

A sensor with an open collector output circuit corresponds to the “Input Type”: “Ground Switching (NPN)”.

- In this context, the switching thresholds defined by the manufacturer must be observed to determine whether the input signal should be interpreted as “normally open” or “normally closed”.

Parameterizable filter time

The digital input module provides a parameterizable filter time. This can be used to suppress interference, such as bouncing of a switch signal. Signals with a pulse duration shorter than the set filter time are suppressed.

Filter function sequence

- The filter is enabled on delivery, index 0x80n0:02 “Enable Filter” = TRUE
- The filter is parameterized via index 0x8n0:12 “Filter Time”. The minimum pulse duration depends on the set software filter (see following table).
  Available filter times:

Index 0x80n0:12 “Filter Time”	Meaning
500_{dec}: 500 µs	Signals < 500 µs are suppressed
750_{dec}: 750 µs	Signals < 750 µs are suppressed
$1{,}000_{dec}$: 1 ms	Signals < 1 ms are suppressed
$3{,}000_{dec}$: 3 ms	Signals < 3 ms are suppressed (default)
$10{,}000_{dec}$: 10 ms	Signals < 10 ms are suppressed
$20{,}000_{dec}$: 20 ms	Signals < 20 ms are suppressed

- The filter is disabled by setting index 0x80n0:02 “Enable Filter” = FALSE. In this case, the input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.

4.4.2 “ENC input (frequency)” | ModuleIdent 0x1809C8

This module provides a frequency measurement. This information can also be used for speed or rotary speed measurement.

The following limit values apply to the determination of the measured values:

Measured value output	Lower measured value limit	Upper measured value limit
“Frequency Value“	1 Hz	1 kHz

The frequency module provides the following features:

- Parameterizable input characteristics
- Parameterizable frequency output

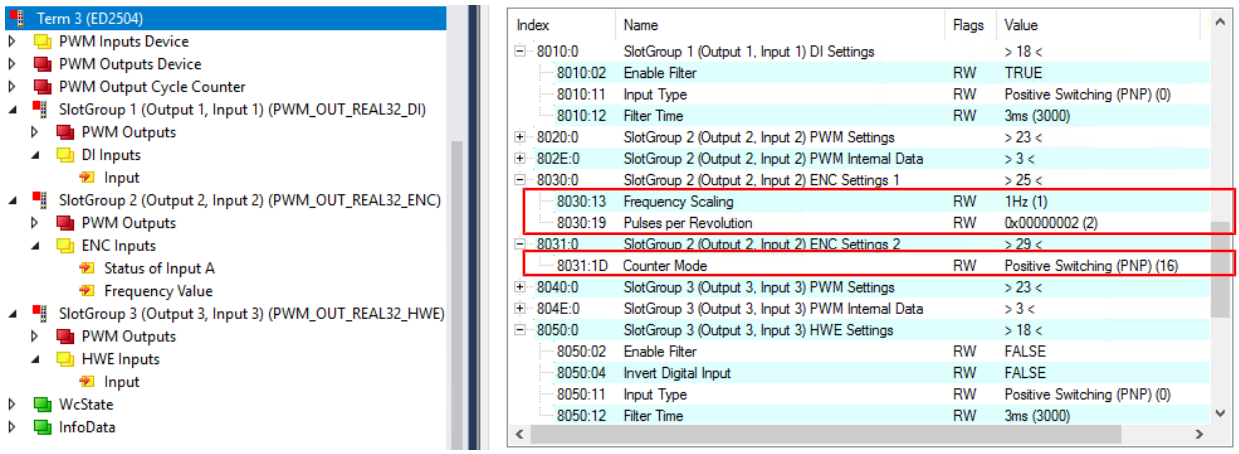


Fig. 31: Settings for the digital input for frequency measurement

Parameterizable input characteristics

The digital input can be interpreted as having a positive or ground switching characteristic.
This is defined under:
0x80n1:1D “Counter Mode” (n = 1 for ENC 1, n = 3 for ENC 2, n = 5 for ENC 3, n = 7 for ENC 4):

Measurement of frequency/rotary speed | Positive switching	
0x80n0:1D „Counter Mode“	Positive Switching (PNP)
Signal voltage “0”	-3…+1.5 V DC
Signal voltage “1”	2.7…28 V DC

Measurement of frequency/rotary speed | Ground switching	
0x80n0:1D „Counter Mode“	Ground Switching (NPN)
Signal voltage “0”	2.5…28 V DC
Signal voltage “1”	-3…+1 V DC
In this operation mode, an additional pull-up resistor is connected to V+.	

Sensors with open collector output circuits

A sensor with an open collector output circuit corresponds to the “Input Type”: “Ground Switching (NPN)”.

- In this context, the switching thresholds defined by the manufacturer must be observed to determine whether the input signal should be interpreted as “normally open” or “normally closed”.

Parameterizable frequency output (“Frequency value”)

- During frequency measurement, the time between two rising edges at the digital input is measured with a resolution of 40 µs.
- The last period within each PLC cycle is considered, and the corresponding reciprocal is calculated.
- “Frequency Scaling” (index 0x80n0:13) specifies the resolution of the output frequency.
  The default value is 1 Hz.
  The frequency can also be output in units of 0.1 Hz, 0.01 Hz, or 1 RPM.
- If “RPM” is chosen as the output, the number of expected pulses per revolution must also be specified in index 0x80n0:19 as “Pulses per Revolution”.
- In general, the following calculation rule is defined:

$$\text{Frequency value f [Hz]} = \frac{1}{\text{time of last period x Pulses per Revolution}}$$

$$\text{Frequency value f [RPM]} = \frac{60}{\text{time of last period x Pulses per Revolution}}$$

- If no full period is detected within a PLC cycle (two positive edges of input n), the last valid value is output.
- The measurement continues across cycles. As soon as a new value is available, the “Frequency Value” process data value is updated.
- If no full period is detected within 1.25 s, the measurement is discarded and the output in the “Frequency Value” process data value is set to the minimum value “0”.

4.4.3 “HWE input (hardware enable)” | ModuleIdent 0x3009C8

This module allows you to enable or disable the PWM output via the digital input.
The status of the binary signal is output via the “HWE Inputs - Input” process data value. The HWE input module provides the following features:

- Definition of the enable level for the digital input (0x80n0:04 “Invert Digital Input”)
- Parameterizable input characteristics [▶ 52] (0x80n0:11 “Input Type”)
- Parameterizable filter time [▶ 52] (0x80n0:12 “Filter Time”)

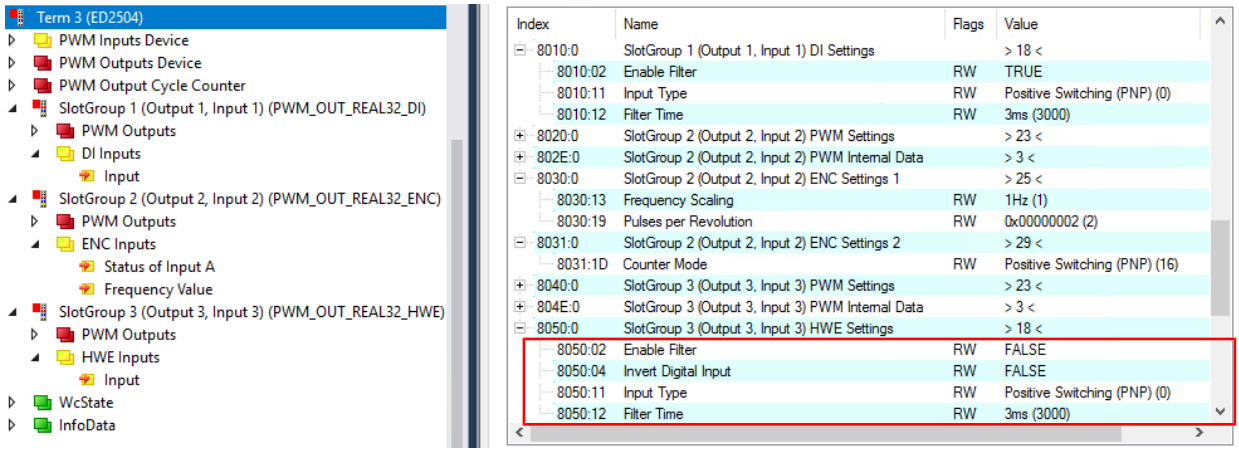


Fig. 32: Settings: Digital input with enable control for the PWM output (hardware enable)

Definition of the PWM output enable level

The PWM output of the respective channel can be enabled via the digital input “Hardware Enable”. Enable is triggered by a rising edge or a falling edge.

- By default, PWM output is enabled as long as the “Inputs” process data value is set to TRUE.
- The enable level can be inverted using the settings objects (0x80n0:04 “Invert Digital Input”)

0x80n0:04 “Invert Digital Input”	Status at the digital input, “HWE inputs – input”	Output of the PWM output signal
FALSE (default)	1 – TRUE	is enabled
	2 – FALSE	is disabled
TRUE	3 – TRUE	is disabled
	4 – FALSE	is enabled

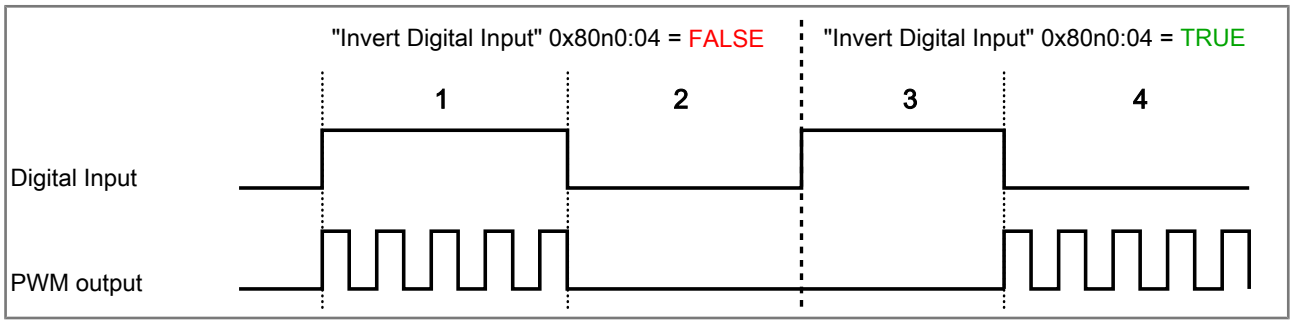


Fig. 33: Enabling the PWM output signal via 0x80n0:04 “Invert digital input”

NOTICE

“Hardware enable” input in case of bus error (watchdog)

The “Hardware Enable” input does not lose its functionality in the event of a bus error (watchdog). If the PWM output has been validly enabled prior to the bus error, this enable status remains in effect even during the bus error.

Parameterizable input characteristics

The digital input can be interpreted as having either a positive switching or ground switching characteristic. This is defined at 0x80n0:11 “Input Type” (n = 1 for DI 1, n = 3 for DI 2, n = 5 for DI 3, n = 7 for DI 4):

Standard digital | Positive switching	
0x80n0:11 „Input Type“	Positive Switching (PNP)
Signal voltage “0”	-3…+1.5 V DC
Signal voltage “1”	2.7…28 V DC

Standard digital | Ground switching	
0x80n0:11 „Input Type“	Ground Switching (NPN)
Signal voltage “0”	2.5…28 V DC
Signal voltage “1”	-3…+1 V DC
In this operation mode, an additional pull-up resistor is connected to V+.	

Sensors with open collector output circuits

A sensor with an open collector output circuit corresponds to the “Input Type”: “Ground Switching (NPN)”.

- In this context, the switching thresholds defined by the manufacturer must be observed to determine whether the input signal should be interpreted as “normally open” or “normally closed”.

Parameterizable filter time

The digital input module provides a parameterizable filter time. This can be used to suppress interference, such as bouncing of a switch signal. Signals with a pulse duration shorter than the set filter time are suppressed.

Filter function sequence

- The filter is enabled on delivery, index 0x80n0:02 “Enable Filter” = TRUE
- The filter is parameterized via index 0x8n0:12 “Filter Time”. The minimum pulse duration depends on the set software filter (see following table).
  Available filter times:

Index 0x80n0:12 “Filter Time”	Meaning
500_{dec}: 500 µs	Signals < 500 µs are suppressed
750_{dec}: 750 µs	Signals < 750 µs are suppressed
$1{,}000_{dec}$: 1 ms	Signals < 1 ms are suppressed
$3{,}000_{dec}$: 3 ms	Signals < 3 ms are suppressed (default)
$10{,}000_{dec}$: 10 ms	Signals < 10 ms are suppressed
$20{,}000_{dec}$: 20 ms	Signals < 20 ms are suppressed

- The filter is disabled by setting index 0x80n0:02 “Enable Filter” = FALSE. In this case, the input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.

4.5 Diagnostics

The following diagnostics options are available:

Hardware error diagnostics	Software error diagnostics
• Power supply monitoring: external power supply (infeed voltage) and Up • Exceeding the permissible output current • Short-circuit monitoring • Temperature monitoring	• Exceeding or falling below valid output values • Invalid module/slot configuration

4.5.1 Software error diagnostics

NOTICE

Specifying an invalid module/slot configuration

If invalid module combinations are configured within a SlotGroup, then

- the specification is rejected and
- the following diagnostic message is output: 0x81B5 “Invalid module and slot configuration”.

Please refer to the Overview of slots and ModuleGroups [▶ 29].

PWM (Real) | ModuleIdent 0x10098C

NOTICE

Specifying invalid duty cycle and frequency values

If the specified duty cycle or frequency value is outside the valid output range, then

- the specification is rejected,
- a diagnostic message is output:
  0x461B “Slot group n: Invalid duty cycle written”,
  0x461A “Slot Group n Invalid frequency/period written”,
- the maximum permissible value is output.

For more information, see the chaptersChanging the duty cycle | “PWM duty cycle” process data value [▶ 32] and “Changing the output frequency | “PWM Frequency” process data value [▶ 32]”.

PWM (Integer) | ModuleIdent 0x8098C, 0x38098C

NOTICE

Specifying invalid period values

If the specified period values are outside the valid output range

- the specification is rejected,
- a diagnostic message is output:
  0x461A “Slot Group n: Invalid frequency/period written”,
- the maximum permissible value is output.

Please refer to the chapter “Specifying the period | “PWM period” process data value [▶ 41]”

4.5.2 Hardware error diagnostics

Hardware errors are logged via a collective diagnostic.
The warning and error thresholds can be found in object 0xF816, “PWM Vendor Data”.
The CoE object 0xFA16 “PWM Diag Data” displays the currently measured values.
Error messages are displayed via the “Dev Error“-LED”, in the process data under “PWM Input Device” via the “PWM-Warning” and “PWM Error” bits, and via the DiagMessages [▶ 56] (see the following table).

Diagnostics	CoE values	Process data	DiagMessages
Dev error-LED lights up red			
Warning External supply voltage is too low	Currently measured value “External Supply Voltage” 0xFA16:13 < 4.75 V, warning threshold 0xF816:14 “External Supply Voltage Warning Level”	0xF616:06 “PWM Warning” = TRUE	0x4601 Warning External supply undervoltage
Warning Overtemperature	Currently measured value “PCB Temperature” 0xFA16:12 > 80.0°C, warning threshold 0xF816:12 “PCB Temperature Warning Level”		–
Error External supply voltage is too low/missing	Currently measured value “External Supply Voltage” 0xFA16:13 < 4.5 V, error threshold 0xF816:15 “External Supply Voltage Error Level”	0xF616:07 “PWM Error” = TRUE	0x8601 Error External supply undervoltage
Error Overtemperature	Currently measured value “PCB Temperature” 0xFA16:12 > 100.0°C, error threshold 0xF816:13 “PCB Temperature Error Level”		–
Error Supply voltage Up is too low or missing	No supply voltage or insufficient supply voltage “Up Supply voltage available” 0xFA16:03 = FALSE		0x810B Error Undervoltage Up
Error Output hardware error Possible causes: - Overcurrent - Short circuit - Undervoltage - Overtemperature	–		0x8144 Error Output hardware error (Trigger a reset to clear the error)
The Dev error-LED is not lit			
There are no warnings or error messages.	The values are within the acceptable range.	0xF616:06 “PWM Warning” = FALSE, 0xF616:07 “PWM Error” = FALSE	–

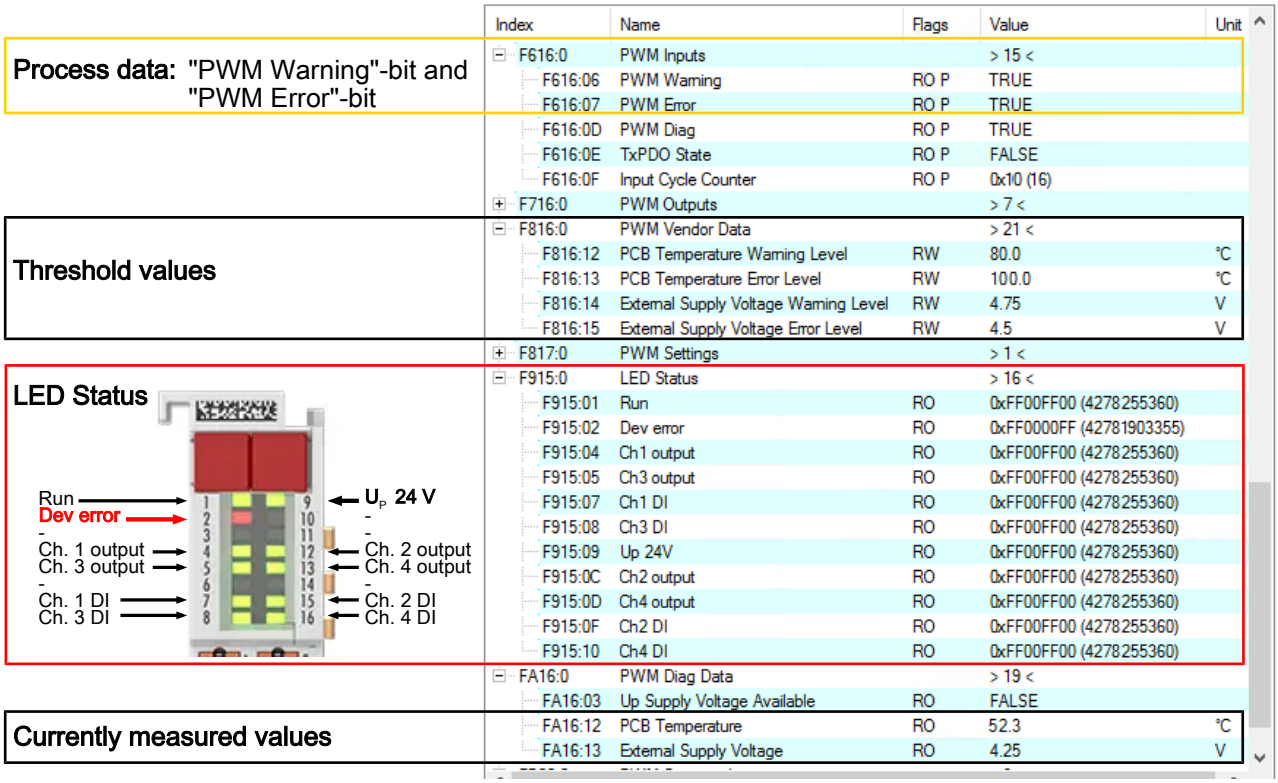


Fig. 34: Hardware error diagnostics

4.5.3 Reading the LED Status via CoE | 0xF915

The status of the LEDs can be read electronically via CoE object 0xF915:0. The status of the LEDs is displayed as a 32-bit value. The value is interpreted as follows.

- Byte 1 indicates the flashing/lighting code with
  - 0x00: LED off
  - 0x01 to 0x82: flashing codes
  - 0xFF: LED on
- Byte 4 (R), byte 3 (G) to byte 2 (B) specify the color as an RGB code.

Byte 1 (flashing code)	Byte 2 blue (B)	Byte 3 green (G)	Byte 4 red (R)	Meaning
0x00	00	00	00	LED not present
0x00	FF	00	00	LED is off (blue)
0x00	00	FF	00	LED is off (green) • Run LED: EtherCAT State Machine: **INIT** • Signal LED: No signal at the input/output
0x00	00	00	FF	LED is off (red) • Error LED: No error at the input/output
0x00	00	FF	FF	LED is off (yellow)
0x00	FF	FF	FF	LED is off (white)
0x01 to 0x14	00	FF	00	LED flashes at 1 Hz to 20 Hz (green)
0x80	00	FF	00	Run LED flashing uniformly (green): EtherCAT State Machine: **PREOP**
0x81	00	FF	00	Run LED flashing slowly (green): EtherCAT State Machine: **SAFEOP**
0x82	00	FF	00	Run LED flashing quickly (green): EtherCAT State Machine: **BOOT**
0xFF	FF	00	00	LED is on (blue)
0xFF	00	FF	00	LED on (green) • Run LED: EtherCAT State Machine: **OP** • Signal LED: Signal at the input/output
0xFF	00	00	FF	LED is on (red) • Error LED: Error at input/output
0xFF	00	FF	FF	LED is on (yellow)
0xFF	FF	FF	FF	LED is on (white)

LED status using the ED2504 EtherCAT Terminal as an example

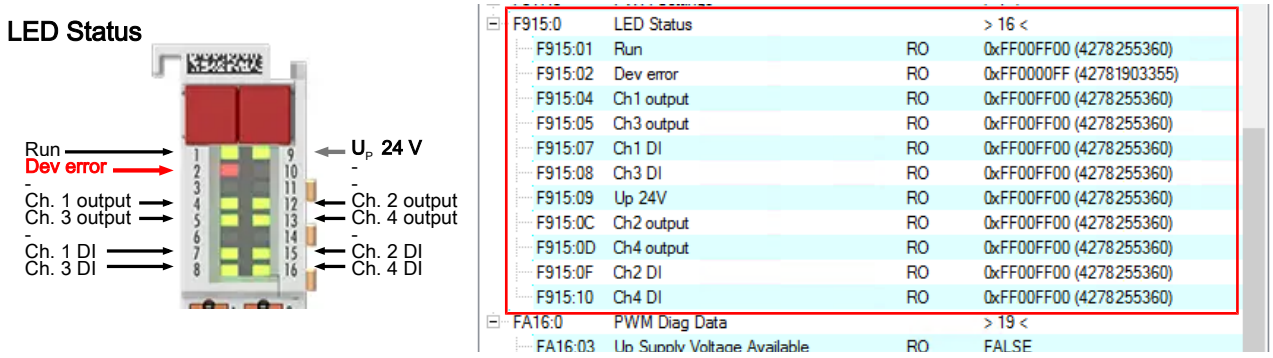


Fig. 35: ED2504 LED display with the corresponding CoE values in index 0xF915:0

4.5.4 Diagnostics - basic principles of diag messages

DiagMessages designates a system for the transmission of messages from the EtherCAT Slave to the EtherCAT Master/TwinCAT. The messages are stored by the device in its own CoE under 0x10F3 and can be read by the application or the System Manager. An error message referenced via a code is output for each event stored in the device (warning, error, status change).

Definition

The *DiagMessages* system is defined in the ETG (EtherCAT Technology Group) in the guideline ETG.1020, chapter 13 “Diagnosis handling”. It is used so that pre-defined or flexible diagnostic messages can be conveyed from the EtherCAT Slave to the Master. In accordance with the ETG, the process can therefore be implemented supplier-independently. Support is optional. The firmware can store up to 250 DiagMessages in its own CoE.

Each DiagMessage consists of

- Diag Code (4-byte)
- Flags (2-byte; info, warning or error)
- Text ID (2-byte; reference to explanatory text from the ESI/XML)
- Timestamp (8-byte, local slave time or 64-bit Distributed Clock time, if available)
- Dynamic parameters added by the firmware

The DiagMessages are explained in text form in the ESI/XML file belonging to the EtherCAT device: on the basis of the Text ID contained in the DiagMessage, the corresponding plain text message can be found in the languages contained in the ESI/XML. In the case of Beckhoff products these are usually German and English.

Via the entry *NewMessagesAvailable* the user receives information that new messages are available.

DiagMessages can be confirmed in the device: the last/latest unconfirmed message can be confirmed by the user.

In the CoE both the control entries and the history itself can be found in the CoE object 0x10F3:

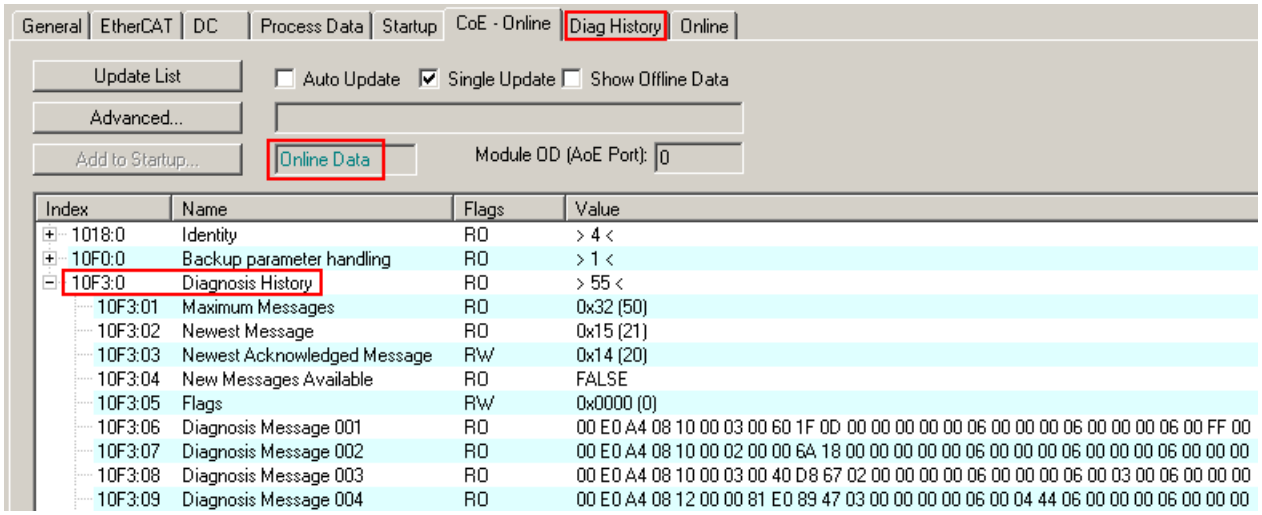


Fig. 36: DiagMessages in the CoE

The subindex of the latest *DiagMessage* can be read under 0x10F3:02.

Support for commissioning

The DiagMessages system is to be used above all during the commissioning of the plant. The diagnostic values e.g. in the StatusWord of the device (if available) are helpful for online diagnosis during the subsequent continuous operation.

TwinCAT System Manager implementation

From TwinCAT 2.11 DiagMessages, if available, are displayed in the device's own interface. Operation (collection, confirmation) also takes place via this interface.

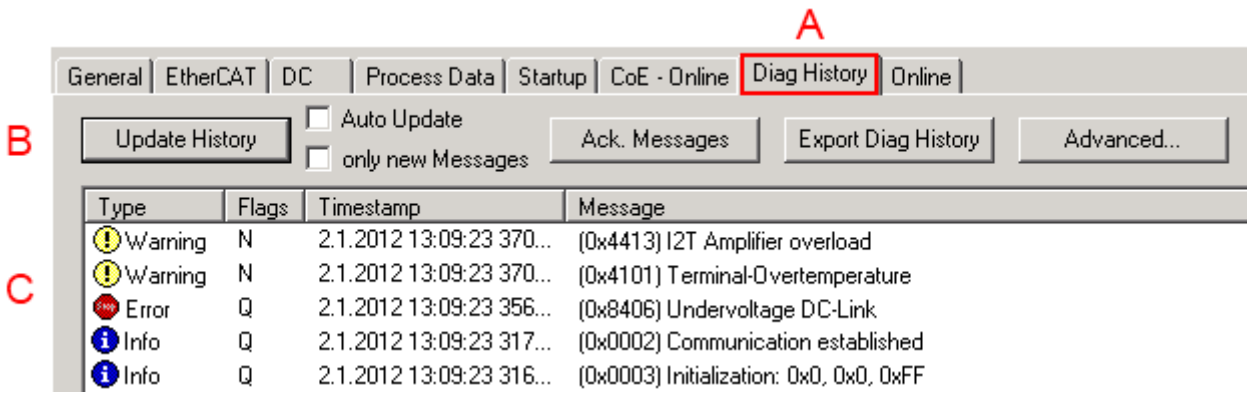


Fig. 37: Implementation of the DiagMessage system in the TwinCAT System Manager

The operating buttons (B) and the history read out (C) can be seen on the Diag History tab (A). The components of the message:

- Info/Warning/Error
- Acknowledge flag (N = unconfirmed, Q = confirmed)
- Time stamp
- Text ID
- Plain text message according to ESI/XML data

The meanings of the buttons are self-explanatory.

DiagMessages within the ADS Logger/Eventlogger

From TwinCAT 3.1 build 4022 onwards, DiagMessages sent by the terminal are shown by the TwinCAT ADS Logger. Given that DiagMessages are represented IO- comprehensive at one place, commissioning will be simplified. In addition, the logger output could be stored into a data file – hence DiagMessages are available long-term for analysis.

DiagMessages are actually only available locally in CoE 0x10F3 in the terminal and can be read out manually if required, e.g. via the DiagHistory mentioned above.

In the latest developments, the EtherCAT Terminals are set by default to report the presence of a DiagMessage as emergency via EtherCAT; the event logger can then retrieve the DiagMessage. The function is activated in the terminal via 0x10F3:05, so such terminals have the following entry in the StartUp list by default:

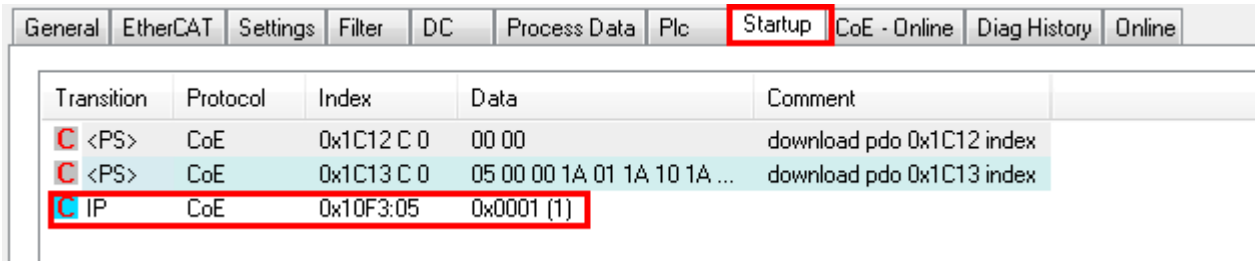


Fig. 38: Startup List

If the function is to be deactivated because, for example, many messages come in or the EventLogger is not used, the StartUp entry can be deleted or set to 0. The value can then be set back to 1 later from the PLC via CoE access if required.

Reading messages into the PLC

- In preparation -

Interpretation

Time stamp

The time stamp is obtained from the local clock of the terminal at the time of the event. The time is usually the distributed clock time (DC) from register x910.

Please note: When EtherCAT is started, the DC time in the reference clock is set to the same time as the local IPC/TwinCAT time. From this moment the DC time may differ from the IPC time, since the IPC time is not adjusted. Significant time differences may develop after several weeks of operation without a EtherCAT restart. As a remedy, external synchronization of the DC time can be used, or a manual correction calculation can be applied, as required: The current DC time can be determined via the EtherCAT master or from register x901 of the DC slave.

Structure of the Text ID

The structure of the MessageID is not subject to any standardization and can be supplier-specifically defined. In the case of Beckhoff EtherCAT devices (EL, EP) it usually reads according to **xyzz**:

x	y	zz
0: Systeminfo 2: reserved 1: Info 4: Warning 8: Error	0: System 1: General 2: Communication 3: Encoder 4: Drive 5: Inputs 6: I/O general 7: reserved	Error number

Example: Message 0x4413 --> Drive Warning Number 0x13

Overview of text IDs

Specific text IDs are listed in the device documentation.

Text ID	Type	Place	Text Message	Additional comment
0x0001	Information	System	No error	No error
0x0002	Information	System	Communication established	Connection established
0x0003	Information	System	Initialization: 0x%X, 0x%X, 0x%X	General information; parameters depend on event. See device documentation for interpretation.
0x1000	Information	System	Information: 0x%X, 0x%X, 0x%X	General information; parameters depend on event. See device documentation for interpretation.
0x1012	Information	System	EtherCAT state change Init - PreOp	
0x1021	Information	System	EtherCAT state change PreOp - Init	
0x1024	Information	System	EtherCAT state change PreOp - Safe-Op	
0x1042	Information	System	EtherCAT state change SafeOp - PreOp	
0x1048	Information	System	EtherCAT state change SafeOp - Op	
0x1084	Information	System	EtherCAT state change Op - SafeOp	
0x1100	Information	General	Detection of operation mode completed: 0x%X, %d	Detection of the mode of operation ended
0x1135	Information	General	Cycle time o.k.: %d	Cycle time OK
0x1157	Information	General	Data manually saved (Idx: 0x%X, SubIdx: 0x%X)	Data saved manually
0x1158	Information	General	Data automatically saved (Idx: 0x%X, SubIdx: 0x%X)	Data saved automatically
0x1159	Information	General	Data deleted (Idx: 0x%X, SubIdx: 0x%X)	Data deleted
0x117F	Information	General	Information: 0x%X, 0x%X, 0x%X	Information
0x1201	Information	Communication	Communication re-established	Communication to the field side restored This message appears, for example, if the voltage was removed from the power contacts and re-applied during operation.
0x1300	Information	Encoder	Position set: %d, %d	Position set - StartInputhandler
0x1303	Information	Encoder	Encoder Supply ok	Encoder power supply unit OK
0x1304	Information	Encoder	Encoder initialization successfully, channel: %X	Encoder initialization successfully completed
0x1305	Information	Encoder	Sent command encoder reset, channel: %X	Send encoder reset command
0x1400	Information	Drive	Drive is calibrated: %d, %d	Drive is calibrated
0x1401	Information	Drive	Actual drive state: 0x%X, %d	Current drive status
0x1705	Information		CPU usage returns in normal range (< 85%%)	Processor load is back in the normal range
0x1706	Information		Channel is not in saturation anymore	Channel is no longer in saturation
0x1707	Information		Channel is not in overload anymore	Channel is no longer overloaded
0x170A	Information		No channel range error anymore	A measuring range error is no longer active
0x170C	Information		Calibration data saved	Calibration data were saved
0x170D	Information		Calibration data will be applied and saved after sending the command “0x5AFE”	Calibration data are not applied and saved until the command "0x5AFE" is sent.

Text ID	Type	Place	Text Message	Additional comment
0x2000	Information	System	%s: %s	
0x2001	Information	System	%s: Network link lost	Network connection lost
0x2002	Information	System	%s: Network link detected	Network connection found
0x2003	Information	System	%s: no valid IP Configuration - Dhcp client started	Invalid IP configuration
0x2004	Information	System	%s: valid IP Configuration (IP: %d.%d.%d.%d) assigned by Dhcp server %d.%d.%d.%d	Valid IP configuration, assigned by the DHCP server
0x2005	Information	System	%s: Dhcp client timed out	DHCP client timeout
0x2006	Information	System	%s: Duplicate IP Address detected (%d.%d.%d.%d)	Duplicate IP address found
0x2007	Information	System	%s: UDP handler initialized	UDP handler initialized
0x2008	Information	System	%s: TCP handler initialized	TCP handler initialized
0x2009	Information	System	%s: No more free TCP sockets available	No free TCP sockets available.

Text ID	Type	Place	Text Message	Additional comment
0x4000	Warning		Warning: 0x%X, 0x%X, 0x%X	General warning; parameters depend on event. See device documentation for interpretation.
0x4001	Warning	System	Warning: 0x%X, 0x%X, 0x%X	
0x4002	Warning	System	%s: %s Connection Open (IN:%d OUT:%d API:%dms) from %d.%d.%d.%d successful	
0x4003	Warning	System	%s: %s Connection Close (IN:%d OUT:%d) from %d.%d.%d.%d successful	
0x4004	Warning	System	%s: %s Connection (IN:%d OUT:%d) with %d.%d.%d.%d timed out	
0x4005	Warning	System	%s: %s Connection Open (IN:%d OUT:%d) from %d.%d.%d.%d denied (Error: %u)	
0x4006	Warning	System	%s: %s Connection Open (IN:%d OUT:%d) from %d.%d.%d.%d denied (Input Data Size expected: %d Byte(s) received: %d Byte(s))	
0x4007	Warning	System	%s: %s Connection Open (IN:%d OUT:%d) from %d.%d.%d.%d denied (Output Data Size expected: %d Byte(s) received: %d Byte(s))	
0x4008	Warning	System	%s: %s Connection Open (IN:%d OUT:%d) from %d.%d.%d.%d denied (RPI:%dms not supported -> API:%dms)	
0x4101	Warning	General	Terminal-Overtemperature	Overtemperature. The internal temperature of the terminal exceeds the parameterized warning threshold.
0x4102	Warning	General	Discrepancy in the PDO-Configuration	The selected PDOs do not match the set operating mode. Sample: Drive operates in velocity mode, but the velocity PDO is but not mapped in the PDOs.
0x417F	Warning	General	Warning: 0x%X, 0x%X, 0x%X	
0x428D	Warning	General	Challenge is not Random	
0x4300	Warning	Encoder	Subincrements deactivated: %d, %d	Sub-increments deactivated (despite activated configuration)
0x4301	Warning	Encoder	Encoder-Warning	General encoder error
0x4302	Warning	Encoder	Maximum frequency of the input signal is nearly reached (channel %d)	
0x4303	Warning	Encoder	Limit counter value was reduced because of the PDO configuration (channel %d)	
0x4304	Warning	Encoder	Reset counter value was reduced because of the PDO configuration (channel %d)	
0x4400	Warning	Drive	Drive is not calibrated: %d, %d	Drive is not calibrated
0x4401	Warning	Drive	Starttype not supported: 0x%X, %d	Start type is not supported
0x4402	Warning	Drive	Command rejected: %d, %d	Command rejected
0x4405	Warning	Drive	Invalid modulo subtype: %d, %d	Modulo sub-type invalid
0x4410	Warning	Drive	Target overrun: %d, %d	Target position exceeded
0x4411	Warning	Drive	DC-Link undervoltage (Warning)	The DC link voltage of the terminal is lower than the parameterized minimum voltage. Activation of the output stage is prevented.
0x4412	Warning	Drive	DC-Link overvoltage (Warning)	The DC link voltage of the terminal is higher than the parameterized maximum voltage. Activation of the output stage is prevented.
0x4413	Warning	Drive	I2T-Model Amplifier overload (Warning)	• The amplifier is being operated outside the specification. • The I2T-model of the amplifier is incorrectly parameterized.
0x4414	Warning	Drive	I2T-Model Motor overload (Warning)	• The motor is being operated outside the parameterized rated values.

Text ID	Type	Place	Text Message	Additional comment
				• The I2T-model of the motor is incorrectly parameterized.
0x4415	Warning	Drive	Speed limitation active	The maximum speed is limited by the parameterized objects (e.g. velocity limitation, motor speed limitation). This warning is output if the set velocity is higher than one of the parameterized limits.
0x4416	Warning	Drive	Step lost detected at position: 0x%X%X	Step loss detected
0x4417	Warning	Drive	Motor overtemperature	The internal temperature of the motor exceeds the parameterized warning threshold
0x4418	Warning	Drive	Limit: Current	Limit: current is limited
0x4419	Warning	Drive	Limit: Amplifier I2T-model exceeds 100%%	The threshold values for the maximum current were exceeded.
0x441A	Warning	Drive	Limit: Motor I2T-model exceeds 100%%	Limit: Motor I2T-model exceeds 100%
0x441B	Warning	Drive	Limit: Velocity limitation	The threshold values for the maximum speed were exceeded.
0x441C	Warning	Drive	STO while the axis was enabled	An attempt was made to activate the axis, despite the fact that no voltage is present at the STO input.
0x4600	Warning	General IO	Wrong supply voltage range	Supply voltage not in the correct range
0x4610	Warning	General IO	Wrong output voltage range	Output voltage not in the correct range
0x4705	Warning		Processor usage at %d %%	Processor load at %d %%
0x470A	Warning		EtherCAT Frame missed (change Settings or DC Operation Mode or Sync0 Shift Time)	EtherCAT frame missed (change DC Operation Mode or Sync0 Shift Time under Settings)

Text ID	Type	Place	Text Message	Additional comment
0x8000	Error	System	%s: %s	
0x8001	Error	System	Error: 0x%X, 0x%X, 0x%X	General error; parameters depend on event. See device documentation for interpretation.
0x8002	Error	System	Communication aborted	Communication aborted
0x8003	Error	System	Configuration error: 0x%X, 0x%X, 0x%X	General; parameters depend on event. See device documentation for interpretation.
0x8004	Error	System	%s: Unsuccessful FwdOpen-Response received from %d.%d.%d.%d (%s) (Error: %u)	
0x8005	Error	System	%s: FwdClose-Request sent to %d.%d.%d.%d (%s)	
0x8006	Error	System	%s: Unsuccessful FwdClose-Response received from %d.%d.%d.%d (%s) (Error: %u)	
0x8007	Error	System	%s: Connection with %d.%d.%d.%d (%s) closed	
0x8100	Error	General	Status word set: 0x%X, %d	Error bit set in the status word
0x8101	Error	General	Operation mode incompatible to PDO interface: 0x%X, %d	Mode of operation incompatible with the PDO interface
0x8102	Error	General	Invalid combination of Inputs and Outputs PDOs	Invalid combination of input and output PDOs
0x8103	Error	General	No variable linkage	No variables linked
0x8104	Error	General	Terminal-Overtemperature	The internal temperature of the terminal exceeds the parameterized error threshold. Activation of the terminal is prevented
0x8105	Error	General	PD-Watchdog	Communication between the fieldbus and the output stage is secured by a Watchdog. The axis is stopped automatically if the fieldbus communication is interrupted. • The EtherCAT connection was interrupted during operation. • The Master was switched to Config mode during operation.
0x8135	Error	General	Cycle time has to be a multiple of 125 µs	The IO or NC cycle time divided by 125 µs does not produce a whole number.
0x8136	Error	General	Configuration error: invalid sampling rate	Configuration error: Invalid sampling rate
0x8137	Error	General	Electronic type plate: CRC error	Content of the external name plate memory invalid.
0x8140	Error	General	Sync Error	Real-time violation
0x8141	Error	General	Sync%X Interrupt lost	Sync%X Interrupt lost
0x8142	Error	General	Sync Interrupt asynchronous	Sync Interrupt asynchronous
0x8143	Error	General	Jitter too big	Jitter limit violation
0x817F	Error	General	Error: 0x%X, 0x%X, 0x%X	
0x8200	Error	Communication	Write access error: %d, %d	Error while writing
0x8201	Error	Communication	No communication to field-side (Auxiliary voltage missing)	• There is no voltage applied to the power contacts. • A firmware update has failed.
0x8281	Error	Communication	Ownership failed: %X	
0x8282	Error	Communication	To many Keys founded	
0x8283	Error	Communication	Key Creation failed: %X	
0x8284	Error	Communication	Key loading failed	
0x8285	Error	Communication	Reading Public Key failed: %X	
0x8286	Error	Communication	Reading Public EK failed: %X	
0x8287	Error	Communication	Reading PCR Value failed: %X	
0x8288	Error	Communication	Reading Certificate EK failed: %X	
0x8289	Error	Communication	Challenge could not be hashed: %X	
0x828A	Error	Communication	Tickstamp Process failed	
0x828B	Error	Communication	PCR Process failed: %X	
0x828C	Error	Communication	Quote Process failed: %X	
0x82FF	Error	Communication	Bootmode not activated	Boot mode not activated
0x8300	Error	Encoder	Set position error: 0x%X, %d	Error while setting the position

Text ID	Type	Place	Text Message	Additional comment
0x8301	Error	Encoder	Encoder increments not configured: 0x%X, %d	Encoder increments not configured
0x8302	Error	Encoder	Encoder error	The amplitude of the resolver is too small
0x8303	Error	Encoder	Encoder power missing (channel %d)	
0x8304	Error	Encoder	Encoder communication error, channel: %X	Encoder communication error
0x8305	Error	Encoder	EnDat2.2 is not supported, channel: %X	EnDat2.2 is not supported
0x8306	Error	Encoder	Delay time, tolerance limit exceeded, 0x%X, channel: %X	Runtime measurement, tolerance exceeded
0x8307	Error	Encoder	Delay time, maximum value exceeded, 0x%X, channel: %X	Runtime measurement, maximum value exceeded
0x8308	Error	Encoder	Unsupported ordering designation, 0x%X, channel: %X (only 02 and 22 is supported)	Wrong EnDat order ID
0x8309	Error	Encoder	Encoder CRC error, channel: %X	Encoder CRC error
0x830A	Error	Encoder	Temperature %X could not be read, channel: %X	Temperature cannot be read
0x830C	Error	Encoder	Encoder Single-Cycle-Data Error, channel. %X	CRC error detected. Check the transmission path and the CRC polynomial
0x830D	Error	Encoder	Encoder Watchdog Error, channel. %X	The sensor has not responded within a predefined time period
0x8310	Error	Encoder	Initialisation error	
0x8311	Error	Encoder	Maximum frequency of the input signal is exceeded (channel %d)	
0x8312	Error	Encoder	Encoder plausibility error (channel %d)	
0x8313	Error	Encoder	Configuration error (channel %d)	
0x8314	Error	Encoder	Synchronisation error	
0x8315	Error	Encoder	Error status input (channel %d)	
0x8400	Error	Drive	Incorrect drive configuration: 0x%X, %d	Drive incorrectly configured
0x8401	Error	Drive	Limiting of calibration velocity: %d, %d	Limitation of the calibration velocity
0x8402	Error	Drive	Emergency stop activated: 0x%X, %d	Emergency stop activated
0x8403	Error	Drive	ADC Error	Error during current measurement in the ADC
0x8404	Error	Drive	Overcurrent	Overcurrent in phase U, V or W
0x8405	Error	Drive	Invalid modulo position: %d	Modulo position invalid
0x8406	Error	Drive	DC-Link undervoltage (Error)	The DC link voltage of the terminal is lower than the parameterized minimum voltage. Activation of the output stage is prevented.
0x8407	Error	Drive	DC-Link overvoltage (Error)	The DC link voltage of the terminal is higher than the parameterized maximum voltage. Activation of the output stage is prevented.
0x8408	Error	Drive	I2T-Model Amplifier overload (Error)	• The amplifier is being operated outside the specification. • The I2T-model of the amplifier is incorrectly parameterized.
0x8409	Error	Drive	I2T-Model motor overload (Error)	• The motor is being operated outside the parameterized rated values. • The I2T-model of the motor is incorrectly parameterized.
0x840A	Error	Drive	Overall current threshold exceeded	Total current exceeded
0x8415	Error	Drive	Invalid modulo factor: %d	Modulo factor invalid
0x8416	Error	Drive	Motor overtemperature	The internal temperature of the motor exceeds the parameterized error threshold. The motor stops immediately. Activation of the output stage is prevented.
0x8417	Error	Drive	Maximum rotating field velocity exceeded	Rotary field speed exceeds the value specified for dual use (EU 1382/2014).
0x841C	Error	Drive	STO while the axis was enabled	An attempt was made to activate the axis, despite the fact that no voltage is present at the STO input.

Text ID	Type	Place	Text Message	Additional comment
0x8550	Error	Inputs	Zero crossing phase %X missing	Zero crossing phase %X missing
0x8551	Error	Inputs	Phase sequence Error	Wrong direction of rotation
0x8552	Error	Inputs	Overcurrent phase %X	Overcurrent phase %X
0x8553	Error	Inputs	Overcurrent neutral wire	Overcurrent neutral wire
0x8581	Error	Inputs	Wire broken Ch %D	Wire broken Ch %d
0x8600	Error	General IO	Wrong supply voltage range	Supply voltage not in the correct range
0x8601	Error	General IO	Supply voltage to low	Supply voltage too low
0x8602	Error	General IO	Supply voltage to high	Supply voltage too high
0x8603	Error	General IO	Over current of supply voltage	Overcurrent of supply voltage
0x8610	Error	General IO	Wrong output voltage range	Output voltage not in the correct range
0x8611	Error	General IO	Output voltage to low	Output voltage too low
0x8612	Error	General IO	Output voltage to high	Output voltage too high
0x8613	Error	General IO	Over current of output voltage	Overcurrent of output voltage
0x8700	Error		Channel/Interface not calibrated	Channel/interface not synchronized
0x8701	Error		Operating time was manipulated	Operating time was manipulated
0x8702	Error		Oversampling setting is not possible	Oversampling setting not possible
0x8703	Error		No slave controller found	No slave controller found
0x8704	Error		Slave controller is not in Bootstrap	Slave controller is not in bootstrap
0x8705	Error		Processor usage to high (>= 100%%)	Processor load too high (>= 100%%)
0x8706	Error		Channel in saturation	Channel in saturation
0x8707	Error		Channel overload	Channel overload
0x8708	Error		Overloadtime was manipulated	Overload time was manipulated
0x8709	Error		Saturationtime was manipulated	Saturation time was manipulated
0x870A	Error		Channel range error	Measuring range error for the channel
0x870B	Error		no ADC clock	No ADC clock available
0xFFFF	Information		Debug: 0x%X, 0x%X, 0x%X	Debug: 0x%X, 0x%X, 0x%X

4.6 CoE object description

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

Introduction

The CoE overview contains objects for different intended applications:

CoE is generated depending on the module/slot assignment

The names and contents of the CoE directory are generated depending on the module/slot assignments.

- In the following description of the CoE objects, some objects therefore have different names and contents, depending on the configuration of the modules, with the same index.
  Example:
  Module: …_DI => 0x80n0:0 "DI Settings"
  Module: …_ENC => 0x80n0:0 "ENC Settings 1"
- The descriptions of the process data and settings objects are given below for each ModuleGroup.
- The placeholder "n" describes the assignment of index labels corresponding to the respective configuration of the individual SlotGroups.
  Example:
  SlotGroup1 is assigned to ModuleGroup: PWM_OUT_REAL32_DI
  => 0x8000 "PWM Settings", 0x8010 "DI Settings"
  SlotGroup2 is assigned to ModuleGroup: PWM_OUT_REAL32_DI
  => 0x8020 "PWM Settings", 0x8030 "DI Settings"

4.6.1 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})

4.6.2 60xx, 70xx, 80xx, F817 | Input, output, and configuration data

4.6.2.1 PWM_OUT_REAL32_DI | ModuleIdent 0x1009C8, 0x2009C8

4.6.2.1.1 0x80n0, 0xF817 | Configuration data (PWM_OUT_REAL32_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) DI Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) DI Settings	Maximum subindex	UINT8	RO	0x12 (18_{dec})
80n0:02	Enable Filter	**TRUE** (default setting): The filter is active. The filter times specified in index 0x80n0:12, “Filter Time”, apply. **FALSE**: The filter is disabled. The input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.	BOOLEAN	RW	0x01 (1_{dec})
80n1:11	Input Type	Selection of the input characteristics 0_{dec}: “Positive Switching (PNP)” 1_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x00 (0_{dec})
80n0:12	Filter Time	Signals shorter than the set filter times are suppressed when the filter is active via index 0x80n0:02 “Enable Filter”: • 500_{dec}: 500 µs • 750_{dec}: 750 µs • $1{,}000_{dec}$: 1 ms • $3{,}000_{dec}$: 3 ms (default setting) • $10{,}000_{dec}$: 10 ms • $20{,}000_{dec}$: 20 ms	UINT32	RW	0x00000BB8 (3000_{dec})

Index F817 PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
F817:0	PWM Settings	Largest subindex of this object	UINT8	RO	0x01 (1_{dec})
F817:01	Enable Low Latency Output Slot 1	Allows new values to be applied with low latency in 1-channel mode (see the chapter “Applying new duty cycle and frequency values [▶ 33]”).	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.1.2 0x60n0 | Input data (PWM_OUT_REAL32_DI)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) DI Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) DI Inputs	Maximum subindex	UINT8	RO	0x01 (1_{dec})
60n0:01	Input	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.1.3 0x70n1 | Output data (PWM_OUT_REAL32_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n1 SlotGroup x (output x, input x) PWM Extended Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n1:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:12	PWM Duty Cycle	Setting the duty cycle for the PWM output	REAL	RW	0x0000 (0_{dec})
70n0:13	PWM Frequency	Specifying the output frequency Value range: 1 Hz…64,000 Hz	REAL	RW	0x0000 (0_{dec})

4.6.2.2 PWM_OUT_REAL32_ENC | ModuleIdent 0x1009C8, 0x1809C8

4.6.2.2.1 0x80n0, 0x80n1, 0xF817 | Configuration data (PWM_OUT_REAL32_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) ENC Settings 1

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) ENC Settings 1	Maximum subindex	UINT8	RO	0x19 (25_{dec})
80n0:13	Frequency Scaling	Resolution of the output frequency: 1_{dec}: “1 Hz” 10_{dec}: “0.1 Hz” 60_{dec}: “1 RPM” 100_{dec}: “0.01 Hz”	UINT16	RW	0x01 (1_{dec})
80n0:19	Pulses per Revolution	The expected number of pulses per revolution must be specified if “1RPM (60)” has been selected in index 0x80n0:13.	UINT32	RW	0x00000002 (2_{dec})

Index 80n1 SlotGroup x (output x, input x) ENC Settings 2

Index (hex)	Name	Meaning	Data type	Flags	Default
80n1:0	80n1 SlotGroup x (Output x, Input x) ENC Settings 2	Maximum subindex	UINT8	RO	0x1D (29_{dec})
80n1:13	Counter Mode	Selection of the input characteristics 16_{dec}: “Positive Switching (PNP)” 17_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x10 (16_{dec})

Index F817 PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
F817:0	PWM Settings	Largest subindex of this object	UINT8	RO	0x01 (1_{dec})
F817:01	Enable Low Latency Output Slot 1	Allows new values to be applied with low latency in 1-channel mode (see the chapter “Applying new duty cycle and frequency values [▶ 33]”).	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.2.2 0x60n0 | Input data (PWM_OUT_REAL32_ENC)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) ENC Inputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
60n0:09	Status of Input A	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})
60n0:13	Frequency Value	Frequency value in Hz	UINT32	RW	0x00000000 (0_{dec})

4.6.2.2.3 0x70n1 | Output data (PWM_OUT_REAL32_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n1 SlotGroup x (output x, input x) PWM Extended Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n1:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:12	PWM Duty Cycle	Setting the duty cycle for the PWM output	REAL	RW	0x0000 (0_{dec})
70n0:13	PWM Frequency	Specifying the output frequency Value range: 1 Hz…64,000 Hz	REAL	RW	0x0000 (0_{dec})

4.6.2.3 PWM_OUT_REAL32_HWE | ModuleIdent 0x1009C8, 0x3009C8

4.6.2.3.1 0x80n0, 0xF817 | Configuration data (PWM_OUT_REAL32_HWE)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) HWE Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) HWE Settings	Maximum subindex	UINT8	RO	0x12 (18_{dec})
80n0:02	Enable Filter	**TRUE** (default setting): The filter is active. The filter times specified in index 0x80n0:12, “Filter Time”, apply. **FALSE**: The filter is disabled. The input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.	BOOLEAN	RW	0x01 (1_{dec})
80n0:04	Invert Digital Input	PWM output enable level **TRUE** (default setting): The PWM output is enabled as long as the “Inputs” process data value is set to TRUE. **FALSE**: The enable level is inverted; see the chapter “HWE Input (hardware enable) [▶ 51]”.	BOOLEAN	RW	0x01 (1_{dec})
80n1:11	Input Type	Selection of the input characteristics 0_{dec}: “Positive Switching (PNP)” 1_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x00 (0_{dec})
80n0:12	Filter Time	Signals shorter than the set filter times are suppressed when the filter is active via index 0x80n0:02 “Enable Filter”: • 500_{dec}: 500 µs • 750_{dec}: 750 µs • $1{,}000_{dec}$: 1 ms • $3{,}000_{dec}$: 3 ms (default setting) • $10{,}000_{dec}$: 10 ms • $20{,}000_{dec}$: 20 ms	UINT32	RW	0x00000BB8 (3000_{dec})

Index F817 PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
F817:0	PWM Settings	Largest subindex of this object	UINT8	RO	0x01 (1_{dec})
F817:01	Enable Low Latency Output Slot 1	Allows new values to be applied with low latency in 1-channel mode (see the chapter “Applying new duty cycle and frequency values [▶ 33]”).	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.3.2 0x60n0 | Input data (PWM_OUT_REAL32_HWE)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) HWE Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) HWE Inputs	Maximum subindex	UINT8	RO	0x01 (1_{dec})
60n0:1	Input	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.3.3 0x70n1 | Output data (PWM_OUT_REAL32_HWE)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n1 SlotGroup x (output x, input x) PWM Extended Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n1:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:12	PWM Duty Cycle	Setting the duty cycle for the PWM output	REAL	RW	0x0000 (0_{dec})
70n0:13	PWM Frequency	Specifying the output frequency Value range: 1 Hz…64,000 Hz	REAL	RW	0x0000 (0_{dec})

4.6.2.4 PWM_OUT_INT32_DI | ModuleIdent 0x3809C8, 0x2009C8

4.6.2.4.1 0x80n0 | Configuration data (PWM_OUT_INT32_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:1	Enable User Scale	Enabling scaling (index 0x80n0:11 “Offset” and 0x80n0:12 “Gain”)	BOOLEAN	RW	0x00 (0_{dec})
80n0:2	Presentation	**0: “Signed presentation”** The value range of the output index 0x70n0:11 is represented as a 16-bit signed integer. • 100% duty cycle corresponds to 0x7FFF, • 50% duty cycle corresponds to 0x3FFF. • 0% is used for the negative range. **1: “Unsigned presentation”** The output value range index 0x70n0:11 is represented as a 16-bit unsigned integer. • 100% duty cycle corresponds to 0xFFFF, • 50% duty cycle corresponds to 0x7FFF.	BIT3	RW	0x00 (0_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:11	Offset	User scale offset	INT16	RW	0x0000 (0_{dec})
80n0:12	Gain	User scale gain The gain has a fixed-point representation with the factor 2^{-16}.	INT32	RW	0x00010000 (65536_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) DI Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) DI Settings	Maximum subindex	UINT8	RO	0x12 (18_{dec})
80n0:02	Enable Filter	**TRUE** (default setting): The filter is active. The filter times specified in index 0x80n0:12, “Filter Time”, apply. **FALSE**: The filter is disabled. The input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.	BOOLEAN	RW	0x01 (1_{dec})
80n1:11	Input Type	Selection of the input characteristics 0_{dec}: “Positive Switching (PNP)” 1_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x00 (0_{dec})
80n0:12	Filter Time	Signals shorter than the set filter times are suppressed when the filter is active via index 0x80n0:02 “Enable Filter”: • 500_{dec}: 500 µs • 750_{dec}: 750 µs • $1{,}000_{dec}$: 1 ms • $3{,}000_{dec}$: 3 ms (default setting) • $10{,}000_{dec}$: 10 ms • $20{,}000_{dec}$: 20 ms	UINT32	RW	0x00000BB8 (3000_{dec})

4.6.2.4.2 0x60n0 | Input data (PWM_OUT_INT32_DI)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) DI Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) DI Inputs	Maximum subindex	UINT8	RO	0x01 (1_{dec})
60n0:01	Input	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.4.3 0x70n0 | Output data (PWM_OUT_INT32_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n0 SlotGroup x (output x, input x) PWM outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:11	PWM Output	Output data	UINT16	RW	0x0000 (0_{dec})
70n0:13	PWM Period 1Hz	Output period 1 Hz Value range: 10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz … $F4240_{hex}$ ($1{,}000{,}000_{dec}$) 1 s corresponds to 1 Hz	UDINT	RW	0x00000000 (0_{dec})

4.6.2.5 PWM_OUT_INT32_ENC | ModuleIdent 0x3809C8, 0x1809C8

4.6.2.5.1 0x80n0, 0x80n1 | Configuration data (PWM_OUT_INT32_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:1	Enable User Scale	Enabling scaling (index 0x80n0:11 “Offset” and 0x80n0:12 “Gain”)	BOOLEAN	RW	0x00 (0_{dec})
80n0:2	Presentation	**0: “Signed presentation”** The value range of the output index 0x70n0:11 is represented as a 16-bit signed integer. • 100% duty cycle corresponds to 0x7FFF, • 50% duty cycle corresponds to 0x3FFF. • 0% is used for the negative range. **1: “Unsigned presentation”** The output value range index 0x70n0:11 is represented as a 16-bit unsigned integer. • 100% duty cycle corresponds to 0xFFFF, • 50% duty cycle corresponds to 0x7FFF.	BIT3	RW	0x00 (0_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:11	Offset	User scale offset	INT16	RW	0x0000 (0_{dec})
80n0:12	Gain	User scale gain The gain has a fixed-point representation with the factor 2^{-16}.	INT32	RW	0x00010000 (65536_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) ENC Settings 1

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) ENC Settings 1	Maximum subindex	UINT8	RO	0x19 (25_{dec})
80n0:13	Frequency Scaling	Resolution of the output frequency: 1_{dec}: “1 Hz” 10_{dec}: “0.1 Hz” 60_{dec}: “1 RPM” 100_{dec}: “0.01 Hz”	UINT16	RW	0x01 (1_{dec})
80n0:19	Pulses per Revolution	The expected number of pulses per revolution must be specified if “1RPM (60)” has been selected in index 0x80n0:13.	UINT32	RW	0x00000002 (2_{dec})

Index 80n1 SlotGroup x (output x, input x) ENC Settings 2

Index (hex)	Name	Meaning	Data type	Flags	Default
80n1:0	80n1 SlotGroup x (Output x, Input x) ENC Settings 2	Maximum subindex	UINT8	RO	0x1D (29_{dec})
80n1:13	Counter Mode	Selection of the input characteristics 16_{dec}: “Positive Switching (PNP)” 17_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x10 (16_{dec})

4.6.2.5.2 0x60n0 | Input data (PWM_OUT_INT32_ENC)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) ENC Inputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
60n0:09	Status of Input A	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})
60n0:13	Frequency Value	Frequency value in Hz	UINT32	RW	0x00000000 (0_{dec})

4.6.2.5.3 0x70n0 | Output data (PWM_OUT_INT32_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n0 SlotGroup x (output x, input x) PWM outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:11	PWM Output	Output data	UINT16	RW	0x0000 (0_{dec})
70n0:13	PWM Period 1Hz	Output period 1 Hz Value range: 10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz … $F4240_{hex}$ ($1{,}000{,}000_{dec}$) 1 s corresponds to 1 Hz	UDINT	RW	0x00000000 (0_{dec})

4.6.2.6 PWM_OUT_INT16_DI | ModuleIdent 0x809C8, 0x2009C8

4.6.2.6.1 0x80n0 | Configuration data (PWM_OUT_INT16_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:1	Enable User Scale	Enabling scaling (index 0x80n0:11 “Offset” and 0x80n0:12 “Gain”)	BOOLEAN	RW	0x00 (0_{dec})
80n0:2	Presentation	**0: “Signed presentation”** The value range of the output index 0x70n0:11 is represented as a 16-bit signed integer. • 100% duty cycle corresponds to 0x7FFF, • 50% duty cycle corresponds to 0x3FFF. • 0% is used for the negative range. **1: “Unsigned presentation”** The output value range index 0x70n0:11 is represented as a 16-bit unsigned integer. • 100% duty cycle corresponds to 0xFFFF, • 50% duty cycle corresponds to 0x7FFF.	BIT3	RW	0x00 (0_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:11	Offset	User scale offset	INT16	RW	0x0000 (0_{dec})
80n0:12	Gain	User scale gain The gain has a fixed-point representation with the factor 2^{-16}.	INT32	RW	0x00010000 (65536_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) DI Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) DI Settings	Maximum subindex	UINT8	RO	0x12 (18_{dec})
80n0:02	Enable Filter	**TRUE** (default setting): The filter is active. The filter times specified in index 0x80n0:12, “Filter Time”, apply. **FALSE**: The filter is disabled. The input signal is only filtered via the hardware. In this case, the filter value is typically 10 µs.	BOOLEAN	RW	0x01 (1_{dec})
80n1:11	Input Type	Selection of the input characteristics 0_{dec}: “Positive Switching (PNP)” 1_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x00 (0_{dec})
80n0:12	Filter Time	Signals shorter than the set filter times are suppressed when the filter is active via index 0x80n0:02 “Enable Filter”: • 500_{dec}: 500 µs • 750_{dec}: 750 µs • $1{,}000_{dec}$: 1 ms • $3{,}000_{dec}$: 3 ms (default setting) • $10{,}000_{dec}$: 10 ms • $20{,}000_{dec}$: 20 ms	UINT32	RW	0x00000BB8 (3000_{dec})

4.6.2.6.2 0x60n0 | Input data (PWM_OUT_INT16_DI)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) DI Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) DI Inputs	Maximum subindex	UINT8	RO	0x01 (1_{dec})
60n0:01	Input	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})

4.6.2.6.3 0x70n0 | Output data (PWM_OUT_INT16_DI)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n0 SlotGroup x (output x, input x) PWM outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:11	PWM Output	Output data	UINT16	RW	0x0000 (0_{dec})
70n0:12	PWM Period	Output period Value range: 10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz … $FFFF_{hex}$ ($65{,}535_{dec}$) 65.565 ms corresponds to 15 Hz	UINT16	RW	0x0000 (0_{dec})

4.6.2.6.4 PWM_OUT_INT16_ENC | ModuleIdent 0x809C8, 0x1809C8

4.6.2.6.4.1 0x80n0, 0x80n1 | Configuration data (PWM_OUT_INT16_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) PWM Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) PWM Settings	Maximum subindex	UINT8	RO	0x17 (23_{dec})
80n0:1	Enable User Scale	Enabling scaling (index 0x80n0:11 “Offset” and 0x80n0:12 “Gain”)	BOOLEAN	RW	0x00 (0_{dec})
80n0:2	Presentation	**0: “Signed presentation”** The value range of the output index 0x70n0:11 is represented as a 16-bit signed integer. • 100% duty cycle corresponds to 0x7FFF, • 50% duty cycle corresponds to 0x3FFF. • 0% is used for the negative range. **1: “Unsigned presentation”** The output value range index 0x70n0:11 is represented as a 16-bit unsigned integer. • 100% duty cycle corresponds to 0xFFFF, • 50% duty cycle corresponds to 0x7FFF.	BIT3	RW	0x00 (0_{dec})
80n0:05	Watchdog	**0: “Default watchdog value”** The default value (index 0x80n0:13) is active. **1: “Watchdog ramp”:** The ramp (index 0x80n0:14) for moving to the default value (index 0x80n0:13) is active. **2: “Last value”:** The last process data value is output in the event of an error (watchdog drop). **3: “High impedance”:** The output is switched to high-impedance.	BIT2	RW	0x00 (0_{dec})
80n0:0C	Enable Output Cycle Counter Watchdog	**TRUE:** In the event of a bus error or when the PLC is inactive, the output assumes the state specified in index 0x80n0:05, “Watchdog”. **FALSE (default):** The output assumes the state defined in index 0x80n0:05, “Watchdog”, only in the event of a bus error.	BOOLEAN	RW	0x00 (0_{dec})
80n0:11	Offset	User scale offset	INT16	RW	0x0000 (0_{dec})
80n0:12	Gain	User scale gain The gain has a fixed-point representation with the factor 2^{-16}.	INT32	RW	0x00010000 (65536_{dec})
80n0:13	Default Output	Output value, if enabled via index 0x80n0:05	UINT16	RW	0x0000 (0_{dec})
80n0:14	Default Output Ramp	This value defines the ramps for the ramp-down to the default value. The value is specified in digits/ms. For example, if the entry is 100 and the default value is 0, it takes 327 ms (32,767/100) for the output value to go from the maximum value (32,767) to the default value in the event of an error.	UINT16	RW	0xFFFF ($65,535_{dec}$)
80n0:17	Default Period	Output value, if enabled via index 0x80n0:05	UINT32	RW	0x000003E8 (1000_{dec})

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 80n0 SlotGroup x (output x, input x) ENC Settings 1

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	80n0 SlotGroup x (Output x, Input x) ENC Settings 1	Maximum subindex	UINT8	RO	0x19 (25_{dec})
80n0:13	Frequency Scaling	Resolution of the output frequency: 1_{dec}: “1 Hz” 10_{dec}: “0.1 Hz” 60_{dec}: “1 RPM” 100_{dec}: “0.01 Hz”	UINT16	RW	0x01 (1_{dec})
80n0:19	Pulses per Revolution	The expected number of pulses per revolution must be specified if “1RPM (60)” has been selected in index 0x80n0:13.	UINT32	RW	0x00000002 (2_{dec})

Index 80n1 SlotGroup x (output x, input x) ENC Settings 2

Index (hex)	Name	Meaning	Data type	Flags	Default
80n1:0	80n1 SlotGroup x (Output x, Input x) ENC Settings 2	Maximum subindex	UINT8	RO	0x1D (29_{dec})
80n1:13	Counter Mode	Selection of the input characteristics 16_{dec}: “Positive Switching (PNP)” 17_{dec}: “Negative Switching (NPN)”	UINT16	RW	0x10 (16_{dec})

4.6.2.6.4.2 0x60n0 | Input data (PWM_OUT_INT16_ENC)

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 60n0 SlotGroup x (output x, input x) ENC Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	60n0 SlotGroup x (Output x, Input x) ENC Inputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
60n0:09	Status of Input A	Status of the digital input	BOOLEAN	RW	0x00 (0_{dec})
60n0:13	Frequency Value	Frequency value in Hz	UINT32	RW	0x00000000 (0_{dec})

4.6.2.6.4.3 0x70n0 | Output data (PWM_OUT_INT16_ENC)

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 70n0 SlotGroup x (output x, input x) PWM outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	70n0 SlotGroup x (Output x, Input x) PWM Outputs	Maximum subindex	UINT8	RO	0x13 (19_{dec})
70n0:11	PWM Output	Output data	UINT16	RW	0x0000 (0_{dec})
70n0:12	PWM Period	Output period Value range: 10_{hex} (16_{dec}) 16 µs corresponds to 62.5 kHz … $FFFF_{hex}$ ($65,535_{dec}$) 65.565 ms corresponds to 15 Hz	UINT16	RW	0x0000 (0_{dec})

4.6.3 80nE, Fn16, F915 | Information and diagnostic data

Index 80nE SlotGroup x (output x, input x) PWM Internal data

Index (hex)	Name	Meaning	Data type	Flags	Default
80nE:0	SlotGroup x (output x, input x) PWM Internal data	Max. subindex	UINT8	RO	0x03 (3_{dec})
80nE:01	Timer Resolution		UINT16	RO	0x0000 (0_{dec})
80nE:02	Duty Cycle		UINT16	RO	0x0000 (0_{dec})
80nE:03	Prescaler		UINT16	RO	0x0000 (0_{dec})

Index F616 PWM Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
F616:0	PWM Inputs	Largest subindex of this object	UINT8	RO	0x0F (15_{dec})
F616:06	PWM Warning	Indicates undervoltage in the external power supply or an excessive PCB temperature; see the chapter"Hardware error diagnostics" [▶ 54]	BOOLEAN	RO	0x00 (0_{dec})
F616:07	PWM Error	Displays hardware errors; see the chapter"Hardware error diagnostics" [▶ 54], for example: • Overcurrent • Short circuit • Undervoltage • Overtemperature	BOOLEAN	RO	0x00 (0_{dec})
F616:0D	PWM Diag		BOOLEAN	RO	0x00 (0_{dec})
F616:0E	TxPDO State	Validity of the data of the associated TxPDO (0 = valid, 1 = invalid).	BOOLEAN	RO	0x00 (0_{dec})
F616:0F	Input Cycle Counter	2 bit counter for synchronization (incremented only if a new value is present)	BIT2	RO	0x00 (0_{dec})

Index F716 PWM outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
F716:0	PWM Outputs	Largest subindex of this object	UINT8	RO	0x11 (17_{dec})
F716:07	PWM Reset		BOOLEAN	RO	0x00 (0_{dec})
F716:11	PWM Output Cycle Counter	The 16 bit counter is not active until the process data value has been mapped and the counter has been enabled via index 0x80n0:0C “Enable Output Cycle Counter watchdog” (see the chapter“Watchdog behavior when the PLC is inactive [▶ 37]”).	UINT16	RO	0x00 (0_{dec})

Index F816 PWM Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
F816:0	PWM Vendor Data	Largest subindex of this object	UINT8	RO	0x15 (21_{dec})
F816:12	PCB Temperature Warning Level	Warning threshold for overtemperature (see the chapter “Hardware error diagnostics [▶ 54]”)	UINT32	RW	0x00000000 (0_{dec})
F816:13	PCB Temperature Error Level	Error threshold for overtemperature (see the chapter “Hardware error diagnostics” [▶ 54])	UINT32	RW	0x00000000 (0_{dec})
F816:14	External Supply Voltage Warning Level	Warning threshold for insufficient or missing external supply voltage (see the chapter “Hardware error diagnostics” [▶ 54])	UINT32	RW	0x00000000 (0_{dec})
F816:15	External Supply Voltage Error Level	Error threshold for insufficient or missing external supply voltage (see the chapter “Hardware error diagnostics” [▶ 54])	UINT32	RW	0x00000000 (0_{dec})

Index F915 LED Status

Index (hex)	Name	Meaning	Data type	Flags	Default
F915:0	LED Status	Largest subindex of this object	UINT8	RO	0x10 (16_{dec})
F915:01	Run	See the chapter "Reading the LED Status via CoE [▶ 55]"	UINT32	RO	0x00000000 (0_{dec})
F915:02	Dev error		UINT32	RO	0x00000000 (0_{dec})
F915:04	Ch.1 output		UINT32	RO	0x00000000 (0_{dec})
F915:05	Ch.3 output		UINT32	RO	0x00000000 (0_{dec})
F915:07	Ch.1 DI		UINT32	RO	0x00000000 (0_{dec})
F915:08	Ch.3 DI		UINT32	RO	0x00000000 (0_{dec})
F915:09	Up 24 V		UINT32	RO	0x00000000 (0_{dec})
F915:0C	Ch.2 output		UINT32	RO	0x00000000 (0_{dec})
F915:0D	Ch.4 output		UINT32	RO	0x00000000 (0_{dec})
F915:0F	Ch.2 DI		UINT32	RO	0x00000000 (0_{dec})
F915:10	Ch.4 DI		UINT32	RO	0x00000000 (0_{dec})

Index FA16 PWM Diag data

Index (hex)	Name	Meaning	Data type	Flags	Default
FA16:0	PWM Diag Data	Largest subindex of this object	UINT8	RO	0x16 (22_{dec})
FA16:03	Up Supply Voltage Available	FALSE: No peripheral voltage (power contacts) present TRUE: Peripheral voltage (power contacts) is present.	BOOLEAN	RW	0x00 (0_{dec})
FA16:12	PCB Temperature	Current PCB temperature reading	UINT32	RW	0x00000000 (0_{dec})
FA16:13	External Supply Voltage	Currently measured externally supplied voltage	UINT32	RW	0x00000000 (0_{dec})
FA16:16	Output Cycle Counter Error	32-bit error counter; see the chapter "Watchdog behavior when the PLC is inactive [▶ 37]"	UINT32	RW	0x00000000 (0_{dec})

4.6.4 1000 - FB40 | Standard objects

Standard objects (0x1000-0x1FFF)

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

4.6.4.1 1000 - 10F8 | Device

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default
1000:0	Device type	Device type of the EtherCAT slave: • The low word contains the CoE profile used. • The high word contains the module profile according to the modular device profile.	UINT32	RO	0x00001389 (5001_{dec})

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	ED2504

Index 1009 Hardware version

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

Index 100A Software version

Index (hex)	Name	Meaning	Data type	Flags	Default
100A:0	Software version	Firmware version of the EtherCAT slave	STRING	RO	00

Index 100B Bootloader version

Index (hex)	Name	Meaning	Data type	Flags	Default
100B:0	Bootloader version	Bootloader version	STRING	RO	n/a

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	0x0981052 (164106322_{dec})
1018:03	Revision	Revision number of the EtherCAT slave • The low word (bit 0–15) identifies the special terminal number. • The high word (bit 16–31) refers to the device description.	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave, • Low word ◦ The low byte (bit 0–7) of the low word contains the year of production. ◦ The high byte (bit 8–15) of the low word contains the week of production. • The high word (bit 16–31) is 0.	UINT32	RO	0x00000000 (0_{dec})

Index 10E2 Manufacturer-specific Identification Code*)

Index (hex)	Name	Meaning	Data type	Flags	Default
10E2:0	Manufacturer-specific Identification Code	Manufacturer-specific Identification Code	UINT8	RO	0x01 (1_{dec})
10E2:01	SubIndex 001	reserved	STRING	RO	

Index 10F0 Backup parameter handling

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

Index 10F2 Backup parameter storage

Index (hex)	Name	Meaning	Data type	Flags	Default
10F2:0	Backup parameter storage	EtherCAT backup object	OCTET-STRING[4]	RW	{0}

Index 10F8 Timestamp Object

Index (hex)	Name	Meaning	Data type	Flags	Default
10F8:0	Timestamp Object	Timestamp Object [ns] For SM synchronous operation: Time since power-on For DC synchronous operation: copy of the DC time Time can be used by the device e.g. for timestamps of the DiagMessage	UINT64	RO	

Index 10F3 Diagnosis History

Index (hex)	Name	Meaning	Data type	Flags	Default
10F3:0	Diagnosis History	Maximum subindex	UINT8	RO	0x1E (30_{dec})
10F3:01	Maximum Messages	Maximum number of stored messages A maximum of 16 messages can be stored.	UINT8	RO	0x00 (0_{dec})
10F3:02	Newest Message	Subindex of the latest message	UINT8	RO	0x00 (0_{dec})
10F3:03	Newest Acknowledged Message	Subindex of the last acknowledged message	UINT8	RW	0x00 (0_{dec})
10F3:04	New Messages Available	Indicates that a new message is available	BOOLEAN	RO	0x00 (0_{dec})
10F3:05	Flags	not used	UINT16	RW	0x0000 (0_{dec})
10F3:06	Diagnosis Message 001	Message 1	OCTET-STRING[28]	RO	{0}
…	…	….	…	…	…
10F3:1E	Diagnosis Message 025	Message 25	OCTET-STRING[28]	RO	{0}

4.6.4.2 16n0, 1700, 1701 | Mapping RxPDO

The following applies to the objects below:
n = 0 for SlotGroup 1, n = 2 for SlotGroup 2, n = 4 for SlotGroup 3, n = 6 for SlotGroup 4

Index 16n0 PWM RxPDO-Map Outputs (INT16)

Index (hex)	Name	Meaning	Data type	Flags	Default
16n0:0	PWM RxPDO-Map Outputs	PDO parameter RxPDO (0xn0+1)	UINT8	RO	0x02 (2_{dec})
16n0:01	SubIndex 001	PDO mapping entry no. 1 (index 0x70n0 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x11 (PWM Output))	UINT32	RO	0x70n0:11, 16
16n0:02	SubIndex 002	PDO mapping entry no. 2 (index 0x70n0 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x12 (PWM Period))	UINT32	RO	0x70n0:12, 16

Index 16n0 PWM RxPDO-Map Outputs (INT32)

Index (hex)	Name	Meaning	Data type	Flags	Default
16n0:0	PWM RxPDO-Map Outputs	PDO parameter RxPDO (0xn0+1)	UINT8	RO	0x03 (3_{dec})
16n0:01	SubIndex 001	PDO mapping entry no. 1 (index 0x70n0 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x11 (PWM Output))	UINT32	RO	0x70n0:11, 16
16n0:02	SubIndex 002	PDO mapping entry no. 2 (16 bits align)	UINT32	RO	0x0000:00, 16
16n0:02	SubIndex 002	PDO mapping entry no. 1 (index 0x70n0 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x13 (PWM Period 1 Hz))	UINT32	RO	0x70n0:13, 32

Index 16n0 PWM RxPDO-Map Extended Outputs (REAL32)

Index (hex)	Name	Meaning	Data type	Flags	Default
16n0:0	PWM RxPDO-Map Extended Outputs	PDO parameter RxPDO (0xn0+1)	UINT8	RO	0x02 (2_{dec})
16n0:01	SubIndex 001	PDO mapping entry no. 1 (index 0x70n1 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x12 (PWM Duty Cycle))	UINT32	RO	0x70n1:12, 32
16n0:02	SubIndex 002	PDO mapping entry no. 1 (index 0x70n1 (SlotGroupx (Outputx, Inputx) “PWM Outputs”), entry 0x13 (PWM Frequency))	UINT32	RO	0x70n1:13, 32

Index 1700 PWM RxPDO-Map Outputs Device

Index (hex)	Name	Meaning	Data type	Flags	Default
1700:0	PWM RxPDO-Map Outputs Device	PDO parameter RxPDO (0xn0+1)	UINT8	RO	0x03 (3_{dec})
1700:01	SubIndex 001	PDO mapping entry no. 1 (6 bits align)	UINT32	RO	0x0000:00, 6
1700:02	SubIndex 002	PDO mapping entry no. 2 (index 0xF716 (“PWM Outputs”)), entry 0x13 (PWM Reset))	UINT32	RO	0xF716:07, 1
1700:03	SubIndex 003	PDO mapping entry no. 3 (9 bits align)	UINT32	RO	0x0000:00, 9

Index 1701 PWM RxPDO-Map Output Cycle Counter

Index (hex)	Name	Meaning	Data type	Flags	Default
1701:0	PWM RxPDO-Map Output Cycle Counter	PDO parameter RxPDO (0xn0+1)	UINT8	RO	0x01 (1_{dec})
1701:01	SubIndex 001	PDO mapping entry no. 2 (index 0xF716 (“PWM Outputs”)), entry 0x11 (PWM Output Cycle Counter))	UINT32	RO	0xF716:11, 16

4.6.4.3 1An0 | Mapping TxPDO

The following applies to the objects below:
n = 1 for SlotGroup 1, n = 3 for SlotGroup 2, n = 5 for SlotGroup 3, n = 7 for SlotGroup 4

Index 1An0 DI TxPDO-Map Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1An0:0	DI TxPDO-Map Inputs	PDO mapping TxPDO (0xn0+1)	UINT8	RO	0x02 (2_{dec})
1An0:01	SubIndex 001	PDO mapping entry no. 1 (index 0x60n0 (DI Inputs), entry 0x01 (Input))	UINT32	RO	0x60n0:01, 1
1An0:02	SubIndex 002	PDO mapping entry no. 2 (15 bits align)	UINT32	RO	0x0000:00, 15

Index 1An0 ENC TxPDO-Map Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1An0:0	ENC TxPDO-Map Inputs	PDO mapping TxPDO (0xn0+1)	UINT8	RO	0x04 (4_{dec})
1An0:01	SubIndex 001	PDO mapping entry no. 1 (8 bits align)	UINT32	RO	0x0000:00, 8
1An0:02	SubIndex 002	PDO mapping entry no. 2 (index 0x60n0 (ENC Inputs), entry 0x09 (Status of Input A))	UINT32	RO	0x60n0:09, 1
1An0:03	SubIndex 003	PDO mapping entry no. 3 (87 bits align)	UINT32	RO	0x0000:00, 87
1An0:04	SubIndex 004	PDO mapping entry no. 4 (index 0x60n0 (ENC Inputs), entry 0x13 (Frequency Value))	UINT32	RO	0x60n0:13, 32

Index 1An0 HWE TxPDO-Map Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
1An0:0	HWE TxPDO-Map Inputs	PDO mapping TxPDO (0xn0+1)	UINT8	RO	0x02 (2_{dec})
1An0:01	SubIndex 001	PDO mapping entry no. 1 (index 0x60n0 (HWE Inputs), entry 0x01 (Input))	UINT32	RO	0x60n0:01, 1
1An0:02	SubIndex 002	PDO mapping entry no. 2 (15 bits align)	UINT32	RO	0x0000:00, 15

4.6.4.4 1B00 | PWM TxPDO-Map Inputs Device

Index 1B00 PWM TxPDO-Map Inputs Device

Index (hex)	Name	Meaning	Data type	Flags	Default
1B00:0	PWM TxPDO-Map Inputs Device	PDO mapping TxPDO (0xn0+1)	UINT8	RO	0x07 (7_{dec})
1B00:01	SubIndex 001	PDO mapping entry no. 1 (5 bits align)	UINT32	RO	0x0000:00, 5
1B00:02	SubIndex 001	PDO mapping entry no. 2 (index 0xF616 (PWM Inputs), entry 0x06 (PWM Warning))	UINT32	RO	0xF616:06, 1
1B00:03	SubIndex 003	PDO mapping entry no. 3 (index 0xF616 (PWM Inputs), entry 0x07 (PWM Error))	UINT32	RO	0xF616:07, 1
1B00:04	SubIndex 004	PDO mapping entry no. 3 (5 bits align)	UINT32	RO	0x0000:00, 5
1B00:05	SubIndex 005	PDO mapping entry no. 3 (index 0xF616 (PWM Inputs), entry 0x0D (PWM Diag))	UINT32	RO	0xF616:0D, 1
1B00:06	SubIndex 006	PDO mapping entry no. 3 (index 0xF616 (PWM Inputs), entry 0x0E (TxPDO State))	UINT32	RO	0xF616:0E, 1
1B00:07	SubIndex 007	PDO mapping entry no. 3 (index 0xF616 (PWM Inputs), entry 0x0F (Input Cycle Counter))	UINT32	RO	0xF616:0F, 2

4.6.4.5 1C00 - 1C33 | Device - System Manager

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	0x05 (5_{dec})
1C12:01	Subindex 001	Assigned RxPDO no. 1 (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	Subindex 002	Assigned RxPDO no. 2 (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1620 (5664_{dec})
1C12:03	Subindex 003	Assigned RxPDO no. 3 (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1640 (5696_{dec})
1C12:04	Subindex 004	Assigned RxPDO no. 4 (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1660 (5728_{dec})
1C12:05	Subindex 005	Assigned RxPDO no. 5 (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1700 (5888_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x05 (5_{dec})
1C13:01	Subindex 001	Assigned TxPDO no. 1 (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 ($6,672_{dec}$)
1C13:02	Subindex 002	Assigned TxPDO no. 2 (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A30 (6704_{dec})
1C13:03	Subindex 003	Assigned TxPDO no. 3 (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A50 (6736_{dec})
1C13:04	Subindex 004	Assigned TxPDO no. 4 (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A70 (6768_{dec})
1C13:05	Subindex 005	Assigned TxPDO no. 5 (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1B00 ($6,912_{dec}$)

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 2 event • 2: DC mode – synchronous with SYNC0 event • 3: DC mode – synchronous with SYNC1 event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Cycle time of the master • DC mode: SYNC0/SYNC1 cycle time	UINT32	RW	0x000F4240 ($1{,}000{,}000_{dec}$)
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: Synchronization with SM 2 event is supported • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 10: Output Shift with SYNC1 event (DC mode only) • Bit 14 = 1: Dynamic times (measurement through writing of 1C32:08)	UINT16	RO	0x0003 (3_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00055730 (350000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:09	Maximum delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of cycle time violations in OPERATIONAL (cycle was not completed on time or the next cycle started too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of times that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC – Synchronous with SYNC0 event • 3: DC – Synchronous with SYNC1 event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Cycle time of the master • DC mode: SYNC0/SYNC1 cycle time	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: Synchronization with SM 2 event is supported (outputs available) • Bit 1: Synchronization with SM 3 event is supported (no outputs available) • Bit 2–3 = 01: DC mode is supported • Bit 4–5 = 01: Input shift through local event (outputs available) • Bit 4–5 = 10: Input shift with SYNC1 event (no outputs available) • Bit 14 = 1: Dynamic times (measurement through writing of 1C32:08 or 1C33:08)	UINT16	RO	0x0003 (3_{dec})
1C33:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x00055730 (350000_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and the inputs being available for the master (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time	Min. time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:09	Maximum delay time	Time between SYNC1 event and reading of the inputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	Number of cycle time violations in OPERATIONAL (cycle was not completed on time or the next cycle started too early)	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	Number of times that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

4.6.4.6 F000 - FB40 | Device - information and diagnostics

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information on the modular device profiles (MDP) Organizational information on the profiles used in the device and listed in 0xF010	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	0x0008 (8_{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 Profile List

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module Profile List	Maximum subindex	UINT8	RO	0x08 (8_{dec})
F010:01	Subindex 001	Profile 250	INT32	RO	0x000000FA (250_{dec})
F010:02	Subindex 002	Profile 101	INT32	RO	0x0000065 (101_{dec})
F010:03	Subindex 003	Profile 250	INT32	RO	0x000000FA (250_{dec})
F010:04	Subindex 004	Profile 101	INT32	RO	0x0000065 (101_{dec})
F010:05	Subindex 005	Profile 250	INT32	RO	0x000000FA (250_{dec})
F010:06	Subindex 006	Profile 101	INT32	RO	0x0000065 (101_{dec})
F010:07	Subindex 007	Profile 250	INT32	RO	0x000000FA (250_{dec})
F010:08	Subindex 008	Profile 101	INT32	RO	0x0000065 (101_{dec})

Index F030 Configured Module Ident List

Index (hex)	Name	Meaning	Data type	Flags	Default
F030:0	Configured Module Ident List	Largest subindex of this object	UINT8	RW	0x08 (8_{dec})
F030:01	SubIndex 001		UINT32	RW	0x001009C8 ($1,051,080_{dec}$)
F030:02	SubIndex 002		UINT32	RW	0x002009C8 (2099656_{dec})
F030:03	SubIndex 003		UINT32	RW	0x001009C8 (1051080_{dec})
F030:04	SubIndex 004		UINT32	RW	0x002009C8 (2099656_{dec})
F030:05	SubIndex 005		UINT32	RW	0x001009C8 (1051080_{dec})
F030:06	SubIndex 006		UINT32	RW	0x002009C8 (2099656_{dec})
F030:07	SubIndex 007		UINT32	RW	0x001009C8 (1051080_{dec})
F030:08	SubIndex 008		UINT32	RW	0x002009C8 (2099656_{dec})

Index F050 Detected Module Ident List

Index (hex)	Name	Meaning	Data type	Flags	Default
F050:0	Detected Module Ident List	Largest subindex of this object	UINT8	RW	0x08 (8_{dec})
F050:01	SubIndex 001		UINT32	RW	0x001009C8 (1051080_{dec})
F030:02	SubIndex 002		UINT32	RW	0x002009C8 (2099656_{dec})
F050:03	SubIndex 003		UINT32	RW	0x001009C8 (1051080_{dec})
F050:04	SubIndex 004		UINT32	RW	0x002009C8 (2099656_{dec})
F050:05	SubIndex 005		UINT32	RW	0x001009C8 (1051080_{dec})
F050:06	SubIndex 006		UINT32	RW	0x002009C8 (2099656_{dec})
F050:07	SubIndex 007		UINT32	RW	0x001009C8 (1051080_{dec})
F050:08	SubIndex 008		UINT32	RW	0x002009C8 (2099656_{dec})

Index F081 Download revision

Index (hex)	Name	Meaning	Data type	Flags	Default
F081:0	Download revision	Download revision	UINT8	RO	0x01 (1_{dec})
F081:01	Revision number	Revision number of the EtherCAT device Relevant as a startup list entry for compatibility	UINT32	RW	0x00000000 (0_{dec})

Index FB40 Memory interface

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

4.6.4.7 FB00 | Device - command object

Index FB00 Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	Command	Command register	UINT8	RO	0x03 (3_{dec})
FB00:01	Request	Request	OCTET-STRING[2]	RW	{0}
FB00:02	Status	Status	UINT8	RO	0x00 (0_{dec})
FB00:03	Response	Response	OCTET-STRING[6]	RO	{0}

5 Appendix

5.1 Firmware compatibility

Beckhoff EtherCAT devices are delivered with the latest available firmware version. Firmware and hardware must be compatible; not every combination ensures compatibility. The overview below shows the hardware versions on which a firmware can be operated.

Note

- The newest possible firmware for the respective hardware should be implemented
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Observe the notes on the firmware update in the EtherCAT System Manual in chapter “Firmware Update”.
If a device is set to BOOTSTRAP mode for firmware update, it may not check whether the new firmware is suitable during download.
This may result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

ED2504			
Hardware (HW)	**Firmware (FW)**	**Revision no.**	**Release date**
01*	00*	ED2504-0000-0016	2026/03

*) This is the current compatible firmware/hardware version at the time of the preparing this documentation. Check on the Beckhoff website whether more up-to-date documentation is available.

5.2 Documentation issue status

Version	Comment
1.1.0	• Update Foreword • Update structure
1.0.0	• First release for ED2504
0.1	• Preliminary documentation for ED2504

5.3 Support and Service

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