XPSBAT

Safety Module

User Guide
Original instructions

EIO0000004254.00
05/2021

www.se.com

Legal Information

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Safety Information

Important Information

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation as well as all documentation of all components and equipment of the machine/process are authorized to work on and with this product.

The qualified person must be a certified expert in functional safety.

The qualified person must be able to detect possible hazards that may arise from parameterization, modifying configurations, settings, and wiring, and generally

from mechanical, electrical, or electronic equipment. The qualified person must be able to understand the effects that modifications to configurations, settings, and wiring may have on the safety of the machine/process.

The qualified person must be familiar with and understand the contents of the risk assessment as per ISO 12100-1 and/or any other equivalent assessment as well as all documents related to such risk assessment or equivalent assessments for the machine/process.

The qualified person must be familiar with the standards, provisions, and regulations for the prevention of industrial accidents, which they must observe when designing, implementing, and maintaining the machine/process.

The qualified person must be thoroughly familiar with the safety-related applications and the non-safety-related applications used to operate the machine/process.

Intended Use

This product described in the present document is a safety module intended to perform safety-related functions in a machine/process according to the present document, to the specified related documents, and to all other documentation of the components and equipment of the machine/process.

The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data.

Prior to using the product, you must perform a risk assessment as per ISO 12100-1 in view of the planned application. Based on the results of the risk assessment, the appropriate safety-related measures must be implemented.

Since the product is used as a component in an overall machine or process, you must ensure the safety of persons by means of the design of this overall machine or process.

Operate the product only with the specified cables and accessories. Use only genuine accessories.

Any use other than the use explicitly permitted is prohibited and can result in hazards.

About the Book

Document Scope

This manual describes technical characteristics, installation, commissioning, operation and maintenance of the safety module XPSBAT.

Validity Note

The present document is valid for the products listed in the Type Code, page 14.

For product compliance and environmental information (RoHS, REACH, PEP, EOLI, etc.), go to www.se.com/ww/en/work/support/green-premium/.

The characteristics that are described in the present document, as well as those described in the documents included in the Related Documents section below, can be found online. To access the information online, go to the Schneider Electric home page www.se.com/ww/en/download/.

The characteristics that are described in the present document should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the document and online information, use the online information as your reference.

Related Documents

Title of documentation	Reference number
XPSBAT User Guide	EIO0000004254 (eng) EIO0000004256 (fre) EIO0000004255 (ger) EIO0000004257 (spa) EIO0000004252 (ita) EIO0000004258 (chi)
XPSBAT Instruction Sheet	NNZ32596 (eng, fre, ger, ita, spa, chi) NNZ32601 (eng, jpn, kor, por, rus, tur)

Product Related Information

⚠DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Where 24 Vdc or Vac is indicated, use PELV power supplies conforming to IEC 60204-1.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to this equipment.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠WARNING

INSUFFICIENT AND/OR INEFFECTIVE SAFETY-RELATED FUNCTIONS

- Verify that a risk assessment as per ISO 12100 and/or other equivalent assessment has been performed before this product is used.
- Fully read and understand all pertinent manuals before performing any type of work on or with this product.
- Verify that modifications do not compromise or reduce the Safety Integrity Level (SIL), Performance Level (PL) and/or any other safety-related requirements and capabilities defined for your machine/process.
- After modifications of any type whatsoever, restart the machine/process and verify the correct operation and effectiveness of all functions by performing comprehensive tests for all operating states, the defined safe state, and all potential error situations.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
IEC 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2015	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2015	Safety of machinery - Emergency stop - Principles for design
IEC 62061:2015	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2016	Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Introduction

Device Overview

Outline

XPSBAT is a safety module for interruption of safety-related electrical circuits.

The safety module provides application functions used to monitor signals from different types of sensors/devices.

Equipment with the following types of outputs can be connected to the safety-related inputs of the safety module:

- NC, for example, Emergency Stop push-buttons, Emergency Stop rope pull switches, guard door switches, coded magnetic switches
- OSSD, for example, electro-sensitive protective equipment (ESPE) proximity switches
- Solid state, for example, proximity switches

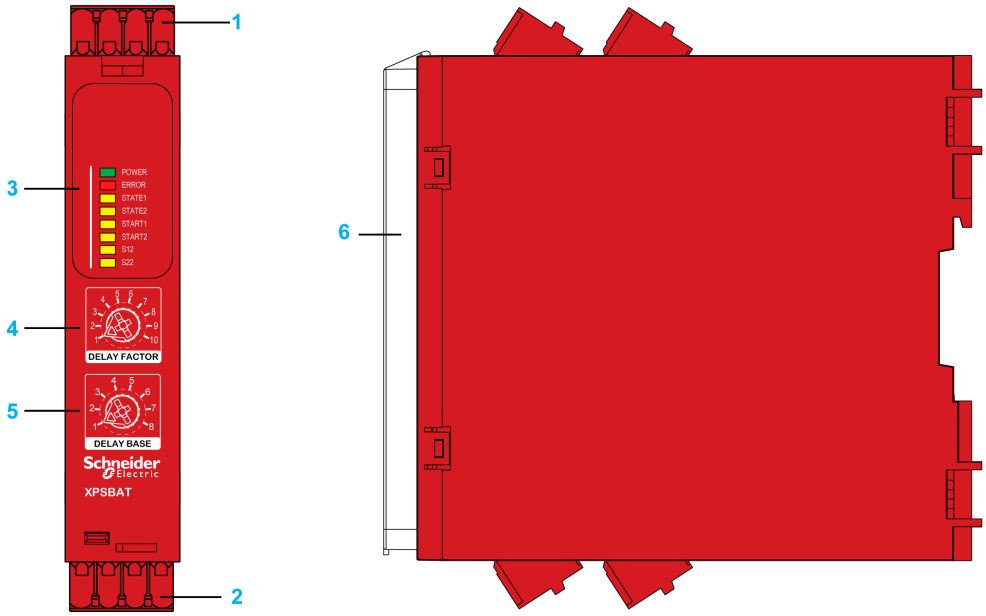
The safety module is available in two different types: either spring terminals or screw terminals with 24 Vac/Vdc supply voltage.

Feature summary:

- Multiple application functions
- Two safety-related inputs
- Two safety-related outputs consisting of two normally open (NO) relay contacts each, instantaneous deactivation
- One safety-related output consisting of two normally open (NO) relay contacts, adjustable delayed deactivation
- One non-safety-related binary status output
- One non-safety-related start/restart input for selectable start/restart function

Front View and Side View

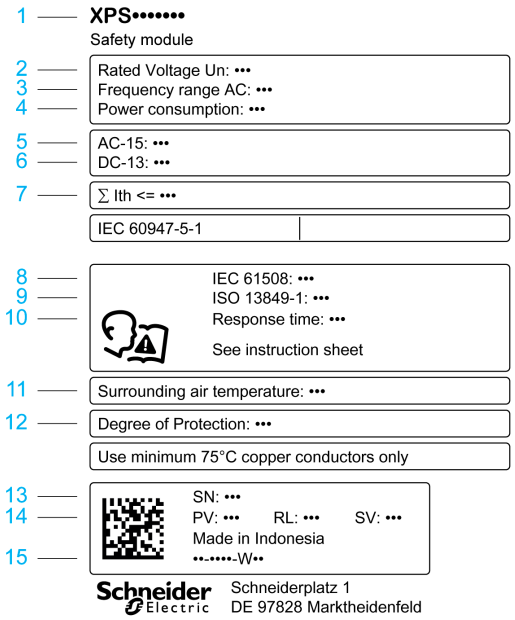
Front View and Side View



1	Removable terminal blocks, top
2	Removable terminal blocks, bottom
3	LED indicators
4	Delay factor selector
5	Delay base selector
6	Sealable transparent cover

Nameplate

Nameplate



The nameplate contains the following data:

1	Device type (refer to chapter Type Code, page 14)
2	Nominal voltage
3	Frequency range Vac supply
4	Input power
5	Maximum current of safety-related outputs with utilization category AC15 (250 Vac)
6	Maximum current of safety-related outputs with utilization category DC13 (24 Vdc)
7	Maximum total thermal current
8	Maximum Safety Integrity Level (SIL) as per IEC 61508-1:2010
9	Maximum Performance Level and Category as per ISO 13849-1:2015
10	Maximum response time to request at safety-related input
11	Permissible ambient temperature range during operation
12	IP degree of protection
13	Serial number
14	Product version (PV), release (RL), software version (SV)
15	Plant code and date of manufacture (example: PP-2019-W10 means plant code PP, year of manufacture 2019, week of manufacture 10)

Type Code

Type Code

Item	1	2	3	4	5	6	7	8	9	10	11	12
Type code (example)	X	P	S	B	A	T	1	2	A	1	A	C

Item	Meaning
1 ... 4	**Product range** XPSB = Basic
5 ... 6	**Product version** AT
7	**Supply voltage** 1 = 24 Vac/Vdc
8 ... 11	**Number of safety-related outputs** 2A1A = 2 normally open relay contacts, instantaneous; 1 normally open relay contact, delayed
12	**Terminal type** C = Spring terminals, removable P = Screw terminals, removable

If you have questions concerning the type code, contact your Schneider Electric service representative.

Technical Data

Environmental Conditions

Environmental Conditions For Storage

Environmental parameters:

Characteristic	Value
Ambient temperature	-40 ... 70 °C (-40 ... 158 °F)
Rate of change of temperature	1 °C/min (1.8 °F/min)
Ambient humidity	10 ... 100 % relative humidity

Mechanical conditions:

Characteristic	Value
Vibration, sinusoidal, displacement amplitude 2 ... 9 Hz	1.5 mm
Vibration, sinusoidal, acceleration amplitude 9 ... 200 Hz	5 m/s^2
Shock, shock response spectrum type L, peak acceleration	40 m/s^2

Environmental Conditions For Transportation

Environmental parameters:

Characteristic	Value
Ambient temperature	-25 ... 85 °C (-13 ... 185 °F)
Ambient humidity	5 ... 95 % relative humidity, no condensation

Mechanical conditions:

Characteristic	Value
Vibration, sinusoidal, displacement amplitude 2 ... 9 Hz	3.5 mm
Vibration, sinusoidal, acceleration amplitude 9 ... 200 Hz	10 m/s^2
Vibration, sinusoidal, acceleration amplitude 200 ... 500 Hz	15 m/s^2
Shock, shock response spectrum type I, peak acceleration	100 m/s^2
Shock, shock response spectrum type II, peak acceleration	300 m/s^2

Environmental Conditions For Operation

Characteristic	Value
Maximum installation altitude above mean sea level	2000 m (6562 ft)
Installation required in control cabinet/enclosure with degree of protection	IP54

Environmental parameters:

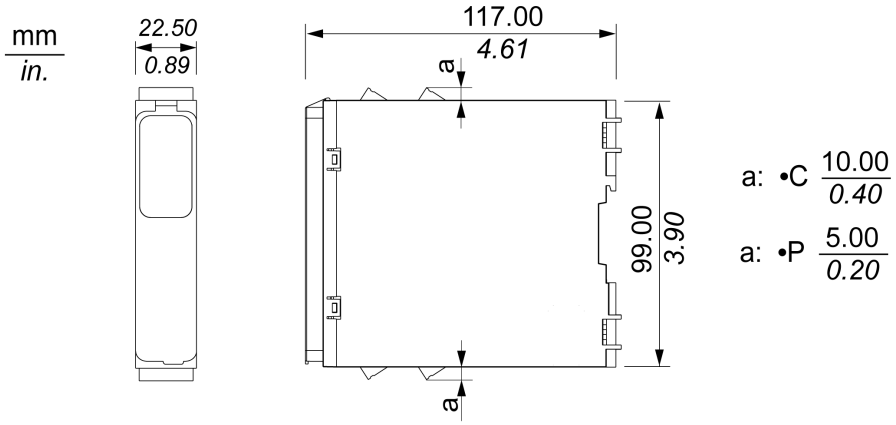
Characteristic	Value
Ambient temperature	-25 ... 55 °C (-13 ... 131 °F), no icing **NOTE:** Refer to Safety-Related Outputs, page 20 for derating information.
Rate of change of temperature	0.5 °C/min (0.9 °F/min)
Ambient humidity	5 ... 95 % relative humidity, no condensation

Mechanical conditions:

Characteristic	Value
Vibration, sinusoidal, displacement amplitude 2 ... 9 Hz	3 mm
Vibration, sinusoidal, acceleration amplitude 9 ... 200 Hz	10 m/s^2
Shock, shock pulse shape: half-sine, peak acceleration	150 m/s^2

Mechanical Characteristics

Dimensions



Characteristic	Value	
	XPSBAT•••C	XPSBAT•••P
Width	22.5 mm (0.89 in)	
Height without terminals	99 mm (3.90 in)	
Height with terminals	119 mm (4.70 in)	109 mm (4.30 in)
Depth	117 mm (4.61 in)	

Weight

Characteristic	Value
Weight	0.2 kg (0.44 lbs)

Degree Of Protection

Characteristic	Value
Housing	IP40
Terminals	IP20

Wire Cross Sections, Stripping Lengths, and Tightening Torques

Spring terminals

Characteristic	Value
Stripping length	12 mm (0.47 in)
Wire cross section, single wire (solid or stranded) without wire ferrule	0.2 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, single wire (stranded) with insulated or uninsulated wire ferrule	0.25 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, two wires (stranded) with insulated twin wire ferrule	0.5 ... 1.0 mm^2 (AWG 20 ... 18)

Screw terminals

Characteristic	Value
Stripping length	7 ... 8 mm (0.28 ... 0.31 in)
Tightening torque	0.5 Nm (4.4 lb-in)
Wire cross section, single wire (solid or stranded) without wire ferrule	0.2 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, single wire (stranded) with insulated or uninsulated wire ferrule	0.25 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, two wires (solid or stranded) without wire ferrule	0.2 ... 1.5 mm^2 (AWG 24 ... 16)
Wire cross section, two wires (stranded) with uninsulated wire ferrules	0.25 ... 0.75 mm^2 (AWG 24 ... 20)
Wire cross section, two wires (stranded) with insulated twin wire ferrule	0.5 ... 1.5 mm^2 (AWG 20 ... 16)

Electrical Characteristics

Supply

Characteristic	Value
Supply voltage AC	24 Vac (-15 ... 10 %)
Supply voltage DC	24 Vdc (-20 ... 20 %)
Nominal input power AC	5 VA (24 Vac)
Nominal input power DC	2 W (24 Vdc)
Frequency range AC	50 ... 60 Hz
Overvoltage category	II
Pollution degree	2
Rated insulation voltage (isolation) as per IEC 60947-5-1	300 V
Impulse withstand voltage	4 kV

Electromagnetic Compatibility (EMC)

Characteristic	Characteristic
Conducted and radiated emissions as per IEC CISPR 11	Group 1/class B
Usage in environment as per IEC/UL 60947-1	Environment B

Safety-Related Inputs

Characteristic	Value
Number of inputs (each with 1 control output DC+ (S11, S21) and 1 input CH+ (S12, S22)), single-channel	2
Output voltage at DC+	>15 Vdc
Input voltage at CH+	0 ... 24 Vdc (+20 %)
Switching voltage for activation of CH+	>15 Vdc
Switching voltage for deactivation of CH+	<5 Vdc
Input current	5 mA
Maximum wire resistance	500 Ω

Start/Restart Input

Characteristic	Value
Output voltage at Y1	>15 Vdc
Input voltage at Y2, Y3	0 ... 24 Vdc (+20 %)
Switching voltage to activate Y2, Y3	>15 Vdc
Switching voltage to deactivate Y2, Y3	<5 Vdc
Input current	5 mA
Maximum wire resistance	500 Ω

Classification of Safety-Related Inputs and Start/Restart Input as per ZVEI CB24I

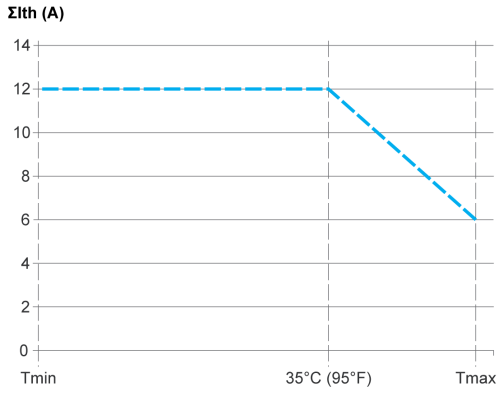
Representation and values as per identifying key, ZVEI CB24I:

Source/sink	Interface type	Additional measure	Source/sink	Interface type
Sink	A	M	Source	C0

Interface type A: Sink		
Parameter	**Minimum value**	**Maximum value**
Input current Ii (in the ON state)	3 mA	5 mA
Output voltage Ui	15 V	24 V (+20 %)
Additional measure M	The inputs are not types as per IEC 61131-2. TG is S•1 for S•2 TG is Y1 for Y2	>15 Vdc

Refer to the chapter Dynamization, page 32 for test pulse times.

Safety-Related Outputs

Characteristic	Value
Number of safety-related outputs, consisting of two normally open relay contacts each, instantaneous deactivation	2
Number of safety-related outputs, consisting of two normally open relay contacts each, delayed deactivation	1
Maximum short circuit current IK	0.6 kA
Maximum continuous current	6 A
Maximum total thermal current ΣIth in free air up to 55°C (131°F) and for side-by-side mounting up to 35°C (95°F)	12 A
Maximum total thermal current ΣIth for side-by-side mounting at 55° C (131°F)	6 A Derating curve (derating starting at 35 °C (95 °F)): 
Minimum load	10 mA / 5 V
Utilization category as per UL 60947-5-1	B300 and R300
Utilization category as per IEC 60947-4-1 and IEC 60947-5-1)	AC1: 250 V AC15: 250 V DC1: 24 V DC13: 24 V
Maximum current, normally open relay contacts	AC1: 5 A AC15: 3 A DC1: 5 A DC13: 3 A
External fusing	6 A, category gG

Timing Data

Maximum Response Times

Characteristic	Value
Maximum response time to request at safety-related input	20 ms
Maximum response time after power outage AC	160 ms
Maximum response time after power outage DC	100 ms

Recovery Time

Characteristic	Value
Recovery time after request at safety-related input	200 ms

Switch-On and Activation Delays

Characteristic	Value
Switch on delay after power on and automatic start/restart	2500 ms
Delay after activation of safety-related input or valid start/restart condition	100 ms

Monitored Start/Restart

Characteristic	Value
Waiting time after power on and beginning of monitored start	2500 ms
Minimum duration of start/restart pulse for monitored start/restart	80 ms

Delay Times for Delay Function of Safety-Related Outputs

Characteristic	Value
Configurable values (accuracy ±5 %)	0 s, 0.1 s, 0.2 s, 0.3 s, 0.4 s, 0.5 s, 0.6 s, 0.7 s, 0.8 s, 0.9 s, 1 s, 2 s, 3 s, 4 s, 5 s, 6 s, 7 s, 8 s, 9 s, 10 s, 20 s, 30 s, 40 s, 50 s, 60 s, 70 s, 80 s, 90 s, 100 s, 200 s, 300 s, 400 s, 500 s, 600 s, 700 s, 800 s, 900 s

Dynamization of Safety-Related Inputs and Start/Restart Input

Characteristic	Value
Test pulse duration (input must be activated for longer than duration of test pulse)	2 ms
Test pulse interval	500 ms
Maximum delay of test pulse	40 ms
Test pulse phase shift	At least 70 ms

Debounce Time of Safety-Related Inputs

Characteristic	Value
Debounce time, standard	2.5 ms
Debounce time if type of output of sensor/device providing input signal is OSSD	4 ms

Signal Interlock Monitoring Time

Characteristic	Value
Signal interlock monitoring time	200 ms

Synchronization Times

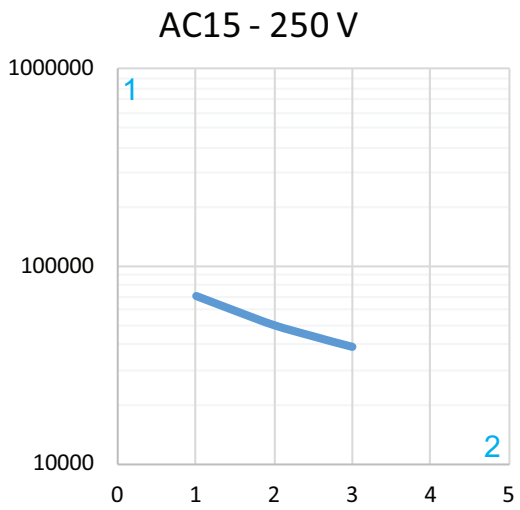
The synchronization times for the synchronization of the safety-related inputs are 0.5 s or 2 s, depending on which input is activated first. Refer to the chapter Application Functions, page 42 for details.

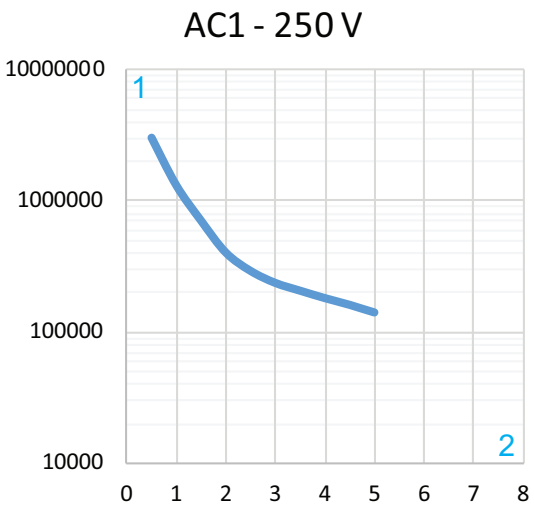
Data Functional Safety

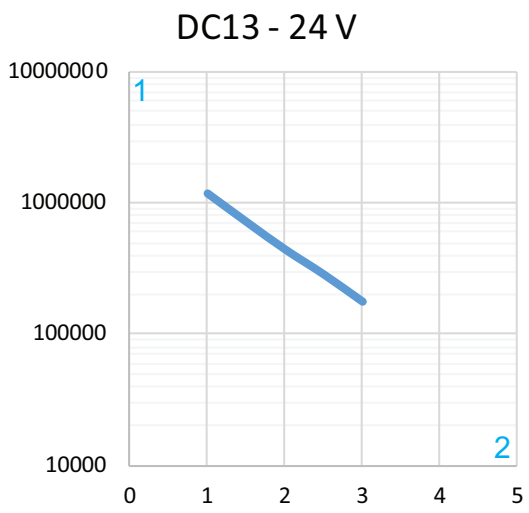
Data Functional Safety

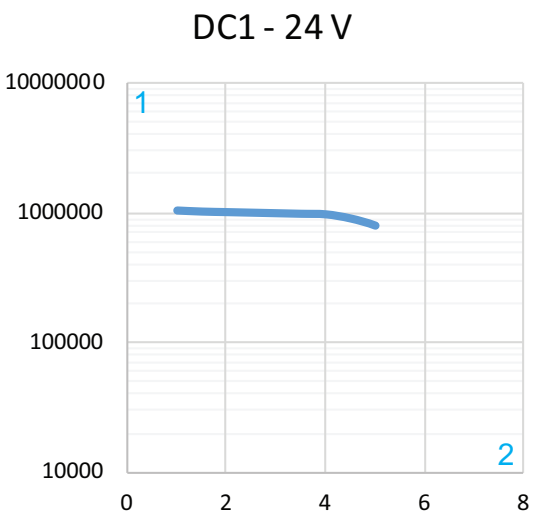
Characteristic	Value
Defined safe state	Safety-related outputs are de-energized Normally open relay contacts: open
Maximum Performance Level (PL), Category (as per ISO 13849-1:2015)	PL e, Category 4 Actual PL and category depend on application.
Maximum Safety Integrity Level (SIL) (as per IEC 61508-1:2010)	3 Actual SIL depends on application.
Safety Integrity Level Claim Limit (SILCL) (as per IEC 62061:2005+AMD1:2012+AMD2:2015)	3 Actual SILCL depends on application.
Type (as per IEC 61508-2)	B
Hardware Fault Tolerance (HFT) (as per IEC 61508 and IEC 62061)	1
Stop Category for Emergency Stops (as per ISO 13850 and IEC 60204-1)	0 or 1
Lifetime in years at an ambient temperature of 55 °C (131 °F)	20
Safe Failure Fraction (SFF) (as per IEC 61508 and IEC 62061)	>99 %
Probability of Dangerous Failure per hour (PFHD) in 1/h (as per IEC 61508 and ISO 13849-1)	0.98 x 10^{-9} with Safe Stop 0 0.96 x 10^{-9} with Safe Stop 1
Mean Time To Dangerous Failure (MTTFd) in years (high as per ISO 13849-1)	>30
Average Diagnostic Coverage (DC_{avg}) (high as per ISO 13849-1)	≥99 %
Demand mode of operation (as per IEC-61508-1, IEC-62061)	High/continuous
Maximum number of cycles over lifetime	DC13, 24 Vdc 1 A: 1200000 with Safe Stop 0 DC13, 24 Vdc 1 A: 361000 with Safe Stop 1 DC13, 24 Vdc 3 A: 190000 with Safe Stop 0 DC13, 24 Vdc 3 A: 12000 with Safe Stop 1 AC1, 250 Vac 4 A: 180000 with Safe Stop 0 AC1, 250 Vac 4 A: 303000 with Safe Stop 1 AC15, 250 Vac 1 A: 60000 with Safe Stop 0 AC15, 250 Vac 1 A: 780000 with Safe Stop 1 AC15, 250 Vac 3 A: 40000 with Safe Stop 0 AC15, 250 Vac 3 A: 100000 with Safe Stop 1

Electrical durability of the safety-related output relay contacts (instantaneous) as per IEC 60947-5-1





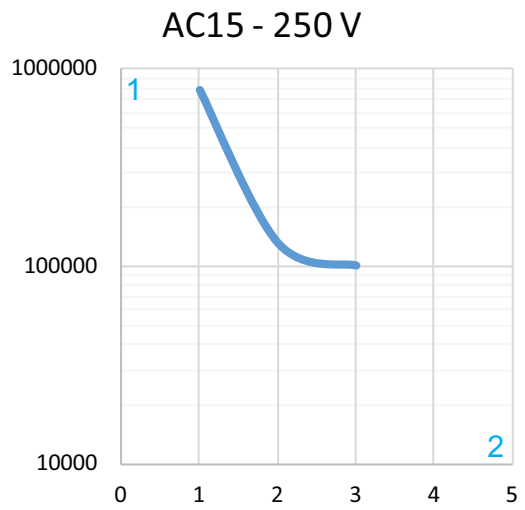


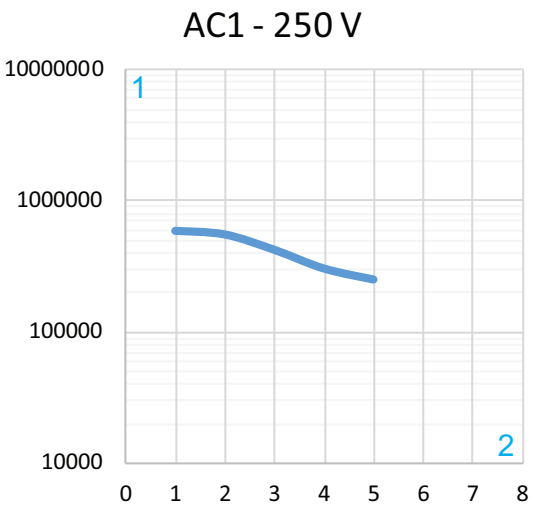


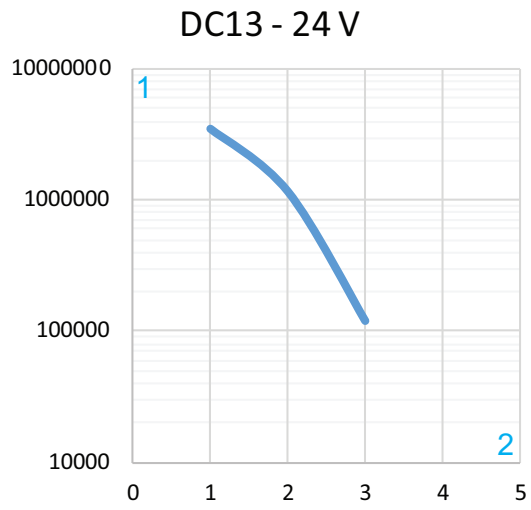
1 Operating cycles

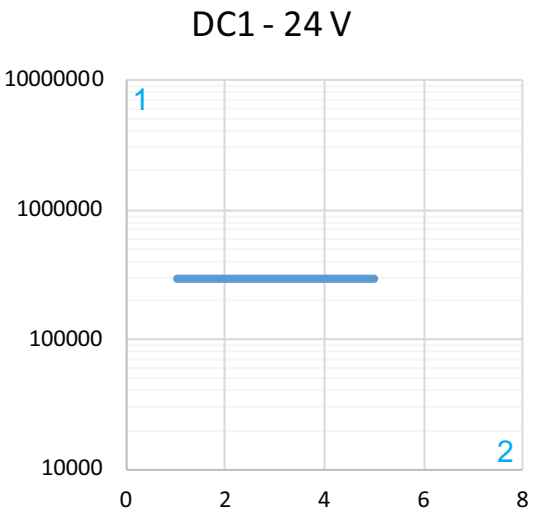
2 Rated current in A

Electrical durability of the safety-related output relay contacts (delayed) as per IEC 60947-5-1









1 Operating cycles

2 Rated current in A

Refer to chapter Timing Data, page 22 for additional technical data that may affect your functional safety calculations.

Engineering

Electromagnetic Compatibility (EMC)

Conducted and Radiated Electromagnetic Emissions

⚠WARNING

INSUFFICIENT ELECTROMAGNETIC COMPATIBILITY

- Verify compliance with all EMC regulations and requirements applicable in the country in which the device is to be operated and with all EMC regulations and requirements applicable at the installation site.
- Implement all required radio interference suppression measures and verify their effectiveness.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

As a machine designer or system integrator, you may need to include this information in the documentation to your customer.

According to IEC CISPR 11, the safety module of type XPSBAT1••• is a group 1, class B device. Class B as per IEC CISPR 11 corresponds to environment B as per IEC 60947-1.

Principles of Operation

Introduction

The following sections provide information on the principles of operation of the safety module to assist you in engineering your application function.

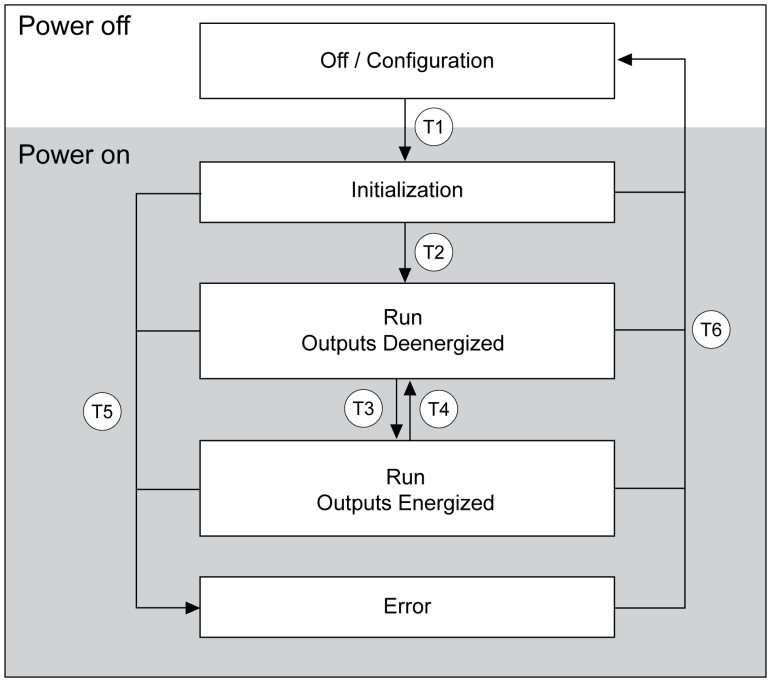
General Information on Activation and Deactivation of Safety-Related Inputs and Safety-Related Outputs

In the present document, “activation” of a safety-related input means that a safety-related input changes its state so that the safety module can enter the operating state Run: Outputs Energized. As a result, the safety-related outputs are “activated” (energized). In this condition, the safety module is not in the defined safe state.

The term “deactivation” of a safety-related input means that a safety-related input changes its state so that the safety module enters the operating state Run: Outputs Deenergized. As a result, the safety-related outputs are “deactivated” (deenergized). In this condition, the safety module is in the defined safe state.

Operating States

The following graphic illustrates the operating states and state transitions of the safety module:



Operating state	Description	In defined safe state
Off / Configuration	Configuration only possible in this operating state	Yes
Initialization	Self-tests	Yes
Run: Outputs Deenergized	Regular operation with safety-related function active	Yes
Run: Outputs Energized	Regular operation with safety-related function not active	No
Error	Error detected	Yes

NOTE: Refer to the chapter Data Functional Safety, page 24 for the defined safe state of the safety module.

State Transitions

State transition	Condition
T1	• Power on
T2	• Initialization successful • Switch on delay has passed
T3	• Start/restart condition fulfilled (for example, automatic start/restart or manual start/restart with start/restart pushbutton pressed) • Safety-related inputs activated • For application functions with signal interlock monitoring: no signal interlock condition • For application functions with synchronization: synchronization time requirements met
T4	• Safety-related inputs deactivated (corresponds to triggering of the safety-related function)
T5	• Error detected
T6	• Power off

NOTE: Refer to the chapter General Information on Activation and Deactivation of Safety-Related Inputs and Safety-Related Outputs, page 28 for details on the use of the terms “activated” and “deactivated” in the present document.

Synchronization of Safety-Related Inputs

The safety module monitors the synchronized behavior of the input channels of the safety-related inputs using the synchronization mechanism with different synchronization times. If the synchronized input channels of the safety-related inputs are not activated within the synchronization time, the safety-related outputs are not activated.

The synchronized terminals of the safety-related inputs and the corresponding synchronization times are listed for each individual application function, page 42, including information on the sequences in which the synchronized input channels are activated.

Example with Emergency Stop

The following example uses a machine with an Emergency Stop pushbutton, a start/restart pushbutton for manual start/restart, and a motor to demonstrate the individual operating states and state transitions. The selected application function is Emergency Stop, page 42. The selected start/restart function is Manual Start/Restart, page 46.

- After the safety module is powered on, it enters the operating state Initialization (T1).
- If the initialization is successful, the safety module enters the operating state Run: Outputs Deenergized (T2).

  If an error is detected, the safety module transitions to the operating state Error (T5).
- When entering the operating state Run: Outputs Deenergized, the safety module verifies the state of the safety-related inputs and of the start/restart input. The motor is at a standstill.
- If the start/restart pushbutton is not pressed, the start/restart input stays deactivated and the safety module remains in the operating state Run: Outputs Deenergized. The motor is at a standstill.

  Detailed information on the start/restart functions and the timing can be found in the chapter Start/Restart Functions, page 45.
- If the start/restart pushbutton is pressed, the start/restart input is activated, that is, the start/restart condition is fulfilled.

The state of the safety-related inputs determines whether the safety module transitions to the operating state Run: Outputs Energized.

- If the safety-related inputs are not activated (actuator of Emergency Stop pushbutton engaged), the safety module remains in the operating state Run: Outputs Deenergized. The motor remains at a standstill.

  If the safety-related inputs are activated (actuator of Emergency Stop pushbutton not engaged (pulled out, rearmed)), the safety module transitions to the operating state Run: Outputs Energized (T3). The motor runs. This operating state corresponds to regular operation of the machine.

  This transition only occurs if the safety-related inputs are activated within the synchronization time.
- In the operating state Run: Outputs Energized, the safety module monitors the state of the safety-related inputs.

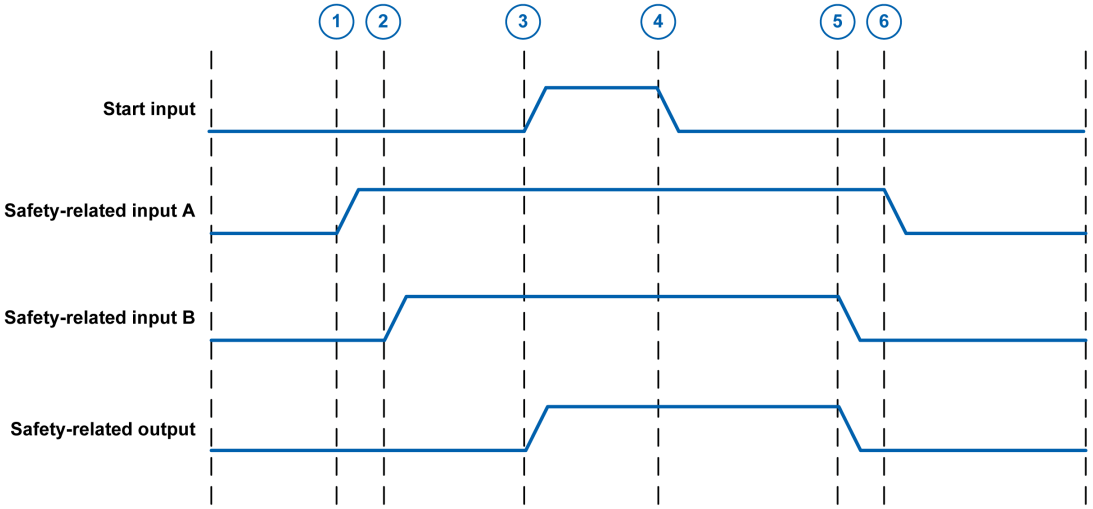
  If the actuator of the Emergency Stop pushbutton is engaged (safety-related inputs deactivated), the safety-related outputs are deactivated within the response time (transition T4 to operating state Run: Outputs Deenergized). The safety module is in the defined safe state. The motor is stopped.

  This corresponds to the Emergency Stop condition of the machine.
- To return to the operating state Run: Outputs Energized (T3), the start/restart input and the safety-related inputs need to be activated again (start/restart pushbutton pressed and actuator of the Emergency Stop pushbutton rearmed (pulled out)).

  If an application function with signal interlock monitoring, page 34 is used, this transition only occurs if there is no signal interlock condition and if the safety-related inputs are activated within the synchronization time.

Timing Diagram for Example with Emergency Stop

The following timing diagram provides an overview of the example with Emergency Stop.



Legend

Item	Description
1	• The first safety-related input (A) is activated (actuator of Emergency Stop pushbutton rearmed (pulled out)). • The safety module remains in the defined safe state.
2	• The second safety-related input (B) is activated (second output contact of Emergency Stop pushbutton) within the synchronization time. • The start/restart pushbutton has not yet been pressed so the start/restart condition is not yet fulfilled and the safety module remains in the defined safe state.
3	• The start/restart pushbutton is pressed.

Item	Description
	• The start/restart condition is fulfilled. Refer to the chapter Start/Restart Functions, page 45 for detailed information on the start functions. • The safety-related output is activated within the activation delay time, page 22. • The safety-related output is only activated if the two channels of the safety-related input have been activated within the synchronization time. • The motor runs. The safety module is not in the defined safe state.
4	• The start/restart pushbutton is released.
5	• The safety-related input B is deactivated (actuator of Emergency Stop pushbutton engaged (pushed)). • The safety-related output is deactivated within the response time, page 22. • The Emergency Stop is active. The safety module is in the defined safe state.
6	• The safety-related input A is deactivated (by second output contact of Emergency Stop pushbutton) within the signal interlock monitoring time, page 34 (between (5) and (6)).

Dynamization

Dynamization of Inputs

Dynamization is used for cross circuit detection between

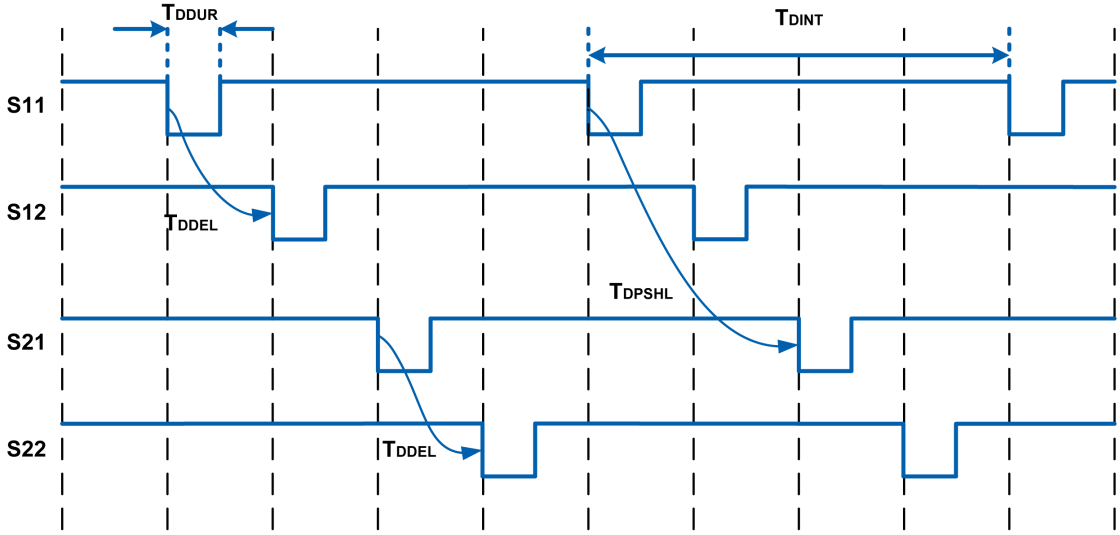
- two safety-related inputs, or
- one safety-related input and the start/restart input, or
- a cross-circuit to an external power supply unit or to ground.

Dynamization is implemented by means of periodically generated test pulses at S11 and S21 of the safety-related inputs and at Y1 of the start/restart input.

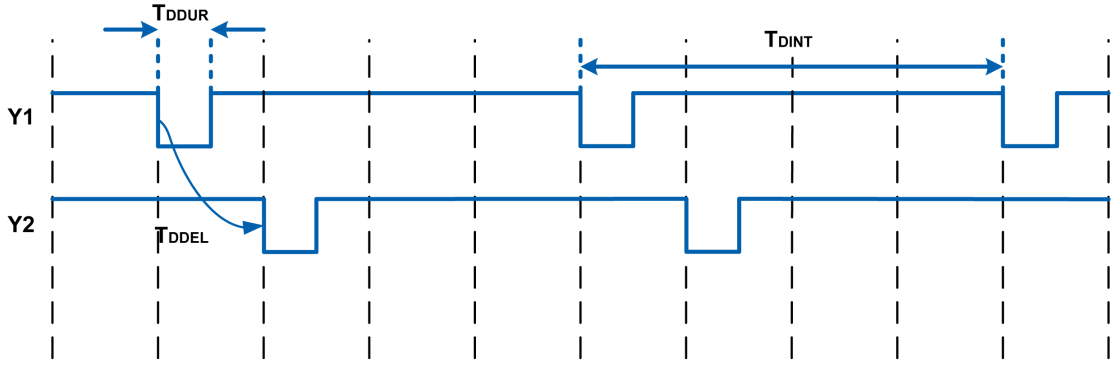
Whether dynamization of the safety-related inputs is used depends on the selected application function, page 42.

Whether dynamization of the start/restart input is used depends on the start/restart function configured by wiring of the start/restart input, page 40. Dynamization is only used if terminals Y1 and Y2 are wired.

The following diagram illustrates the dynamization principle and timing of the safety-related inputs:



The following diagram illustrates the dynamization principle and timing of channels Y1 and Y2 of the start/restart input:



Designation	Value	Explanation
T_{DDUR}	2 ms	Duration of the test pulse. The duration of the test pulse is the time between the start of the test pulse and the end of the test pulse.
T_{DINT}	500 ms	Interval between test pulses. This interval is the time between the start of a test pulse and the start of the next test pulse.

Designation	Value	Explanation
T_{DDEL}	40 ms	Maximum delay of test pulse. This delay is the maximum time between the start of the test pulse at the control output and the associated input channel, that is, the maximum time in which the input expects dynamization.
T_{DPSHL}	At least 70 ms	Phase shift of test pulses. This time is the phase shift between the test pulses at the control outputs of the safety-related inputs.

Signal Interlock Monitoring

Overview

Signal interlock is a monitoring function used to detect conditions in which one of the sensors/devices cannot provide the expected input signal for the safety module, for example, as a result of contact welding.

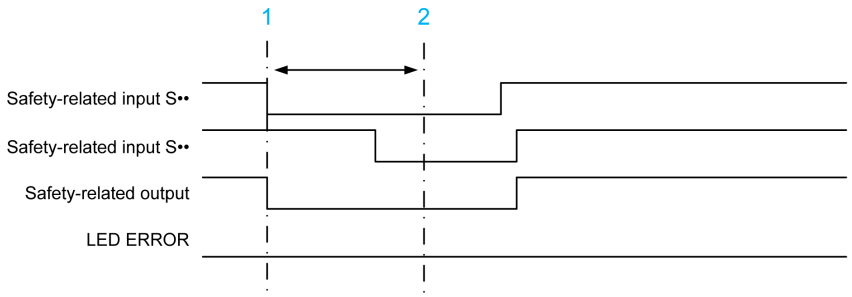
The safety module needs “simultaneous” deactivation of the two safety-related inputs within the signal interlock monitoring time of 200 ms.

If the two monitored safety-related inputs are not deactivated within 200 ms, this is a signal interlock condition and the safety module triggers a signal interlock alert. The safety module remains in the defined safe state, i.e., there is no transition from operating state Run: Outputs Deenergized to operating state Run: Outputs Energized (T3).

To exit the signal interlock condition, the two affected safety-related inputs must be deactivated for at least one second. After that, the safety-related inputs can be activated again which activates the safety-related outputs as well.

Examples

The following figure illustrates a condition without signal interlock:



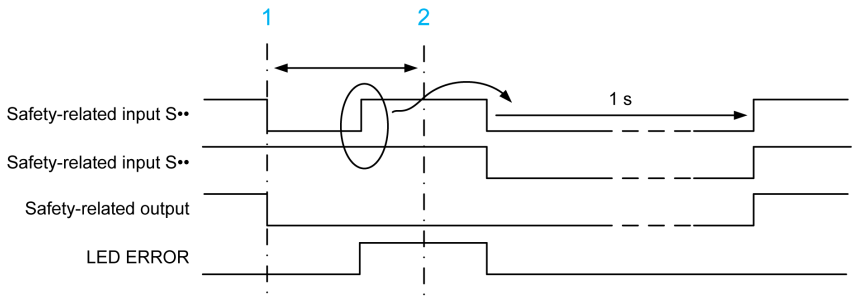
1 Signal interlock monitoring time starts to run

2 Signal interlock monitoring time has elapsed

LED ERROR is off.

Both safety-related inputs are deactivated within the signal interlock monitoring time of 200 ms. When they are activated again, the safety-related outputs are also activated.

The following figure illustrates a condition with signal interlock:



1 Signal interlock monitoring time starts to run

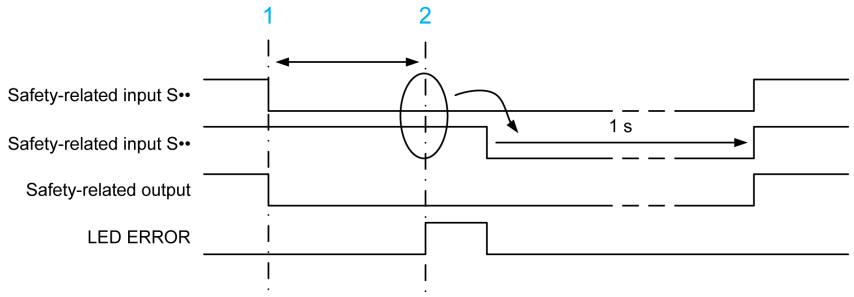
2 Signal interlock monitoring time has elapsed

LED ERROR flashes (alert).

The first safety-related input is deactivated which starts the signal interlock monitoring time of 200 ms. It is then activated again before the second safety-

related input is deactivated. This triggers a signal interlock alert even though the 200 ms have not yet elapsed.

The following figure illustrates a condition with signal interlock:



1 Signal interlock monitoring time starts to run

2 Signal interlock monitoring time has elapsed

LED ERROR flashes (alert).

The first safety-related input is deactivated which starts the signal interlock monitoring time of 200 ms. The second safety-related input remains activated longer than 200 ms. This triggers a signal interlock alert 200 ms after interlock monitoring has started.

Installation

Prerequisites and Requirements

Inspecting the Device

Damaged products may cause electric shock or unintended equipment operation.

⚠⚠DANGER

ELECTRIC SHOCK OR UNINTENDED EQUIPMENT OPERATION

- Do not use damaged products.
- Keep foreign objects (such as chips, screws or wire clippings) from getting into the product.

Failure to follow these instructions will result in death or serious injury.

Verify the product type by means of the type code, page 14 and the data printed on the device.

Control Cabinet/Enclosure

Install the safety module in a control cabinet or enclosure with degree of protection IP54 that is secured by a keyed or tooled locking mechanism.

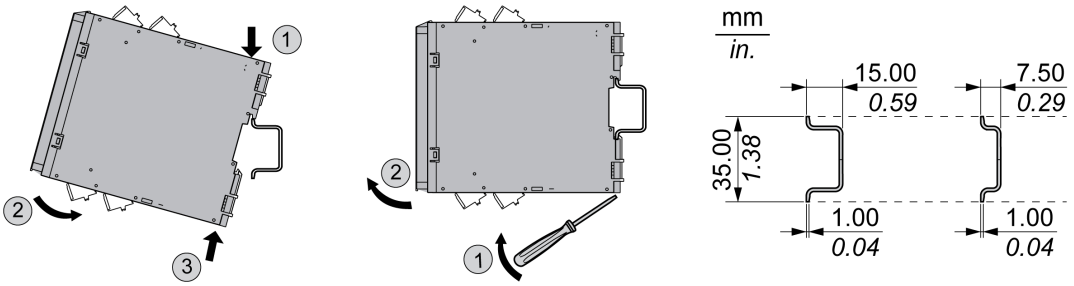
The ventilation of the control cabinet/enclosure must be sufficient to comply with the specified ambient conditions for the safety module and the other components operated in the control cabinet/enclosure.

Mechanical Installation

Mounting to DIN Rail

The safety module can be mounted to the following DIN rails as per IEC 60715:

- 35 x 15 mm (1.38 x 0.59 in)
- 35 x 7.5 mm (1.38 x 0.29 in)



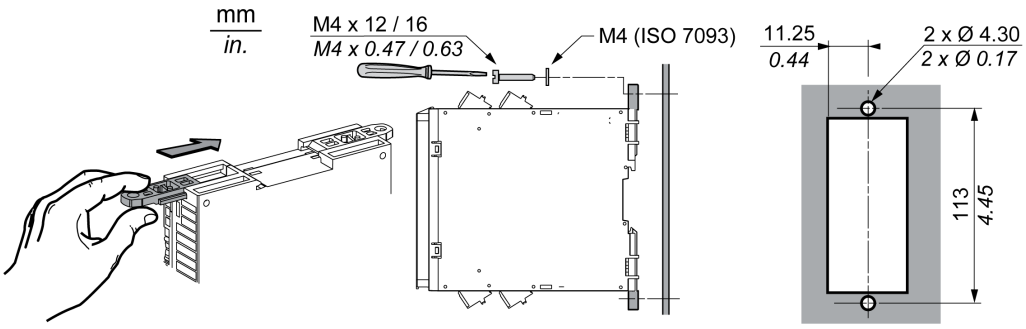
Mounting procedure (left illustration)

Step	Action
1	Slightly tilt the safety module and hook it onto the DIN rail.
2	Push the lower part of the safety module towards the DIN rail.
3	Snap in the DIN rail clip.

Dismounting procedure (center illustration)

Step	Action
1	Unlock the DIN rail clip using a screwdriver.
2	Pull the lower part of the safety module away from the DIN rail and lift the safety module towards the top to remove it from the DIN rail.

Screw-Mounting



Mounting procedure:

Step	Action
1	Push the additional fastener into the grooves at the safety module.
2	Prepare the holes.
3	Screw the safety module to the mounting surface using the specified screws and a washer M4 as per ISO 7093 for each screw.

Electrical Installation

General Information

⚠ DANGER

FIRE, ELECTRIC SHOCK OR ARC FLASH

- Disconnect all power from all equipment of your machine/process prior to electrical installation of the device.
- Confirm the absence of power using a properly rated voltage sensing device.
- Place a "Do Not Turn On" or equivalent hazard label on all power switches and lock them in the non-energized position.

Failure to follow these instructions will result in death or serious injury.

Wiring of the safety module depends on the safety-related function to be implemented. Before wiring the safety module, engineer the safety-related function, perform a risk assessment with regard to your machine/process, and determine the suitability of the safety module as well as the connected equipment.

Refer to the Schneider Electric Safety Chain Solutions at https://www.se.com for examples of safety-related applications.

You can wire the safety module with the terminal blocks inserted, or you can remove the terminal blocks. For the latter, pull the terminal blocks out of the safety module, connect the individual terminals and push the terminal blocks back into the safety module.

Use 75 °C (167 °F) copper conductors to wire the safety module.

Wire Cross Sections, Stripping Lengths, and Tightening Torques

Spring terminals

Characteristic	Value
Stripping length	12 mm (0.47 in)
Wire cross section, single wire (solid or stranded) without wire ferrule	0.2 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, single wire (stranded) with insulated or uninsulated wire ferrule	0.25 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, two wires (stranded) with insulated twin wire ferrule	0.5 ... 1.0 mm^2 (AWG 20 ... 18)

Screw terminals

Characteristic	Value
Stripping length	7 ... 8 mm (0.28 ... 0.31 in)
Tightening torque	0.5 Nm (4.4 lb-in)
Wire cross section, single wire (solid or stranded) without wire ferrule	0.2 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, single wire (stranded) with insulated or uninsulated wire ferrule	0.25 ... 2.5 mm^2 (AWG 24 ... 12)
Wire cross section, two wires (solid or stranded) without wire ferrule	0.2 ... 1.5 mm^2 (AWG 24 ... 16)
Wire cross section, two wires (stranded) with uninsulated wire ferrules	0.25 ... 0.75 mm^2 (AWG 24 ... 20)
Wire cross section, two wires (stranded) with insulated twin wire ferrule	0.5 ... 1.5 mm^2 (AWG 20 ... 16)

Block Diagram and Terminals

The following drawings present the block diagram and the terminals with their designations in the removable terminal blocks.

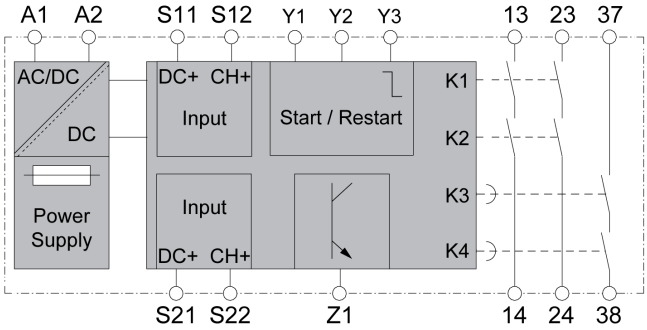
The spring clamp terminals are designed for the connection of only a single wire if you do not use wire ferrules. A maximum of two wires may be connected to a spring clamp terminal if the wires are installed with a twin wire ferrule.

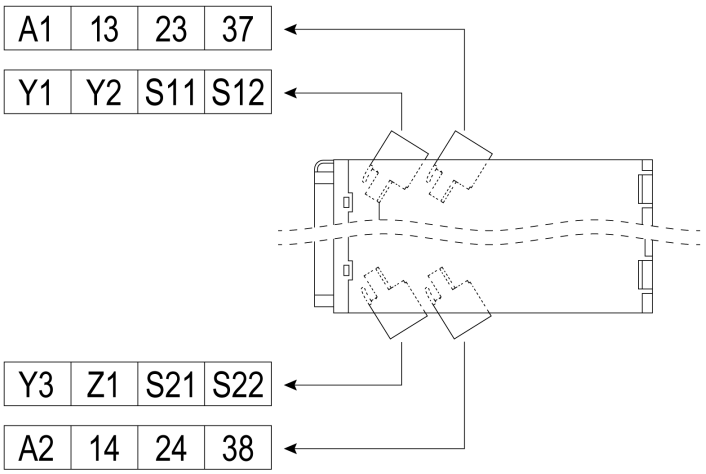
⚠⚠DANGER

LOOSE WIRING CAUSES ELECTRIC SHOCK

Do not connect more than one wire to a spring clamp terminal unless you use an approved twin wire ferrule and make the connection according to the specifications provided in the present document.

Failure to follow these instructions will result in death or serious injury.





Terminal Designation	Explanation
A1, A2	Power supply
S11, S21	Control outputs (DC+) of safety-related inputs
S12, S22	Input channels (CH+) of safety-related inputs
Y1	Control output of Start/Restart input
Y2	Input channel for automatic/manual start
Y3	Input channel for monitored start with falling edge
13, 14, 23, 24	Terminals of the safety-related outputs (instantaneous)
37, 38	Terminals of the safety-related outputs (delayed)
Z1	Solid state output, not safety-related

Safety-Related Inputs

⚠WARNING

INSUFFICIENT AND/OR INEFFECTIVE SAFETY-RELATED FUNCTIONS

Only connect a sensor/device to a safety-related input that meets all requirements as per your risk assessment and that complies with all regulations, standards, and process definitions applicable to your machine/process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The safety module provides two safety-related inputs. Each safety-related input consists of one control output DC+ (terminals S11, S21) and one input channel CH + (terminals S12, S22).

Each control output DC+ provides a nominal voltage of 24 Vdc to the connected sensor/device. It is also used for dynamization, page 32.

Respect the maximum wire resistance of 500 Ω when determining the cable length. The maximum wire length between a safety-related input and a sensor/device is 30 m (98.43 ft) if the supply via the control outputs (terminals S•1) of the safety-related inputs are not used.

Safety-Related Outputs

The wiring of the safety-related outputs depends on the safety-related function to be implemented.

Install fuses with the rating specified in the chapter Electrical Characteristics, page 20.

Start/Restart Input

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not use the Start/Restart function for safety-related purposes.
- Use Monitored Start/Restart if unintended restart is a hazard according to your risk assessment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The start/restart input consists of one control output (terminal Y1) and two input channels (terminals Y2 and Y3).

The control output provides a nominal voltage of 24 Vdc to the connected sensor/device. It is also used for dynamization, page 32.

The wiring of the start/restart input depends on the start/restart, page 45 function to be implemented.

Automatic start/restart:

- Bridge terminals Y1 and Y2 and leave terminal Y3 unconnected

Manual start/restart:

- Connect terminals Y1 and Y2 to the device providing the start/restart signal, such as a push-button. Leave terminal Y3 unconnected.

Monitored start/restart and if the control output Y1 is to be used:

- Connect terminals Y1 and Y3 to the device providing the start/restart signal, such as a push-button. Leave terminal Y2 unconnected.

Monitored start/restart and if the control output Y1 is not to be used (24 Vac/Vdc):

- Connect terminal Y3 to the device providing the start/restart signal, such as a logic controller. Leave terminals Y1 and Y2 unconnected. In this case, terminal A2 is the common reference potential for terminal Y3.

Respect the maximum wire resistance of 500 Ω when determining the cable length. The maximum wire length between the start/restart input and a sensor/device is 30 m (98.43 ft) if the supply via the control output (terminal Y1) of the start/restart input is not used.

Additional, Non-Safety-Related Output Z1

⚠WARNING

INCORRECT USE OF OUTPUT

Do not use the additional output Z1 for safety-related purposes.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Connect the semiconductor binary status output Z1 to a suitable device for evaluation of the signal provided via this output. Output Z1 indicates the state of the delayed safety-related output. Output Z1 is activated as long as the delay is running.

The maximum wire length between the additional output Z1 and connected equipment is 30 m (98.43 ft)

Power Supply

Connect the terminals A1 and A2 to a power supply providing the supply voltage specified for the safety module in the chapter Electrical Characteristics, page 19.

Functions

Application Functions

Introduction

The following sections provide an overview of the available application functions and a detailed listing of requirements and values as well as the wiring of the safety-related inputs for each of the application functions.

Overview of Application Functions

Typical applications	Type of outputs of sensor/device providing the input signal for application function	Synchroni-zation	Dynamiza-tion	Delay base selector position
Application function 1, page 42				
 Monitoring of Emergency Stop circuits as per ISO 13850 and IEC 60204-1, stop category 0  Monitoring of Emergency Stop circuits as per ISO 13850 and IEC 60204-1, stop category 1  Monitoring of guards as per ISO 14119/ 14120 with electrical switches Details, page 42	Normally open, normally closed and/ or changeover outputs	Yes	Yes	1, 2, 3, or 4
Application function 2, page 43				
 Monitoring of electro-sensitive protective equipment such as type 4 light curtains as per IEC 61496-1  Monitoring of RFID sensors Details, page 43	OSSD (Output Signal Switching Device) outputs	Yes	No	5, 6, 7, or 8

Application Function 1

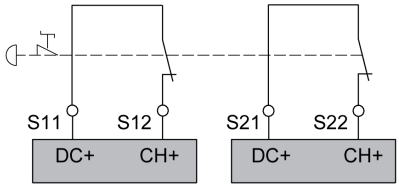
Characteristic	Value/Description
Typical applications	 Monitoring of Emergency Stop circuits as per ISO 13850 and IEC 60204-1, stop category 0  Monitoring of Emergency Stop circuits as per ISO 13850 and IEC 60204-1, stop category 1  Monitoring of guards as per ISO 14119/14120 with electrical switches
Type of outputs of sensor/device providing the input signal for application function	Normally open, normally closed and/or changeover outputs

Characteristic	Value/Description
Dynamization	Yes for safety-related inputs (activated when you set delay base selector (refer to Delay Function, page 48) to 1, 2, 3, or 4 which also selects this application function). Dynamization of the start/restart input depends on the selected start/restart function, page 45 as determined by the wiring, page 40.
Signal interlock monitoring	Between terminals S12 and S22

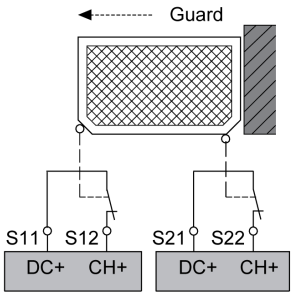
Synchronization:

Synchronized terminals	Synchronization time
S12 synchronized with S22	If S12 is activated before S22, S22 has to be activated within 0.5 s. If S22 is activated before S12, S12 has to be activated within 2 s.

Wiring of the inputs for Emergency Stop



Wiring of the inputs for guards



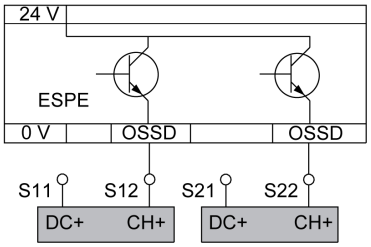
Application Function 2

Characteristic	Value/Description
Typical applications	 Monitoring of electro-sensitive protective equipment such as type 4 light curtains as per IEC 61496-1  Monitoring of RFID sensors
Type of outputs of sensor/device providing the input signal for application function	OSSD (Output Signal Switching Device) outputs
Dynamization	No for safety-related inputs (deactivated when you set delay base selector (refer to Delay Function, page 48) to 5, 6, 7, or 8 which also selects this application function). Dynamization of the start/restart input depends on the selected start/restart function, page 45 as determined by the wiring, page 40.
Signal interlock monitoring	Between terminals S12 and S22

Synchronization:

Synchronized terminals	Synchronization time
S12 synchronized with S22	If S12 is activated before S22, S22 has to be activated within 0.5 s. If S22 is activated before S12, S12 has to be activated within 2 s.

Wiring of the inputs for sensors/devices with OSSD outputs



Start/Restart Functions

Overview

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

- Do not use the Start/Restart function for safety-related purposes.
- Use Monitored Start/Restart if unintended restart is a hazard according to your risk assessment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

The safety module provides several start/restart functions which are selected by means of the wiring. The start/restart function determines the start/restart behavior of the safety module after power-on and the transition from the operating state Run: Outputs Deenergized (defined safe state) to the operating state Run: Outputs Energized.

The start /restart behavior is configured using the following characteristics:

- Automatic start/restart
- Manual start/restart
- Monitored start/restart with falling edge

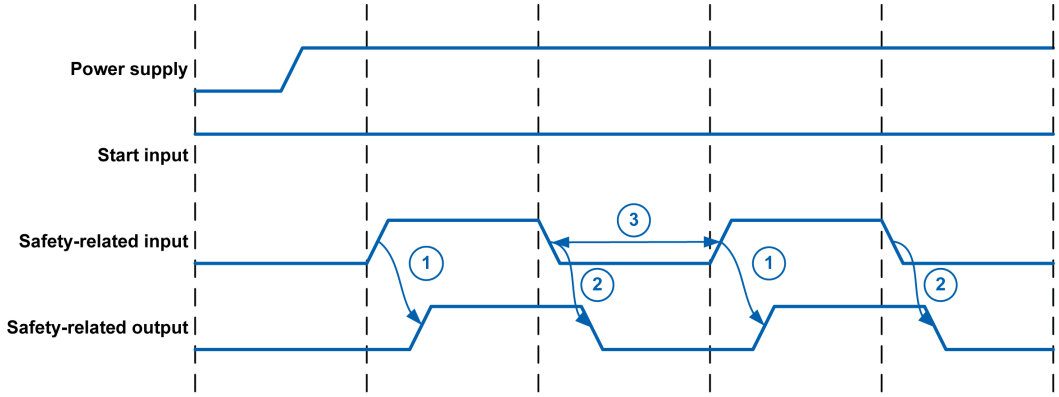
Refer to the chapter Electrical Installation, page 40 for additional information on wiring the start/restart input.

Automatic Start/Restart

With automatic start/restart, the start/restart input is permanently active.

When the safety-related input is activated, the safety-related outputs are activated within a maximum of 100 ms (activation delay).

The following timing diagram illustrates the automatic start/restart:



1 Activation delay (100 ms): maximum time between activation of safety-related input and activation of safety-related output

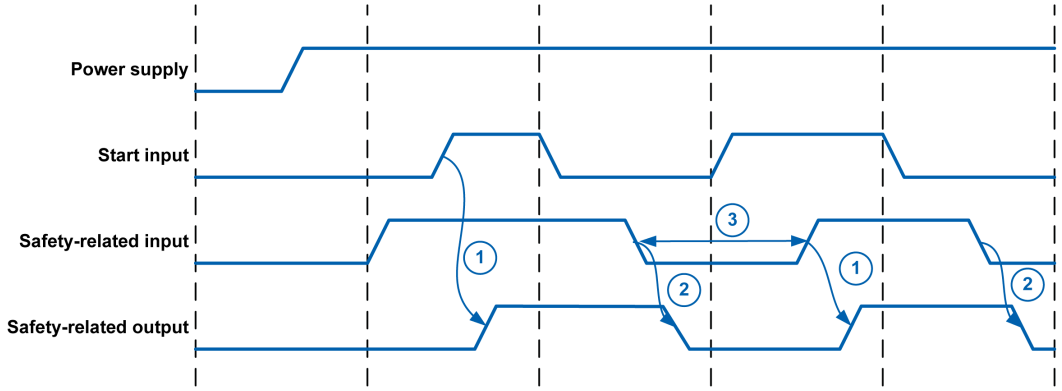
2 Response time (20 ms): maximum time between deactivation of safety-related input and deactivation of safety-related output

3 Recovery time (200 ms): time that must pass before the safety-related input can be activated again

Manual Start/Restart

A manual start/restart requires the start/restart input to be activated. The safety-related output is activated after both the start/restart input and the safety-related input have been activated.

The following timing diagram illustrates the manual start/restart:



1 Activation delay (100 ms): maximum time between activation of start/restart input and activation of safety-related output

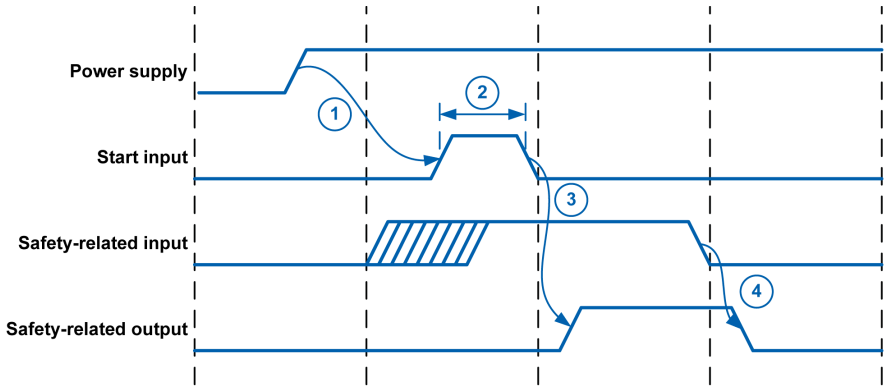
2 Response time (20 ms): maximum time between deactivation of safety-related input and deactivation of safety-related output

3 Recovery time (200 ms): time that must pass before the safety-related input can be activated again

The signal required for activation of the start/restart input can be provided, for example, via a push-button.

Monitored Start/Restart with Falling Edge

In the case of a monitored start/restart with falling edge, the start/restart input must be activated and remain active for a duration of 80 ms. The safety-related outputs are activated with a falling edge of the start input/restart.



NOTE: The safety-related input can have any state when the start/restart input is activated.

1 Waiting time after power-on (2500 ms): time that must pass between power-on and activation of the start/restart input

2 Minimum duration of start/restart pulse (80 ms): time for which the start/restart input must be activated before the falling edge at the start/restart input

3 Activation delay (100 ms): maximum time between deactivation of start/restart input and activation of safety-related output

4 Response time (20 ms): maximum time between deactivation of safety-related input and deactivation of safety-related output

The signal required for activation of the start/restart input can be provided, for example, via a push-button connected to Y1 or an external 24 Vdc supply, or a logic controller.

Delay Function, and Application Function Selection

Overview

The safety module provides a function that allows for delayed deactivation of the delayed safety-related output. The delay is the time between deactivation of the safety-related inputs and the deactivation of the safety-related outputs.

The delay function is available for the safety-related outputs 37-38.

Configuration of Delay and Selection of Application Function

The delay is configured with the delay base selector and the delay factor selector (refer to Front View and Side View, page 12 for the selectors). The numerical value set with the delay base selector is multiplied by the factor set by the delay factor selector. The result is the time delay in seconds for deactivation of the delayed safety-related outputs.

The position of the delay base selector also determines the application function, page 42 and whether the safety-related inputs are dynamized, page 32.

Delay factor selector:

Position of delay factor selector	Factor
1	0.0
2	0.1
3	0.2
4	0.3
5	0.4
6	0.5
7	0.6
8	0.7
9	0.8
10	0.9

Delay base selector (also selects dynamization and application function 1, page 42 or application function 2, page 43):

Position of delay base selector	Base value	Dynamization	Application function
1	1	Yes	Application function 1
2	10	Yes	Application function 1
3	100	Yes	Application function 1
4	1000	Yes	Application function 1
5	1	No	Application function 2
6	10	No	Application function 2
7	100	No	Application function 2
8	1000	No	Application function 2

Configuration Examples

Position of delay factor selector	Position of delay base selector	Application function	Delay time	Dynamization
6	1	1	0.5 seconds	Yes
3	6	2	2 seconds	No

Position of delay factor selector	Position of delay base selector	Application function	Delay time	Dynamization
1	1	1	0 seconds	Yes
1	5	2	0 seconds	No

Configuration and Commissioning

Configuration

Overview

⚠WARNING

INEFFECTIVE SAFETY-RELATED FUNCTION AND/OR UNINTENDED EQUIPMENT OPERATION

- Only modify the settings of the selectors of the device if you are fully aware of all effects of such modifications.
- Verify that the settings of the selectors match the intended safety-related function and the corresponding wiring of the device.
- Verify that modifications do not compromise or reduce the Safety Integrity Level (SIL), Performance Level (PL), and/or any other safety-related requirements and capabilities defined for your machine/process.
- Commission the device before it is used for the first time and after each configuration according to the instructions in the present manual and in compliance with all regulations, standards, and process definitions applicable to your machine/process

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Part of the configuration of the safety module is determined by the type of wiring of the start function and the application function. In addition, you can configure the timing for the delay function via the delay base selector and the delay factor selector, and select an application function via the delay base selector.

The safety module must be installed and wired according to the requirements of the safety-related function to be implemented before you can configure it.

Modifications to the positions of the selectors only become effective after power-up. Remove power from the safety module before modifying the position of the selectors. If the positions of the selectors are modified while power is applied to the safety module, a configuration error is detected.

Go through the commissioning procedure, page 51 after having modified the positions of the selectors or the wiring.

Configuration Procedure

Step	Action
1	Verify that the safety module has been wired according to the safety-related function, page 42 and the start/restart function, page 45 to be implemented.
2	Remove power if the safety module is not powered off.
3	Open the transparent cover of the safety module.
4	Set the delay base selector and the delay factor selector to the required timing and dynamization. Refer to the chapter Delay Function, page 48 for details. The delay base selector setting also determines whether you select application function 1, page 42 (positions 1, 2, 3, or 4) or application function 2, page 43 (positions 5, 6, 7, or 8).
5	Commission the safety module according to the chapter Commissioning, page 51.

Commissioning

Overview

⚠WARNING

INEFFECTIVE SAFETY-RELATED FUNCTION AND/OR UNINTENDED EQUIPMENT OPERATION

- Commission the device before it is used for the first time and after each configuration.
- Commission or recommission the machine/process pursuant to all regulations, standards, and process definitions applicable to your machine/process.
- Only start the machine/process if there are no persons or obstructions in the zone of operation.
- Verify correct operation and effectiveness of all functions by performing comprehensive tests for all operating states, the defined safe state, and all potential error situations.
- Document all modifications and the results of the commissioning procedure in compliance with all regulations, standards, and process definitions applicable to your machine/process.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Commissioning Procedure

Step	Action
1	Verify correct mechanical and electrical installation, page 36 according to the intended application.
2	Verify correct configuration, page 50 according to the intended application.
3	Verify that there are no persons or obstructions in the zone of operation.
4	Apply power and start the machine/process.
5	Perform comprehensive tests for all operating states, the defined safe state, and all potential error situations.
6	Close the transparent cover of the safety module and seal it with the enclosed sealing strip. Additional sealing strips are available as an accessory. Refer to the chapter Accessories, page 55 for additional information.
7	Document all modifications and the results of the commissioning procedure.

Diagnostics

Diagnostics via LED

Overview

The safety module features various LEDs, page 12 that provide status information and information on alerts and detected errors.

Recommission the safety module if, during troubleshooting, you modify the wiring.

Recommission the safety module, page 51 if, during troubleshooting, you modify the position of the delay function selectors.

POWER

State	Meaning
Off	No power supply
On	Power supply on

STATE1

This LED provides information on the state of the instantaneous safety-related outputs.

State	Meaning
Off	Instantaneous safety-related outputs deactivated
On	Instantaneous safety-related outputs activated

STATE2

This LED provides information on the state of the delayed safety-related output. Refer to the chapter Delay Function, page 48 for details.

State	Meaning
Off	Delayed safety-related output deactivated
On	Delayed safety-related output activated

START1 and START2

These LEDs provide information on the start/restart condition and the type of start/restart. Refer to the chapter Start/Restart Function, page 45 for detailed information on the conditions and timing of the selected start/restart function.

State(1)	Meaning
Off	Start/restart condition not fulfilled
On	Start/restart condition fulfilled
Flashing	Waiting for start/restart condition to be fulfilled

(1)	LED START1 = Safety module is wired for manual/automatic start/restart. LED START2 = Safety module is wired for monitored start/restart.

S12 and S22

These LEDs provide information on the state of the corresponding safety-related input terminal.

State	Meaning
Off	Safety-related input deactivated
On	Safety-related input activated

ERROR - Alerts

This LED flashes in conjunction with additional S•• LEDs to indicate alerts.

In the case of an alert, the safety module transitions to the defined safe state. Remove the cause of the alert to be able to exit the defined safe state and resume operation. Contact your Schneider Electric service representative if the condition persists.

State	In conjunction with additional LEDs		Meaning	Remedy
	Additional LEDs	State of additional LEDs		
Flashing	S12 and S22	Flashing alternately	Synchronization time exceeded.	• Verify correct operation of the sensors/ devices providing the input signal.
Flashing	S12 and/or S22	Flashing (synchronously if both inputs are affected)	Signal interlock condition of two safety-related inputs. The two safety-related inputs affected by the signal interlock condition must be deactivated for at least 1 second before the safety-related outputs can be activated again.	• Deactivate the two safety-related inputs affected by the signal interlock condition for at least 1 second. • Verify correct operation of the contacts of the sensors/devices providing the input signal.

ERROR - Detected Errors

This LED illuminates in conjunction with additional LEDs to indicate detected errors. In the case of a detected error, the safety module transitions to the defined safe state. Remove the cause of the detected error and perform a power cycle of the safety module to be able to exit the defined safe state and resume operation. Contact your Schneider Electric service representative if the condition persists.

State	In conjunction with additional LEDs		Meaning	Remedy
	Additional LEDs	State of additional LEDs		
On	STATE1, STATE2, START1, START2, S12 and S22	Flashing synchronously	General error detected.	• Verify correct wiring.
On	STATE1, STATE2, START1, START2, S12 and S22	On	Configuration error detected.	• Verify that the positions of the selectors are appropriate for the application to be implemented.
On	POWER	Flashing	Power supply error detected.	• Verify correct wiring. • Use a suitable power supply.
On	S12 and S22	Flashing synchronously	Cross circuit detected at safety-related inputs (for example, incorrect wiring or dynamization not supported by connected sensor/device).	• Verify correct wiring. • Verify correct configuration.
On	START1	Flashing	Cross circuit detected at start/restart input.	• Verify correct wiring.

State	In conjunction with additional LEDs		Meaning	Remedy
	Additional LEDs	State of additional LEDs		
On	START1 and START2	Flashing synchronously	Safety module wired for both start/restart functions automatic/manual and monitored.	• Wire the safety module for either automatic/manual start/restart or for monitored start/restart.
On	STATE1	Flashing	Error detected at instantaneous safety-related output.	• Perform a power cycle.
On	STATE2	Flashing	Error detected at delayed safety-related output.	• Perform a power cycle.

Accessories, Service, Maintenance, and Disposal

Accessories

Accessories

The following accessories are available for the safety module:

Description	Commercial Reference
Coding bits The coding bits are used if the terminal blocks are removed to help ensure correct insertion of the terminal blocks into the safety module. 30 pieces per packaging unit	XPSEC
Sealing strips The uniquely numbered sealing strips are used to seal the transparent front cover of the safety module to help prevent unauthorized access to the configuration selectors. 10 pieces per packaging unit	XPSES

Maintenance

Service and Repairs

The safety module contains no user-serviceable parts. Do not attempt to open, service, or repair the safety module.

Maintenance Plan

Maintenance plan:

- Ensure that a safety-related function implemented with the safety module is triggered at the minimum intervals required by the regulations, standards, and process definitions applicable to your machine/process.
- Inspect the wiring at regular intervals.
- Tighten the threaded connections at regular intervals.
- Verify that the safety module is not used beyond the specified lifetime, page 24.

  To determine the end of the lifetime, add the specified lifetime to the date of manufacture indicated on the nameplate, page 13 of the safety module.

  Example: If the date of manufacture indicated on the nameplate is 2019-W10, do not use the safety module after week 10, 2039.

As a machine designer or system integrator, include this information in the maintenance plan for your customer.

Transportation, Storage, and Disposal

Transportation and Storage

Ensure that the environmental conditions, page 15 specified for transportation and storage are respected.

Disposal

Dispose of the product in accordance with all applicable regulations.

Visit https://www.se.com/green-premium for information and documents on environmental protection as per ISO 14025 such as:

- EoLi (Product End-of-Life Instructions)
- PEP (Product Environmental Profile)

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As standards, specifications, and design change from time to time, please ask for confirmation of the information given in this publication.

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