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Product description

5 Product description

5.1 General description

EK1914 - TwinSAFE Bus Coupler with two fail-safe inputs and two fail-safe outputs

The EK1914 is an EtherCAT Bus Coupler with 4 standard inputs, 4 standard outputs, and 2 fail-safe inputs and 2 fail-safe outputs.

The EK1914 fulfils the requirements of DIN EN ISO 13849-1:2008 (Cat 4, PL e).

The TwinSAFE Bus Coupler has the usual design of an EtherCAT coupler.

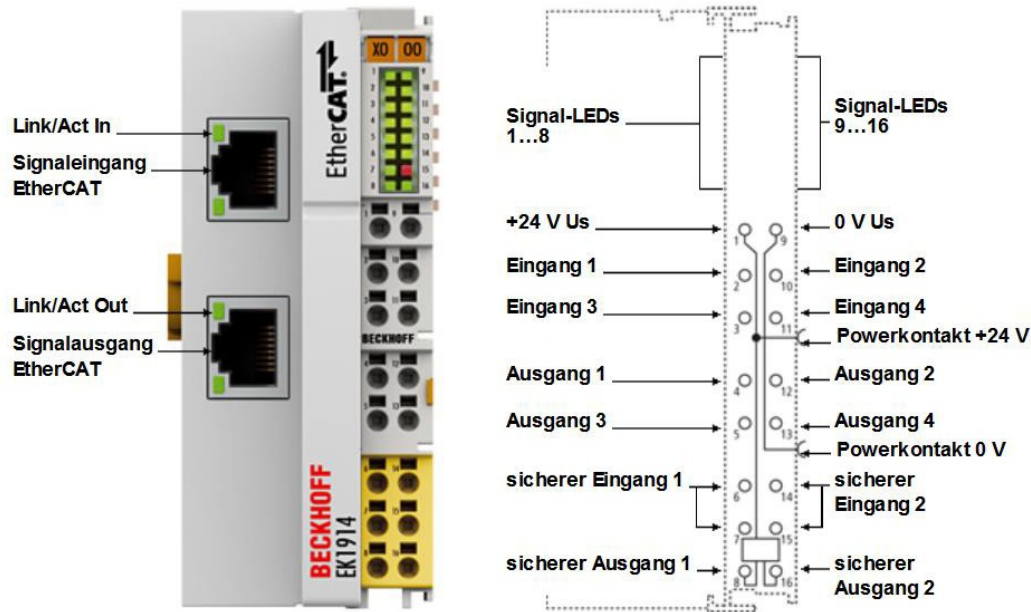


Fig. 4: EK1914 overview

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5.3 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/>.

Data		Comment
• Task within the EtherCAT system	Coupling of EtherCAT Terminals (ELxxxx) to 100BASE-TX EtherCAT networks	
• Protocol / Baud rate	EtherCAT Device Protocol / 100 MBaud	
• Cable length between two Bus Couplers	max. 100 m	100BASE-TX
• Transmission medium	at least Ethernet CAT-5 cable	
• Bus connection	2 x RJ45	
• Supply voltage for the EK1914 (PELV)	24 V _{DC} (–15% / +20%)	
• Number of standard inputs	4	
• Number of standard outputs	4	
• Number of safe inputs	2	
• Number of safe outputs	2	
• Status display	16 LEDs	
• Reaction time	typical: 4 ms, max.: see error reaction time	Read input/write to E-bus
• Error reaction time	≤ watchdog time	
• Signal voltage "0", standard inputs	–3 V - 5 V	EN 61131-2, type 1/3
• Signal voltage "1", standard inputs	11 V - 30 V	EN 61131-2, type 3
• Input filter of standard inputs	500 µs	
• Input current of standard inputs	typical 3 mA	EN 61131-2, type 3
• Output current per standard output	max. 0,5A	
• Output current of the clock outputs	typical 10 mA, max. 15 mA	
• Output current per safe output	max. 500 mA, min. 20 mA	
• Actuators	When selecting actuators please ensure that the test pulses from the safe outputs do not lead to actuator switching	
• Cable length between sensor/ actuator and Bus Coupler	unshielded	max. 100 m (at 0,75 or 1 mm ²)
	shielded	max. 100 m (at 0,75 or 1 mm ²)
• Input process image	8 byte	
• Output process image	8 byte	
• E-bus power supply (5 V)	max. 500 mA	In case of higher current consumption, use additional EL9410 power feed terminals.
• Power contacts (PELV)	max. 24V _{DC} , max. 4A	

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Data		Comment
• Current consumption	typical 72 mA	Excluding current consumption of the sensors/actuators and further terminals on the E-bus.
• Power loss of the Bus Coupler	typical 1,8 W	Without connected sensors/actuators
• Electrical isolation channels	No	Between the channels
• Electrical isolation E-bus	No	Between the channels and the E-bus
• Electrical isolation EtherCAT	Yes	Between the EtherCAT connections and the channels/E-bus
• Insulation voltage	Insulation tested with 500 V _{DC}	Between the EtherCAT connections and the channels/E-bus, under common operating conditions
• Dimensions (W x H x D)	approx. 44 mm x 100 mm x 68 mm	For further information see Dimensions [► 23] .
• Weight	approx. 123 g	

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5.4 Safety parameters

Safety parameters		Comment
Lifetime	20 a	
Prooftest-Intervall	/	Special proof tests during the entire service life of the TwinSAFE Bus Coupler are not required.
PFH _D	2,64E-09	
%SIL3	2,64%	
PFD	3,92E-05	
%SIL3	3,92%	
MTTF _D	High	
DC	High	
SFF	>99 %	
Performance Level	e	
Category	4	
HFT	1	
Element classification	Typ B	According to EN 61508-2:2010 chapter 7.4.4.1.2 and 7.4.4.1.3.

The TwinSAFE Bus Coupler can be used for safety-related applications within the meaning of EN ISO 13849-1 up to PL e (Cat4).

To calculate or estimate the MTTF_D value out of the PFHD value please refer to the Application Guide TwinSAFE or to the ISO 13849-1:2015 table K.1.

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5.5 Environmental conditions

Beckhoff products are designed for operation under certain environmental conditions, which vary according to the product. The following specifications must be observed for operation and environment in order to achieve the optimum service life of the products as well as to ensure product safety.

⚠ WARNING

Do not use TwinSAFE components under the following operating conditions:

- under the influence of ionizing radiation (which exceeds the level of natural ambient radiation)
- in a corrosive environment
- in an environment that leads to inadmissible contamination of the TwinSAFE component.

Permissible requirements for the environment		Explanation
Umweltbedingungen		
• Permissible ambient temperature (operation) up to HW05	0°C to +55°C	
• Permissible ambient temperature (operation) from HW06	-25°C to +55°C	
• Permissible ambient temperature (transport/storage)	-25°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	3K3	According to EN 60721-3-3:1995/A2:1997. 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.
• Pollution degree	2	comply with the chapter Maintenance and cleaning [► 55].
• EMC immunity/emission	According to EN 61000-6-2 / EN 61000-6-4	
• Vibration/shock resistance	According to EN 60068-2-6 / EN 60068-2-27	
• 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	
• Correct installation position	See chapter Installation position and minimum distances [► 26].	

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5.6 Dimensions

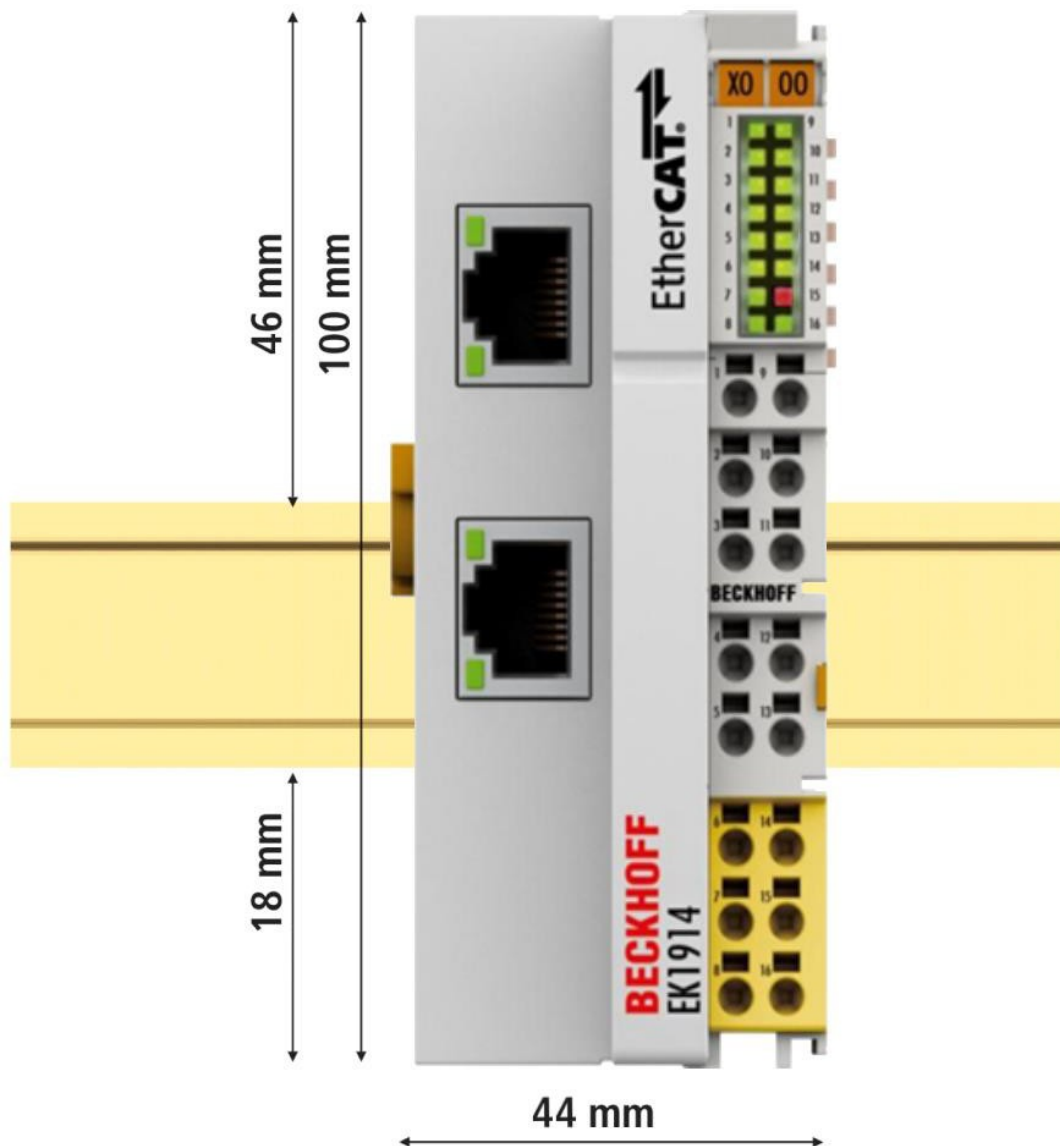


Fig. 5: Dimensions

Width: 44 mm

Height: 100 mm

Depth: 68 mm

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Installation

7 Installation

7.1 Safety instructions

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

7.2 Transport / storage

For transport and storage of the TwinSAFE components, use the original packaging in which the components were delivered.

⚠ CAUTION

Note the specified environmental conditions

Ensure that the digital TwinSAFE components are only transported and stored under the specified ambient conditions. The ambient conditions can be found in the technical data.

Incorrect transport or storage can damage the TwinSAFE components. Never use damaged TwinSAFE components. Dispose of the affected product.

7.3 Mechanical installation

⚠ WARNING

Only work on TwinSAFE components when they are de-energized

The Bus Terminal system is live. Set the Bus Terminal system to a safe, de-energized state before you start mounting, dismounting or wiring the TwinSAFE components.

If you work on the TwinSAFE components while the Bus Terminal system is live, you may be injured by electric shock. In addition, the device may be damaged.

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Installation

7.4.6 Pin assignment

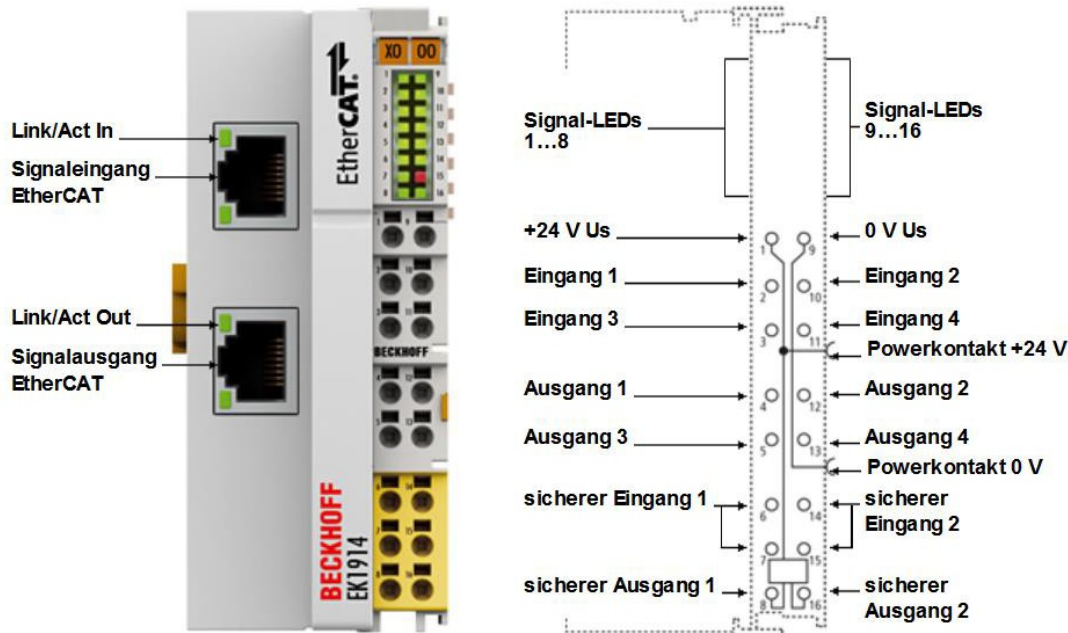


Fig. 12: Pin assignment of the EK1914

Terminalpoint	Signal	Description
1	+24V	Supply Voltage Us
2	In1	Standard input 1
3	In3	Standard input 3
4	Out 1	Standard output 1
5	Out 3	Standard output 3
6	Safe In1	Clock output safe input 1
7		Safe input 1
8	Safe Out 1	Safe output 1
9	0V	Supply Voltage Us
10	In2	Standard input 2
11	In4	Standard input 4
12	Out 2	Standard output 2
13	Out 4	Standard output 4
14	Safe In2	Clock output safe input 2
15		Safe input 2
16	Safe Out 2	Safe output 2

Configurable safe inputs

The safe inputs 1 and 2 can be optionally assigned with normally closed contacts or normally open contacts. The corresponding evaluation takes place in the safety PLC.

NOTE

Test pulses of the safe outputs

When selecting the actuators, ensure that the test pulses of the EK1914 do not lead to switching of the actuator or a diagnostic message of the EK1914.

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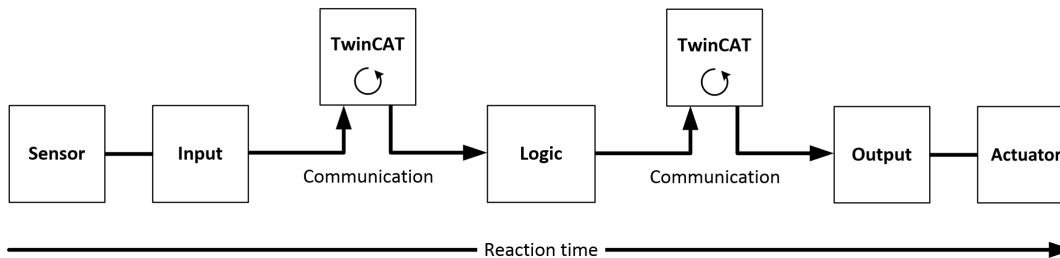
Installation

7.5 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.

7.5.1 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.



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

The following formula results for the typical reaction time:

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

i Example for reaction time calculation:

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

8 Configuration of the EK1914 in TwinCAT

⚠ CAUTION

Do not change register values

Do not make any changes to the CoE objects of the TwinSAFE bus coupler. Changes (e.g. via the SystemManager) to the CoE objects set the coupler permanently to the Fail-Stop state.

8.1 Inserting a Beckhoff TwinSAFE Bus Coupler

An EK1914 is inserted in the same way as any other Beckhoff Bus Coupler. In the list, open Safety Terminals and select the EK1914.

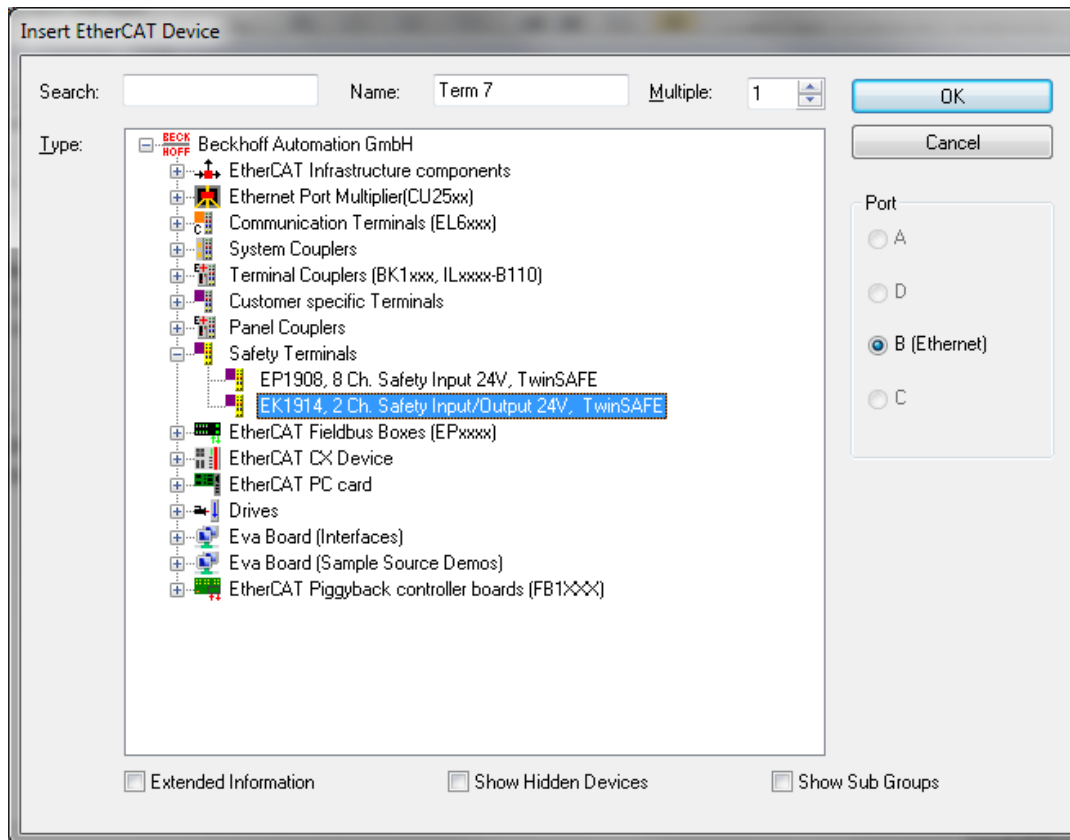


Fig. 20: Insert bus coupler

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Diagnosis

9 Diagnosis

9.1 Diagnosis LEDs

The LEDs Diag 1 (LED 7) and Diag 2 (LED 15) display diagnostic information for the EK1914.

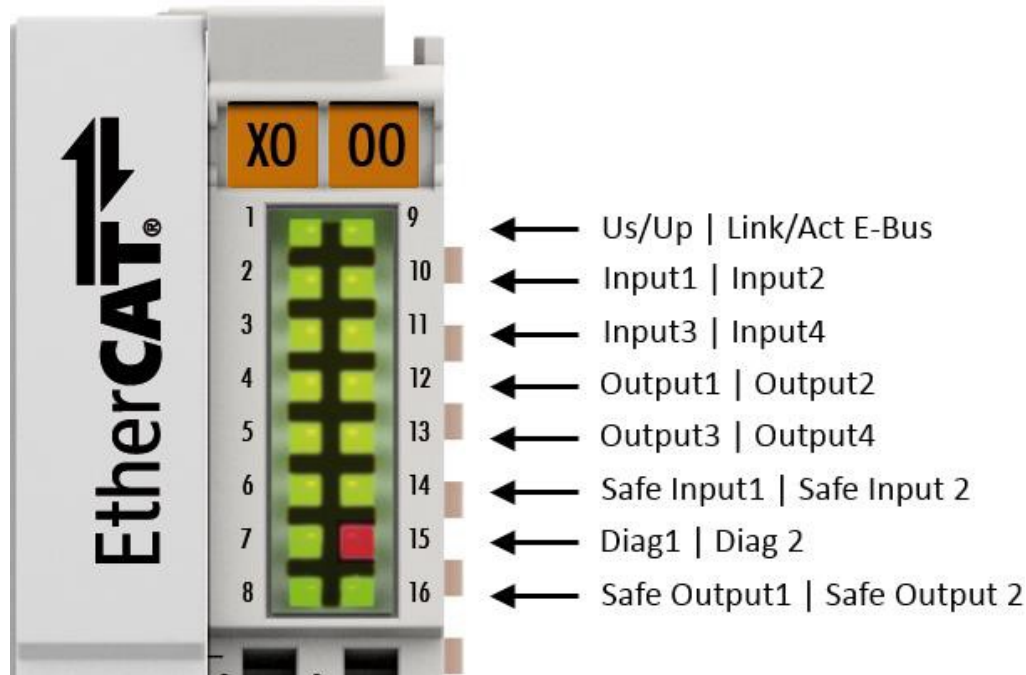


Fig. 26: Diagnosis LEDs

9.1.1 Diag1 (green)

The Diag 1 LED indicates the state of the TwinSAFE interface. The LED is set as soon as the FSoE State Reset is quit and TwinSAFE communication is thus started

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Diagnosis

9.3 Possible causes of diagnostic messages

Diagnosis	Possible cause	Remedial actions
Diag 2 LED 800E:0E / 800E:0F set to: 5.6 or greater than 100	If parameter <i>Testing of outputs active</i> is switched on:	
	Faulty test pulses. Cause: external supply or cross-circuit.	Eliminate cross-circuit or external supply.
	Faulty test pulses. Cause: parallel routed cables with high capacitive coupling and dynamized signals, possibly also in common cables	Isolate lines and lay in separate non-metallic sheathed cable. Create a distance between the non-metallic sheathed cables.
	Cause: current exceeds the limit of 500 mA.	Select actuator accordingly. Current < 500 mA
	Irrespective of whether the parameter <i>Testing of outputs active</i> is switched on:	
	The output voltage lies below the permissible voltage range (24 V -15%/+20%). A possible cause is a short-circuit at the output or e.g. a voltage drop at the instant of switching.	Eliminate short-circuit. Design power supply accordingly. Check supply lines for voltage drop.
	EMC faults	Take suitable EMC measures
	Internal defect	Exchange Bus Coupler
Diag 2 LED 800E:0E / 800E:0F set to: 11	Voltage on the power contacts too low.	Increase Bus Coupler supply voltage and reset error display by power-on reset of the Bus Coupler
	EMC faults	Take suitable EMC measures
	Internal defect	Exchange Bus Coupler
Diag 2 LED 800E:0E / 800E:0F set to: 10	Field potential too high. Voltage on the power contacts too high.	Decrease Bus Coupler supply voltage and reset error display by power-on reset of the Bus Coupler
	Field potential too high. Voltage on the power contacts too high.	Use an R/C or diode-based protective circuit on the actuators
	EMC faults	Take suitable EMC measures
	Internal defect	Exchange Bus Coupler

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Appendix

13.3 Certificate

BECKHOFF New Automation Technology		Originalerklärung Original declaration
EG-Konformitätserklärung EC Declaration of Conformity		
Nummer: 2017040EK1914-1, Datum: 31.07.2017 Number, Date		
Hersteller Manufacturer	Beckhoff Automation GmbH & Co. KG Hülshorstweg 20, 33415 Verl, Germany	
erklärt, dass das Produkt declares that the product	TwinSAFE EK1914 TwinSAFE-Buskoppler mit zwei fehlersicheren Eingängen und zwei fehlersicheren Ausgängen TwinSAFE Bus Coupler with two fail-safe inputs and two fail-safe outputs	
Sicherheitsbauteil nach EG-Richtlinie 2006/42/EG, Anhang IV safety component according to EC directive 2006/42/EC, annex IV		
den einschlägigen Bestimmungen der Maschinenrichtlinie 2006/42/EG entspricht. complies with the relevant requirements of the machinery directive 2006/42/EC.		
Angewandte Normen Applied Standards		
EN 62061:2005+A1:2013	Sicherheit von Maschinen – Funktionale Sicherheit sicherheitsbezogener elektrischer, elektronischer und programmierbarer elektronischer Steuerungssysteme Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems	
EN61131-2:2007	Speicherprogrammierbare Steuerungen - Teil 2: Betriebsmittelanforderungen und Prüfungen Industrial-process control systems - Instruments with analogue inputs and two- or multi-state outputs - Part 2: Guidance for inspection and routine testing	
EN 50581:2012	Technische Dokumentation zur Beurteilung von Elektro- und Elektronikgeräten hinsichtlich der Beschränkung gefährlicher Stoffe Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	
EN ISO 13849-1:2015	Sicherheit von Maschinen – Sicherheitsbezogene Teile von Steuerungen Safety of machinery – Safety-related parts of control systems	
EN 61000-6-2:2011	Elektromagnetische Verträglichkeit (EMV) – Störfestigkeit für Industriebereiche Electromagnetic compatibility (EMC) – Immunity for industrial environments	
EN 61000-6-4:2011	Elektromagnetische Verträglichkeit (EMV) – Störaussendung für Industriebereiche Electromagnetic compatibility (EMC) - Emission standard for industrial environments	
Die Übereinstimmung eines Baumusters des bezeichneten Produkts mit der EG-Richtlinie wurde bescheinigt von The accordance of a production sample of the designated product with the EC directive is certified by		
Benannte Stelle Notified body	TÜV SÜD Product Service GmbH Ridlerstraße 65, 80339 München, Germany	
EG-Baumusterprüfbescheinigung EC-type examination certificate	M6A 17 07 62386 040, 28.07.2017	
Verantwortlich für die Zusammenstellung der technischen Unterlagen Responsible for the compilation of technical documentation		
Bevollmächtigter Authorised person	Beckhoff Automation GmbH & Co. KG Hülshorstweg 20, 33415 Verl, Germany	
Verl. 31.07.2017  Dipl.-Phys. Hans Beckhoff	Geschäftsführer Beckhoff Automation GmbH & Co. KG CEO Beckhoff Automation GmbH & Co. KG	

Fig. 29: EK1914 EC Declaration of Conformity



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