BECKHOFF New Automation Technology

Documentation | EN

ED407x

EtherCAT Terminals, analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in

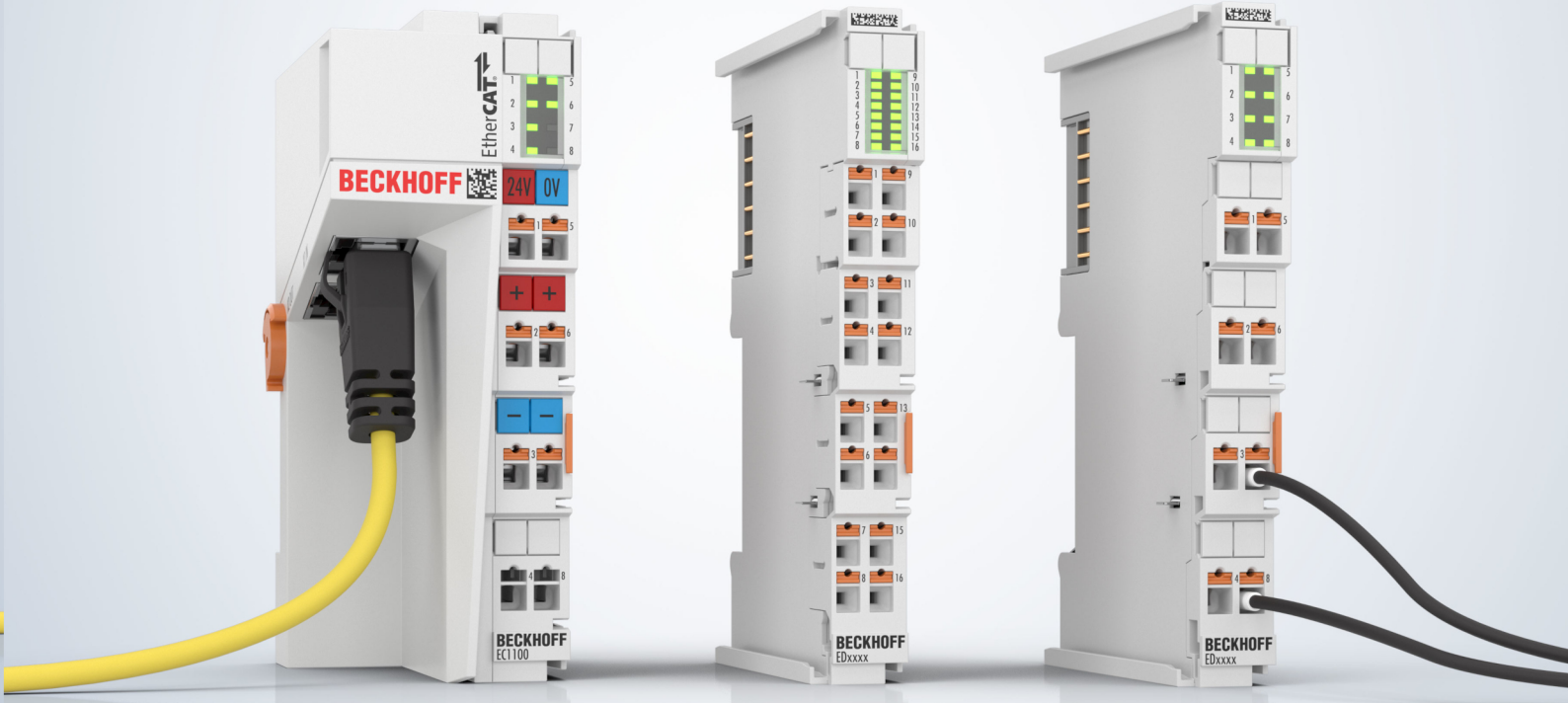

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Table of contents

1 Foreword

1.1 Product overview

This documentation covers the following products:

ED4072 [▶ 9]	EtherCAT Terminal, 2-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in
ED4074 [▶ 17]	EtherCAT Terminal, 4-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in
ED4078 [▶ 25]	EtherCAT Terminal, 8-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in

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.

Trademarks

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https://www.beckhoff.com/trademarks

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
I/O Analog Manual (PDF)	Notes on I/O components with analog in and outputs
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

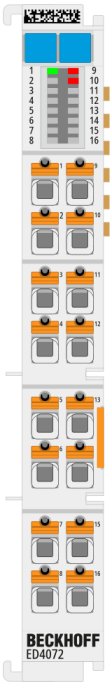
NOTICE
The environment, equipment, or data may be damaged.

Information on handling the product

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

2 Product description

2.1 ED4072



EtherCAT Terminal, 2-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in

The ED4072 analog output terminal is a universal 10 V/20 mA output module in the 16-bit class for simple control tasks. Standard signals in the -10/0 … +10 V or -20/0/+4 … +20 mA ranges can be generated per channel.
CoE can be used to set each channel to U or I mode in TwinCAT or by the controller.

The voltage and current outputs are single-ended. This means that they refer to the 0 V DC power contact.

All outputs are digitized with a 16-bit resolution and transmitted to the higher-level automation system under electrical isolation.
With a technical output range of ±107 % of the nominal range, unconventional setpoints, such as for error reporting purposes, can also be output.

The current outputs can have high load resistances and report overload, wire break, or – in the case of voltage outputs – a short circuit.

The ED4072 has 24 V/0 V DC contacts for the actuator supply.

Special features:

- Combined output terminal: 10 V/20 mA
- Output range ±107 %
- 2 ksps conversion rate per channel for standard automation tasks
- High output power at 20 mA: load up to 750 Ω
- Output diagnostics:
  - Short circuit at voltage output,
  - Wire break at current output

The EtherCAT-Terminals of the ED series feature push-in connection technology, which enables simple wiring without the need for tools.

2.1.1 Technical data

General	ED4072
Number of channels | Total	2
Internal communication protocol	EtherCAT
Minimum cycle time	50 µs

Analog output Voltage	ED4072
Number of channels	max. 2
Load type	ohmic
Connection technology	2-wire, 3-wire, 4-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	327.67... µV in ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-10 … +10 V, 0 … 10 V
Signal range | Technical	-10.73 … +10.73 V (short-circuit proof)
Signal range | end value (FSV)	10 V
Load	> 2 kΩ
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (-25 … +60 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

Analog output Current	ED4072
Number of channels	max. 2
Load type	ohmic
Connection technology	2-wire, 3-wire, 4-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	655.35… nA in the ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-20 … +20 mA, 0 … 20 mA, 4 … 20 mA
Signal range | Technical	-21.47 …+ 21.47 mA (short-circuit proof)
Signal range | end value (FSV)	20 mA
Load	< 750 Ω
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (-25 … +60 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

XFC	ED4072
Distributed Clocks	no
Timestamp	no
Oversampling	no

Supply and electrical isolation	ED4072
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. 60 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	ED4072
Operating temperature	-25 … +60 °C
Storage temperature	-40…+85 °C
Relative humidity	95 %, no condensation
Installation position	variable

Standards and approvals	ED4072
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
Markings*)	cULus (under preparation)
*) 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
Mounting | Terminal/Back wall	35-mm-mounting-rail (EN 60715)
Mounting | Terminal/Terminal	double groove-tongue connection
pluggable wiring level	no
Connection technology	Push-in
Connection cross-section | Single-wire, solid	0.08…1.5 mm²
Connection cross-section | Fine wire, stranded wire	0.25…1.5 mm²
Connection cross-section | ferrule	0.14…0.75 mm²
Connection cross-section AWG | Single-wire, solid	AWG28…16
Connection cross-section AWG | fine wire, stranded wire	AWG22…16
Connection cross section AWG | Wire end ferrule	AWG26…19
Strip 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
Slide-in lock for power contact "⏚"	yes

2.1.2 Connection

⚠ WARNING

Risk of electric shock and damage of device!

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

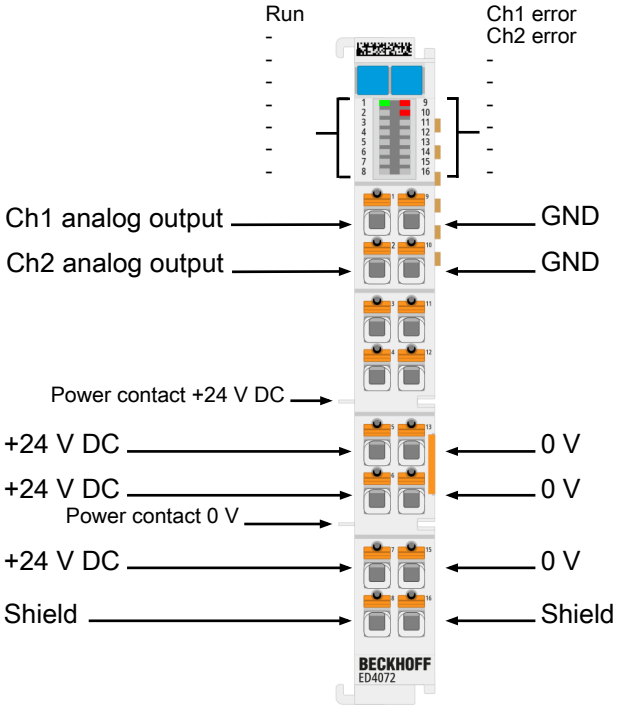


Fig. 1: ED4072

NOTICE

Cable lengths > 30 m

For cable lengths > 30 m, suitable overvoltage protection (Surge-Protection) must be provided (e g. EL9540-0010) if corresponding interference could affect the signal cable.

Terminal point		Description	Internally connected with connection	Max. current carrying capacity *)
Abbreviation	No.			
Ch1 analog output	1	Voltage/current output, channel 1	-	overload protected
Ch2 analog output	2	Voltage/current output, channel 2	-	overload protected
n.c.	3	-	-	-
n.c.	4	-	-	-
+24 V DC	5	+24 V	6; 7, +24 V power contact	1 A
+24 V DC	6	+24 V	5, 7, +24 V power contact	1 A
+24 V DC	7	+24 V	5, 6, +24 V power contact	1 A
Shield	8	Shield connection	16	1 A ***)
GND	9	Analog ground (reference potential for Ch1 … Ch2)	10	100 mA **)
GND	10	Analog ground (reference potential for Ch1 … Ch2)	9	100 mA **)
n.c.	11	-	-	-
n.c.	12	-	-	-
0 V	13	0 V	14, 15, 0 V power contact	1 A
0 V	14	0 V	13, 15, 0 V power contact	1 A
0 V	15	0 V	13, 14, 0 V power contact	1 A
Shield	16	Shield connection	8	1 A ***)

*) Constant current; short-term higher currents are to be avoided and can lead to thermal overload (damage).
**) The "GND" potential is internally coupled to the "0 V" potential, but is subject to a reduced current carrying capacity.
***) The connection point connects directly to the DIN rail contact.
Shield connections should generally be de-energized (DC)! See analog technical information in the Beckhoff analog manual.
If possible, an external shield connection, e.g. via Beckhoff ZB8511 or similar, is preferable.

Voltage output 0 … 10 V / -10 … +10 V

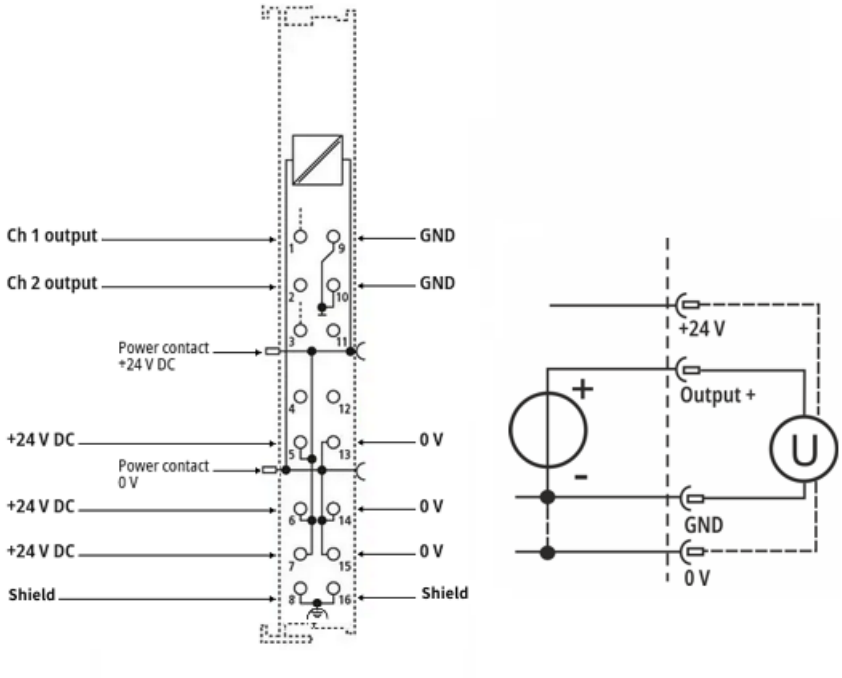


Fig. 2: Connection example ED4072, voltage output, 2-/4-wire

- 2-wire: 2-pin voltage output;
- 4-wire: with additional 24 V supply for the actuator

Current output -20 / 0 / +4 … +20 mA

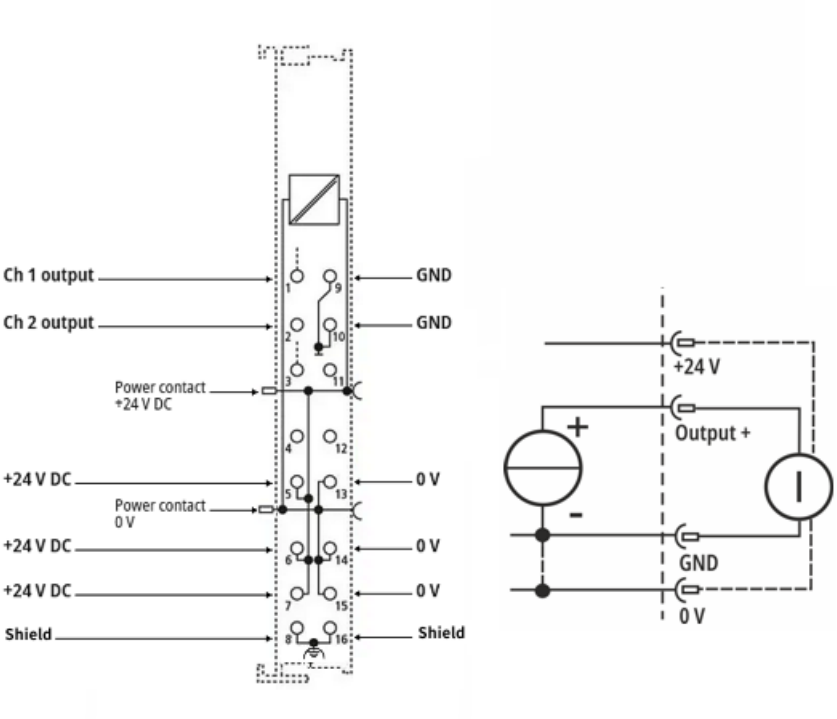


Fig. 3: Connection example ED4072, current output, 2-/4-wire

- 2-wire: 2-pin current output;
- 4-wire: with additional 24 V supply for the actuator

2.1.3 LEDs

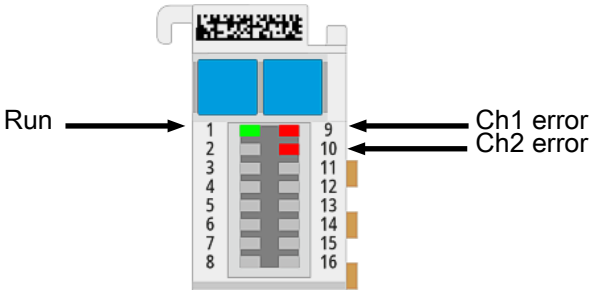
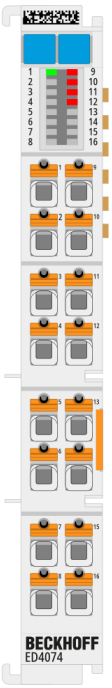


Fig. 4: ED4072 LEDs

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 [▶ 104] of the terminal
Ch1 error, Ch2 error	9, 10	red	off	No error
			on	• Overload of the output: ◦ Wire break at current output ◦ Short circuit at voltage output • Setpoint exceeds limiter: ◦ Low limit undershot ◦ High limit exceeded • Internal DAC error

2.2 ED4074



EtherCAT Terminal, 4-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in

The ED4074 analog output terminal is a universal 10 V/20 mA output module in the 16-bit class for simple control tasks.
Standard signals in the range -10/0 … +10 V or -20/0/+4 … +20 mA can be generated per channel.
Each channel can be set to U or I operation in TwinCAT or by the controller via CoE.

The voltage and current outputs are single-ended, meaning that they each refer to the 0 V DC power contact. All outputs are digitized with a 16-bit resolution and transmitted to the higher-level automation system under electrical isolation. With a technical output range of ±107 % of the nominal range, unconventional setpoints, such as for error reporting purposes, can also be output.

The current outputs can have high load resistances and report overload, wire break, or – in the case of voltage outputs – a short circuit.

The ED4074 terminal has 24 V/0 V DC contacts for the actuator supply.

Special features:

- Combined output terminal: 10 V/20 mA
- Output range ±107 %
- 2 ksps conversion rate per channel for standard automation tasks
- High output power at 20 mA: load up to 500 Ω
- Output diagnostics: short circuit at voltage output, wire break at current output

The EtherCAT-Terminals of the ED series feature push-in connection technology, which enables simple wiring without the need for tools.

2.2.1 Technical data

General	ED4074
Number of channels | Total	4
Internal communication protocol	EtherCAT
Minimum cycle time	50 µs

Analog output Voltage	ED4074
Number of channels	max. 4
Load type	ohmic
Connection technology	2-wire, 3-wire, 4-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	327.67... µV in ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/ n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-10 … +10 V, 0 … 10 V
Signal range | Technical	-10.73 … +10.73 V (short-circuit proof)
Signal range | end value (FSV)	10 V
Load	> 2 kΩ
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (-25 … +60 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

Analog output Current	ED4074
Number of channels	max. 4
Load type	ohmic
Connection technology	2-wire, 3-wire, 4-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	655.35… nA in the ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/ n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-20 … +20 mA, 0 … 20 mA, 4 … 20 mA
Signal range | Technical	-21.47 …+ 21.47 mA (short-circuit proof)
Signal range | end value (FSV)	20 mA
Load	< 500 Ω
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (-25 … +60 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

XFC	ED4074
Distributed Clocks	no
Timestamp	no
Oversampling	no

Supply and electrical isolation	ED4074
Electronics | supply voltage	via E-bus, via power contacts
E-bus | current consumption	typ. 125 mA
Power contacts | Input voltage	24 V_{DC} (-15 %/+20 %)
Power contacts | Current carrying capacity	max. 10 A
Power contacts | Current consumption	typ. 60 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	ED4074
Operating temperature	-25 … +60 °C
Storage temperature	-40…+85 °C
Relative humidity	95 %, no condensation
Installation position	variable

Standards and approvals	ED4074
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*)	cULus (under preparation)
*) 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
Mounting | Terminal/Back wall	35-mm-mounting-rail (EN 60715)
Mounting | Terminal/Terminal	double groove-tongue connection
pluggable wiring level	no
Connection technology	Push-in
Connection cross-section | Single-wire, solid	0.08…1.5 mm²
Connection cross-section | Fine wire, stranded wire	0.25…1.5 mm²
Connection cross-section | ferrule	0.14…0.75 mm²
Connection cross-section AWG | Single-wire, solid	AWG28…16
Connection cross-section AWG | fine wire, stranded wire	AWG22…16
Connection cross section AWG | Wire end ferrule	AWG26…19
Strip 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
Slide-in lock for power contact "⏚"	yes

2.2.2 Connection

⚠ WARNING

Risk of electric shock and damage of device!

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

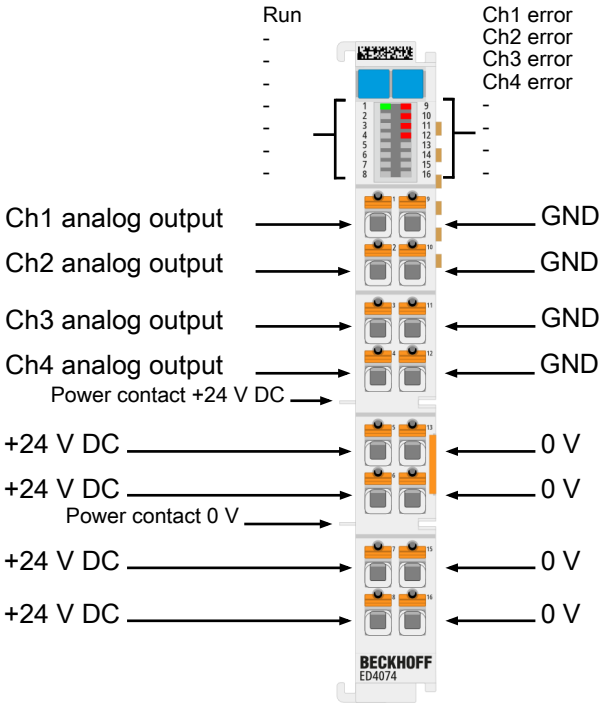


Fig. 5: ED4074

NOTICE

Cable lengths > 30 m

For cable lengths > 30 m, suitable overvoltage protection (Surge-Protection) must be provided (e g. EL9540-0010) if corresponding interference could affect the signal cable.

Terminal point		Description	Internally connected with connection	Max. current carrying capacity *)
Abbreviation	No.			
Ch1 analog output	1	Voltage/current output, channel 1	-	overload protected
Ch2 analog output	2	Voltage/current output, channel 2	-	overload protected
Ch3 analog output	2	Voltage/current output, channel 3	-	overload protected
Ch4 analog output	2	Voltage/current output, channel 4	-	overload protected
+24 V DC	5	+24 V	6; 7, 8 +24 V power contact	1 A
+24 V DC	6	+24 V	5, 7, 8 +24 V power contact	1 A
+24 V DC	7	+24 V	5, 6, 8 +24 V power contact	1 A
+24 V DC	8	+24 V	5, 6, 7, +24 V power contact	1 A
GND	9	Analog ground (reference potential for Ch1 … Ch4)	10, 11, 12	100 mA **)
GND	10	Analog ground (reference potential for Ch1 … Ch4)	9, 11, 12	100 mA **)
GND	11	Analog ground (reference potential for Ch1 … Ch4)	9, 10, 12	100 mA **)
GND	12	Analog ground (reference potential for Ch1 … Ch4)	9, 10, 11	100 mA **)
0 V	13	0 V	14, 15, 16, 0 V power contact	1 A
0 V	14	0 V	13, 15, 16, 0 V power contact	1 A
0 V	15	0 V	13, 14, 16, 0 V power contact	1 A
0 V	16	0 V	13, 14, 15, 0 V power contact	1 A
*) Constant current; short-term higher currents are to be avoided and can lead to thermal overload (damage) **) The "GND" potential is internally coupled to the "0 V" potential, but is subject to a reduced current carrying capacity				

Voltage output 0 … 10 V / -10 … +10 V

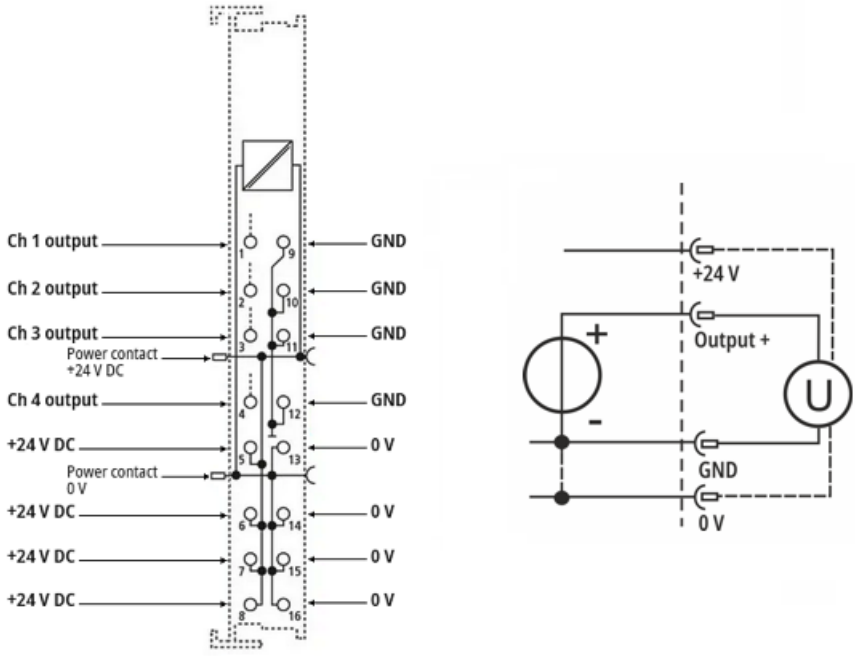


Fig. 6: Connection example ED4074, voltage output, 2-/4-wire

- 2-wire: 2-pin voltage output;
- 4-wire: with additional 24 V supply for the actuator

Current output -20 / 0 / +4 … +20 mA

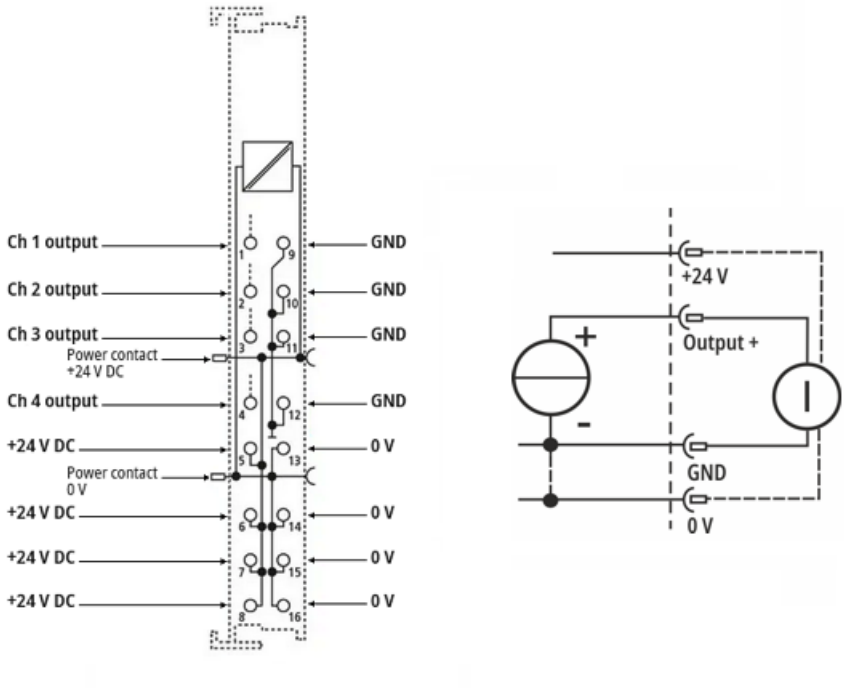


Fig. 7: Connection example EL4074, current output, 2-/4-wire

- 2-wire: 2-pin current output;
- 4-wire: with additional 24 V supply for the actuator

2.2.3 LEDs

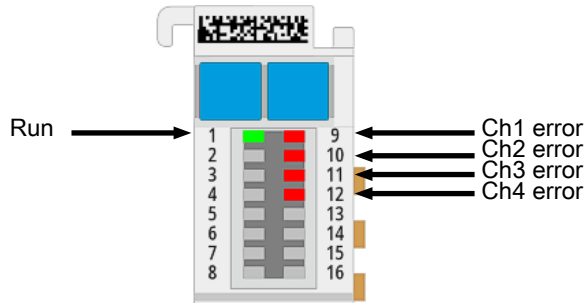


Fig. 8: ED4074 LEDs

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 [▶ 104] of the terminal
Ch1 error, … Ch4 error	9, 10	red	off	No error
			on	• Overload of the output: ◦ Wire break at current output ◦ Short circuit at voltage output • Setpoint exceeds limiter: ◦ Low limit undershot ◦ High limit exceeded • Internal DAC error

2.3 ED4078

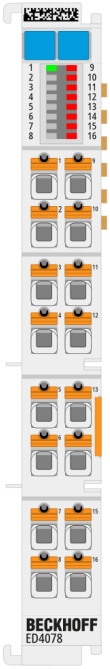


Fig. 9: ED3078

EtherCAT Terminal, 8-channel analog output, multi-function, ±10 V, ±20 mA, 16 bit, single-ended, 2 ksps, push-in

The ED4078 analog output terminal is a universal 10 V/20 mA output module in the 16-bit class for simple control tasks.
Standard signals in the range -10/0 … +10 V or -20/0/+4 … +20 mA can be generated per channel.
Each channel can be set to U or I operation in TwinCAT or by the controller via CoE.

The voltage and current outputs are single-ended, i.e. they each refer to the 0 V DC power contact.
All outputs are digitized with a 16-bit resolution and transmitted to the higher-level automation system under electrical isolation.
With a technical output range of ±107 % of the nominal range, unconventional setpoints, such as for error reporting purposes, can also be output.
The current outputs can have high load resistances and report overload, wire break, or – in the case of voltage outputs – a short circuit.

Special features:

- Combined output terminal: 10 V/20 mA
- Output range ±107 %
- 2 ksps conversion rate per channel for standard automation tasks
- High output power at 20 mA: load up to 300 Ω
- Output diagnostics: short circuit at voltage output, wire break at current output

The EtherCAT-Terminals of the ED series feature push-in connection technology, which enables simple wiring without the need for tools.

2.3.1 Technical data

General	ED4078
Number of channels | Total	8
Internal communication protocol	EtherCAT
Minimum cycle time	50 µs

Analog output Voltage	ED4078
Number of channels	max. 8
Load type	ohmic
Connection technology	2-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	327.67... µV in ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/ n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-10 … +10 V, 0 … 10 V If more than 4 channels are configured for current output, the remaining voltage channels can only be controlled up to max. ±5 V for thermal reasons.
Signal range | Technical	-10.73 … +10.73 V (short-circuit proof)
Signal range | end value (FSV)	10 V
Load	> 2 kΩ
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

Analog output Current	ED4078
Number of channels	max. 8
Load type	ohmic
Connection technology	2-wire
Resolution | Technical	16 bit, incl. sign
Resolution | Process data	655.35… nA in the ExtendedRange
Representation | Process data	REAL32, INT16
Type of conversion	multiplex (approx. 25 µs delay between channels n/ n+1)
Conversion time	min. 500 µs per channel
Conversion rate	max. 2 ksps per channel
Signal range | Nominal	-20 … +20 mA, 0 … 20 mA, 4 … 20 mA
Signal range | Technical	-21.47 …+ 21.47 mA (short-circuit proof)
Signal range | end value (FSV)	20 mA
Load	< 300 Ω
Ground reference	single-ended
Accuracy/uncertainty | From FSV (0 … 55 °C)	< ±0.1 %
Accuracy/uncertainty | From FSV (-25 … +55 °C)	< ±0.12 %
Accuracy/uncertainty | From FSV (largest short-term deviation during an electrical disturbance test)	< ±1 %

XFC	ED4078
Distributed Clocks	no
Timestamp	no
Oversampling	no

Supply and electrical isolation	ED4078
Electronics | supply voltage	via E-bus, via power contacts
E-bus | current consumption	typ. 180 mA
Power contacts | Input voltage	24 V DC (-15 %/+20 %)
Power contacts | Current carrying capacity	max. 10 A
Power contacts | Current consumption	typ. 60 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	ED4078
Operating temperature	-25 … +55 °C
Storage temperature	-40…+85 °C
Relative humidity	95 %, no condensation
Installation position	variable

Standards and approvals	ED4078
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*)	cULus (under preparation)
*) 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
Mounting | Terminal/Back wall	35-mm-mounting-rail (EN 60715)
Mounting | Terminal/Terminal	double groove-tongue connection
pluggable wiring level	no
Connection technology	Push-in
Connection cross-section | Single-wire, solid	0.08…1.5 mm²
Connection cross-section | Fine wire, stranded wire	0.25…1.5 mm²
Connection cross-section | ferrule	0.14…0.75 mm²
Connection cross-section AWG | Single-wire, solid	AWG28…16
Connection cross-section AWG | fine wire, stranded wire	AWG22…16
Connection cross section AWG | Wire end ferrule	AWG26…19
Strip 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
Slide-in lock for power contact "⏚"	yes

2.3.2 Connection

⚠ WARNING

Risk of electric shock and damage of device!

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

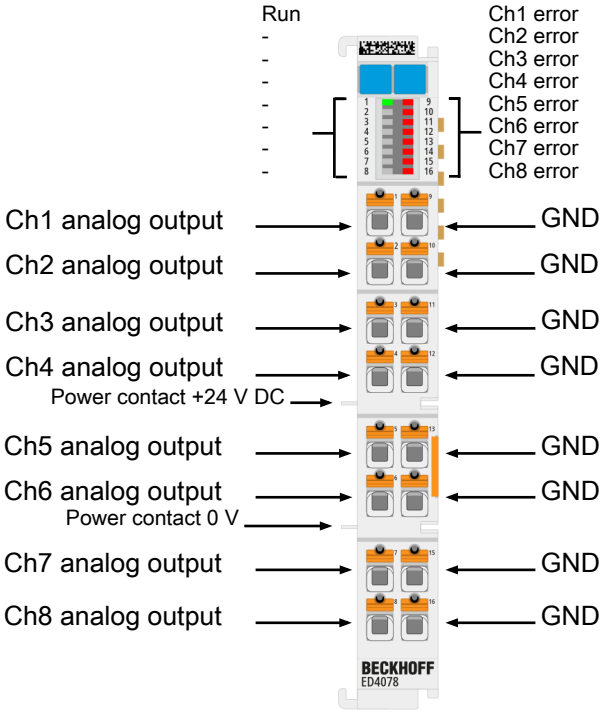


Fig. 10: ED4078

NOTICE

Cable lengths > 30 m

For cable lengths > 30 m, suitable overvoltage protection (Surge-Protection) must be provided (e g. EL9540-0010) if corresponding interference could affect the signal cable.

Terminal point		Description	Internally connected with connection	Max. current carrying capacity *)
Abbreviation	No.			
Ch1 analog output	1	Voltage/current output, channel 1	-	overload protected
Ch2 analog output	2	Voltage/current output, channel 2	-	overload protected
Ch3 analog output	3	Voltage/current output, channel 3	-	overload protected
Ch4 analog output	4	Voltage/current output, channel 4	-	overload protected
Ch5 analog output	5	Voltage/current output, channel 5	-	overload protected
Ch6 analog output	6	Voltage/current output, channel 6	-	overload protected
Ch7 analog output	7	Voltage/current output, channel 7	-	overload protected
Ch8 analog output	8	Voltage/current output, channel 8	-	overload protected
GND	9	Analog ground (reference potential for Ch1 … Ch8)	10, 11, 12, 13, 14, 15, 16	100 mA **)
GND	10	Analog ground (reference potential for Ch1 … Ch8)	9, 11, 12, 13, 14, 15, 16	100 mA **)
GND	11	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 12, 13, 14, 15, 16	100 mA **)
GND	12	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 11, 13, 14, 15, 16	100 mA **)
GND	13	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 11, 12, 14, 15, 16	100 mA **)
GND	14	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 11, 12, 13, 15, 16	100 mA **)
GND	15	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 11, 12, 13, 14, 16	100 mA **)
GND	16	Analog ground (reference potential for Ch1 … Ch8)	9, 10, 11, 12, 13, 14, 15	100 mA **)
*) Constant current; short-term higher currents are to be avoided and can lead to thermal overload (damage) **) The "GND" potential is internally coupled to the "0 V" potential, but is subject to a reduced current carrying capacity				

Voltage output 0 … 10 V / -10 … +10 V

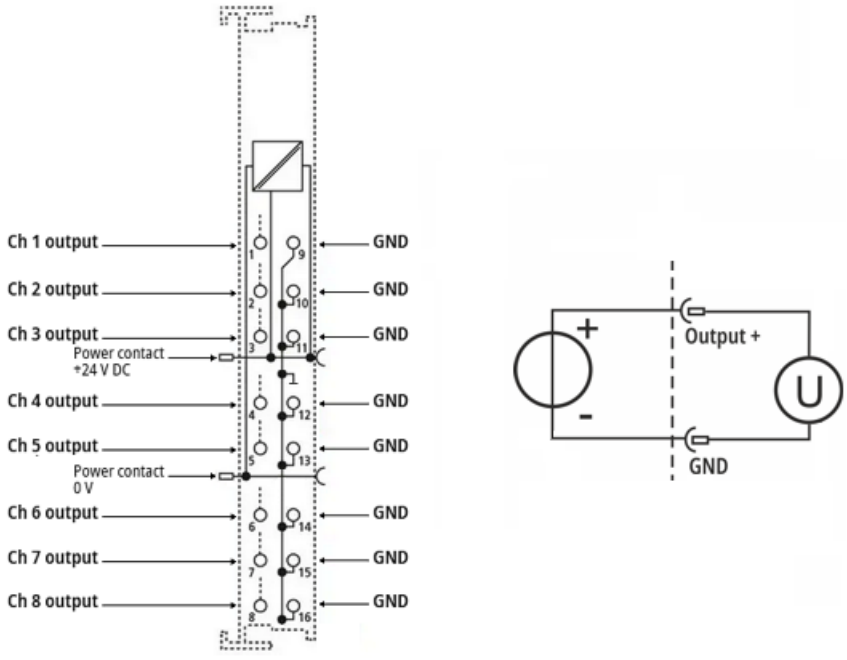


Fig. 11: Connection example ED4078, voltage output, 2-wire

- 2-wire: 2-pin voltage output

Current output -20 / 0 / +4 … +20 mA

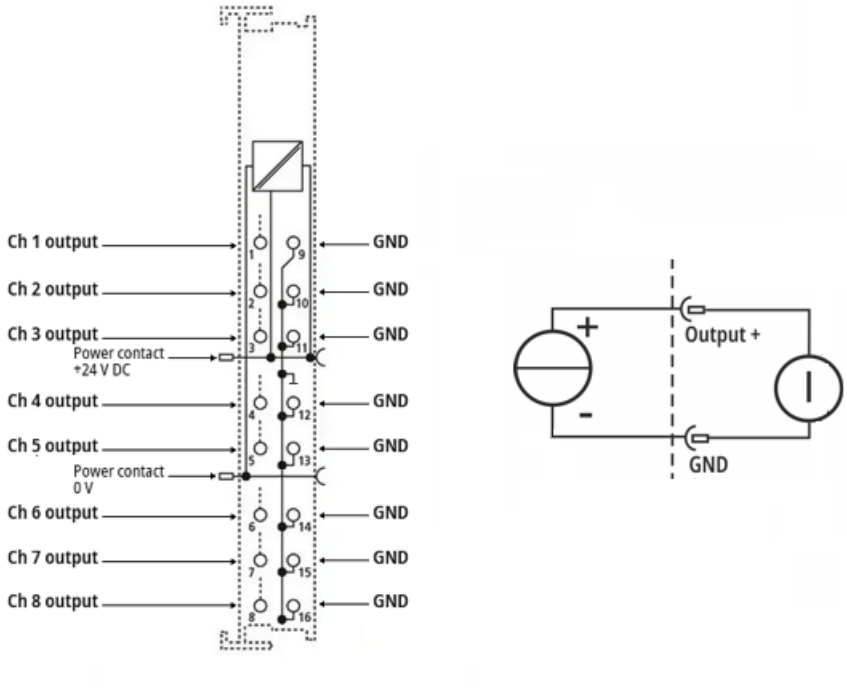


Fig. 12: Connection example ED4078, current output, 2-wire

- 2-wire: 2-pin current output

2.3.3 LEDs

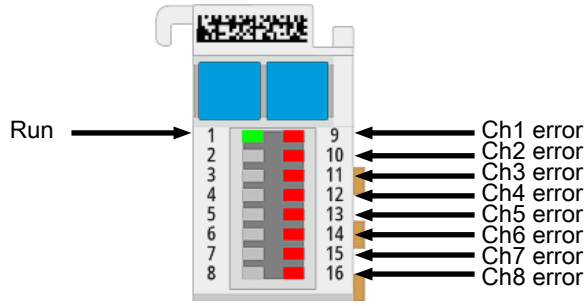


Fig. 13: ED4078 LEDs

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 [▶ 104] of the terminal
Ch1 error, … Ch8 error	9, 10	red	off	No error
			on	• Overload of the output: ◦ Wire break at current output ◦ Short circuit at voltage output • Setpoint exceeds limiter: ◦ Low limit undershot ◦ High limit exceeded • Internal DAC error

3 Mounting and wiring

3.1 Instructions for ESD protection

NOTICE

Destruction of the devices by electrostatic discharge possible!

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

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

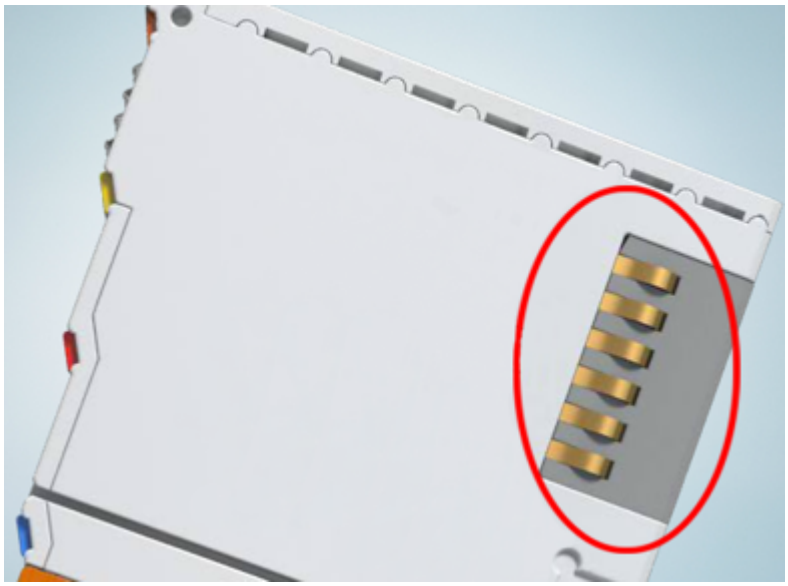


Fig. 14: Spring contacts of the Beckhoff I/O components

3.2 Mounting rail installation

⚠ WARNING

Risk of electric shock and damage of device!

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

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

Assembly

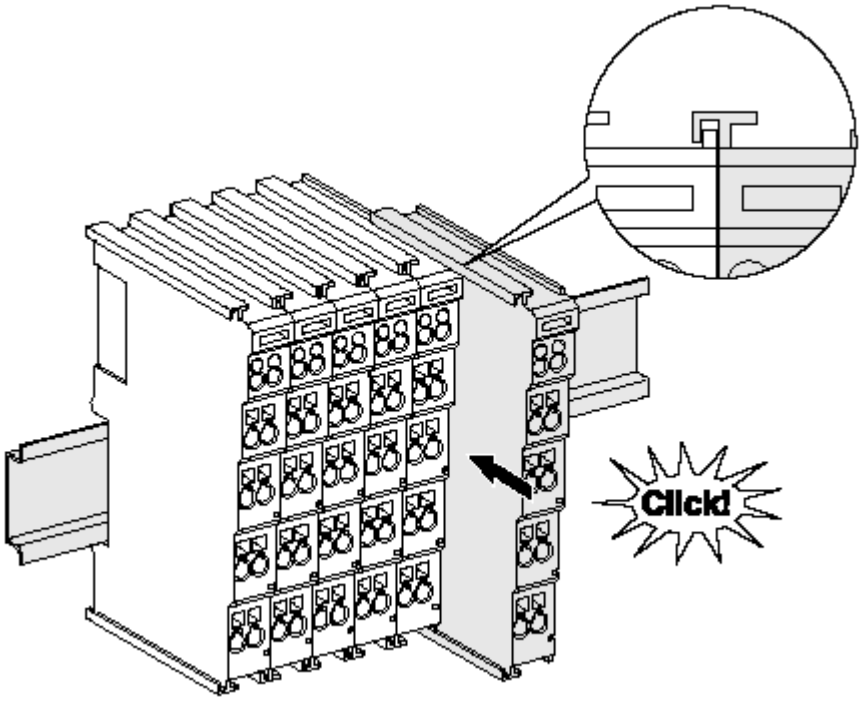


Fig. 15: Attaching on mounting rail

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

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

Fixing of mounting rails

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

NOTICE

Ground the mounting rail!

Ensure that the mounting rail is sufficiently grounded.

Connections within a bus terminal block

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

- The six spring-loaded contacts of the E-bus/K-bus deal with the transfer of the data and the supply of the bus terminal electronics.
- The power contacts deal with the supply for the field electronics and thus represent a supply rail within the bus terminal block. The power contacts are supplied via 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 labeled ⏚ (earthing connection according to IEC 60417-5017, British English: earth, American English: ground) can be used as grounding. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

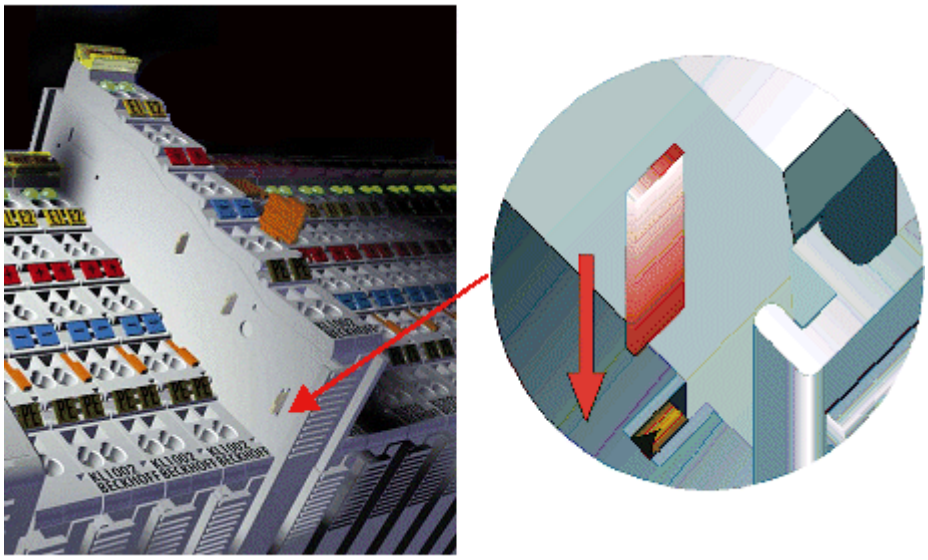


Fig. 16: Power contact on left side

⚠ WARNING

Risk of electric shock!

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

NOTICE

Possible damage of the device

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

Disassembly

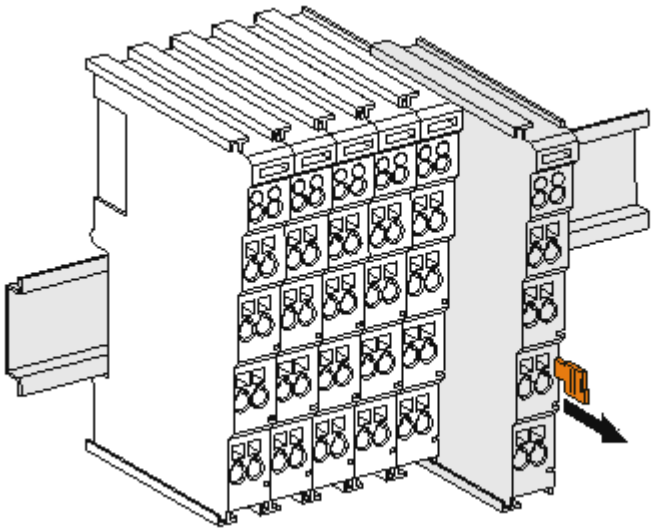


Fig. 17: Disassembling of terminal

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

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

3.3 Positioning of passive Terminals

Hint for positioning of passive terminals in the bus terminal block

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

Examples for positioning of passive terminals (highlighted)

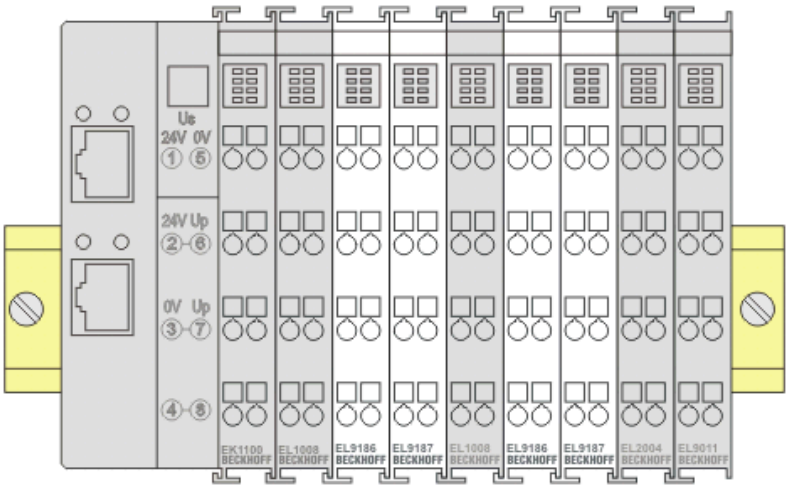


Fig. 18: Correct positioning

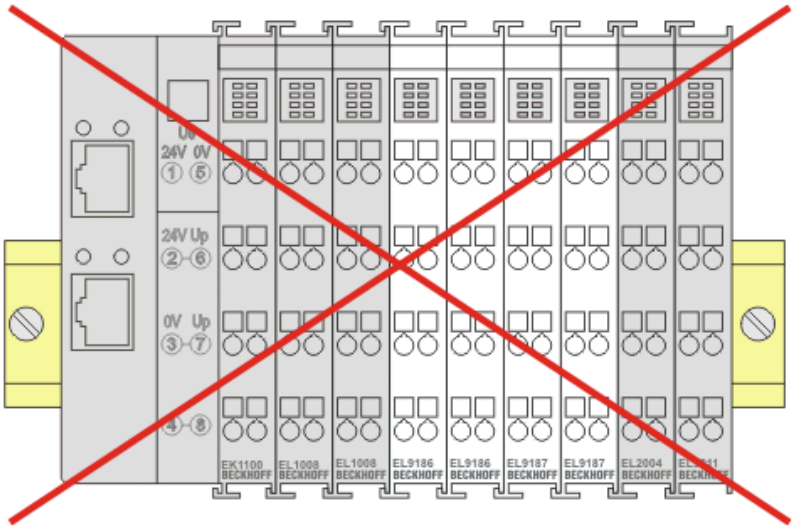


Fig. 19: Incorrect positioning

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 acceleration of gravity.

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.

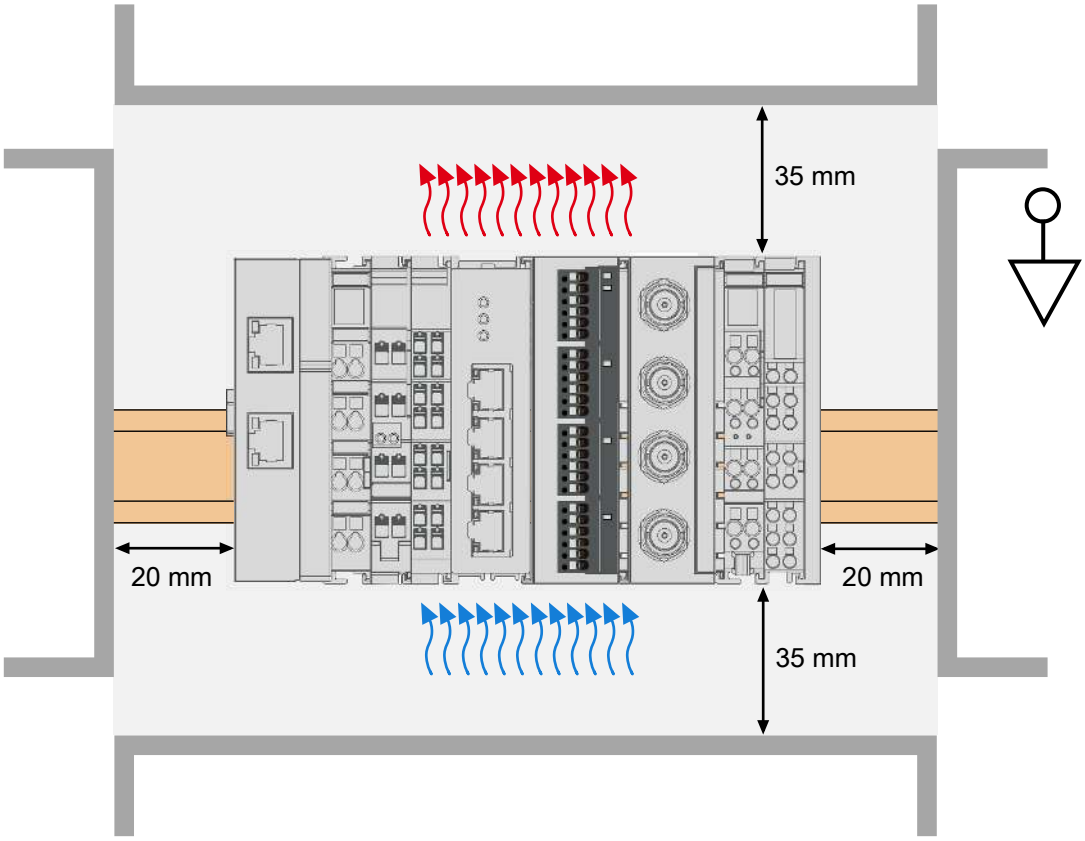


Fig. 20: Recommended minimum distances for standard installation position

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 points to the front.
The devices can be arranged as follows:

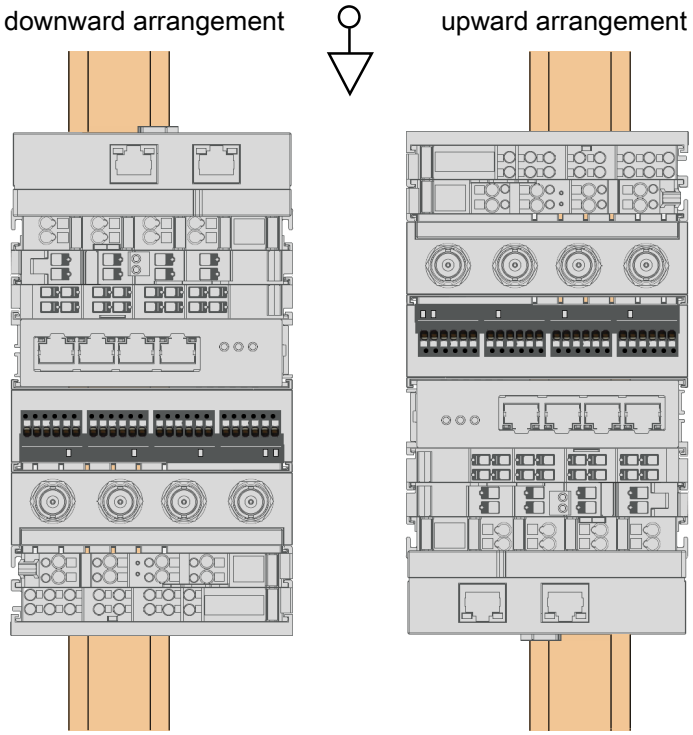


Fig. 21: Installation position Vertical, downward arrangement (left) / upward arrangement (right)

Flat installation

In the flat installation position, the mounting rail is laid on a horizontal mounting plate.
The connection level of the devices points upwards.

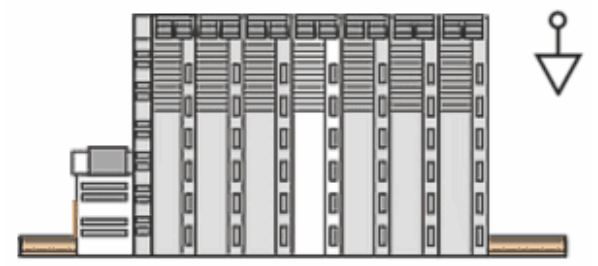


Fig. 22: Flat installation position

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. The 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.).

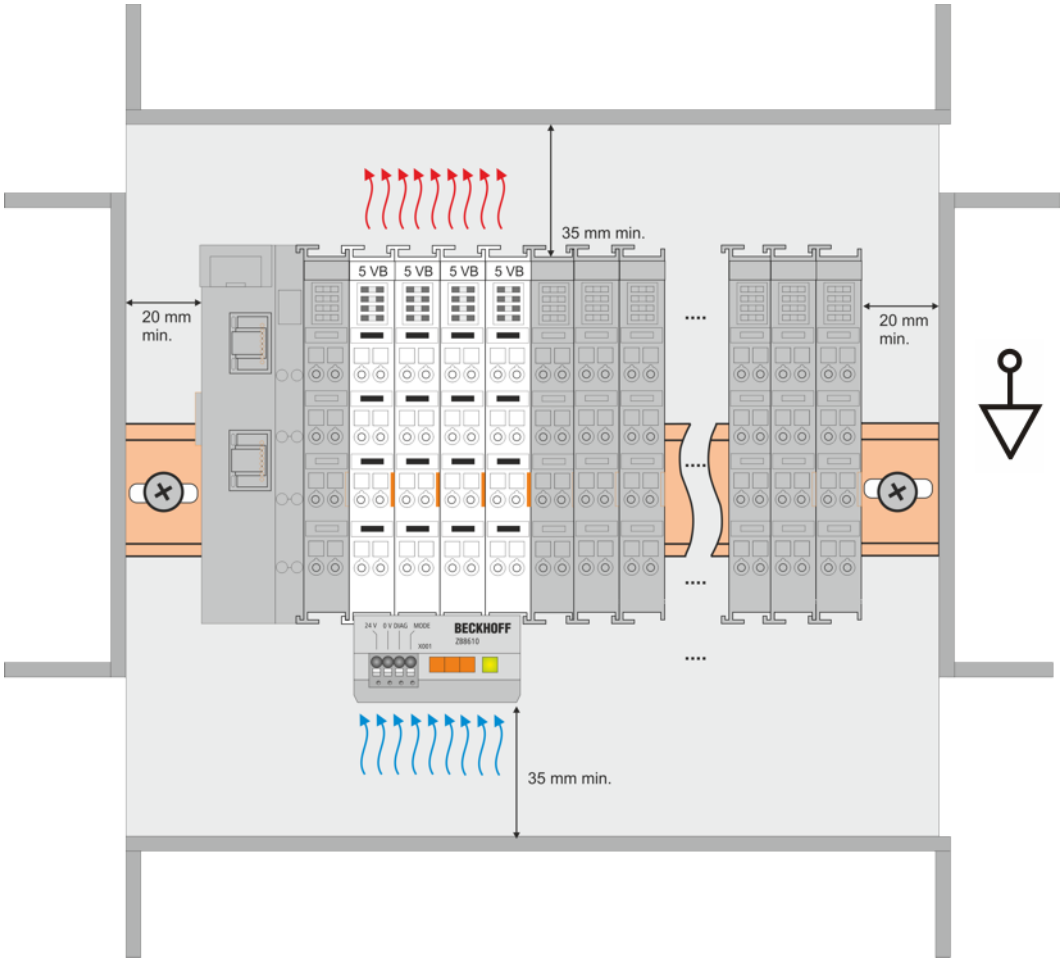


Fig. 23: Recommended minimum distances for operation with fan, using horizontal installation position as an example

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 electric shock and damage of device!

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

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 [▶ 42]" section).

Ultrasonically compacted strands

Ultrasonically compacted (ultrasonically welded) strands 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!

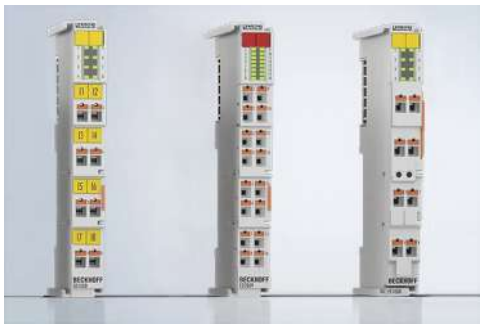


Fig. 24: Tool-free push-in connection; housing types ED-12-8pin, ED-12-16pin and EF-12-8pin

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

- The terminal blocks of the EC/EDxxxx series contain electronics and connection level in one housing.
- The terminal blocks in the EFxxxx series have a pluggable connection level. In the case of service, 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 component to be replaced 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 enclosure designs

EC/EDxxxx housing designs, contain the electronics and connection level in one housing	EFxxxx Enclosure 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 Wiring with push-in connection technology EC/ED/EFxxxx

⚠ WARNING

Risk of electric shock and damage of device!

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

1.) Tool-free connection for solid conductors and Conductors with ferrules

2.) Connection by push-button actuation for stranded wire conductors and loosening the conductor (with tools)

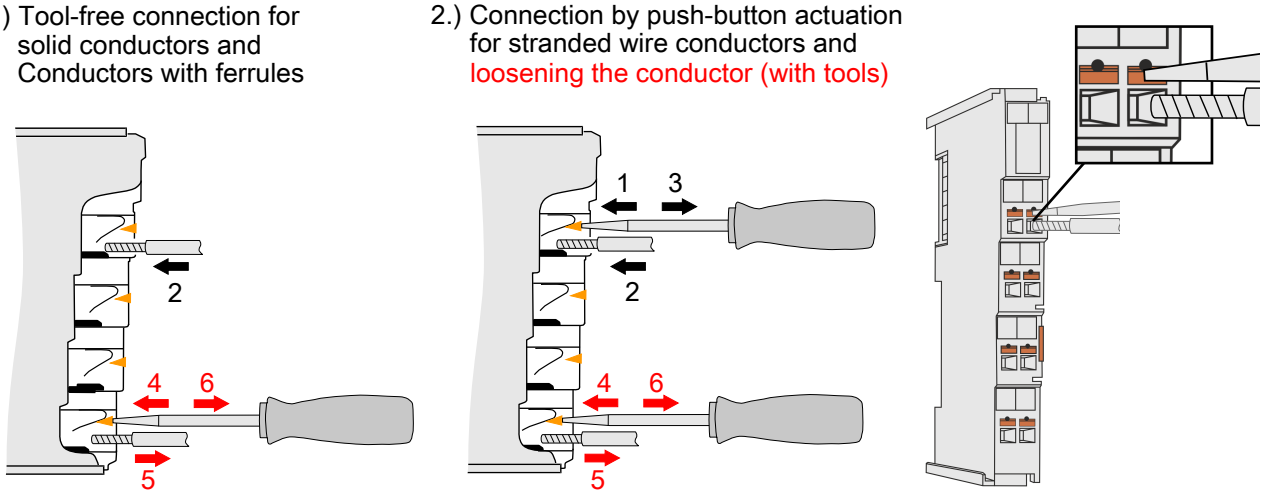


Fig. 25: Wiring and disconnecting the conductors

1. **Connect solid conductors and conductors with ferrules (Fig. top left, step 2)**
   These can be connected using the direct plug-in technique without tools.
   - Insert the conductor into the terminal point after stripping the insulation (2)
2. **Connect fine-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).

Release cables (Fig. above steps 4 - 6)
The release is carried out for all conductor types using the push-button.

- 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 strip lengths

The permissible conductor cross-section and strip 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

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

3.6 Note - power supply

⚠ WARNING

Power supply from SELV / PELV power supply unit!

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

Notes:

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

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

NOTICE

Further information

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

⚠ 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!

4.1 Commissioning ED407x/EL407x

4.1.1 General information on commissioning the ED407x/EL407x

- The ED407x/EL407x terminals ED4072/EL4072, ED4074/EL4074, ED4078/EL4078 are functionally identical except for the number of channels; the EL4072 is used as an example below.
- The output channels are set by default to Interface ±10 V, Floating Point, Extended Range.

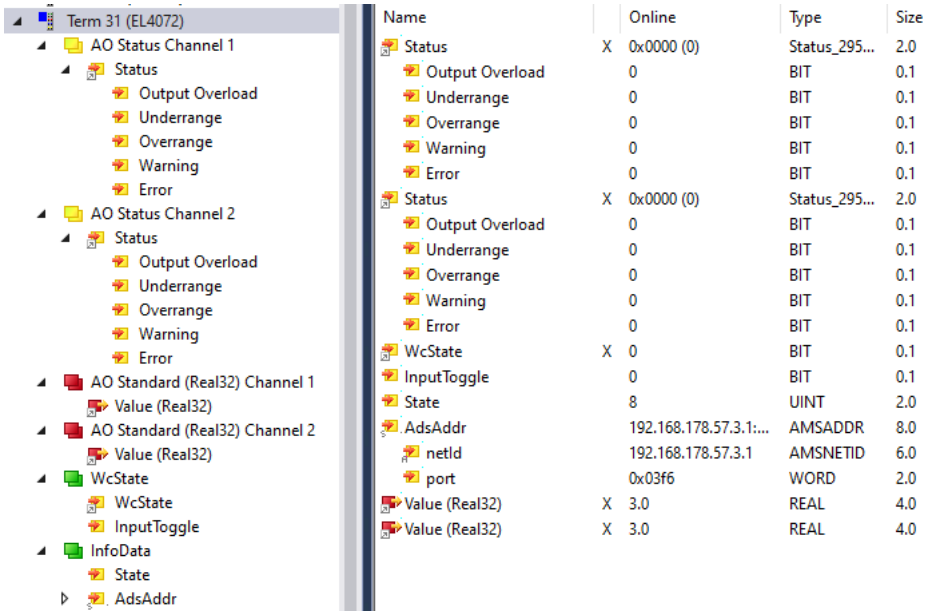


Fig. 26: TwinCAT tree /EL4072, online values as an example

- Time-based operating behavior of the ED/
  The terminals support the following EtherCAT operation modes
  - FreeRun: no
  - SM-synchron (frame triggered): yes
  - DistributedClocks: no

The terminals support EtherCAT cycle times of up to 50 µs, but the following minimum cycle times are recommended for precise value output:
- ED4072/EL4072: >= 150 µs
- ED4074/EL4074: >= 250 µs
- ED4078/EL4078: >= 500 µs

If these values are not reached, it is not guaranteed that the analog value output will start in the corresponding output cycle. There may be a delay in output in the order of a few cycles. The fact that the internal analog value output can no longer follow the cycle can be seen from the incrementing of the local "SM Output" error counter CoE 0x1C32:0C.

Example EL4078:

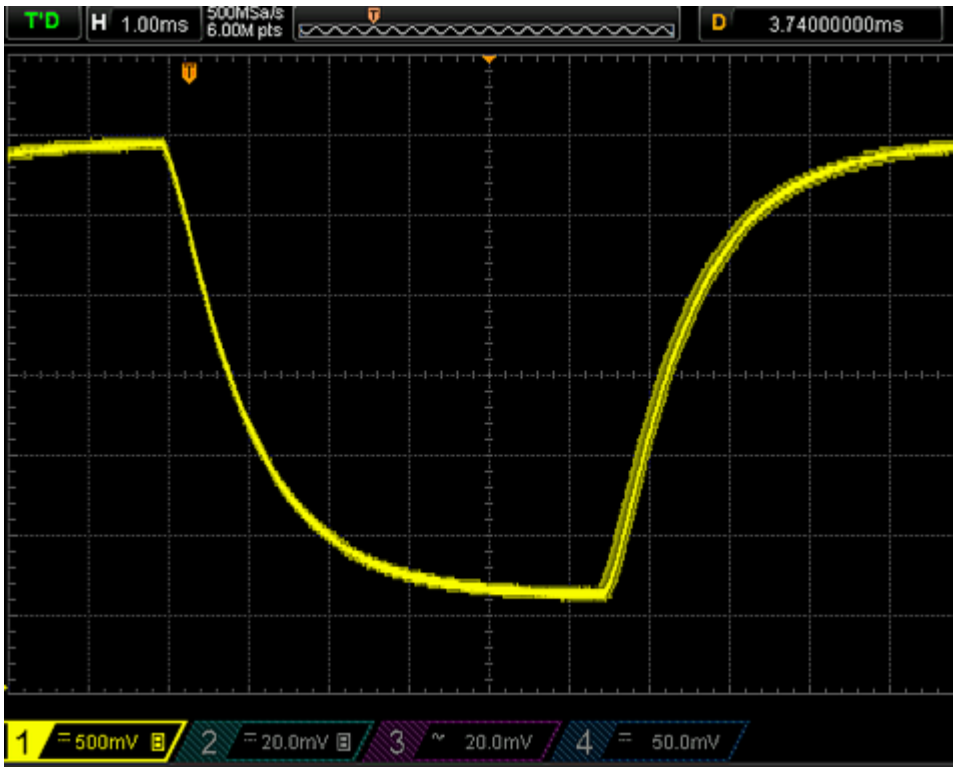


Fig. 27: EL4078 with 500 µs EtherCAT cycle time, output jitter according to theory ±0.5 cycle

Fig. 28: EL4078 with 100 µs EtherCAT cycle time, output jitter > 1 ms

If such precise analog value output timing is required, the EL41xx or EL47xx series should be used.

- The terminal contains several functions that are controlled
  - by enabling/disabling cyclic process data (PDO) at commissioning time in the EtherCAT master
  - by setting/changing so-called CoE settings in the device, this can be done during runtime

  The functions of this terminal are explained in the following commissioning chapter.
- for CoE parameterization:

- CoE registers are named below, the "n" in the index stands for the channel number in the terminal: Channel 1: n=0, channel 2: n=1,…
- The CoE values cannot be read in real-time; they are updated in the online display in TwinCAT approx. every second, or can be get (or written, depending on the type) from the controller via ADS with an update rate of up to a few ms (depending on the EtherCAT cycle time).

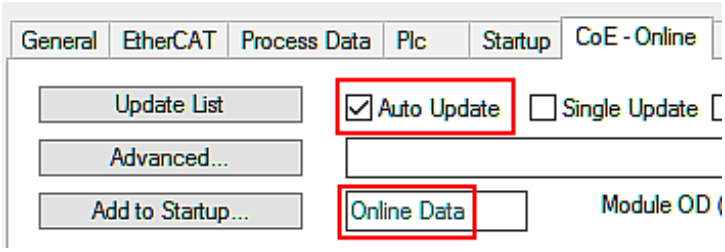


Fig. 29: CoE online tab

- Before initial commissioning, it may be useful to reset the CoE parameters of the terminal using CoE reset by entering the value after 0x1011:01; this covers all channels
  (see chapter "Restoring the delivery state [▶ 116]")

- "Default" or "Default setting" means that the setting named in this way is the basic setting ex factory or CoE reset.
  -

4.1.2 Device diagnostic functions

The following ED407x/EL407x device information can be read from the CoE:

Index	Name	Meaning
0xF900:01	Power Good	FALSE: there is approx. <20.4 V at the power contacts. Operation of the device below this limit is not recommended. Overvoltage is not monitored.
0xF900:11	Operating Time	operating time of the device in [min], cannot be deleted
0xF900:12	Device Temperature	current internal terminal temperature in [°C]. Note: this value depends on the installation position, it is usually well above the ambient temperature.
0xF900:13	Min. Device Temperature	minimum value ever observed by the terminal in [°C], cannot be deleted
0xF900:14	Max. Device Temperature	maximum value ever observed by the terminal in [°C], cannot be deleted

The status of the 5 terminal LEDs can be read electronically as follows:

Index	Name	Meaning
0xF915:01	RUN	RUN-LED
0xF915:09	Error Ch.1	LED channel 1 (AI)
0xF915:0A	Error Ch.2	LED channel 2 (AI)
0xF915:0B	Error Ch.3	LED channel 3 (AO) (if present)
0xF915:0C	Error Ch.4	LED channel 4 (AO) (if present)
0xF915:0D	Error Ch.5	LED channel 5 (AO) (if present)
0xF915:0E	Error Ch.6	LED channel 6 (AO) (if present)
0xF915:0F	Error Ch.7	LED channel 7 (AO) (if present)
0xF915:10	Error Ch.8	LED channel 8 (AO) (if present)

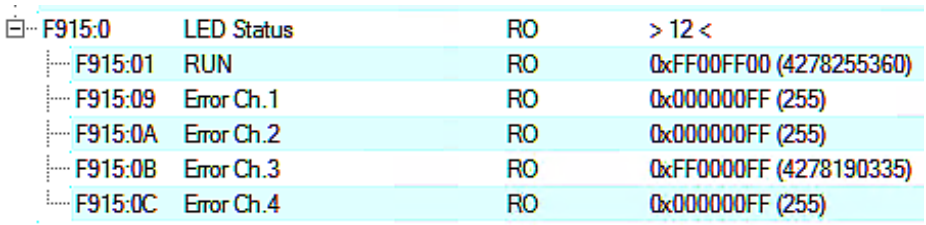


Fig. 30: Subindices Index F915, example values EL4074

The status of the optical displays (LEDs) in the device can be read out electronically in CoE 0xF915 LED Status, e.g. for simultaneous LED display in the visualization.

These are four bytes that describe the RGB value and the light status:

```
0x 12 34 56 78
   |  |  |  \---- Red
   |  |  \------- Green
   |  \---------- Blue
   \------------- Blink
```

- Byte 1 (from left to right): Flashing/lighting code
  - 0x00: Off/ not available
  - 0x01…0x14: 1..20 Hz
  - 0x80: EtherCAT PreOp
  - 0x81: EtherCAT SafeOp
  - 0x82: EtherCAT Boot
  - 0xFF: On/ available

- Byte 2..4:
  - 0x00: Off
  - 0xFF: On

Examples:

- 0x 00 00 00 00: LED not present
- 0x FF 00 00 00 : LED is on, RGB =0, i.e. not illuminated, meaning: LED is present

```
0x 00 00 00 FF : LED off (Red)
0x 00 00 FF 00 : LED off (Green)
0x 00 FF 00 00 : LED off (Blue)
0x 00 00 FF FF : LED off (Yellow)
0x 00 FF FF FF : LED off (White)
```

```
0x FF 00 00 FF : LED on  (Red)
0x FF 00 FF 00 : LED on  (Green)
0x FF FF 00 00 : LED on  (Blue)
0x FF 00 FF FF : LED on  (Yellow)
0x FF FF FF FF : LED on  (White)
```

Fig. 31: Examples LED status

4.1.3 Diag-Messages

The terminal provides the following diagnostic messages:

Diag-Code	Meaning	TwinCAT Message	Troubleshooting
#x0001	no error	no error	-
#x1180	Supply voltage ok	Supply voltage ok	-
#x1707	Channel is not in overload anymore	Channel is not in overload anymore	-
#x1708	Channel %d is not in overload anymore	Channel %d is not in overload anymore	-
#x170E	No overtemperature anymore	No overtemperature anymore	-
#x170F	No overtemperature on channel %d anymore	No overtemperature on channel %d anymore	-
#x1710	Full voltage range is available again	Full voltage range is available again	-
#x4101	Terminal-Overtemperature	Terminal-Overtemperature	Device is too warm internally, but continues to work, ensure cooling
#x4102	Overtemperature on channel %d	Overtemperature on channel %d	Device is too warm internally, but continues to work, ensure cooling
#x4710	More than four channels configured for current output, voltage output is limited to ±5 V	More than four channels configured for current output, voltage output is limited to ±5 V	If > ±5 V is required on the U channels, other outputs/devices must be used to output the current values.
#x8144	Hardware fault %d	Hardware fault %d	Check load, measure output function externally, contact support if necessary
#x8601	Supply voltage too low	Supply voltage too low	Check voltage of power contacts Up
#x8707	Channel overload (Channel %d)	Channel overload (Channel %d)	Check wiring and load, possibly short circuit/ OpenLoad?
#x870A	Range error of channel %d	Range error of channel %d	External voltage applied to the channel?

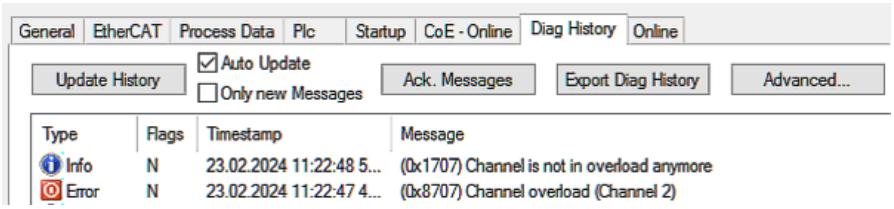


Fig. 32: Display in TwinCAT 3.1

The error states are expressed as follows

Error	PDO Status.Overrange Status.Underrange	PDO Status.Error (channel by channel)	PDO Status.Warning (channel by channel)	DiagMsg	Error-LED (channel by channel)
Supply UP (power contacts) too low/too high	No	No	No	Yes	All channels
Output channel overtemperature	No	No	Yes	Yes	No
Output channel overload [1)]	No	Yes	No	Yes	Yes
Output channel above/below limiter	Yes	Yes	Yes	No	Yes
Device overtemperature	No	no	All channels	yes	No

[1)] probably short circuit at voltage output and setpoint <> 0 V, probably wire break at current output and setpoint <> 0 mA

4.2 Analog output commissioning

4.2.1 Instructions for use

Parallel connection in current mode

The current outputs of the ED407x/EL407x are single-ended and can be connected in parallel to add their currents to the load. Ohm's law must be observed, the internally available output voltage does not increase!

Examples

- ED4072/EL4072, max. 750 ohm load see technical data -> 15 V output voltage is available internally -> if 100 % output (20 mA each) is required for all channels and thus ∑= 40 mA, the load must be < 375 ohm.
- ED4074/EL4074, max. 500 ohm load see technical data -> 10 V output voltage is available internally -> if 100 % output (20 mA each) is required for all channels and thus ∑= 80 mA, the load must be < 125 ohm.
- ED4078/EL4078, max. 300 ohm load see technical data -> 6 V output voltage is available internally -> if 100 % output (20 mA each) is required for all channels and thus ∑= 160 mA, the load must be < 37 ohm.

Output behavior, rise time

You can expect approx. 3 ms for 0->90 % and approx. 6 ms for 0->100 %

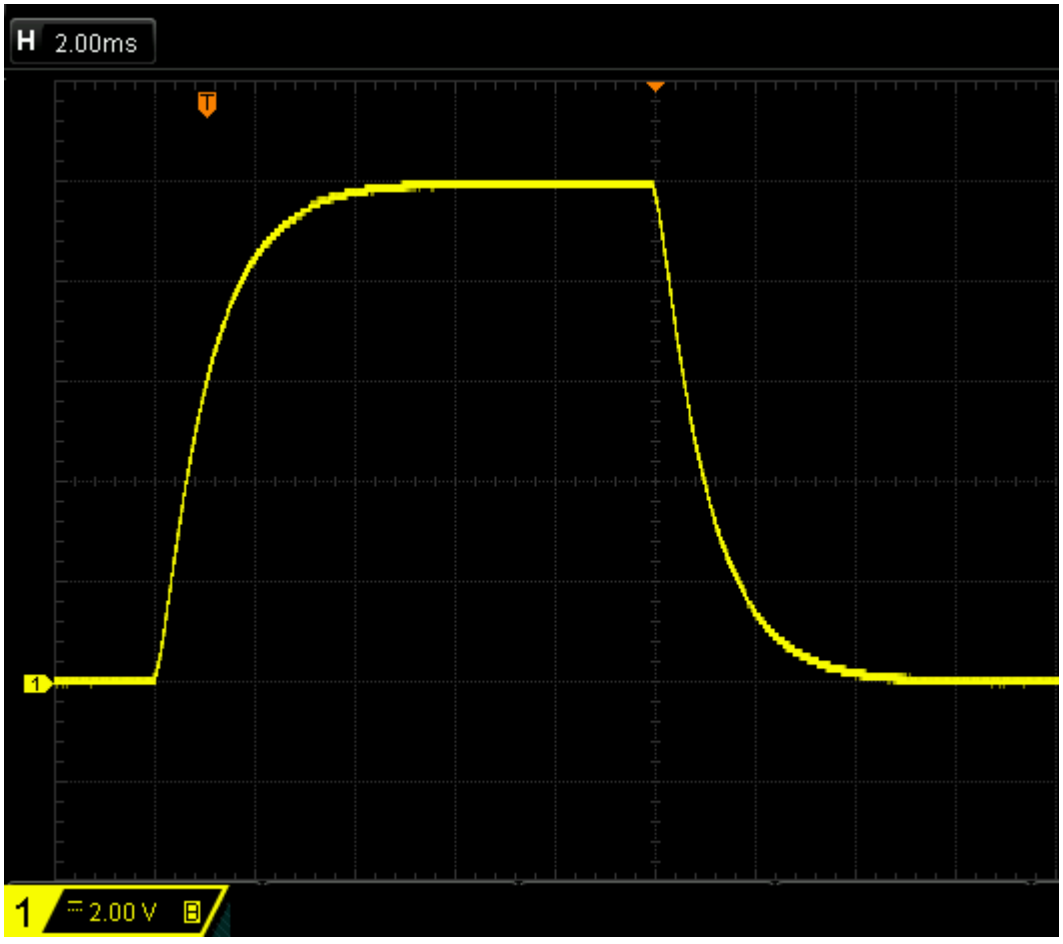


Fig. 33: Rise time representation

Output behavior, dynamics

The output behavior is designed for a dynamic range of 2 ksps/500 µs (setpoint specification). This means that low dynamic signals are output. The output terminals of the EL41xx series are recommended for the output of frequencies above 200 Hz.

Spontaneous output when switching on/off ("glitch")

When the Us supply (E-bus) is switched on or spontaneously switched off and on again, there may be brief, independent value output in the range of a few ±10 % of the FSV for a few ms.

When the Up supply (power contacts) is switched on or spontaneously switched off and on again, there may be brief, independent value output in the range of a few ±% of the FSV for a few ms.

It is recommended that sensitive signal receivers only be switched to receive mode when the terminal/ channel

- is in the OP state
- does not report a warning or error in the PDO state

If a glitch-free output is required, output terminals from the EL417x series can be used.

4.2.2 Fast commissioning

The analog channel is set ready for operation ex factory with default settings for the 10 V output and FloatingPoint PDO (Real32). Experienced users can read immediately by:

- Scan the terminal in TwinCAT (or add it manually in the configuration, paying attention to the EtherCAT Revision!)
- Reload in TwinCAT

Put into operation and output a value via OnlineWrite/OnlineForce or linked to the PLC:

Name	Online	Type
Value (Real32)	4.256	REAL
Value (Real32)	0.0	REAL

Fig. 34: Output of 4.256 V on channel 1

To gain a deeper understanding of the capabilities of this product, it is recommended that you read the following sections.

4.2.3 Commissioning of the analog output

4.2.3.1 Data flow AO (Analog Output)

The signal acquisition and data processing of the analog output of this product is as follows:

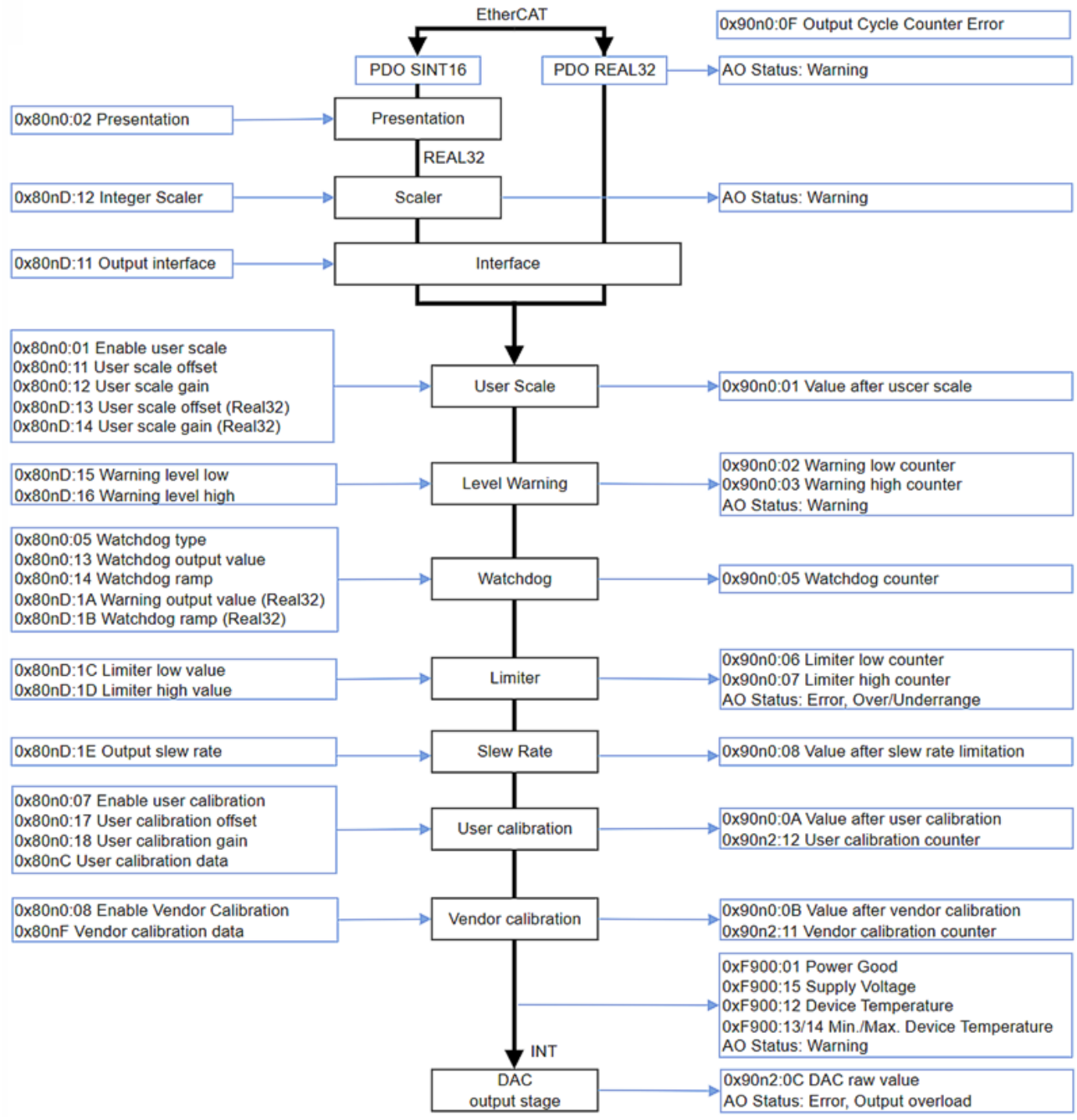


Fig. 35: Data flow of the analog output

Data flow diagram legend	
Left column	Changeable parameters (CoE settings or status PDO) that influence processing
Middle column	Functional units
Right column	Intermediate values and results, displayed in the CoE or status PDO

This terminal calculates internally exclusively in floating point, as shown in the data flow. This considerably simplifies and shortens the commissioning of the analog channel, which minimizes errors in understanding. In addition, intermediate values along the data calculation can be easily displayed in the CoE.

The Real32 and INT16 values are defined in the CoE without units. However, the unit is determined by the context and should, wherever possible, be regarded as an SI unit. For example, the voltage is measured in volts, the current in A (even with 20 mA input!), the resistance in ohms and the ratio in V/V....

Note: Individual functional units (see data flow) have already been introduced in earlier analog devices based on INT16 (integer) and are controlled by these INT-based parameters. Such INT parameters are still supported for compatibility reasons. For example, existing code in the controller should access the CoE via ADS. This means that parameters of functional units are either

- only available as REAL32 types in the CoE if the functional unit was newly introduced with the FloatingPoint data flow, or
- are present in the CoE both as INT type and as REAL32 type with the same meaning, recognizable by the name suffix "(Real32)". The values are automatically mirrored by the firmware when they are changed or taken into account one after the other.

When re-implementing the analog function, it is recommended to use the Real32 parameters.

Commissioning of the analog output in TwinCAT should follow this data flow and is described below.

4.2.3.2 Process data format (PDO)

The PDO (Process Data Objects) are the cyclic data of the EtherCAT Subdevice transmitted in real-time, i.e. measured values and status for analog channels, but not parameters.

4.2.3.2.1 Process data configuration

The PDOs that can be used for this output channel (A) are described in TwinCAT in the PDO list (B):

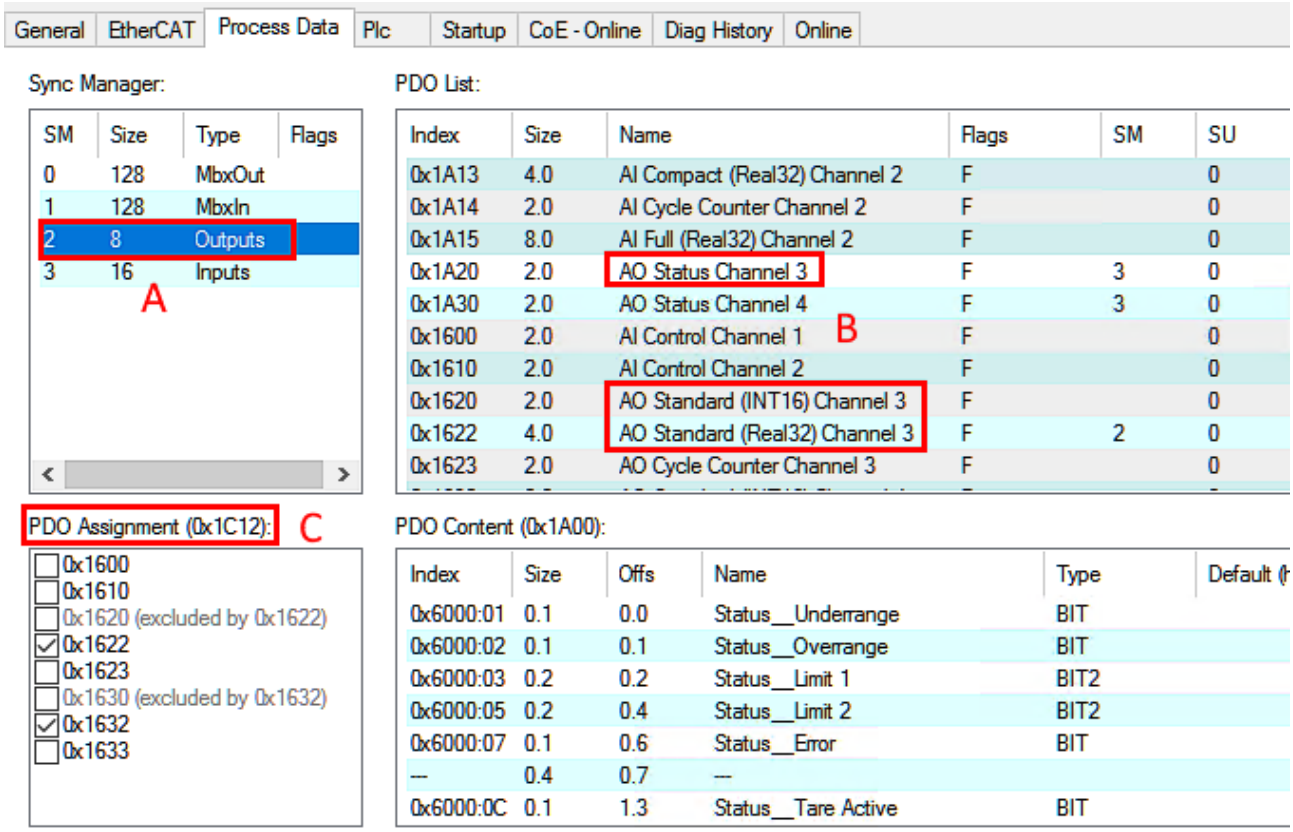


Fig. 36: Tab "Process data"

The desired PDOs can be enabled in (C), exclusions are displayed.

Each channel can be set to one of the above-mentioned process data formats, e.g. 0x1622 must be enabled for Real32 transmission on channel 1 and the control PDO 0x1621 can be added.

Alternatively, the suggested data sets can be selected from the Predefined PDO list:

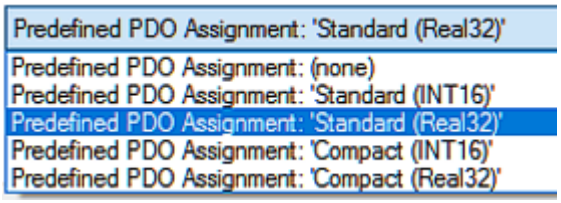


Fig. 37: Predefined PDO

This list summarizes frequently used PDO compositions for convenient choice. It should be noted that these then affect all channels at the same time.

- Standard (INT16) -> see above
- Standard (REAL32) -> see above.
- Compact (INT16) -> see above
- Compact (REAL32) -> see above.

During the PDO changeover, other functional units in the data flow may be reset to the default setting!
Therefore, the PDO decision must be made at the beginning; a change requires an *ActivateConfiguration*.

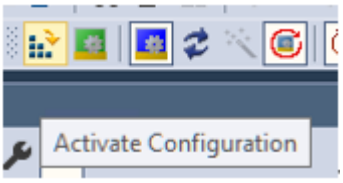


Fig. 38: Button ActivateConfiguration/ReloadDevices

4.2.3.2.2 AO Setpoint transport

The following chapters describe the operation of the PDO *Value* (setpoint specification for the analog output channel, Analog Output = AO).

Floating point output (Real32, default setting of the channel)

The channel expects its analog setpoint as a plain text-readable floating point value, both readable in the TwinCAT configuration

Name		Online	Type	Size
Value (Real32)	X	2.3242424	REAL	4.0

Fig. 39: Value (floating point value), TwinCAT

as well as in the PLC Online View:

Expression	Type	Value	Prepared value	Address
rOut1	REAL	7.310994		%Q*

Fig. 40: Value (REAL) in PLC

The Real32 PDO can simply be linked to a REAL variable in PLC:

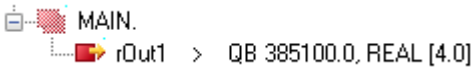


Fig. 41: Linking with REAL variable

This type of transmission avoids scaling errors, as the channel itself takes into account the output range (including any range changes), commissioning and troubleshooting are considerably simplified.

Even if no unit (V, A, Ω, ..) is formally transmitted, the SI unit corresponding to the context must be used, i.e. [A] and not [mA] for a 20 mA input.

If a setpoint outside AEW_{techn} (output end value) is requested by the terminal, it outputs the respective maximum value and displays PDO "AO Status Overrange/Underrange + Warning":

State	Output
Setpoint > AEW_{techn}	"Overange" + "Warning", output AEW_{techn}
Setpoint < AEW_{techn}	"Underrange" + "Warning", output -AEW_{techn}

Integer output (fixed point, INT16 or SINT16)

The channel expects its setpoint as a 16-bit fixed-point value (default incl. sign, signed integer), related to AEW (output end value):

Name		Online	Type	Size
Value	X	19460 <5.939>	INT	2.0

Fig. 42: Value (fixed-point value, "INT)"

The value range extends over -32767 ...0 ... 32768, knowledge of the output range is required for interpretation and transformation on the control side, e.g. 10V ~ x7FFF = 32767 in legacy presentation

If the channel is to be linked with existing PLC code, it can be converted to this INT16 format. Otherwise, the default setting "Real32" is recommended.

As no oversized values can be specified in INT16 format, no warning is evaluated.

4.2.3.2.3 AO Status

The output channel also has optional diagnostic data that can be activated as a status word:

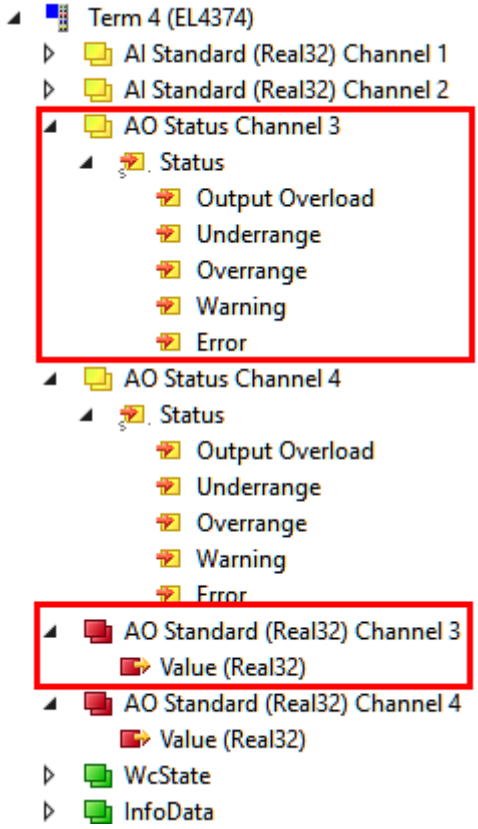


Fig. 43: Status word analog output

Interpretation:

Function [Type]	Output Overload [Bool]	Under-range [Bool]	Over-range [Bool]	Warning [Bool]	Error + Error-LED [Bool]	DiagMessage [▶ 51]	Meaning
Bit position (from 0)	SW.1	SW.2	SW.3	SW.5	SW.6		
	x				x	x	Analog output overload: wire break at I output, short circuit at U output
		x			x		Limiter Low limit undershot [▶ 74]
			x		x		Limiter High limit exceeded [▶ 74]
		x		x			Real32 setpoint < AEW_{techn}
			x	x			Real32 setpoint > AEW_{techn}
					x		DAC error
				x		x	Warning Level Low/High exceeded [▶ 69] Internal overtemperature detected -> cooling required Voltage at the power contacts too low (see 0xF900:01/15 Device information: Output operation not protected!)

4.2.3.2.4 AO Continuity counter

The output channel should cyclically receive its current setpoint from the controller via EtherCAT, see *PDO Value*.

During the commissioning phase and possibly also during ongoing operation, it may be useful to monitor the regular and timely arrival of the setpoint at the device. For this purpose, the 16-bit counter *Output Cycle Counter* can be enabled channel by channel in the PDO assignment:

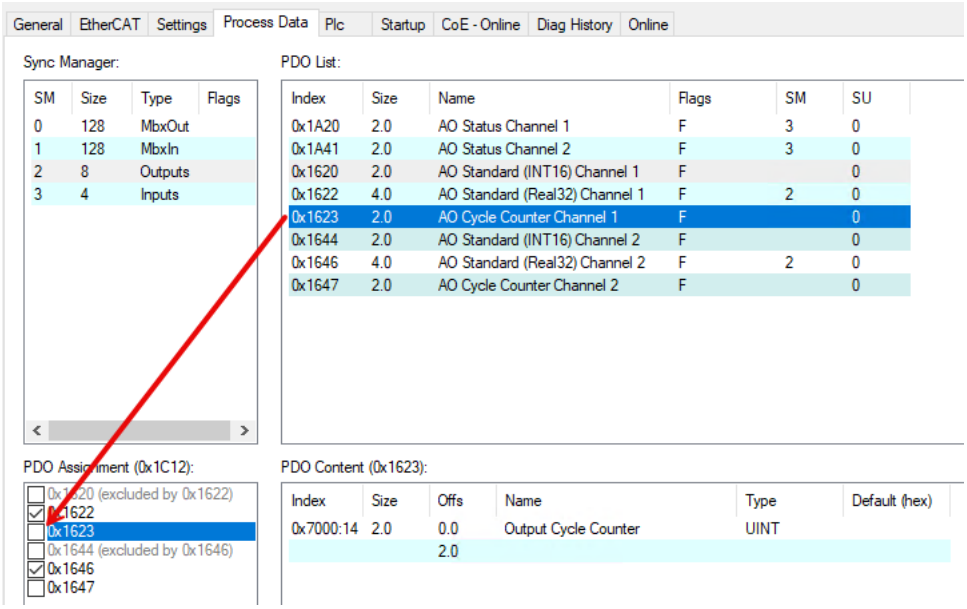
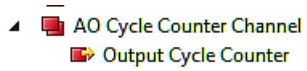


Fig. 44: Enabling 16-bit counter via PDO assignment 0x1623

The respective PDO is then offered for linking in the variable list:



If enabled, the variable is to be operated cyclically with +1 from the controller.
The channel now monitors the counter; if a change > +1 is observed, the channel increments the error counter in CoE 0x90n0:0F by +1. The overflow in the 16-bit value is taken into account. The error counter must be regularly read from the control via ADS and checked.

4.2.3.3 Integer scaler (only when using PDO SINT16)

It may be useful to output analog values slightly beyond the nominal output range AEW_{nom}, e.g. to compensate for power losses or to transport diagnostic information. For this reason, the optional Extended Range "107%" has been introduced in Beckhoff analog channels (support depends on the device). The definition for 16 bits is as follows:

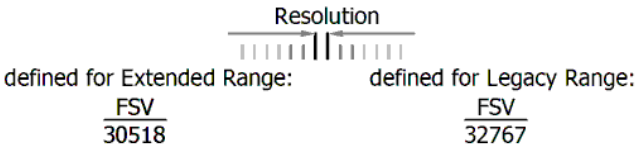


Fig. 45: Defined resolution, 16-bit

Setting:

- Index 80nD:12 = Extended Range Range (default setting)
  The channel operates up to the technical output range AEW_{techn}, which is approx. 107% of the nominal output range.
  For the Extended Range, 16-bit SINT PDO (16 bits + sign) is the nominal. AEW= 100%, the PDO value ±30518 (0x7736) has been set. Accordingly, the displayable output range now extends to 0x7FFF = 32767 ~ 107.37% of the nominal output range.
- Index 80nD:12 = Legacy Range
  The channel operates up to 100% of the nominal output range.
  Accordingly, 0x7FFF = 32767 is to be interpreted as 100% of the nominal AEW.

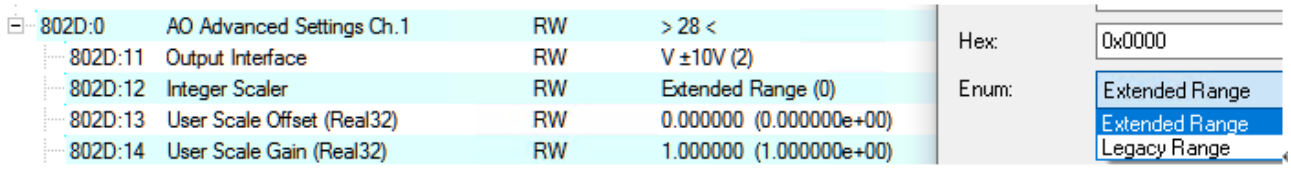


Fig. 46: Setting Index 80nD:12, Legacy Range, Extended Range

Depending on the interface, this means the conversion SINT16 -> Real32 in the controller:

Output range ±10 V (bipolar)

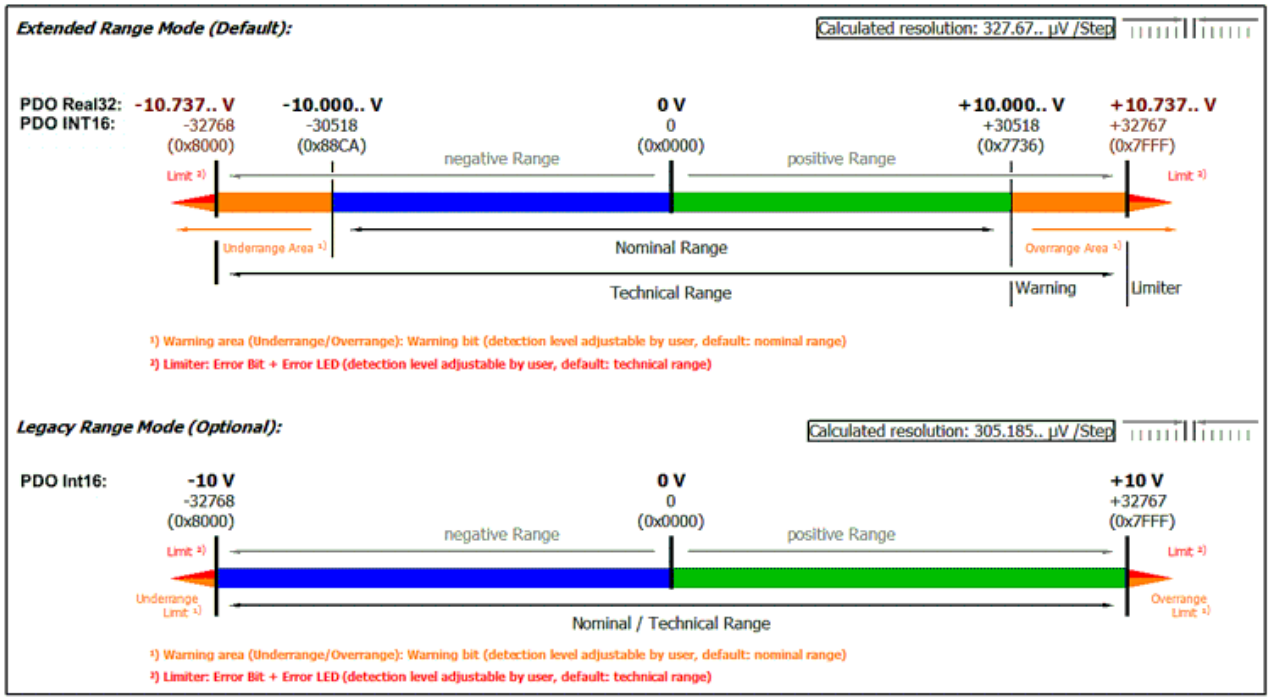


Fig. 47: Output range ±10 V (bipolar)

Output range 0...10 V (unipolar)

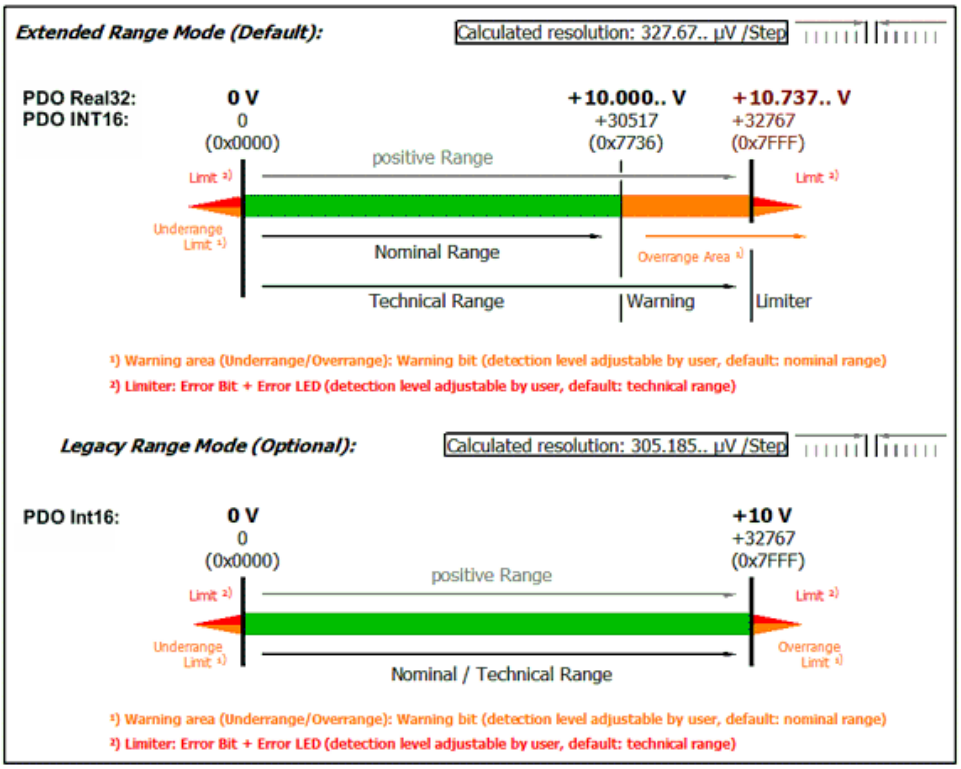


Fig. 48: Output range 0 - 10 V (unipolar)

Output range ±20 mA (bipolar)

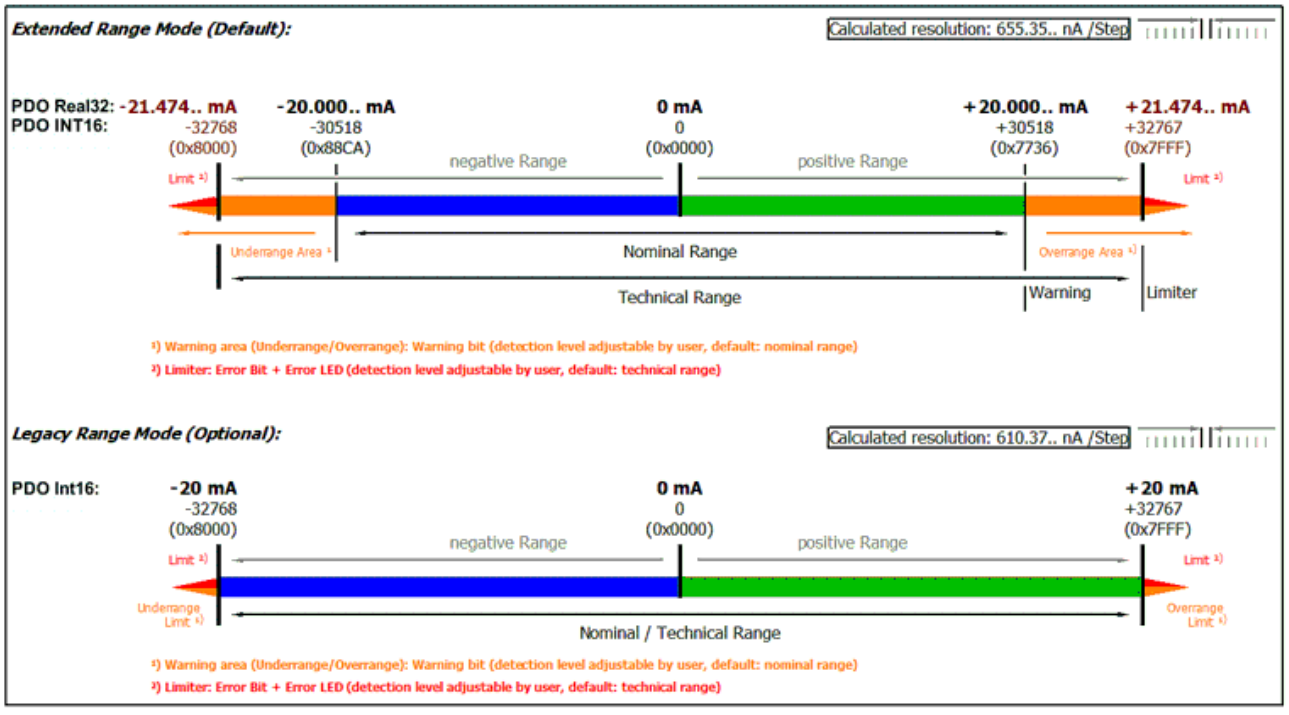


Fig. 49: Output range ±20 mA (bipolar)

Output range 0...20 mA (current loop)

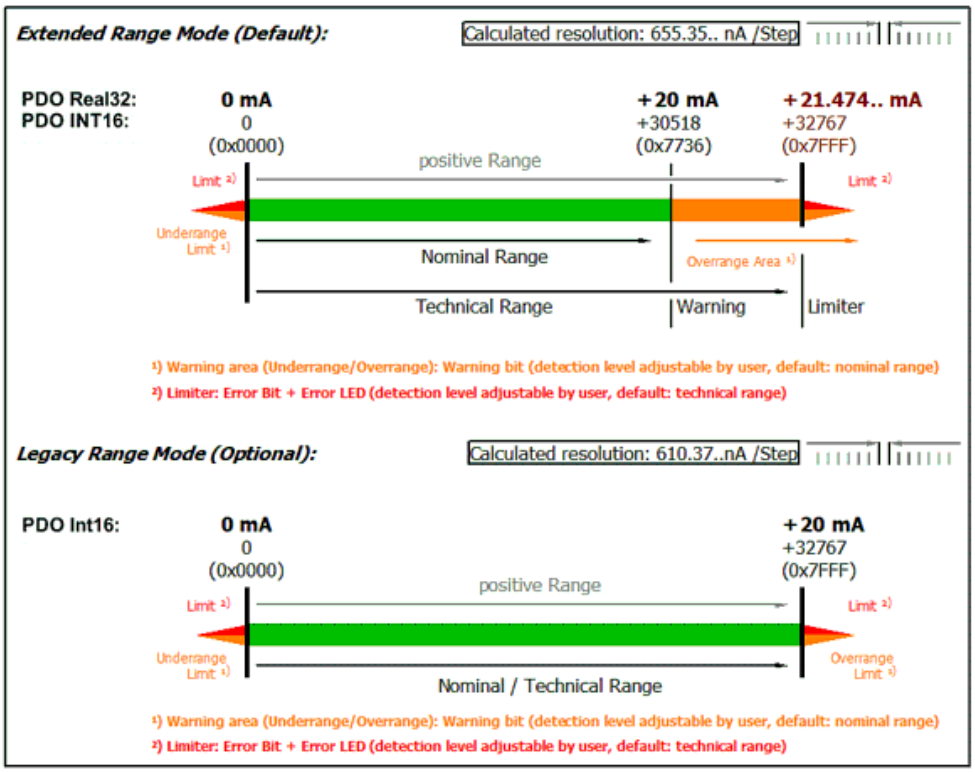


Fig. 50: Output range 0...20 mA (current loop)

Output range 4...20 mA (current loop)

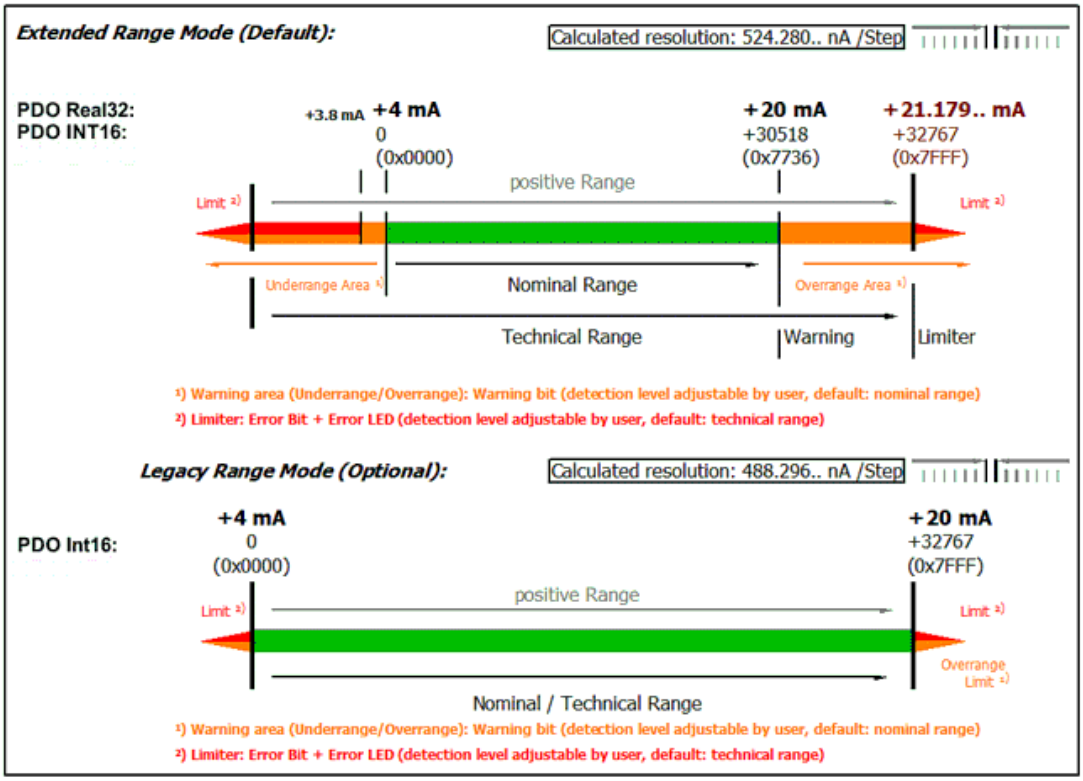


Fig. 51: Output range 4...20 mA (current loop)

4.2.3.4 Presentation (only when using PDO SINT16)

For historical reasons, there are various formats in which the 16 bits of the SINT PDO (Signed Integer Process Data Object) can be interpreted.
The format can be set in the index 80n0:02 .

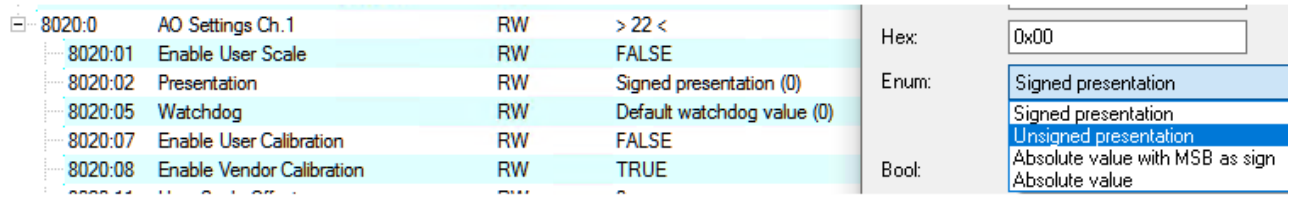


Fig. 52: PDO 80n0:02, "Presentation"

This analog channel supports:

- "Signed" (default): top/highest/0. Bit is sign, negative number in 2's complement in bit 1..15
- "Unsigned": all 16 bits are used for the amount of the analog value, resulting in double resolution for positive analog values. No transmission of negative values possible.
- "Absolute Value with sign": top/highest/0. Bit is sign, bits 1..15 carry the amount of the analog value
- "Absolute Value": the sign of the analog value is ignored, only the (positive) amount in bit 1..15 is transmitted

Legacy Range	Extended Range	Representation (values dec. / values hex.)			
		unsigned integer		Abs. value w. MSB as sign	
		Dec	Hex	Dec	Hex
100%	107.37%	32767	0x7FFF	32767	0x7FFF
-	100%	30518	0x7736	30518	0x7736
0%	0%	0	0x0000	0	0x0000
-	-100%	30518	0x7736	[-30518]	0xF736
-100%	-107.37%	32767	0x7FFF	[-32767]	0xFFFF

Presentation types

The presentation types "Unsigned integer" and "Absolute value with MSB as sign" have no function for unipolar terminals. There is no change in the presentation in the positive range.

4.2.3.5 Interface

The interface setting is fundamental for operation as an electrical output.

Setting: CoE 0x80nD:11 Output interface

Setting	Measuring range
None	-
V	±10 V
V	0-10 V
I	±20 mA
I	0-20 mA
I	4-20 mA

Note: When the interface is changed, the following CoE parameters of UserScale, Warning Level, Limiter, Output SlewRate, Watchdog are reset to the default setting.

4.2.3.6 Setpoint processing, User Scale

The digital setpoint sent from the controller to the analog output channel must or can be changed in the device in order to

- reinterpret the measured value on the application side (e.g. convert the electrical 0..10 V signal of a pressure sensor into a pressure value)
- compensate for hardware dependency (keyword: calibration)

The output value / setpoint can be changed in 3 functional units, all 3 can be active at the same time:

- User Scale
- User calibration [▶ 77]
- Vendor calibration [▶ 77]

The User Scale functional unit is intended for reinterpretations/transformations of the setpoint, so "50 kg" of the controller can become "10 V" with Gain=0.2. It is implemented as a linear transformation with gain/offset.

Parameter:

Index	Name	Data type	Meaning
80n0:01	Enable User Scale	BOOL	disabled by default, calculation only takes place if TRUE
80n0:11	User Scale Offset	SINT16	is added directly in digits.
80n0:12	User Scale Gain	UINT16	1 bit corresponds to 2^{-16}, so "1" corresponds to $x7FFF/32767_{dec}$
80nD:1D	User Scale Offset (Real32)	REAL32	-
80nD:1E	User Scale Gain (Real32)	REAL32	-

The intermediate value after this functional unit can be viewed in index 90n0:01.

NOTICE

Changing the interface

When changing the interface, the gain and offset are reset to 1 and 0 respectively!

4.2.3.7 Level Warning

The output channel makes it possible to return a warning to the controller if a permissible value range is exceeded. This can be used, for example, to detect rare or invalid output values. There is no limit to the output value. The Limiter should be used for this function.

The limits are set to the output range limits by default and after changing the interface.

Parameter:

Index	Designation
80nD:15	Warning Level Low
80nD:16	Warning Level High

Results:

PDO AO Status -> Warning		
Index	**Designation**	**Meaning**
90n0:02	Warning Low Counter	counts +1 when falling below x80nD:15, stored secured against power failure
90n0:03	Warning High Counter	counts +1 when exceeding x80nD:16, stored secured against power failure

The counters are reset by

- an interface change
- or the command x401n after index FB00:01 (channel 1: n=0, channel 2: n=1, ...), the success is displayed with "255" in index FB00:03 Response.
- and the command x4001 "Reset all counters"

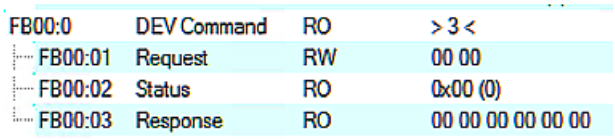


Fig. 53: CoE Index FB00, DEV Command

During command execution, "Status" 255 "busy" is displayed in index FB00:02, "0" means "successfully completed"
The firmware responds to an unknown command with

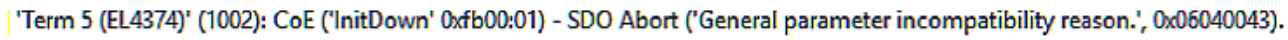


Fig. 54: General parameter incompatibility reason, 0x06040043

4.2.3.8 Watchdog

This output channel is equipped with a safety device (watchdog). This moves the output to a predefined setpoint if process data traffic to the output device is interrupted.

Setting the watchdog time

The watchdog time, i.e. the time at which the watchdog case is triggered, is set via the general TwinCAT dialog "Advanced Settings" -> General -> Behavior -> Watchdog -> "Set Multiplier" and "SM Watchdog" (SM = SyncManager).

Notes on settings

- The setting will only take effect after activating and restarting TwinCAT!
- This setting applies to the entire device (all channels).

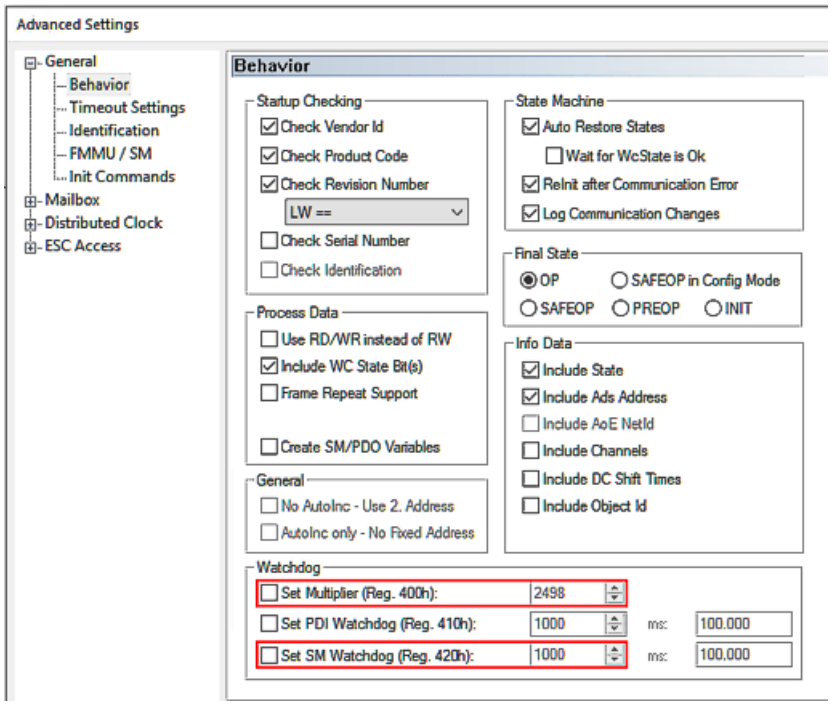


Fig. 55: Watchdog settings, here: 100 ms

Watchdog time [ms] = Multiplier * SM Watchdog [ms]

A maximum watchdog time of 65 s is possible. Larger values are calculated modulo 65, for example 70 s would be shortened to 5 s.

NOTICE

General notes on watchdog settings

Observe the general notes on the watchdog settings.

Sequence of the watchdog case

The sequence is as follows:

- As long as the channel is properly and regularly supplied with EtherCAT process data, they are output. The watchdog observes this without further action; they say "it is being brought up".
- As soon as the data no longer arrives (e.g. due to a wire break, EtherCAT master stopped, etc.), the output value remains at the last value. The watchdog now starts to run down. If data arrive again in time, the watchdog returns to the start value.
  The EtherCAT device remains in the OP state, even if it cannot be reached from the master.
- If the watchdog has expired, i.e. the time set as above has elapsed without new data arriving, the set substitute value is output.
  The EtherCAT devices returns to the Safe-OP state (recognizable by the slow flashing of the EtherCAT RUN-LED if present).
- As soon as new data arrives and the EtherCAT SubDevice has been reset to OP mode by the master (TwinCAT), it is output again and the watchdog resumes monitoring.
- The watchdog value is also output permanently and immediately (without waiting time) if the device leaves the OP state for other reasons.

Setting the watchdog behavior

The following settings can be made for the watchdog, starting from index 0x80n0:05 "Watchdog Type":

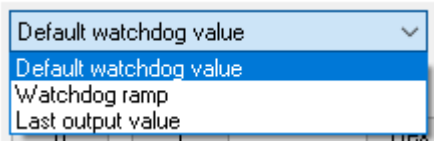


Fig. 56: Selection "Watchdog Type"

Index	Name	Flags	Value	Unit
8020:0	AO Settings Ch.1	RW	> 22 <	
8020:01	Enable User Scale	RW	FALSE	
8020:02	Presentation	RW	Signed presentation (0)	
8020:05	Watchdog Type	RW	Default watchdog value (0)	
8020:07	Enable User Calibration	RW	FALSE	
8020:08	Enable Vendor Calibration	RW	TRUE	
8020:11	User Scale Offset	RW	0	
8020:12	User Scale Gain	RW	65536	
8020:13	Watchdog Output Value	RW	0	
8020:14	Watchdog Ramp	RW	0xFFFF (65535)	
8020:15	User Calibration Offset	RW	0	
8020:16	User Calibration Gain	RW	0x7FFF (32767)	
802C:0	AO User Calibration Data Ch.1	RW	> 13 <	
802D:0	AO Advanced Settings Ch.1	RW	> 30 <	
802D:11	Output Interface	RW	V ±10V (2)	
802D:12	Integer Scaler	RW	Extended Range (0)	
802D:13	User Scale Offset (Real32)	RW	0.000000 (0.000000e+00)	
802D:14	User Scale Gain (Real32)	RW	1.000000 (1.000000e+00)	
802D:15	Warning Level Low	RW	-10.737420 (-1.073742e+01)	
802D:16	Warning Level High	RW	10.737420 (1.073742e+01)	
802D:1A	Watchdog Output Value (Real32)	RW	0.000000 (0.000000e+00)	
802D:1B	Watchdog Ramp (Real32)	RW	0.000000 (0.000000e+00)	s
802D:1C	Limiter Low Value	RW	-10.737420 (-1.073742e+01)	
802D:1D	Limiter High Value	RW	10.737420 (1.073742e+01)	
802D:1E	Output Slew Rate	RW	0.000000 (0.000000e+00)	s

Fig. 57: Indices for watchdog settings

Values Index 0x80nD, “Watchdog Value”	Meaning
Default watchdog value (default)	The analog output value is set without transition to the user-specific substitute value/setpoint according to index 0x80n0:13 or index 0x80nD:1A (default: 0)
Watchdog Ramp	Likewise, substitute value/setpoint according to index 0x80n0:13 or index 0x80nD:1B, but linear ramp to that point. The gradient of the ramp must be specified in relation to AEW_{nom} • per index 0x80n0:14 [digit/ms] • or time duration index 0x80nD:1B [sec]. If, for example, a gradient of 2 V/sec is required with AEW_{nom} = 10 V, the "Watchdog Ramp (Real32)" = 5 [sec] or (with "Extended Range" -> 327 µV/digit) "Watchdog Ramp" = 6 [digit/ms]. Default value: 0 (no ramp)
Last Output value	Last output value remains

Examples

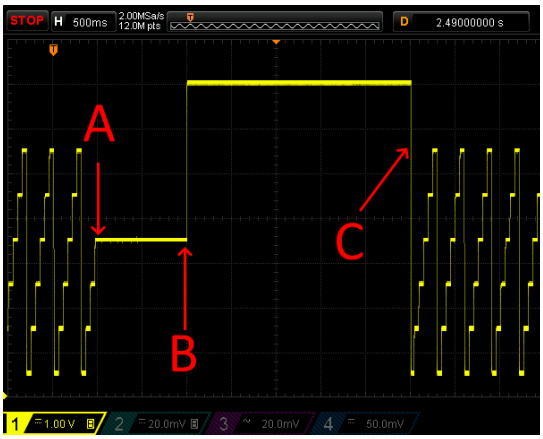
An EL4078 outputs a staircase signal, watchdog time set to 1 second, substitute value 7 V. Demonstration of various events:

1. Interruption of the EtherCAT connection

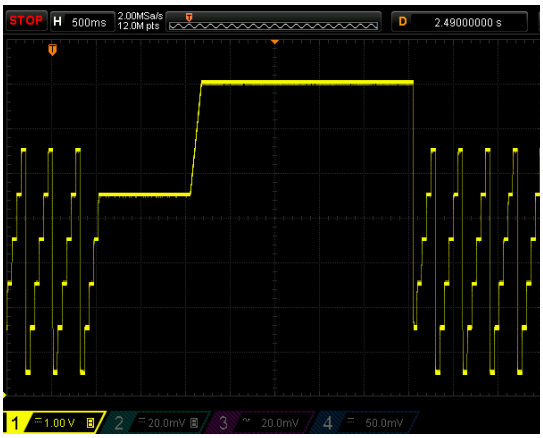
   A: Interruption, last value is output,
   Watchdog starts to run down

   B: immediate output of the substitute value after 1 second

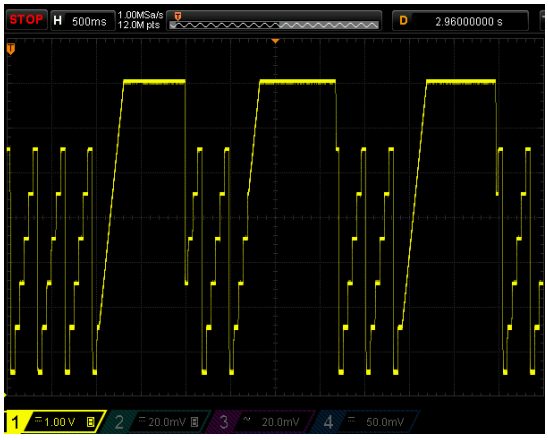
   C: EtherCAT connection restored, device in OP,
   new output data arrives



2. likewise, but with ramp 0.5 sec to the substitute value



3. Intentional EtherCAT status change
   OP -> SafeOP -> OP -> Pre-Op -> OP ->Init -> OP



Watchdog Counter

Each watchdog event is counted in index 0x90n0:05 “Watchdog Counter” (secured against power failure).

NOTICE

Note on resetting the watchdog counters

As the watchdog is a device property, it is displayed for each output channel but has the same value for all channels. When a watchdog counter is reset, all other channel-specific watchdog counters are also reset.

The counter is reset

- by the command x403n to index 0xFB00:01 (channel 1: n = 0, channel 2: n = 1, ...), the success is displayed with "255" in index 0xFB00:03 "Response".
- and by command x4001 "Reset all AO Counter"

FB00:0	DEV Command	RO	> 3 <
FB00:01	Request	RW	00 00
FB00:02	Status	RO	0x00 (0)
FB00:03	Response	RO	00 00 00 00 00 00

Fig. 58: CoE Index 0xFB00, „DEV Command“

During command execution, "Status" 255 "busy" is displayed in index 0xFB00:02, "0" means "successfully completed"
The firmware responds to an unknown command with

'Term 5 (EL4374)' (1002): CoE ('InitDown' 0xfb00:01) - SDO Abort ('General parameter incompatibility reason.', 0x06040043).

Fig. 59: General parameter incompatibility reason, 0x06040043

4.2.3.9 Limiter

The limiter makes it possible to limit the electrical output value to protect the connected signal sink.

Parameter:

Index	Designation
80nD:1C	Limiter Low Value
80nD:1D	Limiter High Value

Result:

A setpoint higher/lower than the limit values leads

- to increase +1 of the corresponding counter Index 90n0:06 "Limiter Low Counter" or Index 90n0:07 "Limiter High Counter" (stored secured against power failure)
- to display Error + Overrange/Underrange in the PDO "AO Status and Error-LED"
- to a limitation of the electrical output in the amount of the set amplitude

By default, the limiter is set to the maximum limits of the technical AEW and therefore has no effect.

The counter is reset

- by the command x402n to index FB00:01 (channel1: n=0, channel 2: n=1, ...), the success is displayed with "255" in index FB00:03 Response.
- or by the command x4001 "Reset all AO counters"
- or by changing the interface

FB00:0	DEV Command	RO	> 3 <
FB00:01	Request	RW	00 00
FB00:02	Status	RO	0x00 (0)
FB00:03	Response	RO	00 00 00 00 00 00

Fig. 60: CoE Index FB00, DEV Command

During command execution, "Status" 255 "busy" is displayed in index FB00:02, "0" means "successfully completed".

The firmware responds to an unknown command with

'Term 5 (EL4374)' (1002): CoE ('InitDown' 0xfb00:01) - SDO Abort ('General parameter incompatibility reason.', 0x06040043).

Fig. 61: General parameter incompatibility reason, 0x06040043

The limiter limits can be password protected, see section "Password protection for user data".

Example: Sawtooth 1..7 V is output and then a "Limiter High Value" of 5 V is set:

Index	Name	Flags	Value
802D:1C	Limiter Low Value	RW	-10.737420 (-1.073742e+01)
802D:1D	Limiter High Value	RW	5.000000 (5.000000e+00)

Fig. 62: Index 80nD set to 5 V

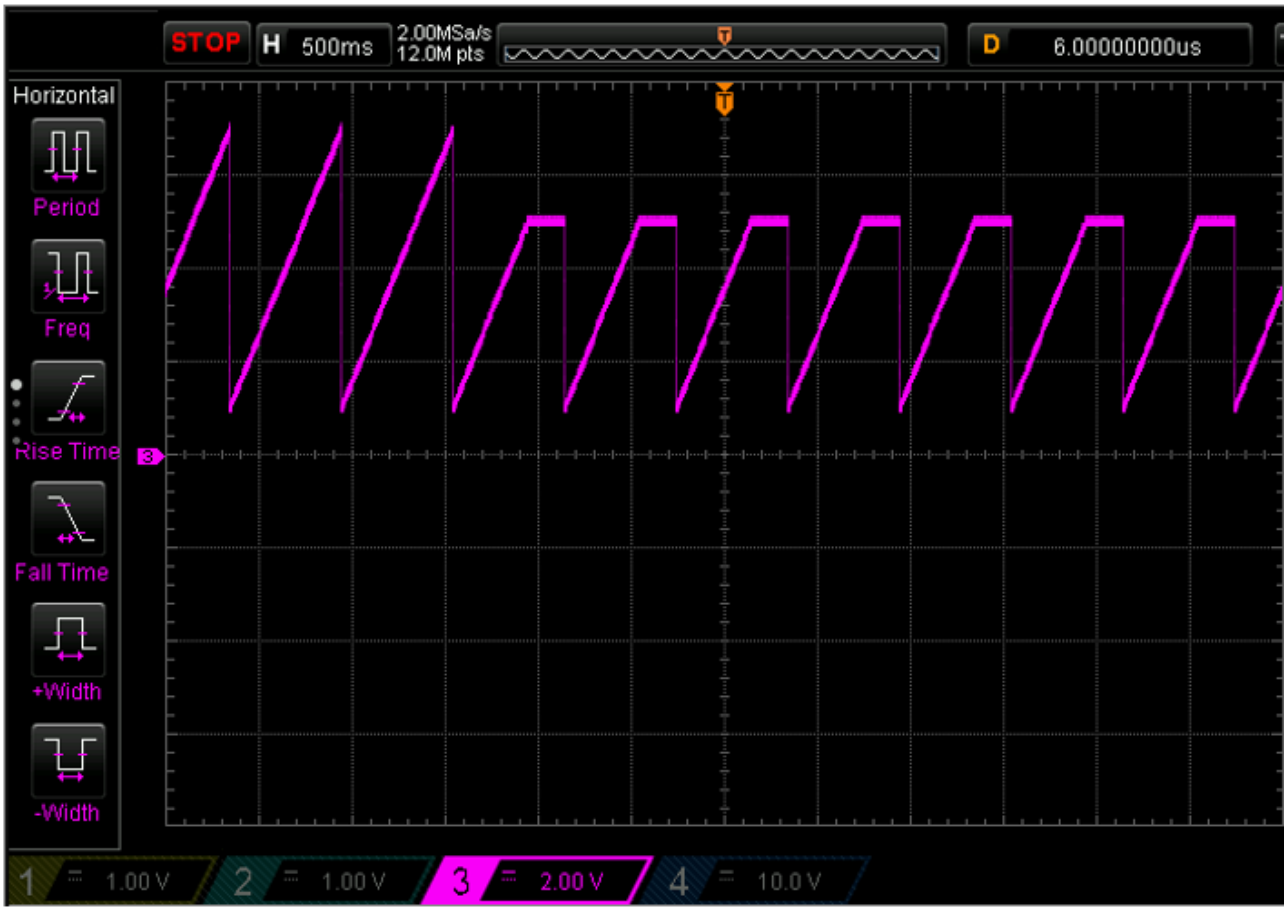


Fig. 63: Sawtooth output

The overrange is counted accordingly below:

9020:07	Limiter High Counter	RO	0x000000D8 (216)

Fig. 64: Counter overrange

Note:

⚠ CAUTION

Consider additional protective functions!

The limiter function protects the connected load from unintentionally high or low outputs, for example due to programming errors. However, it is possible that malfunctions may occur.

Depending on the expected level of damage, additional protective functions should therefore be provided. The function must not be used for functional safety purposes!

4.2.3.10 Slew Rate

The SlewRate function limits the slope with which the next setpoint is output electrically by the terminal. This serves, for example, to protect the connected signal sink or ultimately a mechanical load.

Parameter:

Index	Designation
80nD:1E	Output Slew Rate [s]

Result:

If the setpoint specification causes a higher electrical signal slope than permitted, the channel automatically reduces the setpoint change per internal cycle to the specified level. The value applies to positive and negative changes and is unsigned. The slope of the ramp must be specified in [sec] in relation to AEW_{nom}. If, for example, a maximum permitted slope of ±2 V/s at AEW_{nom} = 10 V is required, this results in an Output Slew Rate of 5 s. By default, the Slew Rate is unlimited (0).

The intermediate value after this functional unit can be viewed in x90n0:08.

Example: A rectangular output of 1 V / 6 V from the PLC is converted to a triangular output by "Output Slew Rate" = 1 s (corresponds to 10 V/s):

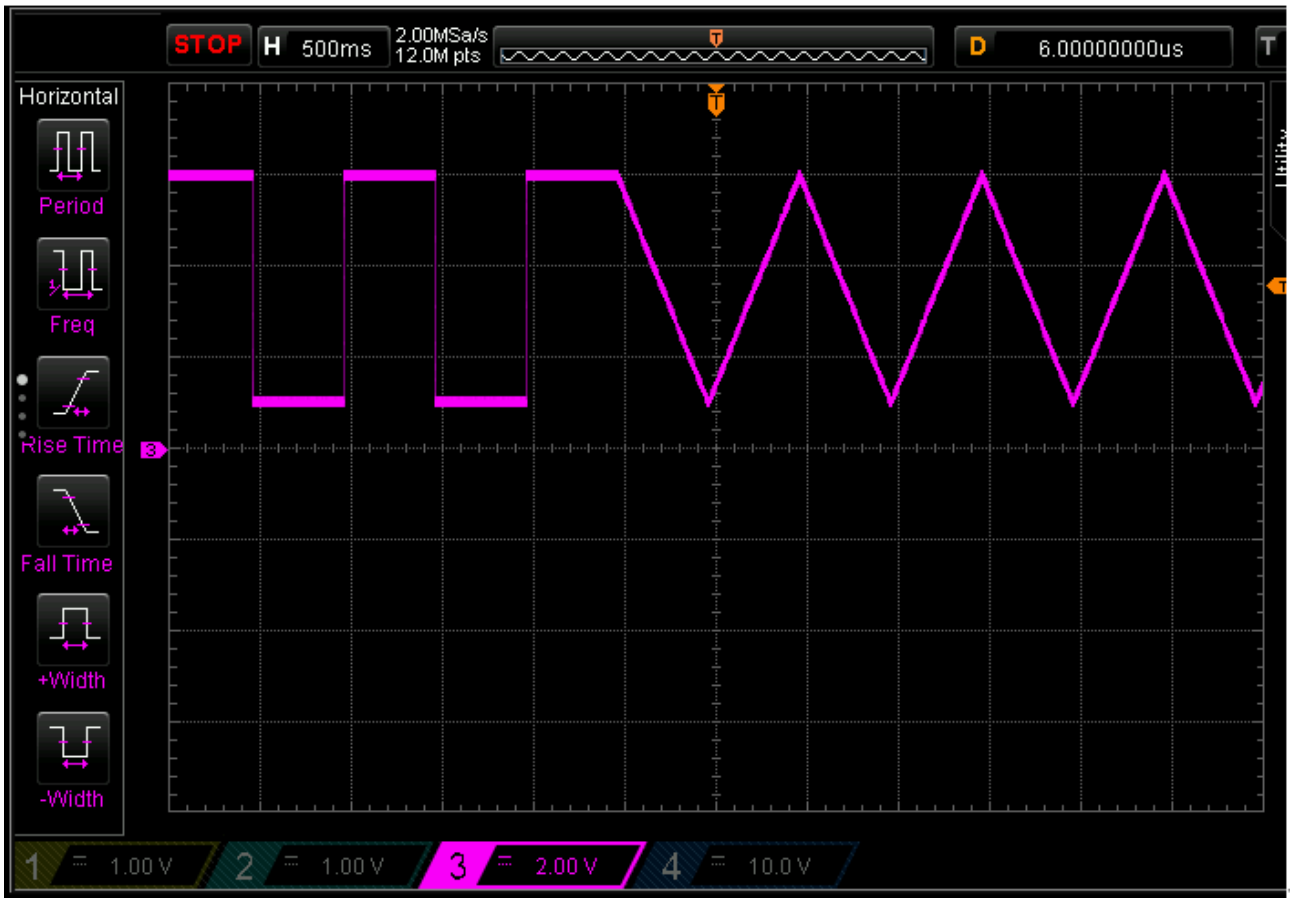


Fig. 65: Triangle output by reshaping

4.2.3.11 Setpoint processing, user/vendor calibration

The electrical set output value generated and digitized by the DAC must or can be changed in the device in order to

- compensate for hardware dependency (keyword: calibration)
- or to make application-specific changes

The output value can be changed in 3 functional units, all 3 can be active at the same time:

- User Scale [▶ 68]
- User calibration
- Vendor calibration

The "User/vendor calibration" functional unit is intended for correcting hardware-specific influences. They are implemented as 3rd order polynomial transformations (offset, gain, x^2, x^3).

Note: The term "calibration", which is historically based at Beckhoff, is used here in the CoE, even if it has nothing to do with deviation statements of a calibration certificate. Actually, this is a description of the vendor or customer calibration data/adjustment data used by the device during operation in order to maintain the assured analog accuracy.

- User Calibration

The "User calibration" functional unit can be used by the user if alternative, system-dependent correction values are to be used permanently.

To be able to work with both INT16-based gain/offset values and Real32 coefficients, processing in "User Calibration" (if Enable User calibration = 1) proceeds as follows:

- for setpoint >=0: "Value after User calibration" = S0 + "Value after Vendor calibration" * S1 +("Value after Vendor calibration")² * S2
- for setpoint <0: "Value after User calibration" = S0 + "Value after Vendor calibration" * S1n +("Value after Vendor calibration")² * S2

Parameter:

Index	Name	Data type	Meaning
80n0:07	Enable User calibration	BOOL	disabled by default, calculation only takes place if TRUE
80n0:17	User calibration offset	SINT16	1 bit = AEW_{nom} / 32767, default: 0
80n0:18	User calibration gain	UINT16	1 bit corresponds to 2-16, "1" therefore corresponds to $x7FFF/32767_{dec}$, default: 1
80nC:01	User calibration data	BYTE4	4 bytes of free memory space; here it is possible to store the calibration date in the form of 8 CHAR, for example
80nC:03..0D	User Scale Gain (Real32)	REAL32	Real32 coefficients S0/S1/S2/S3/S1n of the calculation polynomial, default: S0=0, S1=1, S1n = 1, S2=0

The intermediate value after this functional unit can be viewed in index 90n0:0A.

The number of setting changes in this functional unit is counted up in index 90n2:12 "User Calibration Counter" (cannot be deleted).

Procedure: the counter is incremented the first time any parameter in the data area index 80nC or index 80n0:17/18 is changed; further changes in the data area in the following 30 seconds are not taken into account for the counter. After this time has elapsed, a parameter change will increment the counter again.

- Vendor Calibration

The electrical channel is calibrated by Beckhoff in the Vendor Calibration functional unit for compliance with the given uncertainty specification (see Technical Data, previously: output error). The vendor calibration data from Beckhoff is available in this area.

Parameter:

Index	Name	Data type	Meaning
80n0:08	Enable vendor calibration	BOOL	enabled by default, the data is taken into account. Can be disabled on the application side if only the User Calibration Data is to be used for the calculation
80nF	Vendor calibration data	-	not intended for user modification

The intermediate value after this functional unit can be viewed in index 90n0:0B under 'Value after Vendor Calibration'.

The number of setting changes in this functional unit is counted up in index 90n2:12 as 'Vendor Calibration Counter' and cannot be deleted.

Procedure: the counter is incremented the first time any parameter in the data area is changed; further changes in the data area in the following 30 seconds are not taken into account for the counter. After this time has elapsed, a parameter change will increment the counter again.

Password protection for user data

Some user data are protected against unwanted or inadvertent writing by an additional password to be entered in CoE 0xF009:

- CoE write accesses by the user, PLC or startup entries in *Single* or *CompleteAccess* mode
- Overwrite the values by *RestoreDefaultParameter* Access to 0x80n0 (or 0x80nD, if available)

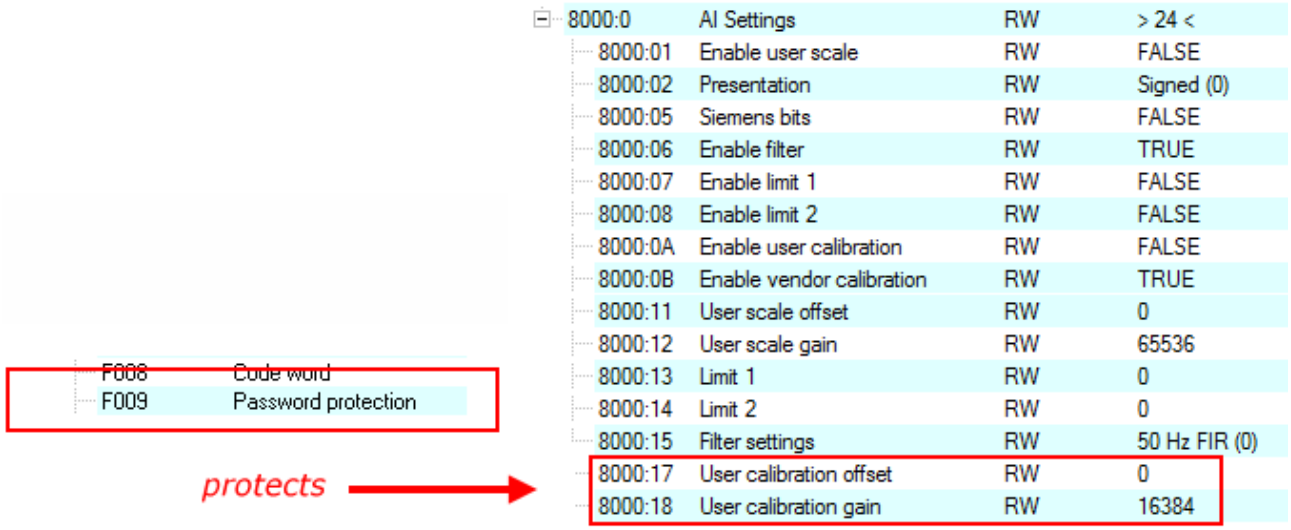


Fig. 66: Password protection for the 0x8000:17 and 0x8000:18 entries (example)

Use of CoE 0xF009

- Entering 0x12345678 enables the password protection → Object shows "1" (enabled)
  Protected objects can now no longer be changed, no error message occurs during a write access!
- Entering 0x11223344 disables password protection → Object displays "0" (disabled)

Password protection takes effect with the following AI settings:

Index	Designation
80n0:07	Enable User calibration
80n0:08	Enable Vendor calibration
80n0:17	User calibration offset
80n0:18	User calibration gain
80nC	User calibration data
80nD:1A	Limiter Low Value
80nD:1B	Limiter High Value

4.2.3.12 DAC output stage

The final processed setpoint is now transferred to the local DAC function block as an integer value and the electrical output is generated.

A case-by-case DAC error is output as PDO "AO Status" -> Error.

Notes:

- During "Power On" (U_s, U_p or both) or "Power Off", brief unregulated output (typically up to ±2 V for 200 ms) may occur at the output. If necessary, use an external signal isolator (relay) or switch to self-isolating analog output products.
- The output voltage in I mode can rise to >20 V, e.g. in the event of a wire break
- The output diagnosis wire break/short circuit should be seen as an informative aid; it cannot cover all error states. It indicates an overload of the analog output.
- In the time between "Power On" (power supply is available, local µC has started up) and EtherCATState = OP, the AO channel outputs the analog output value that is specified in the watchdog as a substitute value.

NOTICE

Note on overload behavior

In the event of an overcurrent, the channel interrupts the current flow periodically (so-called "auto-retry") and normal measuring operation is resumed as soon as the current falls below the limit threshold. The overcurrent event occurs at a signal current > approx. 40 mA for several seconds or also briefly at a significantly higher current, so both current and thermal monitoring takes place.

4.3 Overview of parameter objects (CoE)

EtherCAT XML Device Description

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

Parameterization via the CoE list (CAN over EtherCAT)

The EtherCAT device is parameterized via the CoE-Online tab (double-click on the respective object) or via the Process Data tab (allocation of PDOs). Please note the following general CoE notes 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 [▶ 116]” for resetting changes

CoE directory for EDxxxx and ELxxxx terminals

In the following object description, the information on the (sub)indices applies to both ED and EL series terminals

4.3.1 Restore objects

Index 1011 Restore default parameters

Index (hex)	Name	Meaning	Data type	Flags	Default
1011:0	Restore default parameters	Restore default parameters	UINT8	RO	0x01 (1dec)
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 (0dec)

4.3.2 Configuration data

Index 80n0 AO settings*)

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	AO Settings	Max. Subindex	UINT8	RO	0x16 (22_{dec})
80n0:01	Enable User Scale [▶ 68]	User scaling is enabled. (see data stream flow chart [▶ 55])	BOOLEAN	RW	0x00 (0_{dec})
80n0:02	Presentation [▶ 66]	0: *Signed presentation* The measured value is displayed in two's complement. Maximum presentation range at 16 bits: -32768_{dec} ... $+32767_{dec}$ 1: *Unsigned presentation* Maximum presentation range for 16 bits: 0 ... $+65535_{dec}$ 2: *Absolute value with MSB as sign* The measured value is output in the signed amount representation. Maximum presentation range at 16 bits: - 32768_{dec} .. $+32767_{dec}$ 3: *Absolute value* The negative number range is also output as positive.	BIT3	RW	0x00 (0_{dec})
80n0:05	Watchdog Type [▶ 70]	0: *Default watchdog value* The default value (80n0:13) is active. 1: *Watchdog ramp* The ramp (80n0:14) for moving to the default value is active. 2: *Last output value* The last process data is output when the watchdog drops.	BIT2	RW	0x00 (0_{dec})
80n0:07	Enable user calibration [▶ 77]	Enable user calibration (see data stream flow chart [▶ 55])	BOOLEAN	RW	0x00 (0_{dec})
80n0:08	Enable Vendor Calibration [▶ 77]	Enable vendor calibration (see data stream flow chart [▶ 55])	BOOLEAN	RW	0x01 (1_{dec})
80n0:11	User Scale Offset [▶ 68]	User scale offset	INT16	RW	0x0000 (0_{dec})
80n0:12	User Scale Gain [▶ 68]	User scale gain. The gain has a fixed-point representation with a factor of 2^{-16}. The value 1 corresponds to 65535 (0x00010000).	INT32	RW	0x00010000 (65536_{dec})
80n0:13	Watchdog Output Value [▶ 70]	Watchdog default output value	INT16	RW	0x0000 (0_{dec})
80n0:14	Watchdog Ramp [▶ 70]	Ramps to the default value Value in digits/ms.	UINT16	RW	0xFFFF (65535_{dec})
80n0:15	User Calibration Offset [▶ 77]	User calibration offset	INT16	RW	0x0000 (0_{dec})
80n0:16	User Calibration Gain [▶ 77]	User calibration gain	UINT16	RW	0x7FFF (32767_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

Index 80nC AO User Calibration Data*)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nC:0	AO User Calibration Data	Max. Subindex	UINT8	RO	0x06 (6_{dec})
80nC:01	Calibration Data	4 bytes of free memory space; here it is possible to store the calibration date in the form of 8 CHAR, for example	OCTET-STRING[4]	RW	{0}
80nC:03	S0	Real32 coefficient S0	REAL32	RW	0x00000000 (0_{dec})
80nC:04	S1	Real32 coefficient S1	REAL32	RW	0x00000000 (0_{dec})
80nC:05	S2	Real32 coefficient S2	REAL32	RW	0x00000000 (0_{dec})
80nC:06	S3	Real32 coefficient S3	REAL32	RW	0x00000000 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

Index 80nD AO Advanced Settings*)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nD:0	AI Advanced Settings	Max. Subindex	UINT8	RO	0x1E (30_{dec})
80nD:11	Output Interface [▶ 67]	Values: 0 – None 2 - V ±10V 14 - V 0-10V 17 - I ±20mA 18 - I 0-20mA 19 - I 4-20mA	UINT16	RW	0x0002 (2_{dec})
80nD:12	Integer Scaler [▶ 63]	Values: 0 - Extended Range 3 - Legacy Range	UINT16	RW	0x0000 (0_{dec})
80nD:13	User Scale Offset (Real32) [▶ 68]	User scale offset	REAL32	RW	0x00000000 (0.0)
80nD:14	User Scale Gain (Real32) [▶ 68]	User scale gain.	REAL32	RW	0x3F800000 (1.0)
80nD:15	Warning Level Low [▶ 69]	Warning if output value falls below permitted value	REAL32	RW	0xC1200000 (-10.0)
80nD:16	Warning Level High [▶ 69]	Warning if permissible output value is exceeded	REAL32	RW	0x41200000 (10.0)
80nD:1A	Watchdog Output Value (Real32) [▶ 70]	User-specific setpoint Watchdog (Real32)	REAL32	RW	0x00000000 (0.0)
80nD:1B	Watchdog Ramp (Real32) [▶ 70]	Time of the ramp from maximum value (10 V / 20 mA) to zero. The end value is defined via watchdog value 0x18. [s]	REAL32	RW	0x00000000 (0.0)
80nD:1C	Limiter Low Value [▶ 74]	Output value limit (lowest value)	REAL32	RW	0x412BCC79 (10.7374201)
80nD:1D	Limiter High Value [▶ 74]	Output value limit (highest value)	REAL32	RW	0x412BCC79 (10.7374201)
80nD:1E	Output Slew Rate [▶ 76]	Limitation of the setpoint gradient [s]	REAL32	RW	0x00000000 (0.0)

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

Index 80nF AO Vendor Calibration Data*)

Index (hex)	Name	Meaning	Data type	Flags	Default
80nF:0	AO Vendor Calibration Data	Max. Subindex	UINT8	RO	0x08 (08_{dec})
80nF:01	Calibration Date [▶ 77]	4 bytes of free memory space; here it is possible to store the calibration date in the form of 8 CHAR, for example	OCTET-STRING[4]	RW	{0}
80nF:03	S0	Real32 coefficient S0	REAL32	RW	0x00000000 (0_{dec})
80nF:04	S1	Real32 coefficient S1	REAL32	RW	0x00000000 (0_{dec})
80nF:05	S2	Real32 coefficient S2	REAL32	RW	0x00000000 (0_{dec})
80nF:06	S3	Real32 coefficient S3	REAL32	RW	0x00000000 (0_{dec})
800F:07	T1	Real32 coefficient T1	REAL32	RW	0x00000000 (0_{dec})
800F:08	T1S1	Real32 coefficient T1S1	REAL32	RW	0x00000000 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

4.3.3 Input data

Index 60n0 AO Inputs*)

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	AO Inputs	Maximum subindex	UINT8	RO	0x07 (7_{dec})
60n0:02	Output Overload [▶ 61]	Overload on the analog output.	BOOLEAN	RO	0x00 (0_{dec})
60n0:03	Underrange [▶ 61]	The analog output is smaller than the technical output range or than the set limit value.	BOOLEAN	RO	0x00 (0_{dec})
60n0:04	Overrange [▶ 61]	The analog output is greater than the technical output range or than the set limit value.	BOOLEAN	RO	0x00 (0_{dec})
60n0:06	Warning [▶ 61]	Is set if "AO Output value" is outside the technical output range or the supply voltage is too low or the terminal temperature is too high.	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error [▶ 61]	Is set if the limit values of the output range are exceeded or there is a hardware error.	BOOLEAN	RO	0x00 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

4.3.4 Output data

Index 70n0 AO Outputs*)

Index (hex)	Name	Meaning	Data type	Flags	Default
70n0:0	AI Outputs	Maximum subindex	UINT8	RO	0x14 (20_{dec})
70n0:11	Value [▶ 59]	Analog output value	INT16	RO	0x0000 (0_{dec})
70n0:13	Value (Real32) [▶ 59]	Analog output value (Real32)	REAL32	RO	0x00000000 (0_{dec})
70n0:14	Output Cycle Counter [▶ 62]	The counter is incremented each time the output data in the process image is updated.	UINT16	RO	0x0000 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

4.3.5 Information and diagnostic data

Index 90n0 AO Internal Data*)

Index (hex)	Name	Meaning	Data type	Flags	Default
90n0:0	AO Internal Data	Max. Subindex	UINT8	RO	0x0F (15_{dec})
90n0:01	Value after User Scale	Current output value after UserScale, see data flow, chapter "Analog output commissioning [▶ 55]"	REAL32	RO	0x00000000 (0_{dec})
90n0:02	Warning Low Counter	Counter for "Warning Low" events	UINT32	RO	0x00000000 (0_{dec})
90n0:03	Warning High Counter	Counter for "Warning High" events	UINT32	RO	0x00000000 (0_{dec})
90n0:05	Watchdog Counter	Counter for "Watchdog" events	UINT32	RO	0x00000000 (0_{dec})
90n0:06	Limiter Low Counter	Counter for "Limiter Low" events	UINT32	RO	0x00000000 (0_{dec})
90n0:07	Limiter High Counter	Counter for "Limiter High" events	UINT32	RO	0x00000000 (0_{dec})
90n0:08	Value After Slew Rate Limitation	Current output value after SlewRateLimitation, see data flow, chapter "Analog output commissioning [▶ 55]"	REAL32	RO	0x00000000 (0_{dec})
90n0:0A	Value After User Calibration	Current output value after user adjustment, see data flow, chapter "Commissioning analog output [▶ 55]"	REAL32	RO	0x00000000 (0_{dec})
90n0:0B	Value After Vendor Calibration	Current output value after vendor adjustment, see data flow, chapter "Analog output commissioning [▶ 55]"	REAL32	RO	0x00000000 (0_{dec})
90n0:0C	DAC Raw Value	Output value to the DAC	INT32	RO	0x00000000 (0_{dec})
90n0:0F	Output Cycle Counter Error	Counter for "Output Cycle Counter Error" events	UINT32	RO	0x00000000 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

Index 90n2 AO Info Data*)

Index (hex)	Name	Meaning	Data type	Flags	Default
90n2:0	AO Info Data	Max. Subindex	UINT8	RO	0x12 (18_{dec})
90n2:11	Vendor Calibration Counter [▶ 78]	Counter for changes to the vendor adjustment data	UINT32	RO	0x00000000 (0_{dec})
90n2:12	User Calibration Counter [▶ 77]	Counter for changes to the user calibration data	UINT32	RO	0x00000000 (0_{dec})

*) EL4072 (Ch.1 - 2): $0 \leq n \leq 1$; EL4074 (Ch.1 – 4): $0 \leq n \leq 3$; EL4078 (Ch.1 – 8): $0 \leq n \leq 7$

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for 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 F010 Module Profile List

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module Profile List	Maximum subindex	UINT8	RO	0x04 (4_{dec})
F010:01	Subindex 001	Profile 300	INT32	RO	0x0000012C (300_{dec})
F010:02	Subindex 002	Profile 300	INT32	RO	0x0000012C (300_{dec})
F010:03	Subindex 003	Profile 400	INT32	RO	0x00000190 (400_{dec})
F010:04	Subindex 004	Profile 400	INT32	RO	0x00000190 (400_{dec})

Index F900 DEV Info Data

Index (hex)	Name	Meaning	Data type	Flags	Default
F900:0	DEV Info Data	Largest subindex of this object	UINT8	RO	0x16 (22_{dec})
F900:01	Power Good	see chapter "Device diagnostic functions [▶ 51]"	BOOLEAN	RO	0x00 (0_{dec})
F900:11	Operating Time		UINT32	RO	0x00000000 (0_{dec})
F900:12	Device Temperature		REAL32	RO	0x00000000 (0_{dec})
F900:13	Min. Device Temperature		REAL32	RO	0x00000000 (0_{dec})
F900:14	Max. Device Temperature		REAL32	RO	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 chapter "Device diagnostic functions [▶ 51]"	UINT32	RO	0x00000000 (0_{dec})
F915:09	Error Ch.1		UINT32	RO	0x00000000 (0_{dec})
F915:0A	Error Ch.2		UINT32	RO	0x00000000 (0_{dec})
F915:0B	Error Ch.3		UINT32	RO	0x00000000 (0_{dec})
F915:0C	Error Ch.4		UINT32	RO	0x00000000 (0_{dec})
F915:0D	Error Ch.5		UINT32	RO	0x00000000 (0_{dec})
F915:0E	Error Ch.6		UINT32	RO	0x00000000 (0_{dec})
F915:0F	Error Ch.7		UINT32	RO	0x00000000 (0_{dec})
F915:10	Error Ch.8		UINT32	RO	0x00000000 (0_{dec})

Index FB00 DEV Command

The command object is used for triggering an action in the terminal. The command is started by writing subindex 1 (request). Write access is disabled until the current command is completed.

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	DEV Command	Largest subindex of this object	UINT8	RO	0x03 (3_{dec})
FB00:01	Request	Command value, for use see corresponding application chapter	OCTET-STRING [2]	RW	0x0000 (0_{dec})
FB00:02	Status	Command status, for use see corresponding application chapter	UINT8	RW	0x00 (0_{dec})
FB00:03	Response	Command response, for use see corresponding application chapter	OCTET-STRING [2]	RW	0x00000000 (0_{dec})

4.3.6 Standard objects

Index 1000 Device type

Index (hex)	Name	Meaning	Data type	Flags	Default
1000:0	Device type	Device type of the EtherCAT slave: the Lo-Word contains the used CoE profile (5001). The Hi-Word contains the module profile according to the modular device profile.	UINT32	RO	0x01901389 (26219401_{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	EL407x

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	0x0FEE3052 (267268178_{dec})
1018:03	Revision	Revision number of the EtherCAT slave; the Low Word (bit 0-15) indicates the special terminal number, the High Word (bit 16-31) refers to the device description	UINT32	RO	0x00000000 (0_{dec})
1018:04	Serial number	Serial number of the EtherCAT slave; the Low Byte (bit 0-7) of the Low Word contains the year of production, the High Byte (bit 8-15) of the Low Word contains the week of production, the High Word (bit 16-31) is 0	UINT32	RO	0x00000000 (0_{dec})

Index 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 10F3 Diagnosis History

Index (hex)	Name	Meaning	Data type	Flags	Default
10F3:0	Diagnosis History	Maximum subindex	UINT8	RO	0x15 (21_{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 confirmed message	UINT8	RW	0x00 (0_{dec})
10F3:04	New Messages Available	Indicates that a new message is available	BOOLEAN	RO	0x00 (0_{dec})
10F3:05	Flags	not used	UINT16	RW	0x0000 (0_{dec})
10F3:06	Diagnosis Message 001	Message 1	OCTET-STRING[24]	RO	{0}
…	…	….	…	…	…
10F3:15	Diagnosis Message 016	Message 16	OCTET-STRING[24]	RO	{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 1420 AO RxPDO-Par Standard (INT16) Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1420:0	AO RxPDO-Par Standard (INT16) Ch.1	PDO Parameter RxPDO 33	UINT8	RO	0x06 (6_{dec})
1420:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 33	OCTET-STRING[2]	RO	22 16

Index 1422 AO RxPDO-Par Standard (Real32) Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1422:0	AO RxPDO-Par Standard (Real32) Ch. 1	PDO Parameter RxPDO 35	UINT8	RO	0x06 (6_{dec})
1422:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 35	OCTET-STRING[2]	RO	20 16

Index 1444 AO RxPDO-Par Standard (INT16) Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1444:0	AO RxPDO-Par Standard (INT16) Ch.2	PDO Parameter RxPDO 69	UINT8	RO	0x06 (6_{dec})
1444:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 69	OCTET-STRING[2]	RO	46 16

Index 1446 AO RxPDO-Par Standard (Real32) Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1446:0	AO RxPDO-Par Standard (Real32) Ch.2	PDO Parameter RxPDO 71	UINT8	RO	0x06 (6_{dec})
1446:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 71	OCTET-STRING[2]	RO	44 16

Index 1468 AO RxPDO-Par Standard (INT16) Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1468:0	AO RxPDO-Par Standard (INT16) Ch.3	PDO Parameter RxPDO 105	UINT8	RO	0x06 (6_{dec})
1468:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 105	OCTET-STRING[2]	RO	6A 16

*) EL4074, EL4078 only

Index 146A AO RxPDO-Par Standard (Real32) Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
146A:0	AO RxPDO-Par Standard (Real32) Ch.3	PDO Parameter RxPDO 107	UINT8	RO	0x06 (6_{dec})
146A:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 107	OCTET-STRING[2]	RO	68 16

*) EL4074, EL4078 only

Index 148C AO RxPDO-Par Standard (INT16) Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
148C:0	AO RxPDO-Par Standard (INT16) Ch.4	PDO Parameter RxPDO 141	UINT8	RO	0x06 (6_{dec})
148C:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 141	OCTET-STRING[2]	RO	8E 16

*) EL4074, EL4078 only

Index 148E AO RxPDO-Par Standard (Real32) Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
148E:0	AO RxPDO-Par Standard (Real32) Ch.4	PDO Parameter RxPDO 143	UINT8	RO	0x06 (6_{dec})
148E:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 143	OCTET-STRING[2]	RO	8C 16

*) EL4074, EL4078 only

Index 14B0 AO RxPDO-Par Standard (INT16) Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14B0:0	AO RxPDO-Par Standard (INT16) Ch.5	PDO Parameter RxPDO 177	UINT8	RO	0x06 (6_{dec})
14B0:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 177	OCTET-STRING[2]	RO	B2 16

*) EL4078 only

Index 14B2 AO RxPDO-Par Standard (Real32) Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14B2:0	AO RxPDO-Par Standard (Real32) Ch.5	PDO Parameter RxPDO 179	UINT8	RO	0x06 (6_{dec})
14B2:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 179	OCTET-STRING[2]	RO	B0 16

*) EL4078 only

Index 14D4 AO RxPDO-Par Standard (INT16) Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14D4:0	AO RxPDO-Par Standard (INT16) Ch.6	PDO Parameter RxPDO 213	UINT8	RO	0x06 (6_{dec})
14D4:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 213	OCTET-STRING[2]	RO	D6 16

*) EL4078 only

Index 14D6 AO RxPDO-Par Standard (Real32) Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14D6:0	AO RxPDO-Par Standard (Real32) Ch.6	PDO Parameter RxPDO 215	UINT8	RO	0x06 (6_{dec})
14D6:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 215	OCTET-STRING[2]	RO	D4 16

*) EL4078 only

Index 14F8 AO RxPDO-Par Standard (INT16) Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14F8:0	AO RxPDO-Par Standard (INT16) Ch.7	PDO Parameter RxPDO 249	UINT8	RO	0x06 (6_{dec})
14F8:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 249	OCTET-STRING[2]	RO	FA 16

*) EL4078 only

Index 14FA AO RxPDO-Par Standard (Real32) Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
14FA:0	AO RxPDO-Par Standard (Real32) Ch.7	PDO Parameter RxPDO 251	UINT8	RO	0x06 (6_{dec})
14FA:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 251	OCTET-STRING[2]	RO	F8 16

*) EL4078 only

Index 151C AO RxPDO-Par Standard (INT16) Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
151C:0	AO RxPDO-Par Standard (INT16) Ch.8	PDO Parameter RxPDO 285	UINT8	RO	0x06 (6_{dec})
151C:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 285	OCTET-STRING[2]	RO	1E 17

*) EL4078 only

Index 151E AO RxPDO-Par Standard (Real32) Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
151E:0	AO RxPDO-Par Standard (Real32) Ch.8	PDO Parameter RxPDO 287	UINT8	RO	0x06 (6_{dec})
151E:06	Exclude RxPDOs	Specifies the RxPDOs (index of RxPDO mapping objects) that must not be transferred together with RxPDO 287	OCTET-STRING[2]	RO	1C 17

*) EL4078 only

Index 1620 AO RxPDO-Map Standard (INT16) Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1620:0	AO RxPDO-Map Standard (INT16) Ch.1	PDO Mapping RxPDO 33	UINT8	RO	0x01 (1_{dec})
1620:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (AO Outputs Ch.1), entry 0x11 (Value))	UINT32	RO	0x7000:11, 16

Index 1622 AO RxPDO-Map Standard (Real32) Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1622:0	AO RxPDO-Map Standard (Real32) Ch.1	PDO Mapping RxPDO 35	UINT8	RO	0x01 (1_{dec})
1622:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (AO Outputs Ch.1), entry 0x13 (Value (Real32)))	UINT32	RO	0x7000:13, 32

Index 1623 AO RxPDO-Map Cycle Counter Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1623:0	AO RxPDO-Map Cycle Counter Ch.1	PDO Mapping RxPDO 36	UINT8	RO	0x01 (1_{dec})
1623:01	SubIndex 001	1. PDO Mapping entry (object 0x7000 (AO Outputs Ch.1), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7000:14, 16

Index 1644 AO RxPDO-Map Standard (INT16) Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1644:0	AO RxPDO-Map Standard (INT16) Ch.2	PDO Mapping RxPDO 69	UINT8	RO	0x01 (1_{dec})
1644:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (AO Outputs Ch.2), entry 0x11 (Value))	UINT32	RO	0x7010:11, 16

Index 1646 AO RxPDO-Map Standard (Real32) Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1646:0	AO RxPDO-Map Standard (Real32) Ch.2	PDO Mapping RxPDO 71	UINT8	RO	0x01 (1_{dec})
1646:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (AO Outputs Ch.2), entry 0x13 (Value (Real32)))	UINT32	RO	0x7010:13, 32

Index 1647 AO RxPDO-Map Cycle Counter Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1647:0	AO RxPDO-Map Cycle Counter Ch.2	PDO Mapping RxPDO 72	UINT8	RO	0x01 (1_{dec})
1647:01	SubIndex 001	1. PDO Mapping entry (object 0x7010 (AO Outputs Ch.2), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7010:14, 16

Index 1668 AO RxPDO-Map Standard (INT16) Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1668:0	AO RxPDO-Map Standard (INT16) Ch.3	PDO Mapping RxPDO 105	UINT8	RO	0x01 (1_{dec})
1668:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (AO Outputs Ch.3), entry 0x11 (Value))	UINT32	RO	0x7020:11, 16

*) EL4074, EL4078 only

Index 166A AO RxPDO-Map Standard (Real32) Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
166A:0	AO RxPDO-Map Standard (Real32) Ch.3	PDO Mapping RxPDO 107	UINT8	RO	0x01 (1_{dec})
166A:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (AO Outputs Ch.3), entry 0x13 (Value (Real32)))	UINT32	RO	0x7020:13, 32

*) EL4074, EL4078 only

Index 166B AO RxPDO-Map Cycle Counter Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
166B:0	AO RxPDO-Map Cycle Counter Ch.3	PDO Mapping RxPDO 108	UINT8	RO	0x01 (1_{dec})
166B:01	SubIndex 001	1. PDO Mapping entry (object 0x7020 (AO Outputs Ch.3), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7020:14, 16

*) EL4074, EL4078 only

Index 168C AO RxPDO-Map Standard (INT16) Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
168C:0	AO RxPDO-Map Standard (INT16) Ch.4	PDO Mapping RxPDO 141	UINT8	RO	0x01 (1_{dec})
168C:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (AO Outputs Ch.4), entry 0x11 (Value))	UINT32	RO	0x7030:11, 16

*) EL4074, EL4078 only

Index 168E AO RxPDO-Map Standard (Real32) Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
168E:0	AO RxPDO-Map Standard (Real32) Ch.4	PDO Mapping RxPDO 143	UINT8	RO	0x01 (1_{dec})
168E:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (AO Outputs Ch.4), entry 0x13 (Value (Real32)))	UINT32	RO	0x7030:13, 32

*) EL4074, EL4078 only

Index 168F AO RxPDO-Map Cycle Counter Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
168F:0	AO RxPDO-Map Cycle Counter Ch.4	PDO Mapping RxPDO 144	UINT8	RO	0x01 (1_{dec})
168F:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (AO Outputs Ch.4), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7030:14, 16

*) EL4074, EL4078 only

Index 16B0 AO RxPDO-Map Standard (INT16) Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16B0:0	AO RxPDO-Map Standard (INT16) Ch.5	PDO Mapping RxPDO 177	UINT8	RO	0x01 (1_{dec})
16B0:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (AO Outputs Ch.5), entry 0x11 (Value))	UINT32	RO	0x7040:11, 16

*) EL4078 only

Index 16B2 AO RxPDO-Map Standard (Real32) Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16B2:0	AO RxPDO-Map Standard (Real32) Ch.5	PDO Mapping RxPDO 179	UINT8	RO	0x01 (1_{dec})
16B2:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (AO Outputs Ch.5), entry 0x13 (Value (Real32)))	UINT32	RO	0x7040:13, 32

*) EL4078 only

Index 16B3 AO RxPDO-Map Cycle Counter Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16B3:0	AO RxPDO-Map Cycle Counter Ch.5	PDO Mapping RxPDO 180	UINT8	RO	0x01 (1_{dec})
16B3:01	SubIndex 001	1. PDO Mapping entry (object 0x7040 (AO Outputs Ch.5), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7040:14, 16

*) EL4078 only

Index 16D4 AO RxPDO-Map Standard (INT16) Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16D4:0	AO RxPDO-Map Standard (INT16) Ch.6	PDO Mapping RxPDO 213	UINT8	RO	0x01 (1_{dec})
16D4:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (AO Outputs Ch.6), entry 0x11 (Value))	UINT32	RO	0x7050:11, 16

*) EL4078 only

Index 16D6 AO RxPDO-Map Standard (Real32) Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16D6:0	AO RxPDO-Map Standard (Real32) Ch.6	PDO Mapping RxPDO 215	UINT8	RO	0x01 (1_{dec})
16D6:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (AO Outputs Ch.6), entry 0x13 (Value (Real32)))	UINT32	RO	0x7050:13, 32

*) EL4078 only

Index 16D7 AO RxPDO-Map Cycle Counter Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16D7:0	AO RxPDO-Map Cycle Counter Ch.6	PDO Mapping RxPDO 216	UINT8	RO	0x01 (1_{dec})
16D7:01	SubIndex 001	1. PDO Mapping entry (object 0x7050 (AO Outputs Ch.6), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7050:14, 16

*) EL4078 only

Index 16F8 AO RxPDO-Map Standard (INT16) Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16F8:0	AO RxPDO-Map Standard (INT16) Ch.7	PDO Mapping RxPDO 249	UINT8	RO	0x01 (1_{dec})
16F8:01	SubIndex 001	1. PDO Mapping entry (object 0x7060 (AO Outputs Ch.7), entry 0x11 (Value))	UINT32	RO	0x7060:11, 16

*) EL4078 only

Index 16FA AO RxPDO-Map Standard (Real32) Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16FA:0	AO RxPDO-Map Standard (Real32) Ch.7	PDO Mapping RxPDO 251	UINT8	RO	0x01 (1_{dec})
16FA:01	SubIndex 001	1. PDO Mapping entry (object 0x7060 (AO Outputs Ch.7), entry 0x13 (Value (Real32)))	UINT32	RO	0x7060:13, 32

*) EL4078 only

Index 16FB AO RxPDO-Map Cycle Counter Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
16FB:0	AO RxPDO-Map Cycle Counter Ch.7	PDO Mapping RxPDO 252	UINT8	RO	0x01 (1_{dec})
16FB:01	SubIndex 001	1. PDO Mapping entry (object 0x7060 (AO Outputs Ch.7), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7060:14, 16

*) EL4078 only

Index 171C AO RxPDO-Map Standard (INT16) Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
171C:0	AO RxPDO-Map Standard (INT16) Ch.8	PDO Mapping RxPDO 285	UINT8	RO	0x01 (1_{dec})
171C:01	SubIndex 001	1. PDO Mapping entry (object 0x7070 (AO Outputs Ch.8), entry 0x11 (Value))	UINT32	RO	0x7070:11, 16

*) EL4078 only

Index 171E AO RxPDO-Map Standard (Real32) Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
171E:0	AO RxPDO-Map Standard (Real32) Ch.8	PDO Mapping RxPDO 287	UINT8	RO	0x01 (1_{dec})
171E:01	SubIndex 001	1. PDO Mapping entry (object 0x7070 (AO Outputs Ch.8), entry 0x13 (Value (Real32)))	UINT32	RO	0x7070:13, 32

*) EL4078 only

Index 171F AO RxPDO-Map Cycle Counter Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
171F:0	AO RxPDO-Map Cycle Counter Ch.8	PDO Mapping RxPDO 288	UINT8	RO	0x01 (1_{dec})
171F:01	SubIndex 001	1. PDO Mapping entry (object 0x7070 (AO Outputs Ch.8), entry 0x14 (Output Cycle Counter))	UINT32	RO	0x7070:14, 16

*) EL4078 only

Index 1A20 AO TxPDO-Map Status Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A20:0	AO TxPDO-Map Status Ch.1	PDO Mapping TxPDO 33	UINT8	RO	0x08 (8_{dec})
1A20:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A20:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (AO Inputs Ch.1), entry 0x02 (Output Overload))	UINT32	RO	0x6000:02, 1
1A20:03	SubIndex 003	3. PDO Mapping entry (object 0x6000 (AO Inputs Ch.1), entry 0x03 (Underrange))	UINT32	RO	0x6000:03, 1
1A20:04	SubIndex 004	4. PDO Mapping entry (object 0x6000 (AO Inputs Ch.1), entry 0x04 (Overrange))	UINT32	RO	0x6000:04, 1
1A20:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A20:06	SubIndex 006	6. PDO Mapping entry (object 0x6000 (AO Inputs Ch.1), entry 0x06 (Warning))	UINT32	RO	0x6000:06, 1
1A20:07	SubIndex 007	7. PDO Mapping entry (object 0x6000 (AO Inputs Ch.1), entry 0x07 (Error))	UINT32	RO	0x6000:07, 1
1A20:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

Index 1A41 AO TxPDO-Map Status Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A41:0	AO TxPDO-Map Status Ch.2	PDO Mapping TxPDO 66	UINT8	RO	0x08 (8_{dec})
1A41:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A41:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (AO Inputs Ch.2), entry 0x02 (Output Overload))	UINT32	RO	0x6010:02, 1
1A41:03	SubIndex 003	3. PDO Mapping entry (object 0x6010 (AO Inputs Ch.2), entry 0x03 (Underrange))	UINT32	RO	0x6010:03, 1
1A41:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (AO Inputs Ch.2), entry 0x04 (Overrange))	UINT32	RO	0x6010:04, 1
1A41:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A41:06	SubIndex 006	6. PDO Mapping entry (object 0x6010 (AO Inputs Ch.2), entry 0x06 (Warning))	UINT32	RO	0x6010:06, 1
1A41:07	SubIndex 007	7. PDO Mapping entry (object 0x6010 (AO Inputs Ch.2), entry 0x07 (Error))	UINT32	RO	0x6010:07, 1
1A41:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

Index 1A62 AO TxPDO-Map Status Ch.3*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A62:0	AO TxPDO-Map Status Ch.3	PDO Mapping TxPDO 99	UINT8	RO	0x08 (8_{dec})
1A62:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A62:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (AO Inputs Ch.3), entry 0x02 (Output Overload))	UINT32	RO	0x6020:02, 1
1A62:03	SubIndex 003	3. PDO Mapping entry (object 0x6020 (AO Inputs Ch.3), entry 0x03 (Underrange))	UINT32	RO	0x6020:03, 1
1A62:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (AO Inputs Ch.3), entry 0x04 (Overrange))	UINT32	RO	0x6020:04, 1
1A62:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A62:06	SubIndex 006	6. PDO Mapping entry (object 0x6020 (AO Inputs Ch.3), entry 0x06 (Warning))	UINT32	RO	0x6020:06, 1
1A62:07	SubIndex 007	7. PDO Mapping entry (object 0x6020 (AO Inputs Ch.3), entry 0x07 (Error))	UINT32	RO	0x6020:07, 1
1A62:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4074, EL4078 only

Index 1A83 AO TxPDO-Map Status Ch.4*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A83:0	AO TxPDO-Map Status Ch.4	PDO Mapping TxPDO 132	UINT8	RO	0x08 (8_{dec})
1A83:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A83:02	SubIndex 002	2. PDO Mapping entry (object 0x6030 (AO Inputs Ch.4), entry 0x02 (Output Overload))	UINT32	RO	0x6030:02, 1
1A83:03	SubIndex 003	3. PDO Mapping entry (object 0x6030 (AO Inputs Ch.4), entry 0x03 (Underrange))	UINT32	RO	0x6030:03, 1
1A83:04	SubIndex 004	4. PDO Mapping entry (object 0x6030 (AO Inputs Ch.4), entry 0x04 (Overrange))	UINT32	RO	0x6030:04, 1
1A83:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1A83:06	SubIndex 006	6. PDO Mapping entry (object 0x6030 (AO Inputs Ch.4), entry 0x06 (Warning))	UINT32	RO	0x6030:06, 1
1A83:07	SubIndex 007	7. PDO Mapping entry (object 0x6030 (AO Inputs Ch.4), entry 0x07 (Error))	UINT32	RO	0x6030:07, 1
1A83:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4074, EL4078 only

Index 1AA4 AO TxPDO-Map Status Ch.5*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1AA4:0	AO TxPDO-Map Status Ch.5	PDO Mapping TxPDO 165	UINT8	RO	0x08 (8_{dec})
1AA4:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AA4:02	SubIndex 002	2. PDO Mapping entry (object 0x6040 (AO Inputs Ch.5), entry 0x02 (Output Overload))	UINT32	RO	0x6040:02, 1
1AA4:03	SubIndex 003	3. PDO Mapping entry (object 0x6040 (AO Inputs Ch.5), entry 0x03 (Underrange))	UINT32	RO	0x6040:03, 1
1AA4:04	SubIndex 004	4. PDO Mapping entry (object 0x6040 (AO Inputs Ch.5), entry 0x04 (Overrange))	UINT32	RO	0x6040:04, 1
1AA4:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AA4:06	SubIndex 006	6. PDO Mapping entry (object 0x6040 (AO Inputs Ch.5), entry 0x06 (Warning))	UINT32	RO	0x6040:06, 1
1AA4:07	SubIndex 007	7. PDO Mapping entry (object 0x6040 (AO Inputs Ch.5), entry 0x07 (Error))	UINT32	RO	0x6040:07, 1
1AA4:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4078 only

Index 1AC5 AO TxPDO-Map Status Ch.6*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1AC5:0	AO TxPDO-Map Status Ch.6	PDO Mapping TxPDO 198	UINT8	RO	0x08 (8_{dec})
1AC5:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AC5:02	SubIndex 002	2. PDO Mapping entry (object 0x6050 (AO Inputs Ch.6), entry 0x02 (Output Overload))	UINT32	RO	0x6050:02, 1
1AC5:03	SubIndex 003	3. PDO Mapping entry (object 0x6050 (AO Inputs Ch.6), entry 0x03 (Underrange))	UINT32	RO	0x6050:03, 1
1AC5:04	SubIndex 004	4. PDO Mapping entry (object 0x6050 (AO Inputs Ch.6), entry 0x04 (Overrange))	UINT32	RO	0x6050:04, 1
1AC5:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AC5:06	SubIndex 006	6. PDO Mapping entry (object 0x6050 (AO Inputs Ch.6), entry 0x06 (Warning))	UINT32	RO	0x6050:06, 1
1AC5:07	SubIndex 007	7. PDO Mapping entry (object 0x6050 (AO Inputs Ch.6), entry 0x07 (Error))	UINT32	RO	0x6050:07, 1
1AC5:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4078 only

Index 1AE6 AO TxPDO-Map Status Ch.7*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1AE6:0	AO TxPDO-Map Status Ch.7	PDO Mapping TxPDO 231	UINT8	RO	0x08 (8_{dec})
1AE6:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AE6:02	SubIndex 002	2. PDO Mapping entry (object 0x6060 (AO Inputs Ch.7), entry 0x02 (Output Overload))	UINT32	RO	0x6060:02, 1
1AE6:03	SubIndex 003	3. PDO Mapping entry (object 0x6060 (AO Inputs Ch.7), entry 0x03 (Underrange))	UINT32	RO	0x6060:03, 1
1AE6:04	SubIndex 004	4. PDO Mapping entry (object 0x6060 (AO Inputs Ch.7), entry 0x04 (Overrange))	UINT32	RO	0x6060:04, 1
1AE6:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1AE6:06	SubIndex 006	6. PDO Mapping entry (object 0x6060 (AO Inputs Ch.9), entry 0x06 (Warning))	UINT32	RO	0x6060:06, 1
1AE6:07	SubIndex 007	7. PDO Mapping entry (object 0x6060 (AO Inputs Ch.7), entry 0x07 (Error))	UINT32	RO	0x6060:07, 1
1AE6:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4078 only

Index 1B07 AO TxPDO-Map Status Ch.8*)

Index (hex)	Name	Meaning	Data type	Flags	Default
1B07:0	AO TxPDO-Map Status Ch.8	PDO Mapping TxPDO 264	UINT8	RO	0x08 (8_{dec})
1B07:01	SubIndex 001	1. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1B07:02	SubIndex 002	2. PDO Mapping entry (object 0x6070 (AO Inputs Ch.8), entry 0x02 (Output Overload))	UINT32	RO	0x6070:02, 1
1B07:03	SubIndex 003	3. PDO Mapping entry (object 0x6070 (AO Inputs Ch.8), entry 0x03 (Underrange))	UINT32	RO	0x6070:03, 1
1B07:04	SubIndex 004	4. PDO Mapping entry (object 0x6070 (AO Inputs Ch.8), entry 0x04 (Overrange))	UINT32	RO	0x6070:04, 1
1B07:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RO	0x0000:00, 1
1B07:06	SubIndex 006	6. PDO Mapping entry (object 0x6070 (AO Inputs Ch.8), entry 0x06 (Warning))	UINT32	RO	0x6070:06, 1
1B07:07	SubIndex 007	7. PDO Mapping entry (object 0x6070 (AO Inputs Ch.8), entry 0x07 (Error))	UINT32	RO	0x6070:07, 1
1B07:08	SubIndex 008	8. PDO Mapping entry (9 bits align)	UINT32	RO	0x0000:00, 9

*) EL4078 only

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	0x08 (8_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1622 (5666_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1646 (5702_{dec})
1C12:03	Subindex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x166A (5738_{dec})
1C12:04	Subindex 004	4. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x168E (5774_{dec})
1C12:05	Subindex 005	5. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x16B2 (5810_{dec})
1C12:06	Subindex 006	6. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x16D6 (5846_{dec})
1C12:07	Subindex 007	7. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x16FA (5882_{dec})
1C12:08	Subindex 008	8. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x171E (5918_{dec})
1C12:09	Subindex 009	9. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0A	Subindex 010	10. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0B	Subindex 011	11. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0C	Subindex 012	12. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0D	Subindex 013	13. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0E	Subindex 014	14. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:0F	Subindex 015	15. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})
1C12:10	Subindex 016	16. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x0000 (0_{dec})

Index 1C13 TxPDO assign

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x08 (8_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A20 (6688_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A41 (6721_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A62 (6754_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A83 (6787_{dec})
1C13:05	Subindex 005	5. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1AA4 (6820_{dec})
1C13:06	Subindex 006	6. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1AC5 (6853_{dec})
1C13:07	Subindex 007	7. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1AE6 (6886_{dec})
1C13:08	Subindex 008	8. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1B07 (6919_{dec})

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: cycle time of the local timer • Synchron with SM 2 Event: cycle time of the master • DC-Mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000F4240 (1000000_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Sync modes supported: • Bit 0 = 1: Free Run is supported • Bit 1 = 1: Synchron with SM 2 Event is supported • Bit 2-3 = 01: DC-Mode is supported • Bit 4-5 = 10: Output Shift with SYNC1 Event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 1C32:08)	UINT16	RO	0x0002 (2_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000F4240 (1000000_{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 occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of intervals between SYNC0 and SYNC1 events that are too short (DC Mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC Mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 3 Event (no outputs available) • 2: DC - Synchron with SYNC0 Event • 3: DC - Synchron with SYNC1 Event • 34: Synchron with SM 2 Event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	• as 1C32:02	UINT32	RW	0x000F4240 (1000000_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, DC Mode only)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Sync modes supported: • Bit 0: Free Run is supported • Bit 1: Synchron with SM 2 Event is supported (outputs available) • Bit 1: Synchron with SM 3 Event is supported (no outputs available) • Bit 2-3 = 01: DC-Mode is supported • Bit 4-5 = 01: Input shift through local event (outputs available) • Bit 4-5 = 10: Input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 1C32:08 or 1C33:08)	UINT16	RO	0x0002 (2_{dec})
1C33:05	Minimum cycle time	as 1C32:05	UINT32	RO	0x000F4240 (1000000_{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		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	as 1C32:11	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 1C32:12	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 1C32:13	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 1C32:32	BOOLEAN	RO	0x00 (0_{dec})

Index F008 Code word

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

Index F009 Password protection

Index (hex)	Name	Meaning	Data type	Flags	Default
F009:0	Password protection	Password protection user calibration	UINT32	RW	0x00000000 (0_{dec})

Index F081 Download revision

Index (hex)	Name	Meaning	Data type	Flags	Default
F081:0	Download revision	Max. Subindex	UINT8	RO	0x01 (1_{dec})
F081:01	Download revision	The subindex 0xF081:01 (Download revision) describes the revision level of the module.	UINT32	RW	0x00000000 (0_{dec})

5 Appendix

5.1 Firmware compatibility

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

Note

- It is recommended to use the newest possible firmware for the respective hardware
- Beckhoff is not under any obligation to provide customers with free firmware updates for delivered products.

NOTICE

Risk of damage to the device!

Pay attention to the instructions for firmware updates on the separate page [▶ 104].
If a device is placed in BOOTSTRAP mode for a firmware update, it does not check when downloading whether the new firmware is suitable.
This can result in damage to the device! Therefore, always make sure that the firmware is suitable for the hardware version!

ED4072			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
00 – 02*	01	ED4072-0000-0016	2025/11
	02*		2026/03

ED4074			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
00 – 02*	01	ED4074-0000-0016	2025/11
	02*		2025/12

ED4078			
Hardware (HW)	**Firmware**	**Revision no.**	**Release date**
00 – 02*	01	ED4078-0000-0016	2025/11
	02*		2025/12

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

5.2 Firmware Update

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

NOTICE

Only use TwinCAT 3 software!

A firmware update of Beckhoff IO devices must only be performed with a TwinCAT 3 installation. It is recommended to build as up-to-date as possible, available for free download on the Beckhoff website.

To update the firmware, TwinCAT can be operated in the so-called FreeRun mode, a paid license is not required.

The device to be updated can usually remain in the installation location, but TwinCAT has to be operated in the FreeRun. Please make sure that EtherCAT communication is trouble-free (no LostFrames etc.).

Other EtherCAT master software, such as the EtherCAT Configurator, should not be used, as they may not support the complexities of updating firmware, EEPROM and other device components.

Storage locations

An EtherCAT slave stores operating data in up to three locations:

- Each EtherCAT slave has a device description, consisting of identity (name, product code), timing specifications, communication settings, etc.
  This device description (ESI; EtherCAT Slave Information) can be downloaded from the Beckhoff website in the download area as a zip file and used in EtherCAT masters for offline configuration, e.g. in TwinCAT.
  Above all, each EtherCAT slave carries its device description (ESI) electronically readable in a local memory chip, the so-called **ESI EEPROM**. When the slave is switched on, this description is loaded locally in the slave and informs it of its communication configuration; on the other hand, the EtherCAT master can identify the slave in this way and, among other things, set up the EtherCAT communication accordingly.

NOTICE

Application-specific writing of the ESI-EEPROM

The ESI is developed by the device manufacturer according to ETG standard and released for the corresponding product.
- Meaning for the ESI file: Modification on the application side (i.e. by the user) is not permitted.
- Meaning for the ESI EEPROM: Even if a writeability is technically given, the ESI parts in the EEPROM and possibly still existing free memory areas must not be changed beyond the normal update process. Especially for cyclic memory processes (operating hours counter etc.), dedicated memory products such as EL6080 or IPC's own NOVRAM must be used.

- Depending on functionality and performance EtherCAT slaves have one or several local controllers for processing I/O data. The corresponding program is the so-called **firmware** in *.efw format.
- In some EtherCAT slaves the EtherCAT communication may also be integrated in these controllers. In this case the controller is usually a so-called **FPGA** chip with *.rbf firmware.

Customers can access the data via the EtherCAT fieldbus and its communication mechanisms. Acyclic mailbox communication or register access to the ESC is used for updating or reading of these data.

The TwinCAT System Manager offers mechanisms for programming all three parts with new data, if the slave is set up for this purpose. Generally the slave does not check whether the new data are suitable, i.e. it may no longer be able to operate if the data are unsuitable.

Simplified update by bundle firmware

The update using so-called **bundle firmware** is more convenient: in this case the controller firmware and the ESI description are combined in a *.efw file; during the update both the firmware and the ESI are changed in the terminal. For this to happen it is necessary

- for the firmware to be in a packed format: recognizable by the file name, which also contains the revision number, e.g. ELxxxx-xxxx_REV0016_SW01.efw
- for password=1 to be entered in the download dialog. If password=0 (default setting) only the firmware update is carried out, without an ESI update.
- for the device to support this function. The function usually cannot be retrofitted; it is a component of many new developments from year of manufacture 2016.

Following the update, its success should be verified

- ESI/Revision: e.g. by means of an online scan in TwinCAT ConfigMode/FreeRun – this is a convenient way to determine the revision
- Firmware: e.g. by looking in the online CoE of the device

NOTICE

Risk of damage to the device!

✓ Note the following when downloading new device files

a) Firmware downloads to an EtherCAT device must not be interrupted

b) Flawless EtherCAT communication must be ensured. CRC errors or LostFrames must be avoided.

c) The power supply must adequately dimensioned. The signal level must meet the specification.

⇨ In the event of malfunctions during the update process the EtherCAT device may become unusable and require re-commissioning by the manufacturer.

5.2.1 Device description ESI file/XML

NOTICE

Attention regarding update of the ESI description/EEPROM

Some slaves have stored calibration and configuration data from the production in the EEPROM. These are irretrievably overwritten during an update.

The ESI device description is stored locally on the slave and loaded on start-up. Each device description has a unique identifier consisting of slave name (9 characters/digits) and a revision number (4 digits). Each slave configured in the System Manager shows its identifier in the EtherCAT tab:

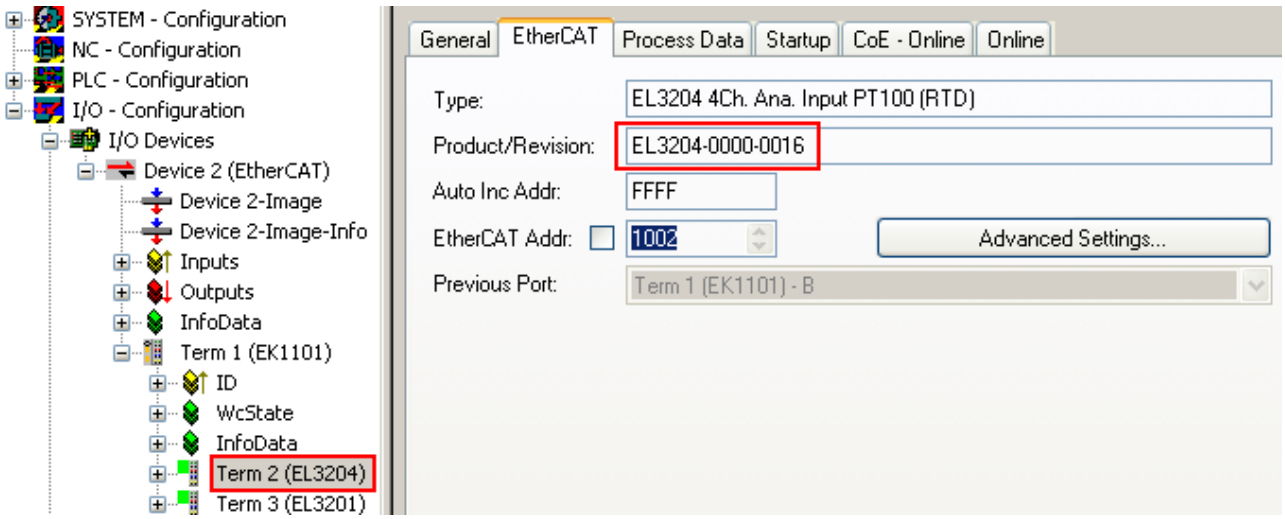


Fig. 67: Device identifier consisting of name EL3204-0000 and revision -0016

The configured identifier must be compatible with the actual device description used as hardware, i.e. the description which the slave has loaded on start-up (in this case EL3204). Normally the configured revision must be the same or lower than that actually present in the terminal network.

For further information on this, please refer to the EtherCAT system documentation.

Update of XML/ESI description

The device revision is closely linked to the firmware and hardware used. Incompatible combinations lead to malfunctions or even final shutdown of the device. Corresponding updates should only be carried out in consultation with Beckhoff support.

Display of ESI slave identifier

The simplest way to ascertain compliance of configured and actual device description is to scan the EtherCAT boxes in TwinCAT mode Config/FreeRun:

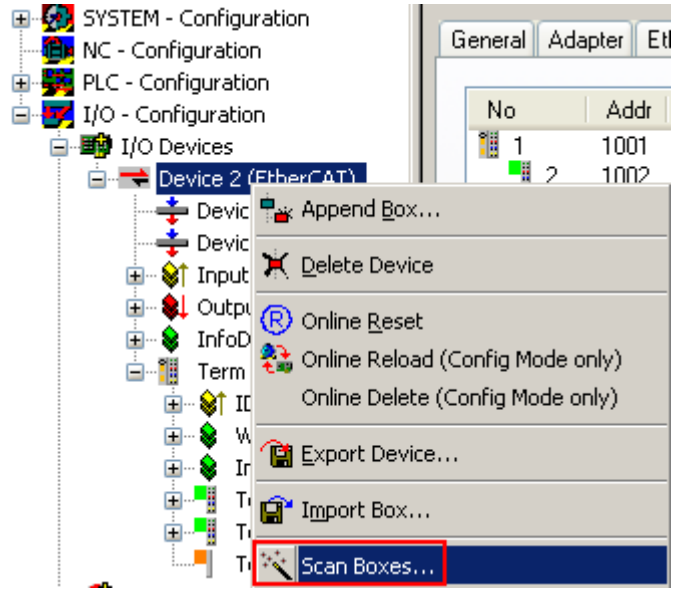


Fig. 68: Scan the subordinate field by right-clicking on the EtherCAT device

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

Fig. 69: Configuration is identical

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

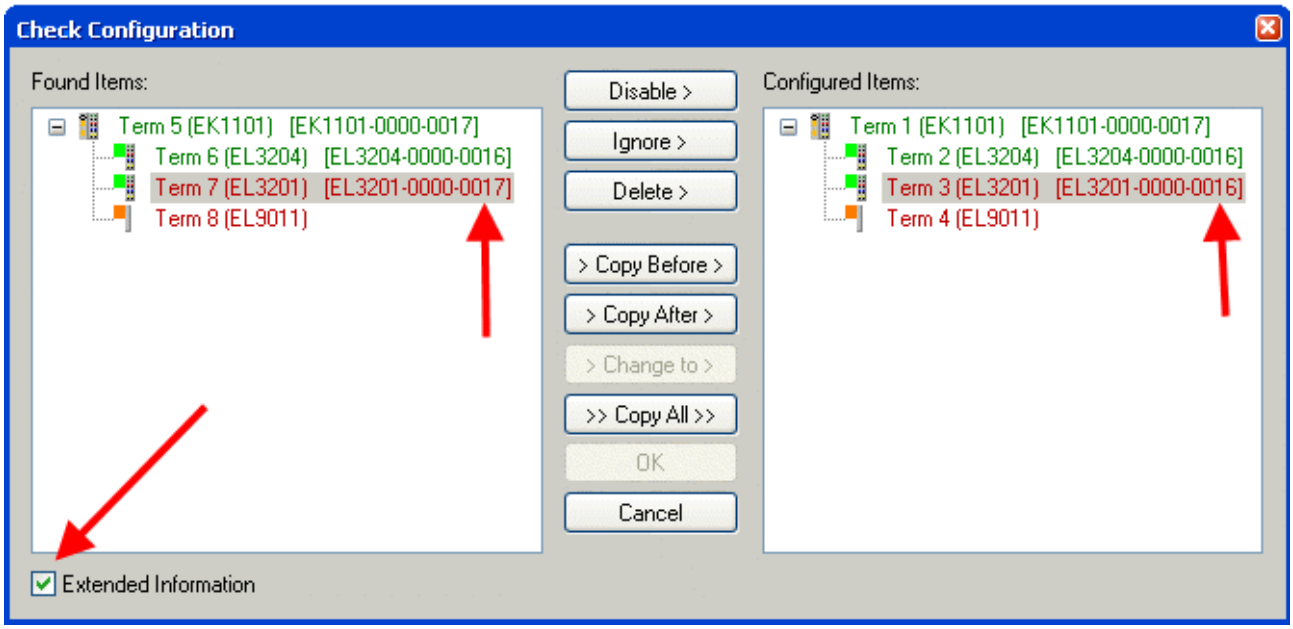


Fig. 70: Change dialog

In this example in Fig. *Change dialog*, an EL3201-0000-**0017** was found, while an EL3201-0000-**0016** was configured. In this case the configuration can be adapted with the *Copy Before* button. The *Extended Information* checkbox must be set in order to display the revision.

Changing the ESI slave identifier

The ESI/EEPROM identifier can be updated as follows under TwinCAT:

- Trouble-free EtherCAT communication must be established with the slave.
- The state of the slave is irrelevant.
- Right-clicking on the slave in the online display opens the *EEPROM Update* dialog, Fig. *EEPROM Update*

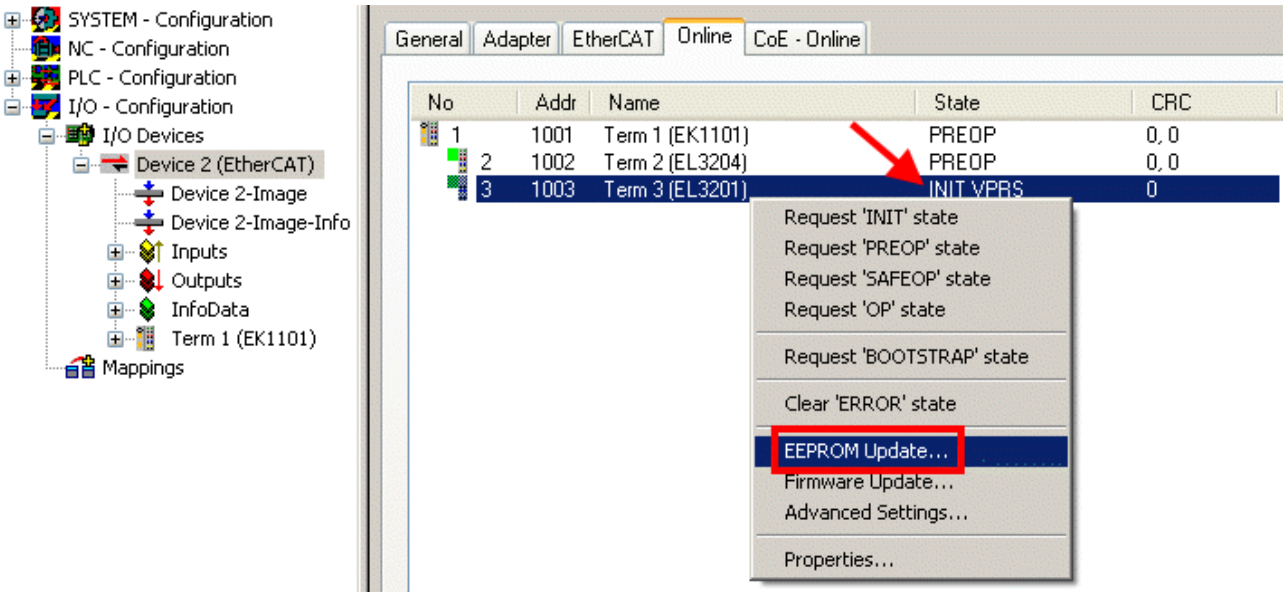


Fig. 71: EEPROM Update

The new ESI description is selected in the following dialog, see Fig. *Selecting the new ESI.* The checkbox *Show Hidden Devices* also displays older, normally hidden versions of a slave.

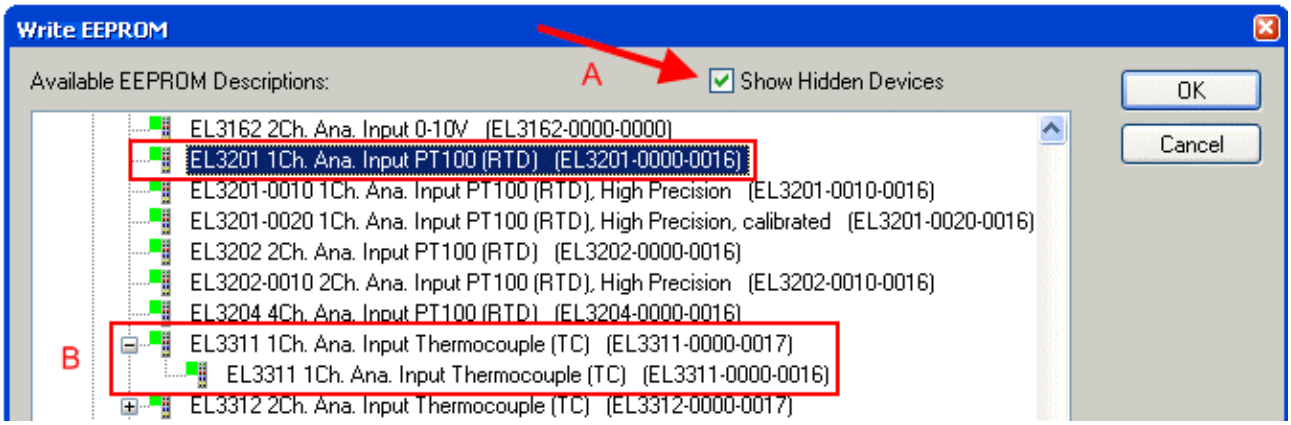


Fig. 72: Selecting the new ESI

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

The change only takes effect after a restart.

Most EtherCAT devices read a modified ESI description immediately or after startup from the INIT. Some communication settings such as distributed clocks are only read during power-on. The EtherCAT slave therefore has to be switched off briefly in order for the change to take effect.

5.2.2 Firmware explanation

Determining the firmware version

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager shows the version of the controller firmware if the master can access the slave online. Click on the E-Bus Terminal whose controller firmware you want to check (in the example terminal 2 (EL3204)) and select the tab *CoE Online* (CAN over EtherCAT).

CoE Online and Offline CoE

Two CoE directories are available:
• **online**: This is offered in the EtherCAT slave by the controller, if the EtherCAT slave supports this. This CoE directory can only be displayed if a slave is connected and operational.
• **offline**: The EtherCAT Slave Information ESI/XML may contain the default content of the CoE. This CoE directory can only be displayed if it is included in the ESI (e.g. “Beckhoff EL5xxx.xml”).

The Advanced button must be used for switching between the two views.

In Fig. *Display of EL3204 firmware version* the firmware version of the selected EL3204 is shown as 03 in CoE entry 0x100A.

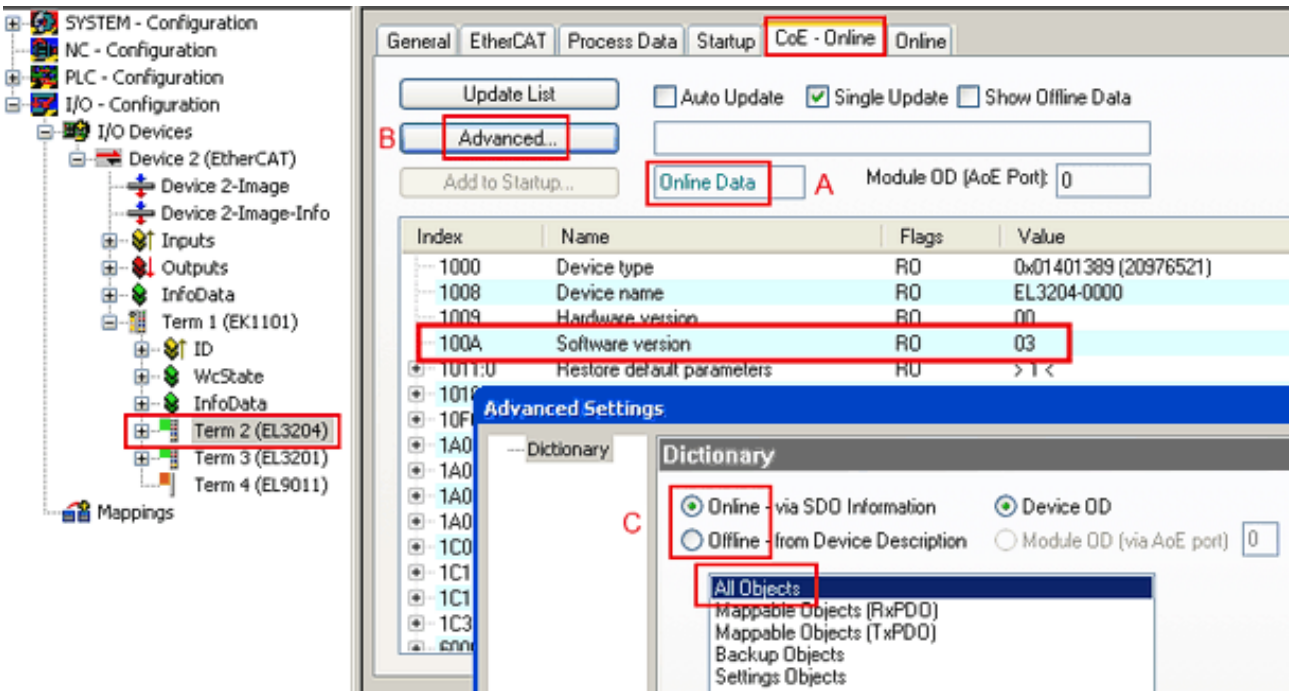


Fig. 73: Display of EL3204 firmware version

In (A) TwinCAT 2.11 shows that the Online CoE directory is currently displayed. If this is not the case, the Online directory can be loaded via the *Online* option in Advanced Settings (B) and double-clicking on *AllObjects*.

5.2.3 Updating controller firmware *.efw

CoE directory

The Online CoE directory is managed by the controller and stored in a dedicated EEPROM, which is generally not changed during a firmware update.

Switch to the *Online* tab to update the controller firmware of a slave, see Fig. *Firmware Update.*

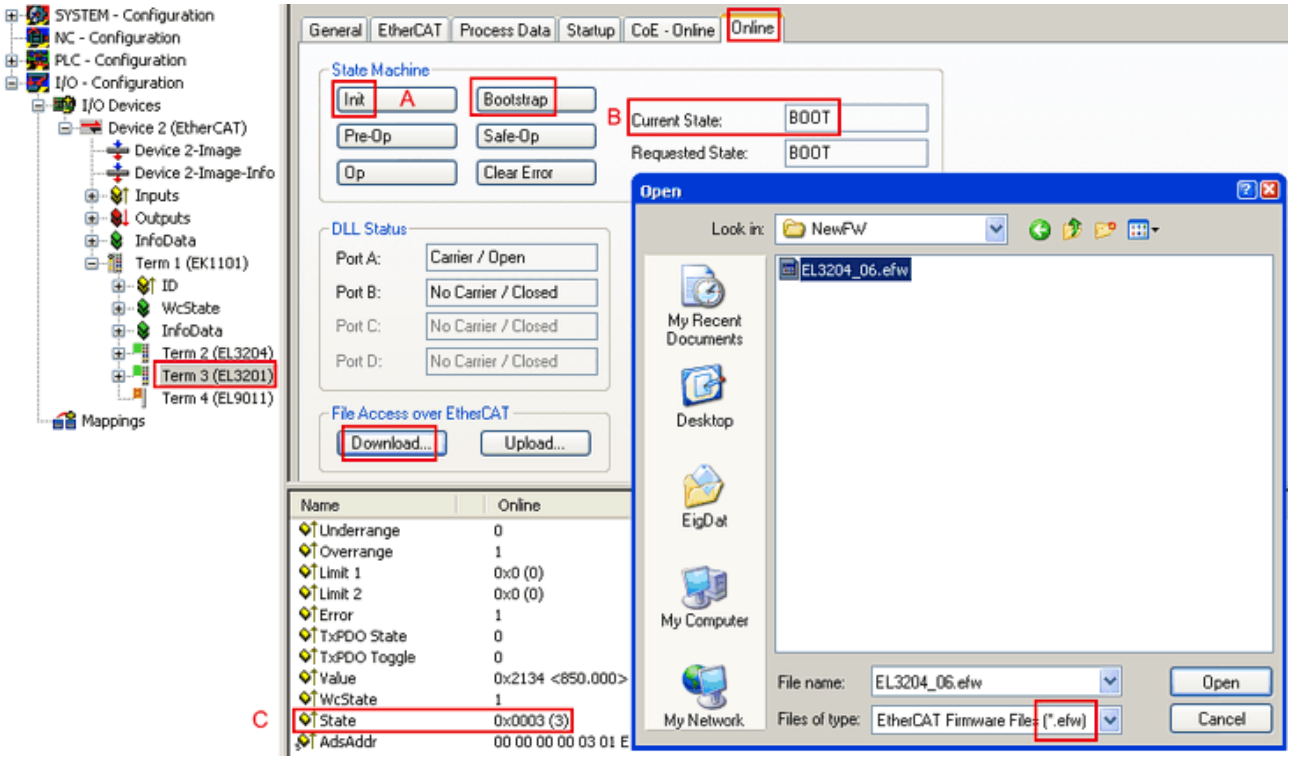
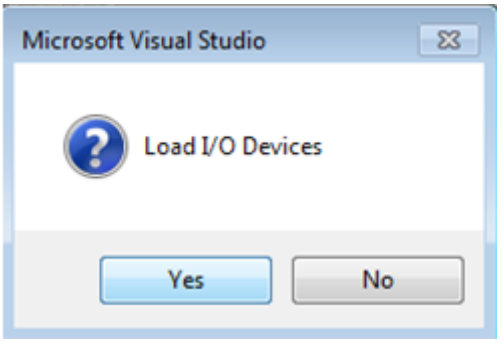
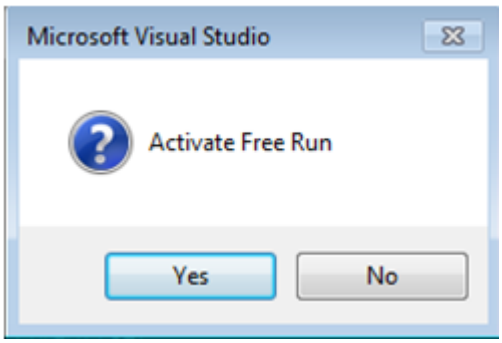


Fig. 74: Firmware Update

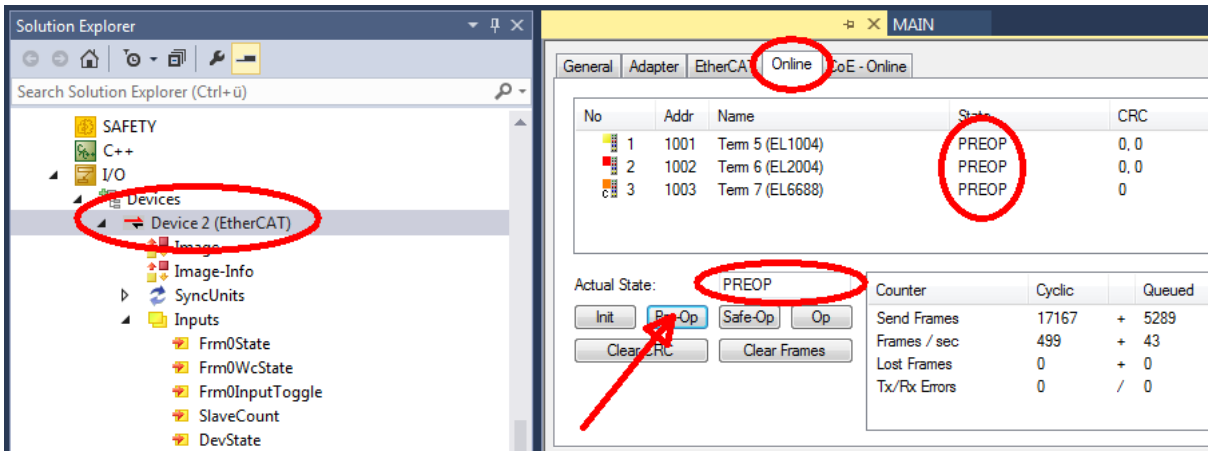
Proceed as follows, unless instructed otherwise by Beckhoff support. Valid for TwinCAT 2 and 3 as EtherCAT master.

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time >= 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.



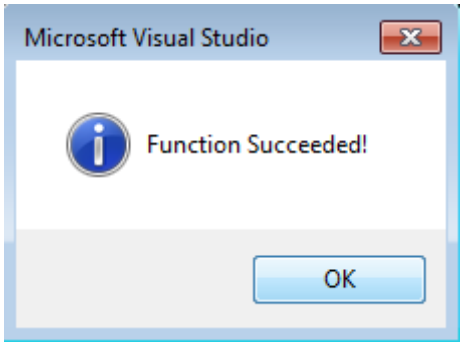


- Switch EtherCAT Master to PreOP



- Switch slave to INIT (A)
- Switch slave to BOOTSTRAP

- Check the current status (B, C)
- Download the new *efw file (wait until it ends). A password will not be necessary usually.



- After the download switch to INIT, then PreOP
- Switch off the slave briefly (don't pull under voltage!)
- Check within CoE 0x100A, if the FW status was correctly overtaken.

5.2.4 FPGA firmware *.rbf

If an FPGA chip deals with the EtherCAT communication an update may be accomplished via an *.rbf file.

- Controller firmware for processing I/O signals
- FPGA firmware for EtherCAT communication (only for terminals with FPGA)

The firmware version number included in the terminal serial number contains both firmware components. If one of these firmware components is modified this version number is updated.

Determining the version via the TwinCAT System Manager

The TwinCAT System Manager indicates the FPGA firmware version. Click on the Ethernet card of your EtherCAT strand (Device 2 in the example) and select the *Online* tab.

The *Reg:0002* column indicates the firmware version of the individual EtherCAT devices in hexadecimal and decimal representation.

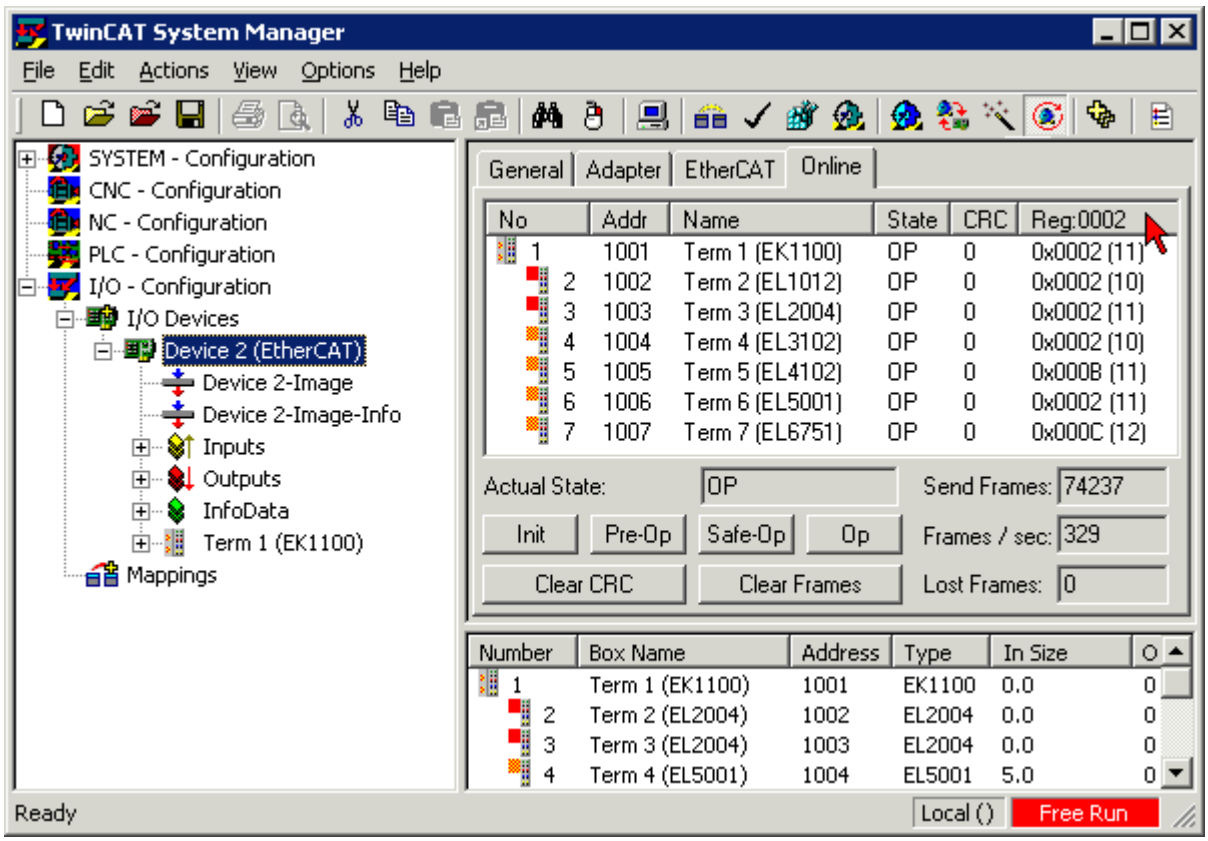


Fig. 75: FPGA firmware version definition

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

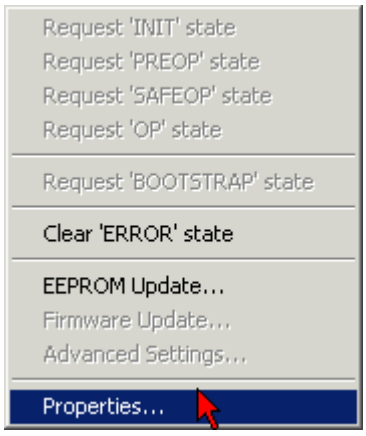


Fig. 76: Context menu *Properties*

The *Advanced Settings* dialog appears where the columns to be displayed can be selected. Under *Diagnosis/***Online View** select the *'0002 ETxxxx Build'* check box in order to activate the FPGA firmware version display.

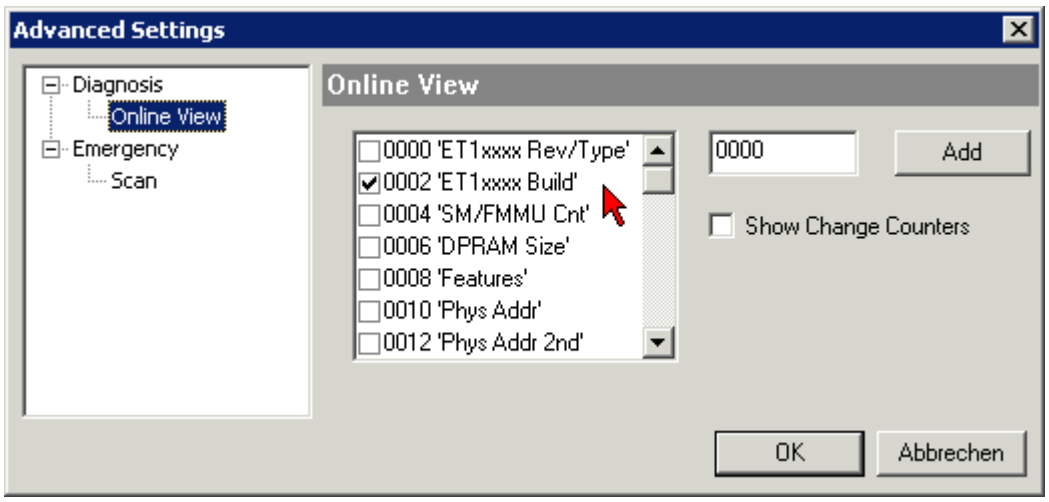


Fig. 77: Dialog *Advanced Settings*

Update

For updating the FPGA firmware

- of an EtherCAT coupler the coupler must have FPGA firmware version 11 or higher;
- of an E-Bus Terminal the terminal must have FPGA firmware version 10 or higher.

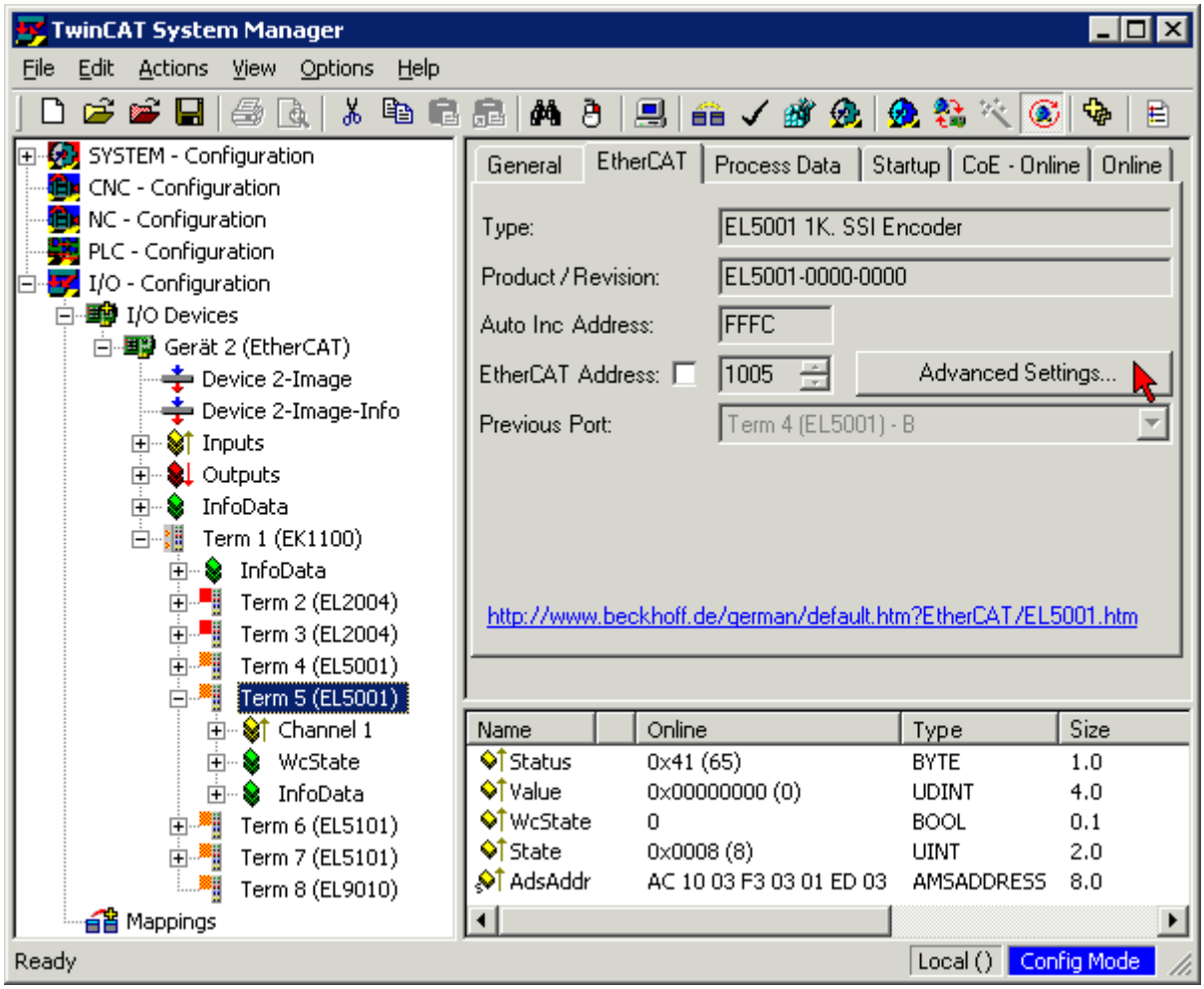
Older firmware versions can only be updated by the manufacturer!

Updating an EtherCAT device

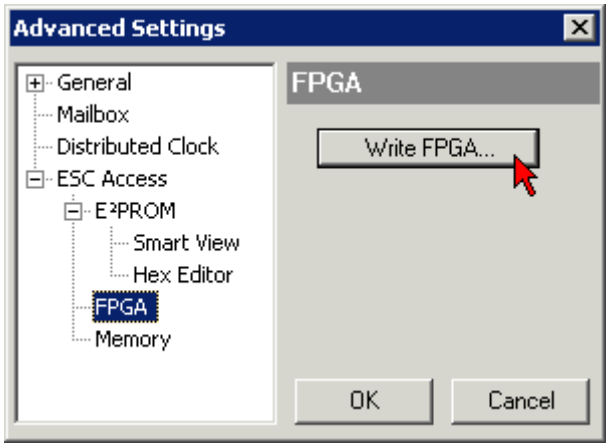
The following sequence order have to be met if no other specifications are given (e.g. by the Beckhoff support):

- Switch TwinCAT system to ConfigMode/FreeRun with cycle time >= 1 ms (default in ConfigMode is 4 ms). A FW-Update during real time operation is not recommended.

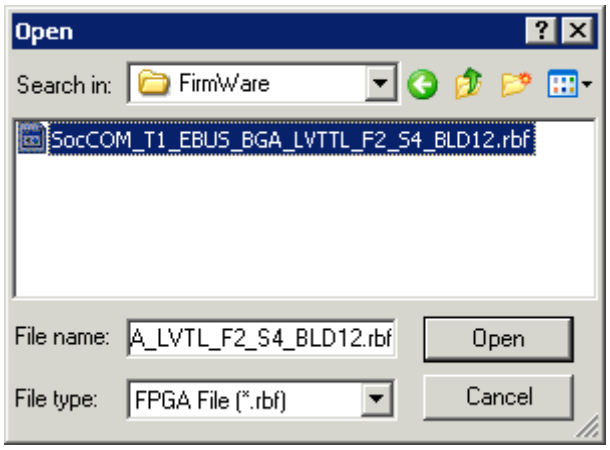
- In the TwinCAT System Manager select the terminal for which the FPGA firmware is to be updated (in the example: Terminal 5: EL5001) and
  click the *Advanced Settings* button in the *EtherCAT* tab:



- The *Advanced Settings* dialog appears. Under *ESC Access/E²PROM*/FPGA click on *Write FPGA* button:



- Select the file (*.rbf) with the new FPGA firmware, and transfer it to the EtherCAT device:



- Wait until download ends
- Switch slave current less for a short time (don't pull under voltage!). In order to activate the new FPGA firmware a restart (switching the power supply off and on again) of the EtherCAT device is required.
- Check the new FPGA status

NOTICE

Risk of damage to the device!

A download of firmware to an EtherCAT device must not be interrupted in any case! If you interrupt this process by switching off power supply or disconnecting the Ethernet link, the EtherCAT device can only be recommissioned by the manufacturer!

5.2.5 Simultaneous updating of several EtherCAT devices

The firmware and ESI descriptions of several devices can be updated simultaneously, provided the devices have the same firmware file/ESI.

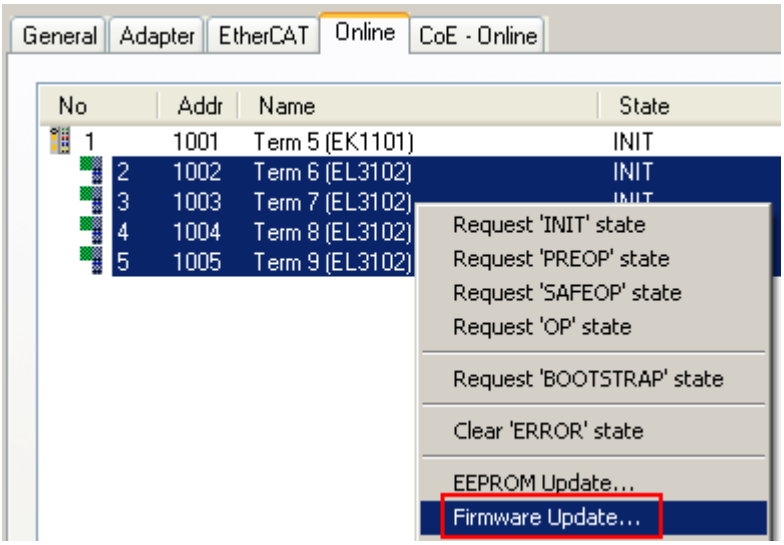


Fig. 78: Multiple selection and firmware update

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

5.3 Restoring the delivery state

To restore the delivery state (factory settings) of CoE objects (object directory) for EtherCAT devices ("slaves"), the CoE object *Restore default parameters*, SubIndex 001 can be used via EtherCAT master (e.g. TwinCAT) (see Fig. *Selecting the Restore default parameters PDO*).

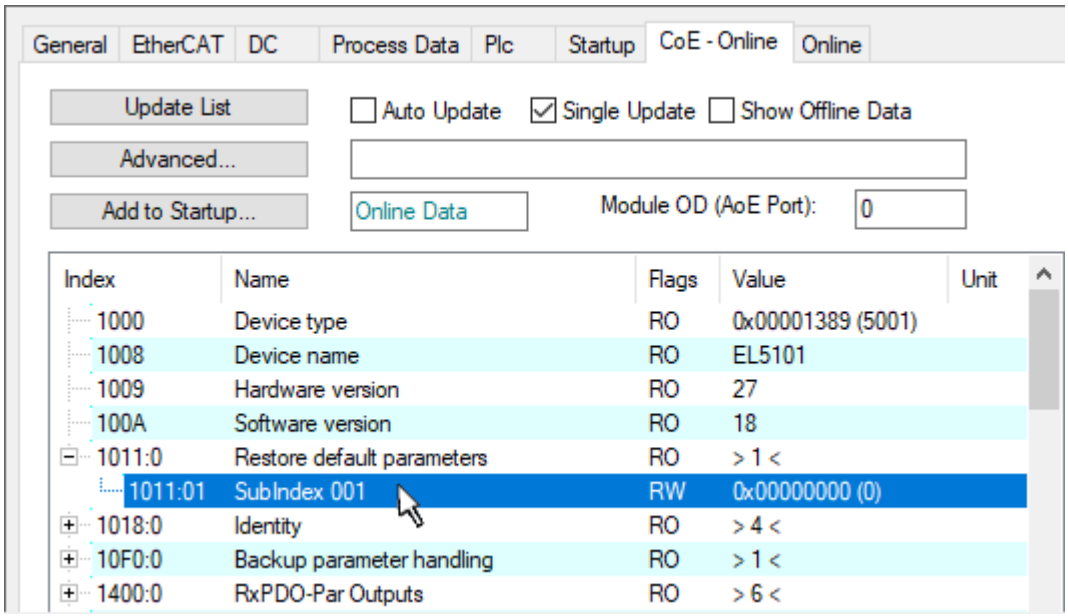


Fig. 79: Selecting the *Restore default parameters* PDO

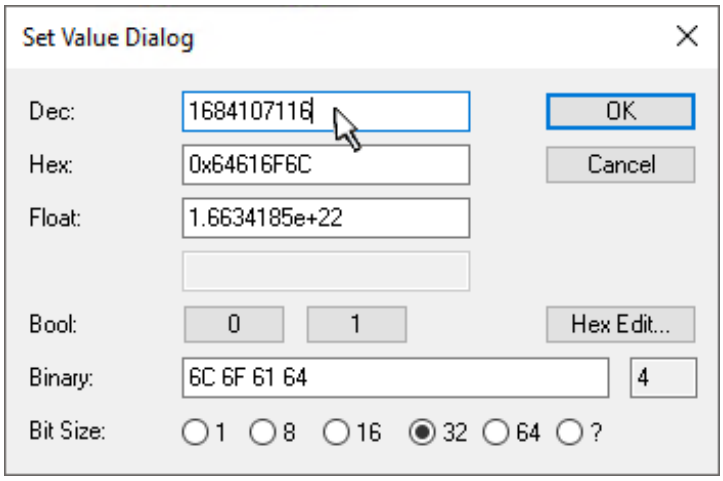


Fig. 80: Entering a restore value in the Set Value dialog

Double-click on *SubIndex 001* to enter the Set Value dialog. Enter the reset value **1684107116** in field *Dec* or the value **0x64616F6C** in field *Hex* (ASCII: "load") and confirm with *OK* (Fig. *Entering a restore value in the Set Value dialog*).

- All changeable entries in the slave are reset to the default values.
  Exception: objects write-protected via password
- Depending on the size of the object directory, this process can take from a few ms to > 1 second.
- The values can only be successfully restored if the reset is directly applied to the online CoE, i.e. to the slave. No values can be changed in the offline CoE.
- TwinCAT must be in the RUN or CONFIG/Freerun state for this; that means EtherCAT data exchange takes place. Ensure error-free EtherCAT transmission.
- No separate confirmation takes place due to the reset. A changeable object can be manipulated beforehand for the purposes of checking.
- This reset procedure can also be adopted as the first entry in the startup list of the slave, e.g. in the state transition PREOP->SAFEOP or, as in Fig. *CoE reset as a startup entry*, in SAFEOP->OP.

All backup objects are reset to the delivery state.

Alternative restore value

In some older terminals (FW creation approx. before 2007) the backup objects can be switched with an alternative restore value: Decimal value: 1819238756, Hexadecimal value: 0x6C6F6164.

An incorrect entry for the restore value has no effect.

5.4 Version identification of EtherCAT devices

5.4.1 General notes on marking

Designation

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

- family key
- type
- version
- revision

Example	Family	Type	Version	Revision
EL3314-0000-0016	EL terminal 12 mm, non-pluggable connection level	3314 4-channel thermocouple terminal	0000 basic type	0016
ES3602-0010-0017	ES terminal 12 mm, pluggable connection level	3602 2-channel voltage measurement	0010 high-precision version	0017
CU2008-0000-0000	CU device	2008 8-port fast ethernet switch	0000 basic type	0000

Notes

- The elements mentioned above result in the **technical designation**. EL3314-0000-0016 is used in the example below.
- EL3314-0000 is the order identifier, in the case of “-0000” usually abbreviated to EL3314. “-0016” is the EtherCAT revision.
- The **order identifier** is made up of
  - family key (EL, EP, CU, ES, KL, CX, etc.)
  - type (3314)
  - version (-0000)
- The **revision** -0016 shows the technical progress, such as the extension of features with regard to the EtherCAT communication, and is managed by Beckhoff.
  In principle, a device with a higher revision can replace a device with a lower revision, unless specified otherwise, e.g. in the documentation.
  Associated and synonymous with each revision there is usually a description (ESI, EtherCAT Slave Information) in the form of an XML file, which is available for download from the Beckhoff web site.
  From 2014/01 the revision is shown on the outside of the IP20 terminals, see Fig. *“EL2872 with revision 0022 and serial number 01200815”*.
- The type, version and revision are read as decimal numbers, even if they are technically saved in hexadecimal.

5.4.2 Version identification of EL terminals

The serial number/ data code for Beckhoff IO devices is usually the 8-digit number printed on the device or on a sticker. The serial number indicates the configuration in delivery state and therefore refers to a whole production batch, without distinguishing the individual modules of a batch.

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

Fig. 81: EL2872 with revision 0022 and serial number 01200815

5.4.3 Beckhoff Identification Code (BIC)

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

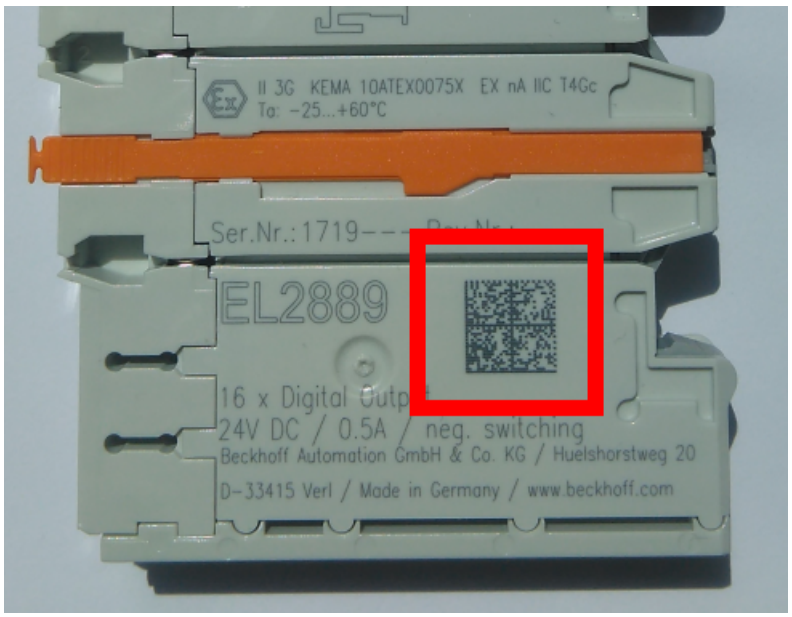


Fig. 82: BIC as data matrix code (DMC, code scheme ECC200)

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

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

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

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

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

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

Position	Type of information	Explanation	Data identifier	Number of digits incl. data identifier	Example
1	Beckhoff order number	**Beckhoff order number**	1P	8	**1P**072222
2	Beckhoff Traceability Number (BTN)	**Unique serial number, see note below**	SBTN	12	**SBTN**k4p562d7
3	Article description	**Beckhoff article description, e.g. EL1008**	1K	32	**1K**EL1809
4	Quantity	**Quantity in packaging unit, e.g. 1, 10, etc.**	Q	6	**Q**1
5	Batch number	Optional: Year and week of production	2P	14	**2P**401503180016
6	ID/serial number	Optional: Present-day serial number system, e.g. with safety products	51S	12	**51S**678294
7	Variant number	Optional: Product variant number on the basis of standard products	30P	12	**30P**F971, 2*K183
...					

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

Structure of the BIC

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

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

Accordingly as DMC:

Fig. 83: Example DMC **1P**072222**SBTN**k4p562d7**1K**EL1809 **Q**1 **51S**678294

BTN

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

NOTICE

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

5.4.4 Electronic access to the BIC (eBIC)

Electronic BIC (eBIC)

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

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

K-bus devices (IP20, IP67)

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

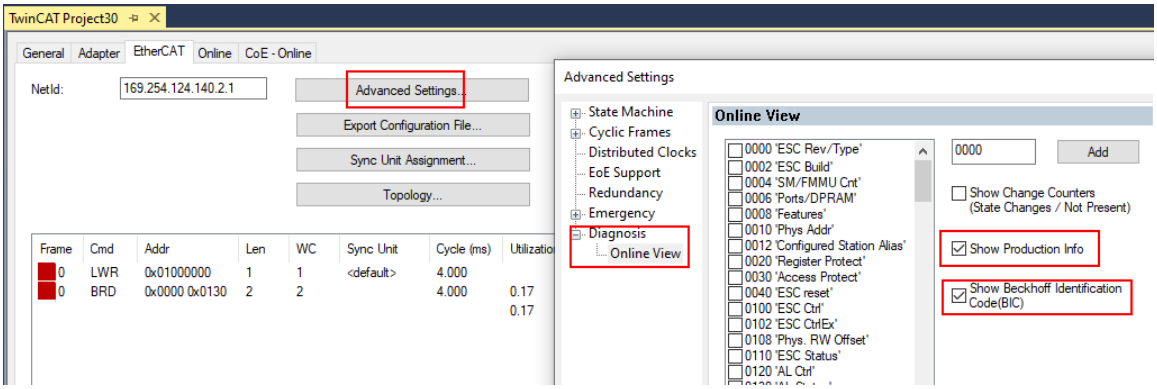
EtherCAT devices (IP20, IP67)

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

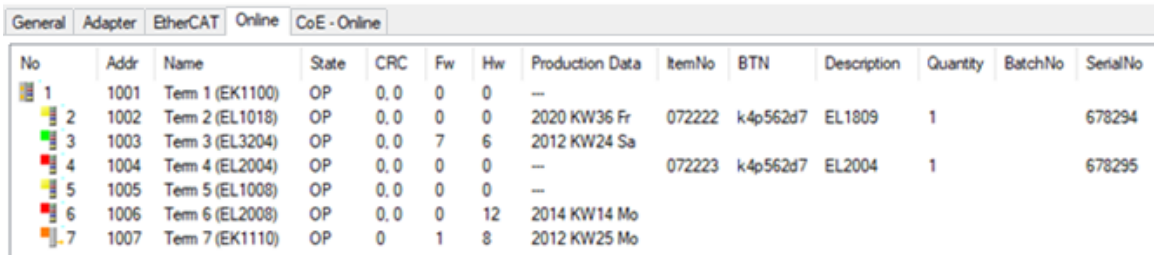
Beckhoff also stores the eBIC in the ESI-EEPROM. The eBIC was introduced into Beckhoff IO production (terminals, box modules) in 2020; as of 2023, implementation is largely complete.

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

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

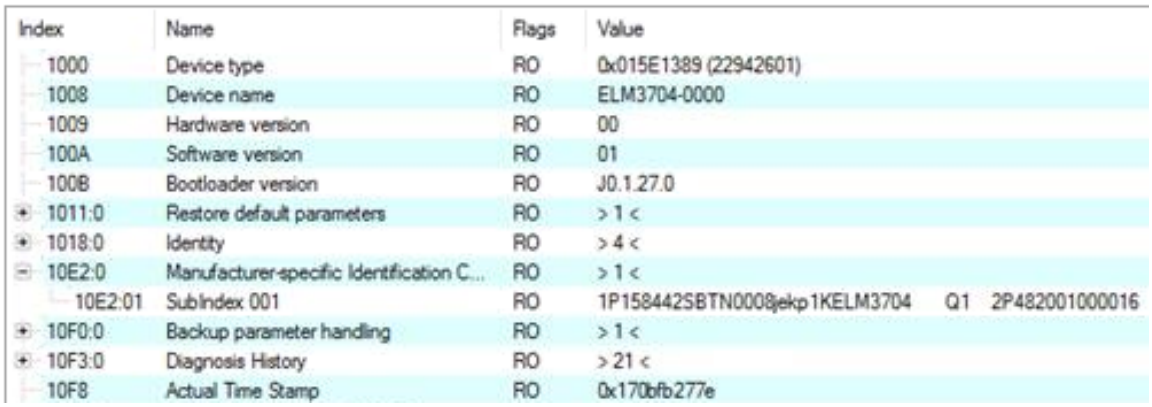


  - The BTN and its contents are then displayed:



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

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



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

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

PROFIBUS, PROFINET, and DeviceNet® devices

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

5.5 Documentation issue status

Version	Comment
1.0.0	• Complements and corrections • First release
0.3.3	• Complements and corrections
0.2:0	• Complements and corrections
0.1	• Preliminary documentation for ED407x

5.6 Support and Service

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

Beckhoff's branch offices and representatives

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