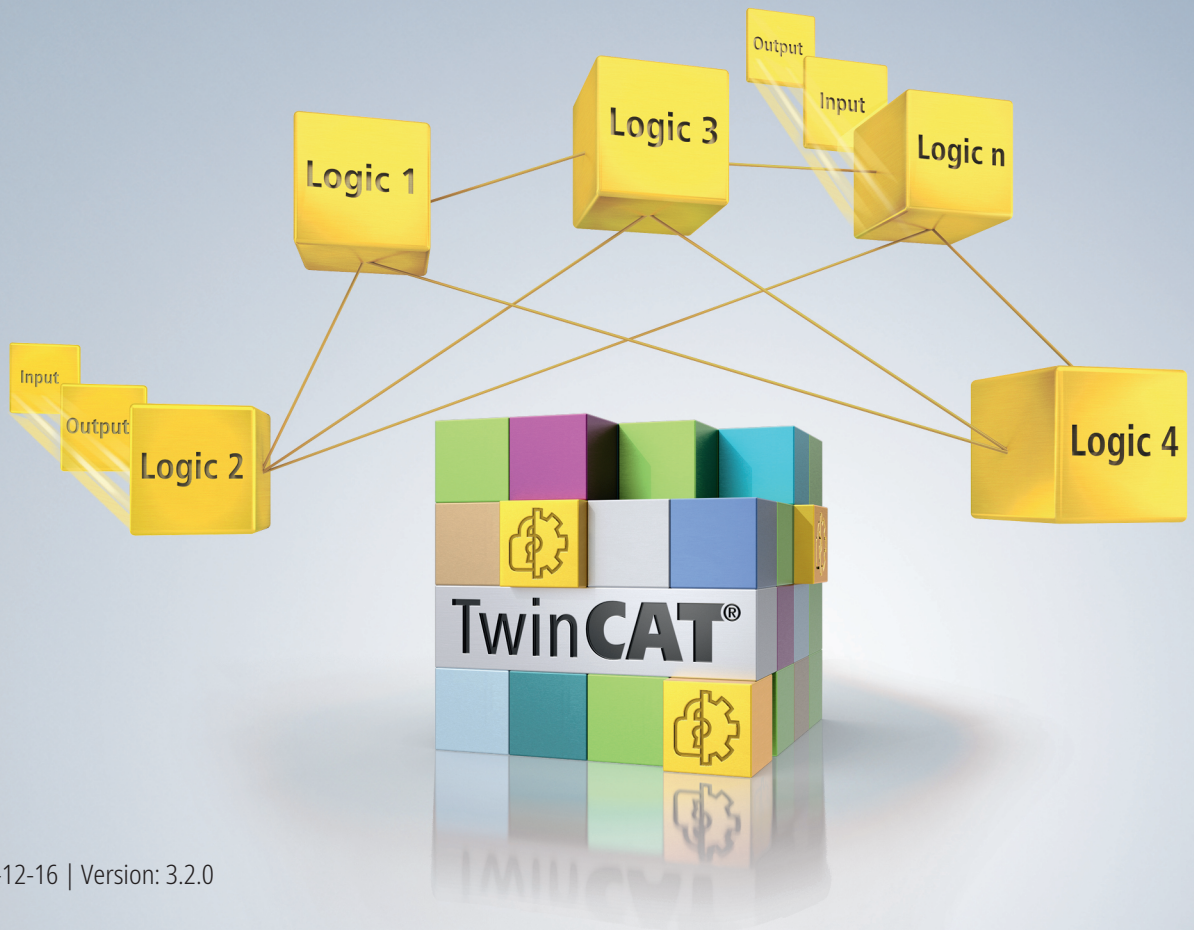
BECKHOFF New Automation Technology

Operating Instructions | EN

# EP1908

## TwinSAFE EtherCAT Box with 8 fail-safe inputs




2025-12-16 | Version: 3.2.0

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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 documentation at any time and without notice. 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.

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

### 1.1.1 Trademarks

Beckhoff®, TwinCAT®, TwinCAT/BSD®, TC/BSD®, EtherCAT®, EtherCAT G®, EtherCAT G10®, EtherCAT P®, Safety over EtherCAT®, TwinSAFE®, XFC®, XTS® and XPlanar® are registered and licensed trademarks of Beckhoff Automation GmbH.

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### 1.1.2 Limitation of liability

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

**The following is excluded from the liability:**

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

### 1.1.3 Copyright

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The distribution and reproduction of this document as well as the use and communication of its contents without express authorization are prohibited.
Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.

### 1.1.4 Third-party trademarks

Trademarks of third parties may be used in this documentation. You can find the trademark notices here: https://www.beckhoff.com/trademarks.

## 1.2 Documentation issue status

| Version | Comment |
|---|---|
| 3.2.0 | • Chapter name changed to “Documentation issue status”<br>• Editorially revised<br>• "System description" chapter removed<br>• In chapter "Address settings on the TwinSAFE EtherCAT Box" information and link to STP file with switch added |
| 3.1.0 | • Chapter "Lifetime" moved<br>• Chapter "Notes on information security", "Version history" and “Laser image” added<br>• Chapter "Duty of care" expanded<br>• Chapter "Support and service" revised<br>• "Safety parameters" changed to "Target failure measures" and “Service life” changed to “Lifetime”<br>• Appendix extended with links to certificates and declarations of conformity<br>• Correction in chapter “EtherCAT connection” |
| 3.0.0 | • Foreword changed to "Documentation notes" and "For your safety"<br>• Added a link to certificate download page in chapter "Technical data"<br>• "Service life" moved<br>• "Maintenance and cleaning" and "Decommissioning" adapted<br>• Appendix adapted and extended |
| 2.2.0 | • Characteristic curve of the inputs added<br>• Notes on earthing connection added<br>• Descriptions $U_S$ updated |
| 2.1.1 | • Technical data for *permissible air pressure* extended |
| 2.1.0 | • Chapter *EP1908 process image* added |
| 2.0.0 | • Migration and structural adaptation<br>• Reliability document updated<br>• Safety parameters updated<br>• Foreword revised |
| 1.2.2 | • Reliability document added<br>• Description of the test pulses added<br>• Reaction time in the technical data updated |
| 1.2.1 | • Certificate updated |
| 1.2.0 | • Company address changed<br>• Documentation versions added<br>• DateCode description added<br>• HFT and element classification according to EN 61508:2010 added |
| 1.1.2 | • Clock output currents in the technical data added<br>• Notes regarding the M8 and M12 connectors expanded |
| 1.1.1 | • Reference to EN 60068-2-29 removed |
| 1.1.0 | • First released version |

**Currentness**

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/twinsafe. In case of doubt, contact Support and Service [▶ 11].

### 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 Version history of the TwinSAFE product

This version history lists the software and hardware version numbers. You will also find a description of the changes to previous versions contained in each case. See the table below for more information.

**Updated hardware and software**

TwinSAFE products are subject to a cyclical revision. We reserve the right to revise and change the TwinSAFE products at any time and without prior notice.
No claims for changes to products already delivered can be asserted from these hardware and/or software changes.

| Software version | Hardware version | Modifications |
|---|---|---|
| 02 | 07 | This table is maintained from SW version 02 and HW version 07. |

## 1.4 References

| No. | Version | Description |
|---|---|---|
| [1] | / | Not used. |
| [2] | / | Not used. |
| [3] | 1.4.1 or newer | **Operating Manual for EL6910 TwinSAFE Logic Module**<br>The document contains a description of the logic functions of the EL6910 and its programming. |
| [4] | 3.1.0 or newer | **Dokumentation TwinSAFE-Logic-FB**<br>The document describes the safety-related function blocks that are available in the EL6910 and thus also in the TwinSAFE card and form the safety-related application. |
| [5] | 3.1.0 or newer | **TwinSAFE Application Guide**<br>The application guide provides the user with examples for the calculation of safety-related parameters for safety functions according to the standards DIN EN ISO 13849-1 and EN 62061 or EN 61508:2010, as they are typically used on machines. |
| [6] | 2023/1230 | **Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC**<br>This regulation, also known as the Machinery Regulation, defines requirements for placing machinery and machine-like components, such as safety components, on the market. |
| [7] | 2017 | **EN 61511-1:2017**<br>The standard serves as a basic safety standard for functional safety in the process industry and is tailored to its safety-related systems. |

## 1.5 Staff qualification

These operating instructions are intended exclusively for trained specialists in control technology and automation with the relevant knowledge.

The trained specialist personnel must ensure that the applications and use of the described product meet all safety requirements. This includes all applicable and valid laws, regulations, provisions and standards.

**Trained specialists**

Trained specialists have extensive technical knowledge from studies, apprenticeships or technical training. Understanding of control technology and automation is available. Trained specialists can:

- Independently identify, avoid and eliminate sources of hazard.
- Apply relevant standards and directives.
- Implement specifications from accident prevention regulations.
- Evaluate, prepare and set up the workplaces.
- Evaluate, optimize and execute work independently.

## 1.6 Safety and instruction

Read the contents that refer to the activities you have to perform with the product. Always read the chapter For your safety [▶ 13] in the operating instructions.

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

### Explanation of symbols

Various symbols are used for a clear arrangement:

1. The numbering indicates an action that should be taken.
• The bullet point indicates an enumeration.
[…] The square brackets indicate cross-references to other text passages in the document.
[1] The number in square brackets indicates the numbering of a referenced document.

The signal words used in the documentation are classified below.

### Signal words

### Warning of personal injuries

| ⚠ DANGER |
| --- |
| Hazard with high risk of death or serious injury. |

| ⚠ WARNING |
| --- |
| Hazard with medium risk of death or serious injury. |

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

### Warning of damage to property or environment

| *NOTICE* |
| --- |
| **Notes**<br>The environment, equipment, or data may be damaged. |

### Information on handling the product

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

## 1.7 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.

### Download finder

Our download finder contains all the files that we offer you for downloading. You will find application reports, technical documentation, technical drawings, configuration files and much more.

The downloads are available in various formats.

### Beckhoff's branch offices and representatives

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

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You will also find further documentation for Beckhoff components there.

### Beckhoff Support

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

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

| | |
|---|---|
| Hotline: | +49 5246 963-157 |
| e-mail: | support@beckhoff.com |

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- repair service
- spare parts service
- hotline service

| | |
|---|---|
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| web: | www.beckhoff.com |

## 1.8 Notes on information security

The products of Beckhoff Automation GmbH & Co. KG (Beckhoff), insofar as they can be accessed online, are equipped with security functions that support the secure operation of plants, systems, machines and networks. Despite the security functions, the creation, implementation and constant updating of a holistic security concept for the operation are necessary to protect the respective plant, system, machine and networks against cyber threats. The products sold by Beckhoff are only part of the overall security concept. The customer is responsible for preventing unauthorized access by third parties to its equipment, systems, machines and networks. The latter should be connected to the corporate network or the Internet only if appropriate protective measures have been set up.

In addition, the recommendations from Beckhoff regarding appropriate protective measures should be observed. Further information regarding information security and industrial security can be found in our https://www.beckhoff.com/secguide.

Beckhoff products and solutions undergo continuous further development. This also applies to security functions. In light of this continuous further development, Beckhoff expressly recommends that the products are kept up to date at all times and that updates are installed for the products once they have been made available. Using outdated or unsupported product versions can increase the risk of cyber threats.

To stay informed about information security for Beckhoff products, subscribe to the RSS feed at https://www.beckhoff.com/secinfo.

# 2 For your safety

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 [▶ 5].
- 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.

The operator is also responsible for the safe operation of the system. This includes risk assessment. The following standards apply for risk assessment:

- EN ISO 12100:2010, Safety of machinery – General principles for design – Risk assessment and risk reduction
- ISO 13849-1, Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design

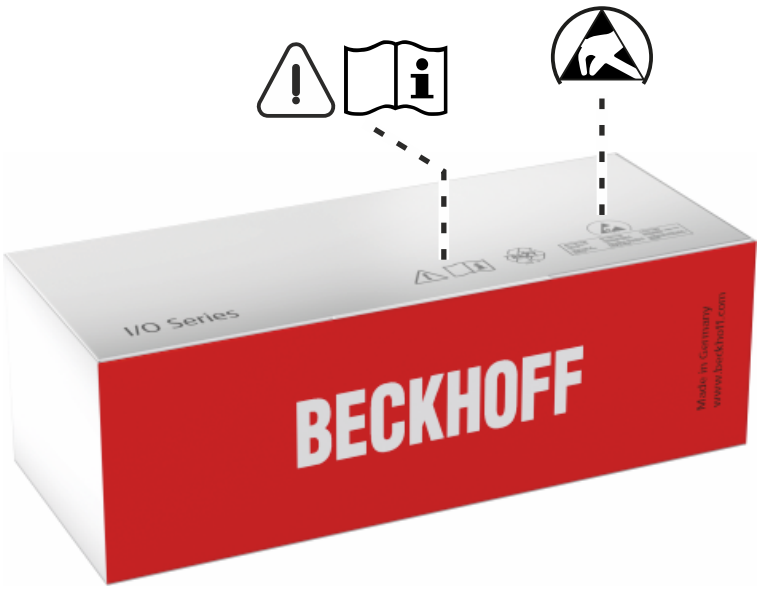
Beckhoff is not responsible for the safe operation of the system.



**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

Beckhoff products feature safety pictograms, either on stickers or printed, which vary depending on the product. They serve to protect people and to prevent damage to the products. Safety pictograms may 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 the warnings.



**Electrostatic sensitive components**
Work with and on the TwinSAFE component is only permitted at protected workplaces.

# 2.3 General safety instructions

## 2.3.1 Before operation

**Use in machines according to the Machinery Regulation and EN 61511**

Only use the TwinSAFE component in machines that comply with the Machinery Directive and the EN 61511 standard for the process industry. This will ensure safe operation.

Refer to the documents [6] and [7] under References [▶ 8].

**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.

## 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 [▶ 51].

# 3 Product description

## 3.1 EP1908-0002

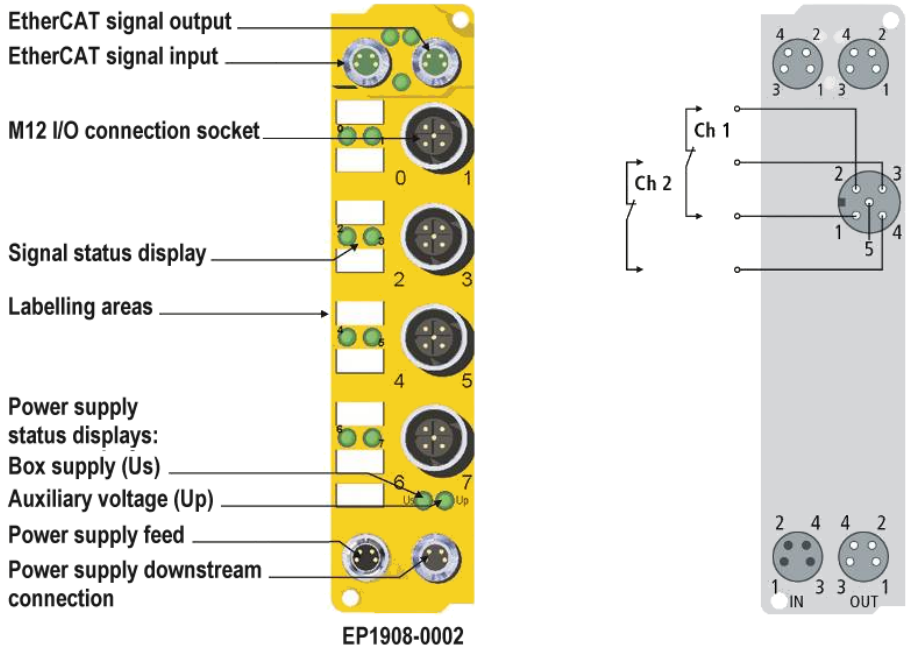



Fig. 1: EP1908

The EP1908-0002 is an EtherCAT Box with digital inputs for 24 $V_{DC}$ encoders or for potential-free contacts. The EtherCAT Box has 8 fail-safe inputs.

In addition to the possibility to read potential-free contacts, the EP1908-0002 also supports the connection of encoders with OSSD signals whose test pulse length does not exceed 350 µs and of safety mats that operate based on the cross-circuit principle.

Frequency measurement is also supported, in order to enable standstill and speed monitoring. The frequency below which a logical 1 is reported at the input is specified in steps of 0.1 Hz. The module supports a minimum frequency of 2 Hz and a maximum frequency of 500 Hz. Frequencies above 500 Hz lead to a diagnostic message from the module. In this case all inputs are set to safe state (logical 0). This message can be reset through a positive edge of the safe output signal ErrAck of the EP1908-0002.

With a two-channel connection, the EP1908-0002 meets the requirements of EN 61508-1:2010 SIL 3 and DIN EN ISO 13849-1:2023 (Cat 4, PL e).

The control voltage $U_S$ supplies the module electronics. The sensors (clock outputs) are supplied from the control voltage $U_P$.

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

## 3.2 Intended use

Operate the TwinSAFE component exclusively for the intended activities defined in this documentation, taking into account the prescribed values.

The functions allow the Beckhoff TwinSAFE components to be used in the field of machine safety and as safety devices for the process industry. The intended field of application for TwinSAFE components is safety functions on machines and process control technology in accordance with EN 61511 and the directly associated tasks in industrial automation.

TwinSAFE components are therefore only approved for applications with a defined "fail-safe state". This safe state is the de-energized. Fail-safety according to the relevant standards is required.

The TwinSAFE EtherCAT Box allows the connection of:

24 $_{VDC}$ sensors such as

- emergency shutdown push buttons, rope pull switches, position switches, two-hand switches, safety mats, light curtains, light barriers, laser scanners etc.
- Initiators and rotary encoders for the measurement of rotary speed (frequency) with a signal voltage of 24 $V_{DC}$

**⚠ WARNING**

**Improper use**

Any use which exceeds the permissible written values from the chapter Technical data [▶ 18] or which does not observe other specifications from these operating instructions or other documents of the overall documentation is considered to be not in accordance with the intended use and is therefore prohibited.

This applies in particular to the use cases defined by Beckhoff Automation, which have been fully tested and certified and whose properties and operating conditions can be guaranteed. Use cases beyond this are regarded as inappropriate and require the approval of Beckhoff Automation.

*Improper use will result in loss of safety and invalidation of certifications and approval*.

## 3.3 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 | EP1908-0002 |
|---|---|
| Fieldbus | EtherCAT |
| Number of inputs | 8 |
| Connecting the inputs | M12 |
| Status display | 8 (one green LED per input) |
| Reaction time<br>(read input/write to E-bus) | typically: 5.5 ms,<br>maximum: see fault reaction time |
| Watchdog time | adjustable from 2 ms to 60 s |
| Fault reaction time | ≤ watchdog time |
| Frequency range for speed measurement | 2 Hz to 500 Hz |
| Cable length between sensor and EtherCAT Box | Unshielded: max. 30 m (0.75 or 1 mm²) |
| | Shielded: max. 30 m (0.75 or 1 mm²) |
| Output current of the clock outputs | typically 10 mA, max. 15 mA |
| Input process image | 6 byte |
| Output process image | 6 byte |
| Supply voltage for the EP1908 | 24 $V_{DC}$ (–15% / +20%) |
| Current consumption $U_S$<br>(wired with 8 potential-free contacts) | 8 channels occupied: typically 87 mA<br>0 channels occupied: typically 80 mA |
| Current consumption from $U_P$<br>(connected with 8 potential-free contacts) | 8 channels occupied: approx. 27 mA<br>0 channels occupied: approx. 6 mA |
| Power loss of the EtherCAT Box | typically 3 watts |
| Electrical isolation (between the channels) | no |
| Electrical isolation (between the channels and EtherCAT) | yes |
| Insulation voltage (between the channels and EtherCAT, under common operating conditions) | Insulation tested with 500 $V_{DC}$ |
| Dimensions (W x H x D) | 30 mm x 126 mm x 26.5 mm |
| Housing material | PA6-F (polyamide) |
| Sealing compound | Polyurethane |
| Weight | approx. 170 g |
| Permissible ambient temperature (operation) | -25 °C ... +60 °C |
| Permissible ambient temperature (transport/storage) | -40 °C ... +85 °C |
| Permissible air humidity | 5% ... 95%, non-condensing |
| Permissible air pressure (operation/storage/transport) | 750 hPa ... 1100 hPa<br>(this is equivalent to an altitude of approx. -690 m to 2450 m above sea level assuming an international standard atmosphere) |
| Inadmissible operating conditions | TwinSAFE EtherCAT Boxes must not be used under the following conditions:<br>• under the influence of ionizing radiation (exceeding the natural background radiation)<br>• in corrosive environments[1] |
| EMC immunity / emission | conforms to EN 61000-6-2 / EN 61000-6-4 |
| Vibration / shock resistance | conforms to EN 60068-2-6 / EN 60068-2-27 |
| Shocks | 15 g with pulse duration 11 ms in all three axes |
| Protection rating (when screwed together) | IP65, IP66, IP67 (according to EN 60529) |
| Permissible installation position | variable |
| Approvals | CE, TÜV SÜD |

[1] A corrosive environment exists when corrosion damage becomes apparent.

## 3.4 Target failure measures

**Calculation of the $MTTF_D$ value from the $PFH_D$ value**

For calculation and estimation of the values described in the following table, refer to the following documentation:

- TwinSAFE Application Guide
- EN ISO 13849-1:2023; table K.1.

In terms of target failure measures, the FSoE communication is considered with 1 % of SIL 3 according to the protocol specification.

The TwinSAFE component is intended for use in safety-related applications. It meets the following standards:

- IEC 61508:2010 up to SIL 3
- EN ISO 13849-1:2023 up to PL e, category 4

| Target failure measures | | Explanation |
|---|---|---|
| Lifetime | 20 a | |
| Prooftest interval | / | Special proof tests during the entire lifetime of the TwinSAFE card are not required. |
| $PFH_D$ | 1.56E-09 | |
| %SIL3 | 1,56 % | |
| PFD | 1.06E-04 | |
| %SIL3 | 10,59 % | |
| $MTTF_d$ | high | |
| DC | high | |
| SIL CL | 3 | according to EN 62061:2005/A2:2015 |
| SIL | 3 | according to IEC 61508:2010. |
| Performance level | e | according to EN ISO 13849-1:2023. |
| CAT | 4 | according to EN ISO 13849-1:2023. |
| SFF | > 99 % | |
| HFT | 1 | |
| Element classification | Type B | according to EN 61508-2:2010, chapter 7.4.4.1.2 and 7.4.4.1.3. |

For further information, please refer to the chapter Lifetime [▶ 23].

## 3.5 Laser image

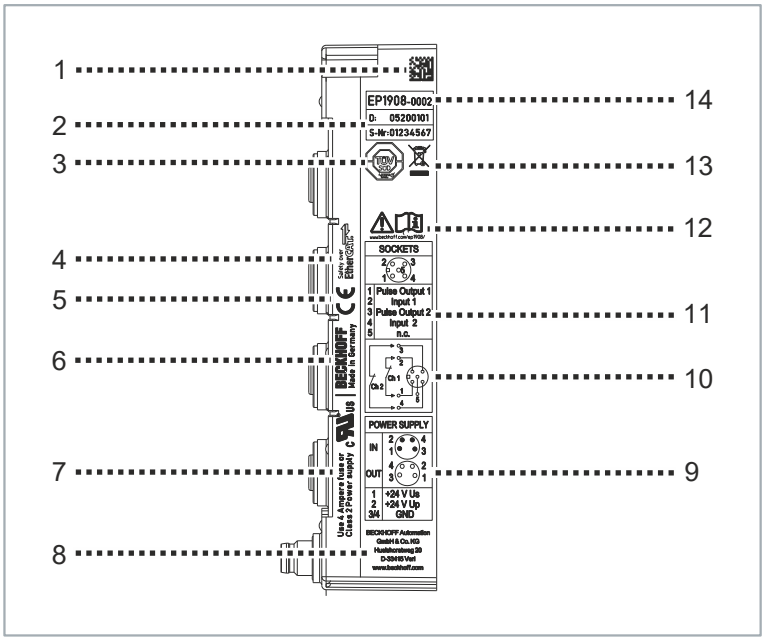



Fig. 2: EP1908 laser image

| Item number | Explanation |
|---|---|
| 1 | Data matix code of the serial number |
| 2 | Serial Number<br>Date Code<br>WW = calendar week of manufacture<br>JJ = year of manufacture<br>SW = software version<br>HW = hardware version |
| 3 | Mark of conformity TÜV SÜD functional safety |
| 4 | Safety over EtherCAT logo |
| 5 | Mark of conformity CE |
| 6 | Manufacturer logo, country of manufacture |
| 7 | Mark of conformity cURus |
| 8 | Address of the vendor, country of manufacture, website |
| 9 | Labeling of the connector pin assignment of the supply |
| 10 | Labeling of the channels |
| 11 | Labeling of the connector pin assignment |
| 12 | Product label “Read operating instructions”, website |
| 13 | Labeling of products that must not be disposed of with domestic waste in accordance with Directive 2012/19/EU |
| 14 | Product designation |

## 3.6 Characteristic curve of the inputs

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

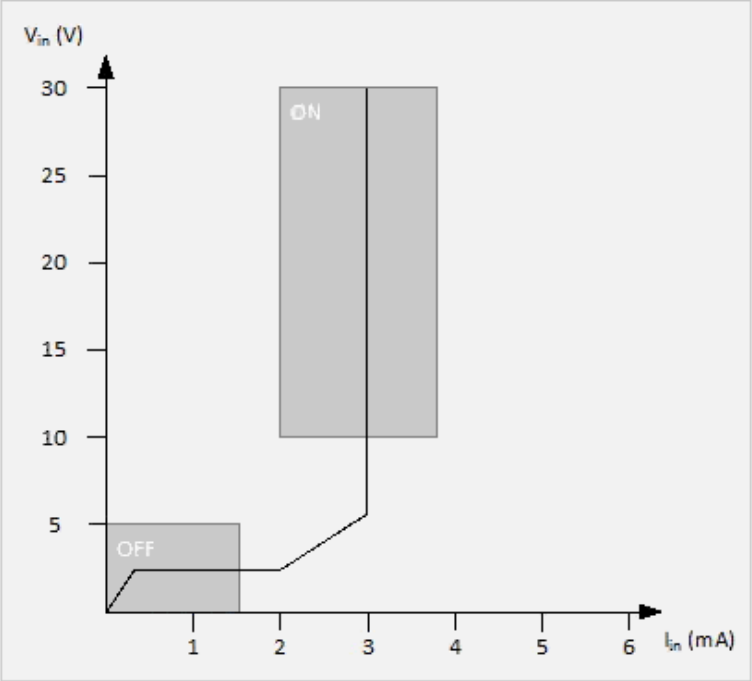



Fig. 3: Characteristic curve of the inputs

## 3.7 Dimensions

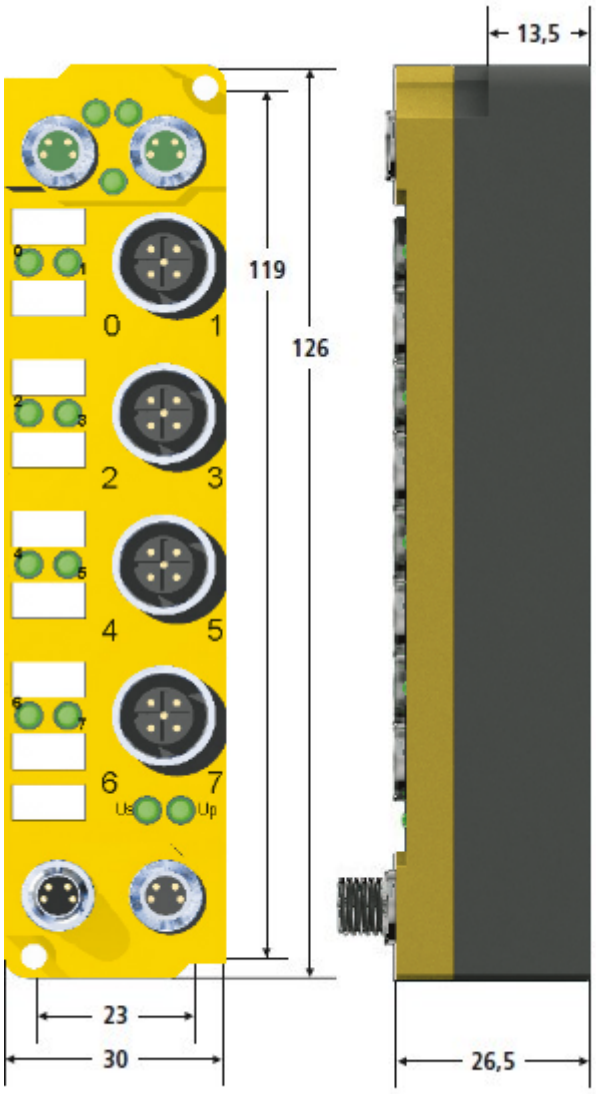



Fig. 4: Dimensions

The modules have the following dimensions.
Width: 30 mm
Height: 126 mm
Depth: 26.5 mm

When fully wired, the connected cables increase the total depth of the module.

## 3.8 Lifetime

TwinSAFE components have a lifetime of 20 years, during which the target failure measures are guaranteed. For more information, see chapter Target failure measures [▶ 19]:

The lifetime starts from the date of manufacture according to the Date Code.

**⚠ WARNING**

**Replace TwinSAFE component after 20 years**

After a lifetime of 20 years, the target failure measures are no longer guaranteed.

*Use beyond the lifetime may result in loss of safety.*

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

The TwinSAFE components bear a Date Code, which is composed as follows:

Date Code: CW YY SW HW

| Legend: | Example: 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 components bear a unique serial number.

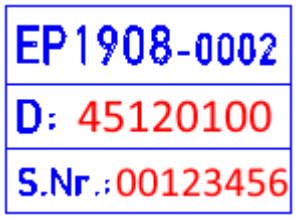



Fig. 5: Unique serial number (S.No.) of a TwinSAFE EtherCAT Box

# 4 Operation

## 4.1 Environmental conditions

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

**⚠ WARNING**

**Risk of injury!**

The TwinSAFE EtherCAT boxes must not be used under the following conditions.

- under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation)
- in corrosive environments

***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.

## 4.2 Installation

### 4.2.1 Safety instructions

Before installing and commissioning the TwinSAFE components read the safety instructions in 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 Address settings on the TwinSAFE EtherCAT Box

**Position of the rotary switch**

The exact position of the rotary switch on the TwinSAFE component can be found in the STP file on the product page and in the download finder on the Beckhoff website.

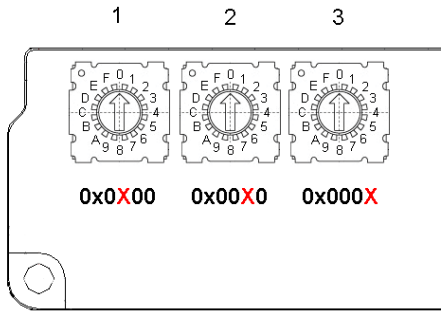



Fig. 6: Rotary switch for setting the TwinSAFE address

The TwinSAFE address of the Box must be set using the three rotary switches on the underside of the TwinSAFE-EP Box. TwinSAFE addresses between 1 and 4095 are available.

| Rotary switch | | | Address |
|---|---|---|---|
| 1 (left) | 2 (center) | 3 (right) | |
| 0 | 0 | 1 | **1** |
| 0 | 0 | 2 | **2** |
| 0 | 0 | 3 | **3** |
| … | … | … | **…** |
| 0 | 0 | F | **15** |
| 0 | 1 | 0 | **16** |
| 0 | 1 | 1 | **17** |
| … | … | … | **…** |
| 0 | F | F | **255** |
| 1 | 0 | 0 | **256** |
| 1 | 0 | 1 | **257** |
| … | … | … | **…** |
| F | F | F | **4095** |

**⚠ WARNING**

**TwinSAFE address**

Each TwinSAFE address set may only occur once within a network or configuration.
The address 0 is not a valid address.

## 4.2.4 Mounting

**Protect connectors against soiling**

Protect all connections from contamination during module installation!

Protection class IP67 can only be guaranteed if all cables and connectors are connected!

Unused connections must be protected with the appropriate connectors (connector sets see catalogue)!

The modules are mounted with two M3 screws. The bolts must be longer than 15 mm. The fixing holes are not threaded. Note when mounting that the overall height is increased further by the fieldbus connections.

**Mounting rail ZS5300-0001**

The mounting rail ZS5300-0001 (500 mm x 129 mm) allows time-saving configuration of the modules. The rail is made of 1.5 mm thick stainless steel (V2A) and features ready-made M3 threads. Use M5 screws (5.3 mm oblong holes) to attach the rail to the machine.

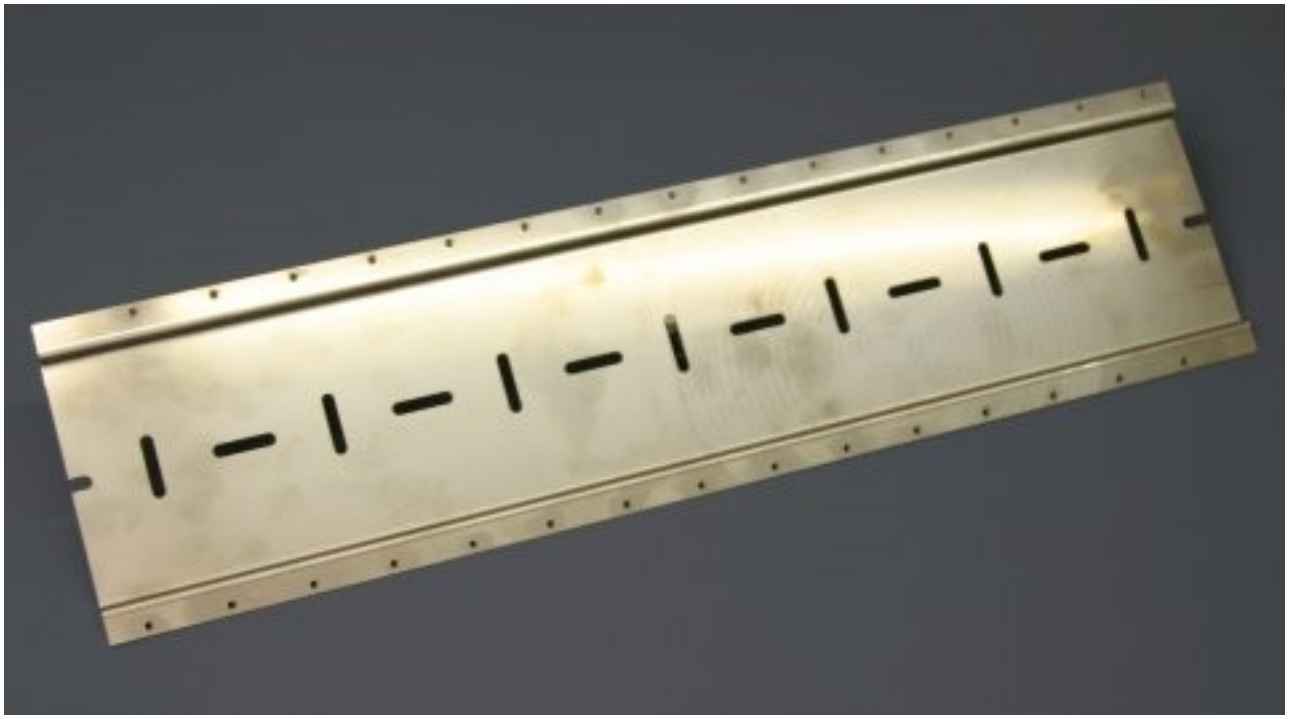


Fig. 7: Mounting rail ZS5300-0001

The rail is 500 mm long and enables the installation of 15 modules, with a distance of 2 mm between them. It can be shortened as required for your particular application.

## 4.2.5 Connection

### 4.2.5.1 Tightening torque for connectors

The plug connectors should be tightened with the recommended torque.

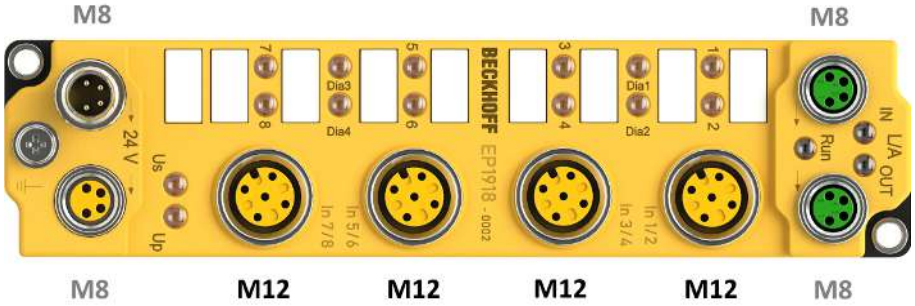



Fig. 8: EtherCAT Box with M8 and M12 connectors

| Type | Connection | Nm | ft-lb |
|---|---|---|---|
| M8 | Power supply, EtherCAT | 0,4 | 0,3 |
| M12 | Input signals | 0,6 | 0,44 |

**Torque wrench**



Fig. 9: Torque wrench ZB8801

**Ensure the proper torque is used**

Use torque wrenches available from Beckhoff to tighten the plug connectors (see accessories)!

### 4.2.5.2 EtherCAT connection

The EtherCAT Box (EPxxxx) has two M8 connectors marked **green** for the incoming and outgoing EtherCAT connection.

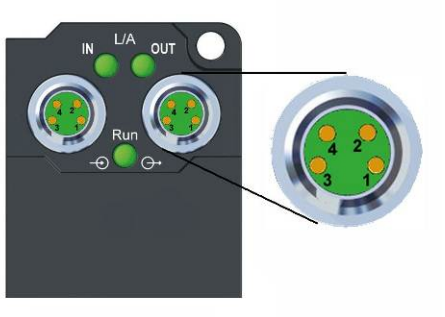



Fig. 10: EtherCAT Box: M8, 30 mm housing

**Assignment**

There are various different standards for the assignment and colors of connectors and cables for EtherCAT.

| EtherCAT | Connector | Cable | | Standard |
|---|---|---|---|---|
| **Signal** | **M8** | **ZB9010, ZB9020, ZK1090-6292** | **ZB903x, ZK1090-31xx** | **TIA-568B** |
| Tx + | Pin 1 | yellow1 | orange/white2 | white/orange |
| Tx - | Pin 4 | orange1 | orange2 | orange |
| Rx + | Pin 2 | white1 | blue/white2 | white/green |
| Rx - | Pin 3 | blue1 | blue2 | green |
| Shield | Housing | Shield | Shield | Shield |

1) Wire colors according to EN 61918

2) Wire colors

### 4.2.5.3 EtherCAT- Fieldbus LEDs




Fig. 11: EtherCAT LEDs

**LED indicators**

| LED | Display | Meaning |
|---|---|---|
| IN L/A | off | no connection to the preceding EtherCAT module |
| | lit | LINK: connection to the preceding EtherCAT module |
| | flashing | ACT: communication with the preceding EtherCAT module |
| OUT L/A | off | no connection to the following EtherCAT module |
| | lit | LINK: connection to the following EtherCAT module |
| | flashing | ACT: Communication with the following EtherCAT module |
| Run | - | See chapter 4.4.1 [▶ 38] |

### 4.2.5.4 EtherCAT cables

For connecting EtherCAT devices only Ethernet cables that meet the requirements of at least **category 5 (CAT5) according to EN 50173 or ISO/IEC 11801** should be used.

**Wiring recommendations**

Detailed recommendations for EtherCAT wiring can be found in the documentation "Design recommendations for EtherCAT/Ethernet infrastructure", which is available for download from www.Beckhoff.de.

EtherCAT uses four cable wires for signal transmission. Due to automatic cable detection (auto-crossing) symmetric (1:1) or cross-over cables can be used between EtherCAT devices from BECKHOFF.

### 4.2.5.5 Power Connection

Two M8 connectors at the low-end of the modules are used for feeding and forwarding the supply voltages:

- IN: left M8 connector for feeding the supply voltages
- OUT: right M8 connector for forwarding the supply voltages
- Grounding screw: The grounding screw is installed in the factory. An additional M3 ring cable lug and the grounding cable are required for the installation.

**Ground connection**

It is recommended to connect the earth connection to PE with low resistance.




Fig. 12: Connections for the supply voltages

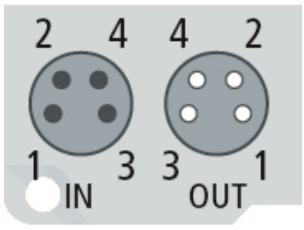



Fig. 13: Pin assignment of the M8 connector the supply voltages

| Contact | Voltage |
|---|---|
| 1 | Control voltage Us, +24 $V_{DC}$ |
| 2 | Peripheral voltage Up, +24 $V_{DC}$ |
| 3 | GNDs* |
| 4 | GNDp* |
| PE | Ground connection |

The contacts of the M8 connectors can conduct a maximum current of 4 A.

Two LEDs indicate the status of the supply voltages.

**NOTICE**

**Do not confuse the power port with EtherCAT port!**

Never connect the power cables (M8, 24 $V_{DC}$) to the green-marked EtherCAT sockets of the EtherCAT Box modules. This can cause the destruction of the modules!

### Control voltage Us: 24 $V_{DC}$

The fieldbus, the processor logic and the inputs are supplied from the 24 $V_{DC}$ control voltage Us. The control voltage is electrically isolated from the fieldbus circuitry.

### Peripheral voltage Up: 24 $V_{DC}$

The peripheral voltage Up supplies the digital clock outputs; it can be brought in separately. Hence, if the load voltage is switched off, the fieldbus function as well as the supply and function of the inputs are retained.

### Redirection of the supply voltages

The power IN and OUT connections are bridged in the module. Hence, the supply voltages Us and Up can be passed from EtherCAT Box to EtherCAT Box in a simple manner.

**⚠ CAUTION**

**Note the maximum current!**

Ensure that the maximum permitted current of 4 A for the M8 connectors is not exceeded when forwarding the supply voltages Us and Up!

### 4.2.5.6 Status-LEDs for the power supply




Fig. 14: Status LEDs for the power supply

| LED | Display | Meaning |
|---|---|---|
| $U_S$ (control voltage) | off | Supply voltage $U_S$ is not present |
| | green illuminated | Supply voltage $U_S$ is present |
| $U_P$ (peripheral voltage) | off | Supply voltage $U_P$ is not present |
| | green illuminated | Supply voltage $U_P$ is present |

### 4.2.5.7 Overvoltage protection

If protection against overvoltage is necessary in your system, provide a protective circuit (surge filter) against overvoltage for the power supply to the EtherCAT Box.

### 4.2.5.8 Signal connection

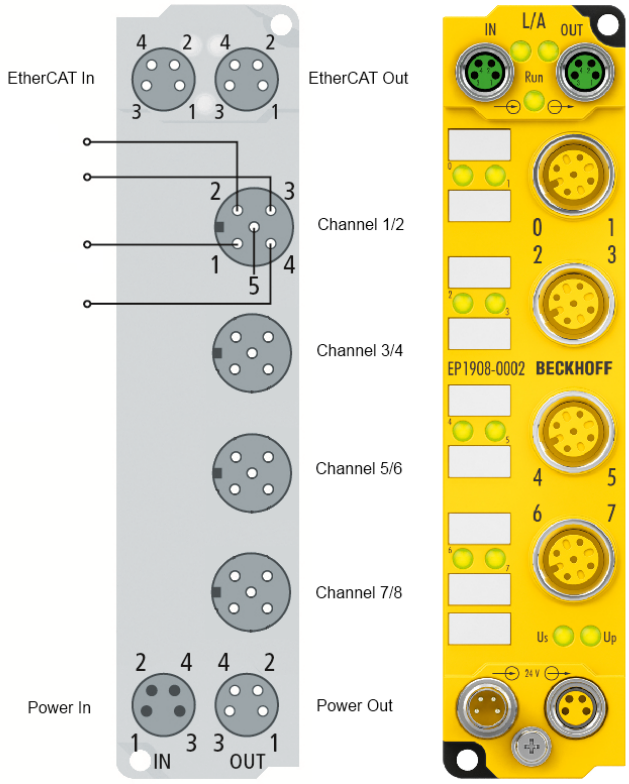



Fig. 15: Signal connection

| M12 connection | Contact | Channel | Signal |
|---|---|---|---|
| 1 | 1 | 1 | Pulse output 1 |
| | 2 | | Input 1 |
| | 3 | 2 | Pulse output 2 |
| | 4 | | Input 2 |
| | 5 | - | not connected |
| 2 | 1 | 3 | Pulse output 3 |
| | 2 | | Input 3 |
| | 3 | 4 | Pulse output 4 |
| | 4 | | Input 4 |
| | 5 | - | not connected |
| 3 | 1 | 5 | Pulse output 5 |
| | 2 | | Input 5 |
| | 3 | 6 | Pulse output 6 |
| | 4 | | Input 6 |
| | 5 | - | not connected |
| 4 | 1 | 7 | Pulse output 7 |
| | 2 | | Input 7 |
| | 3 | 8 | Pulse output 8 |
| | 4 | | Input 8 |
| | 5 | - | not connected |

**Configurable inputs**

The inputs 1 to 8 can be occupied as you want with normally closed contacts or normally open contacts. The corresponding analysis is carried out in the safety PLC.

## 4.2.6 Signal cables

### Permitted cable length

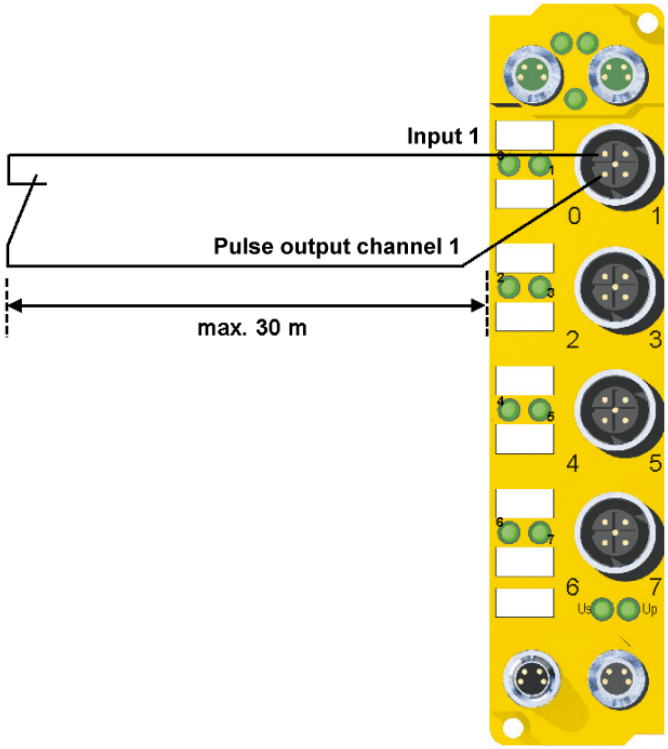



Fig. 16: Permitted cable length

When connecting a single switching contact via a dedicated continuous cable (or via a non-metallic sheathed cable), the maximum permitted cable length is 30 m if a sensor test is active.

The use of contact points, plug connectors or additional switching contacts in the cabling also reduces the maximum propagation.

### Cable routing

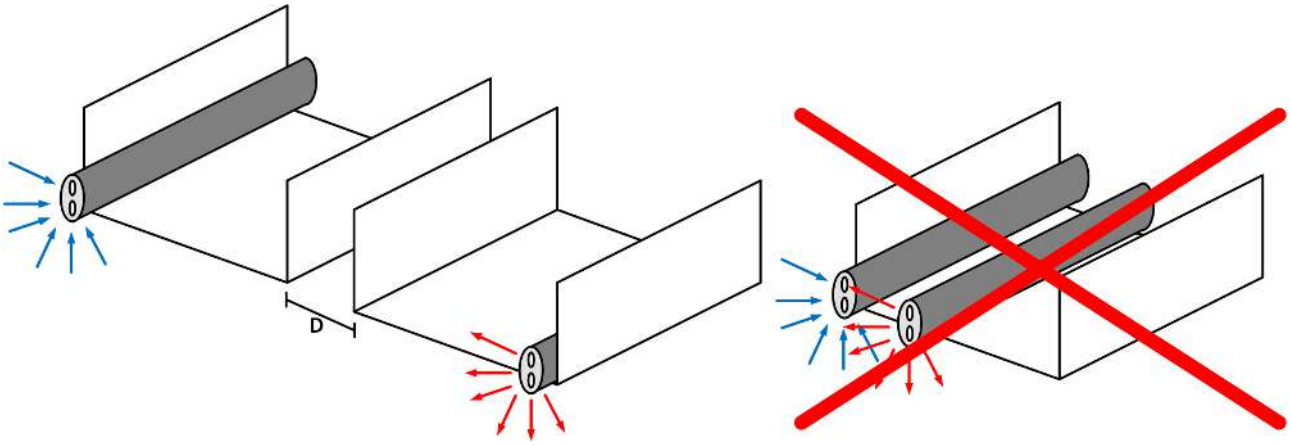



Fig. 17: Cable routing

**NOTICE**

**Route the signal cable separately**

The signal cable must be routed separately from potential sources of interference, such as motor supply cables, 230 $V_{AC}$ power cables etc.!
Interference caused by cables routed in parallel can influence the signal form of the test pulses and thus cause diagnostic messages (e.g. sensor errors or OpenLoad errors).
D: Distance between the cable ducts should be as large as possible
blue arrows: signal line
red arrows: potential source of interference

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

The test pulses can be switched off (sensor test parameter) if the connection of a common cable is unavoidable. However, this then leads to a reduction in the degree of diagnostic cover when calculating the performance level.

### 4.2.7 Description of the EP1908 test pulses

The typical length of a test pulse (switching from 24 V to 0 V and back to 24 V) is 350 µs and takes place approx. 180 times per second.

The test pulses at the outputs Pulse Output 1 to Pulse Output 8 are generated separately for each channel in order to be able to detect cross-circuits between the individual channels of a terminal and also between channels of different terminals. In order to generate test pulses as shown in the diagram, the *Sensor test active* safety parameter must be set to *true* for the respective channels. The test cycle for all 8 channels is typically 5.5 ms. The times between the test pulses of different channels vary, thus allowing better diagnostic detection.

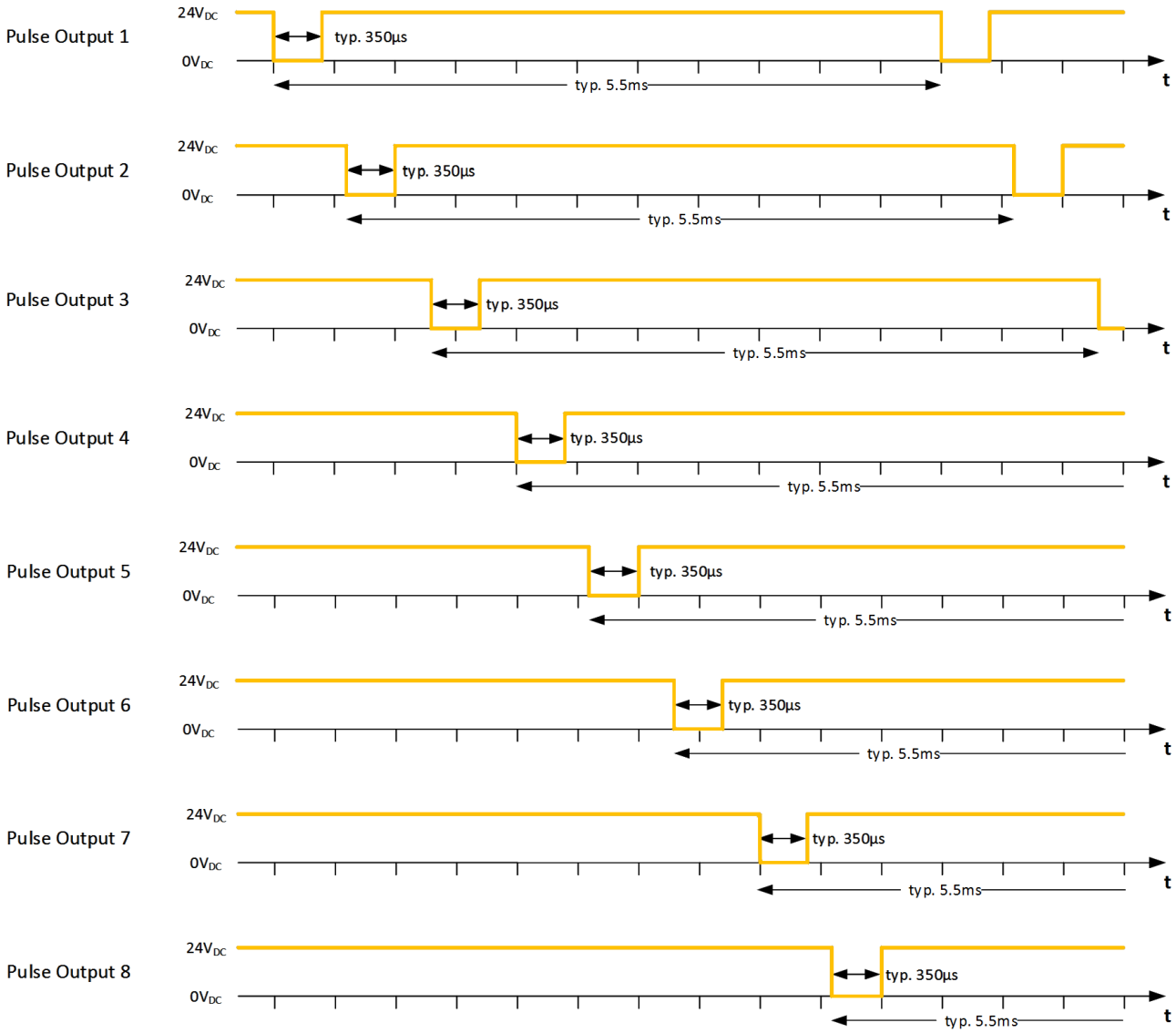



Fig. 18: EP1908 test pulses

If self-testing sensors are to be used on the safe inputs, please refer to chapter 4.5.3.1 [▶ 44].

## 4.2.8 TwinSAFE reaction times

### 4.2.8.1 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.

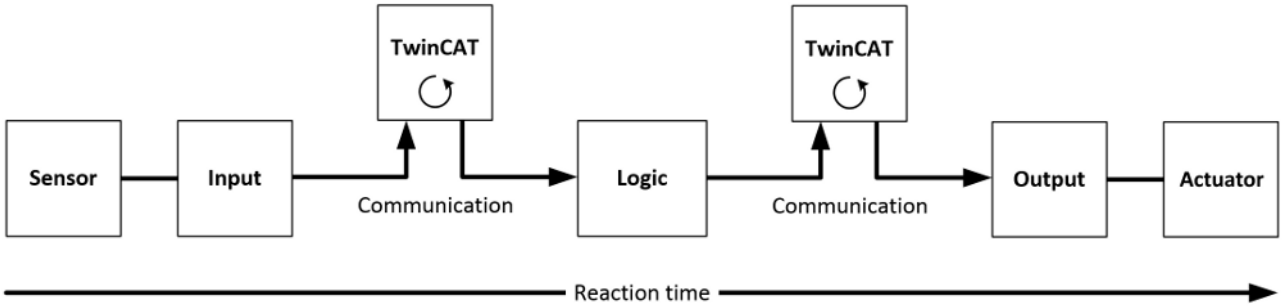



Fig. 19: Typical response time

| 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

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

### 4.2.8.2 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.

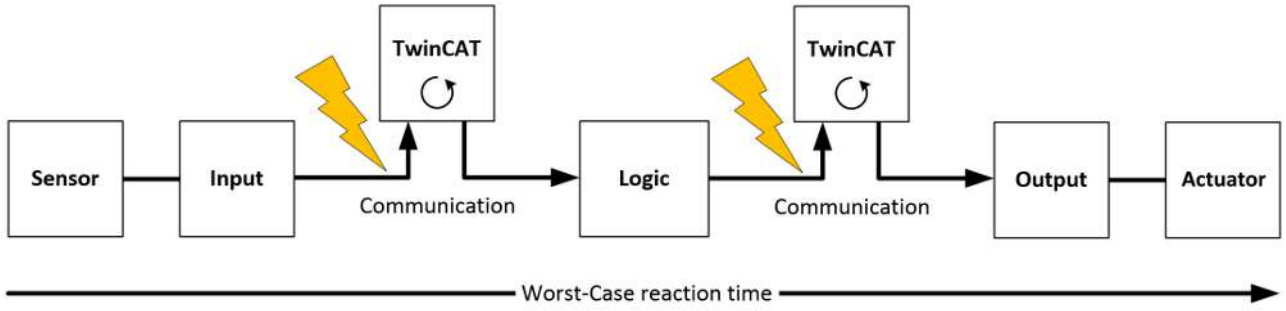



Fig. 20: Worst case response time

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

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

## 4.3 Operation modes

| Operation mode | Description |
|---|---|
| Single logic channel x/y | Each channel is evaluated individually |
| Asynchronous analysis OSSD, sensortest deactivated | Mode for connecting devices with OSSD signals. The test pulses of the OSSD devices must not occur simultaneously. The maximum supported test pulse length is 350 µs.<br>In this mode the sensor test must be switched off for the input pair used. |
| Any pulse repetition OSSD, sensortest deactivated | Mode for connecting devices with OSSD signals. The test pulses of the OSSD devices may occur simultaneously. The maximum supported test pulse length is 350 µs.<br>In this mode the sensor test must be switched off for the input pair used. |
| Short cut channel x/y is no module fault | Mode for connecting safety mats. In this mode the two inputs of the input pair used are monitored for cross-circuit. If a cross-circuit occurs a person has walked on the safety mat, and the inputs report logical 0 in pairs.<br>The sensor test must be switched on for the inputs used. |
| Velocity control channel x / Single logic channel y | Speed monitoring channel x / individual evaluation channel y<br>The first channel (x) returns a logical 1 if the current frequency is below the frequency set under *Velocity limit channel x*.<br>The second channel (y) supplies the current signal state at input y.<br>The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |
| Single logic channel x / Velocity control channel y | Individual evaluation channel x / Speed monitoring channel y<br>The first channel (x) reports the current signal state of input x.<br>The second channel (x) returns a logical 1 if the current frequency is below the frequency set under *Velocity limit channel y*.<br>The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |
| Velocity control channel x/y | Speed monitoring channel x / speed monitoring channel y<br>The first channel (x) returns a logical 1 if the current frequency is below the frequency set under *Velocity limit channel x*.<br>The second channel (x) returns a logical 1 if the current frequency is below the frequency set under *Velocity limit channel y*. |

| Operation mode | Description |
|---|---|
| | The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |
| Two channel sync. Velocity control channel x/y | Two-channel evaluation of the frequency, whereby at least one input signal always has to be at logical 1. The frequencies and the upper limit frequencies have to be the same.<br>The two channels return logical 1 if the current frequency is below the frequency set under *Velocity limit channel x/y*.<br>The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |
| Two channel encoder velocity control channel x/y | Two-channel evaluation of the frequency. The upper limit frequencies are specified separately, but should but the same. The same frequencies have to be supplied, whereby all states are permitted that may occur at the encoder interface.<br>The two channels return logical 1 if the current frequency is below the frequency set under *Velocity limit channel x/y*.<br>The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |
| Two channel async. velocity control channel x/y | Two-channel evaluation of the frequencies. In this mode is only the compliance with the limits for the two channels is monitored. The upper limit frequencies are specified separately.<br>The two channels return logical 1 if both frequencies are below the frequency set under *Velocity limit channel x/y*.<br>The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002. |

**Speed / frequency measurement**

The permitted frequency range is between 2 Hz and 500 Hz. Values below are reported as 0 Hz, values above result in a diagnostic messages of the EP1908-0002. This diagnostic message can be reset through a rising edge at the safe output signal ErrAck of the EP1908-0002.

## 4.4 EP1908 process image

The process image of the EP1908-0002 consists of 6 bytes of input data and 6 bytes of output data. These data contain the Safety over EtherCAT protocol. The eight safe input channels of the EP1908-0002 are contained in the safe input data. The first channel of the safe output data contains the ErrAck signal, which can be used to reset a diagnostic message of the EP1908, such as exceeding of the maximum allowable frequency.

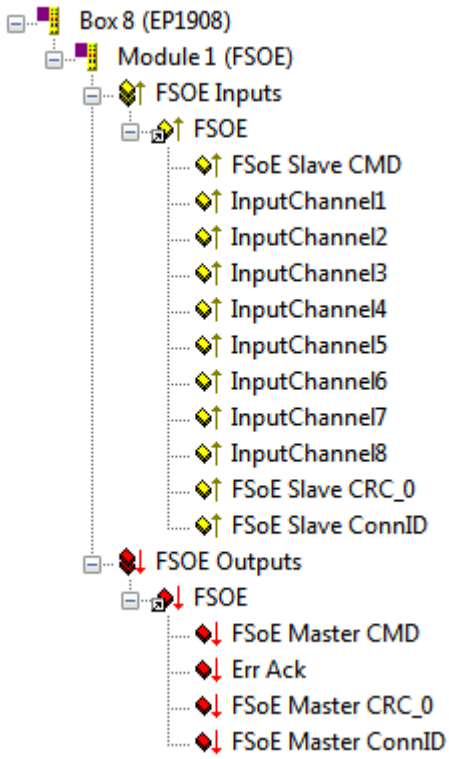



Fig. 21: EP1908 process image

# 4.5 Diagnostics

## 4.5.1 Run LED diagnostics

The Run LED shows diagnostic information for the EP1908-0002.




Fig. 22: Run LED diagnostics

**Run LED (green)**

The *Run* LED lights green when the EP1908-0002 has booted without error.

**Run LED (red)**

The *Run* LED lights red when the TwinSAFE EtherCAT Box has detected an error, such as cross-circuit, external feed or exceeding of the maximum frequency.

## 4.5.2 Diagnostic objects

The CoE objects indicate additional diagnostic information.

**⚠ 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.

### CoE object 0xA008: FSOE Velocity

| Index | Name | Meaning | Flags | Default |
|---|---|---|---|---|
| 0xA008:0 | FSOE Velocity | The following sub-indices contain the currently measured frequencies in 0.1 Hz. | RO | |
| 0xA008:01 … 0xA008:08 | Velocity 1 … Velocity 8 | Frequency at channels 1 to 8 in 0.1 Hz | RO | |

### CoE object 0xA009: FSOE max Velocity

| Index | Name | Meaning | Flags | Default |
|---|---|---|---|---|
| 0xA009:0 | FSOE max Velocity | The following sub-indices contain the maximum frequencies (in 0.1 Hz) determined since the last startup of the TwinSAFE communication with the EP1908-0002. | RO | |
| 0xA009:01 … 0xA009:08 | maxVelocity 1 … maxVelocity 8 | Maximum frequency at channels 1 to 8 in 0.1 Hz | RO | |

### CoE object 0x800E: Diagnostic objects

| Index | Name | Meaning | | | Flags | Default |
|---|---|---|---|---|---|---|
| 800E:0 | FSoE Internal Data | The following sub-indices contain detailed diagnostic information. | | | RO | |
| 800E:0A | Sensor test error | Bit | Error during sensor test. This may be an external feed, for example. | | RO | |
| | | 0 | $1_{bin}$ | Error at input 1 | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Error at input 2 | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Error at input 3 | | $0_{bin}$ |
| | | 3 | $1_{bin}$ | Error at input 4 | | $00_{bin}$ |
| | | 4 | $1_{bin}$ | Error at input 5 | | $0_{bin}$ |
| | | 5 | $1_{bin}$ | Error at input 6 | | $0_{bin}$ |
| | | 6 | $1_{bin}$ | Error at input 7 | | $0_{bin}$ |
| | | 7 | $1_{bin}$ | Error at input 8 | | $0_{bin}$ |
| 800E:0B | Error during two-channel evaluation | Bit | Error during the contiguous evaluation of two channels, i.e. the two channels contradict each other. | | RO | |
| | | 0 | $1_{bin}$ | Error in the first input pair | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Error in the second input pair | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Error in the third input pair | | $0_{bin}$ |
| | | 3 | $1_{bin}$ | Error in the fourth input pair | | $0_{bin}$ |
| 800E:0C | Error in the safety mat operation mode: input pair disagree | Bits | Error in the input pair | | RO | |
| | | 1, 0 | $11_{bin}$ | Error in the first input pair | | $00_{bin}$ |
| | | 3, 2 | $11_{bin}$ | Error in the second input pair | | $00_{bin}$ |
| | | 5, 4 | $11_{bin}$ | Error in the third input pair | | $00_{bin}$ |
| | | 7, 6 | $11_{bin}$ | Error in the fourth input pair | | $00_{bin}$ |
| 800E:0D | Error in the safety mat operation mode: external supply | Bit | Error in the test pulses in the safety mat operating mode; i.e. the EtherCAT Box has detected an external supply. | | RO | |
| | | 0 | $1_{bin}$ | Error at input 1 | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Error at input 2 | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Error at input 3 | | $0_{bin}$ |
| | | 3 | $1_{bin}$ | Error at input 4 | | $0_{bin}$ |
| | | 4 | $1_{bin}$ | Error at input 5 | | $0_{bin}$ |
| | | 5 | $1_{bin}$ | Error at input 6 | | $0_{bin}$ |
| | | 6 | $1_{bin}$ | Error at input 7 | | $0_{bin}$ |
| | | 7 | $1_{bin}$ | Error at input 8 | | $0_{bin}$ |
| 800E:13 | Speed monitoring error: Overspeed | Bit | Overspeed was detected at an input. | | RO | |
| | | 0 | $1_{bin}$ | Speed at input 1 is too high | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Speed at input 2 is too high | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Speed at input 3 is too high | | $0_{bin}$ |

| Index | Name | Meaning | | | Flags | Default |
|---|---|---|---|---|---|---|
| | | 3 | $1_{bin}$ | Speed at input 4 is too high | | $0_{bin}$ |
| | | 4 | $1_{bin}$ | Speed at input 5 is too high | | $0_{bin}$ |
| | | 5 | $1_{bin}$ | Speed at input 6 is too high | | $0_{bin}$ |
| | | 6 | $1_{bin}$ | Speed at input 7 is too high | | $0_{bin}$ |
| | | 7 | $1_{bin}$ | Speed at input 8 is too high | | $0_{bin}$ |
| 800E:14 | Error in operating mode: *Two Channel Sync Velocity Control* | Bit | Both inputs of an input pair were read with inactive state. | | RO | |
| | | 0 | $1_{bin}$ | Error in the first input pair | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Error in the second input pair | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Error in the third input pair | | $0_{bin}$ |
| | | 3 | $1_{bin}$ | Error in the fourth input pair | | $0_{bin}$ |
| 800E:15 | Error in operating mode: *Two Channel Sync Velocity Control* and *Two Channel Encoder Velocity Control* | Bit | Different speeds were identified for the two inputs of an input pair. | | RO | |
| | | 0 | $1_{bin}$ | Error in the first input pair | | $0_{bin}$ |
| | | 1 | $1_{bin}$ | Error in the second input pair | | $0_{bin}$ |
| | | 2 | $1_{bin}$ | Error in the third input pair | | $0_{bin}$ |
| | | 3 | $1_{bin}$ | Error in the fourth input pair | | $0_{bin}$ |

**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.

## 4.6 EP1908 configuration in TwinCAT

**⚠ 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.

### 4.6.1 Adding an EtherCAT device

See TwinCAT automation software documentation.

### 4.6.2 Adding a EP1908

An EP1908-0002 is added in exactly the same way as any other Beckhoff EtherCAT Box. In the list open the item *Safety Terminals* and select the EP1908-0002.

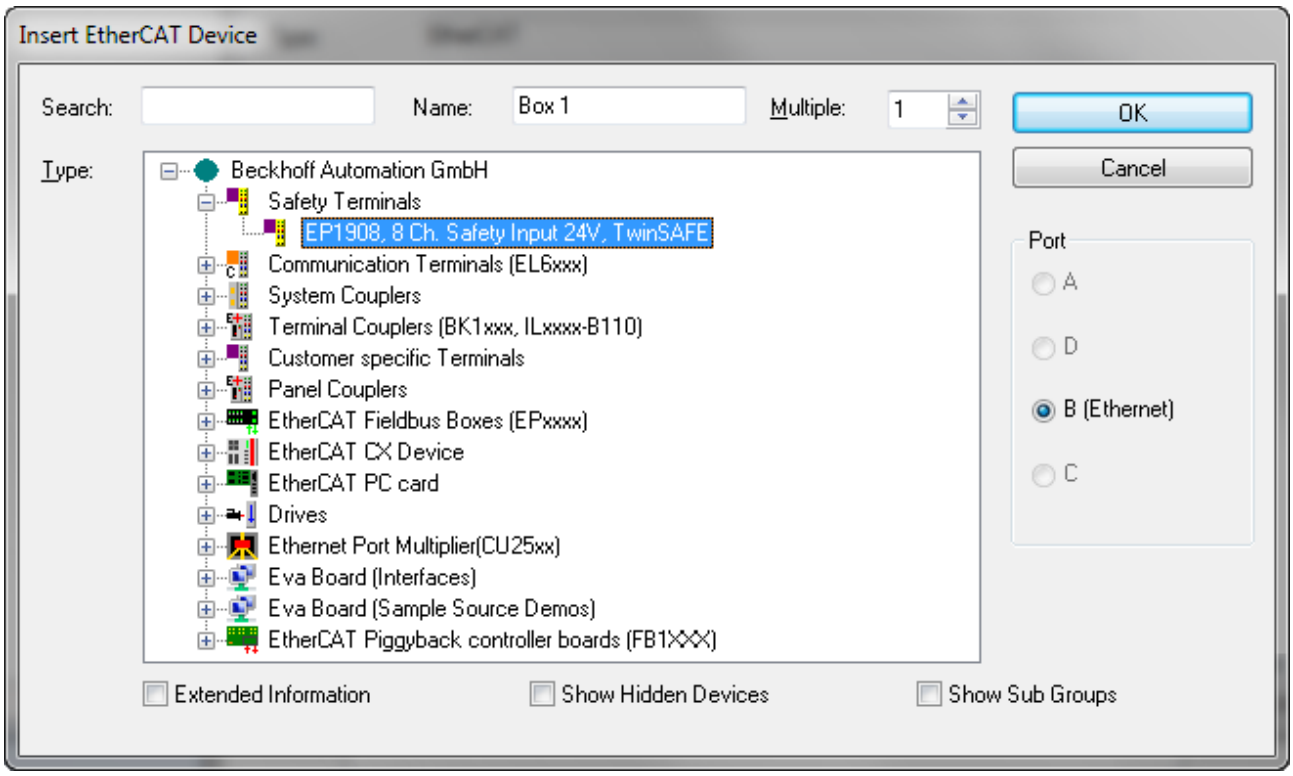



Fig. 23: TwinCAT - Adding a EP1908

### 4.6.3 Entering a TwinSAFE address and parameters in the System Manager

The TwinSAFE address set at the rotary switch must be entered under the tab *Safe Parameters* (*FSoE Address* entry) below the EP1908-0002. All other parameters can also be set there. They can also be found under the respective TwinSAFE connection on the tab *Safe Parameters*.

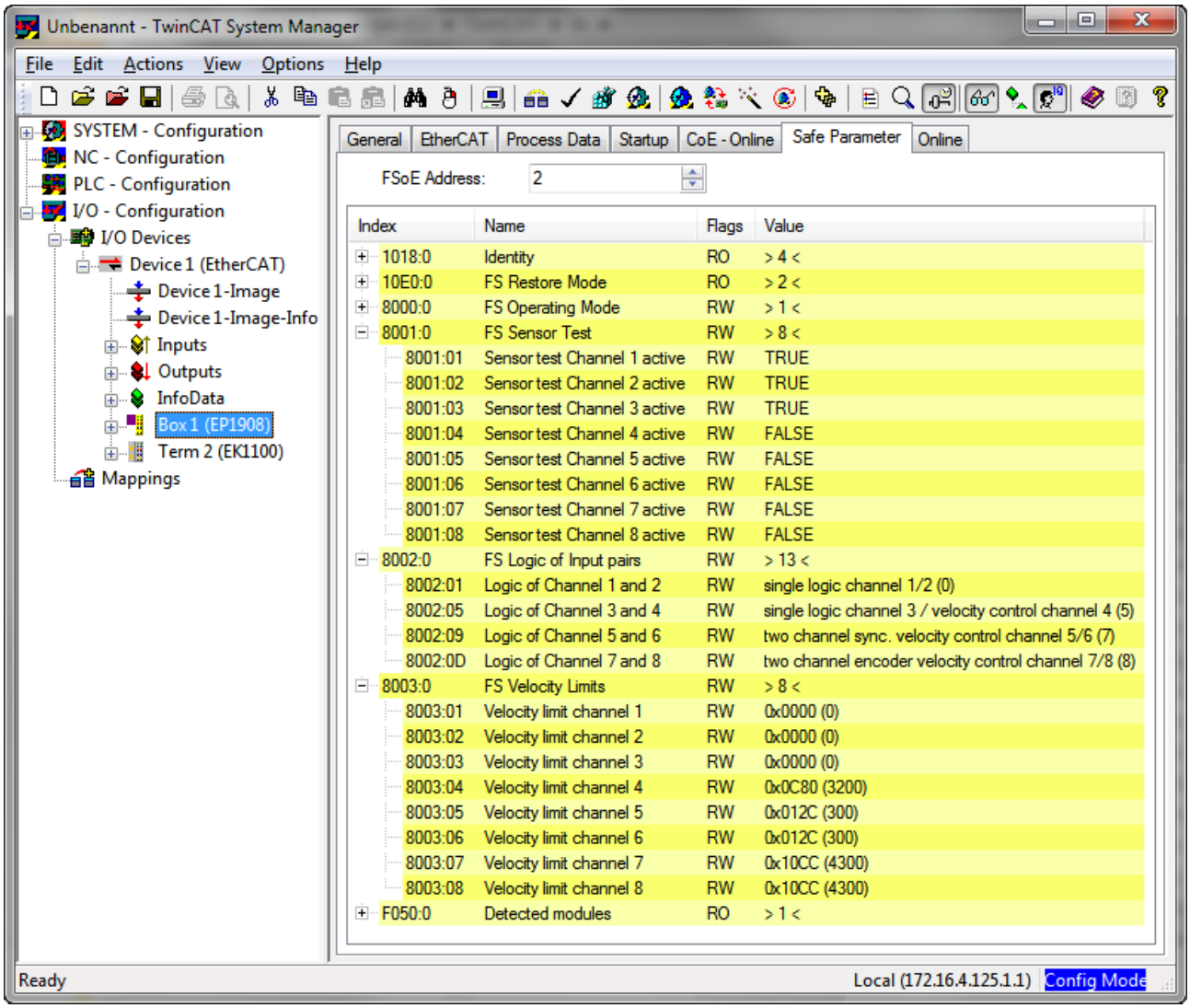



Fig. 24: Safe Parameter tab

The connection-specific parameters are set in the respective TwinSAFE connection on the *Connection* tab.

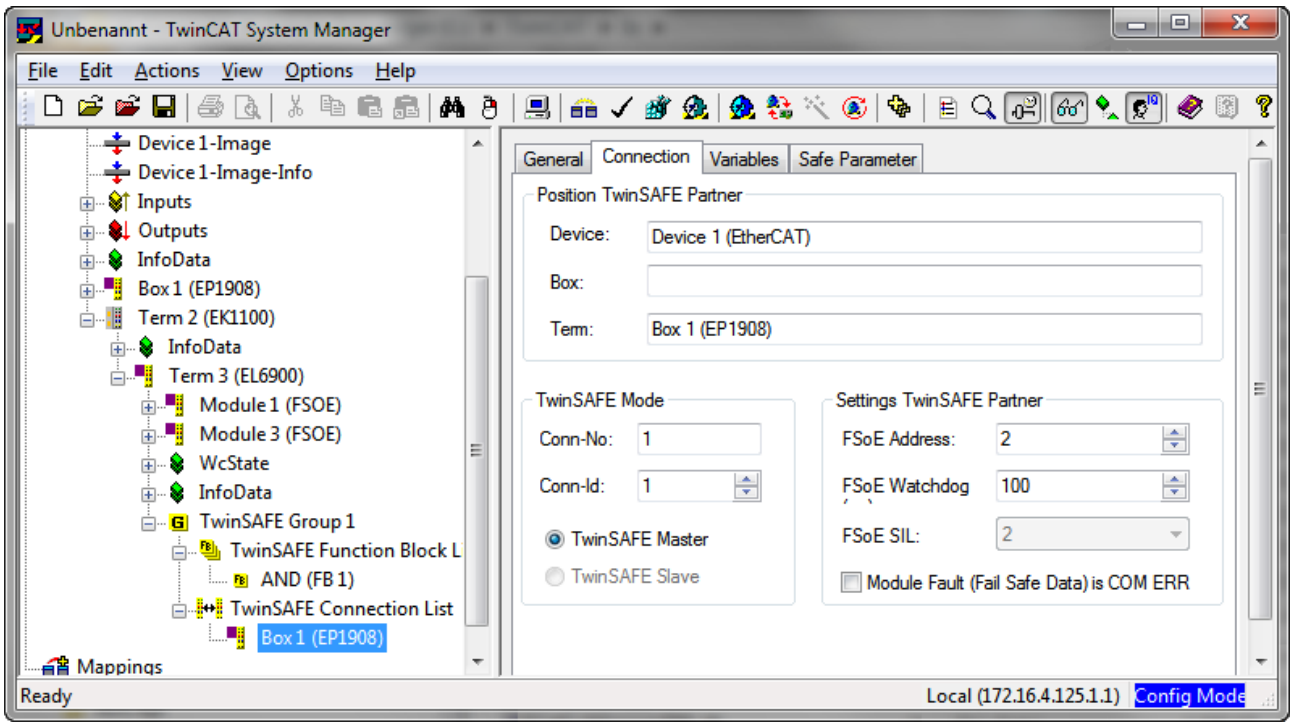



Fig. 25: Connection tab

### Overview of the TwinSAFE parameters

| Parameter name | Meaning | Values |
|---|---|---|
| FSoE_Address | Address of the rotary switch or the setting in the EP1908 | 1 to 4095 |
| Operating Mode | Digital | Digital |
| Sensor test channel 1 active | The clock signal of channel 1 (pin 1) is checked at the channel 1 input (pin 2). | TRUE / FALSE |
| Sensor test channel 2 active | The clock signal of channel 2 (pin 3) is checked at the channel 2 input (pin 4). | TRUE / FALSE |
| Sensor test channel 3 active | The clock signal of channel 3 (pin 1) is checked at the channel 3 input (pin 2). | TRUE / FALSE |
| Sensor test channel 4 active | The clock signal of channel 4 (pin 3) is checked at the channel 4 input (pin 4). | TRUE / FALSE |
| Sensor test channel 5 active | The clock signal of channel 5 (pin 1) is checked at the channel 5 input (pin 2). | TRUE / FALSE |
| Sensor test channel 6 active | The clock signal of channel 6 (pin 3) is checked at the channel 6 input (pin 4). | TRUE / FALSE |
| Sensor test channel 7 active | The clock signal of channel 7 (pin 1) is checked at the channel 7 input (pin 2). | TRUE / FALSE |
| Sensor test channel 8 active | The clock signal of channel 8 (pin 3) is checked at the channel 8 input (pin 4). | TRUE / FALSE |
| Logic channel 1 and 2 | Logic of channels 1 and 2 | see operating modes table |
| Logic channel 3 and 4 | Logic of channels 3 and 4 | see operating modes table |
| Logic channel 5 and 6 | Logic of channels 5 and 6 | see operating modes table |
| Logic channel 7 and 8 | Logic of channels 7 and 8 | see operating modes table |
| Velocity limit channel 1 | Upper frequency limit for channel 1 | Frequency in 1/10 Hz |
| Velocity limit channel 2 | Upper frequency limit for channel 2 | Frequency in 1/10 Hz |
| Velocity limit channel 3 | Upper frequency limit for channel 3 | Frequency in 1/10 Hz |
| Velocity limit channel 4 | Upper frequency limit for channel 4 | Frequency in 1/10 Hz |
| Velocity limit channel 5 | Upper frequency limit for channel 5 | Frequency in 1/10 Hz |
| Velocity limit channel 6 | Upper frequency limit for channel 6 | Frequency in 1/10 Hz |
| Velocity limit channel 7 | Upper frequency limit for channel 7 | Frequency in 1/10 Hz |
| Velocity limit channel 8 | Upper frequency limit for channel 8 | Frequency in 1/10 Hz |
| Store Code | This parameter is required for the TwinSAFE Restore Mode | 0x0000 |
| Project CRC | This parameter is required for the TwinSAFE Restore Mode | 0x0000 |
| Identity | internal use (read only) | |
| Detected Modules | internal use (read only) | |

### 4.6.3.1 EP1908-0002 configuration for light barriers, light grids, light curtains, etc.

The EP1908-0002 also supports direct connection of contact-free protective devices with two self-testing outputs such as light barriers, light grids, light curtains, laser scanners, etc.

**⚠ CAUTION**

**Sensors with self-testing outputs**

Only sensors with self-testing outputs and a maximum sensor self-test duration of 350 µs may be connected to the EP1908-0002.

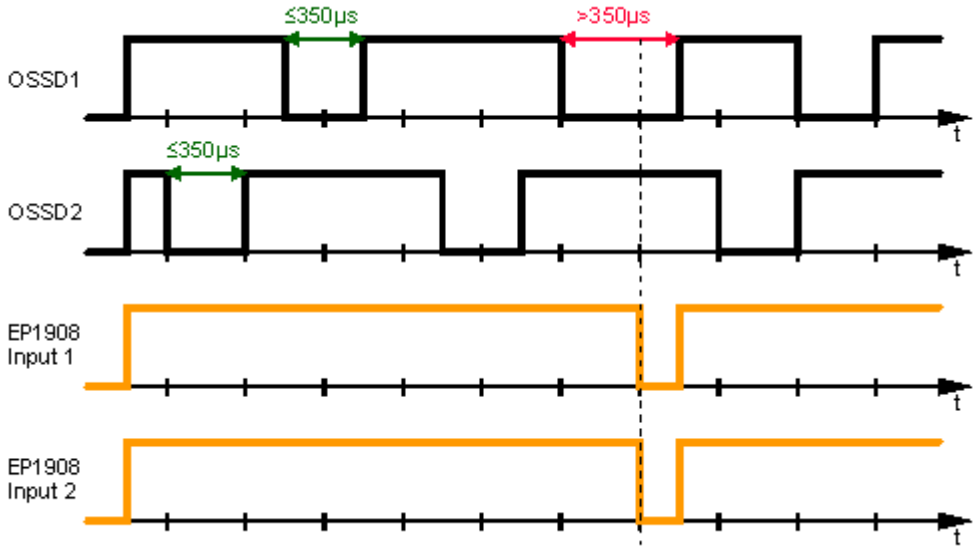



Fig. 26: Maximum permissible sensor self-test duration

**Parameter**

To connect these sensors please set the following parameters for the EP1908-0002 in the TwinCAT System Manager:

- Connect the two sensor signals either to channels 1 & 2, 3 & 4 and 5 & 6 or channels 7 & 8 and activate *asynchronous repetition OSSD* or *any pulse repetition* for the two inputs used under parameter *Logic for channel x and y*. The difference between these settings is that with *any pulse repetition* simultaneous tests of the OSSD signals up to 350 µs are allowed.
- For the two inputs used set the sensor test for the EL1908-0002 to *false*.

### 4.6.3.2 EP1908-0002 configuration for safety switching mats

The EP1908-0002 also supports direct connection of safety mats that operate based on the cross-circuit principle.

**Parameter**

To connect these safety mats please set the following parameters for the EP1908-0002 in the TwinCAT System Manager:

- Connect the two sensor signals either to channels 1 & 2, 3 & 4 and 5 & 6 or channels 7 & 8 and activate the entry *short cut channel x/y is no module fault* for the two inputs used under parameter *Logic for channel x and y*.

### 4.6.3.3 Configuration of the EP1908-0002 for mode Velocity Control Channel x

The TwinSAFE EtherCAT Box also supports direct connection of initiators and encoders for speed measurement or frequency (24 $V_{DC}$).

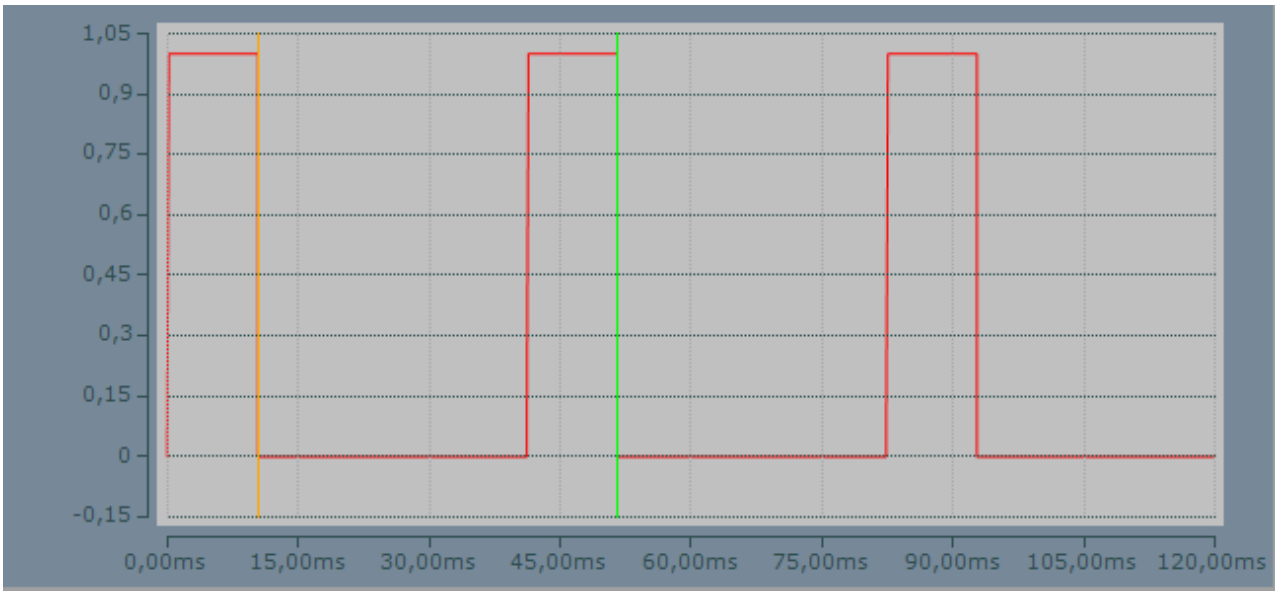
If mode *Velocity Control Channel x* is set, a frequency is determined from two consecutive falling edges of the respective input signal. This mode can be set for each channel individually.

If the current frequency is below the set limit frequency, the corresponding input channel returns a logical 1. If the frequency is above the set limit frequency, the corresponding channel returns a logical 0.

The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002.

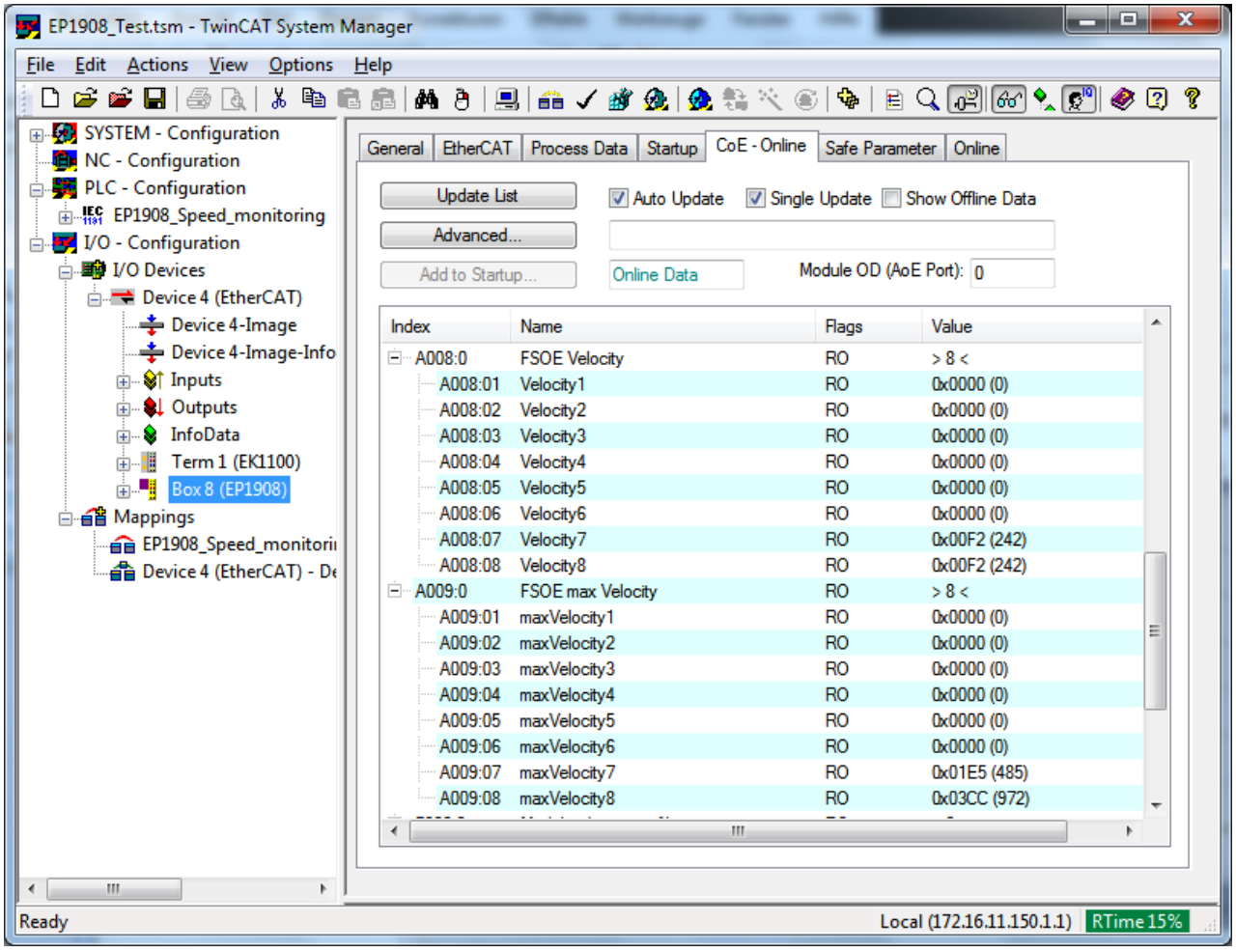
**Parameter**

- Connect the signals of the sensors used to the respective channel(s).
- Switch off the sensor test for the inputs used (*Sensor test Channel x active* = FALSE)
- Set the parameter *Logic of Channel x and y* to
  - *velocity control channel x / single logic channel y* or
  - *single logic channel x / velocity control channel y* or
  - *velocity control channel x/y*, depending on which channel(s) of the input pair is to be used for this mode.
- Set the parameter *Velocity limit channel x* of the used channel to the required value. The entered value has the unit 0.1 Hz.




Example of the signal curve of the input signal in the operating mode Velocity Control Channel x

Read the corresponding current frequencies via CoE Online (0xA008:01 to 0xA008:08).




Frequencies read out via CoE-Online

### 4.6.3.4 Configuration of the EP1908 for mode Two Channel Sync Velocity Control

The TwinSAFE EtherCAT Box also supports direct connection of initiators and encoders for speed measurement or frequency (24 $V_{DC}$).

The set mode *Two Channel SyncVelocity Control Channel x/y* determines a frequency from the signals of an input pair of the EP1908-0002, whereby one input signal always has to be set to logical 1. The frequencies of the two input signals must be the same.

If the current frequency is below the limit frequency set for both channels (*Velocity limit channel x/y*), the corresponding input pair returns a logical 1. If the frequency is above the set limit frequency, the corresponding input pair returns a logical 0. The limit frequencies must be the same.

The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002.

**Parameter**

- Connect the signals of the used sensors to the input pairs
  - 1 and 2,
  - 3 and 4,
  - 5 and 6 or
  - 7 and 8

- Switch off the sensor test for the inputs used (*Sensor test Channel x active* = FALSE)
- Set the parameter *Logic of Channel x and y* to *Two Channel SyncVelocity Control Channel x/y*
- Set the parameters *Velocity limit channel x* and *Velocity limit channel y* of the used channels to the required value. The entered value has the unit 1/10 Hz.

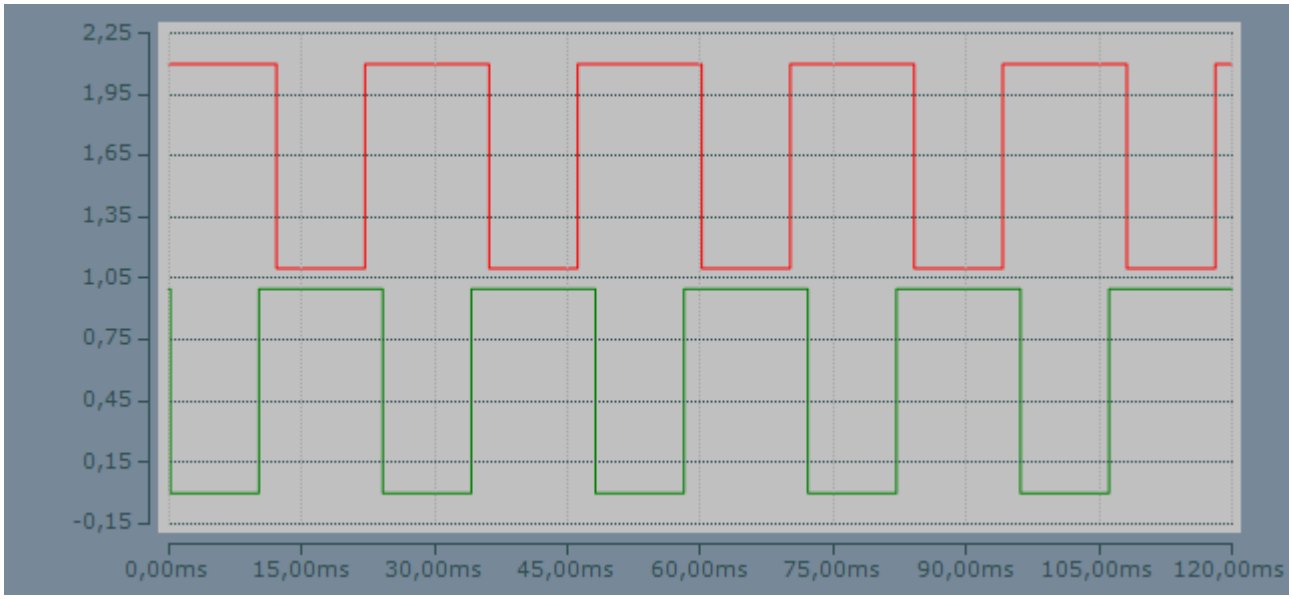



Fig. 27: Example of the signal curve of the input signal in the operating mode Two Channel Sync Velocity Control

### 4.6.3.5 Configuration of the EP1908 for mode Two Channel Encoder Velocity Control

The TwinSAFE EtherCAT Box also supports direct connection of initiators and encoders for speed measurement or frequency (24 $V_{DC}$).

The set mode *Two Channel Encoder Velocity Control Channel x/y* is used to determine a frequency from the signals of an input pair of the EP1908-0002. The upper limit frequencies are specified separately, but should but the same. The same frequencies have to be supplied, whereby all states are permitted that may occur at the encoder interface.

If the current frequency is below the limit frequency set for both channels (*Velocity limit channel x/y*), the corresponding input pair returns a logical 1. If the frequency is above the set limit frequency, the corresponding input pair returns a logical 0.

The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002.

**Parameter**

- Connect the signals of the used sensors/encoders to the input pairs
  - 1 and 2,
  - 3 and 4,
  - 5 and 6 or
  - 7 and 8
- Switch off the sensor test for the inputs used (*Sensor test Channel x active* = FALSE)
- Set the parameter *Logic of Channel x and y* to *Two Channel SyncVelocity Control Channel x/y*

- Set the parameters *Velocity limit channel x* and *Velocity limit channel y* of the used channels to the required value. The entered value has the unit 1/10 Hz.

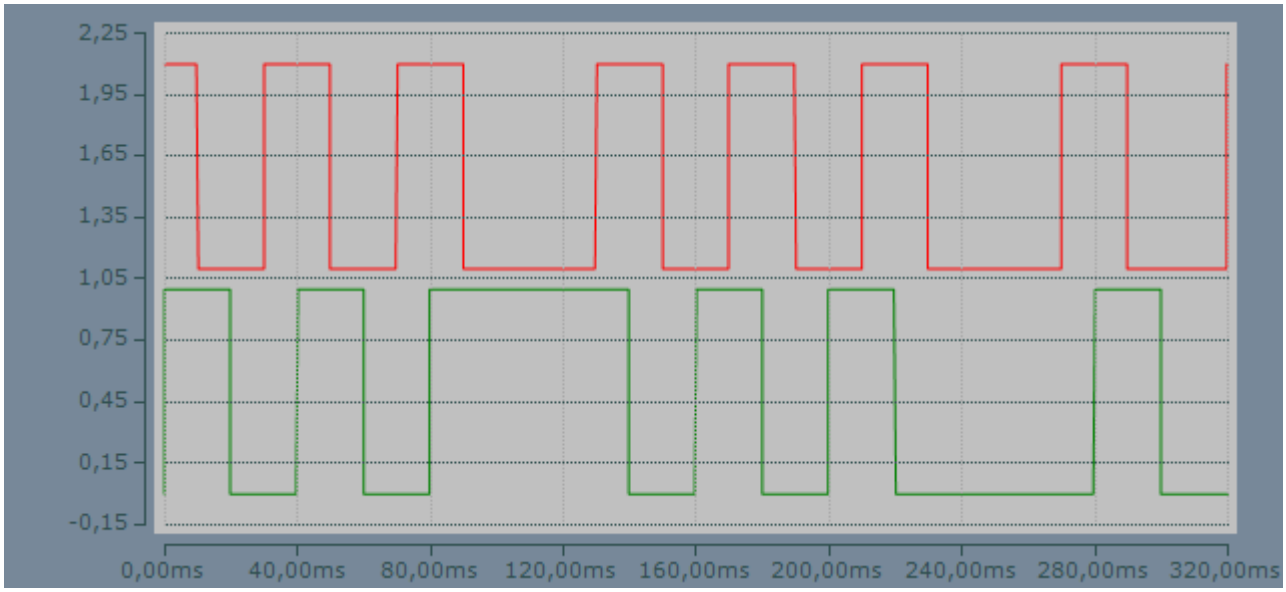



Fig. 28: Example of the signal curve of the input signal in the operating mode Two Channel Encoder Velocity Control

### 4.6.3.6 Configuration of the EP1908-0002 for mode Two Channel Async Velocity Control

The TwinSAFE EtherCAT Box also supports direct connection of initiators and encoders for speed measurement or frequency (24 $V_{DC}$).

The set mode *Two Channel AsyncVelocity Control Channel x/y* is used to determine a frequency from the signals of an input pair of the EP1908-0002. In this mode is only the compliance with the limits for the two channels is monitored. The upper limit frequencies are specified separately.
The two channels return logical 1 if both frequencies are below the frequency set under *Velocity limit channel x/y*.

If the current frequency of the two channels is below the set limit frequency(*Velocity limit channel x/y*) for the respective channel, the corresponding input pair returns a logical 1. If the current frequency of a channel is above the set limit frequency for this channel, the corresponding input pair returns a logical 0.

The minimum supported frequency is 2 Hz. Values below this are shown as 0. The maximum supported frequency is 500 Hz. Values above this result in a diagnostic messages of the EP1908-0002. This message can be reset through a rising edge of the safe output signal ErrAck of the EP1908-0002.

**Parameter**

- Connect the signals of the used sensors to the input pairs
  - 1 and 2,
  - 3 and 4,
  - 5 and 6 or
  - 7 and 8
- Switch off the sensor test for the inputs used (*Sensor test Channel x active* = FALSE)
- Set the parameter *Logic of Channel x and y* to *Two Channel Async Velocity Control Channel x/y*
- Set the parameters *Velocity limit channel x* and *Velocity limit channel y* of the used channels to the required value. The entered value has the unit 1/10 Hz.

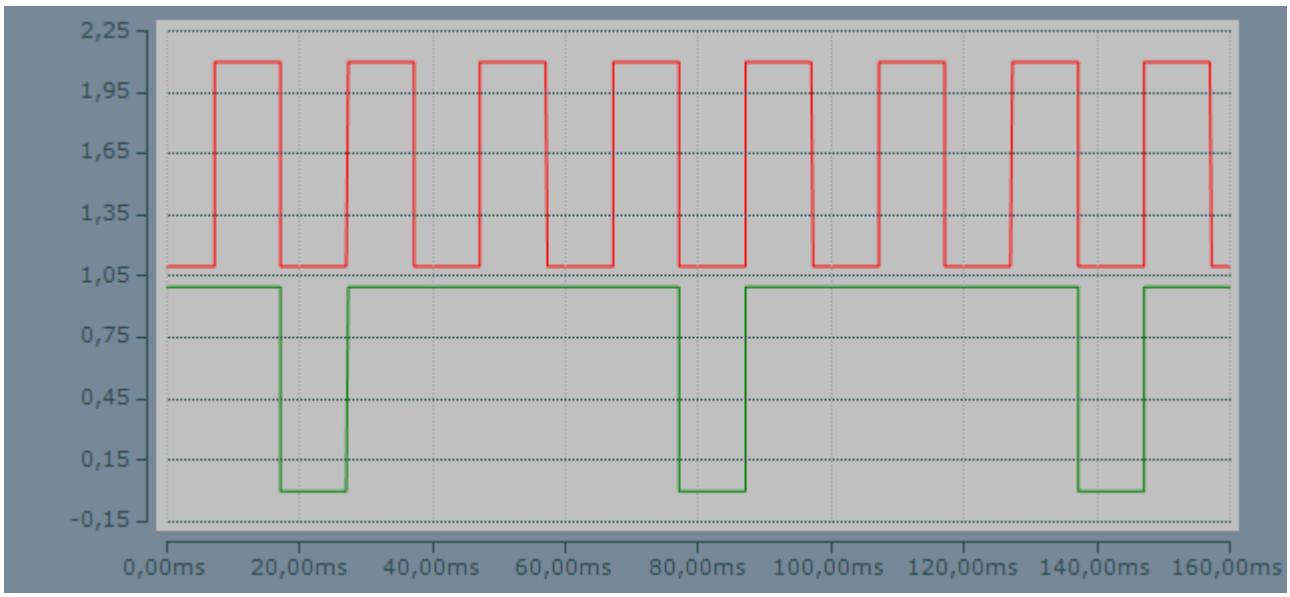



Fig. 29: Example of the signal curve of the input signal in the operating mode Two Channel Async Velocity Control

# 5 Maintenance and cleaning

**Unacceptable contamination**

Do not operate the TwinSAFE component if it is unacceptably dirty. Refer to the technical data for the protection class.

TwinSAFE components are basically maintenance-free.

# 6 Decommissioning

## 6.1 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.

### 6.1.1 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.

# 7 Appendix

## 7.1 Protection classes according to IP code

The levels of protection are defined and divided into different classes in the IEC 60529 standard (DIN EN 60529). The designation follows the scheme below.

**1st digit: Protection against ingress of dust and access to hazardous parts**

| 1st digit | Meaning |
|---|---|
| 0 | Non-protected |
| 1 | Protection against access to hazardous parts with back of hand. Protection against ingress of solid foreign objects = 50 mm diameter |
| 2 | Protection against access to hazardous parts with a finger. Protection against ingress of solid foreign objects = 12.5 mm diameter |
| 3 | Protection against access to hazardous parts with a tool. Protection against ingress of solid foreign objects = 2.5 mm diameter |
| 4 | Protection against access to hazardous parts with a wire. Protection against ingress of solid foreign objects = 1 mm diameter |
| 5 | Protection against access to hazardous parts with a wire. Protection against ingress of dust. Ingress of dust is not prevented completely, although the quantity of dust able to penetrate is limited to such an extent that the proper function of the device and safety are not impaired |
| 6 | Protection against access to hazardous parts with a wire. Dust-proof. No ingress of dust |

**2nd digit: Protection against ingress of water***

| 2nd digit | Meaning |
|---|---|
| 0 | Non-protected. |
| 1 | Protection against dripping water. |
| 2 | Protection against dripping water when housing tilted up to 15°. |
| 3 | Protection against spraying. Water sprayed at an angle of up to 60° from vertical must not have any adverse effect. |
| 4 | Protection against splashing. Water splashing against the housing from any direction must not have any adverse effects. |
| 5 | Protection against jetting. |
| 6 | Protection against powerful jetting. |
| 7 | Protection against the effects of temporary immersion. The quantity of water being able to penetrate if the housing is submerged in water for 30 minutes at a depth of 1 m must not have any adverse effects. |

*) These protection classes only define protection against water, not against other liquids.

## 7.2 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.

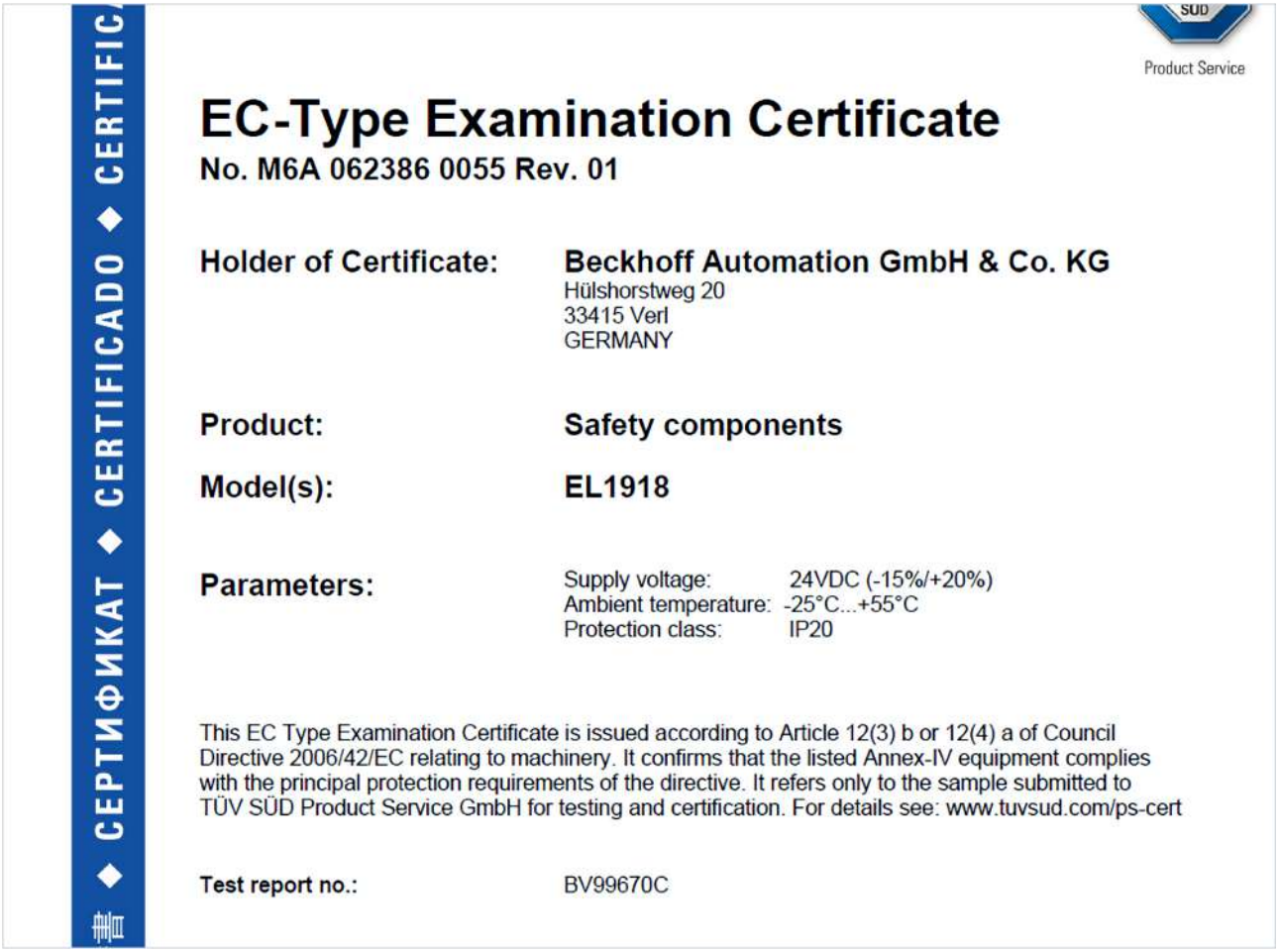
If there is customer specific data saved on the product, it cannot be ensured that this data might not be restored through for example forensic measures, even after the data is deleted through the provided tool chain. If this data is confidential, the scrapping of the product after usage is recommended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

## 7.3 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.



◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFIC

Product Service

**EC-Type Examination Certificate**

**No. M6A 062386 0055 Rev. 01**

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

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

## 7.4 Declarations of conformity and certificates

The EC Declaration of Conformity can be found at

The UKCA Declaration of Conformity can be found at (website link to UKCA Declaration of Conformity).

Further certificates can be found under EP1908 certificates.

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## Trademark statements

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