

Operating Instructions | EN

EL6900

TwinSAFE Logic Terminal



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1 Notes on the documentation

1.1 Disclaimer

Beckhoff products are subject to continuous further development. We reserve the right to revise the operating instructions at any time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in these operating instructions.

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

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- EP1590927
- EP1789857
- EP1456722
- EP2137893
- DE102015105702



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

The following is excluded from the liability:

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

1.1.4 Copyright

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1.2 Documentation issue status

| Version | Comment |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1.0 | <ul style="list-style-type: none"> In chapter Technical data [▶ 21] corrosive gas test and footnote for corrosive environment added |
| 3.0.0 | <ul style="list-style-type: none"> Foreword changed to Notes on the documentation [▶ 5] and For your safety [▶ 11] In chapter Technical data [▶ 21] download link for the certificates added Service life [▶ 61] postponed Maintenance and cleaning [▶ 62] and Decommissioning [▶ 63] adapted Appendix adapted and expanded |
| 2.3.0 | <ul style="list-style-type: none"> Specification of overvoltage category added Protection class III (SELV/PELV) added Device type "Open equipment" added Link in chapter Actuality updated Certificate updated |
| 2.2.0 | <ul style="list-style-type: none"> Description to diagnostic object F100_{hex} added |
| 2.1.1 | <ul style="list-style-type: none"> Technical data for <i>permissible air pressure</i> extended |
| 2.1.0 | <ul style="list-style-type: none"> Chapter on <i>Address settings on TwinSAFE terminals with 1023 possible addresses</i> updated Description of the user management extended Links in the technical data corrected TwinSAFE Loader added |
| 2.0.0 | <ul style="list-style-type: none"> Migration and structural adaptation Reliability document updated Safety parameters updated Foreword revised |
| 1.5.2 | <ul style="list-style-type: none"> Reliability document updated Reaction times added |
| 1.5.1 | <ul style="list-style-type: none"> Certificate updated |
| 1.5.0 | <ul style="list-style-type: none"> Company address changed Safety parameters extended |
| 1.4.0 | <ul style="list-style-type: none"> Extended temperature range added Notes regarding temperature measurement and EMC added Description of date code extended |
| 1.3.1 | <ul style="list-style-type: none"> Document origin added |
| 1.3.0 | <ul style="list-style-type: none"> Notes regarding system limits added |
| 1.2.1 | <ul style="list-style-type: none"> Reference to EN 60068-2-29 removed |
| 1.2.0 | <ul style="list-style-type: none"> ATEX notes added Installation position and minimum distances extended Notes regarding overvoltage protection added Diagnostic object 0xFA00 described |
| 1.1.0 | <ul style="list-style-type: none"> Minor amendments for EtherCAT Copyright and disclaimer modified Support and service addresses updated |
| 1.0.0 | <ul style="list-style-type: none"> First released version |

Currentness

Please check whether you are using the current and valid version of this document. The current version can be downloaded from the Beckhoff homepage at <http://www.beckhoff.de/twinsafe>. In case of doubt, please contact Technical Support (see [Beckhoff Support and Service](#) [► 10]).

Origin of the document

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

Product features

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

1.3 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.

1.4 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 \[▶ 11\]](#) in the operating instructions.

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

1.4.1 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.

1.4.1.1 Signal words

The signal words used in the documentation are classified below.

Warning of personal injuries

DANGER

Hazard with high risk of death or serious injury.

WARNING

Hazard with medium risk of death or serious injury.

CAUTION

There is a low-risk hazard that could result in medium or minor injury.

Warning of damage to property or environment

NOTICE

Notes

The environment, equipment, or data may be damaged.

Information on handling the product



This information includes, for example:
Recommendations for action, assistance or further information on the product.

1.5 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.

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

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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](#).

2 For your safety

Read this chapter containing general safety information. In addition, always observe the safety instructions and warnings in these operating instructions for your own safety, the safety of other persons and the safety of the product.

When working with control and automation products, many dangers can result from careless or incorrect use. Work particularly thoroughly, not under time pressure and responsibly towards other people.

2.1 Duty of care



Read entire documentation for TwinSAFE component

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

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

- comply with the provisions defined in the chapter [Limitation of liability](#) [▶ 6].
- 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.

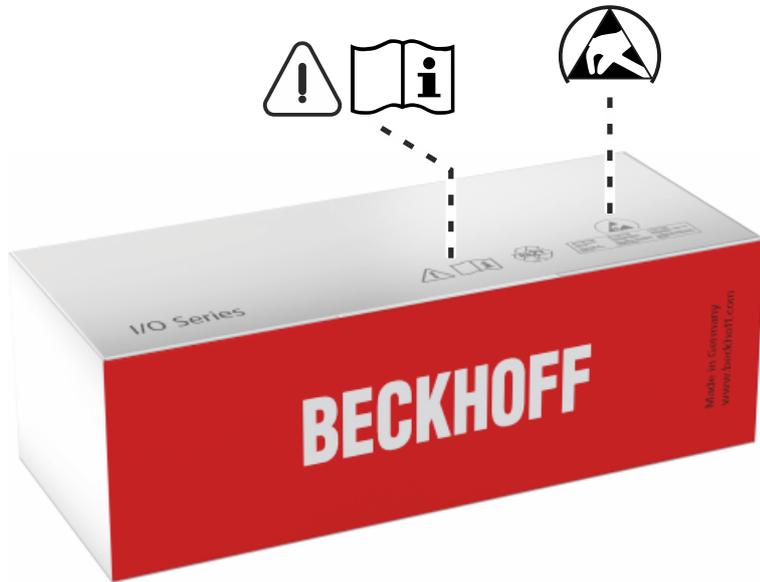


No disposal in domestic waste

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 image signs

On Beckhoff products you will find attached or lasered safety pictograms, which vary depending on the product. They serve to ensure safety for people and to prevent damage to the products. Safety pictograms must not be removed and must be legible for the user.



Read and observe the operating instructions

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



Electrostatic sensitive components

Work with and on the TwinSAFE component is only permitted in protected workplaces.

2.3 General safety instructions

2.3.1 Before operation

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.

Ensure traceability

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

Use SELV/PELV power supply

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

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

Carry out commissioning test

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

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

Use of permissible engineering tools and procedures

The TÜV SÜD certificate applies to these TwinSAFE components, the function blocks available in it, the documentation and the engineering tool. *TwinCAT 3.1* and the *TwinSAFE Loader* are permitted as engineering tools.

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

2.3.2 During operation

Interference due to emitted interference

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

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

2.3.3 After operation

De-energize and switch off components before working on them

Check all safety-relevant equipment for functionality before working on the TwinSAFE component. Secure the working environment. Secure the machine or plant against being inadvertently started up. Observe the chapter [Decommissioning](#) [► 63].

3 System description

3.1 The Beckhoff Bus Terminal system

The Beckhoff Bus Terminal system is used for decentralized connection of sensors and actuators to a control system. The Beckhoff Bus Terminal system components are mainly used in industrial automation and building management applications. In its minimum configuration, a bus station consists of a Bus Coupler or a Bus Terminal Controller and Bus Terminals connected to it. The Bus Coupler forms the communication interface to the higher-level controller, and the terminals are the interface to sensors and actuators. The whole bus station is clipped onto a 35 mm DIN mounting rail (EN 60715). The mechanical cross connection of the bus station is established via a slot and key system at the Bus Coupler and the Bus Terminals.

The sensors and actuators are connected with the terminals via the screwless (spring-loaded) connection system.

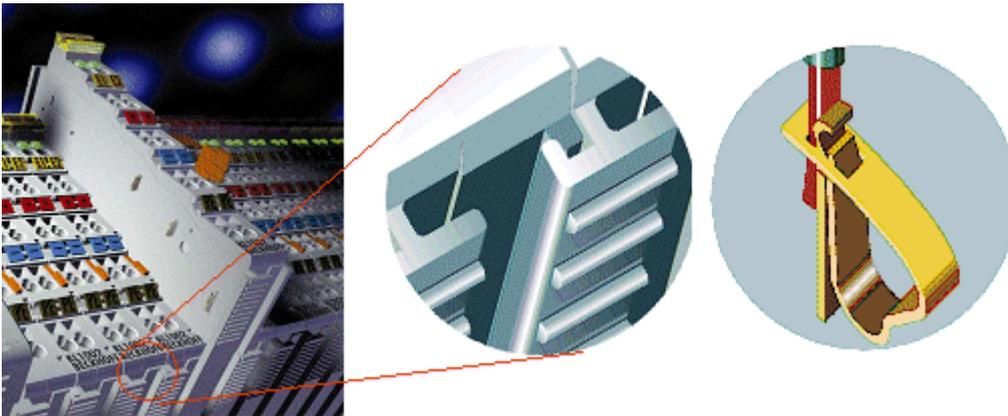


Fig. 1: Slot and key system and screwless (spring-loaded) connection system.

In order to accommodate the wide range of different communication standards encountered in industrial automation, Beckhoff offers Bus Couplers for a number of common bus systems (e.g. EK1100 for EtherCAT).

3.1.1 Bus Coupler

| Mechanical data | Bus Coupler |
|------------------------|------------------------------------------------|
| Material | polycarbonate, polyamide (PA6.6). |
| Dimensions (W x H x D) | 44 mm x 100 mm x 68 mm |
| Mounting | on 35 mm mounting rail (EN 60715) with locking |
| Attachable by | double slot and key connection |

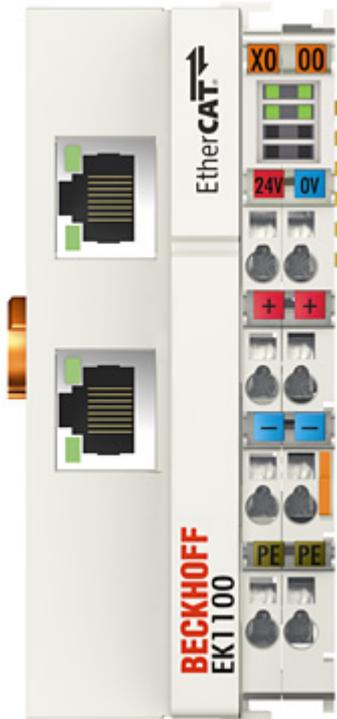


Fig. 2: Bus Coupler (EtherCAT)

| Connection technology | Bus Coupler |
|--------------------------|--------------------------------------------------------------------------|
| Wiring | spring-loaded system |
| Connection cross-section | 0.08 mm ² ... 2.5 mm ² , stranded wire, solid wire |
| Fieldbus connection | depending on fieldbus |
| Power contacts | 3 spring contacts |
| Current load | 10 A |
| Rated voltage | 24 V _{DC} |

3.1.2 Bus Terminals

| Mechanical data | Bus Terminal |
|------------------------|--------------------------------------------------|
| Material | polycarbonate, polyamide (PA6.6). |
| Dimensions (W x H x D) | 12 mm x 100 mm x 68 mm or 24 mm x 100 mm x 68 mm |
| Mounting | on 35 mm mounting rail (EN 60715) with locking |
| Attachable by | double slot and key connection |

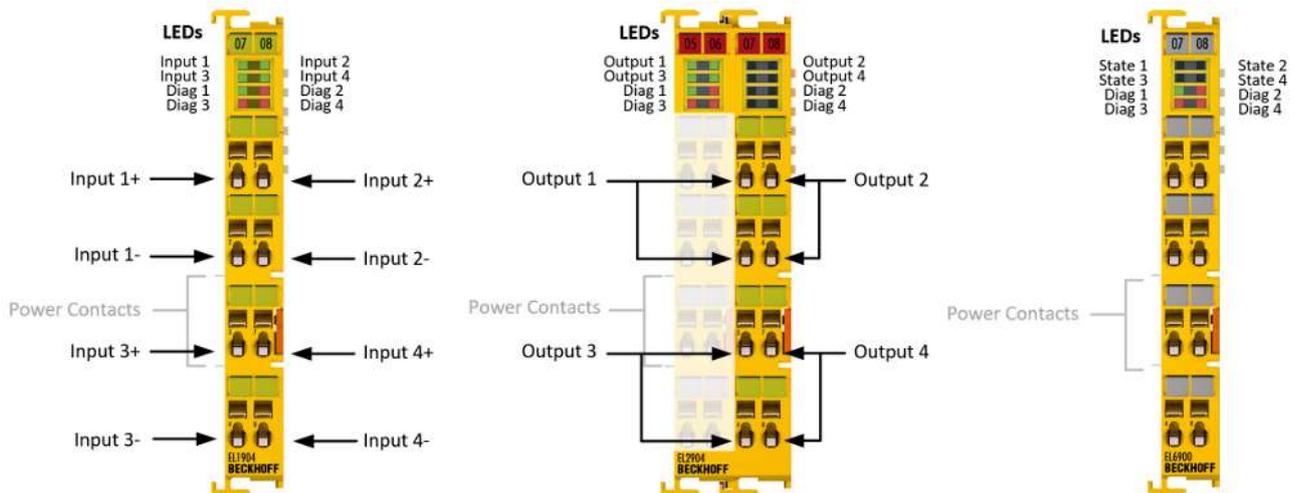


Fig. 3: TwinSAFE Terminals (EtherCAT)

| Connection technology | Bus Terminal |
|--------------------------|--------------------------------------------------------------------------|
| Wiring | spring-loaded system |
| Connection cross-section | 0.08 mm ² ... 2.5 mm ² , stranded wire, solid wire |
| Fieldbus connection | E-bus |
| Power contacts | up to 3 blade/spring contacts |
| Current load | 10 A |
| Rated voltage | depends on Bus Terminal type |

3.1.3 E-bus

The E-bus is the data path within a terminal strip. The E-bus is led through from the Bus Coupler through all the terminals via six contacts on the terminals' side walls.

3.1.4 Power contacts

The operating voltage is passed on to following terminals via three power contacts. Terminal strip can be split into galvanically isolated groups by means of potential feed terminals as required. The power feed terminals play no part in the control of the terminals, and can be inserted at any locations within the terminal strip.

3.2 TwinSAFE

3.2.1 The I/O construction kit is extended safely

With the TwinSAFE Terminals, Beckhoff offers the option of simply expanding the proven Bus Terminal system, and to transfer the complete cabling for the safety circuit into the already existing fieldbus cable. Safe signals can be mixed with standard signals without restriction. This saves design effort, installation and material. Maintenance is simplified significantly through faster diagnosis and simple replacement of only a few components.

The new ELx9xx series Bus Terminals only include three basic functionalities: digital inputs EL19xx, digital outputs EL29xx and a logic unit EL6900. For a large number of applications, all sensors and actuators can be wired on these Bus Terminals. The required logical link of the inputs and the outputs is handled by the EL6900. For small to medium-sized configurations, the tasks of a fail-safe PLC can thus be handled within the Bus Terminal system.

3.2.2 Safety concept

TwinSAFE: Safety and I/O technology in one system

- Extension of the familiar Beckhoff I/O system with TwinSAFE terminals
- Freely selectable mix of safe and standard signals
- Logical link of the I/Os in the EL6900 TwinSAFE logic terminal
- Safety-relevant networking of machines via bus systems

TwinSAFE protocol (FSoE)

- Transfer of safety-relevant data via any media (“genuine black channel”)
- TwinSAFE communication via fieldbus systems such as EtherCAT, Lightbus, PROFIBUS or Ethernet
- IEC 61508:2010 SIL 3 compliant

Configuring instead of wiring: the TwinSAFE configurator

- Configuration of the TwinSAFE system via the TwinCAT System Manager
- System Manager for editing and displaying all bus parameters
- Certified function blocks such as emergency stop, operation mode, etc.
- Simple handling
- Typical function blocks for machine safety
- any bus connection with the EL6900 TwinSAFE logic terminal

TwinSAFE logic Bus Terminal EL6900

- Link unit between TwinSAFE input and output terminals
- Configuration of a simple, flexible, cost-effective, decentralized safety controller
- No safety requirements for higher-level control system
- TwinSAFE enables networks with up to 65535 TwinSAFE devices.
- TwinSAFE Logic Terminal can establish up to 128 connections (TwinSAFE connections).
- Several TwinSAFE Logic Terminals are cascadable in a network
- Safety functions such as emergency stop, protective door, etc. are already included
- Suitable for applications up to SIL 3 according to IEC 61508:2010 and DIN EN ISO 13849-1:2015 (Cat 4, PL e).

TwinSAFE digital input (EL1904) and output terminal (EL2904)

- All current safety sensors can be connected
- Operation with a TwinSAFE logic terminal
- EL1904 with 4 fail-safe inputs for sensors (24 VDC) with potential-free contacts
- EL2904 with four safe channels for actuators (24 VDC, 0.5 A per channel)
- Conforming to IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 (Cat 4, PL e) requirements.

3.2.3 EL1904, EL2904 - Bus Terminals with 4 fail-safe inputs or outputs

The EL1904 and EL2904 Bus Terminals enable connection of common safety sensors and actuators. They are operated with the EL6900 TwinSAFE logic terminal. The TwinSAFE logic terminal is the link unit between the TwinSAFE input and output terminals. It enables the configuration of a simple, flexible and cost-effective decentralized safety control system.

Therefore, there are no safety requirements for the higher-level controller! The typical safety functions required for the automation of machines, such as emergency stop, protective door, two-hand etc., are already permanently programmed in the EL6900. The user configures the EL6900 terminal according to the safety requirements of his application.

3.2.4 EL6900 - TwinSAFE logic terminal

The TwinSAFE Logic Terminal is the link unit between the TwinSAFE input and output terminals. The EL6900 meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 (Cat 4, PL e).

3.2.5 The fail-safe principle (Fail Stop)

The basic rule for a safety system such as TwinSAFE 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.

4 Product description

4.1 EL6900 - TwinSAFE logic terminal

The TwinSAFE logic terminal is the link unit between the TwinSAFE input and output terminals.

The EL6900 meets the requirements of IEC 61508:2010 SIL 3, DIN EN ISO 13849-1:2006 (Cat 4, PL e), NRTL, UL508, UL1998 and UL991.

The TwinSAFE terminal has the typical design of an EtherCAT terminal.

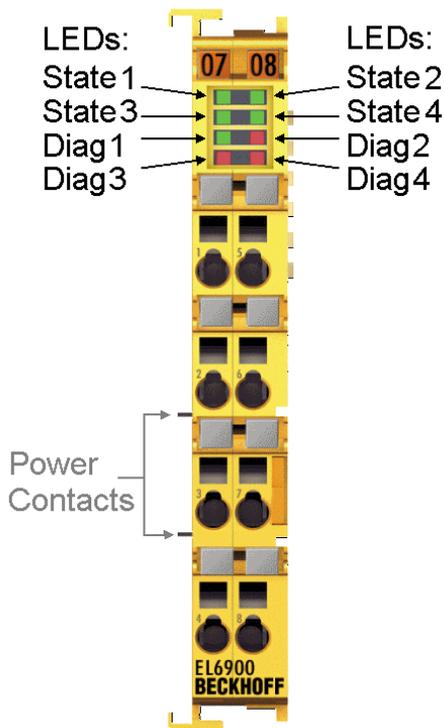


Fig. 4: EL6900 - TwinSAFE logic terminal

4.2 Intended use

⚠ WARNING

Caution - Risk of injury!

TwinSAFE components shall only be used for the purposes described below!

⚠ WARNING

System limits

The TÜV SÜD certificate applies to the EL6900, the function blocks available in it, the documentation and the engineering tool. The permitted engineering tool is TwinCAT with the "TwinSAFE Verifier", the TwinSAFE Loader or "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.

The TwinSAFE terminals expand the application range of Beckhoff Bus Terminal system with functions that enable them to be used for machine safety applications. The TwinSAFE terminals are designed for machine safety functions and directly associated industrial automation tasks. They are therefore only approved for applications with a defined fail-safe state. This safe state is the wattless state. Fail-safety according to the relevant standards is required.

The TwinSAFE Terminals enable connection of:

- 24 V_{DC} sensors (EL1904) such as emergency off pushbutton switches, pull cord switches, position switches, two-hand switches, safety mats, light curtains, light barriers, laser scanner, etc.
- 24 V_{DC} actuators (EL2904) such as contactors, protection door switches with tumbler, signal lamps, servo drives, etc.

i Test pulses

When selecting actuators please ensure that the EL2904 test pulses do not lead to actuator switching or diagnostic message from the EL2904.

The following TwinSAFE components have been developed for these tasks:

- The EL1904 is an EtherCAT Terminal with 4 digital fail-safe inputs.
- The EL2904 is an EtherCAT Terminal with 4 digital fail-safe outputs.
- The EL6900 is an EtherCAT Terminal with integrated TwinSAFE logic.

These TwinSAFE components are suitable for operation on the

- Beckhoff EKxxxx series Bus Couplers
- Beckhoff CXxxxx series Embedded PCs with E-bus connection

⚠ WARNING

Power supply from SELV/PELV power supply unit!

The TwinSAFE components must be supplied with 24 V_{DC} by an SELV/PELV power supply unit with an output voltage limit U_{max} of 36 V_{DC} . Failure to observe this can result in a loss of safety.

⚠ CAUTION

Follow the machinery directive!

The TwinSAFE components shall only be used in machines as defined in the machinery directive.

⚠ CAUTION

Ensure traceability!

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

4.3 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 | EL6900 |
|---------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of inputs | 0 |
| Number of outputs | 0 |
| Status display | 4 diagnostic LEDs |
| Minimum cycle time | approx. 500 µs |
| Fault reaction time | ≤ watchdog times |
| Watchdog time | Min. 2 ms, max. 60000 ms |
| Input process image | Dynamic according to the TwinSAFE configuration in the TwinCAT System Manager |
| Output process image | Dynamic according to the TwinSAFE configuration in the TwinCAT System Manager |
| EL6900 supply voltage (PELV) | 24 V _{DC} (-15% / +20%) |
| Protection class | III (by using a SELV/PELV power supply unit) |
| Overvoltage category | II |
| Current consumption via E-bus | approx. 188 mA |
| Power loss of the terminal | typically 1 W |
| Dimensions (W x H x D) | 12 mm x 100 mm x 68 mm |
| Weight | approx. 50 g |
| Permissible ambient temperature (operation) up to SW 04 | 0 °C ... +55 °C (see chapter Example configuration for temperature measurement [► 26]) |
| Permissible ambient temperature (operation) from SW 05 (CW 02/2014) | -25 °C ... +55 °C (see chapter Example configuration for temperature measurement [► 26]) |
| Permissible ambient temperature (transport/storage) | -40 °C ... +70 °C |
| Permissible air humidity | 5% to 95%, non-condensing |
| Permissible air pressure (operation/storage/transport) | 750 hPa to 1100 hPa (this is equivalent to an altitude of approx. -690 m to 2450 m above sea level assuming an international standard atmosphere) |
| Climate category according to EN 60721-3-3 | 3K3 (the deviation from 3K3 is only possible with optimal environmental conditions and also applies only to the technical data which are specified differently in this documentation) |
| Permissible degree of pollution according to EN 60664-1 | 2 (see chapter Maintenance) |
| Inadmissible operating conditions | TwinSAFE terminals must not be used under the following operating conditions: <ul style="list-style-type: none"> • under the influence of ionizing radiation (exceeding the natural background radiation) • in corrosive environments¹ • in an environment that leads to unacceptable soiling of the bus terminal |
| 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 |
| Corrosive gas test | According to DIN EN 60068-2-60:2016-06, method 4 with increased concentrations according to ANSI/ISA 71.04:2013 Level GX Group A <ul style="list-style-type: none"> • Test duration: 21 days • Hydrogen sulfide: (50 ± 5) ppb |

| Product designation | EL6900 |
|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> Nitrogen dioxide: (1250 ± 20) ppb Chlorine: (10 ± 5) ppb Sulfur dioxide: (300 ± 20) ppb |
| Protection rating | IP20 |
| Device type according to EN 61010-2-201 | Open equipment |
| Permitted operating environment | In the control cabinet or terminal box, with minimum protection rating IP54 according to IEC 60529 |
| Permissible installation position | see chapter Installation position and minimum distances [► 25] |
| Approvals | CE, cULus, ATEX, TÜV SÜD |

¹ A corrosive environment exists when corrosion damage becomes apparent.

4.4 Safety parameters

| Key figures | EL6900 |
|-------------------------------------|---------------------------|
| Lifetime [a] | 20 |
| Proof test Interval [a] | not required ¹ |
| PFH _D | 1.03E-09 |
| %SIL3 | 1,03% |
| PFD | 8.23E-05 |
| %SIL3 | 8,23% |
| MTTF _d | high |
| DC | high |
| Performance level | PL e |
| Category | 4 |
| HFT | 1 |
| Element classification ² | Type B |

1. Special proof tests are not required during the entire service life of the EL6900 EtherCAT terminal.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EL6900 EtherCAT Terminal can be used for safety-related applications within the meaning of IEC 61508:2010 up to SIL3 and EN ISO 13849-1 up to PL e (Cat4).

For the calculation or estimation of the MTTF_d value from the PFH_D value, further information can be found in the TwinSAFE application manual or in ISO 13849-1:2015 Table K.1.

4.5 Dimensions

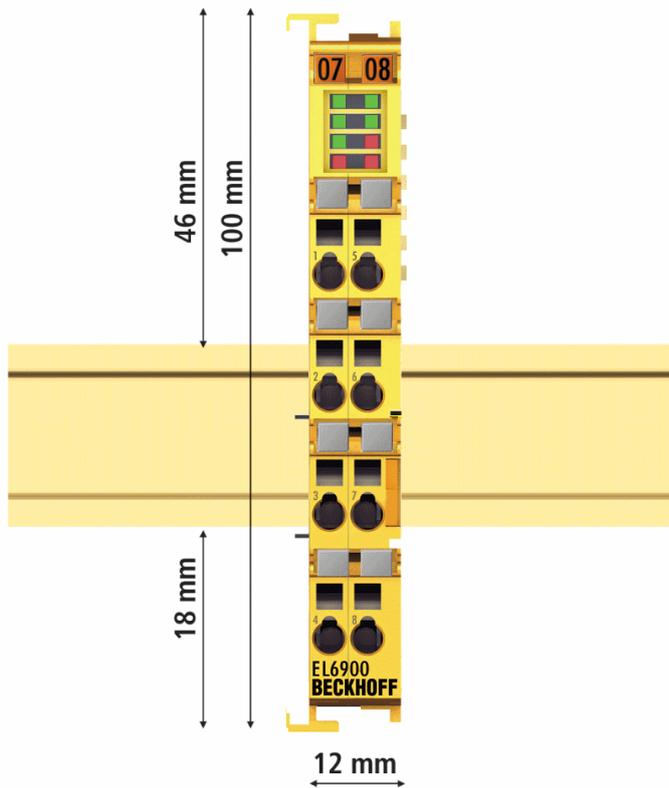


Fig. 5: Dimensions of the EL6900

Width: 12 mm (side-by-side installation)

Height: 100 mm

Depth: 68 mm

5 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

NOTICE

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

WARNING

Risk of injury!

Bring the bus system into a safe, de-energized state before starting installation, disassembly or wiring of the devices!

5.2.3.1 Control cabinet / terminal box

The TwinSAFE terminals must be installed in a control cabinet or terminal box with IP54 protection class according to IEC 60529 as a minimum.

5.2.3.2 Installation position and minimum distances

For the prescribed installation position the mounting rail is installed horizontally and the mating surfaces of the EL/KL terminals point toward the front (see illustration below). The terminals are 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.

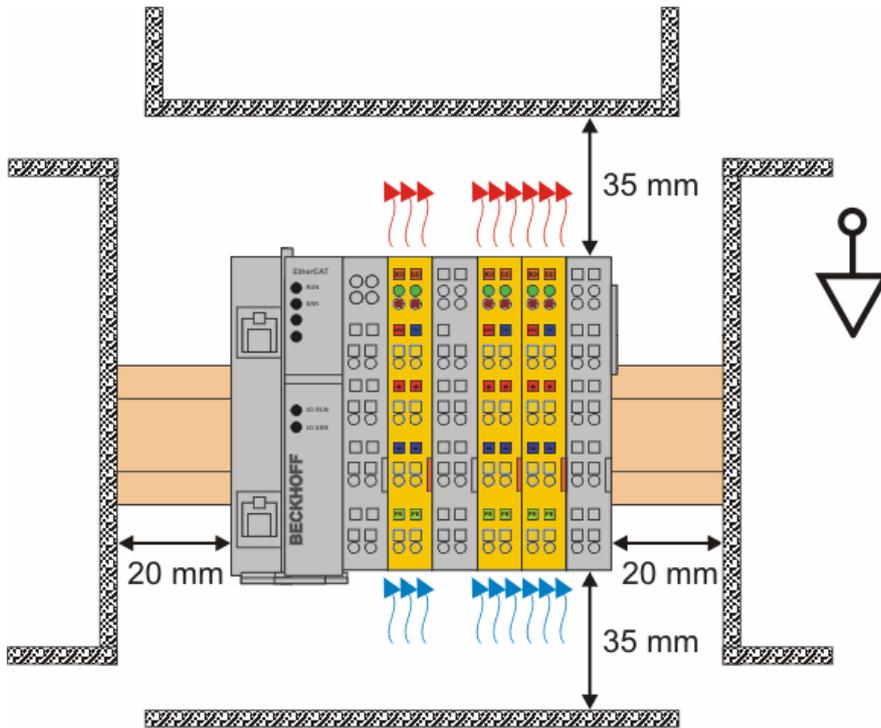


Fig. 6: Installation position and minimum distances

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.

5.2.3.3 Example configuration for temperature measurement

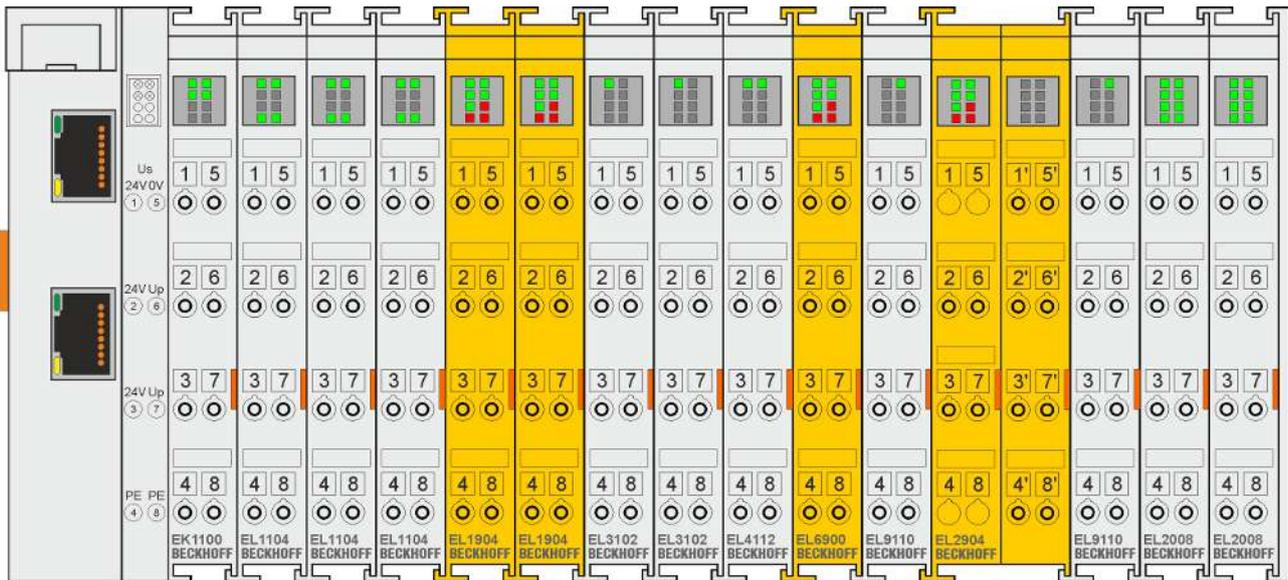


Fig. 7: Example configuration for temperature measurement

The example configuration for the temperature measurement consists of an EK1100 EtherCAT coupler with connected terminals that match the typical distribution of digital and analog signal types at a machine. On the EL6900 a safety project is active, which reads safe inputs and enables all 4 safe outputs during the measurement.

External heat sources / radiant heat / impaired convection

i The maximum permissible ambient temperature of 55°C was checked with the above example configuration. Impaired convection, an unfavorable location near heat sources or an unfavorable configuration of the EtherCAT Terminals may result in overheating of the terminals. The key parameter is always the maximum permitted internally measured temperature of 95°C, above which the TwinSAFE terminals switch to safe state and report an error. The internal temperature can be read from the TwinSAFE components via CoE (see chapter Diagnose).

5.2.3.4 Installation on mounting rails

⚠ WARNING

Risk of electric shock and damage of device!

Bring the bus terminal system into a safe, powered down state before starting installation, disassembly or wiring of the Bus Terminals!

Mounting

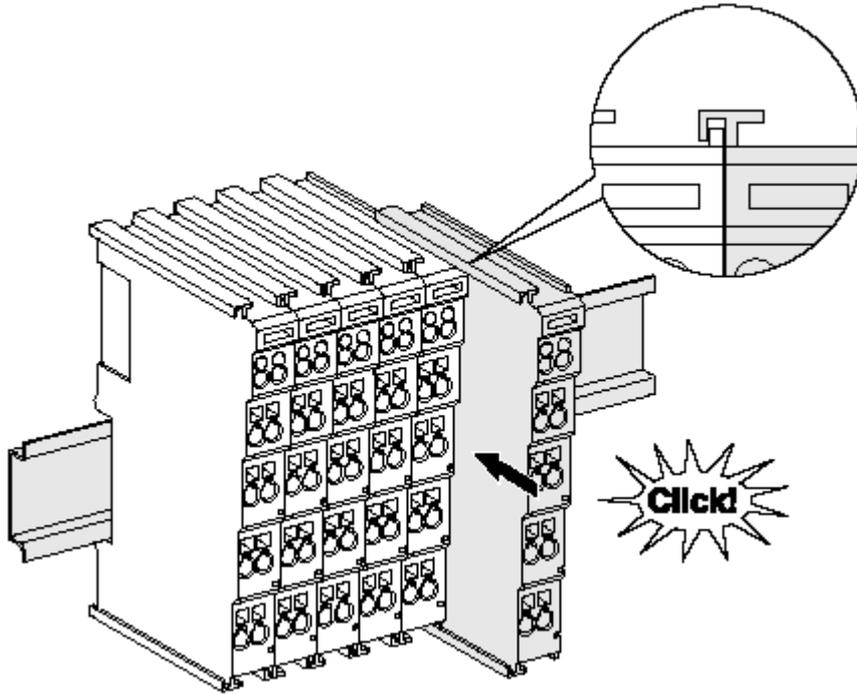


Fig. 8: Installation on the mounting rail

The Bus Couplers and Bus Terminals are attached to commercially available 35 mm mounting rails (DIN rail according to EN 60715) by applying slight pressure:

1. First attach the Fieldbus Coupler to the mounting rail.
2. The Bus Terminals are now attached on the right-hand side of the Fieldbus Coupler. Join the components with slot and key and push the terminals against the mounting rail, until the lock clicks onto the mounting rail.

If the terminals are clipped onto the mounting rail first and then pushed together without slot and key, the connection will not be operational! When correctly assembled, no significant gap should be visible between the housings.

● Fastening of mounting rails

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

Disassembly

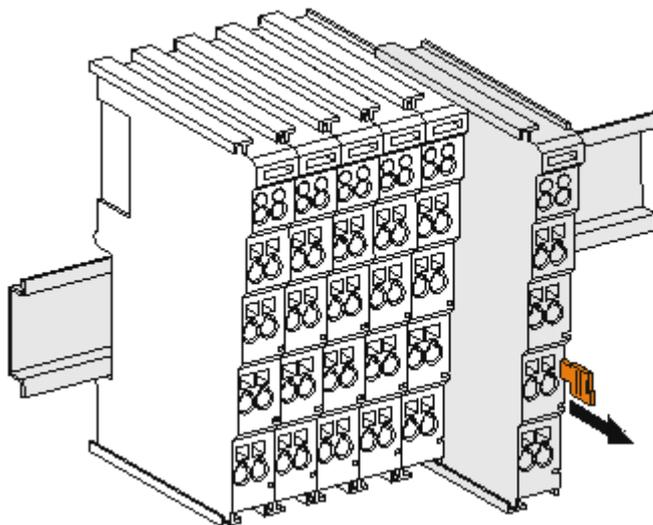


Fig. 9: Removal from mounting rail

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

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

5.2.4 Electrical installation

5.2.4.1 Connections within a Bus Terminal block

The electric connections between the Bus Coupler and the Bus Terminals are automatically realized by joining the components:

Spring contacts (E-bus)

The six spring contacts of the E-bus deal with the transfer of the data and the supply of the Bus Terminal electronics.

NOTICE

Observe the E-bus current

Observe the maximum current that your Bus Coupler can supply to the E-bus! Use the EL9410 Power Supply Terminal if the current consumption of your terminals exceeds the maximum current that your Bus Coupler can feed to the E-bus supply.

Power contacts

The power contacts deal with the supply for the field electronics and thus represent a supply rail within the Bus Terminal block. The power contacts are supplied via terminals on the Bus Coupler.

● Note the connection of the power contacts

i During the design of a Bus Terminal block, the pin assignment of the individual Bus Terminals must be taken account of, since some types (e.g. analog Bus Terminals or digital 4-channel Bus Terminals) do not or not fully loop through the power contacts. Potential supply terminals (EL91xx, EL92xx) interrupt the power contacts and thus represent the start of a new supply rail.

PE power contact

The power contact labelled PE can be used as a protective earth. For safety reasons this contact mates first when plugging together, and can ground short-circuit currents of up to 125 A.

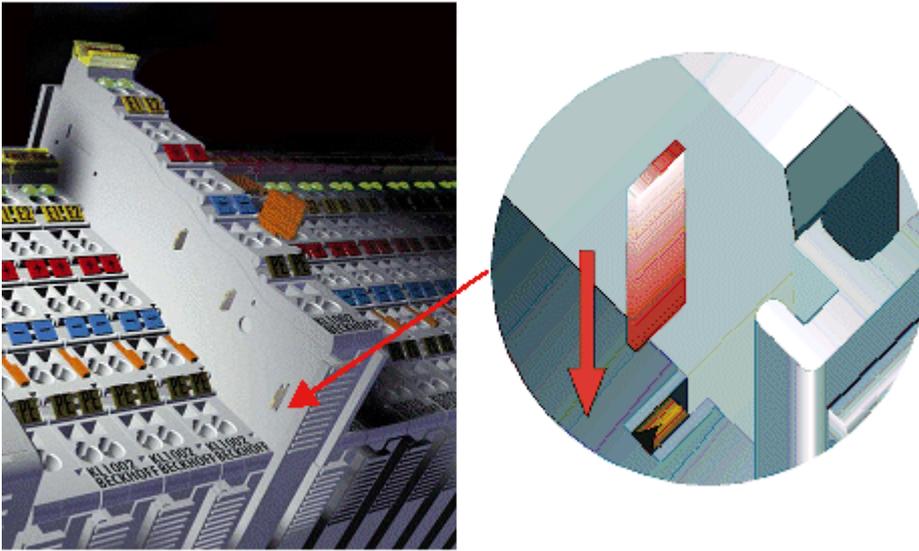


Fig. 10: PE power contact

⚠ CAUTION

Insulation tests

Note that, for reasons of electromagnetic compatibility, the PE contacts are capacitatively coupled to the mounting rail. This may lead to incorrect results during insulation testing or to damage on the terminal (e.g. disruptive discharge to the PE line during insulation testing of a consumer with a rated voltage of 230 V). For insulation testing, disconnect the PE supply line at the Bus Coupler or the Potential Supply Terminal! In order to decouple further feed points for testing, these Power Feed Terminals can be released and pulled at least 10 mm from the group of terminals.

⚠ DANGER

Serious risk of injury!

The PE power contact must not be used for other potentials!

5.2.4.2 Overvoltage protection

If protection against overvoltage is necessary in your plant, provide a surge filter for the voltage supply to the Bus Terminal blocks and the TwinSAFE terminals.

5.2.4.3 Wiring

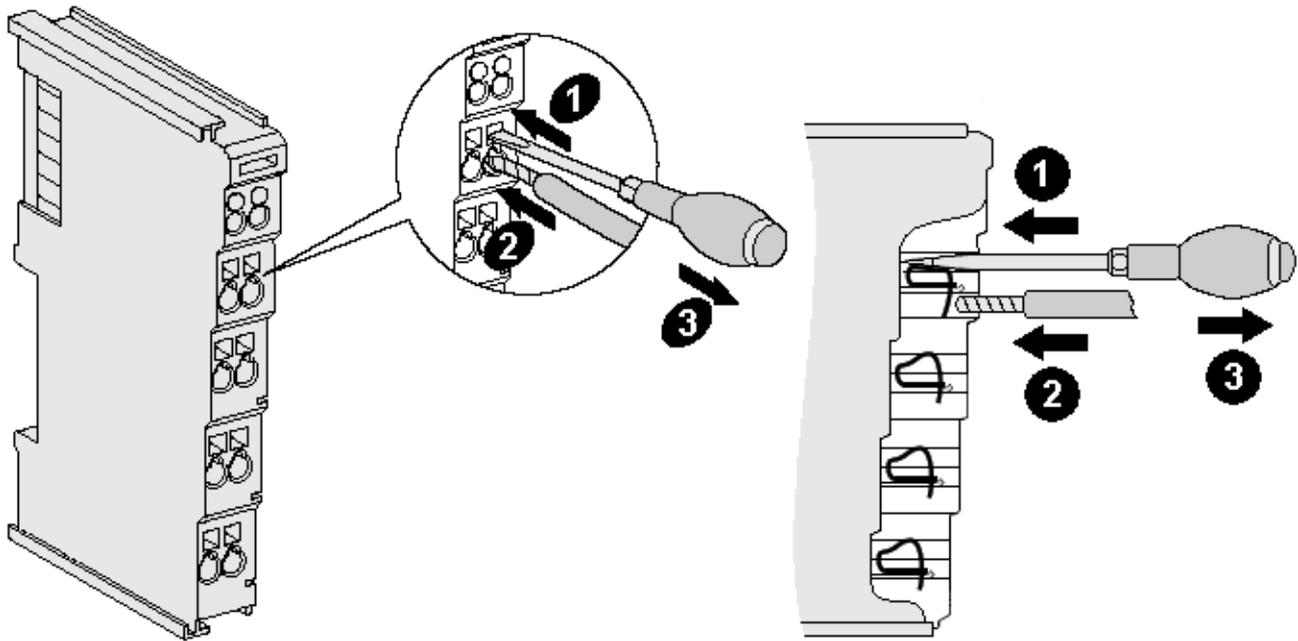


Fig. 11: Connection of a cable to a terminal point

Up to eight terminal points enable the connection of solid or finely stranded cables to the Bus Terminal. The terminal points are implemented in spring force technology. Connect the cables as follows:

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

See the following table for the suitable wire size width.

| | |
|------------------------------------------------------------|------------------------------|
| Wire size width (single core wires) | 0.08 ... 2.5 mm ² |
| Wire size width (fine-wire conductors) | 0.08 ... 2.5 mm ² |
| Wire size width (conductors with a wire end sleeve) | 0.14 ... 1.5 mm ² |
| Wire stripping length | 8 ... 9 mm |

5.2.4.4 EL6900/EL6910 pin assignment

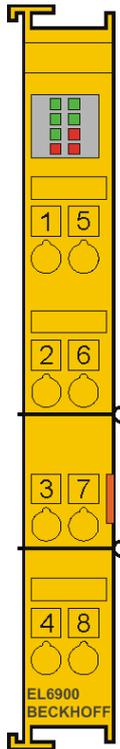


Fig. 12: EL6900/EL6910 pin assignment

| Terminal point | Output | Signal |
|----------------|--------|-----------------------|
| 1 | - | not used, no function |
| 2 | - | not used, no function |
| 3 | - | not used, no function |
| 4 | - | not used, no function |
| 5 | - | not used, no function |
| 6 | - | not used, no function |
| 7 | - | not used, no function |
| 8 | - | not used, no function |

5.2.5 TwinSAFE reaction times

5.2.5.1 Typical response time

The typical reaction time is the time that is required to transmit information from the sensor to the actuator, if the overall system is working without error in normal operation.

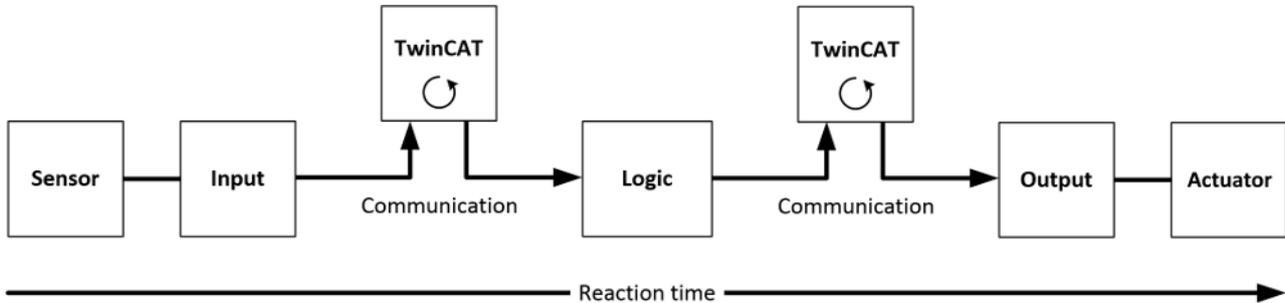


Fig. 13: Typical response time

| Definition | Description |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RTSensor | Response time of the sensor, until the signal is made available at the interface. Typically provided by the sensor manufacturer. |
| RTInput | Response time of the safe input, e.g. EL1904 or EP1908. This time can be found in the technical data. In the case of the EL1904 it is 4 ms. |
| RTComm | Response time of the communication. This is typically 3 times the EtherCAT cycle time, since a new Safety-over-EtherCAT telegram has to be generated before new data can be sent. These times depend directly on the higher-level standard controller (cycle time of the PLC/NC). |
| RTLogic | Response time of the logic terminal. This is the cycle time of the logic terminal and typically ranges from 500 µs to 10 ms for the TwinSAFE logic terminal, depending on the size of the safety project. The actual cycle time can be read from the terminal. |
| RTOutput | Response time of the output terminal. This is typically between 2 and 3 ms. |
| RTActor | Response time of the actuator. This information is typically provided by the actuator manufacturer |
| WDComm | Watchdog time of the communication |

The typical response time is based on the following formula:

$$ReactionTime_{typ} = RT_{Sensor} + RT_{Input} + 3 * RT_{Comm} + RT_{Logic} + 3 * RT_{Comm} + RT_{Output} + RT_{Actuator}$$

with

$$ReactionTime_{typ} = 5ms + 4ms + 3 * 1ms + 10ms + 3 * 1ms + 3ms + 20ms = 48ms$$

5.2.5.2 Worst case response time

The worst-case response time is the maximum time required for switching off the actuator in the event of an error.

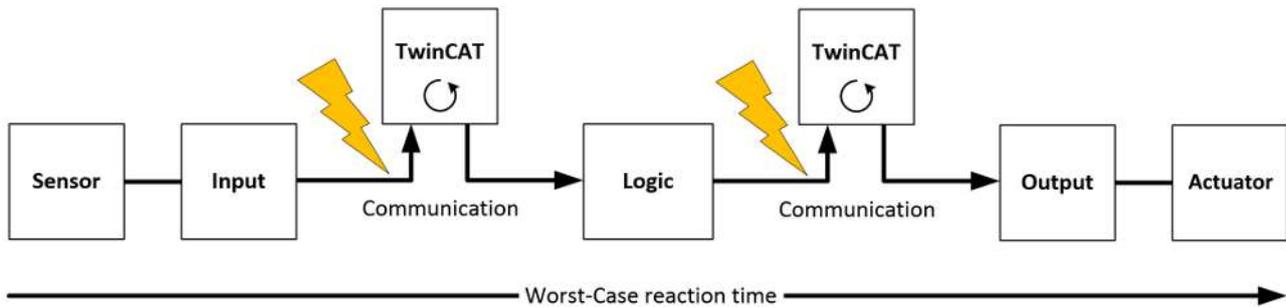


Fig. 14: Worst case response time

It is assumed that a signal change takes place at the sensor, and that this is passed to the input. A communication error occurs just at the moment when the signal is to be passed to the communication interface. This is detected by the logic once the watchdog time of the communication connection has elapsed. This information should then be passed on to the output, resulting in a further communication error. This fault is detected at the output once the watchdog time has elapsed, resulting in shutdown.

This results in the following formula for the worst-case response time:

$$ReactionTime_{max} = WD_{Comm} + WD_{Comm} + RT_{Actuator}$$

with

$$ReactionTime_{max} = 15\text{ ms} + 15\text{ ms} + 20\text{ ms} = 50\text{ ms}$$

5.2.6 Tested EL1904 devices

The following list contains devices that were tested together with the EL1904 TwinSAFE terminal. The results only apply for the current device hardware version at the time of testing. The tests were carried out in a laboratory environment. Modifications of these products cannot be considered here. If you are unsure please test the hardware together with the TwinSAFE terminal.

| Manufacturer | Type | Comment |
|--------------|---------------------------|-------------------------|
| SICK | C4000 | Safety light curtain |
| SICK | S3000 | Safety laser scanner |
| Wenglor | SG2-14ISO45C1 | Safety light grids |
| Leuze | lumiflex ROBUST 42/43/44 | Safety light barriers |
| Schmersal | BNS250-11ZG | Safety switch |
| ifm | GM701S | Inductive safety sensor |
| Keyence | SL-V (with PNP cable set) | Safety light curtain |

The tests were carried out as function tests only. The information provided in the respective manufacturer documentation remains valid.

5.2.7 Tested EL2904 devices

The following list contains devices that were tested together with the EL2904 TwinSAFE terminal. The results only apply for the current device hardware version at the time of testing. The tests were carried out in a laboratory environment. Modifications of these products cannot be considered here. If you are unsure please test the hardware together with the TwinSAFE terminal.

| Manufacturer | Type | Comment |
|---------------|------------------------------------|-----------------------------------------------|
| Beckhoff | AX5801 | TwinSAFE Drive option card: safe restart lock |
| Beckhoff | AX2000 AS option | safe restart lock |
| Siemens | SIRIUS series S00 3RT1016-1BB42 | Contactora |
| Telemecanique | LP1K09 | Contactora |

The tests were carried out as function tests only. The information provided in the respective manufacturer documentation remains valid.

● Recommended protective circuits

i We recommend R/C or diode-based protective circuits for these devices. Varistor-based protective circuits should not be used.

5.3 Configuration of the terminal in TwinCAT

● Identical configuration

i The configuration of the terminal in TwinCAT is identical for the variant.

⚠ CAUTION

Do not change CoE objects!

Do not change any of the CoE objects in the TwinSAFE terminals. Any modifications (e.g. via TwinCAT) of the CoE objects will permanently set the terminals to the Fail-Stop state or lead to unexpected behavior of the terminals!

5.3.1 Configuration requirements

Configuration of the TwinSAFE component requires TwinCAT automation software Version 2.11 Build 1544 or higher. The current version is available for download from the Beckhoff website (www.beckhoff.de).

5.3.2 Inserting a Bus Coupler

See TwinCAT automation software documentation.

5.3.3 Inserting a Bus Terminal

See TwinCAT automation software documentation.

5.3.4 Inserting an EL6900

An EL6900 is inserted in the same way as any other Beckhoff Bus Terminal. In the list open *Safety Terminals (ELx9xx)* and select the EL6900.

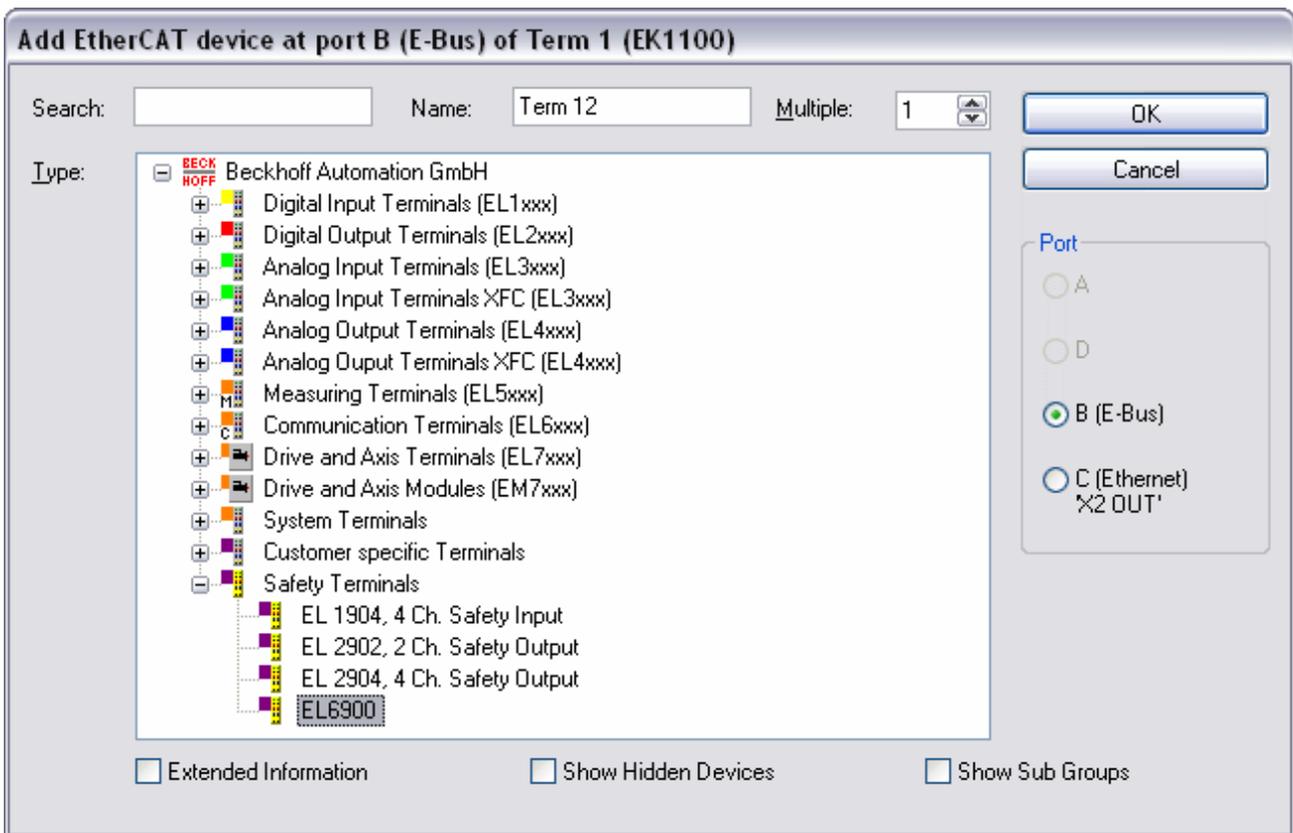


Fig. 15: Inserting an EL6900

i **Size of the process image**

The process image of the EL6900 is adjusted dynamically based on the TwinSAFE configuration created in the TwinCAT automation software.

5.3.5 Address settings on TwinSAFE terminals with 1023 possible addresses

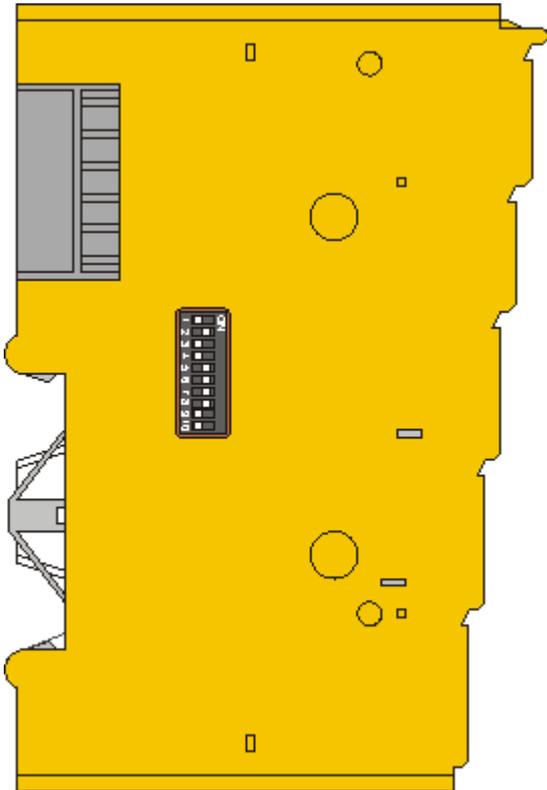


Fig. 16: Address settings on TwinSAFE terminals with 1023 possible addresses

The TwinSAFE address of the terminal is set via the 10-way DIP switch on the left-hand side of the TwinSAFE terminal. TwinSAFE addresses between 1 and 1023 are available.

| DIP switch | | | | | | | | | | Address |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| ON | OFF | 1 |
| OFF | ON | OFF | 2 |
| ON | ON | OFF | 3 |
| OFF | OFF | ON | OFF | 4 |
| ON | OFF | ON | OFF | 5 |
| OFF | ON | ON | OFF | 6 |
| ON | ON | ON | OFF | 7 |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| ON | ON | ON | ON | ON | ON | ON | ON | ON | ON | 1023 |

⚠ WARNING

TwinSAFE address

Each TwinSAFE address may only be used once within a network / a configuration!
The address 0 is not a valid TwinSAFE address!

5.3.6 Registering the TwinSAFE addresses in the TwinCAT automation software

The TwinSAFE address set at the DIP switch must also be entered under the *TwinSAFE Logic* tab (*TwinSAFE address* entry).

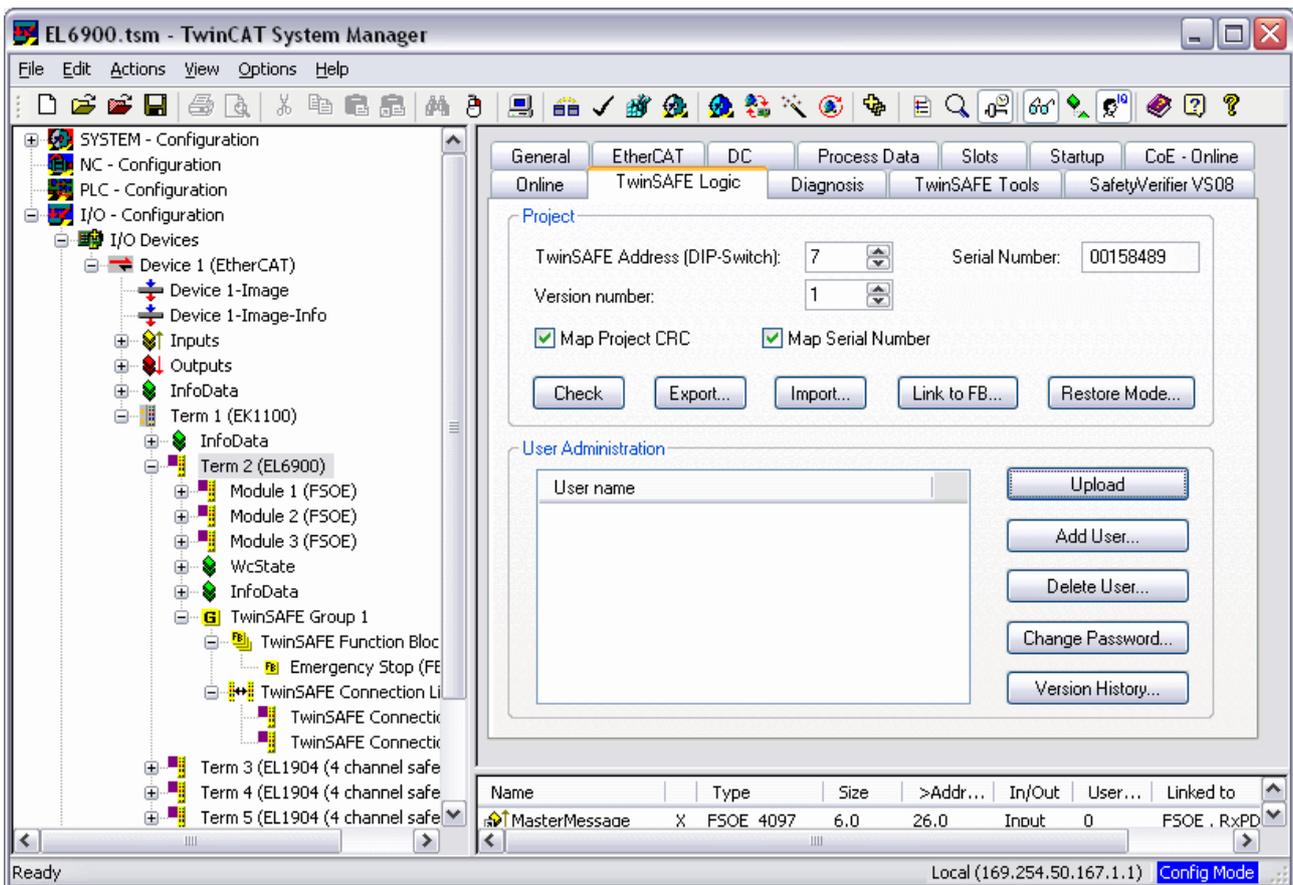


Fig. 17: Registering the TwinSAFE addresses in the TwinCAT automation software

5.3.7 Creating a TwinSAFE group

A TwinSAFE group is a group of TwinSAFE terminals (inputs and outputs) that are logically linked via a TwinSAFE Logic terminal. Any communication faults in the TwinSAFE connections of this group lead to the whole group being switched off. Other TwinSAFE groups are not affected.

A TwinSAFE group is added by right-clicking on the corresponding TwinSAFE component in the tree structure and selecting the item *Append TwinSAFE Group* with the left mouse button in the dialog box that opens (see figure).

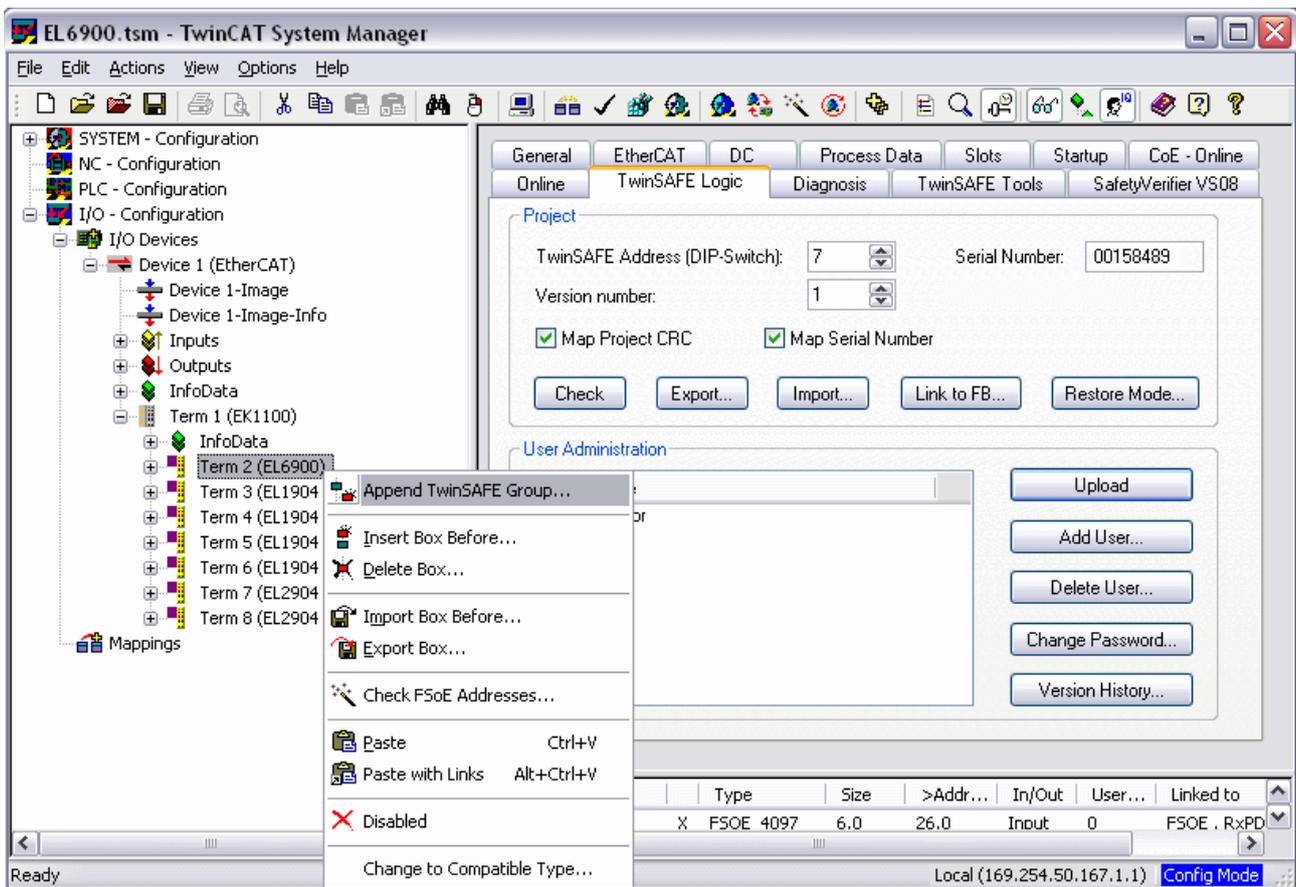


Fig. 18: Creating a TwinSAFE group

5.3.8 TwinSAFE group signals

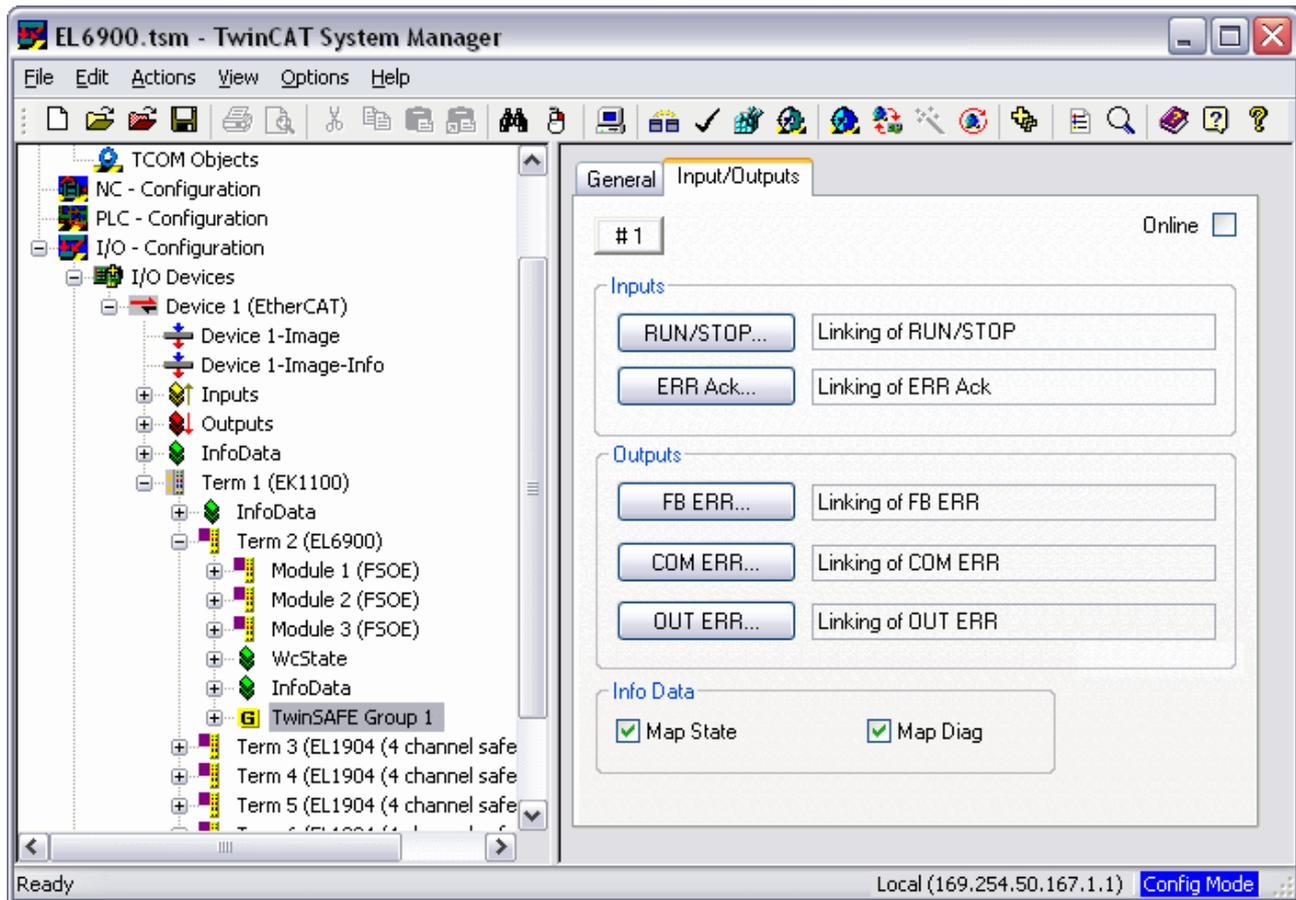


Fig. 19: TwinSAFE group signals

TwinSAFE group inputs

| Name | Permitted type | Description |
|---------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| RUN | FB-Out Standard-In | TRUE The function blocks assigned to the TwinSAFE group are executed. When the input is not linked it is in the TRUE state |
| | | FALSE All of the TwinSAFE group assigned function blocks are at a STOP state and thus all associated outputs are in a safe state. |
| ERR Ack | FB-Out Standard-In | All pending errors in the assigned function blocks and in the TwinSAFE connections are acknowledged by the FALSE->TRUE->FALSE signal sequence. |

TwinSAFE group outputs

| Name | Permitted type | Description |
|---------|---------------------------------------|----------------------------------------------------------------------|
| FB ERR | TwinSAFE-Out FB-In Standard-Out | TRUE At least one assigned function block has an error |
| | | FALSE All assigned function blocks have no errors |
| COM ERR | TwinSAFE-Out FB-In Standard-Out | TRUE At least one TwinSAFE connection of TwinSAFE group has an error |
| | | FALSE All TwinSAFE connections of the TwinSAFE group have no errors |
| OUT ERR | TwinSAFE-Out FB-In Standard-Out | Always FALSE, since the EL6900 has no local outputs |

5.3.9 Append a function block

The TwinSAFE Logic terminal features function blocks like Emergency Stop, Machine Monitoring, AND, OR, Decoupler, Operation Mode, etc.

A function block is added by right-clicking on the corresponding *TwinSAFE Function Block List* in the tree structure and selecting *Append Function Block* with the left mouse button in the dialog box that opens (see figure).

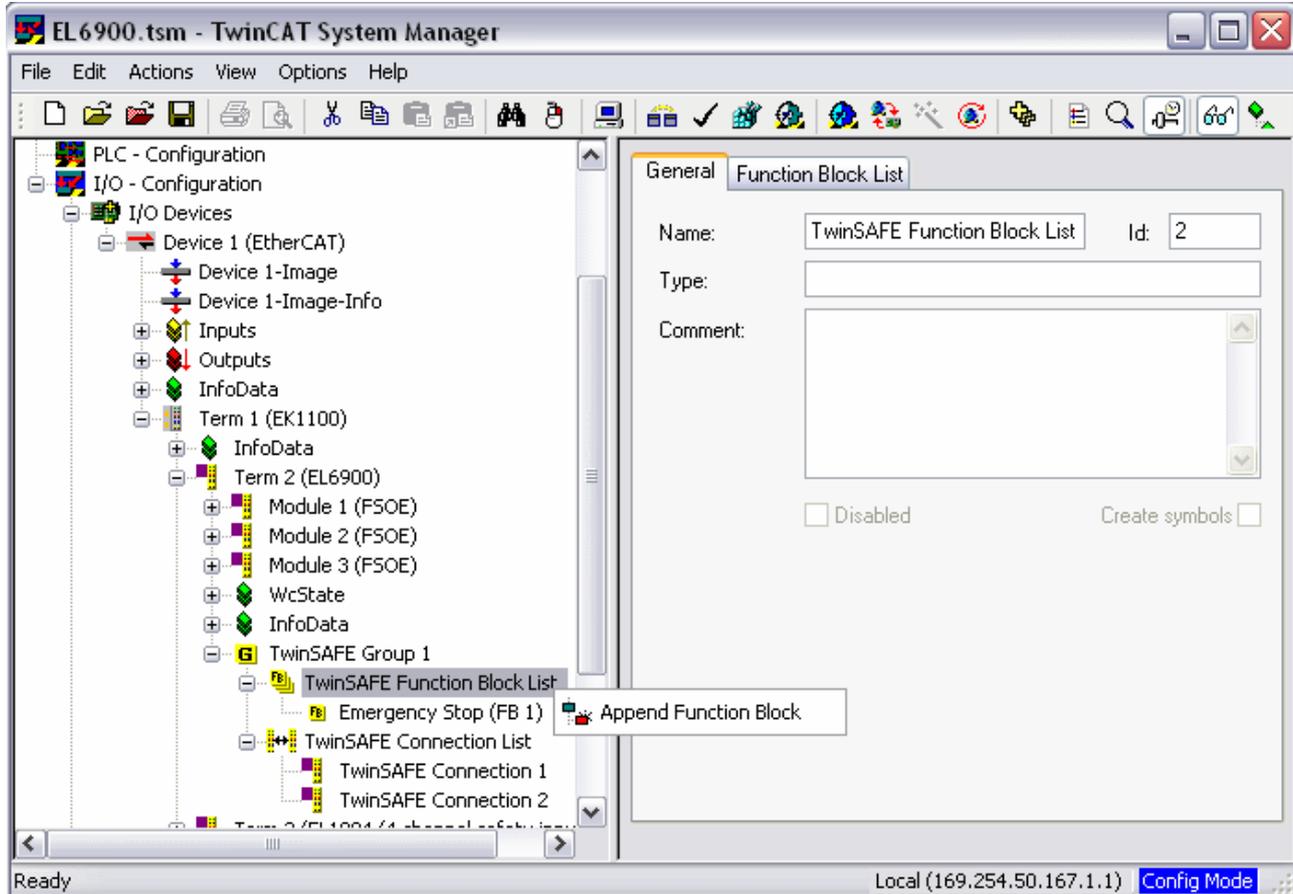


Fig. 20: Appending a function block

The required function block can then be selected from the following window.

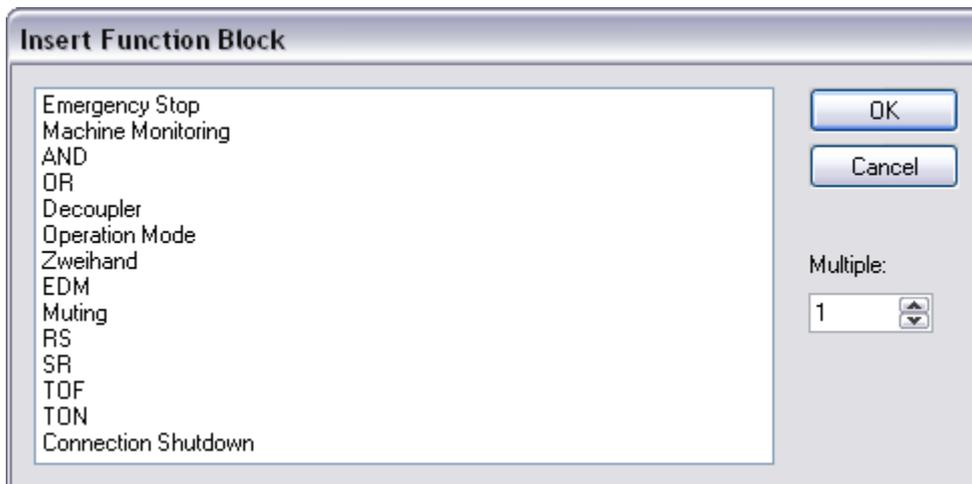


Fig. 21: Selection of the desired function block

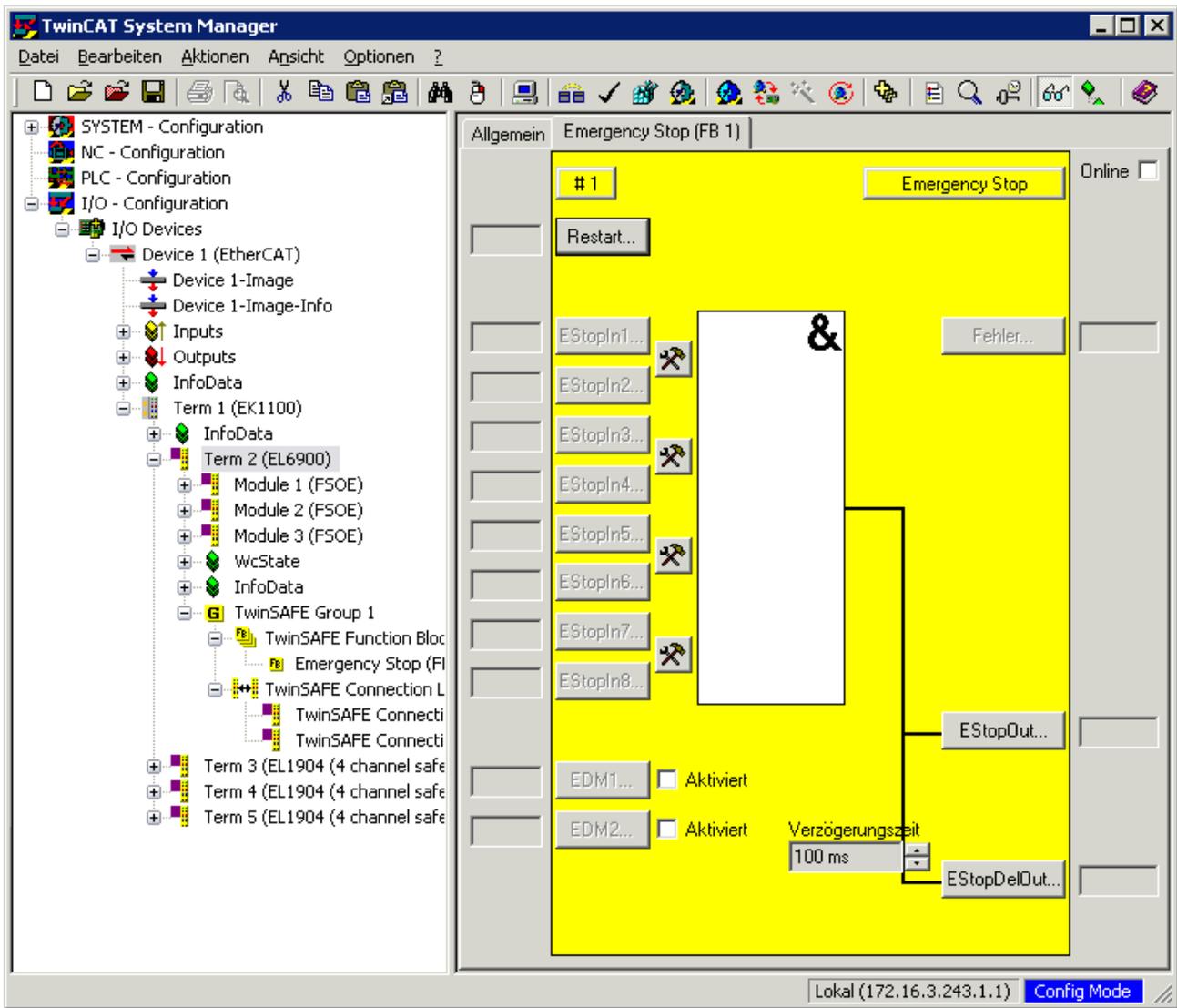


Fig. 22: Appended Emergency Stop function block

5.3.9.1 Activating and configuring the block inputs

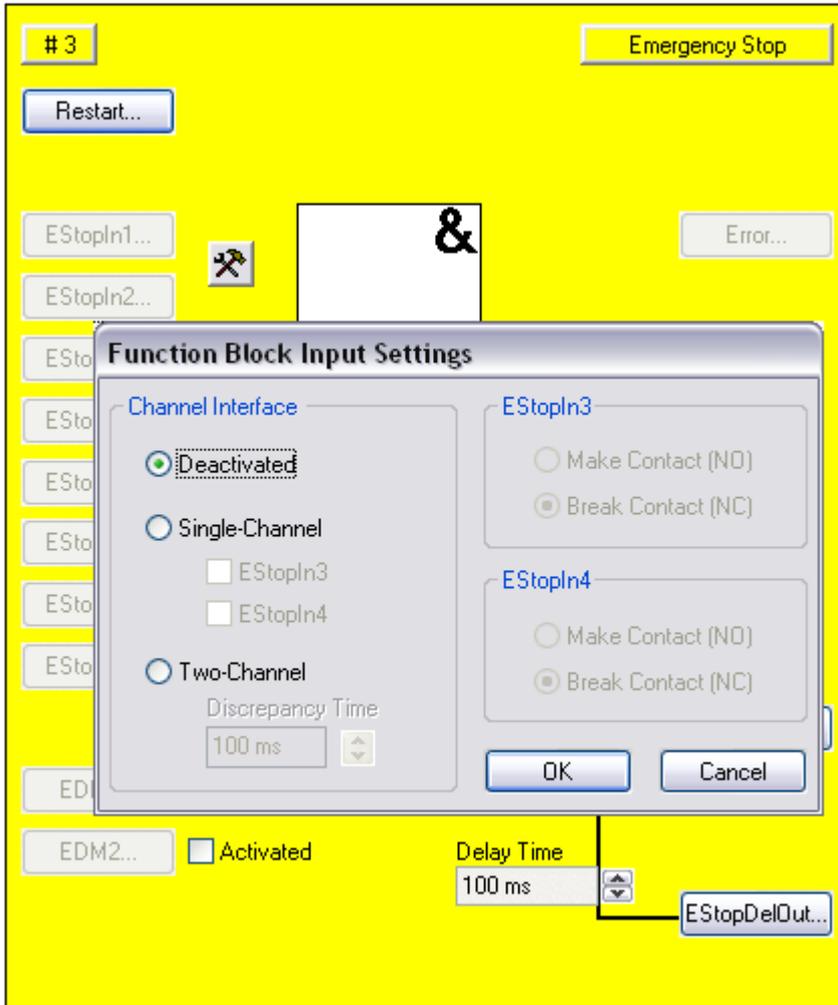


Fig. 23: Function Block Input Settings

The following parameters can be set:

Deactivated: The input is not used

Single-channel: The inputs are linked independent of each other

Two-channel: The inputs are monitored for equality or inequality, depending on the contact type setting. A *Discrepancy Time* can be set for monitoring the two inputs for simultaneous switching.

Make Contact: Contact type setting

Break Contact: Contact type setting

The inputs are now activated.

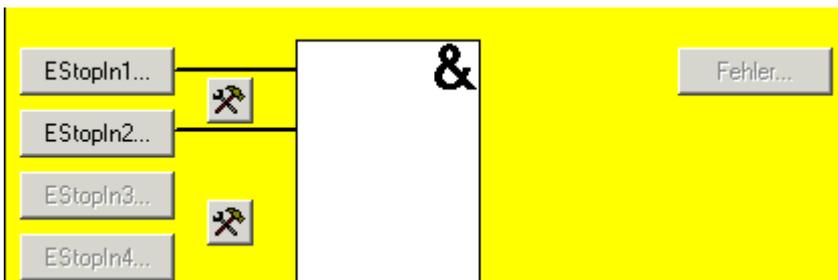


Fig. 24: Activated inputs

The inputs can now be linked.

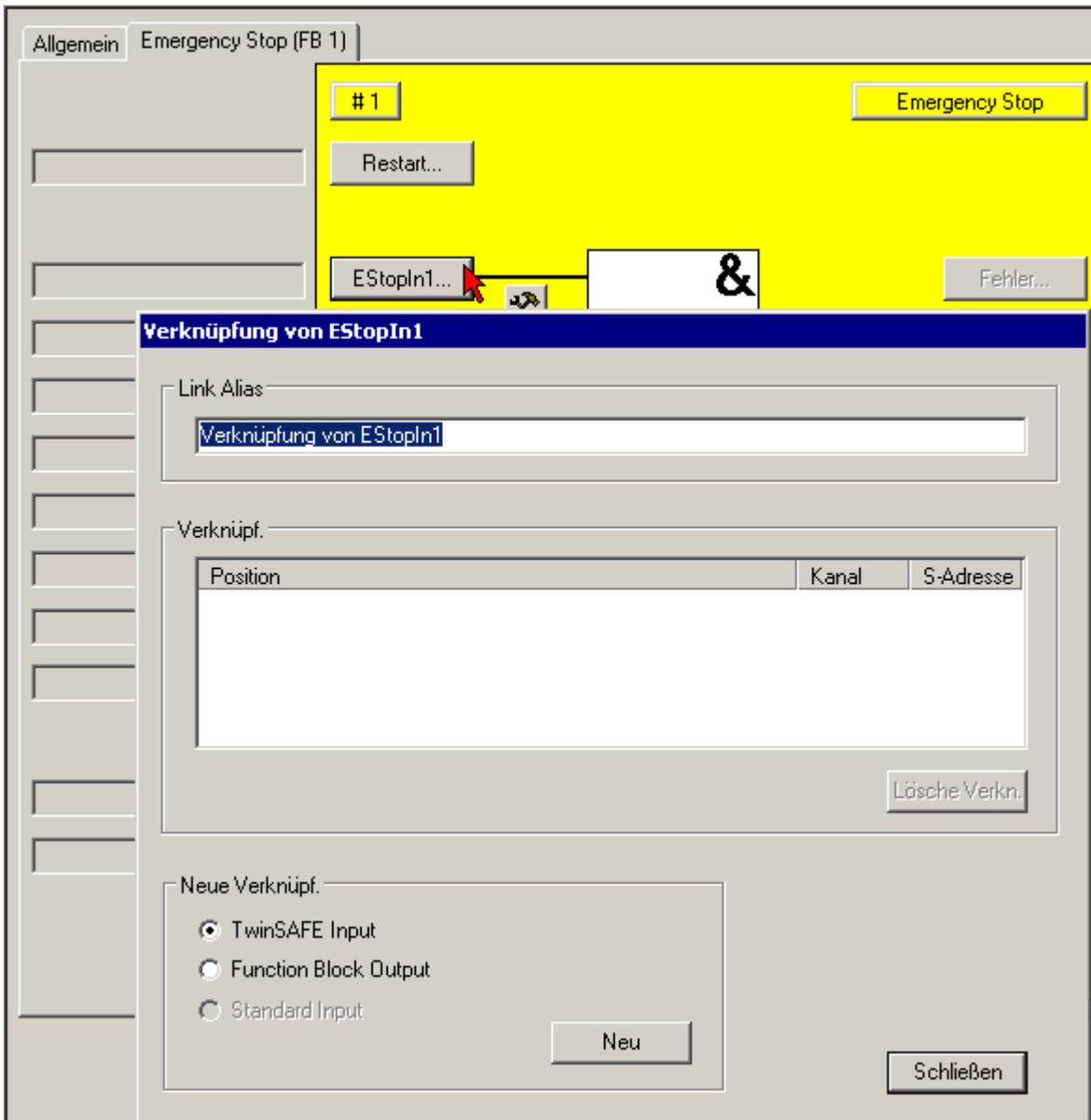


Fig. 25: Link inputs

Select the variable type:

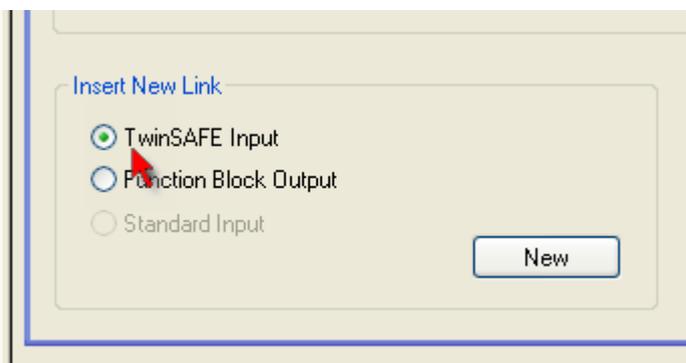


Fig. 26: Select the variable type

Clicking on the *New* button opens the following dialog:

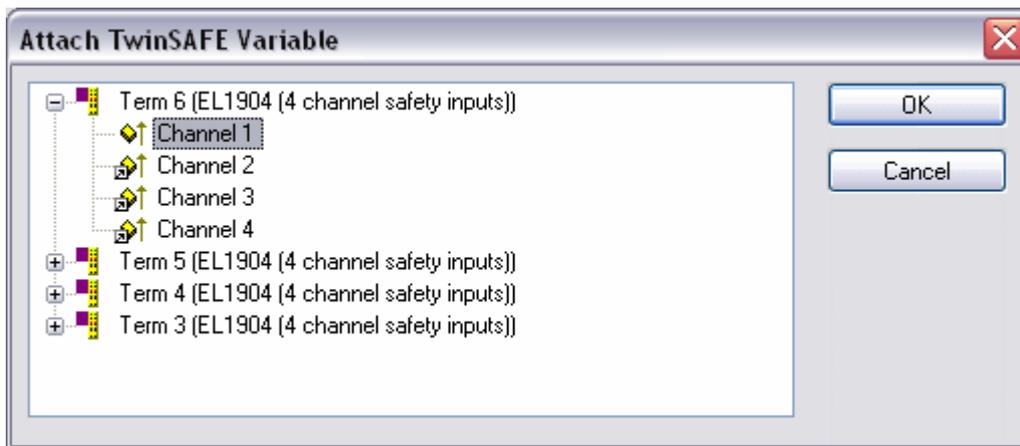


Fig. 27: Available channels

All available channels are displayed as selected.

The desired channel is selected and marked with the mouse. The selection is confirmed via the OK button.

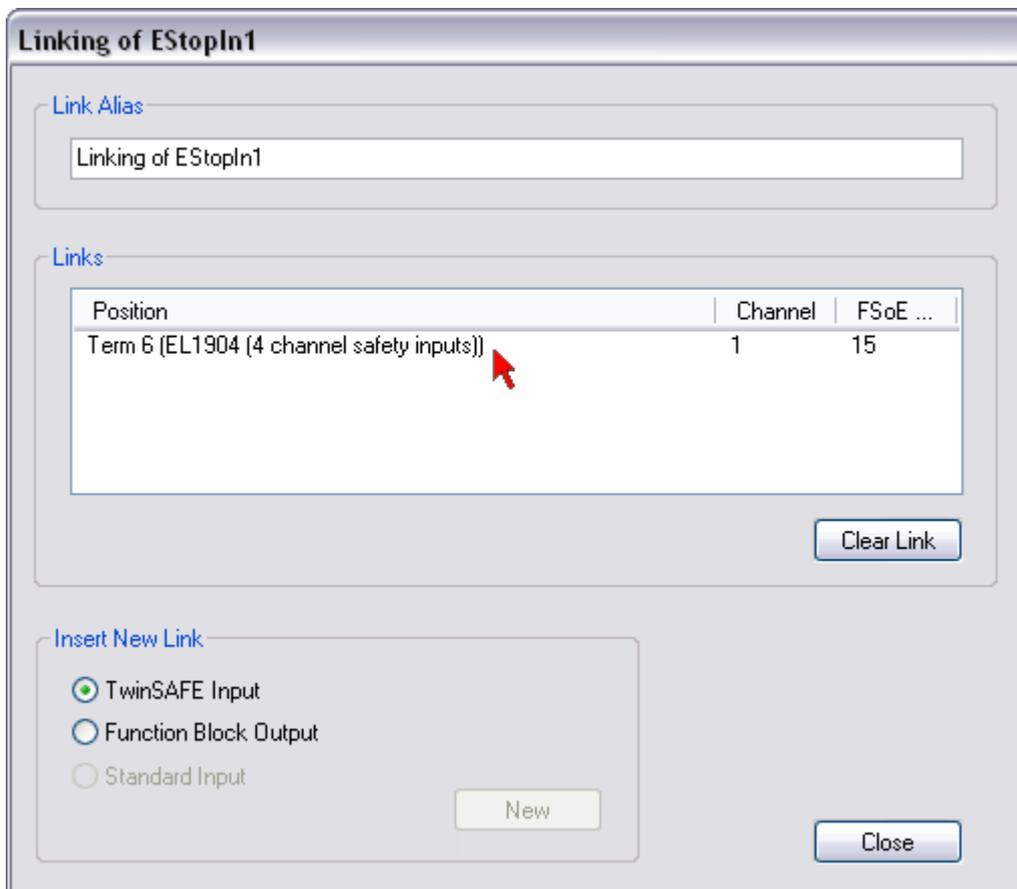


Fig. 28: Selection of the desired channel

The name of the variables should now be entered in the *Link Alias* field.

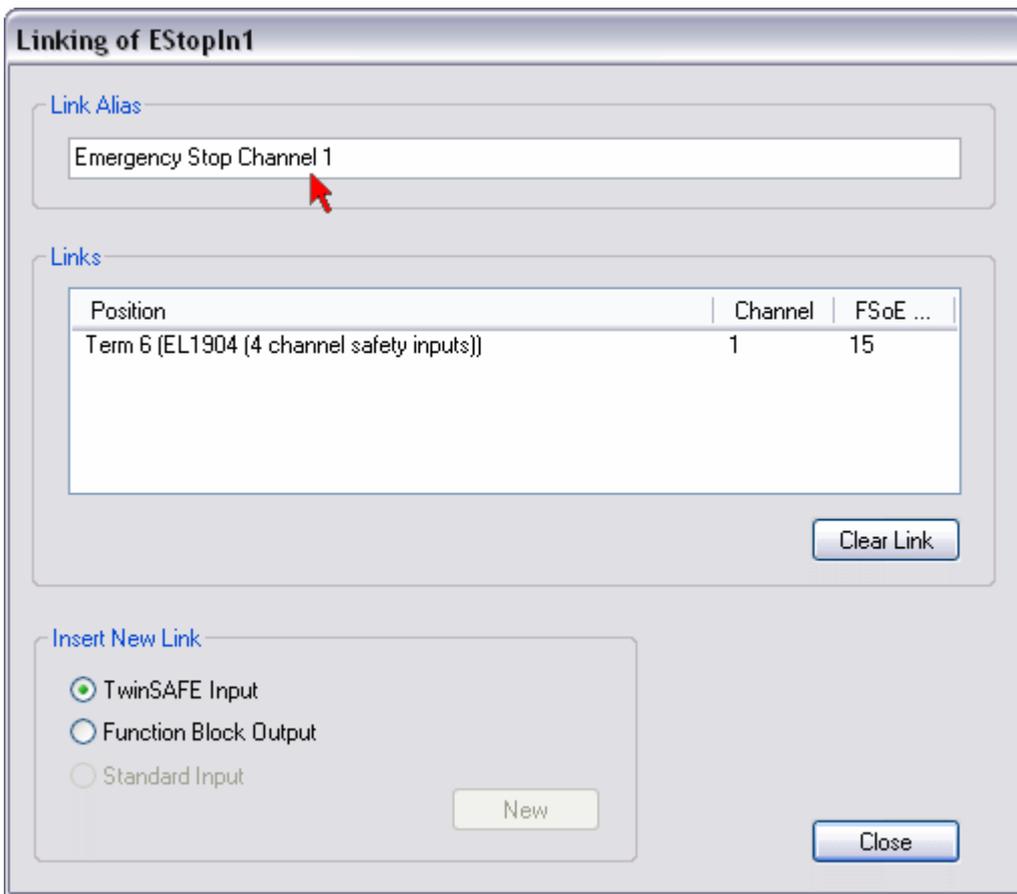


Fig. 29: Enter alias

Repeat the process for the other inputs. Inputs that are already in use are identified with an arrow.

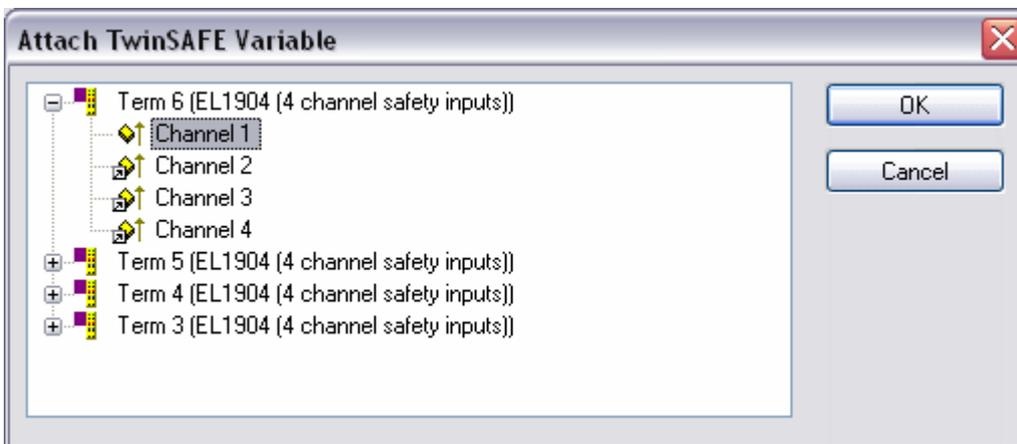


Fig. 30: Identification of inputs already in use

5.3.10 EL6900 user and version administration

The EL6900 has a user administration function. The user *Administrator* can't be deleted, but its default password can and should be changed into a customer specific one. This is to be done via the button Change Password. The default password is *TwinSAFE*. The new password has to be 6 characters long at minimum. Up to 8 further users can be created.

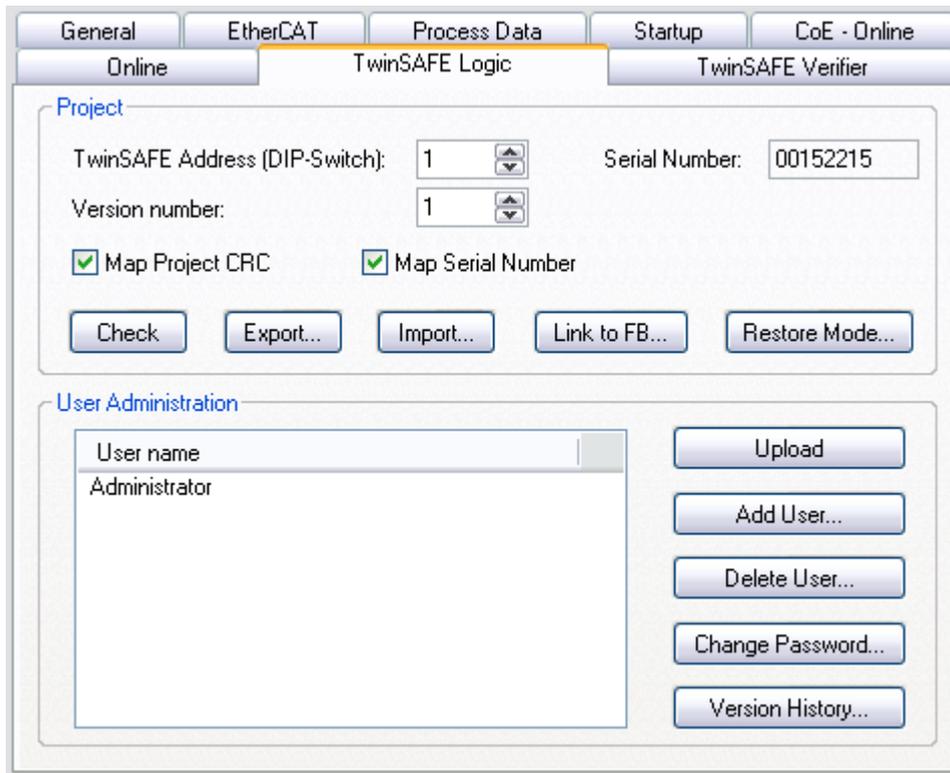


Fig. 31: EL6900 user administration

Via the button *Upload* the list of created users is read from the EL6900.

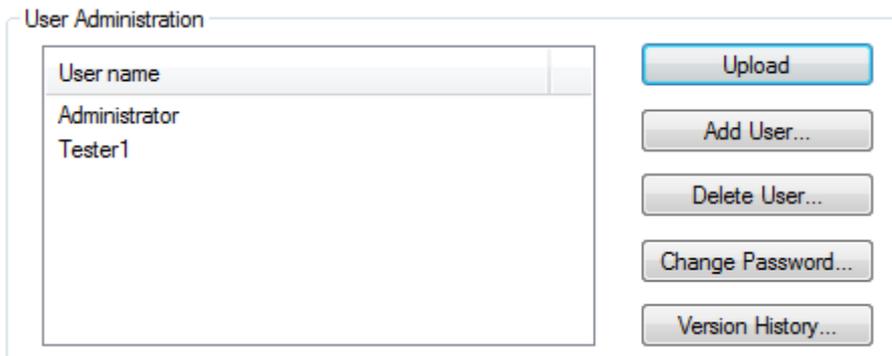


Fig. 32: User Administration - Upload

To create or delete users, the administrator password is needed.

By a left mouse click onto *Add User...* the dialog *Login* will be opened.

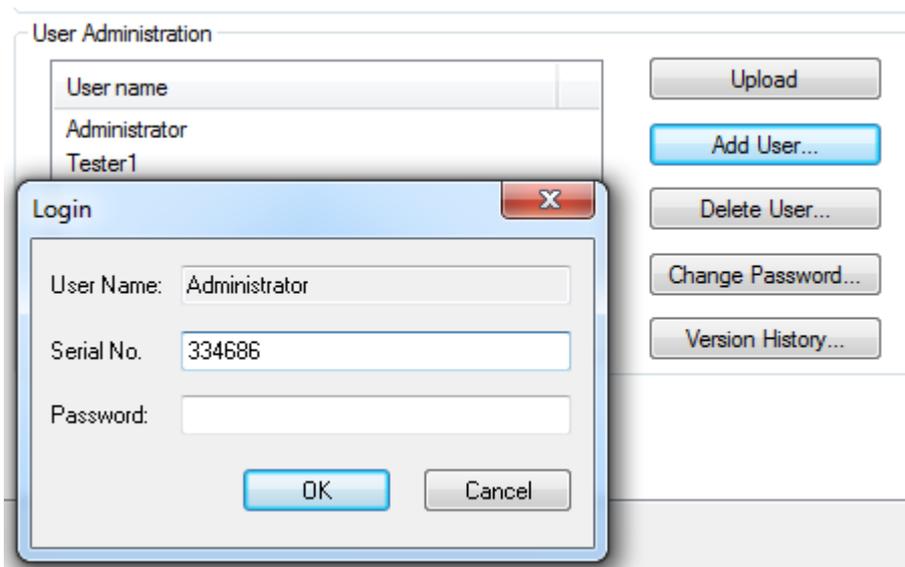


Fig. 33: User Administration - Login

If you enter the correct serial number and the valid administrator password, the Dialog *Add User* will open.

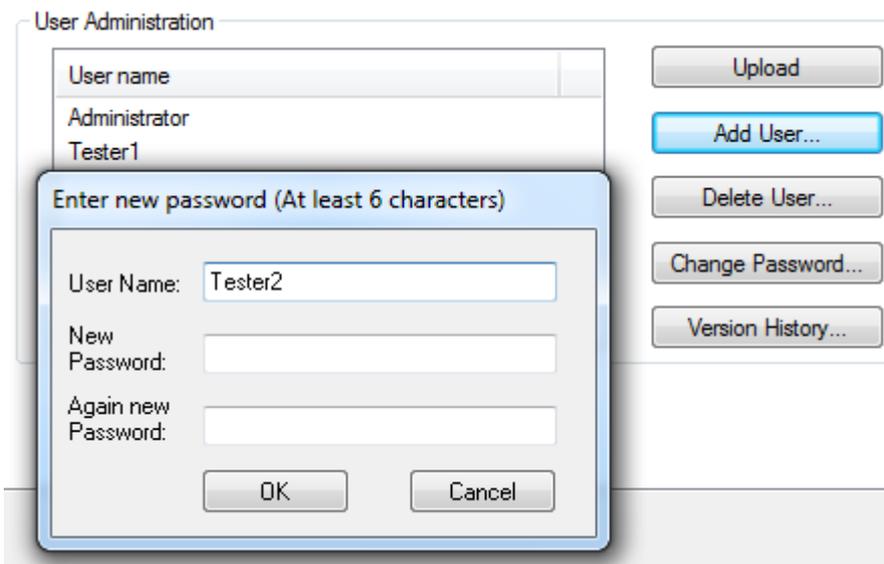


Fig. 34: User Administration - Add User

Enter the new User and twice the desired password.

The user name has to consist of one character at minimum and 16 characters at maximum. The new password has to be 6 characters long at minimum. The new user has the same rights like the administrator except the right to create or delete users. Via the button *OK* the data is assumed and displayed within the User Administration.



Fig. 35: User Administration - User List

To delete a user, the designed user has to be selected and via the button *Delete User...* the dialog *Delete User* will open.

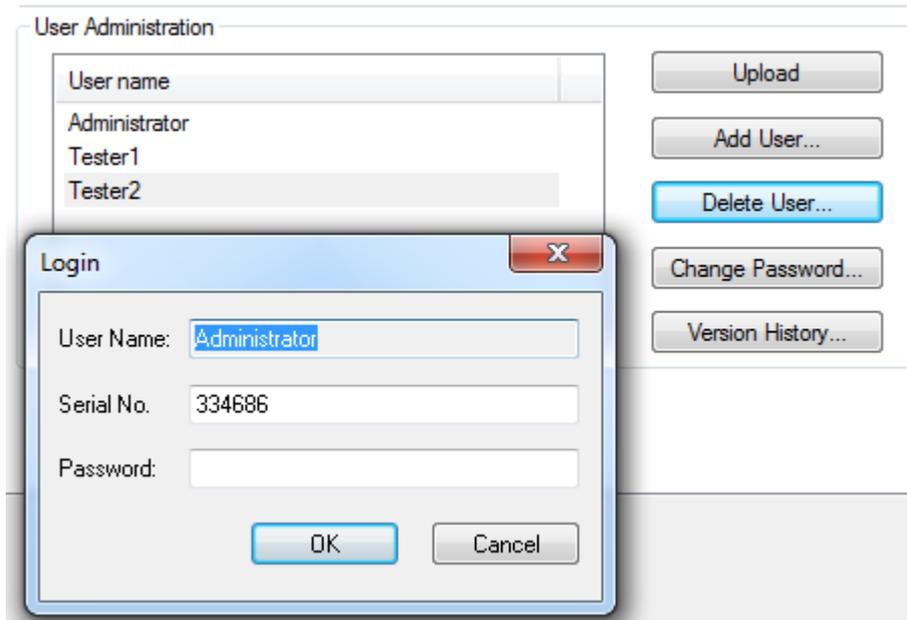


Fig. 36: User Administration - Delete User

After entering the correct serial number and the valid administrator password the selected user can be deleted via the button *OK*. The button *Cancel* finishes the procedure without changes.

To change the password of a user, the designed user has to be selected and via the button *Change Password...* the dialog *Change Password* will open.

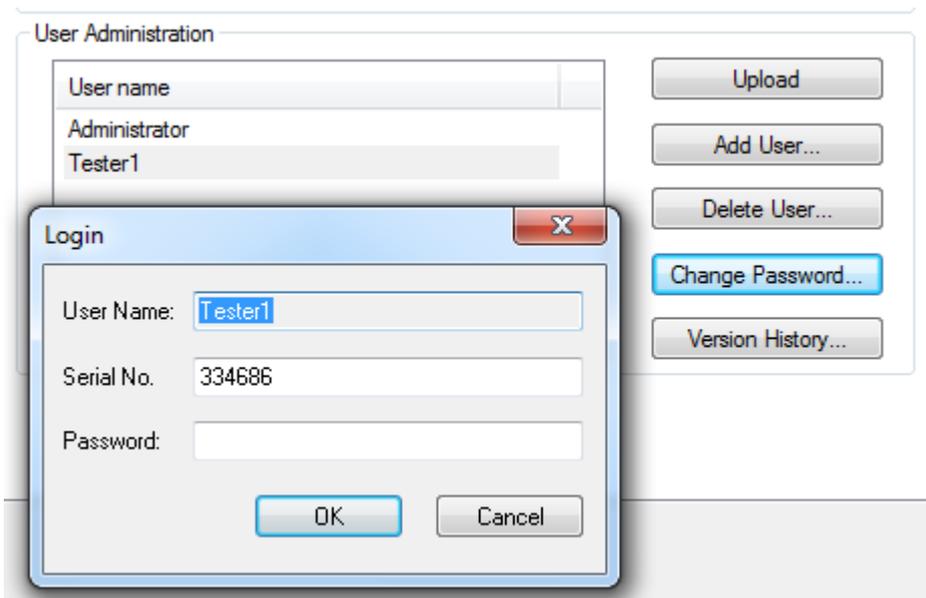


Fig. 37: User Administration - Login to change password

After entering the correct serial number and valid user password via the button *OK* the dialog *Change Password* will open.

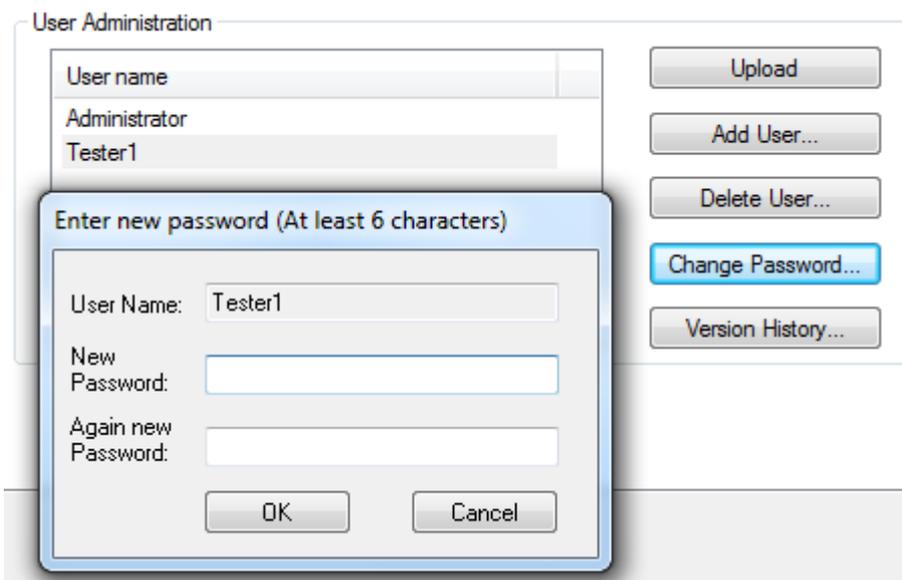


Fig. 38: User Administration - Change Password

Enter the new password twice. The new password has to be 6 characters long at minimum. Via the button *OK* the dialog will be left.

Clicking on the button *Version History* will bring up the version history for the EL6900 (which cannot be deleted) that indicates who activated what version of a project on the EL6900, and when.

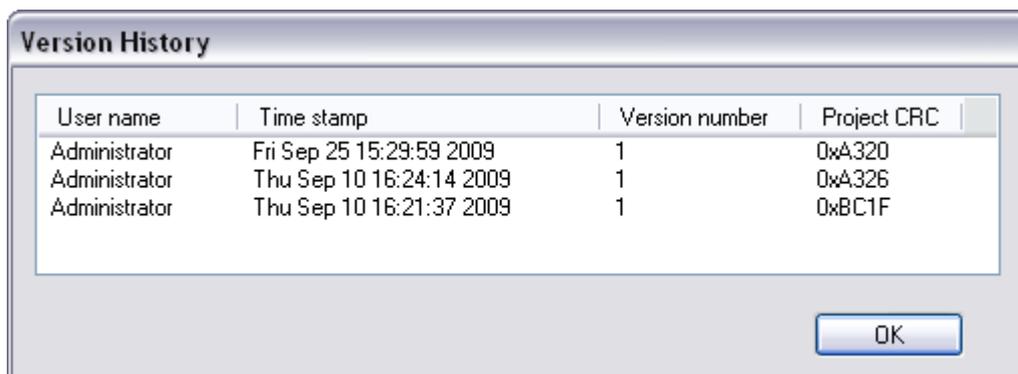


Fig. 39: Display of the version history

5.3.11 Export and import of a TwinSAFE project

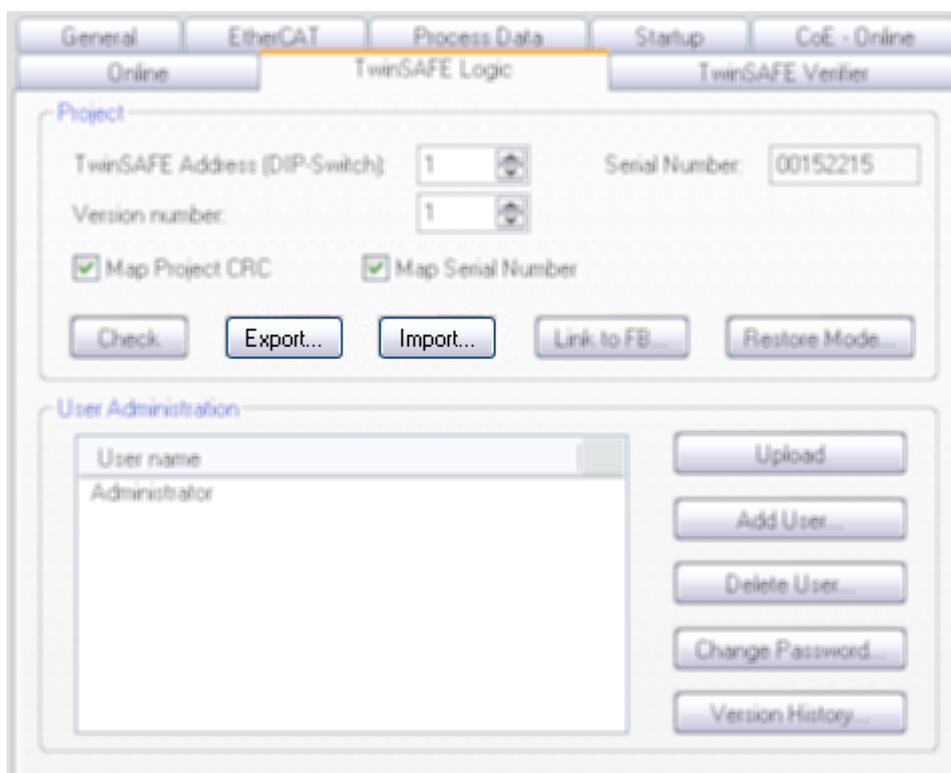


Fig. 40: Export and import of a TwinSAFE project

Using the *Export* button you can export a safety project from a TwinCAT installation in XML format and then import this XML file into another TwinCAT installation using the *Import* button. During the import TwinCAT attempts to restore the connections within the logic to the safe input and output terminals via the FSoE address. An error message is displayed if this is not possible.

5.3.12 EL6900 info data

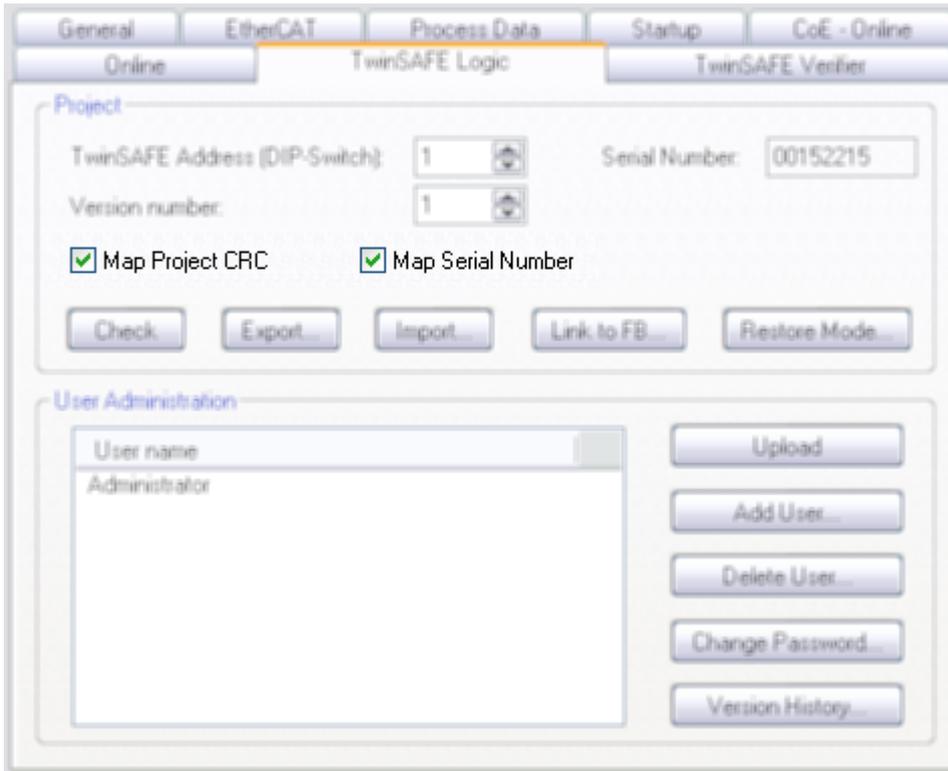


Fig. 41: EL6900 info data

Info data can be displayed in the cyclic process image via the checkboxes *Map Project CRC* and *Map Serial Number*. These info data show the current safety project CRC and the serial number of the EL6900 and can be used in a visualization, for example.

5.3.13 Loading the project into the EL6900

The project is loaded into the EL6900 via the fieldbus.

⚠ CAUTION

Use only qualified tools
 Only use a qualified tool for loading, verifying and enabling the project on the EL6900!

Click the *Download* button on the *TwinSAFE Verifier* tab for loading the project.

The user must enter

- his user name (default: Administrator),
- the terminal serial number (printed on the outside, e.g. 197535), and
- his password (default: TwinSAFE).

● User name and password are case-sensitive

i Pay attention to upper/lower case characters for the user name and password.

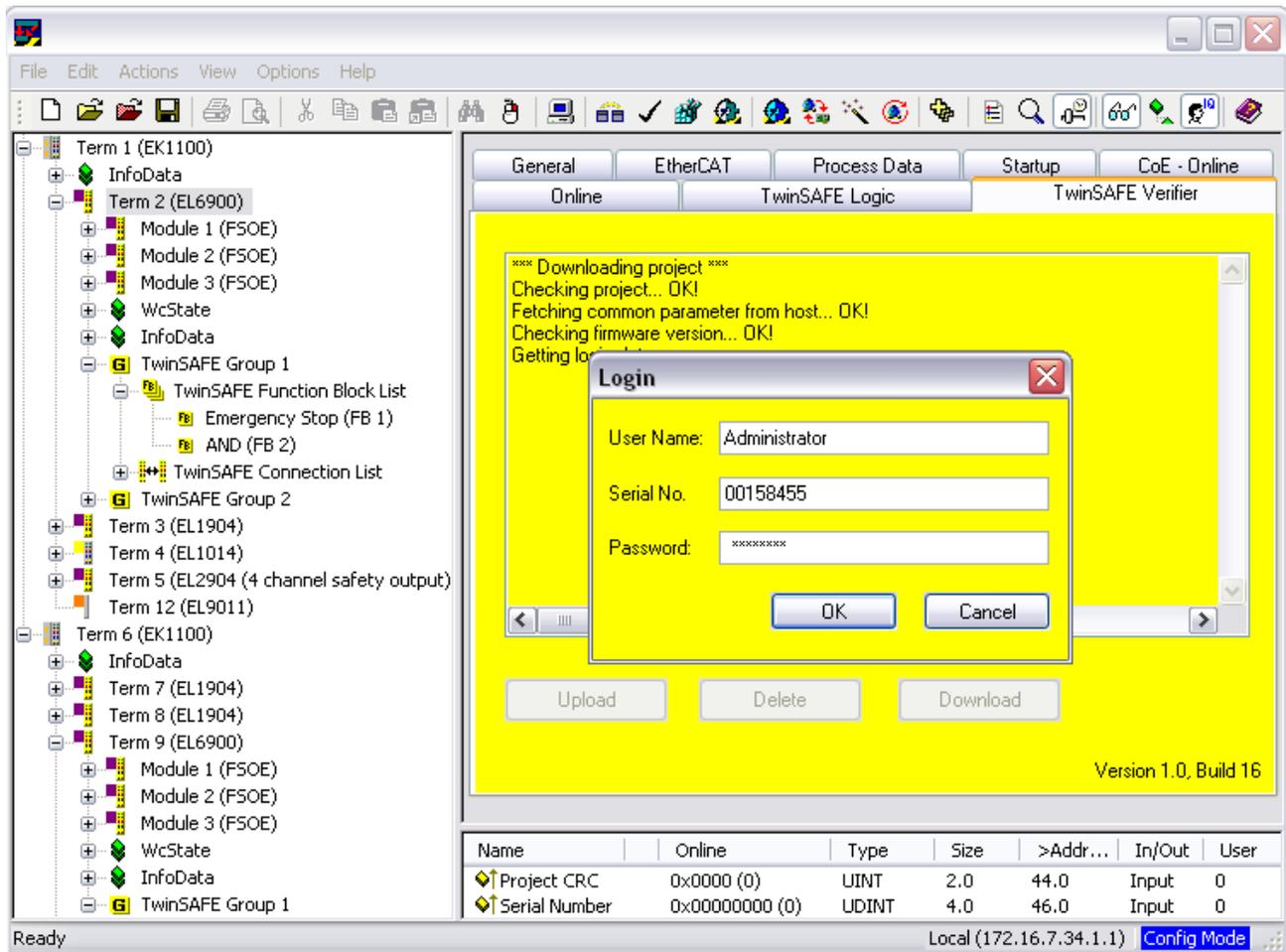


Fig. 42: Loading the project into the EL6900

The project is then displayed in text mode, and the user has to confirm consistency between the information displayed and the currently projected application by re-entering the password. The project is then started on the EL6900.

5.3.13.1 EL6900 project design limits

| | |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TwinSAFE connections | max. 128 (with 1 or 2 bytes safe user data per connection) max. 50 connections per TwinSAFE group Only 16 connections of an EL6900 can be slave connections. |
| Supported hardware for EL6900 TwinSAFE connections | EL1904 (all) EL2904 (all) EL2902 (all) KL1904 (from 2008) KL2904 (from 2008) KL6904 as slave (from 2008) AX5805 (all) |
| Safe data per connection | up to 14 bytes safe user data (correspondingly lower total number of connections) |
| TwinSAFE blocks | 255 max. |
| TwinSAFE groups | 32 max. |
| Standard PLC inputs | dynamic up to 255 bit |
| Standard PLC outputs | dynamic up to 255 bit |

i TwinSAFE connection

Only one TwinSAFE connection between two TwinSAFE terminals is possible. Between two EL6900 logic terminals a connection can be set up that may contain up to 14 bytes safe user data.

5.3.14 Communication between TwinCAT controllers

The MASTER_MESSAGE and SLAVE_MESSAGE data types are used for communication between two or more TwinCAT controllers via network variables.

Corresponding variables must be created on the communicating controllers under Publisher and Subscriber.

During TwinSAFE communication one side acts as the master, the other one as the slave.

This results in the following data types:

| | |
|----------------------------|----------------|
| TwinSAFE Master Publisher | MASTER_MESSAGE |
| TwinSAFE Master Subscriber | SLAVE_MESSAGE |
| TwinSAFE Slave Publisher | SLAVE_MESSAGE |
| TwinSAFE Slave Subscriber | MASTER_MESSAGE |

Linking to the TwinSAFE Logic terminal is done via the following dialog.

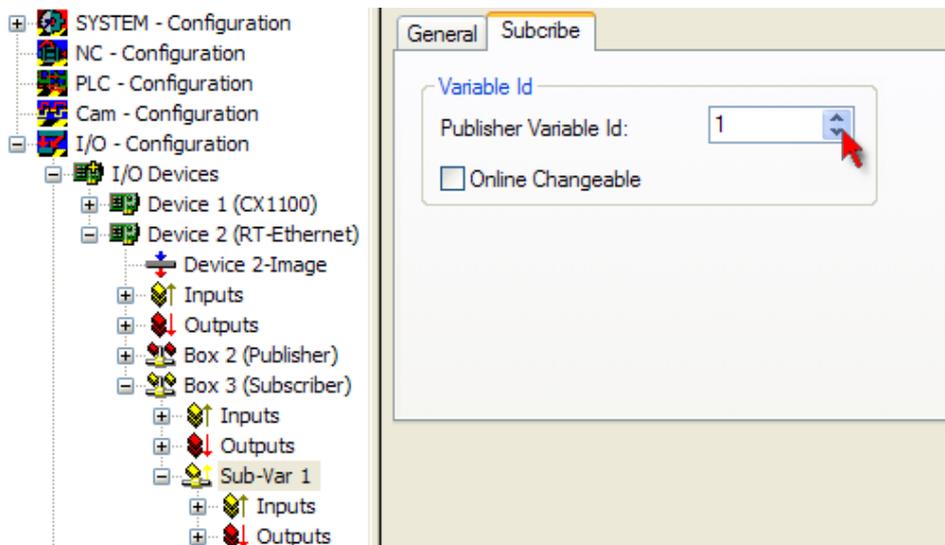


Fig. 43: Linking with the TwinSAFE Logic terminal

The connection created must now be made known to the TwinSAFE Logic terminal. This is done by marking the TwinSAFE Connection List and pressing the right mouse button.

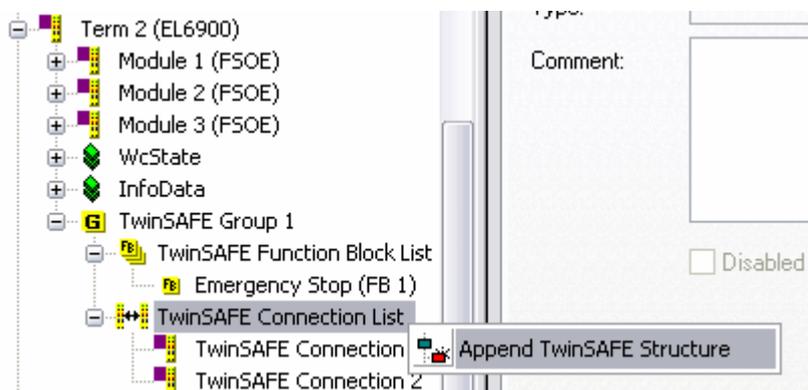


Fig. 44: Make known the connection created to the TwinSAFE Logic terminal

Create a new connection in the list of connections and create associated variables of the required type under Module1 (FSOE).

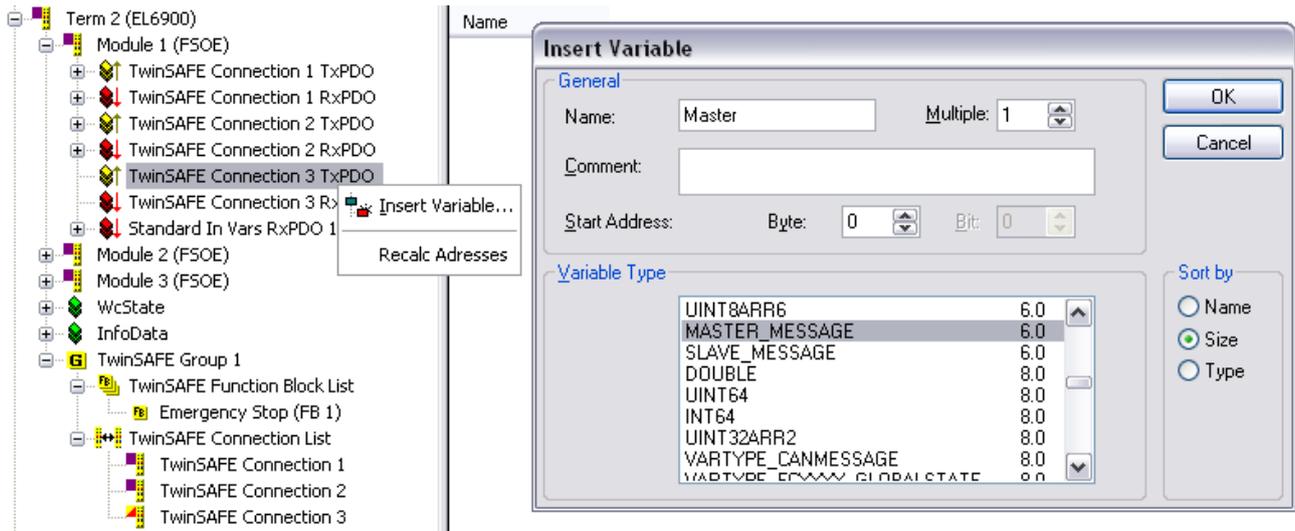


Fig. 45: Creation of a variable for the master message

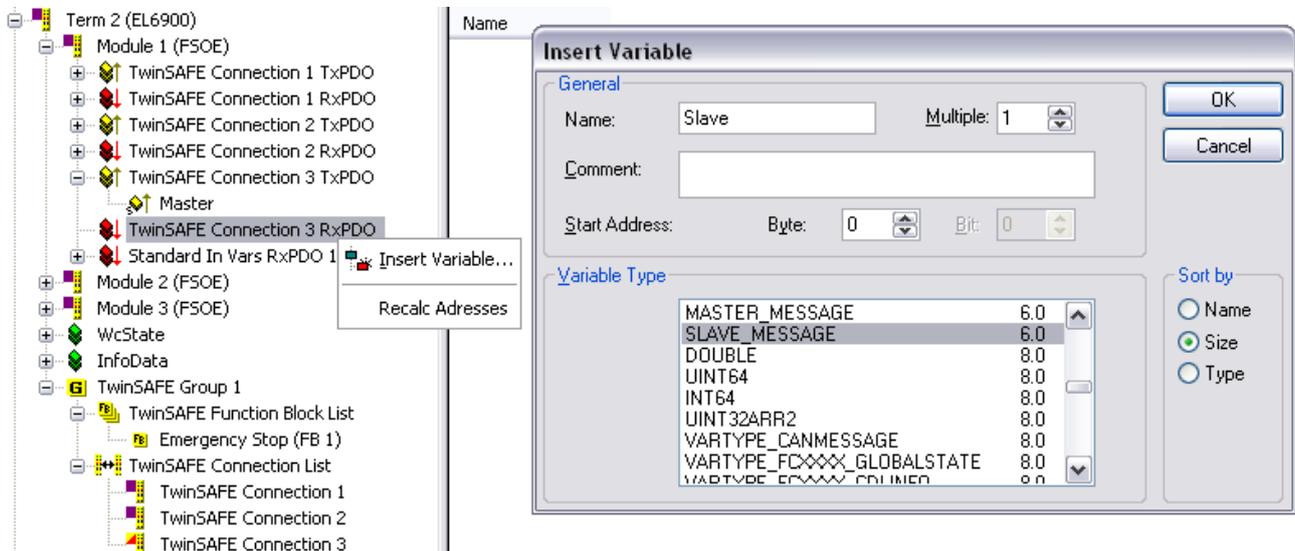


Fig. 46: Creation of a variable for the slave message

These new created variables are now linked to the already created network variables. This is carried out for both the master and the slave message.

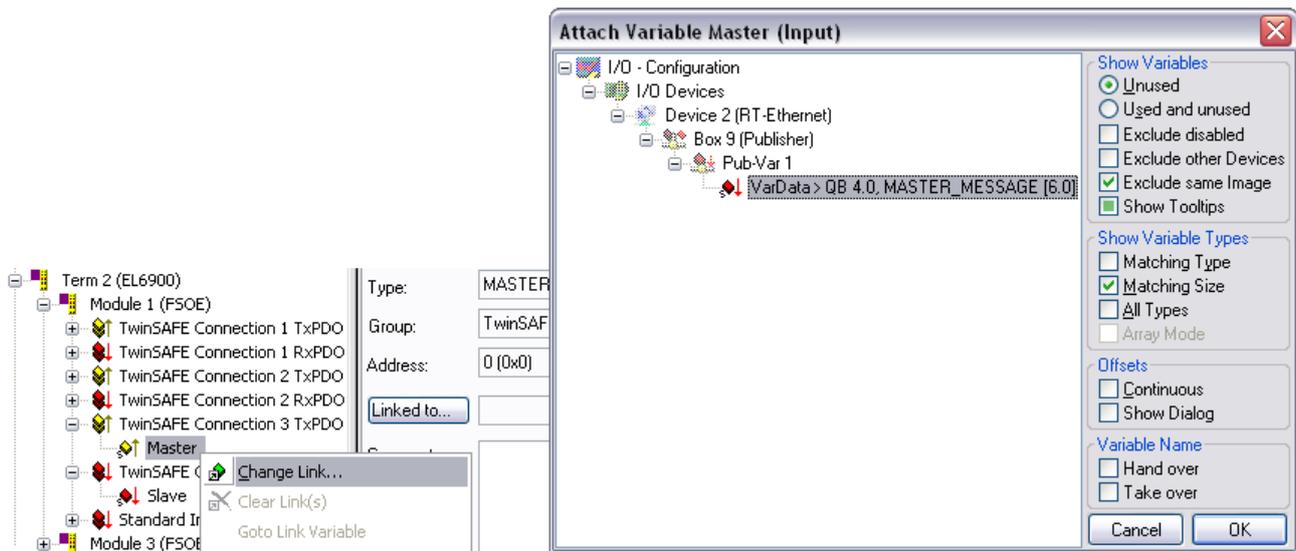


Fig. 47: Linking the variables

The settings for the TwinSAFE connection can then be set, including FSoE address, FSoE watchdog and the communication device type. In addition, the connection can be identified as FSoE master or FSoE slaves, and the information to be mapped in the cyclic process image can be specified.

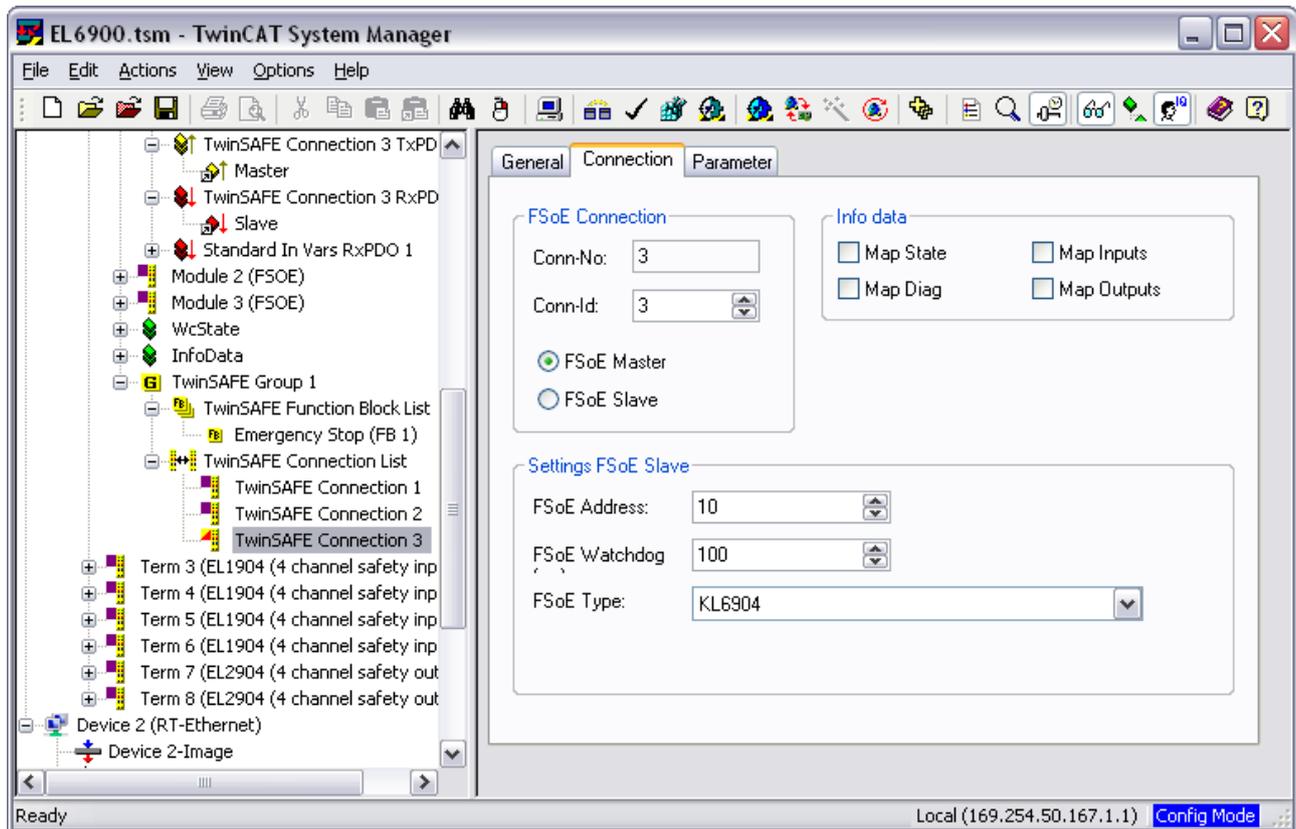


Fig. 48: Settings for the TwinSAFE connection

If several connections are to be established, a unique ID must be set for each Publisher variable.

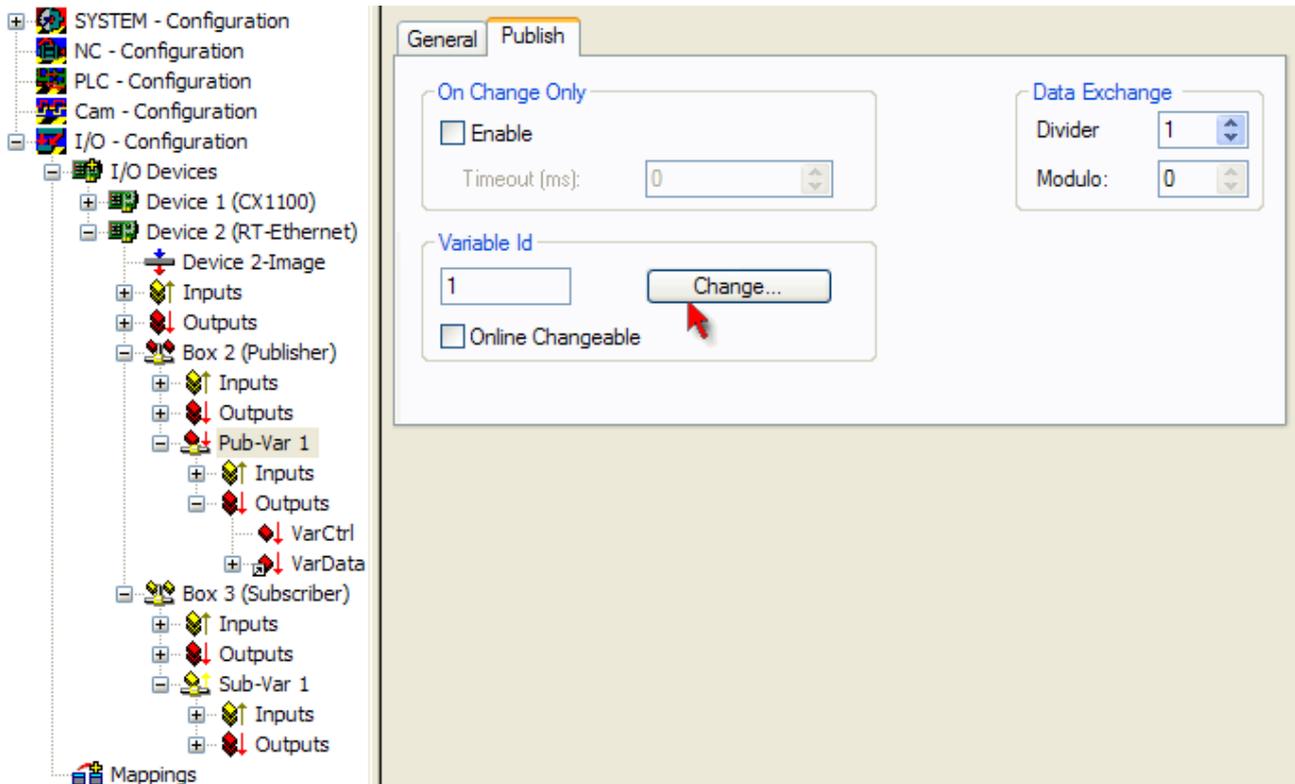


Fig. 49: Setting a unique ID

This ID must also be set on the partner device, i.e. the Subscriber.

The network variables can now be used in the project. The inputs are shown TwinSAFE Input, the outputs under TwinSAFE Output.

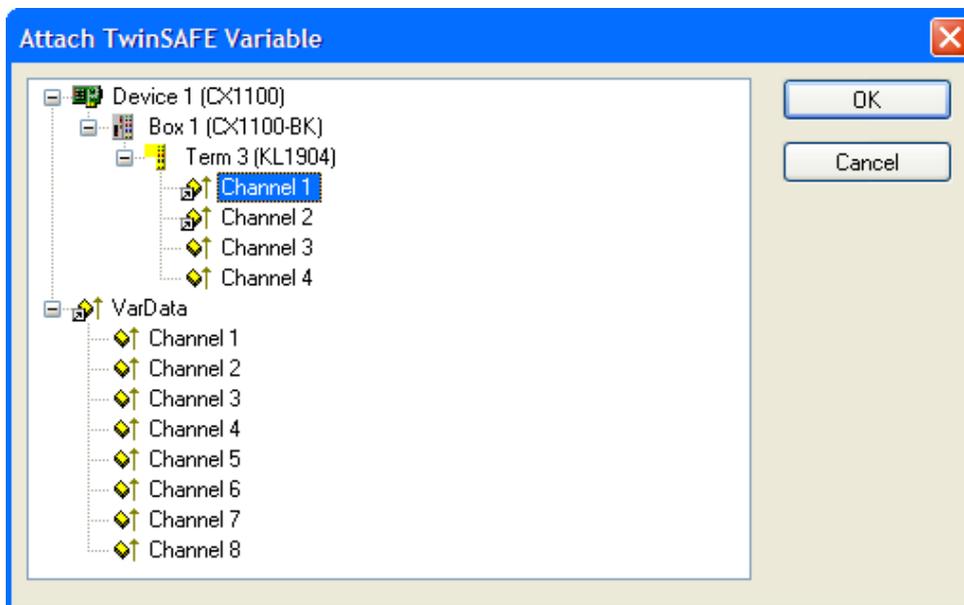


Fig. 50: Attach TwinSAFE variable for inputs

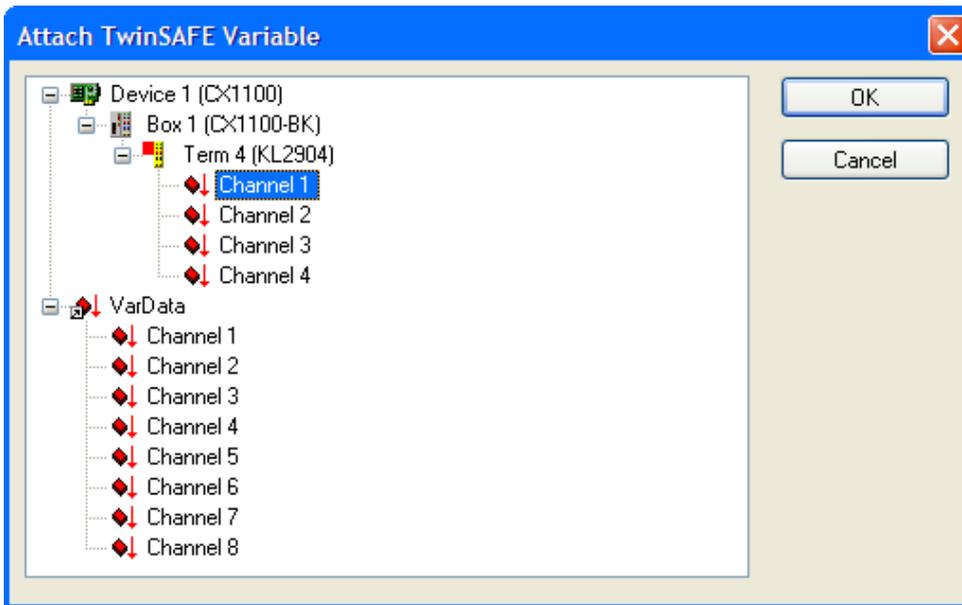


Fig. 51: Attach TwinSAFE variable for outputs

5.4 Diagnostics

5.4.1 Diagnostic LEDs

The LEDs Diag 1 to Diag 4 display diagnostic information for the EL6900.

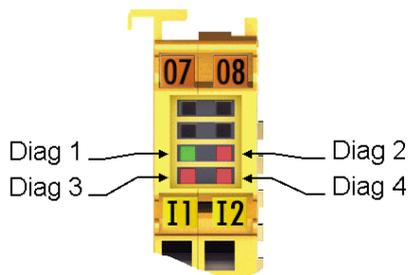


Fig. 52: EL6900 diagnostic LEDs

5.4.1.1 Diag 1 LED (green)

The Diag 1 LED is currently always on when a project is loaded into the terminal.

| Display | Meaning |
|---------|--------------------------------------|
| lit | A project is stored in the terminal. |

5.4.1.2 Diag 2 LED (red)

The Diag 2 LED indicates internal process variable errors (in preparation).

| Display | Meaning |
|---------|----------------|
| - | in preparation |

5.4.1.3 Diag 3 LED (red)

The Diag 3 LED provides further details for the Diag 4 LED (see below).

5.4.1.4 Diag 4 LED (red) if Diag 3 LED (red) is lit

If the Diag 3 LED is lit, the Diag 4 LED indicates internal terminal errors.

| Diag 3 LED | Diag 4 LED | Source of error |
|------------|------------|-----------------|
| lit | flashing | μC1 |
| lit | off | μC2 |

Returning the terminal

These errors lead to the shutdown of the terminal (global fault). The terminal must be checked by Beckhoff Automation GmbH & Co. KG.

5.4.1.5 Diag 4 LED (red) if Diag 3 LED (red) is not lit.

If the Diag 3 LED is not lit, the Diag 4 LED indicates the state of the TwinSAFE terminal.

| Diag 3 LED | Diag 4 LED: Flashing Code | Meaning |
|------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| off | 1 flash pulse (uniform flashing) | Function block error in one of the TwinSAFE groups |
| off | 2 flash pulses (2 pulses with longer pause in between) | Communication error in one of the TwinSAFE groups |
| off | 3 flash pulses (3 pulses with longer pause in between) | Function block and communication error in one of the TwinSAFE groups |
| off | Steadily lit | Supply voltage or internal temperature of the terminal outside the permissible range. The diagnostic object FA00hex provides you with more detailed information. |

5.4.2 Diagnostic object

CAUTION

Do not change CoE objects!

Do not make any modifications to the CoE objects in the TwinSAFE components! Any modifications (e.g. using TwinCAT) of the CoE objects will permanently set the TwinSAFE components to the Fail-Stop state.

Index FA80_{hex}: Internal temperature values

The CoE objects FA80_{hex} indicate the current internal temperature values of the EL6900.

| Index | Name | Meaning | Flags | Default |
|---------|--------------------------|---------------------------|-------|------------------|
| FA80:01 | Temperature Primary MC | Temperature measurement 1 | RO | 0 _{bin} |
| FA80:02 | Temperature Secondary MC | Temperature measurement 2 | RO | 0 _{bin} |

Index FA00_{hex}: Diagnostic object

The CoE object FA00_{hex} displays further diagnostic information.

| Index | Name | Meaning | Flags | Default |
|---------|-------------------|----------------------------------------------------------------------------------|-------|---------------------|
| FA00:0 | Diag | The following sub-indices contain detailed diagnostic information. | RO | |
| FA00:03 | Temperature error | 0005 _{hex} Maximum temperature exceeded | RO | 0000 _{hex} |
| | | 0006 _{hex} Temperature fell below minimum | | |
| | | 0007 _{hex} Temperature difference between the measuring points exceeded | | |
| | Supply error | 0101 _{hex} max. supply voltage μC1 exceeded | | |

| Index | Name | Meaning | Flags | Default |
|-------|------|---------------------------------------------------------------------|-------|---------|
| | | 0102 _{hex} max. supply voltage μ C2 exceeded | | |
| | | 0103 _{hex} voltage fell below min. supply voltage μ C1 | | |
| | | 0104 _{hex} voltage fell below min. supply voltage μ C2 | | |

i Differing diagnostic messages possible

Due to the variable order or execution of the test series, diagnostic messages differing from those given in the table above are possible.

Index F100_{hex}: Device Status

This CoE object is also mapped to the EL6900 process image under DEVICE Inputs.

| Index | Name | Meaning | Data type | Flags |
|---------|----------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------|-------|
| F100:01 | Safety Project State | State of the Safety Logic Project | BIT3 | RO |
| | | 0 OFFLINE Safety Project not loaded | | |
| | | 1 RUN Safety Project is executed, EtherCAT is in SAFEOP or OP state | | |
| | | 2 STOP Safety Project is loaded, but is stopped, due to a logged in user | | |
| | | 3 START Safety Project is loaded, EtherCAT is in INIT or PREOP state | | |
| | | 4 RESTORE When RESTORE Mode is configured: Project CRC is read from the FSoE Slaves | | |
| | | 7 FAULT The EL6900 has switched off due to a severe fault. A safety project can not be loaded or started. | | |
| F100:08 | Login Active | A user is logged in to the EL6900 | BOOLEAN | RO |
| F100:09 | Input Size Mismatch | The length of the input data does not match the input data length calculated from the safety Logic | BOOLEAN | RO |
| F100:0A | Output Size Mismatch | The length of the output data does not match the output data length calculated from the safety Logic | BOOLEAN | RO |
| F100:0F | TxPDO State | This bit is set, when the Safety Project State is unequal to RUN | BOOLEAN | RO |
| F100:10 | TxPDO Toggle | This bit is toggled each time the EtherCAT input data is updated for the first time after it has been read by the EtherCAT master. | BOOLEAN | RO |

5.4.3 Cycle time of the safety project

Index 1C32_{hex}: Cycle Time Measuring

| Index | Name | Meaning | Flags | Default |
|---------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-------------------------|
| 1C32:05 | Minimum cycle time | Minimum cycle time in ns that should be set by EtherCAT. Corresponds to the maximum program running time of the EL6900. | RO | 00000000 _{hex} |
| 1C32:08 | Command | Cycle time measurement is activated by setting the command to 0001 _{hex} . This value should be reset to 0 once the cycle time has been determined. | RW | 0000 _{hex} |

5.4.4 Status LEDs

The LEDs State 1 to State 4 indicate the current status of the EL6900.

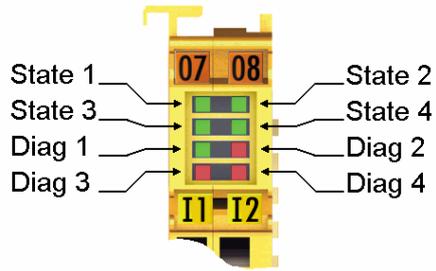


Fig. 53: EL6900 status LEDs

| State 1 | State 2 | State 3 | State 4 | Meaning |
|---------|---------|---------|---------|--------------------------------------------------------------------------------------------------------------------------------------|
| off | off | off | lit | <ul style="list-style-type: none"> No project present on the terminal |
| off | off | lit | lit | <ul style="list-style-type: none"> Project present on the terminal EtherCAT status: Pre-Operational (Pre-OP) |
| lit | lit | lit | lit | <ul style="list-style-type: none"> Project present on the terminal EtherCAT status: Operational (OP) |

6 Service life

The TwinSAFE terminals are designed for a service life of 20 years.

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

The TwinSAFE terminals bear a date code, which is composed as follows:

Date code: CW YY SW HW

Legend:

CW: Calendar week of manufacture

YY: Year of manufacture

SW: Software version

HW: Hardware version

Sample: Date Code 17 11 05 00

Calendar week: 17

Year: 2011

Software version: 05

Hardware version: 00

In addition the TwinSAFE terminals bear a unique serial number.

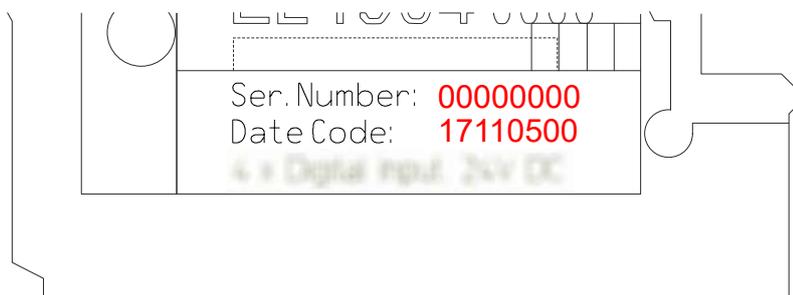


Fig. 54: Unique serial number of a TwinSAFE terminal

7 Maintenance and cleaning

● **Cleaning by the manufacturer only**

i Do not operate the TwinSAFE component if it is impermissibly dirty according to protection class IP20. Send impermissibly dirty TwinSAFE components to the manufacturer for cleaning.

TwinSAFE components are basically maintenance-free.

8 Decommissioning

8.1 Disposal

NOTICE

Correct disposal

Observe the applicable national laws and guidelines for disposal.
Incorrect disposal may result in environmental damage.

Remove the TwinSAFE component for disposal.

Depending on your application and the products used, make sure that the respective components are disposed of properly:

Cast iron and metal

Hand over cast iron and metal parts to scrap metal recycling.

Cardboard, wood and polystyrene

Dispose of packaging materials made of cardboard, wood or Styrofoam in accordance with regulations.

Plastic and hard plastic

You can recycle parts made of plastic and hard plastic via the waste management center or reuse them in accordance with the component regulations and markings.

Oils and lubricants

Dispose of oils and lubricants in separate containers. Hand over containers to the waste oil collection point.

Batteries and accumulators

Batteries and accumulators may also be marked with the crossed-out wheeled garbage can symbol. You must separate these components from waste. You are legally obliged to return used batteries and accumulators within the EU. Outside the validity of the EU Directive 2006/66/EC, observe the respective regulations.

8.1.1 Returning to the vendor

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

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

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

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

9 Appendix

9.1 Volatility

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

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

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

9.2 Focus of certificates

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

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

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

CERTIFICADO ◆ CERTIFICADO ◆ CERTIFICADO ◆ CERTIFICADO ◆ CERTIFICADO ◆



EC-Type Examination Certificate

No. M6A 062386 0055 Rev. 01

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

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

| | |
|-------------------------|-----------------|
| Test report no.: | BV99670C |
|-------------------------|-----------------|

◆ CERTИФИКАТ ◆ CERTИФИКАТ ◆ CERTИФИКАТ ◆ CERTИФИКАТ ◆



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

9.3 Certificate

| | | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------|
| <p>BECKHOFF New Automation Technology</p> | <p>Originalerklärung Original declaration</p> | | |
| <p>EG-Konformitätserklärung EC Declaration of Conformity</p> | | | |
| <p>Nummer: 2017043EL6900-3, Datum: 25.07.2023 <i>Number, Date</i></p> | | | |
| <p>Hersteller <i>Manufacturer</i></p> | <p>Beckhoff Automation GmbH & Co. KG Hülshorstweg 20, 33415 Verl, Germany</p> | | |
| <p>erklärt, dass das Produkt <i>declares that the product</i></p> | <p>TwinSAFE EL6900 TwinSAFE Logic <i>TwinSAFE logic</i></p> | | |
| <p>den Bestimmungen der folgenden EG-Richtlinien entspricht: <i>complies with the relevant requirements of the following EC directives:</i></p> | | | |
| <p>2006/42/EG <i>2006/42/EC</i></p> | <p>Richtlinie 2006/42/EG des Europäischen Parlaments und des Rates vom 17. Mai 2006 über Maschinen und zur Änderung der Richtlinie 95/16/EG (Neufassung) <i>Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)</i></p> | | |
| <p>2011/65/EU <i>2011/65/EU</i></p> | <p>Richtlinie 2011/65/EU des Europäischen Parlaments und des Rates vom 8. Juni 2011 zur Beschränkung der Verwendung bestimmter gefährlicher Stoffe in Elektro- und Elektronikgeräten <i>Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (recast)</i></p> | | |
| <p>2014/30/EU <i>2014/30/EU</i></p> | <p>Richtlinie 2014/30/EU des Europäischen Parlaments und des Rates vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit (Neufassung) <i>Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility (recast)</i></p> | | |
| <p>2014/34/EU <i>2014/34/EU</i></p> | <p>Richtlinie 2014/34/EU des Europäischen Parlaments und des Rates vom 26. Februar 2014 zur Harmonisierung der Rechtsvorschriften der Mitgliedstaaten für Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen (Neufassung) <i>Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (recast)</i></p> | | |
| <p>Die Konformität mit den Bestimmungen der genannten Richtlinien wird durch Einhaltung der folgenden Normen nachgewiesen: <i>The conformity with the listed directives is proved by compliance with the following standards:</i></p> | | | |
| <p>EN ISO 13849-1:2015 EN 62061:2005/A2:2015</p> | <p>EN IEC 63000:2018</p> | <p>EN 61000-6-2:2005 EN 61000-6-4:2007 EN 61131-2:2007</p> | <p>EN 60079-0:2018 EN 60079-15:2010</p> |
| <p>Die Übereinstimmung eines Baumusters des bezeichneten Produkts mit den EU-Richtlinien wurde bescheinigt von <i>The accordance of a production sample of the designated product with the EC directives is certified by</i></p> | | | |
| <p>Richtlinie <i>Directive</i></p> | <p>Benannte Stelle <i>Notified Body</i></p> | <p>Baumusterprüfbescheinigung <i>type examination certificate</i></p> | |
| <p>2006/42/EG <i>2006/42/EC</i></p> | <p>TÜV SÜD Product Service GmbH Ridlerstraße 65, 80339 München, Germany</p> | <p>M6A 062386 0093 Rev. 00 2023-06-16</p> | |
| <p>2014/34/EU <i>2014/34/EU</i></p> | <p>DEKRA Certification B.V. Meander 1051, 6825 MJ Arnhem, Netherlands</p> | <p>KEMA 10ATEX0075 X 2020-07-09</p> | |
| <p>Verantwortlich für die Zusammenstellung der technischen Unterlagen <i>Responsible for the compilation of technical documentation</i></p> | | | |
| <p>Bevollmächtigter <i>Authorised person</i></p> | <p>Beckhoff Automation GmbH & Co. KG Hülshorstweg 20, 33415 Verl, Germany</p> | | |
| <p>Verl, <u>27.7.2023</u></p> | <p></p> | | |
| <p>Ort / Datum <i>Place / Date</i></p> | <p>Dipl.-Phys. Hans Beckhoff, Geschäftsführer <i>Dipl.-Phys. Hans Beckhoff, CEO</i></p> | | |

Fig. 55: EL6900 EC declaration of conformity

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