BECKHOFF New Automation Technology

Documentation | EN

EL3356-00x0

EtherCAT Terminals, 1-channel analog input, measuring bridge, full bridge

2026-07-27 | Version: 4.8.0

Table of contents

1 Foreword

1.1 Product overview

This documentation covers the following products:

EL3356 [▶ 10]	1-channel analog input, measuring bridge, full bridge, 16 bit
EL3356-0010 [▶ 10]	1-channel analog input, measuring bridge, full bridge, 24 bit, high-precision
EL3356-0020 [▶ 10]	1-channel analog input, measuring bridge, full bridge, 24 bit, high-precision, factory calibrated
EL3356-0030 [▶ 10]	1-channel analog input, measuring bridge, full bridge, 24 bit, high-precision, externally calibrated
EL3356-0090 [▶ 10]	1-channel analog input, measuring bridge, full bridge, 24 bit, high-precision, TwinSAFE SC

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

Beckhoff®, ATRO®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, MX-System®, Safety over EtherCAT®, TC/BSD®, TwinCAT®, TwinCAT/BSD®, TwinSAFE®, XFC®, XPlanar® and XTS® are registered trademarks of and licensed by Beckhoff Automation GmbH.

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Copyright

Third-party brands

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

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

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

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

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.

1.5 Documentation issue status

Version	Comment
4.8.0	• Update chapter “Technical data” • Update chapter “Commissioning” • Update structure
4.7	• Chapter “Guide through documentation” added • Chapters removed: ◦ “Notes on analog measured values” ◦ “Similar products” ◦ “Basic principles of strain gauge technology” • Update structure
4.6	• Update chapter “Technical data” • Update structure
4.5	• Update structure • Update revision status
4.4	• EL3356-0020, EL3356-0030 added • Update chapter “Introduction” • Update chapter “Object description” • Update chapter “Technical data” • Update structure • Update revision status
4.3	• Update chapter “Technical data” • Chapter “Similar products” added • Update structure • Update revision status
4.2	• New title • Update chapter “Basic principles of strain gauge technology” • Update structure
4.1	• Update chapter “Basic principles of strain gauge technology” • Update revision status
4.0	• Update revision status • Update structure • Update revision status
0.1-3.9	*archived*

2 Product description

2.1 EL3356, EL3356-00x0 - Introduction

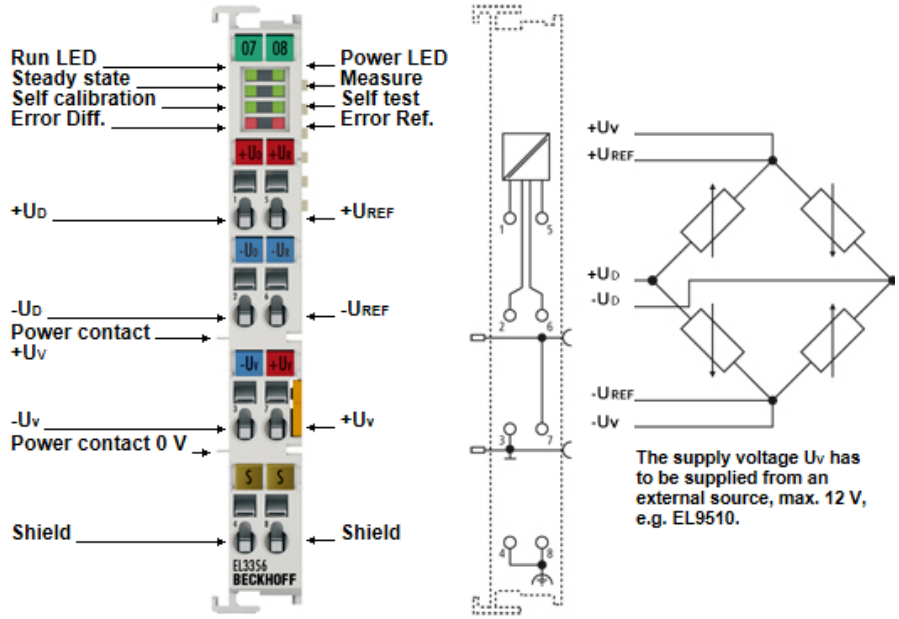


Fig. 1: EL3356

EL3356-00x0 - 1 channel precise resistor bridge analysis

The EL3356-00x0 analog input terminal enables the direct connection of a resistor bridge (strain gauge) or a load cell using a 4 or 6-wire connection technique. The ratio of the bridge voltage U_D to the supply voltage U_{REF} is determined with high precision in the input circuit and the final load value is calculated as a process value on the basis of the settings in the terminal. No further calculations are necessary in the PLC/controller.

The EL3356-0020 with an individual factory working calibration certificate and the EL3356-0030 with an external certificate are available as high-precision variants.

Please read the notes on the calibration certificate [▶ 22] and identification features of these terminals.

The terminal family has the following features in order to meet as many requirements as possible:

- low measuring error of < ±0.01% (see Technical data [▶ 12])
- High resolution: 16-bit (EL3356) or 24-bit (EL3356-0010/-0020/-0030)
- fast measuring cycles: 10 ms (EL3356) or 100 µs (EL3356-0010/-0020/-0030)
- automatic self-calibration of the circuit (can be deactivated)
- adapted to synchronization via Distributed Clocks (EL3356-0010/-0020/-0030 only)
- manual input of the load cell characteristic values according to the load cell certificate (theoretical calibration) or automatic determination by means of calibration procedure
- Tare function
- Special functions for highly dynamic weighing: dynamic filter adaptation, mode change and input freeze

Thus, slow weighings can be performed with high precision using the EL3356. The EL3356-0010/-0020/-0030 is particularly suitable for the fast and precise monitoring of torque or vibration sensors.

The terminal is not a stand-alone scale; it’s to be used only in conjunction with a PLC/controller.

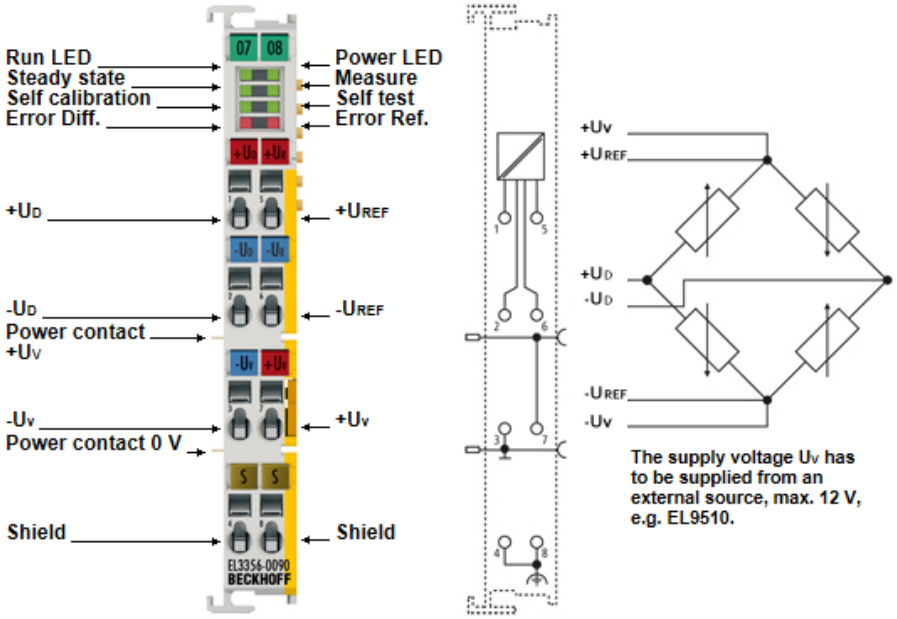


Fig. 2: EL3356-0090

EL3356-0090 - 1 channel precise resistor bridge analysis, TwinSAFE Single Channel

In addition to the full functionality of the EL3356-0010, the EL3356-0090 supports TwinSAFE SC (Single Channel) technology. This enables the use of standard signals for safety tasks in any networks of fieldbuses.

Quick links

Also see about this

- Quick start [▶ 41]
- Basic function principles [▶ 43]
- EL3356, EL3356-00x0 - Object description and parameterization [▶ 79]
- EL3356-0090 - Objects TwinSAFE Single Channel [▶ 92]
- EL3356-0090 - TwinSAFE SC process data [▶ 78]

2.2 EL3356-00x0 - Technical data

Technical data	EL3356	EL3356-0010	EL3356-0020	EL3356-0030	EL3356-0090
Number of analog inputs	2, for 1 bridge circuit (full bridge)				
Resolution	16 bits, 32 bit display	24 bits, 32 bit display			
Sampling type	Simultaneous (bridge and supply voltage)				
Ground reference	differential				
Conversion rate	100…4 sps (10… 250 ms conversion time)	10,000 sps…4 sps (0.1…250 ms conversion time)			
Distributed Clocks	no	yes			
switchable modes	no	yes (2)			
Measuring error	< ±0.01% for the calculated load value, based on the load end value with 12 V power supply and 24 mV bridge voltage (therefore nominal characteristic value for SG: 2 mV/V), self-calibration active, 50 Hz filter active; remaining linearity uncertainty after customer offset and gain adjustment				
Measuring range $U_{D,}$ nominal	-24 mV…+24 mV nominal voltage				
Measuring range U_D, range end value (FSV)	24 mV				
Measuring range U_D, technically usable	max. -27 mV…+27 mV typical (see note on voltage measurement [▶ 61])				
Measuring range $U_{ref,}$ nominal	-12 V…+12 V nominal voltage				
Measuring range U_{ref}, range end value (FSV)	12 V				
Measuring range U_{ref}, technically usable	max. -13.8 V…+13.8 V typical (see note on voltage measurement [▶ 61]) recommended supply voltage: 10 V via power supply terminal EL9510 or 12 V via EL9512 - Note the information provided by the sensor manufacturer!				
Supported nominal characteristic values	any, resolution of the parameter: 0.01 µV/V; recommended: 0.5…4 mV/V				
Min. strain gauge resistance	depending on external supply; parallel operation of strain gauge only recommended with suitable strain gauge				
Filter (hardware)	10 kHz low-pass (-3 dB, see filter notes)				
Filter (software)	preset 50 Hz, configurable: 50/60 Hz FIR notch filter, IIR low-pass, quadruple averager				
Internal resistance	> 200 kΩ (U_{ref}), > 1 MΩ (U_D)				
Special features	auto-calibration				auto-calibration, TwinSAFE SC
Calibration certificate	-		Beckhoff factory certificate	ISO17025 or DAkkS certificate	-
Power supply for the electronics	via the E-bus				
Current consumption via E-bus	typ. 210 mA	typ. 280 mA			
Current consumption power contacts	depending on strain gauge supply, min. 1 mA				
Electrical isolation	500 V (E-bus/signal voltage)				
Configuration	via EtherCAT master/CoE				
MTBF (+55°C)	-				> 780,000 h
Weight	approx. 60 g				
Permissible ambient temperature range during operation	-25°C…+55°C				
Permissible ambient temperature range during storage	-40°C…+85°C				
Permissible relative air humidity	95 %, no condensation				
Dimensions (W x H x D)	approx. 15 mm x 100 mm x 70 mm (width aligned: 12 mm)				
Mounting [▶ 16]	on 35 mm mounting rail according to EN 60715				
Increased mechanical load capacity	yes, see also installation instructions for terminals with increased mechanical load capacity [▶ 28]	-			
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27				
EMC immunity / emission	conforms to EN 61000-6-2 / EN 61000-6-4				
Protection class	IP20				
Installation position	variable				

Technical data	EL3356	EL3356-0010	EL3356-0020	EL3356-0030	EL3356-0090
Marking / Approvals*)	CE, EAC, UKCA, CCC cULus [▶ 24], ATEX [▶ 17], IECEx [▶ 19]	CE, EAC, UKCA, CCC cULus [▶ 24], ATEX [▶ 17], IECEx [▶ 19], cFMus [▶ 20]	CE, EAC, UKCA, CCC cULus [▶ 24], ATEX [▶ 17]	CE, EAC, UKCA, CCC cULus [▶ 24], ATEX [▶ 17]	CE, EAC, UKCA, CCC cULus [▶ 24], ATEX [▶ 17], IECEx [▶ 19]

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

Ex markings

Standard	Marking
ATEX	II 3 G Ex nA IIC T4 Gc II 3 D Ex tc IIIC T135 °C Dc
IECEx	Ex nA IIC T4 Gc Ex tc IIIC T135 °C Dc
cFMus	Class I, Division 2, Groups A, B, C, D Class I, Zone 2, AEx/Ex ec IIC T4 Gc

2.3 Start

For commissioning:

- mount the EL3356 as described in the chapter Mounting and wiring [▶ 16]
- configure the EL3356 in TwinCAT as described in the chapter Commissioning [▶ 41].

For fast commissioning please refer to chapter Commissioning -> Quick start [▶ 41].

2.4 Notes on strain gauge technology

There are the following listed identities of names of used voltage types within this remaining documentation:

Name	Used	
	in the I/O Analog Manual	corresponds in this remaining documentation
Supply-/ Excitation voltage	U_{Exc}	U_V
Bridge-Difference voltage	U_{Bridge}	U_{IN}, Udiff or U_D
Compensation-/ Reference voltage	U_{Sense}	Uref or U_{Ref}

Names of the used voltage types

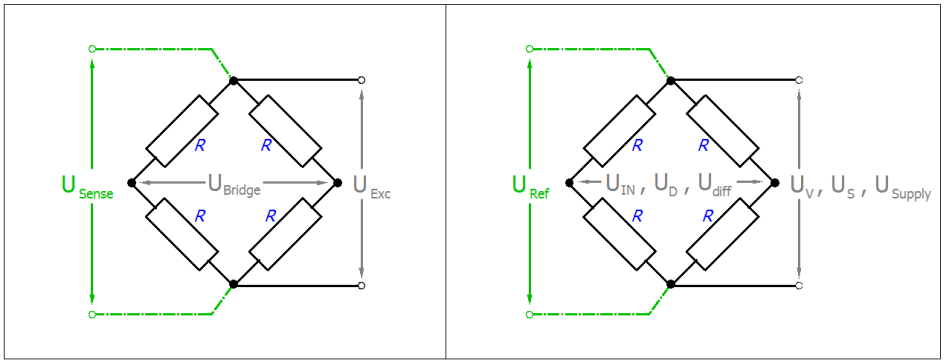


Fig. 3: Used names: in the I/O Analog Manual (left), in this remaining documentation (right)

NOTICE

Further documentation for I/O components with analog in and outputs

Also pay attention to the further documentation:

I/O Analog Manual
Notes on I/O components with analog inputs and outputs,

which is available in the Beckhoff Information-System and for download on the Beckhoff website www.beckhoff.com on the respective product pages!

The content includes the basics of sensor technology and information on analog measured values.

3 Mounting and wiring

3.1 Notes on ESD protection

NOTICE

Devices can be destroyed by electrostatic charging!

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

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

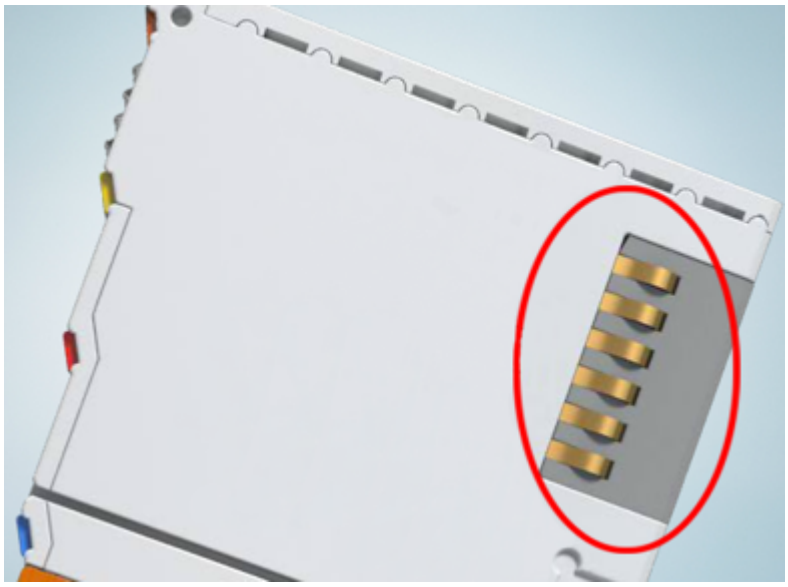


Fig. 4: Spring contacts of Beckhoff I/O components

3.2 Explosion protection

3.2.1 ATEX - Special conditions (standard temperature range)

⚠ WARNING

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

- The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60079-7! The environmental conditions during use are thereby to be taken into account!
- If the temperatures during rated operation are higher than 70°C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values!
- Observe the permissible ambient temperature range of 0 to 55°C for the use of Beckhoff fieldbus components standard temperature range in potentially explosive areas!
- Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages!
- The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- The fuses of the KL92xx/EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!
- Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

Standards

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

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

Marking

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

II 3 G Ex ec IIC T4 Gc
KEMA 10 ATEX0075 X
DEKRA 22UKEX6024X
Ta: 0 ... + 55°C

3.2.2 ATEX - Special conditions (extended temperature range)

⚠ WARNING

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

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

Standards

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

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

Marking

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

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

3.2.3 IECEx - Special conditions

⚠ WARNING

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

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

Standards

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

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

Marking

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

IECEx DEK 16.0078 X

Ex ec IIC T4 Gc

3.2.4 Continuative documentation for ATEX and IECEx

NOTICE

Continuative documentation about explosion protection according to ATEX and IECEx

Pay also attention to the continuative documentation

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

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

3.2.5 cFMus - Special conditions

⚠ WARNING

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

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

Standards

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

M20US0111X (US):

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

FM20CA0053X (Canada):

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

Marking

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

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

3.2.6 Continuative documentation for cFMus

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

3.3 Note on Beckhoff calibration certificates

Basically every Beckhoff analog device (input or output) will be justified i.e. will be calibrated during production. However, this process is not documented individually. This documentation in the form of a calibration certificate is only provided for devices that are explicitly supplied with a certificate.

The calibration certificate indicates the remaining deviation from the standard used (reference device) after adjustment. The calibration certificate (as a PDF document) can be assigned to the device via a unique number. It is therefore not a statement about a device class, such as an approval, but only applies to an individual, named device. It is available for download from the Beckhoff website.

The calibration certificate documents the measuring accuracy at the time the certificate was issued and includes information about the ambient conditions and the reference device used. It contains no statement about the behavior or the change of measuring accuracy in the future. A calibration certificate is used to review the previous period of use. If the calibration process is repeated several times over several years (without readjusting the device), it allows conclusions to be drawn about the aging behavior, the so-called calibration history.

Performance levels of the calibration certificates

Different "qualities" of a calibration certificate are common:

- *Beckhoff factory working standard calibration certificates*
  These IP20 terminals can usually be recognized by the product suffix -0020.
  The device-specific certificate is issued by Beckhoff as a PDF. It is available for download on the Beckhoff website. The terminals can be obtained from Beckhoff and recalibrated via the Beckhoff service.
- *ISO17025 calibration certificates*
  These IP20 terminals can usually be recognized by the suffix -0030.
  The device-specific certificate is issued by a service provider on behalf of Beckhoff as part of Beckhoff production and delivered by Beckhoff as a PDF. For the initial calibration (newly delivered terminals), it is available for download on the Beckhoff website. The terminals can be obtained from Beckhoff, recalibration must be carried out directly by the service provider (see details in the certificate).
- *DAkkS calibration certificates (Deutsche Akkreditierungsstelle GmbH)*
  These IP20 terminals can usually be recognized by the suffix -0030.
  The device-specific certificate is issued by a service provider on behalf of Beckhoff as part of Beckhoff production and delivered by Beckhoff as a PDF. For the initial calibration (newly delivered terminals), it is available for download on the Beckhoff website. The terminals can be obtained from Beckhoff, recalibration must be carried out directly by the service provider (see details in the certificate).

Unique device number

Depending on the device, the following numbers are used for identification:

- EL/ELM terminals up to year of manufacture 2020: the ID number lasered on the side.

Fig. 5: ID number

- From year of manufacture 2021 onwards, the BTN number (Beckhoff Traceability Number) will gradually replace the ID number, this is also lasered on the side.

Beckhoff produces a wide range of analog input/output devices as IP20 terminals or IP67 boxes. A selection is also available with factory/ISO/DAkkS calibration certificates. For specific details and availability, please refer to the technical data of the devices or contact Beckhoff Sales.

Linguistic note

In American English, "calibration" or "alignment" is understood to mean compensation/adjustment, thus a modifying effect on the device. "Verification", on the other hand, refers to observational determination and documentation of the residual error, referred to in German as *Kalibrierung*.

3.4 UL notice

⚠ CAUTION

Application

Beckhoff EtherCAT modules are intended for use with Beckhoff's UL Listed EtherCAT System only.

⚠ CAUTION

Examination

For cULus examination, the Beckhoff I/O System has only been investigated for risk of fire and electrical shock (in accordance with UL508 and CSA C22.2 No. 142).

⚠ CAUTION

For devices with Ethernet connectors

Not for connection to telecommunication circuits.

Basic principles

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

3.5 Mounting rail installation

⚠ WARNING

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

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

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

Installation

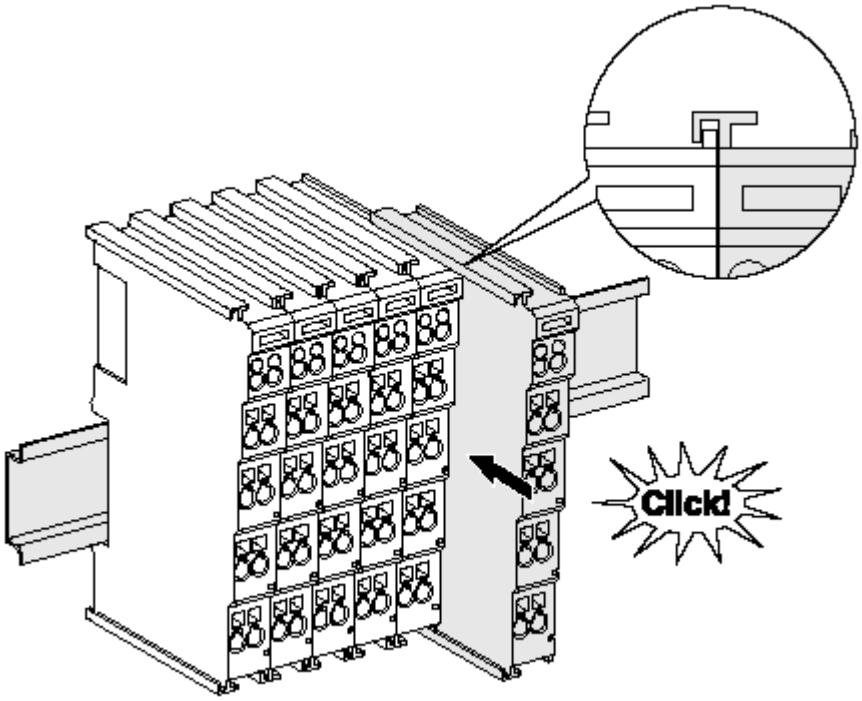


Fig. 6: Installation on the mounting rail

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

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

Fastening the mounting rails

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

NOTICE

Eath the mounting rail!

Make sure the mounting rail is properly earthed.

Connections within a bus terminal block

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

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

Power contacts

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

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

Power contact ⏚

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

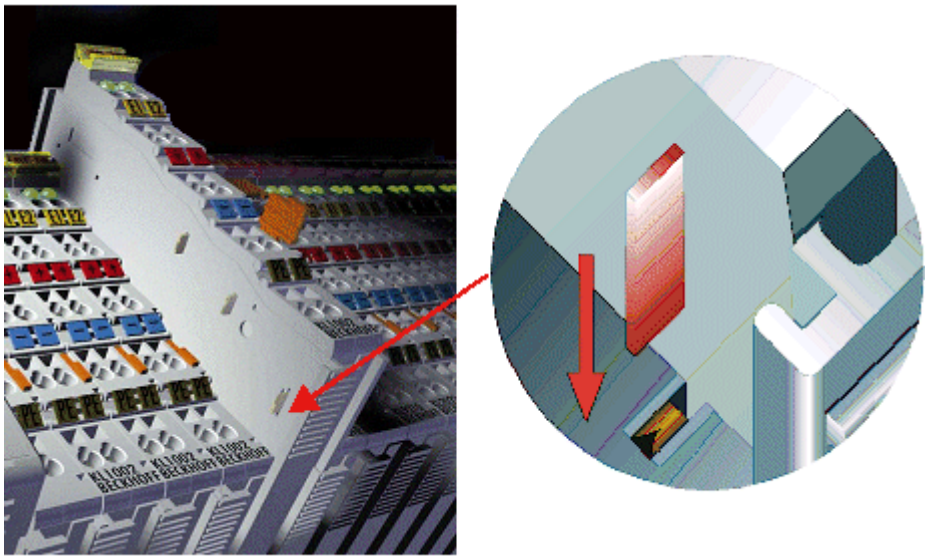


Fig. 7: Power contact on the left

⚠ WARNING

Risk of injury from electric shock!

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

NOTICE

Risk of damage to the device

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

Disassembly

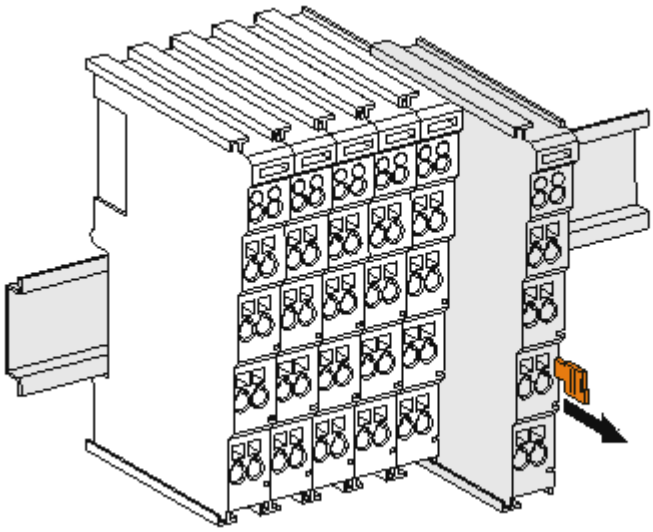


Fig. 8: Removal from mounting rail

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

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

3.6 Installation instructions for enhanced mechanical load capacity

⚠ WARNING

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

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

Additional checks

The terminals have undergone the following additional tests:

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

Additional installation instructions and notes

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

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

3.7 Connection

3.7.1 Connection system

⚠ WARNING

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

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

Overview

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

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

Standard wiring (ELxxxx / KLxxxx)

Fig. 9: Standard wiring

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

Pluggable wiring (ESxxxx / KSxxxx)

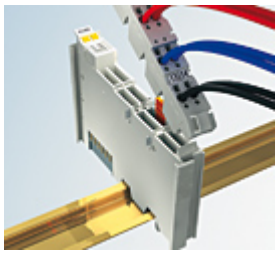


Fig. 10: Pluggable wiring

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

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

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

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

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

High Density Terminals (HD Terminals)

Fig. 11: High Density Terminals

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

Wiring HD Terminals

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

Ultrasonically compacted (ultrasonically welded) strands

Ultrasonically compacted (ultrasonically welded) strands

Ultrasonically compacted (ultrasonically welded) strands can also be connected to the standard and high-density terminals. In this case, please note the tables concerning the wire-size width [▶ 32]!

3.7.2 Wiring

⚠ WARNING

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

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

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

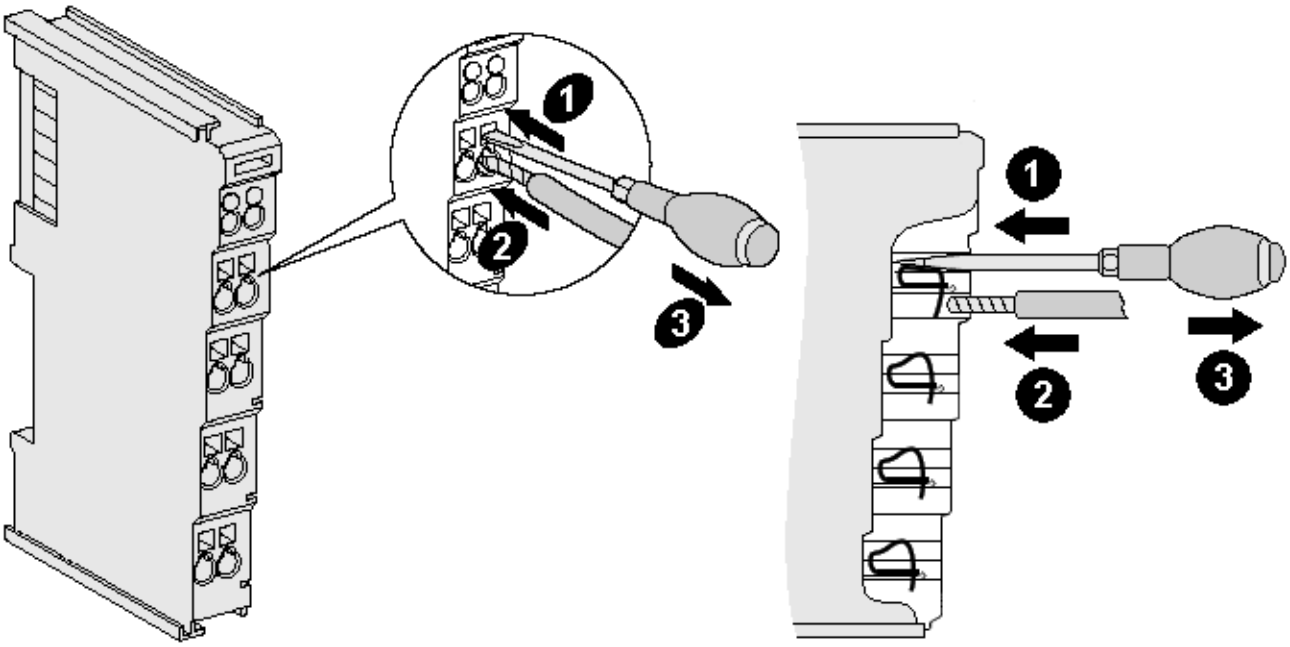


Fig. 12: Connecting a cable on a terminal point

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

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

See the following table for the suitable wire size width:

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

High Density Terminals (HD Terminals [▶ 30]) with 16/32 terminal points

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

Terminal housing	High Density Housing
Wire size width (single core wires)	0.08 ... 1.5 mm²
Wire size width (fine-wire conductors)	0.25 ... 1.5 mm²
Wire size width (conductors with a wire end sleeve)	0.14 ... 0.75 mm²
Wire size width (ultrasonically compacted [ultrasonically welded] strands)	only 1.5 mm² (see notice [▶ 30])
Wire stripping length	8 ... 9 mm

3.7.3 Shielding

Shielding

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

3.8 Note on power supply

⚠ WARNING

Power supply from SELV / PELV power supply unit!

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

Notes:

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

3.9 Installation positions

NOTICE

Constraints regarding installation position and operating temperature range

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

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

Horizontal installation (standard installation)

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

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

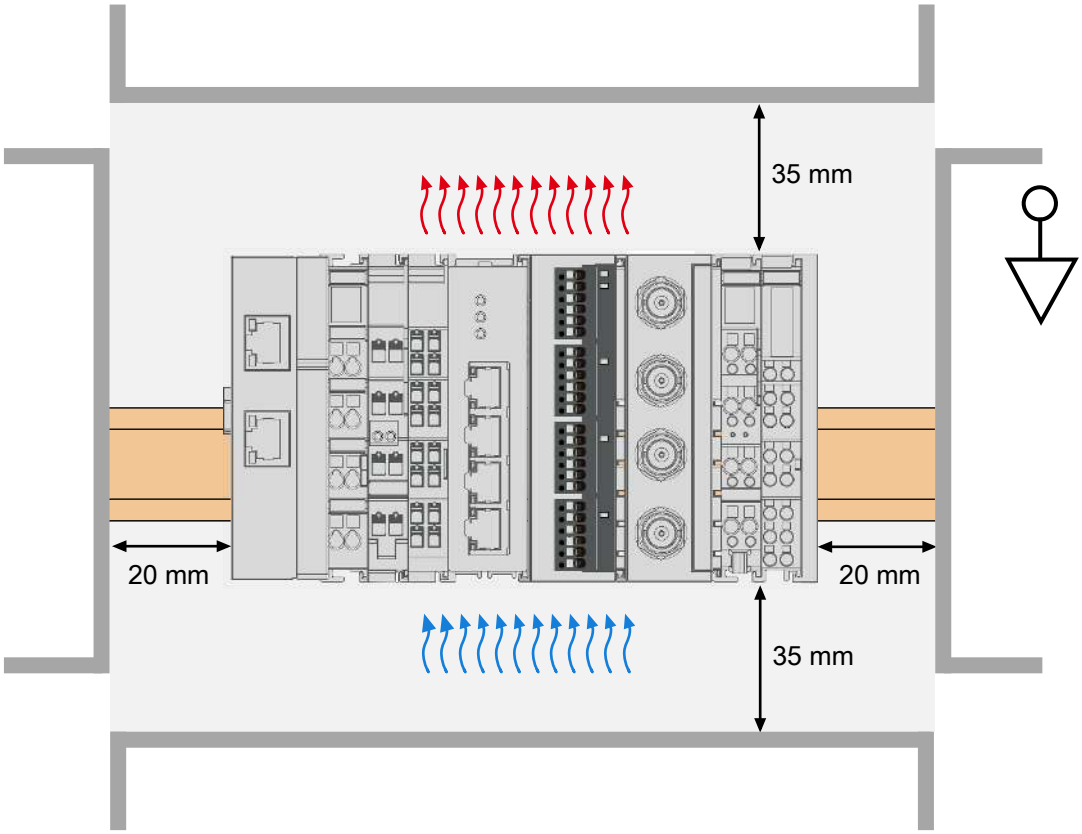


Fig. 13: Recommended minimum distances for standard installation position

NOTICE

Compliance with the minimum distances

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

Vertical installation

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

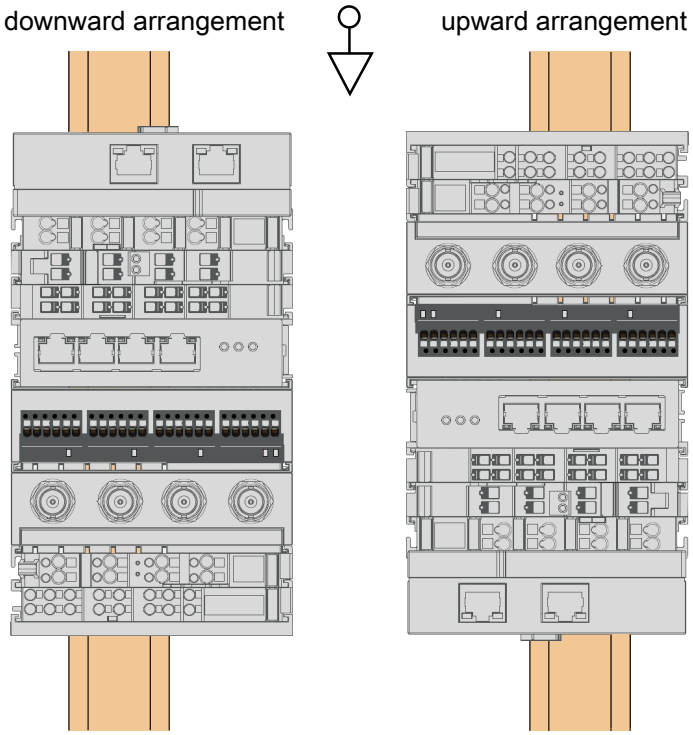


Fig. 14: Installation position: Vertical, downward arrangement (left)/upward arrangement (right)

Flat installation

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

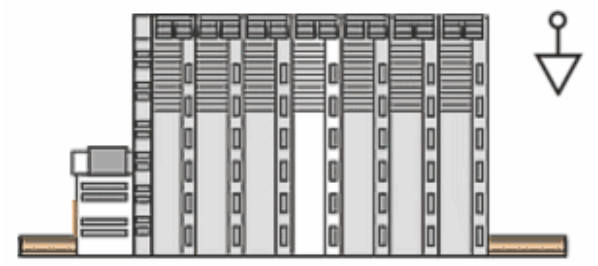


Fig. 15: Flat installation

NOTICE

Danger of sliding off the mounting rail

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

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

NOTICE

Compliance with the minimum distances

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

Installation positions with ZB8610 fan cartridge

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

The fan cartridge can be used in any installation position.

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

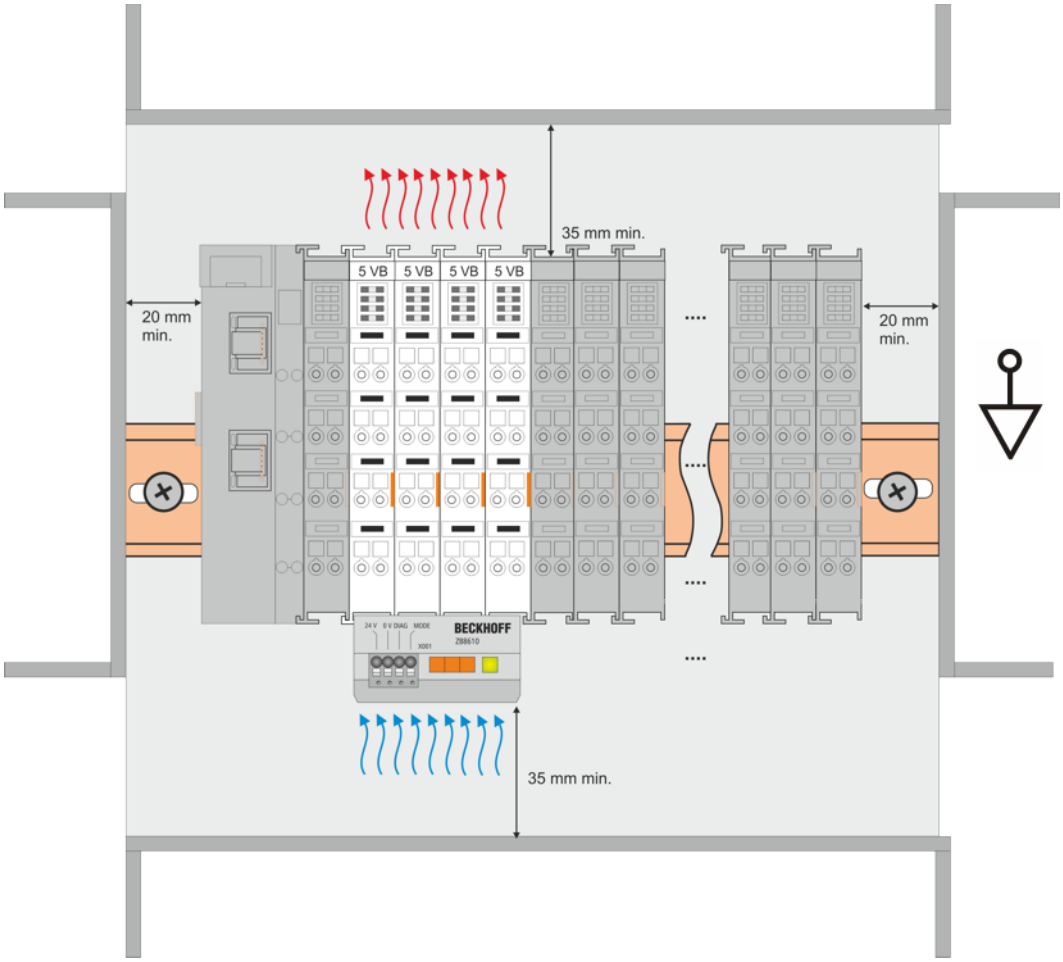


Fig. 16: Recommended minimum distances for operation with fan, using horizontal installation position as an example

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.

3.10 Positioning of passive terminals

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

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

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

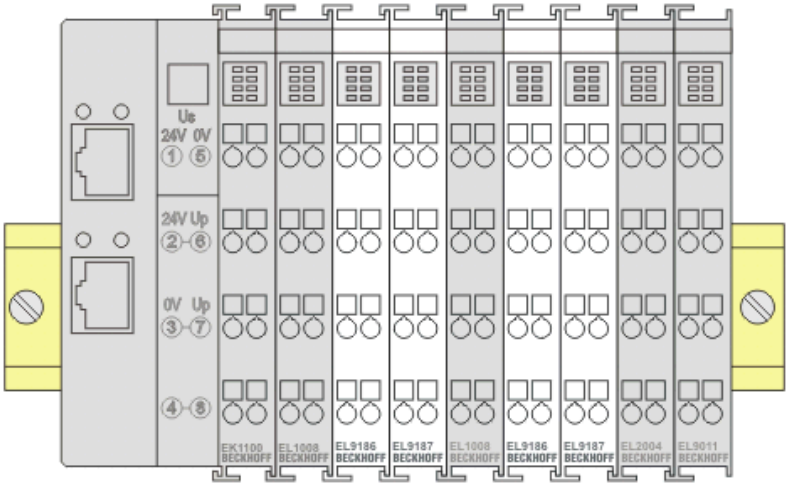


Fig. 17: Proper positioning

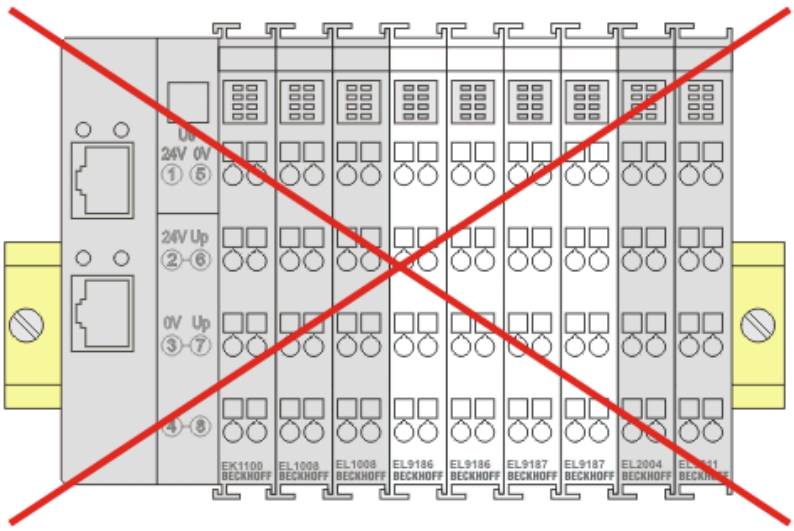


Fig. 18: Incorrect positioning

3.11 EL3356 - LEDs

EL3356 and special versions

Unless stated otherwise, the designation “EL3356” always refers also to special versions such as the EL3356-0010.

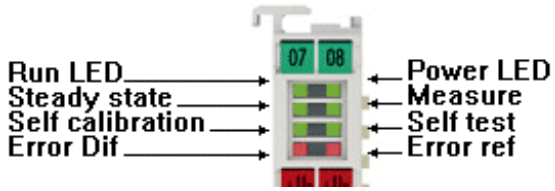


Fig. 19: EL3356 LEDs

LED	Color	Meaning	
RUN	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 standard-settings set
		single flash	State of the EtherCAT State Machine: **SAFEOP** = verification of the Sync Manager channels and the distributed clocks. Outputs remain in safe state
		on	State of the EtherCAT State Machine: **OP** = normal operating state; mailbox and process data communication is possible
		flickering	State of the EtherCAT State Machine: **BOOTSTRAP** = function for firmware updates of the terminal
Measure	green	ON	Measurement active (process data are valid)
		OFF	• Calibration active (if the Calibr. LED is lit) or • Test active (if the Test LED is lit) • Filters are initialized
Steady state	green	ON	The measured value is stable
		OFF	The measured value is not stable
Self Calibr.	green	ON	• Calibration active • Process data are not valid
Self Test	green	ON	• Self-test active • Process data are not valid
Error Dif	red	ON	• Channel 1 (strain gauge differential signal) is above or below the valid range • Internal reference voltage for channel 1 is missing
Error Ref	red	ON	• Channel 2 (strain gauge differential signal) is above or below the valid range • Internal reference voltage for channel 2 is missing • Reference voltage too low (between -1 V and +1 V)

3.12 EL3356 - Connection

Bridge feed

The EL3356 is designed for 6-wire connection. The measuring bridge is supplied by the supply voltage U_V. By feeding the bridge supply voltage U_V back from the measuring point to the EL3356, where it is measured as U_{REF}, the distorting influence of line losses is minimized.
The supply voltage for the measuring bridge can be supplied via the power contacts and measured at connection points 3 and 7. Beckhoff power supply terminals, e.g. EL9510 (10 V) can be used for feeding the supply voltage into the power contacts. The EL3356 does not use the supply voltage supplied at the power contacts internally, but transfers it to the terminal points 3/7. Alternatively, the measuring bridge can be supplied by an external source.
For 4-wire connection and if the power contact supply is used, wire jumpers should be used between terminal points 3/6 and 5/7, in order to measure the supply voltage directly at the terminal.

NOTICE

Otherwise components may be damaged: avoid excessive supply voltage

The potential difference between $+U_{REF}$ and $-U_{REF}$ may be up to 13 V.
Ensure that the power contacts carry no more than 13 V, if the measuring bridge is supplied from terminal points 3 and 7.
Note the limit values for the supply voltage specified in the data sheets of the sensor manufacturers.

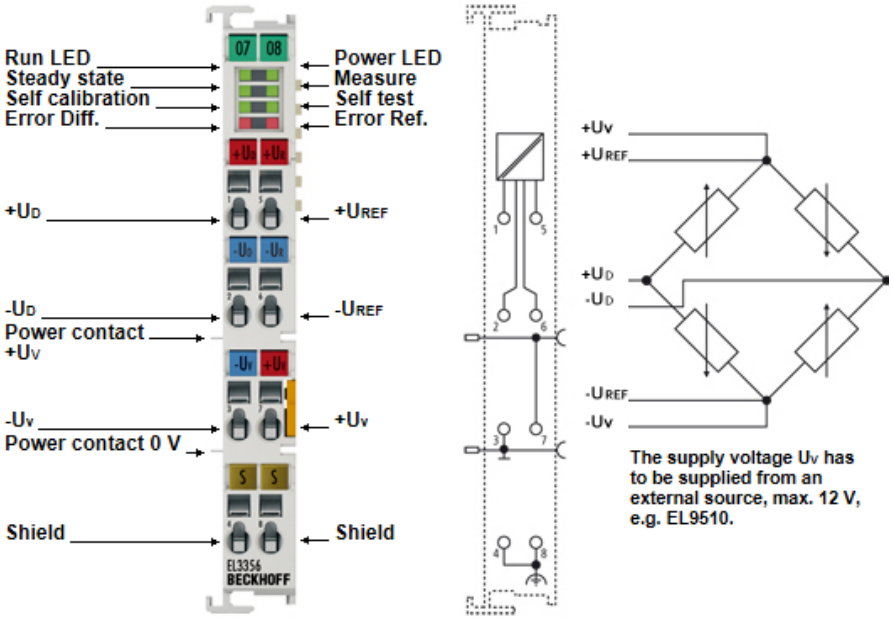


Fig. 20: LEDs and connection EL3356, EL3356-00x0

Terminal point		Description
Name	No.	
+ U_{DIFF}	1	+ input measuring voltage
- U_{DIFF}	2	- input measuring voltage
- U_V	3	- supply voltage, connected to power contact within the terminal
Shield	4	Shield
+ U_{REF}	5	+ input reference voltage
- U_{REF}	6	- input reference voltage
+U_V	7	+ supply voltage, connected to power contact within the terminal
Shield	8	Shield

Electrical isolation of the inputs and shielding concept

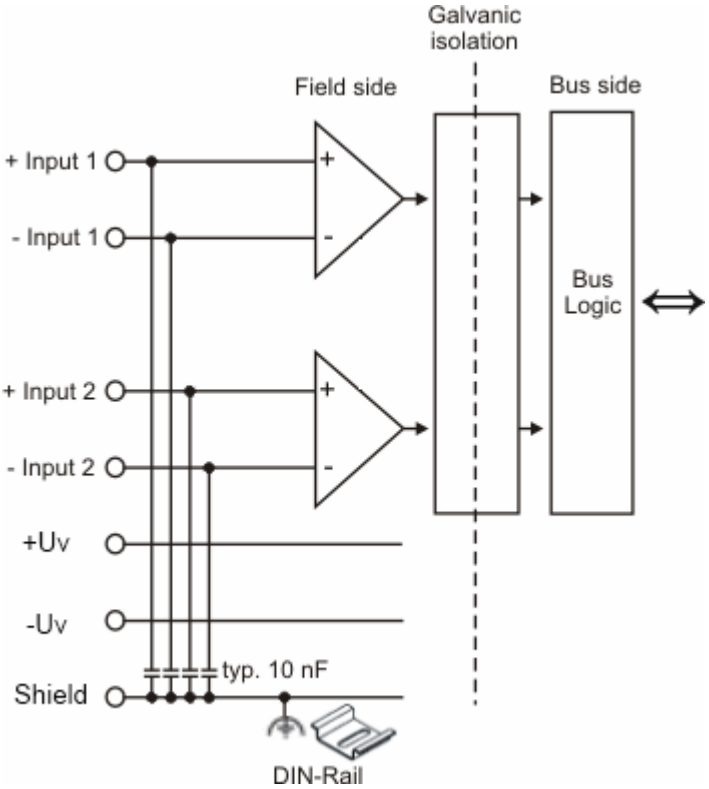


Fig. 21: Electrical isolation of the inputs

4 Commissioning

NOTICE

Further information

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

4.1 Quick start

Unless stated otherwise, the designation EL3356 also applies to the EL3356-00x0.

For standard commissioning of the EL3356-xxxx with a full strain gauge bridge (strain gauge, load cell, balance beam) proceed as follows:

1. Install the EL3356 in the E-bus terminal strand on an EtherCAT coupler, e.g. EK1100 or EK1501.
2. The EL3356 is fed with the DMS supply voltage from the left via the power contacts. Add an EL95xx power supply terminal before the EL3356 or feed in the supply voltage directly at terminal points 3/7 in the EL3356. An isolating terminal to the previous potential may then need to be inserted.
   The following must be observed:
   - Output voltage: 6, 10 or 12 V_{DC} are usual, depending on the requirements of the DMS
     The EL3356 may be fed with max. 12 V rated supply voltage.
   - Load current: each strain gauge has a load current (normally 350 Ω internal resistance). This must not overload the source.
   - Supply quality: The most stable and noise-free supply possible must be ensured.
   - Apply suitable EMC safety measures (shielding, shield connection, cable laying).
3. Connect the strain gauge in accordance with the instructions. The strain gauge is supplied with 4 or 6 connections.
   In the case of 4-wire connection, bridges must be connected to terminal points 3/6 and 5/7.
   In the case of 6-wire connection, terminal points 1 - 8 can be used directly.
   The shield must be connected. Ensure a conductive connection to the system earth.
4. Set up a correct EtherCAT configuration with the terminal.
   Since the device is present and is electrically reachable, the simplest way of accomplishing this is by scanning the devices.
5. Activate the EtherCAT master and start the terminal in OP state.
   In the input variables the EL3356 must deliver State=8 and WC=0.
6. Parameterize the used DMS in the CoE settings of the EL3356 according to the DMS data sheet.
   - Reverse any previous parameter changes by means of a CoE reset: enter **0x64616F6C** in object 0x1011:01 [▶ 79]
   - Nominal characteristic value in object 0x8000:23 [▶ 79] according to the test protocol of the strain gauge manufacturer, e.g. 2.01 mV/V
   - Nominal offset in object 0x8000:25 [▶ 79] according to the test protocol of the strain gauge manufacturer, e.g. -0.0154 mV/V
   - Nominal load of the strain gauge in object 0x8000:24 [▶ 79] according to the test protocol of the strain gauge manufacturer, 5 kg
     Note: the firmware calculates internally without units, the unit used here in "NominalLoad" (as in x8000:28 ReferenceLoad) determines the further calculation
   - Change the scaling factor; default output is in [1 Kg] - enter the factor 1000 here to display in [g]
7. EL3356-0010 /-0090: During operation, the terminal can be configured for two dynamic ranges and can be switched quickly during runtime via ControlWord: mode 0 *HighPrecision* or mode 1 *HighSpeed* (see chapter Conversion mode [▶ 51]). The averager and filter can be preset separately for both modes.
8. The current load can now be read from the process data

What if...

- calculation is to take place in other units of weight, e.g. in English pounds (lb)?
  -> Then the nominal load is also specified in lb and implicitly brings along the new unit
  Note: 1 pound = 0.453592370 kg by definition
- acceleration due to gravity at the place of installation is not equal to the average of 9.80665 m/s²?
  -> in this case the normal local gravity can be entered via the object 0x8000:26 [▶ 79]. See note [▶ 54].
- the EL3356-0010, EL3356-0090 is to be used in Distributed Clocks mode?
  -> then DC and the process data *Timestamp* must be activated. See note [▶ 63].
- the EL3356-0090 is to be used in a safety application?
  -> Then it has to be considered that the measurement readings are frozen during automatic adjustment / self-calibration and
  ->when activating the TwinSAFE SC slot, the measured value has to be selected as INT32.
  Note the hints in chapter TwinSAFE SC process data EL3356-0090 [▶ 78].
- dynamic weighing is demanded, i.e. high measuring accuracy is to be achieved despite rapidly varying loads? This can be the case, for example, when filling sacks or during the mechanical fastening of a bulk material receptacle.
  -> in this case the EL3356 offers three concepts: dynamic filter adaptation [▶ 49] *DynamicIIR*, mode change [▶ 51] and input freeze [▶ 53]
- the self-calibration [▶ 56] carried out every 3 minutes in the standard setting is not desired?
  -> in this case the repeat time is to be changed in the CoE or the calibration procedure itself is to be controlled via the control word.

4.2 Basic function principles

EL3356 and special versions

Unless stated otherwise, the designation “EL3356” always refers also to special versions such as the EL3356-0010.

The measuring functions of the EL3356 can be described as follows:

- The EL3356 Analog Input Terminal is used to acquire the supply voltage to a load cell as a reference voltage, and the differential voltage that is proportional to the force acting on the cell.
- A full bridge must be connected. If only a quarter or half bridge is available, external auxiliary bridges should be added. In this case, the nominal characteristic value should be modified accordingly.
- The reference and differential voltages are measured simultaneously.
- Since the two voltages are measured at the same time, there is basically no need for a high-precision reference voltage with respect to the level.
  On changing the reference voltage, the differential voltage across the full bridge changes by the same degree. Therefore a stabilized reference voltage should be used that is subject to only low fluctuations (e.g. the EL95xx supply terminal).
- The change of the quotient of the differential and reference voltages corresponds to the relative force acting on the load cell.
- The quotient is converted into a weight and is output as process data.
- The data processing is subject to the following filtering procedures:
  - the analog convertor (ADC) integrates over 76 samples
  - calculation of mean values in the averager (if activated)
  - software filter IIR/FIR (if activated)
- The EL3356 has an automatic compensation/self-calibration function.
  - Default state: self-calibration activated, execution every 3 minutes
  - errors in the analog input stages (temperature drift, long-term drift etc.) are checked by regular automatic calibration, and compensated to bring the measurement within the permitted tolerance range.
  - the automatic function can be deactivated or activated in a controlled manner
- The EL3356 can also be used as a 2-channel analog input terminal for voltage measurement [▶ 61].
  Please note: the PDO Ctrl (CoE 0x7000:0) has no function in this case.
- The EL3356-0010 and EL3356-0090 have a timestamp function that can be activated through Distributed Clocks
  In DC mode the filter functions are inactive.

4.2.1 General notes

- The measuring ranges of both channels (supply voltage and bridge voltage) should always be used as widely as possible in order to achieve a high measuring accuracy.
  We recommended a supply voltage of 12 V in connection with a load cell that has such a sensitivity (e.g. 2 mV/V) that the largest possible bridge voltage - ideally ±25 mV - is generated.
  Note the input voltages (see Technical data [▶ 12]).

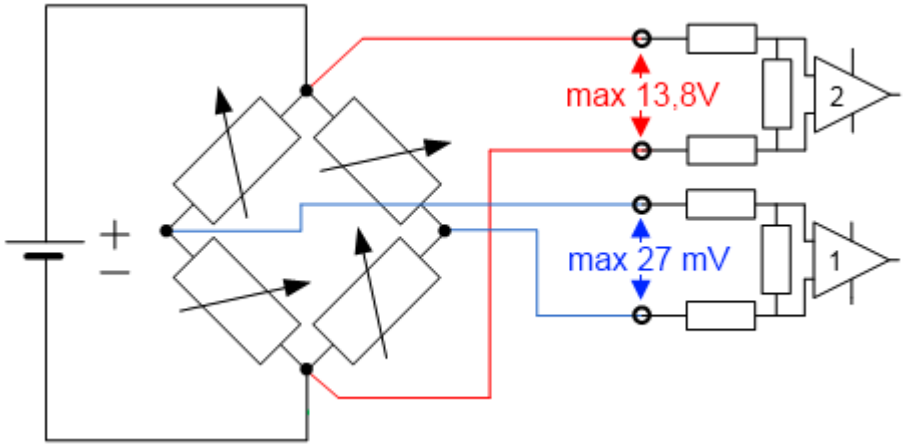


Fig. 22: Max. input voltages

- Parallel operation of load cells is possible with the EL3356. Please note:
  - the EL3356 does not provide a supply! Hence, the power supply employed must be sufficiently large, since the total bridge resistance of all strain gauges connected together is considerably reduced due to the parallel connection.
  - Load cells approved and calibrated by the load cell manufacturer for parallel operation should be used. The nominal characteristic values [mV/V], zero offset [mV/V] and impedance [Ω, ohm] are then usually adjusted accordingly.
  - a 6-wire connection is expressly recommended

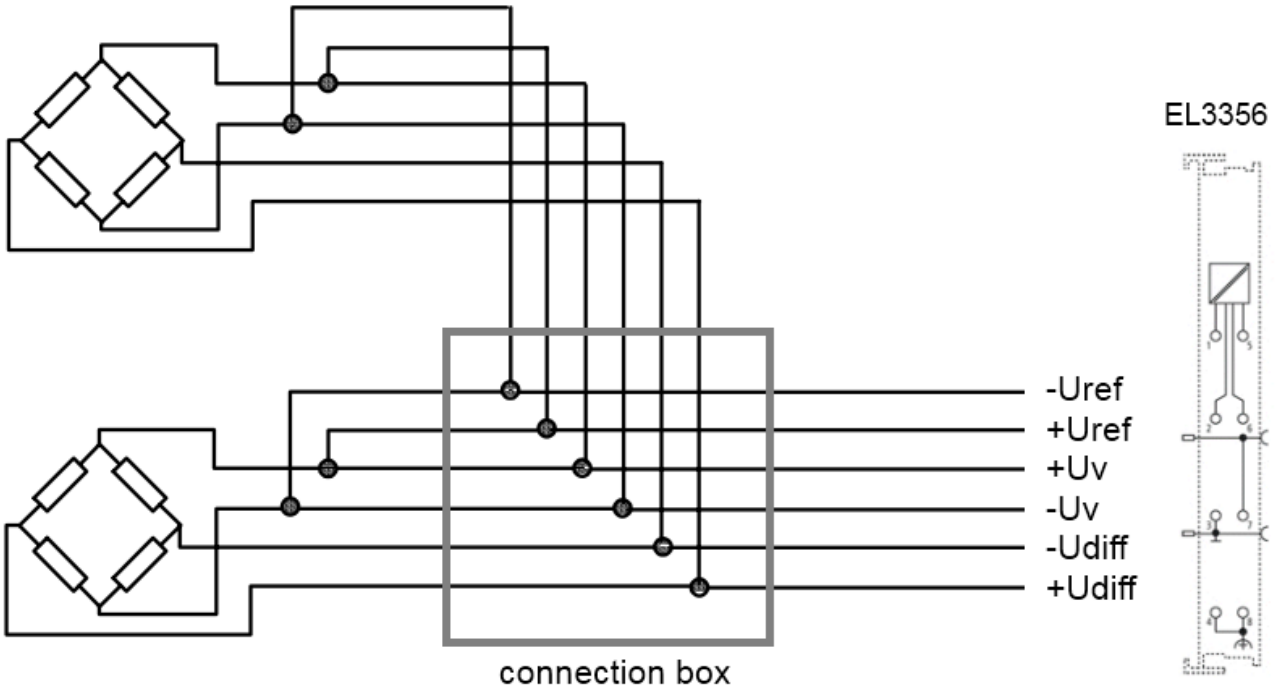


Fig. 23: Parallel connection with EL3356

- Load cell signals have a low amplitude and are occasionally very sensitive to electromagnetic interference. Considering the typical system characteristics and taking into account the technical possibilities, purposeful state-of-the-art EMC protective measures are to be taken. The shield of the sensor cable can be connected to the EL3356 at the terminal points 4/8. In the case of high electromagnetic interference levels, it may be helpful to additionally connect the cable screen before the terminal using suitable screening material.
- The minimum permissible assigned EtherCAT cycle time for the EL3356 is 100 µs.
- If the EL3356-0010 and EL3356-0090 are to be used in Distributed Clocks mode
  - DC must be activated
  - the *timestamp* process record [▶ 65]must be activated.
  In this case, the filter functions are inactive.

4.2.2 Signal flow diagram

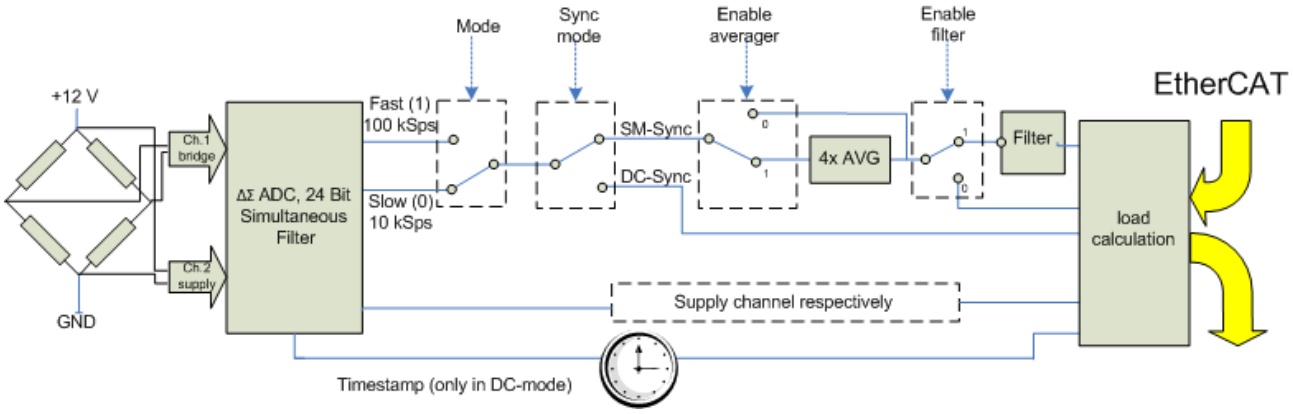


Fig. 24: Block diagram of EL3356-0010

The EL3356 processes the data in the following order

1. Hardware low-pass 10 KHz
2. 2-channel simultaneous sampling at 10.5/105.5 kSps with 64-fold oversampling by delta-sigma (ΔΣ) converter and internal prefiltration
3. 4-fold averager (can be deactivated)
4. Software filter (can be deactivated)
5. Calculating the weight

Measurement principle of delta-sigma (ΔΣ) converter

The measurement principle employed in the EL3356, with real sampling in the MHz range, shifts aliasing effects into a very high frequency range, so that normally no such effects are to be expected in the kHz range.

4.2.3 Averager

In order to make use of the high data rates of the Analog-to-Digital converter (ADC) even with slow cycle times, a mean value filter is connected after the ADC. This determines the sliding mean value of the last four measured values. This function can be deactivated for each mode via the CoE object “Mode *X* enable averager”.

4.2.4 Software filter

The EL3356 is equipped with a digital software filter which, depending on its settings, can adopt the characteristics of a *F*inite *I*mpulse *R*esponse filter (*FIR filter*), or an *I*nfinite *I*mpulse *R*esponse filter (*IIR filter*). The filter is activated by default as *50Hz-FIR*.

In the respective measuring mode the filter can be activated (0x8000:01 [▶ 79], 0x8000:02 [▶ 79]) and parameterized (0x8000:11 [▶ 79], 0x8000:12 [▶ 79]) (the EL3356-0000 supports only mode 0).

- **FIR 50/60 Hz**
  The filter performs a notch filter function and determines the conversion time of the terminal. The higher the filter frequency, the faster the conversion time. A 50 Hz and a 60 Hz filter are available. Notch filter means that the filter has zeros (notches) in the frequency response at the filter frequency and multiples thereof, i.e. it attenuates the amplitude at these frequencies. The FIR filter operates as a non-recursive filter.

- **PDO filter (valid as from firmware 05)**

  The filter behaves like the 50/60 Hz FIR filter described above. However, the filter frequency can be adjusted here in 0.1 Hz steps by means of an output data object. The filter frequency range extends from 0.1 Hz to 200 Hz and can be reparametrized during operation.

  To do this the PDO 0x1601 (“RMB filter frequency”) must be displayed in the process data and the entry “PDO filter frequency” must be selected in the object 0x8000:11.

  This function allows the EL3356 to suppress interference of a known frequency in the measuring signal. A typical application, for example, is a silo that is filled and weighed by a driven screw conveyor. The rotary speed of the screw conveyor is known and can be adopted into the object as a frequency. Thus mechanical oscillations can be removed from the measuring signal.

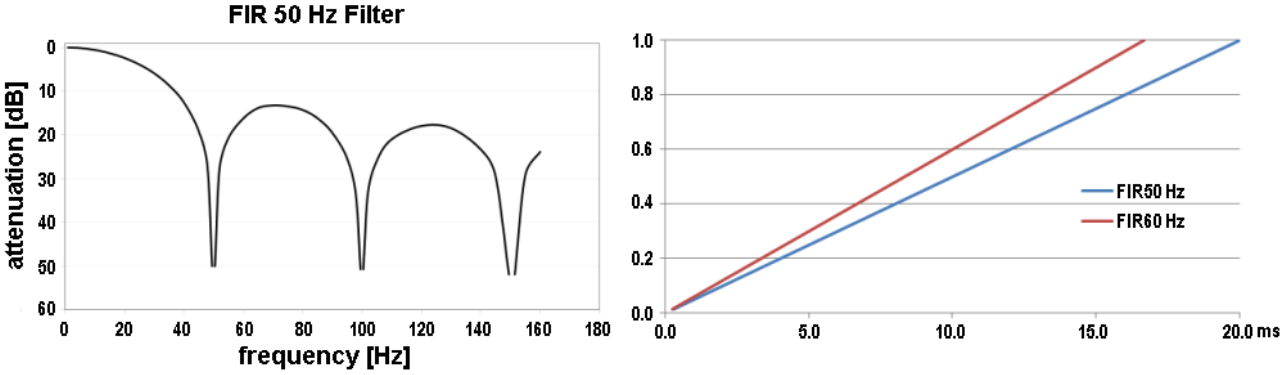


Fig. 25: Notch characteristic/amplitude curve and step response of the FIR filter

- **IIR-Filter 1 to 8**
  The filter with IIR characteristics is a discrete time, linear, time invariant filter that can be set to eight levels (level 1 = weak recursive filter, up to level 8 = strong recursive filter).
  The IIR can be understood to be a moving average value calculation after a low-pass filter.

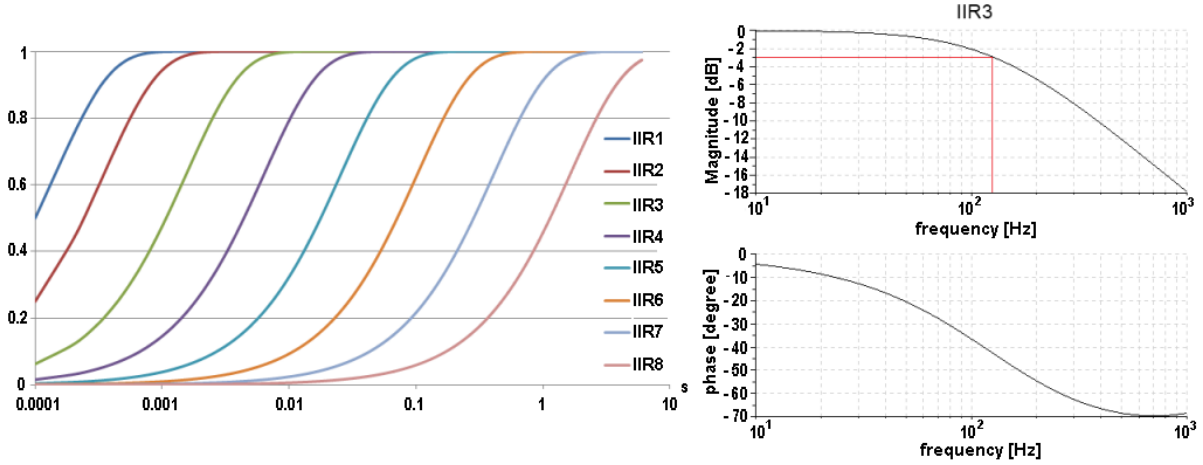


Fig. 26: Step response and Bode diagram of the IIR filter

Overview of conversion times

Filter Settings	Value	PDO update time		Filter property	Limit frequency (-3 dB) [Hz] (typ.)	Comment	Rise time 10-90% [s] (typ.)
		EL3356	EL3356-0010 EL3356-0090				
Filter deactivated	-	min. 10 ms	Cycle-synchronous, EL3356-0010 min. 100 µs EL3356-0090 min. 150 µs	-	-	-	-
0	FIR 50 Hz	min. 10 ms	312.5 µs	50 Hz notch filter	22 Hz	Typ. conversion time 312.5 µs	0.013
1	FIR 60 Hz	min. 10 ms	260.4 µs	60 Hz notch filter	25 Hz	Typ. conversion time 260.4 µs	0.016

Filter Settings	Value	PDO update time		Filter property	Limit frequency (-3 dB) [Hz] (typ.)	Comment	Rise time 10-90% [s] (typ.)
		EL3356	EL3356-0010 EL3356-0090				
2	IIR1	Cycle-synchronous (up to min. 10 ms update	Cycle-synchronous (EL3356-0010: up to min. 100 µs) (EL3356-0090: up to min. 150 µs)	Low-pass	2000 Hz	$a_0 = 1/2^1 = 0.5$	0.0003
3	IIR2			Low-pass	500 Hz	$a_0 = 1/2^2 = 0.25$	0.0008
4	IIR3			Low-pass	125 Hz	$a_0 = 1/2^4 = 62.5e\text{-}3$	0.0035
5	IIR4			Low-pass	30 Hz	$a_0 = 1/2^6 = 15.6e\text{-}3$	0.014
6	IIR5			Low-pass	8 Hz	$a_0 = 1/2^8 = 3.91e\text{-}3$	0.056
7	IIR6			Low-pass	2 Hz	$a_0 = 1/2^{10} = 977e\text{-}6$	0.225
8	IIR7			Low-pass	0.5 Hz	$a_0 = 1/2^{12} = 244e\text{-}6$	0.9
9	IIR8			Low-pass	0.1 Hz	$a_0 = 1/2^{14} = 61.0e\text{-}6$	3.6
10	Dynamic IIR			The filter changes dynamically between the filters IIR1 to IIR8			
11	PDO Filter frequency	min. 10 ms	$\frac{1}{PDO\ Value[Hz] \cdot 64}$	Notch filter with adjustable frequency	approx. 0.443 * PDO value [Hz]	-	-

Filter and cycle time

If the FIR filters (50 Hz or 60 Hz) are switched on, the process data are updated maximally with the specified conversion time. (see table) The IIR filter works cycle-synchronously. Hence, a new measured value is available in each PLC cycle.

IIR filter

Differential equation: $Y_n = X_n * a_0 + Y_{n-1} * b_1$
with $a_0 + b_1 = 1$
a_0 = (see table)
$b1 = 1 - a_0$

4.2.5 Dynamic filter

The dynamic IIR filter automatically switches through the 8 different IIR filters depending on the weight change. The idea:

- The target state is always the IIR8-Filter, i.e. the greatest possible damping and hence a very calm measured value.
- In the input variable changes rapidly the filter is opened, i.e. switched to the next lower filter (if still possible). This gives the signal edge more weight and the measured value curve can follow the load quickly.
- If the measured value changes very little the filter is closed, i.e. switched to the next higher filter (if still possible). Hence the static state is mapped with a high accuracy.
- The evaluation as to whether a downward change of filter is required or whether an upward change is possible takes place continuously at fixed time intervals.

Parameterization takes place via the CoE entries 0x8000:13 [▶ 79] and 0x8000:14 [▶ 79]. Evaluation takes place according to two parameters:

- The “Dynamic filter change time” object (0x8000:13 [▶ 79]) is used to set the time interval at which the existing signal is re-evaluated.
- Object 0x8000:14 [▶ 79] is used to specify the maximum deviation that is permissible during this time without filter switching occurring.

Example:

The dynamic filter is to be adjusted in such a manner that a maximum slope of 0.5 digits per 100 ms (5 digits per second) is possible without the filter being opened. This results in a “calm” measured value. In the case of a faster change, however, it should be possible to immediately follow the load.

- Dynamic filter change time (0x8000:13 [▶ 79]) = 10 (equivalent to 100 ms)
- Dynamic filter delta (0x8000:14 [▶ 79]) = 0.5 (related to the calculated load value)

The measured value curve is shown below for a slower (left) and faster (right) change.

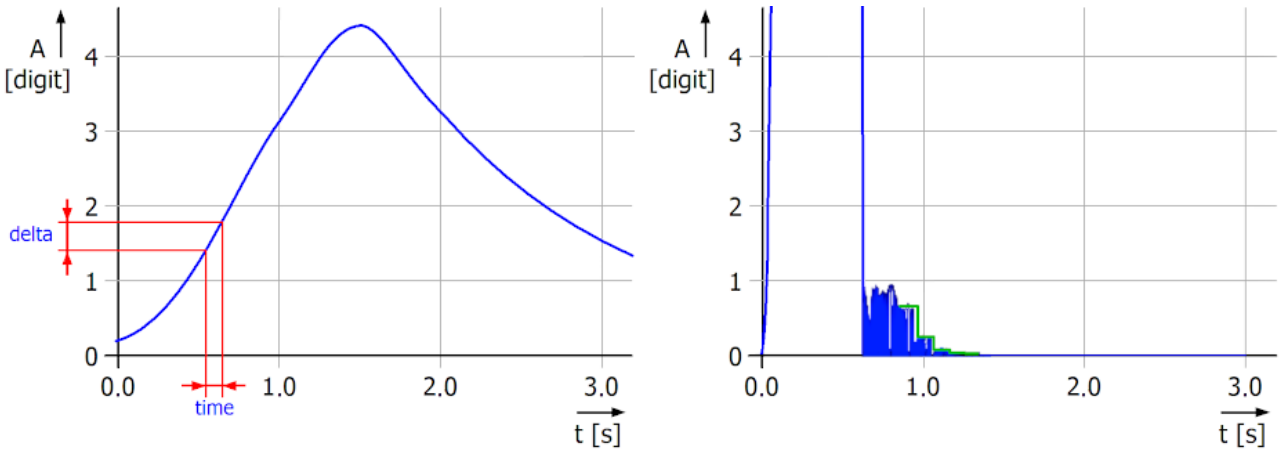


Fig. 27: Effect of dynamic IIR filters

- Links: The scales are slowly loaded. The change in the weight (delta/time) remains below the mark of 0.5 digits per 100 ms. The filter therefore remains unchanged at the strongest level (IIR8), resulting in a low-fluctuation measured value.
- Right: The scales are suddenly loaded. The change in the weight immediately exceeds the limit value of 0.5 digits per 100 ms. The filter is opened every 100 ms by one level (IIR8 --> IIR7 --> IIR6 etc.) and the display value immediately follows the jump. After the removal of the weight the signal quickly falls again. If the change in the weight is less than 0.5 digit per 100 ms, the filter is set one level stronger every 100 ms until IIR8 is reached. The green line is intended to clarify the decreasing “noise level”

4.2.6 Calculating the weight

Each measurement of the analog inputs is followed by the calculation of the resulting weight or the resulting force, which is made up of the ratio of the measuring signal to the reference signal and of several calibrations.

$Y_R = (U_{Diff} / U_{Ref}) \cdot A_i$	(1.0)	Calculation of the raw value in mV/V
$Y_L = ((Y_R - C_{ZB}) / (C_n - C_{ZB})) \cdot E_{max}$	(1.1)	Calculation of the weight
$Y_S = Y_L \cdot A_S$	(1.2)	Scaling factor (e.g. factor 1000 for rescaling from kg to g)
$Y_G = Y_S \cdot (G / 9.80665)$	(1.3)	Influence of acceleration of gravity
$Y_{AUS} = Y_G \cdot Gain - Tare$	(1.4)	Gain and Tare

Name	Description	CoE Index
U_{Diff}	Bridge voltage/differential voltage of the sensor element, after averager and filter	
U_{Ref}	Bridge supply voltage/reference signal of the sensor element, after averager and filter	
A_i	Internal gain, not changeable. This factor accounts for the unit standardization from mV to V and the different full-scale deflections of the input channels	
C_n	Nominal characteristic value of the sensor element (unit mV/V, e.g. nominally 2 mV/V or 2.0234 mV/V according to calibration protocol)	0x8000:23 [▶ 79]
C_{ZB}	Zero balance of the sensor element (unit mV/V, e.g. -0.0142 according to calibration protocol)	0x8000:25 [▶ 79]
E_{max}	Nominal load of the sensor element The firmware always calculates without units, the unit (kg, g, lb) used here is then also applicable to the result	0x8000:24 [▶ 79]
A_S	Scaling factor (e.g. factor 1000 for rescaling from kg to g)	0x8000:27 [▶ 79]
G	Acceleration of gravity in m/s^2 (default: 9.80665 ms/s^2)	0x8000:26 [▶ 79]
Gain		0x8000:21 [▶ 79]
Tare		0x8000:22 [▶ 79]

4.2.7 Conversion mode

The so-called conversion mode determines the speed and latency of the analog measurement in the EL3356. The characteristics:

Mode	Meaning	typ. latency	EL3356	EL3356-0010, EL3356-0090	typ. current consumption
0	High precision Analog conversion at 10.5 kSps (samples per second) Slow conversion and thus high accuracy	7.2 ms	x	x	70% (see Technical data [▶ 12] regarding nominal value)
1	High speed / low latency Analog conversion at 105.5 kSps (samples per second) Fast conversion with low latency	0.72 ms	-	x	100% (see Technical data [▶ 12] regarding nominal value)

Due to the conversion principle of the EL3356, the analog voltage is only available as a digital value after a defined time. This is shown in Fig. *Latency of the analog/digital converter*.

A step signal 0->1 is applied to the input. The measured value is reached and readable within the defined accuracy after 7.2 or 0.72 ms, depending on the conversion mode 0/1. At this time the timestamp is also acquired in Distributed Clocks mode. In real operation a step signal is not normally connected, but rather a higher frequency but constant signal. The EL3356 then maps the input signal with the corresponding latency for further processing, for which reason faster querying of the sampling unit at shorter intervals than the latency (EL3356-0010 allows up to 100 µs and EL3356-0090 allows up to 150 µs) makes sense for true-to-detail mapping of the analog input signal.

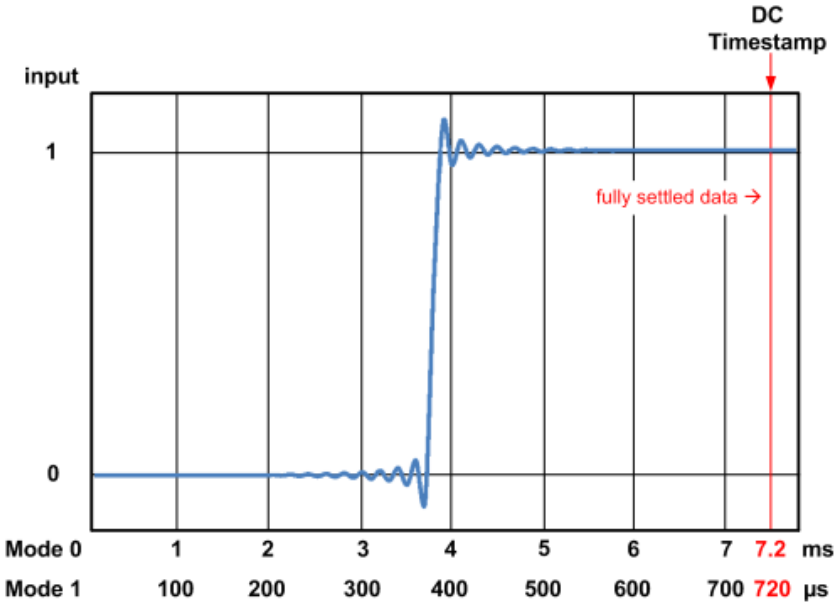


Fig. 28: Latency of the Analog-to-Digital converter

It is not possible to change the specified latency.

Beyond that the following are individually adjustable in each mode via CoE

- activation of the averager
- activation of the filter
- type of filter

8000:0	RMB Settings	RW	> 50 <
8000:01	Mode0 enable filter	RW	TRUE
8000:02	Mode1 enable filter	RW	TRUE
8000:03	Mode0 enable averager	RW	TRUE
8000:04	Mode1 enable averager	RW	TRUE
8000:05	Symmetric reference potential	RW	TRUE
8000:11	Mode0 filter settings	RW	FIR 50 Hz (0)
8000:12	Mode1 filter settings	RW	FIR 50 Hz (0)

Fig. 29: Setting parameters in CoE belonging to the individual modes

The EL3356 has only mode 0, the El3356-0010 and the EL3356-0090 have modes 0 & 1.

Mode change (EL3356-0010, EL3356-0090 only)

In particular for dynamic weighing procedures it may make sense to considerably change the measuring characteristic during the weighing procedure. For example, if a bulk material is filled by the sack within 5 seconds, a very open filter should initially be used so that the measured value quickly follows the fill level. During this phase it is of no importance that the measured value is very inaccurate and subject to high fluctuations. If the sack is >90% full, filling must be slowed down and the loading must be followed with higher accuracy; the filter must be closed. Therefore the two conversion modes can be switched via the process data bit “Sample mode“ in the EL3356-0010 and EL3356-0090 in relation to the processing of the analog values.

The mode change takes about 30 ms, during which time the measured values are invalid and indicate this by the status byte.

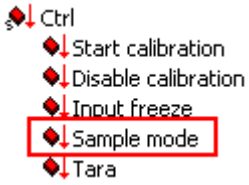


Fig. 30: “Sample mode” switching

4.3 Application notes

4.3.1 Symmetric reference potential

The EL3356 measures the two voltages U_{supply} und U_{bridge} independently of each other and without electrical reference to a supply voltage. The measuring accuracy can be increased further, if an internal coupling is employed to prevent the internal measuring circuits from drifting apart. To this end the EL3356 has an internal switch that is closed in the default state and establishes a potential reference between the internal electronics and the bridge point.

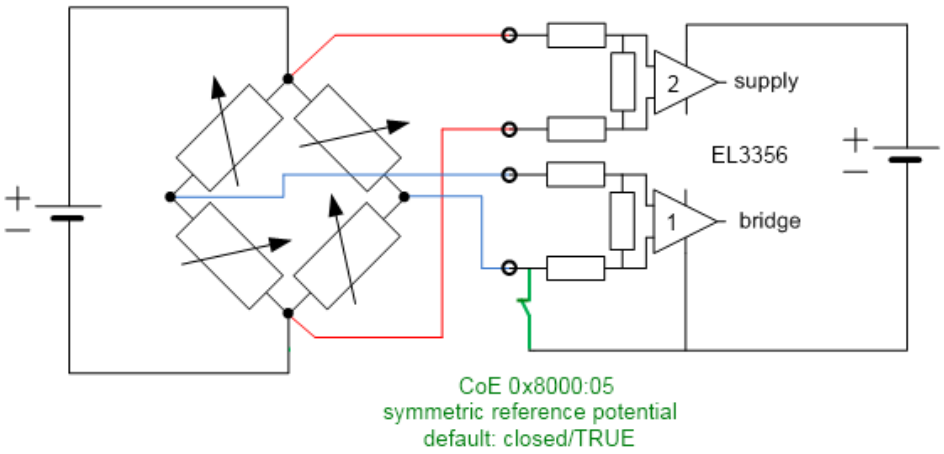


Fig. 31: Internal switch for increasing the measuring accuracy

If several strain gauges are supplied by the same power supply and equalizing currents flow that falsify the measurement, the switch can be opened via CoE 0x8000:05 [▶ 79]. Alternatively, electrically isolated strain gauge supplies are to be installed.

4.3.2 Wiring fail indication

The EL3356 has no express open-circuit recognition facility. If one of the bridge wires is broken, however, the voltage measured there generally moves towards the final value, thus displaying an error in the status word. Over/underrange of the supply voltage is likewise indicated.

4.3.3 InputFreeze

If the terminal is placed in the freeze state by *InputFreeze* in the control word, no further analog measured values are relayed to the internal filter. This function is usable, for example, if a filling surge is expected from the application that would unnecessarily overdrive the filters due to the force load. This would result in a certain amount of time elapsing until the filter had settled again. The user himself must determine a sensible *InputFreeze* time for his filling procedure.

For clarification: temporal control of the *InputFreeze* and the decision regarding its use must be realized by the user in the PLC, they are not components of the EL3356.

In the following example (recorded with Scope2) impulses on a 15 kg load cell are recorded; the filter is wide open at IIR1 so that steep edges occur in the signal.

Fig. 32: InputFreeze example

Explanation: The weight (A) is shown in blue; the state of the *InputFreeze* variable, which can be controlled by the PLC program and can be TRUE/FALSE, is shown in red (B). The first two impulses (C) lead to large peak deflections in the signal. After that the following is activated in the PLC program (see example program [▶ 93]):

- if the measured value for the last cycle (cycle time 100 µs) has changed by more than 10 g (indicating a sudden load),
- *bInputFreeze* is set to TRUE for 50 ms by a TOF block on the EL3356

The effect can be seen in (D): The peak load is no longer acknowledged by the EL3356. If it is optimally adapted to the expected force impulse, the EL3356 can measure the current load value without overshoot.

4.3.4 Gravity adaptation

The calculation of the weight depends on the gravitation/the Earth's gravitational force/acceleration due to gravity at the place of installation of the scales. In general, acceleration due to the gravitational pull of the earth at the place of installation is not equal to the defined standard value of g = 9.80665 m/s². For example, 4 zones of acceleration due to gravity are defined in Germany, in which a local acceleration due to gravity of 9.807 to 9.813 m/s² is to be assumed. Hence, within Germany alone there is a clear dispersion of the order of parts per thousand for acceleration due to gravity, which has a direct effect on the measured weight in accordance with the equation F_G = m*g!

If

- load cells are used in the theoretical calibration with characteristic values according to the sensor certificate
- calibration weights are used whose weight at the place of installation of the scales is by nature different to that at the place of origin
- scales of the accuracy class I to III are to be realized
- scales that are generally independent of acceleration due to gravity are to be realized

then one should check whether the gravity correction needs to be adapted via object 0x8000:26 [▶ 79].

4.3.5 Idling recognition

Weighing is a dynamic procedure that can lead to large jumps in the bridge voltage and thus to the calculation of the value. Following a change in load, the measured value must first “settle” so that the process value is evaluable in the controller. The evaluation of the measured value and the decision over the degree of calmness can be done in the controller; however, the EL3356 also offers this function, which is activated by default. The result is output in the status word.

- If the load value remains within a range of values y for longer than time x, then the *SteadyState* is activated in the *StatusWord*.
- *SteadyState* is set to FALSE as soon as this condition no longer applies.
- The parameters x and y can be specified in the CoE
- The evaluation is naturally considerably affected by the filter setting

In the following example (recorded with TwinCAT Scope2), a 15 kg load cell is suddenly unloaded and loaded with 547 g. *SteadyState* is subject to a window time from 100 ms and a tolerance of 8 g (15 kg nominal value, scaling 1000; see CoE).

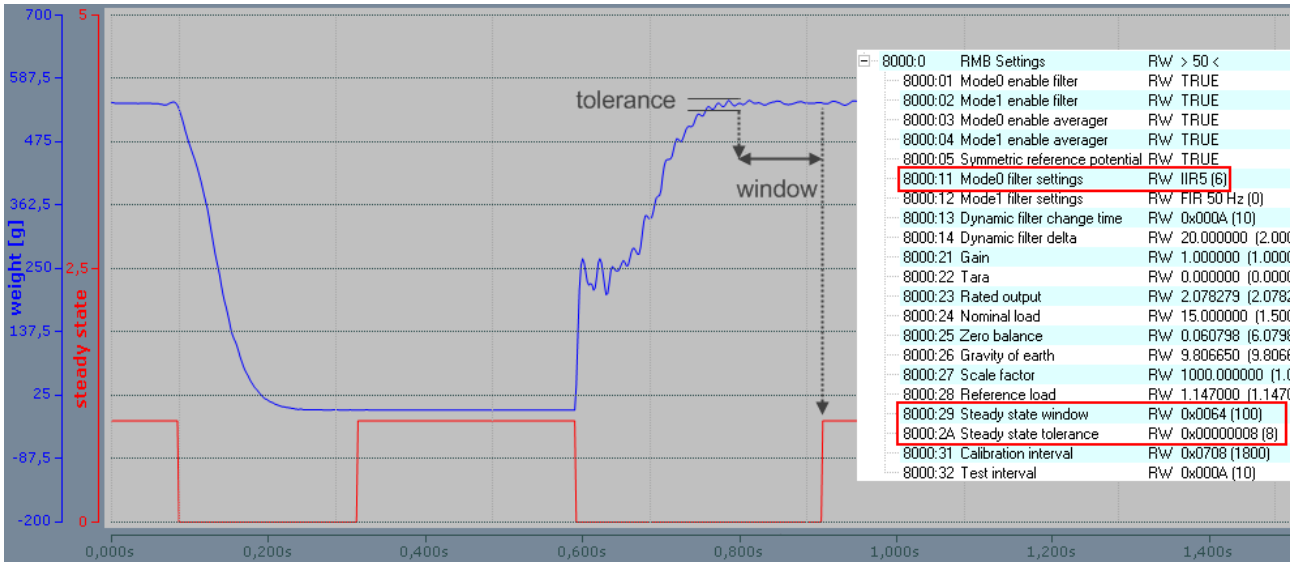


Fig. 33: Idling recognition example

4.3.6 Official calibration capability

“Official calibration” is a special kind of calibration that is accomplished according to special regulations with the involvement of trained personnel using prescribed aids. The use of “officially calibrated” scales is mandatory in the Central European region, in particular for the filling of foodstuffs. This ensures the correctness of the weighed quantities in a particular way.

The Beckhoff EL/KL335x terminals cannot be officially calibrated as individual devices. However, they can be integrated as elements in applications that can then be equipped by the integrator with the required characteristics for official calibration capability using appropriate means.

4.4 Calibration and compensation

The term “calibration” can be applied in three different ways to the EL3356:

- Sensor calibration: once-only calibration of the employed sensor (strain gauge) during commissioning of the system
- Self-calibration: continuously repeated self-calibration of the terminal for the improvement of the measuring accuracy
- Tare: repeated gross/net compensation by taring

EL3356 and special versions

Unless stated otherwise, the designation “EL3356” always refers also to special versions such as the EL3356-0010.

4.4.1 Sensor calibration

The EL3356 is matched to the characteristic curve of the sensor element by means of the calibration. Two values are required for this procedure: the initial value without a load (“zero balance”) and fully loaded (“rated output”). These values can be determined by a calibration protocol or by a calibration using calibration weights.

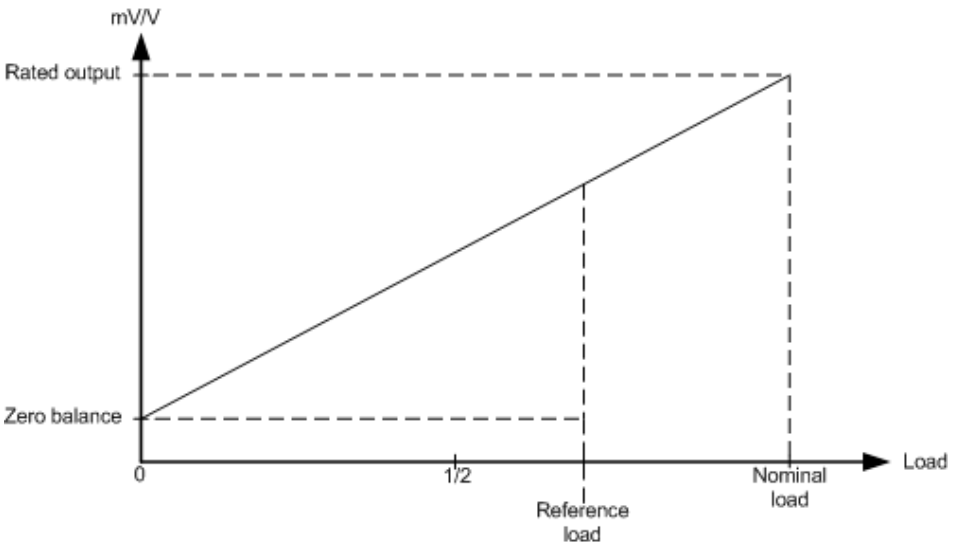


Fig. 34: Adaptation to the sensor curve

Calibration by means of compensation in the system

In the “practical” calibration, measurement takes place first with the scales unloaded, then with a defined load on the scales. The EL3356 automatically calculates the existing sensor characteristic values from the measured values.

Sequence:

1. Perform a CoE reset with object 0x1011:01
   see Restoring the delivery state
2. Activate mode 0 via the control word (EL3356-0010 only)
3. Set scale factor to 1 (0x8000:27 [▶ 79])
4. Set gravity of earth (0x8000:26) [▶ 79] if necessary (default: 9.806650)
5. Set gain to (0x8000:21 [▶ 79]) = 1
6. Set tare to 0 (0x8000:22 [▶ 79])
7. Set the filter (0x8000:11 [▶ 79]) to the strongest level: IIR8
8. Specify the nominal load of the sensor in 0x8000:24 [▶ 79] (“Nominal load”)

9. Zero balance: Do not load the scales
   As soon as the measured value indicates a constant value for at least 10 seconds, execute the command “0x0101” (257_{dec}) on CoE object 0xFB00:01 [▶ 81].
   This command causes the current mV/V value (0x9000:11 [▶ 82]) to be entered in the “Zero balance” object.
   Check: CoE objects 0xFB00:02 and 0xFB00:03 must contain “0” after execution.

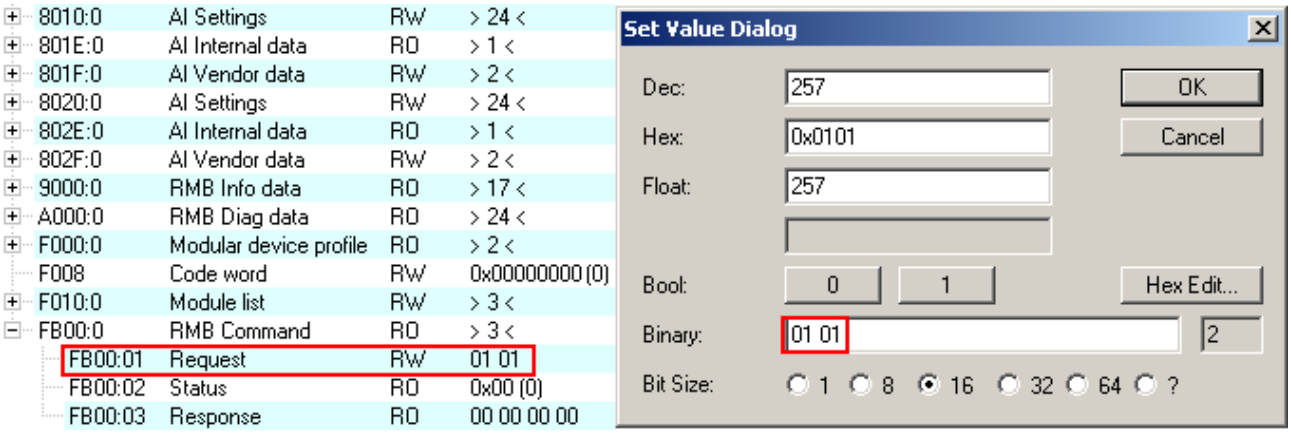


Fig. 35: Zero calibration with command 0x0101 in CoE object 0xFB00:01

10. Load the scales with a reference load. This should be at least 20% of the rated load. The larger the reference load, the better the sensor values can be calculated.
    In object 0x8000:28 [▶ 79] (“Reference load”), enter the load in the same unit as the rated load (0x8000:24 [▶ 79]).
    As soon as the measured value indicates a constant value for at least 10 seconds, execute the command “0x0102” (258_{dec}) on CoE object 0xFB00:01 [▶ 81].
    By means of this command the EL3356 determines the output value for the nominal weight (“Rated output”)
    Check: CoE objects 0xFB00:02 and 0xFB00:03 must contain “0” after execution.

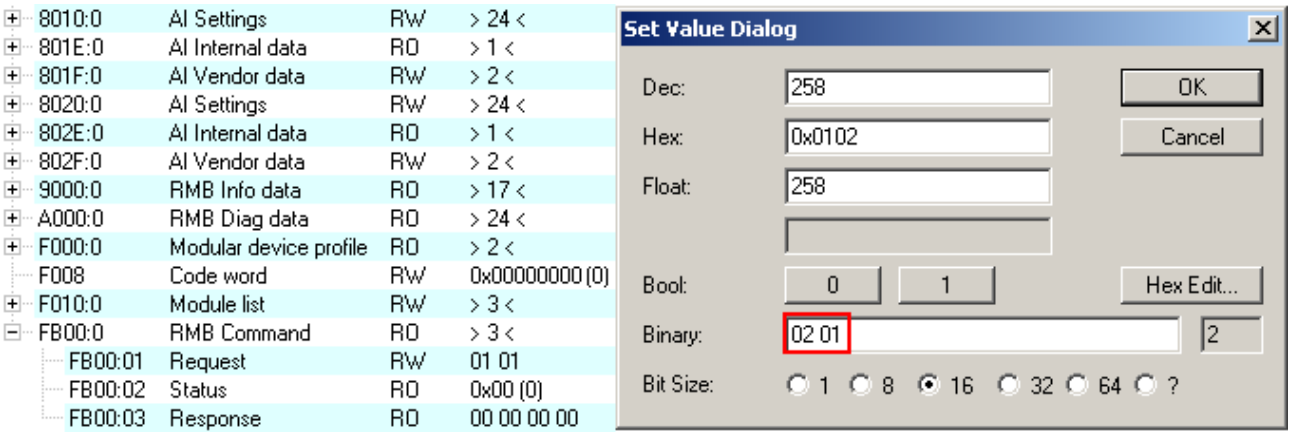


Fig. 36: Loading with reference load, command 0x0102 in CoE object 0xFB00:01

11. Reset: execute the command “0x0000” (0_{dec}) on CoE object 0xFB00:01 [▶ 81].
12. Set the filter to a lower stage.

Calibration according to the sensor calibration protocol (theoretical calibration)

The sensor characteristic values according to the manufacturer's certificate are communicated here directly to the EL3356, so that it can calculate the load.

1. Execute a CoE reset
2. Set scale factor to 1 (0x8000:27 [▶ 79])
3. Set gravity of earth (0x8000:26) [▶ 79] if necessary (default: 9.806650)
4. Set gain to (0x8000:21 [▶ 79]) = 1

5. Set tare to 0 (0x8000:22 [▶ 79])
6. Specify the nominal load of the sensor in 0x8000:24 [▶ 79] (“Nominal load”)
7. Adopt the “Rated output” (mV/V value 0x8000:23 [▶ 79]) from the calibration protocol
8. Adopt the “Zero balance” (0x8000:25 [▶ 79]) from the calibration protocol

Calibration

The calibration is of great importance for the accuracy of the system. In order to increase this, the filter should be set as strong as possible over the entire calibration phase. It may take several seconds before a static value is obtained.

Local storage

The values modified during the theoretical and practical calibration are stored in a local EEPROM. This can be written to up to 1 million time. In order to prolong the life of the EEPROM, therefore, the commands should not be executed cyclically.

4.4.2 Self-calibration

Self-calibration of the measuring amplifiers

The measuring amplifiers are periodically subjected to examination and self-calibration. Several analog switches are provided for this purpose, so that the various calibration signals can be connected. It is important for this process that the entire signal path, including all passive components, is examined at every phase of the calibration. Only the interference suppression elements (L/C combination) and the analog switches themselves cannot be examined. In addition, a self-test is carried out at longer intervals.

The self-calibration is carried out every three minutes in the default setting.

- **Self-calibration**
  The time interval is set in 100 ms steps with object 0x8000:31 [▶ 79]; default: 3 min.
  Duration approx. 150 ms
- **Self-test**
  is additional carried out together with every nth self-calibration.
  The multiple (n) is set with object 0x8000:32 [▶ 79]; default: 10
  additional duration approx. 70 ms.

By means of the self-calibration of the input stages at the two operating points (zero point and final value), the two measuring channels are calibrated to each other.

Interface for controller

The self-calibration takes place automatically at the defined intervals. In order to prevent calibration during a time-critical measurement, the automatic calibration can be disabled permanently via the “Disable calibration” bit in *ControlWord*. If it should be additional necessary to carry out a manual test, this is started by a rising edge of the “Start manual calibration“ bit in the process image.

While the terminal is performing a self-calibration or a self-test, the “Calibration in progress“ bit is set in the process image. Once started, a self-calibration/self-test cannot be aborted.

If the self-calibration has been disabled by “Disable calibration”, it can nevertheless be started by the “Start calibration” process data bit.

Self-calibration

The self-calibration takes place for the first time directly after starting up the terminal. At this point the external reference voltage must already be applied. If the reference voltage is only applied later, the self-calibration must be manually initiated (process data bit: “Start calibration”).
The self-calibration must be executed at least once after each start-up.

The supply voltage must be applied during the self-calibration, since otherwise the necessary reference voltages cannot be generated.

A lower measuring accuracy is to be expected if the self-calibration is disabled for a longer period or permanently.

After a change in the CoE settings (section 0x80nn), a self-calibration is always performed (even if “DisabledCalibration“ = TRUE), since the settings affect the measurement. Changing the CoE settings during an ongoing measurement should therefore be avoided, if possible.

4.4.3 Taring

When taring, the scales are set to zero using an arbitrary applied load; i.e. an offset correction is performed. This is necessary for the gross/net compensation of goods that cannot be weighed without a container that has a mass of its own.

The EL3356 supports two tarings; it is recommended to set a strong filter when taring.

- **Temporary tare**
  The correction value is NOT stored in the terminal and is lost in the event of a power failure.
  To this end the command “0x0001” is executed on CoE object 0xFB00:01 [▶ 81] (binary dialog in the System Manager: “01 00”). This sets the tare object (0x8000:22 [▶ 79]) such that the display value is 0.
  Note: in the case of a device restart (INIT->OP) the tare is not deleted.
  In addition this tare can be executed via the control word:

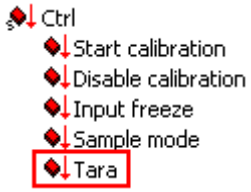


Fig. 37: Control word, tare

- **Permanent tare**
  The correction value is stored locally in the terminal's EEPROM and is not lost in the event of a power failure.
  To this end the command “0x0002” is executed on CoE object 0xFB00:01 [▶ 81] (binary dialog in the System Manager: “02 00”). This sets the tare object (0x8000:22 [▶ 79]) such that the display value is 0.

Local storage

The values modified during the theoretical and practical calibration are stored in a local EEPROM. This can be written to up to 1 million time. In order to prolong the life of the EEPROM, therefore, the commands should not be executed cyclically.

4.4.4 Overview of commands

The functions discussed above are carried out by means of commands in the standardized object 0xFB00 [▶ 81].

Index	Name	Comment
FB00:01	Request	Entry of the command to be executed
FB00:02	Status	Status of the command currently being executed 0: Command executed without error. 255: Command is being executed
FB00:03	Response	Optional response value of the command

The function blocks *FB_EcCoESdoWrite* and *FB_EcCoESdoRead* from the *TcEtherCAT.lib* (contained in the standard TwinCAT installation) can be used in order to execute the commands from the PLC.

Commands of the EL3356

The following commands can be transferred to the terminal via the CoE entry 0xFB00:01 [▶ 81].

Command	Comment
0x0101	Execute zero balance
0x0102	Execute calibration
0x0001	Execute tare procedure (value is NOT saved in the terminal's EEprom)
0x0002	Execute tare procedure (value is saved in the terminal's EEprom)

4.5 Voltage measurement

EL3356 and special versions

Unless stated otherwise, the designation “EL3356” always refers also to special versions such as the EL3356-0010.

The EL3356 principally offers a 2-channel voltage measurement on one terminal with two very different measuring ranges of ±25 mV and ±12 V nominal voltage. The load on the *one* connected strain gauge can be calculated from the *two* simultaneously measured voltages; the EL3356 already performs this calculation in the terminal and thus represents a 1-channel terminal in the sense of load calculation.

NOTICE

Ratiometric Measurement

Since ratiometric measurement in strain gauge mode compensates for significant sources of error, the measurement uncertainty is significantly lower (see Technical data [▶ 12]) than in the “Voltage Measurement” mode described here.

Notice: The Ctrl PDO (CoE 0x7000:0) Start/Disable calibration, Input freeze, Sample Mode and Tara have no function in this case.

The following applies to the individual channels:

- Channel 1
  - Typical measuring range approx. -13.5 V to 0 to +13.5 V (equivalent to process value 0x80.00.00.00...0...0x7F.FF.FF.FF)
  - Nominal measuring range: -12 V...0...+12 V
  - max. permissible voltage - U_{ref} vs. +U_{ref}: ±13.5 V
  - Measuring error< ±0.1% of the full scale value, 50 Hz filter active
- Channel 2:
  - Typical measuring range approx. -27 mV to 0 to +27 mV (equivalent to process value 0x80.00.00.00...0...x07F.FF.FF.FF)
  - Nominal measuring range: -25 mV...0...+25 mV
  - max. permissible voltage -U_D vs. +U_D: ±27 mV
  - Measuring error< ±0.1% of the full scale value, 50 Hz filter active
- in strain gauge mode the connected strain gauge guarantees that no impermissibly high potential differences arise inside and outside the circuit.

In the standard setting the EL3356 operates as a 1-channel strain gauge monitor with the process image; the terminal can be switched to 2-channel voltage measurement by changing the process data. See the notes on the process image [▶ 65] regarding this.

If the EL3356 is not used as a load measuring terminal, but rather as a 2-channel analog input measuring terminal, the following must be observed:

- The CoE settings are to be found for
  - Channel 1: objects under 0x8010:xx [▶ 80]
  - Channel 2: objects under 0x8020:xx [▶ 80]
  - the strain gauge objects under 0x8000:xx have no function
    Exception: the averager (0x8000:03 [▶ 79]) can also be used in voltage measuring mode and applies to both channels simultaneously.
- Self-calibration is not possible and useful.
- The two analog channels are **not** calibrated by the manufacturer, since this is not required for the relative measurement in strain gauge mode.
  This means, for example, for channel 1 with a nominal measuring range of ±12 V or a typical measuring range of ±13.5 V, that the maximum measured value 0x7F.FF.FF.FF can be output by one terminal for example as 13.4 V and by another as 13.6 V.
  If terminals output identical process values for identical applied voltages, meaning that they are

exchangeable, each channel must be calibrated by the user by making settings for each channel in the CoE. The user calibration (CoE 0x80n0:17 [▶ 80] [offset], 0x80n0:18 [▶ 80] [gain]) or the user scaling (CoE 0x80n0:11 [▶ 79] [offset], 0x80n0:12 [▶ 80] [gain]) can be used for this.

Voltage measurement

In the voltage measuring mode the EL3356 is to be connected to external GND with a single-ended connection.
In addition the internal GND reference is to be closed by the CoE switch SymmetricReferencePotential, see the following figure.

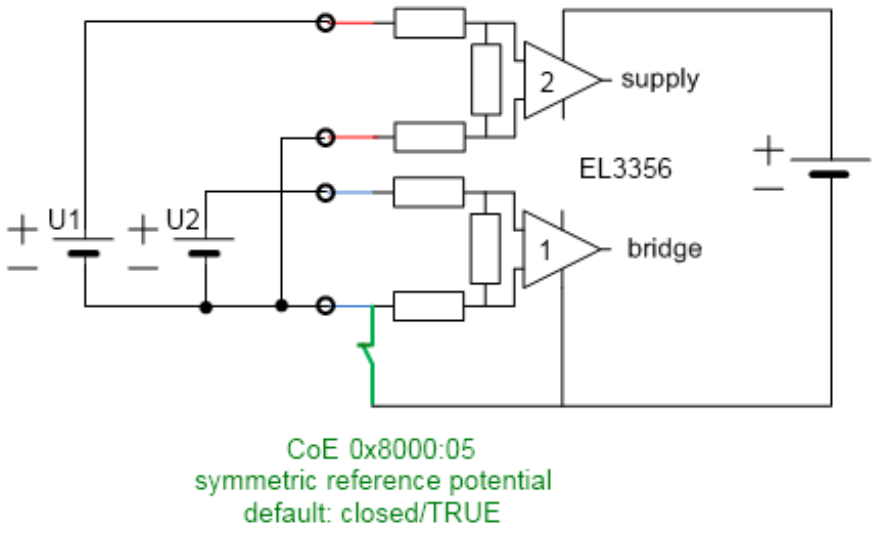
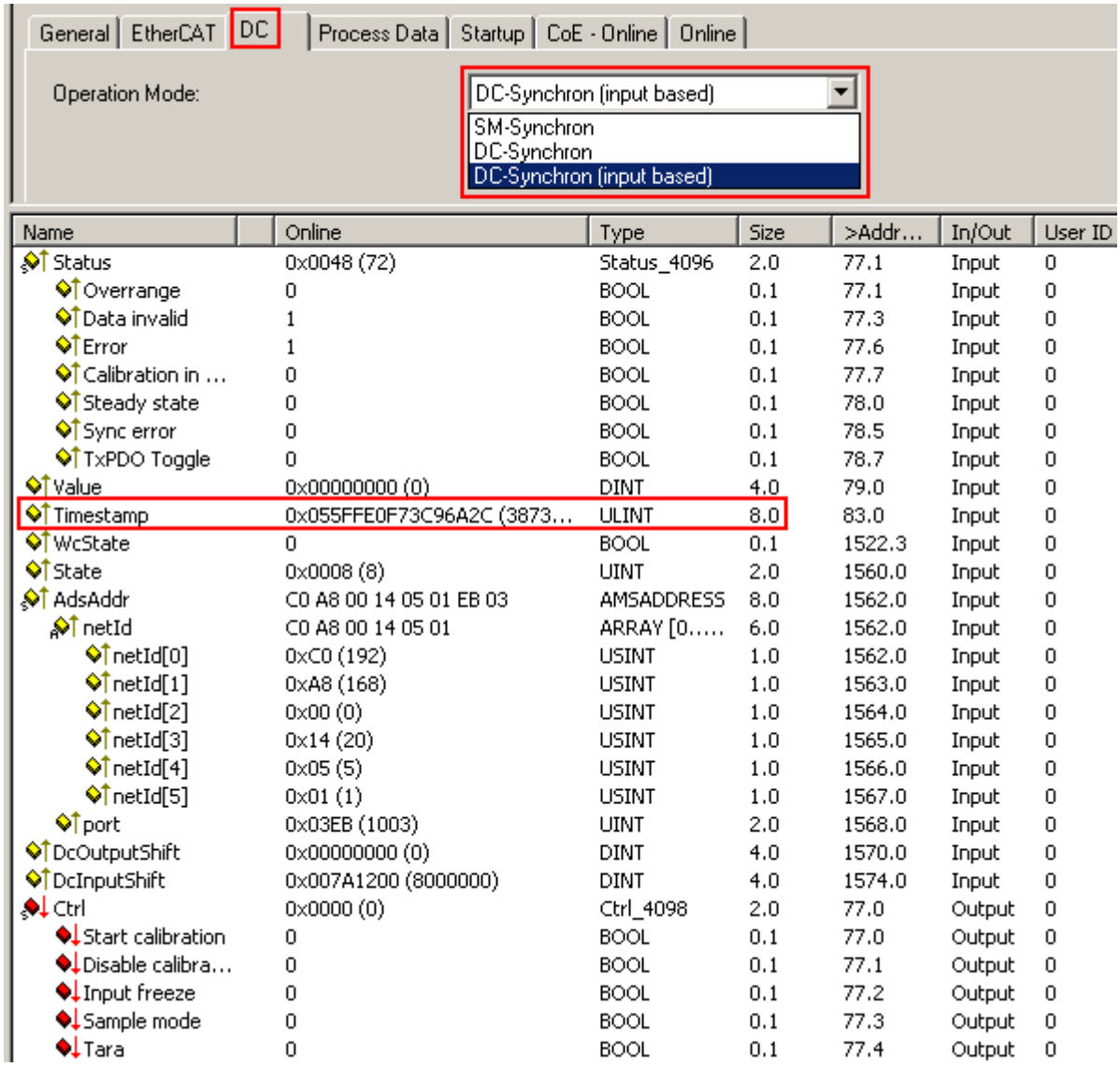


Fig. 38: EL3356 voltage measurement - symmetric reference potential

4.6 Distributed Clocks mode (EL3356-0010, EL3356-0090 only)

In the Distributed Clocks mode (DC mode), the precise timestamp is recorded for each measured value and transmitted to the controller as cyclic process data. To this end

- DC must be activated
  To do this, select DC-Synchron (input based) on the “DC” tab
- The PDO 0x1A03 in the Process data management [▶ 65] is to be activated in the SyncManager 3 “Inputs”



Name	Online	Type	Size	>Addr...	In/Out	User ID
Status	0x0048 (72)	Status_4096	2.0	77.1	Input	0
Overrange	0	BOOL	0.1	77.1	Input	0
Data invalid	1	BOOL	0.1	77.3	Input	0
Error	1	BOOL	0.1	77.6	Input	0
Calibration in ...	0	BOOL	0.1	77.7	Input	0
Steady state	0	BOOL	0.1	78.0	Input	0
Sync error	0	BOOL	0.1	78.5	Input	0
TxPDO Toggle	0	BOOL	0.1	78.7	Input	0
Value	0x00000000 (0)	DINT	4.0	79.0	Input	0
Timestamp	0x055FFE0F73C96A2C (3873...	ULINT	8.0	83.0	Input	0
WcState	0	BOOL	0.1	1522.3	Input	0
State	0x0008 (8)	UINT	2.0	1560.0	Input	0
AdsAddr	C0 A8 00 14 05 01 EB 03	AMSADDRESS	8.0	1562.0	Input	0
netId	C0 A8 00 14 05 01	ARRAY [0.....	6.0	1562.0	Input	0
netId[0]	0xC0 (192)	USINT	1.0	1562.0	Input	0
netId[1]	0xA8 (168)	USINT	1.0	1563.0	Input	0
netId[2]	0x00 (0)	USINT	1.0	1564.0	Input	0
netId[3]	0x14 (20)	USINT	1.0	1565.0	Input	0
netId[4]	0x05 (5)	USINT	1.0	1566.0	Input	0
netId[5]	0x01 (1)	USINT	1.0	1567.0	Input	0
port	0x03EB (1003)	UINT	2.0	1568.0	Input	0
DcOutputShift	0x00000000 (0)	DINT	4.0	1570.0	Input	0
DcInputShift	0x007A1200 (8000000)	DINT	4.0	1574.0	Input	0
Ctrl	0x0000 (0)	Ctrl_4098	2.0	77.0	Output	0
Start calibration	0	BOOL	0.1	77.0	Output	0
Disable calibra...	0	BOOL	0.1	77.1	Output	0
Input freeze	0	BOOL	0.1	77.2	Output	0
Sample mode	0	BOOL	0.1	77.3	Output	0
Tara	0	BOOL	0.1	77.4	Output	0

Fig. 39: Activation of DC and PDO timestamp in the TwinCAT System Manager

The EL3356-0010 and EL3356-0090 operate free running with a cyclic, but not equidistant measurement; the time intervals between two measured values are therefore not constant. For this reason the 64-bit timestamp delivered with the process value must be evaluated by the user.

In order to suppress falsification of the measurement results by upstream filters, both the software filter and the averager are deactivated in this operating mode. The measurement/calculation and provision of the measured value in the process data therefore takes place at the conversion rate corresponding to the mode:

- EL3356: 10.5 kSps
- EL3356-0010, EL3356-0090: 10.5 or 105.5 kSps

The minimum permissible EtherCAT cycle time with and without DC mode is 100 µs for the EL3356-0010 and 150 µs for the EL3356-0090.

Time stamp

See Notes on latency [▶ 51] regarding the time when the actual timestamp is acquired.

4.7 Process data

This section describes the individual PDOs and their content. A PDO (Process Data Object) is a unit on cyclically transmitted process values. Such a unit can be an individual variable (e.g. the weight as a 32-bit value) or a group/structure of variables. The individual PDOs can be activated or deactivated separately in the TwinCAT System Manager. The 'Process data' tab is used for this (visible only if the terminal is selected on the left). A change in the composition of the process data in the TwinCAT System Manager becomes effective only after restarting the EtherCAT system.

The EL3356 can be used in two basic operating modes

- 1-channel strain gauge evaluation (strain gauge, balance beam, load cell)
  Here, both analog input voltages are measured internally, they are calculated locally according to the internal settings in the terminal and the resulting load value is output to the controller as a cyclic process value. The terminal is to be considered as a 1-channel terminal.
  The load value can be output as an integer or as a float/real representation.
- 2-channel voltage measurement
  Both analog input voltages are output directly as process values; no load calculation takes place.
  The value and status information can be output for each channel.

The basic operating mode of the EL3356 terminal is determined by the selection of the process data (PDO).

EL3356 and special versions

- EL3356, EL3356-0010 and EL3356-0090 have the same process data objects except:
- ⇨ EL3356: no mode switching in the *ControlWord*
- ⇨ EL3356-0090: When activating the TwinSAFE SC slot, the measured value has to be selected as INT32 (Index 0x1A01) see chapter TwinSAFE SC process data [▶ 78].

4.7.1 Selection of process data

The process data of the EL3356 are set up in the TwinCAT System Manager. The PDOs can be activated or deactivated separately. The 'Process data' tab is used for this (visible only if the terminal is selected on the left).

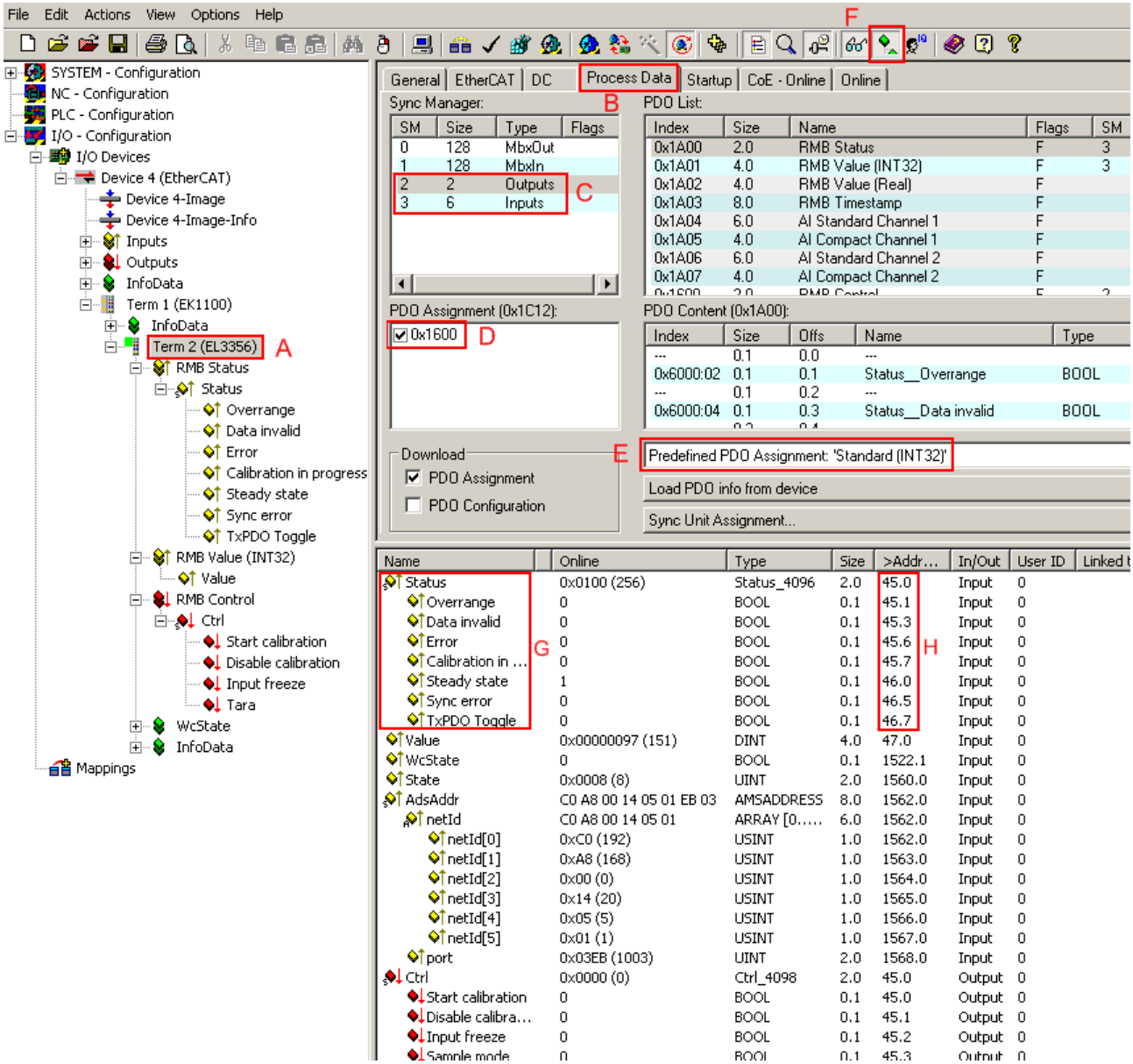


Fig. 40: EL3356 - process data selection in the TwinCAT System Manager

If the terminal is selected in the System Manager (A), the *Process data* tab (B) shows the PDO selection. The two SyncManagers of the inputs (SM3) and outputs (SM2) can be changed (C). If one of the two is clicked on, the PDO possible for this SyncManager appears underneath it (D). PDOs that are already activated have an activated checkbox in front of them; this is activated by clicking on it.

The process data which then belong to the device are listed underneath it (G). So that the individual bit meanings are visible, e.g. in the *Status* status word, and can be separately linked (G), *ShowSubVariables* must be activated in the System Manager (F). The bit position at which the subvariables are located in the status or control word *Ctrl*) can be taken from the address overview (H) or the following information.

Predefined PDO Assignment

In order to simplify the configuration, typical configuration combinations of process data are stored in the device description. The predefined configurations can be selected in the process data overview. Therefore the function is available only if the ESI/XML files are saved in the system (downloadable from the Beckhoff website).

The following combinations are possible (see also Fig. *EL3356 process data selection in the TwinCAT System Manager*, E):

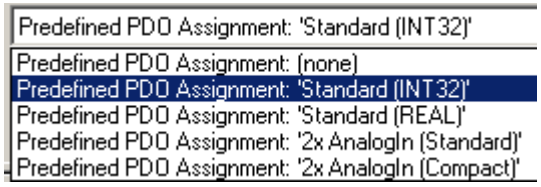


Fig. 41: EL3356 selection Predefined PDO Assignment

- Standard (INT32): [Default setting] load calculation; 32-bit integer load value as final value according to the calculation specifications in the CoE, no further conversion necessary in the PLC
- Standard (REAL): Load calculation; 32-bit floating-point load value as final value according to the calculation specifications in the CoE, no further conversion necessary in the PLC
- 2x AnalogIn (Standard): 2-channel voltage measurement, 32-bit integer voltage value with additional information (under-range, over-range, error, TxPDO Toggle)
- 2x AnalogIn (Compact): 2-channel voltage measurement, 32-bit integer voltage value only

4.7.2 Default process image

The default process image is standard (INT32).

Name	Online	Type	Size	>Addr...	In/Out	User ID
Status	0x8100 (33024)	Status_4096	2.0	45.0	Input	0
Overrange	0	BOOL	0.1	45.1	Input	0
Data invalid	0	BOOL	0.1	45.3	Input	0
Error	0	BOOL	0.1	45.6	Input	0
Calibration in progress	0	BOOL	0.1	45.7	Input	0
Steady state	1	BOOL	0.1	46.0	Input	0
Sync error	0	BOOL	0.1	46.5	Input	0
TxPDO Toggle	1	BOOL	0.1	46.7	Input	0
Value	0x00000097 (151)	DINT	4.0	47.0	Input	0
WcState	0	BOOL	0.1	1522.1	Input	0
State	0x0008 (8)	UINT	2.0	1560.0	Input	0
AdsAddr	C0 A8 00 14 05 01 EB 03	AMSADDRESS	8.0	1562.0	Input	0
netId	C0 A8 00 14 05 01	ARRAY [0.....	6.0	1562.0	Input	0
netId[0]	0xC0 (192)	USINT	1.0	1562.0	Input	0
netId[1]	0xA8 (168)	USINT	1.0	1563.0	Input	0
netId[2]	0x00 (0)	USINT	1.0	1564.0	Input	0
netId[3]	0x14 (20)	USINT	1.0	1565.0	Input	0
netId[4]	0x05 (5)	USINT	1.0	1566.0	Input	0
netId[5]	0x01 (1)	USINT	1.0	1567.0	Input	0
port	0x03EB (1003)	UINT	2.0	1568.0	Input	0
Ctrl	0x0000 (0)	Ctrl_4098	2.0	45.0	Output	0
Start calibration	0	BOOL	0.1	45.0	Output	0
Disable calibration	0	BOOL	0.1	45.1	Output	0
Input freeze	0	BOOL	0.1	45.2	Output	0
Sample mode	0	BOOL	0.1	45.3	Output	0
Tara	0	BOOL	0.1	45.4	Output	0

Fig. 42: Default process image, EL3356-0010

Note regarding EL3356: No switching of *SampleMode* in the Ctrl word

Function of the variables

Variable	Meaning
Status	The status word (SW) is located in the input process image, and is transmitted from terminal to the controller. For explanation see the entries in the object overview, index 0x6000 [▶ 81] see "Bit - meaning of the status word [▶ 68]"
Value	calculated 32-bit DINT load value in unit [1], with sign

Variable	Meaning
Value (Real)	calculated 32-bit fixed point REAL load value with mantissa and exponent in unit [1] The format matches the REAL format of IEC 61131-3, which in turn is based on the REAL format of IEC 559. A REAL number (single precision) is defined as follows (See also Beckhoff InfoSys: TwinCAT PLC Control: standard data types). According to IEC 61131, this 32-bit variable can be linked directly with a FLOAT variable of the PLC, see "Bit - meaning of the variable value (REAL) [▶ 68]"
WcState	cyclic diagnostic variable; "0" indicates correct data transmission
Status	State of the EtherCAT device; *State*.3 = TRUE indicates correct operation in OP
AdsAddr	AmsNet address of the EtherCAT device from AmsNetId (in this case: 192.168.0.20.5.1) and port (in this case: 1003)
Ctrl	The control word (CW) is located in the output process image, and is transmitted from the controller to the terminal. For explanation see the entries in the object overview, index 0x7000 [▶ 81] see "Bit - meaning of the control word [▶ 68]"

See also the example program [▶ 93] for the dissection of the Status and CTRL variable.

Bit - meaning of the "status word"

Bit	SW.15	SW.14	SW.13	SW.12 - SW.9	SW.8	SW.7	SW.6	SW.5 - SW.4	SW.3	SW.2	SW.1	SW.0
Name	TxPDO Toggle	-	Sync Error	-	Steady State	Calibration in progress	Error	-	Data invalid	-	Over-range	-
Meaning	toggeles 0->1->0 with each updated data set	-	Synchronization error	-	Idling recognition [▶ 55]	Calibration [▶ 56] in progress	Collective error display	-	Input data are invalid	-	Measuring range exceeded	-

Bit - purpose of the variable "Value (Real)"

Bit position (from left)	1	8	23 (+1 "hidden bit", see IE559)
Function	Sign	Exponent	Mantissa

Bit - meaning of the "control word"

Bit	CW.15 - CW.5	CW.4	CW.3	CW.2	CW.1	CW.0
Name	-	Tare	Sample Mode	Input Freeze	Disable Calibration	Start Calibration
Meaning	-	starts tare [▶ 59]	mode [▶ 51] switching (EL3356-0010 and EL3356-0090 only)	stops the measurement [▶ 53]	switches the automatic self-calibration [▶ 58] off	starts the self-calibration [▶ 58] immediately

4.7.3 Variants Predefined PDO

Fixed-point representation of the load

The display of the load value can also be converted already in the terminal into a point representation. To do this the input PDOs are to be changed as follows:

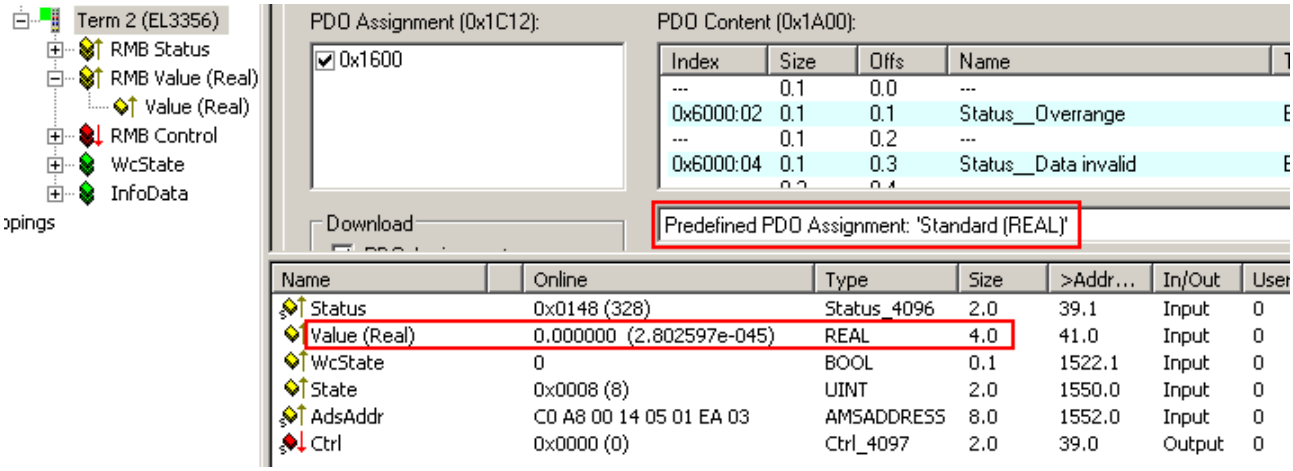


Fig. 43: Load value in fixed-point representation

Variable	Meaning
Value (Real)	calculated 32-bit fixed point REAL load value with mantissa and exponent in unit [1] The format matches the REAL format of IEC 61131-3, which in turn is based on the REAL format of IEC 559. A REAL number (single precision) is defined as follows (See also Beckhoff InfoSys: TwinCAT PLC Control: standard data types). According to IEC61131, this 32-bit variable can be linked directly with a FLOAT variable of the PLC, see "Bit – meaning of the variable value (REAL) [▶ 68]"

Voltage measurement

The EL3356 can also be used as a 2-channel analog input terminal for voltage measurement, see Notes [▶ 61].

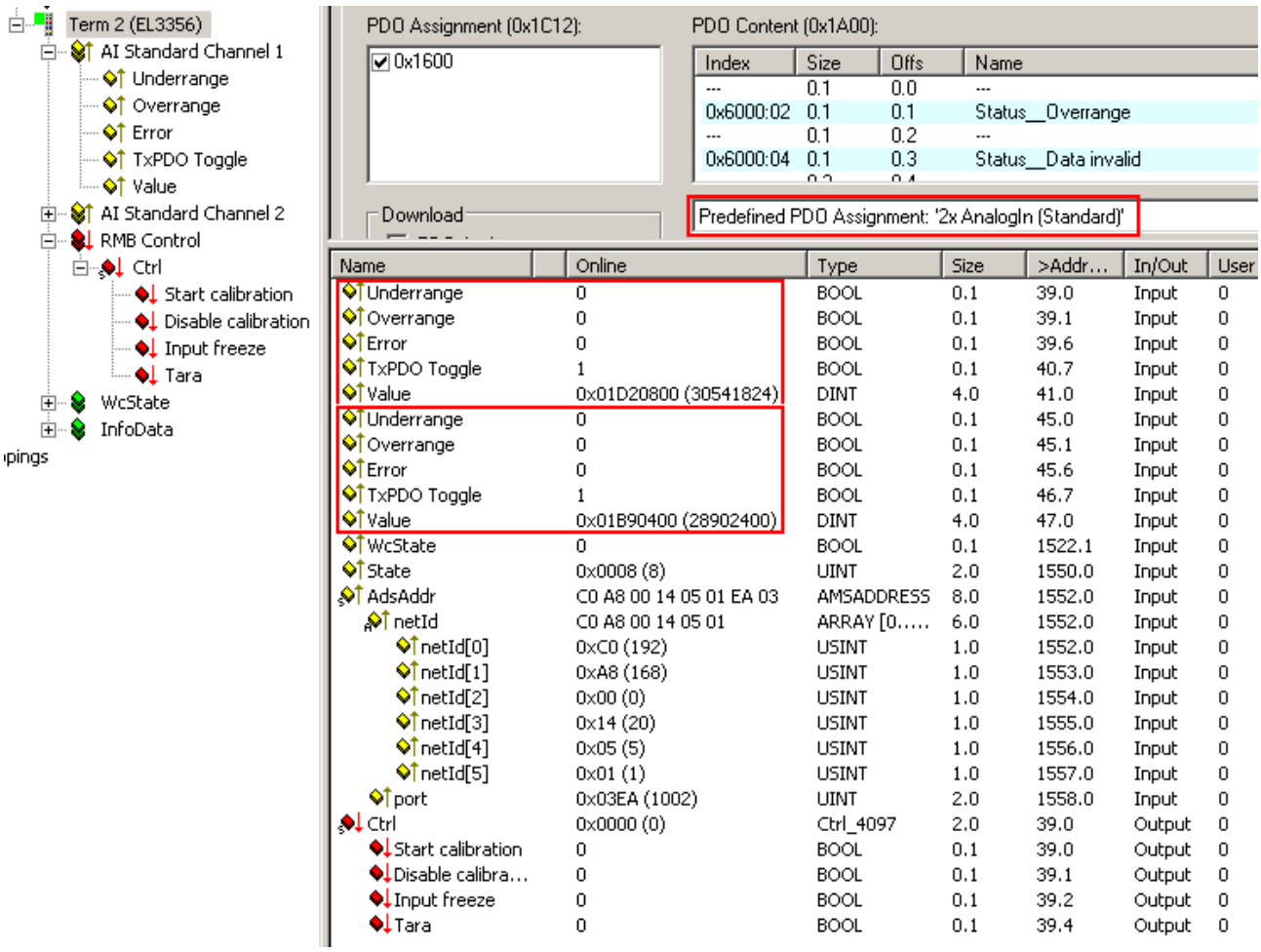


Fig. 44: EL3356 process image for voltage measurement

Variable	Meaning
Underrange	Measurement is below range
Overrange	Measuring range exceeded
Error	Collective error display
TxPdo Toggle	Toggles 0->1->0 with each updated data set
Value	right-justified voltage value over the respective measuring range (range 0x80.00.00.00 ... 0 ... 0x7F.FF.FF.FF) Channel 1: Supply voltage Channel 2: Bridge voltage

4.7.4 Distributed Clocks

In DC mode (Distributed Clocks) the process data 0x1A03 *Timestamp* must be activated.

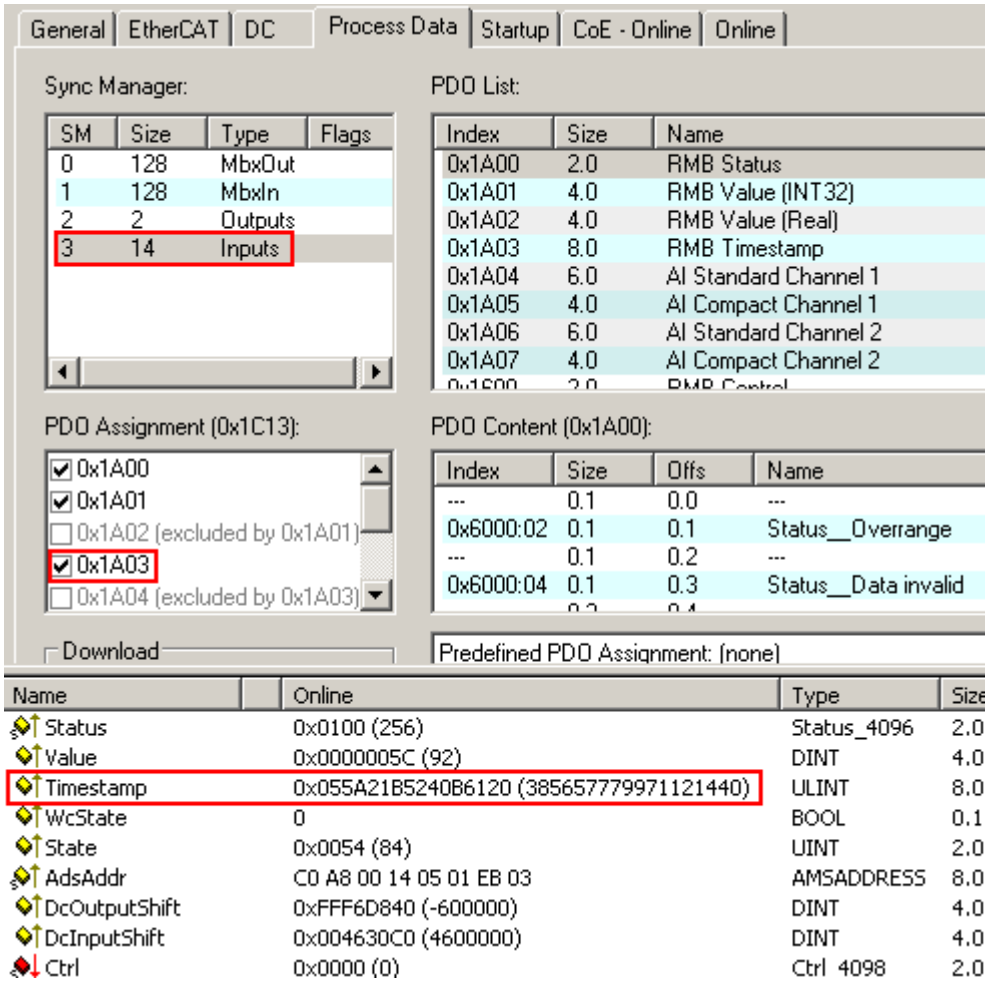


Fig. 45: EL3356-0010, EL3356-0090 activation timestamp 0x1A03 in DC mode

Also, the variables *DcOutputShift* and *DcInputShift* are displayed in the process data in DC mode. Upon activation of the configuration these are calculated once in the unit [ns] on the basis of the set EtherCAT cycle time (observe assigned task!) and DC shift times from the EtherCAT master settings. In the *InputBased* operating mode, *DcInputShift* indicates by how many nanoseconds [ns] before or after the global Sync the terminal determines your process data. For further information on this, see the EtherCAT system description.

Since the EL3356-0010 and EL3356-0090 are not DC-triggered but determine the timestamp itself, these values have no meaning in these terminals.

4.7.5 Sync Manager

PDO Assignment

Inputs: SM3, PDO Assignment 0x1C13				
Index	**Index of excluded PDOs**	**Size (byte.bit)**	**Name**	**PDO content**
0x1A00 (default)	-	2.0	RMB Status (Resistor Measurement Bridge)	Index 0x6000:02 [▶ 81] - Overrange Index 0x6000:04 [▶ 81] - Data invalid Index 0x6000:07 [▶ 81] - Error Index 0x6000:08 [▶ 81] - Calibration in progress Index 0x6000:09 [▶ 81] - Steady State Index 0x6000:0E [▶ 81] - sync error, correction: Index 0x6000:10 [▶ 81] - TxPDO Toggle

Inputs: SM3, PDO Assignment 0x1C13				
Index	**Index of excluded PDOs**	**Size (byte.bit)**	**Name**	**PDO content**
0x1A01(default)	0x1A02 0x1A04 0x1A05 0x1A06 0x1A07	4.0	RMB Value (INT32)	Index 0x6000:11 [▶ 81] - Value
0x1A02	0x1A01 0x1A04 0x1A05 0x1A06 0x1A07	4.0	RMB Value (Real)	Index 0x6000:12 [▶ 81] - Value (Real)
0x1A03	0x1A04 0x1A05 0x1A06 0x1A07	8.0	RMB Timestamp	Index 0x6000:13 [▶ 81]. - Value
0x1A04	0x1A00 0x1A01 0x1A02 0x1A03 0x1A05	6.0	AI Standard Channel 1 (Analog Input)	Index 0x6010:01 [▶ 82] - Underrange Index 0x6010:02 [▶ 82] - Overrange Index 0x6010:07 [▶ 81] - Error Index 0x6010:10 [▶ 82] - TxPdo Toggle Index 0x6010:11 [▶ 82] - Value
0x1A05	0x1A00 0x1A01 0x1A02 0x1A03 0x1A04	4.0	AI Compact Channel 1 (Analog Input)	Index 0x6010:11 [▶ 82] - Value
0x1A06	0x1A00 0x1A01 0x1A02 0x1A03 0x1A07	6.0	AI Standard Channel 2 (Analog Input)	Index 0x6020:01 [▶ 81] - Underrange Index 0x6020:02 [▶ 81] - Overrange Index 0x6020:07 [▶ 81] - Error Index 0x6020:10 [▶ 81] - TxPDO Toggle Index 0x6020:11 [▶ 81] - Value
0x1A07	0x1A00 0x1A01 0x1A02 0x1A03 0x1A06	4.0	AI Compact Channel 2 (Analog Input)	Index 0x6020:11 [▶ 81] - Value

Outputs: SM2, PDO assignment 0x1C12				
Index	**Index of excluded PDOs**	**Size (byte.bit)**	**Name**	**PDO content**
0x1600 (default)	-	2.0	RMB Control (Resistor Measurement bridge)	Index 0x7000:01 [▶ 82] - Start calibration Index 0x7000:02 [▶ 82] - Disable calibration Index 0x7000:03 [▶ 82] - Input freeze Index 0x7000:04 [▶ 82] - Sample Mode (EL3356-0010 and EL3356-0090 only) Index 0x7000:05 [▶ 82] - Tare
0x1601	-	2.0	RMB Filter frequency	Index 0x7000:11 [▶ 82] - Filter frequency (valid as from firmware 05)

4.8 TwinSAFE SC

4.8.1 TwinSAFE SC - operating principle

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

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

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

4.8.2 TwinSAFE SC - configuration

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

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

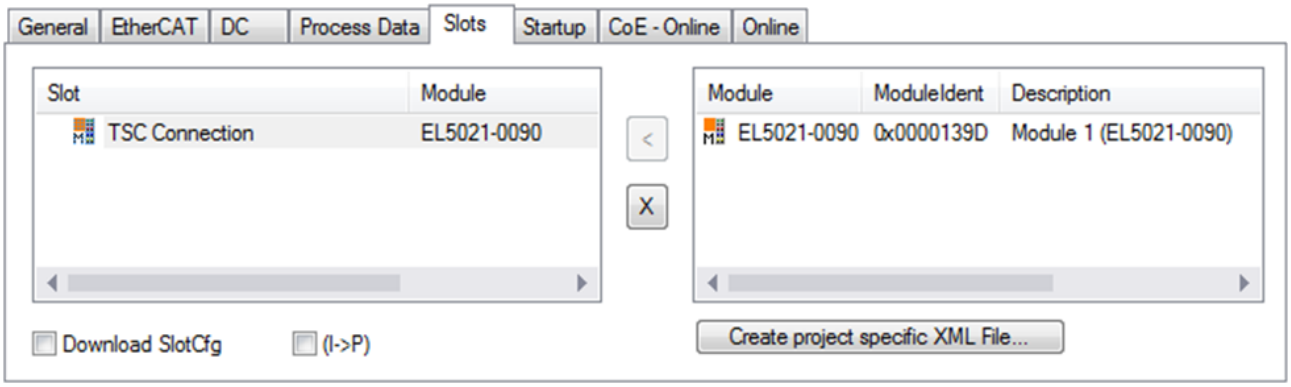


Fig. 46: Adding the TwinSAFE SC process data under the component, e.g. EL5021-0090

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

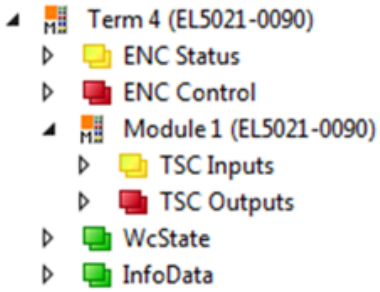


Fig. 47: TwinSAFE SC component process data, example EL5021-0090

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

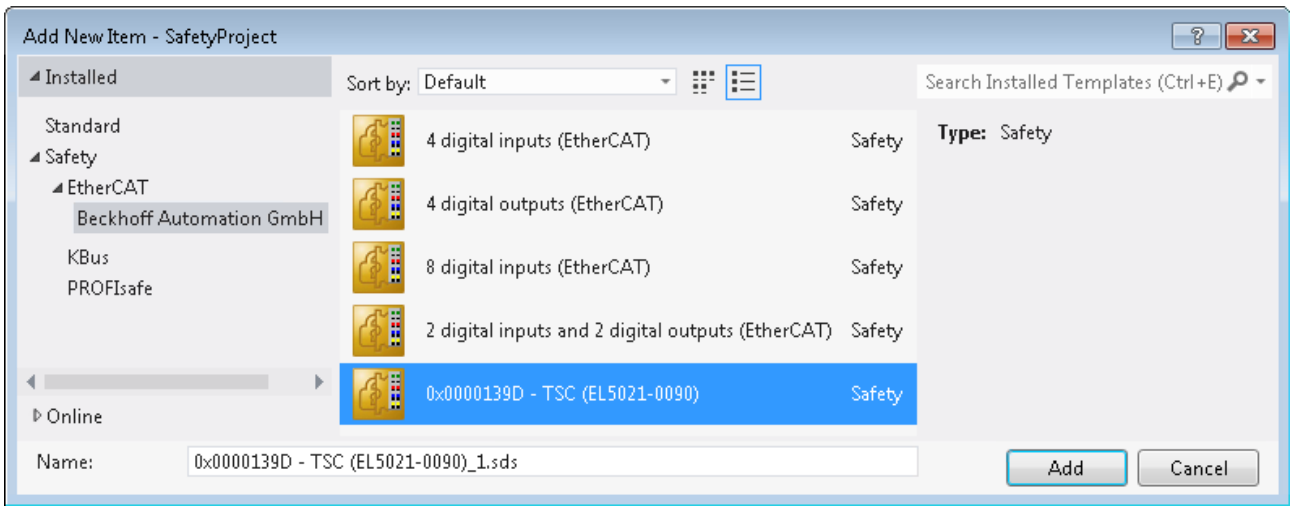


Fig. 48: Adding a TwinSAFE SC connection

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

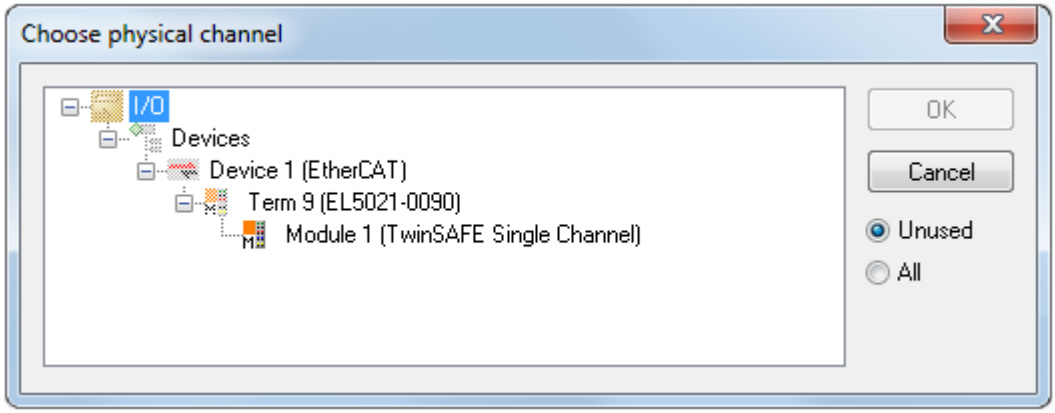


Fig. 49: Creating a link to TwinSAFE SC terminal

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

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

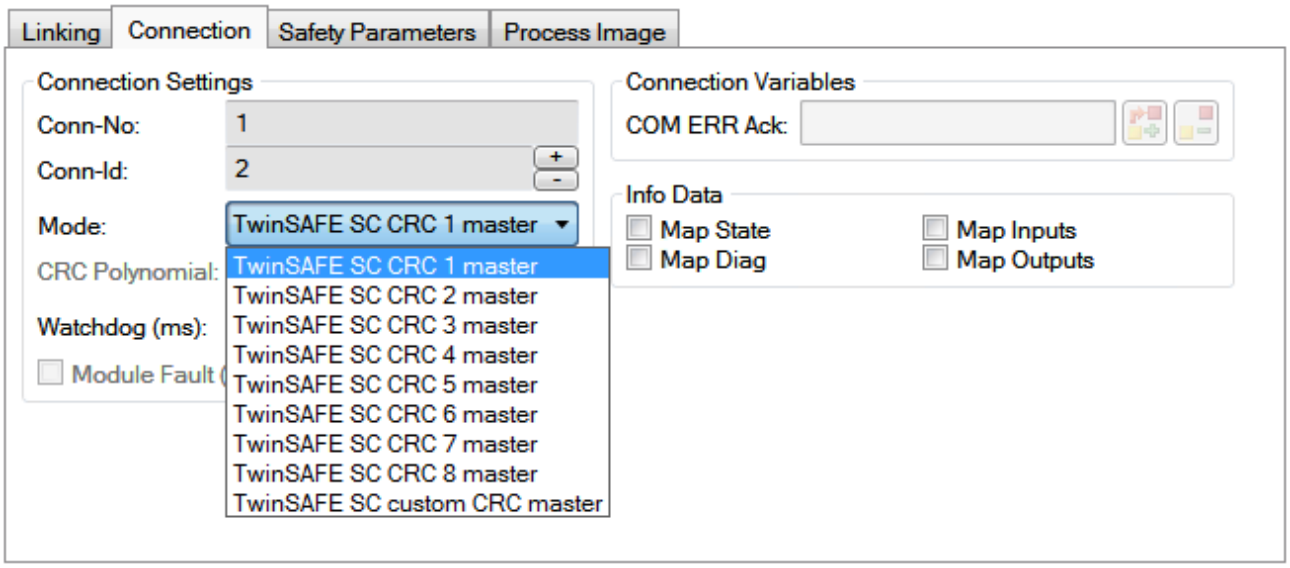


Fig. 50: Selecting a free CRC

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

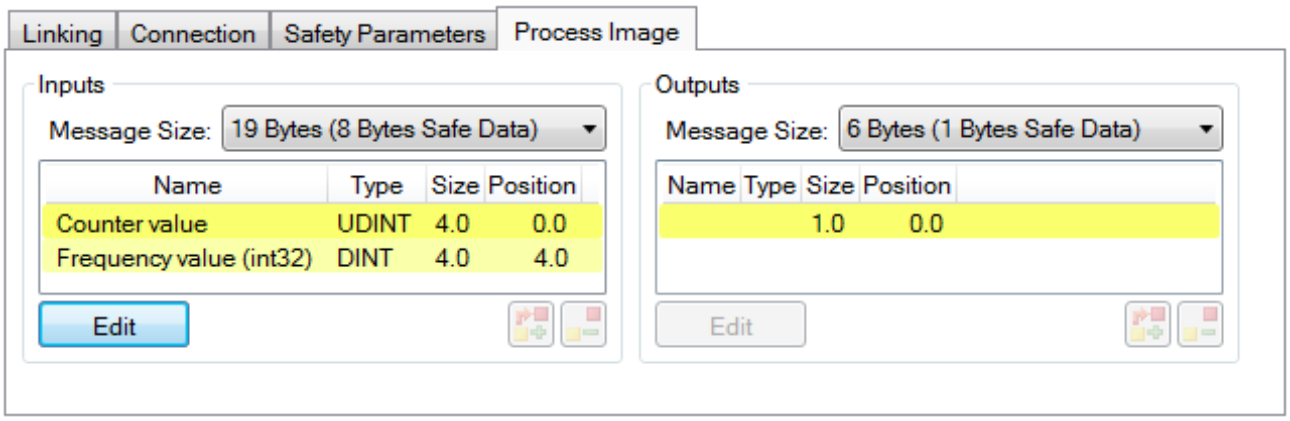


Fig. 51: Selecting the process data size and the process data

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

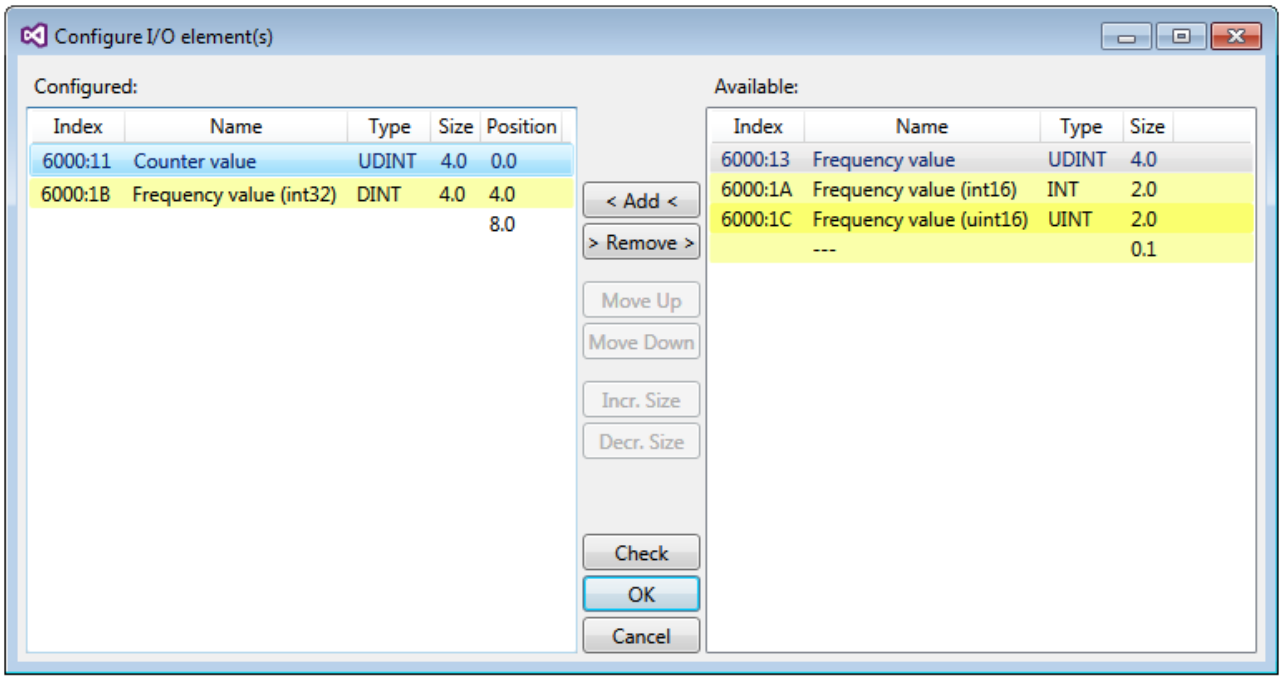


Fig. 52: Selection of the process data

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

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

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

Fig. 53: CoE objects 0x8010:01 and 0x8010:02

Object *TSC Settings*

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

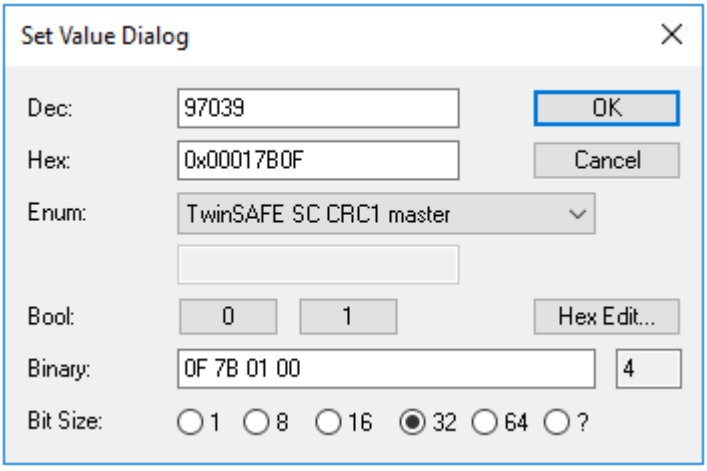


Fig. 54: Entering the safety address and the CRC

TwinSAFE SC connections

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

4.9 EL3356-0090 - TwinSAFE SC process data

The EL3356-0090 transmits the following process data to the TwinSAFE logic:

Index (hex)	Name	Type	Size
6000:11	Value	UINT	2.0

When activating the TwinSAFE SC slot, the measured value has to be selected as INT32 (Index 0x1A01 [▶ 86]).

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

The minimum permissible assigned EtherCAT cycle time for the EL3356-0090 is 150 µs.

Measurement values are not updated during self-calibration

The EL3356-0090 has automatic calibration / self-calibration. This is activated by default and takes effect every three minutes. During self-calibration, the measured values are not updated, they are frozen. This must be taken into account accordingly in the safety application. The automatic can be switched off or controlled.

Measurement values are not updated during mode change

The EL3356-0090 offers several modes, such as: Eg *sample mode*. During the mode change [▶ 52], the measurement values are not updated, they are frozen. This must be taken into account accordingly in the safety application.

TwinSAFE SC Objects

The TwinSAFE SC objects of the EL3356-0090 are listed in chapter Objects TwinSAFE Single Channel (EL3356-0090) [▶ 92].

4.10 EL3356, EL3356-00x0 - Object description and parameterization

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” for resetting changes

4.10.1 Restore object

Index 1011 Restore default parameters

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

4.10.2 Configuration data

Index 8000 RMB Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:0	RMB Settings	Max. subindex	UINT8	RO	0x32 (50_{dec})
8000:01	Mode0 enable filter	0: No filters active. The terminal operates cycle-synchronous 1: The filter settings selected in subindex 0x8000:11 or 0x8000:12 are active.	BOOLEAN	RW	0x01 (1_{dec})
8000:02	Mode1 enable filter (EL3356-0010, EL3356-0090 only)		BOOLEAN	RW	0x01 (1_{dec})
8000:03	Mode0 enable averager	Activate hardware mean value filter	BOOLEAN	RW	0x01 (1_{dec})
8000:04	Mode1 enable averager (EL3356-0010, EL3356-0090 only)		BOOLEAN	RW	0x01 (1_{dec})
8000:05	Symmetric reference potential	Activate symmetric measurement [▶ 53]	BOOLEAN	RW	0x01 (1_{dec})
8000:11	Mode0 filter settings	0: FIR 50 Hz 1: FIR 60 Hz 2: IIR 1 3: IIR 2 4: IIR 3 5: IIR 4 6: IIR 5 7: IIR 6 8: IIR 7 9: IIR 8 10: Dynamic IIR 11: PDO Filter frequency (valid as from firmware 05) see Filter [▶ 46]	UINT16	RW	0x0000 (0_{dec})
8000:12	Mode1 filter settings (EL3356-0010, EL3356-0090 only)		UINT16	RW	0x0000 (0_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:13	Dynamic filter change time	Sampling rate for dynamic filter switching. Scaling in 0.01 ms (100 = 1 s) (only if the filters are active and “dynamic IIR” is selected as filter [▶ 46])	UINT16	RW	0x000A (10_{dec})
8000:14	Dynamic filter delta	Limit value for dynamic filter switching. (only if the filters are active and “dynamic IIR” is selected as filter [▶ 46])	REAL32	RW	0x41A00000 (1101004800_{dec}) = 20.0
8000:21	Gain	Scale factor	REAL32	RW	0x3F800000 (1065353216_{dec}) = 1.0
8000:22	Tare	Process data value offset	REAL32	RW	0x00000000 (0_{dec}) = 0.0
8000:23	Rated output	Nominal characteristic value of the sensor element in mV/V	REAL32	RW	0x40000000 (1073741824_{dec}) = 2.0
8000:24	Nominal load	Nominal load of the force transducer/load cell/etc. (e.g. in kg, N or ...)	REAL32	RW	0x40A00000 (1084227584_{dec}) = 5.0
8000:25	Zero balance	Zero point offset in mV/V	REAL32	RW	0x00000000 (0_{dec}) = 0.0
8000:26	Gravity of earth	Current acceleration of gravity (default 9.806650)	REAL32	RW	0x411CE80A (1092413450_{dec}) = 9.806650
8000:27	Scale factor	This factor can be used to re-scale the process data. In order to change the display from kg to g, for example, the factor 1000 can be entered here.	REAL32	RW	0x447A0000 (1148846080_{dec}) = 1000.0
8000:28	Reference load	Reference weight for manual calibration	REAL32	RW	0x40A00000 (1084227584_{dec}) = 5.0
8000:29	Steady state window	Time constant for the “steady state” bit (used for idle recognition [▶ 55])	UINT16	RW	0x03E8 (1000_{dec})
8000:2A	Steady state tolerance	Tolerance window for the “steady state” bit	UINT32	RW	0x00000005 (5_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
8000:31	Calibration interval	Calibration interval for automatic calibration of the terminal. The unit is 100 ms. The smallest possible value is 5 (500 ms). A value of 0 deactivates automatic self-calibration. This is also possible via the process data bit “Disable calibration”.	UINT16	RW	0x0708 (1800_{dec})
8000:32	Test interval	This register contains the test interval for the cyclic self-test of the terminal. This interval is always a multiple (the default is 10_{dec}) of the calibration interval (0x8000:31).. The test interval when the terminal leaves the factory is therefore 10 x 180 s = 1800 s. The process data bit “Disable calibration” can be used to deactivate the self-test.	UINT16	RW	0x000A (10_{dec})

Index 8010 , 8020 AI Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:0	AI Settings	Max. subindex	UINT8	RO	0x18 (24_{dec})
80n0:01	Enable user scale	User scale is active.	BOOLEAN	RW	0x00 (0_{dec})
80n0:06	Enable filter	Enable filter	BOOLEAN	RW	0x01 (1_{dec})
80n0:0A	Enable user calibration	Enabling of the user calibration	BOOLEAN	RW	0x00 (0_{dec})
80n0:0B	Enable vendor calibration	Enabling of the vendor calibration	BOOLEAN	RW	0x01 (1_{dec})
80n0:11	User scale offset	User scaling offset	INT32	RW	0x00000000 (0_{dec})
80n0:12	User scale gain	User scaling gain. The gain is represented in fixed-point format, with the factor 2^{-16}. The value 1 corresponds to 65535_{dec} ($0x00010000_{hex}$) and is limited to +/- 0x7FFFF.	INT32	RW	0x00010000 (65536_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
80n0:15	Filter settings	This object determines the digital filter settings, if it is active via Enable filter (index 0x80n0:06). The possible settings are sequentially numbered. 0: 50 Hz FIR 1: 60 Hz FIR 2: IIR 1 3: IIR 2 4: IIR 3 5: IIR 4 6: IIR 5 7: IIR 6 8: IIR 7 9: IIR 8	UINT16	RW	0x0000 (0_{dec})
80n0:17	User calibration offset	User calibration offset	INT32	RW	0x00000000 (0_{dec})
80n0:18	User calibration gain	User calibration gain	INT16	RW	0x4000 (16384_{dec})

4.10.3 Command object

Index FB00 RMB Command

Index (hex)	Name	Meaning	Data type	Flags	Default
FB00:0	RMB Command	Max. subindex	UINT8	RO	0x03 (3_{dec})
FB00:01	Request	Commands can be sent to the terminal via the request object. Command: • 0x0101: Zero balance • 0x0102: Calibration • 0x0001 Taring • 0x0002 Taring (data are stored in the EEPROM) see commands [▶ 60]	OCTET-STRING[2]	RW	{0}
FB00:02	Status	Status of the command currently being executed 0: Command executed without error. 255: Command is being executed	UINT8	RO	0x00 (0_{dec})
FB00:03	Response	Optional response value of the command	OCTET-STRING[4]	RO	{0}

4.10.4 Input data

Index 6000 RMB Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
6000:0	RMB Inputs	Max. Subindex	UINT8	RO	0x13 (19_{dec})
6000:02	Overrange	The measured value has reached its end value	BOOLEAN	RO	0x00 (0_{dec})
6000:04	Data invalid	The displayed process data are invalid. e.g. during calibration.	BOOLEAN	RO	0x00 (0_{dec})
6000:07	Error	An error has occurred.	BOOLEAN	RO	0x00 (0_{dec})
6000:08	Calibration in progress	Calibration is running. The process data show the last valid measured value.	BOOLEAN	RO	0x00 (0_{dec})
6000:09	Steady state [▶ 55]		BOOLEAN	RO	0x00 (0_{dec})
6000:0E	Sync error	The Sync error bit is only required for Distributed Clocks mode. It indicates whether a synchronization error has occurred during the previous cycle.	BOOLEAN	RO	0x00 (0_{dec})
6000:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
6000:11	Value	Measured value as 32 bit signed integer	INT32	RO	0x61746144 (1635017028_{dec})
6000:12	Value (Real) [▶ 68]	Measured value as real	REAL32	RO	0x00000000 (0_{dec})
6000:13	Timestamp [▶ 71]	Timestamp of the current measured value. (only EL3356-0010 and EL3356-0090 in DC mode)	UINT64	RO	

Index 6010, 6020 AI Inputs

Index (hex)	Name	Meaning	Data type	Flags	Default
60n0:0	AI Inputs	Max. subindex	UINT8	RO	0x11 (17_{dec})
60n0:01	Underrange	Value below measuring range.	BOOLEAN	RO	0x00 (0_{dec})
60n0:02	Overrange	Measuring range exceeded.	BOOLEAN	RO	0x00 (0_{dec})
60n0:07	Error	An error has occurred. - Over- / Underrange U_{dif} - Over- / Underrange U_{ref} - The external U_{ref} is too low (between -1 V and +1 V) - Data invalid	BOOLEAN	RO	0x00 (0_{dec})
60n0:10	TxPDO Toggle	The TxPDO toggle is toggled by the slave when the data of the associated TxPDO is updated.	BOOLEAN	RO	0x00 (0_{dec})
60n0:11	Value	32-bit measured value	INT32	RO	0x00000000 (0_{dec})

4.10.5 Output data

Index 7000 RMB Outputs

Index (hex)	Name	Meaning	Data type	Flags	Default
7000:0	RMB Outputs	Max. subindex	UINT8	RO	0x05 (5_{dec})
7000:01	Start calibration [▶ 56]	The calibration can be started manually with a rising edge. This can be used to prevent the calibration from starting automatically at an unsuitable time.	BOOLEAN	RO	0x00 (0_{dec})
7000:02	Disable calibration	0: Automatic calibration is active. 1: Automatic calibration is switched off.	BOOLEAN	RO	0x00 (0_{dec})
7000:03	Input freeze [▶ 53]	The process data and the digital filters are frozen.	BOOLEAN	RO	0x00 (0_{dec})
7000:04	Sample mode*	Selecting the sample mode: 0: 10.5 kHz High precision 1: 105 kHz Low latency	BOOLEAN	RO	0x00 (0_{dec})
7000:05	Tare	The process record can be set to 0 with a rising edge. The tare value is not stored in the EEPROM and is therefore no longer available after a terminal reset.	BOOLEAN	RO	0x00 (0_{dec})
7000:11	Filter frequency	Filter frequency of the variable PDO filter in 0.1 Hz, see filter [▶ 46] Value range: 1 ... 2000 (corresponds to 0.1 ... 200 Hz) If the value is 0 or greater than 2000, the filter behaves like a 50 Hz FIR filter	UINT16	RO	0x00 (0_{dec})

*) not EL3356-0000

4.10.6 Information / diagnostic data

Index 801E, 802E AI Internal data

Index (hex)	Name	Meaning	Data type	Flags	Default
801E:0	AI Internal data	Max. subindex	UINT8	RO	0x01 (1_{dec})
801E:01	ADC raw value 1	ADC raw value	INT32	RO	0x00000000 (0_{dec})

Index 9000 RMB Info data

Index (hex)	Name	Meaning	Data type	Flags	Default
9000:0	RMB Info data	Max. subindex	UINT8	RO	0x11 (17_{dec})
9000:11	mV/V	Current mV/V value	REAL32	RO	0x00000000 (0_{dec})

Index A000 RMB Diag data

Index (hex)	Name	Meaning	Data type	Flags	Default
A000:0	RMB Diag data	Max. subindex	UINT8	RO	0x18 (24_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
A000:11	No internal reference supply	No internal reference voltage at the ADC input (U_{Ref} channel)	BOOLEAN	RO	0x00 (0_{dec})
A000:12	No internal reference bridge	No internal reference voltage at the ADC input (U_{Dif} channel)	BOOLEAN	RO	0x00 (0_{dec})
A000:13	No external reference supply	The external reference voltage is less than ±1 V.	BOOLEAN	RO	0x00 (0_{dec})
A000:15	Overrange bridge	Measuring range exceeded in the bridge junction	BOOLEAN	RO	0x00 (0_{dec})
A000:16	Underrange bridge	Value below measuring range in the bridge junction	BOOLEAN	RO	0x00 (0_{dec})
A000:17	Overrange supply	Measuring range of the reference voltage exceeded	BOOLEAN	RO	0x00 (0_{dec})
A000:18	Underrange supply	Value below measuring range for the reference voltage	BOOLEAN	RO	0x00 (0_{dec})

4.10.7 Vendor configuration data (device-specific)

Index 801F, 802F AI Vendor data

Index (hex)	Name	Meaning	Data type	Flags	Default
801F:0	AI Vendor data	Max. subindex	UINT8	RO	0x02 (2_{dec})
801F:01	Calibration offset	Offset (vendor calibration)	INT32	RW	0x01E10000 (31522816_{dec})
801F:02	Calibration gain	Gain (vendor calibration)	INT16	RW	0x4000 (16384_{dec})

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

Index 1008 Device name

Index (hex)	Name	Meaning	Data type	Flags	Default
1008:0	Device name	Device name of the EtherCAT slave	STRING	RO	EL3356, EL3356-0010, EL3356-0090

Index 1009 Hardware version

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

Index 100A Software version

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

Index 1018 Identity

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:0	Identity	Information for identifying the slave	UINT8	RO	0x04 (4_{dec})
1018:01	Vendor ID	Vendor ID of the EtherCAT slave	UINT32	RO	0x00000002 (2_{dec})
1018:02	Product code	Product code of the EtherCAT slave	UINT32	RO	0x0D1C3052 (219951186_{dec})
1018:03	Revision	Revision number of the EtherCAT slave; the low word (bit 0-15) indicates the special terminal number, the high word (bit 16-31) refers to the device description	UINT32	RO	0x00100000 (1048576_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
1018:04	Serial number	Serial number of the EtherCAT slave; the low byte (bit 0-7) of the low word contains the year of production, the high byte (bit 8-15) of the low word contains the week of production, the high word (bit 16-31) is 0	UINT32	RO	0x00000000 (0_{dec})

Index 10F0 Backup parameter handling

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

Index 1600 RMB RxPDO-Map Control (EL3356)

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RMB RxPDO-Map Control	PDO Mapping RxPDO-Map control	UINT8	RO	0x07 (7_{dec})
1600:01	Subindex 001	1. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x01 (Start calibration))	UINT32	RO	0x7000:01, 1
1600:02	Subindex 002	2. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x02 (Disable calibration))	UINT32	RO	0x7000:02, 1
1600:03	Subindex 003	3. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x03 (Input freeze))	UINT32	RO	0x7000:03, 1
1600:04	Subindex 004	4. PDO Mapping entry (1 bit align)	UINT32	RO	0x0000:00, 1
1600:05	Subindex 005	5. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x05 (Tara))	UINT32	RO	0x7000:05, 1
1600:06	Subindex 006	6. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1600:07	Subindex 007	7. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1600 RMB RxPDO-Map Control (EL3356-0010/-0020/-0030/-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1600:0	RMB RxPDO-Map Control	PDO Mapping RxPDO-Map control	UINT8	RO	0x07 (7_{dec})
1600:01	Subindex 001	1. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x01 (Start calibration))	UINT32	RO	0x7000:01, 1
1600:02	Subindex 002	2. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x02 (Disable calibration))	UINT32	RO	0x7000:02, 1
1600:03	Subindex 003	3. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x03 (Input freeze))	UINT32	RO	0x7000:03, 1
1600:04	Subindex 004	4. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x04 (Sample mode))	UINT32	RO	0x7000:04, 1
1600:05	Subindex 005	5. PDO Mapping entry (object 0x7000 (RMB outputs), entry 0x05 (Tara))	UINT32	RO	0x7000:05, 1
1600:06	Subindex 006	6. PDO Mapping entry (3 bits align)	UINT32	RO	0x0000:00, 3
1600:07	Subindex 007	7. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8

Index 1601 RMB RxPDO-Map Filter frequency

Index (hex)	Name	Meaning	Data type	Flags	Default
1601:0	RMB RxPDO-Map Filter frequency	PDO Mapping RxPDO-Map Filter frequency	UINT8	RO	0x01 (1_{dec})
1601:01	Subindex 001	1. PDO Mapping entry (object 0x7000 (RMB ouputs), entry 0x11 (Start calibration))	UINT32	RO	0x7000:11, 16

Index 1800 RMB TxPDO-Par Status

Index (hex)	Name	Meaning	Data type	Flags	Default
1800:0	RMB TxPDO-Par Status	PDO Parameter TxPDO 1	UINT8	RO	0x06 (6_{dec})
1800:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 1	OCTET-STRING[10]	RO	04 1A 05 1A 06 1A 07 1A 00 00

Index 1801 RMB TxPDO-Par Value (INT32)

Index (hex)	Name	Meaning	Data type	Flags	Default
1801:0	RMB TxPDO-Par Value (INT32)	PDO Parameter TxPDO 2	UINT8	RO	0x06 (6_{dec})
1801:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 2	OCTET-STRING[10]	RO	02 1A 04 1A 05 1A 06 1A 07 1A

Index 1802 RMB TxPDO-Par Value (Real)

Index (hex)	Name	Meaning	Data type	Flags	Default
1802:0	RMB TxPDO-Par Value (Real)	PDO Parameter TxPDO 3	UINT8	RO	0x06 (6_{dec})
1802:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 3	OCTET-STRING[10]	RO	01 1A 04 1A 05 1A 06 1A 07 1A

Index 1803 RMB TxPDO-Par Timestamp

Index (hex)	Name	Meaning	Data type	Flags	Default
1803:0	RMB TxPDO-Par Timestamp	PDO Parameter TxPDO 4	UINT8	RO	0x06 (6_{dec})
1803:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 4	OCTET-STRING[10]	RO	04 1A 05 1A 06 1A 07 1A 00 00

Index 1804 AI TxPDO-Par Standard Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1804:0	AI TxPDO-Par Standard Ch.1	PDO Parameter TxPDO 5	UINT8	RO	0x06 (6_{dec})
1804:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 5	OCTET-STRING[10]	RO	05 1A 00 1A 01 1A 02 1A 03 1A

Index 1805 AI TxPDO-Par Compact Ch.1

Index (hex)	Name	Meaning	Data type	Flags	Default
1805:0	AI TxPDO-Par Compact Ch.1	PDO Parameter TxPDO 6	UINT8	RO	0x06 (6_{dec})
1805:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 6	OCTET-STRING[10]	RO	04 1A 00 1A 01 1A 02 1A 03 1A

Index 1806 AI TxPDO-Par Standard Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1806:0	AI TxPDO-Par Standard Ch.2	PDO Parameter TxPDO 7	UINT8	RO	0x06 (6_{dec})
1806:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 7	OCTET-STRING[10]	RO	07 1A 00 1A 01 1A 02 1A 03 1A

Index 1807 AI TxPDO-Par Compact Ch.2

Index (hex)	Name	Meaning	Data type	Flags	Default
1807:0	AI TxPDO-Par Compact Ch.2	PDO Parameter TxPDO 8	UINT8	RO	0x06 (6_{dec})
1807:06	Exclude TxPDOs	Specifies the TxPDOs (index of TxPDO mapping objects) that must not be transferred together with TxPDO 8	OCTET-STRING[10]	RO	06 1A 00 1A 01 1A 02 1A 03 1A

Index 1A00 RMB TxPDO-Map Status

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:0	RMB TxPDO-Map Status	PDO Mapping RxPDO-Map Status	UINT8	RO	0x0C (12_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
1A00:01	Subindex 001	1. PDO Mapping entry (1 bits align)	OCTET-STRING[10]	RO	0x0000:00, 1
1A00:02	Subindex 002	2. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x02 (Overrange))	OCTET-STRING[10]	RO	0x6000:02, 1
1A00:03	Subindex 003	3. PDO Mapping entry (1 bits align)	OCTET-STRING[10]	RO	0x0000:00, 1
1A00:04	Subindex 004	4. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x04 (Data invalid))	OCTET-STRING[10]	RO	0x6000:04, 1
1A00:05	Subindex 005	5. PDO Mapping entry (2 bits align)	OCTET-STRING[10]	RO	0x0000:00, 2
1A00:06	Subindex 006	6. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x07 (Error))	OCTET-STRING[10]	RO	0x6000:07, 1
1A00:07	Subindex 007	7. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x08 (Calibration in progress))	OCTET-STRING[10]	RO	0x6000:08, 1
1A00:08	Subindex 008	8. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x09 (Steady state))	OCTET-STRING[10]	RO	0x6000:09, 1
1A00:09	Subindex 009	9. PDO Mapping entry (4 bits align)	OCTET-STRING[10]	RO	0x0000:00, 4
1A00:0A	Subindex 010	10. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x0E (Sync error))	OCTET-STRING[10]	RO	0x6000:0E, 1
1A00:0B	Subindex 011	11. PDO Mapping entry (1 bits align)	OCTET-STRING[10]	RO	0x0000:00, 1
1A00:0C	Subindex 012	12. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x10 (TxPDO Toggle))	OCTET-STRING[10]	RO	0x6000:10, 1

Index 1A01 RMB TxPDO-Map Value (INT32)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A01:0	RMB TxPDO-Map Value (INT32)	PDO Mapping Value (INT32)	UINT8	RW	0x01 (1_{dec})
1A01:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x11 (Value))	UINT32	RW	0x6000:11, 32

Index 1A02 RMB TxPDO-Map Value (Real)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A02:0	RMB TxPDO-Map Value (real)	PDO Mapping Value (real)	UINT8	RW	0x01 (1_{dec})
1A02:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RMB inputs), entry 0x12 (Value (real)))	UINT32	RW	0x6000:12, 32

Index 1A03 RMB TxPDO-Map Timestamp (EL3356)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	RMB TxPDO-Map Timestamp	PDO Mapping Value Timestamp	UINT8	RW	0x01 (1_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x0000, entry 0x00)	UINT64	RW	0x0000:00, 64

Index 1A03 RMB TxPDO-Map Timestamp (EL3356-0010/-0020/-0030/-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A03:0	RMB TxPDO-Map Timestamp	PDO Mapping Value Timestamp	UINT8	RW	0x01 (1_{dec})
1A03:01	SubIndex 001	1. PDO Mapping entry (object 0x6000 (RMB Inputs), entry 0x13 (Timestamp))	UINT64	RW	0x6000:13, 64

Index 1A04 AI TxPDO-Map Standard Ch. 1 (EL3356, EL3356-0010/-0020/-0030)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	AI supply TxPDO-Map Standard Ch. 1	PDO Mapping TxPDO Standard Ch. 1	UINT8	RW	0x07 (7_{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x01 (Underrange))	UINT32	RW	0x6010:01, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x02 (Overrange))	UINT32	RW	0x6010:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x04 (Error))	UINT32	RW	0x6010:07, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RW	0x0000:00, 8
1A04:06	SubIndex 006	6. PDO Mapping entry (object 0x6010, entry 0x10 (TxPDO Toggle))	UINT32	RW	0x6010:10, 1
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6010, entry 0x11 (Value))	UINT32	RW	0x6010:11, 32

Index 1A04 AI TxPDO-Map Standard Ch. 1 (EL3356-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A04:0	AI supply TxPDO-Map Standard Ch. 1	PDO Mapping TxPDO Standard Ch. 1	UINT8	RW	0x08 (8_{dec})
1A04:01	SubIndex 001	1. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x01 (Underrange))	UINT32	RW	0x6010:01, 1
1A04:02	SubIndex 002	2. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x02 (Overrange))	UINT32	RW	0x6010:02, 1
1A04:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A04:04	SubIndex 004	4. PDO Mapping entry (object 0x6010 (AI supply Inputs), entry 0x04 (Error))	UINT32	RW	0x6010:07, 1
1A04:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RW	0x0000:00, 1
1A04:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A04:07	SubIndex 007	7. PDO Mapping entry (object 0x6010, entry 0x10 (TxPDO Toggle))	UINT32	RW	0x6010:10, 1
1A04:08	SubIndex 008	8. PDO Mapping entry (object 0x6010, entry 0x11 (Value))	UINT32	RW	0x6010:11, 32

Index 1A05 AI TxPDO-Map Compact Ch. 1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A05:0	AI supply TxPDO-Map Compact Ch. 1	PDO Mapping TxPDO Compact Ch. 1	UINT8	RW	0x01 (1_{dec})
1A05:01	SubIndex 001	1. PDO Mapping entry (object 0x6010, entry 0x11 (Value))	UINT32	RW	0x6010:11, 32

Index 1A06 AI TxPDO-Map Standard Ch. 2 (EL3356, EL3356-0010/-0020/-0030)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	AI supply TxPDO-Map Standard Ch. 2	PDO Mapping TxPDO Standard Ch. 2	UINT8	RW	0x07 (7_{dec})
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x01 (Underrange))	UINT32	RW	0x6020:01, 1
1A06:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x02 (Overrange))	UINT32	RW	0x6020:02, 1
1A06:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A06:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x04 (Error))	UINT32	RW	0x6020:07, 1
1A06:05	SubIndex 005	5. PDO Mapping entry (8 bits align)	UINT32	RW	0x0000:00, 8
1A06:06	SubIndex 006	6. PDO Mapping entry (object 0x6020, entry 0x10 (TxPDO Toggle))	UINT32	RW	0x6020:10, 1
1A06:07	SubIndex 007	7. PDO Mapping entry (object 0x6020, entry 0x11 (Value))	UINT32	RW	0x6020:11, 32

Index 1A06 AI TxPDO-Map Standard Ch. 2 (EL3356-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:0	AI supply TxPDO-Map Standard Ch. 2	PDO Mapping TxPDO Standard Ch. 2	UINT8	RW	0x07 (7_{dec})
1A06:01	SubIndex 001	1. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x01 (Underrange))	UINT32	RW	0x6020:01, 1
1A06:02	SubIndex 002	2. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x02 (Overrange))	UINT32	RW	0x6020:02, 1
1A06:03	SubIndex 003	3. PDO Mapping entry (4 bits align)	UINT32	RW	0x0000:00, 4
1A06:04	SubIndex 004	4. PDO Mapping entry (object 0x6020 (AI supply Inputs), entry 0x04 (Error))	UINT32	RW	0x6020:07, 1

Index (hex)	Name	Meaning	Data type	Flags	Default
1A06:05	SubIndex 005	5. PDO Mapping entry (1 bits align)	UINT32	RW	0x0000:00, 1
1A06:06	SubIndex 006	6. PDO Mapping entry (7 bits align)	UINT32	RW	0x0000:00, 7
1A06:07	SubIndex 007	7. PDO Mapping entry (object 0x6020, entry 0x10 (TxPDO Toggle))	UINT32	RW	0x6020:10, 1
1A06:08	SubIndex 008	8. PDO Mapping entry (object 0x6020, entry 0x11 (Value))	UINT32	RW	0x6020:11, 32

Index 1A07 AI TxPDO-Map Compact Ch. 2

Index (hex)	Name	Meaning	Data type	Flags	Default
1A07:0	AI supply TxPDO-Map Compact Ch. 2	PDO Mapping TxPDO Compact Ch. 2	UINT8	RW	0x01 (1_{dec})
1A07:01	SubIndex 001	1. PDO Mapping entry (object 0x6020, entry 0x11 (Value))	UINT32	RW	0x6020:11, 32

Index 1C00 Sync manager type

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

Index 1C12 RxPDO assign (EL3356, EL3356-0010/-0020/-0030)

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x02 (2_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	-

Index 1C12 RxPDO assign (EL3356-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1C12:0	RxPDO assign	PDO Assign Outputs	UINT8	RW	0x02 (2_{dec})
1C12:01	Subindex 001	1. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1600 (5632_{dec})
1C12:02	Subindex 002	2. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	0x1610 (5648_{dec})
1C12:03	Subindex 003	3. allocated RxPDO (contains the index of the associated RxPDO mapping object)	UINT16	RW	-

Index 1C13 TxPDO assign (EL3356, EL3356-0010/-0020/-0030)

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x02 (2_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	-

Index 1C13 TxPDO assign (EL3356-0090)

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:0	TxPDO assign	PDO Assign Inputs	UINT8	RW	0x03 (3_{dec})
1C13:01	Subindex 001	1. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A00 (6656_{dec})
1C13:02	Subindex 002	2. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A01 (6657_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
1C13:03	Subindex 003	3. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	0x1A10 (6672_{dec})
1C13:04	Subindex 004	4. allocated TxPDO (contains the index of the associated TxPDO mapping object)	UINT16	RW	-

Index 1C32 SM output parameter

Index (hex)	Name	Meaning	Data type	Flags	Default
1C32:0	SM output parameter	Synchronization parameters for the outputs	UINT8	RO	0x20 (32_{dec})
1C32:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchron with SM 2 Event • 2: DC-Mode - Synchron with SYNC0 Event • 3: DC-Mode - Synchron with SYNC1 Event	UINT16	RW	0x0001 (1_{dec})
1C32:02	Cycle time	Cycle time (in ns): • Free Run: Cycle time of the local timer • Synchronous with SM 2 event: Master cycle time • DC mode: SYNC0/SYNC1 Cycle Time	UINT32	RW	0x000C65D4 (812500_{dec})
1C32:03	Shift time	Time between SYNC0 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:04	Sync modes supported	Supported synchronization modes: • Bit 0 = 1: free run is supported • Bit 1 = 1: Synchronous with SM 2 event is supported • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 10: Output shift with SYNC1 event (only DC mode) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08)	UINT16	RO	0x4C06 (19462_{dec})
1C32:05	Minimum cycle time	Minimum cycle time (in ns)	UINT32	RO	0x000186A0 (100000_{dec})
1C32:06	Calc and copy time	Minimum time between SYNC0 and SYNC1 event (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:07	Minimum delay time	Minimum time between SYNC1 event and output of the outputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C32:08	Command	• 0: Measurement of the local cycle time is stopped • 1: Measurement of the local cycle time is started The entries 0x1C32:03, 0x1C32:05, 0x1C32:06, 0x1C32:09, 0x1C33:03, 0x1C33:06, 0x1C33:09 [▶ 89] are updated with the maximum measured values. For a subsequent measurement the measured values are reset	UINT16	RW	0x0000 (0_{dec})
1C32:09	Maximum Delay time	Time between SYNC1 event and output of the outputs (in ns, DC mode only)	UINT32	RO	0x00000000 (0_{dec})
1C32:0B	SM event missed counter	Number of missed SM events in OPERATIONAL (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:0C	Cycle exceeded counter	Number of occasions the cycle time was exceeded in OPERATIONAL (cycle was not completed in time or the next cycle began too early)	UINT16	RO	0x0000 (0_{dec})
1C32:0D	Shift too short counter	Number of occasions that the interval between SYNC0 and SYNC1 event was too short (DC mode only)	UINT16	RO	0x0000 (0_{dec})
1C32:20	Sync error	The synchronization was not correct in the last cycle (outputs were output too late; DC mode only)	BOOLEAN	RO	0x00 (0_{dec})

Index 1C33 SM input parameter

Index	Name	Meaning	Data type	Flags	Default
1C33:0	SM input parameter	Synchronization parameters for the inputs	UINT8	RO	0x20 (32_{dec})

Index	Name	Meaning	Data type	Flags	Default
1C33:01	Sync mode	Current synchronization mode: • 0: Free Run • 1: Synchronous with SM 3 event (no outputs available) • 2: DC - Synchronous with SYNC0 Event • 3: DC - Synchronous with SYNC1 Event • 34: Synchronous with SM 2 event (outputs available)	UINT16	RW	0x0022 (34_{dec})
1C33:02	Cycle time	as 0x1C32:02 [▶ 89]	UINT32	RW	0x000C65D4 (812500_{dec})
1C33:03	Shift time	Time between SYNC0 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:04	Sync modes supported	Supported synchronization modes: • Bit 0: free run is supported • Bit 1: synchronous with SM 2 event is supported (outputs available) • Bit 1: synchronous with SM 3 event is supported (no outputs available) • Bit 2-3 = 01: DC mode is supported • Bit 4-5 = 01: input shift through local event (outputs available) • Bit 4-5 = 10: input shift with SYNC1 event (no outputs available) • Bit 14 = 1: dynamic times (measurement through writing of 0x1C32:08 or 0x1C33:08)	UINT16	RO	0x4C06 (19462_{dec})
1C33:05	Minimum cycle time	as 0x1C32:05 [▶ 89]	UINT32	RO	0x000186A0 (100000_{dec})
1C33:06	Calc and copy time	Time between reading of the inputs and availability of the inputs for the master (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:07	Minimum delay time		UINT32	RO	0x00000000 (0_{dec})
1C33:08	Command	as 0x1C32:08 [▶ 89]	UINT16	RW	0x0000 (0_{dec})
1C33:09	Maximum Delay time	Time between SYNC1 event and reading of the inputs (in ns, only DC mode)	UINT32	RO	0x00000000 (0_{dec})
1C33:0B	SM event missed counter	as 0x1C32:11 [▶ 89]	UINT16	RO	0x0000 (0_{dec})
1C33:0C	Cycle exceeded counter	as 0x1C32:12 [▶ 89]	UINT16	RO	0x0000 (0_{dec})
1C33:0D	Shift too short counter	as 0x1C32:13 [▶ 89]	UINT16	RO	0x0000 (0_{dec})
1C33:20	Sync error	as 0x1C32:32 [▶ 89]	BOOLEAN	RO	0x00 (0_{dec})

Index F000 Modular device profile

Index (hex)	Name	Meaning	Data type	Flags	Default
F000:0	Modular device profile	General information for the modular device profile	UINT8	RO	0x02 (2_{dec})
F000:01	Module index distance	Index spacing of the objects of the individual channels	UINT16	RO	0x0010 (16_{dec})
F000:02	Maximum number of modules	Number of channels	UINT16	RO	EL3356, EL3356-0010: 0x0003 (3_{dec}) EL3356-0090: 0x0004 (4_{dec})

Index F008 Code word

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

Index F010 Module list

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:0	Module list	Max. subindex	UINT8	RW	0x03 (3_{dec})
F010:01	SubIndex 001	RMB	UINT32	RW	0x00000172 (370_{dec})

Index (hex)	Name	Meaning	Data type	Flags	Default
F010:02*	SubIndex 002	TSC	UINT32	RW	0x000003B6 (950_{dec})

*) EL3351-0090 only

4.11 EL3356-0090 - Objects TwinSAFE Single Channel

Index 1610 TSC RxPDO-Map Master Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1610:0	TSC RxPDO-Map Master Message	PDO Mapping RxPDO	UINT8	RO	0x04 (4_{dec})
1610:01	SubIndex 001	1. PDO Mapping entry (object 0x7030 (TSC Master Frame Elements), entry 0x01 (TSC__Master Cmd))	UINT32	RO	0x7030:01, 8
1610:02	SubIndex 002	2. PDO Mapping entry (8 bits align)	UINT32	RO	0x0000:00, 8
1610:03	SubIndex 003	3. PDO Mapping entry (object 0x7030 (TSC Master Frame Elements), entry 0x03 (TSC__Master CRC_0))	UINT32	RO	0x7030:03, 16
1610:04	SubIndex 004	4. PDO Mapping entry (object 0x7030 (TSC Master Frame Elements), entry 0x02 (TSC__Master ConnID))	UINT32	RO	0x7030:02, 16

Index 1A10 TxPDO-Map Slave Message

Index (hex)	Name	Meaning	Data type	Flags	Default
1A10:0	TxPDO-Map Slave Message	PDO Mapping TxPDO	UINT8	RW	0x06 (6_{dec})
1A10:01	SubIndex 001	1. PDO Mapping entry (object 0x6030 (TSC Slave Frame Elements), entry 0x01 (TSC__Slave Cmd))	UINT32	RW	0x6030:01, 8
1A10:02	SubIndex 002	2. PDO Mapping entry (object 0x6000 (AI Inputs), entry 0x11 (Value))	UINT32	RW	0x6000:11, 16
1A10:03	SubIndex 003	3. PDO Mapping entry (object 0x6030 (TSC Slave Frame Elements), entry 0x03 (TSC__Slave_CRC_0))	UINT32	RW	0x6030:03, 16
1A10:04	SubIndex 004	4. PDO Mapping entry (16 bits align)	UINT32	RW	0x0000:00, 16
1A10:05	SubIndex 005	5. PDO Mapping entry (object 0x6030 (TSC Slave Frame Elements), entry 0x04 (TSC__Slave_CRC_1))	UINT32	RW	0x6030:04, 16
1A10:06	SubIndex 006	6. PDO Mapping entry (object 0x6030 (AI Inputs), entry 0x02 (TSC__Slave ConnID))	UINT32	RW	0x6030:02, 16

Index 6030 TSC Slave Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
6030:0	TSC Slave Frame Elements	Max. Subindex	UINT8	RO	0x04 ($_{dec}$)
6030:01	TSC__Slave Cmd	reserved	UINT8	RO	0x00 (0_{dec})
6030:02	TSC__Slave ConnID	reserved	UINT16	RO	0x0000 (0_{dec})
6030:03	TSC__Slave CRC_0	reserved	UINT16	RO	0x0000 (0_{dec})
6030:04	TSC__Slave CRC_1	reserved	UINT16	RO	0x0000 (0_{dec})

Index 7030 TSC Master Frame Elements

Index (hex)	Name	Meaning	Data type	Flags	Default
7030:0	TSC Master Frame Elements	Max. Subindex	UINT8	RO	0x03 (3_{dec})
7030:01	TSC__Master Cmd	reserved	UINT8	RO	0x00 (0_{dec})
7030:02	TSC__Master ConnID	reserved	UINT16	RO	0x0000 (0_{dec})
7030:03	TSC__Master CRC_0	reserved	UINT16	RO	0x0000 (0_{dec})

Index 8030 TSC Settings

Index (hex)	Name	Meaning	Data type	Flags	Default
8030:0	TSC Settings	Max. Subindex	UINT8	RO	0x02 (2_{dec})
8030:01	Address	TwinSAFE SC Address	UINT16	RO	0x0000 (0_{dec})
8030:02	Connection Mode	Selection of the TwinSAFE SC CRC	UINT32	RO	0x00000000 (0_{dec})

4.12 Sample Program

Using the sample programs

This document contains sample applications of our products for certain areas of application. The application notes provided here are based on typical features of our products and only serve as examples. The notes contained in this document explicitly do not refer to specific applications. The customer is therefore responsible for assessing and deciding whether the product is suitable for a particular application. We accept no responsibility for the completeness and correctness of the source code contained in this document. We reserve the right to modify the content of this document at any time and accept no responsibility for errors and missing information.

Download https://infosys.beckhoff.com/content/1033/el3356/Resources/1942802187.zip

In this example program an EL3356 is addressed by a PLC program. The https://infosys.beckhoff.com/content/1033/el3356/Resources/1942802187.zip contains the PLC *.pro and the System Manager *.tsm.

The terminal can be operated via simple visualisation; the function *InputFreeze* is programmed out by way of example.

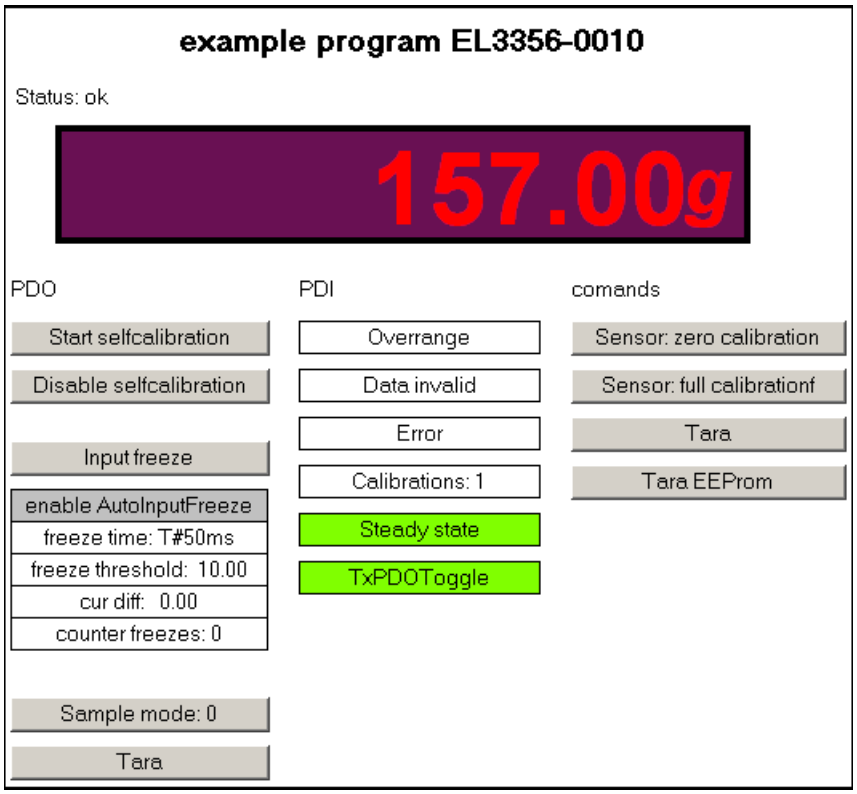


Fig. 55: Use of the example program

The EL3356 terminal is to be connected as shown below:

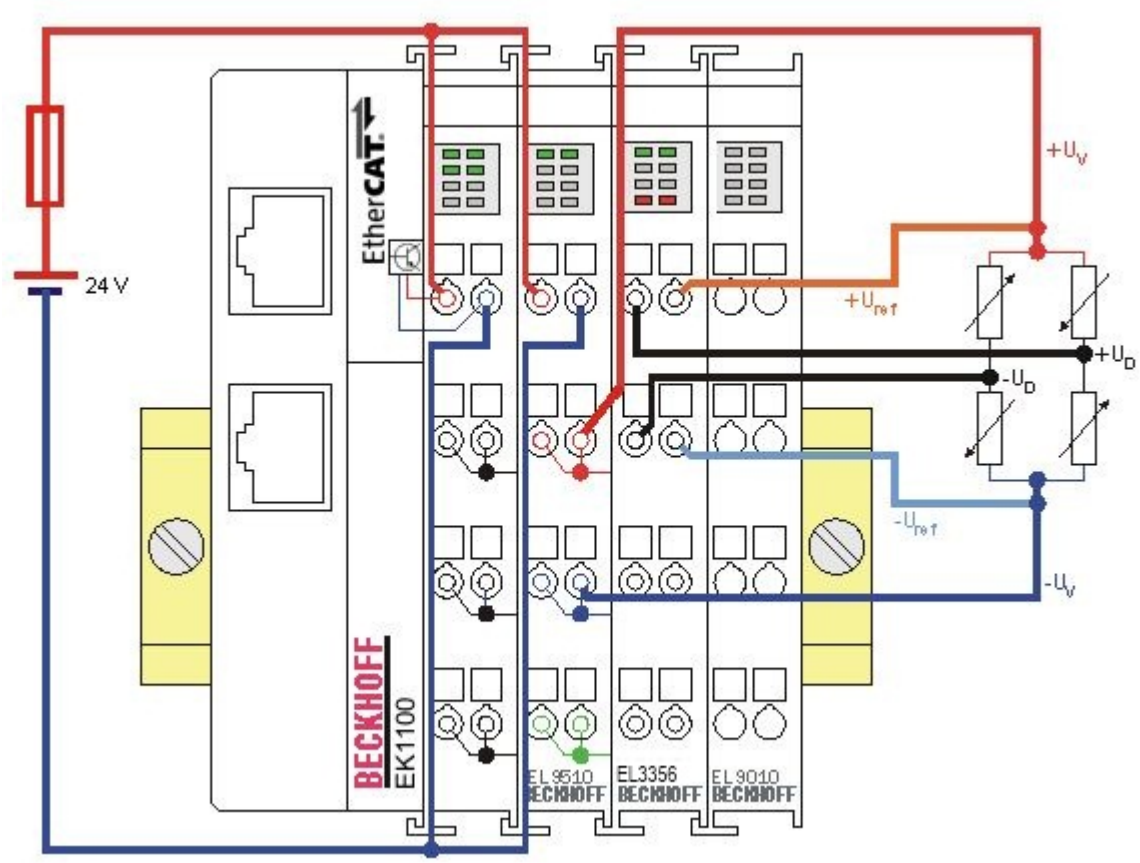


Fig. 56: Connection of the load sensor/full bridge

An EL9510 power supply terminal is used here to feed the strain gauge with 10 V.

Procedure for starting the program

- After clicking the Download button, save the zip file locally on your hard disk, and unzip the *.TSM (configuration) and the *.PRO (PLC program) files into a temporary working folder.
- Run the *.TSM file and the *.PRO file; the TwinCAT System Manager and TwinCAT PLC will open.
- Connect the hardware in accordance with fig. Connection for sample program [▶ 93] and connect the Ethernet adapter of your PC to the EtherCAT coupler (further information on this can be found in the corresponding coupler manuals)
- Select the local Ethernet adapter (with real-time driver, if applicable) under System configuration, I/O configuration, I/O devices, Device (EtherCAT); then on the “Adapter” tab choose “Search...”, select the appropriate adapter and confirm (see Fig. *Searching the Ethernet adapter + Selection and confirmation of the Ethernet adapter*).

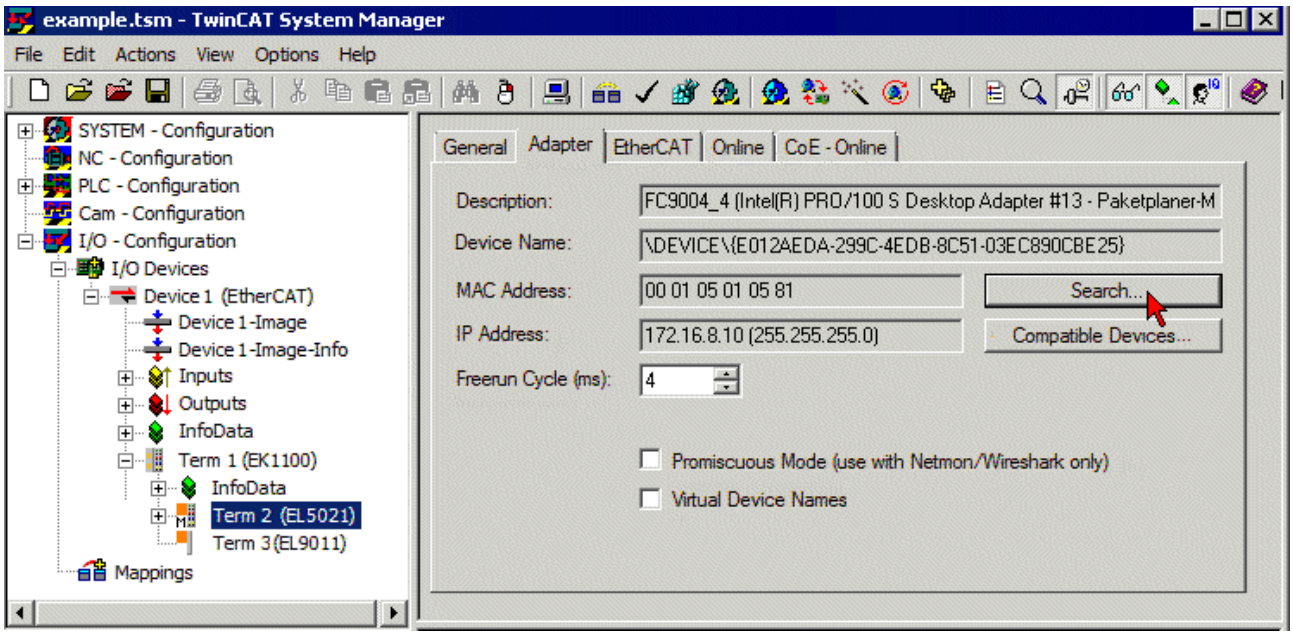


Fig. 57: Searching the Ethernet adapter

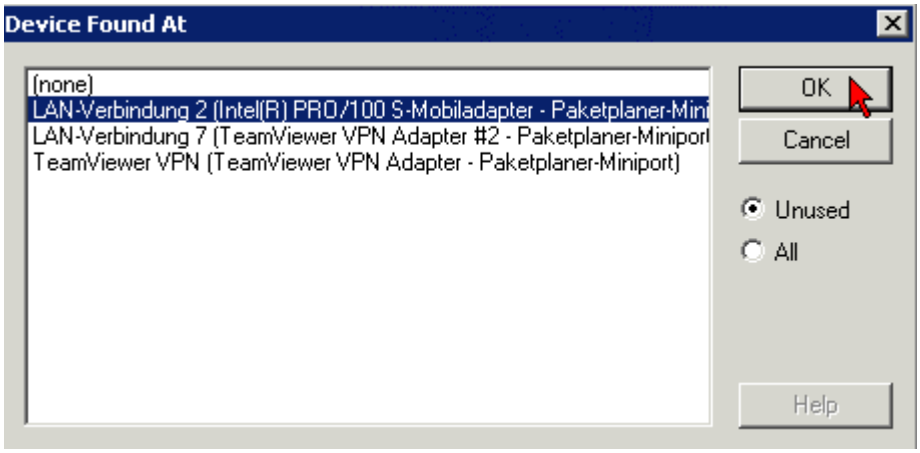


Fig. 58: Selection and confirmation of the Ethernet adapter

- Activate and confirm the configuration (Fig. *Activation of the configuration* + *Confirming the activation of the configuration*)

Fig. 59: Activation of the configuration

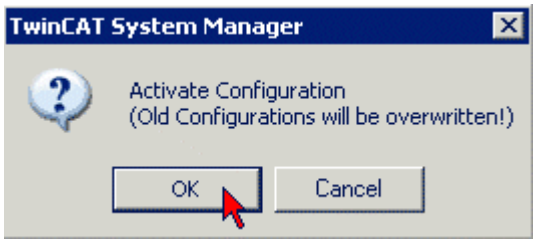


Fig. 60: Confirming the activation of the configuration

- Confirm new variable mapping, restart in RUN mode (Fig. *Generate variable mapping* + *Restarting TwinCAT in RUN mode*)

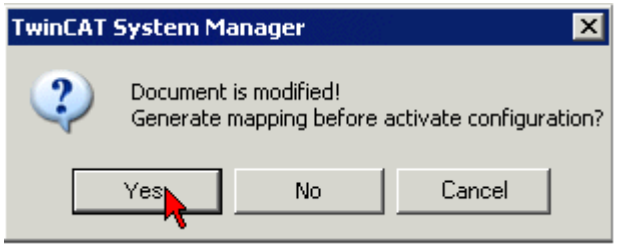


Fig. 61: Generating variable mapping

Fig. 62: Restarting TwinCAT in RUN mode

- In TwinCAT PLC, under the “Project” menu, select “Rebuild all” to compile the project (Fig. *Compile project*)

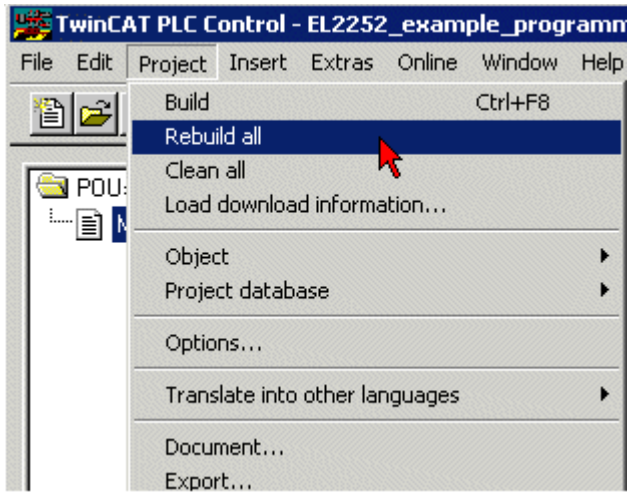


Fig. 63: Compile project

- In TwinCAT PLC: log in with the “F11” button, confirm loading the program (Fig. *Confirming program start*), run the program with the “F5” button

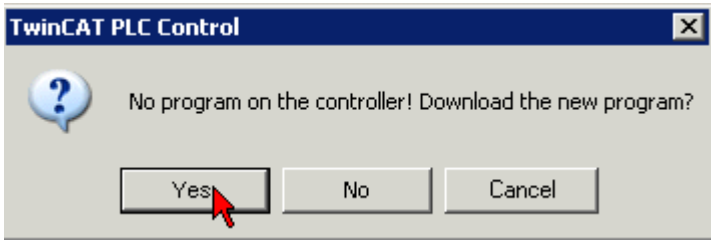


Fig. 64: Confirming program start

5 Appendix

5.1 EtherCAT AL Status Codes

For detailed information please refer to the EtherCAT system description.

5.2 Firmware compatibility

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

Note

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

NOTICE

Risk of damage to the device!

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

EL3356-0000			
Hardware (HW)	**Firmware**	**Revision no.**	**Date of release**
03 – 14*	03	EL3356-0000-0017	2012/02
		EL3356-0000-0018	2012/05
	04		2012/05
		EL3356-0000-0019	2012/06
		EL3356-0000-0020	2012/07
	05	EL3356-0000-0021	2014/01
	06		2014/04
	07	EL3356-0000-0022	2014/07
	08		2014/08
	09		2014/09
		EL3356-0000-0023	2016/09
		EL3356-0000-0024	2017/07
	10*	EL3356-0000-0025	2018/04

EL3356-0010			
Hardware (HW)	**Firmware**	**Revision no.**	**Date of release**
03 - 15*	03	EL3356-0010-0017	2012/02
		EL3356-0010-0018	2012/05
	04		2012/05
		EL3356-0010-0019	2012/06
		EL3356-0010-0020	2012/07
	05	EL3356-0010-0021	2014/01
	06		2014/04
	07	EL3356-0010-0022	2014/07
	08		2014/08
	09		2014/09
		EL3356-0010-0023	2016/09
		EL3356-0010-0024	2017/07
	10*	EL3356-0010-0025	2018/04

EL3356-0020			
Hardware (HW)	**Firmware**	**Revision no.**	**Date of release**
10 - 15*	11*	EL3356-0020-0025	2018/09

EL3356-0030			
Hardware (HW)	**Firmware**	**Revision no.**	**Date of release**
11 – 15*	11*	EL3356-0030-0025	2019/11

EL3356-0090			
Hardware (HW)	**Firmware**	**Revision no.**	**Date of release**
09 - 15*	10*	EL3356-0090-0025	2018/04

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

5.3 Support and Service

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

Beckhoff's branch offices and representatives

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

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