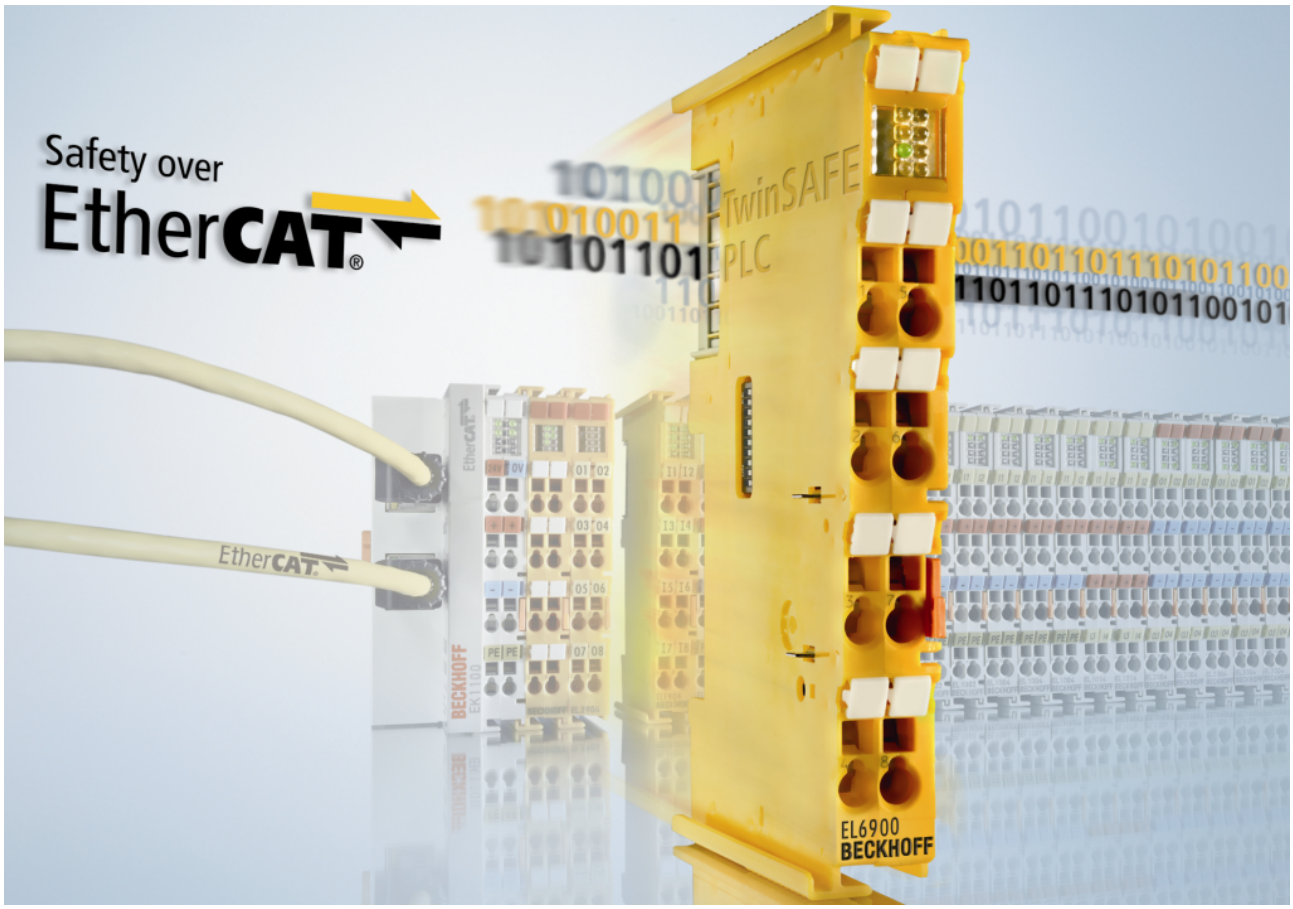

Operating Instructions for

EL6900

TwinSAFE Logic Terminal

Version: 2.2.0
Date: 2017-05-10

BECKHOFF

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1 Foreword

1.1 Notes on the documentation

Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

It is essential that the following notes and explanations are followed when installing and commissioning these components.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

Origin of the document

This documentation was originally written in German. All other languages are derived from the German original.

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.com/english/download/twinsafe.htm. In case of doubt, please contact Technical Support [▶ 58].

Product features

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

Disclaimer

The documentation has been prepared with care. The products described are subject to cyclical revision. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. We reserve the right to revise and change the documentation 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 this documentation.

Trademarks

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Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, DE102004044764, DE102007017835 with corresponding applications or registrations in various other countries.

The TwinCAT Technology is covered, including but not limited to the following patent applications and patents: EP0851348, US6167425 with corresponding applications or registrations in various other countries.

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

Delivery conditions

In addition, the general delivery conditions of the company Beckhoff Automation GmbH & Co. KG apply.

1.2 Safety instructions

1.2.1 Delivery state

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

- the TwinSAFE products are only used as intended (see chapter Product description);
- the TwinSAFE products are only operated in sound condition and in working order.
- the TwinSAFE products are operated only by suitably qualified and authorized personnel.
- the personnel is instructed regularly about relevant occupational safety and environmental protection aspects, and is familiar with the operating instructions and in particular the safety instructions contained herein.
- the operating instructions are in good condition and complete, and always available for reference at the location where the TwinSAFE products are used.
- none of the safety and warning notes attached to the TwinSAFE products are removed, and all notes remain legible.

1.2.3 Description of safety symbols

In these operating instructions the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!

 **DANGER**	**Serious risk of injury!** **Failure** to follow the safety instructions associated with this symbol directly endangers the life and health of persons.
 **WARNING**	**Risk of injury!** **Failure** to follow the safety instructions associated with this symbol endangers the life and health of persons.
 **CAUTION**	**Personal injuries!** **Failure** to follow the safety instructions associated with this symbol can lead to injuries to persons.
 **Attention**	**Damage to the environment or devices** **Failure** to follow the instructions associated with this symbol can lead to damage to the environment or equipment.
 **Note**	**Tip or pointer** This symbol indicates information that contributes to better understanding.

1.3 Documentation issue status

Version	Comment
2.2.0	• Description added for diagnostic object $F100_{hex}$
2.1.1	• Technical data *permissible air pressure* expanded
2.1.0	• Chapter *Address settings on TwinSAFE terminals with 1023 possible addresses* updated • Description of User Administration extended • Links in technical data corrected • TwinSAFE Loader added
2.0.0	• Migration and structural adaptation • Reliability document updated • Safety parameters updated • Foreword revised
1.5.2	• Reliability document updated • Reaction times added
1.5.1	• Certificate updated
1.5.0	• Company address amended • Safety parameters extended
1.4.0	• Extended temperature range added • Notes regarding temperature measurement and EMC added • Description of date code extended
1.3.1	• Document origin added
1.3.0	• Notes regarding system limits amended
1.2.1	• Reference to EN 60068-2-29 removed
1.2.0	• ATEX notes amended • Installation position and minimum distances extended • Notes regarding overvoltage protection amended • Diagnostics for CoE object 0xFA00 described
1.1.0	• Minor amendments for EtherCAT • Copyright and disclaimer modified • Support and service addresses updated
1.0.0	• First released version

2 System description

2.1 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.

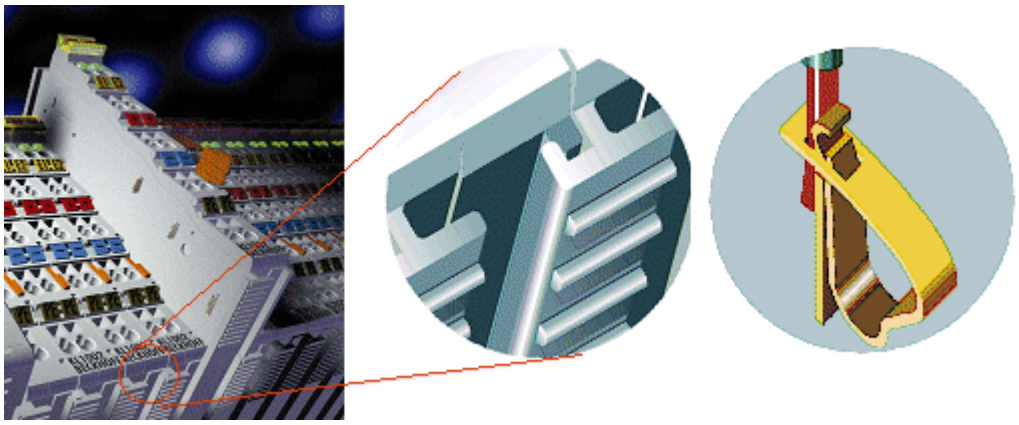

Fig. 1: Slot and key system and screwless (spring-loaded) connection system.

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).

2.1.1 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

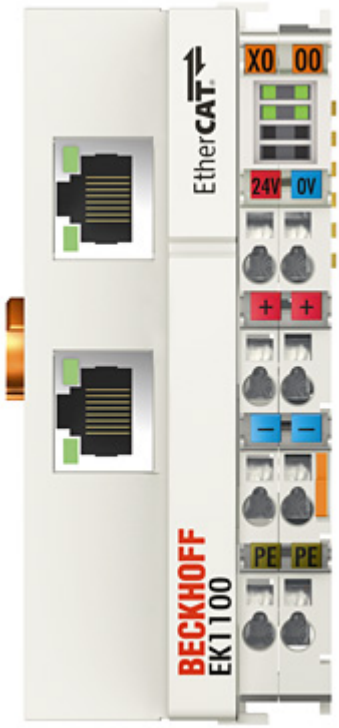

Fig. 2: Bus Coupler (EtherCAT)

Connection technology	Bus Coupler
Wiring	spring-loaded system
Connection cross-section	0.08 mm² ... 2.5 mm², stranded wire, solid wire
Fieldbus connection	depending on fieldbus
Power contacts	3 spring contacts
Current load	10 A
Rated voltage	24 V_{DC}

2.1.2 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

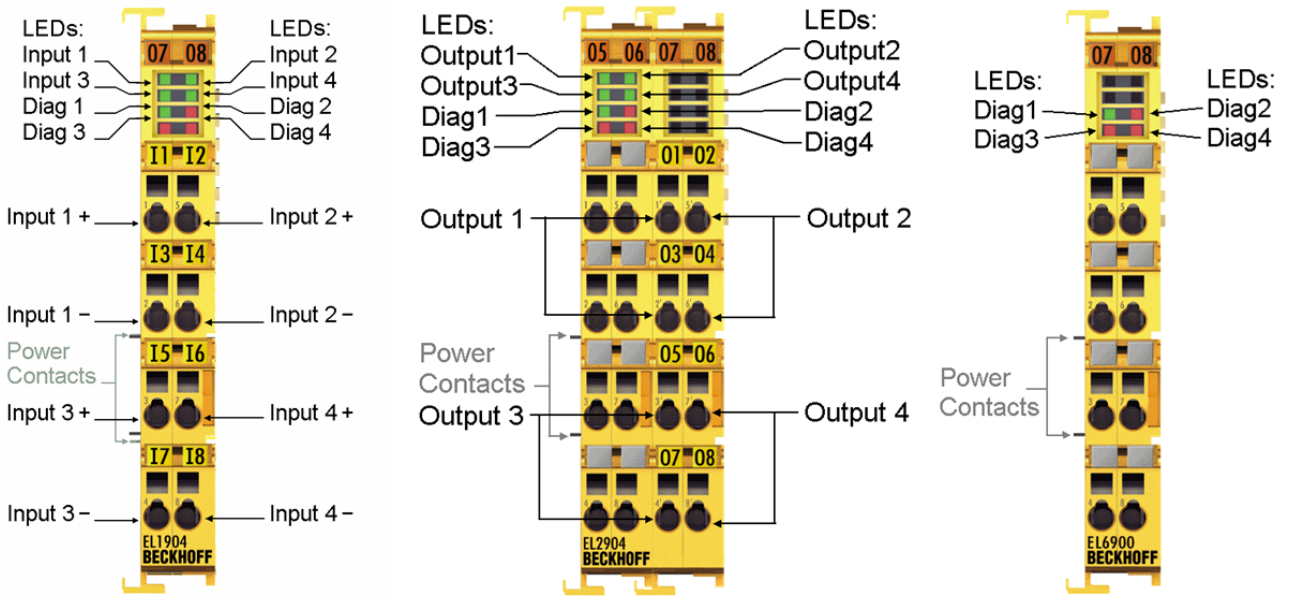

Fig. 3: TwinSAFE Terminals (EtherCAT)

Connection technology	Bus Terminal
Wiring	spring-loaded system
Connection cross-section	0.08 mm² ... 2.5 mm², 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

2.1.3 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.

2.1.4 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.

2.2 TwinSAFE

2.2.1 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.

2.2.2 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 13849-1:2006 (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 floating contacts
- EL2904 with four safe channels for actuators (24 VDC, 0.5 A per channel)
- Conforming to IEC 61508:2010 SIL 3 and DIN EN ISO 13849-1:2006 (Cat 4, PL e) requirements.

2.2.3 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.

2.2.4 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, EN 954 Cat. 4 and DIN EN ISO 13849-1:2006 (Cat 4, PL e).

2.2.5 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.

3 Product description

3.1 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.

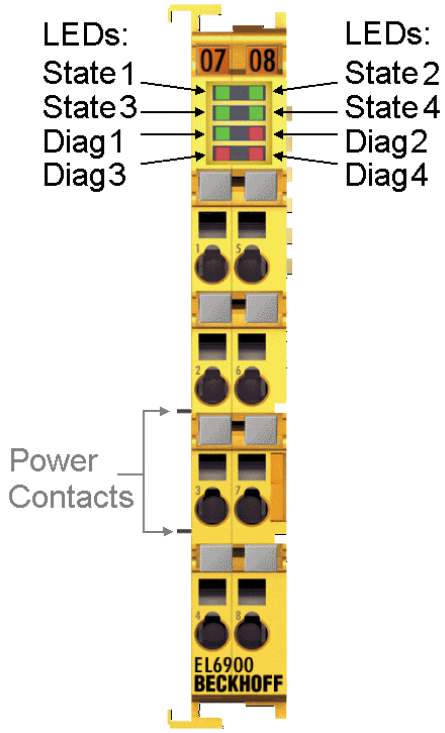

Fig. 4: EL6900 - TwinSAFE logic terminal

3.2 Intended use

WARNING	**Caution - Risk of injury!** TwinSAFE components may 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.

Note	**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 may 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.

3.3 Technical data

Product designation	EL6900
Number of inputs	0
Number of outputs	0
Status display	4 diagnostic LEDs
Minimum cycle time	approx. 500 µs
Error 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%)
Current consumption via E-bus	approx. 188 mA
Power dissipation of the terminal	typically 1 W
Dimensions (W x H x D)	12mm x 100mm x 68mm
Weight	approx. 50 g
Permissible ambient temperature (operation) up to SW 04	0°C to +55°C (see notes in section Example configuration for temperature measurement [▶ 21])
Permissible ambient temperature (operation) from SW 05 (week 02/2014)	-25°C to +55°C (see notes in section Example configuration for temperature measurement [▶ 21])
Permissible ambient temperature (transport/storage)	-40°C to +70°C
Permissible air humidity	5% to 95%, non-condensing
Permissible air pressure (operation/storage/ transport)	750 hPa to 1100 hPa (this corresponds to a height of approx. -690 m to 2450 m over sea level assuming an international standard atmosphere)
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 Maintenance [▶ 56])
Impermissible operating conditions	TwinSAFE terminals 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 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
Protection class	IP20
Permitted operating environment	In the control cabinet or terminal box, with minimum protection class IP54 according to IEC 60529
Permissible installation position	see chapter Installation position and minimum distances [▶ 20]
Approvals	CE, cULus, ATEX, TÜV SÜD

3.4 Safety parameters

Key figures	EL6900
Lifetime [a]	20
Prooftest 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.

3.5 Dimensions

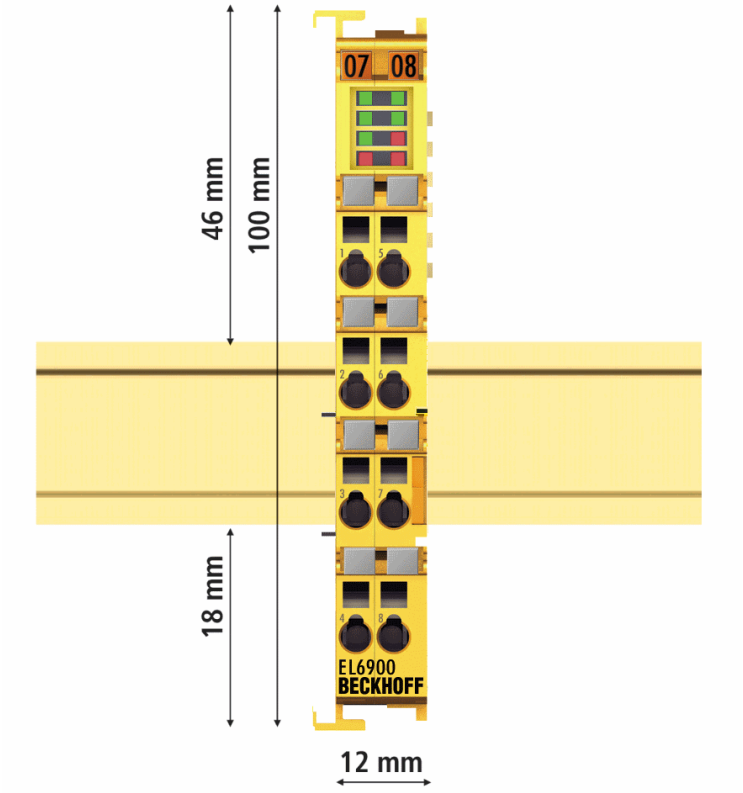

Fig. 5: Dimensions of the EL6900

Width: 12 mm (side-by-side installation)
Height: 100 mm
Depth: 68 mm

4 Operation

4.1 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

 Attention	**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.

4.2 Installation

4.2.1 Safety instructions

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

4.2.2 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).

4.2.3 Mechanical installation

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

4.2.3.1 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.

4.2.3.2 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.

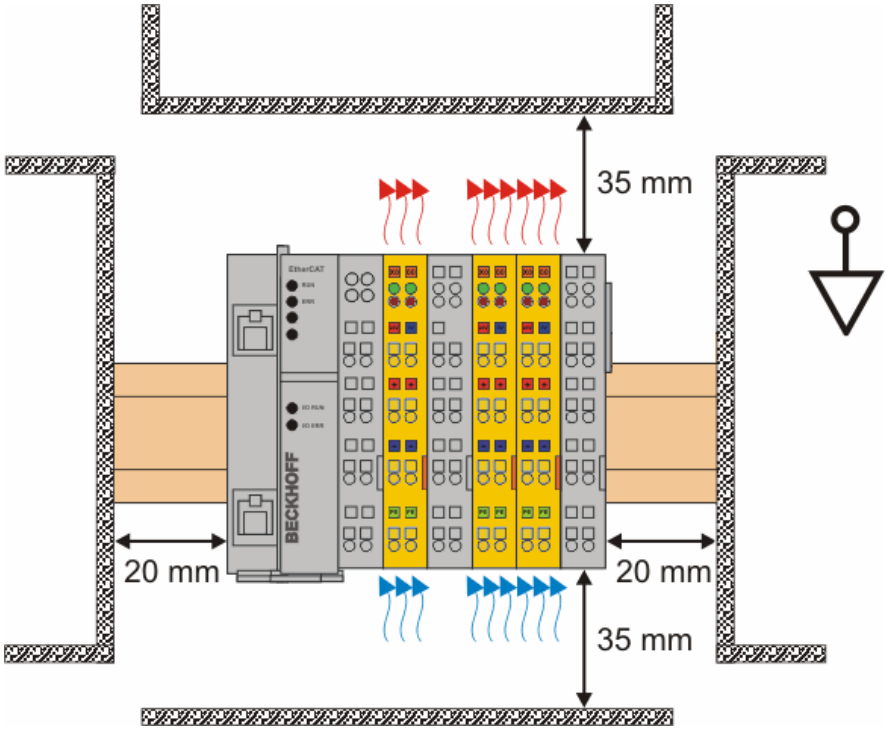

Fig. 6: Installation position and minimum distances

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.

4.2.3.3 Example configuration for temperature measurement

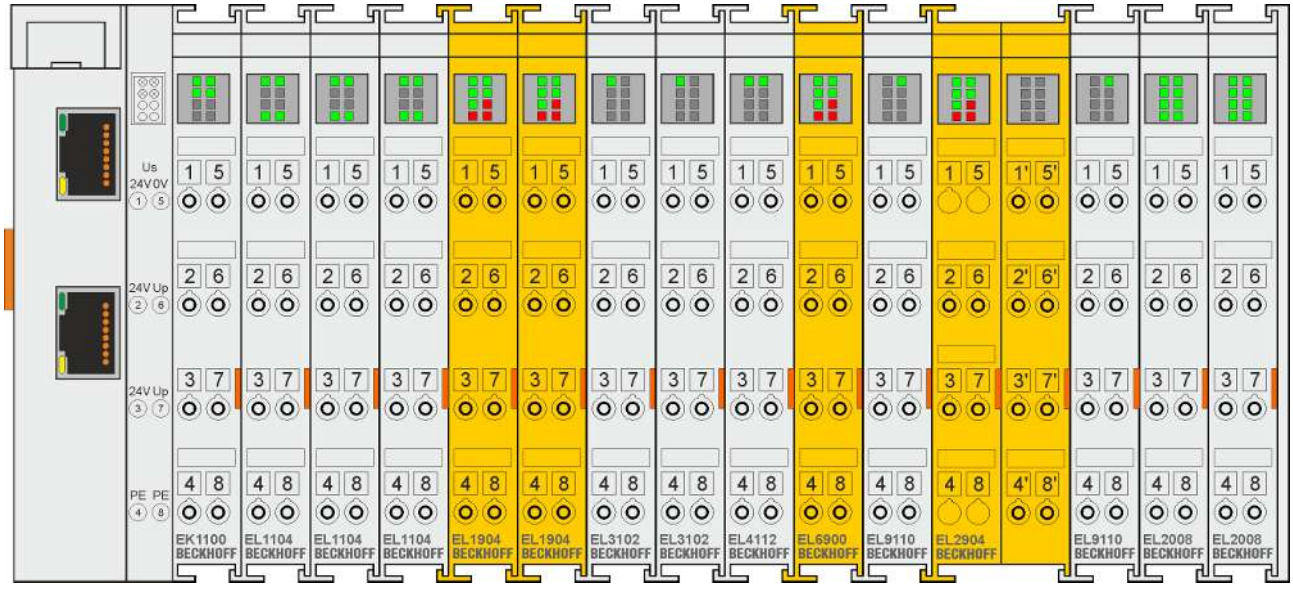

Fig. 7: Example configuration for temperature measurement

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.

Note	**External heat sources / radiant heat / impaired convection** 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).

4.2.3.4 Installation on mounting rails

Mounting

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

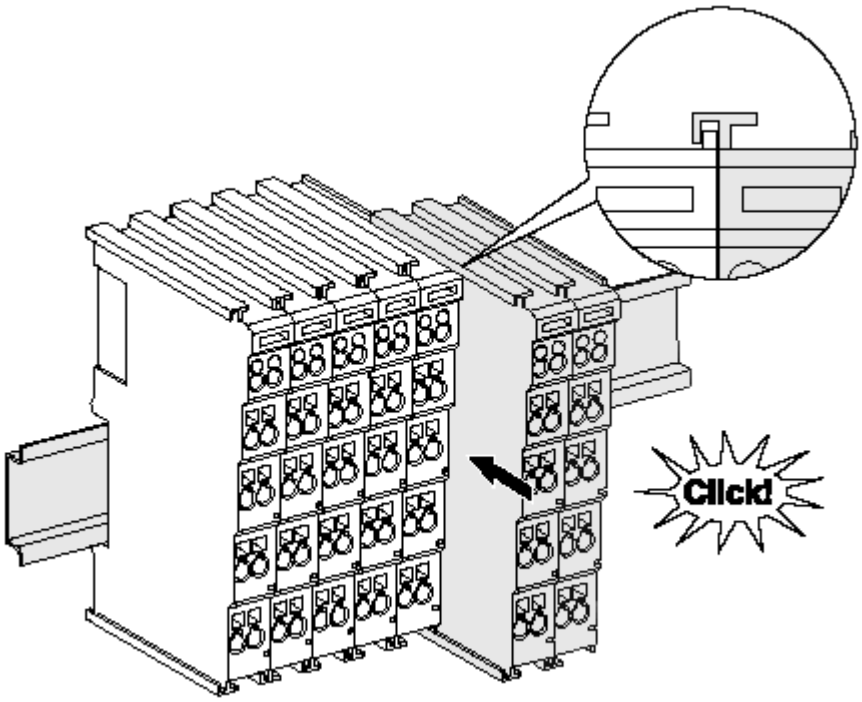

Fig. 8: Installation on the mounting rail

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.

Note	**Fastening of mounting rails** 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.

Removal

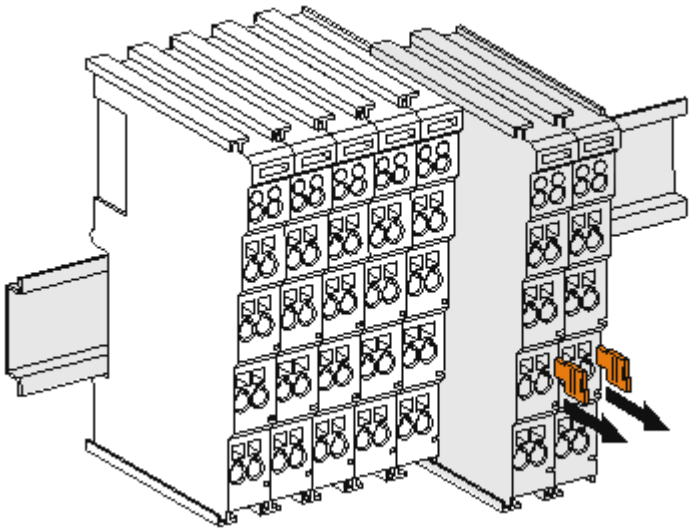

Fig. 9: Removal of mounting rails

1. Carefully pull the orange-colored lugs approximately 1 cm out of the disassembled terminal, until they protrude loosely. The lock with the mounting rail is now released for this terminal, and the terminal can be pulled from the mounting rail without excessive force.
2. Grasp the released terminal with thumb and index finger simultaneous at the upper and lower grooved housing surfaces and pull the terminal away from the mounting rail.

4.2.4 Electrical installation

4.2.4.1 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.

Note	**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	**Note the connection of the power contacts** 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. Power Feed 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.

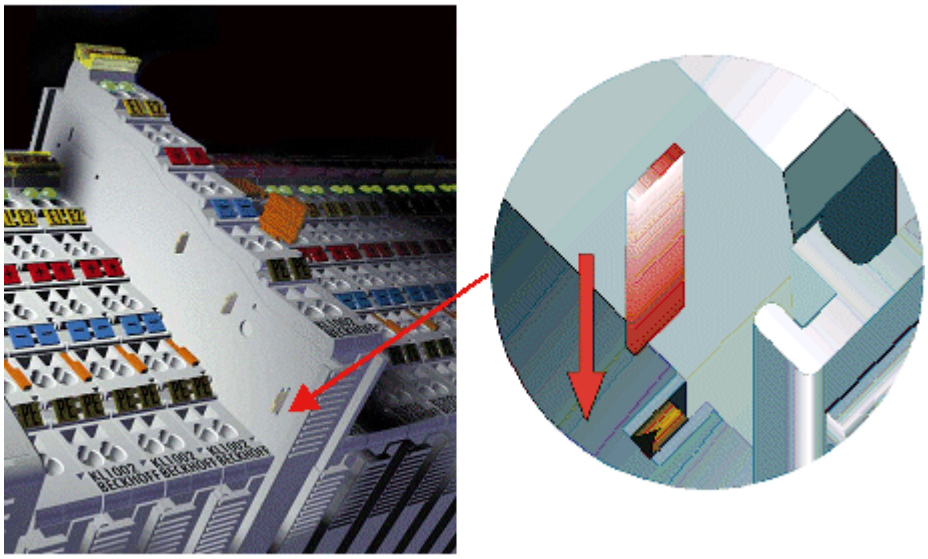

Fig. 10: PE power contact

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 Power Feed 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!

4.2.4.2 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.

4.2.4.3 Wiring

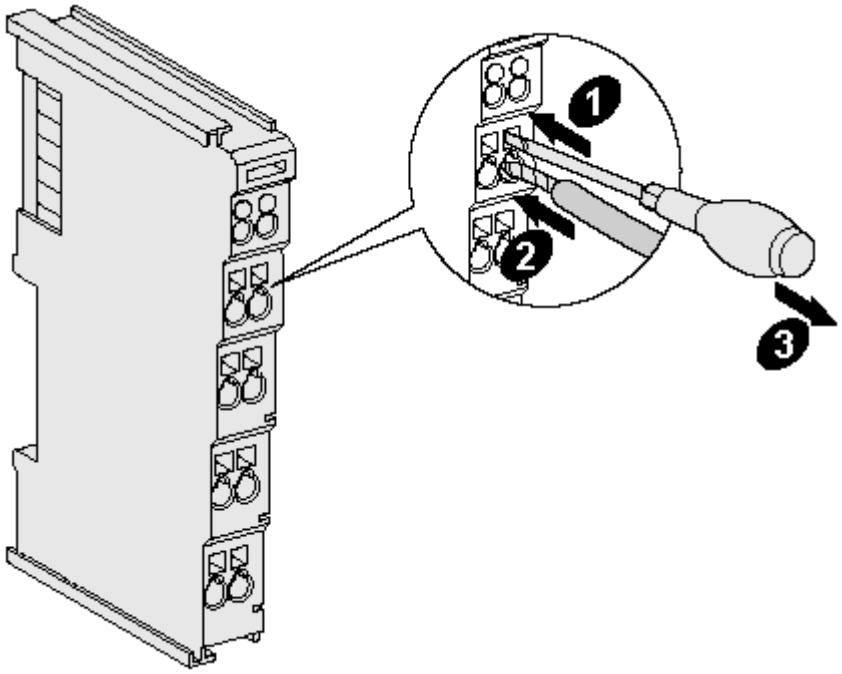

Fig. 11: Connection of a cable to a terminal point

Up to eight connections enable the connection of solid or finely stranded cables to the Bus Terminals. The connections are implemented in spring-loaded technology. Connect the cables as follows:

1. Open a spring-loaded terminal by slightly pushing with a screwdriver or a rod into the square opening above the terminal.
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.

Wire cross section	0,08 ... 2.5 mm^2
Strip length	8 ... 9 mm

4.2.4.4 EL6900/EL6910 pin assignment

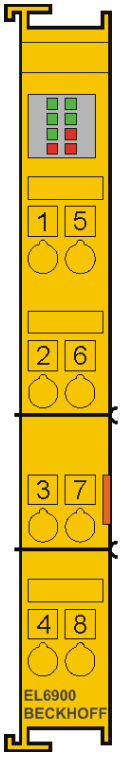

Fig. 12: EL6900/EL6910 pin assignment

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

4.2.5 TwinSAFE reaction times

The TwinSAFE terminals form a modular safety system that exchanges safety-oriented data via the Safety-over-EtherCAT protocol. This chapter is intended to help you determine the system's reaction time from the change of signal at the sensor to the reaction at the actuator.

Typical reaction 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.

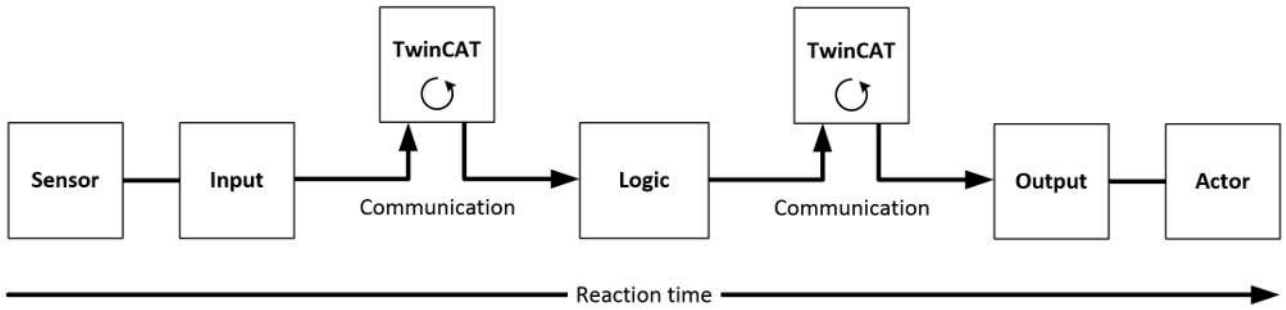

Fig. 13: Typical reaction time

Definition	Description
RTSensor	Reaction time of the sensor until the signal is provided at the interface. Typically supplied by the sensor manufacturer.
RTInput	Reaction time of the safe input, such as EL1904 or EP1908. This time can be found in the technical data. In the case of the EL1904 it is 4 ms.
RTComm	Reaction time of the communication This is typically 3x the EtherCAT cycle time, because new data can only be sent in a new Safety-over-EtherCAT telegram. These times depend directly on the higher-level standard controller (cycle time of the PLC/NC).
RTLogic	Reaction 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 EL6900, depending on the size of the safety project. The actual cycle time can be read from the terminal.
RTOutput	Reaction time of the output terminal. This typically lies within the range of 2 to 3 ms.
RTActor	Reaction time of the actuator. This information is typically supplied by the actuator manufacturer
WDComm	Watchdog time of the communication

This results in the following equation for the typical reaction time:

$$ReactionTime_{typ} = RT_{Sensor} + RT_{Input} + 3 * RT_{Comm} + RT_{Logic} + 3 * RT_{Comm} + RT_{output} + RT_{Actor}$$

with, for example

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

Worst-case reaction time

The worst case reaction time is the maximum time required to switch off the actuator in the case of an error.

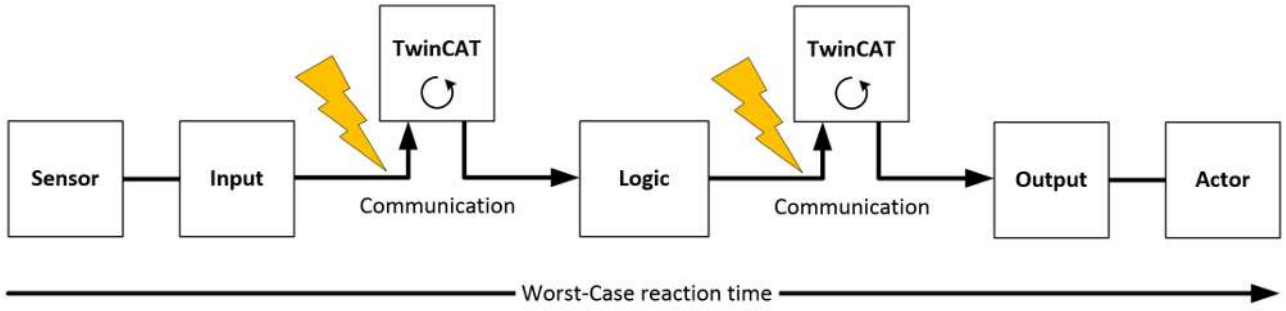

Fig. 14: Worst-case reaction time

This assumes that a signal change occurs at the sensor and is transmitted to the input. A communication error occurs at precisely the moment when the signal is to be transferred to the communication interface. This is detected by the logic following the watchdog time of the communication link. This information should then be transferred to the output, but a further communication error occurs here. This error is detected at the output following the expiry of the watchdog time and leads to the switch-off.

This results in the following equation for the worst-case reaction:

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

with, for example

$$ReactionTime_{max} = 2 * 15ms + 20ms = 50ms$$

4.2.6 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.

4.2.7 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	Contactor
Telemecanique	LP1K09	Contactor

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

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

4.3 Operation in potentially explosive atmospheres (ATEX)

4.3.1 Special conditions

WARNING	**Observe the special conditions for the intended use of Beckhoff fieldbus components in potentially explosive areas (directive 94/9/EU)!** The certified components are to be installed in a suitable housing that guarantees a protection class of at least IP54 in accordance with EN 60529! The environmental conditions during use are thereby to be taken into account! If the temperatures during rated operation are higher than 70 °C at the feed-in points of cables, lines or pipes, or higher than 80°C at the wire branching points, then cables must be selected whose temperature data correspond to the actual measured temperature values! Observe the permissible ambient temperature range of 0 to 55 °C when using Beckhoff fieldbus components in potentially explosive atmospheres! Measures must be taken to protect against the rated operating voltage being exceeded by more than 40% due to short-term interference voltages! The individual terminals may only be unplugged or removed from the Bus Terminal system if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! The connections of the certified components may only be connected or disconnected if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! The fuses of the EL92xx power feed terminals may only be exchanged if the supply voltage has been switched off or if a non-explosive atmosphere is ensured! Address selectors and ID switches may only be adjusted if the supply voltage has been switched off or if a non-explosive atmosphere is ensured!

The fundamental health and safety requirements are fulfilled by compliance with the following standards:

- EN 60079-0: 2006
- EN 60079-15: 2005

4.3.2 Identification

Beckhoff fieldbus components that are certified for use in potentially explosive atmospheres bear one of the following markings:

II 3 G Ex nA II T4 KEMA 10ATEX0075 X Ta: 0 - 55°C

or

II 3 G Ex nA nC IIC T4 KEMA 10ATEX0075 X Ta: 0 - 55°C

4.3.3 Date code and serial number

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

Date code: CW YY SW HW

Legend:	Sample: Date code 29 10 02 01
CW: Calendar week of manufacture	Calendar week: 29
YY: Year of manufacture	Year: 2010
SW: Software version	Software version: 02
HW: Hardware version	Hardware version: 01

In addition the TwinSAFE terminals bear a unique serial number.

4.3.4 Further ATEX documentation

Note	**Please also refer to the further documentation** Notes regarding application of the Bus Terminal system in areas potentially explosive atmosphere are available in the Download section of the Beckhoff website at http://www.beckhoff.de.

4.4 Configuration of the terminal in TwinCAT

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!

4.4.1 Configuration requirements

Version 2.11 build 1544 or higher of the TwinCAT automation software is required for configuring the EL6900. The current version is available for download from the Beckhoff website (www.beckhoff.de).

4.4.2 Inserting a Bus Coupler

See TwinCAT automation software documentation.

4.4.3 Inserting a Bus Terminal

See TwinCAT automation software documentation.

4.4.4 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.

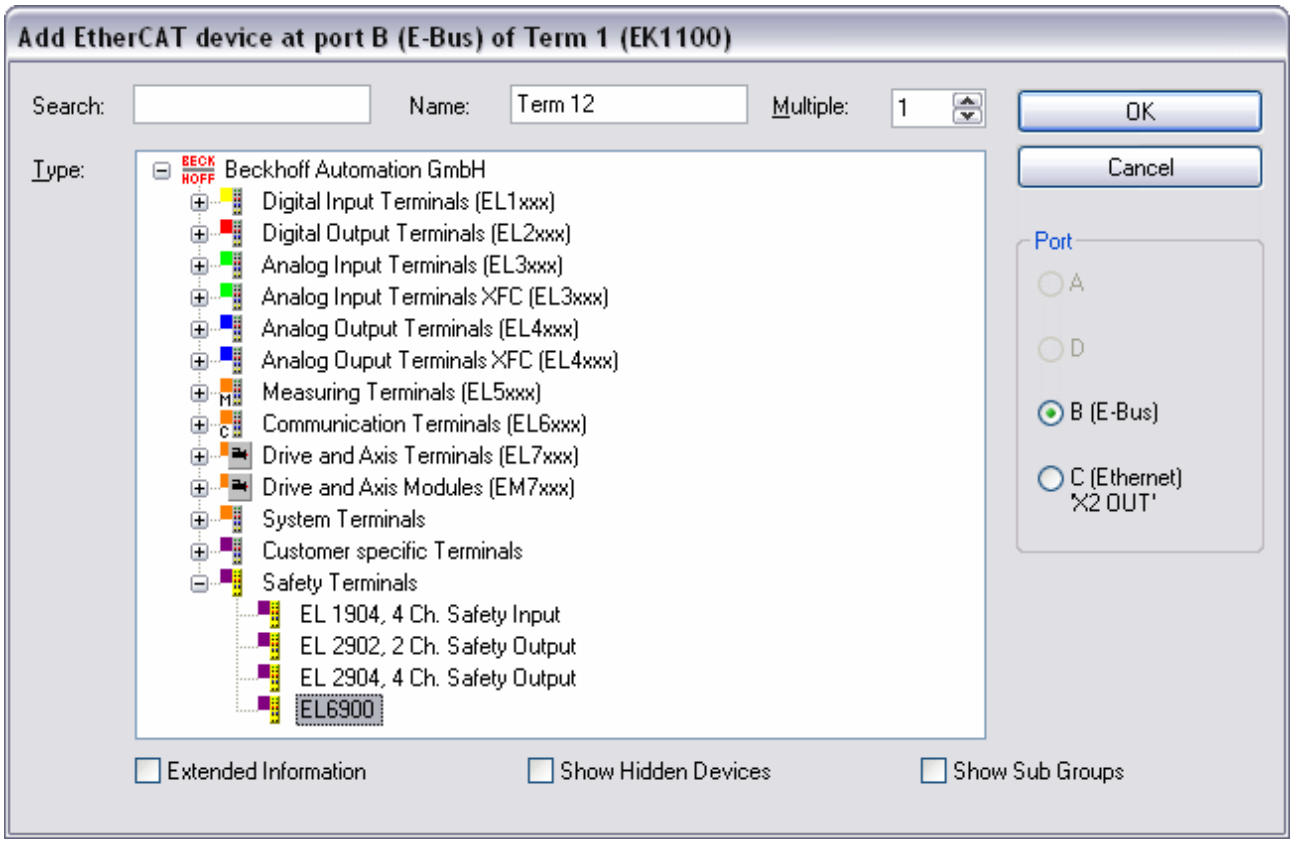

Fig. 15: Inserting an EL6900

Note	**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.

4.4.5 Address settings on TwinSAFE terminals with 1023 possible addresses

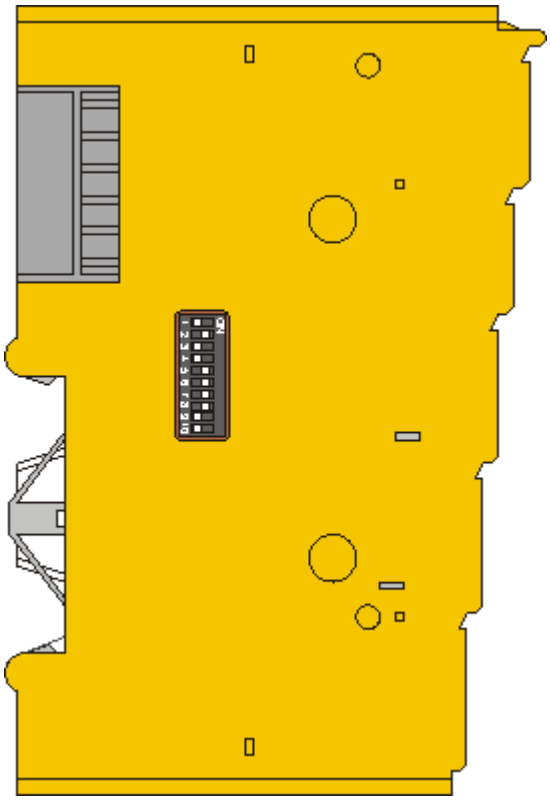

Fig. 16: Address settings on TwinSAFE terminals with 1023 possible addresses

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	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	2
ON	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	3
OFF	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	4
ON	OFF	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	5
OFF	**ON**	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	OFF	6
ON	**ON**	**ON**	OFF	OFF	OFF	OFF	OFF	OFF	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!

4.4.6 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).

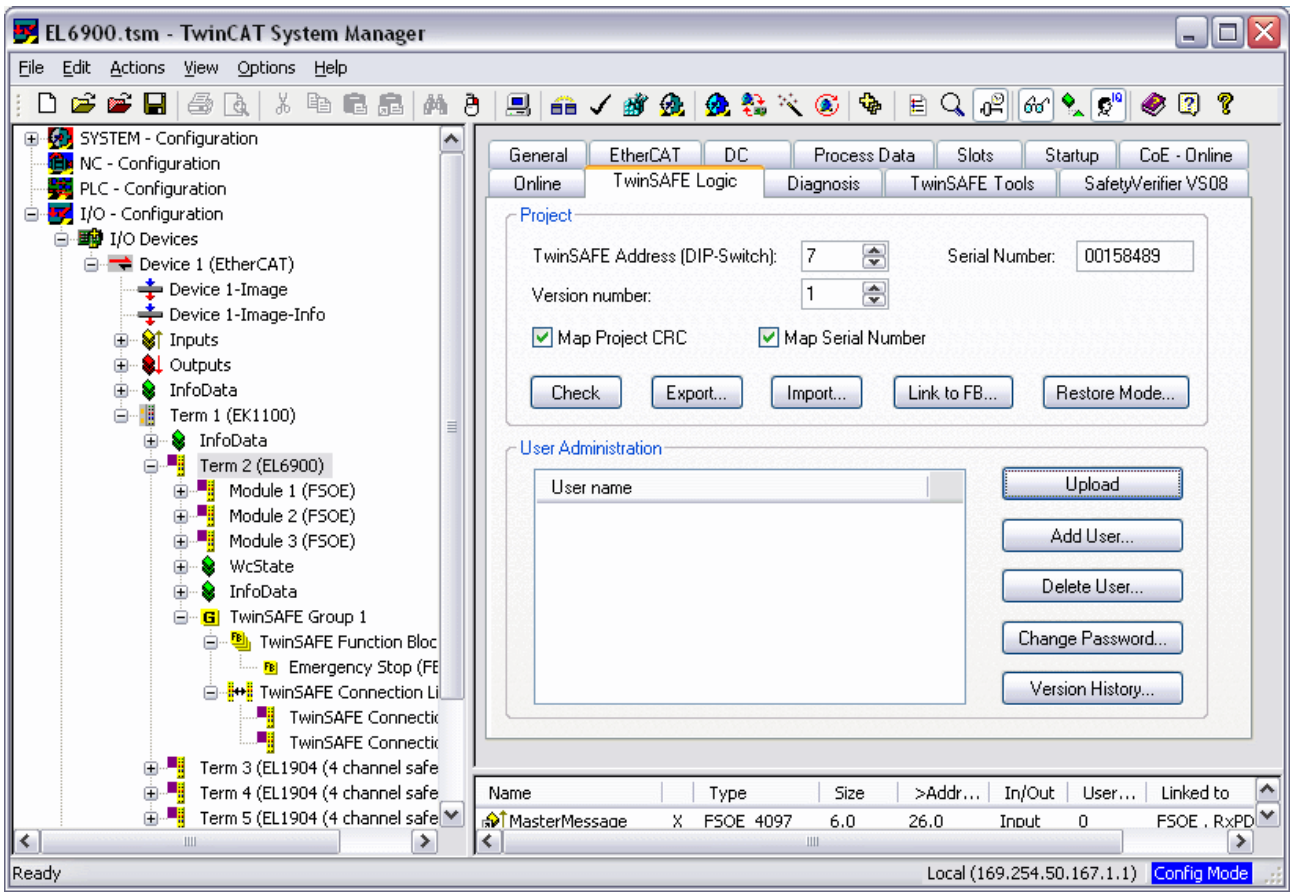

Fig. 17: Registering the TwinSAFE addresses in the TwinCAT automation software

4.4.7 Creating a TwinSAFE group

A TwinSAFE group is a group of TwinSAFE terminals (inputs and outputs) that are logically linked via an EL6900. 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 associated EL6900 in the tree structure and selecting *Append TwinSAFE group* in the dialog box (see diagram).

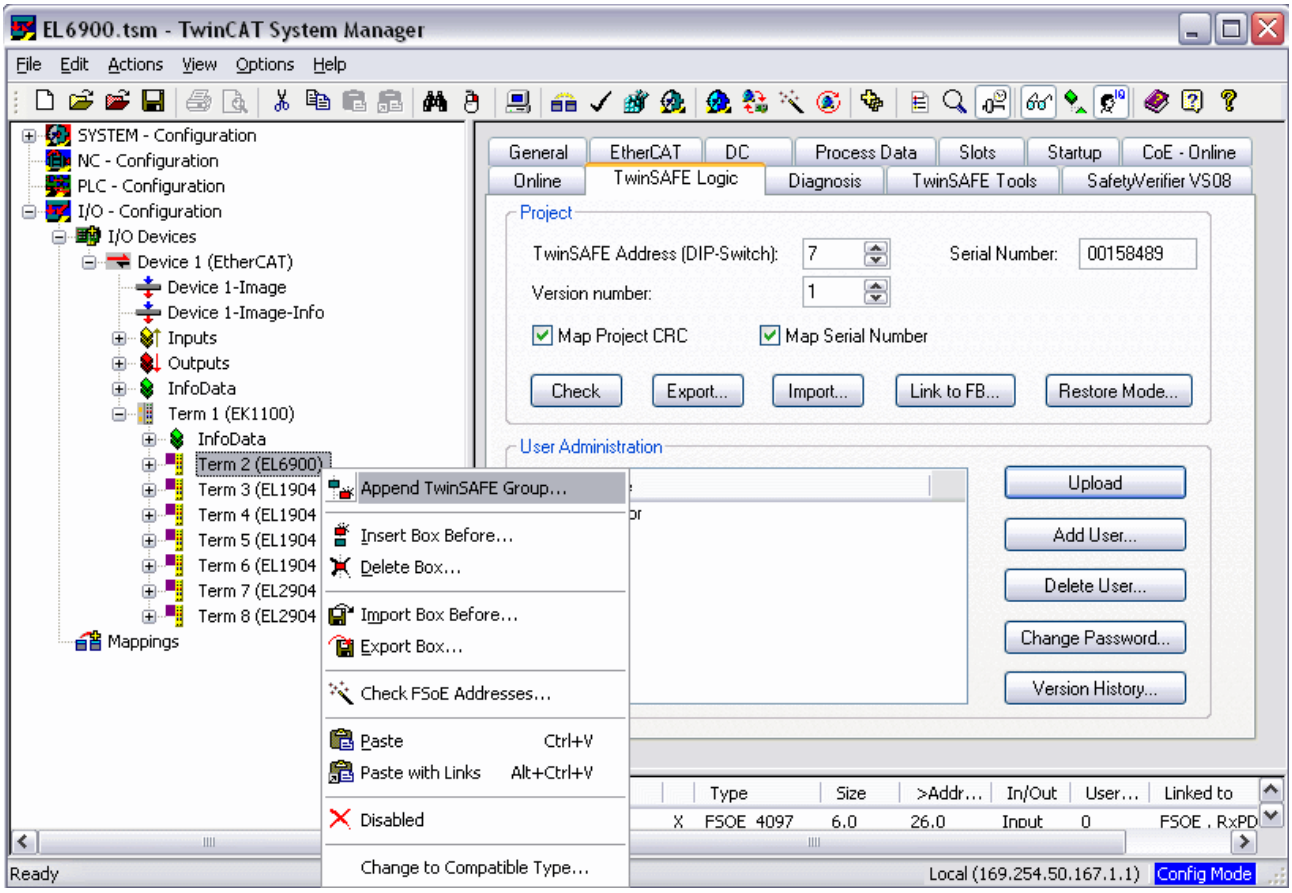

Fig. 18: Creating a TwinSAFE group

4.4.8 TwinSAFE group signals

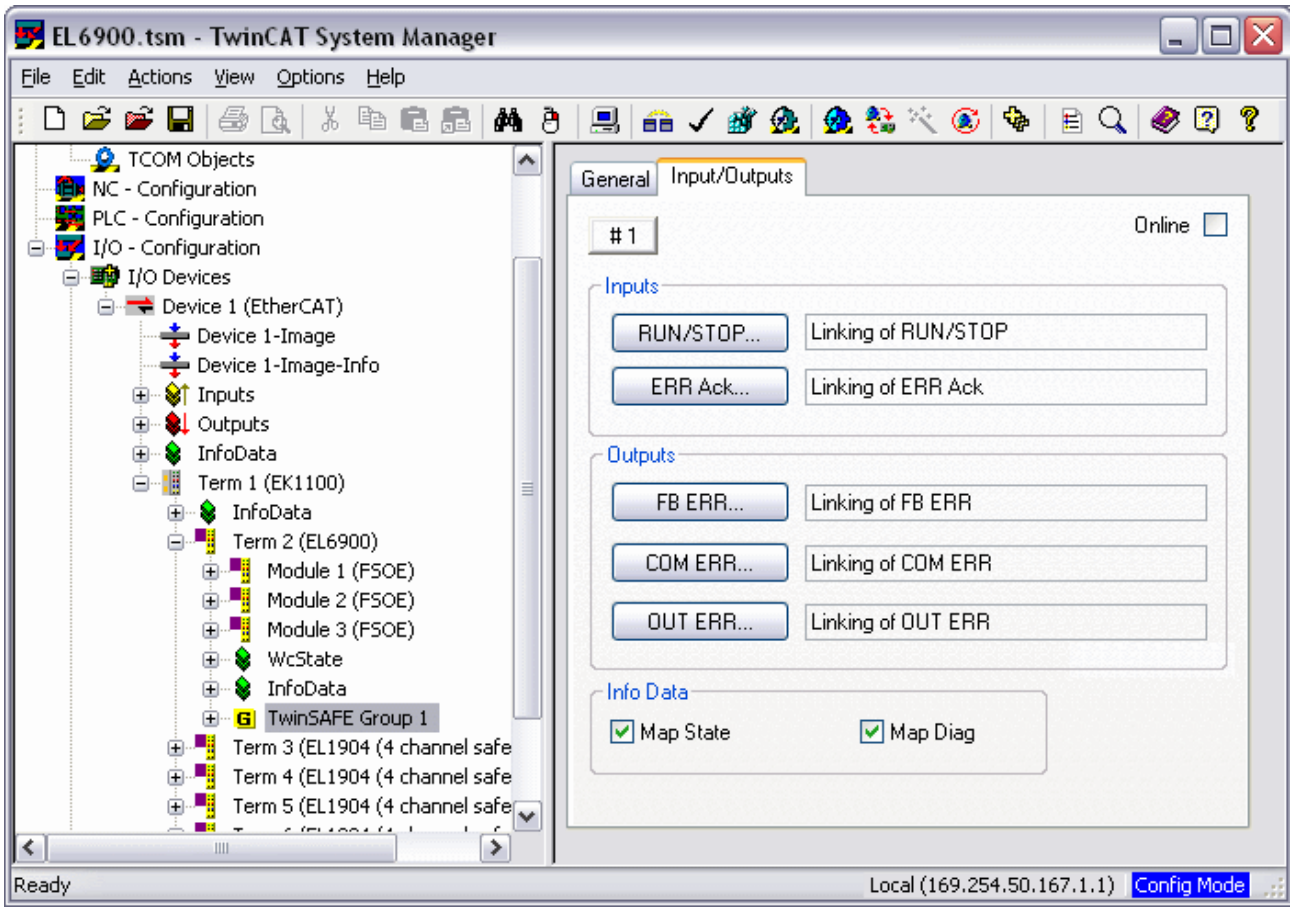

Fig. 19: TwinSAFE group signals

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	FALSE	Always FALSE, since the EL6900 has no local outputs

4.4.9 Append a function block

The EL6900 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 associated *TwinSAFE function block list* in the tree structure and selecting *Append Function Block* in the dialog box with the left mouse button (see diagram).

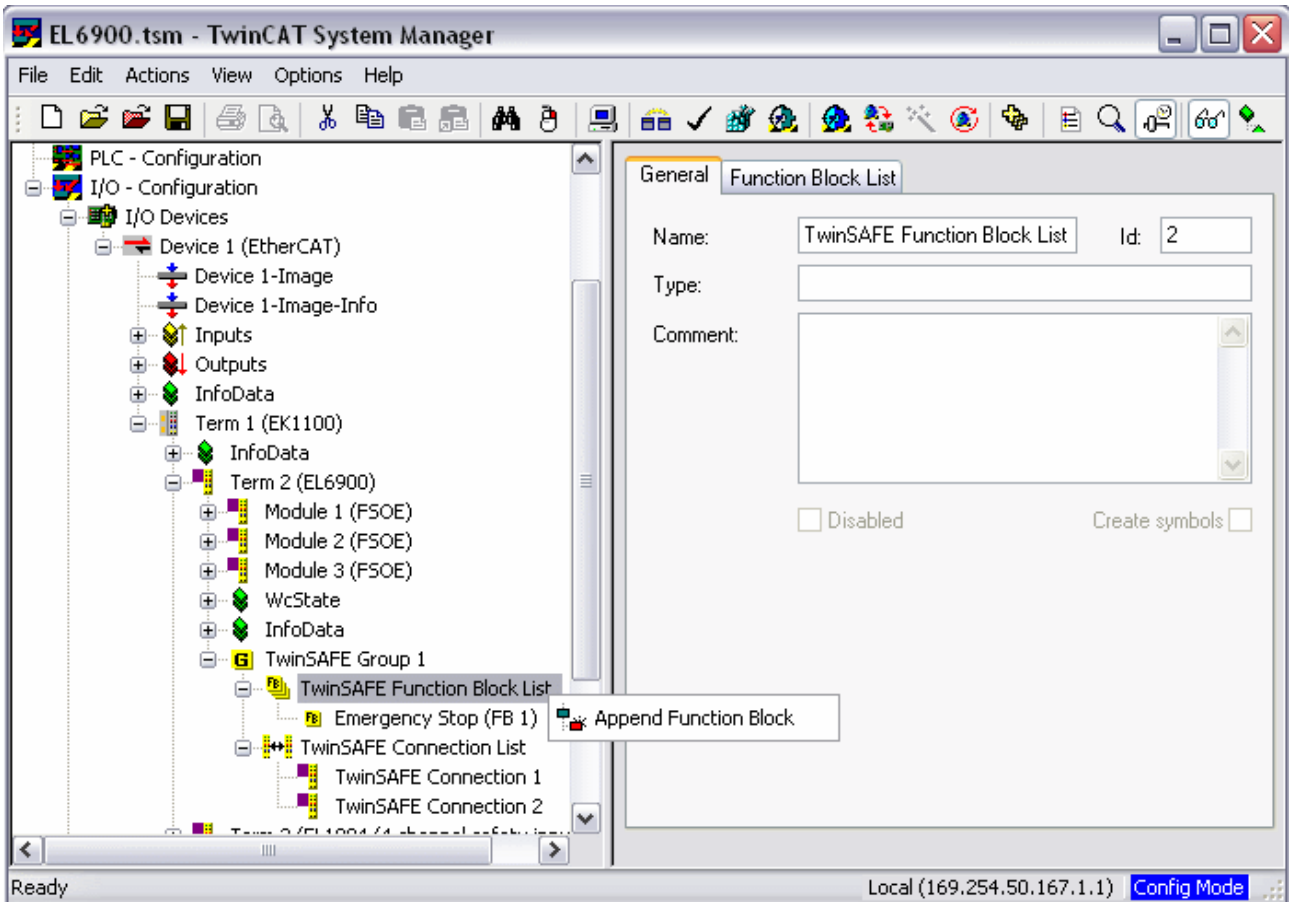

Fig. 20: Appending a function block

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

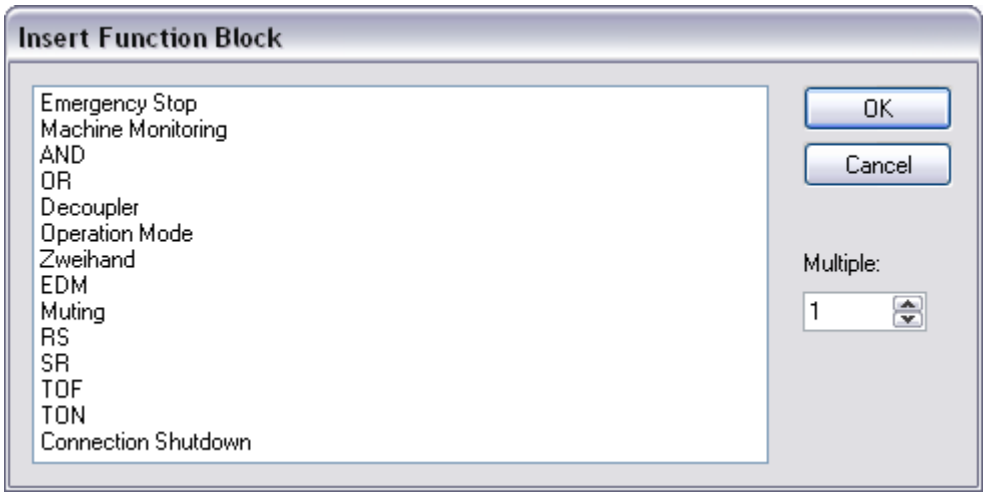

Fig. 21: Selection of the desired function block

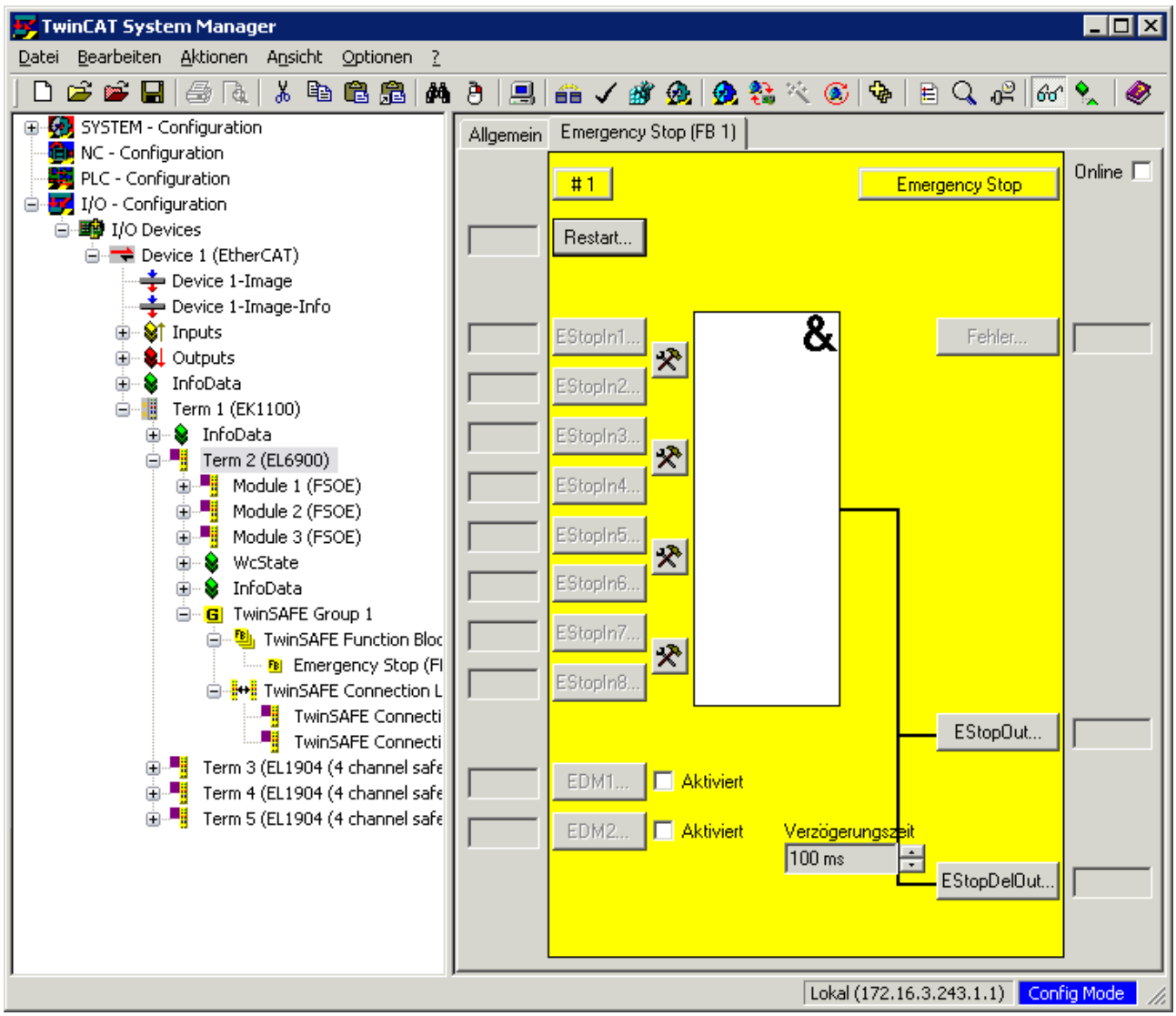

Fig. 22: Appended Emergency Stop block

4.4.9.1 Activating and configuring the block inputs

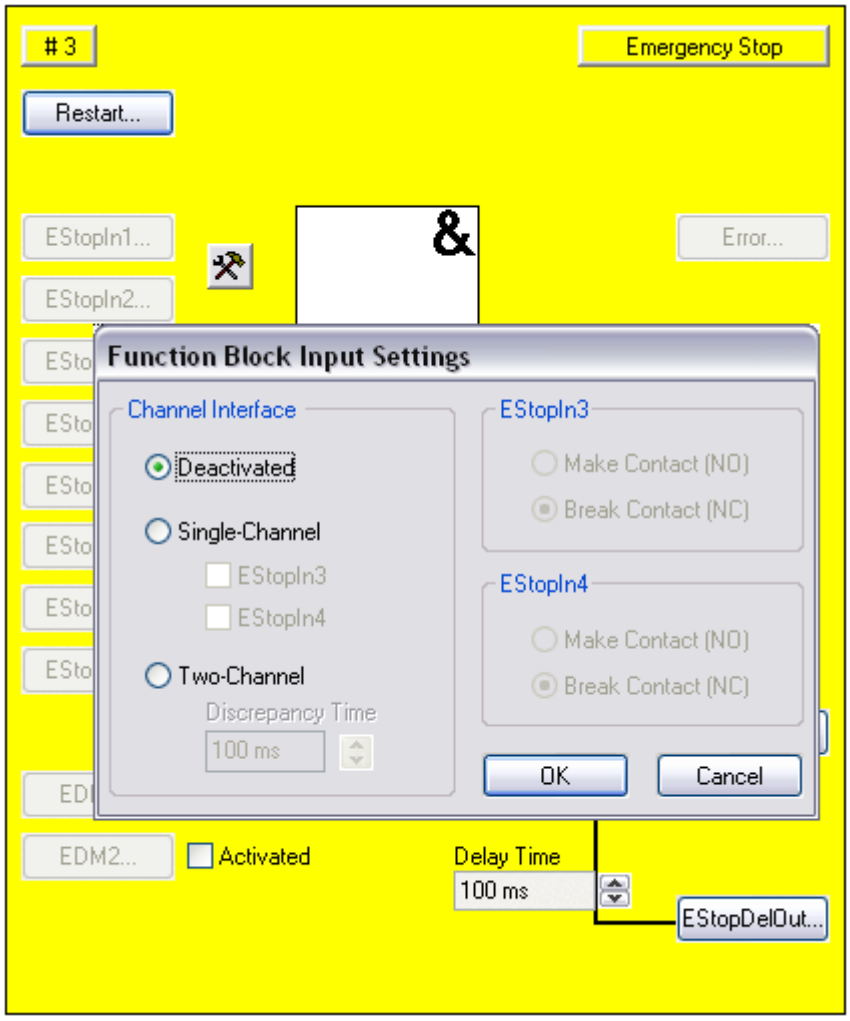

Fig. 23: Function Block Input Settings

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.

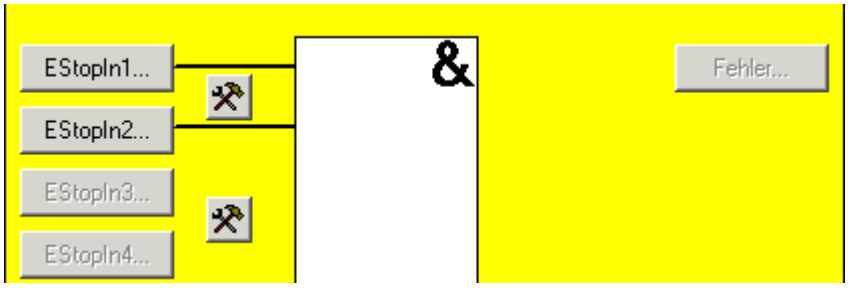

Fig. 24: Activated inputs

The inputs can now be linked.

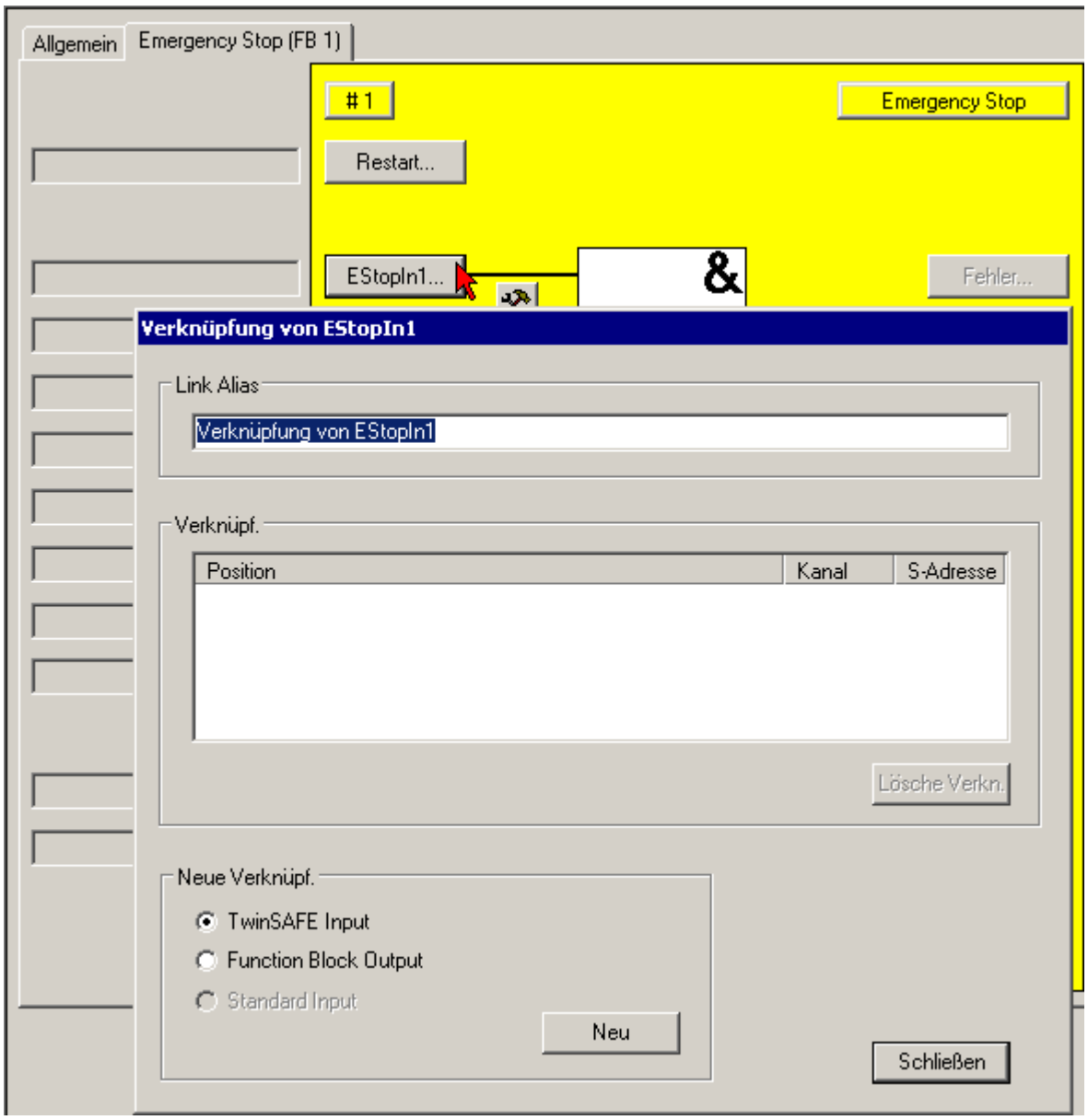

Fig. 25: Link inputs

Select the variable type:

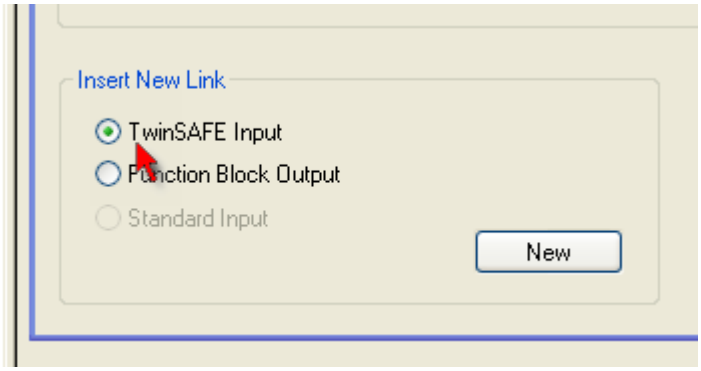

Fig. 26: Select the variable type

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

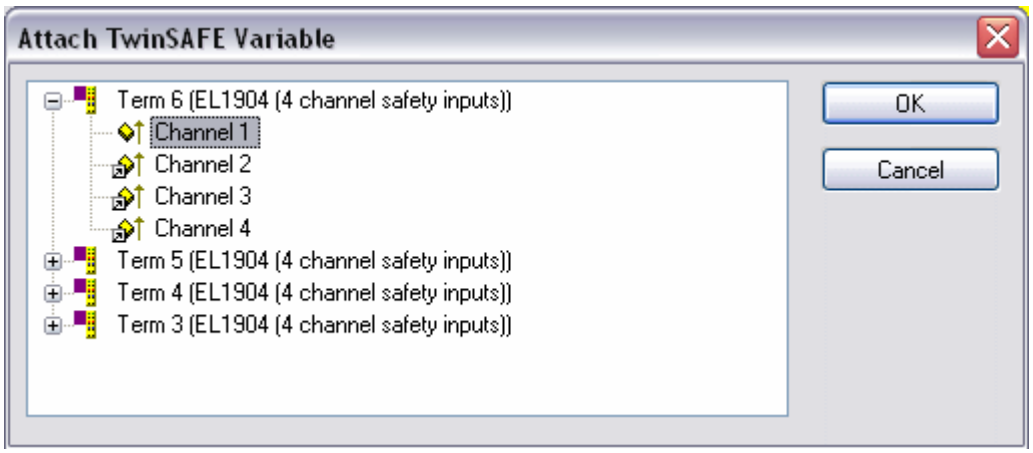

Fig. 27: Available channels

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.

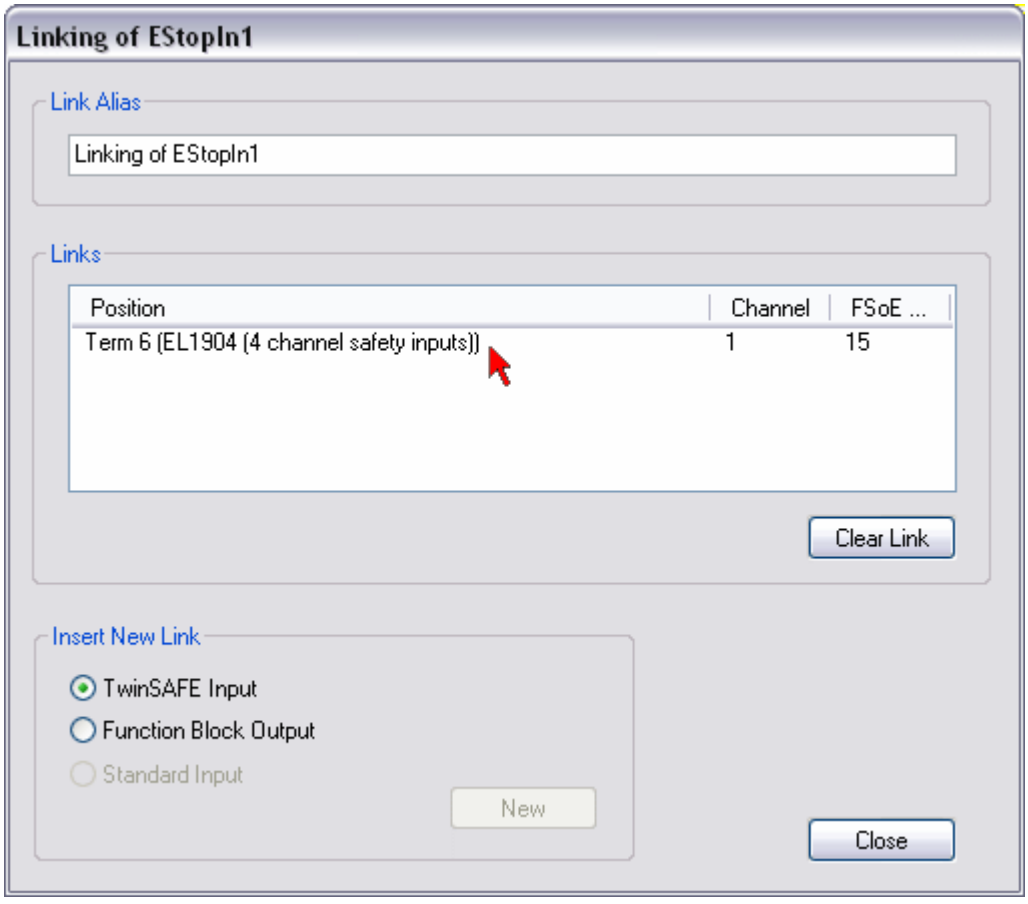

Fig. 28: Selection of the desired channel

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

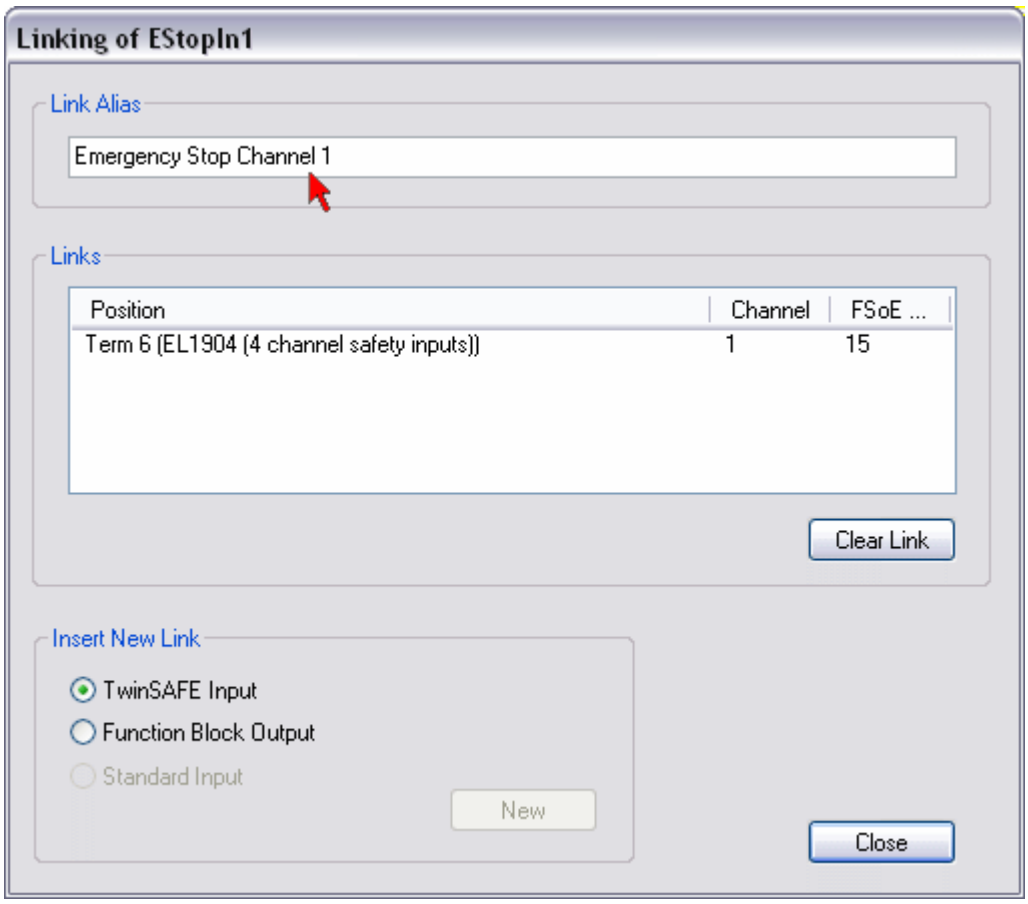

Fig. 29: Enter alias

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

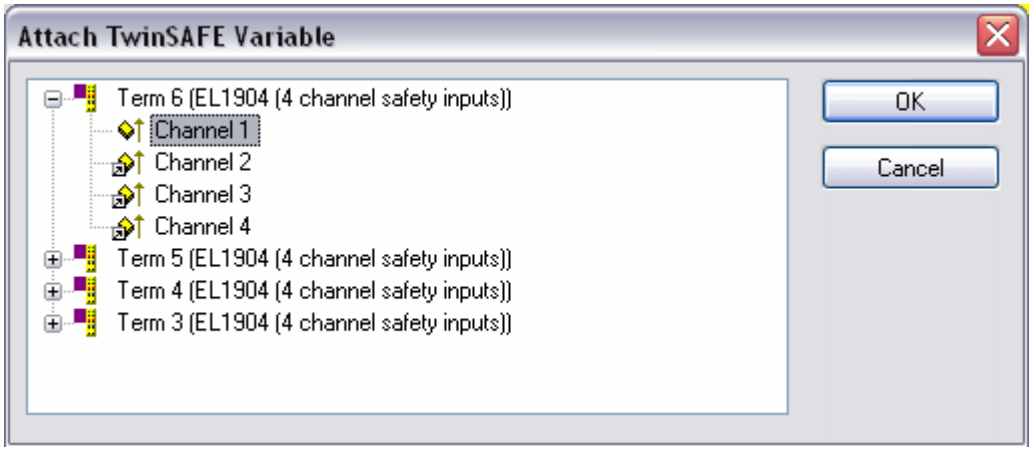

Fig. 30: Identification of inputs already in use

4.4.10 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.

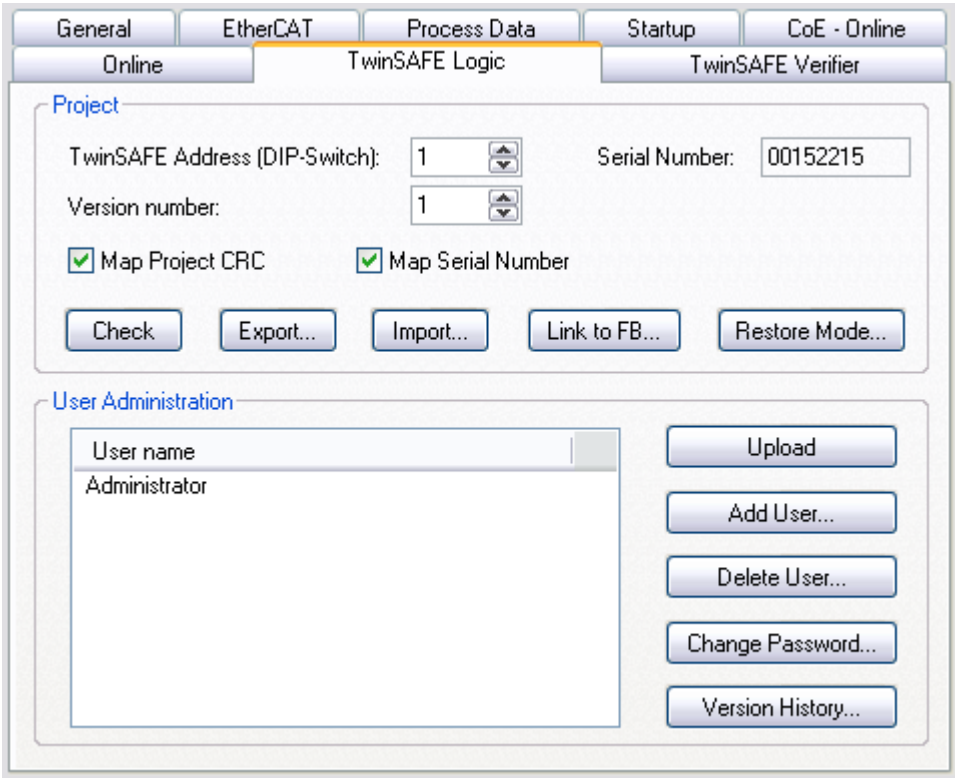

Fig. 31: EL6900 user administration

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.

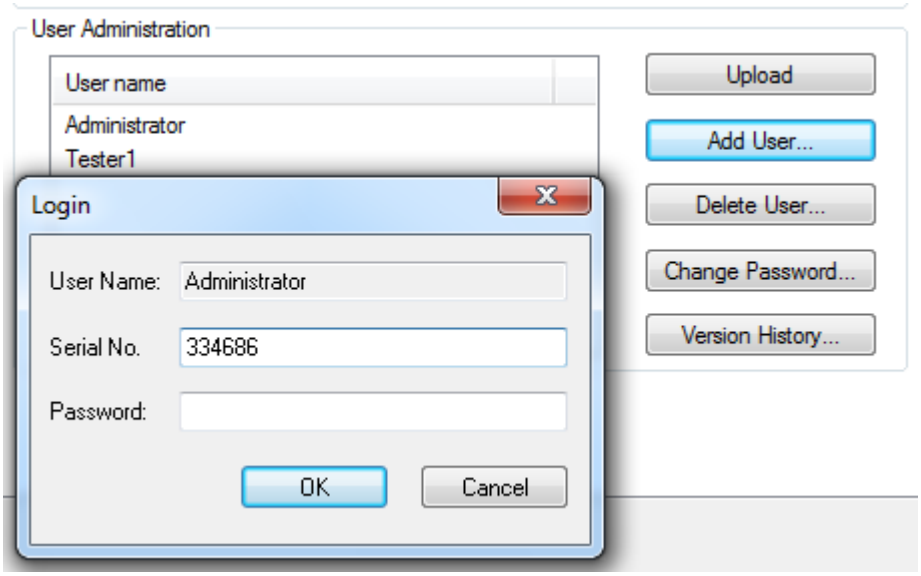

Fig. 33: User Administration - Login

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

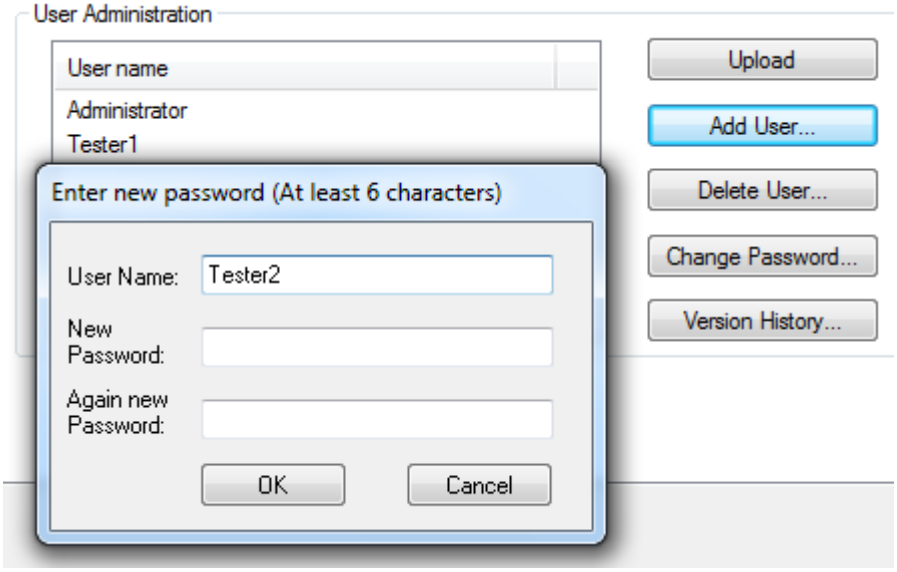

Fig. 34: User Administration - Add User

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.

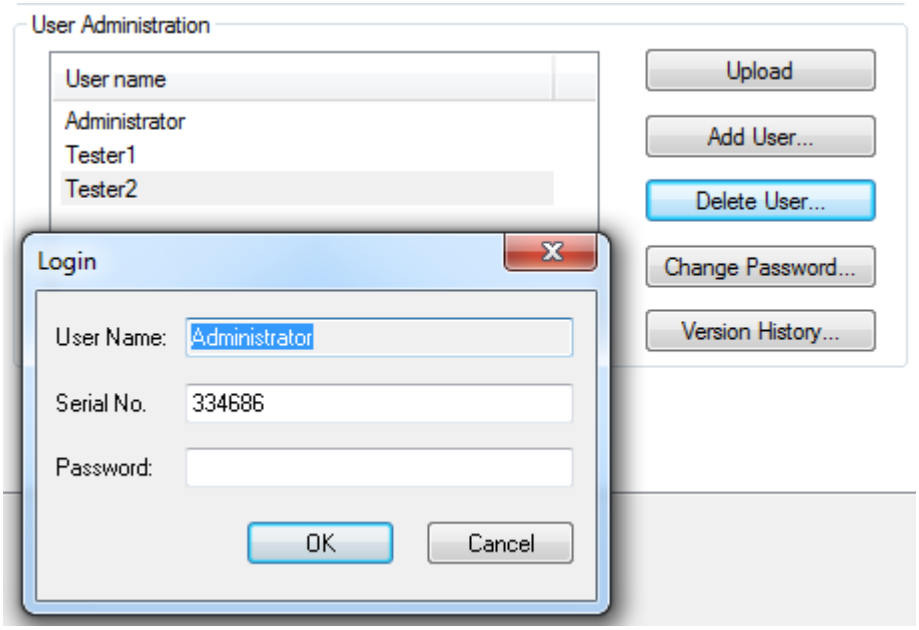

Fig. 36: User Administration - Delete User

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.

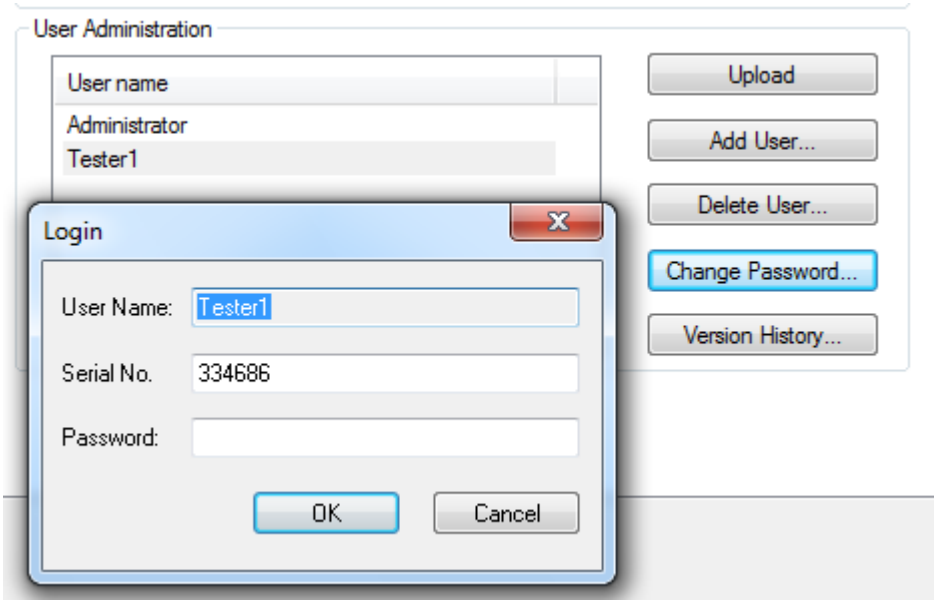

Fig. 37: User Administration - Login to change password

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

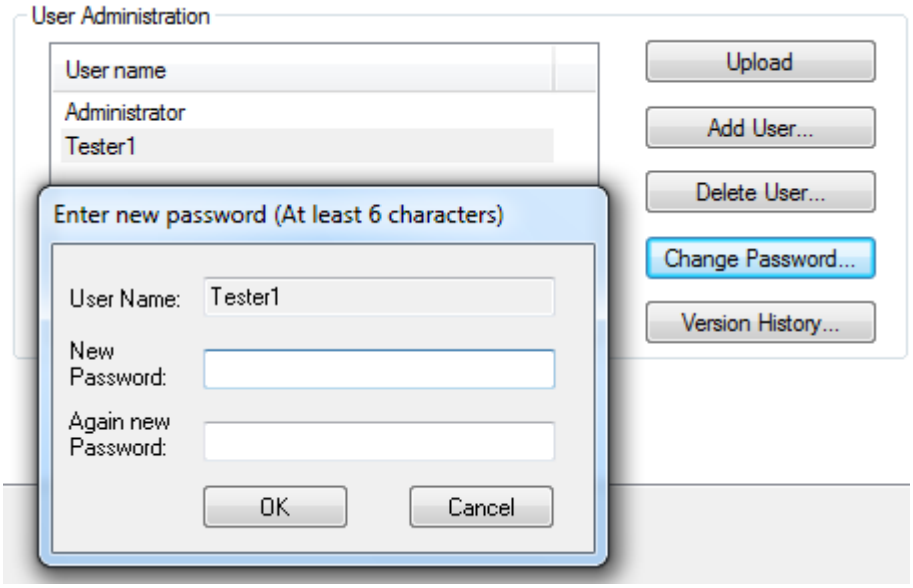

Fig. 38: User Administration - Change Password

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.

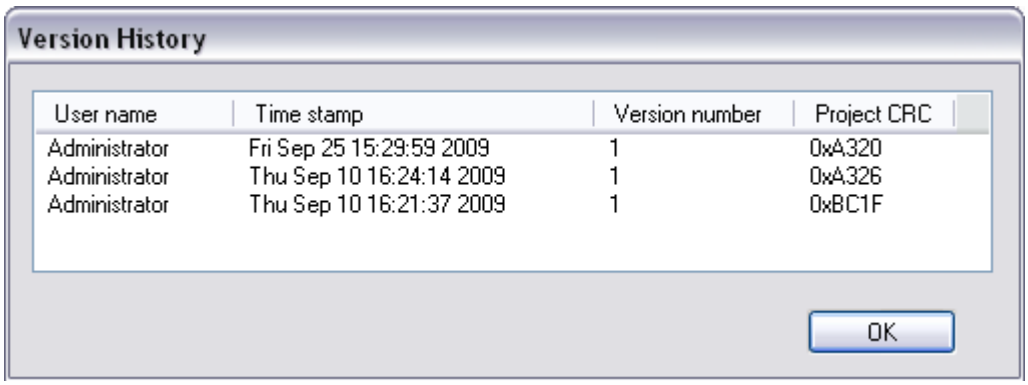

Fig. 39: Display of the version history

4.4.11 Export and import of a TwinSAFE project

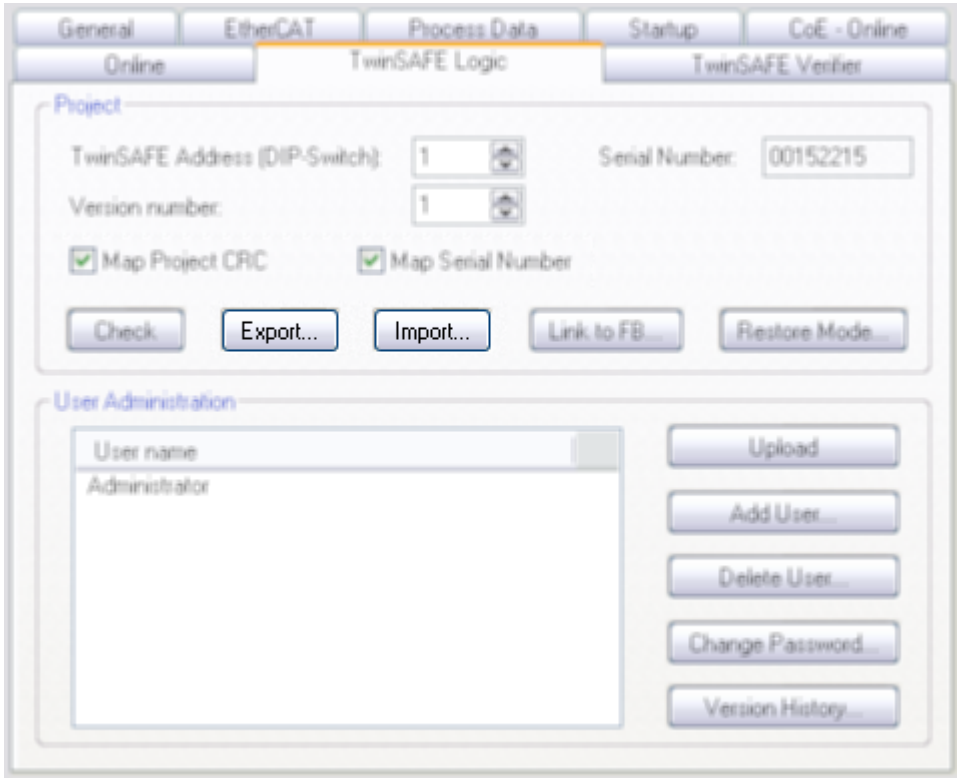

Fig. 40: Export and import of a TwinSAFE project

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.

4.4.12 EL6900 info data

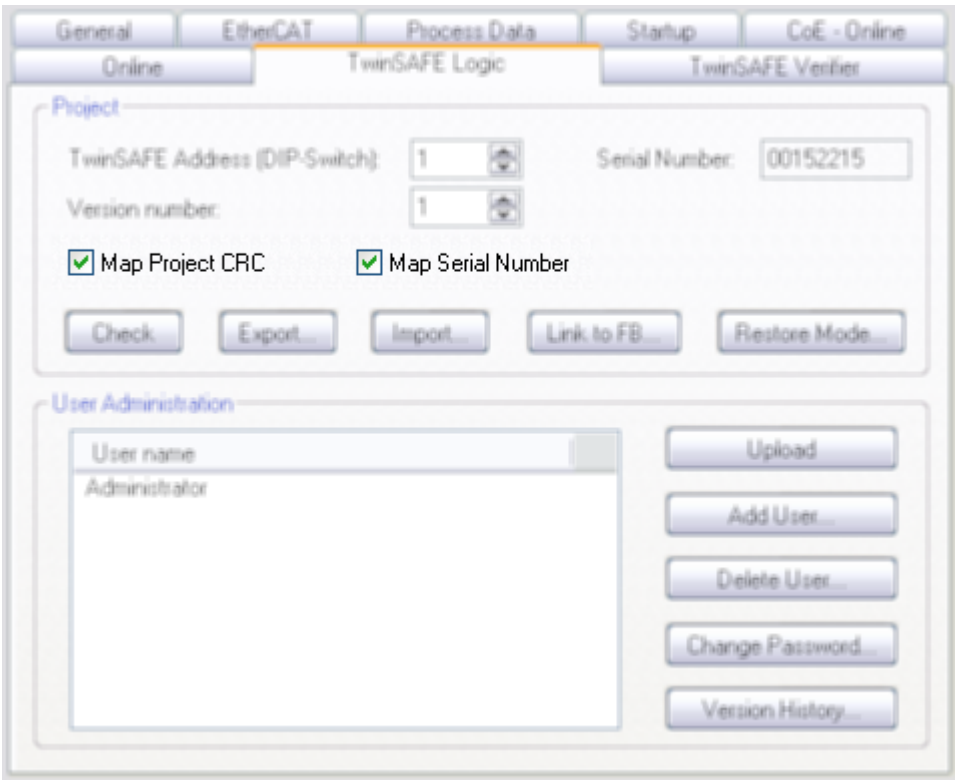

Fig. 41: EL6900 info data

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.

4.4.13 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).

Note	**User name and password are case-sensitive** Pay attention to upper/lower case characters for the user name and password.

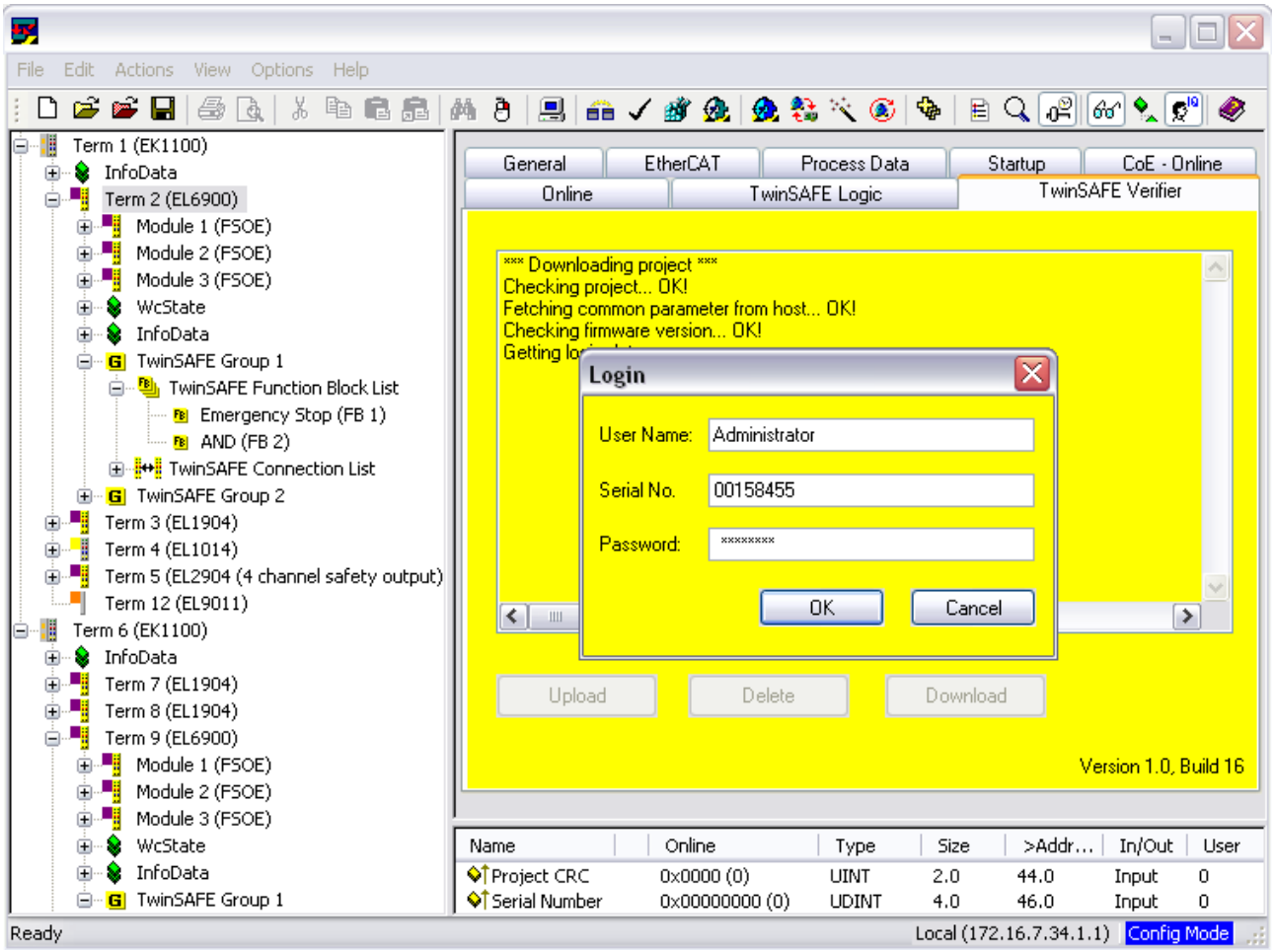

Fig. 42: Loading the project into the EL6900

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.

4.4.13.1 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

Note	**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.

4.4.14 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.

Associated variables have to be created under Publisher and Subscriber on the communicating controllers.

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

The link with the TwinSAFE logic terminal EL6900 is established with the following dialog.

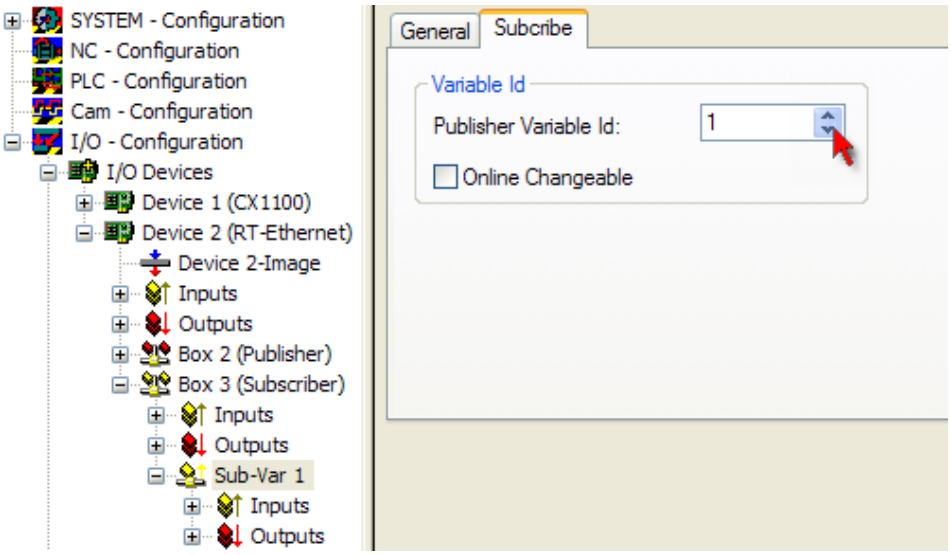

Fig. 43: Link with the TwinSAFE logic terminal EL6900

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.

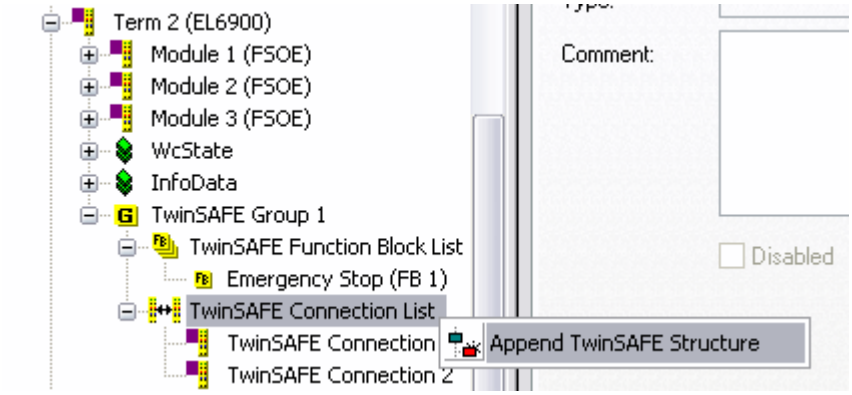

Fig. 44: Make known the connection created to the TwinSAFE logic terminal

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

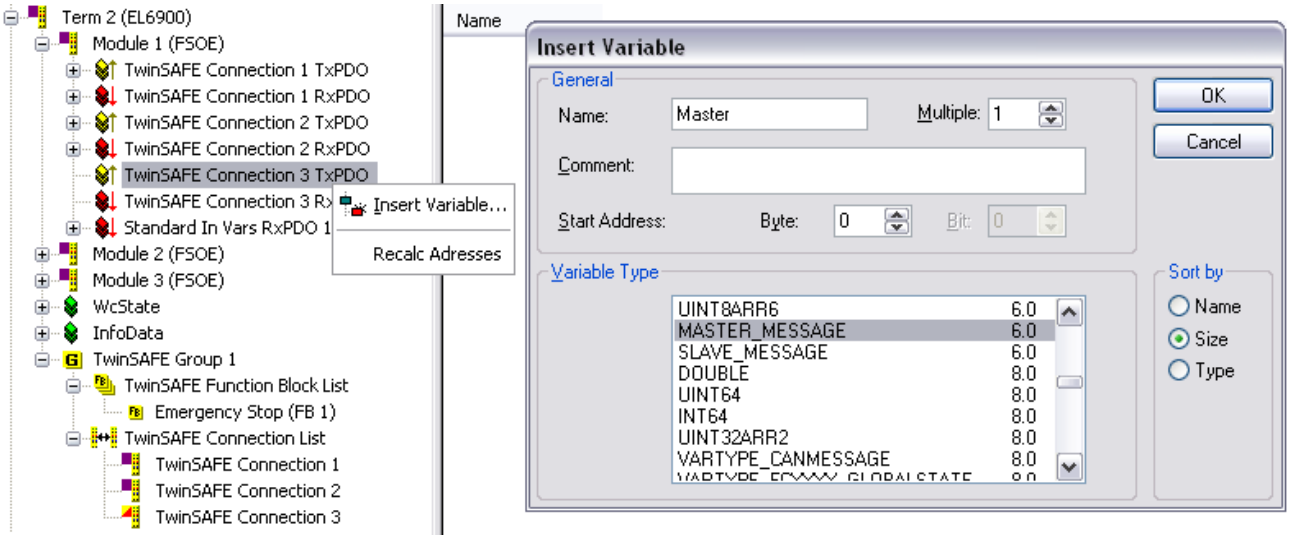

Fig. 45: Creation of a variable for the master message

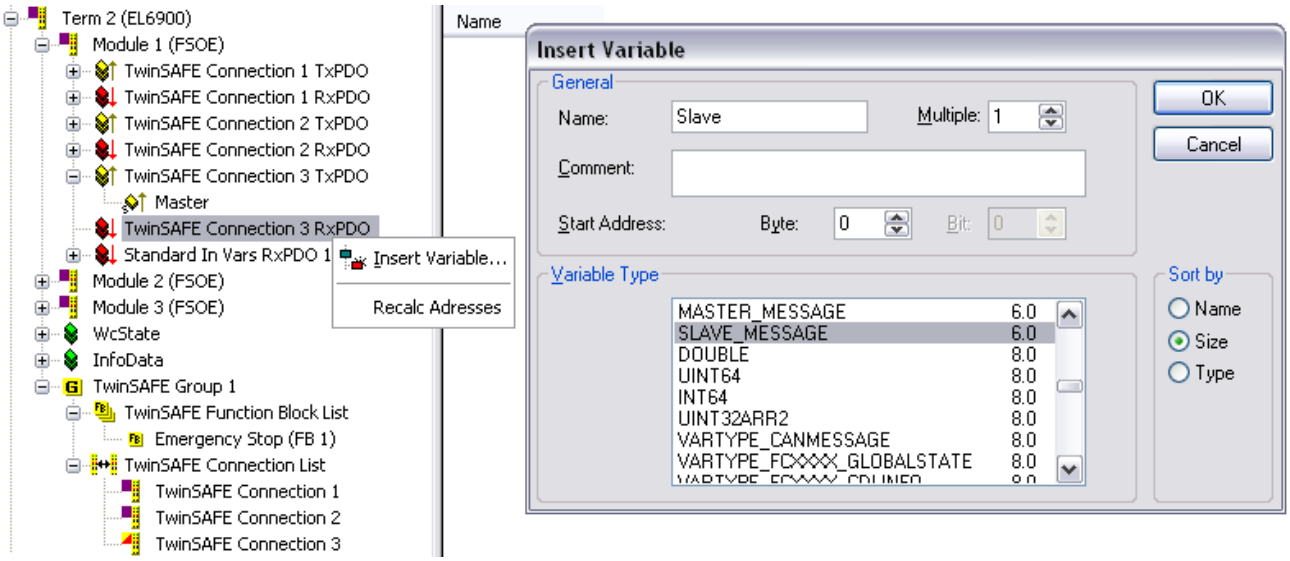

Fig. 46: Creation of a variable for the slave message

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

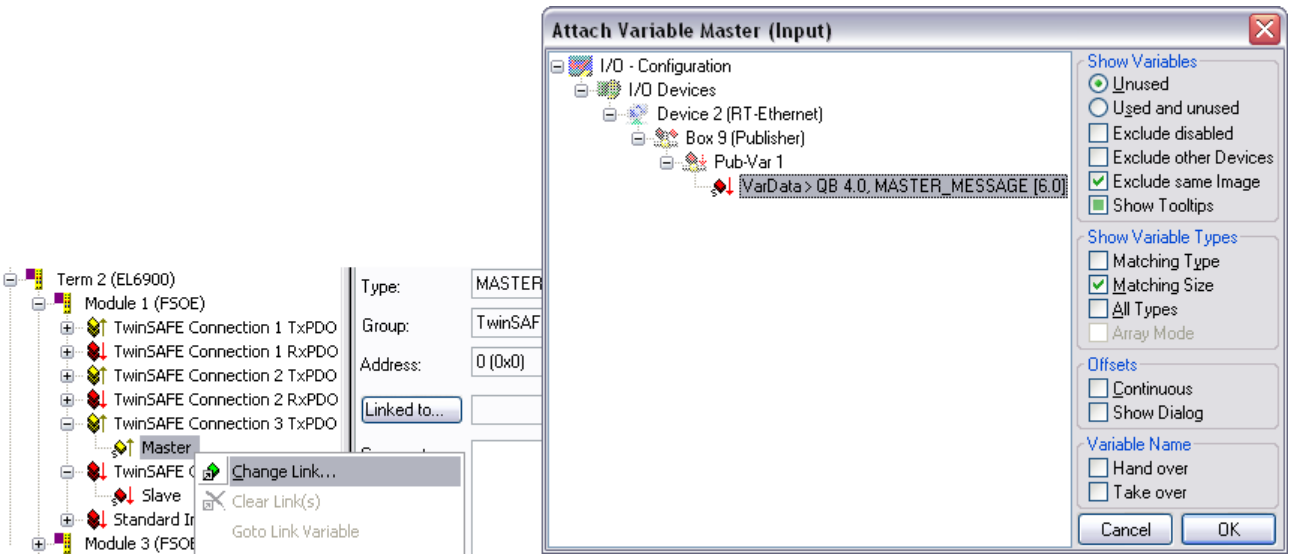

Fig. 47: Linking the variables

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.

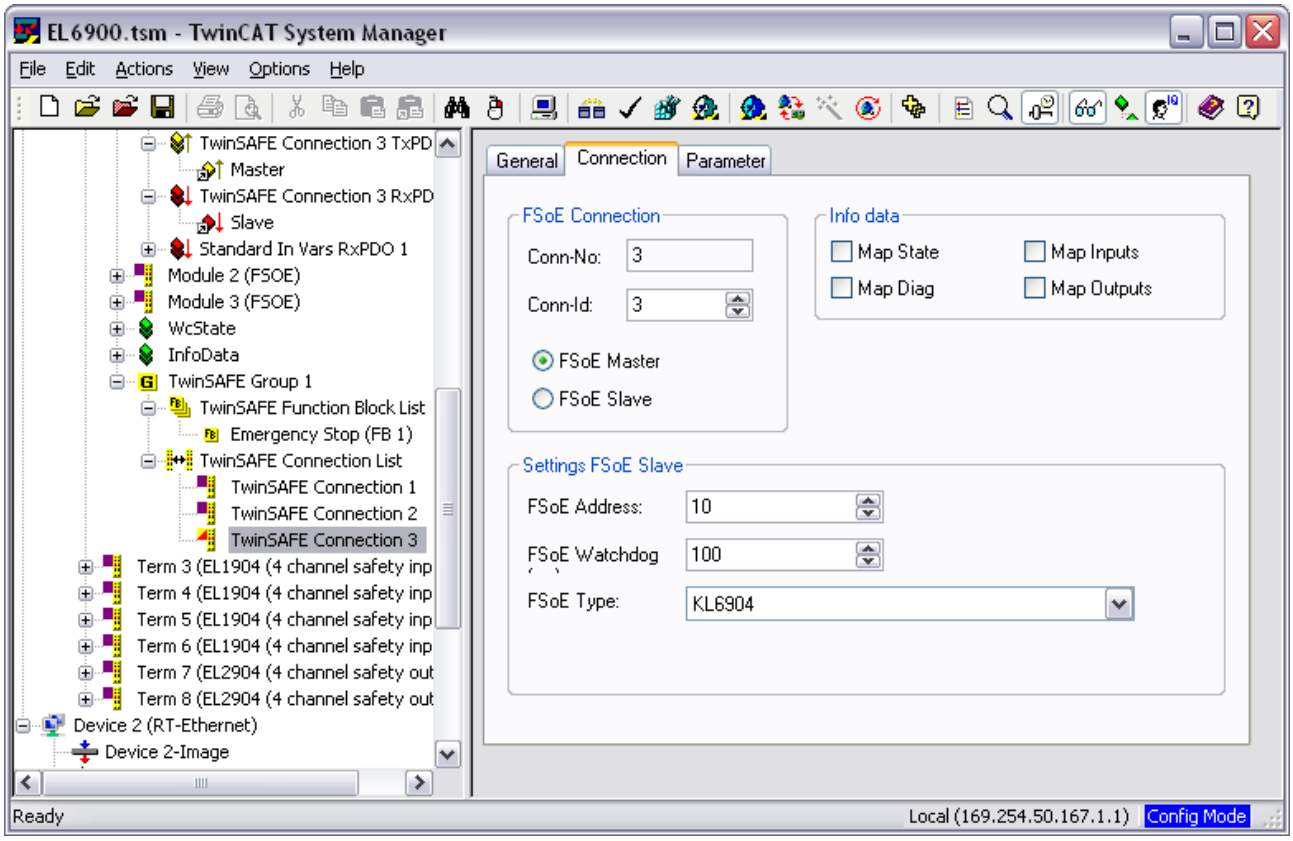

Fig. 48: Settings for the TwinSAFE connection

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

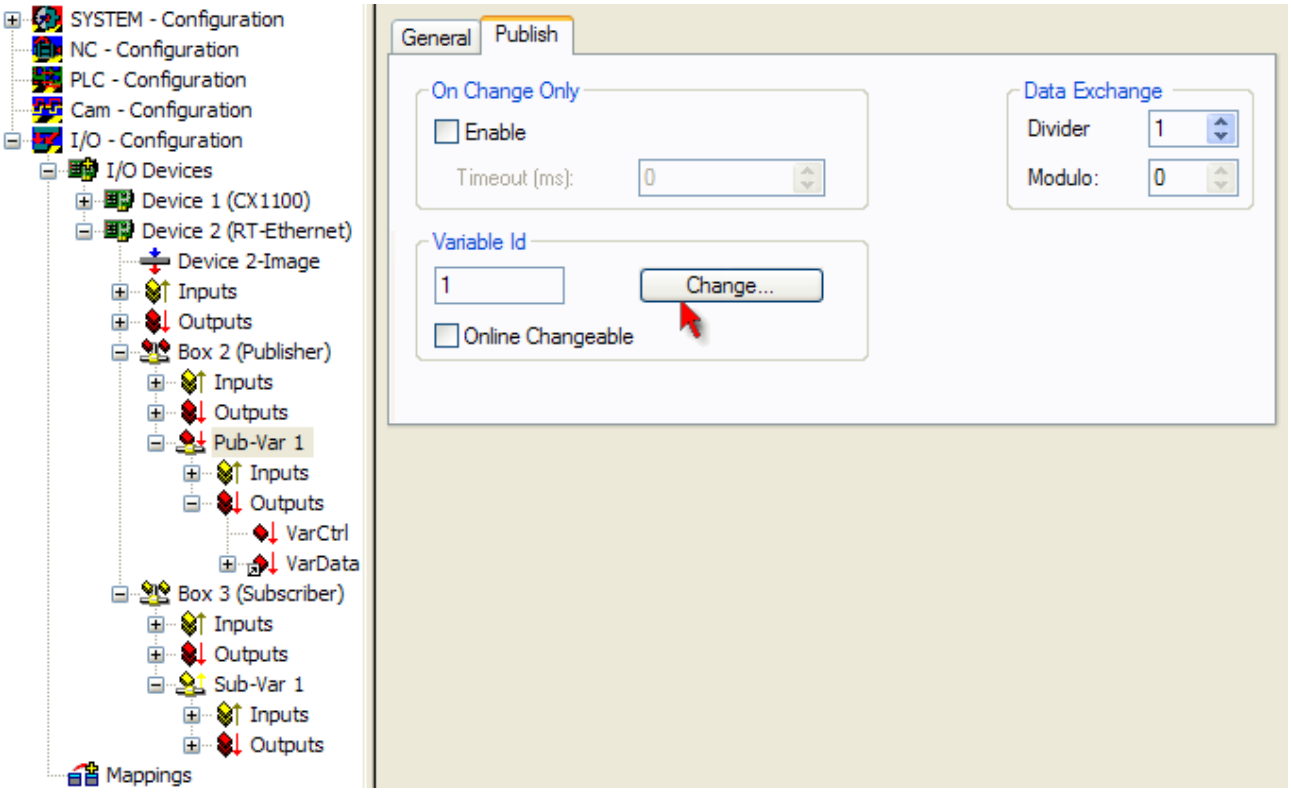

Fig. 49: Setting a unique ID

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.

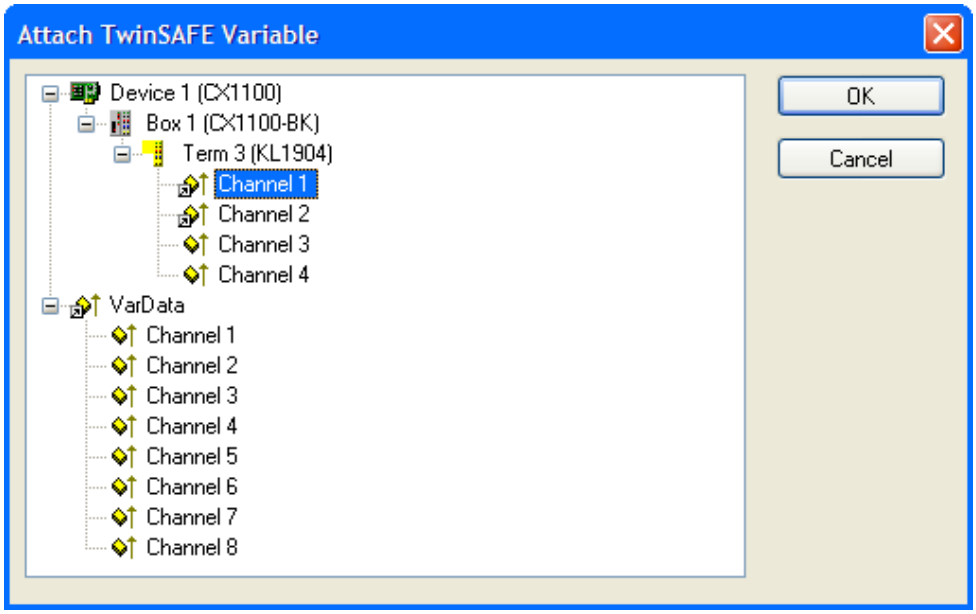

Fig. 50: Attach TwinSAFE variable for inputs

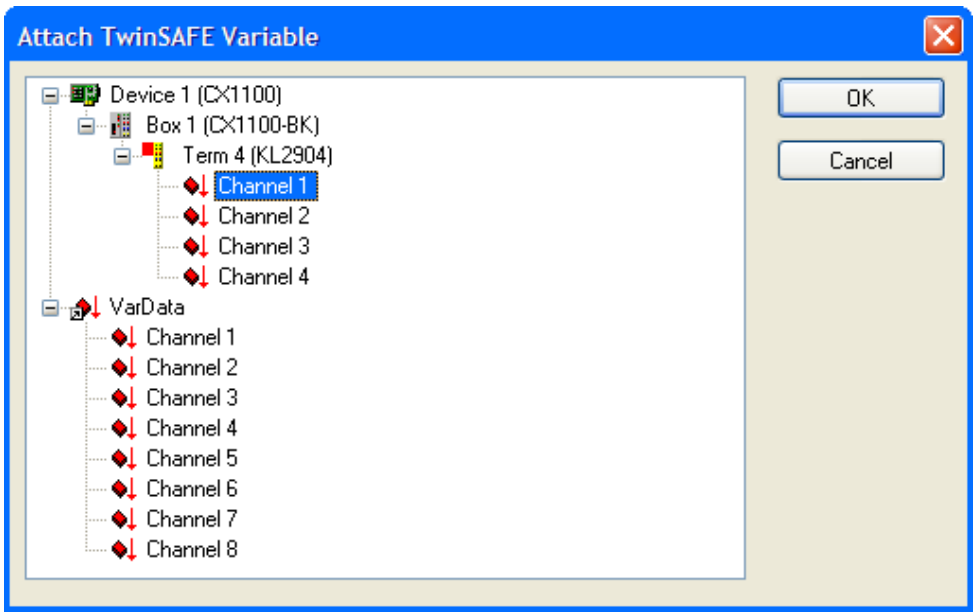

Fig. 51: Attach TwinSAFE variable for outputs

4.5 Diagnostics

4.5.1 Diagnostic LEDs

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

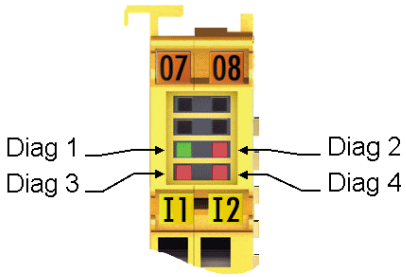

Fig. 52: EL6900 diagnostic LEDs

4.5.1.1 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.

4.5.1.2 Diag 2 LED (red)

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

Display	Meaning
-	in preparation

4.5.1.3 Diag 3 LED (red)

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

4.5.1.4 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

Note

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.

4.5.1.5 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.

4.5.2 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		
		0102_{hex}	max. supply voltage µC2 exceeded		
		0103_{hex}	voltage fell below min. supply voltage µC1		
		0104_{hex}	voltage fell below min. supply voltage µC2		

Note

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

4.5.3 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 0001hex. **This value should be reset to 0 once the cycle time has been determined.**	RW	0000_{hex}

4.5.4 Status LEDs

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

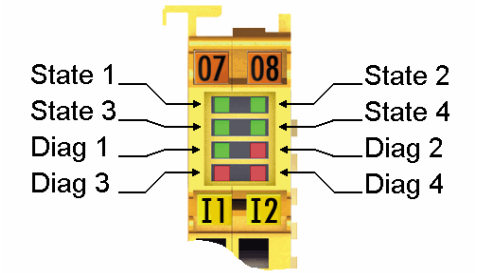

Fig. 53: EL6900 status LEDs

State 1	State 2	State 3	State 4	Meaning
off	off	off	lit	• No project present on the terminal
off	off	lit	lit	• Project present on the terminal • EtherCAT status: Pre-Operational (Pre-OP)
lit	lit	lit	lit	• Project present on the terminal • EtherCAT status: Operational (OP)

4.6 Maintenance

Maintenance

The TwinSAFE components are maintenance-free!

Environmental conditions

WARNING	**Observe the specified environmental conditions!** Please ensure that the TwinSAFE components are only stored and operated under the specified conditions (see technical data).

If the TwinSAFE component is operated outside the permitted temperature range it will switch to *Global Shutdown* state.

Cleaning

Protect the TwinSAFE component from unacceptable soling during operation and storage!

If the TwinSAFE component was subjected to unacceptable soiling it may no longer be operated!

WARNING	**Have soiled terminals checked!** Cleaning of the TwinSAFE component by the user is not permitted! Please send soiled terminals to the manufacturer for inspection and cleaning!

4.7 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:	Sample: Date Code 17 11 05 00
CW: Calendar week of manufacture	Calendar week: 17
YY: Year of manufacture	Year: 2011
SW: Software version	Software version: 05
HW: Hardware version	Hardware version: 00

In addition the TwinSAFE terminals bear a unique serial number.

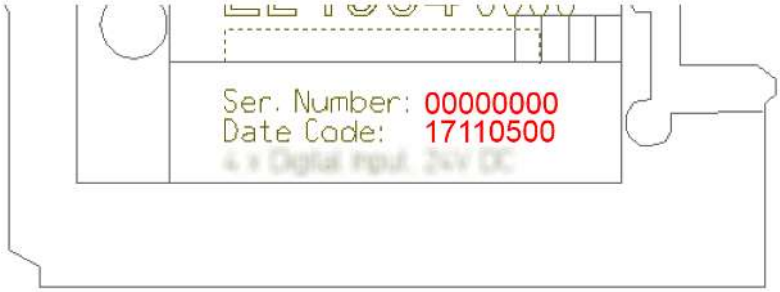

Fig. 54: Unique serial number of a TwinSAFE terminal

4.8 Decommissioning

DANGER	**Serious risk of injury!** Bring the bus system into a safe, de-energized state before starting disassembly of the devices!

Disposal

In order to dispose of the device, it must be removed and fully dismantled.

- Housing components (polycarbonate, polyamide (PA6.6)) are suitable for plastic recycling.
- Metal parts can be sent for metal recycling.
- Electronic parts such as disk drives and circuit boards must be disposed of in accordance with national electronics scrap regulations.

5 Appendix

5.1 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

Beckhoff's branch offices and representatives

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

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages:
http://www.beckhoff.com

You will also find further documentation for Beckhoff components there.

Beckhoff Headquarters

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20
33415 Verl
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Phone:	+49(0)5246/963-0
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e-mail:	info@beckhoff.com

Beckhoff Support

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

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e-mail:	support@beckhoff.com

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The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49(0)5246/963-460
Fax:	+49(0)5246/963-479
e-mail:	service@beckhoff.com

5.2 Certificates

Reliability of EL6900

Test and Certification body

TÜV SÜD Rail GmbH
Rail Automation - IQSE
Barthstraße 16
D-80339 Munich

Manufacturer

Beckhoff Automation GmbH & Co. KG
Huelshorstweg 20
D-33415 Verl

Safety parameters EL6900

Key figures	EL6900
Lifetime [a]	20
Prooftest Intervall [a]	not required [1)]
PFH_D	1.03E-09
%SIL3	1.03%
PFD	8.23E-05
%SIL3	8.23%
$MTTF_d$	High
B10d (cycles)	-
DC	High
Performance level	PL e
Category	4
HFT	1
Element classification*	Type B

*) 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).

[1)] Special proof tests for the product are not required during the lifetime of the EL6900 EtherCAT terminal as a result of the high diagnostic coverage of the system.

Munich, 2016-03-07

Günter Greil

Digital unterschrieben von Guenter Greil
DN: c=DE, o=TUEV SUED Rail GmbH, ou=Rail & Automation, cn=Guenter Greil, email=guenter.greil@tuev-sued.de
Datum: 2016.03.07 17:30:27 +01'00'

ZERTIFIKAT ◆ CERTIFICATE ◆ 認証証書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Product Service

CERTIFICATE

No. Z10 15 03 62386 033

Holder of Certificate: **Beckhoff Automation GmbH & Co. KG**
Hülshorstweg 20
33415 Verl
GERMANY

Factory(ies): 62386

Certification Mark:

Product: **Safety components**

Model(s): **KL 6904, EL 6900, EL 6930**

Parameters:

Supply voltage:	24VDC (-15%...+20%)
Power dissipation:	2W
Protection class:	IP20

with "TwinSAFE Verifier" OR "CODESYS Safety for EtherCAT Safety Module".
Note: "CODESYS Safety for EtherCAT Safety Module" is developed in accordance with EN 61508:2010.

Tested according to:
2006/42/EC
EN 61508-1:2010 (SIL1-3)
EN 61508-2:2010 (SIL1-3)
EN 61508-3:2010 (SIL1-3)
DIN EN ISO 13849-1:2008 (Cat 4, PL e)
DIN EN 81-1:2010
EN 13243:2004
DIN EN 61000-6-2:2006
DIN EN 61000-6-4:2007

The product was tested on a voluntary basis and complies with the essential requirements. The certification mark shown above can be affixed on the product. It is not permitted to alter the certification mark in any way. In addition the certification holder must not transfer the certificate to third parties. See also notes overleaf.

Test report no.: BV82168T

Valid until: 2020-03-05

Date, 2015-03-06 (Günter Greil)

584377

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TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany

TÜV®

A1 / 04.11

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