Operation Manual for

EJ19xx and EJ29xx

TwinSAFE EJ Modules with digital fail-safe in and outputs

Version: 1.2.0
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BECKHOFF

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1 Foreword

1.1 Notes on the documentation

Intended audience

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

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

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

Origin of the document

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

Currentness

Please check whether you are using the current and valid version of this document. The current version can be downloaded from the Beckhoff homepage at http://www.beckhoff.com/english/download/twinsafe.htm. In case of doubt, please contact Technical Support [▶ 39].

Product features

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

Disclaimer

The documentation has been prepared with care. The products described are subject to cyclical revision. For that reason the documentation is not in every case checked for consistency with performance data, standards or other characteristics. We reserve the right to revise and change the documentation at any time and without prior announcement. No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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Patent Pending

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

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

1.2 Safety instructions

1.2.1 Delivery state

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

1.2.2 Operator's obligation to exercise diligence

The operator must ensure that

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

1.2.3 Description of safety symbols

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

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

1.3 Documentation issue status

Version	Comment
1.2.0	• Description temperature measurement updated
1.1.0	• Description of the testpulses of the outputs updated
1.0.0	• Certificate added • Technical data updated • Description *Digital Input* updated
0.0.2	• LED description adapted
0.0.1	• First preliminary version

2 References

No	Version	Title / description
[1]	1.3.0 or newer	Design guide for EJ backplane for TwinSAFE modules The design guide contains specifications for the development of an EJ backplane when EJ modules are to be used
[2]	1.5.1 or newer	Operating instructions for EJ6910 TwinSAFE logic module The document contains a description of the logic functions of the EJ6910 and their programming
[3]	3.1.0 or newer	Documentation – TwinSAFE Logic FB The document describes the safety function blocks that are available in the EJ6910 and form the safety application.
[4]	4.7 or newer	EJxxxx | EtherCAT plug-in modules - design guide The design guide contains general specifications for the development of an EJ backplane.

3 System description TwinSAFE

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

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

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

3.2 Safety concept

TwinSAFE: Safety and I/O technology in one system

- Extension of the familiar Beckhoff EJ system with TwinSAFE components
- Safe and non-safe EJ components can be combined as required
- Logical link of the I/Os in the EJ69xx TwinSAFE logic terminal
- Suitable for applications up to SIL 3 according to EN 61508:2010 and Cat 4, PL e according to EN ISO 13849-1:2015
- Safety-relevant networking of machines via bus systems
- In the event of an error, all TwinSAFE components always switch to the wattless and therefore safe state
- No safety requirements for the higher-level standard TwinCAT system

Safety over EtherCAT protocol (FSoE)

- Transfer of safety-relevant data via any media (“genuine black channel”)
- TwinSAFE communication via fieldbus systems such as EtherCAT, Lightbus, PROFIBUS, PROFINET or Ethernet
- IEC 61508:2010 SIL 3 compliant
- FSoE is IEC standard (IEC 61784-3-12) and ETG standard (ETG.5100)

Fail-safe principle (fail stop)

The basic rule for a safety system such as TwinSAFE is that failure of a part, a system component or the overall system must never lead to a dangerous condition. The safe state is always the switched off and wattless state.

 **CAUTION**	**Safe state** For all TwinSAFE components the safe state is always the switched-off, wattless state.

3.3 EtherCAT plug-in module system (EJ)

Similar to the EtherCAT terminal system, a module strand consists of a Bus Coupler and any desired I/O modules. In contrast to the EtherCAT Terminals, however, the EtherCAT plug-in modules have no spring-loaded contacts, since the wiring level is outsourced: communication, signal distribution and the supply of power to the modules takes place via plug connectors on the back side of the modules and the conductive tracks of the signal distribution board.

The EtherCAT plug-in modules and the plug level for sensors and actuators can be placed flexibly on the signal distribution board. Signal distribution boards can be user-developed or provided as custom solutions by Beckhoff Automation GmbH & Co. KG.

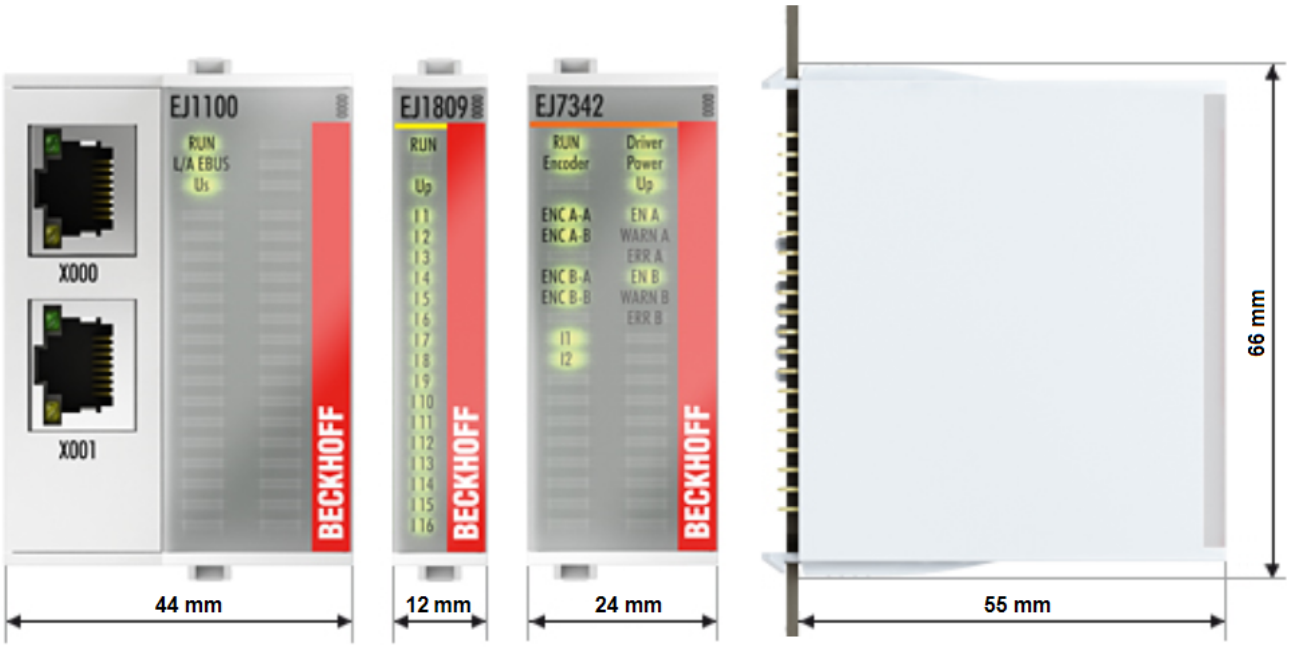

Fig. 1: EtherCAT plug-in module system (EJ)

4 Intended use

 WARNING	**Caution - Risk of injury!** TwinSAFE EJ modules may only be used for the purposes described below!

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

The TwinSAFE EJ modules are suitable for operation on an EJ distribution board.

 WARNING	**System limits** The TÜV-SÜD certificate applies to the TwinSAFE EJ modules, the function blocks available in it, the documentation and the engineering tool. Approved engineering tools are *TwinCAT 3.1*, *TwinSAFE Loader* and *CODESYS Safety for EtherCAT Safety Module*. Any deviations from these procedures or tools, particularly externally generated xml files for TwinSAFE import or externally generated automatic project creation procedures, are not covered by the certificate.
 WARNING	**Power supply** An SELV/PELV power supply unit with a voltage limit of U_{max}= 36 V_{DC} on the output side must be used to supply power for the TwinSAFE EJ modules with 24 V_{DC}. Failure to observe this can result in a loss of safety.
 WARNING	**Commissioning test** Before the TwinSAFE EJ modules can be used for the safety task, the user must carry out a commissioning test so that sensor and actuator wiring errors can be ruled out.
 CAUTION	**Note the Machinery Directive** The TwinSAFE EJ modules may only be used in machines according to the machinery directive.
 CAUTION	**Ensure traceability** The buyer has to ensure the traceability of the device via the serial number.

5 General operation / function

5.1 Environmental conditions

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

 WARNING	**Risk of injury!** The TwinSAFE components must not be used under the following operating conditions. • under the influence of ionizing radiation (that exceeds the level of the natural environmental radiation) • in corrosive environments • in an environment that leads to unacceptable soiling of the TwinSAFE component
 Attention	**Electromagnetic compatibility** The TwinSAFE components comply with the current standards on electromagnetic compatibility with regard to spurious radiation and immunity to interference in particular. However, in cases where devices such as mobile phones, radio equipment, transmitters or high-frequency systems that exceed the interference emissions limits specified in the standards are operated near TwinSAFE components, the function of the TwinSAFE components may be impaired.

5.1.1 EJ backplane

 CAUTION	**EJ backplane** Make sure that the TwinSAFE EJ modules are used only on an EJ backplane that has been developed and manufactured in accordance with the *Design guide for EJ backplanes for TwinSAFE modules* (see References [▶ 8]).
 Note	**Pin-out and coding of the TwinSAFE EJ modules** The pin-out and description of the coding via the coding pins of the TwinSAFE EJ modules are listed in the document *Design guide for EJ backplanes for TwinSAFE modules* (see References [▶ 8]).

5.2 Installation

5.2.1 Safety instructions

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

5.2.2 Transport / storage

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

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

5.2.3 Mechanical installation

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

5.2.3.1 Control cabinet / terminal box

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

5.2.3.2 Installation position and minimum distances

For the prescribed installation position the backplane is mounted horizontally (EJ plug connector vertical), and the connection surfaces of the EJ modules face forward (see diagram below). The EJ modules are ventilated from below, which enables optimum cooling of the electronics through convection. The direction indication “down” corresponds to the direction of positive acceleration due to gravity.

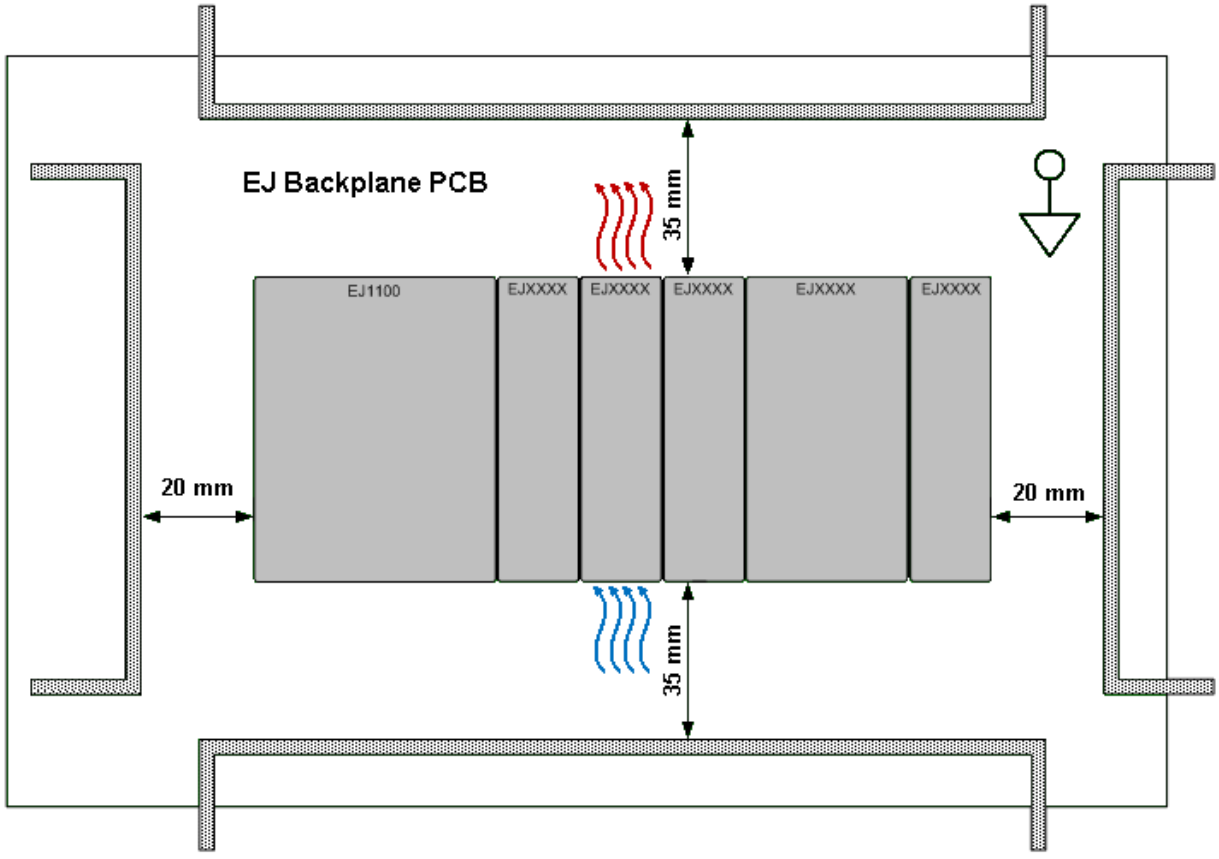

Fig. 2: Installation position and minimum distances

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

5.2.3.3 Temperature measurement

The temperature measurement consists of an EJ1100 EtherCAT coupler, to which EJ modules are attached, based on the typical distribution of digital and analog signal types at a machine. On the EJ6910 a safety project is active, which reads safe inputs and enables safe outputs during the measurement.

Note	**External heat sources / radiant heat / impaired convection** The maximum permissible ambient temperature of 55°C was checked with the sample configuration described above. Impaired convection; an unfavorable location near heat sources or an unfavorable configuration of the EtherCAT EJ modules may result in overheating of the modules. The key parameter is always the maximum permitted internally measured temperature of 110°C, above which the TwinSAFE components switch to safe state and report an error. The internal temperature can be read from the TwinSAFE components via CoE.

5.2.4 Electrical installation

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

5.2.4.1 Connections between EJ modules

The electrical connections between the EJ Bus Coupler and EJ modules are realized automatically by plugging the components into the EJ backplane.

Note	**Note the maximum E-bus current!** Observe the maximum current that your EJ Bus Coupler can supply to the E-bus! Use the EJ9400 power supply module if the current consumption of your modules exceeds the maximum current your EJ Bus Coupler can provide.

5.2.4.2 Overvoltage protection

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

5.3 Digital input

5.3.1 Parameterization

Two indices are provided under the safety parameters for the parameterization of the inputs. These are the general settings for the test pulse outputs and the channel-specific settings for the input filter. In the TwinSAFE EJ modules an input module consists of two channels.

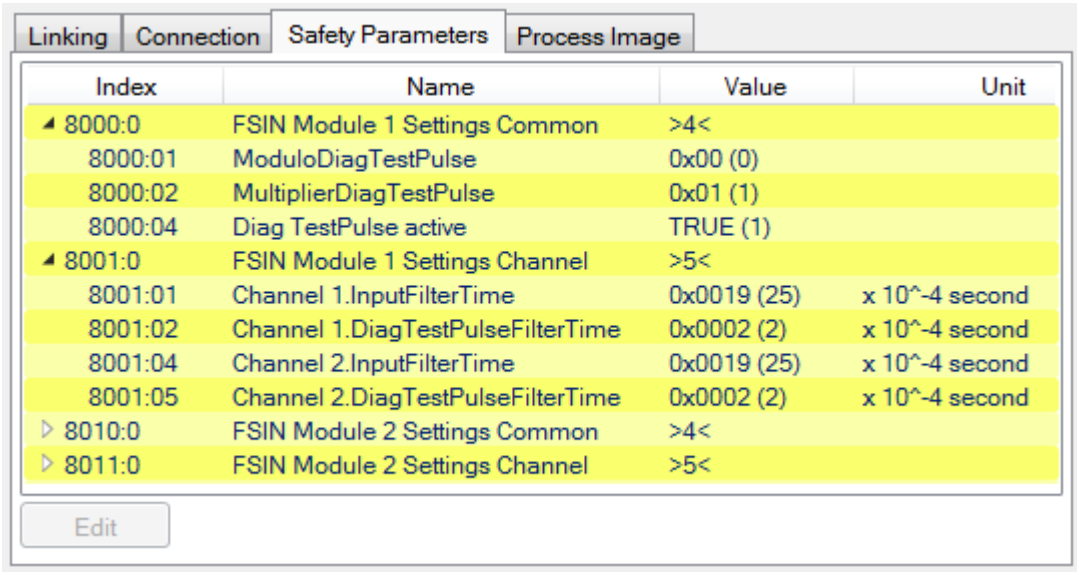

Fig. 3: Digital input - safety parameters

Index	Name	Default value / unit	Description
80x0:01	ModuloDiagTestPulse	0x00 / integer	Modulo value for the frequency of the generation of a test pulse. 0 -> every time 1 -> every second time ...
80x0:02	MultiplierDiagTestPulse	0x01 / integer	Length of the test pulse in multiples of 2 ms
80x0:04	Diag TestPulse active	TRUE / Boolean	Activation of test pulses for the corresponding input module
80x1:01	Channel 1.InputFilterTime	0x0019 / 0.1 ms	Input filter of safe input 1. Following this time the internal input signal changes to the applied signal state.
80x1:02	Channel 1.DiagTestPulseFilterTime	0x0002 / 0.1 ms	Input filter for the test pulse signal
80x1:04	Channel 2.InputFilterTime	0x0019 / 0.1 ms	Input filter of safe input 2. Following this time the internal input signal changes to the applied signal state.
80x1:05	Channel 2.DiagTestPulseFilterTime	0x0002 / 0.1 ms	Input filter for the test pulse signal

The index is incremented by 0x10 for each input module in accordance with the number of inputs.

5.3.2 Characteristic curve of the inputs

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

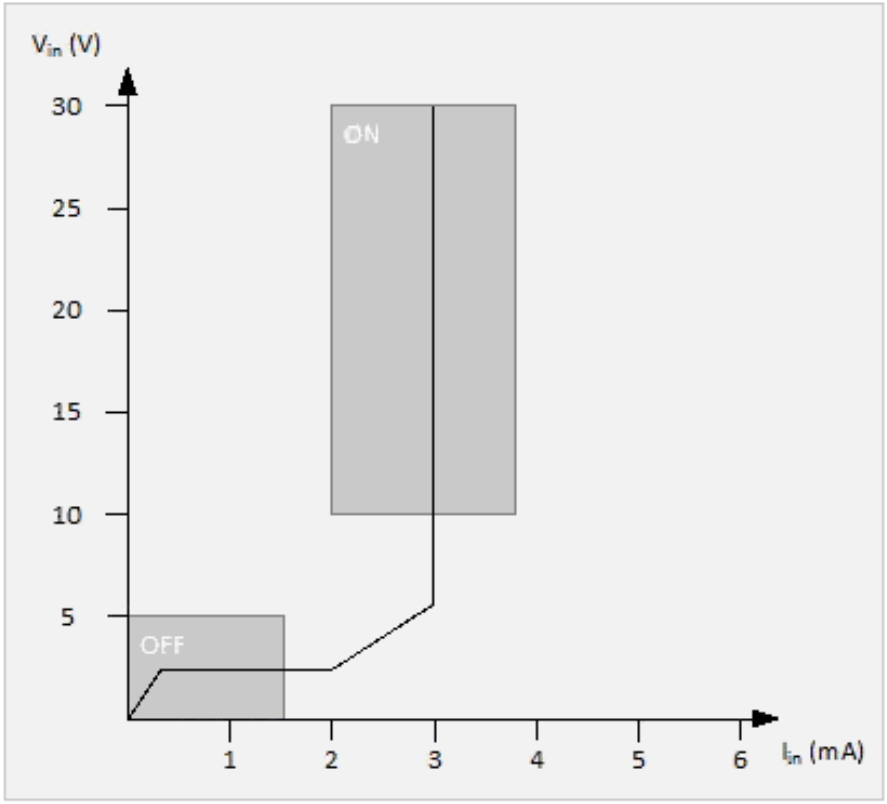

Fig. 4: Characteristic curve of the inputs

5.4 Digital output

Attention	**protected wiring** If the wiring of the outputs or the connected actuators leaves the control cabinet, the user must ensure that the wiring is protected.
WARNING	**Active loads** The use of active loads (with their own power supply) is not permissible unless the manufacturer of the load ensures the non-reactivity of the power supply to the control signal.
DANGER	**Clocked signals inside a sheathed cable** If clocked signals from different output modules are used inside a single sheathed cable, then a module error such as a cross-circuit or external power supply must lead to the switch-off of all of these modules. This switch-off must be executed by the user program.

5.4.1 Parameterization

The outputs are parameterized via the *Safety Parameters* tab of the alias devices. A TwinSAFE EJ output module consists of four channels.

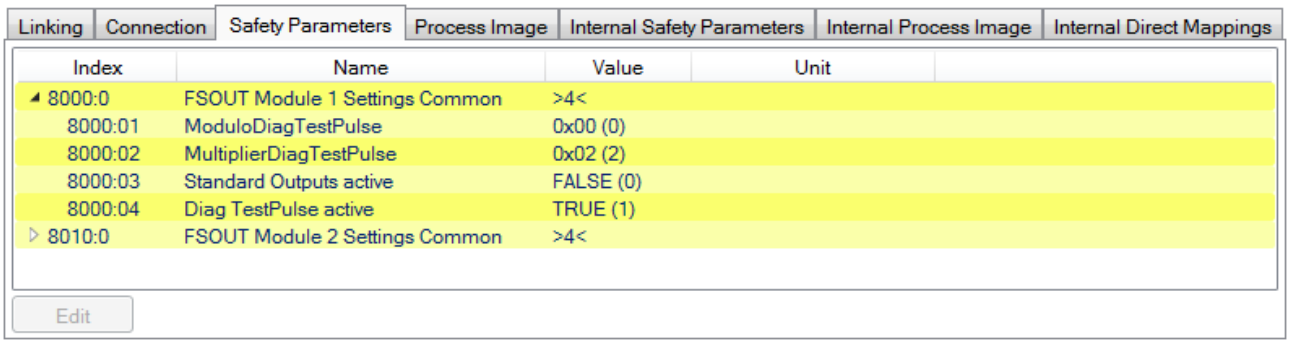

Fig. 5: Digital output –safety parameters

Index	Name	Default value / unit	Description
80x0:01	ModuloDiagTestPulse	0x00 / integer	Modulo value for the frequency of the generation of a test pulse. 0 -> every time 1 -> every second time ...
80x0:02	MultiplierDiagTestPulse	0x02 / integer	Length of the test pulse in multiples of 400 µs
80x0:03	Standard outputs active	FALSE / Boolean	Activation of the logical AND operator of the safe and standard outputs of the module
80x0:04	Diag TestPulse active	TRUE / Boolean	Activation of test pulses for the corresponding output module

The index is incremented by 0x10 for each output module in accordance with the number of outputs.

Testpulse length of the output signals

The setting via the parameter MultiplierDiagTestPulse controls the test pulses of the individual channels. In addition, the second internal switch off path is also tested. This leads to a prolongation of the length of the test pulses by approx. 700µs.

Together with the setting MultiplierDiagTestPulse = 2 results in a minimum test pulse length of 1.5 ms.

The parameter MultiplierDiagTestPulse can not be reduced to 1 since a reliable readback of the test pulse at the output is not possible.

Note	**Testpulse length of the output** The minimum useful setting of MultiplierDiagTestPulse = 2 results in a total test pulse length of approx. 1.5 ms.

5.4.2 Actuators

The outputs have a maximum permissible output current of 0.5 A. This must not be exceeded. The simultaneity factor of the outputs of an EJ module is 100%.

Inductive, resistive and capacitive loads are supported.

5.5 Local logic functions

Apart from their standard function, all EJ input and output modules also support the option to execute a local safety user program.

Information on creating a safety user program can be found in the documentation for the EJ6910 (see References [▶ 8]).

5.6 General technical data

Product property	EJx9xx
Supply voltage (SELV / PELV)	24 V_{DC} (–15% / +20%)
Permissible ambient temperature (operation)	-25°C to +55°C
Permissible ambient temperature (transport/ storage)	-40°C to +70°C
Permissible air humidity	5% to 95%, non-condensing
Permissible air pressure (operation/storage/ transport)	750 hPa to 1100 hPa (this corresponds to an altitude of approx. -690 m to 2450 m above sea level, assuming an international standard atmosphere)
Minimum/maximum cycle time	approx. 500 µs / according to project size (if a user-specific project is used)
Fault response time	≤ watchdog times
Watchdog time	min. 2 ms, max. 60,000 ms
Cable length between sensor/actuator and terminal	unshielded max. 100 m (0.75 or 1 mm²) shielded max. 100 m (0.75 or 1 mm²)
Input process image	dynamic in accordance with the configuration
Output process image	dynamic in accordance with the configuration
Reaction time (read input/write to E-bus)	typically: 4 ms, maximally: see error reaction time
Output current of the clock outputs	typically 8 mA, max. 11 mA
Output current of the outputs	max. 500 mA
Actuators	• inductive • resistive • capacitive When selecting actuators please ensure that the test pulses do not lead to actuator switching
Actuator switching frequency (inductive load)	max. 2.5 mH at 100 Hz max. 1 H at 1 Hz These are example working points. The user must evaluate the actuators used in relation to energy.
Reading back the outputs (Diagnostic thresholds)	Signal voltage “1”: > 5.61 V Signal voltage “0”: < 1.68 V
Signal voltage "0" inputs	-3 V ... 5 V (EN 61131-2, type 3) see chapter Characteristic curve of the inputs [▶ 16]
Signal voltage "1" inputs	11 V ... 30 V (EN 61131-2, type 3) see chapter Characteristic curve of the inputs [▶ 16]
Climate category according to EN 60721-3-3	3K3 (the deviation from 3K3 is possible only with optimal environmental conditions and also applies only to the technical data which are specified differently in this documentation)
Permissible level of contamination according to EN 60664-1	level of contamination 2

Product property	EJx9xx
Inadmissible operating conditions	TwinSAFE EJ modules must not be used under the following conditions: • under the influence of ionizing radiation (exceeding the natural background radiation) • in corrosive environments • in an environment that leads to impermissible contamination of the EJ module
Vibration / shock resistance	conforms to EN 60068-2-6 / EN 60068-2-27
EMC immunity/emission	conforms to EN 61000-6-2 / EN 61000-6-4
Shocks	15 g with pulse duration 11 ms in all three axes
Protection class	IP20
Permitted operating environment	In the control cabinet or terminal box, with minimum protection class IP54 according to IEC 60529
Correct installation position	horizontal (see chapter Installation position and minimum distances [▶ 13])
Approvals	CE, TÜV SÜD

Note	**Specific technical data** The specific technical data for the respective product together with the safety parameters can be found in the respective product-specific sub-chapter.

5.7 Dimensions

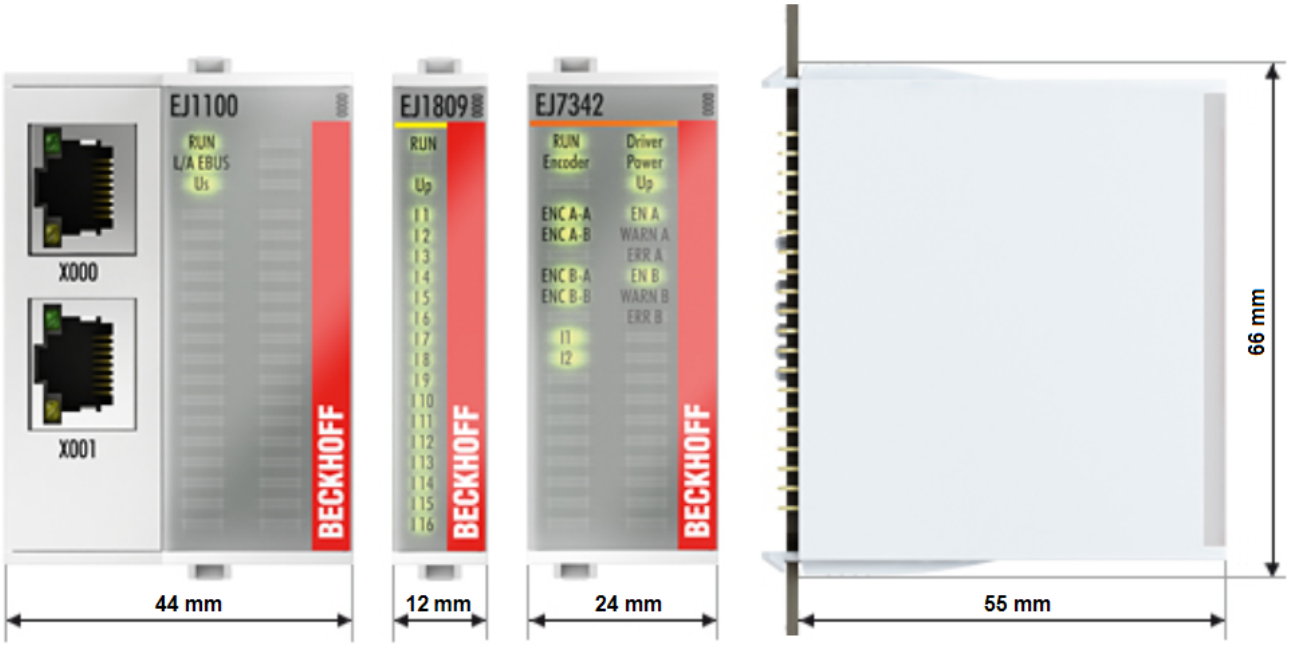

Fig. 6: EJxxxx - dimensions (short modules)

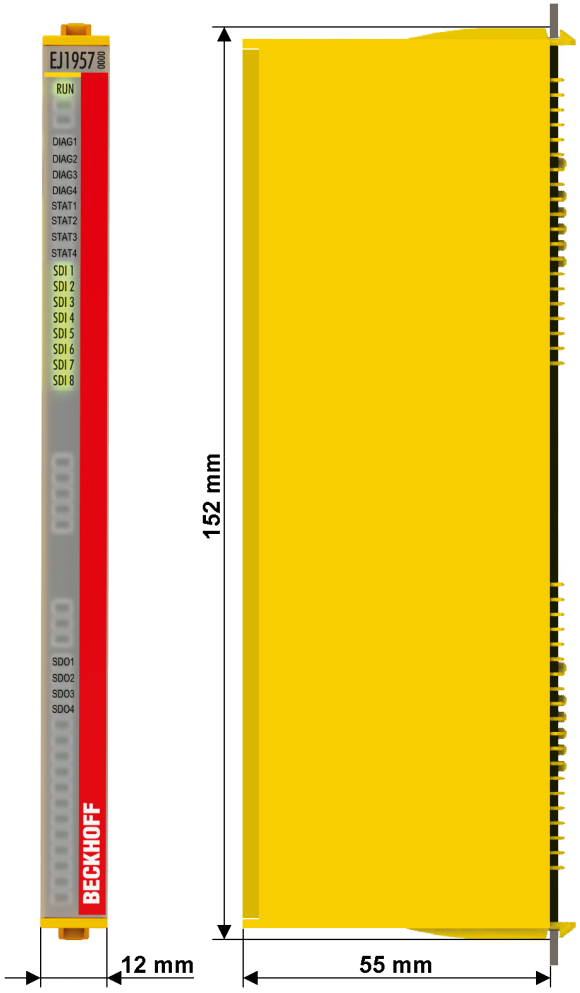

Fig. 7: EJxxxx - dimensions (long modules)

Dimension table

Product	Width	Height	Depth (above EJ distribution board)
Single module EJ6910	12 mm	66 mm	55 mm
Double module EJ1914, EJ2914	24 mm	66 mm	55 mm
Single module (long) EJ1918, EJ1957, EJ2918	12 mm	152 mm	55 mm

5.8 Status LEDs

The status LEDs of the TwinSAFE EJ modules are labeled STAT1 to STAT4.

STAT1	STAT2	STAT3	STAT4	Meaning
Off	Off	Off	lit	No TwinSAFE project available on the component
Off	Off	lit	lit	TwinSAFE project loaded, but not yet in RUN state
lit	Off	lit	lit	TwinSAFE project loaded and in RUN state. Customization is active for at least one TwinSAFE group
lit	lit	lit	lit	TwinSAFE project loaded and in RUN state. Customization is NOT active

5.9 Diagnostic LEDs

The diagnostic LEDs of the TwinSAFE EJ modules are labeled DIAG1 to DIAG4.

5.9.1 Flashing codes

LED	lit	flashes	flickers	off
DIAG1 (green)	Environment variables, operating voltage and internal tests are in the valid range • If DIAG2 flashes, a logic error code applies	-		Environment variables, operating voltage and internal tests are outside the valid range • If DIAG2 flashes, an environment error code applies
DIAG2 (red)	Together with DIAG3 and 4: Global shutdown[1)] has occurred (see diag history of the TwinSAFE components).	Logic or environment error code according to Diag1 and tables below is output	Error of the safe input or output module	Together with DIAG3 and 4: Global fault[1)] has occurred (see diag history of the TwinSAFE components).
DIAG3 (red)	Global fault or global shutdown on µC1[1)]	-		No global fault or global shutdown on µC1[1)]
DIAG4 (red)	Global fault or global shutdown on µC2[1)]	-		No global fault or global shutdown on µC2[1)]

1. A global fault permanently disables the TwinSAFE component, so that it has to be replaced. A global shutdown temporarily disables the TwinSAFE component. The error can be reset by switching off and back on again.

Logic error codes of LED DIAG2 (if LED DIAG1 is lit)

Flashing Code	Description
1	Function block error in one of the TwinSAFE groups
2	Communication error in one of the TwinSAFE groups
3	Error combination: Function block and communication
4	General error in one of the TwinSAFE groups
5	Error combination: General and function block
6	Error combination: General and communication
7	Error combination: General, function block and communication

Environment error codes of LED DIAG2 (if LED DIAG1 is off)

Flashing Code	Description
1	Maximum supply voltage µC1 exceeded
2	Supply voltage µC1 below minimum value
3	Maximum supply voltage µC2 exceeded
4	Supply voltage µC2 below minimum value
5	Maximum internal temperature exceeded
6	Internal temperature below minimum value
7	Valid temperature difference between µC1 and µC2 exceeded
8	not used
9	not used
10	General error

5.9.2 Flash code display

LED	Display	Description
flashing		400 ms ON / 400 ms OFF 1 second pause between the flash codes
flickering		50 ms ON / 50 ms OFF

5.10 Maintenance

Maintenance

The TwinSAFE components are maintenance-free!

Environmental conditions

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

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

Cleaning

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

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

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

5.11 Service life

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

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

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

Date code: CW YY SW HW

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

In addition the TwinSAFE EJ modules bear a unique serial number.

Fig. 8: Unique serial number of a TwinSAFE EJ module

5.12 Decommissioning

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

Disposal

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

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

6 EJ1914

6.1 Overview

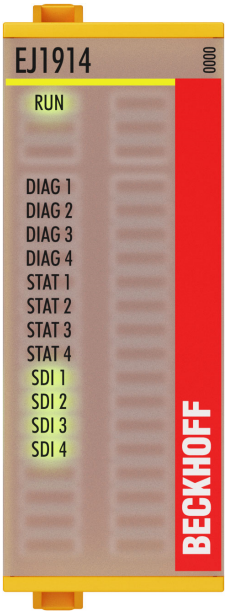

Fig. 9: EJ1914 - TwinSAFE module with 4 fail-safe inputs

The EJ1914 Safety EtherCAT plug-in module is a digital input module for sensors with floating contacts for 24 V_{DC}. The plug-in module has 4 fail-safe inputs and 4 clock outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 PL e.

The EJ module is parameterized via two input modules.

6.2 Insertion of the EJ1914

An EJ1914 is inserted in exactly the same way as any other Beckhoff EtherCAT module. In the list, open *Safety Terminals* and select the EJ1914 module.

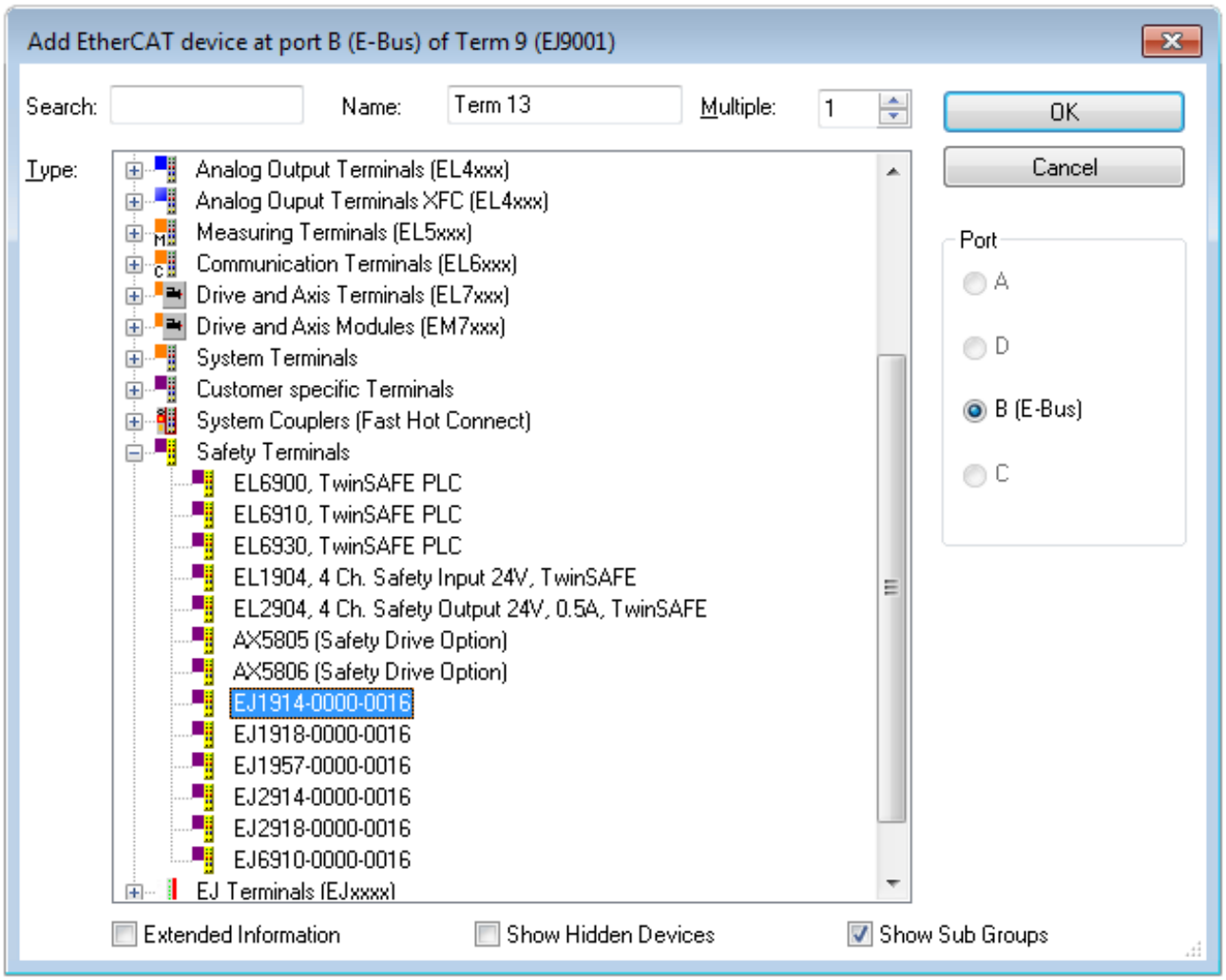

Fig. 10: Addition of an EJ1914

6.3 Specific technical data

The EJ1914 Safety EtherCAT plug-in module is a digital input module for sensors for 24 V_{DC}. The EJ plug-in module has 4 fail-safe inputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 Category 4 / PL e.

Product property	EJ1914
Number of inputs	4
Number of clock outputs	4
Number of outputs	-
Status indicator	4 (one green LED per input)
Diagnostic display	4 (1 green, 3 red LEDs)
Current consumption of the modular electronics at 24 V (without current consumption of sensors)	4 channels occupied: typ. 15 mA 0 channel occupied: typ. 2 mA
Current consumption via E-bus	4 channels occupied: approx. 260 mA
Weight	approx. 45 g

6.4 Safety parameters

Characteristic numbers	EJ1914
Lifetime [a]	20
Proof test interval [a]	not required [1)]
PFH_D	3.21E-09
%SIL3 of PFH_D	3.2%
PFD_{avg}	5.1E-05
%SIL3 of PFD_{avg}	5.1%
$MTTF_D$	2406 a
DC	98.3% (CAT 4)
Performance Level	PL e
Category	4
HFT	1
Classification element [2)]	Type B

1. Special proof tests are not required during the entire service life of the EJ1914 EtherCAT module.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EJ1914 EtherCAT module can be used for fail-safe applications within the meaning of IEC 62061 and IEC 61508:2010 up to SIL3 and EN ISO 13849-1:2015 up to PL e (Cat4).

Further information on calculating or estimating the $MTTF_D$ value from the PFH_D value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.

In terms of safety-related parameters, the Safety-over-EtherCAT communication is already considered with 1% of SIL3 according to the protocol specification.

7 EJ1918

7.1 Overview

Fig. 11: EJ1918 - TwinSAFE module with 8 digital fail-safe inputs

The EJ1914 Safety EtherCAT plug-in module is a digital input module for sensors with floating contacts for 24 V_{DC}. The plug-in module has 8 fail-safe inputs and 8 clock outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 PL e.

The EJ module is parameterized via four input modules.

7.2 Insertion of the EJ1918

An EJ1918 is inserted in exactly the same way as any other Beckhoff EtherCAT module. In the list, open *Safety Terminals* and select the EJ1918 module.

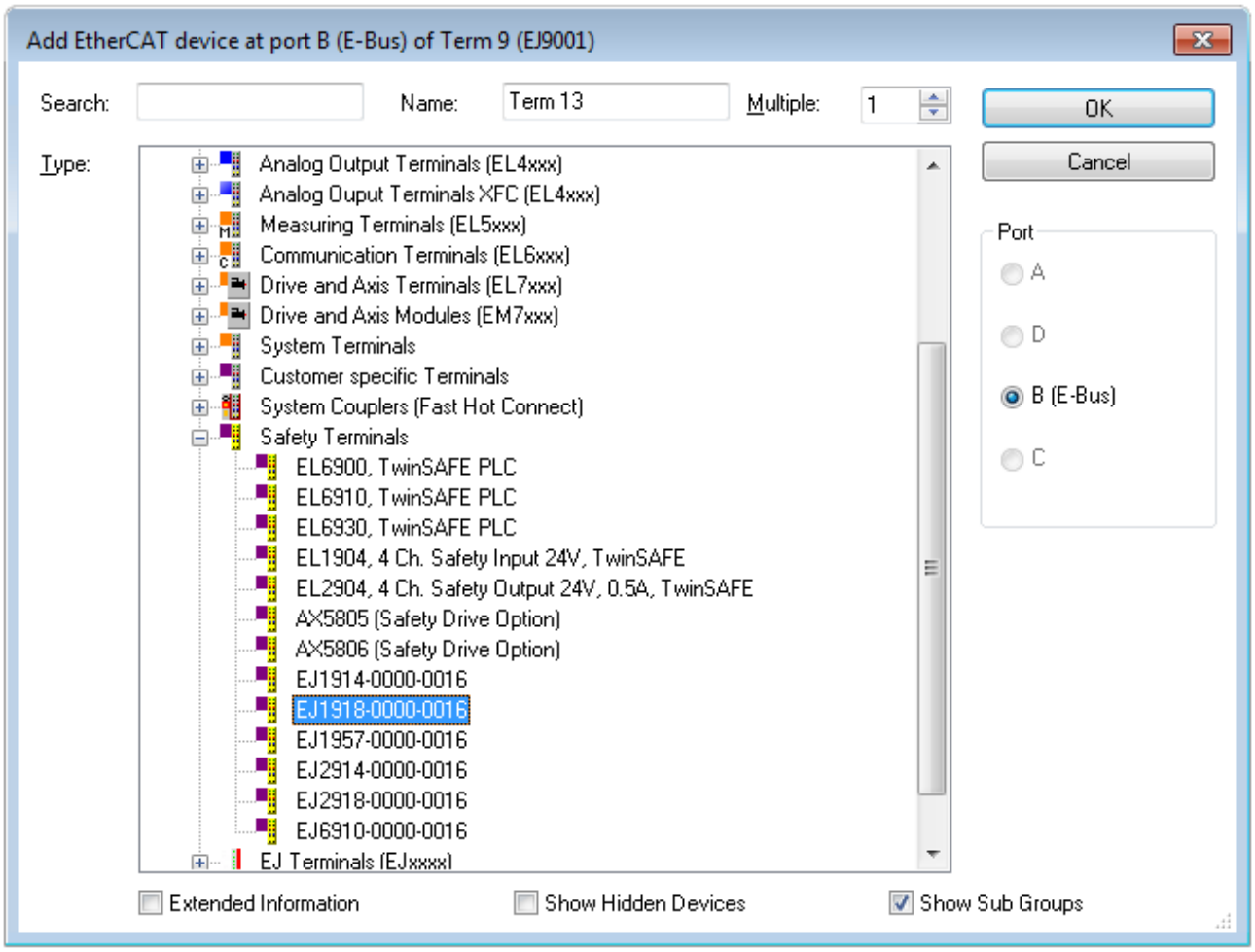

Fig. 12: Addition of an EJ1918

7.3 Specific technical data

The EJ1918 Safety EtherCAT plug-in module is a digital input module for sensors for 24 V_{DC}. The EJ plug-in module has 8 fail-safe inputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 Category 4 / PL e.

Product property	EJ1918
Number of inputs	8
Number of clock outputs	8
Number of outputs	-
Status indicator	8 (one green LED per input)
Diagnostic display	4 (1 green, 3 red LEDs)
Current consumption of the modular electronics at 24 V (without current consumption of sensors)	8 channels occupied: typ. 26 mA 0 channel occupied: typ. 3 mA
Current consumption via E-bus	8 channels occupied: approx. 290 mA
Weight	approx. 60 g

7.4 Safety parameters

Characteristic numbers	EJ1918
Lifetime [a]	20
Proof test interval [a]	not required [1)]
PFH_D	3.21E-09
%SIL3 of PFH_D	3.2%
PFD_{avg}	4.95E-05
%SIL3 of PFD_{avg}	5.0%
$MTTF_D$	2406 a
DC	98.3% (CAT 4)
Performance Level	PL e
Category	4
HFT	1
Classification element [2)]	Type B

1. Special proof tests are not required during the entire service life of the EJ1914 EtherCAT module.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EJ1918 EtherCAT module can be used for fail-safe applications within the meaning of IEC 62061 and IEC 61508:2010 up to SIL3 and EN ISO 13849-1:2015 up to PL e (Cat4).

Further information on calculating or estimating the $MTTF_D$ value from the PFH_D value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.

In terms of safety-related parameters, the Safety-over-EtherCAT communication is already considered with 1% of SIL3 according to the protocol specification.

8 EJ1957

8.1 Overview

Fig. 13: EJ1957 – TwinSAFE module with 8 digital fail-safe inputs and 4 digital fail-safe outputs

The EJ1957 TwinSAFE module is a digital input and output terminal for sensors with potential-free contacts for 24 V_{DC}. The plug-in module has 8 fail-safe inputs with 8 clock outputs and 4 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 PL e.

The EJ module is parameterized via four input modules and one output module.

8.2 Insertion of the EJ1957

An EJ1957 is inserted in exactly the same way as any other Beckhoff EtherCAT module. In the list, open *Safety Terminals* and select the EJ1957 module.

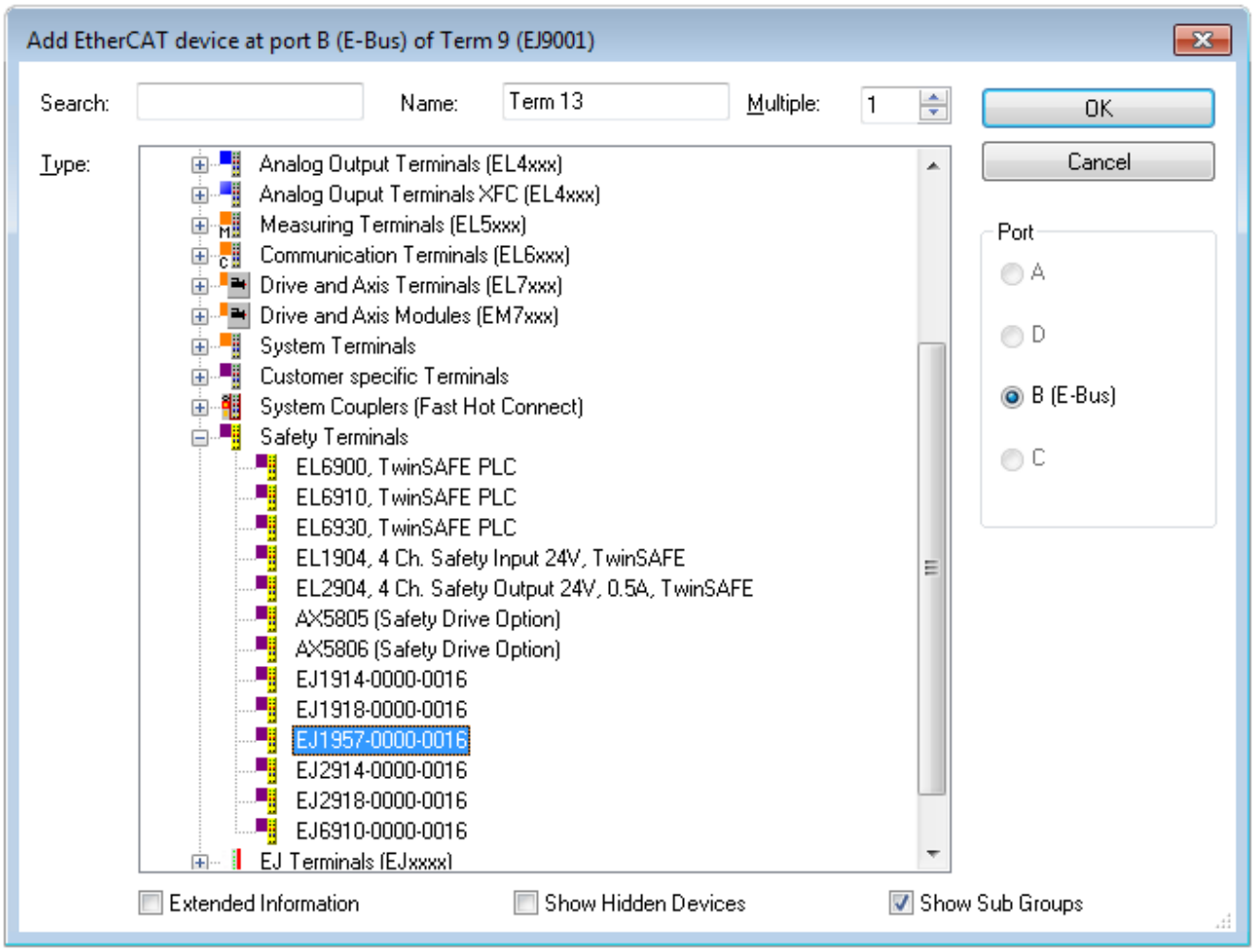

Fig. 14: Addition of an EJ1957

8.3 Specific technical data

The EJ1957 Safety EtherCAT plug-in module is a digital input/output module for sensors for 24 V_{DC}. The EJ plug-in module has 8 fail-safe inputs, 4 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 Category 4 / PL e.

Product property	EJ1957
Number of inputs	8
Number of clock outputs	8
Number of outputs	4
Status indicator	12 (one green LED per input/output)
Diagnostic display	4 (1 green, 3 red LEDs)
Current consumption of the modular electronics from 24 V (without current consumption of sensors and actuators)	12 channels occupied: typ. 46 mA 0 channel occupied: typ. 3 mA
Current consumption via E-bus	12 channels occupied: approx. 330 mA
Weight	approx. 64 g

8.4 Safety parameters

Characteristic numbers	EJ1957
Lifetime [a]	20
Proof test interval [a]	not required [1)]
PFH_D	4.43E-09
%SIL3 of PFH_D	4.4%
PFD_{avg}	5.0E-05
%SIL3 of PFD_{avg}	5.0%
$MTTF_D$	1731 a
DC	98.4% (CAT 4)
Performance Level	PL e
Category	4
HFT	1
Classification element [2)]	Type B

1. Special proof tests are not required during the entire service life of the EJ1957 EtherCAT module.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EJ1957 EtherCAT module can be used for fail-safe applications within the meaning of IEC 62061 and IEC 61508:2010 up to SIL3 and EN ISO 13849-1:2015 up to PL e (Cat4).

Further information on calculating or estimating the $MTTF_D$ value from the PFH_D value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.

In terms of safety-related parameters, the Safety-over-EtherCAT communication is already considered with 1% of SIL3 according to the protocol specification.

9 EJ2914

9.1 Overview

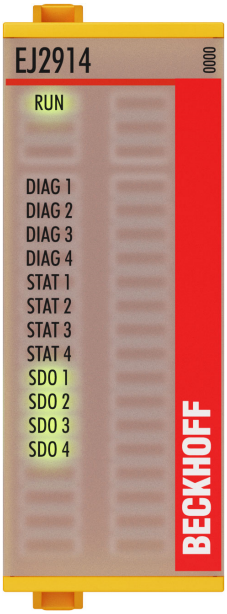

Fig. 15: EJ2914 - TwinSAFE module with 8 digital fail-safe outputs

The EJ2914 TwinSAFE module is a digital output module for actuators with 24 V_{DC}. The plug-in module has 4 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 PL e.

The EJ module is parameterized via one output module.

9.2 Insertion of the EJ2914

An EJ2914 is inserted in exactly the same way as any other Beckhoff EtherCAT module. In the list, open *Safety Terminals* and select the EJ2914 module.

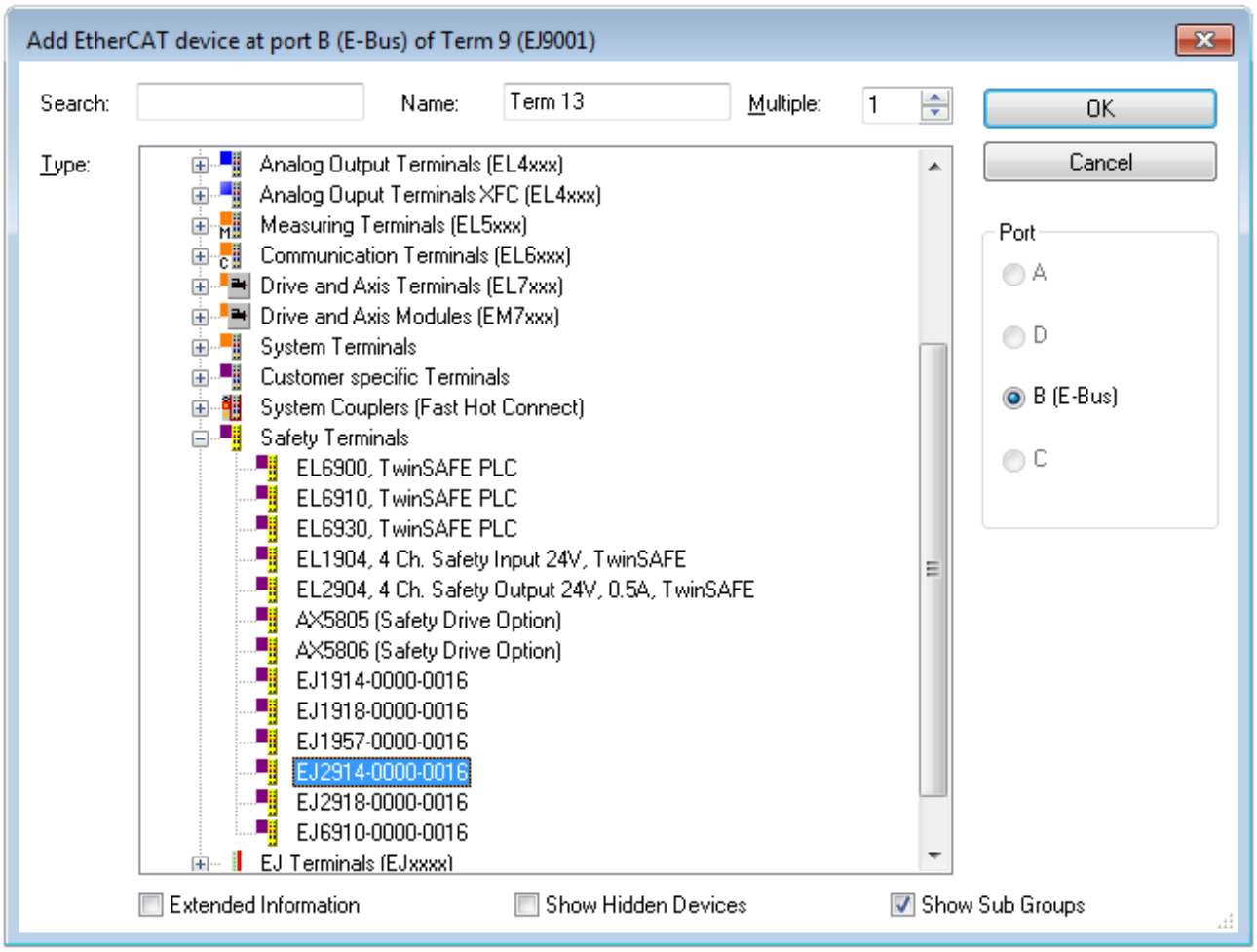

Fig. 16: Addition of an EJ2914

9.3 Specific technical data

The EJ2914 Safety EtherCAT plug-in module is a digital output module for actuators for 24 V_{DC}. The EJ plug-in module has 4 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 Category 4 / PL e.

Product property	EJ2914
Number of inputs	-
Number of clock outputs	-
Number of outputs	4
Status indicator	4 (one green LED per output)
Diagnostic display	4 (1 green, 3 red LEDs)
Current consumption of the modular electronics from 24 V (without current consumption of actuators)	0 channel occupied: typ. 1 mA 4 channels occupied: typ. 22 mA
Current consumption via E-bus	4 channels occupied: approx. 260 mA
Weight	approx. 47 g

9.4 Safety parameters

Characteristic numbers	EJ2914
Lifetime [a]	20
Proof test interval [a]	not required [1)]
PFH_D	3.03E-09
%SIL3 of PFH_D	3.0%
PFD_{avg}	2.6E-05
%SIL3 of PFD_{avg}	2.6%
$MTTF_D$	1994 a
DC	98.1% (CAT 4)
Performance Level	PL e
Category	4
HFT	1
Classification element [2)]	Type B

1. Special proof tests are not required during the entire service life of the EJ2914 EtherCAT module.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EJ2914 EtherCAT module can be used for fail-safe applications within the meaning of IEC 62061 and IEC 61508:2010 up to SIL3 and EN ISO 13849-1:2015 up to PL e (Cat4).

Further information on calculating or estimating the $MTTF_D$ value from the PFH_D value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.

In terms of safety-related parameters, the Safety-over-EtherCAT communication is already considered with 1% of SIL3 according to the protocol specification.

10 EJ2918

10.1 Overview

Fig. 17: EJ2918 - TwinSAFE module with 8 digital fail-safe outputs

The EJ2918 TwinSAFE module is a digital output module for actuators with 24 V_{DC}. The plug-in module has 8 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 PL e.

The EJ module is parameterized via two output modules.

10.2 Insertion of the EJ2918

An EJ2918 is inserted in exactly the same way as any other Beckhoff EtherCAT module. In the list, open *Safety Terminals* and select the EJ2918 module.

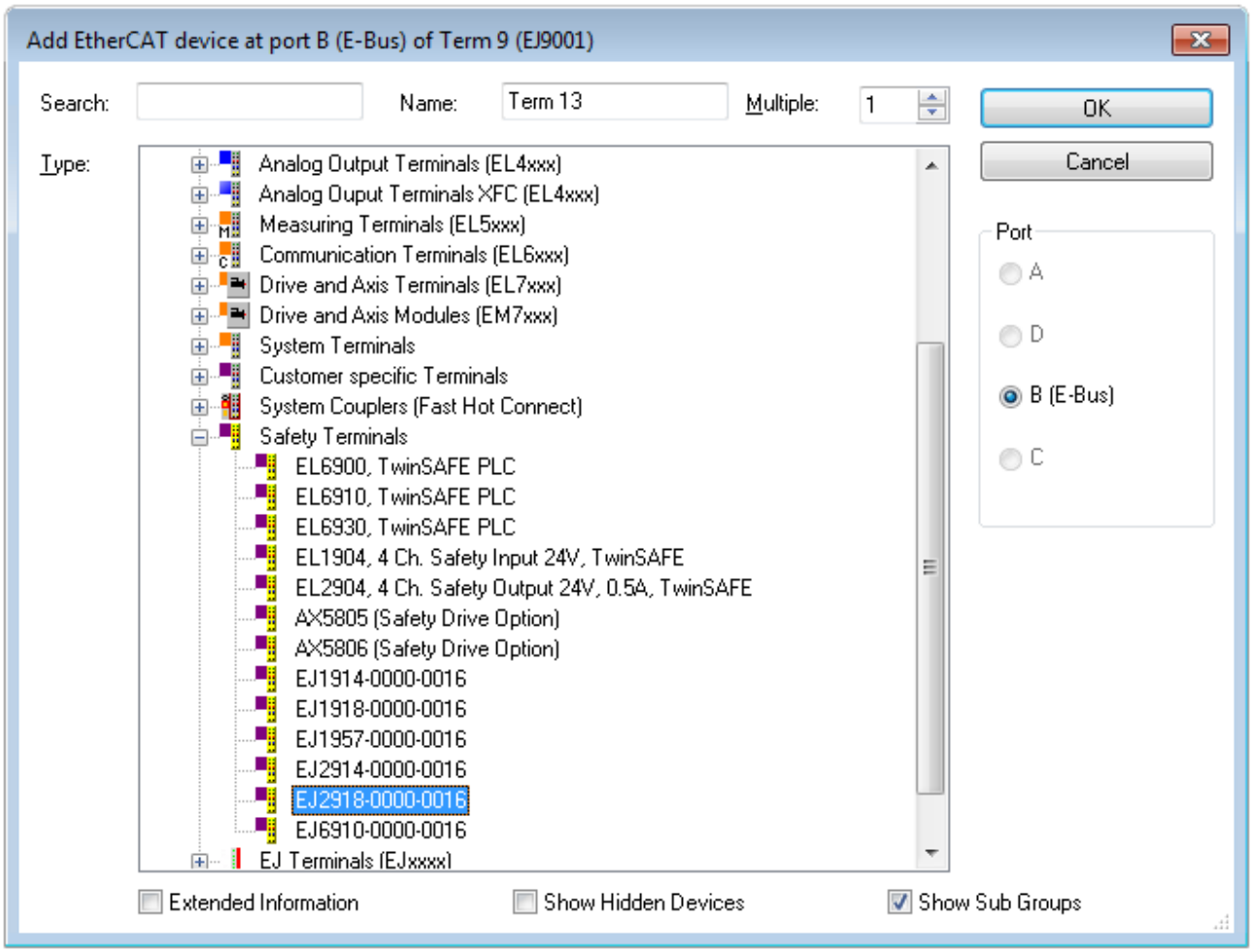

Fig. 18: Addition of an EJ2918

10.3 Specific technical data

The EJ2918 Safety EtherCAT plug-in module is a digital output module for actuators for 24 V_{DC}. The EJ plug-in module has 8 fail-safe outputs and meets the requirements of IEC 61508:2010 SIL 3 and EN ISO 13849-1:2015 Category 4 / PL e.

Product property	EJ2918
Number of inputs	-
Number of clock outputs	-
Number of outputs	8
Status indicator	8 (one green LED per output)
Diagnostic display	4 (1 green, 3 red LEDs)
Current consumption of the modular electronics from 24 V (without current consumption of actuators)	8 channels occupied: typ. 42 mA 0 channel occupied: typ. 1 mA
Current consumption via E-bus	8 channels occupied: approx. 310 mA
Weight	approx. 62 g

10.4 Safety parameters

Characteristic numbers	EJ2918
Lifetime [a]	20
Proof test interval [a]	not required [1)]
PFH_D	3.03E-09
%SIL3 of PFH_D	3.0%
PFD_{avg}	2.6E-05
%SIL3 of PFD_{avg}	2.6%
$MTTF_D$	1994 a
DC	98.1% (CAT 4)
Performance Level	PL e
Category	4
HFT	1
Classification element [2)]	Type B

1. Special proof tests are not required during the entire service life of the EJ2918 EtherCAT module.
2. Classification according to IEC 61508-2:2010 (see chapters 7.4.4.1.2 and 7.4.4.1.3)

The EJ2918 EtherCAT module can be used for fail-safe applications within the meaning of IEC 62061 and IEC 61508:2010 up to SIL3 and EN ISO 13849-1:2015 up to PL e (Cat4).

Further information on calculating or estimating the $MTTF_D$ value from the PFH_D value can be found in the TwinSAFE application manual or in EN ISO 13849-1:2015, Table K.1.

In terms of safety-related parameters, the Safety-over-EtherCAT communication is already considered with 1% of SIL3 according to the protocol specification.

11 Appendix

11.1 Support and Service

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

Beckhoff's branch offices and representatives

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

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

You will also find further documentation for Beckhoff components there.

Beckhoff Headquarters

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33415 Verl
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Fax:	+49(0)5246/963-198
e-mail:	info@beckhoff.com

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

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Fax:	+49(0)5246/963-9157
e-mail:	support@beckhoff.com

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- repair service
- spare parts service
- hotline service

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

11.2 Certificates

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

Product Service

CERTIFICATE

No. Z10 17 04 62386 037

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

Factory(ies): 62386

Certification Mark:

Product: **Safety components**
EtherCAT Plugin Module

Model(s): **EJx9xx**
For nomenclature see attachment

Parameters:

Supply voltage:	24VDC (-15%/+20%)
Protection class:	IP 20
Ambient temperature:	-25°C ... +55°C

Tested according to:
EN ISO 13849-1:2015 (up to Cat 4, PL e)
EN 61508-1:2010 (up to SIL 3)
EN 61508-2:2010 (up to SIL 3)
EN 61508-3:2010 (up to SIL 3)
EN 61508-4:2010 (up to SIL 3)
EN 62061:2005/A2:2015 (up to SILCL 3)

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

Test report no.: BV90900T

Valid until: 2022-04-18

Date, 2017-04-19

(Jürgen Blum)

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

Product Service

ATTACHMENT TO CERTIFICATE
No. Z10 17 04 62386 037

1 Nomenclature of EJx9xx

EJ x 9 x x
(A) (B)(C) (D) (E)

(A) Series
EJ: EtherCAT plug-in module / TwinSAFE I/O

(B) I/O
1: digital input
2: digital output

(C) Product family
9: TwinSAFE product

(D) Generation
1: second device generation
5: combi module

(E) Channel
4: 4-channel
7: 8-input / 4-output
8: 8-channel

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List of figures