06/25 MN050020

XN Safety System Manual

Powering Business Worldwide

Company information

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Original Operating Instructions

is the German-language edition of this document

Publication date

06/25 MN0500201th edition

DANGER!

Hazardous electrical voltage!

Before starting with the installation

- Installation requires qualified electrician
- Disconnect the power supply of the device.
- Secure against retriggering
- Verify isolation from the supply
- Ground and short-circuit
- Cover or enclose any neighboring live parts.
- Follow the engineering instructions (IL) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the equipotential bonding. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Deviations of the mains voltage from the nominal value must not exceed the tolerance limits given in the specifications, otherwise this may result in malfunction and hazardous states.
- Emergency-Stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency switching off devices must not result in an automatic restart.
- Built-in devices for enclosures or cabinets must only be run and operated in an installed state; desktop devices and portable devices only when the housing is closed.
- Measures should be taken to ensure the proper restarting of programs interrupted after a voltage dip or outage. This should not result in dangerous operating states even for a short time. If necessary, emergency switching off devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks, etc.).

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0.1 About this manual

The XN Safety documentation contains all the information you will need in order to use the XN Safety modular safety PLC safely and correctly and is structured as follows:

The XN Safety System Manual is the master document for the XN Safety system.

The XN Safety Designer programming software program is an integrated part of the XN Safety modular safety PLC system. This software is used to program the corresponding Safety projects. The description of the XN Safety Designer Configuration tool is integrated into XN Safety designer as user help.

The product documentation for the individual safety modules contains detailed technical data and the information required for their use.

XS-102-C00-000	MN050019
XS-322-10DI-PF	MN050021
XS-322-8DO-P20	MN050022
XS-322-8DIO-PF20	MN050023
XS-322-4AI-I2	MN050025
XS-322-2INC	MN050024
XS-322-2DO-RNODC	MN050027
XS-322-2DO-RNOAC	MN050026

The entire XN Safety documentation is considered part of the XN Safety module and must be kept accessible to the user at all times.

Specialist knowledge of electrical engineering is required to use the documentation.

Make sure to always use the latest documentation for XN Safety. The latest version of this documentation, as well as additional references, is available for download on the Internet, see also → Section "Further usage information", page 92.

Eaton.com/documentation

Please send any comments, recommendations, or suggestions regarding this document to: DocumentationEGBonn@eaton.com

0.1.1 List of revisions

The following significant amendments have been introduced since previous issues:

Publication date	Page(s)	Keyword	New	Modification	Deleted
2025-06-01	subsequent	Product launch edition	✓		

0.1 About this manual

0.1.2 Target group

This operating manual contains all the information you will need in order to operate the Safety modules.

This operating manual is intended for electricians and electrical engineers, as well as for the people who will be in charge of performing the electrical installation and people who will be using the XN Safety System Manual:

- Project planners, automation technicians, and automation engineers
- Installers, commissioning technicians
- Machine operators
- Maintenance personnel / testing technicians

This manual assumes that the reader has extensive knowledge of automation and the specifics behind it.

For additional help, information, and compatible accessories, please visit our web-site: Eaton.com.

If you have any questions, our Support Team will of course be happy to assist you. For our emergency phone number and office hours, please visit our website.

CAUTION

Installation requires qualified electrician

XN Safety module must be installed and connected exclusively by electricians and people who are familiar with electrical installation work.

Follow the safety instructions for the XN Safety module!

The section on safety instructions must be read and understood by everyone who will be working with the XN Safety CPU module before the actual work is performed Safety modules.

0.1.3 Legal disclaimer

All the information in this manual has been prepared to the best of our knowledge and in conformity with the state of the art. However, this does not exclude the possibility of there being errors or inaccuracies. Accordingly, this manual is subject to change without notice, with potential changes including technical changes intended to improve devices.
We hereby disclaim any and all liability for the correctness and completeness of this information. Please note that this operating manual purely provides a product description. In particular, the information in it does not guarantee any specific properties in terms of warranty laws and similar regulations.
The machine manufacturer will be responsible for proper installation and product configuration. Meanwhile, the machine operator will be responsible for the product's safe use and proper operation.

Do not use the XN Safety before reading and understanding this manual.

It is assumed that the user of this manual is thoroughly familiar with the information found in the manuals for incorporating the safety controller into automation processes.

Hazards posed by the safety controller cannot be ruled out if the safety instructions are not observed – especially if the safety controller is installed and commissioned by inadequately qualified personnel or if it is used improperly. Eaton accepts no liability for damage resulting from failure to follow these instructions or the relevant regulations.

The use of sample programs and of the program part screenshots used in the documentation are subject to the following safety instructions and operating guidelines:

1. The program examples provided were created to the best of our knowledge and belief and in accordance with the current state-of-the-art. The program examples provided were created to the best of our knowledge and belief and in accordance with the current state-of-the-art. However, errors cannot be totally excluded, and the example programs do not cover all function blocks and applications that are available for the safety controller.
2. Electrical engineering skills and know-how are required in order to be able to program and commission the safety controller. An incorrectly wired or incorrectly configured safety controller will pose a property damage risk and an injury hazard when active components such as motors and pressure cylinders are being driven.
3. When using the provided sample programs and generating a program with XN Safety Designer Configuration tool, the user has the sole responsibility to observe the following:
   - All relevant rules and practices for preparing circuit diagrams for the safety controller as specified in the latest documents for these XN Safety.

- All occupational health and safety and accident prevention directives, standards, and regulations applicable to the commissioning, circuit diagram creation for, and use of the safety controller for your planned application, in particular those imposed by employers' liability insurance associations (Berufsgenossenschaften).
- Acknowledged rule of technology and state of science.
- All other general due diligence regarding the prevention of damages to life and physical condition of persons as well as material damage.

4. The manufacturer cannot accept any liability for any damages that are caused by customers not using the program examples provided in accordance with the conditions of use specified here under points 1 to 3.

The latest version of this manual can be found on our Download Center by using the following search term: MN050020.

Eaton.com/documentation

0.1.4 Short designations

The following general terms are used throughout this manual:

Short designation	Explanation
XN Safety	Entire series, used to refer to all the modules in the product family
Safety CPU	XN Safety CPU module
XN Safety module	XN Safety CPU module expansions
XN Safety designer	XN Safety Designer Configuration tool
Hardware Tree	Graphic representation of the structure of the hardware configuration in the safety project

For the exact designation for your XN Safety modules, please refer to the inscription on the XN Safety module.

0.1.5 Writing conventions

0.1.5.1 Warning labels

Risk of personal injury warning.

DANGER

"Danger" means that death or serious injury will occur if the specified measures are not taken.

- Follow all instructions in order to prevent death and serious injury.

WARNING

"Warning" means that death or serious injury may occur if the specified measures are not taken.

- Follow all instructions in order to prevent death and serious injury.

CAUTION

"Caution" means that moderate or minor injury may occur if the specified measures are not taken.

- Follow all instructions in order to prevent moderate to minor injury.

Property damage warning

ATTENTION

Warns about the possibility of material damage.

Prohibited use

Prohibited uses, actions, etc.

Prohibition signs interdict actions or the use of certain objects

Requirements

Requirement

Mandatory signs require a certain behavior

Notes

Additional information, information worth knowing, useful additional information

- Provides important information regarding the product, handling, use, or relevant parts of the documentation that require special attention.

▶ Indicates instructions to be followed

0.1.5.2 Additional information for use

Documents (such as manuals) are listed after the icon together with the corresponding name and Eaton number.

Publication title — For identifying the Eaton publication code

Links to external Internet addresses are shown after the symbol.

Destination address without http(s)://www.

Links to external content are shown in blue.

1. Basic safety instructions aboutXN Safety

1.1 General safety instructions

This XN Safety System Manual supplements the manuals for the XN Safety modules. Together, these two documents fulfill the requirements for operating instructions in accordance with Machinery Directive 2006/42/EC. According to Directive 2006/42/EC, the operating instructions are an integral part of a product.

- Therefore, keep this XN Safety System Manual and the manual close to the machine at all times, as they contain important information.
- Pass on both documents when selling, disposing of or lending the product.

Follow the safety instructions in all of this manual's sections without fail. These instructions will be highlighted visually with appropriate symbols.

Before handling a safety module, please read the relevant data sheets, instructions, and this system manual thoroughly. EATON accepts no liability for damage resulting from failure to observe these instructions or the relevant regulations.

The technical data for the safety modules and the installation instructions in section 3 must be strictly observed.

Therefore, observe the general and specific safety instructions and the technical rules and regulations listed in the following sections.

We reserve the right to make technical changes that serve to improve the XN Safetx modules. Please note that this operating documentation purely provides a product description. These are not warranted characteristics within the meaning of warranty law and similar regulations.

In regard to all occupational health and safety requirements associated with the machine's use, the manufacturer must conduct a risk assessment in accordance with Machinery Directive 2006/42/EC before a machine is placed on the market.

Always use the safety modules of the XN Safety series for their intended purpose.

Observe all accident prevention and occupational health and safety standards and regulations that apply at the location of use.

1.2 Use as intended

The safety functions implemented with the Safety modules are intended for use in safety applications within the context of a Safety CPU and meet all necessary requirements for safe operation in conformity with SIL 3 as defined in EN IEC 62061 and PL e / Cat. 4 as defined in EN ISO 13849-1.

These safety protection levels refer to dual-channel applications. In single-channel operation, some modules have lower safety protection levels. Please refer to the respective EC type examination certificates (TÜV certificate).

CAUTION

Always observe the instructions and information in this documentation.
Safety functions must only be operated by power supply units that meet PELV requirements according to EN60204.
Properly transporting and storing the device are essential for proper operation.
The device must be installed, mounted, programmed, commissioned, operated, maintained, and removed from service solely by trained qualified personnel.
Within this context, "trained qualified personnel" refers to individuals who have received the required vocational training as skilled workers or who have been trained by a skilled worker and accordingly are authorized to operate and take care of safety devices and systems in compliance with all applicable safety guidelines, standards, and Directives. The required ambient conditions must be met.

The required ambient conditions must be met.

For your safety and the safety of others, make sure to only use the Safety modules as intended.
This intended use also includes installing the device properly in terms of EMC.
Within this context, the following are instances of unintended use:

- Any alterations of any type made to the safety modules, as well as the use of damaged safety modules.
- Use of the safety modules outside the technical framework described in this documentation
- Use of the safety modules outside the technical data specified in this documentation and in the “Technical Data” section of the respective product documentation.

CAUTION

Follow the safety instructions in all of this manual's sections without fail. These instructions will be highlighted visually with appropriate symbols.

The requirements set out in standard EN 60204-1 apply regarding electrical safety.

- Please ensure that environmental conditions are observed for your own safety and the safety of others.
- The control cabinet and the module support must have a proper ground connection.
- Always disconnect the system from the mains when performing maintenance and repairs. Check that there is no voltage and ensure that it cannot be switched back on.

1.3 Notes on risk assessment

When carrying out the risk assessment (Machinery Safety Directive 2006/42/EC), the manufacturer of a machine or system must take into account the residual risks that may be caused by the safety modules. These include, for example:

1. Unintended movements of driven parts on the machine.
2. Unusual temperatures, emissions of gas, particles, noise, and light.
3. Dangerous touch voltages
4. Effects of operational electric, magnetic, and electromagnetic fields (for example on pacemakers and implants).
5. Possible effects of IT devices (cell phones, smartphones, etc.).
6. Release of environmentally harmful substances and emissions.

1.3.1 Residual risks

CAUTION

The following residual risks for the XN Safety modules must be taken into account in the risk assessment conducted by the system integrator:

- Release of environmentally harmful substances, emissions, and unusual temperatures
- Dangerous touch voltages
- Effects of operational electric, magnetic, and electromagnetic fields
- Possible effects of IT devices

1.4 Special safety instructions

Hazards due to live parts
The requirements set out in standard EN 60204-1 apply.

- Please ensure that environmental conditions are met for your own safety.

There is a particular risk of electric shock from live parts during installation and operation of the machine. Live parts must not be touched.

Improper or unintended use may result in damage to the machine and personal injury, including fatal injuries.

The electrical connections must not be disconnected while live. Before disconnecting the connections, the machine must be switched off in a controlled manner and disconnected from the power supply. Check that there is no voltage and ensure that it cannot be switched back on. Wait 5 minutes before touching live parts or disconnecting connections after switching off or disconnecting the safety modules from the power supply.
Measure the voltage and wait until it has dropped below 40 volts for safety reasons.

Failure to follow the instructions may result in damage to the system and serious injury or death!

Dangers from hot surfaces
During installation and operation, high temperatures may occur on thermally conductive parts (heat sinks). It is therefore advisable to check the temperature of these parts before touching them; if necessary, wait until the temperature has dropped below 40 °C.
Failure to comply these precautions may result in serious injury.
It is the responsibility of the machine manufacturer to ensure that the safety modules are handled correctly and, if necessary, to ensure accessibility through organizational measures!

1.5 Machine or system safety

Please observe the safety guidelines carefully, as failure to do so will void all warranty and guarantee claims:

Observe all accident prevention and occupational health and safety standards and regulations that apply at the location of use.

1.6 Directives and standards

The safety modules have been designed to meet the requirements of the following standards:

- EN / IEC 62061
- EN ISO 13849-1
- EN ISO 13849-2

Regarding use in a machine or system, the system integrator must first carry out a risk assessment and observe the following standards:

- EN ISO 12100-1/-2 and EN ISO 14121
- EN 60204-1

Depending on the application or type of machine, compliance with additional C-type standards (e.g., lift) may be required.

1.7 EC Declaration of Conformity

EU Declaration of Conformity

The safety modules conform to all applicable European standards for programmable logic controllers and comply with the following European Directives:

- **2006/42/EG** directive 2006/42/EG of the European Parliament and Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (Machinery Safety Directive)
- **2014/30/EU** electromagnetic compatibility (EMC Directive)
- **2011/65/EU** Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive)

EU Declarations of Conformity are available on the EATON homepage. In addition, this one is included as a resource in the data sheet for the XN Safety module.

1.8 Service life, usage time, and switching cycle times

Lifetime

The maximum service life of all safety modules is 20 years. The safety module must be replaced after the end of its service life at the latest. It is therefore advisable to take appropriate measures to ensure that this requirement is met.

Operating time

In certain cases, such as safety modules with mechanical relay outputs, the service life can be reduced by the shorter “usage time” if, for example, the maximum number of permissible mechanical switching cycles is reached. When the usage time is reached, the corresponding assembly must be replaced, even if the service life has not yet expired. The calculation formula for the usage time is specified in the relevant documentation.

Switching cycle times

The safety-related parameters (diagnostic options) of the safe inputs and outputs are based on the assumption that the safe inputs and outputs are switched at least once a year.

If regular switching at intervals of less than one year cannot be ensured by normal operation of the machine then manual switching must be performed at least once a year.

Emergency stop switches on hand-held devices must be checked at least once every 30 days!

Take appropriate measures to ensure that the requirements regarding service life, usage time, and switching cycle times are met.

1.9 System requirements

The XN Safety modules require at least the following system version of the programming software for implementation:

XN Safety Designer version: 11.01.076 or higher

1.9.1 Software

Safety projects are created with XN Safety Designer Configuration tool. The application compiled from this is transferred to XN Safety CPU module.

1.9.2 IT security

XN Safety modules have been developed for integration into networks that are secure against third-party access.

The network being used could be exposed to the following risks, for example:

- Unauthorized access
- Data tampering
- And many other IT security risks

The integrator, or the company operating the device, is responsible for conducting a risk assessment for the connections between XN Safety and the corresponding integration into the general infrastructure. This assessment can result in a variety of measures, including, but not limited to (if necessary):

- IT/OT network segmentation (VLANs or physical)
- Firewalls
- Password-protected user accounts
- Data encryption
- and much more.

When it comes to functional safety, the various functions and their integrity are completely invulnerable to direct manipulation in this regard, since these functions cannot be affected through communication-based interfaces.

However, the availability of the overall system (as is the case with all safety functions) can be negatively affected as a result of third-party attacks, which is why the aforementioned measures are required.

2. Introduction to the XN Safety security system

2.1 Structure of the XN Safety System

The XN Safety System's modular concept makes it easy to implement an I/O requirement that is optimized for the customer.

Fig. 1: Architecture of an XN safety controller

The figure above shows a Safety CPU with expansion modules.
The minimum configuration consists of a safety CPU and an expansion module.

The safety-related assembly meets the requirements of SIL 3 according to EN 62061 and PL e, Cat. 4 according to EN ISO 13849-1.

The modular design allows safe and non-safe system components to be readily combined.

This allows the individual requirements of a wide variety of machine types to be implemented.

The XN Safety System can be operated as a stand-alone safety controller (stand-alone operation). Furthermore, integrated operation is possible directly on a standard PLC of the XC series or decentralized on an XN300 fieldbus gateway (integrated operation). In integrated operation, only non-safety-related data can be exchanged between the standard PLC and the Safety CPU.

A typical operating system structure:

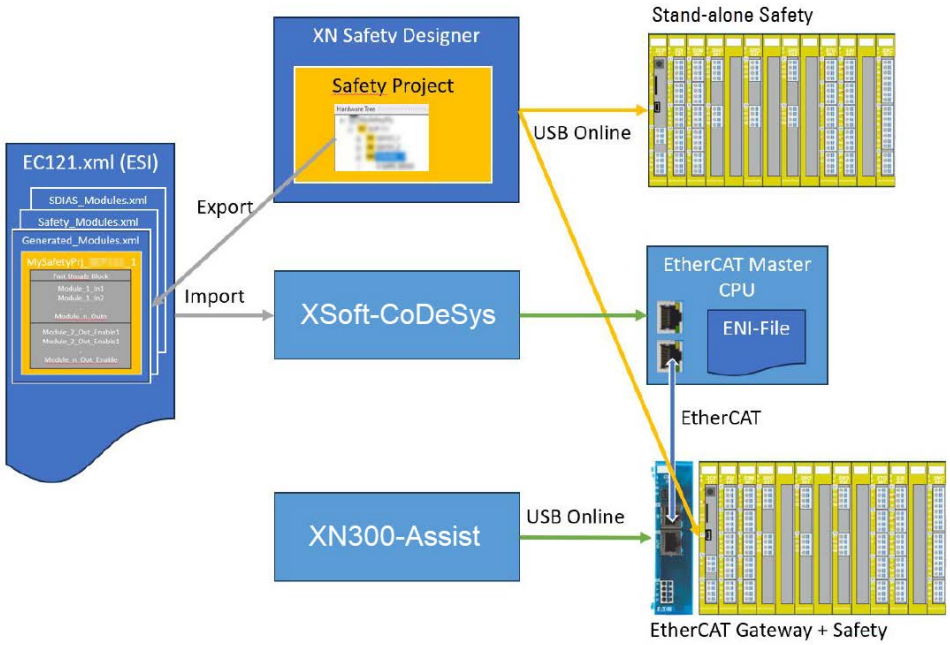


Fig. 2: Example of a safety system

The safety modules are configured using XN Safety designer. The secure application is processed directly in Safety CPU module.

When designing a safe control system, proceed as follows:

- Install and wire up the safety modules.
- Configure safety modules via the XN Safety designer.
  XN Safety designer is used to create and download (transfer) the secure application that is executed on the safety controller.
- Validation of the secure system.
  Once the secure application has been created and downloaded (transferred) to the safety modules, the system must be checked to ensure it is functioning correctly.

2.1.0.1 Safety modules

In general, the following module groups are available:

- XN Safety modules
  The XS-102-C00-000 Safety CPU can support up to 16 cards (XS-322-10DI-PF digital input module, XS-322-8DO-P20 digital output module, XS-322-2DO-RNODC DC relay output module, XS-322-2INC incremental encoder module, XS-322-8DIO-PF20 digital input/output module). A maximum of 8 relay cards, relay DC output module XS-322-2DO-RNODC or relay output module XS-322-2DO-RNOAC, can be plugged in (relay cards occupy 2 slots).
  The configuration is transferred to the Safety CPU either via the XN Safety Designer or SD card.

2.1.0.2 Safety state

The safety state always corresponds to the low level. If the system is not in the Operational or Temporary Operational operating state then the safe outputs are always switched off, i.e., the output is at earth potential. This is also the case in the fault state.

2.2 Communication in the safety system

The XN Safety Designer can be used to perform read and write accesses to the Safety CPU. Write accesses are possible on the Safety CPU, e.g. to transfer the configuration to it. Alternatively, the configuration can also be transferred from an SD card to the Safety CPU.

The XN Safety Designer can only access the Safety CPU for the safety modules in read and write mode. Communication with the plug-in cards (XS-322-10DI-PF, XS-322-8DO-P20, XS-322-2DO-RNODC, XS-322-2DO-RNOAC, XS-322-2INC, XS-322-4AI-I2, and XS-322-8DIO-PF20) is not possible.

2.3 System features

2.3.0.1 Configuration features

There are certain restrictions when creating the configuration; for example, a safe input or output module may only be addressed by a Safety CPU.

The safe outputs can be read back and reused. This is described in the XN Safety Designer.

DANGER

Replacement of safety modules
A module may only be replaced when the device is switched off. Incremental encoders must be re-taught when replacing an XS-322-2INC, refer to the product documentation.

2.3.0.2 System configuration

Configuration of the system via the XN Safety Designer

The system is configured using the “XN Safety Designer” software tool. The safe application is created in XN Safety Designer. Standard function blocks such as AND gates are available for this purpose. Complex function blocks that comply with the PLC Open standard are also available.

The safe application is put together from the available function blocks. The safe inputs and outputs are linked accordingly. The safe Safebool inputs and outputs have a special format that allows three states:

- Safebool_True
- Safebool_False
- Safebool_Error

The signals from a standard PLC can assume the two logical states True and False. If, for example, a signal from the standard PLC is to be linked to a safe AND gate, it must first be converted to a safe signal format using a corresponding function block.

An output calculated by the safe application can be switched off using an enable signal from the non-safe PLC. If an unsafe enable signal is used, it must be linked to the corresponding safe output. However, the reverse case, where an unsafe enable signal can switch on an output that has been switched off by the safe application, is not possible.

The configuration created can be transferred to a Safety CPU using XN Safety Designer. To avoid possible errors, the module safety number of the Safety CPU to which the configuration is being transferred must be confirmed during the configuration download. The data to be transferred is transferred from the XN Safety Designer to the Safety CPU with CRC protection. The transferred data is then read back by the XN Safety Designer using a differently calculated CRC. This allows the

user to check whether the download and upload data match. For more details, refer to the description of the XN Safety Designer.

Configuring the system via the SD card

The configuration can also be distributed via an SD card. To do this, you must first write to the SD card. The Safety CPU must be switched to service mode for this. Once the Safety CPU is in service mode, the SD card can be inserted and written to using the XN Safety Designer (command “Write SD card”). After writing to the SD card, it can be inserted into another safety CPU. However, the corresponding Safety CPU must be de-energized. If there is no configuration on the safety CPU, the Safety CPU will take over the configuration from the SD card when it is started up. For a detailed description of how to configure the system using the SD card, see → "Configuration via the SD card", page 49.

2.3.0.3 Changes to the system

Changes to the system may consist of a change to the secure application or the hardware configuration if a safety module is removed, added, or replaced. The system supports the replacement of a safety module, but not the replacement of multiple safety modules. For a detailed description, see → "Changes to the system", page 82.

2.3.0.4 Response time and shutdown time

The response time from a safe input to the safe output of the safety CPU is estimated by the XN Safety Designer when the safe application is created. The response times of the sensor connected to the input or the output circuit are not included in the response time estimate by the XN Safety Designer. For the modules XS-322-2DO-RNODC and XS-322-2DO-RNOAC (output modules with relay), the response time of its own relay is included in the calculation.

The XN Safety Designer estimates a worst-case reaction time. More details on this: → Section "Time of reaction", page 65 .

2.3.0.5 LEDs on the safety modules

In order to check the status of a safety module during operation, the safety modules are equipped with LED indicators that provide the following information:

Tab. 1: LED description

LED	LED	Function
X3	GREEN	Signals whether the +24 V supply for outputs and clock signal outputs is within the defined limits.
R	GREEN	Run signaled Temporary ("S" LED on) Operational Mode Standard (indefinite) ("S" LED off) Operational Mode

LED	LED	Function
S	YELLOW	State Solid light: The module is in Service Mode Slow flashing frequency: The module is in Idle or Check Configuration Mode (configuration distribution)
E	RED	Error Solid light: The module is in Error Mode Slow flashing frequency: In the case of remote inputs, the maximum age has been exceeded (can be read with XN Safety Designer) Fast flashing frequency: Serious fault; it is no longer possible to communicate with the module (CANNOT be read with SafetyDesigner)

If a safety module has secure inputs or outputs, an LED indicator is implemented for each of them. The position of these LEDs can be found in the corresponding data sheets for the safety modules. In general, these LEDs can indicate three states:

Tab. 2: Input and output LEDs

LED status	Function
Switched off	If the LED is off, a logical “0” is present at the safe input or the safe output is switched off.
Luminaries	When the LED is lit, a logical “1” is read at the safe input, or the safe output is switched on.
Flashing	If the LED flashes then an error has been detected. Possible errors are described in → "Diagnostics", page 76.

If the safety module is a safety CPU, four additional LED indicators are provided for operating the validation button:

Tab. 3: Validation button LEDs

LED	LED	Function
B	RED	Signals whether the validation button has been pressed Lights up: Valid sequence has been or is being entered Flashing rapidly: An invalid sequence has been entered. This means that the invalid sequence will be discarded. Slow flashing (1x, 2x or 3x) to confirm that the command entered has been executed
C1	YELLOW	Confirmation of input for command 1 after a valid start sequence has been issued
C2	YELLOW	Confirmation of input for command 2 after a valid start sequence has been issued
C3	YELLOW	Confirmation of input for command 3 after a valid start sequence has been issued

2.3.0.6 Diagnostics

There are two different diagnostic options in the XN safety system in the event of a fault.

- Via the LED indicators on the safety modules.
- Via the XN Safety Designer. There must be an online connection with the corresponding safe PLC and the corresponding project must be open on the Safety CPU. The corresponding errors in the safety modules can then be read out. Further details: → Section "Diagnostics", page 76.

2.4 Operating states

A Safety CPU Module assumes each of the operating states shown in the → "States of a module", page 32 diagram.
Safety output and safety input modules, on the other hand, do not necessarily assume every operating state.
The operating states of a Safety CPU are:

- Post (Power On Self Test)
- Idle
- Check Configuration
- Temporary Operational
- Operational
- Service
- Error

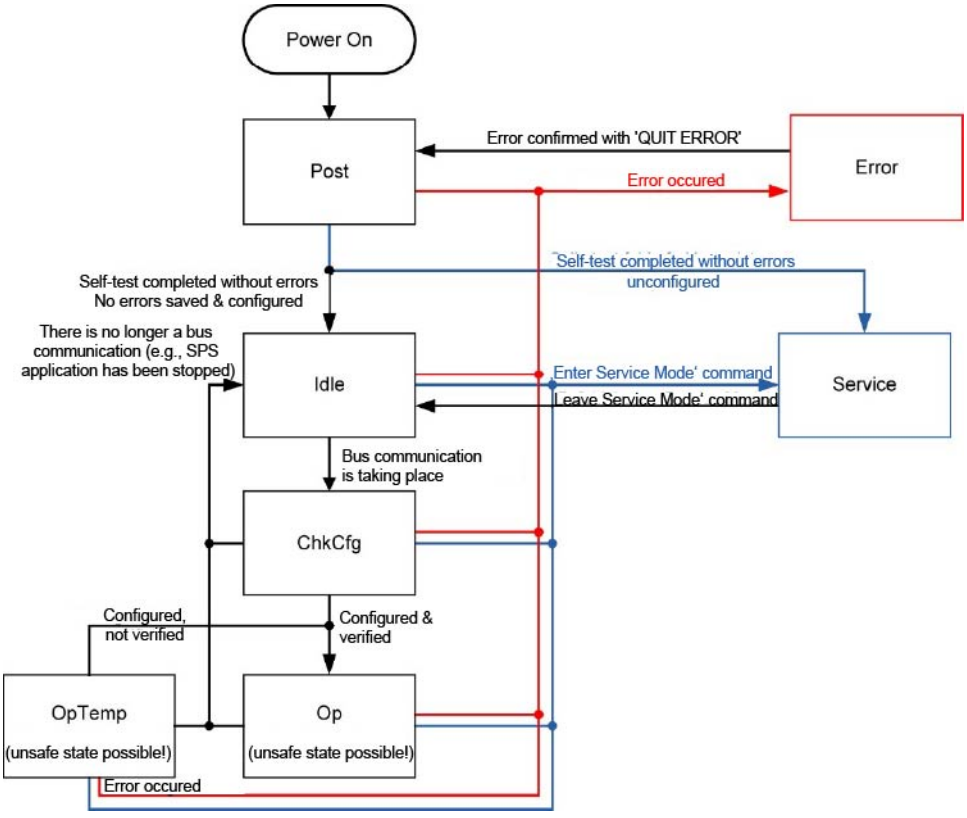


Fig. 3: States of a module

The state transitions at runtime are described in the following subsections.

2.4.0.1 Post – Power On Self Test

After switching on or restarting, the Safety CPU Module performs a self-test. It also checks the configuration status (configured/not configured) and, depending on the

result of these checks, branches to one of the states Idle, Service, or Error (see Figure → "POST status", page 33).

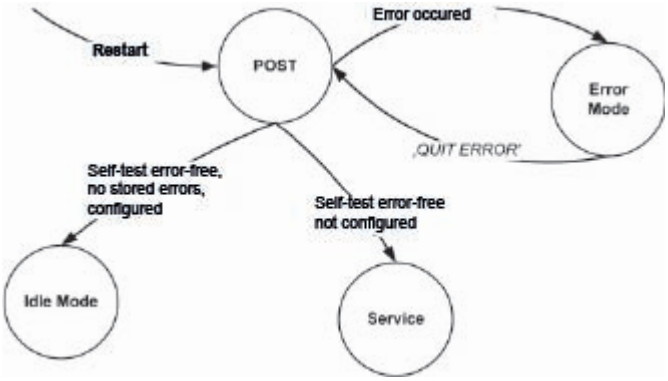


Fig. 4: POST status

Tab. 4: Possible state changes of POST

Branch to	Exactly when
IDLE	Self-test error-free No errors stored Configuration status: "configured"
SERVICE	Self-test error-free Configuration status: "unconfigured"
ERROR	Error occurred in POST

Except when switching on (restart), a status change after POST is also triggered when an existing error is confirmed by “QUIT ERROR.” This command can be triggered using the XN Safety Designer or via the validation button on the Safety CPU Module. The safe inputs/outputs of the respective modules are in the “safe state” during POST!

2.4.0.2 Idle

The module is ready to transition to the check configuration (ChkCfg) state. In idle state, the safe inputs/outputs of the respective modules are always in the “safe state.”

2.4.0.3 ChkCfg – Check Configuration

The module checks the configuration. The safe inputs/outputs of the respective modules are always in the “safe state” here. If an error occurs during the Check Configuration phase, the module switches to the error state after a timeout (Error LED lights up). The error can then be read out via the XN Safety Designer (see Diagnostics chapter). If the Check Configuration phase is completed successfully then the module switches to OpTemp or Operational Mode.

2.4.0.4 OpTemp – Temporary Operational state

The module is in temporary operation. The safety system must be validated in this state. This means that the correct functionality of the configured safety control must

now be checked. The module cannot be switched to the Op state until it has been verified. If verification does not take place within a certain period of time (temporary operation time), the system switches to error mode (with error code 1222, see documentation for XN Safety Designer). After issuing a "Quit Error" command, the system returns to service mode. The project must be reloaded.

The temporary operation time must be configured using the XN Safety Designer and can be set between a minimum of 300 seconds and a maximum of 28,800 seconds. The safe inputs/outputs of the respective modules are switched on/off here depending on the application.

2.4.0.5 Op – Operational

The module can be operated indefinitely. The safe inputs/outputs of the respective modules are switched here according to the application.

2.4.0.6 Service – Service Mode

The safety modules are configured in service mode. The safety modules are delivered in service mode. To change a configuration, you must switch to service mode. To do this, you must log in at the configuration level of the Safety CPU.

A password must be assigned during the initial configuration (described in XN Safety Designer) for newly delivered safety modules.

The Service Mode offers the following options via the XN Safety Designer:

- ***"Clear Program"***
  This command deletes the configuration on the Safety CPU. If the safety module is not configured, it cannot switch back to operational or temporary operational mode.
- ***"Download"***
  The download command transfers the configuration designed or modified in XN Safety Designer to the Safety CPU(s) in the project.
- ***"Write SD Card"***
  If, for example, an SD card is inserted into the Safety CPU during service mode, it can be written to using the "Write SD Card" command. This writes the project opened in XN Safety Designer to the SD card.
- ***"Set Verified"***
  After the configuration has been transferred and the system is running in temporary operational mode, the "Set Verified" command can be executed after the system has been successfully validated. After executing this command, you can switch to unlimited operational mode (see "Start" command).
- ***"Start"***
  The Start button can be used to switch from service mode to operational or temporary operational mode. After downloading the configuration from the XN Safety Designer to the corresponding Safety CPU, pressing the "Start" button triggers a

change of the system to temporary operational status. If the 'Start' button is pressed after the "Set Verified" command has been executed successfully then the system switches to operational mode.

- ***"Quit Error"***
  This command can also be issued in service mode. Executing the Quit Error resets the login, i.e., you must log in again to return to service mode.

The safe inputs/outputs of the respective modules are in the "safe state".

2.4.0.7 Error – error condition

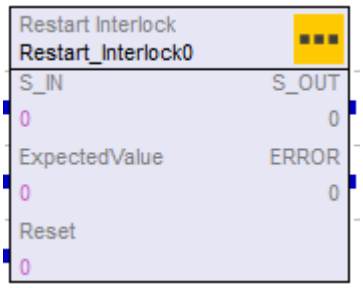
The module remains in this mode in the event of an error until a "Quit Error" command is executed. It then switches to the Post state so that the self-test is run again. The safe inputs/outputs of the respective modules are in the "safe state".

2.4.0.8 XS-322-4AI-I2 – Auto-Quit

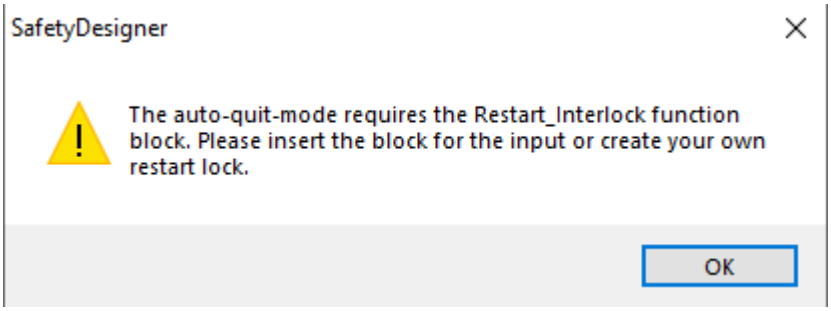
Using Auto Quit Mode

The additional feature ("AutoQuit") of an XS-322-4AI-I2 input channel is provided to enable the internal restart interlock to be deactivated for each input channel, i.e., after fault situations on the module and/or the network, the associated channel data automatically returns to the correct state.

Disabling the restart interlock may only be used in conjunction with an expected value in the safety application. In the event of a discrepancy, the safe state must be initiated and the Safety CPU stops the application. It is the responsibility of the user to connect the channel data of the safe input channels correctly and to provide them with a restart interlock. For example, the restart interlock of the Restart_Interlock function block can be used for this purpose.



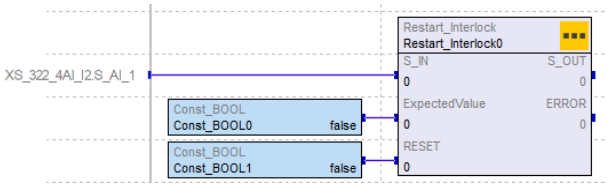
The user is advised to use the function block or to create their own restart interlock.



The use of input channels without properly connected restart interlocks can result in automatic restart.

Examples of the use of restart interlocks:

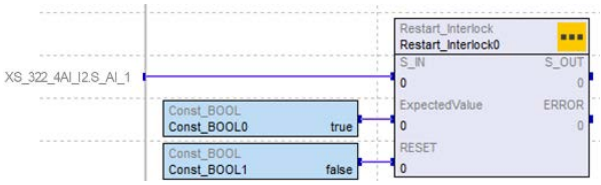
Example 1: Error at the input of the XS-322-4AI-I2, expected value = FALSE:



The expected value = FALSE, i.e., no measured value is expected because this input channel is disabled in the safety application logic.

Input S_IN is output at output S_OUT. The ERROR output is set to FALSE.

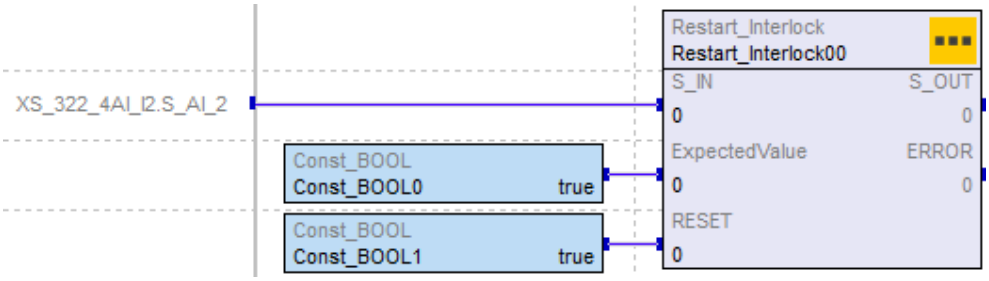
Example 2: Measured value at the input of the XS-322-4AI-I2, expected value = TRUE:



The expected value = TRUE, i.e., a measured value is expected because this input channel is enabled in the safety application logic (restart interlock disabled).

The measured value at input XS-322-4AI-I2.S_AI_1 is displayed at output S_OUT. The ERROR output is set to FALSE.

Example 3: Error at the input of the XS-322-4AI-I2, expected value = TRUE:



The expected value = TRUE, i.e., a measured value is expected because this input channel is enabled in the safety application logic (restart interlock disabled).

If there is a fault at input XS-322-4AI-I2.S_AI_1, the fault is displayed at output S_OUT, as this indicates an unexpected fault, such as a cable break. The ERROR output is set to TRUE. The error is permanently passed to the output. The ERROR output is set to TRUE. The error must be explicitly acknowledged via the RESET input. The XS-322-4AI-I2.S_AI_1 input is then displayed again at the S_OUT output. The ERROR output is set to FALSE.

3. Installation

3.1 Fitting a safety module

The XN safety modules must be installed on a top-hat rail. The supply voltage must be switched off.

Further details on installation are provided in the documents for the safety modules.

→ Section "Further usage information", page 92

3.1.1 Mounting

XN Safety modulees are intended for installation in control cabinets. An EN/IEC 60715 DIN-rail is required in order to mount the modules. The DIN-rail must establish a conductive connection to the control panel's back plate. The individual XN Safety modulees need to be mounted side by side on the DIN-rail and then secured in place by closing the locking elements. The grounding tab at the back of the XN Safety modulees is used to establishing the functional earth connection between the module and the DIN-rail.

The device must always, without exception, be installed in a horizontal mounting position (module designation on top) with sufficient clearance between the XN Safety module block's vents and surrounding components / the control cabinet wall. This is necessary in order to achieve optimal cooling and air circulation so that the device's proper functionality will be guaranteed all the way up to the maximum operating temperature ϑ: ≦ 55 °C (UL) (≦ 131 °F) .

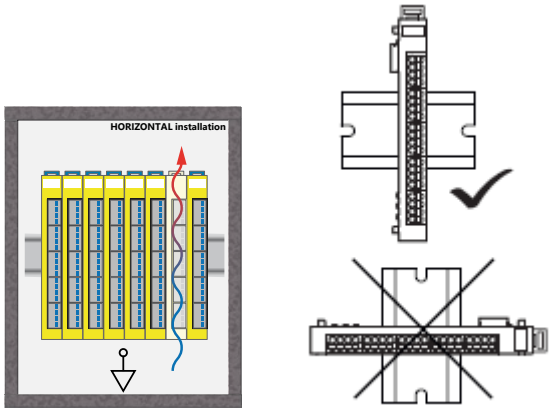
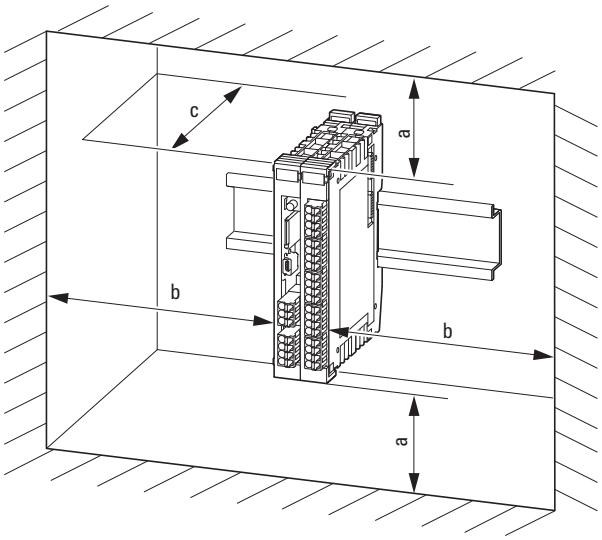


Fig. 5: Mounting position - horizontal fitting

Recommended minimum clearances between XN Safety modulees and surrounding components / the control cabinet wall:

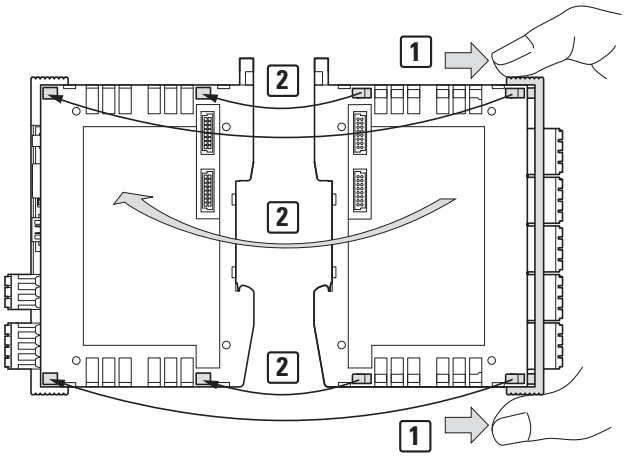


Clearances in mm (inch)
a, b ≧ 30 mm (1.18"), c ≧ 100 mm (3.94")
Operating temperature
ϑ: 0°C (32°F) ≦ T ≦ 55°C (131°F) [UL] or ± 0 – +60 °C (+32 – +140 °F) [CE]

To mount the system on the DIN-rail, join the XN Safety modules and the XN Safety CPU module to form a system block and then snap the entire system block onto the DIN-rail.
The XN Safety CPU module must be the first element on the left in the system block.

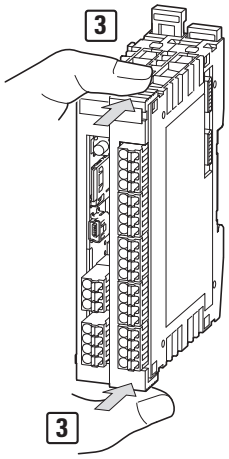
To mount the system block, follow the steps below:

- Disengage the side locking tabs on the XN Safety modules by pulling on the front cover (yellow). Make sure that all locking tabs (yellow) are in the front so that they will engage the new slice. The front cover stay-put function is intended to make the process easier.

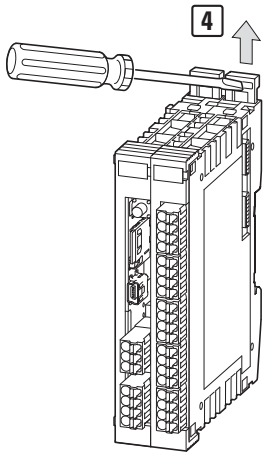


- Grab the front cover from the top and bottom and push it back towards the XN300 slice module so that the XN Safety moduless lock solidly into place with

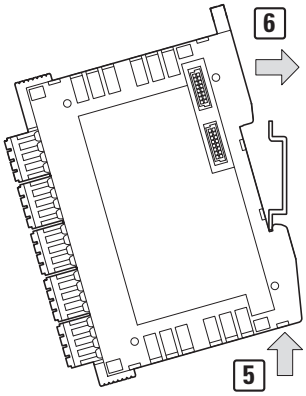
each other.



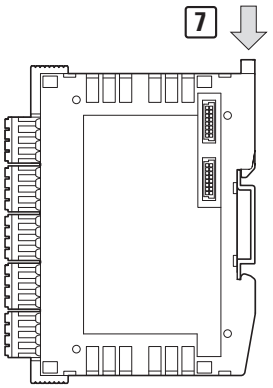
- Repeat these steps until all XN Safety modules form a system block with the XN Safety CPU module.
- Pull the locking elements at the back of the XN Safety CPU module and all XN Safety modules up. You can use a screwdriver to do this.



- Check to make sure that the system block is solidly mounted.
- Tilt the system block forward and place it against the DIN-rail's bottom edge in an inclined position.



- Push the system block over the DIN-rail's top edge.
- Push the locking elements on the back of all XN Safety modules downwards in order to secure the modules. You can use a screwdriver to do this.

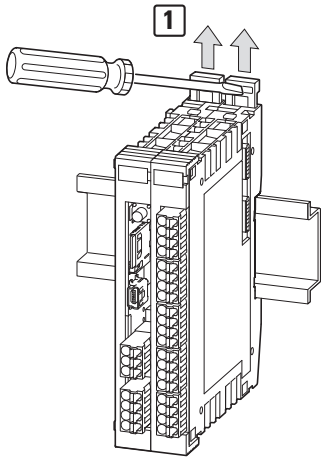


- Check to make sure that the system block is solidly mounted.

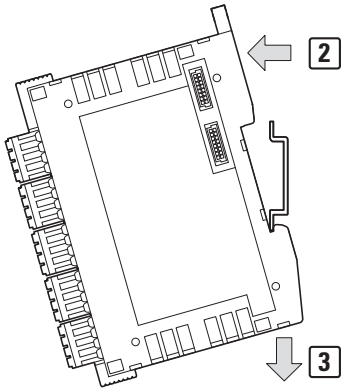
3.1.2 Dismantling system block XN Safety modules

To remove the XN Safety modules, follow the steps below:

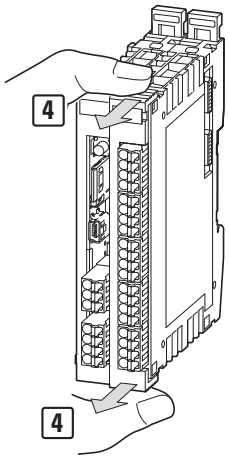
- Slide the locking elements on the back of all XN Safety modules upwards. You can use a screwdriver to do this.



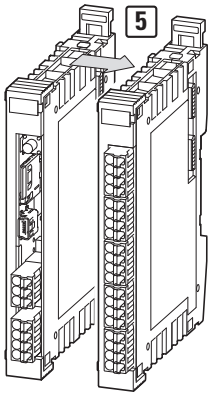
- Tilt the system block forward, then pull the block, from its bottom edge, away from the DIN-rail.



▶ Disengage the locking tabs between the XN Safety moduless by pulling on the front cover (yellow). The front cover's stay-put function will indicate that the locking tabs have been disengaged.



▶ Once the locking tabs have been disengaged, you can separate the XN Safety modules from each other.



3.2 Wiring topic

Please also note the following information when wiring:

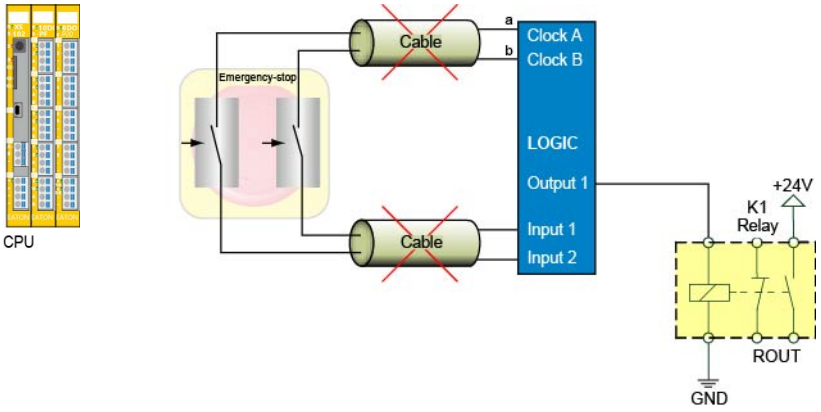
- Safety-oriented inputs are subject to the closed-circuit principle.
- In the user program, ensure that a “0” signal from the module always causes the relevant outputs to be switched off.
- Do not assign the same test cycle to adjacent inputs.
- A short circuit to ground will go unnoticed by the operating system for cable lengths greater than 200 m and a cable cross-section of 1.5 mm² or for cable lengths greater than 300 m and a cable cross-section of 2.5 mm².
- For cable lengths exceeding 800 m, the test cycle outputs of switching operations may be disrupted in 24 V DC signals.
- For cable lengths greater than 500 m, the functionality of the test clocking must be tested by simulating short circuits between the clocked inputs.
- Short circuits between the test cycle output and the corresponding input must be prevented by suitable cable routing.
- Copper should be used as the conductor material.
- The input wiring of contact sensors must be checked for cross-connections and short circuits.
- If the XN Safety supply voltage comes from the same power supply unit as the 24 V supply voltage of the inputs or outputs, a short circuit of the external supply voltage to ground can cause the entire XN Safety system to fail.

CAUTION

Improper wiring can cause damage to the safety modules. Furthermore, it cannot be guaranteed that the safety function will be performed correctly if the wiring is not done properly.

3.2.1 Wiring examples and examples of configuration creation

3.2.1.1 Example: Controlling a relay



S -1 **Testing the configuration after installation**

After installing all safety modules or replacing a safety module, the system must be verified by testing the individual safety modules one after the other. Only when all safety modules are controlled correctly and the wiring of the safety modules has been verified by this test can the system be approved for operation.

S -2 **Wiring of clock signals**

When connecting the clock signals, make sure that the connecting cables for clock A and clock B are not routed in a common multi-core cable.
Provide a separate cable with a sufficiently thick insulation sheath for each clock line.
Ensure that the cables are not cross-connected.

3.2.1.2 Example: two hand button

A two-hand switch is connected to the safe inputs 1 & 2 of the XS-322-10DI-PF safe input module, which is supplied via the clock outputs of the input module. This allows, among other things, cross connections between the safe inputs to be configured and thus detected. The safe input module is connected to a Safety CPU via an internal bus system. The safety application is processed in the Safety CPU, i.e., the inputs from the safe input module are read and forwarded to the safe CPU. The safe inputs are processed in the Safety CPU. In this example, the result of the safe application is forwarded to an output module. This then switches an actuator, e.g., a signal lamp, on or off.

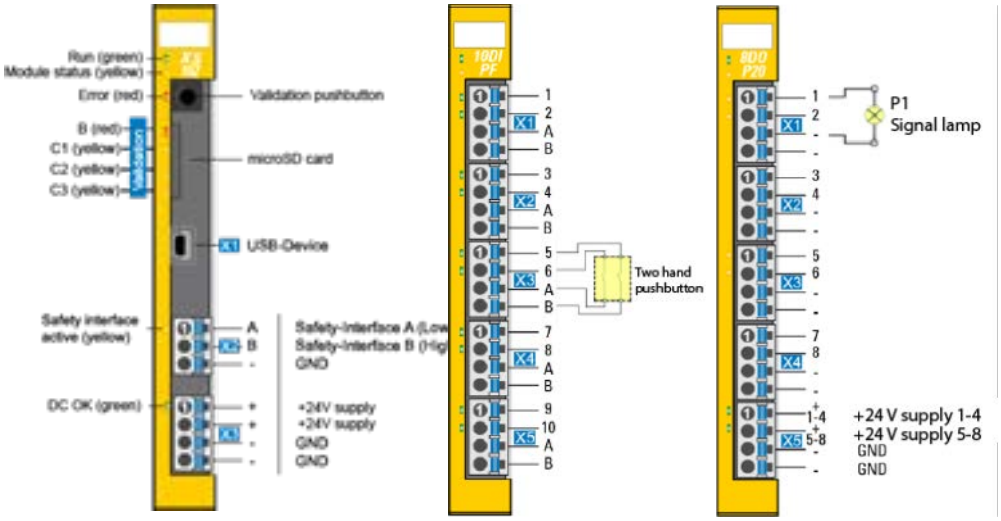


Fig. 6: XN safety hardware assembly for the example

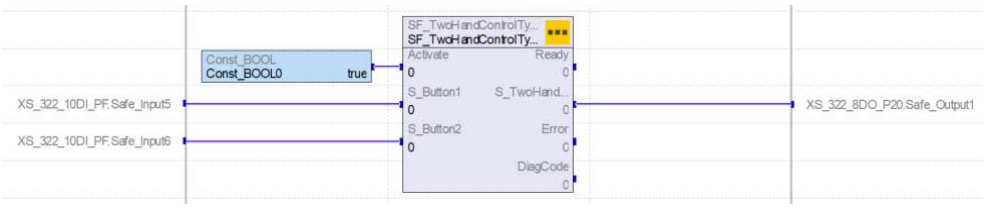


Fig. 7: Possible safety application

Dual-channel output

EN ISO 13849-1 and SIL 3 in accordance with EN 62061. Each relay is connected to a safe output TO1 and TO2 and has its own feedback circuit using the clock signals TA and TB, which are read in via two safe inputs DI1 and DI2 (cross-circuit detection). The relays must also have positively driven contacts.

4. Commissioning and configuration

4.1 Creating the secure application using XN Safety Designer

4.1.1 Creating the configuration

When creating the configuration, the hardware tree can either be imported online or set up manually in XN Safety Designer. The USB interface is required to go online to an XN safety module in stand-alone mode. Standard logic blocks and complex PLC Open-like function blocks are available for setting up the safe application. The configuration process is described in XN Safety Designer.

Please note the following points when creating the configuration:

- A safe output can only be set by one signal at a time.
- A safe input can be used multiple times.
- Particular attention must be paid to the wiring of the safe inputs and their configuration (dual channel, cross-circuit detection, etc.).

4.1.2 System configuration

After creating the configuration, you must go online with the XN Safety Designer in order to transfer the configuration to the corresponding Safety CPU. To do this, you must switch to the service mode of the Safety CPU. To make this change, you must log in with the corresponding password. If no password has been assigned yet then you must first create one.

When you first use the system, a password will not have been assigned to the Safety CPU yet.
The Safety CPU comes without a password when supplied.
You will accordingly have to set a password on the Safety CPU.

▶ To do this, press the “Change Password” button in online mode.

The new password can then be set on the Safety CPU via the Change Password dialog. The input field for the old password remains empty, the input fields for the new password and for confirming the new password must be filled in.
(password length 6-8 characters).

Once you've switched to Service Mode, you can use the “Download” button to transfer the configuration to the Safety CPU. If the online connection to XN Safety Designer is lost during the download, an invalid configuration will be on the Safety CPU and the safe outputs will stay in the safe state. You'll need to repeat the download once the online connection is back up.

After downloading, press the “Start” button. Once the configuration has been checked, the system switches to the time-limited runtime state. The maximum time that the system remains in this state can be configured is 8 hours. If this time is exceeded, the system switches to the error state and the safe outputs are switched off.

The purpose of the time-limited runtime status is to enable the user to validate the safety system. During validation, it must be checked whether the safety system behaves as expected. Validation includes the following points, among others:

- **Checking the wiring**
  Check that all inputs and outputs are wired as configured. For safe inputs, make sure that the inputs are supplied with the correct clock signals.
- **Function tests**
  The response to each switching operation of the safe inputs must be checked. For example, when an emergency stop is activated at the input, a specific output must be switched off within the configured response time. All switching operations in the safety system and their responses must be simulated and checked in this way.

If validation was successful, you can switch to the unlimited runtime state using the “Set Verified” command in Service Mode.

WARNING

When validating the safety system, all safety functions must be checked to ensure that they are performing correctly.
When adding optional safety modules at a later date, the system must always be reconfigured and validated. This can be done either using the XN Safety Designer or the SD card.
If this revalidation does not take place, the Safety CPU module loses its configuration and switches to error state 1222 Temporary Operation Time, → Section " OpTemp – Temporary Operational state", page 33.
This is a safety measure for unauthorized modules within the safety system.

4.2 Configuration via the SD card

4.2.1 Writing to the SD card

When writing to the SD card, the currently open XN Safety Designer project is saved to the SD card. This can only be done using XN Safety Designer.

To write to the SD card, proceed as follows:

1. Switch to service mode
2. Writing to the SD card
3. Return to normal operating mode

4.2.1.1 Switch to service mode

After switching to service mode with the help of the XN Safety Designer, the SD card can be inserted into the Safety CPU.

Do not insert the SD card into the Safety CPU during normal operation (Operational Mode or Temporary Operational Mode). If this happens nevertheless, the safety CPU switches to error condition (error message 1088). If this error occurs, remove the SD card and send a "Quit Error" command. Once the error has been rectified, you can switch to service mode and insert the SD card.

4.2.1.2 Writing to the SD card

In service mode, the “Write SD card” command is enabled in XN Safety Designer. This command can be used to transfer the open project in XN Safety Designer to the Safety CPU.

4.2.1.3 Return to normal operating mode

After writing to the SD card, it can be removed from the Safety CPU and then switched back to operational or temporary operational mode.

If the configuration on the SD card is the same as in the flash memory of the corresponding Safety CPU, it is also possible to switch back to operational mode with the SD card inserted.

If the configuration on the SD card and the configuration in the Safety CPU's flash memory differ from each other, the system will switch to its error condition (error message 1087).
If this error occurs, remove the SD card and send a "Quit Error" command.

4.2.2 Configuring a Safety CPU via the SD card

To transfer the configuration stored on an SD card to the flash memory of a Safety CPU, proceed as follows:

4.2.2.1 Delete the configuration in the Safety CPU's flash memory

In order to be able to apply the configuration from the SD card, you will first need to delete the configuration that is on the Safety CPU. This can be done either with the XN Safety Designer (log in to service mode and execute the "Clear" command) or via the validation button on the Safety CPU. Please note that once the configuration on the Safety CPU has been deleted, the Safety CPU will no longer be able to switch back to the runtime Operational Mode or Temporary Operational Mode. Instead, the Safety CPU will remain in Service Mode.

4.2.2.2 Shut down the system and insert the microSD card

The next step is to shut down the system. Next, you will need to insert the SD card with the configuration you want into the Safety CPU.

4.2.2.3 Switch on the system with the SD card

When you restart the system, the configuration will be transferred from the SD card to the Safety CPU's flash memory. However, please note that this can only happen if the configuration on the SD card is valid.

If the SD card has the wrong format (error message 1086) or the Safety CPU's flash memory has not been deleted (error message 1084), this is detected and the Safety CPU switches to error status.
In these cases, the SD card must be rewritten.
This error can be cleared by removing the SD card and then acknowledging the error using a “Quit Error” command.

If the configuration does not match the modules that are actually physically present, the configuration distribution operation will fail (error message 1009) and the Safety CPU will switch to its safe state. In this case, you must check in the configuration whether all required safety modules are available, whether they are in error status, and whether the standard communication to these safety modules is intact.

4.3 Configuring a safe input

4.3.1 Establishment of a safe digital input

The image Structure of a digital input shows the structure of the safe input circuit:

The input is designed in accordance with IEC 61131-2, Type 1, protected against overvoltage, and has a fixed input delay time.

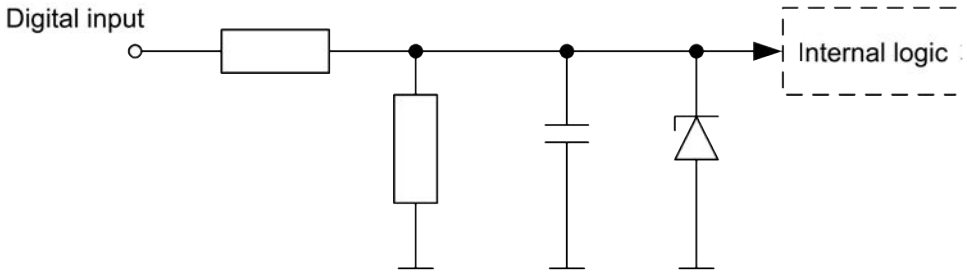


Fig. 8: Setting up a digital input

The digital input signal is reduced to a lower potential by a voltage divider. The voltage divider and capacitor cause a delay in the input signal, which must be taken into account when calculating the response time. The Zener diode protects the internal logic from overvoltages.

The time delay with which a change in the input signal can be detected is a maximum of 1 ms. An additional filter time can be added using the XN Safety Designer.

4.3.2 Configuring a safe input

Each safe input has the following configuration properties:

- Filter Time
- Cross Circuit Detection

These properties can be set using the XN Safety Designer. By clicking on an input, these properties can be assigned in the "Properties" field of the XN Safety Designer. These variables are defined as follows:

4.3.2.1 Filter Time

This is the software filter, which can be set between 1 ms and 100 ms. The software filter is particularly useful for better suppressing noise pulses on the input signal.

4.3.2.2 Cross Circuit Detection

If cross-circuit detection is required, the safe inputs must be supplied with the signals from the clock outputs of the respective safety module. One input must be connected to clock A and the second to clock B and, in addition to the wiring, must be configured separately in the “Cross Circuit Detection” field in XN Safety Designer. If cross-circuit detection is activated, the response times change.

The settings for the filter time and cross circuit detection have a direct influence on the system's → Section "Time of reaction", page 65.

4.3.3 Examples of wiring a safe input

4.3.3.1 Single-channel reading with clock supply and cross-circuit detection

The XN Safety system supports single-channel sensor input. The sensor must be connected to the clock supply of clock A or clock B of the corresponding safety module. The output of the sensor that is supplied with clock output A or B and must be wired to a safe input must also be configured on the corresponding safety module. This must be set using the XN Safety Designer. Input 1 – in the following example in the Cross Circuit Detection field – must be configured with clock A.
For more information, refer to the XN Safety Designer user guide.

The clock outputs are switched off every 50 seconds for a maximum of 4 ms.

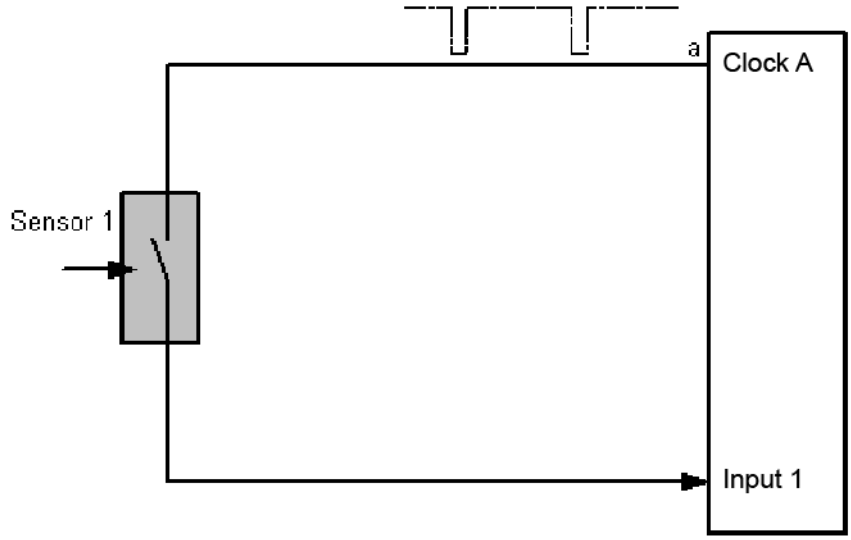


Fig. 9: Single-channel reading of an input

This example is structured as follows in XN Safety Designer:

Fig. 10: Network of a single-channel control section

The inputs are configured as follows:

XN Safety Designer, Properties Pane

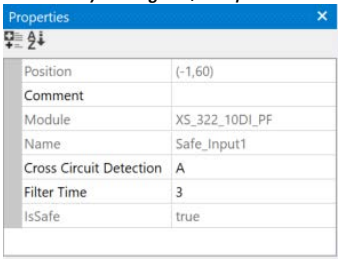


Fig. 11: Configuration of the safe inputs

If single-channel wiring is used, the following errors can be detected:

- Clock pulse could not be detected - error code 1102
  If the safe input to be tested is wired so that it is "High" and the clock pulse cannot be detected, there may be a cross-circuit with the supply or the clock output may be defective. In this case, the wiring must be checked by the user. If the wiring is correct, the corresponding clock output must be measured.
- Incorrect clock detected – failure code 1103
  If the incorrect clock is detected at a safe input during the external input test, this is detected. Possible causes are cross-faults or incorrect wiring.

If the clock outputs are used for wiring then the safe application must be configured accordingly!

If the clock output is defective so that it always outputs the low state then this cannot be detected! However, if the high state can no longer be switched off, this is detected via clock pulses!

In this example, it is also important to note that the response time is extended by the cross-circuit detection test. The response time is extended by 6 ms.

4.3.3.2 Single-channel reading without clock supply and cross-circuit detection

If a sensor is connected to a single-channel safe input, the following must be observed during configuration:

- The sensor must not be supplied with any of the clock signals, otherwise the clock pulses may affect safe operation.
- In XN Safety Designer, the cross-circuit detection of the single-channel connected input must be set to “0”.

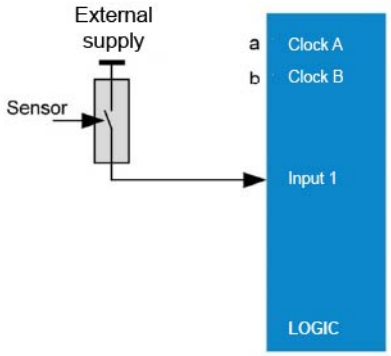


Fig. 12: Single-channel reading of an input

4.3.3.3 Dual-channel reading with clock supply and cross-circuit detection

The XN Safety system supports dual-channel reading of a sensor, e.g., a dual-channel emergency stop button. One connection of the sensor must be connected to the clock supply of clock A and the other to the clock supply of clock B of the corresponding safety module. The output of the sensor that is supplied with clock output A and must be wired to a safe input must be configured on the corresponding safety module. This must be set using the XN Safety Designer. Input 1 – in the following example in the Cross Circuit Detection field – must be configured with clock A and input 2 with clock B. This automatically checks whether the outputs are short-circuited to each other. For more information, refer to the XN Safety Designer description.

The two clock outputs are switched off at different times every 50 seconds for a maximum of 4 ms.

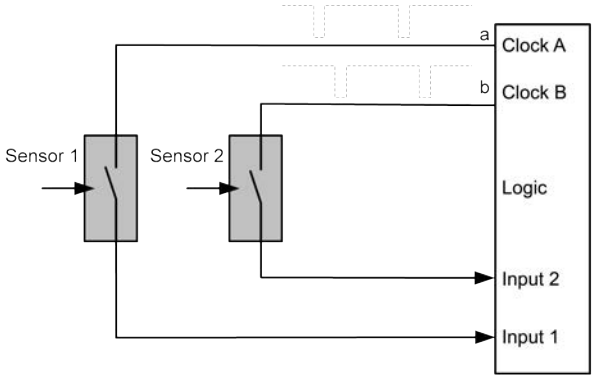


Fig. 13: Dual-channel reading of an input

This example is structured as follows in XN Safety Designer:

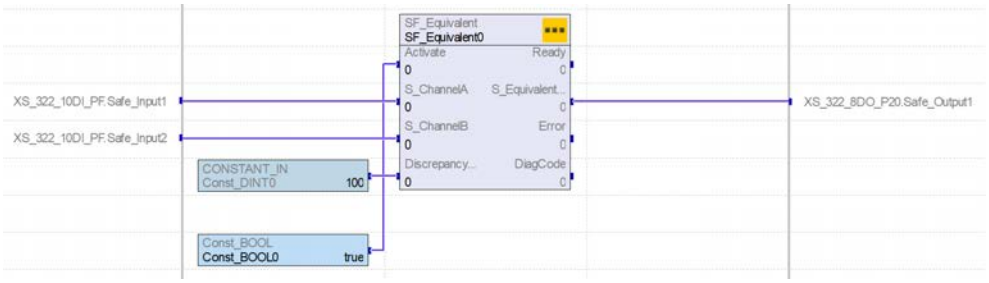


Fig. 14: Network of a dual-channel control section

The inputs are configured as follows:

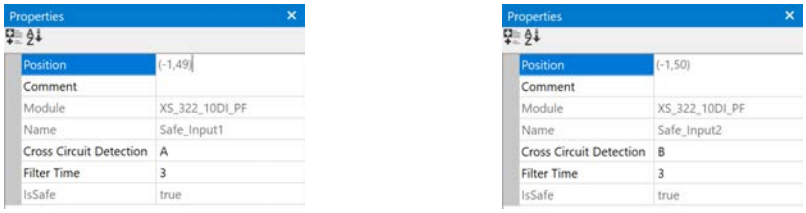


Fig. 15: Configuration of the safe inputs

- Clock pulse could not be detected - error code 1102
  If the safe input to be tested is wired so that it is "High" and the clock pulse cannot be detected, there may be a cross-circuit or the clock output may be defective. In this case, the wiring must be checked by the user. If the wiring is correct, the corresponding clock output must be measured.
- Incorrect clock detected (error code 1103)
  If the incorrect clock is detected at a safe input during the external input test, this is detected. Possible causes are cross-circuits or incorrect wiring.

→ If the clock outputs are used for wiring,
the safe application must be configured accordingly!

→ If the clock output is defective so that it always outputs the low state, this cannot be detected! However, if the high state can no longer be switched off, this is detected via clock pulses!

In this example, it is also important to note that the response time is extended by the cross-circuit detection test. The response time is extended by 6 ms.

4.3.3.4 Dual-channel reading

Dual-channel reading with cross-circuit detection can also be implemented without extending the response time by the duration of the input test. In this case, the respective safe inputs must be linked locally with equivalence.

The signal generated by the equivalence link must be reconfigured in XN Safety Designer, i.e., the parameters

- Cross Circuit Detection
  and
- Filter Time

of the signal must be specified.

4.3.3.5 Monitoring contact sensors using the example of emergency stops

When monitoring contact-based dual-channel sensors (see → Section "Dual-channel reading with clock supply and cross-circuit detection", page 56), such as an emergency stop, the problem arises that the sensor contacts must also be checked for faults.

The image → "Interfacing for an emergency stop function", page 59 shows how this can be achieved using the example of an emergency stop.

The two safety-related inputs of the emergency stop are connected to an equivalence function (SF_Equivalent), whose output controls the function block for the emergency stop (SF_EmergencyStop). The equivalence function ensures that a defective sensor is detected. For more details on the function blocks, refer to the XN Safety Designer.

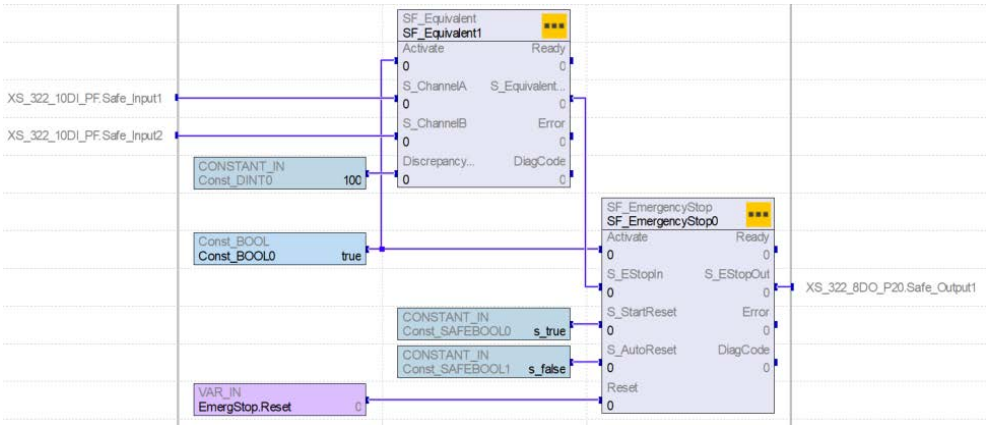


Fig. 16: Interfacing for an emergency stop function

4.3.3.6 OSSD signals at Safety CPU inputs

Devices with OSSD outputs (e.g., light grids) that have their own test pulses for their outputs only work in conjunction with modules with a configurable SW input filter, depending on the test pulse duration. This can be configured in Safety Designer.

OSSD outputs generate test pulses that can cause the inputs to drop and thus trigger a safety error without a SW input filter and with cross circuit detection activated.

Cross circuit detection must be disabled because clock outputs A/B are not used in this case. The SW input filter can be used to suppress the externally generated OSSD output test pulses so that the input signals are evaluated correctly.

XS-102-C00-000 with XS-322-10DI-PF and XS-322-8DIO-PF20 have a SW input filter.

Example

A safety switch with dual-channel OSSD output with test pulses of 500 µs is used. The XS-322-10DI-PF has a hardware-side input delay of max. 500 µs, which can vary by up to 20%. This means that it cannot be guaranteed that the test pulses will be filtered. An additional SW input filter must therefore be used. As this is a dual-channel device, cross-circuit detection must be disabled in Safety Designer.

ATTENTION

Clock output A/B are not used in this connection variant. Wiring errors cannot therefore be detected. The user must take appropriate measures to detect wiring errors.

ATTENTION

Depending on the setting of the SW input filter, it may also be necessary to adjust the discrepancy time.

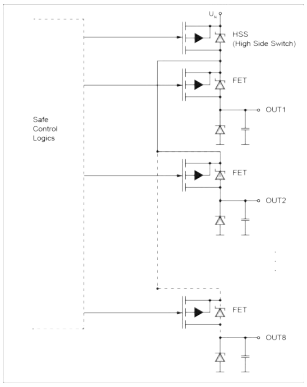
4.4 Configuring a safe output

4.4.1 Establishing a safe digital gateway

The following image shows the structure of the safe output circuit:

The output is designed in accordance with IEC 61131-2, protected against over-voltage, and has a fixed output delay time (less than 1 ms). The safe outputs are always switched off when the system is started or in a fault scenario. If one of the two output drivers is destroyed, the output can always be switched off via the other output driver. To guarantee safe shutdown, the system tests whether a switched-on output can be switched off (see hardware documentation for shutdown time). No dual-channel configuration is required for the wiring, as this is implemented in the module.

Internal Logic



Digital Output

Fig. 17: Schematic output circuit

4.4.2 Configuring a safe output

If the output is safe, an “Enable signal used” can be changed from the default ‘false’ to “true.” This means that the safe output can be disabled via an unsafe signal from the standard control, regardless of the result of the safe application. Switching on the safe output via the unsafe enable signal is only possible if the safe application has also switched on the output.

A safe output can only be enabled in temporary operational or operational mode. In all other operating states, the outputs are always switched off and therefore in a safe state.

4.4.3 Use of unsafe release signals

The use of unsafe release signals is explained in more detail in the → "Use of unsafe release signals", page 62 image.

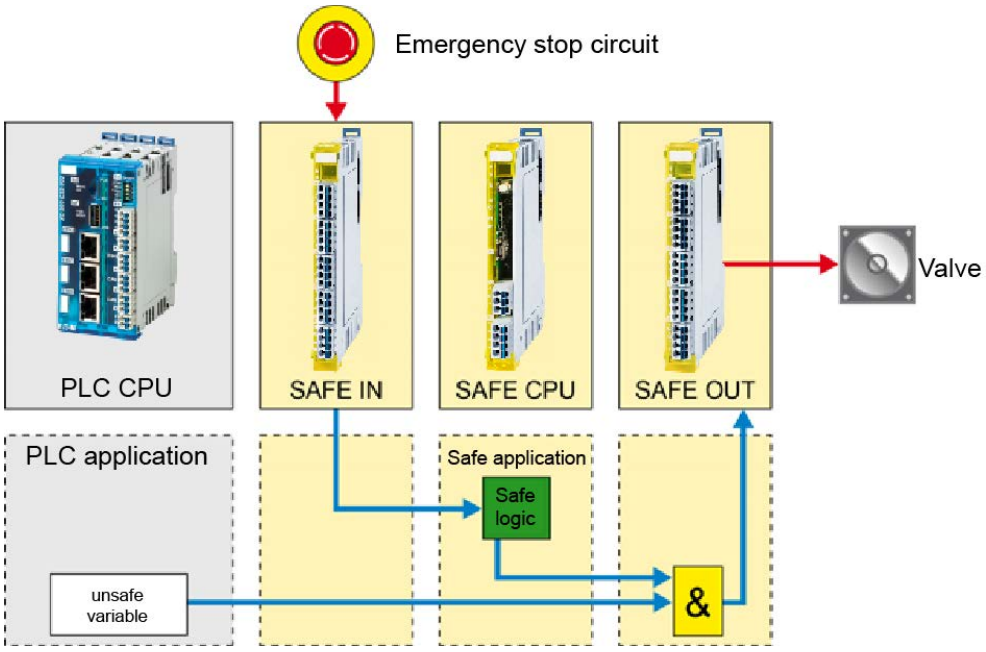


Fig. 18: Use of unsafe release signals

The unsafe release variable must be initialized in the unsafe application.

In XN Safety Designer, the variable “Enable signal used” must be set from false to true as a default.

4.5 Configuration of a Safety CPU

The safety system is configured via the Safety CPU. The Safety CPU is the only safety module that the XN Safety Designer can write to. The safe application is also processed in the Safety CPU. For the safe application, the Safety CPU has a specific area of the micro-controller's flash and RAM memory at its disposal, which cannot be exceeded.

In terms of configuration, a module can assume various states:

Tab. 5: Module states regarding configuration

State	Description
Unconfigured	The module does not contain any parameterized data. (state of delivery)
Invalid	The parameterized data of the module are invalid.
Configured, not veryfied	The module contains parameterized data, but has not yet been verified and can therefore only be run for a limited period of time.
Verified	The module has been verified and can therefore be run without any time restrictions.

The configuration status of the Safety CPU(s) is displayed in XN Safety Designer.

The maximum cycle time available to the Safety CPU for processing the safe application can be set within a range of 1 ms to 50 ms.
If the cycle time selected is too short, the system switches to the error condition (error code 1001). In this case, the cycle time can be reconfigured in XN Safety Designer to ensure that the safe application can be processed within the configured cycle time. The maximum cycle time of the Safety CPU is estimated by XN Safety Designer and serves as a guideline.

4.6 Calculation of the Monitoring Settings

After creating a configuration, the maximum cycle time required for a Safety CPU can be calculated using the button in the XN Safety Designer Monitored Settings. The value for the cycle time can be determined with the help of these settings and the created application (structure of the hardware tree and interconnection in the networks). The calculated value can be transferred to the project by the user.

Make absolutely sure to check the value suggested by XN Safety Designer while the system is running to make sure they are correct!

4.7 Time of reaction

After creating a configuration, the response time of the safe outputs used is displayed via the XN Safety Designer button “Check Resources”. The maximum monitored response time is always estimated.

IMPORTANT!
The response times calculated here do not include response times of sensors at the inputs and outputs. Switching delays of relays are not included.
For XS-322-2DO-RNODC modules and XS-322-2DO-RNOAC, the times of the individual relays are included.

Check the values suggested by XN Safety Designer in the system while it is running to make sure they are correct (e.g., by repeatedly measuring the response times in the running system)!

The following section explains how to determine the reaction time using a few specific examples.

4.7.1 Reaction time determination on a Safety CPU with local inputs and outputs

4.7.1.1 Single-channel wiring

In this example, input 1 (XS-322-10DI-PF) is linked to output 1 (XS-322-8DO-P20) in a Safety CPU. The input sensor must not be supplied with a clock output, as otherwise a test pulse from the input tests could affect the safe application.

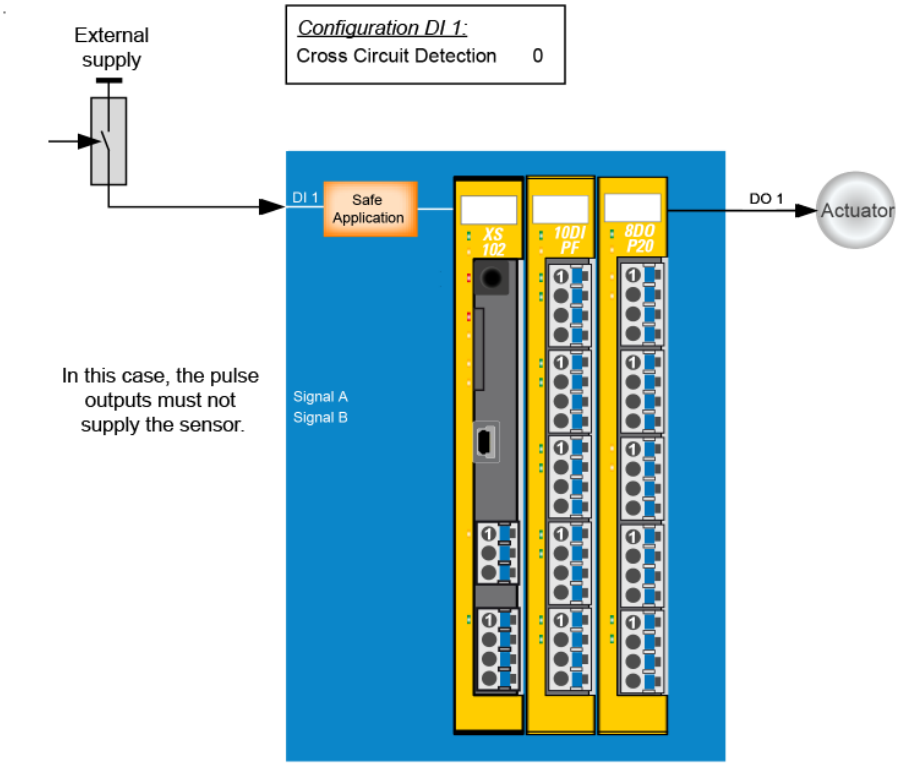


Fig. 19: Local input - Safety CPU - Local output

The response time of such a system can be determined as follows:

$$T_{Response\ time} = T_{IN} + T_{SW\ filter} + 2*T_{SafetyCPU,cycle}$$

Meaning of the parameters

Tab. 6: Configuration parameters of a single-channel circuit

Parameter	Description	Parameterizable
T_{IN}	Maximum hardware filter time; in the worst case, this is 1 ms.	no
$T_{SW\ filter}$	Additional filter time	Yes
$T_{SafetyCPU,cycle}$	Safety CPU's cycle time	Yes

4.7.1.2 Dual-channel input with cross-circuit detection

In this example, safe input 1 (XS-322-10DI-PF) and input 2 (XS-322-10DI-PF) of a Safety CPU are linked to output 1 (XS-322-8DO-P20). The safe inputs come from two different sensors. The input sensors are each supplied with a clock output. The corresponding inputs must also be configured with the respective clocks.

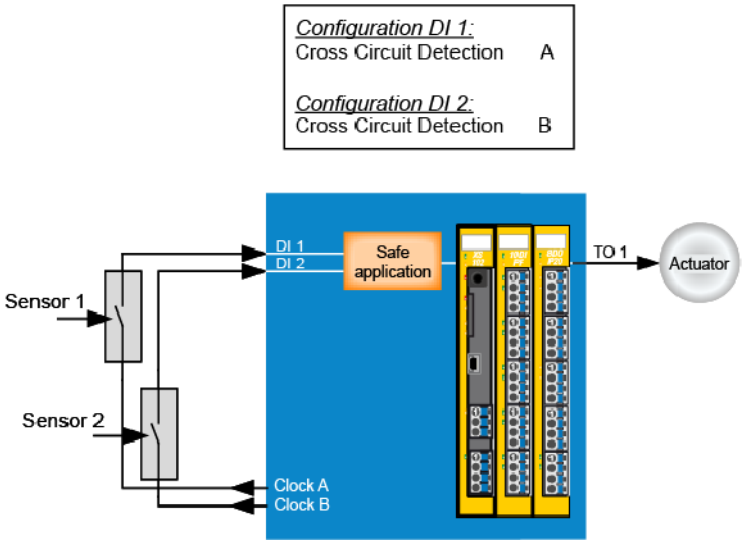


Fig. 20: Local input - Safety CPU - Local output

The response time of such a system can be determined as follows:

$$T_{Response\ time} = T_{IN} + T_{Input\ test} + T_{SW\ filter} + 2*T_{SafetyCPU,cycle}$$

Tab. 7: Significance of the configuration parameters of a dual-channel circuit

Parameter	Description	Parameterizable
T_{IN}	Maximum hardware filter time; in the worst case, this is 1 ms.	no
$T_{SW\ filter}$	Additional filter time	Yes
$T_{SafetyCPU,cycle}$	Safety CPU's cycle time	Yes
$T_{Input\ test}$	Duration of the input test in the worst case: 6 ms	no

4.7.1.3 Two-channel connection of a sensor with cross-circuit detection and local AND sequence

This is a dual-channel connected system in which the two input signals come from the same sensor and are linked with a local AND. If cross-circuit detection is activated, the XN Safety Designer calculates the maximum response time without the input test time $T_{Input\ test}$. This is because both input signals come from the same sensor and the input test is not performed simultaneously on both input signals. This means that while the input test is being performed on the input connected to clock A, the other input connected to clock B can initiate the safe state if necessary, and vice versa.

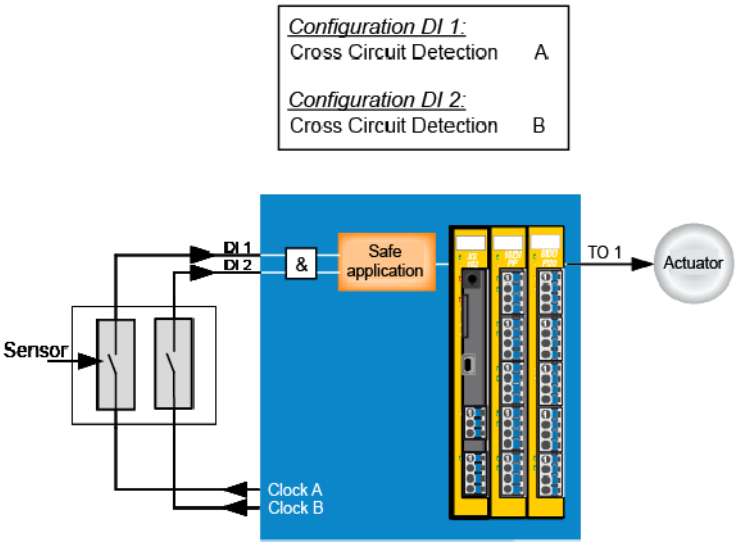


Fig. 21: Dual-channel connected sensors

The response time of such a system can be determined as follows:

$$T_{Response\ time} = T_{IN} + T_{SW\ filter} + 2*T_{SafetyCPU,cycle}$$

Tab. 8: Meaning of the parameters

Parameter	Description	Parameterizable
T_{IN}	Maximum hardware filter time; in the worst case, this is 1 ms.	no
$T_{SW\ filter}$	Additional filter time	Yes
$T_{SafetyCPU,cycle}$	Safety CPU's cycle time	Yes

4.7.1.4 Configurable time parameters that influence the response time

The following table, Adjustable time parameters, lists the time parameters that can be configured.

Tab. 9: Adjustable time parameters

Abbreviation	Min	Max	Default	Explanation
$T_{SW\ filter}$	0 ms	100 ms	0 ms	Configurable input filter to filter out any interference from the external input signal.
SafetyCPU, cycle	1 ms	50 ms	3 ms	corresponds to max. cycle time; see → Section "Configuration of a Safety CPU", page 63

In addition to the time parameters in the Adjustable time parameters table, you must also specify whether the system is wired with two channels or one channel. If there are two channels and cross-circuit detection is required, one input must be supplied with clock A and the other with clock B, and both must be configured accordingly.

5. Operation

→ Section "Processing the safety application", page 71
→ Section "Actuation of the validation button", page 72
→ Section "Diagnostics", page 76

5.1 Processing the safety application

After successfully configuring the safety modules, see chapter → Section "Commissioning and configuration", page 46, the safety system switches to Operational Mode.

WARNING

In operational mode, the XN Safety Designer must be disconnected from the controller.

5.2 Actuation of the validation button

Regardless of the XN Safety Designer, the safety system can also be controlled using the validation button. Like the SD card, the validation button is only implemented on the Safety CPU. Since the system is in continuous operation, only a useful subset of the XN Safety Designer commands is available. These are:

- **Quit Error**
  This command can be used to reset an error. If the error persists even after the "Quit Error" command, it is either a "permanent error" or the error has been detected again, e.g. due to faulty wiring or similar.
- **Clear Config**
  This command clears the flash memory of the Safety CPU, for example, if a new application is to be imported via the SD card. The functionality of this command corresponds to that of the "Clear" command in XN Safety Designer.
- **Set Verified**
  This command sets the Verified flag, i.e., a state transition occurs from the time-limited runtime state to the time-unlimited state.

If an incorrect command is entered, this is detected. The LED on the validation button then starts flashing intermittently. The system does not change its runtime status.

To enter a command with the validation button, you will need three sequences: the start sequence, the end sequence, and the sequence for selecting the command you want (refer to the diagram below).

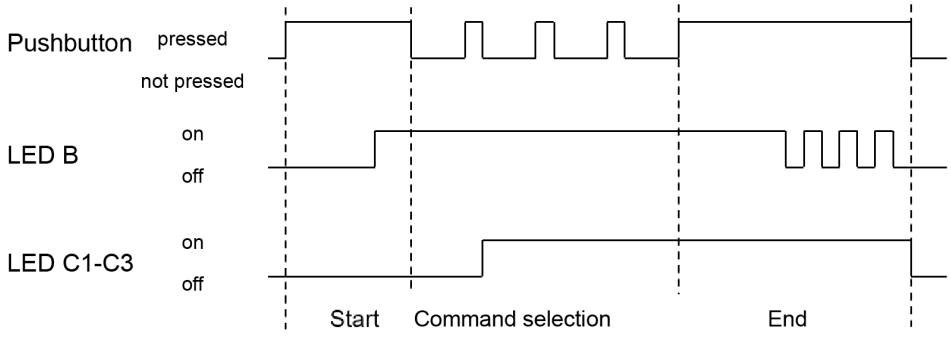


Fig. 22: Command input via the validation button

5.2.1 How the individual sequences work

5.2.1.1 Start sequence

Press and hold down the button until LED B lights up (after approx. 3 seconds).
If you hold down the button too long (longer than approx. 10 seconds), an error sequence will be output (please refer to "Error sequence").
The same will happen if you release the button too early (before LED B turns on) or you press the button again immediately after releasing it (less than approx. 200 ms between two button presses).

5.2.1.2 Command selection sequence

After entering the start sequence, you can select the command you want.

This is done by pressing buttons with the following time settings:

- Actuation time min. 200 ms, max. approx. 3 seconds,
- Pause between individual button presses: min. 200 ms, max. 10 seconds.

Every time after you press the button correctly (incl. the minimum pause of approx. 200 ms), the currently selected command will be indicated with LEDs C1, C2, C3.

If you select an invalid command (please refer to "Valid commands"), the error sequence will be output. It will also be output if you fail to meet the timing requirements.
LED B will show a solid light all throughout this sequence.

5.2.1.3 End sequence

This sequence is used to confirm the selected command.

To do this, press and hold down the button until LED B starts flashing (after approx. 3 seconds; it will flash at a slow interval).
The number of light pulses on LED B will depend on the command you selected previously (please refer to "Valid commands").

When LED B goes out, the button must be released.

After a minimum pause of approx. 200 ms during which you should not press the button again, the device will switch to Service Mode and run the command.

If you hold down the button longer than approx. 3 seconds after the flashing phase is done, the selected command will not be accepted and the error sequence will be shown.

The same will happen if you release the button too early or press it during the minimum pause of approx. 200 ms. Once the command is run, the device will switch to the appropriate mode based on the command in question (please refer to "Valid commands").

If running the command results in an error (because, for instance, SET_VERIFIED is run even though there is no valid configuration data present on the Safety CPU), the error sequence will be output.

5.2.1.4 Error sequence

If you press the button in a way you are not supposed to (as described in the sequences above), the device will switch to the error sequence. This sequence will be indicated with fast LED B flashing. LED B will continue to flash for at least approx. 3 seconds.

If you are still holding down the button after the 3 seconds elapse, LED B will continue to flash until you release the button and do not press it again for at least approx. 200 ms. The start sequence can only be entered again after LED B goes out.

Once the error sequence is done, the device will switch mode as shown in "Module state overview." If the C1, C2, or C3 LED is on, it will turn off after the error sequence is done.

5.2.1.5 Command overview

The number of times you press the button will match the number of light pulses on LED B during the end sequence.

Tab. 10: Validation button commands

Commands	Number of times the button is pressed	LED C1	LED C2	LED C3
QUIT_ERROR	1	X		
CLR_CFG	2	X	X	
SET_VERIFIED	3	X	X	X

5.2.1.6 Overview of module states and commands

The following tables show the states that the system can assume, as well as the commands that can take effect in each of these states and their effects.

Tab. 11: Module states and commands

	Command		
System state	**QUIT_ERROR**	**CLR_CFG**	**SET_VERIFIED**
Check configuration		X	
Temporary Operational Mode		X	X
Operational Mode		X	
Service Mode		X	
Error	X		

Tab. 12: Commands Validation button

Command	What the command does	State after the command is run
QUIT_ERROR	If there is an error, it will be reset on the Safety CPU and all the Safety IO modules required by the Safety CPU, and the corresponding error conditions will be exited.	SW-RESET (1)
CLR_CFG	The configuration on the Safety CPU will be deleted. After the command is run, the Safety CPU will be in Service Mode.	Service Mode
SET_VERIFIED	The configuration state will be set to "verified".	Operational Mode

1) A SW reset will be carried out. If the error persists after that, the Safety CPU will remain in error mode; otherwise, the Safety CPU will start up correctly.

General note: If you enter a command incorrectly, the Safety CPU will run the error sequence (see above). Once the error sequence is done, you can enter the command again.

5.3 Diagnostics

5.3.1 Fault condition diagnostics

5.3.1.1 Diagnostics via the LEDs

The LEDs on the safety modules can be used to distinguish between different types of faults:

Module itself is faulty

If the safety module detects an error during its self-tests, it switches to the error condition. This is indicated by the error LED lighting up continuously. The error cannot be identified in more detail via the LEDs. To identify it, a diagnosis via the XN Safety designer is necessary. If the DCOK LED is off, this is usually due to an incorrect supply voltage. In this case, the external auxiliary power to the clock outputs or the safe outputs must be checked.

Removed module is in error

If a XN Safety module device, e.g. a Safety- output module, has an expectation from another remote XN Safety module device, e.g. a Safety CPU, and the remote XN Safety module device is in an error condition, the Safety CPU device only receives error data. The safe output module then switches the outputs to the safe state and the error LED starts flashing. To rectify the error, the error that has occurred in the remote XN Safety module device must be diagnosed with the help of the XN Safety designer device so that it can be rectified.

The same behavior occurs when the Safety CPU in the above example works correctly, but the secure data received by the Safety- output module is out of date. If this is the case, you may need to check the configuration and adjust the maximum age that can be set there. However, if this is not the case, secure communication between the two secure modules may be interrupted and the output module is therefore not receiving any valid data.

Internal error

If an internal error (hardware error) occurs in an XN Safety module, it is detected by the internal self-tests. The module then enters the error condition. This error can be identified via the XN Safety designer. If the error cannot be reset with the “Quit Error” command, the user must contact Eaton Support.

Safe input or output in fault state

In some cases, incorrect wiring of a safe input or output can also be detected. In such cases, the wiring of the XN Safety module must be checked.

The detectable faults depend largely on the configuration; for example, the cross-circuit test can only detect cross-circuits if dual-channel wiring is used. This must be explicitly set on the XN Safety designer.
Examples of the circuit for this are shown in the chapters on determining the response time.

Whether a fault can be detected at all also depends on the electrical state of the safe input or output. For example, a switched-off output cannot, by its very nature, be tested to see whether it can still be switched off.
Similarly, if an input signal is switched off, it is not possible to test whether the input can still be switched off.

5.3.1.2 Diagnosis via the XN Safety designer

Regardless of the error that has occurred, the user can go online with the XN Safety designer at any time to read out the error. If a safe module is in error status, this can be queried using the “Get Module State” service command. For a Safety CPU, the error status is automatically output in the console window of the XN Safety designer.

If the safety module is not in error status but a safe input or output has been detected as faulty, this is indicated in the “Error of Channels” window of the XN Safety designer.

5.3.1.3 Error handling

If an error occurs as a result of faulty wiring, for example, it can be acknowledged after the wiring has been corrected. However, if an error is diagnosed that was caused by a hardware defect, it cannot be acknowledged. In this case, a “permanent error” has occurred. Examples of such errors are:

Tab. 13: Permanent errors

Type of fault	Error message
RAM error	E_RA_MARCH; E_RA_GALPAT
ROM error	E_ROMTEST_VECTORS, E_ROMTEST_BOOTSECTOR, E_ROMTEST_OSIMAGE
Internal clock errors	E_REFCLOCK_MIN, E_REFCLOCK_MAX
Defective output semiconductor	E_WD_TEST E_SO_TEST_FET3 E_SOTEST_HSS1
Excessive drift of the modules	E_CYCLIC_TIME_DRIFT

If one of these permanent errors occurs, the affected XN Safety module must be replaced with a functional XN Safety module. The defective XN Safety module must be sent to Eaton for repair.

If, for example, a safe output can no longer be switched off and this error occurs during operational mode, the corresponding output goes into error status (output LED flashes). In the XN Safety designer, the error can now be read specifically in the “Error of Channels” field. If a “Quit Error” is now issued and the error has not been rectified, the error state remains. If, on the other hand, the error has been rectified, the system returns to operational mode after a “Quit Error.”

5.3.1.4 Errors at safe inputs

The errors listed here are only detected on systems where cross-circuit detection has been activated.

Clock signal could not be recognized

If cross-circuit detection is activated and the safe input to be read is high, the input sensor must be supplied with the corresponding clock supply from the safety module. This clock supply is briefly switched off at regular intervals.

This checks whether there is a cross-circuit between two inputs supplied with different clock signals or whether the input can still be switched off. If the input is high and the clock pulse is not detected, an error is detected. Possible causes are incorrect wiring or a defect in the clock output. After eliminating the cross-circuit, the error can be corrected by quitting the error or restarting the system.

An incorrect clock signal was detected.

In this case, there is probably a short circuit between the inputs or incorrect wiring, and error code 103 is displayed in the “Error of Channels” window of the XN Safety designer. After rectifying the error, the error can be cleared with a “Quit Error” or by restarting the system.

5.3.1.5 Errors at safe outputs

Read-back and expected output values do not match

If the values of the output signals read back by the safety module do not match those calculated by the application, error 137 or 1137 is displayed in the "Error of Channels" window of the SafetyDesigner. The corresponding output LED flashes and the safe outputs of the module are switched off. The cause of this error can be either a hardware defect or incorrect wiring of the output (capacitive load too high). The wiring must be checked. If the error has been fixed, it can be reset with a "Quit Error" command or by restarting the system.

Outputs cannot be switched off

If the safe outputs cannot be switched off, this is detected within the internal test interval (every 26 seconds). The affected output on the corresponding XN Safety module then flashes and is switched off. In the XN Safety designer, the cor-

responding faulty output is displayed in “Error of Channels” with failure code 143 or 1143 or 144 or 1144. The error can have the following causes:

- Safe output is clamped to 24 V due to a wiring error.
- There is too high a capacitive load on the safe output (see data sheets for the corresponding Safety modules)
- This is a defect in the safe output.

Once the error has been rectified (with the exception of the defect, which cannot be rectified), the error must be acknowledged. If the error status still exists after the "Quit Error" (e.g. in the event of a defect), the output remains switched off. If the system is restarted or the "Quit Error" is sent via the validation button, this defect is detected in POST. The XN Safety module then changes to the error state.

Cross connection between the outlets

If there is a short circuit between safe outputs, these are switched off and the error LEDs for these outputs flash. In XN Safety designer, error 144 or 1144 is displayed in “Error of Channels” for the corresponding output.. During operation, this error can only be detected if the safe outputs are set. If this error occurs, the wiring of the safe outputs must be checked. Once the error has been rectified, it can be reset by issuing a “Quit Errors” command.

5.3.1.6 Error when distributing the configuration

If a configuration has been successfully transferred to a security system consisting of a Safety CPU and remote safety modules and the distribution process for the configuration has been initiated, this process may fail under certain conditions.

The same applies to distribution of the configuration when such a system is restarted. In such a case, error 9 or 1009 is output in XN Safety designer with a special identifier. The possible identifiers are:

• Identifier 0:

If this error code is displayed, more than one secure module required by the configuration is missing from the hardware topology. If this error occurs, check that all Safety modules modules are actually present. In addition, communication with each XN Safety module module must be intact. This can be checked, for example, using the hardware classes in the standard PLC project. If all hardware classes of the Safety modules are found, communication will work. After fixing the error, it can be resolved with a “Quit Error” command.

• Identifier 1:

This error occurs, for example, if more than one safety module has been replaced. In this case, the configuration must be redistributed.

• Identifier 2:

In this case, the Safety CPU contained in the configuration cannot be identified. It is therefore necessary to check whether all Safety CPU contained in the configuration are actually present and whether communication with them is correct.

• Identifier 3:

If this error occurs, the configuration could not be distributed. In this case, check whether all safety modules are present and whether there is a communication connection to them. Also check whether the hardware classes of the safety modules are correctly placed in the standard PLC project. The error can be corrected using a "Quit Error" command or by restarting the system.

• Identifier 4:

This identifier indicates that a remote module has an error. This must be identified and the error corrected. The error can then be rectified using a "Quit Error" command or by restarting the system.

• Identifier 5 (XN Safety modulee):

This identifier indicates that at least one local Safety Digital Input Module is missing in a Safety CPU. The missing XS-322-10DI-PF module must be inserted. The error can then be corrected using a "Quit Error" command or by restarting the system.

• Identifier 6 (XN Safety modulee):

This identifier indicates that at least one local Safety Interface Module is missing in a Safety CPU. The missing e.g. XN300 Gateway module must be inserted. The error can then be corrected using a "Quit Error" command or by restarting the system.

• Identifier 7 (XN Safety modulee):

This identifier indicates that at least one local Safety Digital output module is missing in a Safety CPU. The missing XS-322-8DO-P20 module must be inserted. The error can then be corrected using a "Quit Error" command or by restarting the system.

• Identifier 8 (XN Safety modulee):

This identifier indicates that at least one local safety relay output module is missing in a Safety CPU. The missing module XS-322-2DO-RNODC or XS-322-2DO-RNOAC must be inserted. Afterwards, you can use a

"Quit Error" command or restart the program to resolve the error.

• Identifier 9 (XN Safety modulee):

This identifier indicates that a Safety CPU (module is in master mode)

has tried to write to the configuration. Your own configuration is set to master mode. The configuration of your own module must be deleted. The configuration can then be redistributed.

• Identifier 10 (XN Safety modulee):

This identifier indicates that a slave module has detected that the remote module is not configured correctly. Remote modules must be configured. The error can then be corrected using a "Quit Error" command or by restarting the system.

• Identifier 11 (XN Safety modulee):

This identifier indicates that an input module is in the wrong place. Insert the module in the correct place. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 12 (XN Safety modulee):

This identifier indicates that an output module is in the wrong place. Insert the module in the correct place. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 13 (XN Safety modulee):

This identifier indicates that a SafeDint input module is in the wrong place. Insert the module in the correct place. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 14 (XN Safety modulee):

This identifier indicates that the number of local inputs is incorrect. Correct the number by removing or inserting input modules. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 15 (XN Safety modulee):

This identifier indicates that the number of local outputs is incorrect. Correct the number by removing or inserting output modules. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 16 (XN Safety modulee):

This identifier indicates that an attempt was made to access a missing module. Insert the module at the appropriate location. The error can then be corrected using a “Quit Error” command or by restarting the program.

• Identifier 17 (XN Safety modulee):

This identifier indicates that an extension module could not be configured. Try configuring again. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 18 (XN Safety modulee):

This identifier indicates that there are too many extension modules. Remove any excess modules. The error can then be corrected using a “Quit Error” command or by restarting the system.

• Identifier 19 (XN Safety modulee):

This identifier indicates that too few extension modules are available. Insert the missing extension modules. The error can then be corrected using a “Quit Error” command or by restarting the system.

6. Changes to the system

6.1 Update of safety modules

The firmware update of a safety module cannot be performed by the user. For a firmware update, the safety module must be sent to Eaton.

6.2 Change to the configuration

Any changes to the configuration must be made using the XN Safety Designer. The configuration file can only be changed when the XN Safety Designer is disconnected from the target system, i.e. when there is no online connection between the two.

After changing the configuration file, it must be transferred to the corresponding target system using the XN Safety Designer. After successful download, the system switches to the time-limited runtime state. The target system must then be validated. After thoroughly checking all functions for correctness, the system can be switched to the unlimited runtime state.

When replacing or adding optional safety modules, the system must always be reconfigured and validated. This can be done either with the XN Safety Designer or the SD card.

If this revalidation does not take place, the Safety CPU loses its configuration and switches to an error state (ERRVAL 1222 Temporary Operation Time – → Section " OpTemp – Temporary Operational state", page 33). This is a safety measure for unauthorized modules within the safety system.

6.3 Module replacement

When replacing a safety module, a distinction must be made between replacing a Safety CPU and replacing a remote safety input or output module.

DANGER

When replacing a safety module, it is essential to ensure that the system is disconnected from the supply voltage beforehand.

6.3.1 Replacement of a safety CPU

The new Safety CPU that has been installed must first be reconfigured. This can be done either using the XN Safety Designer or the SD card.

6.3.2 Replacement of safe input or output modules for the XS-102-C00-000 Safety CPU

Several of the associated safety modules can be replaced on the XS-102-C00-000. After switching off the power supply, the safety modules can be replaced with new ones. The system can then be restarted. If the safe system was in operational mode before the safety module was replaced, this mode is retained.

6.4 Adding a safety module

If the safe system is in operational mode and another safety module that is not part of the configuration is added, this will affect the safe system. The Safety CPU will go into an error state.

7. Special features of the system

7.1 Use of optional modules

In XN Safety Designer, you can set Safety modules to "optional" in the Properties pane. When you do this, the corresponding individual modules will not need to be physically present in order for the Safety CPU to process the configuration. Instead, values preset by you can be used for these modules' data. Please note that using optional modules involves certain prerequisites.

To use this option, you will need to place special function blocks (SF_Optional_Pwd/SF_Optional_PwdII, and SF_Optional_Switch) after the inputs of the optional module and the remaining logic in the safety application. When a module is missing, these special function blocks will pass defined values (including values that do not correspond to a safe state) to the logic downstream of them.

DANGER

Please note that a dangerous situation can arise if the state of these function blocks (in regard to the presence of an optional module) does not match the actual real-life situation.

Every time the system switches between "optional" and "not optional," the user must check it to make sure everything is correct.

The system may only be changed (from optional to non-optional) by trained specialists!

7.2 Safety measures and instructions

The use of the "SF_OPTIONAL_PWDII" function block affects all safety functions in general, which is why it is absolutely necessary to observe the following measures and hazard information. Failure to observe these warnings can result in serious injury or death!

WARNING

The machine's user must conduct a risk assessment regarding the potential hazards that can be posed by the use of the "SF_ OPTIONAL_PWDII" function block while taking into account the standard-based requirements that apply to the specific application in question (e.g., hydraulic press brakes) and take all required risk mitigation measures.

WARNING

The time during which the code calculated by the Safety CPU continues to be valid (login time) must always be as short as possible. In particular, it must always be ensured that this time does not cut across shifts.

WARNING

It is absolutely necessary to ensure that the authorized operator that enters the password is exactly the same one that confirms the automatically calculated code.

WARNING

The machine must be within sight of the machine's operator at all times while the automatically calculated code continues to be valid.

WARNING

With the exception of the machine's operator, no one else should be within the machine's limits as defined in EN 12100. In particular, suitable measures must be used in order to ensure that the machine cannot be freely accessed.

WARNING

Actuators without an emergency stop function must be installed in such a way that an emergency stop can be triggered within hand's reach from any position at all times.

8. Maintenance and decommissioning

8.1 General

WARNING

Remote maintenance must be restricted to diagnostic mode.
Forcing or even downloading the safety application is only permitted with organizational measures in place on site.
In this case, the system user must explicitly allow the connection from outside via the firewall (VPN, etc.).

Since a technical security concept (IT security) is always the responsibility of the network planner and operator, only an organizational procedure is described here.

8.2 Prerequisites

WARNING

1. Parameterization, programming, debugging, and forcing are only permitted using the XN Safety Designer from Eaton.
2. A network must be protected with a firewall that can withstand the expected threats.

8.3 Requirements for the network operator

DANGER

1. The network operator must ensure that no communication with a configurable tool (e.g., via XN Safety Designer and PC) is possible from outside the internal network. This is usually ensured by the firewall.
2. A connection may only be established if the network administrator explicitly activates a specific IP address (for the desired configuration tool). Activation requires additional direct contact (e.g., telephone) between a service technician on site and the teleworker.
3. The service technician on site must supervise all actions and is responsible for the system.
4. Once external activities have been completed, the firewall must be blocked again to prevent access from outside.

Adequate methods that ensure state-of-the-art technology and an appropriate level of security are also permitted.

8.4 Storage

If you are not using the Safety modules, store it in conformity with the corresponding storage conditions. For more information, please refer to → "Transport/storage", page 88.
Make sure that when the Safety modules is stored, all protective caps (if any) are in place so that the device will not become soiled and foreign objects and liquids will be unable to get into it.

8.5 Transport/storage

The Safety moduless are sensitive electronic components. This means that you should make sure that it is not subjected to any large mechanical loads during transportation and storage.
The humidity, shock, and vibration conditions that apply during operation apply to storage and transportation as well!
Temperature and humidity fluctuations may occur during transportation. Accordingly, make sure that no moisture condenses inside the Safety modules by turning off the Safety modules and letting it acclimate to room temperature first.
If possible, ship / transport the Safety modules in its original packaging. Otherwise, select packaging that will adequately protect the XN Safety module from external mechanical factors (a cardboard box filled with air pillows, for instance).

8.6 Disposal

If the Safety modules are to be disposed of then the national disposal regulations must be strictly observed.
Do not dispose of the Safety modules with household waste.

9. Declarations of conformity

The → Section "EC Declaration of Conformity", page 22 for the XN safety modules is available for download on the Eaton/xnsafety product page and in the data sheet for the respective module in the Eaton online catalog Eaton.com/ecat.

10. Certificates

The certificates for the XN Safety modules are available for download from the Eaton/xnsafety product page, and the data sheet for each module is available in the Eaton online catalog Eaton.com/ecat.

Appendix

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A.1 Further usage information

Hardware

Further information on the XN Safety module can be found in the following documents:

XN Safety System Manual	MN050020
Installation instructions XS-102-C00-000, XS-322-...	IL050036ZU
ManualXN Safety CPU module XS-102-C00-000	MN050019
ManualXN Safety module XS-322-10DI-PF	MN050021
ManualXN Safety module XS-322-8DO-P20	MN050022
ManualXN Safety module XS-322-8DIO-PF20	MN050023
ManualXN Safety module XS-322-2INC	MN050024
ManualXN Safety module XS-322-4AI-I2	MN050025
ManualXN Safety module XS-322-2DO-RNOAC	MN050026
ManualXN Safety module XS-322-2DO-RNODC	MN050027

Software

For information on XN Safety designer, open the XN Safety Designer Configuration tool software and then the user help (MN050028).

Download Center, Eaton Online Catalog

Enter "xnsafety" into the search box and the catalog will take you directly to the corresponding product group in the Automation, Control and visualization section.

Eaton.com/documentation

Eaton.com/ecat

Product information

For up-to-date information, please consult the product page on the Internet.

Eaton.com/xnsafety

A.2 Data sheets

For the latest information on available XN Safety modules, please refer to the data sheet for the module in the Eaton online catalog.

Eaton.com/ecat

XN Safety CPU module

EP-401352 XS-102-C00-000	Safety CPU module, SIL3/PLe, Kat.4

XS-Safety modules as expansions

with relay outputs	
EP-401359 XS-322-2DO-RNODC	Safety Digital, 30VDC 2 Out,relay,NO,,6A
EP-401360 XS-322-2DO-RNOAC	Safety Digital,230VAC 2 Out,relay,NO,,6A

With digital inputs	
EP-401353 XS-322-10DI-PF	Safety Digital,10 input, 24VDC,0.5ms

with digital output	
EP-401354 XS-322-8DO-P20	Safety Digital,8 output, 24VDC,2A

with digital inputs/outputs	
EP-401355 XS-322-8DIO-PF20	Safety Digital,6 In / 2 Out, 24VDC,0.5ms,2A

Rotary encoder	
EP-401357 XS-322-2INC	Safety rotary encoder, 2 inputs, incremental, 12-bit

with analog inputs	
EP-401356 XS-322-4AI-I2	Safety Analog current input, 4 inputs, 4-20 mA, 16-bit

Accessory devices

Cat No. and type	Description
191080 XC-303-C32-002	XC modular PLC XC303, Small PLC, CODESYS 3 programmable, SD Slot, USB, 3x Ethernet, 2x CAN, RS485, four digital inputs/outputs
191081 XC-303-C32-001	XC modular PLC XC303, Small PLC, CODESYS 3 programmable, SD Slot, USB, 2x Ethernet, CAN, RS485
191082 XC-303-C32-000	XC modular PLC XC303, Small PLC, CODESYS 3 programmable, SD Slot, Ethernet, CAN
199973 XC-204-C10-000	Modular PLC XC204, Micro PLC, programmable CODESYS 3, USB, Ethernet
199975 XC-204-C21-001	Modular PLC XC204, Micro PLC, programmable CODESYS 3, USB, 2x Ethernet, CAN, 2DIO
199977 XC-204-C20-002	Modular PLC XC204, Micro PLC, programmable CODESYS 3, USB, 2x Ethernet, RS485, 2DIO
199971 XC-104-C10-000	Modular PLC XC104, Micro PLC, programmable CODESYS 3, USB, Ethernet
178782 XN-312-GW-CAN	XN-312 gateway to bus system CANopen
178785 XN-312-GW-EC	XN-322 digital input module, 20 digital inputs with 24 VDC each, pulse-switching, 5.0 ms
191087 MEMORY-SDU-A1	microSD card
206903 TS-CI-K3	DIN-rail that fit to 4RU
206904 TS-CI-K4	DIN-rail that fit to 6RU

A.3 Error codes

If none of the measures listed below solve the problem, please contact Eaton.

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(0)	No Error			Normal mode	
ERRVAL(1000)	No Error			Normal mode	
ERRVAL(1001)	Cyclical processing has not been completed within the permitted time. Possible cause(s): ■ Incorrect application	Current cycle time in microseconds (the maximum of the two values from controller 1 and 2)	Cycle time limit in microseconds	Configuration must be changed, e.g. increasing the max. cyclic time for the safety CPU Troubleshooting with "Quit Error".	Error LED of the safety module lights up red
ERRVAL(1002)	A buffer was passed as a parameter in a function call. However, the size of the buffer is too small. Possible cause(s): ■ Program error	Actual buffer size or with a value ≥ 0x1000 Identification of the program location of the error (possible values 0x1000-0x100B)	Required buffer size	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1003)	A global variable has been overwritten. Possible cause(s): ■ Program error ■ Defective RAM	Affected variable that was overwritten Possible values: 0: Current error code	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1004)	Program code is executed which, according to the program logic, should never be executed. Possible cause(s): ■ Program error ■ Faulty CPU	is used to identify the code location that was executed Possible values: 0 up to 104	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1005)	When accessing an array, the index lies outside the array boundaries. Possible cause(s): ■ Program error	is used to identify the cause of the error Possible values: 0 up to 57	contains the maximum possible array index	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1006)	Invalid parameter value for a function call (NULL pointer). Possible cause(s): ■ Program error	is used to identify the cause of the error Possible values: 0 up to 28	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1007)	A read error or CRC-32 error was detected during the RAM test, algorithm March C. This is a permanent error that cannot be reset. Possible cause(s): ■ Hardware fault ■ RAM, flash, address- or data line Program error ■ A RAM test was run when there were unmasked interrupts	relevant test step	affected area in RAM	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1008)	A read error or CRC-32 error was detected during the RAM test, GALPAT algorithm. This is a permanent error that cannot be reset. Possible cause(s): ■ Hardware fault ■ RAM, flash, address- or data line Program error ■ A RAM test was run when there were unmasked interrupts	relevant test step	affected areas in RAM (CRC32 check and GalPat check)	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1009)	The configuration of the required modules is not correct. Possible cause(s): ■ Exchange of several modules ■ Modules configured incorrectly ■ Incompatible Interface Frame (incorrect CRC)	0: More than one module is missing	if reason code 0 is between 0 and 1: always 0	- If more than one module has been replaced, the application must be downloaded again. - If the configuration is incorrect, the application must be downloaded again. - Check whether the hardware structure matches the application; modify the application accordingly. - If the interface CRC is incorrect, the writing interface must be re-exported and imported on the reading side. The application must be downloaded again. -Troubleshooting with Quit Error	Error LED of the safety module lights up red
		1: A module is missing and a module update has already taken place beforehand			
		2: Nothing can be distributed to the missing module (S-CPU)	if reason code 0 is 2: Security number of the removed module		
		3: Maximum number of retries of the configuration distribution or configuration check has been exceeded	if reason code 0 is 3: number of retries		
		4: when trying to send the configuration, it was determined that the target module is in error state	if reason code 0 4 is runtime state of the removed module		

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
		5: At least one local SDI module is missing	if reason code 0 is between 5 and 10: Always 0		
		6: At least one local safety interface module is missing			
		7: At least one local STO module is missing			
		8: At least one local SRO module is missing			
		9: a module (master module) tried to write to the configuration while its own configuration was not deleted and was set to master			
		10: A slave module has detected that the remote modules are not configured correctly			
		11: Local input module in the wrong slot (counting starts at 1)	if reason code 0 is between 11 and 13: Slot number of the module		
		12: Local output module in the wrong slot (counting starts at 1)			
		13: DINT input module in wrong slot (count starts from 1)			

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
		14: Wrong number of local inputs			
		15: Wrong number of local outputs			
		16: An attempt was made to address a local module that is missing			
		17: An expansion module could not be configured (count starts from 1)	If reason code 0 is 17: Module slot number		
		18: Too many connected expansion modules			
		19: Too few connected expansion modules			
		20: Wrong Safety interface module connected			
ERRVAL(1010)	The RAM memory used for data structures with a configuration-dependent size is too small. Possible cause(s): ■ Too many modules ■ Excessively large application	0: Data for I/O lists and remote modules	Always 0	■ Check the size of the application and reduce it accordingly. Download the application again, reset the error with Quit Error. ■ Check the number of modules and remove modules accordingly; reset the error with Quit Error.	Error LED of the safety module lights up red
		1: FSoE connection status			
		2: FSoE buffer			

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1011)	The max. number of errors was exceeded while deploying the configuration data to a remote module. Possible cause(s): ■ Transmission error ■ Another module is faulty	Error code for last deployment attempt	Return code of last SSDO command run	Trigger the deployment multiple times If there are faulty modules: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1012)	An error occurred during exception handling. Possible cause(s): ■ Software error	0: The maximum number of nested TRY-CATCH-RETRY blocks was exceeded	Number of open TRY-CATCH-RETRY blocks	Please contact Eaton	Error LED of the safety module lights up red
		1: End of a TRY-CATCH-RETRY block reached without starting TRY			
		2: Exception not thrown in normal program mode			
		3: No TRY block for catching the exception present			
ERRVAL(1013)	After the configuration data was deployed to a remote module, a difference was detected on readback.	Module index of affected remote module	Always 0	Download and start the application multiple times If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1014)	The interpreter code in the configuration data was not found. Possible cause(s): ■ Faulty configuration ■ Software error	Always 0	Always 0	Download and start the application multiple times If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1015)	The configuration interpreter list specifies an FSB for which there is no existing FSB code. Possible cause(s): ■ A faulty configuration has been imported ■ Flash defective	FSB ID of the FSB code that was not found	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1016)	An error was detected during the ROM test in a read-only flash memory area. This is a permanent error that cannot be reset. Possible cause(s): ■ Flash defective	Information regarding the cause of the error	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1017)	The called FSB has returned an error code.	The FSB's error code (never 0)	FSB ID and object index of affected FSB	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1018)	The remote safe input of a missing optional module (remote module or Safety interface module) has exceeded its maximum age.	Always 0	Always 0	Check whether standard communications with the required safety module are intact. In addition, make sure that the required safety module is not in its error condition. Moreover, it is possible that the configured maximum transmission time is too short. Check all these. If the error is fixed, you can reset it with Quit Error or by restarting the system.	The safety module's Error LED will flash
ERRVAL(1019)	After the FSB was called, an illegal value was detected in the application memory. Possible cause(s): ■ Faulty FSB	Actual pattern at the end of the object memory	Target pattern at the end of the object memory	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1020)	The called FSB did not increment the counter variable. Possible cause(s): ■ Faulty FSB	Actual counter variable value	Target counter variable value	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1021)	An error was detected when managing the RAM memory for data structures with a configuration-dependent size. Possible cause(s): ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1022)	The response to an SSDO request is not yet present. Possible cause(s): ■ Running time via the bus ■ Excessively long processing time in target module	Always 0	Always 0	Increase the time on the bus; if the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1023)	An error was signaled in the return code field in an SSDO response. Possible cause(s): ■ Error in remote module	Always 0	Always 0	Check remote modules for errors If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1024)	An SSDO response contains less data than expected. Possible cause(s): ■ Error in remote module	Actual length of the data in the SSDO response	Target length of data in the SSDO response	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1025)	An error was detected when testing the checksums for the constant elements of the configuration tables in RAM. Possible cause(s): ■ Software error ■ RAM faulty	Table identification Possible values: 0 up to 11	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1026)	Could not access the application memory. Possible cause(s): ■ Software error ■ Incorrect XN Safety Designer request	0	If reason code 0 = 0: The two least significant bytes will contain the determined invalid cell index; the two most significant bytes will contain the number of existing cells	Please contact Eaton	Error LED of the safety module lights up red
		1	If reason code 0 = 1: invalid cell index		
		2	If reason code 0 = 2: invalid address offset		
		3	If reason code 0 = 3: The two least significant bytes will contain the address offset; the two most significant bytes will contain the length		
		4	If reason code 0 = 4: invalid length (not divisible by 4)		
ERRVAL(1027)	An invalid block header was detected in a flash memory area. Possible cause(s): ■ Hardware fault (faulty flash memory) ■ The programming operation was interrupted	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1028)	An invalid password was entered when attempting to log in. The error will be shown in the console pane in XN Safety Designer. Possible cause(s): ■ Typing error ■ Cyberattack	Always 0	Always 1	The password needs to be entered again.	Normal operation
ERRVAL(1029)	There is an invalid parameter in an SSDO frame. Possible cause(s): ■ Software error	0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
		1			
		2			
		3			
		4	If reason code 0 = 4: The two least significant bytes will contain the size of the passed buffer; the two most significant bytes will contain the max. size		
ERRVAL(1030)	A parameter is missing in an SSDO frame. Possible cause(s): ■ Software error	Used only in the firmware for the hardware test.		Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1031)	Internal error when processing the SSDOs. Possible cause(s): ■ Software error	Length of SSDO being written	Maximum length of an SSDO	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1032)	The SSDO package contains an invalid command byte. Possible cause(s): ■ Software error	Invalid command	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1033)	An invalid new password was entered when attempting to change the password. Possible cause(s): ■ Software error ■ Faulty Safety Designer	Always 0	Always 0	If you enter the wrong password, Safety Designer will show a warning. If error 33 occurs, it is an internal operating system error. Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1034)	The SSDO package contains an invalid virtual address. Possible cause(s): ■ Software error	Error cause identification Possible values: 0 up to 1	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1035)	While processing the SSDOs, the system detected that an internal buffer was too small for the requested data volume. Possible cause(s): ■ Software error ■ Faulty Safety Designer	Error cause identification Possible values: 0 up to 1	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1036)	An error was detected during the Safety interface controller's self-test. Possible cause(s): ■ Hardware fault	Error cause identification Possible values: 0: Test message could not be sent 1: No response to the test message was received 2: The data in the received test message is incorrect	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1037)	The retentive variables are inconsistent. Possible cause(s): ■ Hardware fault ■ Software error	0: During POST, the system detected that the checksum for the retentive variables in the EEPROM is incorrect 1: Error in the consistency of the retentive variables detected during cyclical processing	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1038)	A watchdog error occurred Possible cause(s): ■ Software error	Code address	In the event of an exception outside of the FSB call: ■ Always 0 In the event of an exception during the FSB call: ■ FSB ID in the least significant two bytes ■ Object index in the most significant two bytes	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1039)	The bootloader version is incorrect Possible cause(s): ■ Wrong firmware	Bootloader version that is present	Minimum bootloader version required	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1040)	An error occurred when attempting to access the internal I/O bus. Possible cause(s): ■ Hardware fault ■ The module was disconnected	0: Error attempting a read access operation for a byte	If reason code 0 is between 0 and 1: Bytes 0 and 1 are the error's address Bytes 2 and 3 are the module's address; if you divide	If a module has been disconnected, reconnect the module and restart If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
		1: Error attempting a read access operation for a two-byte value			
		2: Error attempting a write access operation for a byte	If reason code 0 is between 2 and 3: Bytes 0 and 1 are the error's address Bytes 2 and 3 are the value being written		
		3: Error attempting a write access operation for a two-byte value			
		4: Different controller values for the module ID			
		5: Timeout error while waiting for the SPI master's Grant	If reason code 0 is between 5 and 8: Position of module in which the error occurred (starting from 0)		
		6: Timeout error while waiting for the SPI master's Ready			
		7: Wrong SPI flash memory length			
		8: Wrong SPI flash memory CRC			
		9: Different safety numbers in the two controllers			

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
		10: No unique safety numbers in the expansion modules	If reason code 0 = 10: Value of safety number for which there is a duplicate		
		11: When determining the serial numbers, the two controllers return different values	If reason code 0 = 11: Position of the module in which the error occurred (starting from 0)		
		12: Different number of expansion modules in the two controllers	If reason code 0 = 12: Byte 0: Number of detected I/O modules on controller Byte 1: Number of detected I/O modules on other controller		
		13: Missing safety number in an expansion module	If reason code 0 = 13: Position of the module in which the error occurred (starting from 0)		
ERRVAL(1041)	The values of the readback outputs that are already in an error state are not 0. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External error (e.g., short-circuit) ■ Software error	Outputs that are not enabled (bit 0 = 1st output)	Actual value (bit 0 = 1st output)	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1042)	Not all outputs assumed a value of 0 when testing the OUTRESET signal. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External error (e.g., short-circuit) ■ Software error	Tested outputs (bit 0 = 1st output)	Actual value (bit 0 = 1st output)	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1043)	A local expansion module is in its error condition. Possible cause(s): ■ Error in the expansion module	0: Expansion module error	Reason code 0 of expansion module	Replace the expansion module If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
		1: 0-based position of expansion module			
ERRVAL(1044)	An error occurred during the init phase for a local expansion module. Possible cause(s): ■ Error in the expansion module ■ Wrong configuration	0: The current values of the INC module cannot be read from the module	0-based position of expansion module	Check the current values, switch Safety CPU to master mode; replace the INC module If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
		1: There are no available current values that should be written to the INC module			
		2: There is an INC module on a slave Safety CPU			
		3: There is an INC module with an unsupported version number			

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1045)	The expansion module corresponding to the input or output is not present. Possible cause(s): ■ An optional module is not connected	0: Digital output 1: Digital input 2: Incremental encoder module	Always 0	Check optional modules	Error LED of the safety module lights up red
ERRVAL(1046)	There are too few resources available for the requested function Possible cause(s): ■ Incorrect configuration	Always 0	Always 0	Check configuration. If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1047)	An error with the parameter list has occurred. Possible cause(s): ■ Hardware fault (faulty flash memory) ■ Software error	Serves to identify the cause of the error Possible values: 0 up to 8	Serves to identify the cause of the error	Please contact Eaton	Safety module error LED
ERRVAL(1048)	An error occurred during the OUTRESET watchdog test. Possible cause(s): ■ Hardware fault	Bit mask for identifying the test steps in which the error was detected	Current test step	Please contact Eaton	Safety module error LED
ERRVAL(1049)	When checking the LOG memory during POST, the system detected that both sectors were full. Possible cause(s): ■ Hardware fault ■ Program error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1050)	When checking the LOG memory during POST, the system detected that both sectors contained data but were not full. Possible cause(s): ■ Hardware fault ■ Program error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1051)	The messages in the LOG memory are not continuous (gaps in LOG memory). Possible cause(s): ■ Program error	Start address of first empty entry found in the LOG memory	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1052)	The information regarding the stored safety numbers for the remote modules is inconsistent. Possible cause(s): ■ Program error	always 0xFFFFFFFF	always 0xFFFFFFFF	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1053)	The SSDO command cannot be run in the current state. Possible cause(s): ■ Module is running boot code	Always 0	Always 0	Restart If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1054)	An attempt was made to access a memory area (flash or SD card) that cannot be accessed or to which access is not allowed. Possible cause(s): ■ Program error ■ Error in Safety Designer.	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1055)	An error occurred during flash programming. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error	Serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1056)	During the status change in the STM module, the system detected that a change is already active. Possible cause(s): ■ Program error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1057)	While attempting to activate the timer in the STM module, the system detected that a timer is active already. Possible cause(s): ■ Program error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1058)	Not all the required flags were set in a query in the STM module. Possible cause(s): ■ Program error	Flags that should be set	Flags that are currently set	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1059)	The diagnostic code or the login status in function block HGW-Login has a wrong value Possible cause(s): ■ Error in Safety Designer. ■ Programming error	Serves to identify the cause of the error 1: The diagnostic code has assumed an invalid value 2: The login status has assumed an invalid value	Value of diagnostic code or login status	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1060)	The flag for deactivating Safety interface communications (HBG/SIB061) is set, but deactivation is not allowed. Possible cause(s): ■ Programming error	1: At least one HBG/SIB061 is configured 2: There is a connection to an HBG/SIB061	Always 0	Check the configuration; either set the flag to false or remove the HBG/SIB061	Error LED of the safety module lights up red
ERRVAL(1061)	An error occurred when programming the external flash memory. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error	Serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1062)	One of the ADC channels for voltage and temperature monitoring did not return a valid reading.	Serves to identify the cause of the error 0: Temperature 1: 1V8 2: 5V0 4-6: ADC configuration failed 7: ADC did not return a reading despite a retry	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1063)	One of the ADC channels for voltage and temperature monitoring was outside the valid value range.	Serves to identify the cause of the error 0: Temperature 1: 1V8 2: 5V0 3: 24V	Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1064)	An error occurred during the cyclical test for the OUTRESET watchdog. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error 1: Test was not ended 2: Response to toggle signal being turned off did not occur on time 3: Watchdog output was already active during startup	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1065)	An error occurred during an I2C access operation (e.g., EEPROM/EERAM). Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error	Serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1066)	Not Used				

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1067)	The FSoE connection between the HGW module and the Safety CPU dropped out in an uncontrolled manner. Possible cause(s): ■ Connection faulty ■ Excessive distance between the modules	Always 0	Always 0	Reset the error and log in again	Error LED of the safety module lights up red
ERRVAL(1068)	Invalid parameter value in a function call. Possible cause(s): ■ Program error	Serves to identify the cause of the error Possible values: 0 up to 95	serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1069)	The space in the SPDO for the safety values to be transmitted is too small. Possible cause(s): ■ Software error	Index of most significant byte of the safety values to be transmitted.	Maximum size of the safety values to be transmitted.	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1070)	Cross-communications not working (transmission error). Possible cause(s): ■ Hardware fault	1: Error during self-test in POST 2: Fault detected in UART	Error flags	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1071)	Not Used				
ERRVAL(1072)	An attempt was made to divide by 0. Possible cause(s): ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1073)	An unexpected value was received through cross-communications. Possible cause(s): ■ Software error	Received value	serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1074)	The logical program run monitoring detected that a program section that had to be run in Op/OpTemp mode was not run. Possible cause(s): ■ Software error	Program section ID	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1075)	The local input values read in the two controllers have different values for an impermissibly long time. Possible cause(s): ■ Hardware fault ■ Input circuit	Bit mask with the inputs of your own controller	Bit mask with the inputs of the other controller	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1076)	Cross-communications not working (timeout). Possible cause(s): ■ Hardware fault ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1077)	The content of an STDO response is different in the two controllers. Possible cause(s): ■ Software error	0 or 1 depending on the type of error	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1078)	Runtime monitoring was deactivated in an Operational runtime state despite this not being allowed. Possible cause(s): ■ Software error	ID of the caller that deactivated runtime monitoring.	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1079)-ERRVAL(1081)	Cross-communications not working (unexpected value received). Possible cause(s): ■ Hardware fault ■ Software error	Value received through cross-communications	Expected value (= target value)	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1082)	The computed output image is different in the two controllers. Possible cause(s): ■ Software error ■ Hardware fault	Index of the cell in the application memory with content that does not match the content in the cell of the other controller.	Content of the cell specified in reason code 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1083)	The other controller is no longer synchronized during cross communication. This is not yet an error that causes a safe state. In response to this error, the controllers resynchronize, exchange information, and only then is a decision made as to whether the safe state is initiated. Possible cause(s): ■ A controller has detected an error, while the other one has not (yet)	Always 0	Always 0	Reset the error and, if applicable, restart the system If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1084)	The SD card content could not be loaded, since the configuration is not found in the flash memory and has not been deleted either. Possible cause(s): ■ User error	Always 0	Always 0	Clear the Safety CPU's memory and try again.	Error LED of the safety module lights up red
ERRVAL(1085)	The SD card could not be initialized Possible cause(s): ■ Hardware fault	Always 0	Always 0	Use a different SD card If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1086)	The content on the SD card does not match the expected format. Possible cause(s): ■ Hardware fault ■ Software error ■ User error	Always 0	Always 0	Write the content to the SD card again If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1087)	The configuration data on the SD card does not match the configuration data in the flash memory. Possible cause(s): ■ User error	CRC of configuration data on the SD card	CRC of configuration data in the flash memory	Either the configuration in the flash memory must be deleted if the configuration of the SD card is to be adopted. However, if the configuration is to be adopted from the SD card, the configuration on the flash memory must be deleted and the system restarted with the SD card inserted.	Error LED of the safety module lights up red
ERRVAL(1088)	The SD card was inserted while the module was on and not in Service Mode. A dongle was connected when the application started; Service Mode cannot be exited. Possible cause(s): ■ User error ■ Dongle plugged in	Always 0	Always 0	Remove the SD card again, acknowledge the error and switch to service mode, then insert the SD card. Remove the dongle, acknowledge the error and restart.	Error LED of the safety module lights up red
ERRVAL(1089)	Internal error in a flow table.	Serves to identify the cause of the error Possible values: 0 up to 1	Invalid status or index	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1090)	The measured value of the FPGA (REFCLK) reference clock is too low. This is a permanent error that cannot be reset. Possible cause(s): ■ Hardware fault ■ CPU ■ FPGA	Number of measured edges	Minimum number of edges to be measured	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1091)	The measured value of the FPGA (REFCLK) reference clock is too high. This is a permanent error that cannot be reset. Possible cause(s): ■ Hardware fault ■ CPU ■ FPGA	Number of measured edges	Maximum number of edges to be measured	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1092)	A timeout occurred while waiting for the SSDO response. Possible cause(s): ■ Running time via the bus ■ Processing time in the target module	Always 0	Always 0	Reduce running times	Error LED of the safety module lights up red
ERRVAL(1093)	The other controller has detected an error. Possible cause(s): ■ Cause as per the error code from the other controller	Error code from the other controller	Always 0	Check the error code from the other controller	Error LED of the safety module lights up red
ERRVAL(1094)	The configuration state of the other controller does not match the configuration state of your own controller Possible cause(s): ■ Module was shut down during configuration	Configuration status of your own controller	Configuration status of the other controller	Reconfigure module	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL1095)	A constant in the application memory was changed and does not match the value stored in the flash memory. Possible cause(s): ■ Hardware fault (faulty flash memory, faulty RAM) ■ Software error	Index of memory cell corresponding to the faulty constant in the application memory	Index of constant in the flash memory	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1096)-ERRVAL(1097)	Not Used				
ERRVAL(1098)	The response to the internal test could not be determined. Possible cause(s): ■ Software error	Bit mask of the digital inputs	0: Error on a local input 1: Error on a Safety interface module input	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1099)	An error was detected during the input test (internal test). Possible cause(s): ■ Hardware fault	Digital input states	Bit mask of the digital inputs	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1100)	An internal test is active during the external test. Possible cause(s): ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1101)	The response to the external test could not be determined. Possible cause(s): ■ Software error	Bit mask of the digital inputs	0: Error on a local input 1: Error on a Safety interface module input	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1102)	External test: The clock pulse was not detected at an input connected to the clock signal. Possible cause(s): ■ Cross-circuit	Always 0	Always 0	Compare the cross-circuit wiring to the application	The safety module's Error LED will flash
ERRVAL(1103)	External test: The clock pulse of a different clock signal output was detected at an input connected to the clock signal. Possible cause(s): ■ Cross-circuit	Always 0	Always 0	Compare the cross-circuit wiring to the application	The safety module's Error LED will flash
ERRVAL(1104)	The lo-resolution timer is not working correctly (the measured values are too small). Possible cause(s): ■ Hardware fault	Measured value of lo-resolution timer	Lower limit for the measurement	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1105)	The lo-resolution timer is not working correctly (the measured values are too large). Possible cause(s): ■ Hardware fault	Measured value of lo-resolution timer	Upper limit for the measurement	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1106)	The millisecond timer is not working correctly (the measured values are too small). Possible cause(s): ■ Hardware fault ■ Software error	Measured value of millisecond timer	Lower limit for the measurement	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1107)	The millisecond timer is not working correctly (the measured values are too large). Possible cause(s): ■ Hardware fault ■ Software error	Measured value of millisecond timer	Upper limit for the measurement	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1108)	Not Used				

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1109)	The format of the info sector in the flash memory is incorrect. Possible cause(s): ■ Module was never initialized (with the Clear All command) ■ Hardware fault in flash memory	Always 0	Always 0	Configure module If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1110)-ERRVAL(1114)	The format of the configuration data in the flash memory is incorrect. Possible cause(s): ■ Module was configured incorrectly ■ Hardware fault in flash memory	Detailed information on the cause of the error	Detailed information on the cause of the error	Configure module If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1115)	The format of the configuration data in the flash memory is incorrect. Possible cause(s): ■ Module was configured incorrectly ■ The configuration data specifies an unsupported expansion module Hardware fault in flash memory	1 Unsupported expansion module 2–39 Error information 40 More global flags than allowed in the configuration 41 More than five unsafe CAN receive variables	If reason code 0 = 1: Module type If reason code 0 = 2–32: Detailed information	Configure the module, check whether an unsupported expansion module is connected, and, if applicable, use a Safety CPU with up-to-date firmware; check the number of CAN variables If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1116)-ERRVAL(1128)	The format of the configuration data in the flash memory is incorrect. Possible cause(s): ■ Module was configured incorrectly ■ Hardware fault in flash memory	Detailed information on the cause of the error	Detailed information on the cause of the error	Configure module If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1129)	An error occurred during communications with the FPGA. Possible cause(s): ■ Hardware fault (FPGA)	Value that provides more detailed information regarding the error 0: SPI access 0 failed 1: SPI access 1 failed 2: DMA no long working 3: Invalid FPGA version 4: FPGA not ready	Value that provides more detailed information regarding the error	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1130)	A buffer was passed as a parameter in a function call. However, the size of the buffer is too large. Possible cause(s): ■ Program error	Actual size of the buffer	Maximum size of the buffer	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1131)	A wrong frame type was used for the SSDO command. Possible cause(s): ■ Error in the safety tool	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1132)	A duplicate value is found in the module safety numbers for the remote modules. Possible cause(s): ■ An error occurred while determining the module safety number based on the topology path.	Reason-Code 0: < 1024: Index of module in the table of remote modules Reason-Code 0: = 1024: A safety number of a remote module is the same as the system's own safety number Reason-Code 0: = 1025: When retrieving the system's own safety number, the system's own safety number was not received	Duplicate module safety number	- Restart the application Check all safety numbers to make sure they are unique	Error LED of the safety module lights up red
ERRVAL(1133)	The microcontroller is not in the correct processor mode. Either the flags for the processor mode or for activating the interrupts are not set correctly in the program status register or the wrong stack is being used. Possible cause(s): ■ The processor mode change is not working correctly (due to a hardware fault or software error)	Set flags in the program status register or stack pointer value	Target value for the flags in the program status register or lower/upper limit of the stack range that must be used	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1134)	The computed output image is different in the two controllers.	States of the local outputs of your own controller	States of the local outputs of the other controller	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1135)	The supply voltage for an expansion module is not OK. Possible cause(s): ■ External power supply not connected ■ Hardware fault	0: If the CPU module's supply voltage is not OK 1: If, during the watchdog test, an error that occurred due to a missing supply voltage was detected	Module position (0 = 1st expansion module)	Make sure that the external power supply for the clock signal outputs for safety modules with digital inputs and the supply voltage of the outputs for safety modules with digital outputs are correct. After applying the correct voltage, you can reset the error with "Quit Error" or by restarting the system.	Error LED of the safety module lights up red DCOK LED does not light up.
ERRVAL(1136)	The Boolean representation of an output has an invalid value. Possible cause(s): ■ Software error (memory was overwritten at illegal point) ■ Hardware error (RAM defective)	0x00000000 means that the error was detected when decoding a cell in the application memory. 0xFFFFFFFF means that the error was detected when coding the SAFE BOOL value for the SPDO frame.	Invalid value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1137)	The values of the readback outputs do not match the values of the outputs' target values. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External fault (e.g., short-circuit, output supply voltage missing) ■ Software error	Setpoint values (bit 0 = 1st output)	Actual values (bit 0 = 1st output)	Check power supply If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1138)	An error occurred during the watchdog test. Possible cause(s): ■ Hardware fault	Bit mask for identifying the test steps in which the error was detected	Current test step	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1139)-ERRVAL(1141)	Invalid parameters were specified for the COPY command in the configuration. Possible cause(s): ■ An incorrect configuration has been imported ■ Flash defective	Index of the source or destination	Maximum number of existing cells or lower or upper index limit	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1142)	After the high-side output switch (HSS) was switched on, at least one output switched to a value of 1 even though none of the low-side output switches (FET) were switched on. This is a permanent error that cannot be reset. Possible cause(s): ■ Output semiconductor (FET) defective	Setpoint value (bit 0 = 1st output) Always 0	Actual value, affected outputs (bit 0 = 1st output)	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1143)	After the HSS output switch was switched off, none of the previously set outputs switched to 0. Possible cause(s): ■ Output semiconductor (HSS) defective ■ Impermissibly large capacitive load	Output values after the HSS was switched off (bit 0 = 1st output)	Previously set outputs (bit 0 = 1st output)	Please contact Eaton	The safety module's Error LED will flash
ERRVAL(1144)	After the FET output switch was switched off, the corresponding output did not switch to 0. Possible cause(s): ■ Output semiconductor (FET) defective ■ Impermissibly large capacitive load	Affected output (bit 0 = 1st output)	Always 0	Please contact Eaton	The safety module's Error LED will flash

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1145)	After the FET output switch was switched off, an output that was not connected through this FET changed its value. Possible cause(s): ■ Internal cross-fault short-circuit in output circuit	Status of outputs (bit 0 = 1st output)	Target status of outputs (bit 0 = 1st output)	Please contact Eaton	The safety module's Error LED will flash
ERRVAL(1146)	Cyclical processing has not been completed within the permitted time. Possible cause(s): ■ Incorrect application	Caller ID with which runtime triggering occurred the last time	Code address that will be used to resume after the interrupt function is ended	Increase the Safety CPU's cycle time	Error LED of the safety module lights up red
ERRVAL(1147)	Logical program run monitoring detected that a program section has not been called for an impermissibly long time. Possible cause(s): ■ Software error	Safety-CPU XS-102: < 1000 Program section index ≥1000 ID of the program section where the error was detected 1000–1009	Safety-CPU XS-102: Reason code 0: < 1000: Program section time that must be adhered to	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1148)	HS transistor readback is not OK. Possible cause(s): ■ Hardware fault ■ No supply voltage	Expansion module position (0 = 1st module)	Value of HS signal	Check power supply If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1149)	An SSI expansion module detected an incorrectly encoded value at an input. Possible cause(s): ■ Hardware fault	Module position and incorrectly encoded value	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1150)	The input value has not been refreshed for an impermissibly long time. Possible cause(s): ■ Fault in input hardware ■ Continuous change in input signal	Affected input (bit 0 = 1st input)	Maximum age	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1151)	The reserved stack areas were overwritten (lower limit). Possible cause(s): ■ Software error ■ Stack reserve sized too small	ID of affected stack area	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1152)	The reserved stack areas were overwritten (upper limit). Possible cause(s): ■ Software error ■ Stack reserve sized too small	ID of affected stack area	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1153)	The computer output image is different in the controllers. Possible cause(s): ■ Software error	CRC of transmission SPDO frames and the app memory of your own controller	CRC of transmission SPDO frames and the app memory of the other controller	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1154)	The information regarding the stored safety numbers for the remote modules is inconsistent. Possible cause(s): ■ Program error	Index of searched module	Number of elements in the table of the remote modules	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1155)	The CPU test detected an error. Possible cause(s): ■ CPU error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1156)	The encoder (incremental encoder) did not read any encoder values, since the CPLD did not start any read operations. Possible cause(s): ■ The standard application was not started ■ Hardware class for the incremental encoder module has not been placed.	Always 0	Always 0	Restart the application Check whether the hardware layout matches the application; modify the application accordingly.	
ERRVAL(1157)	The maximum jitter between two read operations for the encoder value was exceeded. Possible cause(s): ■ Invalid configuration with hardware classes ■ Hardware fault	Always 0	Always 0	Check the versions of the FPGA and hardware class	
ERRVAL(1158)	The CPLD for the encoder reported a fault, which meant that no encoder values could be read. Possible cause(s): ■ Incorrect settings for the encoder ■ Encoder is not connected ■ Encoder is not supported ■ Encoder is faulty	Always 0	Always 0	Check the encoder data sheet to see whether the parameters for the encoders are correct in the standard application and have been applied in the safe application Check the cable connection to the encoders Check whether the encoder used is supported as per the data sheet Check whether there is a faulty encoder	
ERRVAL(1159)	The data read by the CPLD is invalid. Possible cause(s): ■ Incorrect settings for the encoder ■ The settings for the encoder were changed at runtime. ■ Encoder is faulty	Always 0	Always 0	Check the encoder data sheet to see whether the parameters for the encoders are correct in the standard application and have been applied in the safe application Check the cable connection to the encoders Check whether there is a faulty encoder	

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1160)	The supply voltage for the encoder is not OK. Possible cause(s): ■ The supply voltage for the encoders is not present ■ Hardware fault	Always 0	Always 0	Check the wiring for the encoders' supply voltage. The error message will be generated in the event of an undervoltage or overvoltage in the 24 V encoder power supply, which must be externally connected, at the SNC 021/SSI 021(X3). The supply voltage tolerances of the power supply can be found in the HW documentation for the SNC 021/SSI 021.	
ERRVAL(1161)	There is an error in the configuration for the module. Possible cause(s): ■ Encoder connected even though it is not used as per the Safety application	Always 0	Always 0	Check whether the parameters were set correctly for the connected encoder in the Safety application.	
ERRVAL(1162)	When testing the incremental encoder's signals, the first RS-422 driver detected a signal error. Possible cause(s): ■ Signal cable cross-fault short-circuit. ■ Wire break ■ Short-circuit	Always 0	Always 0	Check the encoder's wiring and the encoder itself.	Safe DATA OK LED of affected encoder channel does not light up Encoder status LED of affected encoder flashes
ERRVAL(1163)	When testing the incremental encoder's signals, the second RS-422 driver detected a signal error. Possible cause(s): ■ Signal cable cross-fault short-circuit. ■ Wire break ■ Short-circuit	Always 0	Always 0	Check the encoder's wiring and the encoder itself.	Safe DATA OK LED of affected encoder channel does not light up Encoder status LED of affected encoder flashes

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1164)	A signal error was detected when testing the signals from the incremental encoder's Z channel. Possible cause(s): ■ Signal cable cross-fault short-circuit. ■ Wire break ■ Short-circuit	Always 0	Always 0	Check the encoder's wiring and the encoder itself.	Safe DATA OK LED of affected encoder channel does not light up Encoder status LED of affected encoder flashes
ERRVAL(1165)	When testing the signals from the incremental encoder's Z channel, the system detected that signal cables Z+ and Z- were swapped. Possible cause(s): ■ Swap signal cables Z+ and Z-	Always 0	Always 0	Check the encoder's wiring	Safe DATA OK LED of affected encoder channel does not light up The affected encoder's encoder status LED flashes
ERRVAL(1166)	No Z pulse was detected even though the motion in question should have resulted in a Z pulse. Possible cause(s): ■ The configured encoder resolution does not match the encoder's actual resolution ■ Faulty encoder	Always 0	Always 0	Check the encoder's resolution in the parameters for the SNC 021 in XN Safety Designer Check the encoder's wiring and the encoder itself.	Safe DATA OK LED of affected encoder channel does not light up
ERRVAL(1167)	Too few edges were counted on the A and B signals between two Z pulses. Possible cause(s): ■ The configured encoder resolution does not match the encoder's actual resolution ■ Faulty encoder	Always 0	Always 0	Check the encoder's resolution in the parameters for the SNC 021 in XN Safety Designer Check the encoder's wiring and the encoder itself.	Safe DATA OK LED of affected encoder channel does not light up

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1168)-ERRVAL(1171)	An input or output of an expansion module is in its error condition. Possible cause(s): ■ Error in the expansion module	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1172)	Not Used				
ERRVAL(1173)	The values of the readback outputs do not match the target values. The target value is 1, but the actual value is 0. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External fault (e.g., short-circuit, output supply voltage missing) ■ Software error	Always 0	Always 0	Check power supply If the error continues to occur: Please contact Eaton	The LED of the safe output flashes
ERRVAL(1174)	The values of the readback outputs do not match the target values. The target value is 0, but the actual value is 1. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External fault (e.g., short-circuit, output supply voltage missing) ■ Software error	Always 0	Always 0	Check power supply If the error continues to occur: Please contact Eaton	The LED of the safe output flashes

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1175)	The values of the readback outputs do not match the target values. Possible cause(s): ■ Hardware fault (e.g., faulty output transistor) ■ External fault (e.g., short-circuit, output supply voltage missing) ■ Software error	Always 0	Always 0	Check power supply If the error continues to occur: Please contact Eaton	The LED of the safe output flashes
ERRVAL(1176)	The firmware update for a local expansion module has failed. Possible cause(s): ■ Incorrect update file ■ Flashing the image in the expansion module is not possible due to a hardware defect. ■ Error in the expansion module ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1177)-ERRVAL(1180)	Not Used				
ERRVAL(1181)	The input's safe measurement range was fallen below. Possible cause(s): ■ Hardware fault ■ Wiring faults	Always 0	Always 0	Check the wiring If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1182)	The input's safe measurement range was exceeded. Possible cause(s): ■ Hardware fault ■ Wiring faults	Always 0	Always 0	Check the wiring If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1183)	The tolerance for the end value between the controllers was exceeded. Possible cause(s): ■ Hardware fault	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1184)-ERRVAL(1188)	Not Used				
ERRVAL(1189)	The input's safe measurement range was fallen below. The error will be reset automatically if the reading becomes valid again. Possible cause(s): ■ Hardware fault ■ Wiring faults	Always 0	Always 0	Check the wiring If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1190)	The input's safe measurement range was exceeded. The error will be reset automatically if the reading becomes valid again. Possible cause(s): ■ Hardware fault ■ Wiring faults	Always 0	Always 0	Check the wiring If the error continues to occur: Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1191)-ERRVAL(1196)	Not Used				
ERRVAL(1197)	There is an incorrect CRC2 in the configuration. The module's status cannot be changed to "configured." Possible cause(s): ■ Hardware fault ■ Incorrect configuration	Always 0	Always 0	Check the configuration to make sure it is valid If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1198)	The internal counter for the cycle time is working incorrectly. Possible cause(s): ■ Software error	Last time difference	Maximum time difference	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1199)	The remote safe input value has exceeded the maximum age. Possible cause(s): ■ Bus transmission error ■ Fault in the remote module's hardware ■ Software error in remote module	Always 0	Always 0	Check whether standard communications with every required safety module are intact. In addition, make sure that none of the required safety modules are in their error condition. Moreover, it is possible that the configured maximum transmission time is too short. Check all these. If the error is fixed, you can reset it with Quit Error or by restarting the system.	The safety module's Error LED will flash
ERRVAL(1200)	Not Used				
ERRVAL(1201)-ERRVAL(1205)	An unexpected exception has occurred. Possible cause(s): ■ Software error	Address of interrupted code	In the event of an exception outside of the FSB call: - always 0 In the event of an exception during the FSB call: - FSB ID in the two least significant bytes - Object index in the two most significant bytes	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1206)	The controllers' system times have an excessive large deviation between them. This is a permanent error that cannot be reset. Possible cause(s): ■ Hardware fault	Calculated drift between the two controller system times	Maximum permissible drift	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1207)	The module type and module version in the firmware do not match the values stored in the non-editable module parameters. Possible cause(s): ■ Wrong firmware	The bootloader's module type and version	The firmware's module type and version	Please contact Eaton	Error LED of corresponding safety module lights up red
ERRVAL(1208)-ERRVAL(1209)	The non-editable module parameters are different in the controllers. Possible cause(s): ■ Hardware fault ■ Flash memory programmed incorrectly	Your own controller's module parameters	The other controller's module parameters	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1210)	The firmware versions are different in the controllers. Possible cause(s): ■ Wrong firmware	Firmware version in your own controller	Firmware version in the other controller	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1211)-ERRVAL(1212)	An error was detected during the ROM test in a read-only flash memory area. This is a permanent error that cannot be reset. Possible cause(s): ■ Flash defective	Contains more detailed information regarding the error's cause	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1213)-ERRVAL(1217)	An error was detected during the ROM test in an editable flash memory area. Possible cause(s): ■ Flash defective ■ The module was turned off during flash programming	Contains more detailed information regarding the error's cause	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1218)	After the low-side output switch (FET) was switched on, at least one output switched to a value of 1 even though none of the high-side output switches (HSS) were switched on. Possible cause(s): ■ Output semiconductor (HSS) defective	Setpoint value (bit 0 = 1st output) Always 0	Actual value, affected outputs (bit 0 = 1st output)	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1219)	The content of an SSDO response is different in the two controllers. Possible cause(s): ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1220)	An attempt was made to write to the flash memory with an invalid length. Possible cause(s): ■ Program error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1221)	An attempt was made to read from a data buffer that contained less than the requested data volume. Possible cause(s): ■ Software error ■ Faulty Safety tool (SSDO command)	Number of bytes that should be read from the buffer	Size of buffer	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1222)	The time for test mode or the maximum idle time has elapsed. Possible cause(s): ■ Test mode time has elapsed; PLC is currently being reset	0: The time for test mode has elapsed	Always 0	If test mode has elapsed, download the configuration again and restart or reset the error and restart	Error LED of the safety module lights up red
		1: The max. idle time has elapsed 2: The max. check config time has elapsed	Always 0	If the IDLE time or check config time has elapsed, reset the error and restart. Start the PLC if it is being reset	

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1223)	The timing in the internal test is incorrect. An attempt was made to start a test while the previous test had not yet ended. Possible cause(s): ■ Software error	Bit mask for the inputs or number of faulty test step	More detailed information regarding the error's cause	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1224)	The timing in the internal test is incorrect. An attempt was made to start a test while the previous test had not yet ended. Possible cause(s): ■ Software error	Bit mask for the inputs being tested	Bit mask for the inputs previously tested	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1225)	The configuration state cannot be set to "configured," since the CRC for the areas belonging to the configuration are invalid. Possible cause(s): ■ A firmware update has been carried out ■ Module was configured incorrectly ■ Hardware fault in flash memory	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1226)	The configuration state cannot be set to "configured," since the CRC passed by the caller does not match the actual CRC. The module will not switch to its error condition. The error will be shown in the console pane in XN Safety Designer. Possible cause(s): ■ Module was configured incorrectly ■ Hardware fault in flash memory	Always 0	Always 0	The safety module must be reconfigured If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1227)	The format of the configuration data in the flash memory is incorrect. Possible cause(s): ■ Module was configured incorrectly ■ Hardware fault in flash memory	Actual configuration state	Target configuration state	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1228)	The configuration state cannot be set to "configured," since the configuration has been deleted. Possible cause(s): ■ Module was configured incorrectly ■ Hardware fault in flash memory	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1229)	The configuration is not in the state in which the verified flag can be set. Possible cause(s): ■ The configuration has never been deployed ■ The configuration was written to the Safety CPU in Developer Mode	Always 0	Always 0	Do not start the program in Developer Mode Restart the program to trigger the deployment	Error LED of the safety module lights up red
ERRVAL(1230)	The SSDO command cannot be run due to missing permissions. Possible cause(s): ■ Error in XN Safety Designer	Always 0	Always 0	Go back online with XN Safety Designer and run the commands again	Error LED of the safety module lights up red
ERRVAL(1231)	It was not possible to open a session when going online. Possible cause(s): ■ Another instance of XN Safety Designer is already online	Always 0	Always 0	Check whether there are multiple instances of XN Safety Designer online; only one instance of XN Safety Designer should be trying to connect	Error LED of the safety module lights up red
ERRVAL(1232)	The max. number of remote modules has been exceeded.	Number of remote modules	Maximum number of possible remote modules	Check the number of remote modules and change it accordingly	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1233)	The module type coded in the CFG pins does not match the firmware, or an unsupported I/O expansion card is connected. Possible cause(s): ■ Wrong firmware	Bit 31 = 0: CFG pins as per hardware Bit 31 = 1: ID of unsupported expansion card Bit 30 = 1: Vendor ID of unsupported expansion card Bit 29 = 1: ID of unsupported Safety interface module	If reason code 0 bit 31 = 0: CFG pins as per hardware If reason code 0 bit 31 = 1: Always 0 If reason code 0 bit 30 = 1: Device ID of unsupported expansion card	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1234)	The SSDO command cannot be run in this runtime state. Possible cause(s): ■ Error in the safety tool	Always 0	Always 0	Go back online with XN Safety Designer and run commands again	Error LED of the safety module lights up red
ERRVAL(1235)	The parameters in the firmware header of the new firmware do not match this module. Possible cause(s): ■ Wrong firmware	Parameters in the firmware	Parameters in the boot code	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1236)	An error occurred while attempting to access the SD card. Possible cause(s): ■ SD card was removed ■ Faulty or incompatible SD card	Error cause identification	Error that last occurred	Check whether the SD card has been removed. If the SD card has not been removed, replace the SD card. You can reset the error by removing the SD card and running a "Quit Error" command If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1237)	Write/read error in configuration interpreter code. One of the following errors was detected when checking the configuration: a) An attempt was made to write to a cell to which writing was already carried out from a different source (e.g., if there are two COPY commands with the same target or if a COPY command specifies a read-only cell as a target). b) An attempt was made to read from an unreadable cell. A cell is unreadable if there is no corresponding source from which it was written to (not initialized) or if it is not allowed to be used as a source for a COPY command (e.g., the object memory header). Possible cause(s): ■ A faulty configuration has been imported ■ Flash defective	Index of faulty cell	0 Write error 1 Read error 2 For FSoE: A remote input is being written to by more than one source	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1238)	The POST (power-on self-test) was not completed. Possible cause(s): ■ Software error	Bit mask of pending POST test steps.	Always 0	An error was detected during the boot test. XN Safety Designer will show which error was detected. The error can be fixed after this. If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1239)	The sector buffer that should be written to the SD card is different in the two controllers. Possible cause(s): ■ Software error	Number of sector buffer that should be written	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1240)	Force mode was ended impermissibly. Possible cause(s): ■ A session timeout or login timeout, e.g., due to an interruption in online communications with XN Safety Designer ■ Change in login level (e.g., logout) ■ Session closed in XN Safety Designer	Always 0	Always 0	Reset the error if there was an interruption in communications between XN Safety Designer and the module	Error LED of the safety module lights up red
ERRVAL(1241)	The format of the passwords on the SD card is incorrect. Possible cause(s): ■ Faulty SD card ■ Content was changed afterwards	Always 0	Always 0	Try to write the content to the SD card again. If the error keeps happening, replace the SD card If the error continues to occur: Contact Eaton	Error LED of the safety module lights up red
ERRVAL(1242)	Internal error when processing the STDOs. Possible cause(s): ■ Software error	Length of STDO being written	Maximum length of an STDO	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1243)	The information regarding the module safety number of a remote module is required, but is not available or is invalid. Possible cause(s): ■ Software error	Value of invalid module safety number (0 or 0xFFFFffff)	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(1244)	The configuration interpreter code specifies an FSB ID for which no corresponding code exists. Possible cause(s): ■ Error in the safety tool	FSB ID	Always 0	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1245)	A value specified in the configuration data is too large. Possible cause(s): ■ An excessively large value was entered in XN Safety Designer	Specifies which parameter is too large 0 Test time in temporary Operational status 1 Cycle time for runtime monitoring 2 Maximum age of a remote input 3 Filter time of a local input 4 Watchdog time of a Safety interface input 5 Optional flag of a Safety interface input 6 Cfg major version 7 Unknown data after the container header 8 There is no 0 at the end of the function block area 9 Invalid length for the FSoE slave parameters 10 Invalid value in the FSoE configuration 11 Invalid FSoE connection ID 12 Invalid FSoE slave address 13 Saved FSoE addresses in the controllers different or	Limit	Set the value in the configuration correctly (enter a smaller value)	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
		required number of addresses does not match 14 Slave address used to respond to the C_GET_SLAVEADDR command could not be unambiguously determined			
ERRVAL(1246)	Error in the function blocks. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1247)	Error in the function blocks; overflow in internal calculations. Possible cause(s): ■ Software error ■ Wrong parameters ■ SafeDINT values outside the permissible range			Check the parameters and the configured value range. If the error continues to occur: Please contact Eaton	
ERRVAL(1248)	Error in the function blocks, wrong SafeDINT values. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1249)	Error in the function blocks, wrong internal status. Possible cause(s): ■ Software error			Please contact Eaton	

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(1250)	Error in the function blocks, wrong parameters. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1251)	Error in the function blocks, wrong SafeBool values. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1252)	Error in the function blocks, wrong function block ID. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1253)	Error in the function blocks, wrong terminator. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1254)	Error in the function blocks, wrong start delimiter. Possible cause(s): ■ Software error			Please contact Eaton	
ERRVAL(1255)	The function block has returned an error code. Possible cause(s): ■ Software error	Always 0	Always 0	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10000)	The encoder's external supply voltage is not OK. Possible cause(s): ■ External supply voltage not connected ■ Hardware fault	Byte 0 = 0; On boot, the system detected that the supply voltage was not OK Byte 1: Position of module downstream of Safety CPU	Always 0	Check the supply voltage. If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10001)	The maximum permissible current of an encoder was exceeded (please refer to "Technical data" in the product data sheet for the SNC 021 module). Possible cause(s): ■ Wiring faults ■ Cross-circuit ■ Short-circuit ■ Use of an incorrect encoder	Byte 0: 0: Max. current of first encoder exceeded 1: Max. current of second encoder exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Max. permissible current in 10 µA Byte 2 and 3: Measured encoder current in in 10 µA	Check the encoder's current Check the encoder's wiring and the encoder itself. If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red
ERRVAL(10002)	The current measured for an encoder is lower than the allowed limit. Possible cause(s): ■ Wiring faults ■ Cable break ■ Faulty encoder ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been fallen below 1: The limit for encoder 2 has been fallen below Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Lower limit for allowed current in 10 µA Byte 2 and 3: Measured encoder current in in 10 µA	Check the encoder's wiring and the encoder itself. If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red
ERRVAL(10003)	The current measured for an encoder is higher that the allowed limit. Possible cause(s): ■ Wiring faults ■ Cross-circuit ■ Short-circuit ■ Faulty encoder ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been exceeded 1: The limit for encoder 2 has been exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Upper limit for allowed current in 10 µA Byte 2 and 3: Measured encoder current in in 10 µA	Check the encoder's wiring and the encoder itself. If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10004)	The voltage offset for current monitoring measured for an encoder is lower than the allowed limit when the supply voltage is cut off. Possible cause(s): ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been fallen below 1: The limit for encoder 2 has been fallen below Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Lower limit for the allowed voltage offset in mV Byte 2 and 3: Measured voltage offset of encoder in mV	Replace the SNC module	Error LED of Safety CPU lights up red
ERRVAL(10005)	The voltage offset for current monitoring measured for an encoder is higher than the allowed limit when the supply voltage is cut off. Possible cause(s): ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been exceeded 1: The limit for encoder 2 has been exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Upper limit for the allowed voltage offset in mV Byte 2 and 3: Measured voltage offset of encoder in mV	Replace the SNC module	Error LED of Safety CPU lights up red
ERRVAL(10006)	The supply voltage measured for an encoder is lower than the allowed limit. Possible cause(s): ■ Wiring faults ■ Cable break ■ Cross-circuit ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been fallen below 1: The limit for encoder 2 has been fallen below Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Lower limit for the allowed voltage in mV Byte 2 and 3: Measured encoder voltage in mV	Check the external power supply's and the encoders' wiring If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10007)	The supply voltage measured for an en encoder is higher than the allowed limit. Possible cause(s): ■ Wiring faults ■ Hardware fault	Byte 0: 0: The limit for encoder 1 has been exceeded 1: The limit for encoder 2 has been exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Upper limit for the allowed voltage in mV Byte 2 and 3: Measured encoder voltage in mV	Check the external power supply's and the encoders' wiring If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red
ERRVAL(10008)	The parameters for the current setpoint are invalid. Possible cause(s): ■ Software error ■ Incompatible Safety CPU (see product data sheet for SNC 021 module)	Byte 0: Error information Byte 1: Position of module downstream of Safety CPU	Always 0	Check Safety CPU If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red
ERRVAL(10009)	An error was detected when checking the check-sum for the constant elements for current mon-itoring in RAM. Possible cause(s): ■ Software error ■ RAM faulty	Byte 0: Error information Byte 1: Position of module downstream of Safety CPU	Always 0	Replace the SNC module	Error LED of Safety CPU lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10010)	The two RS-422 drivers are returning different results for at least one encoder signal. Possible cause(s): ■ Hardware fault	Byte 0: Information indicating which signal is affected (bit 0 = signal A; bit 1 = signal B, bit 2 = signal Z) Byte 1: Position of module downstream of Safety CPU	Always 0	Replace the SNC module	Error LED of Safety CPU lights up red
ERRVAL(10011)	The max. permissible input or counter frequency was exceeded (please refer to the product data sheet for the SNC 021 module). Possible cause(s): ■ The encoder has an excessively high resolution ■ The encoder is being operated at an excessive speed	Byte 0: 0: The maximum permissible input or counter frequency for encoder 1 was exceeded 1: The maximum permissible input or counter frequency for encoder 2 was exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 1: Maximum permissible counter frequency in increments/ms Byte 2 and 3: Measured counter frequency in increments/ms	Check the encoder in terms of its resolution and the speed at which it is being operated. If the error continues to occur: Please contact Eaton	Error LED of Safety CPU lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10012)	The configured encoder resolution falls outside the defined limits (please refer to the product data sheet for the SNC 021 module). Possible cause(s): ■ The configured encoder resolution is too high	Byte 0: 0 The maximum configured resolution for encoder 1 was exceeded 1 The maximum configured resolution for encoder 2 was exceeded Byte 1: Position of module downstream of Safety CPU	Byte 0 and 3: Configured encoder resolution	Check the encoder's resolution. If the error continues to occur: Please contact Eaton	
ERRVAL(10013)	The 3V3 supply voltage is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10014)	The 3V3 voltage is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10015)	The 5V0 supply voltage is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10016)	The 5V0 voltage is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10017)	The 5V1 supply voltage is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10018)	The 5V1 voltage is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10019)	The 15V0 supply voltage is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10020)	The 15V0 voltage is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10021)	The 24V1 supply voltage is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10022)	The 24V1 voltage is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10023)	The analog voltage monitoring has reported an excessively low value. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10024)	The analog voltage monitoring has reported an excessively high value. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: Index of the ADC channel Byte 1: Module position	Permitted limit value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10025)	The calibration data is incorrect or could not be read. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error 0 Read error 1 Wrong length 2 Wrong CRC 3 Wrong version 4 Wrong module ID 5 Invalid controller ID	Serves to identify the cause of the error	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10026)	The voltage supplied by the 24 V sensor power supply is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: 0 = Error triggered by measurement; 1 = Error triggered by DCOK pin Byte 1: Module position	Serves to identify the cause of the error Bytes 0–1: Allowed voltage limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10027)	The voltage supplied by the 24 V sensor power supply is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 1: Module position	Serves to identify the cause of the error Bytes 0–1: Allowed voltage limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10028)	The common-mode voltage (CMVR) is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: CMVR index (0–3) Byte 1: Module position	Serves to identify the cause of the error Bytes 0–1: Allowed voltage limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10029)	The common-mode voltage (CMVR) is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: CMVR index (0–3) Byte 1: Module position	Serves to identify the cause of the error Bytes 0–1: Allowed voltage limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10030)	The temperature or an ADC reference is higher than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: 0 = ADC reference; 1 = Temperature Byte 1: Module position	Serves to identify the cause of the error Byte 0-1: Permitted limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10031)	The temperature or an ADC reference is lower than the allowed limit. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 0: 0 = ADC reference; 1 = Temperature Byte 1: Module position	Serves to identify the cause of the error Byte 0-1: Permitted limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red

Error variable	Description	Reason-Code 0	Reason-Code 1	Measures	LED status indication
ERRVAL(10032)	The calibration or offset voltage is lower than the allowed limit	Serves to identify the cause of the error Byte 0: Bits 0–3 channel index Byte 1: Module position Byte 2–3: Extended error code	Serves to identify the cause of the error Byte 0-1: Permitted limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10033)	The calibration or offset voltage is above the allowed limit	Serves to identify the cause of the error Byte 0: Bits 0–3 channel index Byte 1: Module position Byte 2–3: Extended error code	Serves to identify the cause of the error Byte 0-1: Permitted limit Byte 2-3: Measured value	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10034)	The ADC received unexpected data. Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 1: Module position	Serves to identify the cause of the error Bytes 0–3: Received data	Please contact Eaton	Error LED of the safety module lights up red
ERRVAL(10035)	A brownout fault occurred Possible cause(s): ■ Hardware fault	Serves to identify the cause of the error Byte 1: Module position Byte 2–3: Extended error code	Always 0	Please contact Eaton	Error LED of the safety module lights up red

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