

Operating Instructions | EN

# ELM8911

TwinSAFE drive option card for servo drive ELM72xx-9016





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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 operating instructions at any time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in these operating instructions.

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

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The EtherCAT technology is protected by patent rights through the following registrations and patents with corresponding applications and registrations in various other countries:

- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702



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### 1.1.3 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

### 1.1.4 Copyright

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## 1.2 Version numbers

Version	Comment
1.2.0	<ul style="list-style-type: none"> <li>• Chapter “Notes on information security” added</li> <li>• Safety instructions for engineering tools revised</li> <li>• “lifetime” and “target failure measures” renamed</li> <li>• Chapters “Target failure measures”, “Version history” and “Environmental conditions” adapted</li> </ul>
1.1.0	<ul style="list-style-type: none"> <li>• Information block added to chapter “Description”</li> <li>• Chapter “Factory setting STO in the TwinSAFE drive option card” revised</li> <li>• Chapter “Address setting” added</li> </ul>
1.0.0	<ul style="list-style-type: none"> <li>• First released version</li> </ul>
0.0.1	<ul style="list-style-type: none"> <li>• Preliminary (internal only)</li> </ul>

### 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

Please 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.de/twinsafe>. In case of doubt, please contact Technical Support (see Beckhoff Services).

## 1.3 Version history

This version history lists the firmware version numbers. You will also find an overview of the available ModuleIdents and which firmware supports which ModuleIdents. See the following table.

ModuleIdent	ELM8911 firmware version
Single-axis: x001022D9 Double-axis: X001022DA	ELM8911 Firmware 01 (V0102) - STO

## 1.4 References

No	Version	Title / description
[1]	/	Not used.
[2]	1.1 or newer	<b>Documentation ELM72xx - servomotor terminal in metal housing</b> This documentation contains a description of the mechanical and electrical characteristics, as well as all the information necessary for using the ELM72xx servomotor terminals.
[3]	1.9.0 or newer	<b>Operating instructions for EL6910 TwinSAFE Logic module</b> The document contains a description of the logic functions of the EL6910, and thus also of the TwinSAFE drive option card, and their programming
[4]	3.1.0 or newer	<b>Documentation for TwinSAFE Logic FB</b> The document describes the safety function blocks that are available in the EL6910, and thus also in the TwinSAFE drive option card, and form the safety application.
[5]	1.8.0 or newer	<b>TwinSAFE Application Guide</b> The Application Guide provides the user with examples for the calculation of target failure measures for safety functions according to the standards DIN EN ISO 13849-1 and EN 62061 or EN 61508, such as are typically used on machines.
[6]	2006/42/EC	<b>Directive 2006/42/EC of the European Parliament and of the Council of 17. May 2006 on machinery and amending Directive 95/16-7/EC (revised) of 29 June 2006</b> This directive, also known as the Machinery Directive, defines requirements for the placing on the market of machines and machine-like components, such as safety components.
[7]	/	Not used.

### Document classification in the overall documentation

This documentation applies exclusively to ELM72xx variants with integrated safety technology, in accordance with the [Type key](#) [► 18].

This TwinSAFE drive option card is a permanently installed part of a servomotor terminal with integrated safety technology. For this reason, some life phases, such as decommissioning and disposal, apply exclusively to the servomotor terminals 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](#) [► 8]. 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 Beckhoff Services

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e-mail: service@beckhoff.com  
Web: www.beckhoff.de/service

### 1.7.4 Download area

In the download area you will find product information, software updates, the TwinCAT automation suite, documentation and much more.

Web: www.beckhoff.de/download

### 1.7.5 Headquarters

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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](#) [► 6].
- 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 General safety instructions

#### 2.2.1 Before operation

##### Use in machines according to the Machinery Directive

Only use the overall system in machines in accordance with the Machinery Directive to ensure safe operation.

##### 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.

##### Install in control cabinet/terminal box

The TwinSAFE components must be installed for operation in a control cabinet or terminal box with at least protection rating IP54 according to IEC 60529.

##### 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  $U_{\max} = 36 \text{ V}_{\text{DC}}$  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. 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.

## 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 ELM72xx and ELM8911 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 ELM8911 leading to shutdown

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° 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.

## 2.2.2 During operation

### Caution - 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.

### **2.2.3 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 System overview



#### Compact drive technology in robust metal housing

The ELM72xx EtherCAT Terminals are fully-fledged servo drives in a robust metal housing with an output current ( $I_{rms}$ ) of up to 16 A at 48 V<sub>DC</sub> voltage for the power supply.

They expand the Beckhoff portfolio of compact drive technology in terminal format and offer all current technology features with increased performance and functionality compared to the comparable EL versions.

The metal housing of the ELM72xx results in optimal heat dissipation even at high output powers as well as good shielding against electrical interference. The servo terminals can be directly connected to the EtherCAT Terminals and are therefore an integral part of the Beckhoff I/O system. The comprehensive functionality includes the direct connection of motor, feedback and brake via the convenient connector front end, an integrated absolute value interface and the One Cable Technology (OCT). Additional I/Os enable latching of position values. The integrated brake chopper control also allows a braking resistor to be connected directly. Compared to the EL series, the wiring level of the ELM72xx is designed to be pluggable. Matching motor and sensor cables further simplify installation. The design of the drive - ELM72xx combined with servomotors [AM8100](#) - is done as usual via the TwinCAT 3 Motion Designer ([TE5910](#)). Commissioning is very easy thanks to the electronic identification plate and the TwinCAT 3 Drive Manager 2 ([TE5950](#)).



## 4 Product overview

### 4.1 Product description

#### **ELM8911 – TwinSAFE drive option card for servomotor terminals of the ELM72xx series**

The ELM8911 TwinSAFE drive option card is an optional extension of the Beckhoff ELM72xx servo drive series, in which it is permanently installed. The servo drive forms the overall system. The card enables you to define the safety functions by application. The type key of the servo drive determines whether it is a servo drive with STO or Safe Motion. In the delivery state, a factory setting 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 [Factory setting project](#) [► 25].

The variant in the ELM72xx-9016 servomotor terminals provides the STO (Safe Torque Off) safety function.

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. Further information can be found in chapter [Creating a project with the Safe Motion Wizard](#) [► 31].

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 user documentation. See document [3] at [References](#) [► 8].

## 4.2 Type key

ELM72ab-901c	Explanation
ELM	Product area Servomotor terminal, servo drive
72	Series ELM72xx
a	Output current $I_{rms}$ 1 = 4.5 A 2 = 8 A 3 = 16 A
b	Axis module 1 = 1-channel axis module 2 = 2-channel axis module
901	Integrated TwinSAFE drive option card
c	Safety function 6 = Safety functions STO, SS1 8 = Safe Motion function

Depending on the order identifier in the type key, the following safety functions according to EN 61800-5-2 can be implemented with the corresponding ELM72xx variant.

Order identifier	Safety functions			
ELM72xx-9016	<b>Stop functions</b>			
	<b>STO</b>	Safe torque off		
	<b>SS1</b>	Safe stop 1	- t	Time controlled

## 4.3 Intended use

Operate the TwinSAFE drive option card 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 servo drive 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 servo drive according to document [2] at [References \[▶ 8\]](#).

### **WARNING**

#### **Improper use**

Any use which exceeds the permissible written values from the chapter [Technical data \[▶ 20\]](#) 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.*

## 5 Technical data

### 5.1 Product data

Hardware data		Explanation
• Number of switch-off channels	1 channel per axis	
• Status display	Status and diagnostic LEDs	See document [2] at <a href="#">References [▶ 8]</a> .

Software data		Explanation
<b>Response times</b>		
• 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	
<b>Process image</b>		
• Input	6 to 51 bytes (1 to 24 bytes Safe Data)	For more information, see the chapter <a href="#">Local process image [▶ 40]</a> .
• Output	6 to 59 bytes (1 to 28 bytes Safe Data)	
<b>Miscellaneous</b>		
• 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.

## 5.2 Target failure measures

### **i** 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 13849-1:2015; 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 a	
Proof test interval	/	Special proof tests are not required during the entire lifetime of the TwinSAFE drive option card.
$PFH_D$	4.67E-9	
$PFD_{avg}$	9.85E-6	
$MTTF_D$	high	
DC	medium, 98.5 %	
SFF	>99 %	
SIL	3	According to IEC 61508:2010.
Performance Level	e	According to EN ISO 13849-1:2015.
CAT	4	According to EN ISO 13849-1:2015.
HFT	1	
Element classification	Type B	According to EN 61508-2:2010.

For further information, please refer to the chapter [Lifetime](#) [► 24].

## 5.3 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<sup>1</sup>
- in an environment that would lead to impermissible contamination of the TwinSAFE drive option card

<sup>1</sup> 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 servomotor terminal. For the conditions, see document [2] at [References](#) [► 8].

## 5.4 Project design limits ELM8911



### Project design limits

The maximum project design size of the ELM8911 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.

<b>TwinSAFE connections</b>	maximum 8 (Maximum 12 CRCs in total - 1 CRC is required for a TwinSAFE connection with 1 or 2 bytes of safe data).
<b>Safe data per TwinSAFE connection</b>	maximum 24 bytes (telegram length 51 bytes)
<b>TwinSAFE function blocks</b>	maximum 512 (ESTOP with complete input and output mapping)
<b>TwinSAFE groups</b>	maximum 128
<b>TwinSAFE user</b>	maximum 40
<b>Standard PLC inputs</b>	dynamic (memory-dependent), max. 54 bytes
<b>Standard PLC outputs</b>	dynamic (memory-dependent), max. 62 bytes

## 5.5 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

### 5.5.1 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.

### 5.5.2 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.

### 5.5.3 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.

## 5.6 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](#) [► 21].

The lifetime starts from the date of manufacture according to the name plate of the servo drive. For more information, see document [2] at [References](#) [► 8].

### **WARNING**

#### **Replace overall system 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 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 overall system can be found on the name plate of the servo drive. See document [2] at [References](#) [► 8].



## 6 Factory setting 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.*

### 6.1 Description

The servo drive with integrated safety technology cannot be operated without safety. The servo drive with integrated safety technology is supplied with a factory setting project as an example, which enables simple commissioning.

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

#### ● Address setting

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

If you want to use more than one ELM72xx, change the addresses of the additional ELM72xxs to ensure specific addressing. Then download the project again.

For further information on address setting, please refer to the chapter [Address setting \[▶ 37\]](#).

### 6.2 Factory setting STO in the TwinSAFE drive option card

#### ⚠ WARNING

#### STO switch-off paths

Within the logic there is one STO switch-off path "STO\_1" per axis. If you replace the safety logic on the TwinSAFE drive option card with a user-specific project, you must set the switch-off path for each axis.

In addition, the signal must be reported back to the servo system via the "no\_STO\_to\_Drive" output.

A safety-oriented logic program, the factory setting 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 set as a 16-bit value in the software.

## 6.3 Factory setting process image in I/O tree



### Process image valid for the factory setting 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 factory setting 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](#) [▶ 27].

### 6.3.1 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	<b>True:</b> No STO, STO outputs are enabled <b>False:</b> 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	<b>True:</b> No STO, STO outputs are enabled <b>False:</b> STO, safe state

### 6.3.2 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) <b>True:</b> No STO, STO outputs are enabled <b>False:</b> 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) <b>True:</b> No STO, STO outputs are enabled <b>False:</b> STO, safe state

## 7 Configuration in TwinCAT

### 7.1 Addition of an axis module

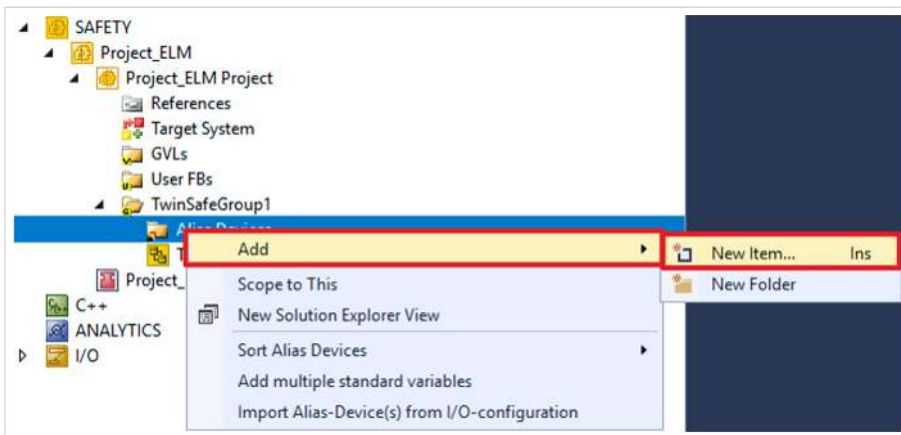
Adding an axis module is done in the same way as adding any other TwinSAFE component.

To add a TwinSAFE component, refer to the chapter Adding an EL6910 of document [3] at [References](#) [▶ 8].

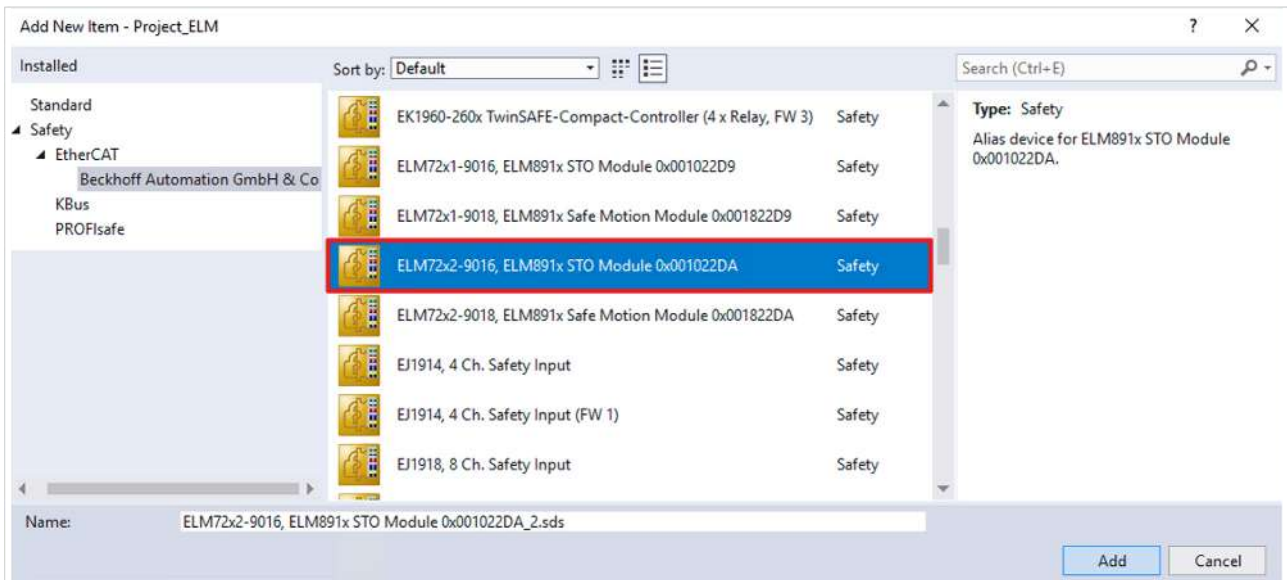
### 7.2 Using the ELM8911 with the factory setting project

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

To use the ELM8911 in a safety project, proceed as follows:

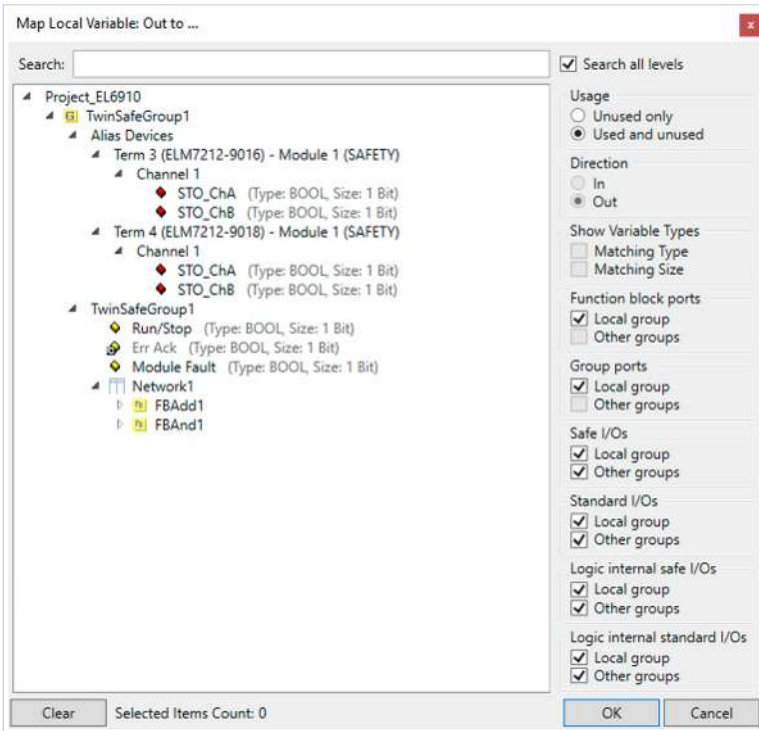


1. Right-click on the Alias Device folder of your safety project
2. Select "New Item..." via "Add"

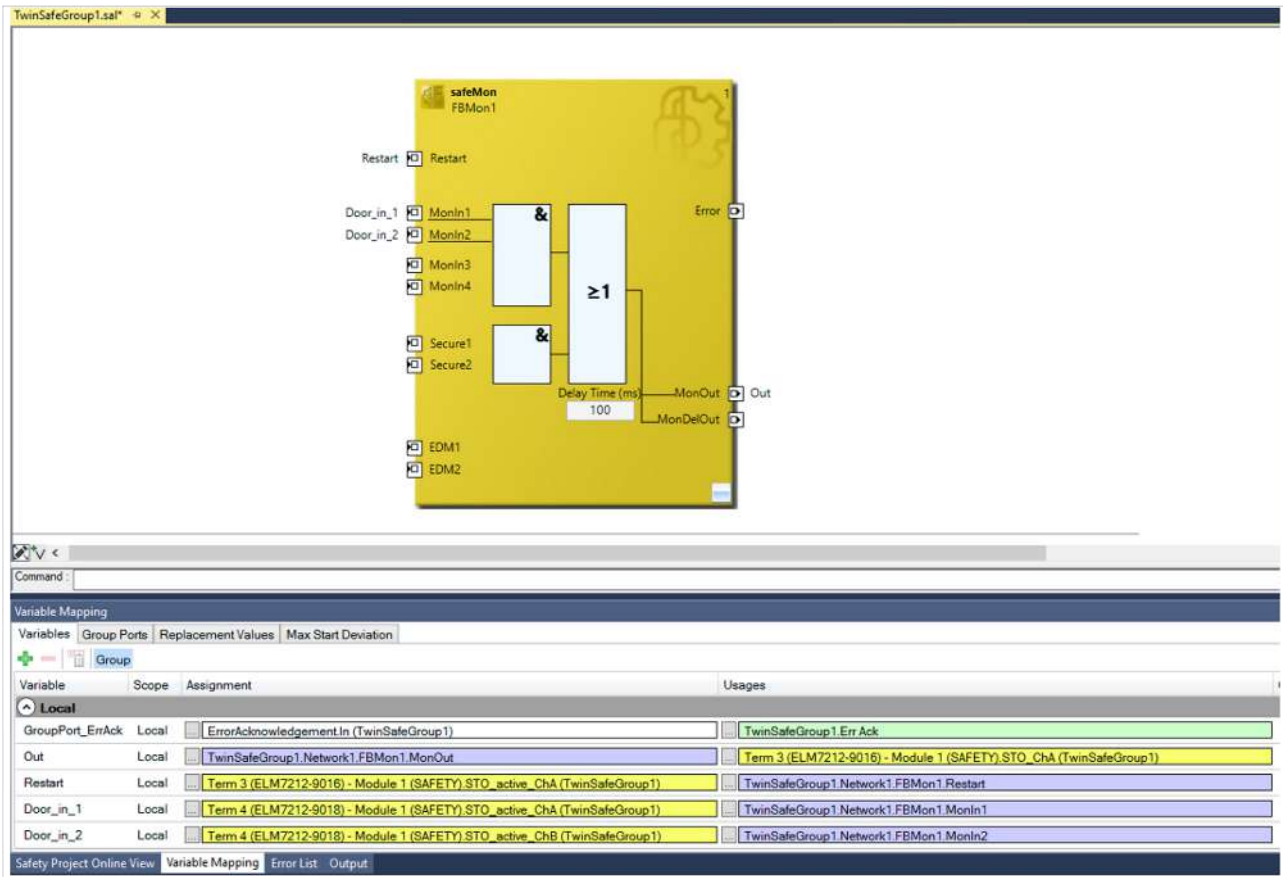


The "Add New Item" window opens and you can select the desired Alias Device. In the name you will find the information about which ELM8911 variant with the associated ModuleIdent it is.

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



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



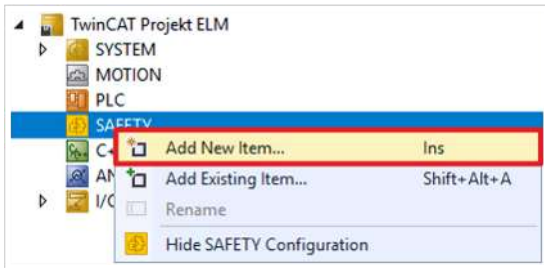
### 7.3 Implementing the ELM8911 with a safety-oriented user program

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.

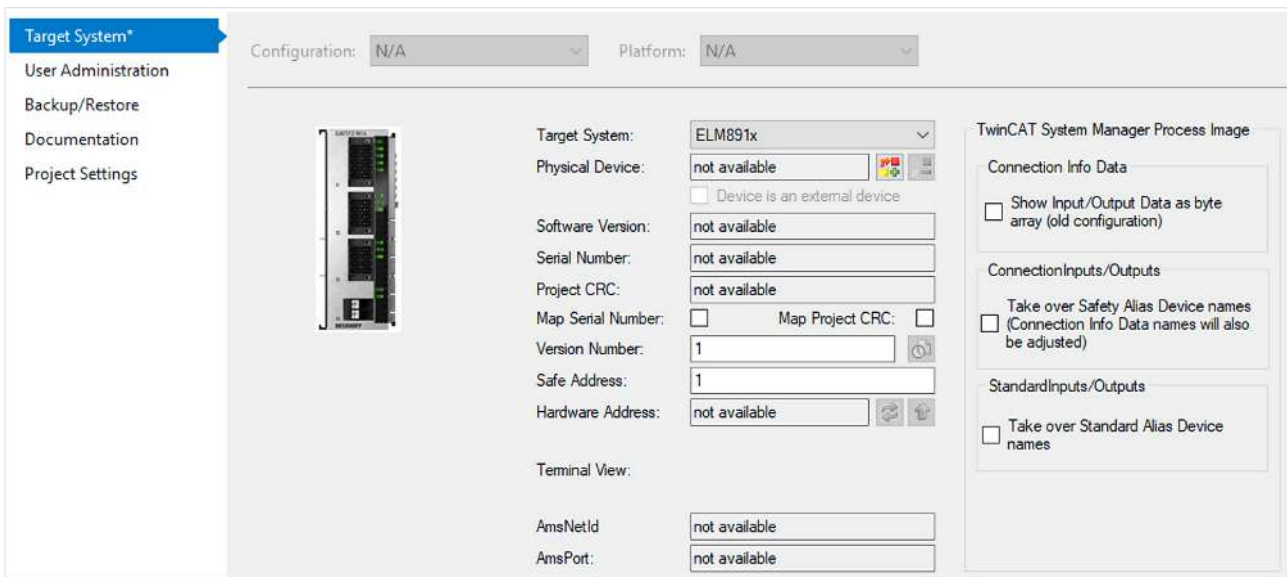
The function to run a customer-specific safety project is password protected. The login data is the standard login information for TwinSAFE components.


#### Target system

To use the user-specific functions in the ELM8911, a safety project is created in TwinCAT 3 and the ELM8911 or the axis module is selected as the target system. Proceed as follows:

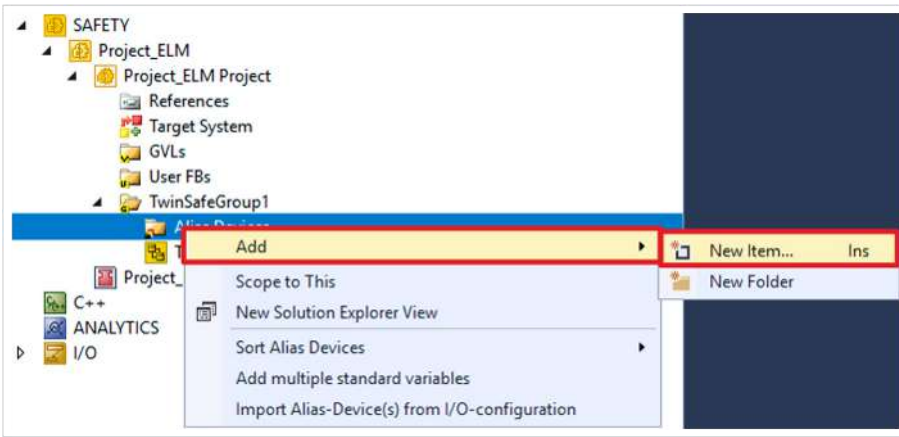


1. Right click on the safety configuration
2. Click on "Add New Item..."



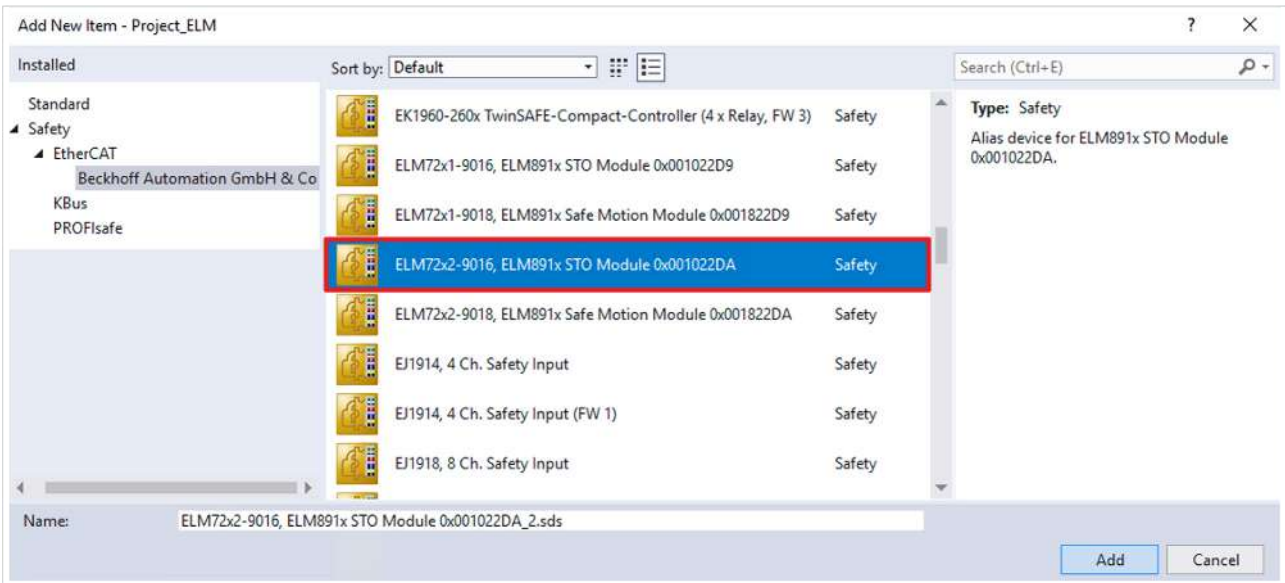
3. Double click on the newly added node
4. Open "Target System" tab to select the target system
5. Select "ELM891x" in the drop-down list of the target system
6. Click on  to link the TwinSAFE drive option card to the axis module

Proceed as follows to use the local inputs and outputs of the ELM8911:



7. Right-click on the Alias Device folder of the Safety project

8. Select "New Item..." via the "Add" field

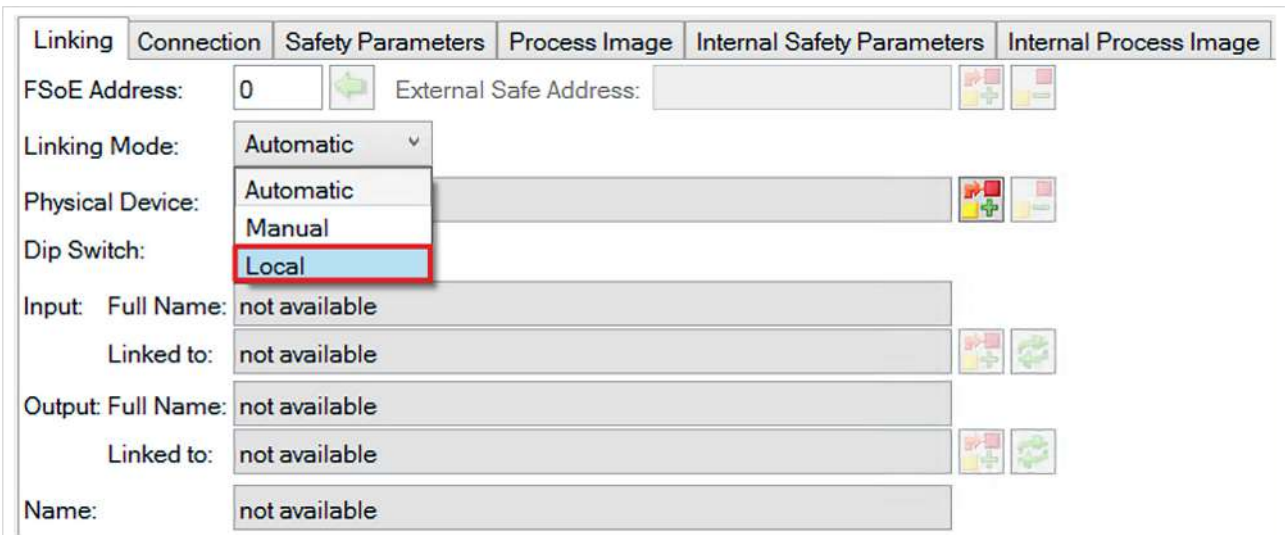


The "Add New Item" window opens. You can select your desired ELM72xx variant here. The name and the ModuleIdent in the alias device description tell you which ELM8911 variant it is.

Which ModuleIdent belongs to which firmware version and which ELM72xx firmware is supported can be found in the chapter [Version history](#) [▶ 7].

9. Select "ELM72x1-9016" or "ELM72x2-9016" for the STO variant

10. Confirm the selection with "Add"



11. Double click on the Alias Device
12. Open "Linking" tab
13. 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](#) [▶ 39].

### 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](#) [▶ 40].

## 7.4 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](#) [▶ 8].

## 7.5 Creating a project with the Safe Motion Wizard

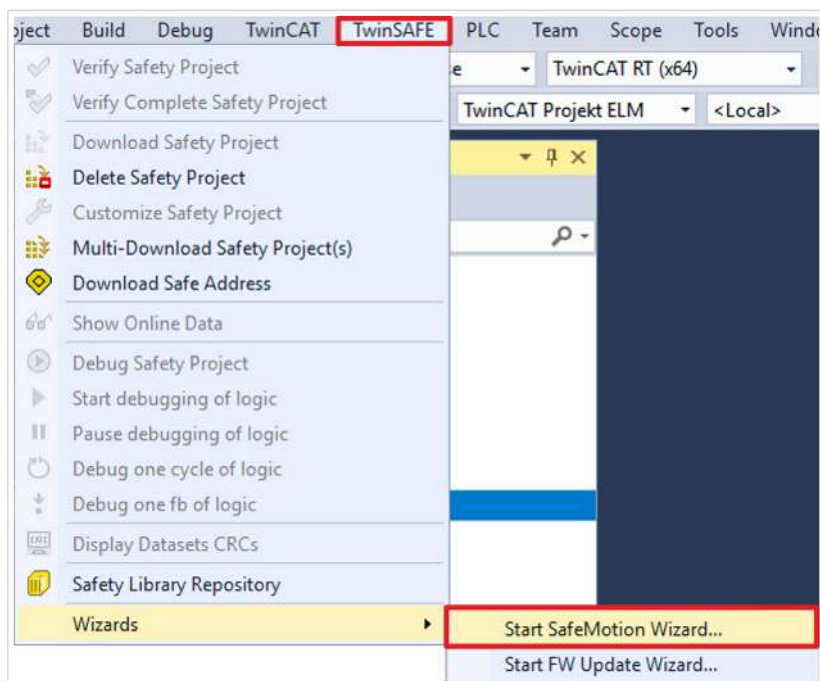
The Safe Motion Wizard is part of the TwinCAT 3 Safety Editor [TE9000](#) and is used to simplify the creation of safety projects for TwinSAFE Safe Motion functions, such as SLS or SS2.

You can use the wizard for existing axes in the I/O configuration or virtual axes. You can also use the wizard to create a connection to a master project.

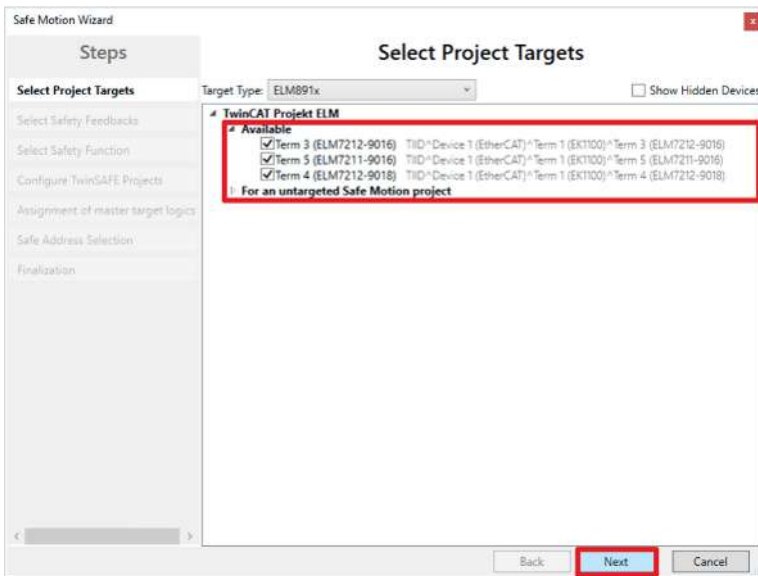
### **i** Example connection to a master project

For example, you can select the master project of an EL6910 terminal as the master project. This requires a solution with an I/O configuration and an EL6910 master safety project.

Proceed as follows:

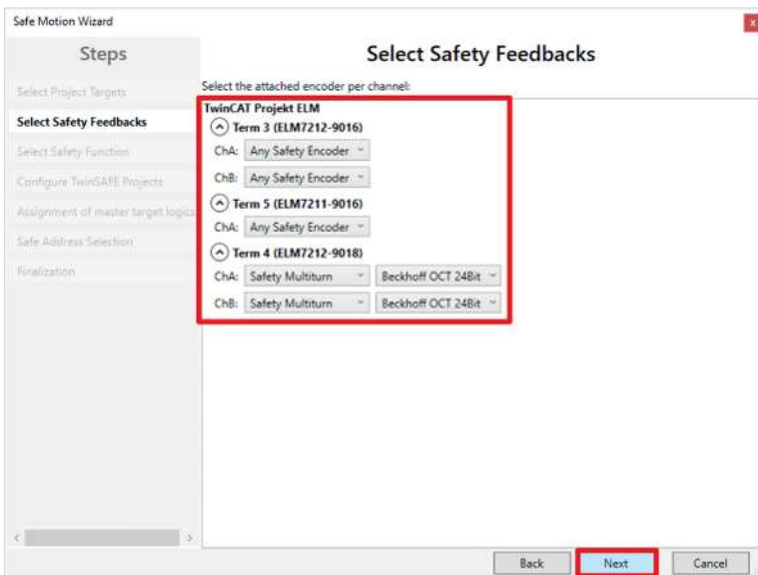


1. select "TwinSAFE" in the menu bar
2. Select "Start Safe Motion Wizard" via the menu item "Wizards"



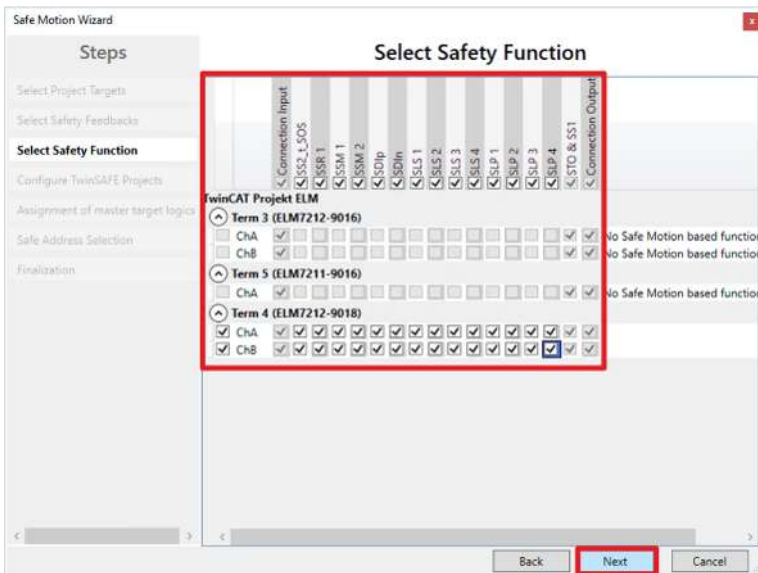
The "Select Project Targets" window shows the existing components and the virtual axes for single-axis and double-axis modules.

3. Select the desired components and axes
4. Confirm the selection with "Next"



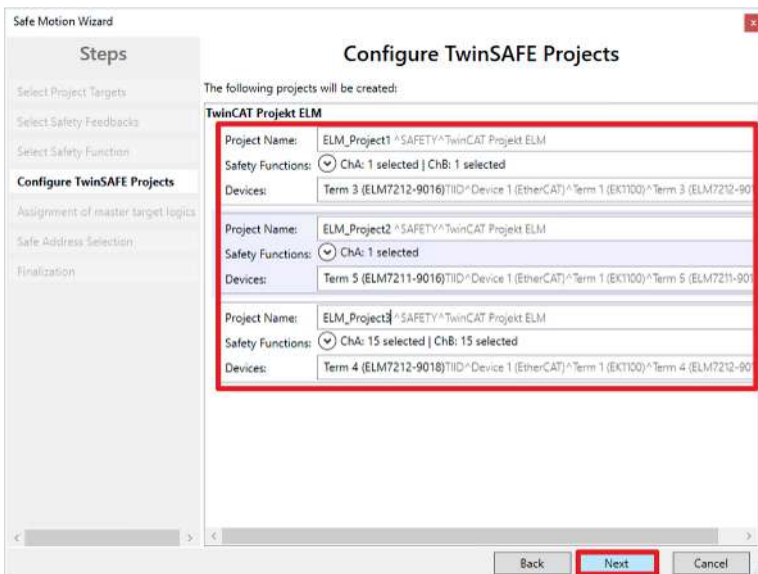
5. Configure the feedback in the "Select Safety Feedbacks" window
6. Confirm configuration with "Next"





7. In the "Select Safety Function" window, select the safety functions of the axes

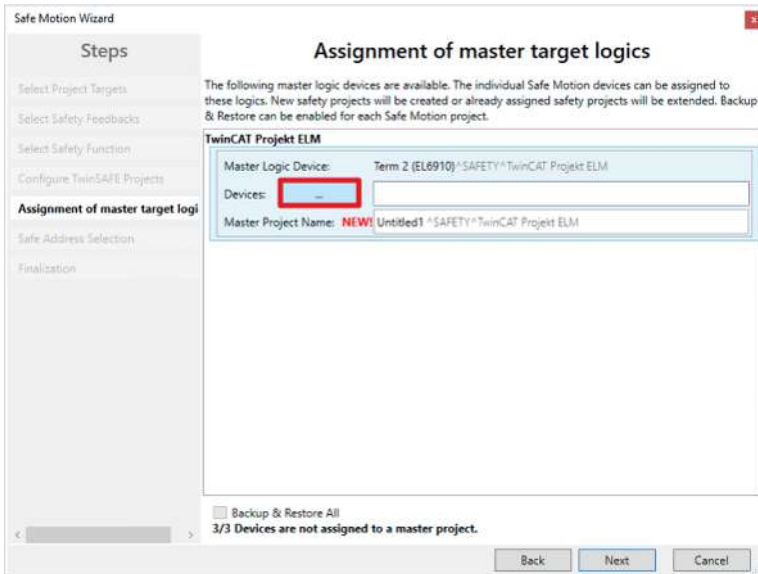
8. Confirm the selection with "Next"



The "Configure TwinSAFE Projects" window appears. The "Configure TwinSAFE Projects" window shows the safety projects that are generated. You can rename the safety projects here.

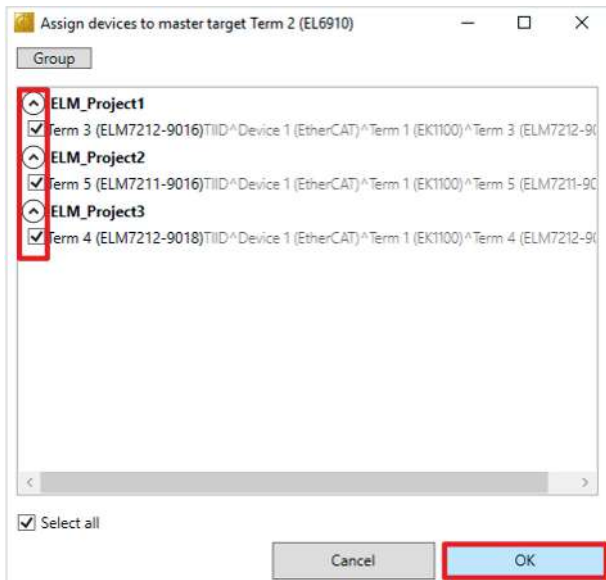
9. If desired, rename safety projects

10. Confirm the selection with "Next"



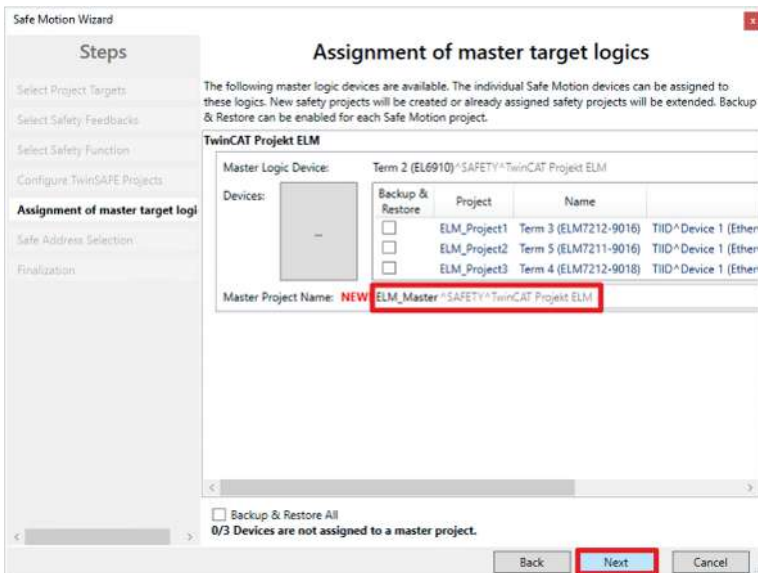
11. Set the master project in the "Assignment of master target logics" window

To do this, first select the devices that you want to connect to the master project.



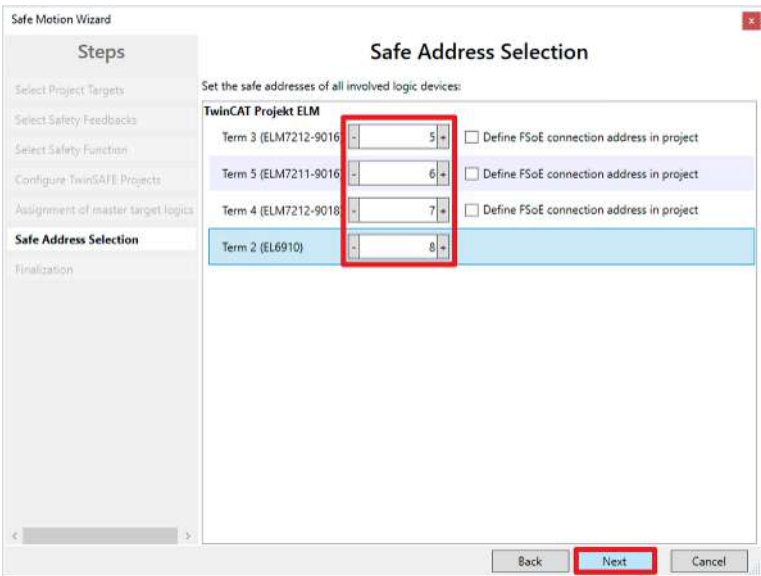
12. Select devices

13. Press "OK" to confirm your selection



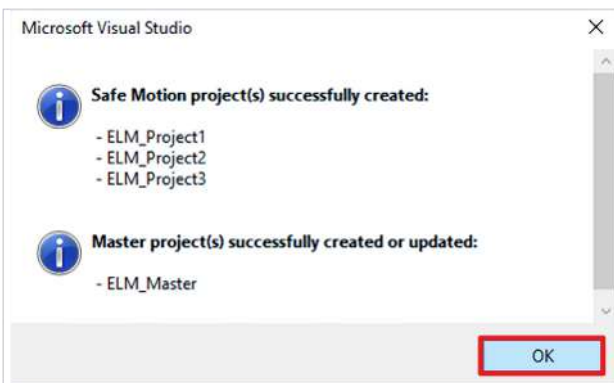
Either use an existing master project or generate a new one. In the marked field you have the possibility to enter the master project name.

14. Confirm with "Next"



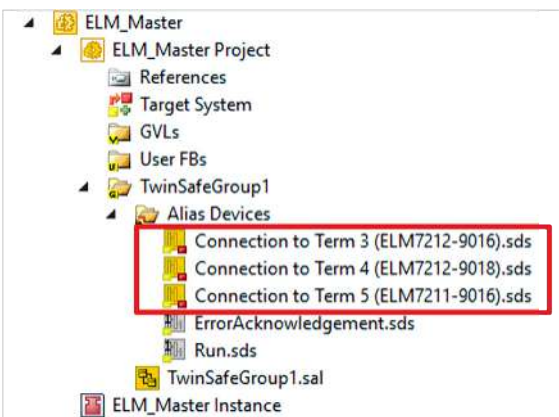
15. In the "Safe Address Selection" window, configure safe addresses of all devices  
 Alternatively, you can also configure the safe addresses within the safety project.

16. Confirm the settings with "Finish"



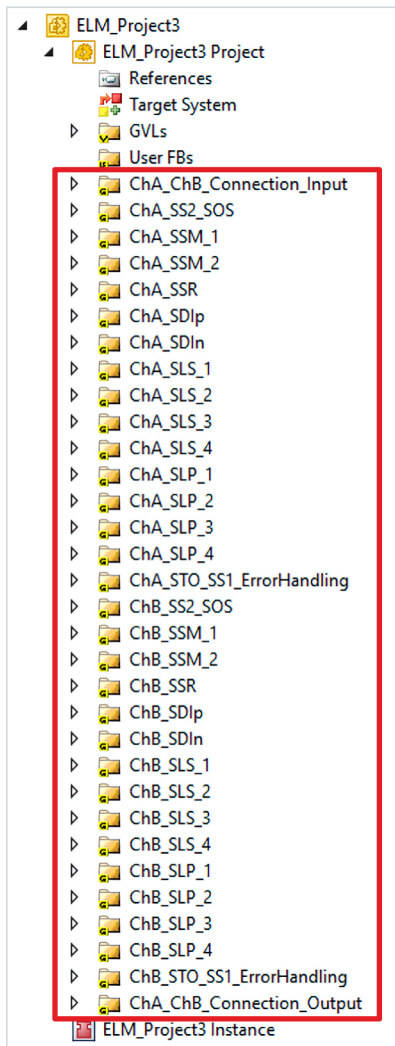
17. Confirm the window with "OK"

You have successfully generated the safety projects.



After this procedure you will receive a TC3-Solution with the corresponding safety projects for ELM72xx and for example EL6910.

The master project contains the connections to the configured axes.



The ELM72xx projects contain the safety functions selected in the wizard. Each safety function is implemented by a separate TwinSAFE group.

Variable	Scope	Assignment	Usages	Online Val
GroupPort_ErrAck	Local	[Target System.ChA_DriveReq_ErrAck (ChA_ChB_Connection_Input)]	ChA_SLS_1.ErrAck	
GroupPort_Run	Local	[Target System.ChA_DriveReq_Run (ChA_ChB_Connection_Input)]	ChA_SLS_1.Run/Stop	
STO_CMD	Global	[ChA_ChB_Connection_Input.Connection_Input_ChA.Connection_ChA_Input_Byte0.DecOut1]	ChA_STO_SS1_ErrorHandling.STO_SS1_1.STO_ChA.MonIn1	
SS1_CMD	Global	[ChA_ChB_Connection_Input.Connection_Input_ChA.Connection_ChA_Input_Byte0.DecOut2]	ChA_STO_SS1_ErrorHandling.STO_SS1_1.SS1_ChA.MonIn1	
SS2_CMD	Global	[ChA_ChB_Connection_Input.Connection_Input_ChA.Connection_ChA_Input_Byte0.DecOut3]	ChA_SS2_SOS.SS2_SOS_ChA.SS2.MonIn1	
SOS_CMD	Global	[ChA_ChB_Connection_Input.Connection_Input_ChA.Connection_ChA_Input_Byte0.DecOut4]	ChA_SS2_SOS.SS2_SOS_ChA.NEGATION_SS2_SOS.OrIn2 ChA_SS2_SOS.SS2_SOS_ChA.COMMAND_SS2_SOS.AndIn2	
SSR_CMD	Global	[ChA_ChB_Connection_Input.Connection_Input_ChA.Connection_ChA_Input_Byte0.DecOut5]	ChA_SSR.SSR_1.ChA.SSR.OrIn1 ChA_SSR.SSR_1.ChA.INVERT_SSR.STATE_ChA.AndIn1	

18. Set parameters according to the present requirements of the safety applications. Shown here using SLS as an example.

## 7.6 Address setting

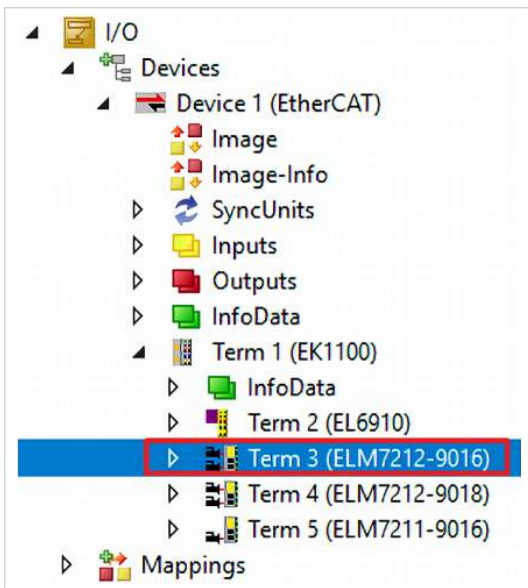
### ● User name and password



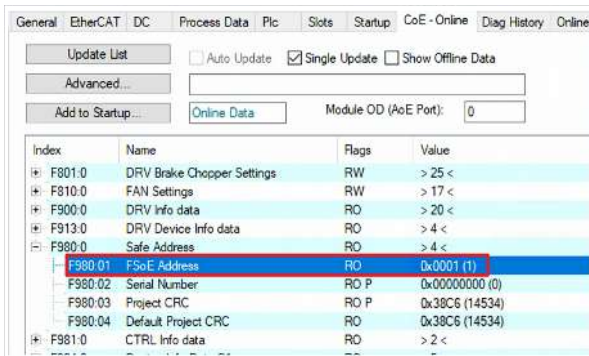
Some actions, such as setting the address, must be confirmed by entering the user name and password. The default user name is *Administrator* and the default password is *TwinSAFE*.

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.

Proceed as follows to set the safety address of your TwinSAFE component:

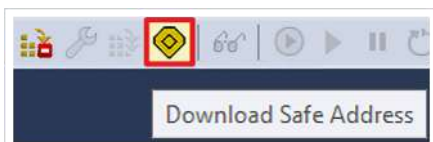


1. Open Safe Motion component



2. Open "CoE-Online" tab

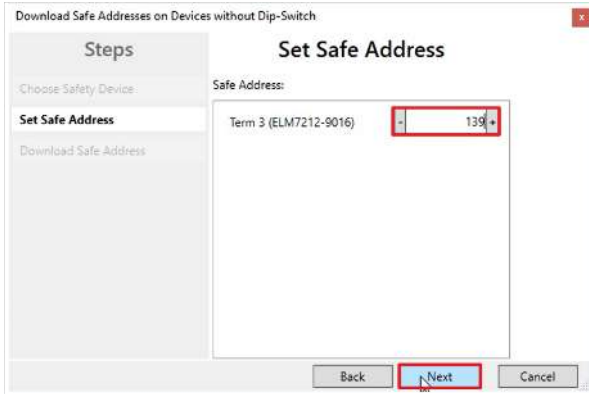
At index F980:01 you see the current FSoE address.



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

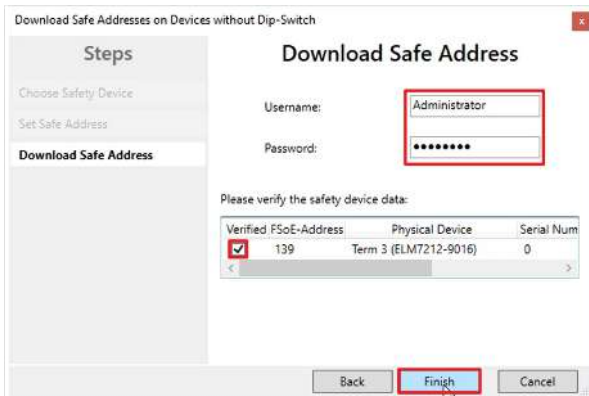


4. In the "Choose Safety Device" window, select Safe Motion component
5. Confirm the selection with "Next"

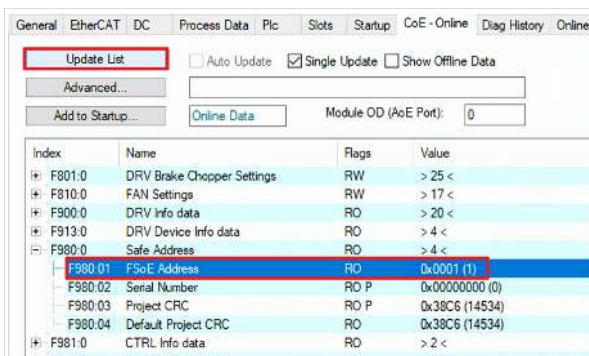


The "Set Safe Address" window opens.

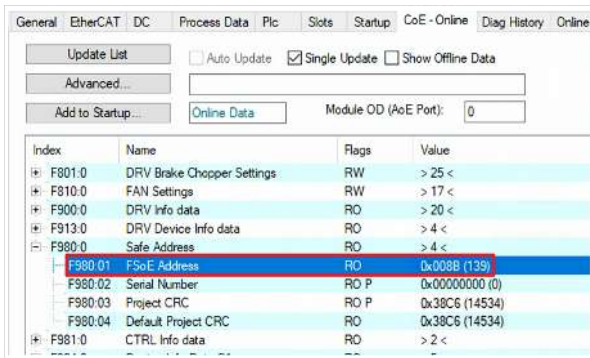
6. Enter desired address
7. Confirm the entry with "Next"



8. Enter the user name and password in the "Download Safe Address" window
9. Select the Safe Motion component for which you want to load a new address
10. Close the window with "Finish"



11. Click on "Update List"



You will now see at index F980:01 that the new FSoE address has been successfully set.

12. Download the safety project again

## 7.7 Safety parameters

The STO variant ELM72xx-9016 has no internal safety parameters.

## 8 Local process image

The process image of the ELM8911 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.

## 8.1 Input

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

### 8.1.1 Single-axis variant

Offset	Name	Data type	Group	Description
0.0	ChA_STO_Error	BOOL	Safety	<b>True:</b> Error detected in switch-off paths STO of axis 1 <b>False:</b> No error (link to output signal 6.1)
0.1	ChA_STO_State	BOOL	Standard	<b>True:</b> Axis 1 enabled <b>False:</b> No error
2.0	ChA_EncoderVoltage_Underange	BOOL	Standard	<b>True:</b> Undervoltage at encoder (OCT or EnDat axis 1) <b>False:</b> No error (link to output signal 6.4)
2.1	ChA_EncoderVoltage_Overrange	BOOL	Standard	<b>True:</b> Overvoltage at encoder (OCT or Endat axis 1) <b>False:</b> No error (link to output signal 6.5)
2.2	ChA_EncoderVoltage_Error	BOOL	Standard	<b>True:</b> Axis 1 encoder voltage error <b>False:</b> No error
2.3	ChA_DriveReq_Activate_Encoder	BOOL	Standard	<b>True:</b> Encoder of axis 1 is switched on according to ELM72xx. <b>False:</b> Encoder of axis 1 is switched off according to ELM72xx. (Link to output signal 6.6)
4.0	ChA_EncoderVoltage	INT16	Standard	Analog value of the encoder voltage (OCT or EnDat axis 1) in mV
6.0	ChA_DriveReq_Run	BOOL	Standard	Run signal for axis 1 of the ELM72xx control word
6.1	ChA_DriveReq_ErrAck	BOOL	Standard	Error acknowledge signal for axis A of the ELM72xx control word (link to output signal 0.4, 1.5, 2.2, 4.0, 14.0, 18.0)

### 8.1.2 Double-axis variant

For a double-axis application, the following process image applies in addition to the process image in chapter [Single-axis variant](#) [► 40].



Offset	Name	Data type	Group	Description
0.2	ChB_STO_Error	BOOL	Safety	<b>True:</b> Error detected in switch-off paths STO of axis 2 <b>False:</b> No error (link to output signal 10.1)
0.3	ChB_STO_State	BOOL	Standard	<b>True:</b> Axis 2 enabled <b>False:</b> No error
8.0	ChB_EncoderVoltage_Underrange	BOOL	Standard	<b>True:</b> Undervoltage at encoder (OCT or EnDat axis 2) <b>False:</b> No error (link to output signal 6.4)
8.1	ChB_EncoderVoltage_Overrange	BOOL	Standard	<b>True:</b> Overvoltage at encoder (OCT or EnDat axis 2) <b>False:</b> No error (link to output signal 6.5)
8.2	ChB_EncoderVoltage_Error	BOOL	Standard	<b>True:</b> Axis 2 encoder voltage error <b>False:</b> No error
8.3	ChB_DriveReq_Activate_Encoder	BOOL	Standard	<b>True:</b> Encoder of axis 2 is switched on according to ELM72xx. <b>False:</b> Encoder of axis 2 is switched off according to ELM72xx. (Link to output signal 6.6)
10.0	ChB_EncoderVoltage	INT16	Standard	Analog value of the encoder voltage (OCT or EnDat axis 2) in mV
12.0	ChB_DriveReq_Run	BOOL	Standard	Run signal for axis 2 of the ELM72xx control word
12.1	ChB_DriveReq_ErrAck	BOOL	Standard	Error acknowledge signal for axis 2 of the ELM72xx control word (link to output signal 0.4, 1.5, 2.2, 4.0, 14.0, 18.0)

## 8.2 Output

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

### 8.2.1 Single-axis variant

Offset	Name	Data type	Group	Description
0.0	ChA_STO_1	BOOL	Safety	<b>True:</b> Enable switch-off path A (STO axis 1) <b>False:</b> Disable switch-off path A (STO axis 1)
0.1	ChA_STO_ErrAck	BOOL	Standard	Acknowledgement of an error in the switch-off paths of axis 1
0.2	ChA_no_STO_to_Drive	BOOL	Standard	<b>True:</b> Enable to ELM72xx: Output stage is enabled for ELM72xx (axis 1) <b>False:</b> Output stage is disabled for ELM72xx.
2.0	ChA_EncoderVoltage_ErrAck	BOOL	Standard	Acknowledgement of an error of the encoder voltage monitoring of axis 1
4.0	ChA_DriveCmd_GroupError	BOOL	Standard	Status to ELM72xx: Group error at axis 1
6.0	ChA_DriveCmd_Emergency_Stop	BOOL	Standard	reserved
6.1	ChA_DriveCmd_2	BOOL	Standard	reserved
6.2	ChA_DriveCmd_3	BOOL	Standard	reserved
6.3	ChA_DriveCmd_4	BOOL	Standard	reserved
6.4	ChA_DriveCmd_5	BOOL	Standard	reserved
6.5	ChA_DriveCmd_6	BOOL	Standard	reserved

Offset	Name	Data type	Group	Description
6.6	ChA_DriveCmd_7	BOOL	Standard	reserved
6.7	ChA_DriveCmd_8	BOOL	Standard	reserved
8.0	ChA_DiagMessage_1	BOOL	Safety	On falling edge, Diag message 0xD300 is entered in the Diag history.
8.1	ChA_DiagMessage_2	BOOL	Safety	On falling edge, Diag message 0xD301 is entered in the Diag history.
8.2	ChA_DiagMessage_3	BOOL	Safety	On falling edge, Diag message 0xD302 is entered in the Diag history.
8.3	ChA_DiagMessage_4	BOOL	Safety	On falling edge, Diag message 0xD303 is entered in the Diag history.
8.4	ChA_DiagMessage_5	BOOL	Safety	On falling edge, Diag message 0xD304 is entered in the Diag history.
8.5	ChA_DiagMessage_6	BOOL	Safety	On falling edge, Diag message 0xD305 is entered in the Diag history.
8.6	ChA_DiagMessage_7	BOOL	Safety	On falling edge, Diag message 0xD306 is entered in the Diag history.
8.7	ChA_DiagMessage_8	BOOL	Safety	On falling edge, Diag message 0xD307 is entered in the Diag history.
9.0	ChA_DiagMessage_9	BOOL	Safety	On falling edge, Diag message 0xD308 is entered in the Diag history.
9.1	ChA_DiagMessage_10	BOOL	Safety	On falling edge, Diag message 0xD309 is entered in the Diag history.
9.2	ChA_DiagMessage_11	BOOL	Safety	On falling edge, Diag message 0xD30A is entered in the Diag history.
9.3	ChA_DiagMessage_12	BOOL	Safety	On falling edge, Diag message 0xD30B is entered in the Diag history.
9.4	ChA_DiagMessage_13	BOOL	Safety	On falling edge, Diag message 0xD30C is entered in the Diag history.
9.5	ChA_DiagMessage_14	BOOL	Safety	On falling edge, Diag message 0xD30D is entered in the Diag history.
9.6	ChA_DiagMessage_15	BOOL	Safety	On falling edge, Diag message 0xD30E is entered in the Diag history.
9.7	ChA_DiagMessage_16	BOOL	Safety	On falling edge, Diag message 0xD30F is entered in the Diag history.

## 8.2.2 Double-axis variant

For a double-axis application, the following process image applies in addition to the process image in chapter [Single-axis variant](#) [► 41].

Offset	Name	Data type	Group	Description
0.3	ChB_STO_1	BOOL	Safety	<b>True:</b> Enable switch-off path A (STO axis 2) <b>False:</b> Disable switch-off path A (STO axis 2)
0.4	ChB_STO_ErrAck	BOOL	Standard	Acknowledgement of an error in the switch-off paths of axis 2
0.5	ChB_no_STO_to_Drive	BOOL	Standard	<b>True:</b> Enable to ELM72xx: Output stage is enabled for ELM72xx (axis 2) <b>False:</b> Output stage is disabled for ELM72xx. (1=Port to Drive Application is 0 (no STO))
10.0	ChB_EncoderVoltage_ErrAck	BOOL	Standard	Acknowledgement of an error of the encoder voltage monitoring of axis 2
12.0	ChB_DriveCmd_GroupError	BOOL	Standard	Status to ELM72xx: Group error at axis 2

Offset	Name	Data type	Group	Description
14.0	ChB_DriveCmd_Emergency_Stop	BOOL	Standard	reserved
14.1	ChB_DriveCmd_2	BOOL	Standard	reserved
14.2	ChB_DriveCmd_3	BOOL	Standard	reserved
14.3	ChB_DriveCmd_4	BOOL	Standard	reserved
14.4	ChB_DriveCmd_5	BOOL	Standard	reserved
14.5	ChB_DriveCmd_6	BOOL	Standard	reserved
14.6	ChB_DriveCmd_7	BOOL	Standard	reserved
14.7	ChB_DriveCmd_8	BOOL	Standard	reserved
16.0	ChB_DiagMessage_1	BOOL	Safety	On falling edge, Diag message 0xD310 is entered in the Diag history.
16.1	ChB_DiagMessage_2	BOOL	Safety	On falling edge, Diag message 0xD311 is entered in the Diag history.
16.2	ChB_DiagMessage_3	BOOL	Safety	On falling edge, Diag message 0xD312 is entered in the Diag history.
16.3	ChB_DiagMessage_4	BOOL	Safety	On falling edge, Diag message 0xD313 is entered in the Diag history.
16.4	ChB_DiagMessage_5	BOOL	Safety	On falling edge, Diag message 0xD314 is entered in the Diag history.
16.5	ChB_DiagMessage_6	BOOL	Safety	On falling edge, Diag message 0xD315 is entered in the Diag history.
16.6	ChB_DiagMessage_7	BOOL	Safety	On falling edge, Diag message 0xD316 is entered in the Diag history.
16.7	ChB_DiagMessage_8	BOOL	Safety	On falling edge, Diag message 0xD317 is entered in the Diag history.
17.0	ChB_DiagMessage_9	BOOL	Safety	On falling edge, Diag message 0xD318 is entered in the Diag history.
17.1	ChB_DiagMessage_10	BOOL	Safety	On falling edge, Diag message 0xD319 is entered in the Diag history.
17.2	ChB_DiagMessage_11	BOOL	Safety	On falling edge, Diag message 0xD31A is entered in the Diag history.
17.3	ChB_DiagMessage_12	BOOL	Safety	On falling edge, Diag message 0xD31B is entered in the Diag history.
17.4	ChB_DiagMessage_13	BOOL	Safety	On falling edge, Diag message 0xD31C is entered in the Diag history.
17.5	ChB_DiagMessage_14	BOOL	Safety	On falling edge, Diag message 0xD31D is entered in the Diag history.
17.6	ChB_DiagMessage_15	BOOL	Safety	On falling edge, Diag message 0xD31E is entered in the Diag history.
17.7	ChB_DiagMessage_16	BOOL	Safety	On falling edge, Diag message 0xD31F is entered in the Diag history.

## **9 Appendix**

### **9.1 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.

## 9.2 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.



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



More Information:  
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