BECKHOFF EK1960 Twin Safe Compact Controller Instruction Manual

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Contents

EK1960 Twin Safe Compact Controller

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.

1.1.1 Trademarks

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

1.1.2 Patents

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

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

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

1.1.3 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

1.2 Version numbers

Version	Comment
2.0.0	• Editorially revised • In chapter Technical data [? 24] link to download page of certificates added • Chapter “Firmware update of TwinSAFE products” removed • Appendix adapted and expanded • Name of EtherCAT connectors corrected
1.3.1	• Layout corrected at chapter *Sample program for parameterization*
1.3.0	• Description of *Module Fault Link active* parameter added • Description of *Multiple Download* added • Description of input and output signals expanded • Description of error response times added • Version history of TwinSAFE product added • Description of firmware update added
1.2.0	• Description of inductive load and free-wheeling diode changed • New features Twin CAT 3.1 Build 4022 added • Diagnosis history described • Reaction times Bumper Mode and ambient conditions added • Description TwinSAFE SC updated • Description of Behavior when restarting added • Project design limits adjusted • Note to the permissible loads on the relay contacts added
1.1.0	• Note to the input and output process image added • Description for Sync Manager configuration added • Twin SAFE SC description updated
1.0.0	• Certificate added • General document revision • Description of input module 9 and 10 updated
0.7.0	• Load characteristics for inductive loads added • Backup/Restore flow chart added
0.6.1	• User administration screenshots updated • State and Diag of the Twin SAFE group updated
0.6.0	• Safety parameters adopted from review report
0.5.0	• Safety parameters revised • Parameter values revised • Diag messages added
0.4.0	• Safety concept requirements for the manual implemented
0.3.0	• Update of the designation of the contact points • Addendum: illustration of the Tw Insafe compact controller without relay option
0.2.0	• Extension of the general description • Description of diagnostic and status LEDs added
0.1.0	• Migration, layout adaptation

Correctness

Please check whether you are using the current and valid version of this document. The current version can be downloaded from the Benchoff homepage at **http://www.beckhoff.de/twinsafe**. In case of doubt, please contact Technical Support (see Benchoff Support and Service [} 13]).

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 Benchoff homepage, in emails or in other publications is not authoritative.
1.3 Version history of the TwinSAFE product
This version history lists the software and hardware version numbers. You will also find a description of the changes to previous versions contained in each case. See the following table.

Updated hardware and software
The TwinSAFE products are subject to a cyclical revision. We reserve the right to revise and change the TwinSAFE products at any time and without notice.
These hardware and/or software changes do not give rise to any claims for changes to products that have already been delivered.

Date	SW-Version	HW-Version	Changes
2018-09-19	03	01	• Local logic projects can now also be created without a linked RUN signal. • Time stamp for diagnostic messages corrected. • FB Muting: After an FB error in the backwards operating mode, the FB error can be acknowledged without restarting the Tw Insafe group. • An error acknowledgement is now required after a user has logged in to the Logic without deleting the project. • Support of Module Fault Link active parameter added. • Firmware and vendor data CRCs can be read out in Coe objects.
2017-07-14	02	01	• Optimized safety mat function • Added support for backup/restore mode • Protective circuit of the outputs changed
2017-05-02	01	00	• First Release

1.4 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.

1.5 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.
1.5.1 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.

1.5.1.1 Pictograms

In order to make it easier for you to find text passages, pictograms and signal words are used in warning notices:

 **DANGER**
Failure to observe will result in serious or fatal injuries.

 **WARNING**
Failure to observe may result in serious or fatal injuries.

 **CAUTION**
Failure to observe may result in minor or moderate injuries.

NOTE
Notes
Notes are used for important information on the product. The possible consequences of failure to observe these include:

- Malfunctions of the product
- Damage to the product
- Damage to the environment

 **Information**
This sign indicates information, tips and notes for dealing with the product or the software.

1.6 Beckhoff Support and Service

Support
Beckhoff Support offers technical advice on the use of individual Beckhoff products and system planning. The employees support you in the programming and commissioning of sophisticated automation systems.

Hotline:	+102.5524403
E-mail:	support@beckhoff.com
Web:	www.beckhoff.com/support

Training
Training in Germany takes place in our training center at the Beckhoff headquarters in Verl, at subsidiaries or, by arrangement, at the customer’s premises.

Hotline:	+4945.55244
E-mail:	training@beckhoff.com
Web:	www.beckhoff.com/training

Service
The Beckhoff Service Center supports you with after-sales services such as on-site service, repair service or spare parts service.

Hotline:	+405.5524403
E-mail:	service@beckhoff.com
Web:	www.beckhoff.com/service

Download area
In the download area you can obtain product information, software updates, the TwinCAT automation software, documentation and much more.

Web:	www.beckhoff.com/download

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For the addresses of our worldwide locations, please visit our website at Global Presence.

For your safety

2.1 Duty of care


Read entire documentation for TwinSAFE component

- Twin SAFE application manual
- EL6910 Twin SAFE logic terminal operating manual
- Twin SAFE Logic FB documentation manual

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

- comply with the provisions defined in the chapter Limitation of liability [} 8].
- only operate the TwinSAFE component when it is in perfect working order.
- provide the operating instructions in a legible condition and complete at the place of use of the TwinSAFE component.
- do not remove the safety markings attached to the TwinSAFE component and maintain their legibility.


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

2.2 Safety instructions

2.2.1 Before operation

Ensure traceability

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

Use in machines according to the Machinery Directive

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

Carry out commissioning test

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

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

Use SELV/PELV power supply

Use a SELV/PELV power supply unit with an output-side voltage limit of Umax = 36 VDC to supply the TwinSAFE component with 24 VDC.

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

Use permissible engineering tools and procedures

The TÜV SÜD certificate applies to the TwinSAFE component, the function blocks available in it, the documentation and the engineering tool. Approved engineering tools are TwinCAT 3.1, the TwinSAFE Loader and CODESYS Safety for EtherCAT Safety Module.

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 or externally generated automatic project creation procedures.

2.2.2 In operation

Interference due to emitted interference

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

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

2.2.3 After operation

De-energize and switch off components before working on them

Check all safety-relevant equipment for functionality before working on the TwinSAFE component. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter Decommissioning [} 139].

System description Tw Insafe

3.1 Extension of the Beckhoff I/O system with safety functions

The Tw Insafe products from Benchoff enable convenient expansion of the Benchoff I/O system with safety components, and integration of all the cabling for the safety circuit within the existing fieldbus cable. Safe signals can be mixed with standard signals as required. The transfer of safety-related Tw Insafe telegrams is handled by the standard controller. Maintenance is simplified significantly thanks to faster diagnosis and simple replacement of components.

The following basic functionalities are included in the Tw Insafe components:

digital inputs (e.g. EL19xx, EP1908), digital outputs (e.g. EL29xx), drive components (e.g. AX5805) and logic units (e.g. EL6900, EL6910). For a large number of applications, the complete safety sensor and actuator technology can be wired on these components. The required logical link of the inputs and the outputs is handled by the EL69xx. In addition to Boolean operations, the EL6910 now also enables analog operations.

3.2 Safety concept

Tw Insafe: Safety and I/O technology in one system

- Extension of the familiar Beckhoff I/O system with Tw Insafe components
- Safe and non-safe components can be combined as required

- Logical link of the I/Os in the EL69xx TwinSAFE logic terminal
- Suitable for applications up to SIL 3 according to EN 61508:2010 and Cat 4, PL e according to EN ISO 13849-1:2015
- Safety-relevant networking of machines via bus systems
- In the event of an error, all Tw Insafe components always switch to the wattles and therefore safe state
- No safety requirements for the higher-level standard Twin CAT system

Safety over Ether CAT protocol (FSoE)

- Transfer of safety-relevant data via any media (“genuine black channel”)
- Tw Insafe communication via fieldbus systems such as Ether CAT, Light bus, PROFIBUS, PROFINET or Ethernet
- IEC 61508:2010 SIL 3 compliant
- Foe is IEC standard (IEC 61784-3-12) and ETG standard (ETG.5100)

Fail-safe principle (fail stop)
The basic rule for a safety system such as Tw Insafe is that failure of a part, a system component or the overall system must never lead to a dangerous condition. The safe state is always the switched off and wattless state.

CAUTION
Safe state
For all Tw Insafe components the safe state is always the switched-off, wattles state.

Product description

4.1General description
EK1960 – Tw Insafe-Compact-Controller
The EK1960 is a Tw Insafe controller with 20 fail-safe inputs and 24 fail-safe outputs. The EK1960-2600 and EK1960-2608 variants feature an additional four relays, each with one make contact.
The EK1960 Tw Insafe compact controller is suitable for safety applications up to SIL 3 according to IEC 62061 and IEC 61508 and up to Cat. 4, PL e according to EN ISO 13849-1:2015. (See following list for restrictions):

- The single-channel relay output is suitable up to Cat. 2, PL d
- The two-channel relay output (use of two relay contacts in series) is suitable up to Cat. 3, PL d or Cat. 4, PL e, depending on the number of actuations. Cat. 4, PL e requires an actuation at least once per month, Cat. 3, PL d at least once per year.
- The safe input for the safety mat operation mode is limited to Cat. 2, PL d. Special proof tests are not necessary during the entire lifetime of the EK1960 on account of the high level of diagnostic coverage.
  The EK1960 can be used in three different application cases:
- As a stand-alone TwinSAFE compact controller without the use of an EtherCAT network with 20 inputs and 24 outputs. An extension with terminals to the right of the EK1960 on the E-bus is not possible in this operation mode.
- As a TwinSAFE compact controller integrated into an EtherCAT network. The EK1960 can be extended with standard and safety terminals on the E-bus connection and via the EtherCAT network.
- As a Twin SAFE I/O module. The logic on the Twin SAFE compact controller is not used. The coupler can be addressed by a Twin SAFE logic terminal as an I/O module with 20 inputs and 24 outputs.

The inputs of the EK1960 can be used as digital 24 V inputs. They can be fed to the safe input either with static 24 VDC or with a clock from one of the Twin SAFE outputs of the EK1960 or via an external clock source via, for example, a switch contact. Inputs 17 to 20 can additionally be switched to a safety mat operation mode (Bumper Mode On) . Only safety mats operating according to the resistance-change principle are supported. The safety mats can also be cascaded in accordance with the manufacturer’s specifications. The inputs can be parameterized in groups of two.
The outputs can be parameterized in groups of four. It is possible to set the mark-to-space-ratio and the activation as a clock source for the safe inputs.

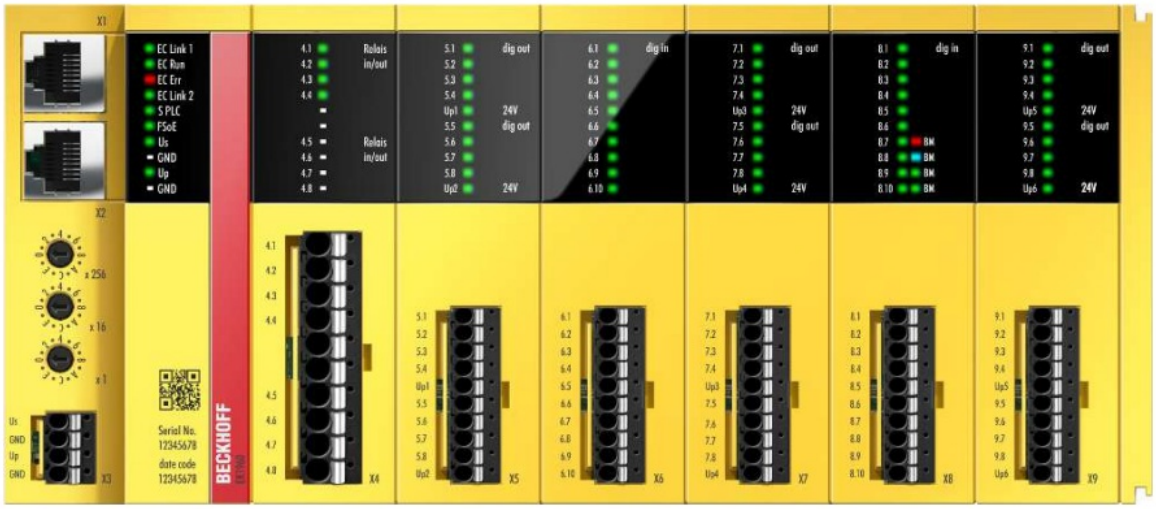


Fig. 1: EK1960-260x TwinSAFE-Compact-Controller

The EK1960 without relay option has a dummy cap on X4.

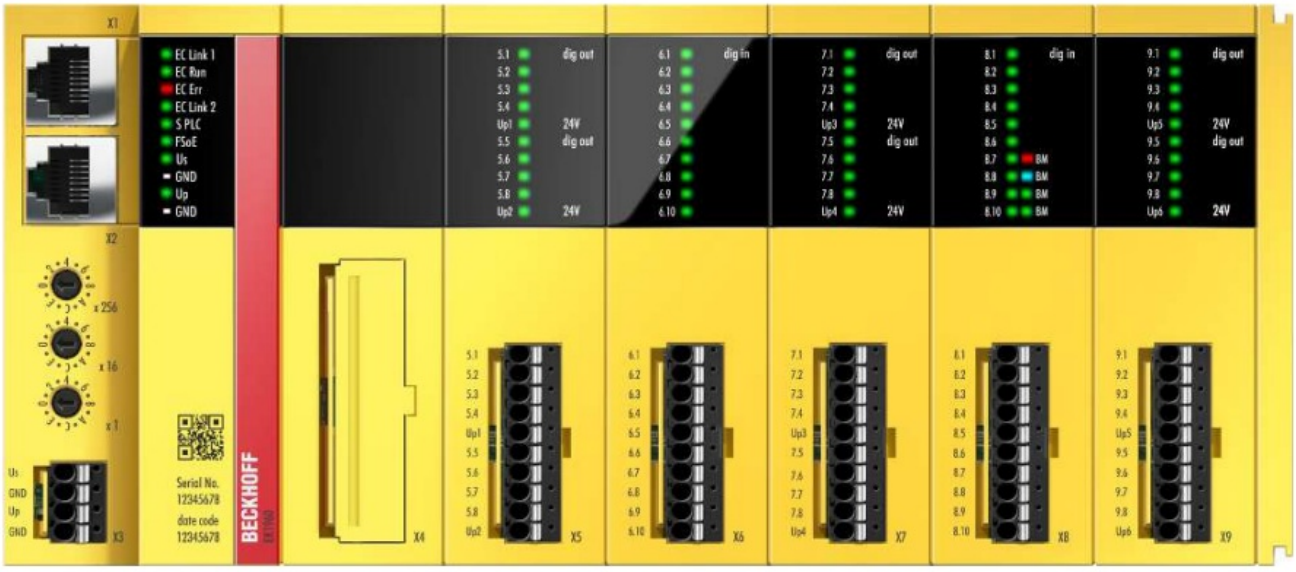


Fig. 2: EK1960-000x TwinSAFE compact controller without relay option

4.2 Product designations

Product designation	Description
EK1960-0000	EK1960 with EtherCAT RJ45 connections – without relay option
EK1960-0008	EK1960 with EtherCAT M8 connections – without relay option
EK1960-2600	EK1960 with EtherCAT RJ45 connections – with four potential-free contacts (NO)
EK1960-2608	EK1960 with EtherCAT M8 connections – with four potential-free contacts (NO)
ZS2003-0001	Spare part, power supply spring contact strip, 4-pole Contact spacing 3.5 mm
ZS2003-0002	Spare part, input/output spring contact strip, 10-pole Contact spacing 3.5 mm
ZS2003-0003	Spare part, relay contact spring contact strip, 10-pole Contact spacing 5.0 mm (EK 1960-260x only)

4.3 Inputs and outputs of the EK1960

NOTE

Fuses for the EK1960

Fuses must be provided for the power supplies of the EK1960 2 A each for US and UP (X3) and 5 A each for UP1 to UP6 (X5, X7, X9).

plug	contact	Name	Description
EtherCAT IN (X1)		EtherCAT 1	EtherCAT connection 1 (EtherCAT IN) (RJ45 or M8)
EtherCAT OUT (X2)		EtherCAT 2	EtherCAT connection 2 (EtherCAT OUT) (RJ45 or M8)
Power (X3)	1	U_s	Control voltage 24 V_{DC} (SELV/PELV) Supply of power for internal logic and E-bus connection
	2	0 V	GND
	3	U_p	Peripheral voltage 24 V_{DC} (SELV/PELV) Supply of power for relays and inputs in the safety mat operation mode
	4	0 V	GND
Relais (X4) (EK1960-260x only)	1	4.1	Input to Relay 1 make contact (Channel7.FSOUT RelaisModule.Channel1.Output)
	2	4.2	Input to Relay 2 make contact (Channel7.FSOUT RelaisModule.Channel2.Output)
	3	4.3	Input to Relay 3 make contact (Channel7.FSOUT RelaisModule.Channel3.Output)
	4	4.4	Input to Relay 4 make contact (Channel7.FSOUT RelaisModule.Channel4.Output)
	5	n.c.	not used
	6	n.c.	not used

	7	4.5	Output to Relay 1 make contact (Channel7.FSOUT RelaisModule.Channel1.Output)
	8	4.6	Output to Relay 2 make contact (Channel7.FSOUT RelaisModule.Channel2.Output)
	9	4.7	Output to Relay 3 make contact (Channel7.FSOUT RelaisModule.Channel3.Output)
	10	4.8	Output to Relay 4 make contact (Channel7.FSOUT RelaisModule.Channel4.Output)
Output (X5)	1	5.1	Output 1 from U_{P1} (Channel1.FSOUT Module 1.Channel1.Output)
	2	5.2	Output 2 from U_{P1} (Channel1.FSOUT Module 1.Channel2.Output)
	3	5.3	Output 3 from U_{P1}(Channel1.FSOUT Module 1.Channel3.Output)
	4	5.4	Output 4 from U_{P1} (Channel1.FSOUT Module 1.Channel4.Output)
	5	UP1	Peripheral voltage U_{P1} 24 V_{DC} (SELV/PELV)
	6	5.5	Output 5 from U_{P2} (Channel2.FSOUT Module 2.Channel1.Output)
	7	5.6	Output 6 from U_{P2} (Channel2.FSOUT Module 2.Channel2.Output)
	8	5.7	Output 7 from U_{P2} (Channel2.FSOUT Module 2.Channel3.Output)
	9	5.8	Output 8 from U_{P2} (Channel2.FSOUT Module 2.Channel4.Output)
	10	UP2	Peripheral voltage U_{P2} 24 V_{DC} (SELV/PELV)
Input (X6)	1	6.1	Input 1 (Channel8.FSIN Module 1.Channel1.Input)
	2	6.2	Input 2 (Channel8.FSIN Module 1.Channel2.Input)
	3	6.3	Input 3 (Channel9.FSIN Module 2.Channel1.Input)
	4	6.4	Input 4 (Channel9.FSIN Module 2.Channel2.Input)
	5	6.5	Input 5 (Channel10.FSIN Module 3.Channel1.Input)

plug	**contact**	**Name**	**Description**
	6	6.6	Input 6 (Channel10.FSIN Module 3.Channel2.Input)

	7	6.7	Input 7 (Channel11.FSIN Module 4.Channel1.Input)
	8	6.8	Input 8 (Channel11.FSIN Module 4.Channel2.Input)
	9	6.9	Input 9 (Channel12.FSIN Module 5.Channel1.Input)
	10	6.10	Input 10 (Channel12.FSIN Module 5.Channel2.Input)
Output (X7)	1	7.1	Output 9 from U_{P3} (Channel3.FSOUT Module 3.Channel1.Output)
	2	7.2	Output 10 from U_{P3} (Channel3.FSOUT Module 3.Channel2.Output)
	3	7.3	Output 11 from U_{P3} (Channel3.FSOUT Module 3.Channel3.Output)
	4	7.4	Output 12 from U_{P3} (Channel3.FSOUT Module 3.Channel4.Output)
	5	UP3	Peripheral voltage U_{P3} 24 V_{DC} (SELV/PELV)
	6	7.5	Output 13 from U_{P4} (Channel4.FSOUT Module 4.Channel1.Output)
	7	7.6	Output 14 from U_{P4} (Channel4.FSOUT Module 4.Channel2.Output)
	8	7.7	Output 15 from U_{P4} (Channel4.FSOUT Module 4.Channel3.Output)
	9	7.8	Output 16 from U_{P4} (Channel4.FSOUT Module 4.Channel4.Output)
	10	UP4	Peripheral voltage U_{P4} 24 V_{DC} (SELV/PELV)
Input (X8)	1	8.1	Input 11 (Channel13.FSIN Module 6.Channel1.Input)
	2	8.2	Input 12 (Channel13.FSIN Module 6.Channel2.Input)
	3	8.3	Input 13 (Channel14.FSIN Module 7.Channel1.Input)
	4	8.4	Input 14 (Channel14.FSIN Module 7.Channel2.Input)
	5	8.5	Input 15 (Channel15.FSIN Module 8.Channel1.Input)
	6	8.6	Input 16 (Channel15.FSIN Module 8.Channel2.Input)
	7	8.7	Input 17 (digital – Digital Mode On, safety mat operation mode (resistance change) – *Bumper Mode On*) (Channel16.FSIN Module 9.Channel1.Input)

	8	8.8	Input 18 (digital – *Digital Mode On*, safety mat operation mode (resistance change) – *Bumper Mode On*) (Channel16.FSIN Module 9.Channel2.Input)
	9	8.9	Input 19 (digital – Digital Mode On, safety mat operation mode (resistance change) – *Bumper Mode On*) (Channel17.FSIN Module 10.Channel1.Input)
	10	8.10	Input 20 (digital – *Digital Mode On*, safety mat operation mode (resistance change) – *Bumper Mode On*) (Channel17.FSIN Module 10.Channel2.Input)
Output (X9)	1	9.1	Output 17 from U_{P5} (Channel5.FSOUT Module 5.Channel1.Output)
	2	9.2	Output 18 from U_{P5} Channel5.FSOUT Module 5.Channel2.Output)
	3	9.3	Output 19 from U_{P5} (Channel5.FSOUT Module 5.Channel3.Output)
	4	9.4	Output 20 from U_{P5} (Channel5.FSOUT Module 5.Channel4.Output)
	5	UP5	Peripheral voltage U_{P5} 24 V_{DC} (SELV/PELV)
	6	9.5	Output 21 from U_{P6} (Channel6.FSOUT Module 6.Channel1.Output)

NOTE
Protected wiring If the wiring of the outputs or the connected actuators leaves the control cabinet, the user must ensure that the wiring is protected.

WARNING
Active loads
The use of active loads (with their own power supply) is not permissible unless the manufacturer of the load ensures the non-reactivity of the power supply to the control signal.

DANGER
Clocked signals within a sheathed cable
Are clocked signals of different output modules used within a sheathed cable, a failure of a module, such as cross-circuit or external power supply must lead to a switch off of all these modules. This switch off must be performed by the user program.
From firmware version 03 and revision -0021 the parameter Module Fault Link active is available. If the parameter is set to TRUE for all modules involved, all these modules are set to the error state in the event of a module error. This parameter is set to TRUE by default.

4.4 Connection technology
4.4.1 Power supply spring contact strip
The power supply spring contact strip is required for the X3 connection.

Item number	ZS2003-0001
Number of contacts	4
Contact spacing	3.5 mm
Connection methods	Spring-loaded terminal technology
Wire cross-section (solid-wire)	0.2 – 1.5 mm²
Wire cross-section (fine-wire)	0.2 – 1.5 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules with plastic collars)	0.25 – 0.75 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules without plastic collars)	0.25 – 1.5 mm²
Strip length	8 – 9 mm

4.4.2 Input and output spring contact strip

The input and output spring contact strip is required for the connection X5 to X9.

Item number	ZS2003-0002
Number of contacts	10
Contact spacing	3.5 mm
Connection methods	Spring-loaded terminal technology
Wire cross-section (solid-wire)	0.2 – 1.5 mm²
Wire cross-section (fine-wire)	0.2 – 1.5 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules with plastic collars)	0.25 – 0.75 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules without plastic collars)	0.25 – 1.5 mm²
Strip length	8 – 9 mm

4.4.3 Relay contact spring contact strip

The relay contact spring contact strip is required for the connection X4 (EK1960-260x only).

Item number	ZS2003-0003
Number of contacts	10
Contact spacing	5.0 mm
Connection methods	Spring-loaded terminal technology
Wire cross-section (solid-wire)	0.2 – 2.5 mm²
Wire cross-section (fine-wire)	0.2 – 2.5 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules with plastic collars)	0.25 – 1.5 mm²
Conductor cross-sectional area – fine wire (with wire-end ferrules without plastic collars)	0.25 – 2.5 mm²
Strip length	9 – 10 mm

4.5 Intended use

WARNING

Caution – Risk of injury!

The TwinSAFE compact controller may only be used for the purposes described below!

The TwinSAFE compact controller expands the application range of the Beckhoff EtherCAT system by functions that enable it to be used in the field of machine safety as well. The TwinSAFE compact controller is designed for machine safety functions and the directly associated industrial automation tasks. It is therefore approved only for applications with a defined fail-safe state. This safe state is the wattles state.

The EK1960 TwinSAFE compact controller is suitable for operation as

- Stand-alone Safety Controller
- a safety controller within an EtherCAT network
- a safety I/O device within an EtherCAT network with, for example, an EL6910 as TwinSAFE Master

WARNING

System limits

The TÜV-Süd certificate applies to the EK1960, the function blocks available in it, the documentation and the engineering tool. Approved engineering tools are Twin CAT 3.1, TwinSAFE Loader and CODESYS Safety for EtherCAT Safety Module. Any deviations from the procedures or tools, particularly externally generated xml files for TwinSAFE import or externally generated automatic project creation procedures, are not covered by the certificate.

WARNING

Power supply

The TwinSAFE compact controller must be supplied with 24 VDC by an SELV/PELV power supply unit with an output voltage limit Umax of 36 VDC. Failure to observe this can result in a loss of security.

WARNING

Commissioning test

Before the EK1960 can be used for the safety task, the user must carry out a commissioning test so that sensor and actuator wiring errors can be ruled out.

CAUTION

Note the Machinery Directive

The TwinSAFE compact controller may only be used in machines within the meaning of the Machinery Directive.

CAUTION
Ensure traceability
The buyer has to ensure the traceability of the device via the serial number.

4.6 Technical 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 designation	**EK1960**
Number of inputs	20
Number of outputs	24 (+ 4 optional relay outputs)
Cable length between sensor and input	30 m (if cables with a cross-sectional area of 0.75 mm² are used)
Cable length between output and actuator	30 m (if cables with a cross-sectional area of 0.75 mm² are used)
Minimum/maximum logic cycle time	approx. 1 ms / according the project size
Fault response time	≤ watchdog times
Watchdog time	min. 2 ms, max. 60,000 ms
Input process image	Dynamic, according to the TwinSAFE configuration in Twin CAT 3
Output process image	Dynamic, according to the TwinSAFE configuration in Twin CAT 3
Supply voltage (SELV/PELV)	24 V_{DC} (–15% / +20%) Provide a 2 A fuse for U_S and U_P
E-bus power supply (5 V)	max. 500 mA (In the case of higher current consumption, please use the EL9410 power feed terminals in addition!)
Signal voltage inputs	see Characteristic curve of the inputs [? 32]
Output module (4 channels)	24 V_{DC} (–15% / +20%) SELV/PELV for U_{P1} to U_{P6} max. 2 A per channel min. 30 mA with a test pulse length of 400 µs and resistive load Simultaneity factor 50% per module Provide 5 A fuse for each U_{Px} Diagnostic thresholds: > 4 V -> high signal is detected < 2.4 V -> low signal is detected
Permissible actuators	• inductive loads (see also Load characteristic curve – inductive load [? 34]) (A free-wheeling diode must be provided on the load) • resistive loads • capacitive loads
Current consumption of the modular electronics at 24 V_{DC} (without current consumption of sensors/actuators)	U_S typ. 80 mA U_P typ. 2 mA U_{P1} to U_{P6} each typ. 2 mA

Dimensions (W x H x D)	230.5 mm x 100 mm x 58.6 mm
Weight	approx. 560 g (EK1960-260x) / approx. 500 g (EK1960-000x)
Permissible ambient temperature (operation)	-25 °C to +55 °C
Permissible ambient temperature (transport/ storage)	-40 °C to +70 °C
Permissible humidity	5% to 95%, non-condensing
permissible air pressure (operation/storage/transport)	750 hPa to 1100 hPa (this corresponds to an altitude of approx. -690 m to 2450 m above sea level, assuming an international standard atmosphere)
Product designation	EK1960
Climate category according to EN 60721-3-3	3K3 (the deviation from 3K3 is possible only with optimal environmental conditions and also applies only to the technical data which are specified differently in this documentation)
Permissible level of contamination according to EN 60664-1	level of contamination 2 (comply with the chapter Cleaning [? 136])
Inadmissible operating conditions	TwinSAFE controllers must not be used under the following operating conditions:

	• under the influence of ionizing radiation (exceeding the natural background radiation) • in corrosive environments • in an environment that leads to impermissible soiling of the controller
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Shocks	15 g with pulse duration 11 ms in all three axes
Protection class as per IEC 60529	IP20
Permitted operating environment	In the control cabinet or terminal box, with minimum protection class IP54 according to IEC 60529
Correct installation position	see chapter Installation position and minimum distances [? 43]
Technical approvals	CE, TÜV SÜD

NOTE
Protective circuit No protective circuit is integrated in the output circuit of the EK1960, so it is necessary to provide a freewheeling diode on the actuator for inductive loads. However, it must be borne in mind that the free-wheeling diode may prolong the switch-off times of the actuator.
The protective circuit must limit the induced voltage at the output to an amount of less than 29V. Thus, R/Ccircuits and varistors are typically unsuitable.

4.6.1 Technical data – relay option

Product designation	EK1960-260x
Contacts	1 NO / 1 NC
Make contact material (NO)	AgNi + 0.2 µm Au
Feedback contact material (NC)	AgNi + 5 µm Au
Coil voltage	$24V_{DC}$
Maximum continuous current, NO contact (when u sed in safety applications)	DC13 (24 V_{DC}) I = 2 A AC15 (230 V_{AC}) I = 3 A
Maximum switching current (NO contact)	8 A
Minimum switching current (NO contact)	10 mA (AgNi)
Switching capacity according to IEC/EN 60947-5-1 AC15 DC13	250 V_{AC} / 3 A 24 V_{DC} / 2 A
Switching frequency (maximum)	20 switching cycles / s
Response time	≤ 15 ms (typically 10 ms)
Release time	≤ 5 ms (typically 2 ms)

NOTE
Allowed loads of the relay option
The potential-free contacts of the relay option (X4) may only be connected to resistive and inductive loads. Capacitive loads are not permissible.

Load limit curve

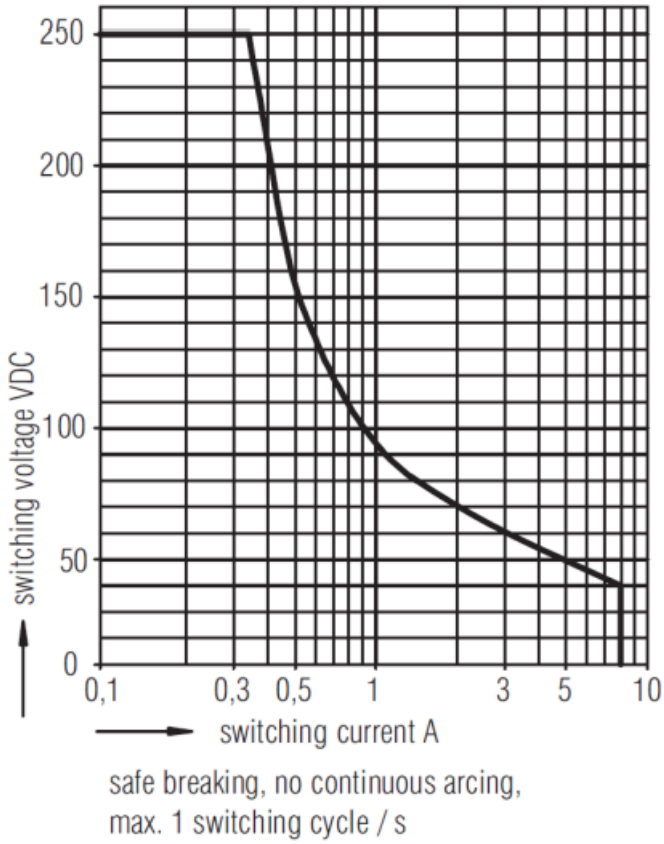


Fig. 3: Load limit curve, make contact

Operating lifetime for contact material AgNi

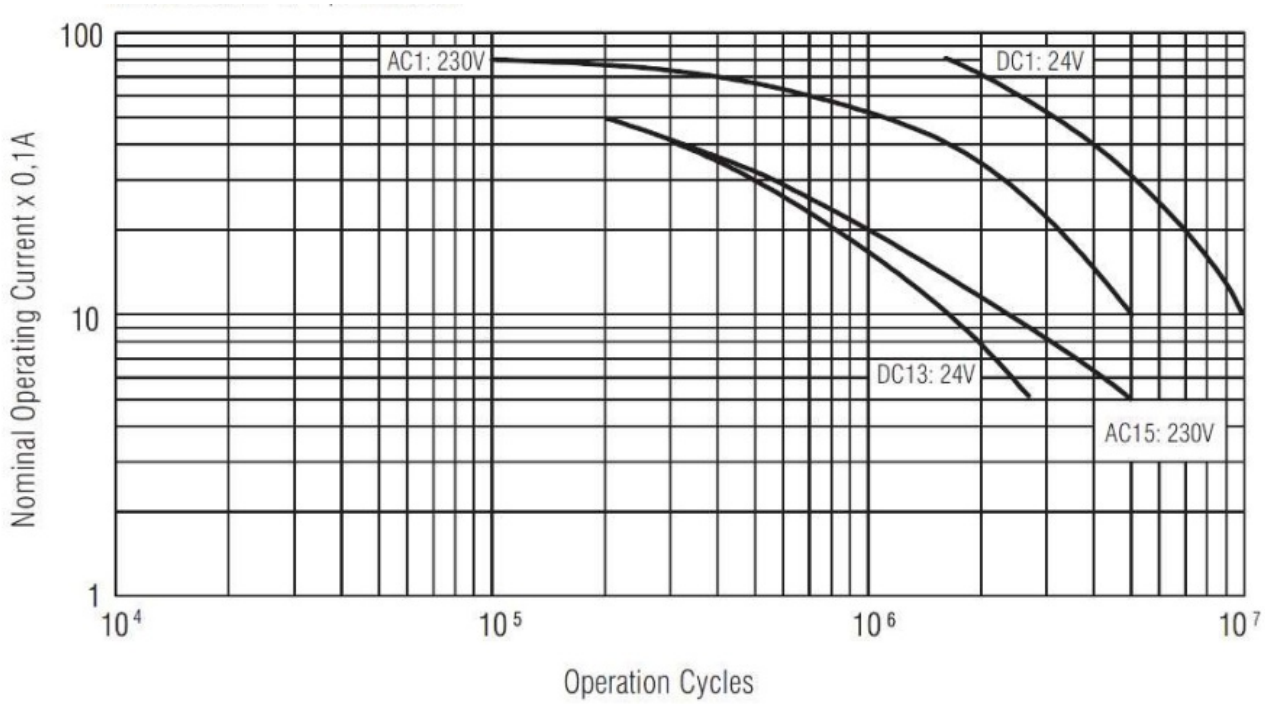


Fig. 4: Operating lifetime of the AgNi NO contact for DC1, DC13, AC1 and AC15

Fig. 4: Operating lifetime of the AgNi NO contact for DC1, DC13, AC1 and AC15
Reduction factor for inductive loads

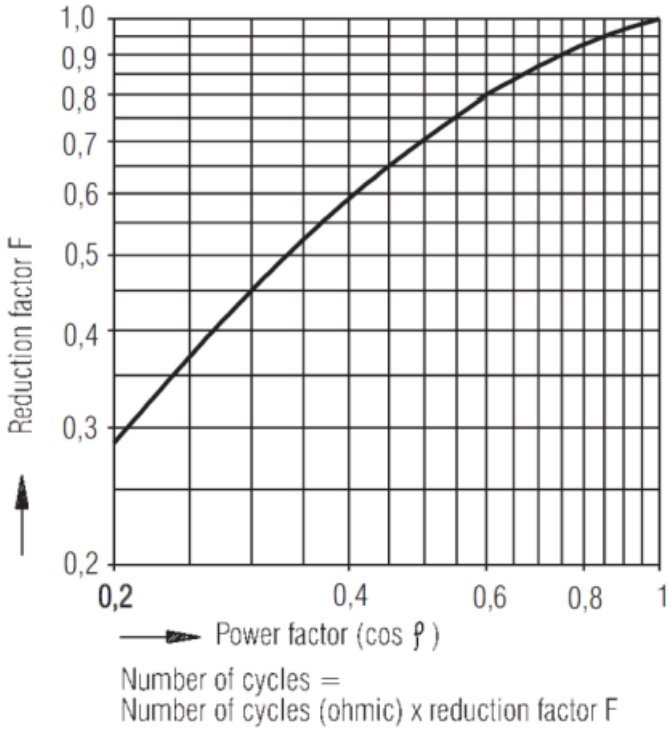


Fig. 5: Reduction factor for inductive loads

4.7 Safety parameters

In the following tables the safety parameters are shown separately for inputs, logic and outputs. The PFH values for the inputs, logic and outputs used must be added together for the complete safety loop. The Safety-over-EtherCAT communication is included in the logic part.

General parameters	**EK1960**
Lifetime [a]	20
Prooftest Intervall [a]	– 1)
HFT	1
Classification element 2)	Type B

1. Special proof tests are not necessary during the entire lifetime of the EK1960 TwinSAFE compact controller on account of the high level of diagnostic coverage.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)
   The EK1960 TwinSAFE compact controller can be used for safety-related applications within the meaning of IEC 62061:2005/A2:2015 up to SILCL3 and IEC 61508:2010 up to SIL 3 and EN ISO 13849-1:2015 up to Cat. 4, PL e. (See following note for restrictions):

CAUTION

EK1960 category and performance level restrictions

- The single-channel relay output is suitable up to Cat. 2, PL d

- The two-channel relay output (use of two relay contacts in series) is suitable up to Cat. 3, PL d or Cat. 4, PL e, depending on the number of actuations. Cat. 4, PL e requires an actuation at least once per month, Cat. 3, PL d at least once per year.
- The safe input for the safety mat operation mode is limited to Cat. 2, PL d.

Further information on calculating or estimating the MTTFD value from the PFHD value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.
Relay output safety parameters (Cat. 4 – two-channel)
The following table contains the safety parameters for the two-channel relay output. This must be added to the logic and input value to determine the total PFH value.
One actuation of the relay per hour is assumed for the calculation.

Relay output parameters (Cat. 4 – two-channel)	**Value**
PFH_D	1.46 E-09
PFD_G	1.48 E-06
$MTTF_D$	high
DCavg	high
Performance Level	PL e
Category	4
SIL	3

Relay output safety parameters (Cat. 2 – single-channel)
The following table contains the safety parameters for the single-channel relay output. This must be added to the logic and input value to determine the total PFH value.
One actuation of the relay per hour is assumed for the calculation.

Relay output parameters (Cat. 2 – single-channel)	**Value**
PFH_D	7.25 E-10
PFD_G	6.42 E-05
$MTTF_D$	high

B10D relay option values

Relay output parameters (Cat. 2 – single-channel)	**Value**
DCavg	high
Performance Level	PL d
Category	2
SIL	2

Digital input safety parameters

The following table contains the safety parameters for the digital input of the EK1960. This must be added to the logic and input value to determine the total PFH value.

Digital input parameters	**Value**
PFH_D	6.4 E-11
PFD_G	6.1 E-06
$MTTF_D$	high
DCavg	high
Performance Level	PL e
Category	4
SIL	3

Safety mat input safety parameters
The following table contains the safety parameters for the analog input in the safety mat operation mode of the EK1960. This must be added to the logic and input value to determine the total PFH value.

Safety mat input parameters	**Value**
PFH_D	8.84 E-10
PFD_G	7.5 E-05
$MTTF_D$	high
DCavg	medium
Performance Level	PL d
Category	2
SIL	2

Logic safety parameters
The following table contains the safety parameters for the logic module of the EK1960. This must be added to the input and output value to determine the total PFH value. The Safety-over-EtherCAT communication is included in the logic part.

Logic parameters	**Value**
PFH_D	5.18 E-09
PFD_G	4.32 E-05
$MTTF_D$	high
DCavg	high
Performance Level	PL e
Category	4

Output safety parameters
The following table contains the safety parameters for the digital output of the EK1960. This must be added to the input and logic value to determine the total PFH value.

Digital output parameters	Value
PFH_D	1.5 E-10
PFD_G	2.62 E-07
$MTTF_D$	high
DCavg	high
Performance Level	PL e
Category	4
SIL	3

Examples of safety loops

Characteristic numbers			Sample 1	Sample 2	Sample 3	Sample 4
Safety mat input	PLd, Cat. 2	8.48 E-10	8.48 E-10		8.48 E-10	8.48 E-10
Digital input	PLe, Cat. 4	6.4 E-11		6.4 E-11		
Logic	PLe, Cat. 4	5.18 E-09	5.18 E-09	5.18 E-09	5.18 E-09	5.18 E-09
Digital output	PLe, Cat. 4	1.5 E-10	1.5 E-10	1.5 E-10		
Relay output (Cat. 4)	PLe, Cat. 4	1.46 E-09			1.46 E-09	
Relay output (Cat. 2)	PLd, Cat. 2	7.25 E-10				7.25 E-10
Overall result **PFH_D/ Performance Level / Category**			**6.18 E-09** **PLd, Cat. 2**	**5.39 E-09** **PLe, Cat. 4**	**7.49 E-09** **PLd, Cat. 2**	**6.75 E-09** **PLd, Cat. 2**

4.8 Error response times
The error response times depend, among other things, on the logic program used and the settings of the Multiplier Diag Test Pulse and Modulo Diag Test Pulse parameters.
An error reaction for the tests of the I/O signals is realized by a weighted counter, therefore the switch-off does not occur immediately at the first error of the diagnostic tests.
The maximum error reaction time results from the duration of the longest lasting test, this is the RAM test and this is several hours.

4.9 Characteristic curve of the inputs

The characteristic curve of the inputs of the EK1960 is similar to type 3 according to EN 61131-2.

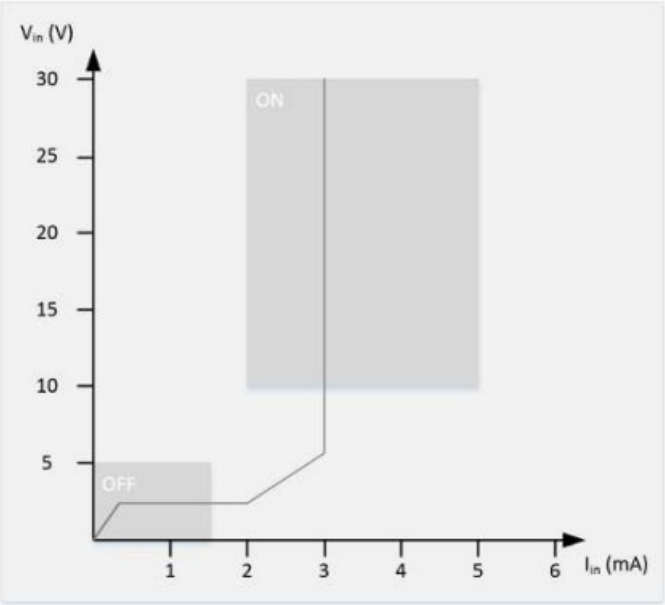


Fig. 6: EK1960 input characteristic curve

4.10 Test pulses for the outputs

The output signals of each module of the EK1960 can be determined via the parameter Diag TestPulse Active. The test pulses generated have a length of 400 µs, which is multiplied by the factor MultiplierDiagTestPulse. This factor should be set to at least 2 for outputs with no load or only a small load, so that a test pulse length of 800 µs results. The frequency of the test pulses results from the processing of the input and output modules and the cycle time of the internal logic. For example, if the logic has a cycle time of 2 ms and a ModuloDiagTestpulse of 0, a typical time b results in accordance with the following calculation.

For each output module the resulting time is: module time = (4 cycles feedback test + (4 cycles diagnostic test * (ModuloDiagTestPulse + 1))) * internal cycle time * 1.25 * 4 outputs = (4 + (4 * 1)) * 2 ms * 1.25 * 4 = 80 ms

For the relay module the resulting time is:

Relay module time = 100 * internal cycle time * 1.25

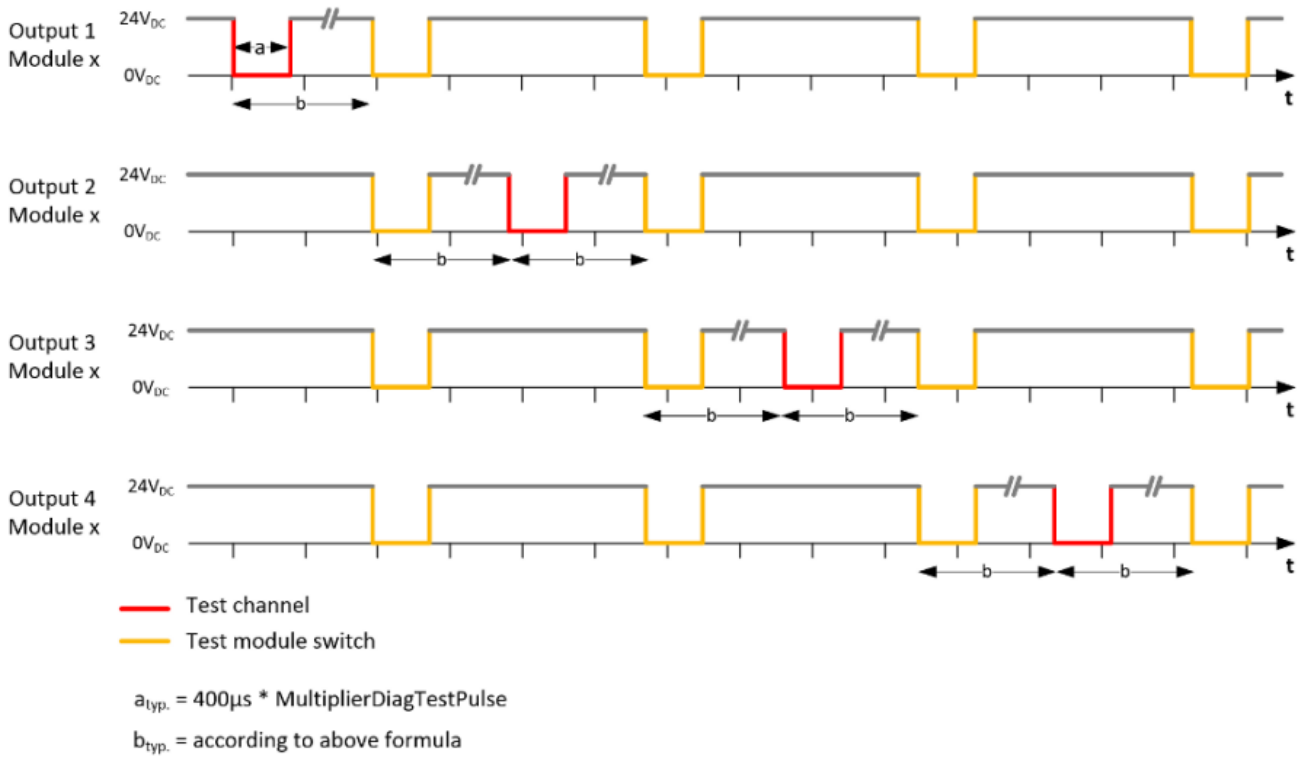
The input modules each require one cycle. This results in a total time b of: b = 6 x module time + 1x relay module time + 10 x internal cycle time x 1.25 (for the input modules)

Inserting the values, this produces: b= (6 * 80 ms) + (100 * 2 ms * 1.25) + (10 * 2 ms * 1.25) = 480 ms + 250 ms + 25 ms = 755 ms

The test pulse sequence is shown in the following table, where the time b typically elapses between a channel test and a module switch test. The tests start over once they have been performed for all four channels.

If the parameter Diag TestPulse for Inputs active is set in addition, all outputs of the module are switched on and the test pulses shown here are similarly applied to the individual output channels. These signals can then be used as clocked signals for the safe inputs. The module switch test is not performed in this operation mode; instead, the four channels are tested directly in succession, leading to the time interval b between the tests of the individual channels.

Test	Time until next test
Module switch (all four channels are tested)	b
Channel 2 (only channel 2 is tested)	b
Module switch (all four channels are tested)	b
Channel 3 (only channel 3 is tested)	b
Module switch (all four channels are tested)	b
Channel 4 (only channel 4 is tested)	b
Module switch (all four channels are tested)	b (next test channel 1)



NOTE

Length of the test pulses

When setting the test pulses, make sure that the connected actuator is not switched due to the test pulse length. The output signal must be 0 V for at least 200 µs within a test pulse. This is independent of the setting of the parameter Multi plier Diag Test Pulse.

Minimum load

The test pulse length of the outputs is set by default to 2 x 400 µs. This setting is suitable for typical actuators with and without a protective circuit. The test pulse length can typically be reduced to 400 µs with a resistive load and a current of at least 30 mA.

Please observe the violation counter in the diagnostic history. If messages are displayed for the corresponding output module, this means that the setting of the test pulse length is borderline and may need to be increased.

For electronic contactors that tend towards a capacitive behavior, it may be necessary to set the parameter Multiplier Diag Test Pulse to 3 or higher.

4.11 Load characteristic curve – inductive load

If an external freewheeling diode is not used for inductive loads, the permissible maximum load can be taken from

the following characteristic curve.

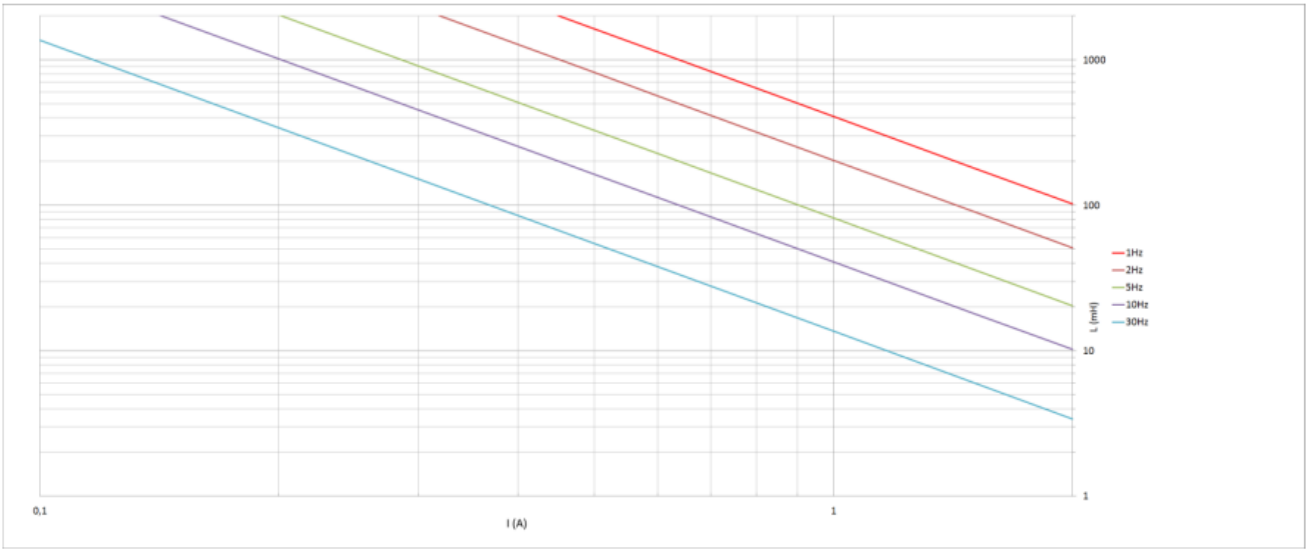


Fig. 7: Characteristic curve - inductive load

4.12 Block diagram of the EK1960

The following block diagram shows the basic structure of the EK1960. The sub-modules shown exist several times according to the information on the sub-modules.

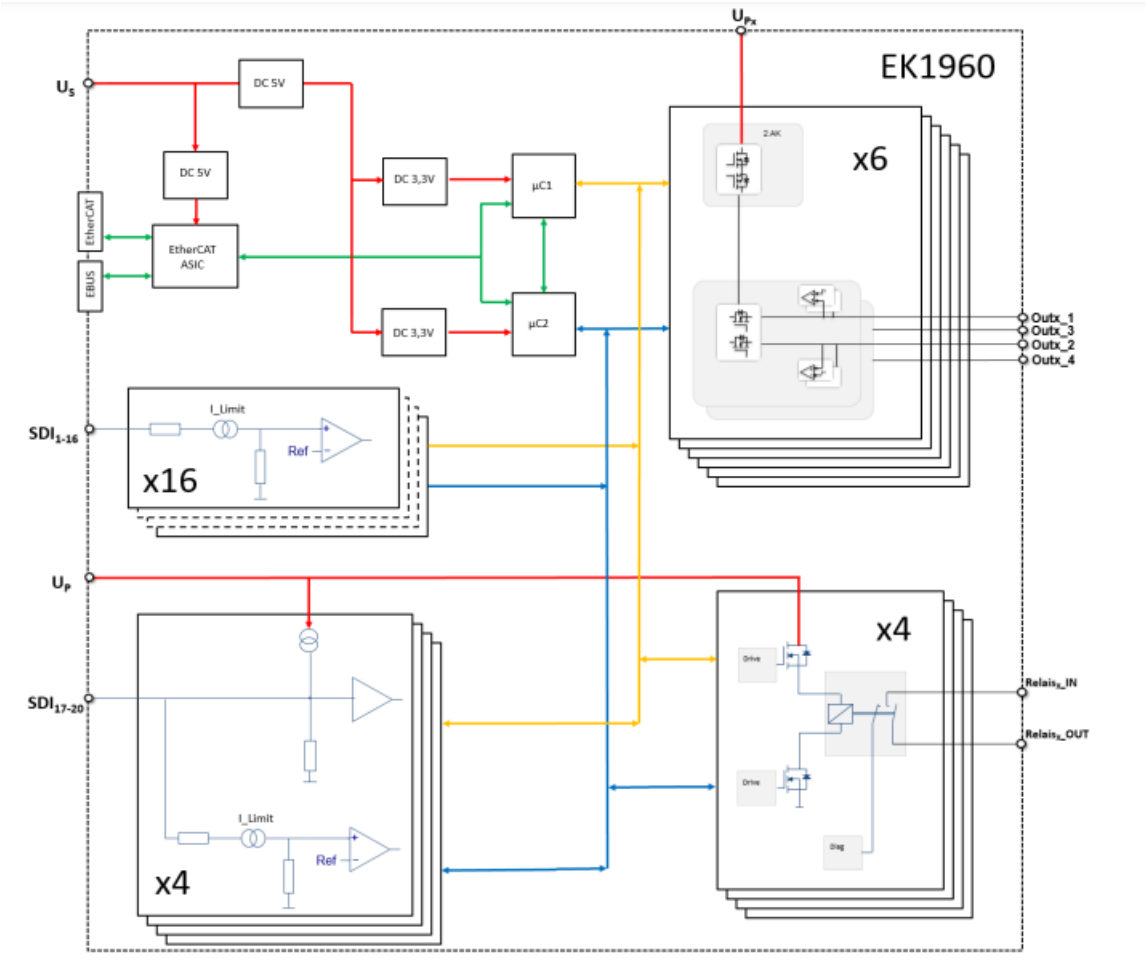


Fig. 8: Block diagram EK1960

4.13 Address setting of the TwinSAFE compact controller

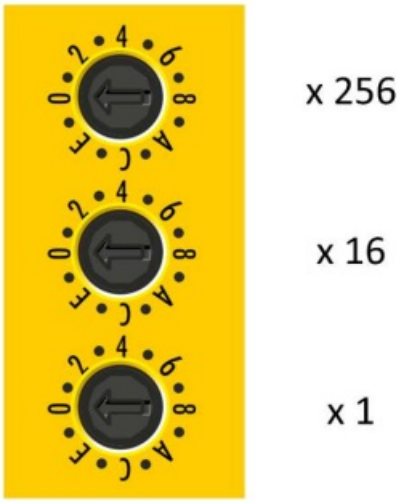


Fig. 9: Address selection switch of the EK1960

The TwinSAFE address of the controller must be set with the three rotary switches on the housing of the EK1960 TwinSAFE controller. TwinSAFE addresses between 1 and 4095 are available.

Rotary switch			**Address**
1 (top)	**2 (center)**	**3 (bottom)**	
0	0	1	**1**
0	0	2	**2**
0	0	3	**3**
…	…	…	**…**
0	0	F	**15**
0	1	0	**16**
0	1	1	**17**
…	…	…	**…**
0	F	F	**255**
1	0	0	**256**
1	0	1	**257**
…	…	…	**…**
F	F	F	**4095**

WARNING
TwinSAFE address
Each TwinSAFE address must be unique within a network!
The address 0 is not a valid address.

4.14 Dimensions

Fig. 10: EK1960 dimensions

Width: 230.5 mm
Height: 100 mm
Depth: 58.6 mm

4.15 Wiring examples

4.15.1 Inputs and outputs

Examples of the wiring of the individual connections of the EK1960 are shown in the following.

Power supply X3

The X3 connection is for the supply of power to the EK1960. The internal logic and the E-bus connection are supplied via US, while UP supplies the relays and the safe inputs (safety mat operation mode). The GND connections are internally bridged.

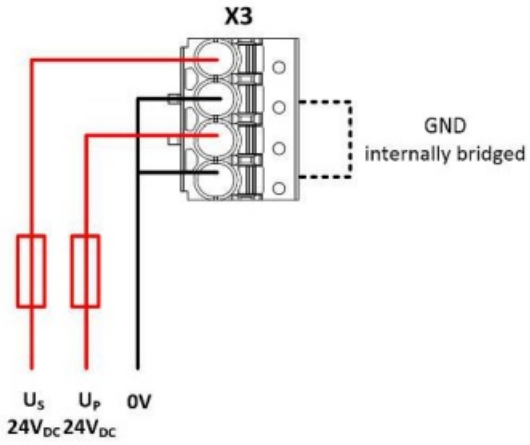


Fig. 11: Power supply X3

Potential-free relay contacts C4 (EK1960-260x)

The relay contacts (four relays each with one make contact) are fed out to the X4 connection. The area surrounded by the dotted line shows the make contacts of the individual relays.

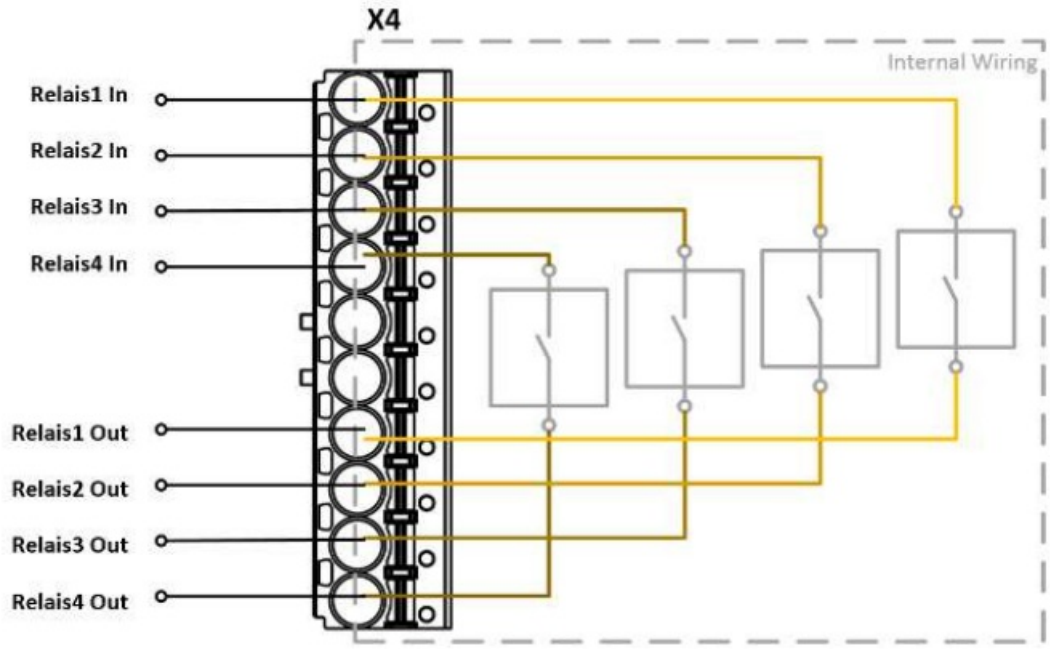


Fig. 12: Relay contact X4 (EK1960-260x only)

Digital outputs X5, X7 and X9

Connection X5, X7 and X9 must be supplied with 24 VDC on contacts 5 and 10. These each supply four outputs. The connected actuator is not fed back to the EK1960; instead it is wired directly to GND.

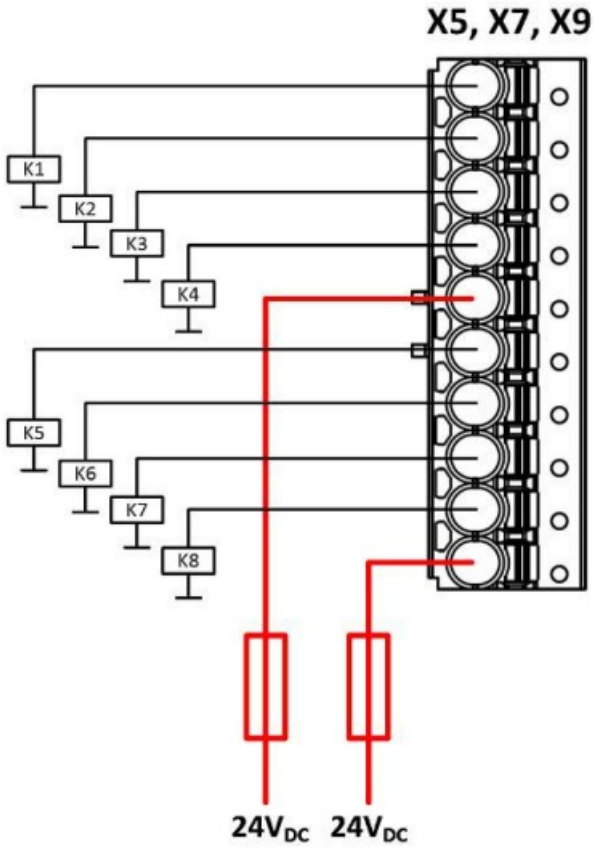


Fig. 13: Digital outputs X5, X7 and X9

Digital inputs X6, X8

The digital inputs are supplied with 24VDC signals. In the default setting, static or clocked signals are supported. Safe outputs of the EK1960 can also be selected as the clock signal source.

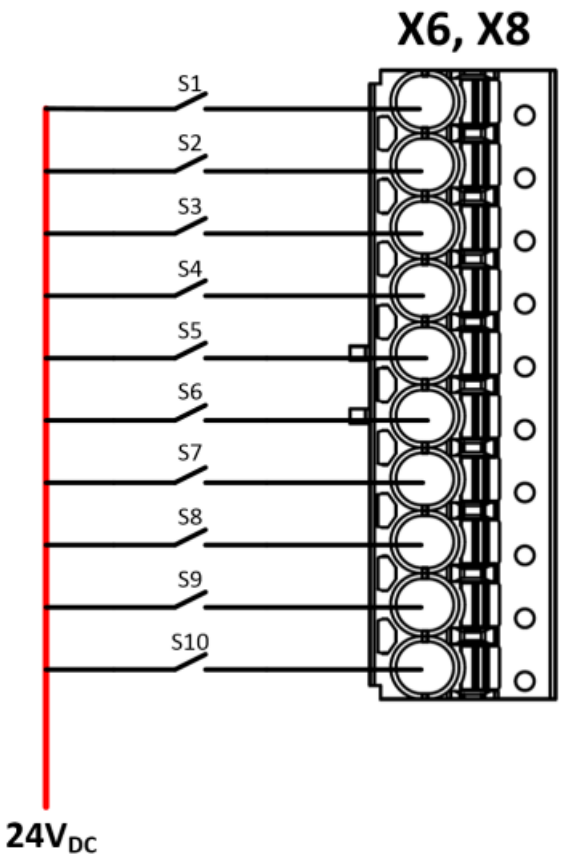


Fig. 14: Digital inputs X6 and X8

Safety mat connection example

Inputs 8.7 to 8.10 on connection X8 of the EK1960 can be configured for a safety mat operation mode. Only safety mats operating according to the resistance-change principle may be used. Only 8K2 (8.2 kΩ) termination resistors are supported.

CAUTION

Safety mat wiring

The ground connection of the safety mat used must be fed back to the EK1960 in accordance with the following diagram.

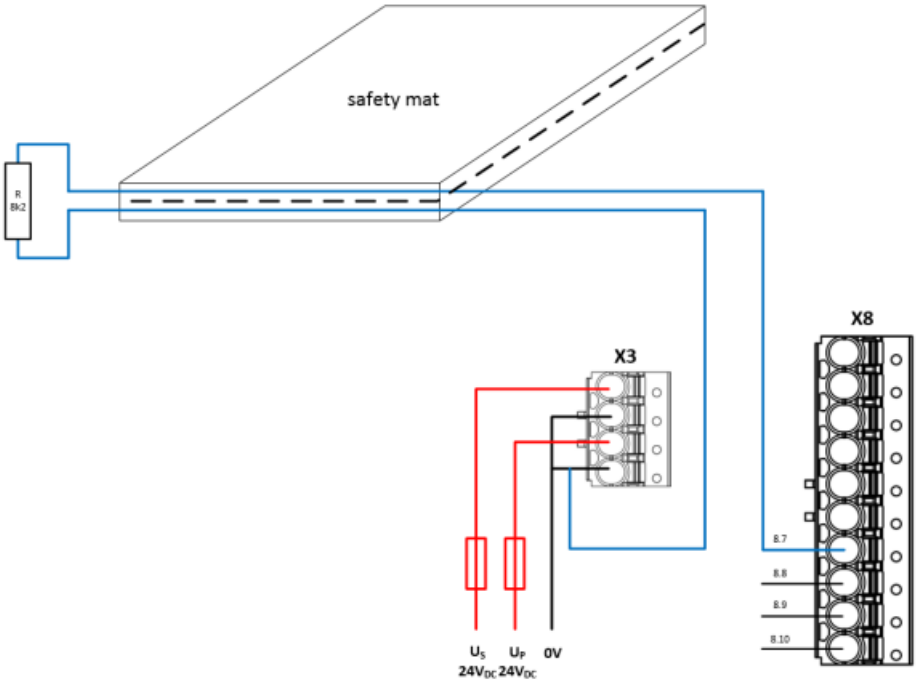


Fig. 15: Safety mat wiring

4.15.2 Clocked signals

All output groups (four outputs each) can be configured as clock outputs. The test pulses of the groups can be set accordingly via parameters.

If a sensor such as a key switch (represented here by S19 and S20) is two-channel wired within one single non-metallic sheathed cable, the two channels must be fed from different clock sources. This makes it possible to detect cross- circuits or external power supplies within the common non-metallic sheathed cable and to achieve a high level of diagnostic coverage.

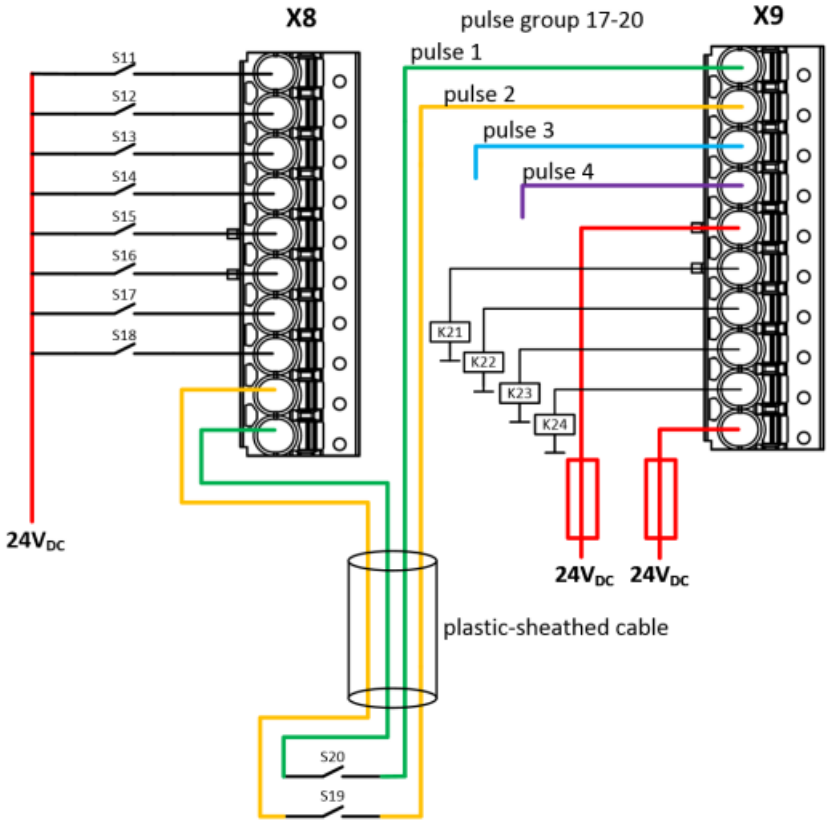


Fig. 16: Wiring example – clock outputs to inputs

Operation

5.1 Environmental conditions

Please ensure that the TwinSAFE components are only transported, stored and operated under the specified conditions (see technical data)!

WARNING

Risk of injury!

The TwinSAFE components must not be used under the following operating conditions.

- under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation)
- in corrosive environments
- in an environment that leads to unacceptable soiling of the TwinSAFE component

NOTE

Electromagnetic compatibility

The TwinSAFE components comply with the current standards on electromagnetic compatibility with regard to spurious radiation and immunity to interference in particular.

However, in cases where devices such as mobile phones, radio equipment, transmitters or high-frequency systems that exceed the interference emissions limits specified in the standards are operated near TwinSAFE components, the function of the TwinSAFE components may be impaired.

5.2 Installation

5.2.1 Safety instructions

Before installing and commissioning the TwinSAFE components please read the safety instructions in the foreword of this documentation.

5.2.2 Transport/storage

Use the original packaging in which the components were delivered for transporting and storing the TwinSAFE components.

CAUTION

Note the specified environmental conditions

Please ensure that the digital TwinSAFE components are only transported and stored under the specified environmental conditions (see technical data).

5.2.3 Mechanical installation

5.2.3.1 De-energized condition

DANGER

Serious risk of injury!

Bring the bus system and the controller into a safe, de-energized state before installing, disassembling or wiring of the controller!

5.2.3.2 Control cabinet / terminal box

For operation, the TwinSAFE compact controller must be installed in a control cabinet or terminal box with IP54 protection class according to IEC 60529 as a minimum.

5.2.3.3 Installation position and minimum distances

For the prescribed installation position the mounting rail is installed horizontally and the mating surfaces of the TwinSAFE compact controller point towards the front (see illustration below). The controller is ventilated from below, which enables optimum cooling of the electronics through convection. The direction indication “down” corresponds to the direction of positive acceleration due to gravity.

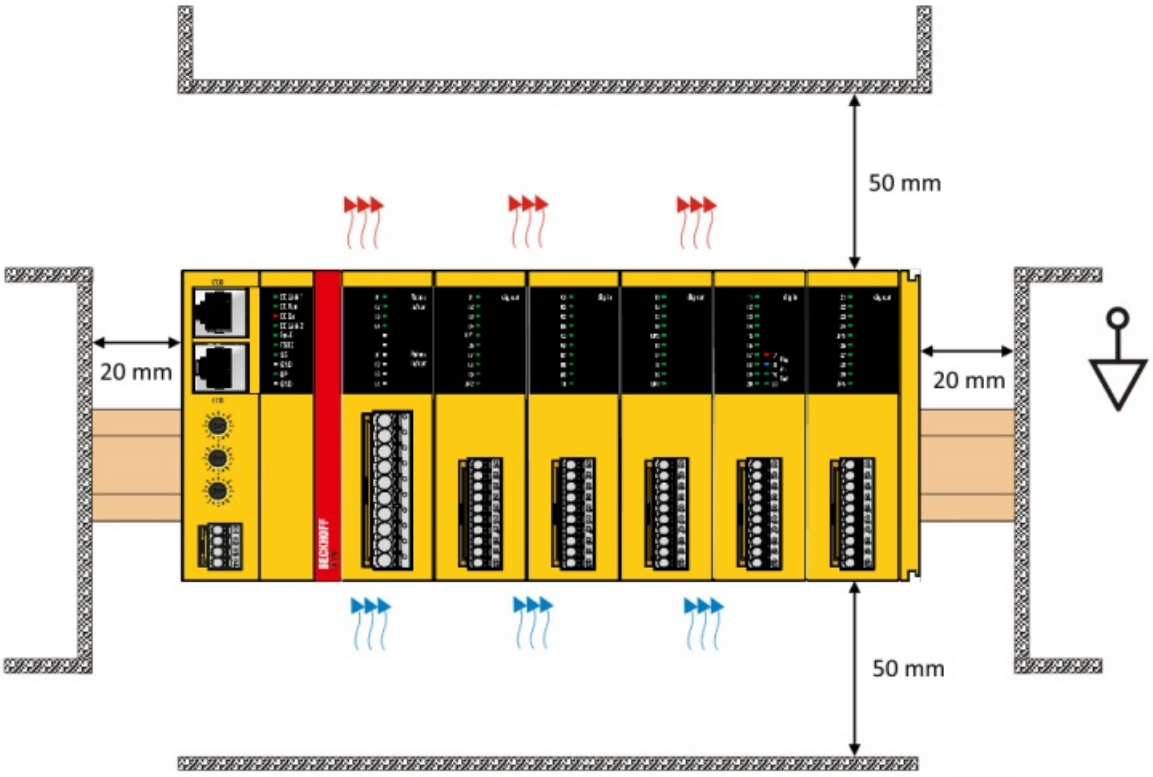


Fig. 17: Installation position and minimum distances

In order to ensure optimum convection cooling, the distances to neighboring devices and to control cabinet walls must not be smaller than those shown in the diagram.

5.2.3.4 Installation on mounting rails

The EK1960 is mounted on a DIN rail by inserting the device onto the DIN rail and then pressing it down onto the rail as shown in the diagram below. In the case of flat DIN rails it may be better to position the controller to the DIN rail from below and to snap it upwards onto the rail.

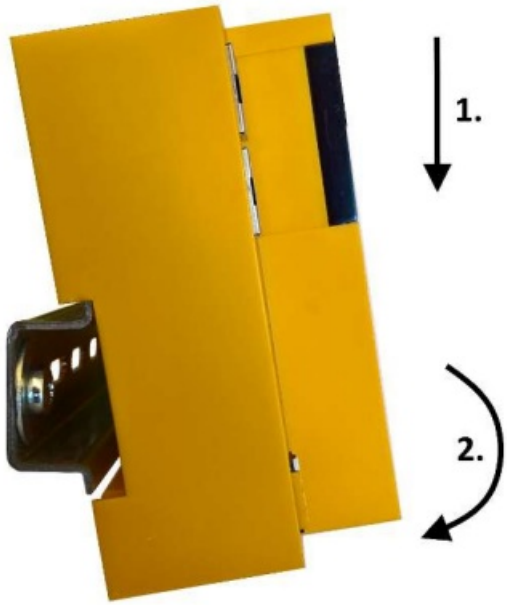


Fig. 18: Mounting the EK1960 on the DIN rail

The EK1960 is released from the DIN rail by opening the two clamps on top of or underneath the device. To do this, insert a screwdriver into the recess provided and open the clamp until it latches.

Fig. 19: DIN rail clamp closed

Once the two upper or lower clamps are unlocked, the device can be taken off the DIN rail in an upward or downward direction.

Fig. 20: DIN rail clamp opened

5.2.4 Electrical installation

5.2.4.1 Overvoltage protection

If protection against overvoltage is necessary in your system, provide an overvoltage protective circuit (surge filter) for the power supply to the TwinSAFE compact controller.

5.2.4.2 Wiring

The connectors support the push-in wiring of individual wires and fine-wire conductors with wire-end sleeves.
In the case of multi-wire and fine-wire conductors, the latch must be depressed to connect the conductor with the contact point.
Depress the latch with a screwdriver, insert the conductor and release the latch.

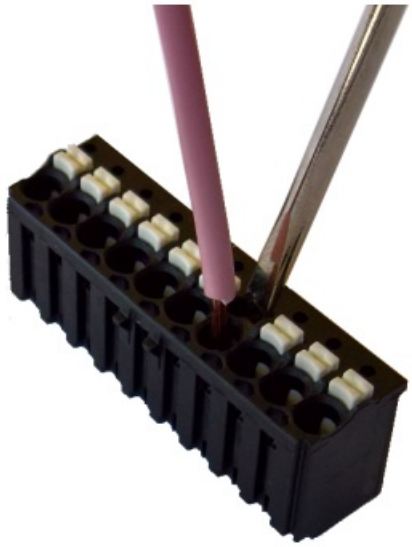


Fig. 21: ZS2003-0002 Depressing the latch

5.2.4.3 Signal cables

Cable routing

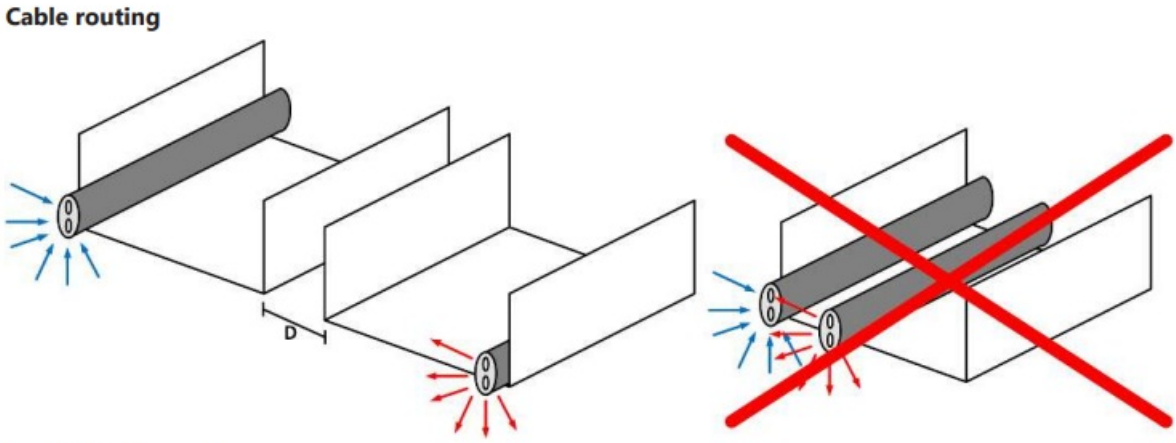


Fig. 22: Cable routing

NOTE

Route the signal cable separately

The signal cable must be routed separately from potential sources of interference, such as motor supply cables, 230 VAC power cables etc.!

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

D: Distance between the cable ducts should be as large as possible blue arrows: signal line red arrows: potential source of interference

The common routing of signals together with other clocked signals in a common cable also reduces the maximum propagation, since crosstalk of the signals can occur over long cable lengths and cause diagnostic messages.

5.3 Configuration of the controller in TwinCAT

CAUTION

Do not change CoE objects!

Do not make modifications to the CoE objects of the TwinSAFE compact controller. Any modifications of the CoE objects (e.g. via TwinCAT 3) will permanently set the controller to the Fail-Stop state or lead to unexpected behavior of the controller!

5.3.1 Configuration requirements

Version 3.1 build 4020 or higher of the TwinCAT automation software is required for configuring the EL6910.

The current version is available for download from the Beckhoff website (**www.beckhoff.de**).

TwinCAT support

The EK1960 cannot be used under TwinCAT 2

5.3.2 Insertion of a controller

An EK1960 is inserted in exactly the same way as any other Beckhoff EtherCAT device. In the list, open Safety Terminals and select the EK1960.

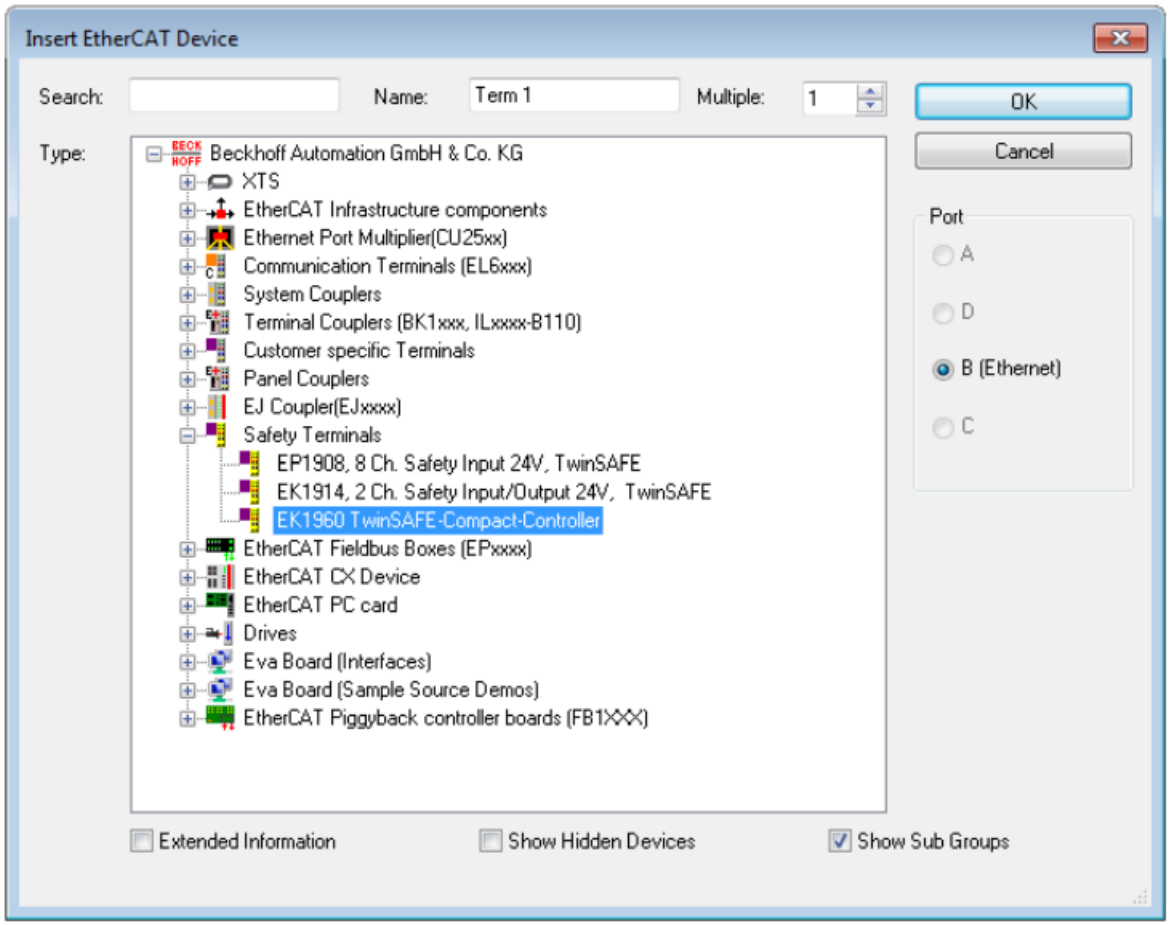


Fig. 23: Inserting an EK1960

Size of the process image
The process image of the EL6910 is adjusted dynamically, based on the TwinSAFE configuration created in TwinCAT 3.

5.3.3 Creating a safety project in TwinCAT 3

Further documentation
Information regarding the TwinSAFE-blocks, -groups and -connections can be found in the TwinSAFE-Logik-FB Documentation available on the Beckhoff website under http://www.beckhoff.de/german/download/twinsafe.htm.

5.3.3.1 Add new item

In TwinCAT 3 a new project can be created via Add New Item… in the context menu of the Safety node.

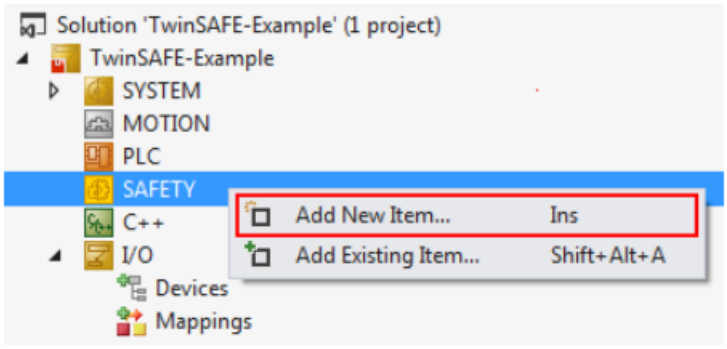


Fig. 24: Creating a safety project - Add New Item

The project name and the directory can be freely selected.

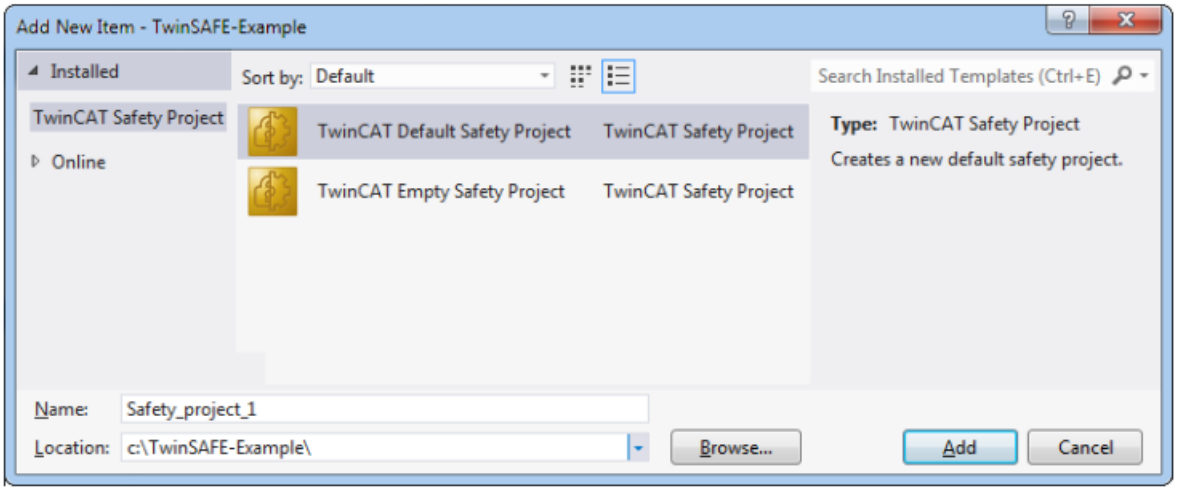


Fig. 25: Creating a safety project - project name and directory

5.3.3.2 TwinCAT Safety Project Wizard

In the TwinCAT Safety Project wizard you can then select the target system, the programming language, the author and the internal project name. Select the setting Hardware Safety PLC as the target system and the graphical editor as the programming language. The author and the internal project name can be freely selected by the user.

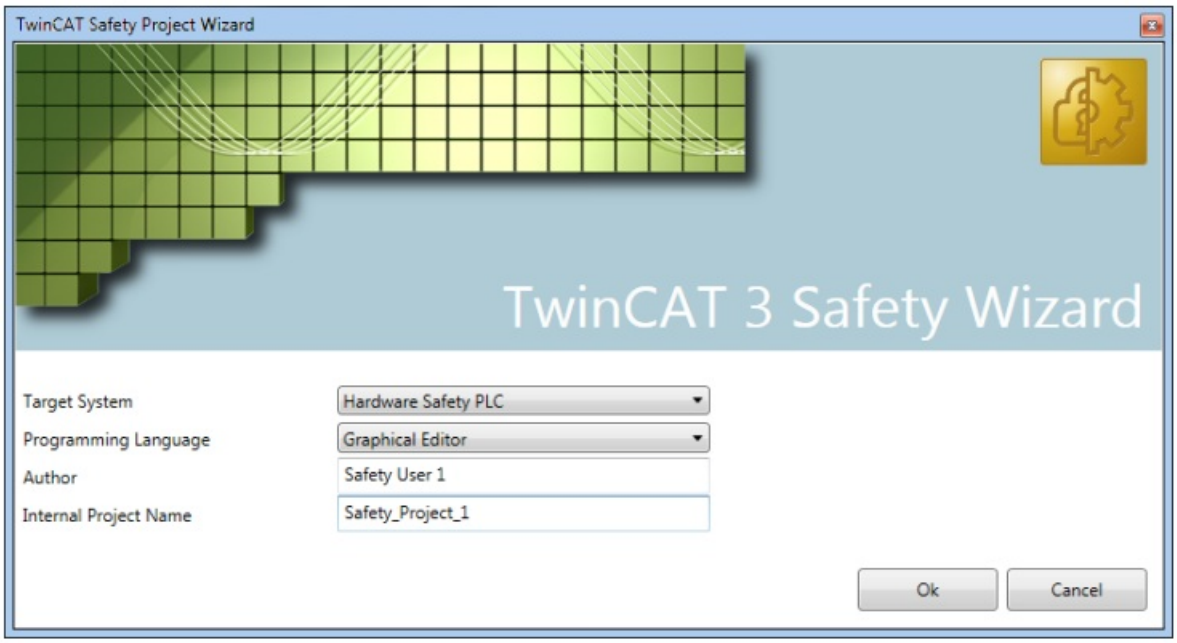


Fig. 26: TwinCAT Safety Project Wizard

5.3.3.3 Target System

After creating the project with the Project Wizard, the safety project can be assigned to the physical EK1960 TwinSAFE controller by selecting the Target System node.

Fig. 27: Selecting the Target System node

The target system is set to EK1960 via the drop-down list and linked with the EK1960 controller via the link button  next to Physical Device. If online ADS access to the controller is possible, the software version, serial number, online project CRC and rotary switch address are automatically read from the controller. The rotary switch address must correspond to the Safe Address set by the user.

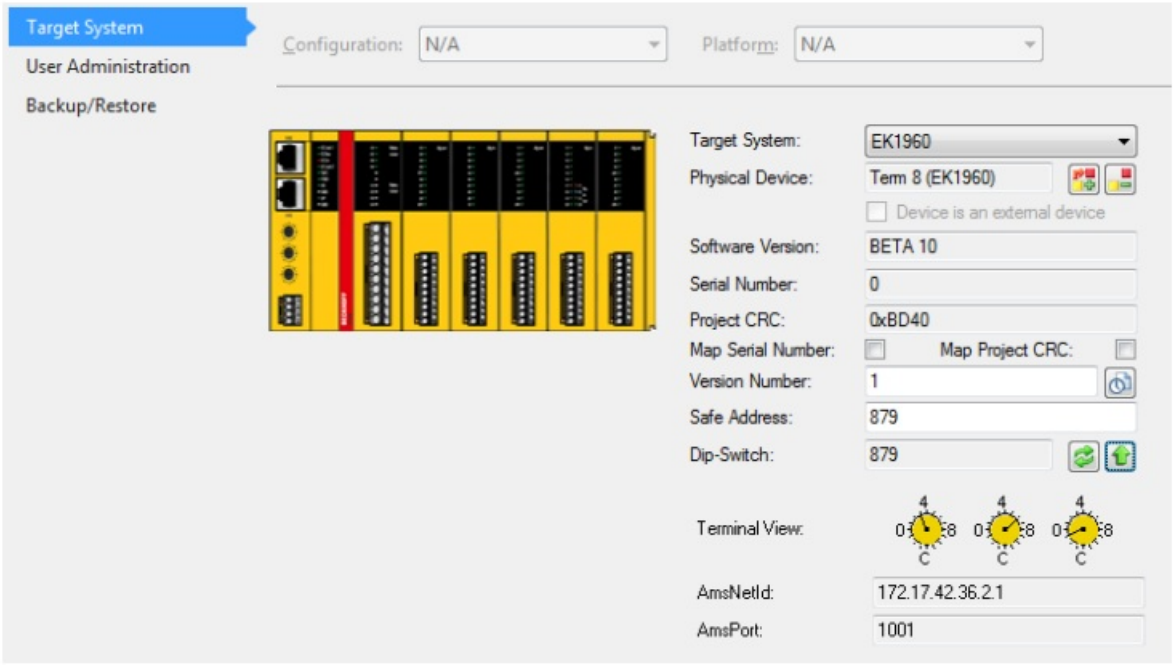


Fig. 28: Linking of target system and TwinSAFE compact controller

5.3.3.4 Alias devices

The communication between the safety logic and the I/O level is realized via an alias level. At this alias level (subnode Alias Devices) corresponding alias devices are created for all safe inputs and outputs, and also for standard signal types. For the safe inputs and outputs, this can be done automatically via the I/O configuration. The connection- and device-specific parameters are set via the alias devices.

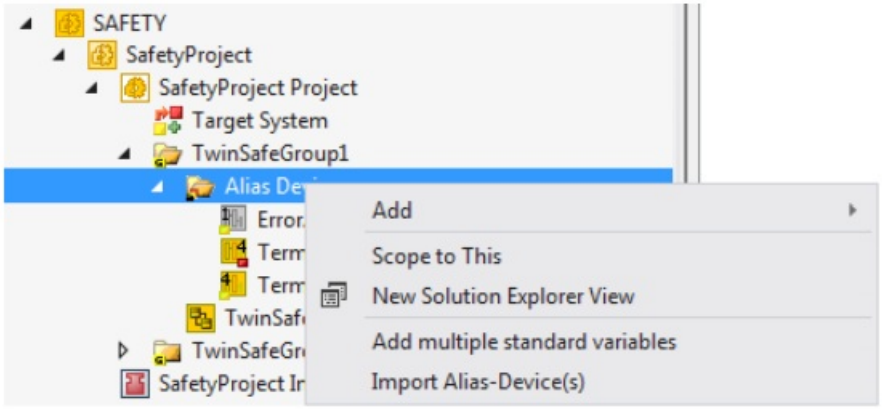


Fig. 29: Starting the automatic import from the I/O configuration

If the automatic import is started from the I/O configuration, a selection dialog opens, in which the individual terminals to be imported can be selected.

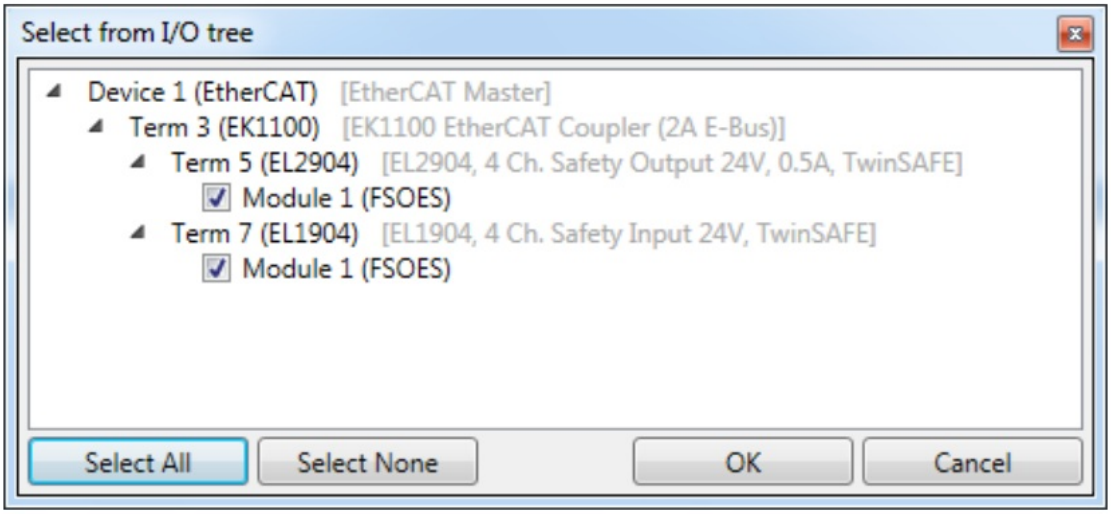


Fig. 30: Selection from the I/O tree

The alias devices are created in the safety project when the dialog is closed via OK.
Alternatively, the user can create the alias devices individually. To this end select Add and New item from the context menu, followed by the required device.

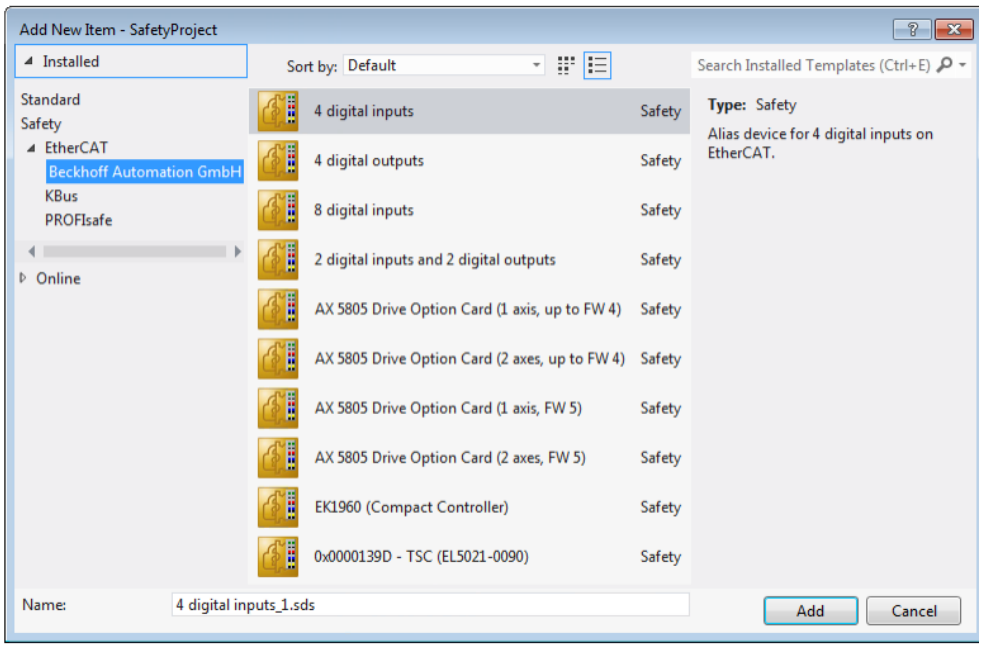


Fig. 31: Creating alias devices by the user

5.3.3.5 Parameterization of the alias device

The settings can be opened by double-clicking on the Alias Device in the safety project structure.

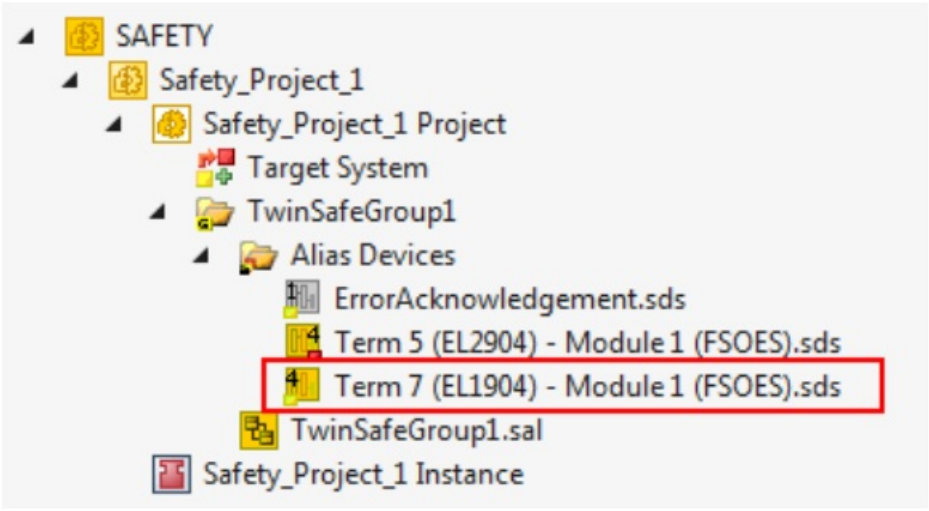


Fig. 32: Alias Device in the safety project structure

The Linking tab contains the FSoE address, the checkbox for setting as External Device and the link to the physical I/O device. If an ADS online connection to the physical I/O device exists, the DIP switch setting is displayed. Re-reading of the setting can be started via the button . The links to the EL6910/EJ6910 process image are displayed under Full Name (input) and Full Name (output).

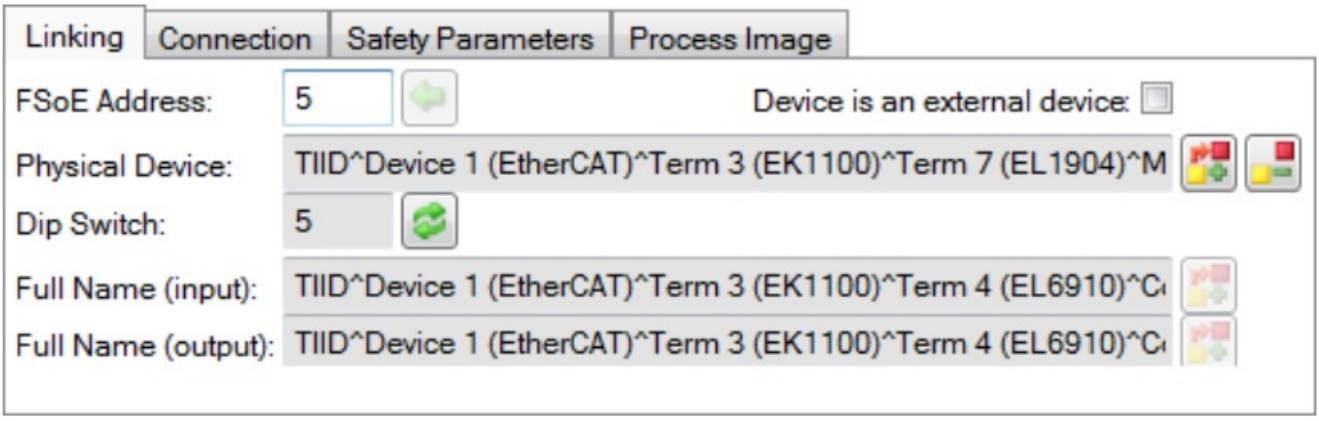


Fig. 33: Links to EL6910/EJ6910 process image

The Connection tab shows the connection-specific parameters.

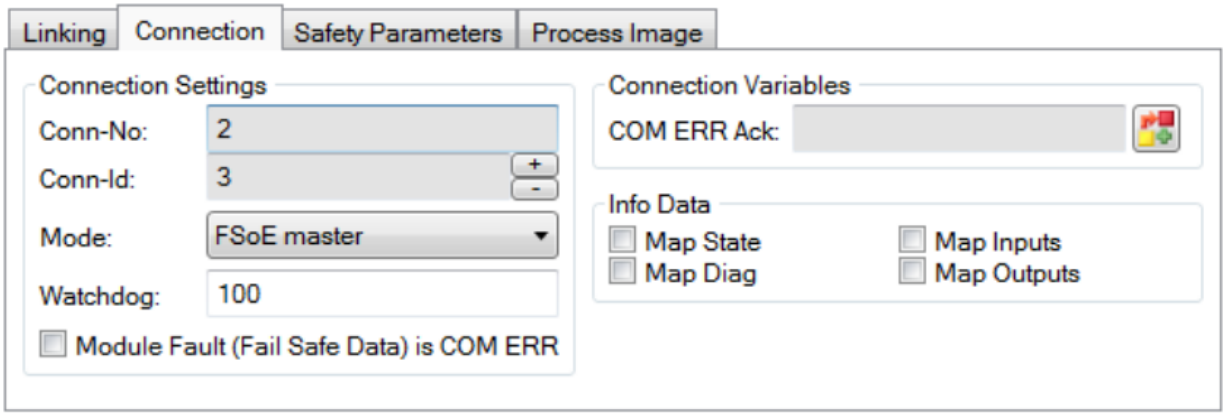


Fig. 34: Connection-specific parameters

Parameter	Description	User interaction required
Conn. no.	Connection number – automatically assigned by the TwinCAT system	No

Parameter	Description	User interaction required
Conn ID	Connection ID: reallocated by the system, but can be changed by the user. A Conn ID must be unique within a configuration. Duplicate connection IDs result in an error message.	Check
Mode	Foe master: EL6910/EJ6910 is Foe master for this device. Foe slave: EL6910/EJ6910 is Foe slave for this device.	Check
Watchdog	Watchdog time for this connection. A Comerford is generated if the device fails to return a valid telegram to the EL6910/EJ6910 within the watchdog time.	Yes
Module Fault is Comerford	This checkbox is used to specify the behavior in the event of an error. If the checkbox is ticked and a module error occurs on the Alias Device, this also leads to a connection error and therefore to disabling of the TwinSAFE group, in which this connection is defined.	Yes
Comer rack	If Comer rack is linked to a variable, the connection must be reset via this signal in the event of a communication error.	Yes
Info data	The info data to be shown in the process image of the EL6910/EJ6910 can be defined via these checkboxes. Further information can be found in the documentation for TwinCAT function blocks for TwinSAFE Logic terminals.	Yes

The EL6910/EJ6910 support activation of a ComErrAck at each connection. If this signal is connected, the respective connection must be reset after a communication error via the signal Com ErrAck, in addition to the Erick of the TwinSAFE group. This signal is linked via the link button  next to COM ERR Ack. The following dialog can be used for selecting an alias device. The signal can be cancelled via the Clear button in the Map to dialog.

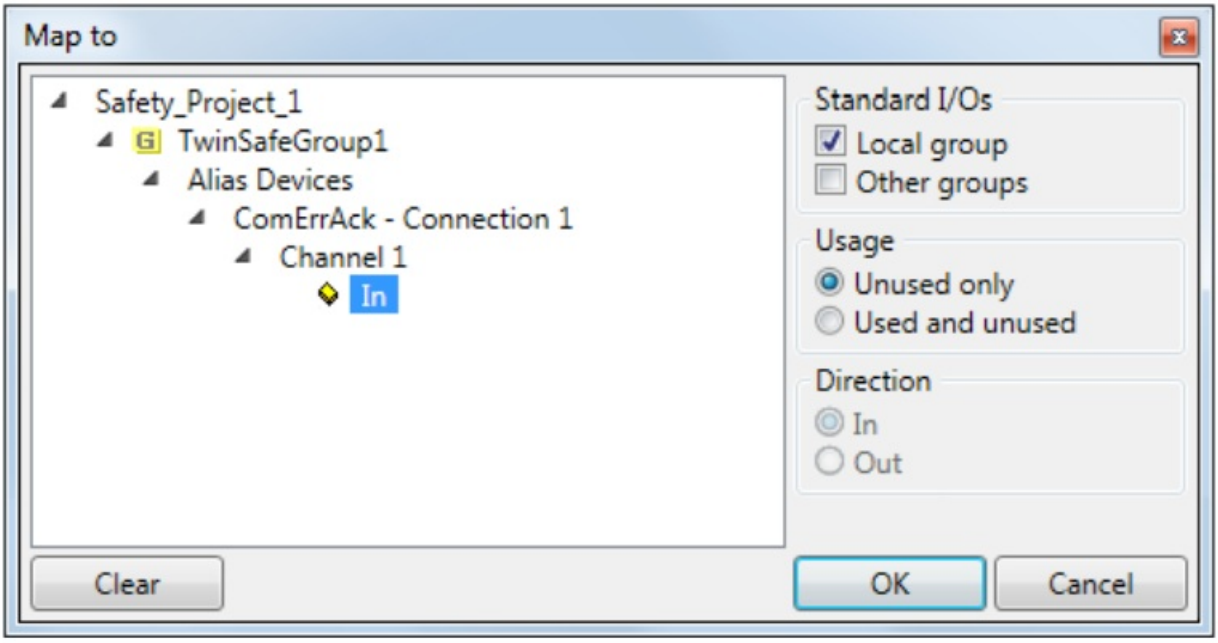


Fig. 35: Selecting an alias device

The safety parameters matching the device are displayed under the Safety Parameters tab. They have to be set correctly to match the required performance level. Further information can be found in the TwinSAFE application manual.

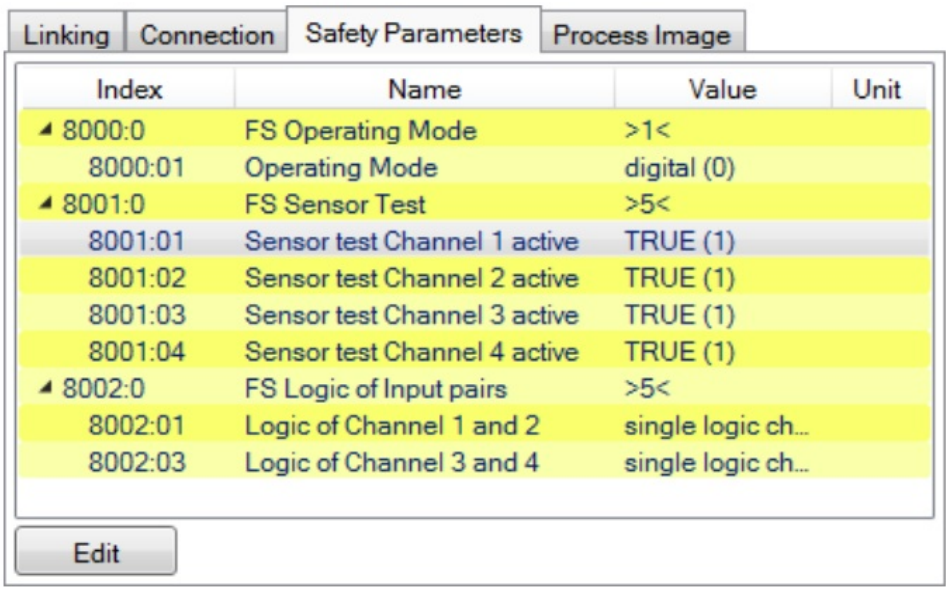


Fig. 36: Safety parameter for the device

5.3.3.6 Connection to AX5805/AX5806

There are separate dialogs for linking an AX5805 or AX5806 TwinSAFE Drive option card, which can be used to set the safety functions of the AX5000 safety drive options.

Creating and opening of an alias device for an AX5805 results in five tabs; the Linking, Connection and Safety Parameters tabs are identical to other alias devices.

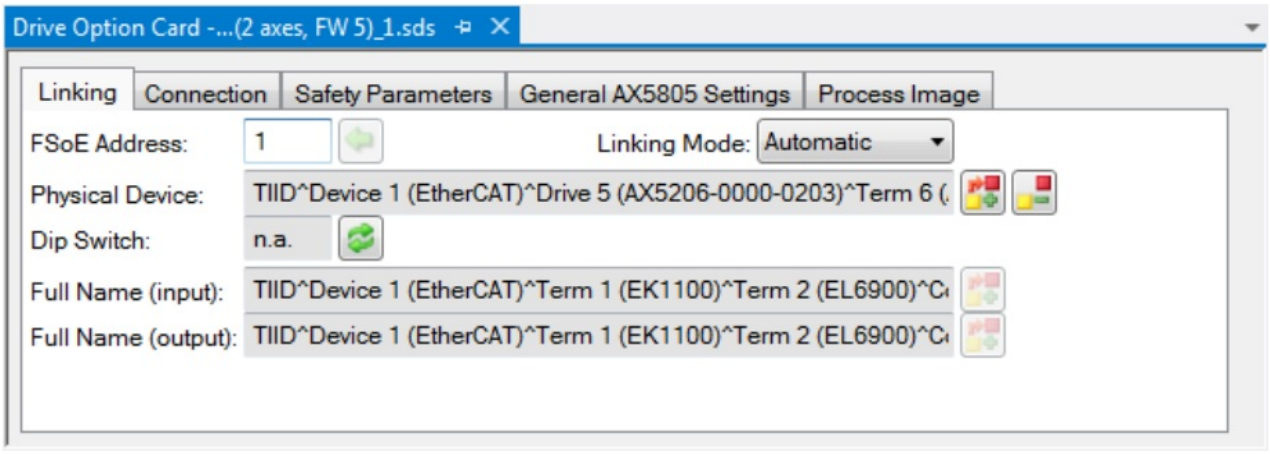


Fig. 37: AX5000 safety drive functions

The General AX5805 Settings tab can be used to set the motor string and the SMS and SMA functions for one or two axes, depending on the added alias device.

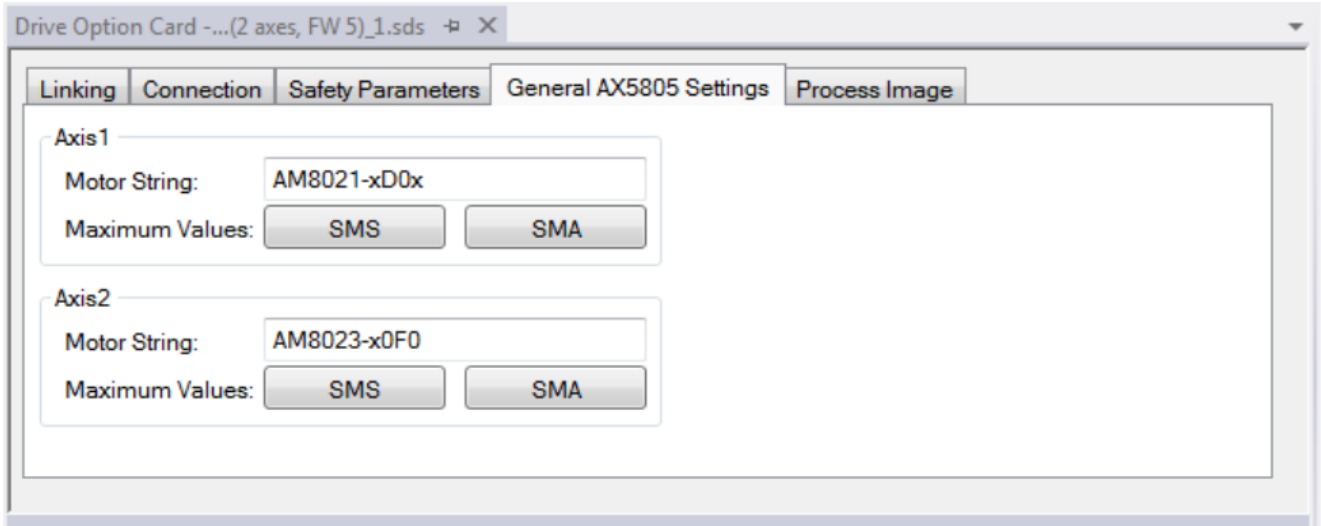


Fig. 38: AX5000 safety drive options - general AX5805 settings

The Process Image tab can be used to set the different safety functions for the AX5805.

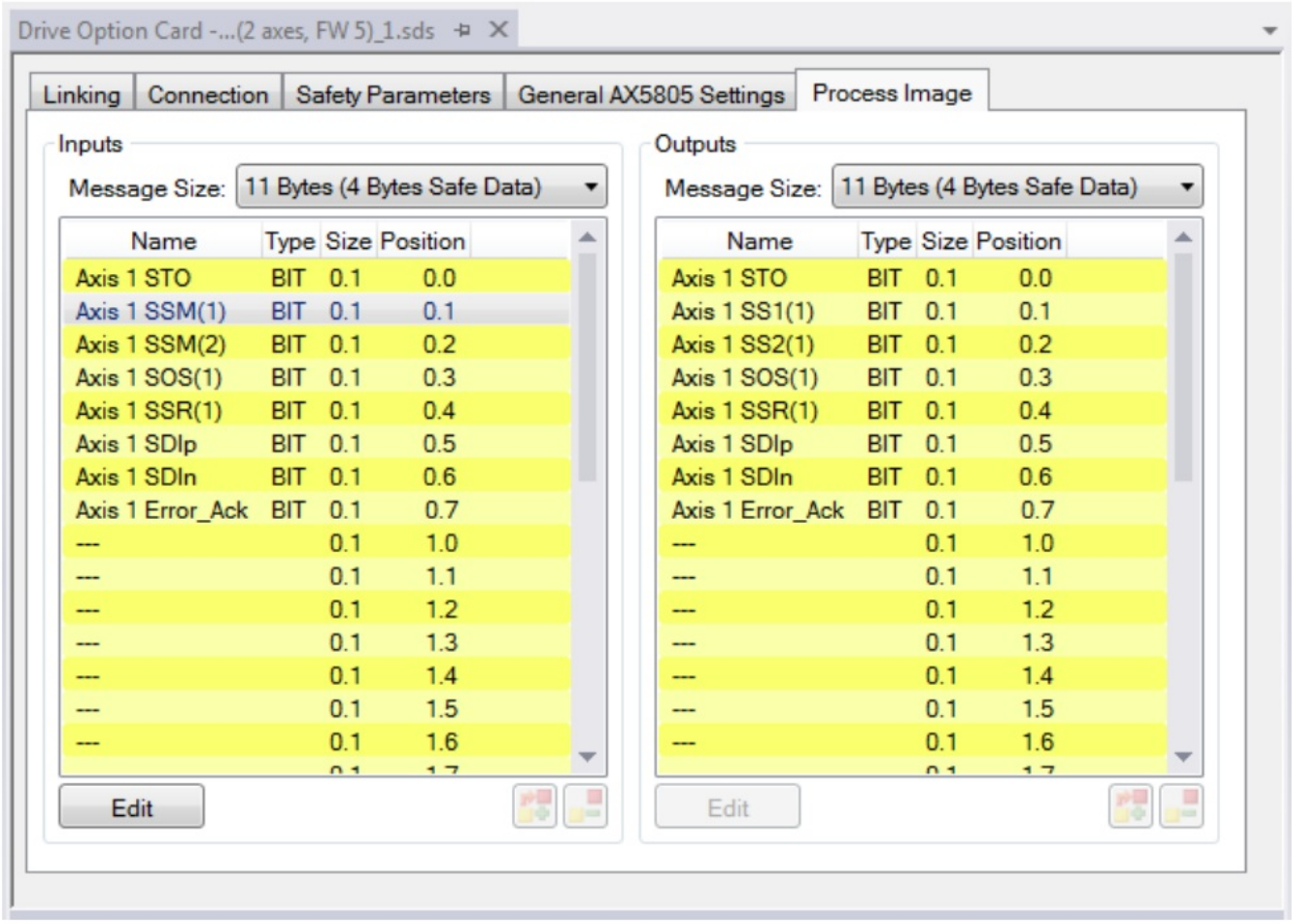


Fig. 39: AX5000 safety drive options - Process Image

The parameters under the General AX5805 Settings and Process Image tabs are identical to the parameters under the Safety Parameters tab. Offers user-friendly display and editing of the parameters. The parameters under the Safety Parameters tab can also be edited.

The parameters for this function can be set by selecting a function in the inputs or outputs and pressing the Edit button. New safety functions can be added in the process image by selecting an empty field (—) and pressing Edit.

The parameter list corresponding to the safety function can be shown; in addition, an optional diagram of the function can be shown. At present the diagram is still static and does not show the currently selected values.

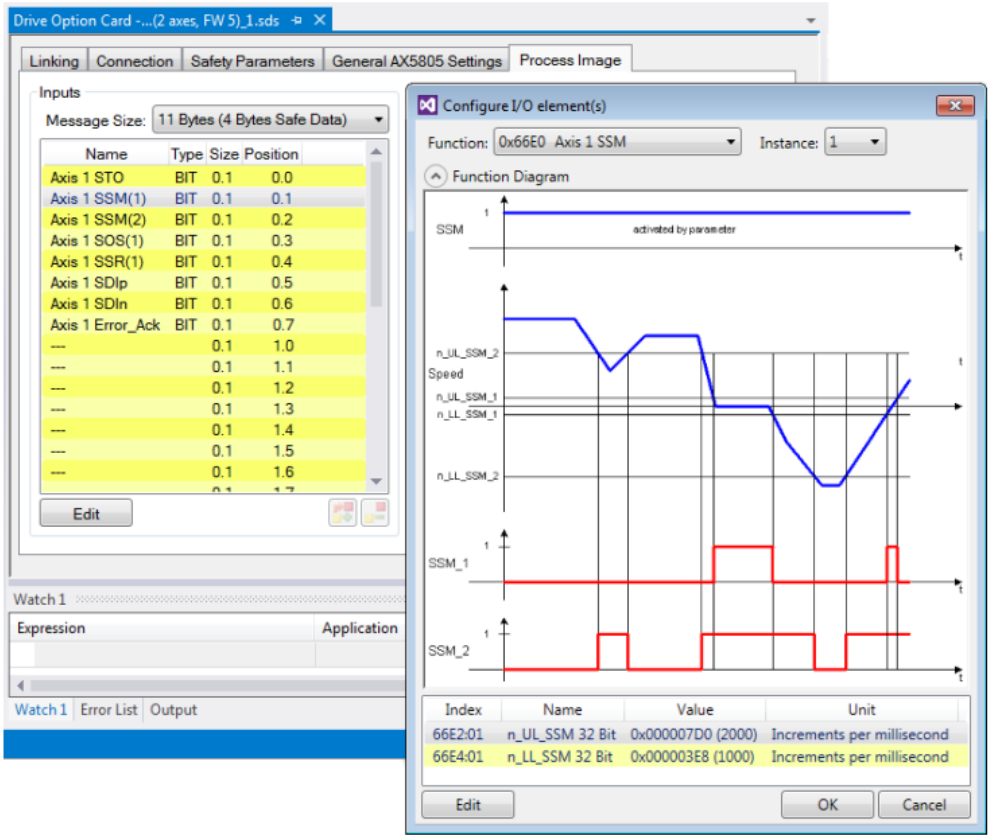


Fig. 40: AX5000 safety drive options - Function Diagram

5.3.3.7 External connection

An external Custom FSoE Connection can be created for a connection to a further EL69x0, EJ6910, KL6904 or third-party device. If a dedicated ESI file exists for a third-party device, the device is listed as a selectable safety device, and the Custom FSoE Connection option is not required.

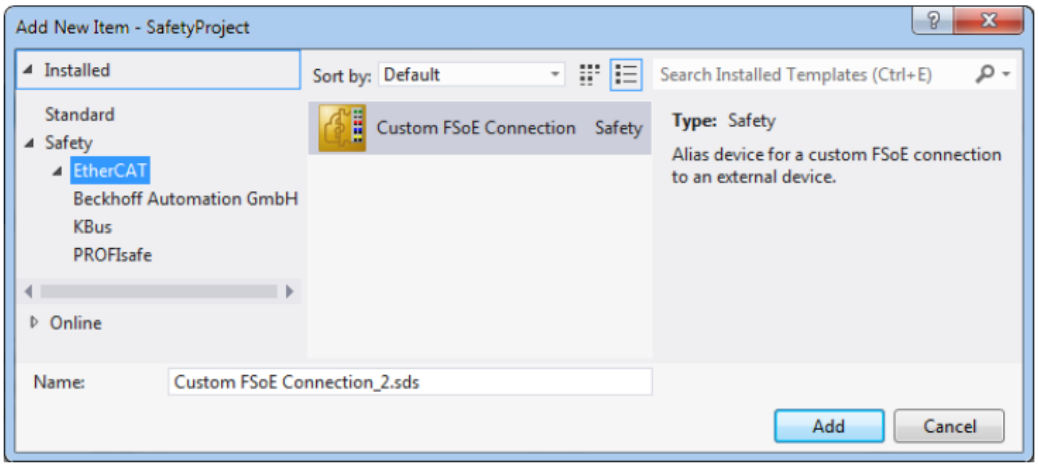


Fig. 41: Creating an external connection (Custom FSoE Connection)

Before the connection can be used and linked further, the process image size must be parameterized. This can be set under the Process Image tab. Suitable data types for different numbers of safety data are provided in the dropdown lists for the input and output parameters.

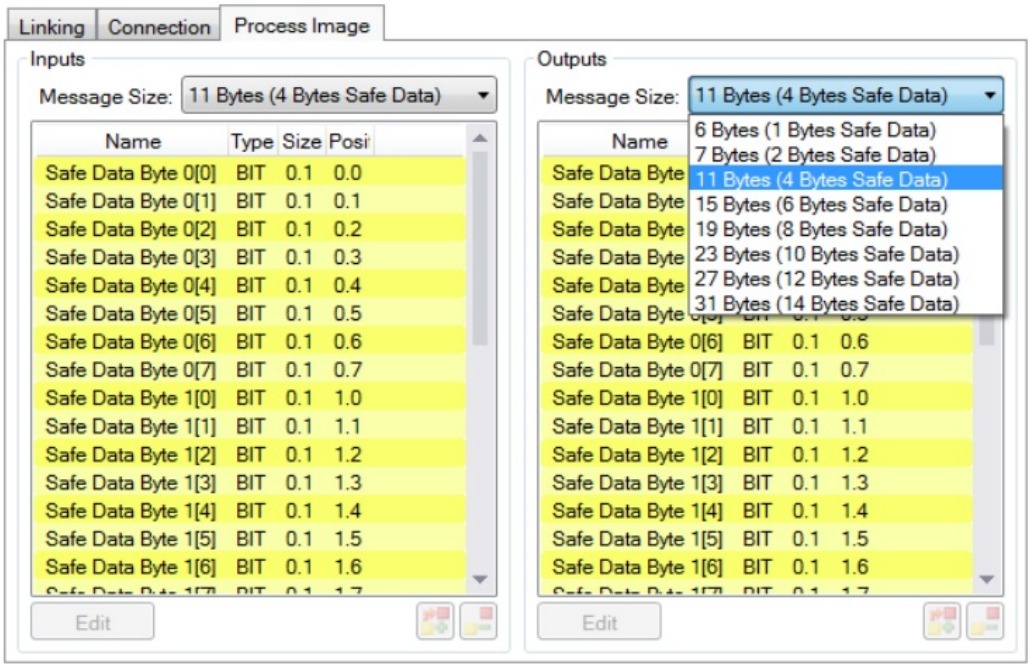


Fig. 42: Parameterization of the process image size

Once the size is selected, the individual signals within the telegram can be renamed, so that a corresponding plain text is displayed when these signals are used in the logic. If the signals are not renamed, the default name is displayed in the editor (Safe Data Byte 0[0], …).

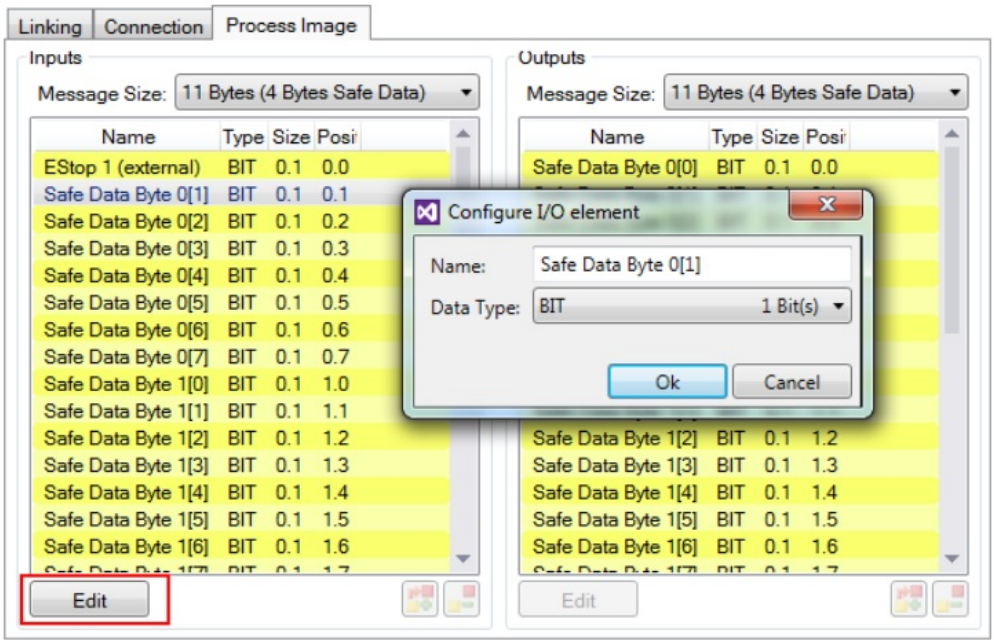


Fig. 43: Renaming the individual signals within the telegram

The connection is linked under the Linking tab. The Link button  next to Full Name (input) and Full Name (output) can be used to select the corresponding variable.

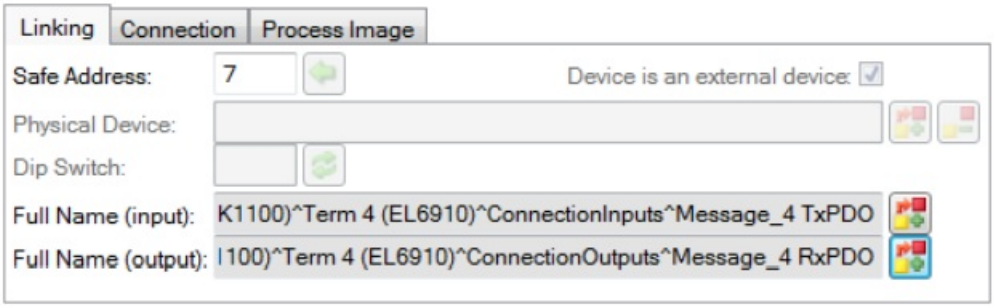


Fig. 44: Selecting the variables

This can be a PLC variable, for example, which is then forwarded to the remote device or can be linked directly with the process image of an EtherCAT Terminal (e.g. EL69x0 or EL6695).

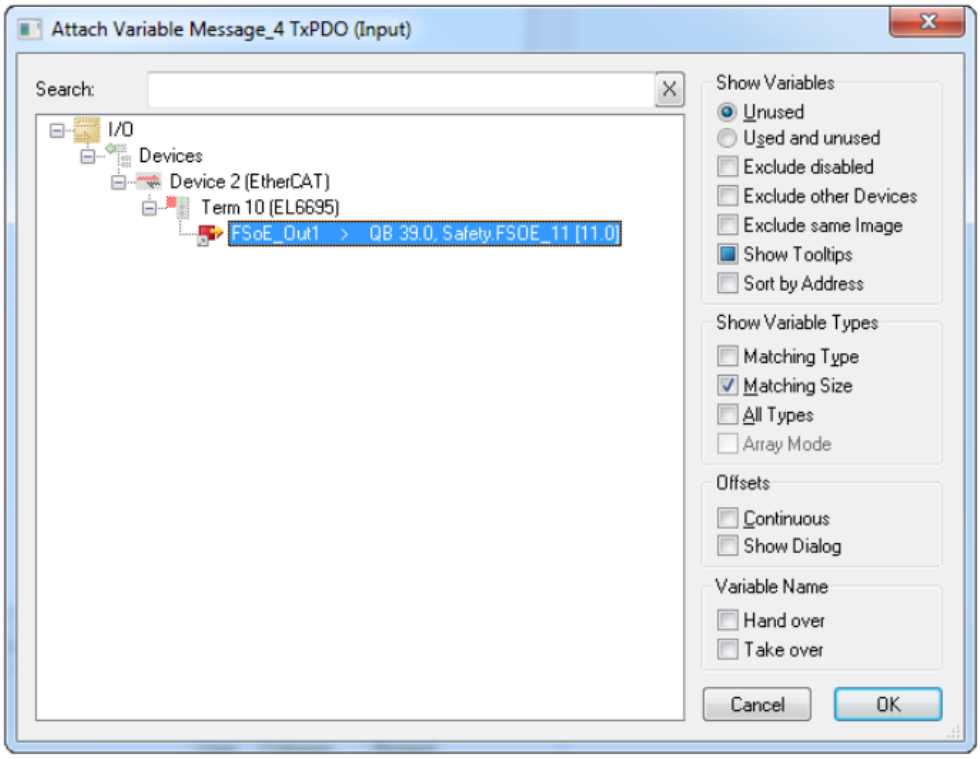


Fig. 45: Direct linking with the process image of an EtherCAT Terminal

Further information can be found in the TwinCAT documentation for the variable selection dialog. The Connection tab is used to set the connection-specific parameters.

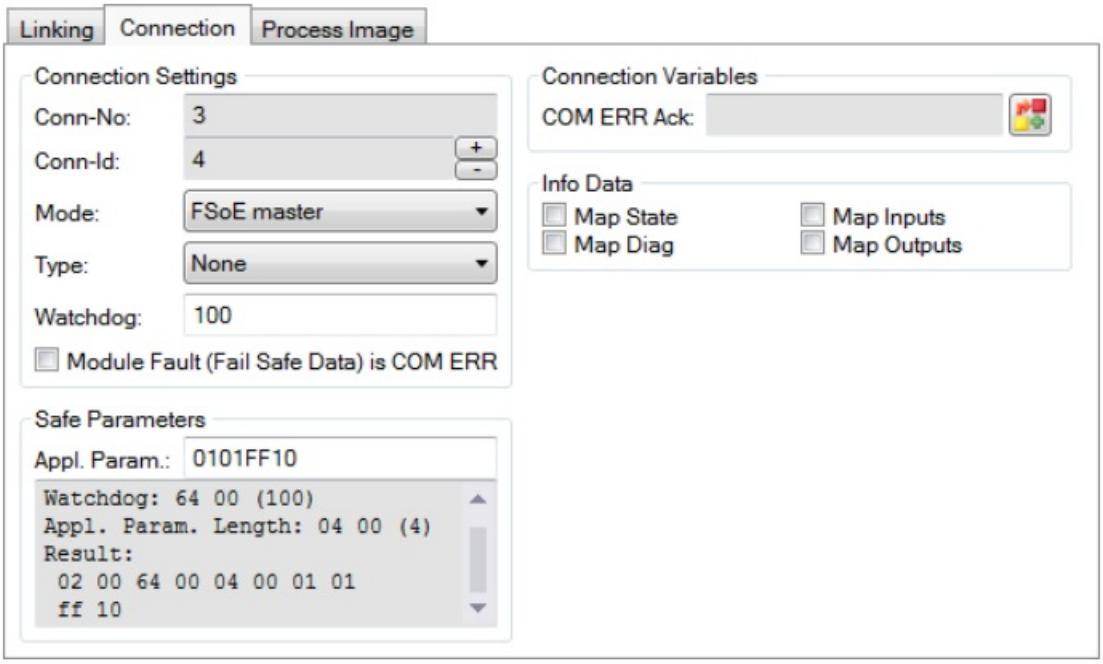


Fig. 46: Connection-specific parameters

Detailed information about the individual settings can be found in the following table.

Parameter	Description	User interaction required
Conn. no.	Connection number: is automatically assigned by the TwinCAT system	No
Conn ID	Connection ID: reallocated by the system, but can be changed by the user. A Conn ID must be unique within a configuration. Duplicate connection IDs result in an error message	Check
Mode	FSoE master: EL6910/EJ6910 is FSoE master for this device. FSoE slave: EL6910/EJ6910 is FSoE slave for this device.	Check
Type	None: Setting for third-party equipment, for which no ESI file is available. KL6904: Setting for KL6904 (safety parameter inactive) EL69XX: Setting for EL6900/EL6930/EL6910/EJ6910 (safety parameter inactive)	Yes
Watchdog	Watchdog time for this connection: A Comerford is generated, if the device fails to return a valid telegram to the EL6910 within the watchdog time.	Yes
Module Fault is Comerford	This checkbox is used to specify the behavior in the event of an error. If the checkbox is ticked and a module error occurs on the Alias Device, this also leads to a connection error and therefore to disabling of the TwinSAFE group, in which this connection is defined.	Yes
Safe Parameters (Appl. Param)	Device-specific parameters: The parameter length is automatically calculated from the number of characters that is entered. This information will typically be provided by the device manufacturer.	Yes
Comer rack	If Comer rack is linked to a variable, the connection must be reset via this signal in the event of a communication error.	Yes
Info data	The info data to be shown in the process image of the EL6910/EJ6910 can be defined via these checkboxes. Further information can be found in the documentation for Twin CAT function blocks for TwinSAFE Logic terminals.	Yes

5.3.3.8 Local safe inputs and outputs of the EK1960

An alias device must also be created for the local safe inputs and outputs of the EK1960. To do this, a new alias device is created and the EK1960 selected via Add New item. The name of the alias device can be freely assigned.

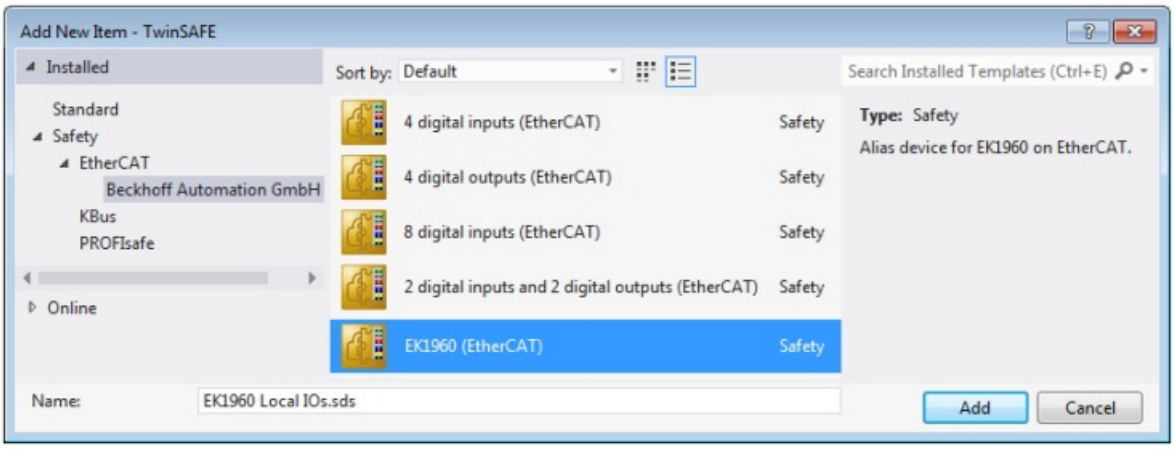


Fig. 47: Insertion of an EK1960 alias device

After opening the alias device the Linking Mode must be set to Local. The result of this is that all settings that are not relevant for this mode are grayed out.

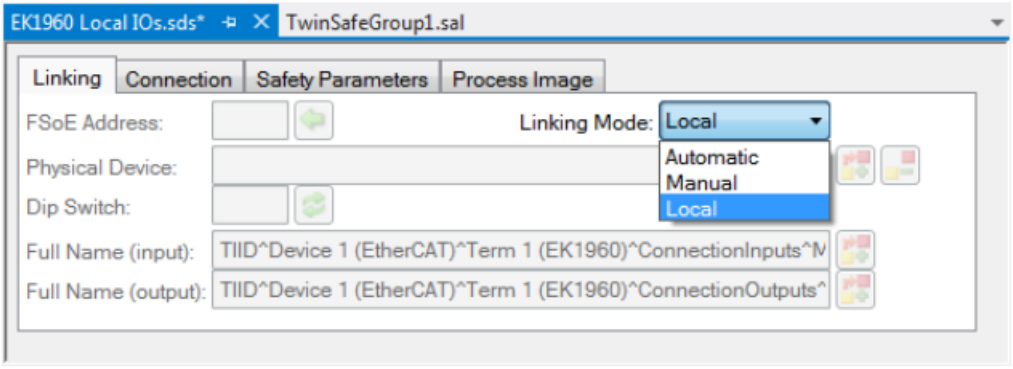


Fig. 48: Switching the alias device to *Local*

Only the info data for inputs and outputs can be activated on the Connection tab.

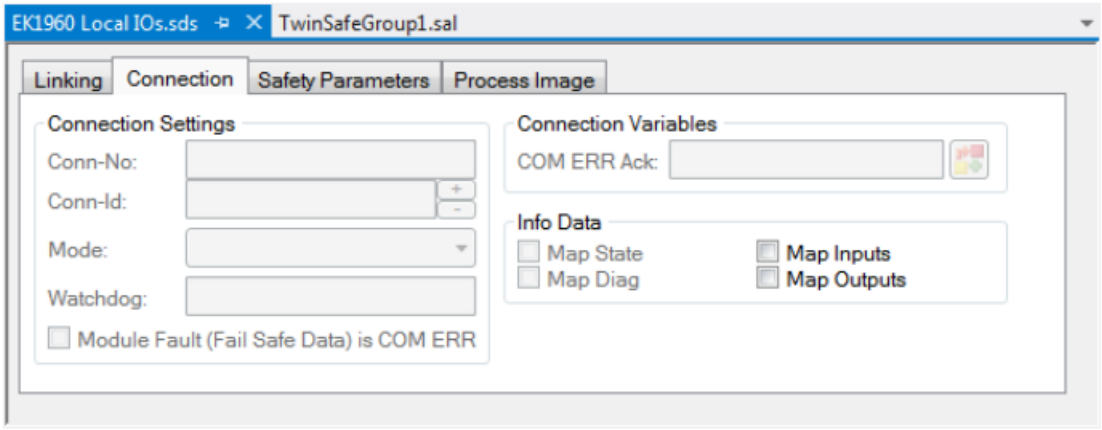


Fig. 49: Info data for local connection

The corresponding parameters are set for each input and output module on the Safety Parameter tab.

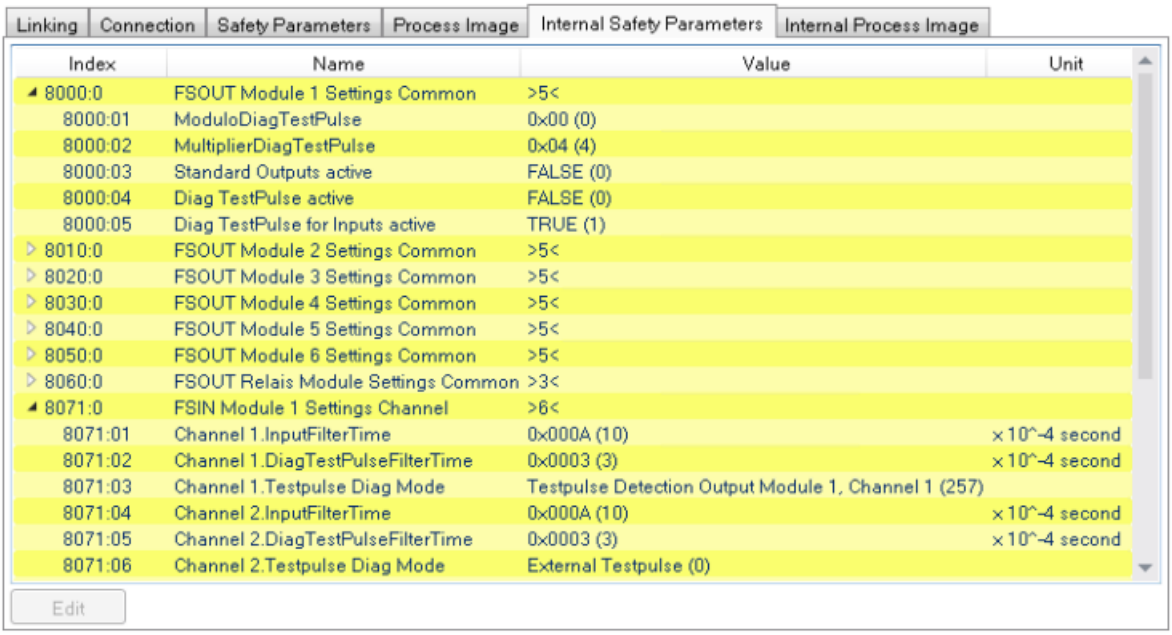


Fig. 50: Safety parameters of the output and input modules

Overview of output parameters

PrmName	Index	Meaning	Value
FSOUT Module 0 Settings Common	80×0:00	Settings for output module 0 (outputs 01 – 04)	–
ModuloDiag TestPulse	80×0:01	Test frequency of the clocking All modules used are processed in succession in one logic cycle respectively. With Modulo=0 the test is carried out in each cycle in the respectively current module; with Modulo=1 only every second pass and so on.	0
Multiplier Diag Test Pulse	80×0:02	Duration of the clocking 1 = 400 µs (this value will need to be increased according to the connected load if the outputs are open circuit or in the case of very small output currents)	1
Standard Outputs active	80×0:03	FALSE = standard outputs deactivated TRUE = standard outputs are ANDed with the safe outputs	FALSE
Diag Test Pulse active	80×0:04	FALSE: Clocking of the outputs deactivated TRUE: Clocking of the outputs activated	FALSE
Diag Test Pulse for Inputs active	80×0:05	FALSE: Clocking of the outputs for local inputs deactivated TRUE: Clocking of the outputs for local inputs activated. If TRUE is set here the parameter DiagTestPulseActive is also set to TRUE.	FALSE
Module Fault Link active	80×0:07	In the event of a module error of this module, all other modules of this TwinSAFE component, where this parameter is also set to TRUE, are set to a module error.This parameter is available from FW03 and ESI revision -0021. For projects, which are created with a firmware smaller than 03 and a revision smaller than 0021, the behavior remains unchanged.	TRUE

WARNING
Parameter Diag TestPulse for Inputs active
If this parameter is activated, all outputs of this module are switched on and can be used as test pulses for controller inputs. In this setting the parameter Diag TestPulse Active must be set to TRUE.
Corresponding parameters exist under the indices 8000:0 to 8050:0 for the output modules 0 to 5. The module 8060:0 exists for the relay module.
The corresponding parameters are set for each input module on the Safety Parameter tab.

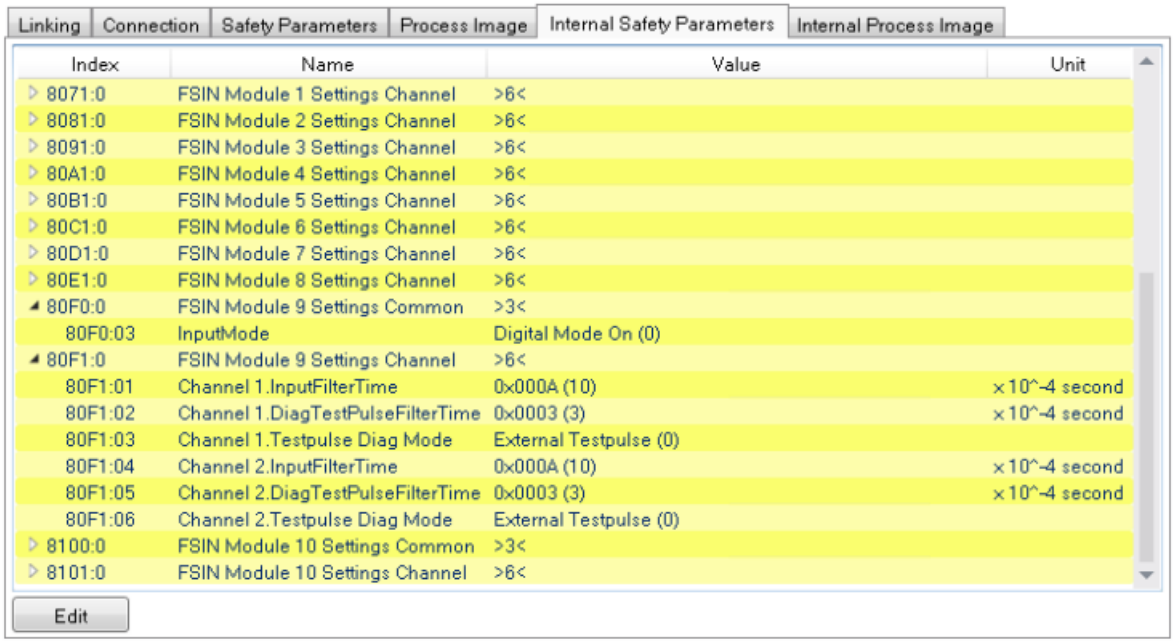


Fig. 51: Safety parameters of the input modules

Overview of input parameters

Prm Name	Index	Meaning	Value
FSIN Module 9 Settings Common	80F0:00	Settings for input module 9 (inputs 17 – 18) This setting exists only for modules 9 and 10	–
Input Mode	80F0:03	Only input modules 9 and 10 support the parameters *Digital Mode On* and *Bumper Mode On*. All other modules are set to Digital Mode On and cannot be changed by the user.	– Digital Mode On – Bumper Mode On
FSIN Module 1 Settings Channel	8071:00	Settings for input module 1 (inputs 01 – 02)	–
Channel1. Input Filter time	8071:01	Filter time for an input in the unit 100 µs. After the expiry of this time the signal state is transmitted to the logic on an edge change at the input. This value must be adapted to the length of the test pulses if they are used.	10 (1 ms)
Channel1. Diag Test Pulse Filter Time	8071:02	Filter time for an input in the unit 100 µs. This time must elapse before a measurement of the momentary signal state is carried out after an edge change. This value should be adapted to the length of the test pulses if they are used.	3 (300 µs)
Channel1. TestPulse Diag Mode	8071:03	The output channel from which the test pulse is expected must be set here	External Test pulse or drop-down list of the EK1960 outputs
Channel2. Input Filter time	8071:04	Filter time for an input in the unit 100 µs. After the expiry of this time the signal state is transmitted to the logic on an edge change at the input. This value must be adapted to the length of the test pulses if they are used.	10 (1 ms)
Channel2. Diag Test Pulse Filter Time	8071:05	Filter time for an input in the unit 100 µs. This time must elapse before a measurement of the momentary signal state is carried out after an edge change. This value should be adapted to the length of the test pulses if they are used.	3 (300 µs)

PrmName	Index	Meaning	Value
Channel2. TestPulse Diag Mode	8071:06	The output channel from which the test pulse is expected must be set here	External Testpulse or drop-down list of the EK1960 outputs

Corresponding parameters are available for input modules 1 to 10 (inputs 01 to 20) under the indices 8071:0 to 80E1:0 (in 10hex steps – 8071, 8081, 8091, 80A1 and so on).
The input modules 9 and 10 have additional parameters under indices 80F0:0 and 8100:0 with which the operation modes Digital Mode On and Bumper Mode On can be set.

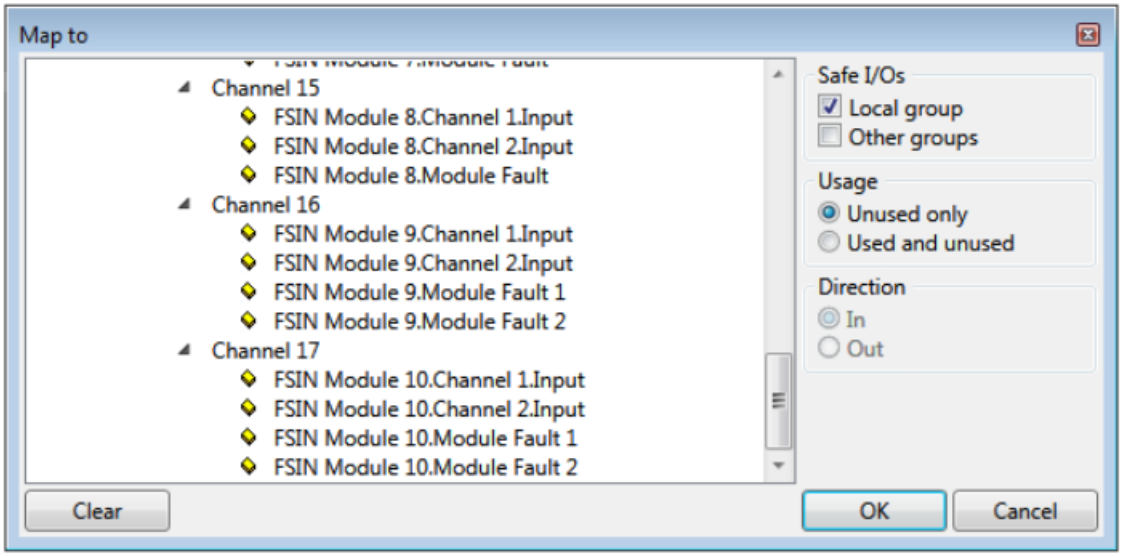


Fig. 52: Process data of input modules 9 and 10

The input modules 9 and 10 have a fault evaluation per channel when using the Bumper Mode, so there are also 2 separate Module Fault signals. When using the digital mode, both signals are set in the case of a module fault.

Module use within the safety logic

Other than with external alias devices, only the corresponding module (two inputs or four outputs) is assigned to the respective TwinSAFE group when selecting an input or output signal of the local alias device. All other modules can be assigned to further TwinSAFE groups. A decouple FB can be used to make the inputs of a module available to a further group.

5.3.3.9 Creating the safety application

The safety application is realized in the SAL worksheet pertaining to the TwinSAFE group (SAL – Safety Application Language).

The toolbox provides all the function blocks available on the EL6910/EJ6910.

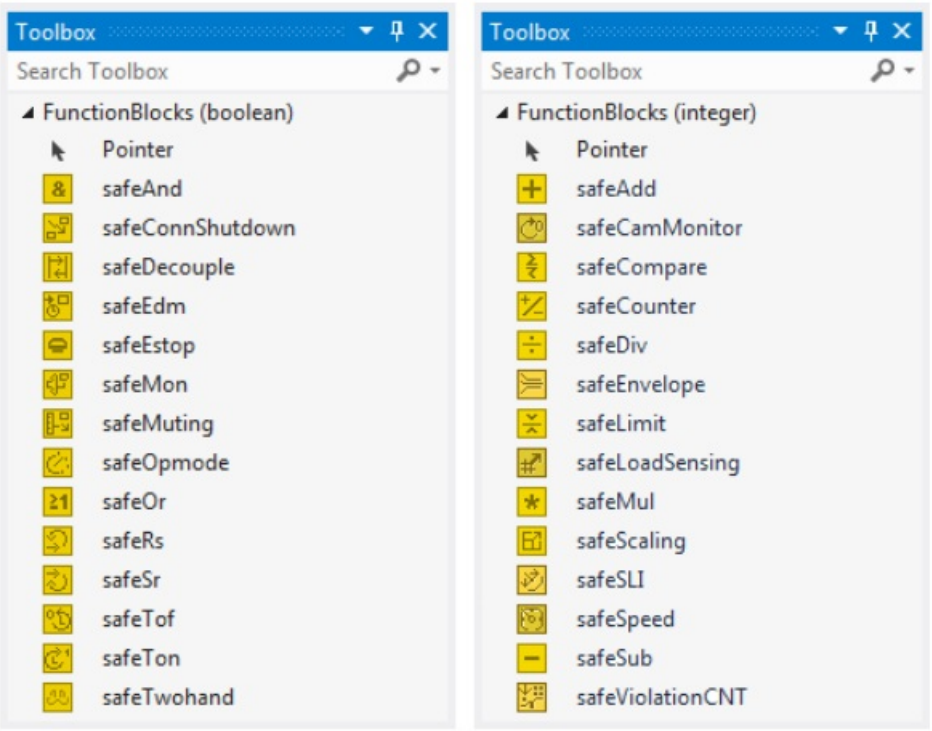


Fig. 53: Function blocks available for EL6910/EJ6910

The function blocks can be moved from the toolbox into the SAL worksheet via drag and drop. Variables can be created by clicking next to a function block input or output, which can then be linked with alias devices in the Variable Mapping dialog.

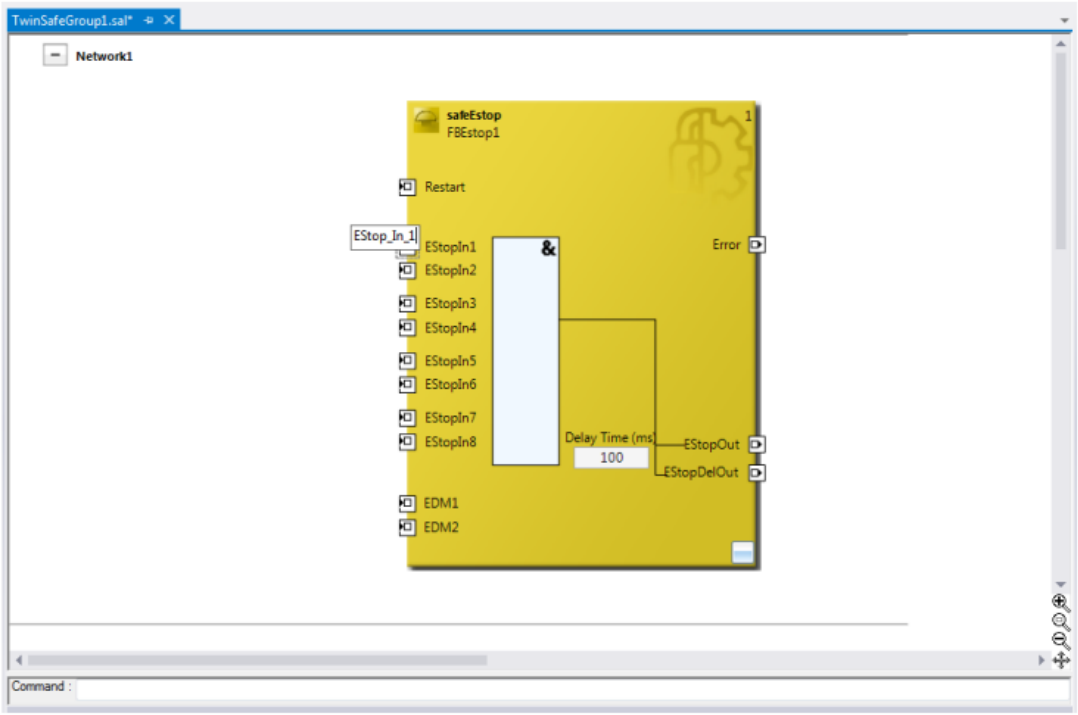


Fig. 54: Function block on the SAL worksheet

Once the pointer connector Pointer has been selected from the toolbox, connections between the input and output ports of the function blocks can be dragged with the mouse.

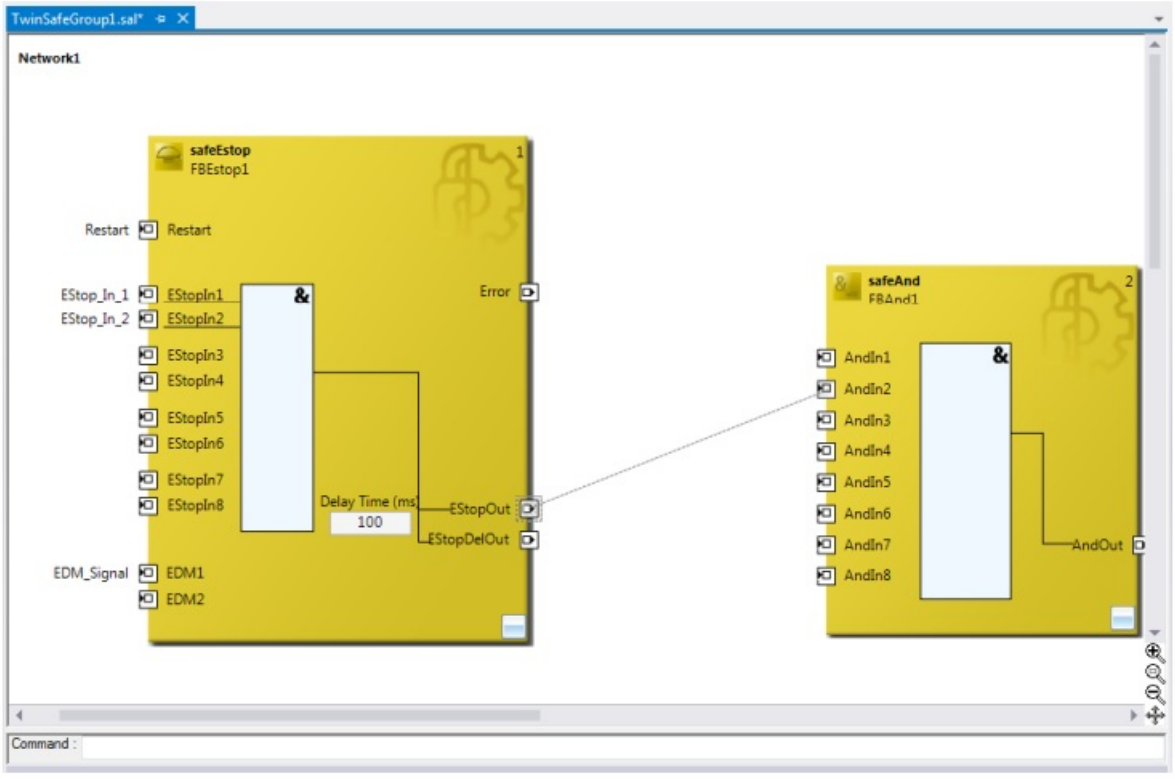


Fig. 55: Dragging a connection between two function blocks

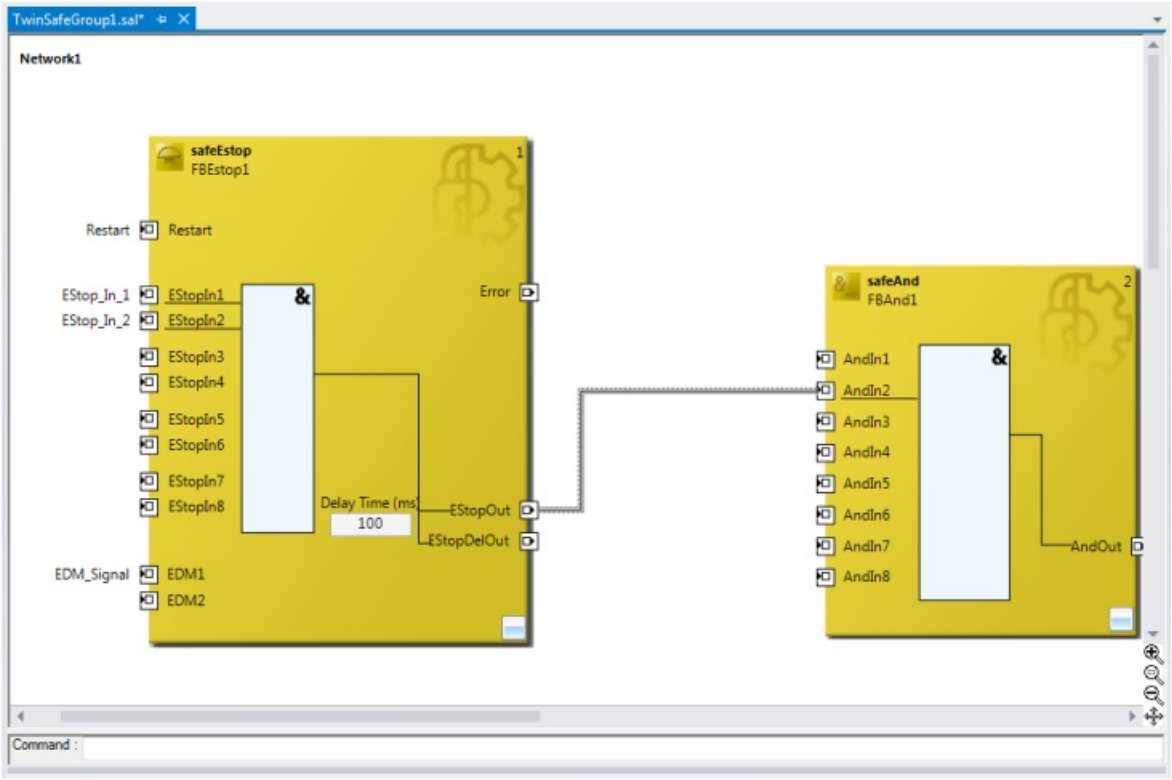


Fig. 56: Connection between two function blocks

5.3.3.10 Networks

For structuring the safety application, several networks can be created within a sale worksheet. Right-click in the worksheet and select Add After and Network or Add Before and Network to create a network after or before the current network.

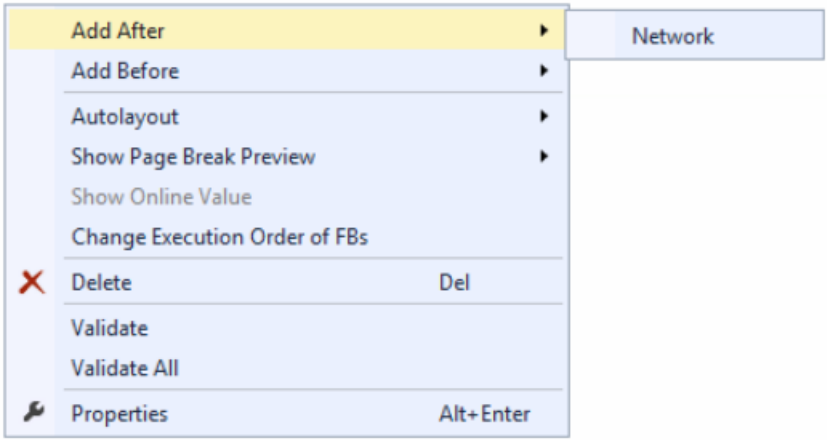


Fig. 57: Creating a network

The instance path to the FB port to be linked can be specified, in order to exchange signals between the networks. The instance path consists of the network name, the FB name and the FB port, each separated by a dot. The input of the instance path is case-sensitive.
<Network name>.<FB name>.<FB port name>
Sample: Network1.FBEstop1.EStopIn3
Alternatively, Change Link can be selected by opening the context menus next to the FB port.

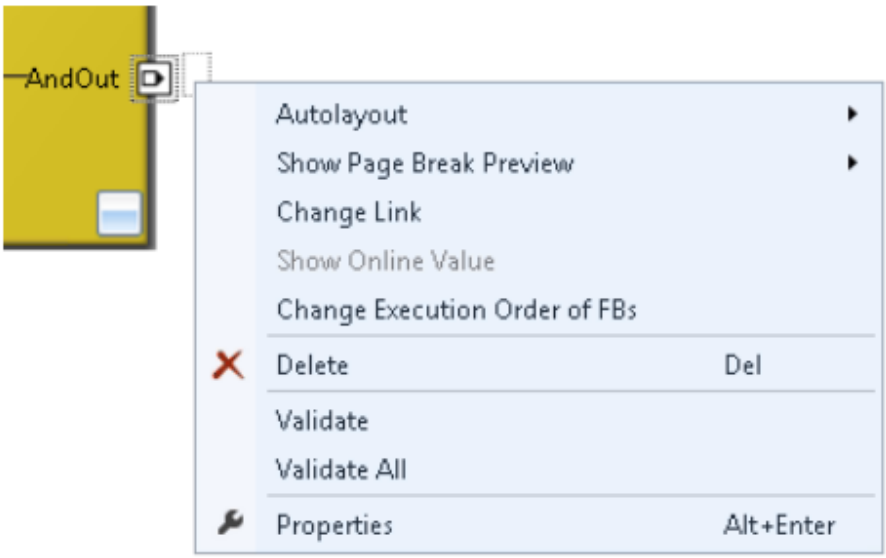


Fig. 58: Change Link

This function opens a dialog for selecting a suitable FB port.

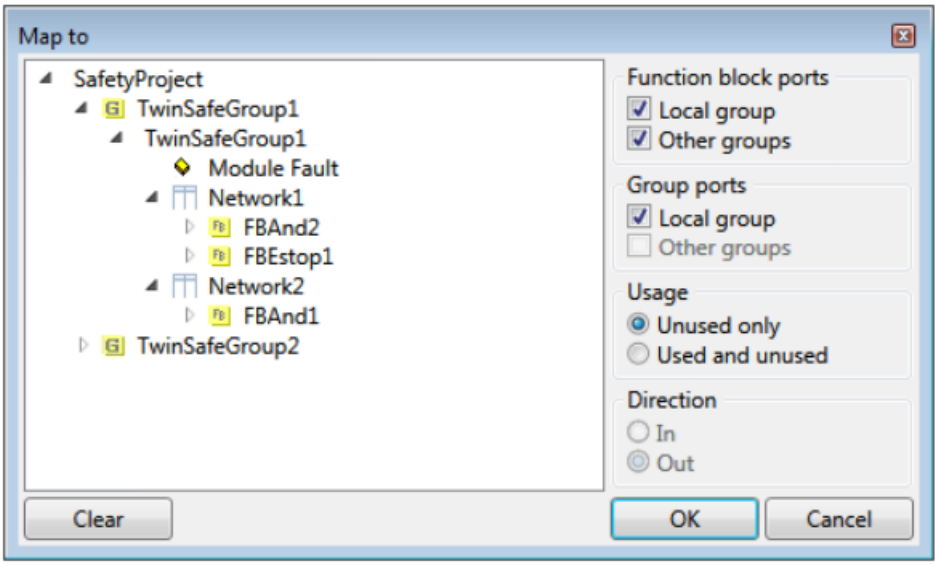


Fig. 59: Dialog for selecting a suitable FB port

Once the link has been created on one side of the connection, the link is automatically set/displayed on the opposite side.

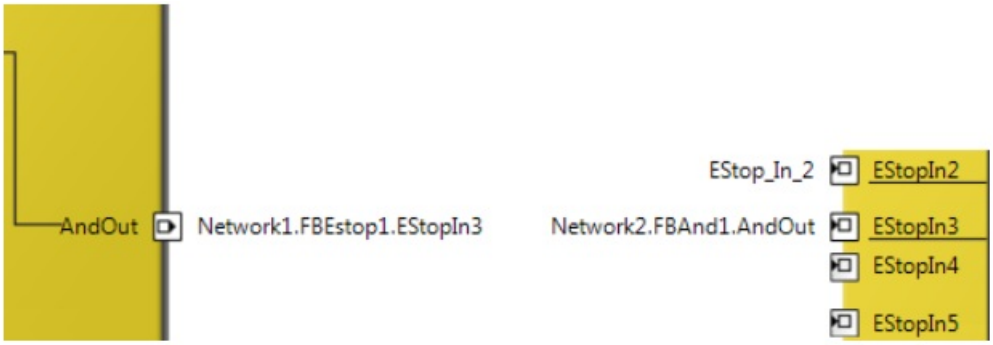


Fig. 60: Link display

5.3.3.11 TwinSAFE groups

It makes sense to create TwinSAFE groups in cases where different machine safety zones are to realize, or simply in order to separate the fault behavior. Within a group, a FB or connection error (here: alias device) leads to a group error and therefore to switching off all outputs for this group. If an error output of an FB is set, it will be forwarded as a logical 1 signal.

A group can be created by opening the context menu of the safety project and selecting Add and New Item….

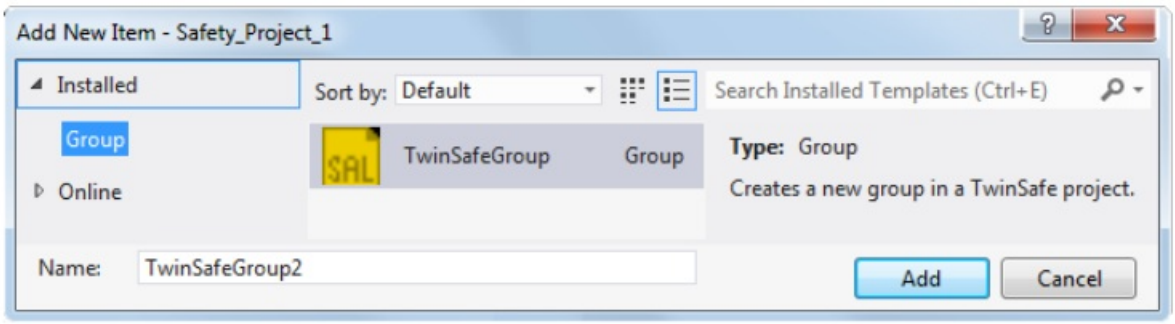


Fig. 61: Creating a TwinSAFE group

Like the first group, the group of a subitem for the alias devices and a sal worksheet.

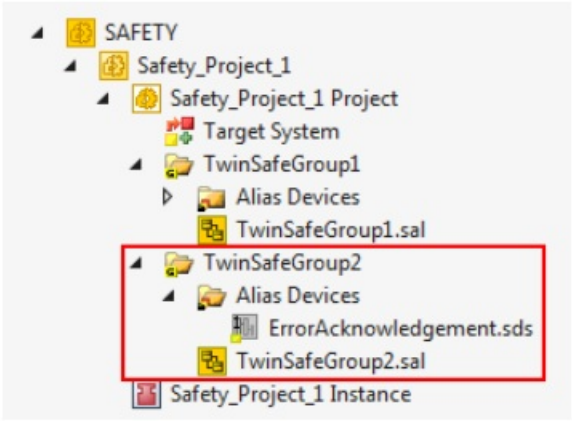


Fig. 62: Components of the TwinSAFE group

The instance path to the FB port to be linked can be specified, in order to exchange signals between the groups. The instance path consists of the group name, the FB name and the FB port, each separated by a dot. The input of the instance path is case-sensitive.
<group name>.<network name>.<FB name>.<FB port name> Sample: TwinSafeGroup1.Network1.FBEstop1.EStopIn3
Alternatively, Change Link can be selected by opening the context menus next to the FB port.

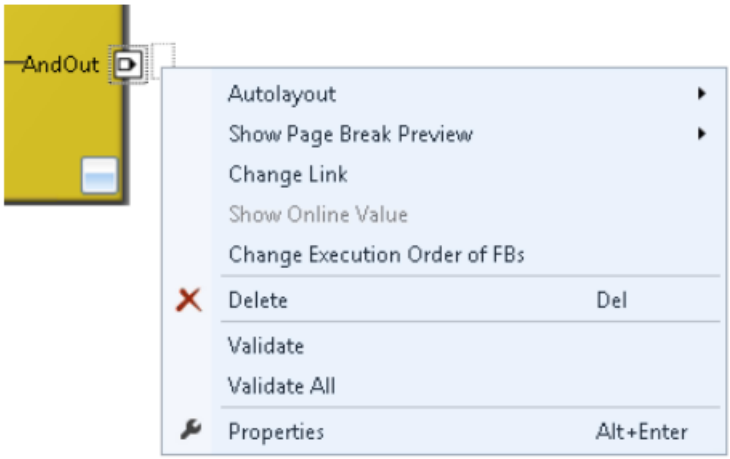


Fig. 63: Change Link

This function opens a dialog for selecting a suitable FB port.

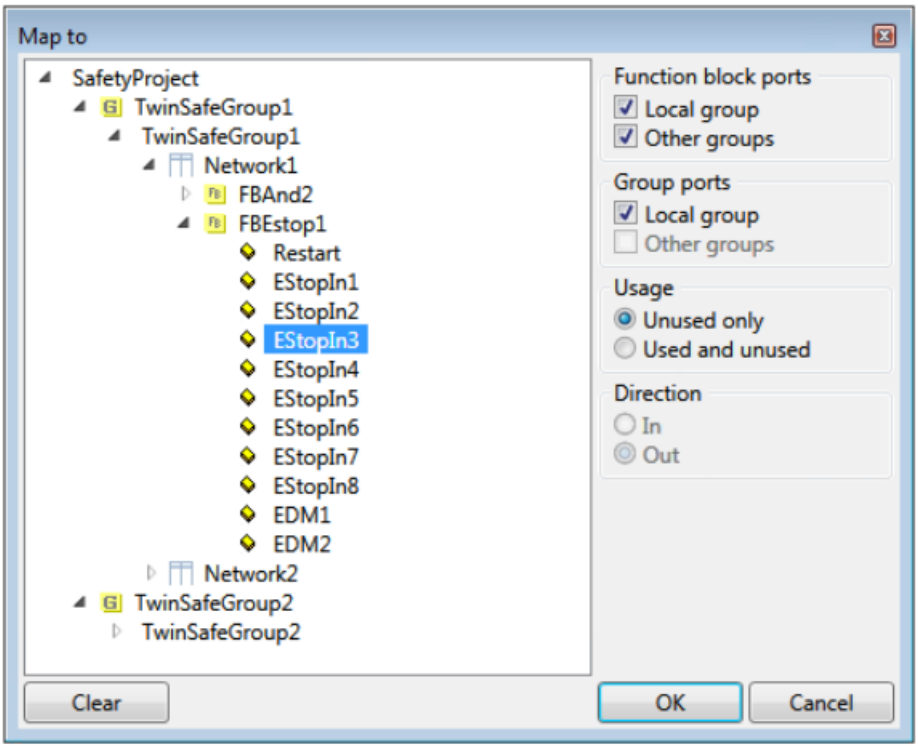


Fig. 64: Dialog for selecting a suitable FB port

Once the link has been created on one side of the connection, the link is automatically set/displayed on the opposite side.

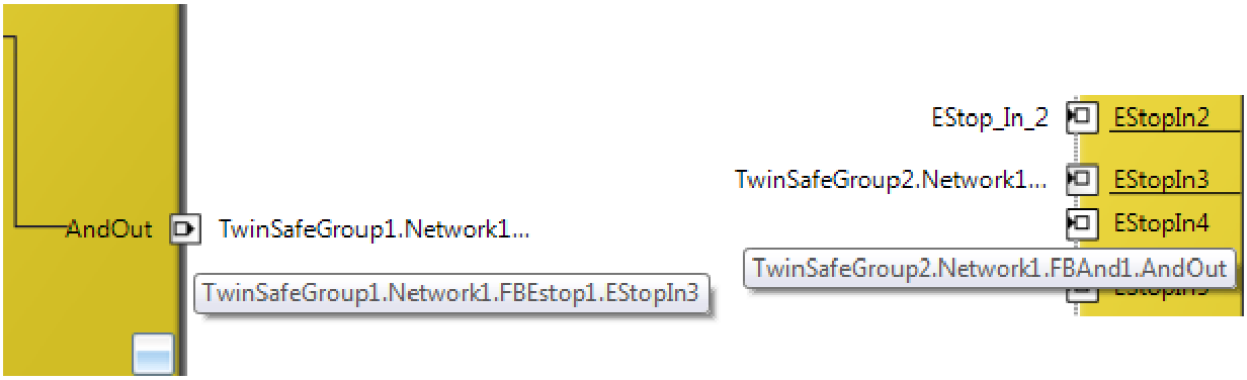


Fig. 65: Link display

5.3.3.12 Variables of the TwinSAFE group

The inputs and outputs of the TwinSAFE groups are consolidated under the Group Ports tab of the Variable Mapping dialog.

Group inputs EL6910/EJ6910

For a project to be valid, as a minimum the signals Run/Stop and ErrAck must be linked.

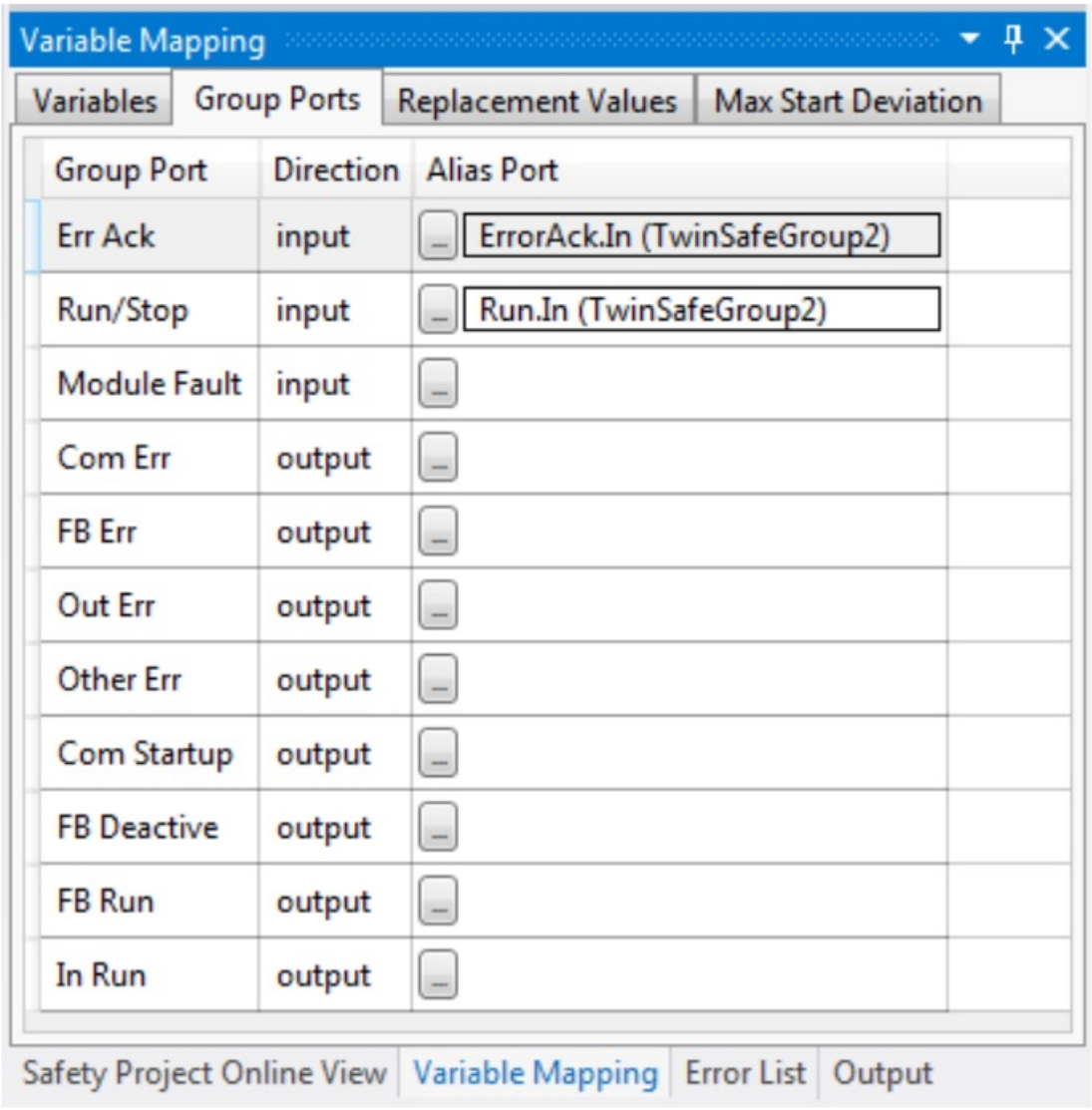


Fig. 66: The Variable Mapping dialog

Group Port	Direction	Description
Err Ack	IN	Error Acknowledge for resetting errors within the group – Signal must be linked with a standard variable
Run/Stop	IN	1 – Run; 0 – Stop – Signal must be linked with a standard variable
Module Fault	IN	Input for an error output of another module that is connected, e.g. EK1960

Group Port	Direction	Description
Com Err	OUT	Communication error in one of the connections
FB Err	OUT	Error at one of the FBs used
Out Err	OUT	not used
Other Err	OUT	ModuleFault OR AnalogValueFault OR WaitComTimeoutFault
Com Startup	OUT	At least one of the connections of this group is in startup
FB Deactive	OUT	The group was deactivated. (See also chapter Customizing / disabling TwinSAFE groups [? 100])
FB Run	OUT	FBs of the TwinSAFE group are processed
In Run	OUT	TwinSAFE group is in RUN state

Group State

Value	Status	Description
1	RUN	Input RUN=1, no error in the group, and all connections have started up without error
2	STOP	Input RUN = 0
4	ERROR	Group is in error, see Diagnostic information
5	RESET	After an error has occurred, all errors have been rectified and the Err Ack signal is 1
6	START	The group remains in this state as long as not all connections have started up after the start of the group (RUN=1)
7	STOPERROR	When the group is started or initialized, it assumes the STOPERROR status if the TwinSAFE connections are assigned to the group. The group switches from STOPERROR state into ERROR state if the Run input is TRUE.
16	DEACTIVE	Group was deactivated via customizing
17	WAITCOMERROR	This state is set when the customizing function “Passivate” is selected and the system waits for Comerford of the group

Group Diag

Value	Status	Description
0	–	No error
1	FBERROR	at least one FB is in ERROR state
2	COMERROR	at least one connection is faulty
3	MODULEERROR	the input Module Fault is 1
4	CMPERROR	On startup, at least one analog FB input deviates from the last saved value (Power-On Analog Value Check Error)
5	DEACTIVATE ERROR	In “passivate manual control unit” mode the timeout has elapsed while waiting for the COM error
6	RESTARTERROR	The TwinSAFE Logic program was restarted because the EtherCAT connection was restarted or a user logged in without reloading the TwinSAFE Logic program (or parts of it).

5.3.3.13 Order of the TwinSAFE groups

The order of the groups can be changed, in order to realize a defined processing sequence of the safety application.

To this end, select the entry Edit TwinSAFE Group Order via the node menu of the safety project node. A dialog opens, in which the order of the groups can be changed. The individual groups do not necessarily have to be numbered in consecutive ascending order. The numbering can contain gaps.

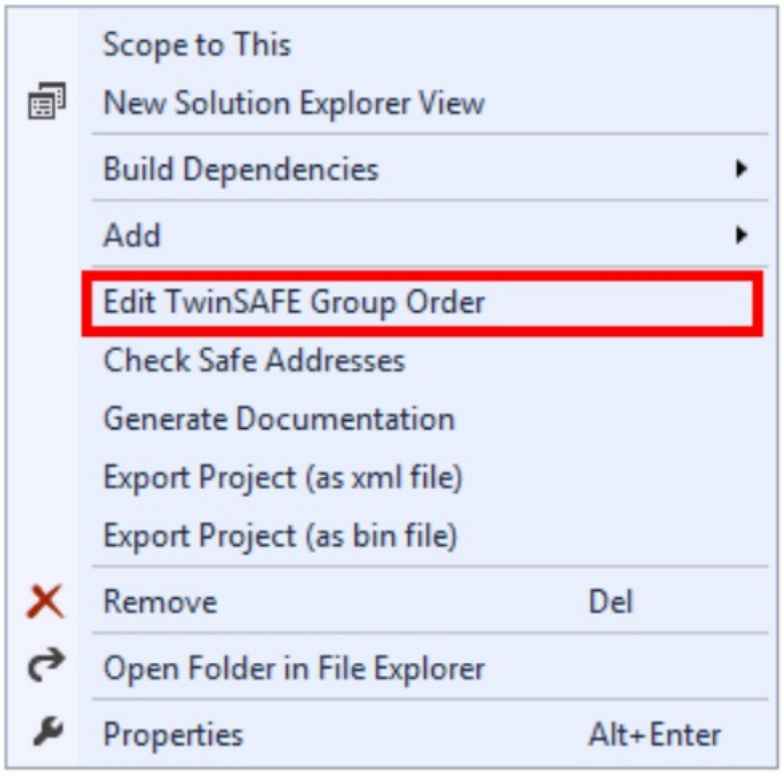


Fig. 67: Context menu Edit TwinSAFE Group Order

The current group order is shown in the column Current Value. The new order is specified by entering a value in the column New Value, followed by OK.

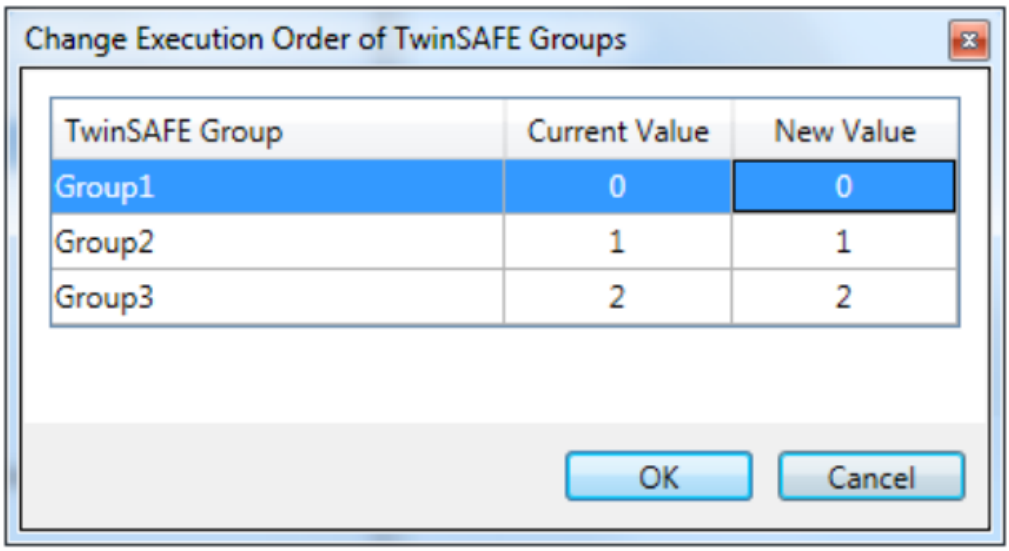


Fig. 68: Dialog Change Execution Order of TwinSAFE Groups

5.3.3.14 Command line

The command line below the SAL worksheet can be used to enter commands for executing functions.

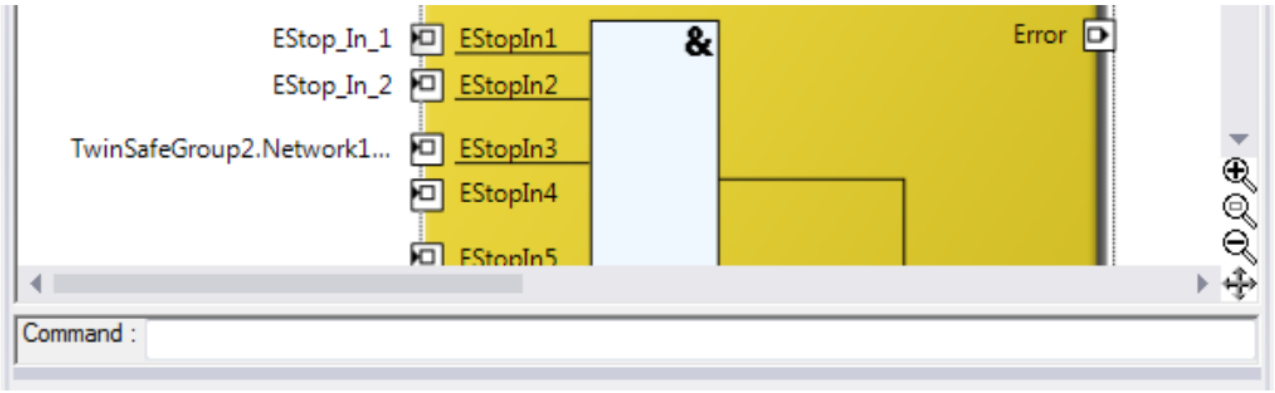


Fig. 69: The command line below the SAL worksheet

Currently the commands listed in the following table are supported.

Command	**Description**
FBNAME FB_INSTANCENAME NETWORKNAME;	Adding a function block Sample: safeAnd FBAnd1 Network1
FB_INSTANCENAME->PORTNAME = VARIABLE_NAME;	Creating a variable mapping Sample: FBAnd1->AndIn1 = testVariable
FB_INSTANCENAME->PORTNAME = FB_INSTANCENAME->PORTNAME;	Creating a connection between two FBs Sample: FBAnd1->AndIn1 = FBOr1->Or Out;

5.3.3.15 FB port properties

The behavior of the inputs can be parameterized by opening the properties for the upper input of an input pair or an individual input of the function block. For an input group, such as the function block ESTOP, the individual inputs to be activated or deactivated, and single- or two-channel evaluation can be set.

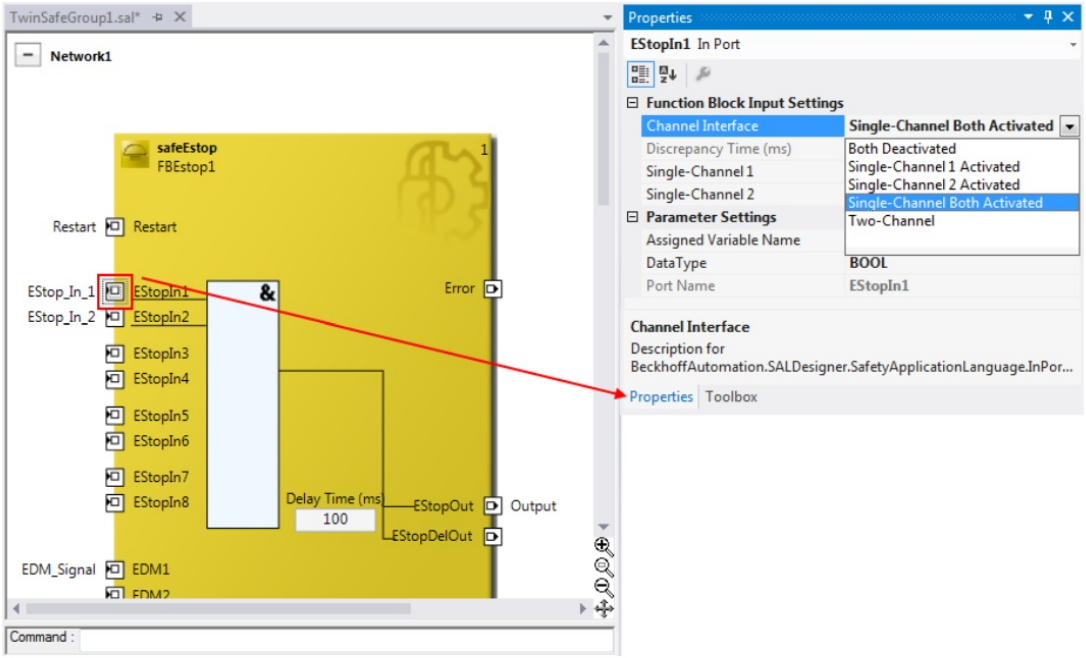


Fig. 70: FB port properties

Channel Interface	**Description**
Both Deactivated	Both inputs are deactivated
Single-Channel 1 Activated	Channel 1: Single-channel evaluation Channel 2: deactivated
Single-Channel 2 Activated	Channel 1: deactivated Channel 2: Single-channel evaluation
Single-Channel Both Activated	Channel 1: Single-channel evaluation Channel 2: Single-channel evaluation
Two-Channel	Both inputs are activated, and two-channel evaluation with Discrepancy Time (ms)

If the Two-Channel evaluation is enabled, the corresponding Discrepancy time (ms) can be set in milliseconds. For each input there is a setting to indicate whether the input should be evaluated as Break Contact (NC) or Make Contact (NO). When a variable or a connecting line is connected to the function block, the corresponding channel is enabled automatically.

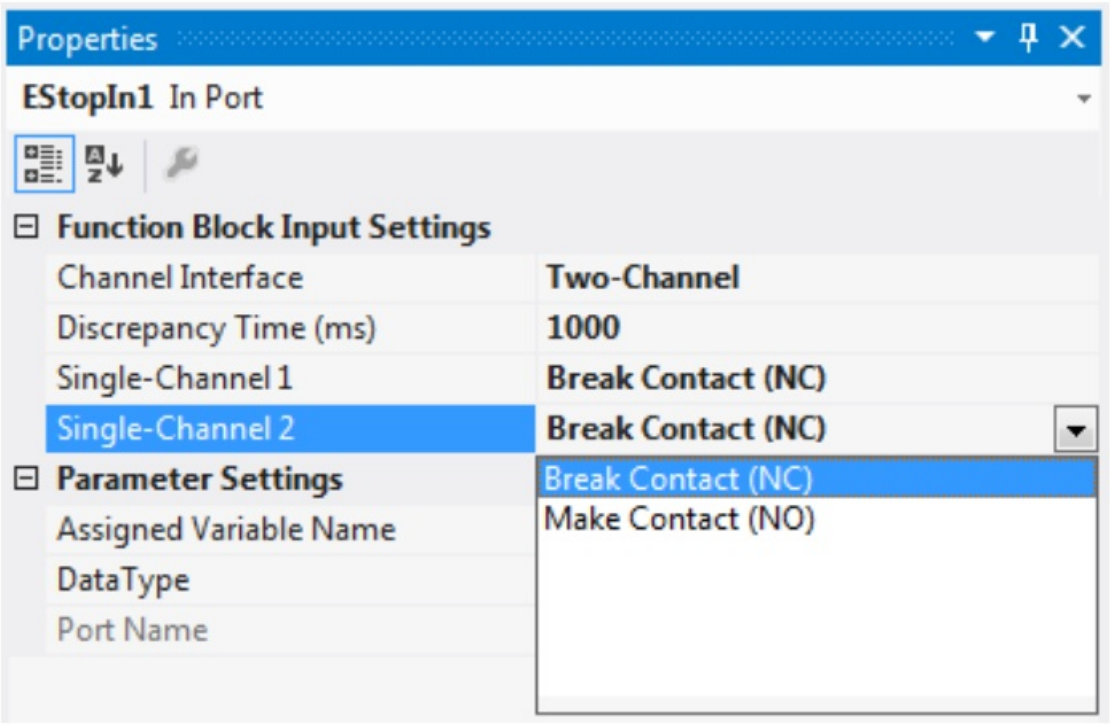


Fig. 71: Make Contact (NO) / Break Contact (NC) setting

These settings are also accessible for each individual port of an FB via the context menu item Change In Port Settings.

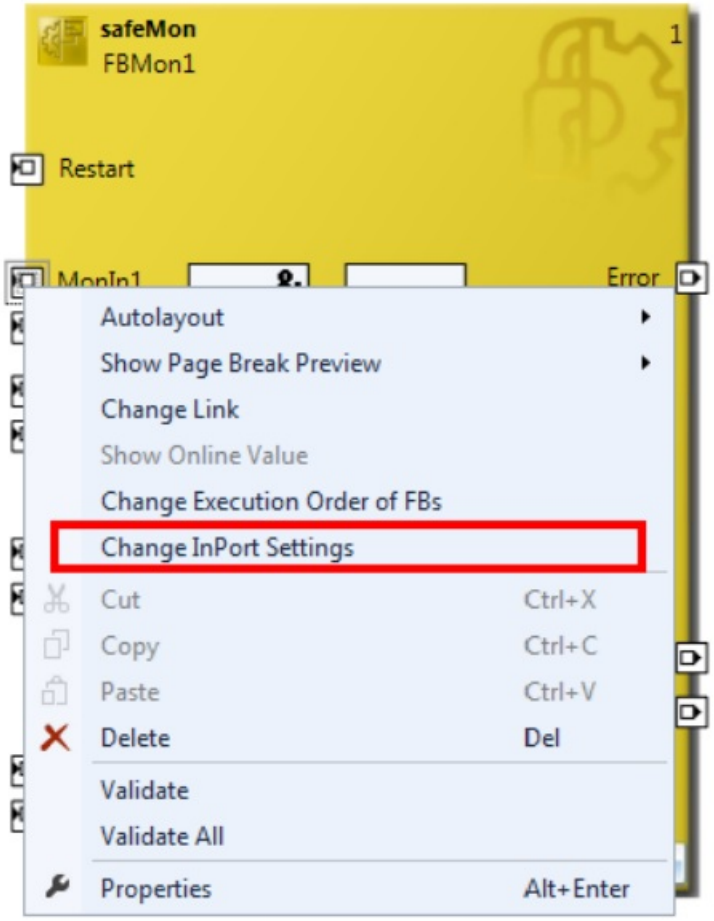


Fig. 72: Menu Change Inport Settings

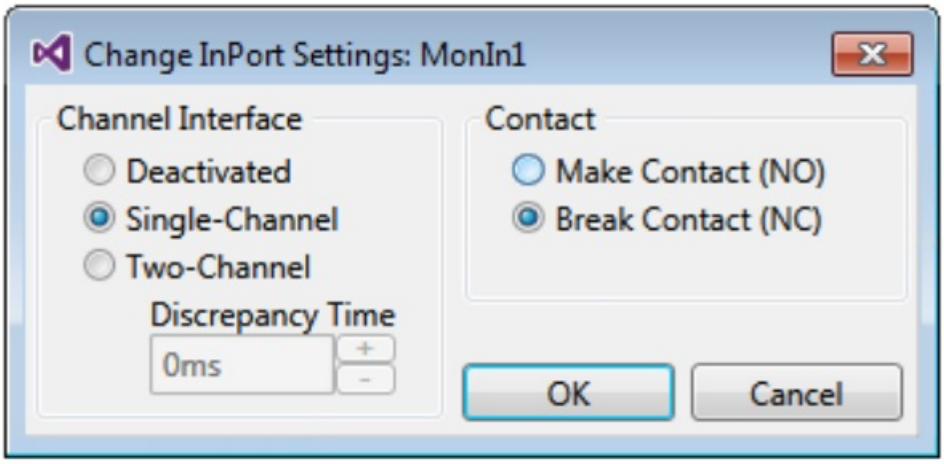


Fig. 73: Dialog Change InPort Settings

5.3.3.16 Variable Mapping

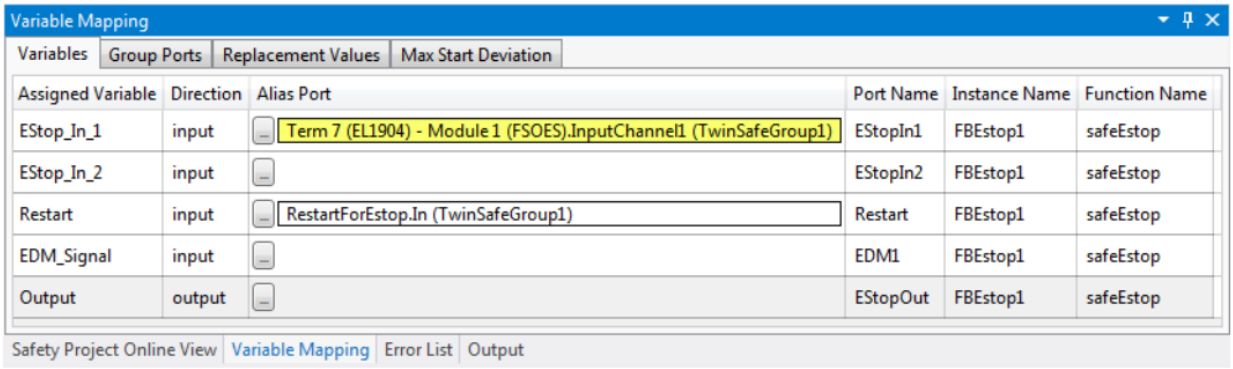


Fig. 74: Variable Mapping

Variables are linked to the alias devices in the Variable Mapping window. Use the Link button to open the selection dialog for the alias port. Safe only signal types or safe and standard signal types are offered in the selection dialog, depending on the port setting of the FB. Safe Boolean signals are shown with a yellow background, standard signal types with a white background.
If several outputs are to be written by one variable, these signals can be assigned by holding down the CTRL key and selecting the channels.

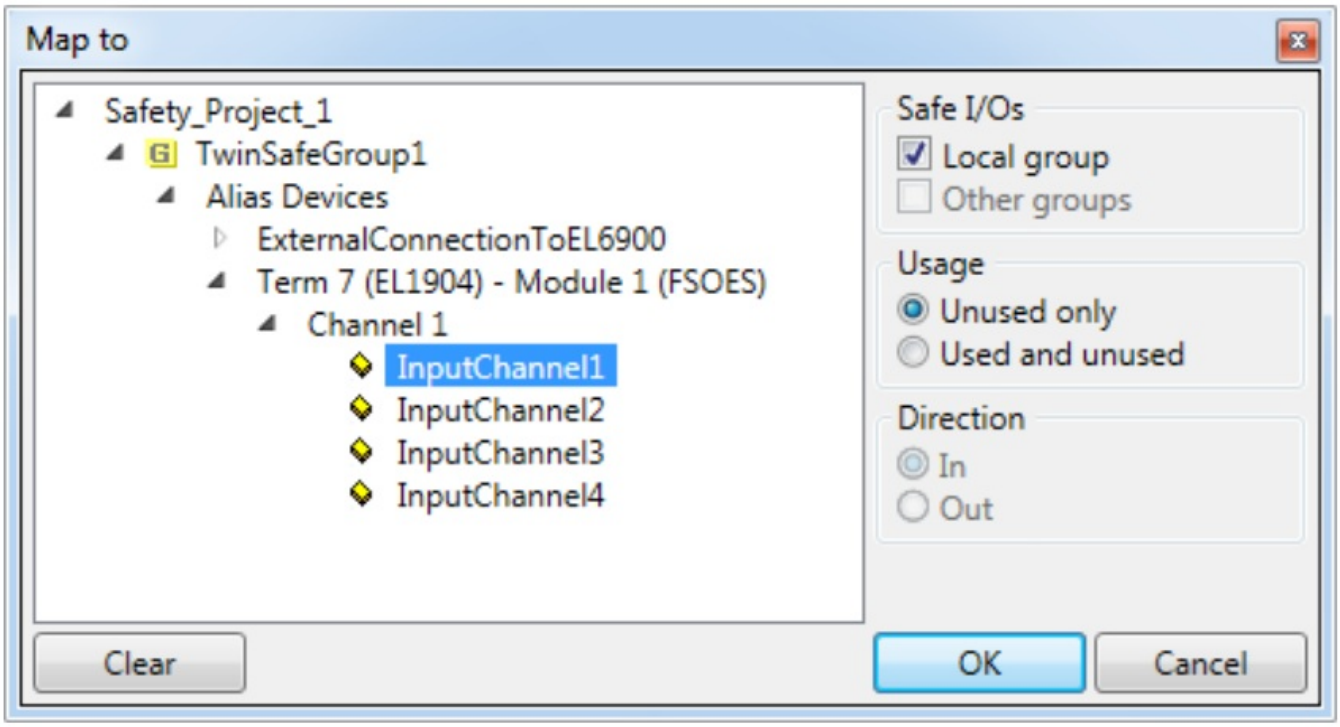


Fig. 75: Selection dialog for the alias port

5.3.3.17 Safety toolbars

Once the development of the safety project is complete, the project has to be loaded onto the target system, in this case EL6910/EJ6910. To this end the toolbars TwinCAT Safety and TwinCAT Safety CRC have to be added.

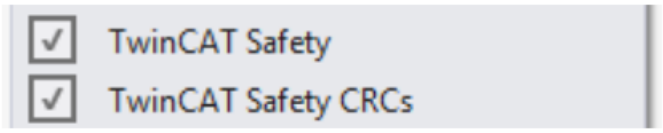


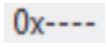
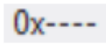
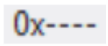
Fig. 76: Activation of the TwinCAT Safety and TwinCAT Safety CRC toolbars

Fig. 77: Display of the TwinCAT Safety and TwinCAT Safety CRC toolbars

Toolbar TwinCAT Safety

Icon	Name	Description
	Verify Safety Project	The safety project is checked for validity.
	Verify Complete Safety Proj ect	The safety project including the hardware level is checked for validity.
	Download Safety Project	Loading the safety project onto the target system, here EL6910/ EJ6910
	Delete Safety Project	Deleting the safety project from the target system, here EL6910/ EJ6910
	Show Online Data of Safety Project	Switching on the Online View for the safety project.
	Customize Safety Project	Customizing the safety project (switching off TwinSAFE groups and setti ng of safe substitute values for the group outputs). This is possible if the online and offline CRC are the same and at least one group has been co nfigured for customizing.

Toolbar TwinCAT Safety CRC

Icon	Name	Description
	CRC Toolbar	Left-click on the toolbar to initiate an update of the CRCs by the user. Red icon: CRCs are different
	CRC Toolbar	Green icon: All CRCs are identical
	Online CRC	CRC of the safety project on EL6910/EJ6910. This value is read online by the EL6910/EJ6910. In the absence of an ADS connection to the EL6910/EJ6910, this value is displayed with  .
	Downloaded CRC	CRC of the safety project that was loaded last. If no safety project is loaded when the TwinCAT project is opened, the value is displayed with  .
	Offline CRC	CRC of the current safety project, as stored in the safety editor. A CRC is displayed, if the stored project is valid. If the project is invalid,  is displayed as CRC.

5.3.3.18 Checking the TwinSAFE addresses

The hardware addresses of the alias devices used can be checked and set via the dialog Check Safe Addresses. To this end, select the entry Check Safe Addresses via the node menu of the safety project node. A dialog opens, which lists all alias devices that use hardware addresses. The addresses set in the software (Safe/ FSoE Address) and the hardware addresses (Hardware Address) are shown in separate columns for each alias device and for the target system. In the column Take Hardware Address the user can specify whether the hardware addresses for the alias devices settings are applied when the dialog is closed via the OK button.

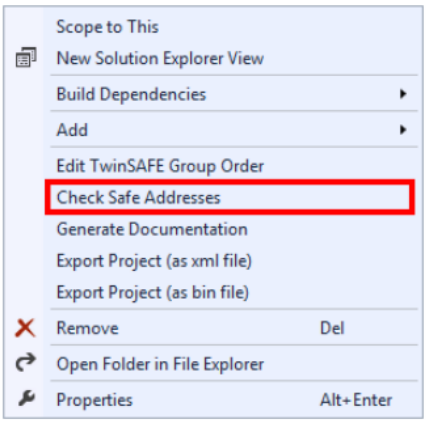


Fig. 78: Check Safe Addresses context menu

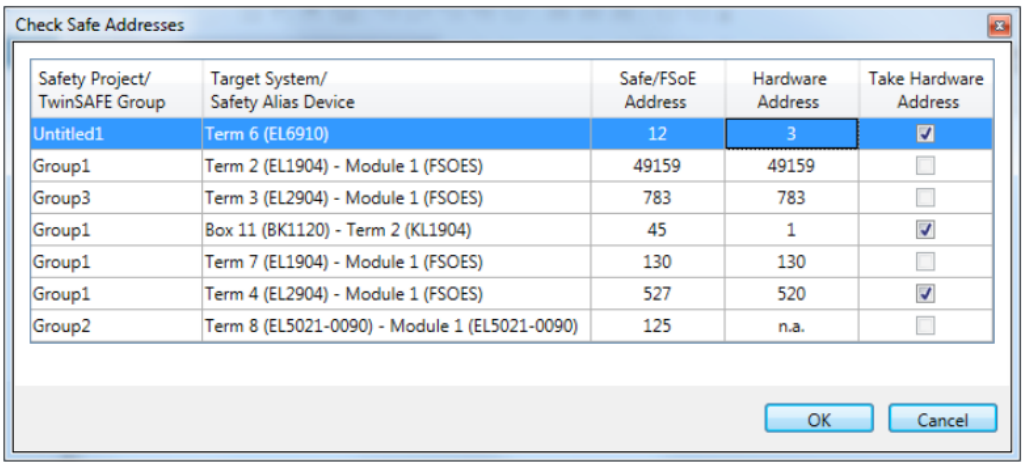


Fig. 79: Check Safe Addresses dialog

5.3.4 Downloading the safety application

Before downloading the safety project to the EL6910/EJ6910 or a logic component, the project should first be checked for validity. If the hardware is complete, the hardware level  can be used for checking, or checking can take place at the project level  , if online access is only available for the EL6910/EJ6910 or the logic component. If the check returns no errors, the project download  can continue.

CAUTION
Use only qualified tools
Only use a qualified tool (see note on system limits) for loading, verifying and enabling the project on the EL6910/EJ6910 or the logic component!
User name and password are case-sensitive

Pay attention to upper/lower case characters for the user name and password.
The standard user is Administrator, the standard password is TwinSAFE.

NOTE
Power supply during download
Make sure that the TwinSAFE Logic is not switched off during the download. This can lead to unexpected behavior or permanently disable the TwinSAFE Logic.

WARNING
Execution of the safety application
During a login or download of a safety application, the execution of the current project is stopped on the TwinSAFE Logic.

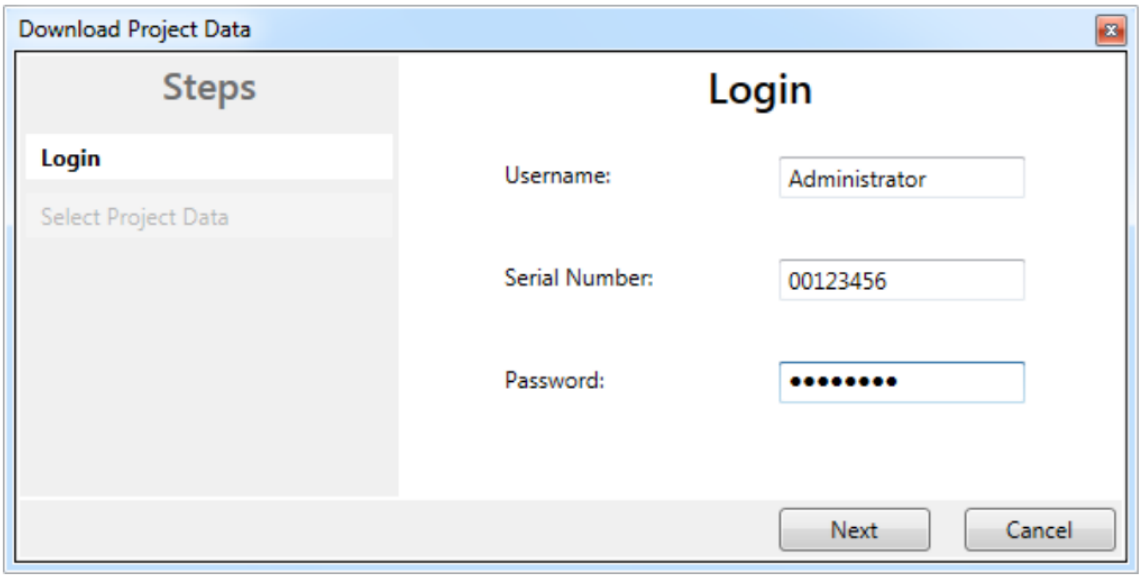


Fig. 80: Download Project Data – The Login dialog

In the Download Project Data dialog specify the user name, the serial number of the EL6910/EJ6910 or the logic component onto which the project is to be loaded, and the user password. The default user name is Administrator, the default-password is TwinSAFE. Use the Next button to move to the next dialog.

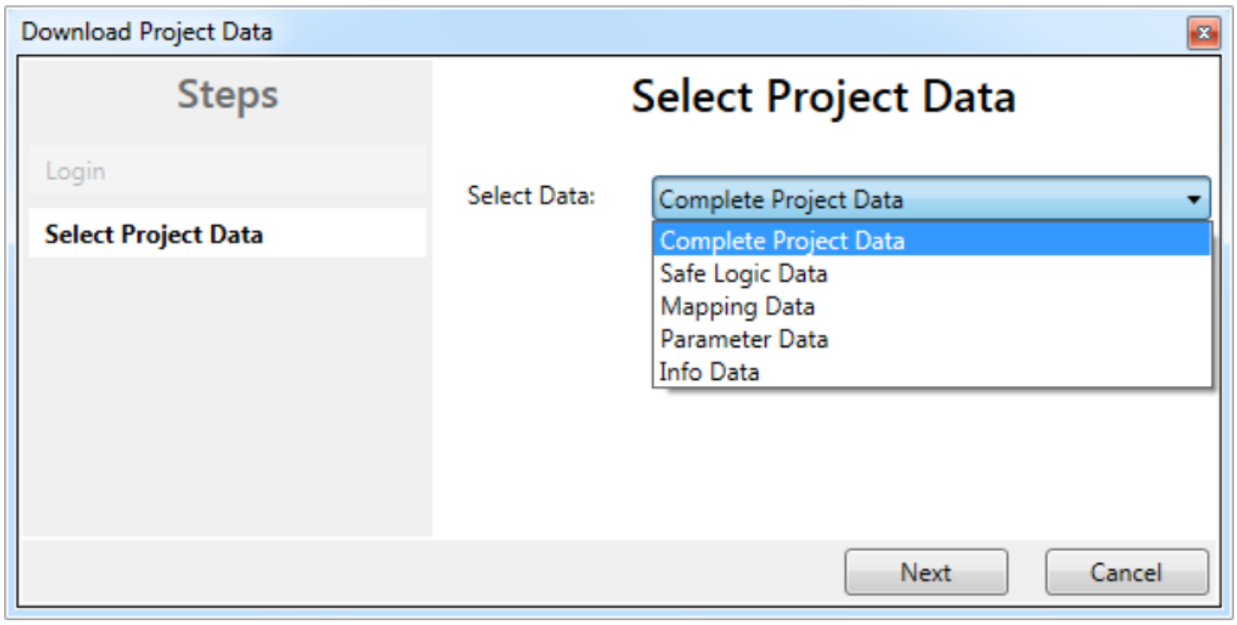


Fig. 81: Download Project Data – The Select Project Data dialog

In the Select Project Data dialog select Complete Project Data to load the whole project onto the EL6910/ EJ6910 or the logic component. Use the Next button to move to the next dialog.

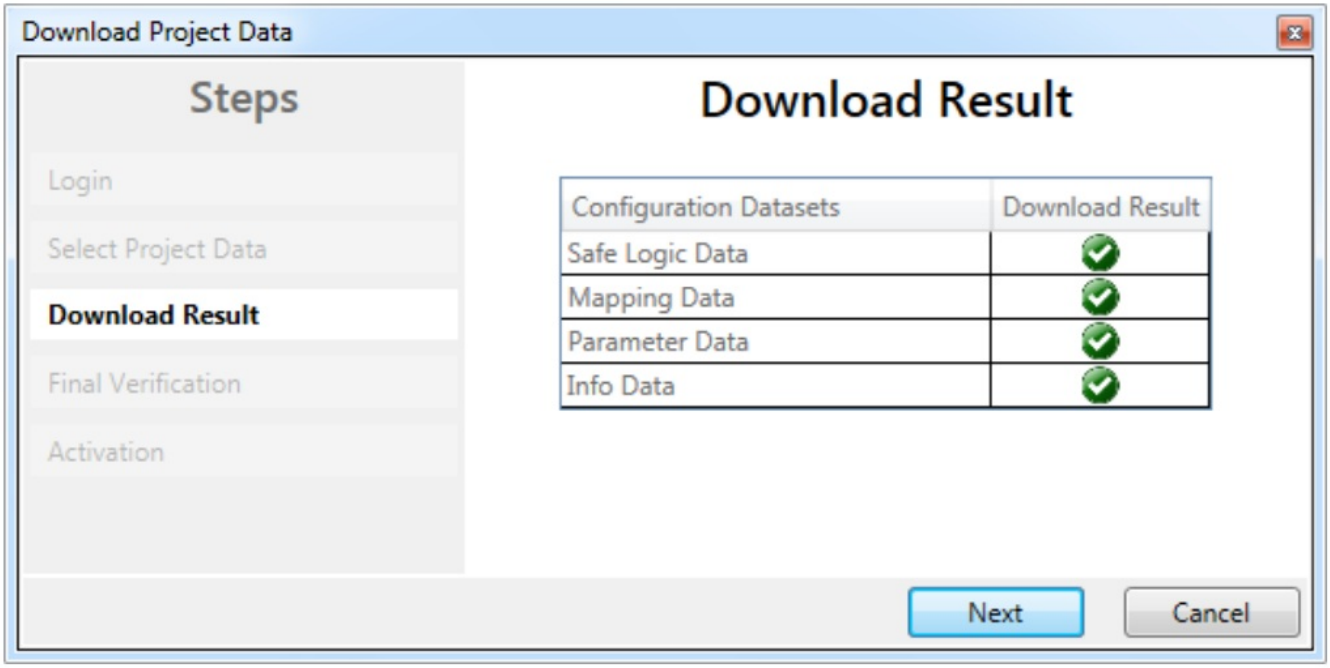


Fig. 82: Download Project Data – The Download Result dialog

Once the download is complete, the download results are displayed. Use the Next button to move to the next dialog.

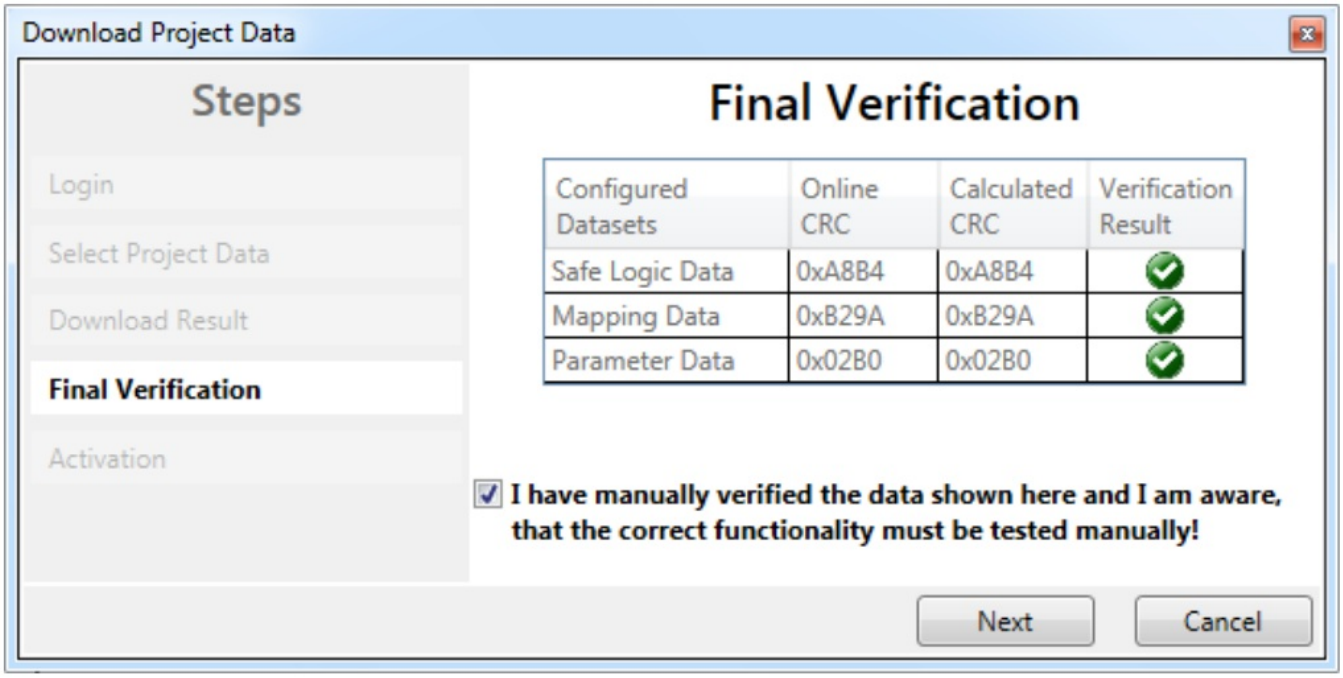


Fig. 83: Download Project Data – The Final Verification dialog

The locally calculated CRCs and the online CRCs of the safety project are displayed in the Final Verification dialog. They are automatically checked for equality and displayed via the column Verification Result. The user must also check these data for equality and then confirm this by ticking the checkbox. Use the Next button to move to the next dialog.

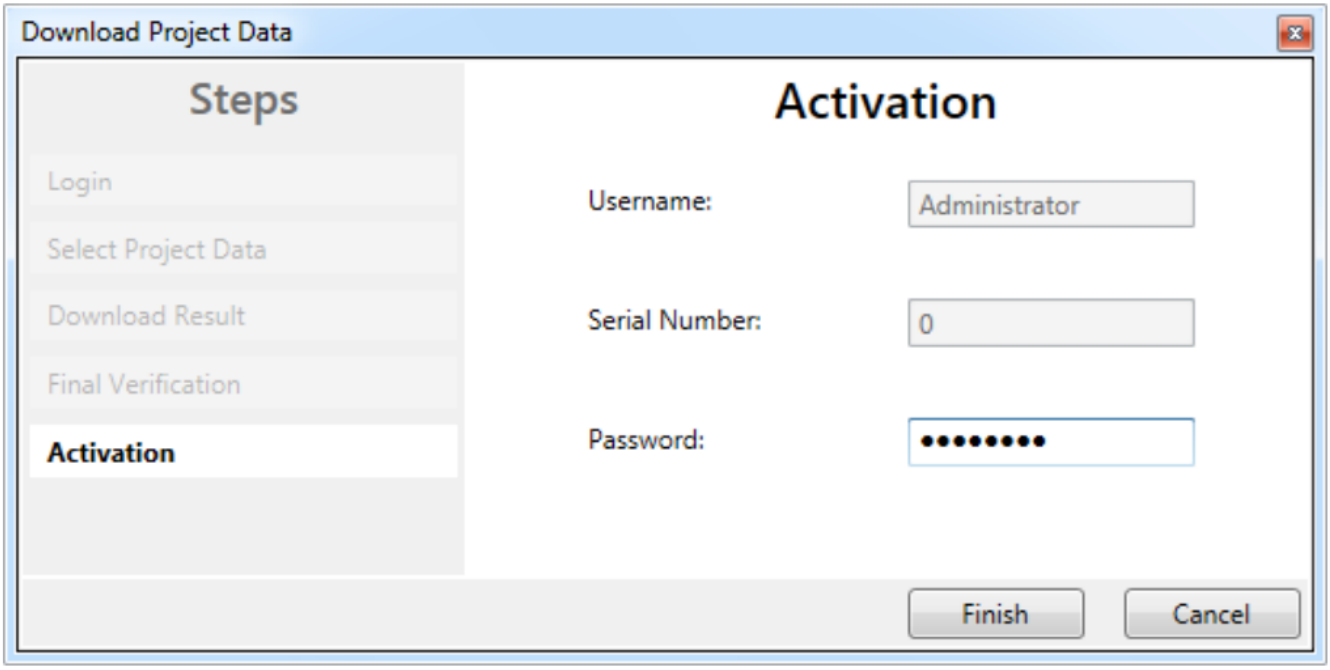


Fig. 84: Download Project Data – The Activation dialog

In the Activation dialog the user re-enters the password to activate the safety project on the EL6910/EJ6910 or the logic component. Use the Finish button to complete the download of the safety project.

WARNING

Verification of the input and output process data

After downloading the safety-related program to the TwinSAFE logic, the user must check that the input and output process data of the TwinSAFE logic are plausible, within the valid value range and in the expected magnitude. This is especially true for analog signals, which are transmitted via e.g. PROFIsafe, FSoE sensors, TwinSAFE SC terminals or external control systems to the TwinSAFE logic. It is particularly important to check whether the device uses the Motorola or the Intel format or Big or Little Endian.

Project data	Description
Safe Logic Data	Safe Logic Data contains the safety related program.
Mapping Data	Mapping Data contains the link data for inputs, outputs, function blocks, connections etc.
Parameter Data	Parameter Data contains the safe user parameters that are stored on the TwinSAFE Logic. These can be safe substitute values and the user parameters of the connections.
Info Data	Info Data contains the settings which Info Data for connections, function blocks, groups etc . are activated and have to be filled by the TwinSAFE Logic.

Info Data of the safety project

The Info Data will NOT take effect to the calculation of the project CRC. This allows the Info Data to be changed at a later stage without changing the project CRC.

If the Info Data for an existing project are changed, a project download including at least the Info Data must be carried out, despite the fact that the CRC is unchanged, otherwise the Info Data will not be filled. In addition, the TwinCAT configuration must be activated so that the process image size in TwinCAT matches the expected size within the TwinSAFE Logic.

5.4 Info data

5.4.1 Info data for the connection

Info data for connections can be enabled on the Connection tab of the alias device.

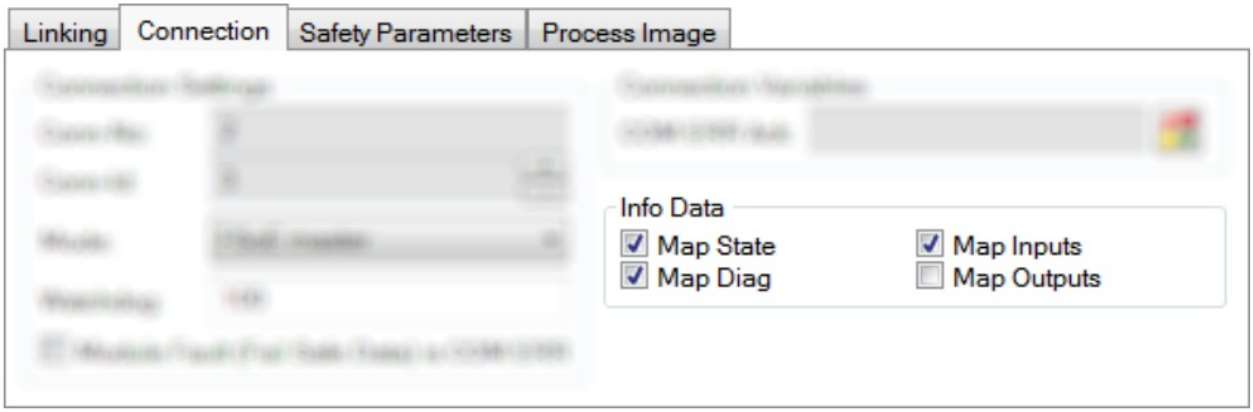


Fig. 85: Enabling the info data for connections

The info data are shown in the I/O tree structure below the EL6910 in the process image. From here, these signals can be linked with PLC variables. Further information on the included data can be found in the documentation for TwinCAT function blocks for TwinSAFE logic terminals. Use the checkbox Show Input/ Output Data as byte array under Target System to adjust the process image.

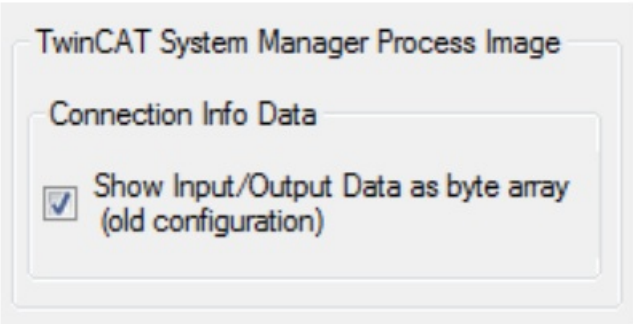


Fig. 86: Checkbox for the connection info data

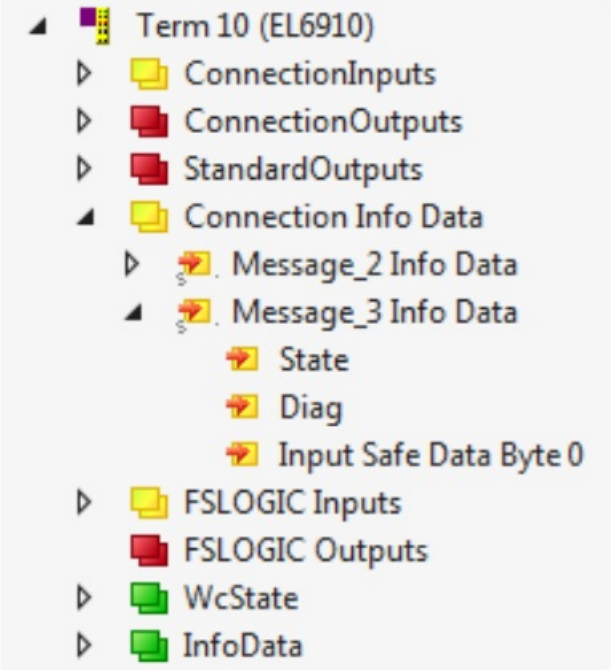


Fig. 87: Info data for the connection in the I/O tree structure as byte array

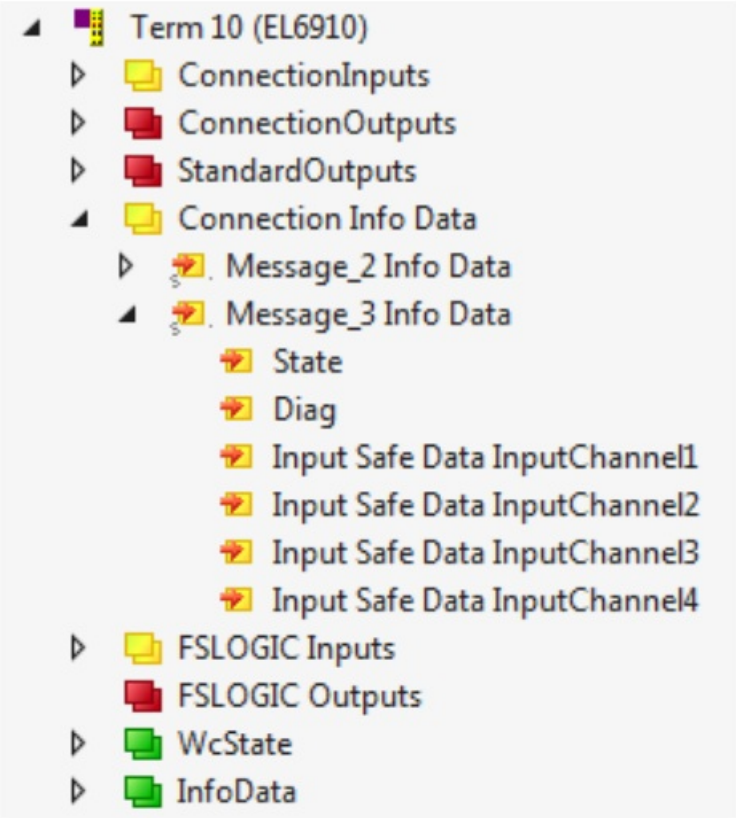


Fig. 88: Info data for the connection in the I/O tree structure as individual data

5.4.2 Info data for function blocks

For function blocks, info data can be enabled in the properties of the function block.

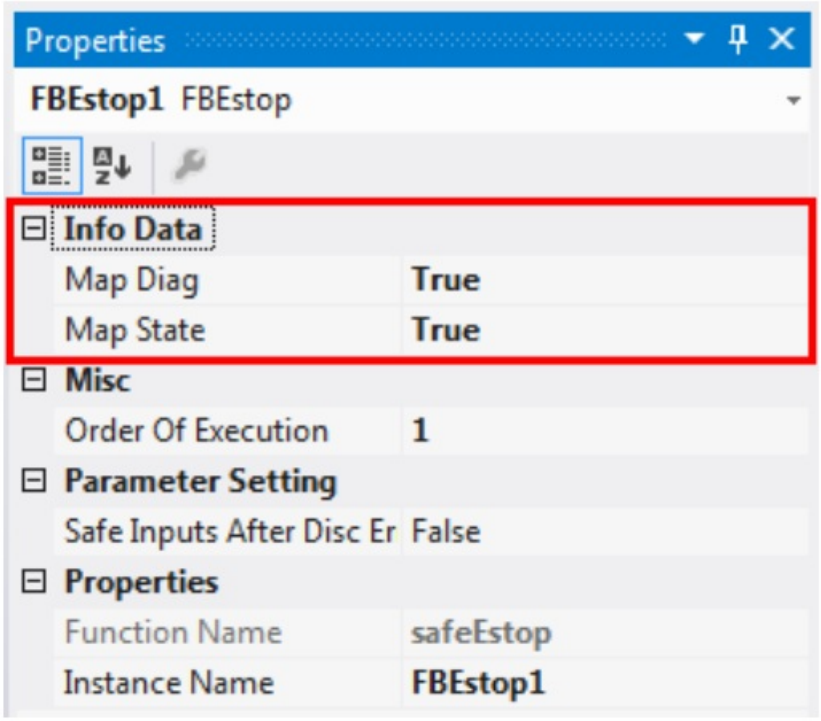


Fig. 89: Enabling the info data for function blocks

The info data are shown in the I/O tree structure below the EL6910 in the process image. From here, these signals can be linked with PLC variables. Further information on the included data can be found in the documentation for TwinCAT function blocks for TwinSAFE logic terminals.

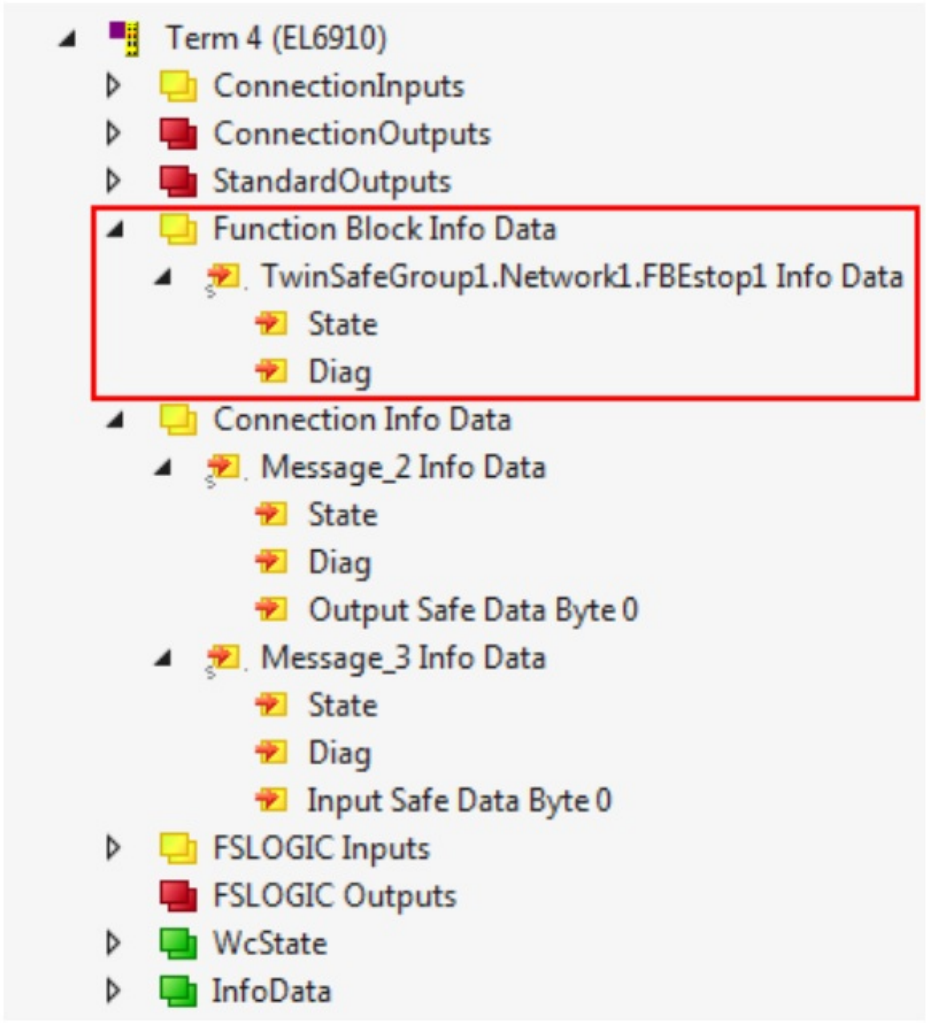


Fig. 90: Info data for the function block in the I/O tree structure

5.4.3 Info data for the TwinSAFE group

For TwinSAFE groups, info data can be enabled via the properties of the TwinSAFE group.

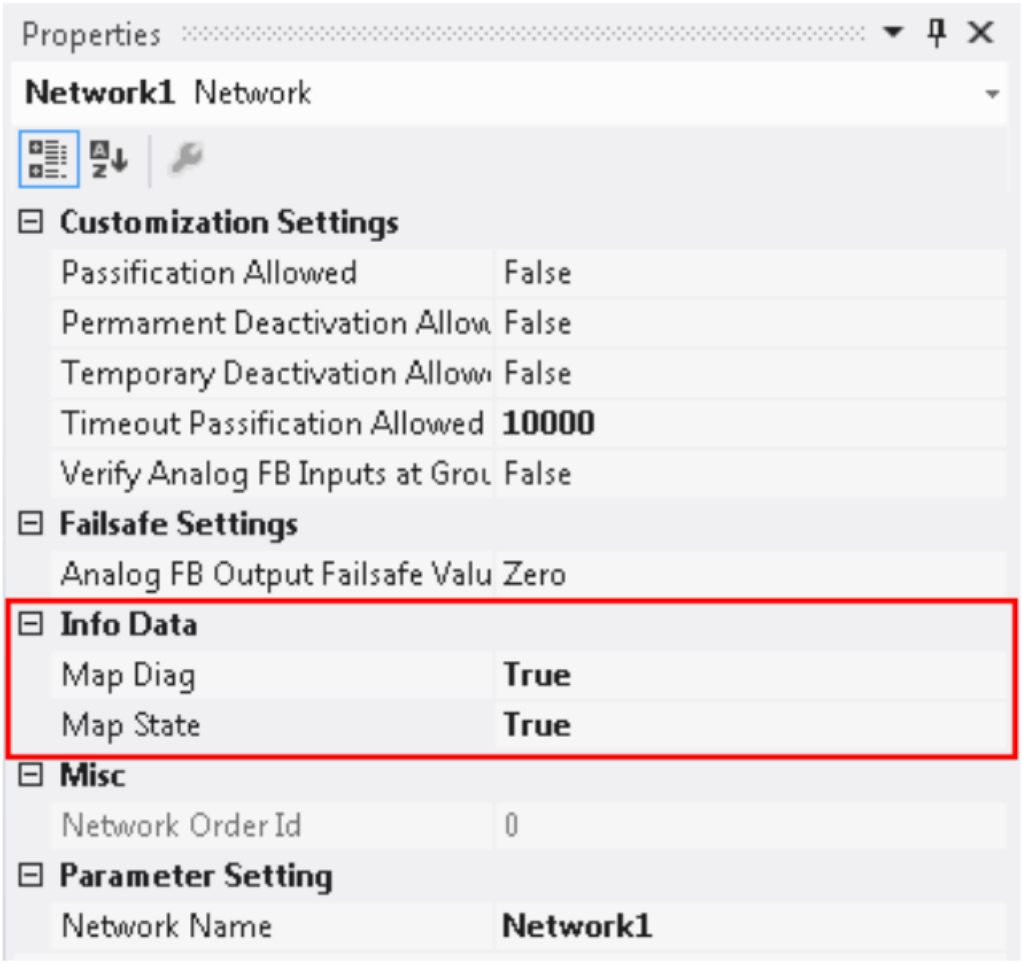


Fig. 91: Enabling the info data in the properties of the TwinSAFE group

The info data are shown in the I/O tree structure below the I/O device in the process image. From here, these signals can be linked with PLC variables. Further information on the included data can be found in the documentation for TwinCAT function blocks for TwinSAFE logic terminals.

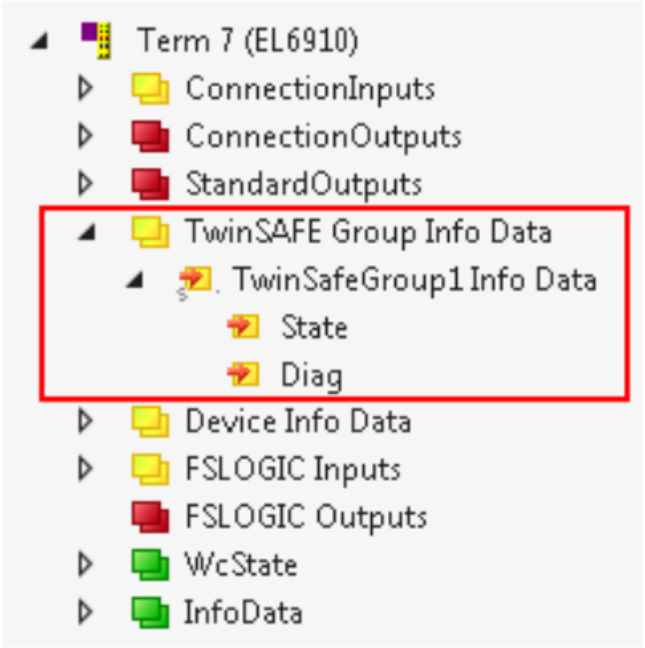


Fig. 92: Info data for the TwinSAFE group in the tree structure

5.4.4 Info data for the device

The info data for the EK1960 can be activated on the Target System tab. These are the serial number of the EK

1960 and the current online-CRC of the safety project.

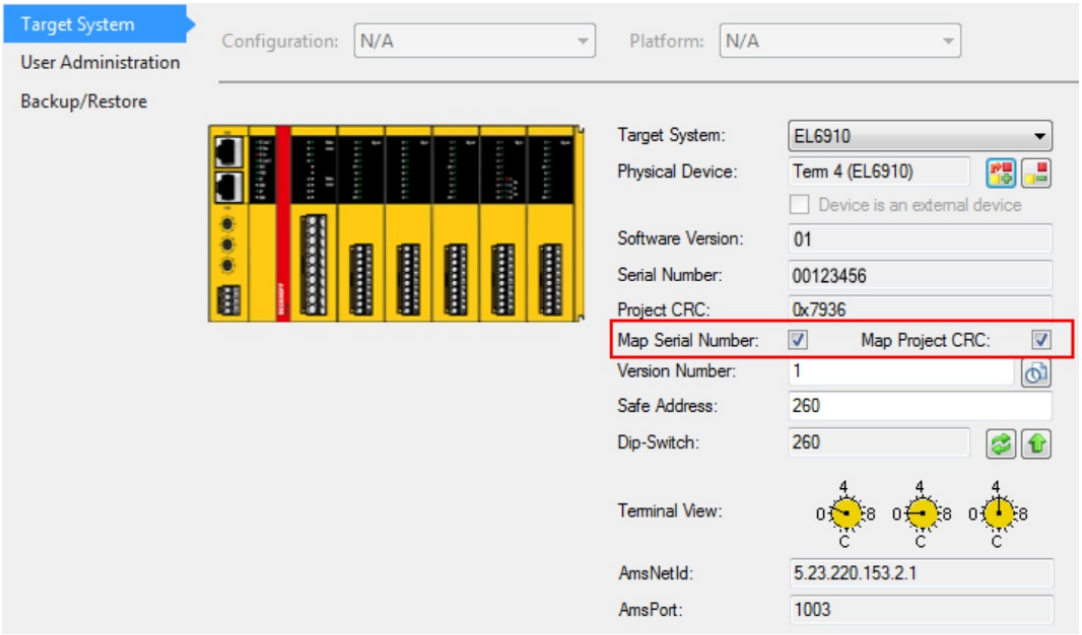


Fig. 93: Activation of the info data for the EK1960

The info data are shown in the I/O tree structure below the EK1960 in the process image. From here, these signals can be linked with PLC variables.

Documents / Resources

	BECKHOFF EK1960 Twin Safe Compact Controller [pdf] Instruction Manual EK1960 Twin Safe Compact Controller, EK1960, Twin Safe Compact Controller, Safe Compact Controller, Compact Controller, Controller

References

- Beckhoff | New Automation Technology | Beckhoff USA
- Download finder | Beckhoff USA
- EK1960 | TwinSAFE Compact Controller | Beckhoff Australia
- Our service offerings | Beckhoff United Kingdom
- Support | Beckhoff USA
- Training offerings | Beckhoff USA
- Beckhoff | New Automation Technology | Beckhoff Deutschland
- EL9410 | Netzteilklemme zur E-Bus-Auffrischung, mit Diagnose | Beckhoff Deutschland
- Beckhoff | New Automation Technology | Beckhoff Deutschland
- TwinSAFE | Sicherheitstechnologie | Beckhoff Deutschland
- Beckhoff | New Automation Technology | Beckhoff Australia
- Globale Präsenz | Beckhoff Deutschland
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