BECKHOFF New Automation Technology

Operating Instructions | EN

MX8911

TwinSAFE drive option card for MD8206 servo amplifier with Safe Motion

2025-12-08 | Version: 1.2.0

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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

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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
1.2.0	• “Factory settings project” renamed to “Initial project” • Chapter “Factory settings process image in the I/O tree” renamed to “Process image”
1.1.0	• Document subtitle changed from "TwinSAFE drive option card for MX-System drive modules with Safe Motion" to "TwinSAFE drive option card for MD8206 servo drives with Safe Motion" • Chapter "Drive module variants" adapted
1.0.0	• First released version
0.0.1	• Preliminary (internal only)

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.

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].

1.3 Version history of the TwinSAFE product

This version history lists the firmware and hardware version numbers. You will also find an overview of the available ModuleIdents and which firmware supports which ModuleIdents. See the table below for more information.

ModuleIdent	Firmware version	Hardware version
0x006B0077	Single axis MX8911 01 (V0101)	00
0x006B0075	Double axis MX8911 01 (V0101)	00

1.4 References

No.	Issue	Title / description
[1]	/	**MX-System product manuals**
[2]	/	**MX-System system manual**
[3]	1.4.1 or newer	**Operating instructions for EL6910 TwinSAFE Logic module** The document contains a description of the logic functions of the EL6910 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.

No.	Issue	Title / description
[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.

Document classification in the overall documentation

This documentation applies exclusively to MX-System drive modules with integrated safety technology in accordance with Drive module variants [▶ 16].

This TwinSAFE drive option card is a permanently installed part of MX- System drive modules with integrated safety technology. For this reason, some life phases, such as decommissioning and disposal, apply exclusively to the MX-System drive modules as an overall system and are not listed in this documentation.

⚠ WARNING

Observe TwinSAFE drive option card documentation as a matter of priority

The values and specifications defined in these operating instructions apply in addition and primarily to the documents [1] and [2] at References. Observe these operating instructions as a matter of priority.

Non-observance can endanger safety.

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.

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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.

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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

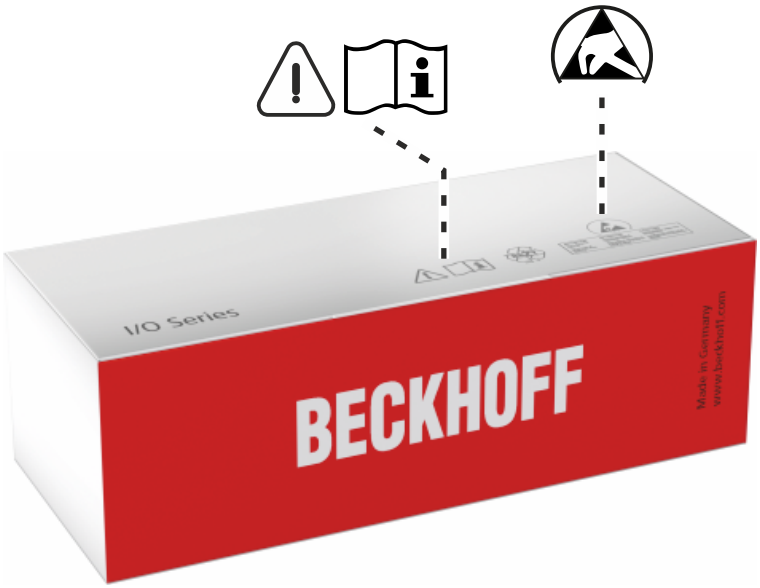
2.1 Due diligence

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 drive option card 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 drive option card.
- do not remove the safety markings attached to the overall system and maintain their legibility.

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

2.3.1 Before operation

Use in machines in accordance with the Machinery Directive and EN 61511

Only use the TwinSAFE component in machines that comply with the Machinery Directive and the EN 61511 standard for the process industry. This is how you ensure safe operation.

See the documents [6] and [7] at References.

Certification for third-party motors invalid

The TÜV SÜD certificate applies to the list of approved motors. Other motors are not covered by the certificate. When using a third-party motor, you are responsible for the attachment and FMEA.

Non-observance may endanger product safety.

Installation according to MX-System manual

TwinSAFE components must be mounted in a control cabinet or terminal box for operation. Install MX-System drive modules in accordance with document [3] at References.

Ensure traceability

Ensure traceability of the TwinSAFE drive option card via the serial number of the overall system.

Using the SELV/PELV power supply unit

Use a SELV/PELV power supply unit with an output voltage limitation in the event of a fault of U_{max} = 36 V_{DC} for the power supply.

Commissioning test

Before commissioning, application errors and wiring faults must be excluded. Before commissioning, carry out a commissioning test. After a successful commissioning test, you can use the TwinSAFE drive option card for the intended safety-related task.

Use of permissible engineering tools and procedures

The TÜV SÜD certificate applies to the overall system with integrated TwinSAFE drive option card, the function blocks available in it, the documentation and the engineering tool. TE9000 - TwinCAT 3 Safety Editor, TE9200 - TwinSAFE Loader and TE5950 - TwinCAT 3 Drive Manager 2 Setup are permitted as engineering tools. 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.

Control of the parameterization of the TwinSAFE drive option card

The TwinSAFE drive option card determines errors in the parameterization, but no logical testing of the parameters or the loaded safety program can take place. Ensure by means of an acceptance test that the parameterization and the safety program are correct for the use case. This test must be performed by the machine manufacturer.

The combination of MX-System drive modules and MX8911 may be used in production only when this test has produced a positive result for all safety-relevant functions.

External safety measures

External safety measures are required in the following cases:

- In the event of incorrect parameterization of the overall system, which can lead to shutdown, for example because the current controller is too sluggish or oscillates
- For loads that cannot be braked by the overall system because the overall system is under-dimensioned
- When executing the safety function STO
- The STO error reaction is executed if the TwinSAFE drive option card determines an error
- Line interruptions that lead to shutdown
- Faults and interruptions in the EtherCAT communication that lead to shutdown
- Activation or restart of a project in TwinCAT, which can lead to shutdown
- Downloading the safety project to the TwinSAFE logic or the MX8911 leading to switch-off

As a result, the motors are not braked, but switched torque-free. This leads to the motors coasting to a halt. The duration of this coasting depends on how much kinetic energy is present in the system. With suspended or pulling loads the motors may also accelerate.

To prevent this, observe the following measures:

- Provide appropriate external safety measures, such as mechanical service brakes.
- Avoid incorrect parameterization or dimensioning of the overall system.
- Avoid line interruptions as well as faults and interruptions in the EtherCAT communication.

Caution: possible motor movements

Even if STO is triggered with interrupted PWM control, a jerky movement (with a maximum of 180° divided by the number of pole pairs) on the motor can occur, for example due to faults in the power circuit.

Consider this in your risk and hazard analysis.

2.3.2 During operation

Risk of injury

Basically, electronic devices are not fail-safe. The machine manufacturer is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a voltage outage in the drive system.

Impairment due to interference emissions

Do not operate the following devices in the vicinity of the overall system: mobile phones, radio equipment, transmitters or high-frequency systems.

The overall system with integrated TwinSAFE drive option card complies with the requirements of the applicable standards for electromagnetic compatibility with regard to spurious radiation and immunity to interference. If you exceed the limits for interference emissions specified in the standards, the function of the TwinSAFE drive option card may be impaired.

2.3.3 After operation

De-energize and switch off the overall system before working on it

Check all safety-relevant equipment for functionality before working on the overall system. Secure the working environment. Secure the machine or plant against being inadvertently started up.

3 Product overview

3.1 Product description

The MX8911 TwinSAFE drive option card is an optional extension of the Beckhoff MX-System drive modules and is permanently installed in them. The drive module forms the overall system. The card enables you to define the safety functions by application. The type key of the drive module determines whether it is a module with STO or Safe Motion. In the delivery state, a initial project with the safety function STO according to EN 61800-5-2 is integrated as an example. For further information, please refer to the chapter Initial project [▶ 25].

If the STO function integrated in the factory state is not suitable for your application, you have the option of creating application-specific projects and loading them onto the TwinSAFE drive option card.

The entire parameterization of the TwinSAFE drive option card is carried out in the same way as the programming and configuration of a safety application in the TE9000 - TwinCAT 3 Safety Editor. For the exchange of the overall system you have the possibility to use the Backup&Restore function known from the EL69x0. Further information on this can be found in the EL6910 operating instructions. See document [3] at .

The Safe Motion variant provides additional parameters and functionalities to implement more complex Safe Motion functions, such as SLS (Safe Limited Speed).

You have the option to implement Safe Motion functions with higher requirements regarding the safety level, for example by using another encoder system or an encoder with a higher safety level.

⚠ CAUTION

Higher Performance Level for Safe Motion functions

The machine manufacturer or user is solely responsible for the execution and evaluation of the measures to attain a higher Performance Level, for example with the aid of an integrated encoder.

For Safe Motion, you can order the MX-System drive modules mentioned in chapter Drive module variants [▶ 16] with an MX8911 as integrated safety technology.

3.2 Block diagram

The TwinSAFE card is permanently integrated in the servo drive and has a passing or interrupting effect on the PWM control signals between the drive logic and output stage.

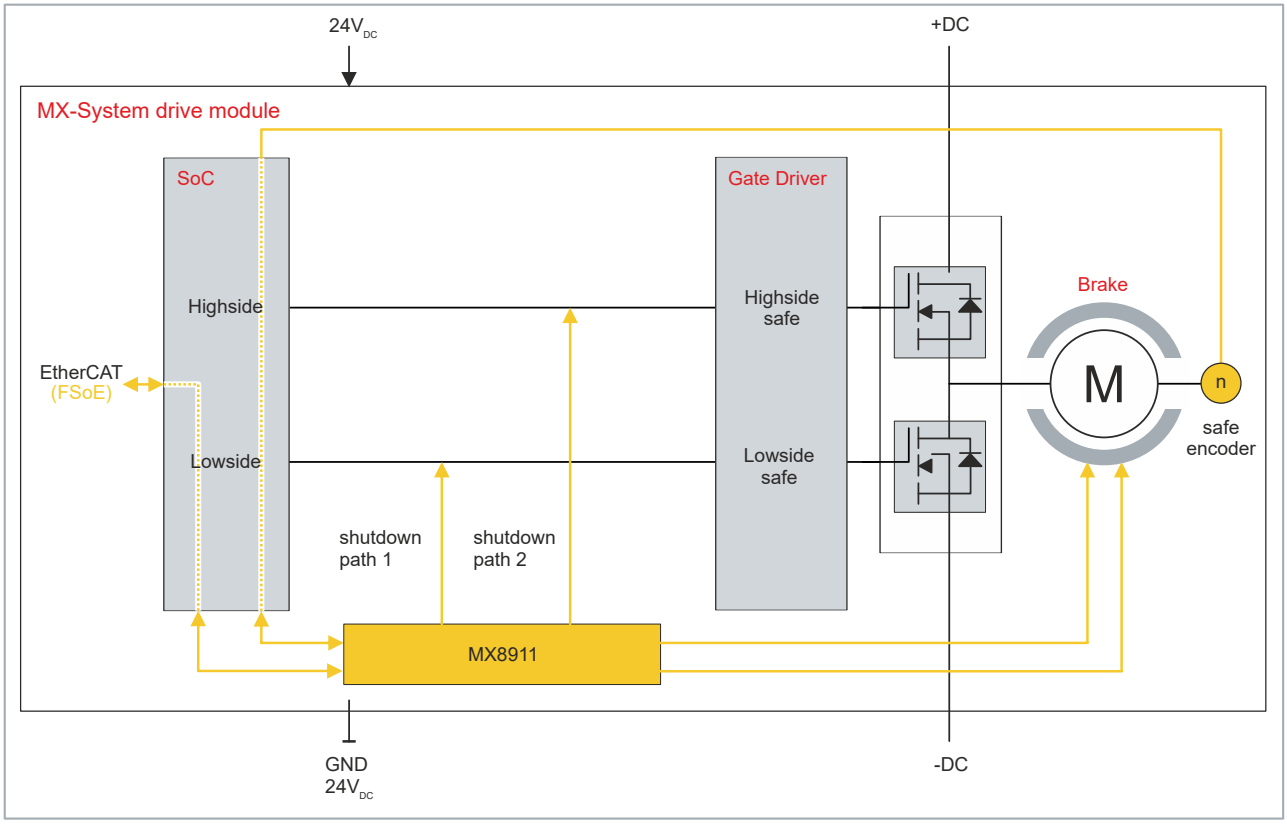
⚠ WARNING

Consider possible motor movements

Even if STO is triggered with interrupted PWM control, a jerky movement (with a maximum of 180° per pole pair) on the motor can occur, for example due to faults in the power circuit.

Consider this in your risk and hazard analysis.

The block diagram describes the mode of operation of the TwinSAFE card within the servo drive.



The TwinSAFE card has an internal two-channel structure based on a 1oo2 structure.

3.3 Drive module variants

This documentation applies to the following drive module variants:

- MD8206-0200-2254
- MD8206-0208-2254 (Dual Use)

The following safety functions in accordance with EN 61800-5-2 can be implemented with these drive module variants.

Safety functions			
Stop functions			
STO	Safe torque off		
SOS	Safe operating stop		
SS1	Safe stop 1	- t	Time controlled
		- r	Ramp monitored
SS2	Safe stop 2		
Speed functions			
SLS	Safely limited speed		
SSM	Safe speed monitor		
SSR	Safe speed range		
SMS	Safe maximum speed		
Position functions			
SLP	Safely limited position		
SCA	Safe cam		
SLI	Safely limited increment		
Acceleration functions			
SAR	Safe acceleration range		
SMA	Safe maximum acceleration		
Direction of rotation functions			
SDIp	Safe direction positive		
SDIn	Safe direction negative		
Brake functions			
SBC	Safe brake control		
SBT	Safe brake test (only with external application)		

3.4 Laser image

Since the TwinSAFE drive option card is permanently installed in the overall device, only the laser image of the overall device exists.

3.5 Intended use

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

The TwinSAFE drive option card is designed for machine safety functions and directly associated industrial automation tasks. The TwinSAFE drive option cards are used to switch the MX-System drive module torque-free in hazardous situations.

The TwinSAFE drive option cards are therefore only approved for applications with a defined fail-safe state. This safe state is the wattless state.

Observe the intended use of the MX-System drive module in accordance with document [2] at References [▶ 6].

⚠ 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

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/.

Product data		Explanation
Hardware		
• Number of axes	1 or 2 axes	For more information, see chapter Drive module variants [▶ 16].
• Number of switch-off channels	2 channels per axis	
Reaction times		
• Cycle time	approx. 10 ms according the project size	The internal cycle time is the runtime of the logic task plus the time difference until it is called again.
• Fault reaction time	Adjustable ≤ watchdog time	
• Watchdog time	2 ms to 60000 ms	
Process image		
• Input	6 to 51 bytes (1 to 24 bytes Safe Data)	For more information, see chapter Local process image [▶ 39].
• Output	6 to 59 bytes (1 to 28 bytes Safe Data)	
Miscellaneous		
• Number of downloads	max. 10,000	When 90% of this value is reached, a Diag message is issued as a warning for each further write access. When 100% is reached, no further write access is possible and the device goes into the GLOBAL_SHUTDOWN state as soon as another write access occurs.
• Safety-related accuracy for OCT Safety (SICK)	0.439°	Safety-related accuracy is specified in the SICK encoder documentation. Deviating from this, 4 increments are configured in the TwinSAFE drive option card.

Further product data can be found in the respective product manual. You can find the product manuals online in the Download finder.

4.2 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.

STO

Target failure measures			Explanation
Limit value	**Single-axis**	**Double-axis**	
Lifetime	20 years	20 years	
Proof test interval	/	/	Special proof tests are not required during the entire lifetime of the TwinSAFE drive option card.
PFH_D	4.95E-09	6.77E-09	
PFD_{avg}	6.81E-05	7.16E-05	
$MTTF_D$	High	High	
DC	High	High	
Performance Level	e	e	According to EN ISO 13849-1:2023.
Category	4	4	According to EN ISO 13849-1:2023.
SFF	99.57 %	99.59 %	
HFT	1	1	
Element classification	Type B	Type B	According to EN 61508-2:2010.

Safe Motion without SBC

Target failure measures			Explanation
Limit value	**Single-axis**	**Double-axis**	
Lifetime	20 years	20 years	
Proof test interval	/	/	Special proof tests are not required during the entire lifetime of the TwinSAFE drive option card.
PFH_D	6.30E-09	8.19E-09	
PFD_{avg}	7.82E-05	8.78E-05	
$MTTF_D$	High	High	
DC	High	High	
Performance Level	e	e	According to EN ISO 13849-1:2023.
Category	4	4	According to EN ISO 13849-1:2023.
SFF	99.50 %	99.54 %	
HFT	1	1	
Element classification	Type B	Type B	According to EN 61508-2:2010.

Safe Motion with SBC

⚠ WARNING

Target failure measures restricted

The PL e, Cat 4 / SIL 3 classification for SBC is limited to the TwinSAFE drive option card and ends at the connection points of the brake.

For further information, please refer to the chapter Brake control [▶ 21].

Target failure measures			Explanation
Limit value	**Single-axis**	**Double-axis**	
Lifetime	20 years	20 years	
Proof test interval	/	/	Special proof tests are not required during the entire lifetime of the TwinSAFE drive option card.
PFH_D	6.82E-09 [1]	9.23E-09 [1]	
PFD_{avg}	7.92E-05	8.98E-05	
$MTTF_D$	High	High	
DC	High	High	
Performance Level	e	e	According to EN ISO 13849-1:2023.
Category	4	4	According to EN ISO 13849-1:2023.
Basis for safety functions	Safe single-turn absolute position		
Safety-related resolution	13-bit		
Safety-related accuracy [3]	0.439°		
SFF	99.53 %	99.57 %	
HFT	1	1	
Element classification	Type B	Type B	According to EN 61508-2:2010.

[1] *These data are related to a max. ambient temperature of 115 °C.*
The PFH_D value is determined in accordance with the approximation formula from the manufacturer's data for MTTFD and DC (see Application Guide).

[2] *With additional measures, SIL 3 / PL e category 4 is possible with an EnDat 3 encoder. See chapter "*AdvPosMon with integrated EnDat 3 encoder*" of document [5] at* References.

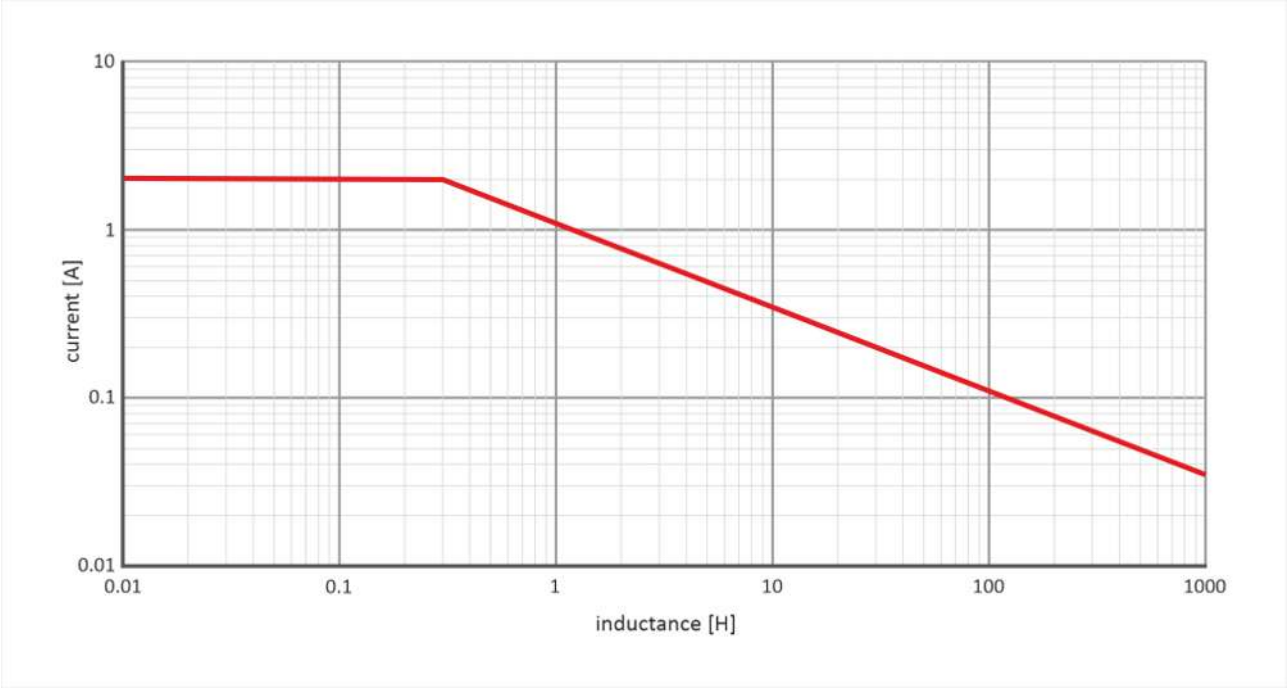
[3] *The safety-related accuracy indicates the maximum position error limit with which the safety functions can be supported.*

For further information, please refer to the chapter Lifetime.

4.2.1 Brake control

The inductive energy stored in the connected released brake has an influence on the category achievable for the safety function SBC according to DIN EN ISO 13849.

The following diagram shows the limit values of the permissible braking parameters current and inductance for MX8911 with Safe Motion functions. Using these parameters, you can draw the brake used in the diagram and see whether the SBC safety function meets the requirements of category 4.



4.3 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 drive option cards under the following operating conditions:

- under the influence of ionizing radiation (exceeding the natural background radiation)
- in corrosive environments[1]
- in an environment that would lead to impermissible contamination of the TwinSAFE drive option card

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

The environmental conditions of this TwinSAFE drive option card are defined by its installation in the MX-System drive module. For the conditions, see document [2] at References [▶ 6].

4.4 Project design limits MX8911

Project design limits

The maximum project design size of the TwinSAFE drive option card is limited by the available memory. This is managed dynamically. The values specified in the following table are therefore only guide values and may differ from the actual values, depending on the safety project.

Process image size	Input process image: 6 to 51 bytes (1 to 24 bytes of Safe Data) Output process image: 6 to 59 bytes (1 to 28 bytes of Safe Data)
TwinSAFE connections	maximum 8 (Maximum 14 CRCs in total - 1 CRC is required for a TwinSAFE connection with 1 or 2 bytes of safe data).
Safe data per TwinSAFE connection	maximum 24 bytes (telegram length 51 bytes)
TwinSAFE function blocks	maximum 512 (ESTOP with complete input and output mapping)
TwinSAFE Groups	maximum 128
TwinSAFE users	maximum 40
Standard PLC inputs	dynamic (memory-dependent), max. 54 bytes
Standard PLC outputs	dynamic (memory-dependent), max. 62 bytes

4.5 Error reaction

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

Depending on the severity of the cause of the error, the TwinSAFE drive option card changes to one of the following error states:

- Global Shutdown
- Global Fault
- Module Shutdown

4.5.1 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.

4.5.2 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.

4.5.3 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.

4.6 Lifetime

The TwinSAFE Drive option card has a lifetime of 20 years, during which the target failure measures are guaranteed. For more information, see the chapter Target failure measures [▶ 19].

The lifetime starts from the date of manufacture as indicated on the drive module's name plate. For more information, see document [1] at References [▶ 6].

⚠ WARNING

Replace drive module after 20 years

After a lifetime of 20 years, the safety parameters are no longer guaranteed.

Use beyond the lifetime may result in loss of safety.

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

The internal TwinSAFE drive option card has a unique serial number that you can read out via CoE.

The date of manufacture and the serial number of the drive module can be found on its name plate. See document [1] at References [▶ 6].

5 Initial project

⚠ WARNING

Setup of a restart lock

Set up a restart lock in the higher-level safety controller.
Alternatively, you have the option of setting up a restart lock by changing the safety-oriented program on the TwinSAFE drive option card.

An uncontrolled restart of the overall system can lead to serious injuries.

5.1 Description

The MX-System drive module with integrated safety technology cannot be operated without safety. The MX-System drive module with integrated safety technology is supplied with a initial project as an example, which enables simple commissioning.

By using the initial project, you have the option of triggering the STO safety function via FSoE.

Address setting

In the delivery state, a safe address of "1" is set.

If you want to use more than one MX-System drive module, change the addresses of the additional MX-System drive modules to ensure specific addressing. After changing the address, it is not necessary to load the project.

For further information on address setting, please refer to the chapter Address setting [▶ 32].

5.2 Factory setting STO in the TwinSAFE drive option card

⚠ WARNING

STO switch-off paths

There are two STO switch-off paths per axis within the logic: STO_1 and STO_2. If you replace the safety logic on the TwinSAFE drive option card with a user-specific project, you must set all switch-off paths per axis.

In addition, the signal must be reported back to the MX-System drive module via the "no_STO_to_Drive" output.

A safety-oriented logic program, the initial project, is stored on the TwinSAFE drive option card in the delivery state.

You have the option to activate the STO function via a Safety over EtherCAT connection. This connection contains the STO signals for axis A and axis B. For the STO signal a logic TRUE signal is required so that movement of the axis is possible. The safety address for this connection is defined as a 16 bit value in the software.

5.3 Process image

Process image valid for the initial project

Note that the process image depends on the active project and the implemented safety functions. The process image listed in this document applies exclusively to the initial project. For customer-specific projects, the process image may differ from the process image shown here. For further information on customer-specific projects, please refer to the chapter Configuration in TwinCAT.

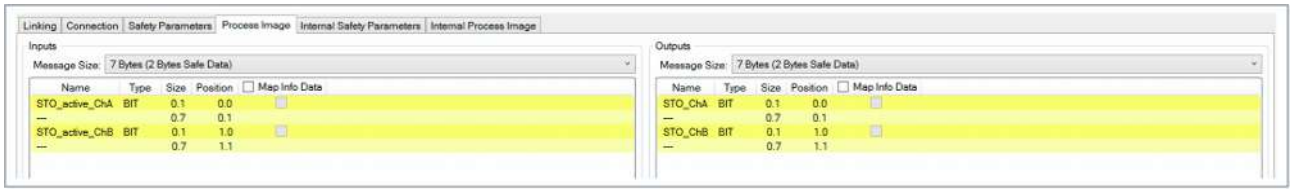


Fig. 1: Process image factory settings project MX8911

5.3.1 Input

The process image of the input signals consists of 7 bytes of data, 2 bytes of which are usage data.

Single-axis variant

The following process image applies to the single-axis product variant.

Offset	Name	Data type	Group	Description
0.0	STO_ChA	BOOL	Safety	**True:** No STO, STO outputs are enabled **False:** STO, safe state

Double-axis variant

For a double-axis application, the following process image applies in addition to the upper process image.

Offset	Name	Data type	Group	Description
1.0	STO_ChB	BOOL	Safety	**True:** No STO, STO outputs are enabled **False:** STO, safe state

5.3.2 Output

The process image of the output signals consists of 7 bytes of data, 2 bytes of which are usage data.

Single-axis variant

The following process image applies to the single-axis product variant.

Offset	Name	Data type	Group	Description
0.0	STO_active_ChA	BOOL	Safety	State of the signal reported to the Drive Application (standard firmware) **True:** No STO, STO outputs are enabled **False:** STO, safe state

Double-axis variant

For a double-axis application, the following process image applies in addition to the upper process image.

Offset	Name	Data type	Group	Description
0.0	STO_active_ChB	BOOL	Safety	State of the signal reported to the Drive Application (standard firmware) **True:** No STO, STO outputs are enabled **False:** STO, safe state

6 Configuration in TwinCAT

6.1 Adding an MX8911

Adding an MX8911 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 [▶ 6].

6.2 Using the MX8911 with the Initial project

For more information about this project, see the chapter Factory setting STO in the TwinSAFE drive option card [▶ 25].

To use the MX8911 in a safety project, proceed as follows:

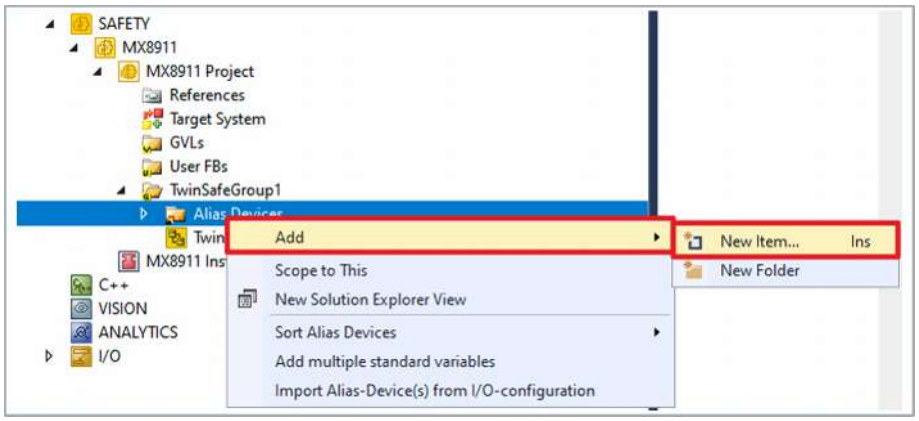


Fig. 2: Add alias device MX8911

1. Right-click on the Alias Device folder of your safety project
2. Select "New Item..." via "Add"

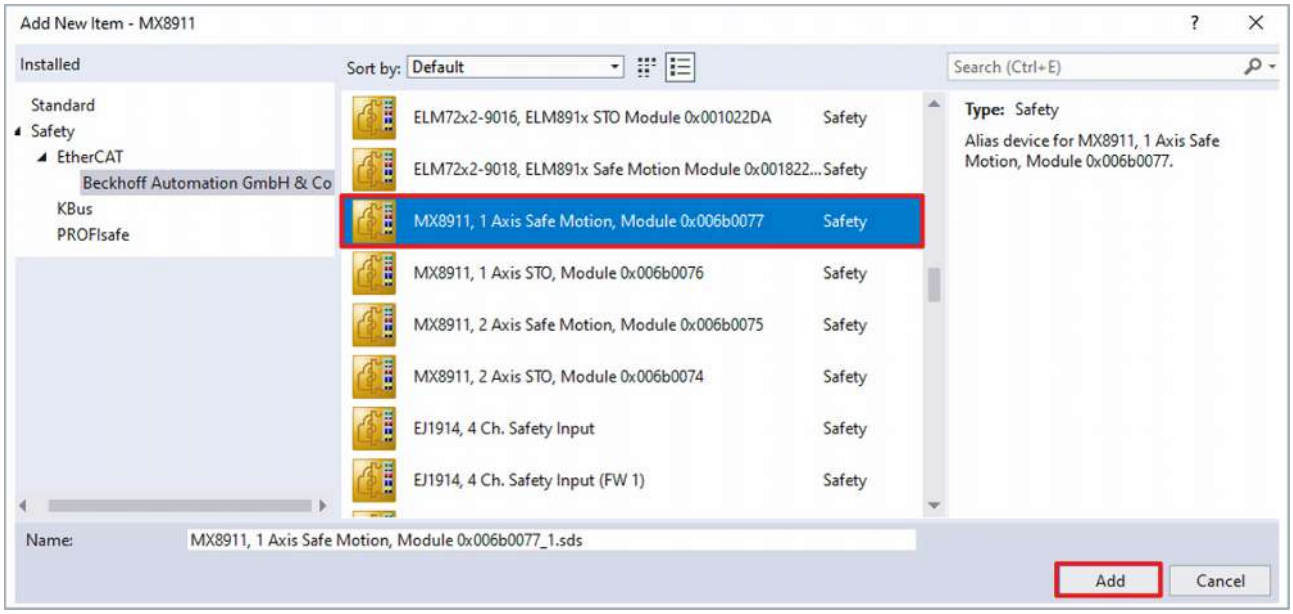


Fig. 3: Add New Item

The "Add New Item" window opens and you can select the desired Alias Device. The designation contains information about which MX8911 variant with the corresponding ModuleIdent is involved.

You can use the STO signals as safe outputs in the safety-oriented user program.

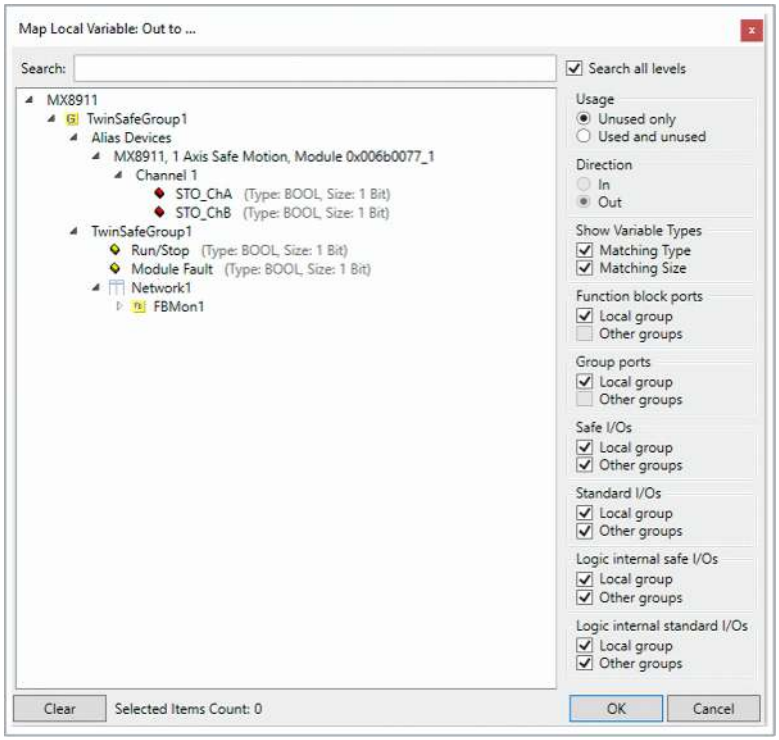


Fig. 4: Map variable

The variables are displayed with the corresponding designation in *Variable Mapping*.

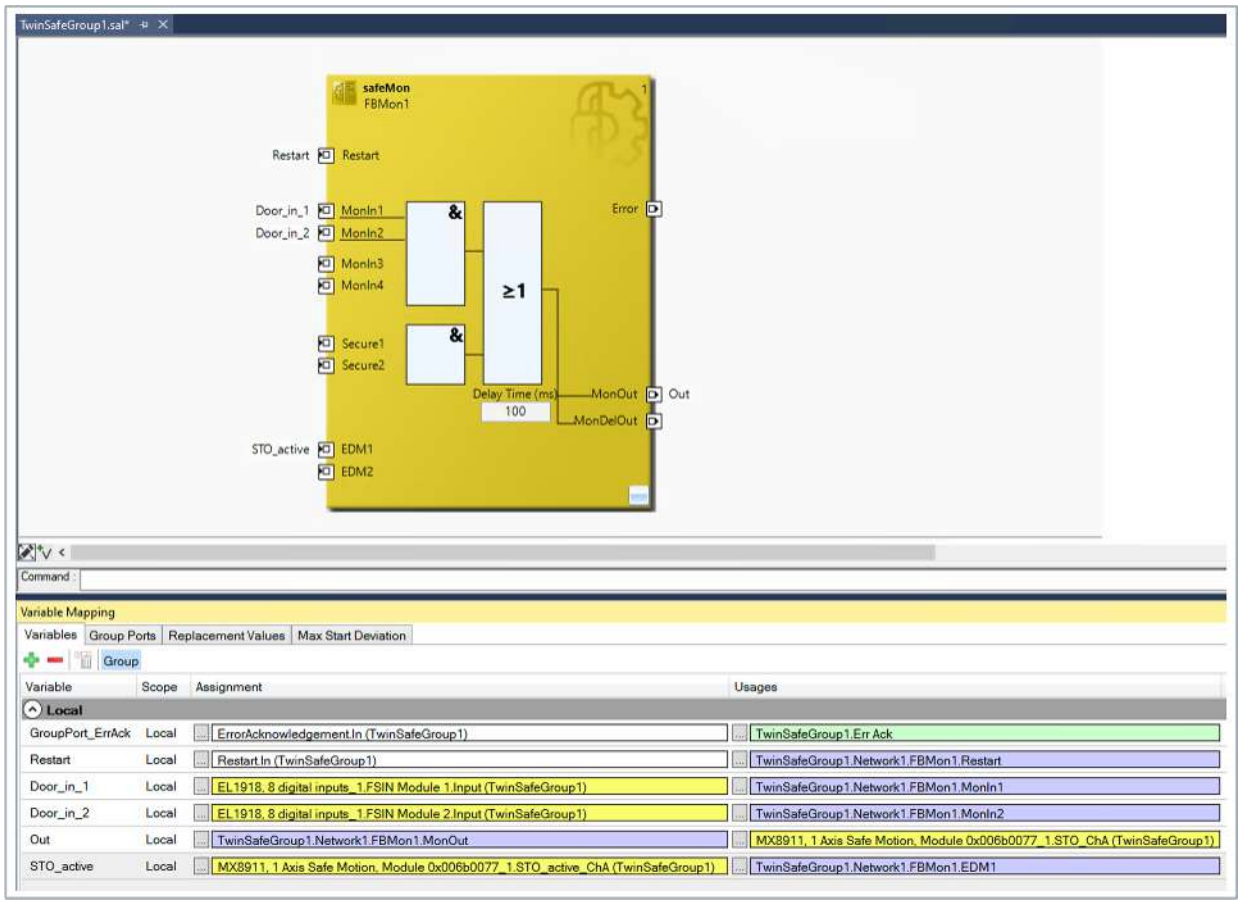


Fig. 5: Variable Mapping

6.3 Use of the MX8911 with a safety-related user program

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

Target system

For the use of the user-specific functions in the MX8911, a safety project is created in TwinCAT 3 and the MX8911 or the axis module is selected as the target system. Proceed as follows:

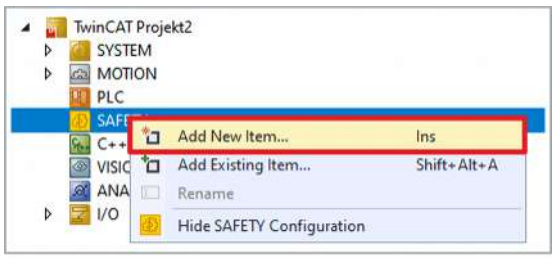


Fig. 6: Add new item

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

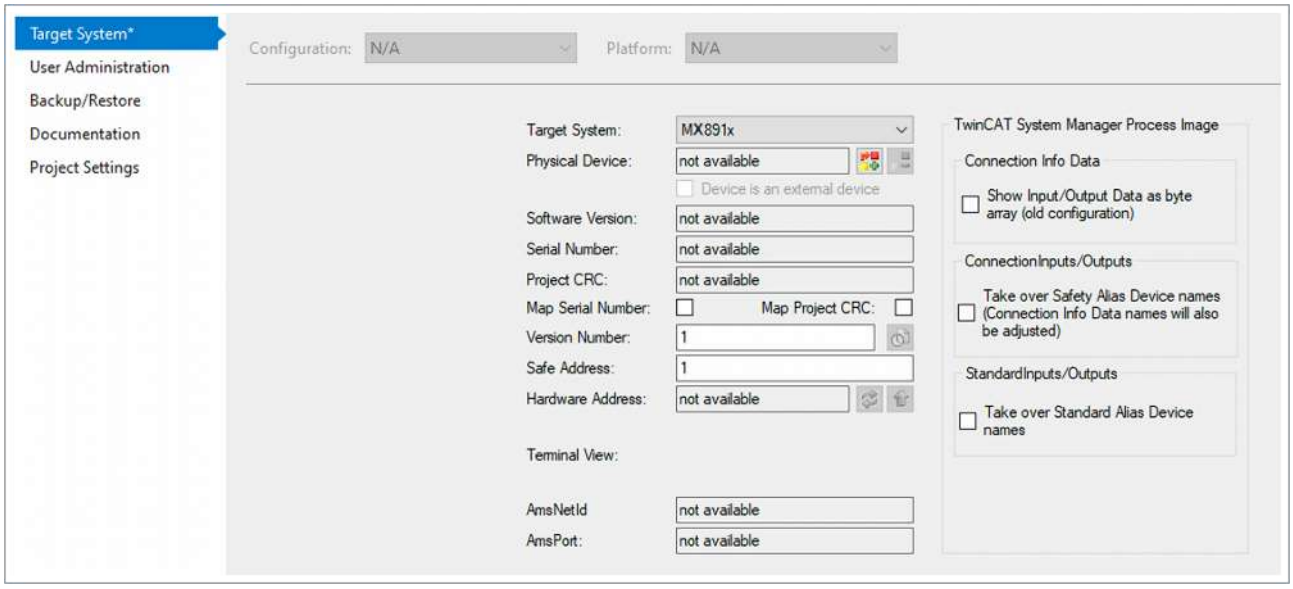


Fig. 7: Target system MX8911

3. Double click on the newly added node
4. Open "Target System" tab to select the target system
5. Select "MX891x" in the drop-down list of the target system
6. Click on  to link the TwinSAFE drive option card to the axis module

Proceed as follows to use the local inputs and outputs of the TwinSAFE drive option card:

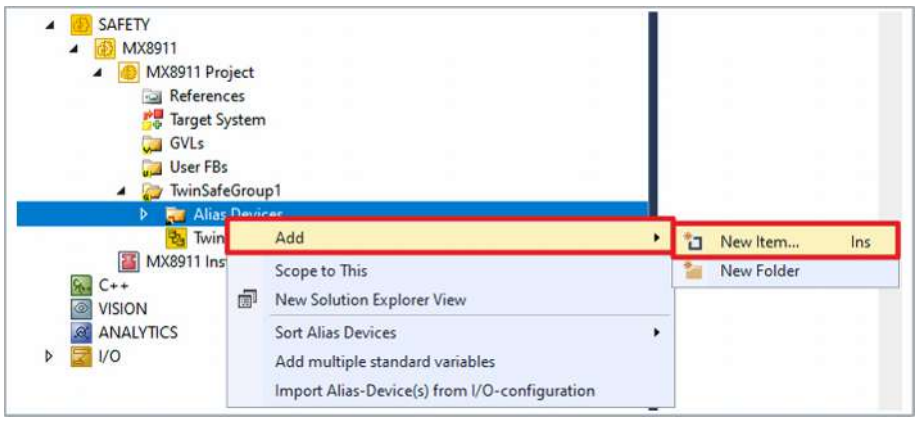


Fig. 8: Add alias device

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

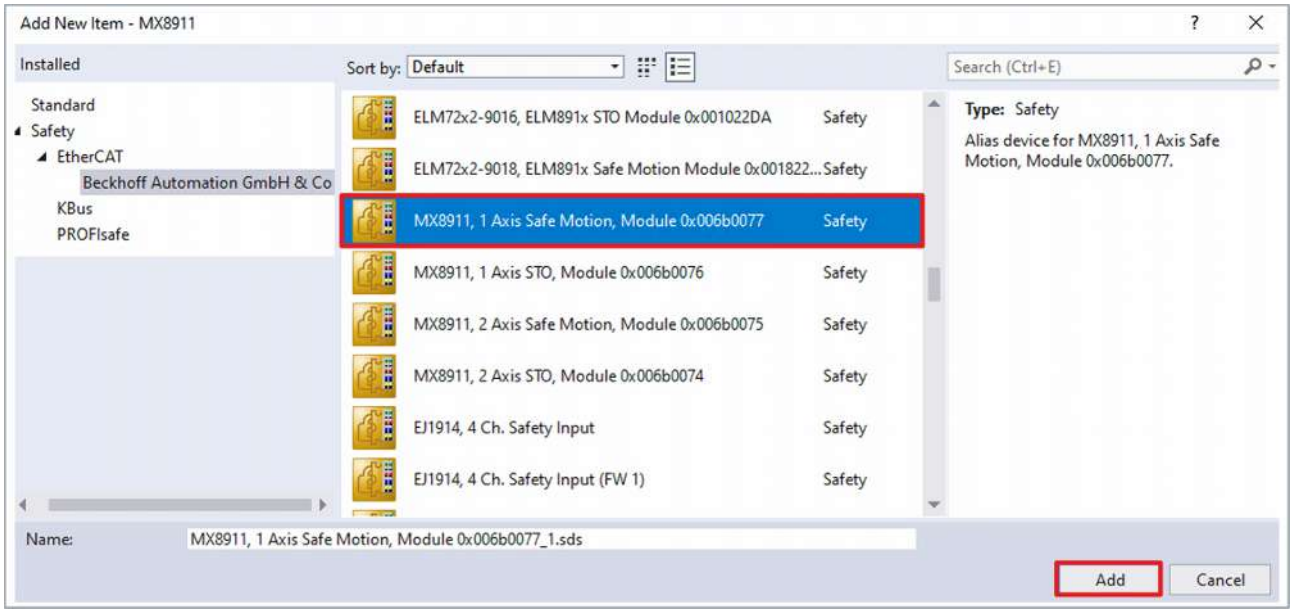


Fig. 9: MX8911 - Add new item

The "Add New Item" window opens. Here you can select your desired MX8911 variant. The name and the ModuleIdent in the alias device description tell you which MX8911 variant it is.

Which ModuleIdent belongs to which firmware version and which MX firmware is supported can be found in the chapter .

9. For the Safe Motion variant, select "MX8911, 1 Axis Safe Motion" or "MX8911, 2 Axis Safe Motion"
10. For the STO variant, select "MX8911, 1 Axis STO" or "MX8911, 2 Axis STO"
11. Confirm the selection with "Add"

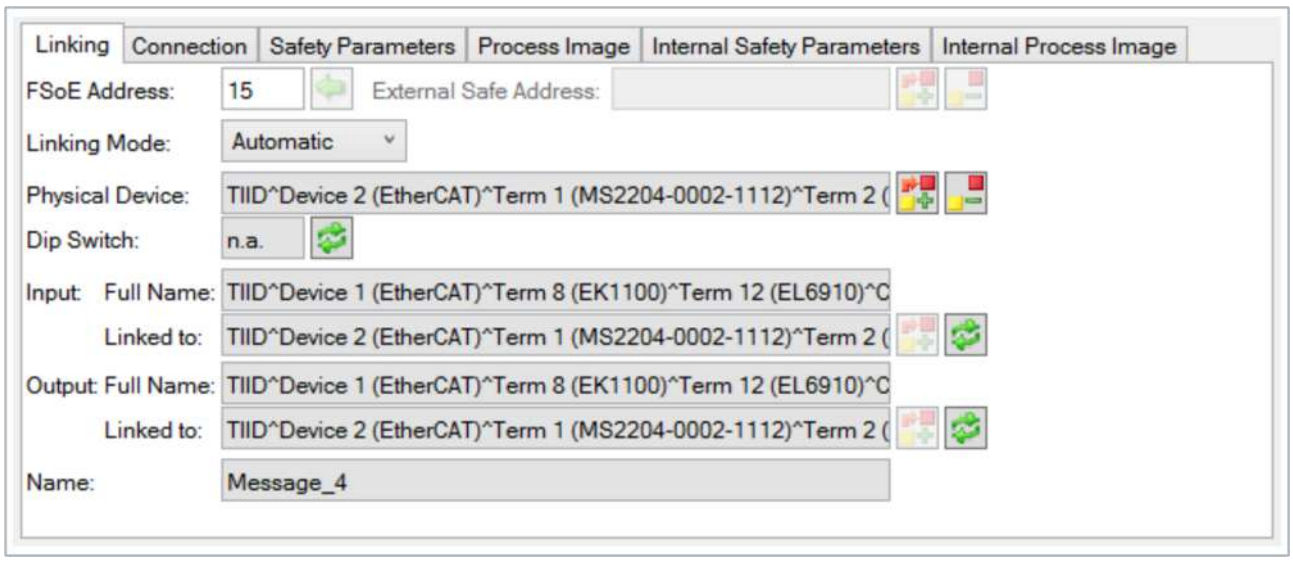


Fig. 10: Linking

12. Double click on the Alias Device
13. Open "Linking" tab
14. 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 [▶ 35].

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 Local process image [▶ 39].

6.4 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 [▶ 6].

6.5 Address setting

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:

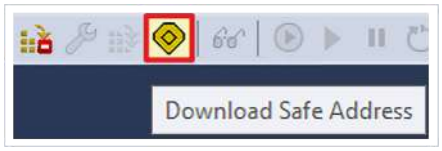


Fig. 11: Download Safe Address

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

Fig. 12: Choose Safety Device

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

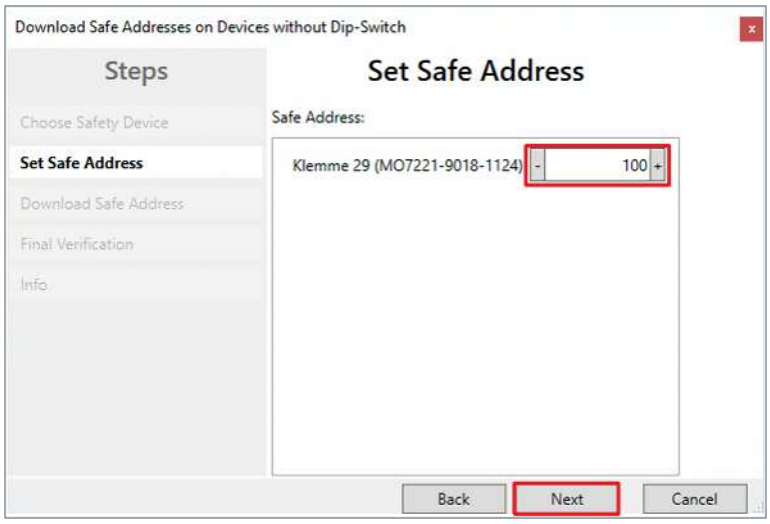


Fig. 13: Set Safe Address

The "Set Safe Address" window opens.

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

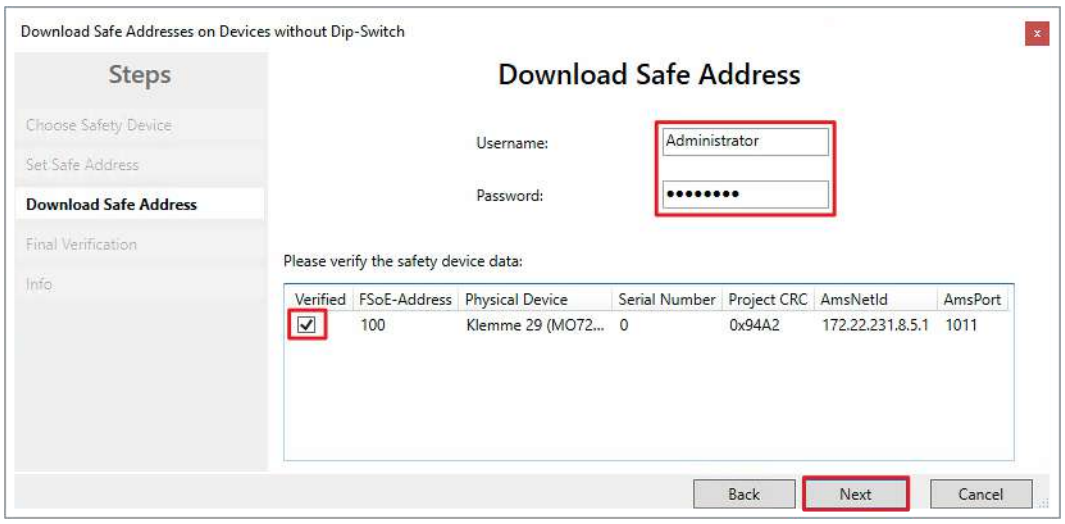


Fig. 14: Download Safe Address

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"

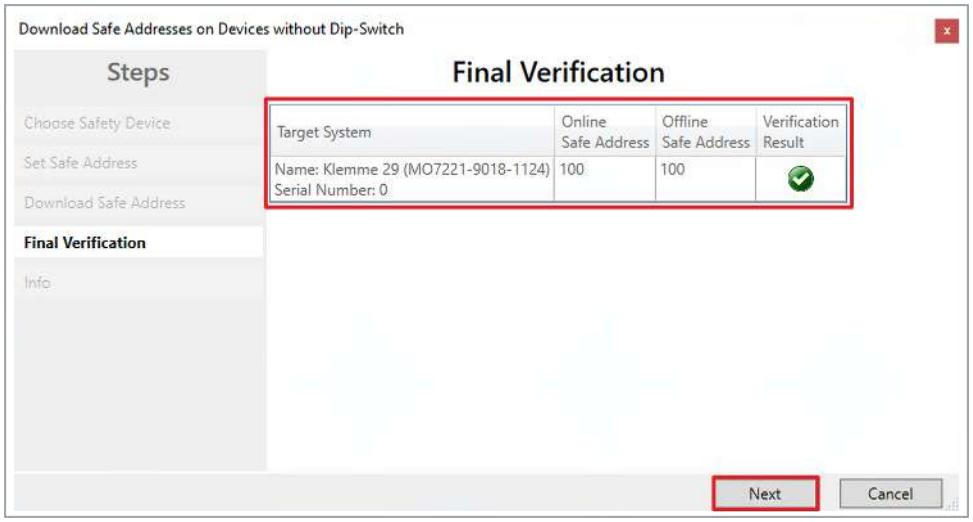


Fig. 15: Final Verification

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. 16: 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.

6.6 Safety parameters

In the delivery state, use the TwinSAFE drive option card with the initial project STO. If you use the TwinSAFE drive option card with a user-specific application program, you have the option of additionally configuring the TwinSAFE drive option card via the internal safety parameters.

⚠ WARNING

Perform error evaluation

If you activate the parameter for the Safe Motion functions, perform the corresponding error evaluations and evaluate the feedback *Position Valid* of the encoder(s) used.

Failure to comply may endanger safety.

⚠ WARNING

Testing of the brake control

In the parameter 0xC110:4 you have the possibility to deactivate the test pulses. In this case, control the brake cyclically every 8 hours.

Failure to comply may endanger safety.

The following internal safety parameters are available for the Safe Motion ordering option in accordance with Drive module variants [▶ 16].

6.6.1 Single-axis variant

Index	Name	Data type	Description
0xC110:0	ChA FSOUT BRAKE Settings Common		
0xC110:1	ModuloDiagTestPulse	UINT8	Modulo value for the frequency of the generation of a test pulse. 0 -> every time 1 -> every second time and so on
0xC110:2	MultiplierDiagTestPulse	UINT8	Length of the test pulse in multiples of 625 µs
0xC110:4	Diag TestPulse active	BOOL	**True:** test pulses active **False:** test pulses inactive
0xC130:0	ChA FSDRIVE Settings		
0xC130:1	Brake Control Enabled	BOOL	**True:** brake control enabled **False:** brake control disabled
0xC130:2	Primary Feedback Enabled	BOOL	**True:** feedback module enabled **False:** feedback module disabled
The following parameters are only evaluated if parameter 0xC130:2 is TRUE.			
0xC140:0	ChA SAFEDRIVEFEEDBACK Primary Feedback Settings		
0xC140:01	Average Calculation Acceleration	ENUM(4)	Average acceleration calculation
0xC140:05	Average Calculation Velocity	ENUM(4)	Average velocity calculation
0xC140:11	Encoder Direction Shift	BIT5	Detection limit for direction of rotation detection For more information, see the chapter Description of the "Encoder Direction Shift" parameter [▶ 37].
0xC140:19	Encoder Position Shift	BIT5	Detection limit for position detection
0xC142:0	ChA SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings		
0xC142:01	Operation Mode	ENUM(4)	Referencing the operation mode • Automatic referencing, "Set reference position" activated

Index	Name	Data type	Description
			• Automatic referencing, "Set reference position" deactivated • Manual referencing
0xC142:11	Reference SafePosition Singleturn	UINT32	Safe single-turn reference position
0xC142:12	Reference SafePosition Multiturn	INT32	Safe multi-turn reference position
0xC142:13	Speed at Reference Position	UINT32	Maximum permissible speed at the reference position
0xC142:14	Maximum Singelturn Referenced SafePosition	UINT32	Maximum safe single-turn reference position
0xC142:15	Maximum Multiturn Referenced SafePosition	INT32	Maximum safe multi-turn reference position
0xC142:16	Minimum Singleturn Referenced SafePosition	UINT32	Minimum safe single-turn reference position
0xC142:17	Minimum Multiturn Referenced SafePosition	INT32	Minimum safe multi-turn reference position
0xC142:18	Deviation Startup Position	UINT32	Permissible deviation when initializing the reference position
0xC240:0	ChA SAFEDRIVEFEEDBACK Primary Feedback Parameter		
0xC240:1B	Parameter CRC	UINT16	CRC of the parameters

6.6.2 Double-axis variant

Safety parameters for double-axis applications

For a double-axis application, the following safety parameters apply in addition to the safety parameters in chapter Single-axis variant [▶ 35].

Index	Name	Data type	Description
0xC390:0	ChB FSOUT BRAKE Settings Common		
0xC390:01	ModuloDiagTestPulse	UINT8	Modulo value for the frequency of the generation of a test pulse. 0 -> every time 1 -> every second time and so on
0xC390:02	MultiplierDiagTestPulse	UINT8	Length of the test pulse in multiples of 625 µs
0xC390:04	Diag TestPulse active	BOOL	**True:** test pulses active **False:** test pulses inactive
0xC3B0:0	ChB FSDRIVE Settings		
0xC3B0:01	ChB FSDRIVE Brake Control Enabled	BOOL	**True:** brake control enabled **False:** brake control disabled
0xC3B0:02	ChB FSDRIVE Primary Feedback Enabled	BOOL	**True:** feedback module enabled **False:** feedback module disabled
The following parameters are only evaluated if parameter 0xC130:2 is TRUE.			
0xC3C0:0	ChB SAFEDRIVEFEEDBACK Primary Feedback Settings		
0xC3C0:01	Average Calculation Acceleration	ENUM(4)	Average acceleration calculation
0xC3C0:05	Average Calculation Velocity	ENUM(4)	Average velocity calculation
0xC3C0:11	Encoder Direction Shift	BIT5	Detection limit for direction of rotation detection For more information, see the chapter Description of the "Encoder Direction Shift" parameter [▶ 37].
0xC3C0:19	Encoder Position Shift	BIT5	Detection limit for position detection

Index	Name	Data type	Description
0xC3C2:0	ChB SAFEDRIVEFEEDBACK Primary Feedback Referencing Settings		
0xC3C2:01	ChB Primary Feedback Operation Mode	ENUM(4)	Referencing the operation mode • Automatic referencing, "Set reference position" activated • Automatic referencing, "Set reference position" deactivated Manual referencing
0xC3C2:11	Reference SafePosition Singleturn	UINT32	Safe single-turn reference position
0xC3C2:12	Reference SafePosition Multiturn	INT32	Safe multi-turn reference position
0xC3C2:13	Speed at Reference Position	UINT32	Maximum permissible speed at the reference position
0xC3C2:14	Maximum Singelturn Referenced SafePosition	UINT32	Maximum safe single-turn reference position
0xC3C2:15	Maximum Multiturn Referenced SafePosition	INT32	Maximum safe multi-turn reference position
0xC3C2:16	Minimum Singleturn Referenced SafePosition	UINT32	Minimum safe single-turn reference position
0xC3C2:17	Minimum Multiturn Referenced SafePosition	INT32	Minimum safe multi-turn reference position
0xC3C2:18	Deviation Startup Position	UINT32	Permissible deviation when initializing the reference position
0xC4C0:0	ChB SAFEDRIVEFEEDBACK Primary Feedback Parameter		
0xC4C0:1B	Parameter CRC	UINT16	CRC of the parameters

6.6.3 Description of the "Encoder Direction Shift" parameter

Analog values are generally susceptible to noise due to various factors such as electromagnetic interference, thermal noise and component tolerances. This noise can affect the accuracy and precision of the measured values. The direction of rotation information is determined based on the safe speed.

To reduce the influence of noise on the speed used to evaluate the direction of rotation, it can be minimized by specifically shifting the evaluation mask. Use the "Encoder Direction Shift" parameter to set the detection limit of the direction of rotation detection.

The speed is scaled to a 32-bit value by default, corresponding to the resolution of the encoder used. For example, when using a 24-bit encoder, the least significant 8 bits are always set to 0. These are ignored when the direction of rotation is detected.

Use the "Encoder Direction Shift" parameter to define the number of least significant counting bits that should also be ignored for direction detection.

Example:

- Single-turn encoder: 24 bits
- "Encoder Direction Shift" parameter: 4
- The least significant 8 bits are 0 and in addition bits 9 to 12 are ignored. Direction detection only becomes active from a speed change in bit 13.

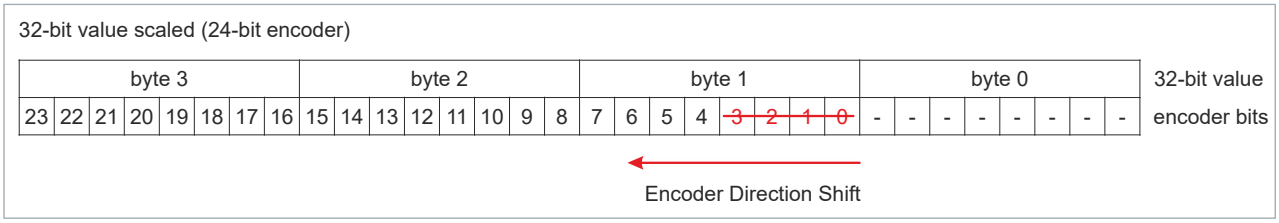


Fig. 17: Example of the "Encoder direction shift" parameter

Special case Encoder Direction Shift = 0

The default value of the "Encoder Direction Shift" parameter is 0. This is a special case in which the resolution of the encoder used is used to set the detection limit by dividing it by 3.

- Example:

⇨ Single-turn encoder: 24 bits

⇨ "Encoder Direction Shift" parameter: 0

⇨ Calculated "Encoder Direction Shift": 24/3 = 8

Parameterization limits

Please note that the parameterized value for "Encoder Direction Shift" must not be greater than SingleTurnBits minus 1. Otherwise, the bits for the direction of rotation information (SDIn / SDIp) cannot be set.

7 Local process image

The process image of the MX8911 is composed of the input process image and the output process image. The following local process image is available for your customer-specific safety application.

⚠ WARNING

Use non-safe signals only functionally

For each signal in the process image, the column "Group" indicates whether it is a safety-related or a standard signal. Non-safe signals must not be used for safety-related evaluation or shutdown without additional measures.

7.1 Input

The local process image of the input signals consists of a maximum of 512 bytes of data.

7.1.1 Single-axis variant

The following process image applies to the single-axis product variant.

Offset	Name	Data type	Group	Description
0.0	ChA_STO _Error	BIT	Safety	**True**: Error detected in switch-off paths STO of axis A **False**: No error (link to output signal 6.1)
0.1	ChA_STO_State	BIT	Standard	**True**: Axis A enabled **False**: No error
0.4	ChA_Brake_Error	BIT	Safety	**True**: brake control error detected **False**: no error
0.5	ChA_DriveReq_Activate_Brake	BIT	Standard	**True**: brake is released according to drive **False**: brake is applied according to drive
2.0	ChA_EncoderVoltage_Underrange	BIT	Standard	**True**: Undervoltage at encoder (OCT axis A) **False**: No error (link to output signal 6.4)
2.1	ChA_EncoderVoltage_Overrange	BIT	Standard	**True**: Overvoltage at encoder (OCT axis A) **False**: No error (link to output signal 6.5)
2.2	ChA_EncoderVoltage_Error	BIT	Standard	**True**: Axis A encoder voltage error **False**: No error
2.3	ChA_DriveReq_Activate_Encoder	BIT	Standard	**True**: Encoder of axis A is switched on according to the drive. **False**: Encoder of axis 1 is switched off according to the drive. (Link to output signal 6.6)
4.0 - 5.7	ChA_EncoderVoltage	INT16	Standard	Analog value of encoder voltage (OCT or Endat) in mV
14.0 - 15.7	ChA_ElectricalAngle	UINT16	Standard	Electrical angle (2π per pole)
16.0 - 17.7	ChA_Current_Iq	DINT32	Standard	Analog value of current I_Q, torque-forming current
20.0 - 21.7	ChA_Current_Id	DINT32	Standard	Analog value of current I_D, field-forming current
26.0	ChA_DriveReq_Run	BIT	Standard	Run signal for axis A of the drive control word
26.1	ChA_DriveReq_ErrAck	BIT	Standard	Error Acknowledge signal for axis A of the drive control word (Link to output signal 0.4, 1.5, 2.2, 4.0, 14.0, 18.0)

Offset	Name	Data type	Group	Description
50.0	ChA_PriFb_Error	BIT	Safety	**True**: Error in primary feedback module of axis A **False**: No error
50.1	ChA_PriFb_Encoder_Ready	BIT	Standard	**True**: Primary feedback module of axis A ready **False**: No error
50.2	ChA_PriFb_Position_Valid	BIT	Safety	**True**: Position of the primary feedback module of axis A valid **False**: No error
50.3	ChA_PriFb_SDI_p	BIT	Safety	**True**: Drive rotates in positive direction (axis A) **False**: No error
50.4	ChA_PriFb_SDI_n	BIT	Safety	**True**: Drive rotates in negative direction (axis A) **False**: No error
50.5	ChA_PriFb_RefRequired	BIT	Safety	**True**: Reference position of primary feedback module of axis A required **False**: No error
50.6	ChA_PriFb_RefPosition_Valid	BIT	Safety	**True**: Reference position of the primary feedback module of axis A valid **False**: No error
52.0-55.7	ChA_PriFb_Safe_RefMultiturnPosition	DINT32	Safety	Multi-turn position value of the primary feedback module of axis A
56.0-59.7	ChA_PriFb_Standard_MultiturnPosition	UDINT32	Standard	Multi-turn position value of the primary feedback module of axis A
60.0-63.7	ChA_PriFb_Safe_SingleturnPosition	UDINT32	Safety	Single-turn position value of the primary feedback module of axis A
64.0-67.7	ChA_PriFb_Safe_RefSingleturnPosition	UDINT32	Safety	Single-turn position value of the primary feedback module of axis A
68.0-71.7	ChA_PriFb_Acceleration_Maximum	DINT32	Safety	Analog value of the maximum acceleration in the last logic cycle (unit: increments/ms²).
72.0-75.7	ChA_PriFb_Acceleration_Average	DINT32	Safety	Analog value of the average acceleration according to the setting of the safety parameters (unit: increments/ms²).
76.0-79.7	ChA_PriFb_Velocity_Maximum	DINT32	Safety	Analog value of the maximum velocity in the last logic cycle (unit: increments/ms).
80.0-83.7	ChA_PriFb_Velocity_Average	DINT32	Safety	Analog value of the average velocity according to the setting of the safety parameters (unit: increments/ms).

7.1.2 Double-axis variant

Process image with double-axis application

For a double-axis application, the following process image applies in addition to the process image in chapter Single-axis variant [▶ 39].

Offset	Name	Data type	Group	Description
0.2	ChB_STO_Error	BIT	Safety	**True**: Error detected in switch-off paths STO of axis B **False**: No error (link to output signal 10.1)
0.3	ChB_STO_State	BIT	Standard	**True**: Axis B enabled **False**: No error
0.6	ChB_Brake_Error	BIT	Safety	**True**: brake control error detected **False**: no error
0.7	ChB_DriveReq_Activate_Brake	BIT	Standard	**True**: brake is released according to drive **False**: brake is applied according to drive
28.0	ChB_EncoderVoltage_Underrange	BIT	Standard	**True**: Undervoltage at encoder (OCT axis B) **False**: No error (link to output signal 6.4)
28.1	ChB_EncoderVoltage_Overrange	BIT	Standard	**True**: Overvoltage at encoder (OCT axis B) **False**: No error (link to output signal 6.5)
28.2	ChB_EncoderVoltage_Error	BIT	Standard	**True**: Axis B encoder voltage error **False**: No error
28.3	ChB_DriveReq_Activate_Encoder	BIT	Standard	**True**: Encoder of axis B is switched on according to the drive. **False**: Encoder of axis B is switched off according to the drive. (Link to output signal 6.6)
30.0-31.7	ChB_EncoderVoltage	INT16	Standard	Analog value of encoder voltage (OCT or Endat) in mV
36.0-37.7	ChB_ElectricalAngle	UINT16	Standard	Electrical angle (2π per pole)
38.0-41.7	ChB_Current_Iq	DINT32	Standard	Analog value of current I_Q, torque-forming current
42.0-45.7	ChB_Current_Id	DINT32	Standard	Analog value of current I_D, field-forming current
48.0	ChB_DriveReq_Run	BIT	Standard	Run signal for axis B of the drive control word
48.1	ChB_DriveReq_ErrAck	BIT	Standard	Error Acknowledge signal for axis B of the drive control word (Link to output signal 0.4, 1.5, 2.2, 4.0, 14.0, 18.0)
92.0	ChB_PriFb_Error	BIT	Safety	**True**: Error in primary feedback module of axis B **False**: No error
92.1	ChB_PriFb_Encoder_Ready	BIT	Standard	**True**: Primary feedback module of axis B ready **False**: No error
92.2	ChB_PriFb_Position_Valid	BIT	Safety	**True**: Position of the primary feedback module of axis B valid **False**: No error
92.3	ChB_PriFb_SDI_p	BIT	Safety	**True**: Drive rotates in positive direction (axis B) **False**: No error
92.4	ChB_PriFb_SDI_n	BIT	Safety	**True**: Drive rotates in negative direction (axis B) **False**: No error
92.5	ChB_PriFb_RefRequired	BIT	Safety	**True**: Reference position of primary feedback module of axis B required **False**: No error

Offset	Name	Data type	Group	Description
92.6	ChB_PriFb_RefPosition_Valid	BIT	Safety	**True**: Reference position of the primary feedback module of axis B valid **False**: No error
94.0-97.7	ChB_PriFb_Safe_RefMultiturnPosition	DINT32	Safety	Multi-turn position value of the primary feedback module of axis B
98.0-101.7	ChB_PriFb_Standard_MultiturnPosition	UDINT32	Standard	Multi-turn position value of the primary feedback module of axis B
102.0-105.7	ChB_PriFb_Safe_SingleturnPosition	UDINT32	Safety	Single-turn position value of the primary feedback module of axis B
106.0-109.7	ChB_PriFb_Safe_RefSingleturnPosition	UDINT32	Safety	Single-turn position value of the primary feedback module of axis B
110.0-113.7	ChB_PriFb_Acceleration_Maximum	DINT32	Safety	Analog value of the maximum acceleration in the last logic cycle (unit: increments/ms²).
114.0-117.7	ChB_PriFb_Acceleration_Average	DINT32	Safety	Analog value of the average acceleration according to the setting of the safety parameters (unit: increments/ms²).
118.0-121.7	ChB_PriFb_Velocity_Maximum	DINT32	Safety	Analog value of the maximum velocity in the last logic cycle (unit: increments/ms).
122.0-125.7	ChB_PriFb_Velocity_Average	DINT32	Safety	Analog value of the average velocity according to the setting of the safety parameters (unit: increments/ms).

7.2 Output

The local process image of the output signals consists of a maximum of 32 bytes of data.

7.2.1 Single-axis variant

The following process image applies to the single-axis product variant.

Offset	Name	Data type	Group	Description
0.0	ChA_STO_1	BIT	Safety	**True**: Enable switch-off path 1 (STO axis A) **False**: Disable switch-off path 1 (STO axis A)
0.1	ChA_STO_2	BIT	Safety	**True**: Enable switch-off path 2 (STO axis A) **False**: Disable switch-off path 2 (STO axis A)
0.2	ChA_STO_ErrAck	BIT	Standard	Acknowledgement of an error in the switch-off paths of axis A
0.3	ChA_no_STO_to_Drive	BIT	Standard	**True**: Enable to drive: output stage is enabled for drive (axis A) **False**: output stage is disabled for drive.
1.0	ChA_Brake_Release	BIT	Safety	**True**: Release brake on axis A **False**: Lock brake
1.1	ChA_Brake_ErrAck	BIT	Standard	Acknowledgement of a brake control error
2.0	ChA_EncoderVoltage_ErrAck	BIT	Standard	Acknowledgement of an error of the encoder voltage monitoring of axis A
4.0	ChA_DriveCmd_GroupError	BIT	Standard	Drive status: Group error on axis A
6.0	ChA_DriveCmd_Emergency_Stop	BIT	Standard	reserved
6.1	ChA_DriveCmd_2	BIT	Standard	reserved
6.2	ChA_DriveCmd_3	BIT	Standard	reserved
6.3	ChA_DriveCmd_4	BIT	Standard	reserved
6.4	ChA_DriveCmd_5	BIT	Standard	reserved

Offset	Name	Data type	Group	Description
6.5	ChA_DriveCmd_6	BIT	Standard	reserved
6.6	ChA_DriveCmd_7	BIT	Standard	reserved
6.7	ChA_DriveCmd_8	BIT	Standard	reserved
8.0	ChA_DiagMessage_1	BIT	Safety	On falling edge, Diag message 0xD300 is entered in the Diag history.
8.1	ChA_DiagMessage_2	BIT	Safety	On falling edge, Diag message 0xD301 is entered in the Diag history.
8.2	ChA_DiagMessage_3	BIT	Safety	On falling edge, Diag message 0xD302 is entered in the Diag history.
8.3	ChA_DiagMessage_4	BIT	Safety	On falling edge, Diag message 0xD303 is entered in the Diag history.
8.4	ChA_DiagMessage_5	BIT	Safety	On falling edge, Diag message 0xD304 is entered in the Diag history.
8.5	ChA_DiagMessage_6	BIT	Safety	On falling edge, Diag message 0xD305 is entered in the Diag history.
8.6	ChA_DiagMessage_7	BIT	Safety	On falling edge, Diag message 0xD306 is entered in the Diag history.
8.7	ChA_DiagMessage_8	BIT	Safety	On falling edge, Diag message 0xD307 is entered in the Diag history.
9.0	ChA_DiagMessage_9	BIT	Safety	On falling edge, Diag message 0xD308 is entered in the Diag history.
9.1	ChA_DiagMessage_10	BIT	Safety	On falling edge, Diag message 0xD309 is entered in the Diag history.
9.2	ChA_DiagMessage_11	BIT	Safety	On falling edge, Diag message 0xD30A is entered in the Diag history.
9.3	ChA_DiagMessage_12	BIT	Safety	On falling edge, Diag message 0xD30B is entered in the Diag history.
9.4	ChA_DiagMessage_13	BIT	Safety	On falling edge, Diag message 0xD30C is entered in the Diag history.
9.5	ChA_DiagMessage_14	BIT	Safety	On falling edge, Diag message 0xD30D is entered in the Diag history.
9.6	ChA_DiagMessage_15	BIT	Safety	On falling edge, Diag message 0xD30E is entered in the Diag history.
9.7	ChA_DiagMessage_16	BIT	Safety	On falling edge, Diag message 0xD30F is entered in the Diag history.
18.0	ChA_PriFb_Enable	BIT	Standard	**True**: Enable primary feedback module of axis A **False**: Disable primary feedback module of axis A
18.1	ChA_PriFb_ErrAck	BIT	Standard	Acknowledgement of an error of the primary feedback module of axis A
18.2	ChA_PriFb_SetRef	BIT	Safety	Setting the reference position for the primary feedback module of axis A

7.2.2 Double-axis variant

Process image with double-axis application

For a double-axis application, the following process image applies in addition to the process image in chapter Single-axis variant [▶ 42].

Offset	Name	Data type	Group	Description
0.4	ChB_STO_1	BIT	Safety	**True**: Enable switch-off path 1 (STO axis B) **False**: Disable switch-off path 1 (STO axis B)

Offset	Name	Data type	Group	Description
0.5	ChB_STO_2	BIT	Safety	**True**: Enable switch-off path 2 (STO axis B) **False**: Disable switch-off path 2 (STO axis B)
0.6	ChB_STO_ErrAck	BIT	Standard	Acknowledgement of an error in the switch-off paths of axis B
0.7	ChB_no_STO_to_Drive	BIT	Standard	**True**: Enable to drive: output stage is enabled for drive (axis B) **False**: output stage is disabled for drive. (1=Port to Drive Application is 0 (no STO))
1.2	ChB_Brake_Release	BIT	Safety	**True**: Release brake on axis B **False**: Lock brake
1.3	ChB_Brake_ErrAck	BIT	Standard	Acknowledgement of a brake control error
10.0	ChB_EncoderVoltage_ErrAck	BIT	Standard	Acknowledgement of an error of the encoder voltage monitoring of axis B
12.0	ChB_DriveCmd_GroupError	BIT	Standard	Drive status: Group error on axis B
14.0	ChB_DriveCmd_Emergency_Stop	BIT	Standard	reserved
14.1	ChB_DriveCmd_2	BIT	Standard	reserved
14.2	ChB_DriveCmd_3	BIT	Standard	reserved
14.3	ChB_DriveCmd_4	BIT	Standard	reserved
14.4	ChB_DriveCmd_5	BIT	Standard	reserved
14.5	ChB_DriveCmd_6	BIT	Standard	reserved
14.6	ChB_DriveCmd_7	BIT	Standard	reserved
14.7	ChB_DriveCmd_8	BIT	Standard	reserved
16.0	ChB_DiagMessage_1	BIT	Safety	On falling edge, Diag message 0xD310 is entered in the Diag history.
16.1	ChB_DiagMessage_2	BIT	Safety	On falling edge, Diag message 0xD311 is entered in the Diag history.
16.2	ChB_DiagMessage_3	BIT	Safety	On falling edge, Diag message 0xD312 is entered in the Diag history.
16.3	ChB_DiagMessage_4	BIT	Safety	On falling edge, Diag message 0xD313 is entered in the Diag history.
16.4	ChB_DiagMessage_5	BIT	Safety	On falling edge, Diag message 0xD314 is entered in the Diag history.
16.5	ChB_DiagMessage_6	BIT	Safety	On falling edge, Diag message 0xD315 is entered in the Diag history.
16.6	ChB_DiagMessage_7	BIT	Safety	On falling edge, Diag message 0xD316 is entered in the Diag history.
16.7	ChB_DiagMessage_8	BIT	Safety	On falling edge, Diag message 0xD317 is entered in the Diag history.
17.0	ChB_DiagMessage_9	BIT	Safety	On falling edge, Diag message 0xD318 is entered in the Diag history.
17.1	ChB_DiagMessage_10	BIT	Safety	On falling edge, Diag message 0xD319 is entered in the Diag history.
17.2	ChB_DiagMessage_11	BIT	Safety	On falling edge, Diag message 0xD31A is entered in the Diag history.
17.3	ChB_DiagMessage_12	BIT	Safety	On falling edge, Diag message 0xD31B is entered in the Diag history.
17.4	ChB_DiagMessage_13	BIT	Safety	On falling edge, Diag message 0xD31C is entered in the Diag history.
17.5	ChB_DiagMessage_14	BIT	Safety	On falling edge, Diag message 0xD31D is entered in the Diag history.
17.6	ChB_DiagMessage_15	BIT	Safety	On falling edge, Diag message 0xD31E is entered in the Diag history.

Offset	Name	Data type	Group	Description
17.7	ChB_DiagMessage_16	BIT	Safety	On falling edge, Diag message 0xD31F is entered in the Diag history.
20.0	ChB_PriFb_Enable	BIT	Standard	**True**: Enable primary feedback module of axis B **False**: Disable primary feedback module of axis B
20.1	ChB_PriFb_ErrAck	BIT	Standard	Acknowledgement of an error of the primary feedback module of axis B
20.2	ChB_PriFb_SetRef	BIT	Safety	Setting the reference position for the primary feedback module of axis B

8 Requirements for the feedback system

This chapter describes the requirements for the feedback system when using the SICK OCT encoder EDS35/EDM35.

⚠ WARNING

Comply with the requirements

The requirements arising from the use of the SICK EDS35/EDM35 encoder are listed in the table below. It is imperative that you comply with these requirements.

Failure to do so may result in malfunction of the TwinSAFE card and thus loss of security.

Name	Description
Service Mode	It is not allowed to operate the feedback system in Access Level 4 ("Service") when using a safe absolute position.
Servomotor applications	Currently, only applications on a servomotor basis may be implemented with this feedback system. Operation with variable frequency drive is not permitted.
Safe resolution	The data type of the SingleTurn Position is a UDINT with a length of 32 bits. The maximum resolution of the encoder with 24 bits is entered left aligned in the variables. Only the upper 13 bits of this SingleTurn position can be loaded for safety reasons (see chapter "Target failure measures [▶ 19]" in the TwinSAFE card documentation).
Encoder functions	If functions of the encoder such as *Set Position* (101h) or *Factory Settings* (108h) are executed, this will be detected by the TwinSAFE card and an error displayed. A subsequent start is possible only after an update and download of the safety parameters.
Encoder documentation	Instructions and requirements from the respective user documentation and data sheets for the encoder must be followed.
Safety-related accuracy	A deviation of 4 increments is implemented as standard, deviating from the SICK EDS35/EDM35 data sheet. Further information can be found in chapters Product data [▶ 18].

9 Motor replacement

You have the option to replace the motor used. If you want to use this possibility, you must already provide for a possible motor exchange during the engineering time by a corresponding parameterization.

NOTICE

Check axes

After a motor replacement, check that the axes are not reversed to ensure clear signal transmission.

It may be necessary to adjust the position offset and the reference position by means of the application.

Two different CRCs are available to implement the exchange of a motor:

- Full CRC
- Reduced CRC

You can still use the full CRC to prevent motor replacement. This CRC gives you more control on the one hand, and prevents the creation of offline projects on the other.

Motor replacement is not possible if

- the read encoder parameters do not match the stored encoder parameters for any of the two possible encoders. The module reports a module error. Only one motor can be replaced at a time.

Motor replacement is possible if

- the calculated reduced CRC matches the CRC transmitted via the safety parameters.
- if there are two possible encoders, the read out encoder parameters of one encoder do not match the stored encoder parameters and the parameters of the other encoder match.
- the module is activated for one encoder only and the read encoder parameters of the encoder do not match the stored encoder parameters. The encoder ID is not evaluated.

The module sends a diagnostic message in the Diag history once when the motor is replaced.

10 Appendix

10.1 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.

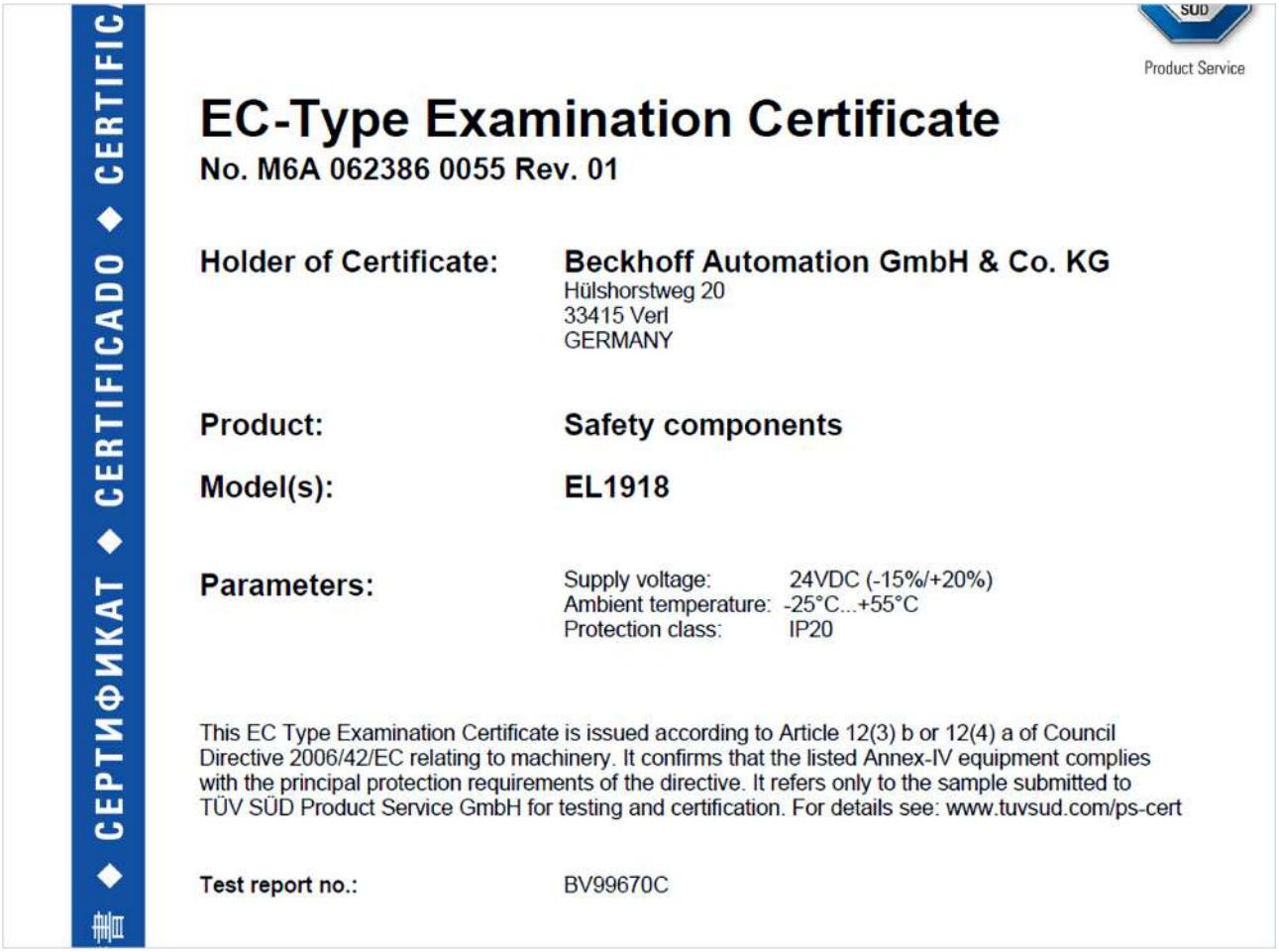
If there is customer specific data saved on the product, it cannot be ensured that this data might not be restored through for example forensic measures, even after the data is deleted through the provided tool chain. If this data is confidential, the scrapping of the product after usage is recommended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

10.2 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.

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