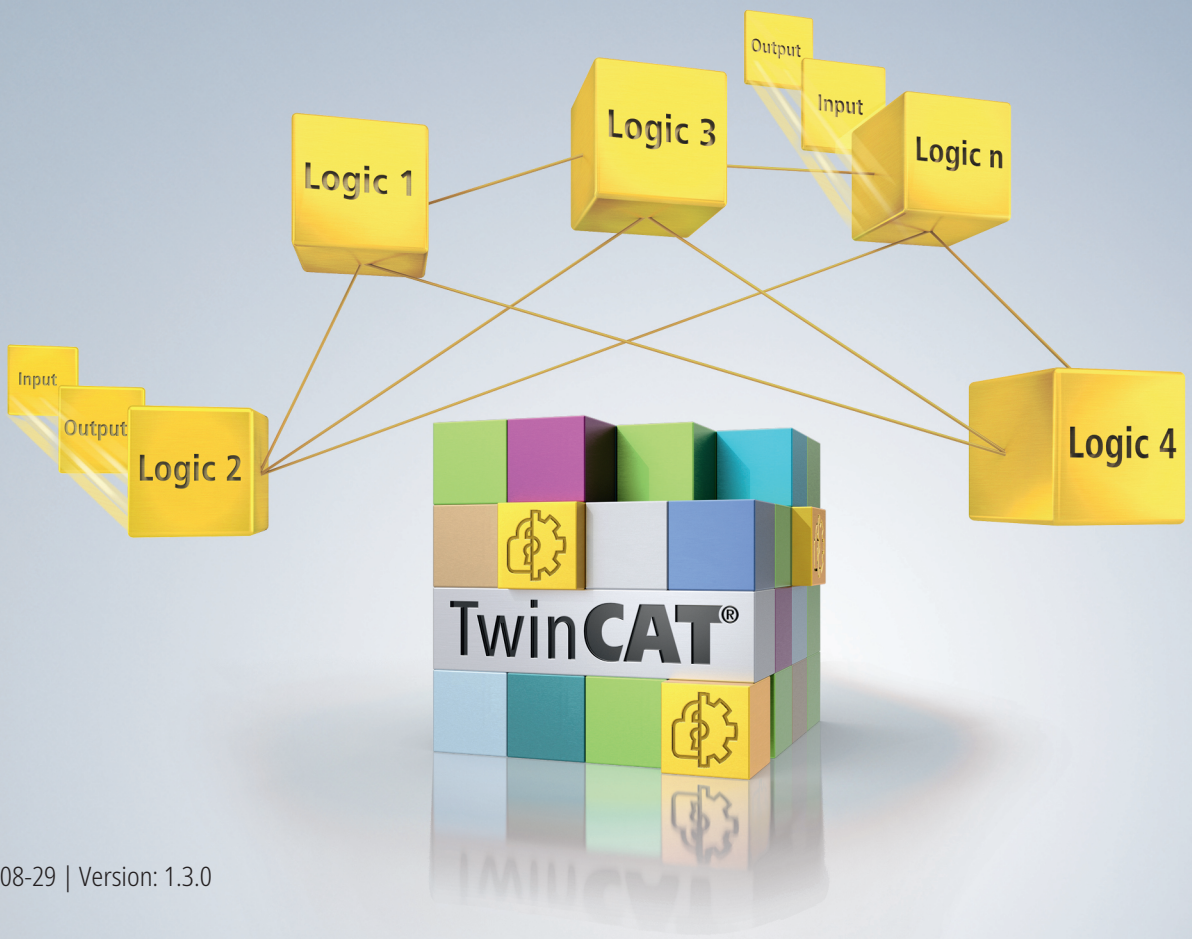
BECKHOFF New Automation Technology

Operating Instructions | EN

MO1918

TwinSAFE MO module with 8 digital inputs



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1 Notes on the documentation

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the documentation at any time and without notice. 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.

In this documentation, we define all permissible use cases whose properties and operating conditions we can guarantee. The use cases we define are fully tested and certified. Any other use cases not described in this documentation, require the approval of Beckhoff Automation GmbH & Co KG.

1.1.1 Trademarks

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

The use of other brand names or designations by third parties may lead to an infringement of the rights of the owners of the corresponding designations.

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

Safety over EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH.

1.1.2 Limitation of liability

All components in this product as described in the operating instructions are delivered in a specific configuration of hardware and software, depending on the application regulations. Modifications and changes to the hardware and/or software configuration that go beyond the documented options are prohibited and nullify the liability of Beckhoff Automation GmbH & Co. KG.

The following is excluded from the liability:

- Failure to observe these operating instructions
- Improper use
- Use of untrained personnel
- Use of unauthorized spare parts

1.1.3 Copyright

1.1.4 Third-party trademarks

Trademarks of third parties may be used in this documentation. You can find the trademark notices here: https://www.beckhoff.com/trademarks.

1.2 Documentation issue status

Issue	Comment
1.3.0	• Chapter “LEDs” revised
1.2.0	• Laser image revised • Chapter “Use in a safety-related user program” added • Minor corrections
1.1.0	• Laser image revised • Temperatures adjusted in the chapter "Environmental conditions"
1.0.0	• First released version
0.0.1	• Preliminary (internal only)

Currentness

Check whether you are using the current and valid version of this document. The current version can be downloaded from the Beckhoff homepage at http://www.beckhoff.com/twinsafe. In case of doubt, contact Support and Service [▶ 9].

Origin of the document

The original documentation is written in German. All other languages are derived from the German original.

Product features

Only the product properties specified in the current operating instructions are valid. Further information given on the product pages of the Beckhoff homepage, in emails or in other publications is not authoritative.

1.3 Version history of the TwinSAFE product

This version history lists the software and hardware version numbers. You will also find a description of the changes to previous versions contained in each case. See the table below for more information.

Updated hardware and software

TwinSAFE products are subject to a cyclical revision. We reserve the right to revise and change the TwinSAFE products at any time and without prior notice.
No claims for changes to products already delivered can be asserted from these hardware and/or software changes.

Software version	Hardware version	Changes
01 (V01.03)	00	-

1.4 References

No.	Issue	Title / description
[1]	/	Not used.
[2]	/	Not used.
[3]	2.5.0 or newer	**Operating instructions for EL6910 TwinSAFE Logic module** The document contains a description of the Logic functions of the EL6910, and thus also of the TwinSAFE functionality, and their programming.
[4]	3.1.0 or newer	**Documentation for TwinSAFE Logic FB** The document describes the safety function blocks that are available in the EL6910 and form the safety application.
[5]	1.8.0 or newer	**TwinSAFE Application Guide** The Application Guide provides the user with examples for the calculation of safety parameters for safety functions according to the standards DIN EN ISO 13849-1 and EN 62061 or EN 61508:2010, such as are typically used on machines.
[6]	2023/1230	**Regulation (EU) 2023/1230 of the European Parliament and of the Council of June 14, 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC** This regulation, also known as the Machinery Regulation, defines requirements for the placing on the market of machines and machine-like components, such as safety components.
[7]	2017	**EN 61511-1:2017** The standard serves as a basic safety standard for functional safety in the process industry and is tailored to its safety-related systems.

1.5 Staff qualification

These operating instructions are intended exclusively for trained specialists in control technology and automation with the relevant knowledge.

The trained specialist personnel must ensure that the applications and use of the described product meet all safety requirements. This includes all applicable and valid laws, regulations, provisions and standards.

Trained specialists

Trained specialists have extensive technical knowledge from studies, apprenticeships or technical training. Understanding of control technology and automation is available. Trained specialists can:

- Independently identify, avoid and eliminate sources of hazard.
- Apply relevant standards and directives.
- Implement specifications from accident prevention regulations.
- Evaluate, prepare and set up the workplaces.
- Evaluate, optimize and execute work independently.

1.6 Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety in the operating instructions.

Observe the warnings in the chapters so that you can handle and work with the product as intended and safely.

Explanation of symbols

Various symbols are used for a clear arrangement:

1. The numbering indicates an action that should be taken.
• The bullet point indicates an enumeration.
[…] The square brackets indicate cross-references to other text passages in the document.
[1] The number in square brackets indicates the numbering of a referenced document.

The signal words used in the documentation are classified below.

Signal words

Warning of personal injuries

⚠ 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

Notes

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.

1.7 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.

Download finder

Our download finder contains all the files that we offer you for downloading. You will find application reports, technical documentation, technical drawings, configuration files and much more.

The downloads are available in various formats.

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

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

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

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1.8 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

2 For your safety

2.1 Duty of care

Read entire documentation for TwinSAFE component

- TwinSAFE application manual
- EL6910 TwinSAFE logic terminal operating manual
- TwinSAFE Logic FB documentation manual

The operator must comply with all the requirements and notes specified in these operating instructions in order to fulfill his duty of care. This includes in particular that you

- comply with the provisions defined in the chapter Limitation of liability [▶ 5].
- only operate the TwinSAFE component when it is in perfect working order.
- provide the operating instructions in a legible condition and complete at the place of use of the TwinSAFE component.
- do not remove the safety markings attached to the TwinSAFE component and maintain their legibility.

The operator is also responsible for the safe operation of the system. This includes risk assessment. The following standards apply for risk assessment:

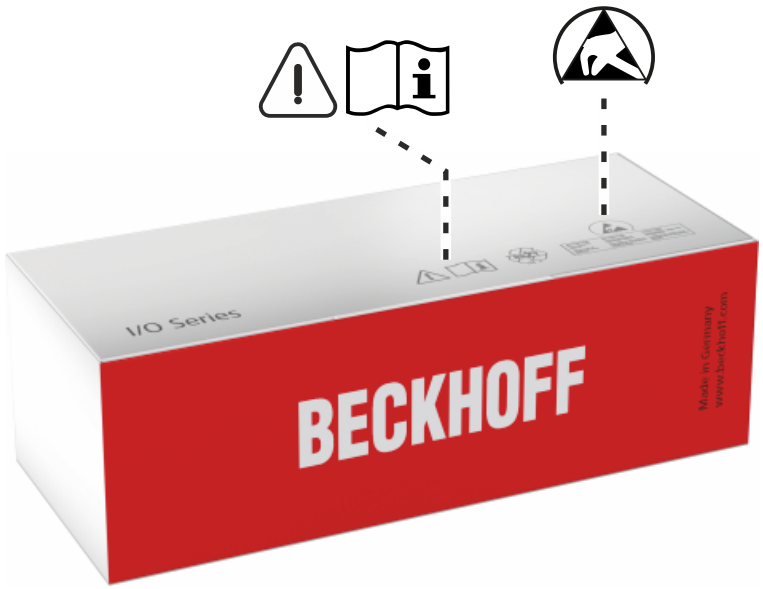
- EN ISO 12100:2010, Safety of machinery – General principles for design – Risk assessment and risk reduction
- ISO 13849-1, Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design

Beckhoff is not responsible for the safe operation of the system.

No disposal in domestic waste
Products marked with a crossed-out waste bin must not be disposed of with domestic waste. The device is considered waste electrical and electronic equipment when it is disposed of. Observe the national regulations for the disposal of waste electrical and electronic equipment.

2.2 Safety image signs

Beckhoff products feature safety pictograms, either on stickers or printed, which vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms may not be removed and must be legible for the user.



Read and observe the operating instructions
Commissioning is only permitted if the operating instructions have been read and understood beforehand. This applies in particular to the safety instructions and the warnings.

Electrostatic sensitive components
Work with and on the TwinSAFE component is only permitted at protected workplaces.

2.3 General safety instructions

This chapter contains safety instructions for handling the product. This product is a safety component as defined by the Machinery Directive. The product must be installed in a machine or system by the machine builder and is used to ensure the safety function. Safety components are not required for the functioning of a machine. However, a failure or malfunction of safety components will result in a hazard to personal safety. Read the documentation prepared by the machine builder.

2.3.1 Before operation

Use in machines in accordance with the Machinery Regulation

Only use the TwinSAFE component in machines that comply with the Machinery Regulation. This is how you ensure safe operation.

See document [6] at References [▶ 7].

Ensure traceability

Ensure the traceability of the TwinSAFE component via the serial number.

Use SELV/PELV power supply

Use a SELV/PELV power supply unit with an output-side voltage limit of U_{max} = 36 V_{DC} to supply the TwinSAFE component with 24 V_{DC}.

Failure to observe this will endanger the safety function of the product. Depending on the machine, death and danger to life, serious physical injury and damage to the machine may result.

Carry out commissioning test

Before commissioning, wiring faults to the sensors must be excluded. Before commissioning, carry out a commissioning test. After a successful commissioning test, you can use the TwinSAFE component for the intended safety-related task.

In case of wiring errors, the safety function of the product is at risk. Depending on the machine, death and danger to life, serious bodily injury and damage to the machine may result.

Use of permissible engineering tools and procedures

The TÜV SÜD certificate applies to these TwinSAFE components, the function blocks available in it, the documentation and the engineering tool. Engineering tools allowed are TE9000 - TwinCAT 3 Safety Editor and TE9200 - TwinSAFE Loader. Use only the latest versions of the engineering tools. You will find this on the Beckhoff website.

Procedures or engineering tools that deviate from this are not covered by the certificate. This is especially true for externally generated xml files for the TwinSAFE import.

2.3.2 During operation

Interference due to emitted interference

Do not operate the following devices in the vicinity of the TwinSAFE component: for example, radio telephones, radios, transmitters or high-frequency systems.

TwinSAFE components comply with the requirements of the applicable electromagnetic compatibility standards with regard to interference emission and immunity. If you exceed the limits for emitted interference specified in the standards, the function of the TwinSAFE component may be impaired.

2.3.3 After operation

De-energize and switch off components before working on them

Check all safety-relevant equipment for functionality before working on the TwinSAFE component. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter Decommissioning.

3 Product overview

3.1 Product description

The MO1918 TwinSAFE component has eight fail-safe digital inputs. The signal state is shown on the display; the signal interface and the power supply for the sensors are established via screw-type M12 connectors.

The module offers safety parameters for specifically adapting the functionality to the safety requirements that apply in each case. The parameters are not stored directly on the component, but are transferred to the MO module by a TwinSAFE Logic-capable component when the safety application is started, provided that the MO module is configured as an alias device.

The module also has integrated TwinSAFE Logic and can also be used as a safety controller.

The MO1918 meets the requirements of the following standards:

- EN 61508:2010 (SIL 3)
- IEC 62061:2021 (SIL CL 3)
- EN ISO 13849-1:2023 (Cat. 4, PL e)

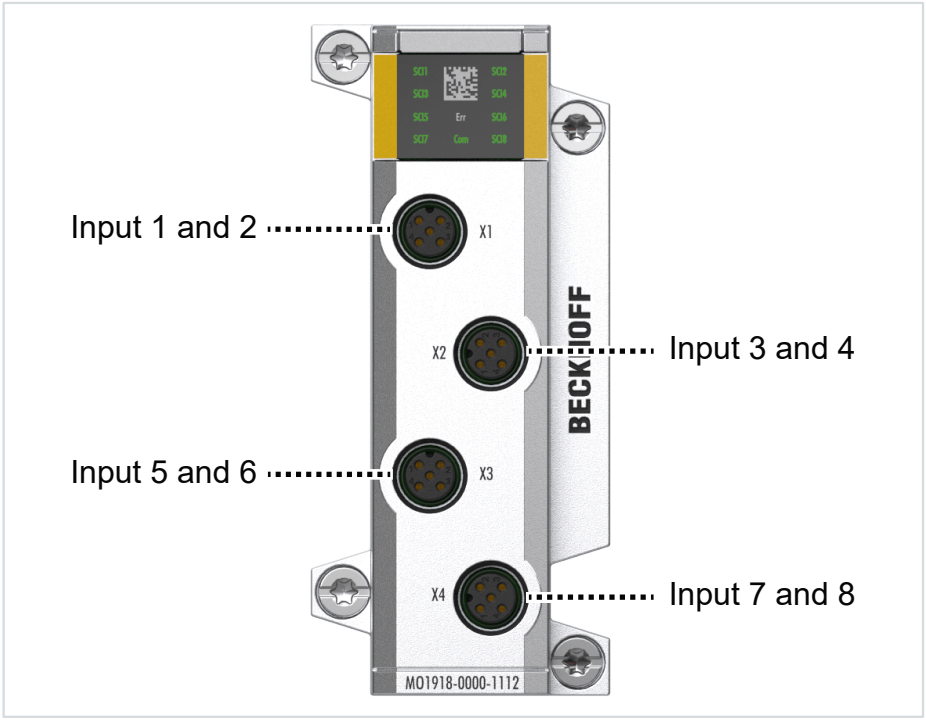


Fig. 1: MO1918 - TwinSAFE MO module with 8 fail-safe inputs

3.2 Laser image

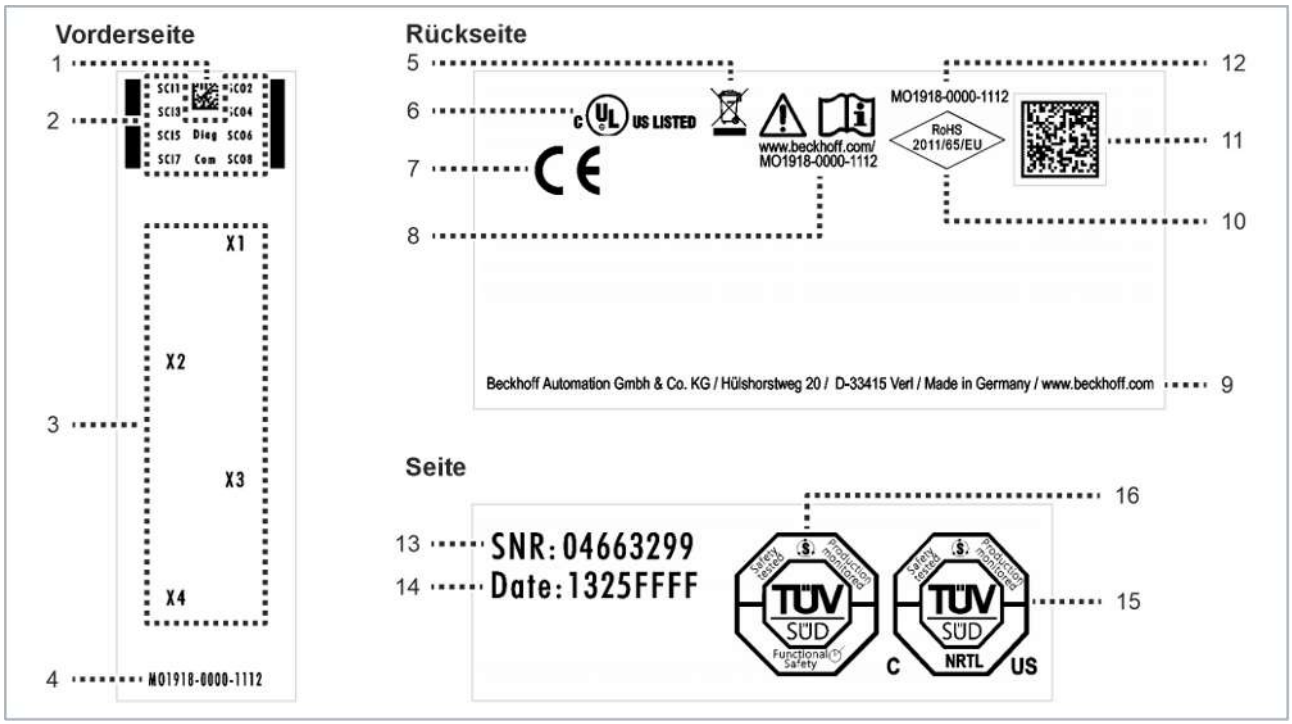


Fig. 2: Laser image

Item number	Explanation
Front side	
1	Data Matrix code of the serial number
2	Labeling the LEDs
3	Labeling the connections
4	Product designation
Rear side	
5	Labeling of products that must not be disposed of with domestic waste in accordance with Directive 2012/19/EU.
6	cULus conformity mark
7	CE conformity mark
8	Product label “Read operating instructions”, website
9	Vendor, address, country of manufacture, vendor website
10	RoHS conformity mark
11	Data Matrix code for reading the BIC (Beckhoff Identification Code) 1P<6-digit order number> SBTNsee coe! 1K<product name> Q1
12	Product designation
Page	
13	Serial number
14	Date Code WW = calendar week of manufacture JJ = year of manufacture SW = software version HW = hardware version
15	TÜV SÜD mark for NRTL
16	TÜV-SÜD mark for functional safety

3.3 Intended use

Operate the TwinSAFE component exclusively for the intended activities defined in this documentation, taking into account the prescribed values.

The functions allow the use of Beckhoff TwinSAFE components in the area of machine safety. The TwinSAFE components are designed for machine safety functions and directly associated industrial automation tasks.

TwinSAFE components are therefore only approved for applications with a defined "fail-safe state". This safe state is the wattless state. Fail-safety according to the relevant standards is required.

⚠ WARNING

Improper use

Any use which exceeds the permissible written values from the chapter Technical data [▶ 18] or which does not observe other specifications from these operating instructions or other documents of the overall documentation is considered to be not in accordance with the intended use and is therefore prohibited.

This applies in particular to the use cases defined by Beckhoff Automation, which have been fully tested and certified and whose properties and operating conditions can be guaranteed. Use cases beyond this are regarded as inappropriate and require the approval of Beckhoff Automation.

Improper use will result in loss of safety and invalidation of certifications and approval.

4 Technical data

The technical data of the TwinSAFE component can be found in the following chapters. These include the product data, the permissible minimum and maximum ambient conditions and the target failure measures with the safety-related parameters.

4.1 Product data

The current certificates of all TwinSAFE products with the underlying standards and directives can be found at https://www.beckhoff.com/en-en/support/download-finder/certificates-approvals/.

Hardware data		Explanation
Electrotechnical data		
• Number of inputs	8	
• Connecting the inputs	M12	
• Supply voltage	24 V_{DC} (- 15 % / + 20 %) SELV/PELV with maximum 36 V_{DC}	According to DIN EN ISO 61131-2:2008-04.
• Output current of the clock outputs	typically 10 mA	(Parameter *Input Power Mode*: Diag test pulse)
• Output current sensor supply	max. 250 mA	(Parameter *Input Power Mode*: PowerMode A/B)
• Max. output current clock outputs / sensor supply in the event of an error	max. 3 A	The duration depends on the overtemperature-related shutdown of the output driver
• Electrical isolation	between the channels: no	
	between the channels and EtherCAT: yes	
• Insulation voltage	Insulation tested with 500 V_{DC}	Between the channels and EtherCAT, under common operating conditions.
Mechanical data		
• Dimensions	30 mm × 110 mm × 32 mm	Width x height x depth See chapter .
• LEDs	• 8 x status LEDs (green) • 1 x Diag LED (red) • 1 x Com (green)	See chapter LEDs [▶ 42].
• Cable length	• max. 30 m	
Material		
• Housing	Zinc die-cast	

Software data		Explanation
• Protocol	TwinSAFE / Safety over EtherCAT (FSoE)	According to IEC 61511 and IEC 61784-3-12.
Reaction times		
• Reaction time in operation *read input/write to E-bus*	4 ms maximum see fault reaction time	
• Watchdog time	adjustable from 2 ms to 60000 ms	
• Fault reaction time	Adjustable ≤ watchdog time	

Software data		Explanation
• Internal cycle time	max. 1 ms with minimum configuration max. 25 ms with maximum configuration	
Process image as Alias Device		
• Input	≥ 7 bytes	For more information, see chapter Process image [▶ 41].
• Output	≥ 6 bytes	

4.2 Environmental conditions

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products as well as to ensure product safety.

⚠ WARNING

Do not use TwinSAFE components under the following operating conditions:

- under the influence of ionizing radiation (exceeding the natural background radiation)
- in corrosive environments[1]
- in an environment that leads to unacceptable contamination of the TwinSAFE component

[1] *A corrosive environment exists when corrosion damage becomes apparent.*

Permissible requirements for the environment		Explanation
Environmental conditions		
• Class for climatic environmental conditions	3K3	According to EN 60721-3-3:1995/ A2:1997. The deviation from 3K3 is only possible under optimum environmental conditions and also applies only to the technical data which are specified differently in this documentation.
• Device type	Classified as a closed device	According to DIN EN IEC 61010-2-201:2019-04.
• Pollution degree	2	According to EN 60664-1:2007.
• Overvoltage category	III	Overvoltage category II is permissible if the requirements of EN ISO 13849-2:2013 Table D.5 can be met.
• Protection class	III	By using a SELV/PELV power supply unit.
• Utilization category	DC-13 direct voltage, control of electromagnetic loads	According to EN 60947-5-1:2017.
Operating conditions		
• Fieldbus	EtherCAT	
• EMC requirements	Severity level conforms to SIL 3 Zone B	According to EN 61326-3-1:2017 and EN 61131-2:2017, Chapter 6.2 and 7.
• Vibration resistance	5 Hz ≤ f < 8.4 Hz; 3.5 mm_{peak} 8.4 Hz ≤ f < 150 Hz; 10 m/s^2_{peak}	According to DIN EN 60068-2-6:2008-10.
• Shock resistance	15 g with a pulse duration 11 ms in all three axes	According to EN 60068-2-27:2010-02.

Permissible requirements for the environment		Explanation
• Protection rating	IP67	According to EN 60529:1991 + A1:2000 + A2:2013. After mounting on backplane, with screwed connectors.
• Correct installation position	Variable	
Temperatures Tested according to IEC 60068-2-1:2007, IEC 60068-2-2:2007 and IEC 60068-2-14:2009. *The measuring device has a tolerance range of ± 3 °C for the minimum temperature and ± 2 °C for the maximum temperature.*		
• during operation	0 °C...50 °C	For altitudes above 2000 m, the derating factors in the following table apply.
• during transport and storage	-25 °C...85 °C	
• internal switch-off temperature	≤ - 40 °C, ≥ 110 °C	If the value falls below or exceeds the limit, the TwinSAFE component switches to the state Global Shutdown [▶ 24].
Ambient air		
• Air humidity	5% to 95%	Non-condensing
• Air pressure (operation/storage/ transport)	750 hPa to 1100 hPa	Corresponds to an altitude of approx. -690 m to 2450 m above sea level, assuming an international standard atmosphere.

Derating table for altitudes above 2000 m

The derating table (table 8) from the IEC 61131-2:2017 standard can be referred to for the use of the TwinSAFE components above the specified maximum altitude.

Altitude in m	Derating factor for the temperature[1]
0 to 2000[2]	1.0
3000	0.9
4000	0.8
5000	0.7
Note: Linear interpolation is permissible between the altitudes [1)] Ambient temperature of the device at an altitude of 2000 m [2)] The air pressure and air density increase as the altitude decreases. Therefore the derating factor for 0 to 2000 m (1.0) is used for altitudes below sea level.	

Calculation example

The following example shows the calculation for a TwinSAFE component at an operating altitude of 4000 m.

- Permissible maximum ambient temperature up to 2000 m above sea level = 55 °C
- Permissible maximum ambient temperature up to 4000 m above sea level = 55°C * 0.8 = **44 °C**

4.3 Target failure measures

Calculation of the $MTTF_D$ value from the PFH_D value

For calculation and estimation of the values described in the following table, refer to the following documentation:

- TwinSAFE Application Guide
- EN ISO 13849-1:2023; table K.1.

In terms of target failure measures, the FSoE communication is considered with 1 % of SIL 3 according to the protocol specification.

Target failure measures		Explanation
Lifetime	20 years	
Proof test interval	/	Special proof tests during the entire service life of the TwinSAFE component are not required.
PFH_D	5.08E-09	
PFD	9.83E-05	
$MTTF_D$	High	
DC	High	
SIL	3	According to IEC 61508:2010.
Performance Level	e	According to EN ISO 13849-1:2023.
Category	4	According to EN ISO 13849-1:2023.
SFF	99.54%	
HFT	1	
Element classification	Type B	According to EN 61508-2:2010 Chapter 7.4.4.1.2 and 7.4.4.1.3.

4.4 Dimensions

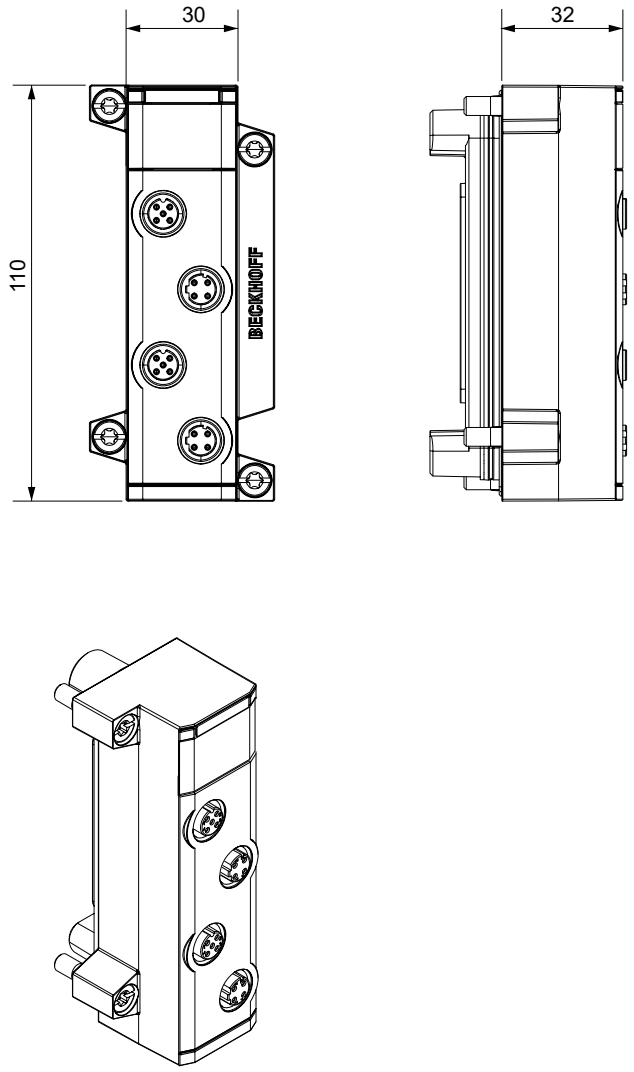


Fig. 3: Dimensional drawing

4.5 Lifetime

TwinSAFE components have a lifetime of 20 years, during which the target failure measures are guaranteed. For more information, see chapter Target failure measures [▶ 21].

The lifetime starts from the date of manufacture according to the Date Code.

⚠ WARNING

Replace TwinSAFE component after 20 years

After a lifetime of 20 years, the target failure measures are no longer guaranteed.

Use beyond the lifetime may result in loss of safety.

Due to the high diagnostic coverage within the lifetime no special proof tests are required.

The TwinSAFE components bear a Date Code, which is composed as follows:

Date Code: CW YY SW HW

Legend:	Example: Date Code 17 11 05 00
CW: calendar week of manufacture	Calendar week: 17
YY: year of manufacture	Year: 2011
SW: software version	Software version: 05
HW: hardware version	Hardware version: 00

4.6 Error reaction

The product performs a permanent self-diagnosis. In the event of a detected malfunction, the product switches to the safe state according to the fail-safe principle.

Depending on the severity of the cause of the error, the system enters one of the following error states:

- Global Shutdown
- Global Fault
- Module Shutdown

4.6.1 Global Shutdown

If transient faults are detected, such as overvoltage, undervoltage or EMC influences, the TwinSAFE component switches to the "Global Shutdown" state.

This operating state is a safe state and temporarily shuts down the TwinSAFE drive option card.

Reset the operating state by disconnecting and reconnecting the 24 V supply to the overall system.

4.6.2 Global Fault

When errors are detected that affect the integrity of the safety logic, such as memory errors, the TwinSAFE component card switches to the "Global Fault" state.

This operating state permanently shuts down the TwinSAFE component.

Replace the overall system.

4.6.3 Module Shutdown

If software errors are detected, the affected software module switches to the "Module Shutdown" state.

This operating state is a safe state and temporarily shuts down the software module.

An Error Acknowledge resets the operating state.

5 Transport and storage

⚠ WARNING

Observe the specified environmental conditions

Ensure that the digital TwinSAFE components are only transported and stored under the specified ambient conditions. The ambient conditions can be found in the chapter Environmental conditions.

The TwinSAFE components can be damaged if they are transported or stored incorrectly.

Ensure that the TwinSAFE component is not damaged during transportation and storage. Use the original manufacturer's packaging.

The TwinSAFE components can be stored for shorter or longer periods. Observe the conditions specified in chapter Environmental conditions.

Check the seal for damage

Check the barcode sticker used to seal the outer packaging for damage. If the sticker is missing, opened or damaged, contact Beckhoff Support and Service.

6 Installation

6.1 Mounting

NOTICE

External heat sources / radiant heat / impaired convection

The maximum permissible ambient temperature of 50 °C has been tested. Impaired convection or an unfavorable location near heat sources may have a negative effect on the internal heating of the TwinSAFE components.

The key parameter is always the maximum permitted internally measured temperature of 110 °C, above which the TwinSAFE component switches to safe state and report an error. The internal temperature can be read from the TwinSAFE components via CoE.

The installation instructions can be found in the chapter "Mounting the modules" of the system manual.

6.2 Connection

The EtherCAT Box has eight fail-safe inputs.

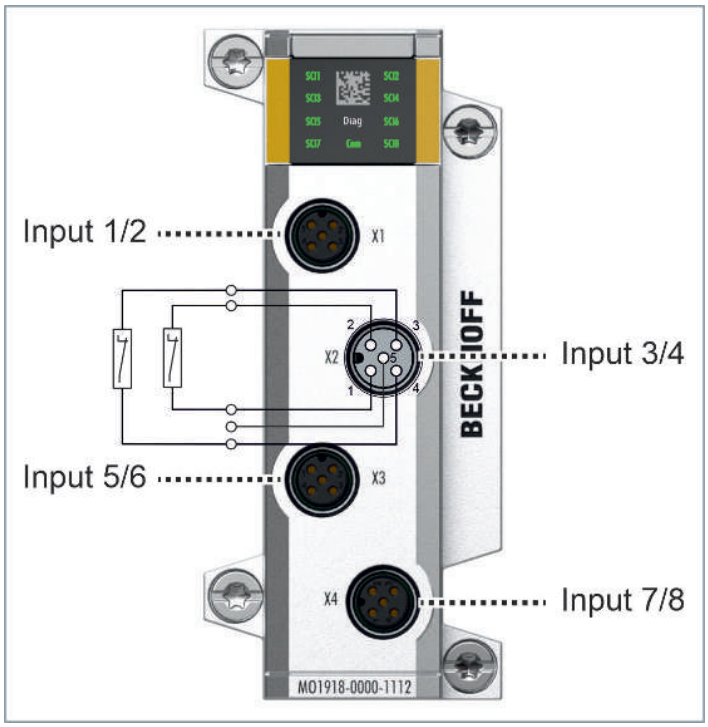


Fig. 4: Connection

⚠ CAUTION

Configurable inputs

The inputs 1 to 8 can be occupied as you want with normally closed contacts or normally open contacts. The corresponding evaluation takes place in the safety controller.
Alternatively, a safe sensor can be supplied with 24 V_{DC}, instead of the clock outputs for potential-free contacts. The polarity of pins 1 and 3 can be parameterized. Detection of cross-circuits or external feeds must take place via the connected safe sensor.

6.2.1 DiagTestPulse

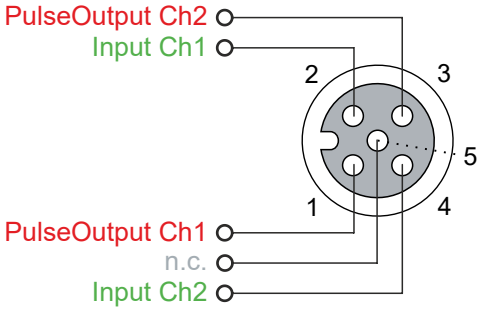


Fig. 5: PinOut default setting

M12 connection	Contact	Channel	Signal
X1 (Input 1/2)	1	1	Pulse output 1
	2		Input 1
	3	2	Pulse output 2
	4		Input 2
	5	-	not connected
X2 (Input 3/4)	1	3	Pulse output 3
	2		Input 3
	3	4	Pulse output 4
	4		Input 4
	5	-	not connected
X3 (Input 5/6)	1	5	Pulse output 5
	2		Input 5
	3	6	Pulse output 6
	4		Input 6
	5	-	not connected
X4 (Input 7/8)	1	7	Pulse output 7
	2		Input 7
	3	8	Pulse output 8
	4		Input 8
	5	-	not connected

6.2.2 PowerMode A

NOTICE

Sensor power supply

For the sensor supply, please ensure that the maximum current consumption does not exceed 250 mA and the parameter *Diag TestPulse active* is set to FALSE.

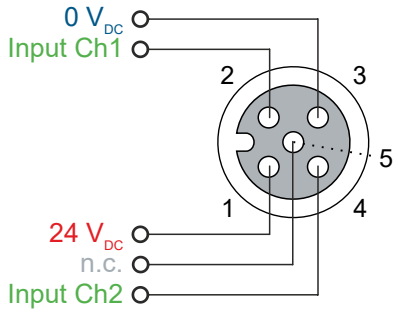


Fig. 6: PowerModeA

PinOut alternative 1
(Parameter Input Power Mode = PowerMode A)

M12 connection	Contact	Channel	Signal
X1 (Input 1/2)	1	1	24 V_{DC} sensor power supply
	2		Input 1
	3	2	0 V_{DC} sensor power supply
	4		Input 2
	5	-	not connected
X2 (Input 3/4)	1	3	24 V_{DC} sensor power supply
	2		Input 3
	3	4	0 V_{DC} sensor power supply
	4		Input 4
	5	-	not connected
X3 (Input 5/6)	1	5	24 V_{DC} sensor power supply
	2		Input 5
	3	6	0 V_{DC} sensor power supply
	4		Input 6
	5	-	not connected
X4 (Input 7/8)	1	7	24 V_{DC} sensor power supply
	2		Input 7
	3	8	0 V_{DC} sensor power supply
	4		Input 8
	5	-	not connected

6.2.3 PowerMode B

NOTICE

Sensor power supply

For the sensor supply, please ensure that the maximum current consumption does not exceed 250 mA and the parameter *Diag TestPulse active* is set to FALSE.

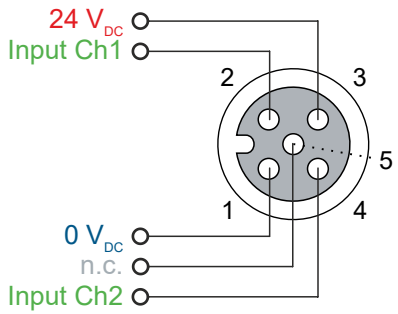


Fig. 7: PowerMode B

PinOut alternative 2
(Parameter Input Power Mode = PowerMode B)

M12 connection	Contact	Channel	Signal
X1 (Input 1/2)	1	1	0 V_{DC} sensor power supply
	2		Input 1
	3	2	24 V_{DC} sensor power supply
	4		Input 2
	5	-	not connected
X2 (Input 3/4)	1	3	0 V_{DC} sensor power supply
	2		Input 3
	3	4	24 V_{DC} sensor power supply
	4		Input 4
	5	-	not connected
X3 (Input 5/6)	1	5	0 V_{DC} sensor power supply
	2		Input 5
	3	6	24 V_{DC} sensor power supply
	4		Input 6
	5	-	not connected
X4 (Input 7/8)	1	7	0 V_{DC} sensor power supply
	2		Input 7
	3	8	24 V_{DC} sensor power supply
	4		Input 8
	5	-	not connected

6.3 Safe inputs

The FSIN safe input modules and corresponding clock outputs have a 2-channel design. This has the advantage that a 2-channel safe sensor with an M12 connection can be used, and a fault such as cross-circuit or external feed will cause the entire FSIN module to shut down.

⚠ DANGER

Clocked signals inside a sheathed cable

If clocked signals (clock outputs for the safe inputs) of different FSIN modules are used within a sheathed cable, a fault of one FSIN module, such as cross-circuit or external feed, must lead to the shutdown of all of these modules. This is achieved by setting the *Module Fault Link active* parameter on all FSIN modules involved. This parameter is set to TRUE by default.

⚠ DANGER

Safe inputs in Cat.4 / PL e

If two safe input channels are to be used in a category 4 structure that are not on one M12 connector, make sure to combine always an even and an odd channel number.

Further information on the FSIN modules can be found in chapters Safety parameters and configuration of the Alias Device [▶ 37] and Process image [▶ 41].

6.4 Signal cables

When connecting a single switching contact via its own continuous cabling (or via a sheathed cable), the maximum permitted cable length with test pulses activated is 30 meters.

The use of contact points, connectors or additional switching contacts in the cabling reduces the maximum propagation.

NOTICE

Route the signal line separately

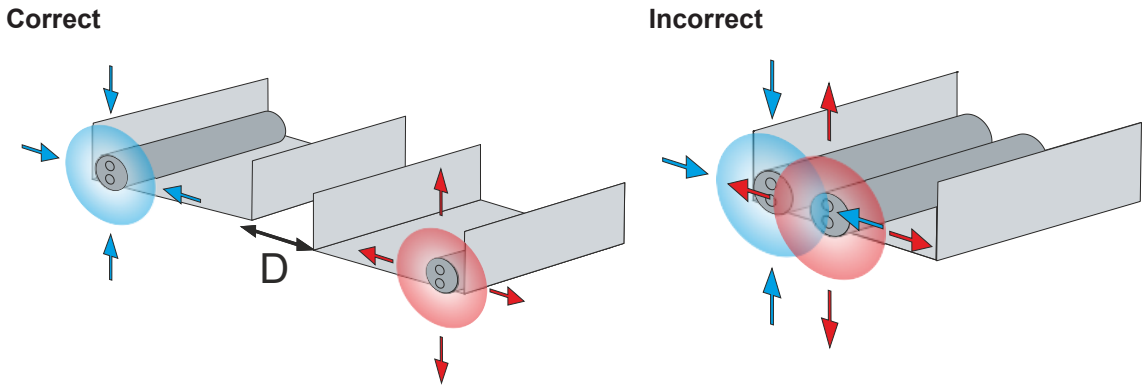
Route the signal line separately from potential sources of interference. Possible sources of interference are, for example, motor supply cables or power cables with 230 V_{AC}. Keep the distance between the cables as large as possible.

Interference caused by cables routed in parallel can influence the signal form of the test pulses and thus cause diagnostic messages. Possible diagnostic messages are sensor errors or OpenLoad errors.

Common signal routing with other clocked signals in a common cable also reduces the maximum expansion. The reason for this is that the signals may crosstalk over long cable lengths and diagnostic messages may appear.

The following figures show correct and incorrect signal routing. Please refer to the figure legend.

Figure legend	
D	Distance between the cable channels
Blue arrows	Signature lines
Red arrows	Potential sources of interference



6.5 Characteristic curve of the inputs

The characteristic curve of the inputs is similar to type 3 according to EN 61131-2.

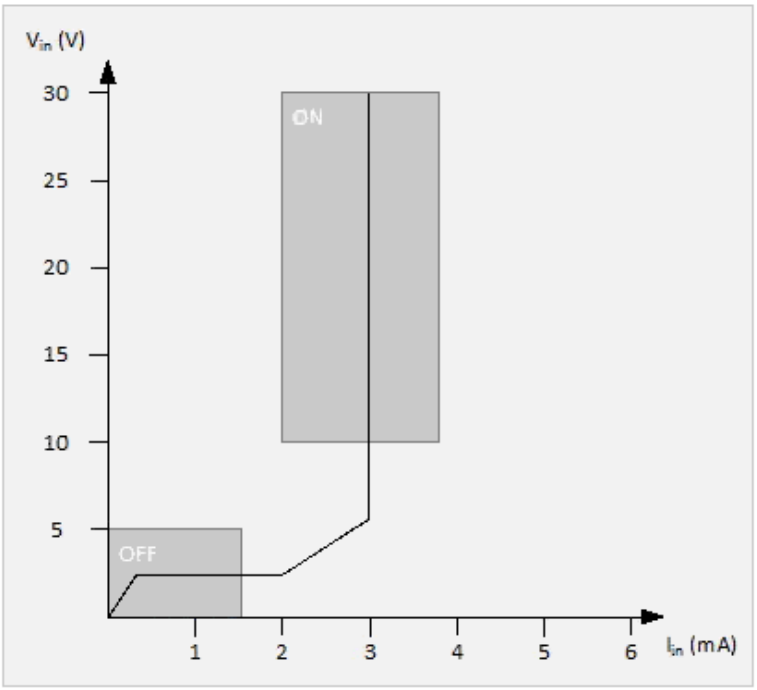


Fig. 8: Characteristic curve of the inputs

7 Configuration in TwinCAT

7.1 Adding an MO module

Adding an MO module is done in the same way as adding any other TwinSAFE component.

To add a TwinSAFE component, refer to the chapter Adding an EL6910 of document [3] at References [▶ 7].

7.2 Using the MO module as a safety controller

To use your TwinSAFE component with a safety-related user program, you must make certain settings for the target system and the inputs and outputs.

Target system

To use user-specific functions in the MO module, a Safety project is created in TwinCAT 3 and the MO module is selected as the target system. Proceed as follows:

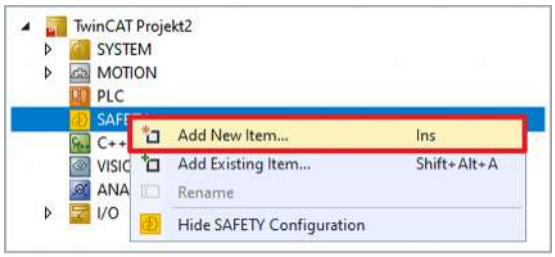


Fig. 9: Add new item

1. Right click on the Safety configuration
2. Click on "Add New Item..."

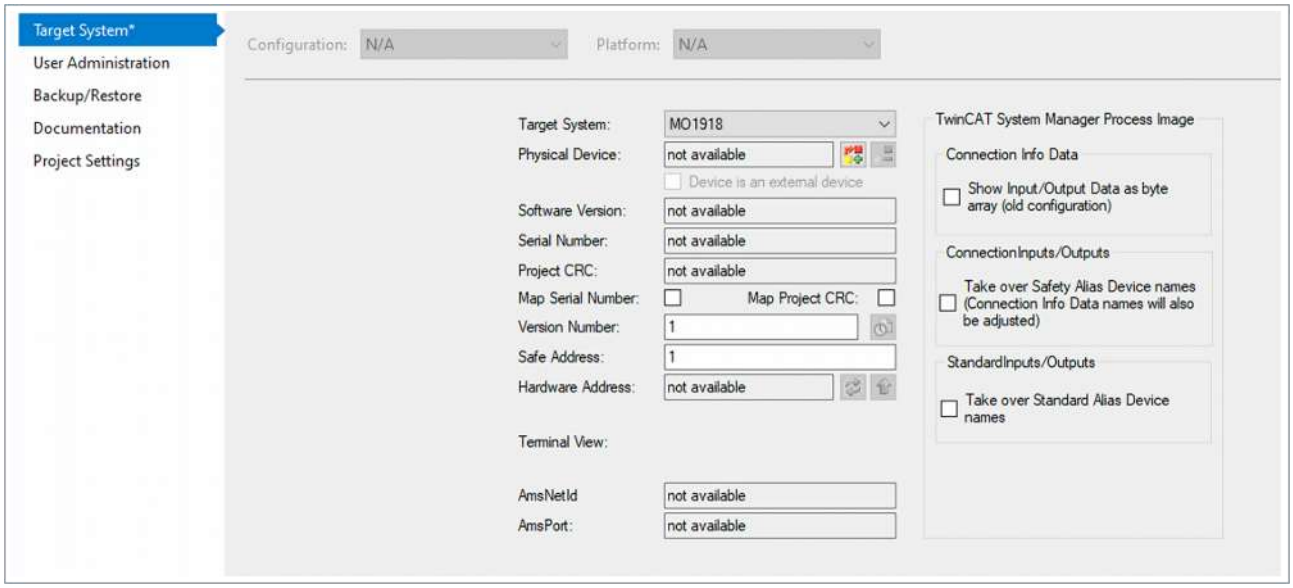


Fig. 10: Target system

3. Double click on the newly added node
4. Open "Target System" tab to select the target system
5. Select the MO module in the drop-down list of the target system
6. Click on  to link the MO module

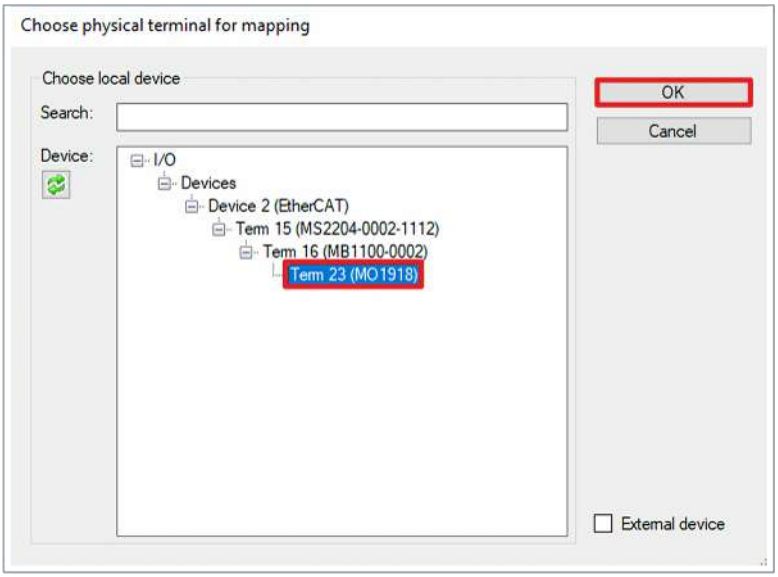


Fig. 11: Choose physical terminal

7. Choose MO module
8. Press "OK" to confirm your selection

Proceed as follows to create the MO module as an Alias Device and use the local inputs and outputs of the MO module:

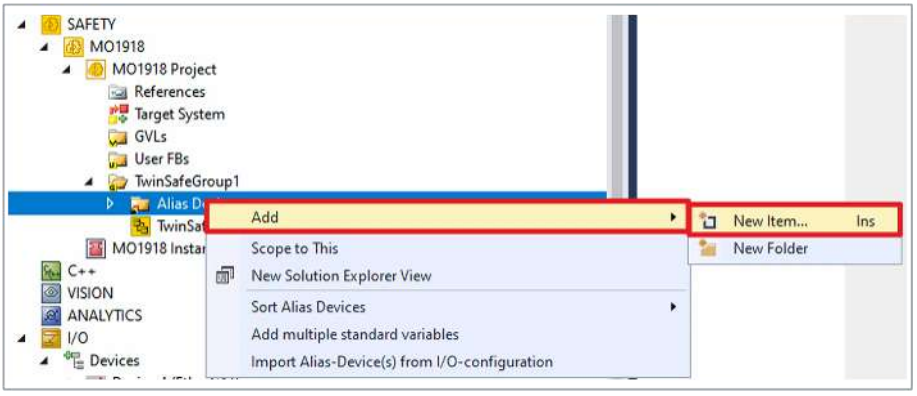


Fig. 12: Add Alias Device

9. Right-click on the Alias Device folder of the Safety project
10. Select "New Item..." via the "Add" field

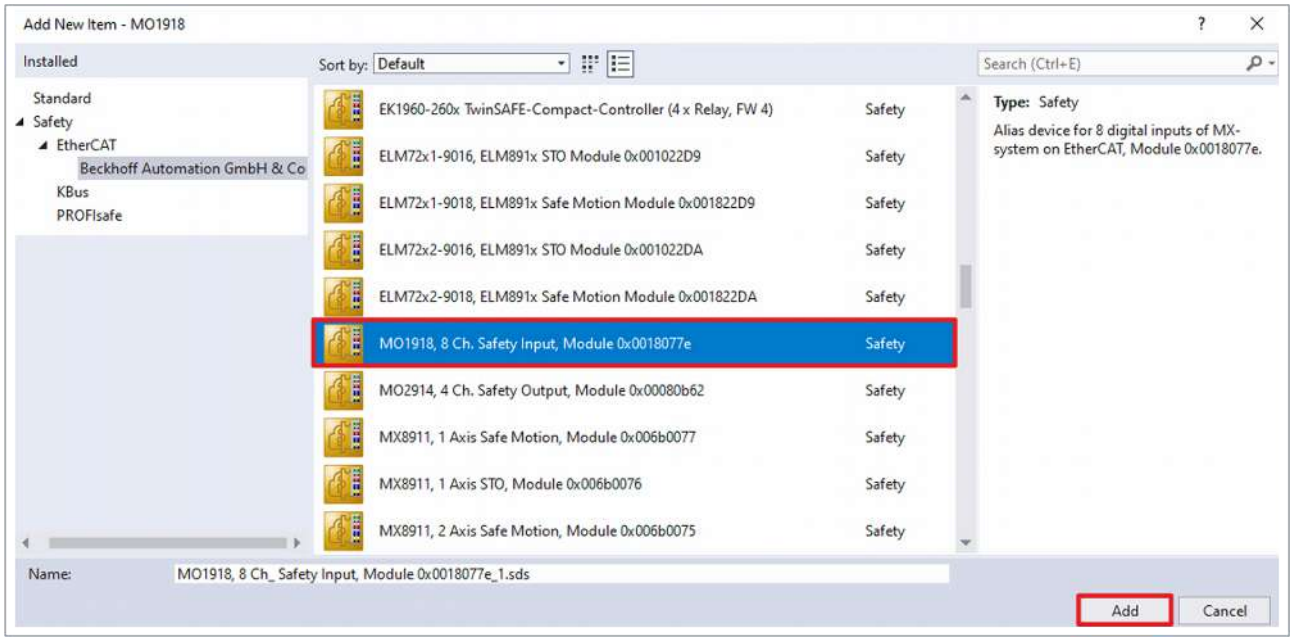


Fig. 13: Add new item

The "Add New Item" window opens. You can choose the desired MO module here.

Which ModuleIdent belongs to which firmware version can be found in the chapter Version history of the TwinSAFE product [▶ 6].

11. Choose MO module
12. Confirm the selection with "Add"

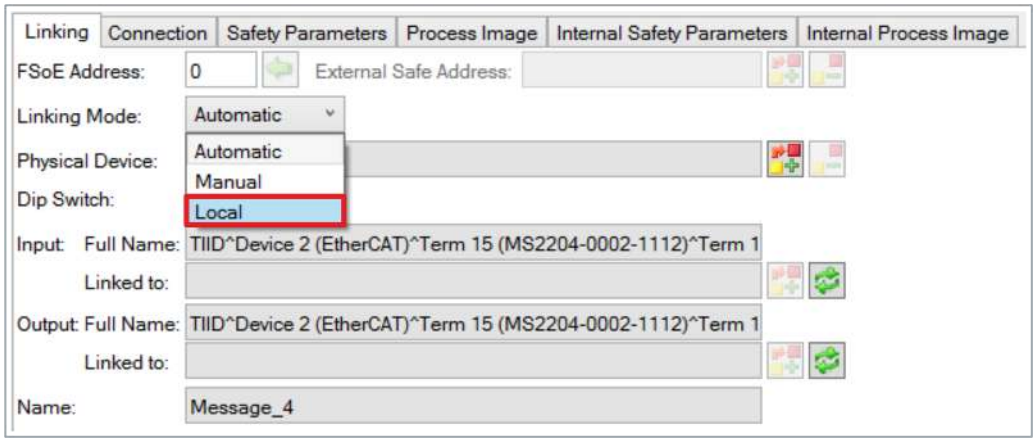


Fig. 14: Linking

13. Double click on the Alias Device
14. Open "Linking" tab
15. Select "Local" from the Linking Mode drop-down menu

After changing the linking mode to "Local", all alias device settings that are not relevant are shown as disabled for input. The other safety parameters can be found in chapter Safety parameters and configuration of the Alias Device [▶ 37].

Safe inputs and outputs within the safety logic

Further information on the process image and the safe and unsafe input and output signals can be found in the chapter Process image [▶ 41].

7.3 Manual creation of safety functions

The creation of a safety-oriented user program is explained in the documentation for the EL6910 and the FB description. The corresponding documents are numbers [3] and [4] at References [▶ 7].

7.4 Address settings

User name and password

Some actions, such as the address setting, must be confirmed by entering the user name and password. The default user name is *Administrator*, the default password is *TwinSAFE*.

When commissioning the TwinSAFE component for the first time, change the default password to a customer-specific password. The password must be at least 6 characters long.

In this chapter you will learn how to change the address of your TwinSAFE component in TwinCAT. This is done by downloading the safe address. Proceed as follows:

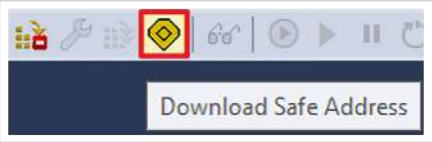


Fig. 15: Download Safe Address

1. Click on "Download Safe Address" in the menu bar

Fig. 16: Choose Safety Device

2. Select the TwinSAFE component in the “Choose Safety Device” window
3. Confirm the selection with "Next"

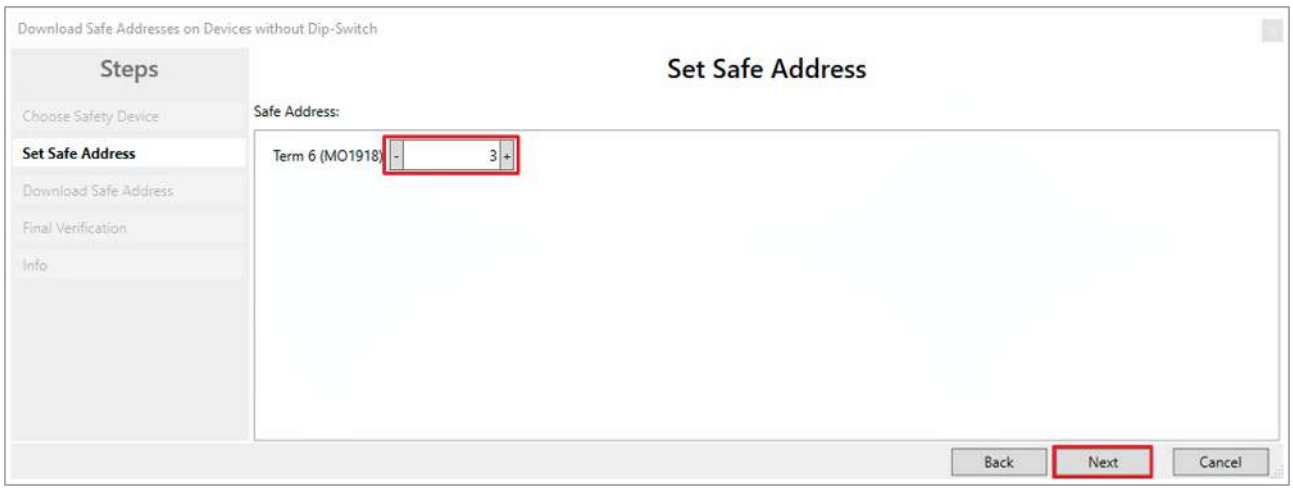


Fig. 17: Set Safe Address

The "Set Safe Address" window opens.

4. Enter desired address
5. Confirm the entry with "Next"

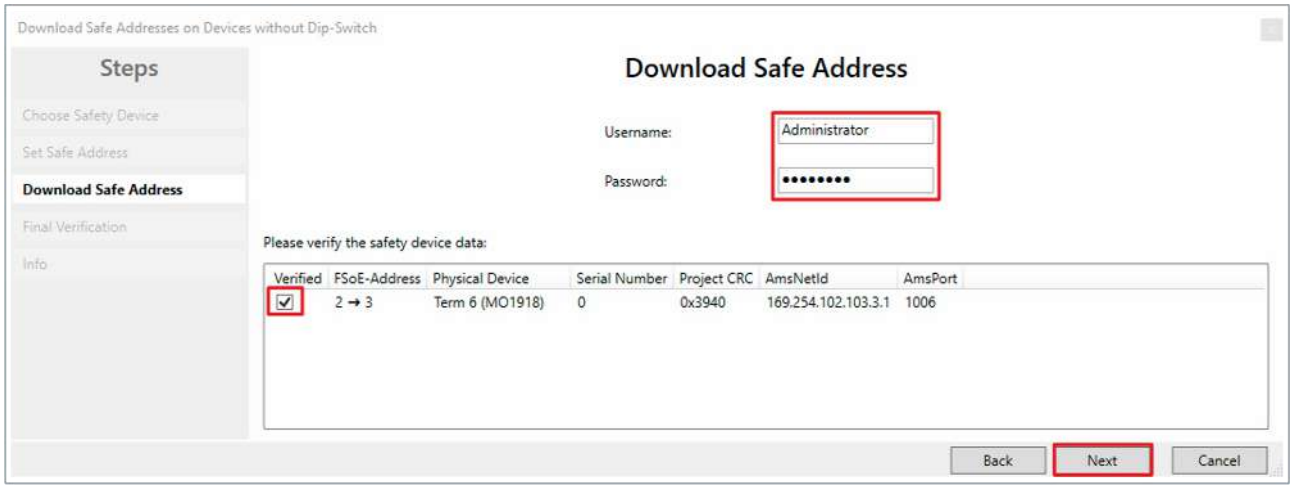


Fig. 18: Download Safe Address

6. Enter the username and password in the "Download Safe Address" window

Default username: Administrator

Default password: TwinSAFE

7. Select the TwinSAFE component for which you want to load a new address
8. Confirm the selection with "Next"

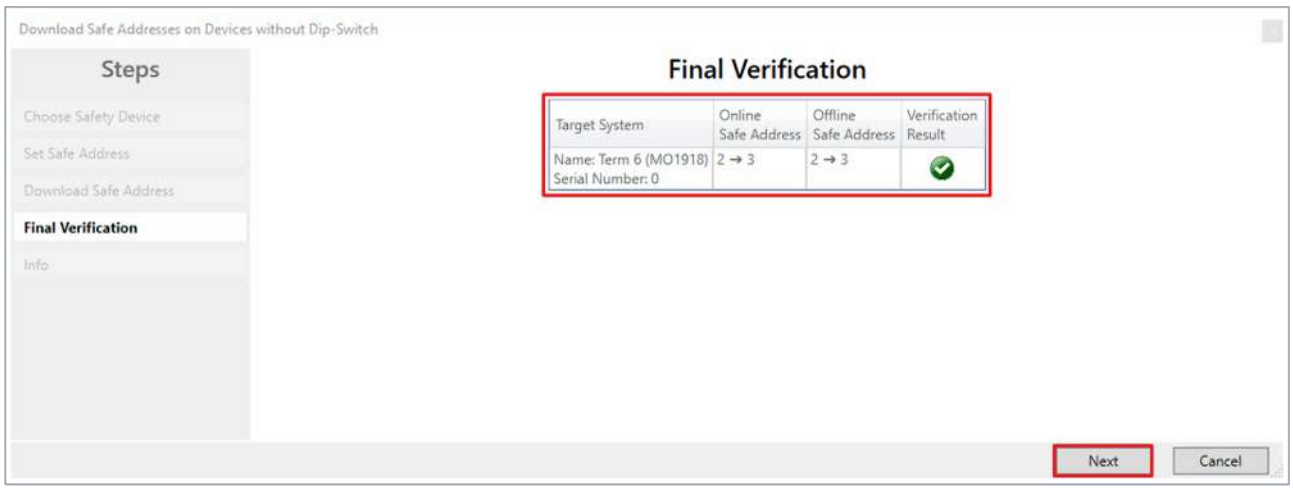


Fig. 19: Final Verification

The "Final Verification" window summarizes the change in a table and provides feedback on whether the change has been verified.

9. Confirm window with "Next"

Fig. 20: Info

The Info window provides the final information you need to change your address.

10. Close the window with "Finish".
11. Restart the TwinSAFE component.

After restarting your TwinSAFE component, the download of the safe address is complete.

7.5 Safety parameters and configuration of the Alias Device

After creating the alias device, it can be parameterized according to the user specifications. The FSoE address is set under the *Linking* tab, and the link to the physical device is created.

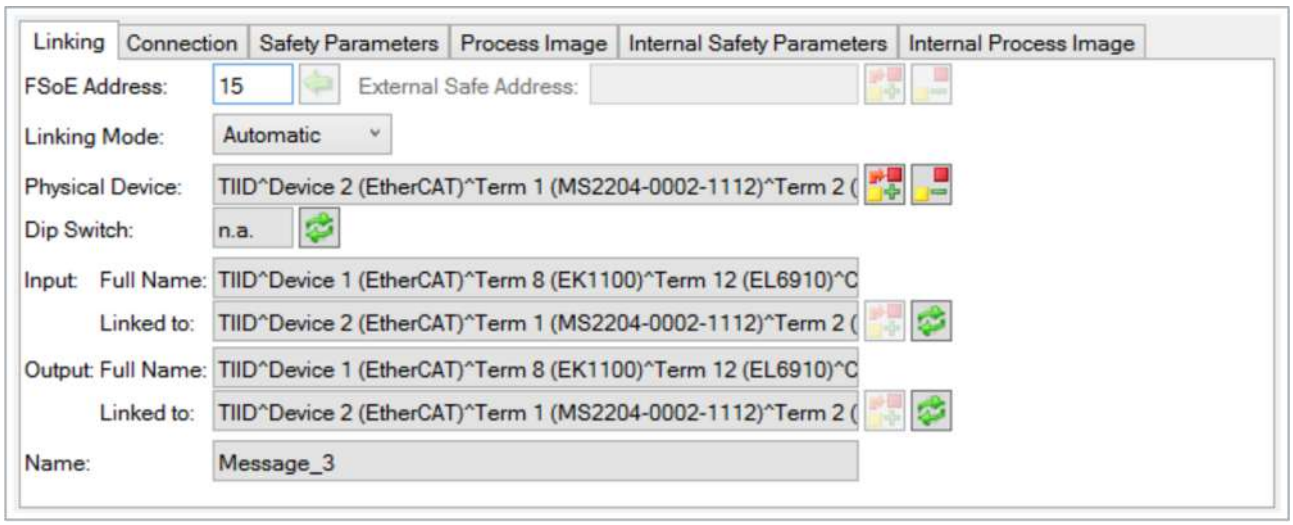


Fig. 21: Linking tab

Name	Description
FSoE Address	Parameterized FSoE address (to be set by the user)
External Safe Address	currently not supported
Linking Mode	• Automatic (automatic linking to the physical device) • Manual (manual linking, e.g. to network variables) • Local (signals are used in the local logic)
Physical Device	Link to the TwinSAFE component within the TwinCAT solution
Dip Switch	DIP or rotary switch address read from the TwinSAFE component
Input: Full Name	In manual mode: Display of the variables below the TwinSAFE Logic, e.g. EL6910
Input: Linked to	In Manual Mode: Display of the linked variables
Output: Full Name	In manual mode: Display of the variables below the TwinSAFE Logic, e.g. EL6910
Output: Linked to	In Manual Mode: Display of the linked variables
Name	In Manual Mode: Name of the TwinSAFE message below the TwinSAFE Logic and for the info data

Under the *Connection* tab you can make further settings, e.g. the mapping of the info data or the behavior in case of a module error.

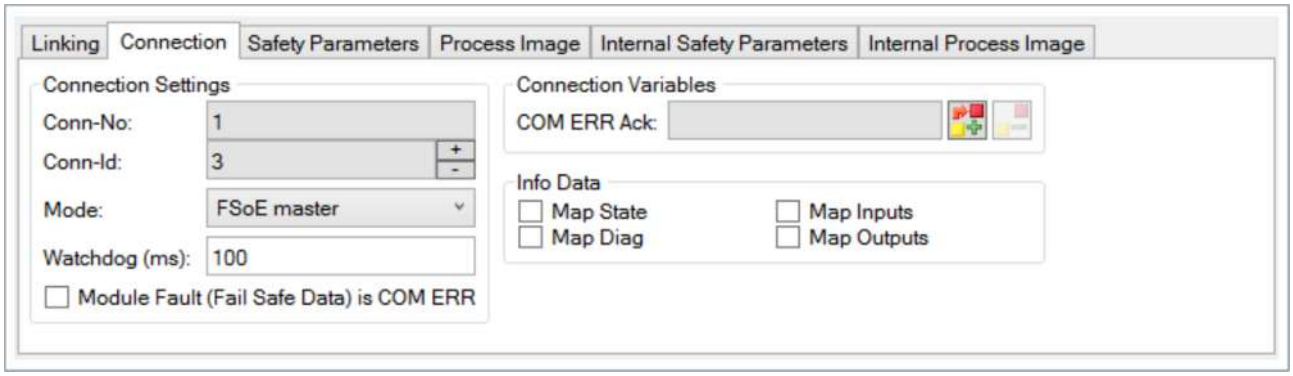


Fig. 22: Connection tab

Name	Description
Conn-No	Connection number (issued by the system)

Name	Description
Conn-Id	Connection ID: Preallocated by the system, but can be changed by the user. The connection ID must be unique within the TwinCAT project.
Mode	• FSoE master (the logic is the master for this alias device) • FSoE slave (the logic is a slave for this alias device)
Watchdog	Setting the watchdog time in ms for this connection. This setting directly affects the fault reaction time.
Module Fault is ComError	If the checkbox is checked, module error also triggers a ComError, which switches the TwinSAFE group where the connection was created to the error state.
Com ERR Ack	For each connection, an additional error acknowledge can be configured. In this case, the connection must also be acknowledged, in addition to the Err Ack for the respective group.
Map State	The connection state is placed in the cyclic process data.
Map Diag	The connection diagnostics is placed in the cyclic process data.
Map Inputs	The safe input information of the connection is placed in the cyclic process data.
Map Outputs	The safe output information of the connection is placed in the cyclic process data.

The *Safety Parameters* tab contains the parameters of the MO1918 to be set. The inputs are parameterized via the objects 0x8000 etc.

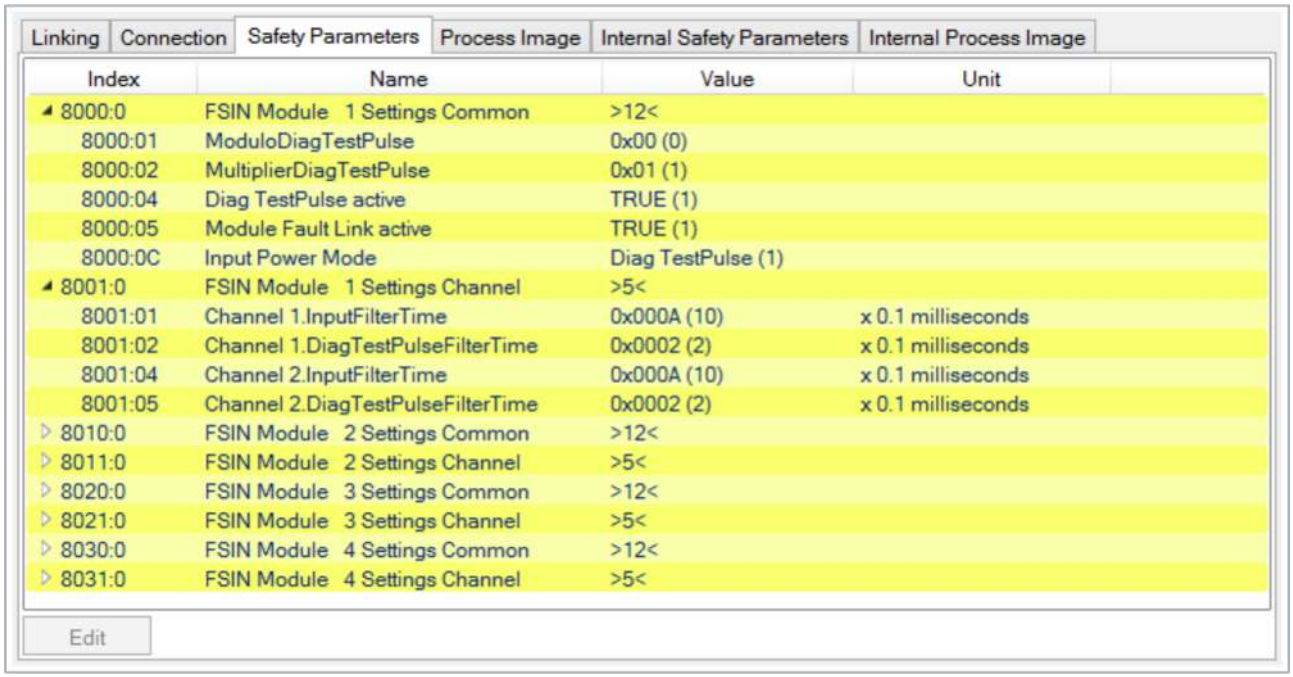


Fig. 23: Safety parameters

Index	Name	Default value/ unit	Description
8000:01	ModuloDiagTestPulse (FSIN Module 1)	0x00 / integer	Modulo value for the frequency of the generation of a test pulse. 0 -> every time 1 -> every second time and so on
8000:02	MultiplierDiagTestPulse (FSIN Module 1)	0x01 / integer	Length of the test pulse in multiples of 400 µs
8000:04	Diag TestPulse active (FSIN Module 1)	TRUE / Boolean	Activation of test pulses for the corresponding input module
8000:05	Module Fault Link active	TRUE / Boolean	If a module error occurs in this module, a module error is also set for all other input modules of this TwinSAFE component for which this parameter is also set to TRUE.

Index	Name	Default value/ unit	Description
8000:0C	Input Power Mode (FSIN Module 1)	Diag test pulse / ENUM	• Diag test pulse • PowerMode A (*Diag TestPulse active* must be FALSE) • PowerMode B (*Diag TestPulse active* must be FALSE) see chapter Signal connection for inputs
8001:01	Channel1.InputFilterTime	0x000A / 0.1 ms	Input filter of the safe input. Following this time the internal input signal changes to the applied signal state. Internal test pulses can have a length of up to 2 ms.
8001:02	Channel1.DiagTestPulseFilter Time	0x0002 / 0.1 ms	Input filter for the test pulse signal
8001:04	Channel2.InputFilterTime	0x000A / 0.1 ms	Input filter of the safe input. Following this time the internal input signal changes to the applied signal state. Internal test pulses can have a length of up to 2 ms.
8001:05	Channel2.DiagTestPulseFilter Time	0x0002 / 0.1 ms	Input filter for the test pulse signal
8010:01-0C	Parameters for FSIN module 2	see module 1	see module 1
8011:01-05	Parameters for FSIN module 2	see module 1	see module 1
8020:01-0C	Parameters for FSIN module 3	see module 1	see module 1
8021:01-05	Parameters for FSIN module 3	see module 1	see module 1
8030:01-0C	Parameters for FSIN module 4	see module 1	see module 1
8031:01-05	Parameters for FSIN module 4	see module 1	see module 1

8 Process image

The process image of the MO1918 consists of 7 bytes of input data and 6 bytes of output data. The 7-byte telegram contains 2 bytes of safe data, while the 6-byte telegram contains 1 byte of safe data. The process image only applies if you create the MO1918 module as an Alias Device.

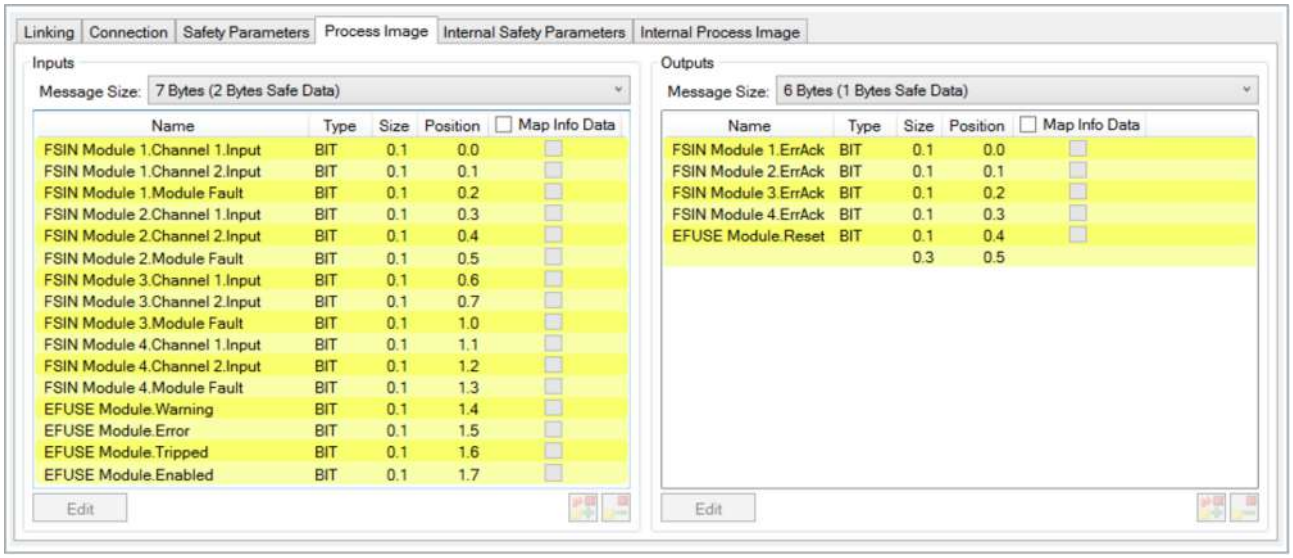


Fig. 24: Process image

The assignment of the individual signals in the safe data is listed in the following table.

Name	Process image	Bit position	Description
FSIN Module1.Channel1.Input	IN	0.0	Safe input channel 1
FSIN Module1.Channel2.Input	IN	0.1	Safe input channel 2
FSIN Module1.Module Fault	IN	0.2	Module error information for safe input module 1
FSIN Module2.Channel1.Input	IN	0.3	Safe input channel 3
FSIN Module2.Channel2.Input	IN	0.4	Safe input channel 4
FSIN Module2.Module Fault	IN	0.5	Module error information for safe input module 2
FSIN Module3.Channel1.Input	IN	0.6	Safe input channel 5
FSIN Module3.Channel2.Input	IN	0.7	Safe input channel 6
FSIN Module3.Module Fault	IN	1.0	Module error information for safe input module 3
FSIN Module4.Channel1.Input	IN	1.1	Safe input channel 7
FSIN Module4.Channel2.Input	IN	1.2	Safe input channel 8
FSIN Module4.Module Fault	IN	1.3	Module error information for safe input module 4
EFUSE Module.Warning	IN	1.4	Intermediate states of the electronic fuse **TRUE** = warning present **FALSE** = warning not present
EFUSE Module.Error	IN	1.5	Error state of the electronic fuse **TRUE** = error present **FALSE** = error not present
EFUSE Module.Tripped	IN	1.6	Trip state of the electronic fuse **TRUE** = tripped **FALSE** = not tripped
EFUSE Module.Enabled	IN	1.7	Switching state of the electronic fuse **TRUE** = enabled **FALSE** = disabled
FSIN Module1.ErrAck	OUT	0.0	Error acknowledge for safe input module 1
FSIN Module2.ErrAck	OUT	0.1	Error acknowledge for safe input module 2
FSIN Module3.ErrAck	OUT	0.2	Error acknowledge for safe input module 3
FSIN Module4.ErrAck	OUT	0.3	Error acknowledge for safe input module 4
EFUSE Module.Reset	OUT	1.0	Reset output for electronic fuse (reset is executed after low->high->low edge)

9 Diagnosis

9.1 LEDs

9.1.1 Status LEDs

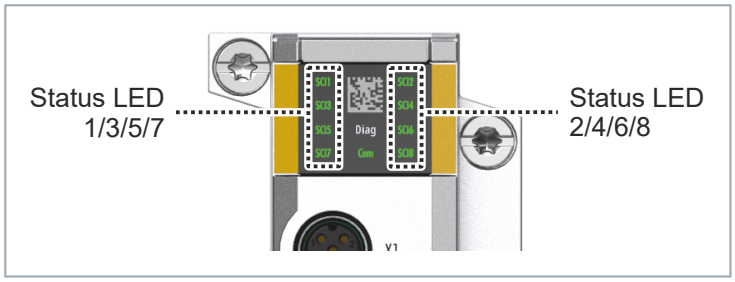
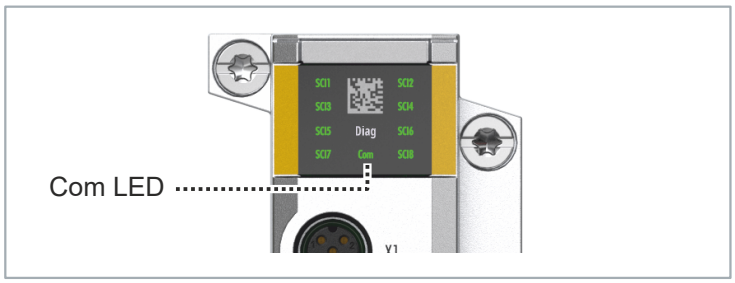


Fig. 25: Status LEDs

The LEDs SCI1 to SCI8 show the status of the respective input 1 to 8.

LED lights up:	The corresponding input is set.
LED off:	The corresponding input is not set.

9.1.2 Com-LED



The green "Com" LED indicates the communication interface of the MO module.

LED lights up:	The MO module is in "Operational" status.
LED flickers: (200 ms on, 200 ms off)	The MO module is in "Pre-Operational" status.
LED flashes: (200 ms on, 1000 ms off)	The MO module is in "Safe-Operational" status.
LED off:	The MO module is in "Boot" status.
LED off:	The MO module is in “Init” status.

9.1.3 Diag LED

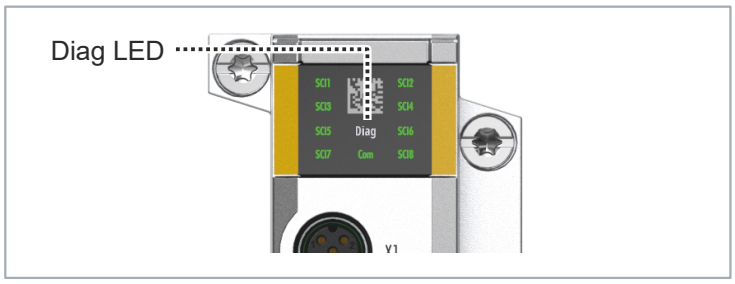


Fig. 26: Diag LED

The red Diag LED is used to diagnose the inputs.

LED lights up:	There is a Global Shutdown or a Global Fault.
LED flickers: (200 ms on, 200 ms off)	There is an output error or a logic error. For more detailed information and the content of the diagnostic message, see Diagnostic history [▶ 43].
LED off:	There is no diagnosis message.

9.2 Diagnostic history

The diagnostic history of the TwinSAFE components that support this function is implemented in accordance with the ETG guideline ETG.1020 Chapter 13 "Diagnosis Handling".

The CoE object 0x10F3$_{hex,}$ displays current diagnosis messages and stores them in the object. They can be read out by the application or by TwinCAT and viewed in the "Diag History" tab.

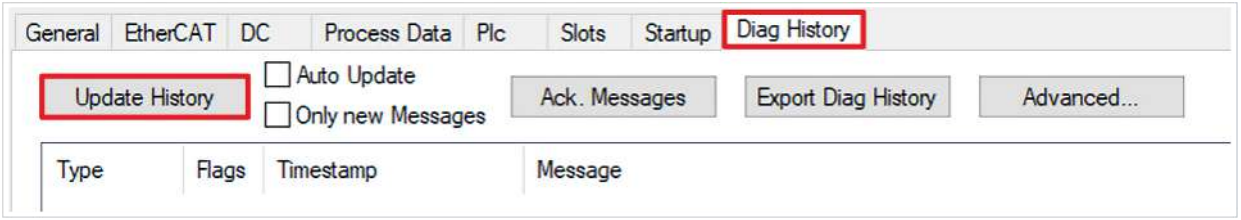


Fig. 27: *Diag History* tab

If you want to retrieve the current data:

1. Click on "Update History"

Information on the parameters can be found in the table below:

Index	Name	Function	Data type	Flags	Default
10F3:0	Diagnosis History	---	---	---	---
10F3:01	Maximum Messages	Maximum number of stored messages 64 messages can be stored. The oldest messages are overwritten.	UINT8	RO	0x40; 64$_{dec}$
10F3:02	Newest Message	Subindex of the latest message		RO	0x00; 0$_{dec}$
10F3:03	Newest Acknowledged Message	Subindex of the last acknowledged message		RW	
10F3:04	New Messages Available	Display of new messages	BOOLEAN	RO	0x00; 0$_{dec}$

Index	Name	Function	Data type	Flags	Default
10F3:05	Flags	Is set via the StartUp list: at 0x0001 the diagnosis messages are sent to the EtherCAT master via Emergency.	UINT 16	RW	0x000; 0_{dec}
10F3:06	Diagnosis Message 001	Diagnosis message 1	BYTE 32	RO	0
---	---	---	---	---	---
10F3:45	Diagnosis Message 064	Diagnosis message 64	BYTE 32	RO	0

9.2.1 Structure of diagnosis messages

Component	Number of bytes	Description
DiagCode	4	The DiagCode is in this case always 0x0000 E000.
Flags	2	Contains the diagnostic type information, warning or error Contains the timestamp and the number of parameters contained
Text ID	2	ID of the diagnosis message as a reference to the message text from the SCI/XML file
Timestamp	8	Local slave time [in ns] since switching on the TwinSAFE component
Dynamic parameters	16	Parameters that can be inserted in the message text

Flags

Data type	Offset	Description	
UINT16	Bit 0…3	DiagType (value)	
		0	Info message
		1	Warning message
		2	Error message
		3…15	reserved
	Bit 4	If the bit = 1, the timestamp contained in the message is the local time stamp of the TwinSAFE device. The age of the diagnosis message can be deduced by calculation with the current timestamp from the CoE object 0x10F8.	
	Bit 5…7	reserved	
	Bit 8…15	Number of parameters in this diagnosis message	

Dynamic parameters

Type	Data type	Description	
Flags parameter 1	UINT16	Describes the type of parameter 1	
		Bit 12…15 = 0	Bit 0…11 = data type of parameter 1 0x0001 - BOOLEAN 0x0002 - INT8 0x0003 - INT16 0x0004 - INT32 0x0005 - UINT8 0x0006 - UINT16 0x0007 - UINT32 0x0008 - REAL32 0x0011 - REAL64 0x0015 - INT64 0x001B - UINT64 Text parameters and formats are specified in ETG.2000.

Type	Data type	Description
Parameter 1	Data type in accordance with flags	Value of parameter 1
Flags parameter 2	UINT16	see Flags parameter 1
Parameter 2	Data type in accordance with flags	Value of parameter 2
...		

Diagnostic messages are stored as text format in the ESI/XML file of the TwinSAFE component. You can find the corresponding message in all available languages via the text ID in the diagnostic message. You can insert the parameters at the appropriate places in the ESI/SML file.

Example

In the following example, %x will be used for a hexadecimal representation of the parameters:

9.2.2 Startup

The "New Messages Available" entry indicates that new messages are available. You read the messages via CompleteAccess. CompleteAccess is a CoE read command for the complete CoE object 0x10F3. The "New Messages Available" bit is reset after reading the messages.

The sending of emergency messages to the EtherCAT master is activated by adding the CoE object 0x10F3:05 to the startup list (Transition IP, value 0x0001). If new diagnosis messages arrive, they are entered in object 0x10F3 and additionally sent by emergency to the EtherCAT master.

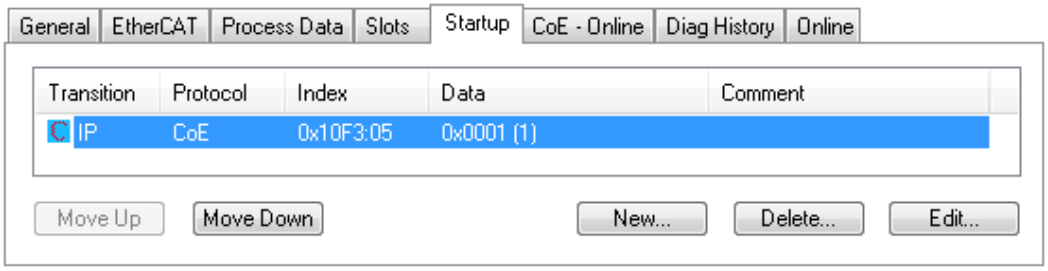
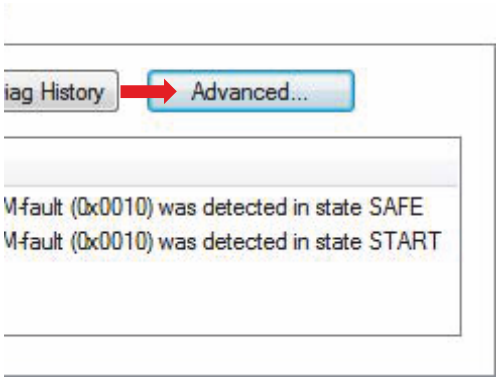


Fig. 28: *Startup* tab

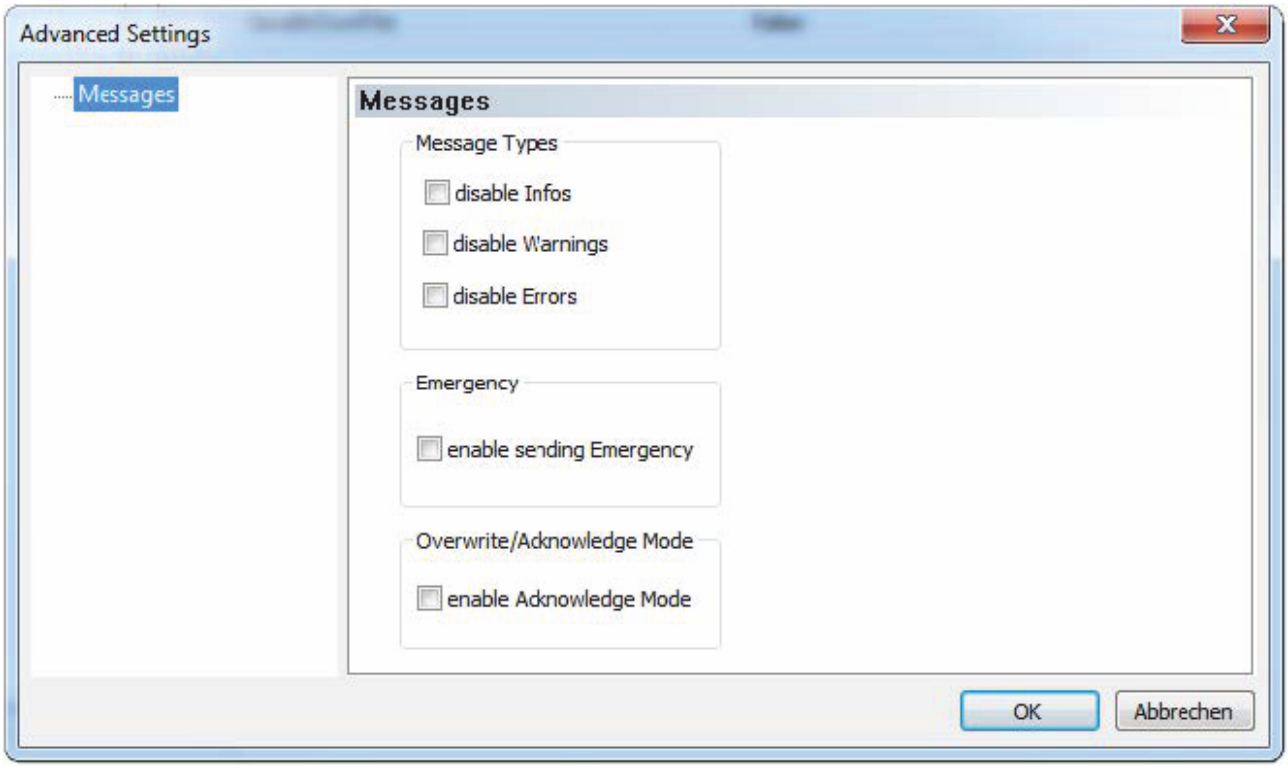
9.2.3 Advanced Settings

If you want to adjust the behavior of the history:



1. Select "Advanced Settings"

The dialog box "Advanced Settings" opens.



The following table contains information on the possible settings:

Setting	Explanation
Message Types	Disable Info *No saving of "Messages" with status "Info" in the "Diag history".* Disable Warnings *No saving of "Messages" with "Warning" status in the "Diag history".* Disable Errors *No saving of "Messages" with "Error" status in the "Diag history".*
Emergency	Additional sending of an emergency object, which is displayed in the "TwinCAT Logger window"
Overwrite / Acknowledge Mode	This setting is currently not supported.

10 Maintenance and cleaning

Unacceptable contamination

Do not operate the TwinSAFE component if it is unacceptably dirty. Refer to the technical data for the protection class.

TwinSAFE components are basically maintenance-free.

10.1 Disassembly

Information on disassembling the MO module can be found in the chapter "Disassembly" of the system manual.

11 Disposal

NOTICE

Correct disposal

Observe the applicable national laws and guidelines for disposal.

Incorrect disposal may result in environmental damage.

Remove the TwinSAFE component for disposal.

No disposal in domestic waste
Products marked with a crossed-out waste bin must not be disposed of with domestic waste. The device is considered waste electrical and electronic equipment when it is disposed of. Observe the national regulations for the disposal of waste electrical and electronic equipment.

11.1 Returning to the vendor

In accordance with the WEEE-2012/19/EU directives, you can return used devices and accessories for professional disposal. The transport costs are borne by the sender.

Send the used devices with the note "For disposal" to:

Beckhoff Automation GmbH & Co. KG
Gebäude „Service“
Stahlstraße 31
D-33415 Verl

In addition, you have the option to contact a local certified specialist company for the disposal of used electrical and electronic appliances. Dispose of the old components in accordance with the regulations applicable in your country.

12 Appendix

12.1 Volatility

If there are requirements concerning the volatility of products in your application, for example of the U.S. Department of Defense or similar authorities or security organizations, the following process applies:

The product has both volatile and non-volatile components. Volatile components lose their data immediately after removing power. Non-volatile components keep the data even after loss of power.

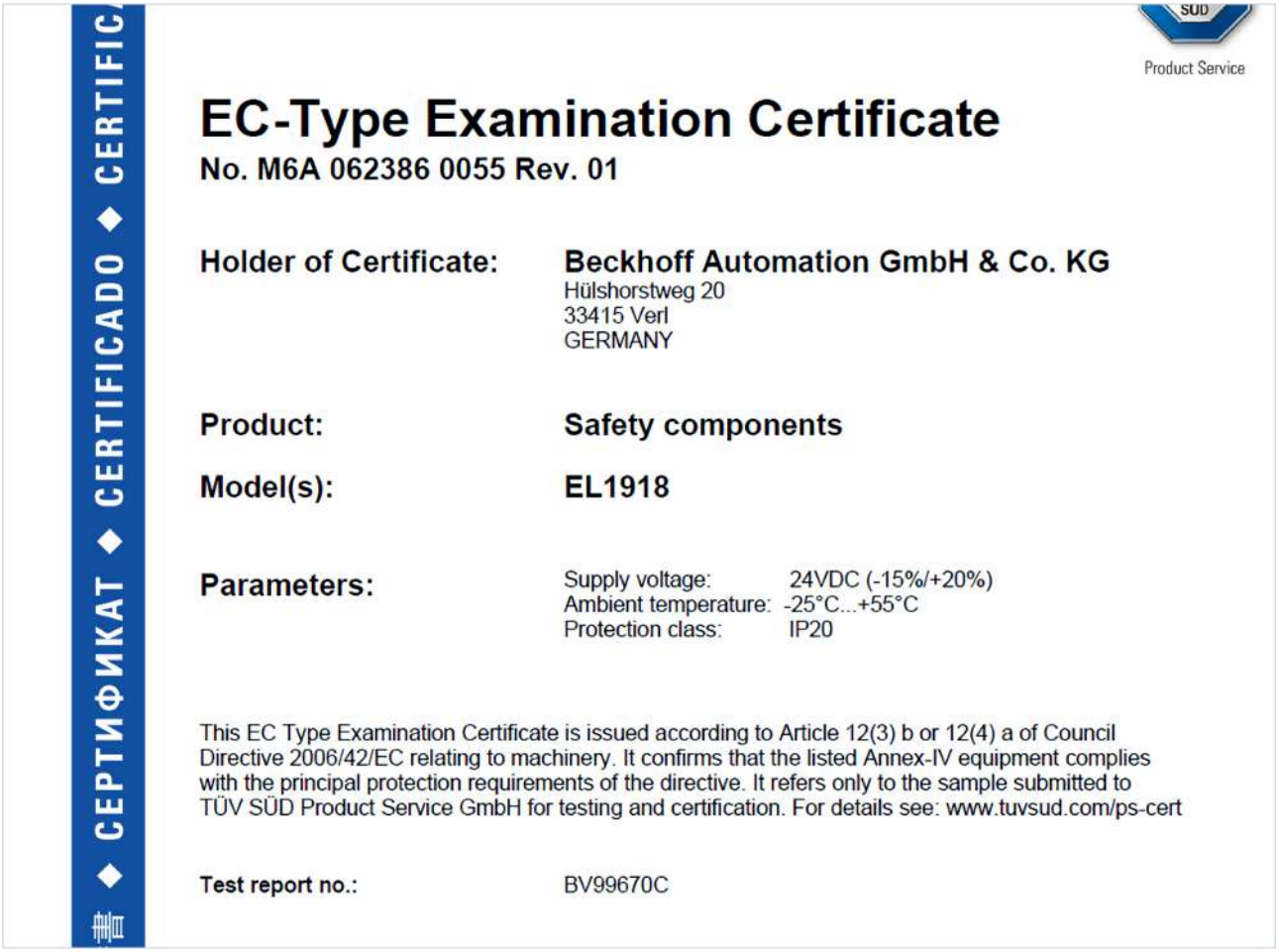
If there is customer specific data saved on the product, it cannot be ensured that this data might not be restored through for example forensic measures, even after the data is deleted through the provided tool chain. If this data is confidential, the scrapping of the product after usage is recommended to protect this data.

12.2 Focus of certificates

The most decisive document for certified components of the TwinSAFE department is the EC type examination certificate. The document contains both the test coverage and the regarded component and component family.

The current certificates of all TwinSAFE components with the underlying standards and directives can be found at https://www.beckhoff.com/en-en/support/download-finder/certificates-approvals/.

If the document refers only to the first four figures of a product (ELxxxx), the certificate is valid for all available variants of the component (ELxxxx-abcd). This is applicable for all components like EtherCAT Terminals, EtherCAT Boxes, EtherCAT plug-in modules and Bus Terminals.



◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFIC

Product Service

EC-Type Examination Certificate

No. M6A 062386 0055 Rev. 01

Holder of Certificate:	**Beckhoff Automation GmbH & Co. KG** Hülshorstweg 20 33415 Verl GERMANY
Product:	**Safety components**
Model(s):	**EL1918**
Parameters:	Supply voltage: 24VDC (-15%/+20%) Ambient temperature: -25°C...+55°C Protection class: IP20

This EC Type Examination Certificate is issued according to Article 12(3) b or 12(4) a of Council Directive 2006/42/EC relating to machinery. It confirms that the listed Annex-IV equipment complies with the principal protection requirements of the directive. It refers only to the sample submitted to TÜV SÜD Product Service GmbH for testing and certification. For details see: www.tuvsud.com/ps-cert

Test report no.: BV99670C

If you regard the example EL1918 in the picture, the certificate is valid for both the EL1918 and the available variant EL1918-2200.

Trademark statements

More Information:
www.beckhoff.com/MO1918-0000-1112

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