X20(c)SLXx1x

Information:

B&R makes every effort to keep data sheets as current as possible. From a safety point of view, however, the current version of the data sheet must always be used.

The certified, currently valid data sheet can be downloaded from the B&R website www.br-automation.com.

Organization of notices

Safety notices

Contain **only** information that warns of dangerous functions or situations.

Signal word	Description
Danger!	Failure to observe these safety guidelines and notices will result in death, severe injury or substantial damage to property.
Warning!	Failure to observe these safety guidelines and notices can result in death, severe injury or substantial damage to property.
Caution!	Failure to observe these safety guidelines and notices can result in minor injury or damage to property.
Notice!	Failure to observe these safety guidelines and notices can result in damage to property.

Table 1: Organization of safety notices

General notices

Contain **useful** information for users and instructions for avoiding malfunctions.

Signal word	Description
Information:	Useful information, application tips and instructions for avoiding malfunctions.

Table 2: Organization of general notices

1 General information

The modules are equipped with SafeLOGIC functionality that allows them to safely execute applications designed in SafeDESIGNER. The modules can be used in safety applications up to PL e or SIL 3.

The SafeLOGIC controller coordinates the safety-related communication of all modules involved in the application. In this context, the SafeLOGIC controller also monitors the configuration of these modules and autonomously carries out parameter downloads to the modules if necessary. This guarantees a consistent and correct module configuration in the network from a safety point of view in all scenarios involving module replacement and service. For SafeLOGIC products, these services are executed by the SafeLOGIC controller. For SafeLOGIC-X products, these services are executed on the standard CPU in interaction with Automation Runtime. The safety-related characteristics up to PL e or SIL 3 for applications are provided in both variants, however.
In addition, SafeLOGIC-X products have the same I/O properties as the associated SafeIO products.

- openSAFETY manager for up to 10 / 20 / 100 / 280 SafeNODES
- Flexibly programmable using Automation Studio / SafeDESIGNER
- Innovative management of safe machine options (SafeOPTION)
- Parameter and configuration management

1.1 Function

Safe digital inputs

The module is equipped with safe digital input channels. It can be flexibly used for a wide range of tasks involving the reading of digital signals in safety-related applications up to PL e or SIL 3.

The module is equipped with filters that are individually configurable for switch-on and switch-off behavior. Switch-on filters are used to filter out signal disturbances. Switch-off filters are used to smooth testing gaps in external signal sources – i.e. OSSD signals – so that unintended cutoffs can be avoided.

The input signals of signal pairs (channels 1 and 2, 3 and 4, etc.) are monitored in the module for simultaneity. The maximum permitted discrepancy of inputs of a signal pair is configurable. Here, the signals of dual-channel evaluation directly represent the safe signal of a 2-channel sensor, such as from an E-stop button or safety light curtain.

The module provides pulse signals for diagnosing the sensor line. By default, each pulse signal provides a unique pulse pattern derived from the module's serial number and pulse channel number. This allows any pulse signals to be combined in one signal cable and still cover any cross fault combinations in the cable. The pulse check can also be disabled to connect electronic sensors with separate line monitoring (OSSD signals).

SafeLOGIC function

The module is equipped with SafeLOGIC functionality that allows it to safely execute applications designed in SafeDESIGNER. The module can be used in safety-related applications up to PL e or SIL 3.

In addition, the module coordinates the safety-related communication of all modules involved in the application. In this context, the module also monitors the configuration of these modules and autonomously carries out parameter downloads to the modules if necessary. This guarantees a consistent and correct module configuration in the network from a safety point of view in all scenarios involving module replacement and service. For SafeLOGIC products, these services are executed by the SafeLOGIC controller. For SafeLOGIC-X products, these services are executed on the standard CPU in interaction with Automation Runtime. The safety-related characteristics up to PL e or SIL 3 for applications are provided with both variants, however.

openSAFETY

This module uses the protective mechanisms of openSAFETY when transferring data to the various bus systems. Because the data is encapsulated in the openSAFETY container in a fail-safe manner, the components on the network that are involved in the transfer do not require any additional safety-related features. At this point, only the safety-related characteristic values specified for openSAFETY in the technical data are to be consulted. The data in the openSAFETY container undergoes safety-related processing only when received by the remote station; for this reason, only this component is involved from a safety point of view. Read access to the data in the openSAFETY container for applications without safety-related characteristics is permitted at any point in the network without affecting the safety-related characteristics of openSAFETY.

open▮▮▮
SAFETY

1.2 Coated modules

Coated modules are X20 modules with a protective coating for the electronics component. This coating protects X20c modules from condensation.
The modules' electronics are fully compatible with the corresponding X20 modules.

> **Information:**
>
> **For simplification purposes, only images and module IDs of uncoated modules are used in this data sheet.**

The coating has been certified according to the following standards:

- Condensation: BMW GS 95011-4, 2x 1 cycle
- Corrosive gas: EN 60068-2-60, Method 4, exposure 21 days

Contrary to the specifications for X20 system modules without safety certification and despite the tests performed, X20 safety modules are **NOT suited for applications with corrosive gases (EN 60068-2-60)!**

2 Overview

Module	X20SLX210	X20SLX410	X20SLX811	X20SLX910
Safe digital inputs				
Number of inputs	2	4	8	20
Nominal voltage	24 VDC			
Input filter				
Hardware	≤150 µs			
Software	Default 0 ms, configurable between 0 and 500 ms			
Input circuit	Sink			
Pulse outputs				
Design	Push-Pull			
Switching voltage	I/O power supply minus residual voltage			

Table 3: Digital input modules

3 Order data

X20SLX210 / X20SLX410   X20SLX811   X20SLX910

Model number	Short description
	Intelligent programmable modules
X20SLX210	X20 safe digital input module, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 2 safe digital inputs, configurable input filter, 2 pulse outputs, 24 VDC
X20SLX410	X20 safe digital input module, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 4 safe digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20cSLX410	X20 safe digital input module, coated, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 4 safe digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20SLX811	X20 safe digital input module, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 8 safe digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, single-width
X20SLX910	X20 safe digital input module, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 20 safe digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20cSLX910	X20 safe digital input module, coated, safety controller, openSAFETY, 11 openSAFETY nodes, 4 SafeMOTION axes, 20 safe digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
	Required accessories
	Bus modules
X20BM13	X20 bus module, for X20 SafeIO modules, internal I/O power supply continuous, single-width
X20BM16	X20 bus module, for X20 SafeIO modules, with node number switch, internal I/O power supply continuous, single-width
X20BM33	X20 bus module, for X20 SafeIO modules, internal I/O power supply continuous
X20BM36	X20 bus module, for X20 SafeIO modules, with node number switch, internal I/O power supply continuous
X20cBM33	X20 bus module, coated, for X20 SafeIO modules, internal I/O power supply continuous
	Terminal blocks
X20TB52	X20 terminal block, 12-pin, safety-keyed

Table 4: X20SLX210, X20SLX410, X20cSLX410, X20SLX811, X20SLX910, X20cSLX910 - Order data

4 Technical data

Model number	X20SLX210	X20SLX410	X20cSLX410	X20SLX811	X20SLX910	X20cSLX910
Short description						
I/O module	2 safe digital inputs, 2 pulse outputs, 24 VDC, SafeLOGIC-X technology	4 safe digital inputs, 4 pulse outputs, 24 VDC, SafeLOGIC-X technology		8 safe digital inputs, 4 pulse outputs, 24 VDC, SafeLOGIC-X technology	20 safe digital inputs, 4 pulse outputs, 24 VDC, SafeLOGIC-X technology	
General information						
B&R ID code	0xC5B0	0xC5B2	0xE288	0xE757	0xC5B1	0xE4D1
System requirements						
Automation Studio	4.0.16 or later			4.0 or later	4.0.16 or later	
Automation Runtime	From Safety Release 1.7 to 1.9: F4.06 or later Safety Release 1.10 or later: B4.25 or later			B4.25 or later	From Safety Release 1.7 to 1.9: F4.06 or later Safety Release 1.10 or later: B4.25 or later	
SafeDESIGNER	3.1.0 or later			4.2.0 or later	3.1.0 or later	
Safety Release	1.7 or later			1.10 or later	1.7 or later	
Status indicators	I/O function per channel, operating state, module status					
Diagnostics						
Module run/error	Yes, using status LED and software					
Inputs	Yes, using status LED and software					
Max. I/O cycle time	1600 µs			1 ms	1600 µs	
Power consumption						
Bus	0.25 W	0.32 W			0.4 W	
Internal I/O	1 W	1.25 W		2.5 W	1.6 W	
Electrical isolation						
Channel - Bus	Yes					
Channel - Channel	No					
Certifications						
CE	Yes					
KC	Yes		-		Yes	-
EAC	Yes					
UL	cULus E115267 Industrial control equipment			cULus E115267 Industrial control equipment	cULus E115267 Industrial control equipment	
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5			-	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5	
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X					
DNV GL	Temperature: **A** (0 - 45°C) Humidity: **B** (up to 100%) Vibration: **A** (0.7 g) EMC: **B** (bridge and open deck)			In preparation	Temperature: **A** (0 - 45°C) Humidity: **B** (up to 100%) Vibration: **A** (0.7 g) EMC: **B** (bridge and open deck)	
Functional safety	cULus FSPC E361559 Energy and industrial systems Certified for functional safety ANSI UL 1998:2013					
Functional safety	IEC 61508:2010, SIL 3 EN 62061:2013, SIL 3 EN ISO 13849-1:2015, Cat. 4 / PL e IEC 61511:2004, SIL 3					
Functional safety	EN 50156-1:2004					
Safety characteristics						
EN ISO 13849-1:2015						
Category	Cat. 3 when using individual input channels, Cat. 4 when using input channel pairs (e.g. SI1 and SI2) or more than 2 input channels [1]					
PL	PL e					
DC	>94%					
MTTFD	2500 years					
Mission time	Max. 20 years					
IEC 61508:2010, IEC 61511:2004, EN 62061:2013						
SIL CL	SIL 3					
SFF	>90%					
PFH / PFH_d						
Module	$<1*10^{-10}$					
openSAFETY wired	Negligible					
openSAFETY wireless	$<1*10^{-14}$ * Number of openSAFETY packets per hour					
PFD	$<2*10^{-5}$					
Proof test interval (PT)	20 years					

Table 5: X20SLX210, X20SLX410, X20cSLX410, X20SLX811, X20SLX910, X20cSLX910 - Technical data

X20(c)SLXx1x

Model number	X20SLX210	X20SLX410	X20cSLX410	X20SLX811	X20SLX910	X20cSLX910
Functionality						
Communication with each other	Communication only possible with SafeLOGIC controller X20(c)SL81xx Max. 1 active SafeLOGIC-X controller per standard X20(c)CPxxxx CPU [2]					
Support for machine options						
BOOL	64					
INT	-					
UINT	-					
DINT	-					
UDINT	-					
SafeMOTION support	Yes					
Max. number of SafeMOTION axes	4, depends on the data width of the modules used					
Timing precision	Time * 0.05 + Cycle time of the safety application					
Shortest task class cycle time	2 ms					
Max. number of openSAFETY nodes	10, depends on the data width of the modules used					
Data exchange between CPU and SL						
Max. total data width for each direction	8 bytes					
Max. number of data points for each direction						
BOOL	64					
INT	4					
UINT	4					
DINT	2					
UDINT	2					
Data exchange between SL and SL						
Max. total number of data points for each direction [3]	2					
Max. number of data points for each direction						
BOOL	16					
INT	2					
UINT	2					
DINT	2					
UDINT	2					
Limit values for SafeDESIGNER application						
Max. resources available for SafeDESIGNER info window entries [4]						
FB instances	V1.7.xx: 128, V1.8.xx and later: 256					
Marker memory	5120 bytes (0x1400)					
Stack memory	2048 bytes					
Memory for safe input data	128 bytes, 68 bytes of which are usable for modules					
Memory for safe output data	64 bytes					
Memory for standard input data	64 bytes					
Memory for standard output data	64 bytes					
Marker count	V1.7.xx: 128, V1.8.xx and later: 256					
Additional SafeDESIGNER limit values						
Max. number of function block types	64					
Max. number of force variables	8					
Max. number of variable with variable status	V1.7.xx: 64, V1.8.xx and later: 128					
I/O power supply						
Nominal voltage	24 VDC					
Voltage range	24 VDC -15% / +20%					
Integrated protection	Reverse polarity protection					
Safe digital inputs						
Nominal voltage	24 VDC					
Input characteristics per EN 61131-2	Type 1					
Input filter						
Hardware	≤150 µs					
Software	Configurable between 0 and 500 ms					
Input circuit	Sink					
Input voltage	24 VDC -15% / +20%					
Input current at 24 VDC	Max. 3.28 mA					
Input resistance	Min. 7.33 kΩ					
Error detection time	200 ms			100 ms	200 ms	
Isolation voltage between channel and bus	500 V_{eff}					
Switching threshold						
Low	<5 VDC					
High	>15 VDC					
Line length between pulse output and input	Max. 60 m with unshielded line Max. 400 m with shielded line					

Table 5: X20SLX210, X20SLX410, X20cSLX410, X20SLX811, X20SLX910, X20cSLX910 - Technical data

Model number	X20SLX210	X20SLX410	X20cSLX410	X20SLX811	X20SLX910	X20cSLX910
Pulse outputs						
Variant	Push-Pull					
Nominal output current	50 mA					
Output protection	Shutdown of individual channels in the event of overload or short circuit [5]					
Peak short-circuit current	25 A for 15 µs			0.5 A for 120 µs	25 A for 15 µs	
Short-circuit current	100 mA$_{eff}$			15 mA$_{eff}$	100 mA$_{eff}$	
Leakage current when switched off	0.1 mA					
Residual voltage	2 VDC			≤4 VDC	2 VDC	
Switching voltage	I/O power supply minus residual voltage					
Total nominal current	100 mA	200 mA				
Operating conditions						
Mounting orientation						
Horizontal	Yes					
Vertical	Yes					
Installation elevation above sea level	0 to 2000 m, no limitation					
Degree of protection per EN 60529	IP20					
Ambient conditions						
Temperature						
Operation						
Horizontal mounting orientation	0 to 60°C	-40 to 60°C [6]		0 to 60°C		-40 to 60°C [6]
Vertical mounting orientation	0 to 50°C	-40 to 50°C [7]		0 to 50°C		-40 to 50°C [7]
Derating	See section "Derating".					
Storage	-40 to 85°C					
Transport	-40 to 85°C					
Relative humidity						
Operation	5 to 95%, non-condensing	Up to 100%, condensing		5 to 95%, non-condensing		Up to 100%, condensing
Storage	5 to 95%, non-condensing					
Transport	5 to 95%, non-condensing					
Mechanical properties						
Note	Order 1x safety-keyed terminal block separately. Order 1x safety-keyed bus module separately.			Order 1x safety-keyed terminal block separately. Order 1x safety-keyed bus module (single-width) separately.	Order 2x safety-keyed terminal block separately. Order 1x safety-keyed bus module separately.	
Spacing	25$^{+0.2}$ mm			12.5$^{+0.2}$ mm	25$^{+0.2}$ mm	

Table 5: X20SLX210, X20SLX410, X20cSLX410, X20SLX811, X20SLX910, X20cSLX910 - Technical data

1)   The related danger warnings in the technical data sheet must also be observed.
2)   If there are multiple SafeLOGIC-X controllers in the Automation Studio hardware tree, all but 1 must be disabled.
3)   Keep in mind that 8 BOOL count as 1 data point.
4)   For a parameter description, see section "Message window" of the SafeDESIGNER documentation.
5)   The protective function is provided for max. 30 minutes for a continuous short circuit.
6)   Up to hardware upgrade <1.10.5.0: -25 to 60°C
7)   Up to hardware upgrade <1.10.5.0: -25 to 50°C

Danger!

Operation outside the technical data is not permitted and can result in dangerous states.

Information:

For detailed information about installation, see chapter "Installation notes for X20 modules" on page 72.

Derating

The derating curve refers to standard operation and can be shifted to the right by the specified derating bonus if in a horizontal mounting orientation.

Module	X20SLX210	X20SLX410	X20SLX811	X20SLX910
Derating bonus				
At 24 VDC	+2.5°C		+0°C	+5°C
Dummy module on the left	+0°C			
Dummy module on the right	+2.5°C		+0°C	+2.5°C
Dummy module on the left and right	+5°C		+0°C	+5°C
With double PFH / PFH$_d$	+0°C			

Table 6: Derating bonus

The number of inputs that should be used at the same time depends on the operating temperature and the mounting orientation. The resulting amount can be looked up in the following table.

Horizontal (0 to 60°C, coated: -40 to 60°C)	Vertical (0 to 50°C, coated: -40 to 50°C)
X20SLX210	
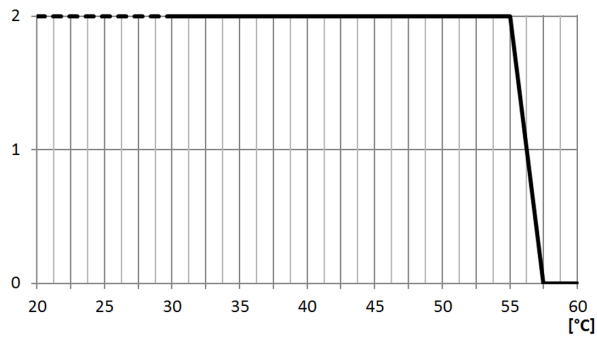
No derating

X20SLX410	
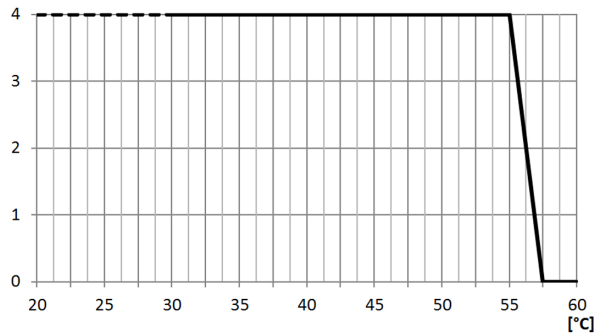
No derating

X20SLX811	
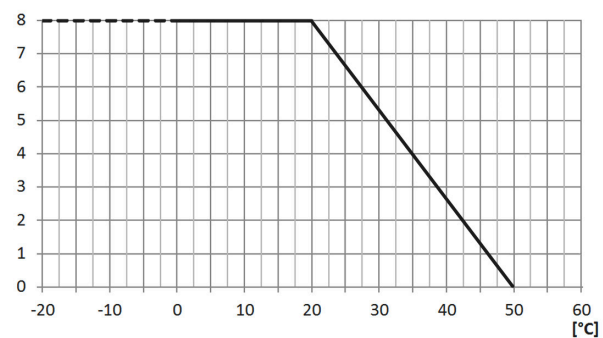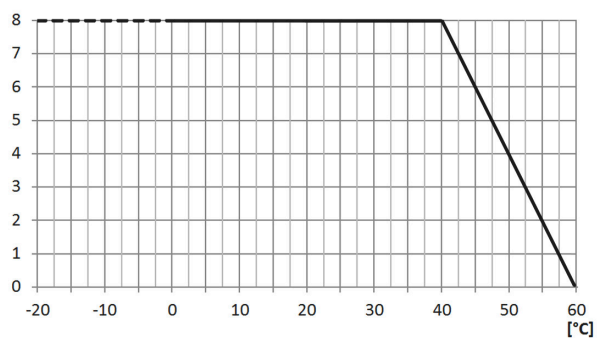
X20SLX910	
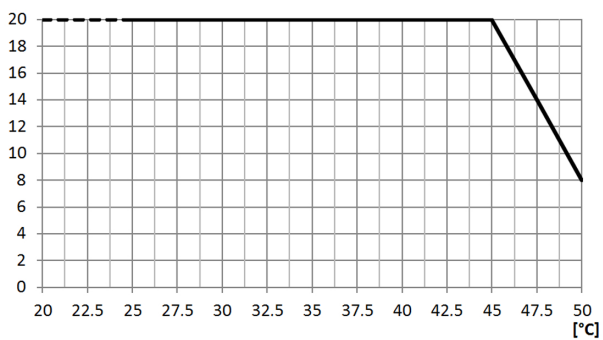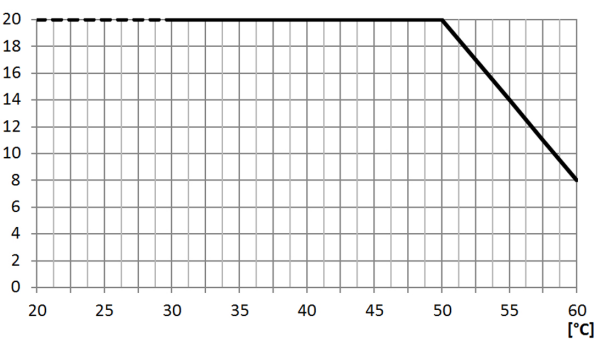
Table 7: Derating in relation to operating temperature and mounting orientation

Information:

Regardless of the values specified in the derating curve, the module cannot be operated above the values specified in the technical data.

5 LED status indicators
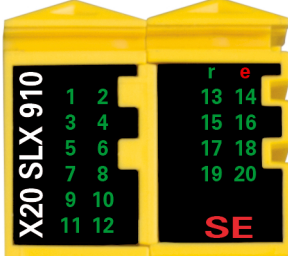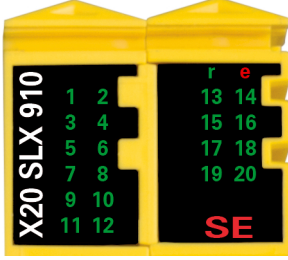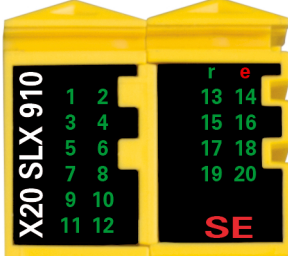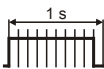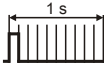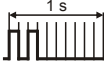
Figure	LED	Color	Status	Description
X20SLX210 X20SLX410 X20SLX811 X20SLX910	r	Green	Off	No power to module
			Single flash	Reset mode
			Double flash	Updating firmware
			Blinking	PREOPERATIONAL mode
			On	RUN mode
	e	Red	Off	No power to module or everything OK
			Pulsating	Boot loader mode
			Triple flash	Updating safety-related firmware
			On	Error or I/O component not provided with voltage
	e + r	Red on / green single flash		Invalid firmware
	1 to 20	Input state of the corresponding digital input The number of channel LEDs varies depending on the number of channels on the module type.		
		Red	On	Warning/Error on an input channel
			Blinking (only for X20SLX910 and X20SLX811)	Error in dual-channel evaluation (synchronous blinking of 2 affected channels)
			All on	Error on all channels or booting not yet completed
		Green	On	Input set
	OO	These LEDs may not be available depending on the module type. Errors in dual-channel evaluation are indicated by channel LEDs 1 to 20 in this case.		Open - Open: Dual-channel evaluation on channels 1 and 2 using the "Equivalent" function block
		Red	On	Warning/Error on this evaluation channel
			All on	Error on all channels or startup not yet completed
		Green	On	Evaluation channel set
	OC	These LEDs may not be available depending on the module type. Errors in dual-channel evaluation are indicated by channel LEDs 1 to 20 in this case.		Open - Closed: Dual-channel evaluation on channels 1 and 2 using the "Antivalent" function block
		Red	On	Warning/Error on this evaluation channel
			All on	Error on all channels or booting not yet completed
		Green	On	Evaluation channel set
	SE	Red	Off	RUN mode or I/O component not supplied with voltage, safety firmware in OPERATIONAL state
			1 s	Boot phase, missing X2X Link or defective processor
			1 s	Safety PREOPERATIONAL state or "SafeOSstate!=RUN"
			1 s	Safe communication channel not OK, openSAFETY connection valid problem or "SafeOSstate!=RUN"
			1 s	Boot phase, faulty firmware, setup mode active (hardware upgrade 1.10.2.x and later) For details about setup mode, see section "Setup mode" on page 64.
			1 s	Test/Pilot firmware or safety application created with test/pilot version of SafeDESIGNER
			1 s	SafeDESIGNER in "Debug" mode
			On	Safety state active for the entire module (= "FailSafe" state)
		The "SE" LEDs separately indicate the status of safety processor 1 ("S" LED) and safety processor 2 ("E" LED).		

Table 8: Status display

Danger!

Constantly lit "SE" LEDs indicate a defective module that must be replaced immediately.
It is your responsibility to ensure that all necessary repair measures are initiated after an error occurs since subsequent errors can result in a hazard!
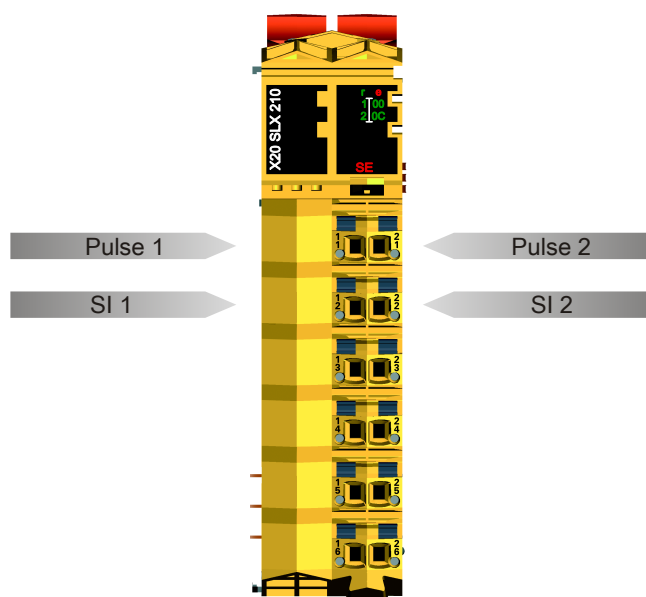
6 Pinouts
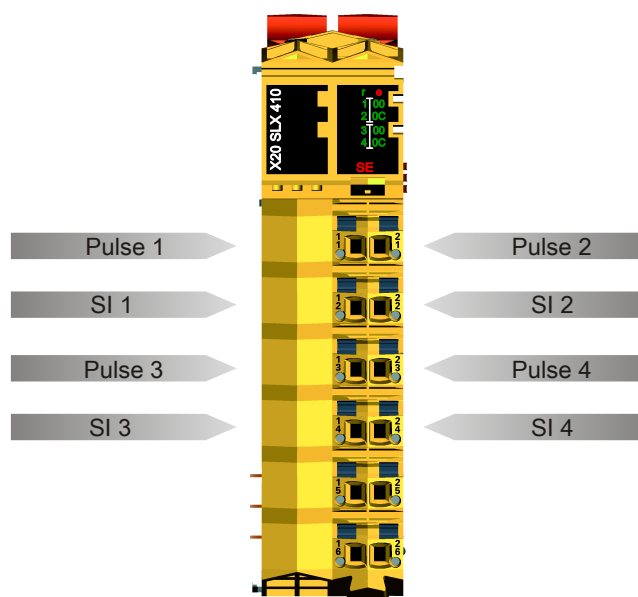

Figure 1: X20SLX210 - Pinout
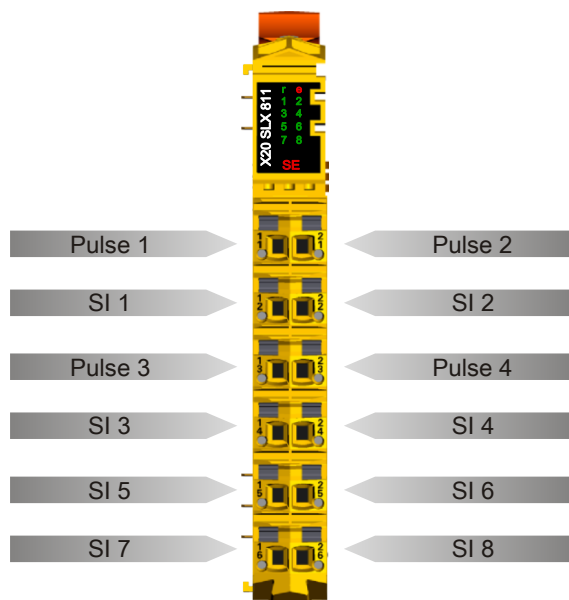

Figure 2: X20SLX410 - Pinout
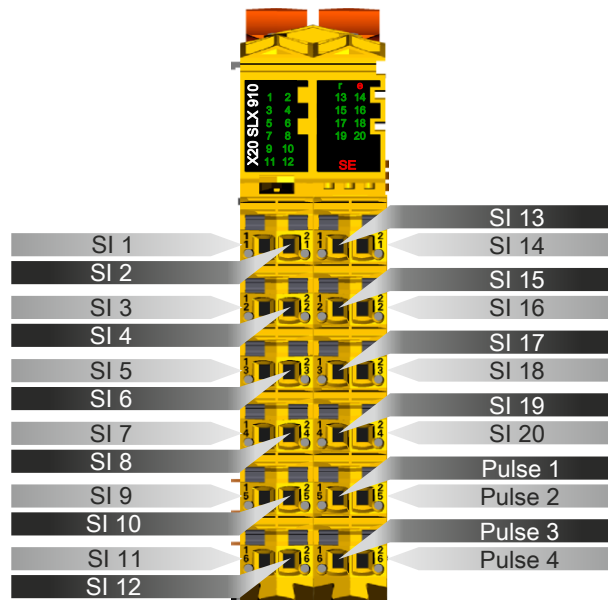

Figure 3: X20SLX811 - Pinout

Figure 4: X20SLX910 - Pinout

7 Connection examples

The typical connection examples in this section only represent a selection of the different wiring methods. The user must take error detection into account in each case.

> ## Information:
>
> **For details about connection examples (such as circuit examples, compatibility class, max. number of supported channels, terminal assignments, etc.), see chapter Connection examples of the "Integrated safety technology" user's manual (MASAFETY-ENG).**

7.1 Connecting single-channel sensors with contacts
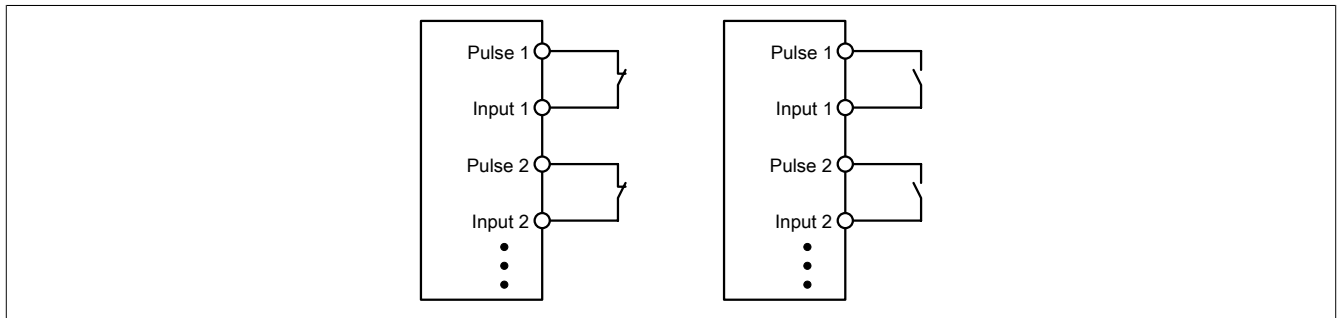
Figure 5: Connecting single-channel sensors with contacts

Single-channel sensors with contacts are the simplest connection.

With this connection, the module satisfies Category 3 requirements in accordance with EN ISO 13849-1:2015. Be aware that this statement applies only to the module and not to the wiring shown. You are responsible for wiring the sensor according to the required category.

7.2 Connecting two-channel sensors with contacts
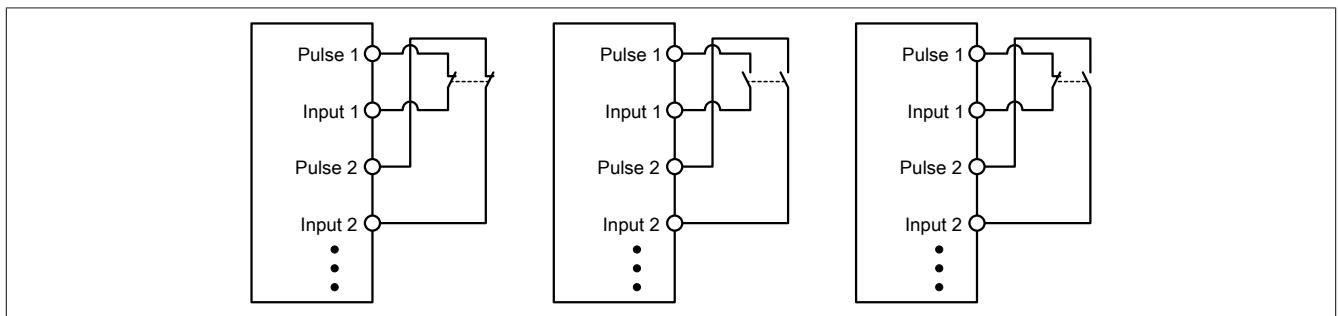
Figure 6: Connecting two-channel sensors with contacts

Sensors with contacts can be connected directly to a safe digital input module via two channels. Dual-channel evaluation is handled directly by the module.

With this connection, the module satisfies Category 4 requirements in accordance with EN ISO 13849-1:2015. Be aware that this statement applies only to the module and not to the wiring shown. You are responsible for wiring the sensor according to the required category.

7.3 Connecting multi-channel sensors with contacts
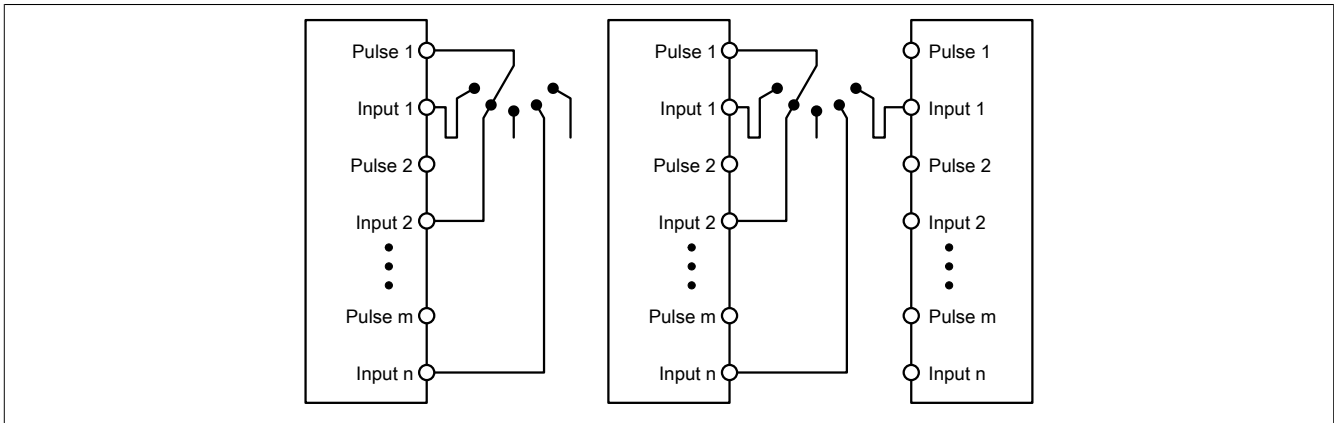
Figure 7: Connecting multi-channel sensors with contacts

Multi-channel switches (mode selector switches, switching devices with "shift key" capability) can be connected to multiple safe digital input modules.

If signals are evaluated internally in the module (see image to the left), the same pulse must be configured for all of the inputs being used. If signals are evaluated across all modules (see image to the right), all of the inputs must be configured to use an external pulse. In this type of application, pulse evaluation with the "default" pulse is not suitable; therefore, a separate pulse signal with approx. 4 ms low-phase is available.

In this case, multi-channel evaluation must be handled in the safety application (PLCopen function block "SF_ModeSelector"). The category achieved per EN ISO 13849-1:2015 in this way depends on the error models of the switching element (e.g. mode selector switch) and must be examined in combination with the error detection present in the PLCopen function block.

7.4 Connecting electronic sensors
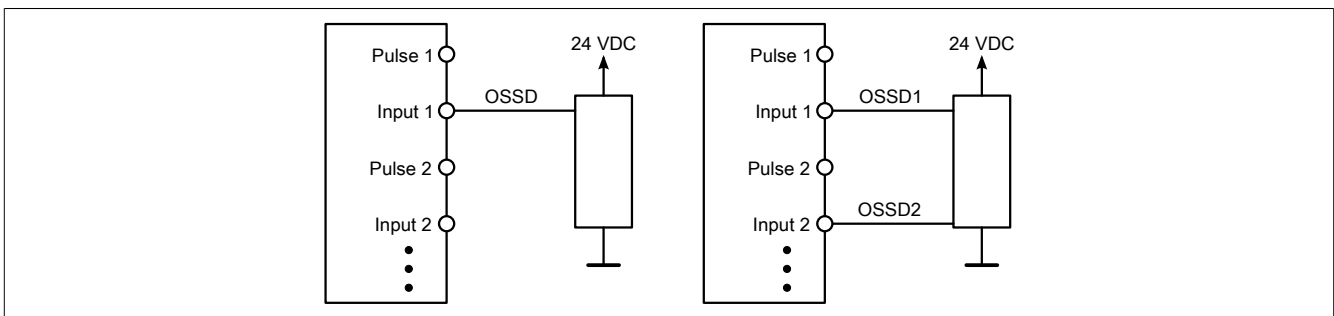
Figure 8: Connecting electronic sensors

Electronic sensors (light curtains, laser scanners, inductive sensors, etc.) can be connected directly to safe digital input modules. The switching thresholds of the input channels must be taken into account for these types of applications.

With single-channel wiring (see image on the left), the module satisfies Category 3 requirements in accordance with EN ISO 13849-1:2015. With two-channel wiring (see image on the right), the module satisfies Category 4 requirements in accordance with EN ISO 13849-1:2015. Be aware that this statement applies only to the module and not the wiring or connected electronic sensor. You are responsible for wiring the sensor in accordance with the required category and within the specifications set forth by the manufacturer of the electronic sensor.

7.5 Using the same pulse signals
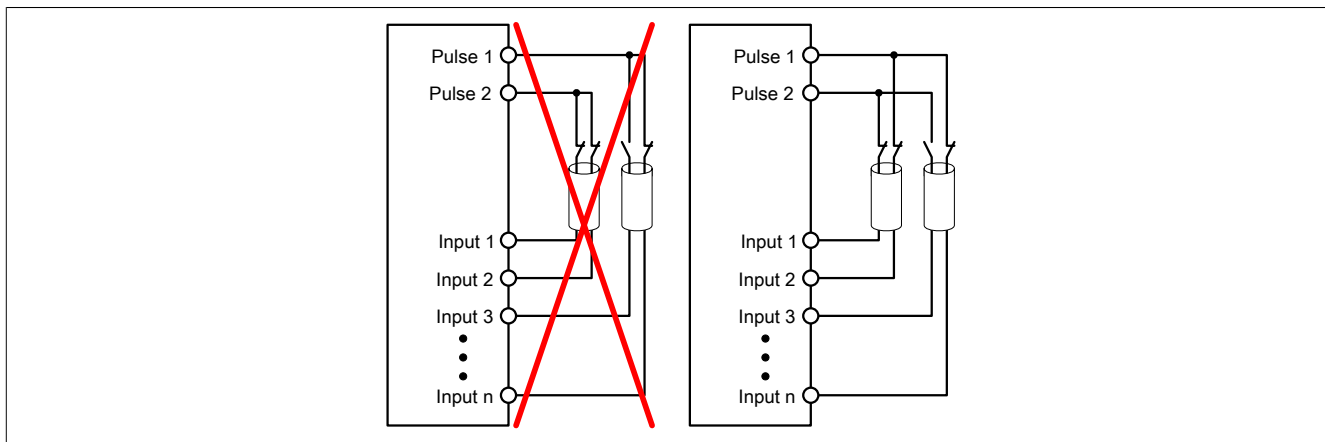
Figure 9: Using the same pulse signals

When using the same pulse signals for different inputs, they must be isolated from one another. Otherwise, damage to the cables may cause errors that are not detected by the module.

Danger!

If the same pulse signals are routed in the same cable, damage to the cable can cause cross faults between the signals to occur that are not detected by the module. This can result in dangerous situations.

For this reason, signal lines with the same pulse signal should be routed in different cables, or you should implement other error prevention measures in accordance with EN ISO 13849-2:2012.

Danger!

It is especially important to check the wiring when using the same pulse signal for two inputs that are located next to each other on the terminal. Pay special attention to ensure that poor wiring has not resulted in the two inputs being connected together.

8 Error detection

8.1 Internal module errors

The red "SE" LED makes it possible to evaluate the following error states:

- Module error, e.g. defective RAM, defective CPU, etc.
- Overtemperature/Undertemperature
- Overvoltage/Undervoltage
- Incompatible firmware version

Errors that occur within the module are detected according to the requirements of the standards listed in the certificate and within the minimum safety response time specified in the technical data. After this occurs, the module enters a safe state.

The internal module tests needed for this are only performed, however, if the module's firmware has been booted and the module is in either the PREOPERATIONAL state or the OPERATIONAL state. If this state is not achieved (for example, because the module has not been configured in the application), then the module will remain in the boot state.

BOOT mode on a module is clearly indicated by a slowly blinking SE LED (2 Hz or 1 Hz).

The error detection time specified in the technical data is relevant only for detecting external errors (i.e. wiring errors) in single-channel structures.

> **Danger!**
>
> **Operating the safety module in BOOT mode is not permitted.**

> **Danger!**
>
> **A safety-related output channel is only permitted to be switched off for a maximum of 24 hours. The channel must be switched on by the end of this period so that the module's internal channel test can be performed.**

8.2 Wiring errors

The wiring errors described in section "Error detection" are indicated by the red channel LED according to the application.

If a module detects an error, then:

- The channel LED is lit constantly red.
- Status signal (e.g. (Safe)ChannelOK, (Safe)InputOK, (Safe)OutputOK, etc.) is set to (SAFE)FALSE.
- Signal "SafeDigitalInputxx" or "SafeDigitalOutputxx" is set to SAFEFALSE.
- An entry is generated in the logbook.

> **Danger!**
>
> **Recognizable errors (see the following chapters) are detected by the module within the error detection time. Errors not recognized by the module (or not recognized on time) that can lead to safety-critical states must be detected using additional measures.**

> **Danger!**
>
> **It is your responsibility to ensure that all necessary repair measures are initiated after an error occurs since subsequent errors can result in a hazard!**

8.2.1 Connecting single-channel sensors with contacts

By default, every input channel is assigned a dedicated pulse output. This pulse output issues a specific signal that helps detect wiring problems, such as a short circuit to 24 VDC, GND or other signal channels. The status of the connected switches is indicated by channel-specific LEDs. The LEDs "OO" and "OC" have no significance with this type of connection.

With this type of connection in combination with the configuration "Pulse Mode = Internal", the modules can detect the following errors:

Error	Error on contact	
	Open	**Closed**
Ground fault on the pulse output	Detected	Detected
Pulse output shorted to 24 VDC	Detected	Detected
Cross fault between the pulse output and the other pulse signal	Detected	Detected
Ground fault on signal input	**Not detected**	Detected
Signal input shorted to 24 VDC	Detected	Detected
Cross fault between the signal input and the other pulse signal	Detected	Detected
Cross fault between the pulse output and the signal input	**Not detected**	**Not detected**
Open circuit	**Not detected**	**Not detected**

Table 9: SI error detection when "Pulse mode = Internal"

8.2.2 Connecting two-channel sensors with contacts

By default, every input channel is assigned a dedicated pulse output. This pulse output issues a specific signal that helps detect wiring problems, such as a short circuit to 24 VDC, GND or other signal channels.

The status of the connected switches is signaled via channel-specific LEDs, and the status of the dual-channel evaluation is signaled via the "OO" (for combinations with N.C./N.C. contacts) or "OC" LED (for combinations with N.C./N.O. contacts). On module types that do not have these LEDs, errors detected in the dual-channel evaluation are indicated by the respective channel LED blinking red.

With this type of connection in combination with the configuration "Pulse Mode = Internal" and combined with dual-channel evaluation in the module or in SafeDESIGNER, the modules can detect the following errors:

Error	Error on contact	
	Open	**Closed**
Ground fault on the pulse output	Detected	Detected
Pulse output shorted to 24 VDC	Detected	Detected
Cross fault between the pulse output and the other pulse signal	Detected	Detected
Ground fault on signal input	**Not detected**	Detected
Signal input shorted to 24 VDC	Detected	Detected
Cross fault between the signal input and the other pulse signal	Detected	Detected
Cross fault between the pulse output and the signal input	Detected[1]	**Not detected**
Open circuit	**Not detected**	Detected[1]

Table 10: SI error detection with "Pulse Mode = Internal" combined
with dual-channel evaluation in the module or in SafeDESIGNER

1) Dual-channel evaluation of the module.

8.2.3 Connecting multi-channel sensors with contacts

The status of the connected switches is indicated by channel-specific LEDs. The LEDs "OO" and "OC" have no significance with this type of connection.

With this wiring, the following errors can be detected:

Error	
Ground fault on the pulse output	Detected
Pulse output shorted to 24 VDC	Detected
Cross fault between the pulse output and the other pulse signal	Detected[1]
Ground fault on signal input (active signal)	Detected[1]
Ground fault on signal input (inactive signal)	**Not detected**
Signal input shorted to 24 VDC	Detected
Cross fault between the signal input and the other pulse signal	Detected[1]
Cross fault between the pulse output and the signal input (active signal)	**Not detected**
Open circuit (active signal)	Detected[1]
Cross fault between the pulse output and the signal input (inactive signal)	Detected[1]
Open circuit (inactive signal)	**Not detected**

Table 11: SI error detection when "Pulse Mode = External"

1)   Detected by PLCopen function block "SF_ModeSelector" in the application.

Danger!

If "Pulse Mode = External" is used in the channel configuration, then an additional TOFF filter with 5 ms is enabled in the module. The corresponding information regarding the TOFF filter must also be considered when using the "Pulse Mode = External" setting.

Information:

With the configuration "Pulse Mode = Internal", the pulses have a low phase of approximately 300 µs. This low phase is designed such that no additional degradation of the total response time can occur in the system. If line lengths exceed the max. line length (see technical data), problems may occur with this configuration. In these cases, configuration "Pulse Mode = External" can also be useful for normal sensors with contacts. The reduced error detection and extension of the total response time must be taken into account, however.

8.2.4 Connecting electronic sensors

A pulse pattern cannot be used with electronic sensors. The input channels must therefore be configured to "Pulse Mode = No Pulse".

Any gaps when testing the connected OSSD outputs must be masked out with the module's cutoff filter in order to avoid an unintended shutdown.

Danger!

With the configuration "Pulse Mode = No Pulse", the module itself is not able to detect wiring errors. Internal errors are still detected, however. All errors resulting from incorrect or faulty wiring must be handled through supplementary measures per EN ISO 13849-2:2012 or by the connected device.

Danger!

Configuring a switch-off filter lengthens the safety response time. The configured filter value must be added to the total response time.

9 Input circuit diagram
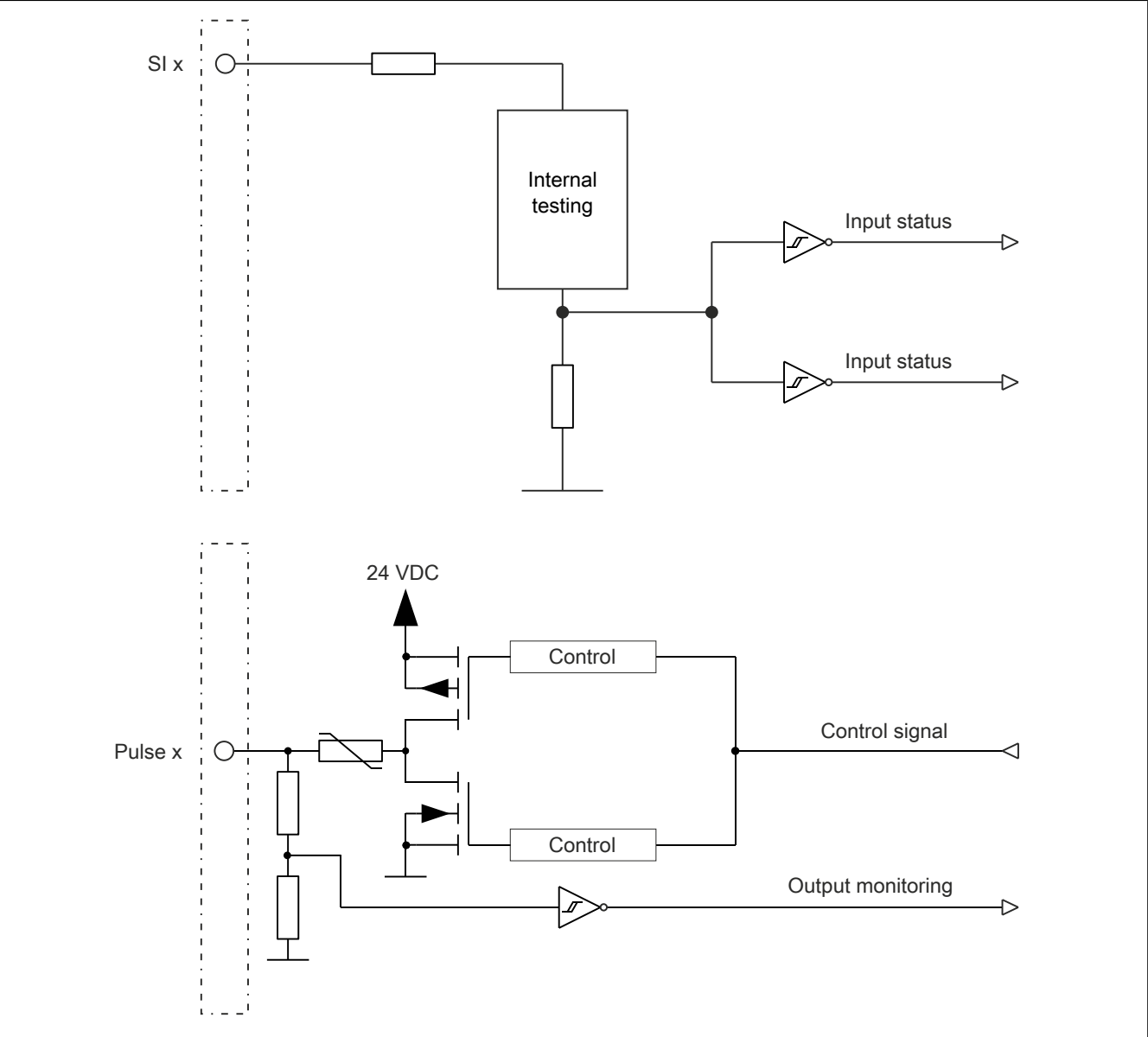
Figure 10: Input circuit diagram

10 Minimum cycle time

The minimum cycle time specifies the time up to which the bus cycle can be reduced without communication errors occurring.

Minimum cycle time
200 µs

11 I/O update time

The time needed by the module to generate a sample is specified by the I/O update time.

Minimum I/O update time			
X20SLX210	X20SLX410	X20SLX811	X20SLX910
800 µs	800 µs	500 µs	800 µs

Maximum I/O update time			
X20SLX210	X20SLX410	X20SLX811	X20SLX910
3350 µs + Filter time (see chapter "Filter")	3350 µs + Filter time (see chapter "Filter")	1150 µs + Filter time (see chapter "Filter")	3350 µs + Filter time (see chapter "Filter")

12 Filter

All safe digital input modules are equipped with separately configurable switch-on and switch-off filters. The functionality of the filters depends on the firmware version and is illustrated in the following table and figures:

Module type	Version	TOFF filter diagram	Filter time to be considered in addition to the total response time
I/O modules	<301	Diagram 1	2x TOFF filter time
SafeLOGIC-X	301, 311, 312	Diagram 1	2x TOFF filter time
I/O modules	≥301	Diagram 2	1x TOFF filter time
SafeLOGIC-X	302, ≥313	Diagram 2	1x TOFF filter time
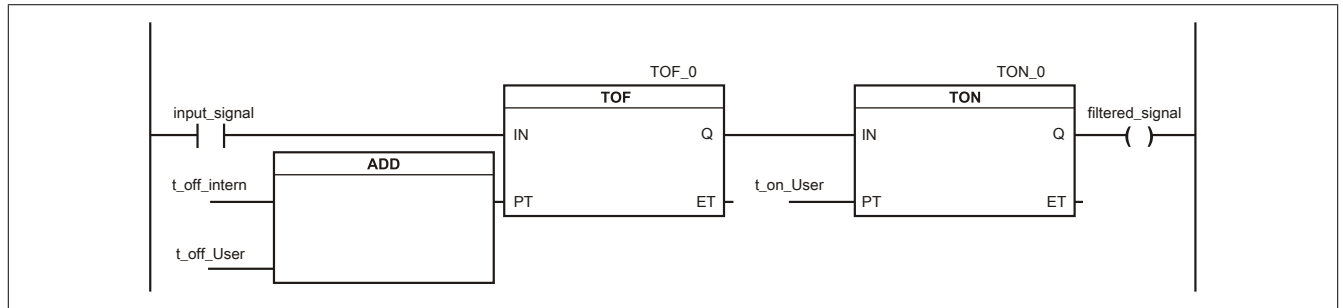
Figure 11: SI input filter - Diagram 1
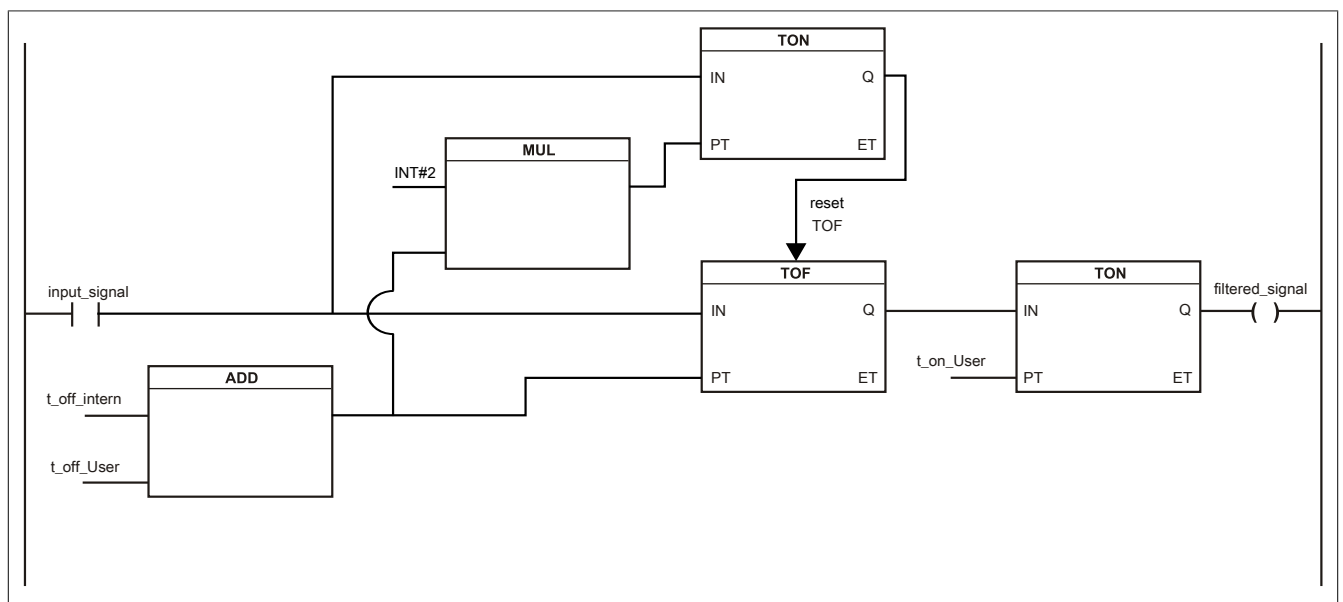
Figure 12: SI input filter - Diagram 2

Key:

- input_signal: Status of the input channel
- filtered_signal: Filtered status of the input channel. This is used as an input for the PLCopen function block and forwarded to the SafeLOGIC controller
- t_off_intern: Internal parameter (5 ms) for suppressing "external" test pulses (only with "Pulse Mode = External")
- t_off_User: Parameter for the switch-off filter
- t_on_User: Parameter for the switch-on filter

Unfiltered

The input state is collected with a fixed offset to the network cycle and transferred.

Switch-on filter

When switching from 0 to 1, the filtered status is collected with a fixed offset to the network cycle and transferred. The filter value can be configured (limit values are listed in the technical data).

Danger!

Errors that result from cross faults to other signals are detected by the module within the error detection time at the latest. By default, the switch-on filter is set to the error detection time value, which filters out faulty signals caused by possible cross faults. If the switch-on filter is set to a value smaller than the error detection time, faulty signals can cause temporary switch-on pulses to occur.

Information:

The actual effective filter depends on the I/O cycle time of the module. The actual effective filter can therefore deviate below the input value by the I/O cycle time (see the technical data for the module). If filter times are set less than the I/O cycle time of the module, no filter is effective.

Switch-off filter

When switching from 1 to 0, the filtered status is collected with a fixed offset to the network cycle and transferred. The switch-off filter can be configured separately. This makes it possible to use the switch-off filter in actual applications (e.g. testing gaps of the light curtain) and to shorten response times. The filter value can be configured (limit values are listed in the technical data).

Danger!

Configuring a switch-off filter lengthens the safety response time!
The configured filter value must be added to the total response time once or twice depending on the firmware version (for details, see the chapter "Filters" in the technical data sheet).
Configuring a switch-off filter causes signals with a low phase shorter than the switch-off filter to be filtered out. If this results in a problem concerning safety functionality, then the switch-off filter must be set to 0.
To minimize the effect of EMC interference, the max. line lengths between the pulse output and input specified in the technical data must be taken into account.
When connecting devices with OSSD signals (signals with test pulses), you must select a switch-off filter in each case that is substantially smaller than the repeat rate of the test pulses.

Information:

The actual effective filter depends on the I/O cycle time of the module. The actual effective filter can therefore deviate below the input value by the I/O cycle time (see the technical data for the module). If filter times are set less than the I/O cycle time of the module, no filter is effective.

Danger!

If "Pulse Mode = External" is used in the channel configuration, then an additional TOFF filter with 5 ms is enabled in the module. The corresponding information regarding the TOFF filter must also be considered when using the "Pulse Mode = External" setting.

13 Restart behavior

Each digital input channel is not equipped with an internal restart interlock, which means that the associated channel data reverts back to the proper state automatically after an error situation on the module and/or network.
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. The restart interlocks of PLCopen function blocks can be used here, for example.
Using input channels without a correctly connected restart interlock can result in an automatic restart.

Each output channel is equipped with an internal restart interlock, which means that the following sequence must be followed in order to switch on a channel after an error situation on the module/network and/or after ending the safety function:

- Correct all module, channel or communication errors.
- Enable the safety-related signal for this channel (SafeOutput, etc.).
- Pause to ensure that the safety-related signal has been processed on the module (min. 1 network cycle).
- Positive edge on the release channel

For switching the release signal, the notes for manual reset function in EN ISO 13849-1:2015 must be observed.

The restart interlock functions independently of the enabling principle, which means that the behavior described above is not influenced by the parameter settings for the enabling principle or by the chronological position of the functional switching signal.

An automatic restart of the module can be configured by setting parameters. With this function, the output channel can be enabled using safety technology without an additional signal edge on the release channel. This function remains active as long as the release signal is TRUE and there is no error situation on the module/network.

Regardless of this parameter, a positive edge is required on the release channel for enabling the output channel in the following situations:

- After switching on
- After correcting an error on the safe communication channel
- After correcting a channel error
- After the release signal drops out

The automatic restart is configured in SafeDESIGNER using the channel parameters. If using an automatic restart, note the information in EN ISO 13849-1:2015.

> # Danger!
> **Configuring an automatic restart can result in critical safety conditions. Take additional measures to ensure proper safety-related functionality.**

14 Register description

14.1 Parameters in the I/O configuration

Group: Function model

Parameter	Description	Default value	Unit
Function model	This parameter is reserved for future functional expansions.	Default	-

Table 12: I/O configuration parameters: Function model

Group: General

Parameter	Description	Default value	Unit
Module supervised	System behavior when a module is missing	On	-
	<table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>On</td><td>A missing module triggers service mode.</td></tr><tr><td>Off</td><td>A missing module is ignored.</td></tr></table>		
Input status information	This parameter enables/disables channel-specific status information in the I/O mapping.	On	-
State number of 2-channel evaluation	This parameter enables/disables the status information of dual-channel evaluation. This parameter may not be available depending on the module type.	Off	-
SafeLOGIC ID	In applications with multiple SafeLOGIC controllers, this parameter defines the module's association with a particular SafeLOGIC controller. • Permissible values: 1 to 1024	Assigned automatically	-
SafeMODULE ID	Unique safety address of the module • Permissible values: 1	1	-
SafeDESIGNER project	Name of the safety project	Assigned automatically	-
SafeDESIGNER version	SafeDESIGNER version of the safety project	Assigned automatically	-

Table 13: I/O configuration parameters: General

Group: SafeDESIGNER to SafeLOGIC communication

Starting with SafeLOGIC V1.4.0.0 and Automation Runtime V3.04:

When SPROXY is enabled, the SafeLOGIC controller can be accessed via a TCP/IP port on the standard CPU.

This uses the SafeDESIGNER setting "SL communication via the CPU" (SafeDESIGNER V2.80 or higher).

Parameter	Description	Default value	Unit
Activate SPROXY	Enables the SafeDESIGNER online connection	On	-
Server communication port	TCP/IP port number used to access the SafeLOGIC controller • Recommended values: 50,000 to 50,100 **Note:** If multiple SafeLOGIC controllers are being used in the project, then a different port number must be configured for each one!	50000	-

Table 14: I/O configuration parameters: SafeDESIGNER to SafeLOGIC communication

Group: CPU to SafeLOGIC communication

Parameter	Description	Default value	Unit
Number of BOOL channels	Number of BOOL channels from the CPU to the SafeLOGIC controller • Permissible values: 0, 8, 16, 24, 32, 40, 48, 56, 64.	8	-
Number of INT channels	Number of INT channels from the CPU to the SafeLOGIC controller • Permissible values: 0 to 4.	0	-
Number of UINT channels	Number of UINT channels from the CPU to the SafeLOGIC controller • Permissible values: 0 to 4.	0	-
Number of DINT channels (Safety Release 1.4 and Automation Runtime V3.08 required)	Number of DINT channels from the CPU to the SafeLOGIC controller • Permissible values: 0 to 2.	0	-
Number of UDINT channels	Number of UDINT channels from the CPU to the SafeLOGIC controller • Permissible values: 0 to 2.	0	-

Table 15: I/O configuration parameters: CPU to SafeLOGIC communication

Group: SafeLOGIC to CPU communication

Parameter	Description	Default value	Unit
Number of BOOL channels	Number of BOOL channels from the SafeLOGIC controller to the CPU • Permissible values: 0, 8, 16, 24, 32, 40, 48, 56, 64.	8	-
Number of INT channels	Number of INT channels from the SafeLOGIC controller to the CPU • Permissible values: 0 to 4.	0	-
Number of UINT channels	Number of UINT channels from the SafeLOGIC controller to the CPU • Permissible values: 0 to 4.	0	-
Number of DINT channels (Safety Release 1.4 and Automation Runtime V3.08 required)	Number of DINT channels from the SafeLOGIC controller to the CPU • Permissible values: 0 to 2.	0	-
Number of UDINT channels	Number of UDINT channels from the SafeLOGIC controller to the CPU • Permissible values: 0 to 2.	0	-

Table 16: I/O configuration parameters: SafeLOGIC to CPU communication

Group: SafeLOGIC to SafeLOGIC communication

Parameter	Description	Default value	Unit
Use as source SafeLOGIC	This parameter configures this SafeLOGIC controller as a data source for another SafeLOGIC controller. | Parameter value	Description | |---|---| | On | This SafeLOGIC controller is available as a data source for another SafeLOGIC controller. | | Off | This SafeLOGIC controller is not available as a data source for other SafeLOGIC controllers. |	Off	-
Extended source SafeLOGIC communication (Safety Release 1.4 and Automation Runtime V3.08 required)	This parameter enables the option of configuring the number of data points for "SafeLOGIC to SafeLOGIC communication" for connections where this SafeLOGIC controller serves as a data source for another SafeLOGIC controller.	Off	-

Table 17: I/O configuration parameters: SafeLOGIC to SafeLOGIC communication

14.2 Parameters in SafeDESIGNER - up to Release 1.9

Group: Basic

Parameter	Description	Default value	Unit
Min_required_FW_Rev	This parameter is reserved for future functional expansions.	Basic Release	-
Cycle_Time_typical_us	This parameter specifies the cycle time of the SafeDESIGNER application. If set correctly, this can improve the stability of the cyclic data connection. The correct value is application-dependent and can be read in the "Cycle time" field of the SafeLOGIC controller's Info dialog box in the RUN [Safe] state of the SafeLOGIC-X controller. • Permissible values: 2000 to 20,000 µs (corresponds to 2 to 20 ms)	20000	µs
Cycle_Time_max_us (Release 1.5 and later)	Parameter for checking whether a maximum time between 2 SafeLOGIC cycles is exceeded. • Permissible values: 2100 to 41,000 µs (corresponds to 2.1 to 41 ms) **IMPORTANT:** This value should not be the same as the actual cycle time; jitter must also be taken into account. The actual cycle time is influenced by the SafeDESIGNER application and the "SLXioCycle" data point. The actual cycle time can be seen in the SafeLOGIC "Info" dialog box.	40000	µs

Node_Guarding_Timeout_s	Timeout for changing the safety modules to the PREOPERATIONAL state after the SafeLOGIC controller drops out or if there is a communication problem between the safety module and the SafeLOGIC controller.
	This parameter also defines how long it takes for the SafeLOGIC controller to detect a missing module.
	
	  • Permissible values: 30 to 3000 s
	
	Notes
	
	  • The shorter the time, the greater the amount of asynchronous data traffic.
	  • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently using parameter "Worst_Case_Response_Time_us".
		60	s

Number_of_scans	This parameter defines the number of module search scans completed during startup. This parameter is used to optimize the startup behavior of the system, especially if optional modules are configured. • Permissible values: 1 to 10	5	-
ExternalMachineOptions (Release 1.4 and later)	Enables external machine options	No	-
ExternalStartupFlags (Release 1.4 and later)	Enables external startup flags	No	-

For ExternalMachineOptions:

Parameter value	Description
Yes-ATTENTION	External machine options are enabled.
No	External machine options are disabled.

For ExternalStartupFlags:

Parameter value	Description
Yes-ATTENTION	External startup flags are enabled.
No	External startup flags are disabled.

Table 18: SafeDESIGNER parameters: Basic

Danger!

If parameter "ExternalMachineOptions" or "ExternalStartupFlags" is set to "Yes-ATTENTION", thus enabling one of these functions to be used in SafeDESIGNER, then the associated notices in chapter "Operation via the AsSafety library" must be taken into account. Failure to do so can result in hazardous situations caused by malfunctions.

Group: Safety_Response_Time_Defaults

The parameters for the safety response time are generally set in the same way for all stations involved in the application. This is why these parameters are configured for the SafeLOGIC controller in group "Safety_Response_Time_Defaults" in SafeDESIGNER.

If "Manual_Configuration = No" is set for the modules in the network, then these default values are used.

Parameter	Description	Default value	Unit
Default_Synchronous_Network_Only	This parameter describes the synchronization characteristics of the network being used. They are defined in Automation Studio / Automation Runtime. <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Yes</td><td>In order to calculate the safety response time, networks must be synchronous and their cycle times must either be the same or an integer ratio of the cycle times.</td></tr><tr><td>No</td><td>No requirement for synchronization of the networks</td></tr></table>	Yes	-
Default_Max_X2X_CycleTime_us	This parameter specifies the maximum X2X cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	12000	µs
Default_Max_Powerlink_CycleTime_us	This parameter specifies the maximum POWERLINK cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	5000	µs
Default_Max_CPU_CrossLinkTask_CycleTime_us	This parameter specifies the maximum cycle time for the copy task on the CPU used to calculate the safety response time. The value 0 indicates that a copy task is not included for the response time. • Permissible values: 0 to 30,000 µs (corresponds to 0 to 30 ms)	5000	µs
Default_Min_X2X_CycleTime_us	This parameter specifies the minimum X2X cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	200	µs
Default_Min_Powerlink_CycleTime_us	This parameter specifies the minimum POWERLINK cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	200	µs
Default_Min_CPU_CrossLinkTask_CycleTime_us	This parameter specifies the minimum cycle time for the copy task on the CPU used to calculate the safety response time. The value 0 indicates that configurations without a copy task are also included for the response time. • Permissible values: 0 to 30,000 µs (corresponds to 0 to 30 ms)	0	µs
Default_Worst_Case_Response_Time_us	This parameter specifies the limit value for monitoring the safety response time. • Permissible values: 10,000 to 5,000,000 µs (corresponds to 10 ms to 5 s)	150000	µs
Default_Node_Guarding_Lifetime	This parameter specifies the maximum number of attempts to be made during the time set with parameter "Node_Guarding_Timeout_s". The purpose of these attempts is to ensure that the module is available. • Permissible values: 1 to 255 **Note** • The larger the configured value, the greater the amount of asynchronous data traffic. • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently using parameter "Worst_Case_Response_Time_us".	5	-

Table 19: SafeDESIGNER parameters: Safety_Response_Time_Defaults

Group: SafeDigitalInputxx

Parameter	Description	Default value	Unit
Pulse_Source (Release 1.4 and later)	This parameter can be used to specify the pulse source for the input channel.	See table.	-

	Possible "Pulse_Source" for X20SLX210 and X20SLX410			
Channel	1	2	3	4
1	Default	-	-	-
2	Channel 1	Default	-	-
3	Channel 1	-	Default	-
4	Channel 1	-	Channel 3	Default

All available pulse outputs on the X20SLX811 and X20SLX910 can be specified as pulse sources.
The default values can be determined using the following tables:

Channel	Default "Pulse_Source" for X20SLX811
1, 5	Channel 1
2, 6	Channel 2
3, 7	Channel 3
4, 8	Channel 4

Channel	Default "Pulse_Source" for X20SLX910
1, 3, 5, 7, 9, 11	Channel 1
2, 4, 6, 8, 10, 12	Channel 2
13, 15, 17, 19	Channel 3
14, 16, 18, 20	Channel 4

Note:
If a value other than "Default" is set for "Pulse_Source", then parameter "Pulse_Mode" must be set to "Internal" on the respective channel of the selected "Pulse_Source".

Parameter	Description	Default value	Unit
Pulse_Mode	This parameter can be used to specify the "Pulse_Mode" for the input channel.	Internal	-

Parameter value	Description
Internal	The channel works exclusively with the associated pulse output. Release 1.4 and later: The channel works exclusively with the pulse output that is set for "Pulse_Source".
External	The channel works with any pulse output on a B&R input module as long as the pulse output is configured to "Pulse_Mode = External" (X20SLX210 and X20SLX410 only).
No Pulse	The pulse check on the channel is disabled. Potential low phases of the signal must be removed using the switch-off filter in order to prevent unintended cutoff.

Parameter	Description	Default value	Unit
Filter_Off_us	Switch-off filter for the channel to remove potentially disruptive signal low phases. • Permissible values: 0 to 500,000 µs (corresponds to 0 to 0.5 s)	0	µs
Filter_On_us	Switch-on filter for the channel used to "debounce" the signals. This function also makes it possible for the module to lengthen a switch-off signal that would otherwise be too short. • Permissible values: 0 to 500,000 µs (corresponds to 0 to 0.5 s)	200000	µs
Discrepancy_Time_us	Parameter only available for odd-numbered channels. This parameter specifies the maximum time for the "Dual-channel evaluation" function during which the state of both physical individual channels is permitted to be undefined without triggering an error. • Permissible values: 0 to 10,000,000 µs (corresponds to 0 to 10 s) (up to Release 1.4: 0 to 500,000 µs - corresponds to 0 to 0.5 s)	0	µs
TwoChannelProcessingMode (only for X20SLX811 and X20SLX910)	Parameter only available for odd-numbered channels. This parameter specifies the type of dual-channel evaluation. Permissible values: • None • Equivalent • Antivalent	None	-

Table 20: SafeDESIGNER parameters: SafeDigitalInputxx

Danger!

Configuring a switch-off filter lengthens the safety response time!

Danger!

Signals with a low phase shorter than the safety response time can potentially be lost. Such signals should be lengthened accordingly using the "switch-on filter" function on the input module.

Danger!

Configuring a switch-off filter causes signals with a low phase shorter than the switch-off filter to be filtered out. If this results in a problem concerning safety functionality, then the switch-off filter must be set to 0. Lengthening the low phase with a switch-on filter is not possible in these cases.

14.3 Parameters in SafeDESIGNER - Release 1.10 and later

Group: Basic

Parameter	Description	Default value	Unit
Min required FW Rev	This parameter is reserved for future functional expansions.	Basic release	-
Node Guarding Timeout	Timeout for changing the safety modules to the PRE_OPERATIONAL state after the SafeLOGIC controller drops out or if there is a communication problem between the safety module and the SafeLOGIC controller. This parameter also defines how long it takes for the SafeLOGIC controller to detect a missing module. • Permissible values: 30 to 300 s **Notes** • The shorter the time, the greater the amount of asynchronous data traffic. • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently of this.	60	s
External Startup Flags	Enables external startup flags 	Parameter value	Description	 	Yes-ATTENTION	Enables external startup flags	 	No	Disables external startup flags		No	-
Number of scans	This parameter defines the number of module search scans completed while booting. This parameter is used to optimize the startup behavior of the system, especially if optional modules are configured but not available. • Permissible values: 1 to 10	5. Hardware upgrade 1.10.2.0 or later: 3	-
Activate Setup Mode on empty SafeKEY (hardware upgrade 1.10.2.x or later)	This parameter enables setup mode after downloading a project to a blank SafeKEY / blank section of the CompactFlash card. 	Parameter value	Description	 	Yes-ATTENTION	Setup mode is enabled.	 	No	Setup mode is disabled.		No	-
Auto acknowledge firmware mismatch (hardware upgrade 1.10.2.x or later)	This parameter enables automatic acknowledgment of a firmware exchange (acknowledgment request "Firmware Acknowledge"). 	Parameter value	Description	 	Yes-ATTENTION	Automatic acknowledgment of firmware exchange is enabled.	 	No	Automatic acknowledgment of firmware exchange is not enabled.		No	-
Auto acknowledge SafeKEY exchange (hardware upgrade 1.10.2.x or later)	This parameter enables automatic acknowledgment of a SafeKEY exchange (acknowledgment request "SafeKEY Exchange"). 	Parameter value	Description	 	Yes-ATTENTION	Automatic acknowledgment of SafeKEY exchange is enabled.	 	No	Automatic acknowledgment of SafeKEY exchange is not enabled.		No	-

Table 21: SafeDESIGNER parameters: Basic

Danger!

If parameter "External Startup Flags" is set to "Yes-ATTENTION", thus enabling one of these functions to be used in SafeDESIGNER, then the associated notices in chapter "Operation via the AsSafety library" must be taken into account. Failure to do so can result in hazardous situations caused by malfunctions.

Information:

Startup time is also affected by the asynchronous bandwidth on the POWERLINK network. For optimization options, see Automation Help under Communication → POWERLINK → General information → Multiple asynchronous send.

Information:

The information in section "Setup mode" on page 64 must be observed when using parameter "Activate Setup Mode on empty SafeKEY". The information in section "Automatic acknowledgment" on page 47 must be observed when using parameters "Auto acknowledge firmware mismatch" and "Auto acknowledge SafeKEY exchange".

Group: Safety Response Time Defaults

The parameters for the safety response time are generally set in the same way for all stations involved in the application. This is why these parameters are configured for the SafeLOGIC controller in group "Safety Response Time Defaults" in SafeDESIGNER.

If "Manual Configuration = No" is set for the individual modules, then these default values are used.

Parameter	Description	Default value	Unit
Default Safe Data Duration	This parameter specifies the maximum permitted data transmission time between the SafeLOGIC controller and SafeIO module. For more information about the actual data transmission time, see section Diagnostics and service → Diagnostics tools → Network analyzer → Editor → Calculation of safety runtime of Automation Help. The cycle time of the safety application must also be added. • Permissible values: 2000 to 10,000,000 µs (corresponds to 2 ms to 10 s)	150000	µs
Default Additional Tolerated Packet Loss	This parameter specifies the number of additional tolerated lost packets during data transfer. • Permissible values: 0 to 10	0	Packets
Default Packets per Node Guarding	This parameter specifies the maximum number of packets used for node guarding. • Permissible values: 1 to 255 **Note** • The larger the configured value, the greater the amount of asynchronous data traffic. • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently of this.	5	Packets

Table 22: SafeDESIGNER parameters: Safety Response Time Defaults

Group: Module Configuration

Parameter	Description		Default value	Unit
External Machine Options	Enables external machine options		No	-
	Parameter value	**Description**		
	Yes-ATTENTION	Enables external machine options		
	No	Disables external machine options		
Cycle Time max	Parameter for checking whether a maximum time between 2 SafeLOGIC cycles is exceeded. • Permissible values: 2100 to 41,000 µs (corresponds to 2.1 to 41 ms) **Important:** This value should not be the same as the actual cycle time; jitter must also be taken into account. The actual cycle time is influenced by the SafeDESIGNER application and the "SLXioCycle" data point. The actual cycle time of the safety application can be seen in the SafeLOGIC "Info" dialog box.		40000	µs

Table 23: SafeDESIGNER parameters: Module Configuration

Danger!

If parameter "External Machine Options" is set to "Yes-ATTENTION", thus enabling one of these functions to be used in SafeDESIGNER, then the associated notices in chapter "Operation via the AsSafety library" must be taken into account. Failure to do so can result in hazardous situations caused by malfunctions.

Group: SafeDigitalInputxx

Parameter	Description	Default value	Unit
Pulse Source	This parameter can be used to specify the pulse source for the input channel.	See table	-

	Possible "Pulse Source" for X20SLX210 and X20SLX410			
Channel	**1**	**2**	**3**	**4**
1	Default	-	-	-
2	Channel 1	Default	-	-
3	Channel 1	-	Default	-
4	Channel 1	-	Channel 3	Default

All available pulse outputs on the X20SLX811 and X20SLX910 can be specified as pulse sources.
The default values can be determined using the following tables:

Channel	Default "Pulse Source" for X20SLX811
1, 5	Channel 1
2, 6	Channel 2
3, 7	Channel 3
4, 8	Channel 4

Channel	Default "Pulse Source" for X20SLX910
1, 3, 5, 7, 9, 11	Channel 1
2, 4, 6, 8, 10, 12	Channel 2
13, 15, 17, 19	Channel 3
14, 16, 18, 20	Channel 4

Note:
If a value other than "Default" is set for "Pulse Source", then the "Pulse Mode" parameter must be set to "Internal" on the respective channel of the selected "Pulse Source".

Parameter	Description	Default value	Unit
Pulse Mode	This parameter can be used to specify the "Pulse Mode" for the input channel.	Internal	-

Parameter value	Description
Internal	The channel works exclusively with the pulse output that is configured for "Pulse Source".
External	The channel works with any pulse output on a B&R input module as long as the pulse output is configured to "Pulse Mode = External" (X20SLX210 and X20SLX410 only).
No Pulse	The pulse check on the channel is disabled. Potential "low phases" of the signal must be removed using the switch-off filter in order to prevent unintended cutoff.

Parameter	Description	Default value	Unit
Filter Off	Switch-off filter for the channel to remove potentially disruptive signal low phases. • Permissible values: 0 to 500,000 µs (corresponds to 0 to 0.5 s)	0	µs
Filter On	Switch-on filter for the channel that can be used to "debounce" the signals. This function also makes it possible for the module to lengthen a switch-off signal that would otherwise be too short. • Permissible values: 0 to 500,000 µs (corresponds to 0 to 0.5 s)	200000	µs
Discrepancy Time	Parameter only available for odd-numbered channels. This parameter specifies the maximum time for "dual-channel evaluation", during which the status of both physical individual channels can be undefined without triggering an error. • Permissible values: 0 to 10,000,000 µs (corresponds to 0 to 10 s)	50000	µs
Two-Channel Processing Mode (only for X20SLX811 and X20SLX910)	Parameter only available for odd-numbered channels. This parameter specifies the type of dual-channel evaluation. Permissible values: • None • Equivalent • Antivalent	None	-

Table 24: SafeDESIGNER parameters: SafeDigitalInputxx

Danger!

Configuring a switch-off filter lengthens the safety response time!
The configured filter value must be added to the total response time.

Danger!

Signals with a low phase shorter than the safety response time can potentially be lost. Such signals should be lengthened accordingly using the "switch-on filter" function on the input module.

Danger!

Configuring a switch-off filter causes signals with a low phase shorter than the switch-off filter to be filtered out. If this results in a problem concerning safety functionality, then the switch-off filter must be set to 0. Lengthening the low phase with a switch-on filter is not possible in these cases.

14.4 Channel list

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
ModuleOk	●	●	●	Read	-	BOOL	Indicates if the module is OK
SerialNumber	●	●	●	Read	-	UDINT	Module serial number
ModuleID	●	●	●	Read	-	UINT	Module ID
HardwareVariant	●	●	●	Read	-	UINT	Hardware variant
FirmwareVersion	●	●	●	Read	-	UINT	Firmware version of the module
SLXioCycle	●	●	●	Read	-	UDINT	Exchanging cyclic data between the SafeLOGIC-X controller and CPU (time in µs). This value is influenced by: • Quantity and data width of SafeNODEs • Cycle times set in Automation Studio (POWERLINK, X2X, Crosslink task) • Automation Studio configuration (see items above) Up to Safety Release 1.9: The value must be <12 ms since the openSAFETY data connection cannot be configured for larger values. Safety Release 1.10 and later: The value must be <30 ms; otherwise, the max. SafeLOGIC-X cycle time (parameter "Cycle Time max") is exceeded. In addition, values <15 ms are recommended since large values slow down the SafeDESIGNER online connection.
UDID_low	●	●	●	(Read) [1]	-	UDINT	UDID, lower 4 bytes
UDID_high	●	●	●	(Read) [1]	-	UINT	UDID, upper 2 bytes
SafetyFWversion1	●	●	●	(Read) [1]	-	UINT	Firmware version - Safety processor 1
SafetyFWversion2	●	●	●	(Read) [1]	-	UINT	Firmware version - Safety processor 2
SafetyFWversionSCM	●	●	●	(Read) [1]	-	UINT	Firmware version - SCMar
SafetyFWcrc1 (hardware upgrade 1.10.5.0 or later)	●	●	●	(Read) [1]	-	UINT	CRC of firmware header on safety processor 1
SafetyFWcrc2 (hardware upgrade 1.10.5.0 or later)	●	●	●	(Read) [1]	-	UINT	CRC of firmware header on safety processor 2
ApplSDcrc	●	●	●	(Read) [1]	-	UDINT	CRC of the SafeDESIGNER application on the module
ApplSDtime	●	●	●	(Read) [1]	-	UDINT	Timestamp of the SafeDESIGNER application on the module in UNIX format
ApplMOptCRC	●	●	●	(Read) [1]	-	UDINT	CRC of the external machine options on the module
ApplMOptTime	●	●	●	(Read) [1]	-	UDINT	Timestamp of the external machine options on the module in UNIX format

Table 25: Channel list

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
Bootstate (hardware upgrade 1.10.5.0 or later)	●	●	●	(Read) [1]	-	UINT	Startup state of the module. Notes:

Some of the boot states do not occur during normal startup or are cycled through so quickly that they are not visible externally.

The boot states usually cycle through in ascending order. There are cases, however, in which a previous value is captured.

Value	Description
0x0003	Startup communication processor OK, no communication to the safety processors (check 24 V supply voltage!)
0x0010	FAILSAFE. At least one of the safety processors is in the safe state.
0x0020	Internal communication to safety processors started
0x0024	Firmware update of safety processors or download of the SafeDESIGNER application to the safety processors
0x0040	Firmware of safety processors started
0x0440	Firmware of safety processors running
0x0840	Waiting for openSAFETY "Operational" (loading SafeDESIGNER application or no valid application exists, waiting on acknowledgments such as module exchange)
0x3440	Stabilizing cyclic openSAFETY data exchange. **Note:** If the boot state remains here, check SafeDESIGNER parameters "(Default) Safe Data Duration", "(Default) Additional Tolerated Packet Loss".
0x4040	RUN. Final state, startup completed.

Table 25: Channel list

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
SLXbootState	●	●	●	(Read) [1]	-	USINT	Startup state of the SafeLOGIC-X system

Startup state description table (for SLXbootState):

Status	Description
0	Invalid - Firmware not yet running
1	Start - Waiting for synchronization of internal cyclic systems
4	Up to Safety Release 1.9: Start OK - Waiting for SOD data from SCMar / Safety Release 1.10 and later: Start OK - Application data valid
5 to 7 [2]	Download of SOD data from SCMar active
8 [2]	Waiting for download of SD application from SCMar
9 to 11 [2]	Download of SD application from SCMar active
16 [2]	Waiting for external machine option data 1 from SCMar
17 to 19 [2]	Download of external machine option data 1 from SCMar active
20 [2]	Waiting for external machine option data 2 from SCMar
21 to 23 [2]	Download of external machine option data 2 from SCMar active
25	Safety Release 1.10 and later: Safety PREOPERATIONAL state or "SafeOSstate!=RUN"
30 [2]	Downloads OK - All data received from SCMar
32 [2]	Write data received from the SCMar to flash memory
34	Waiting on X2X parameters from Automation Runtime
40 [2]	Start initialization of the SD application
50 [3]	Ready for RUN - Waiting on "SafeModuleOK" for the modules
52 [3]	Waiting period for stable valid "SafeModuleOK" active
54 [3]	Startup complete - SafeRUN

[2] Up to Safety Release 1.9
[3] Possible to establish connection to the SafeLOGIC-X controller via the SafePLC window in SafeDESIGNER (see dialog box "SafePLC" (control dialog box) in Automation Help).

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
SafeOsState	●	●	●	(Read) [1]	-	USINT	Status of the safety application. For details, see "SafeLOGIC "Info" dialog box in SafeDESIGNER".

Status description table (for SafeOsState):

Status	Description
0x00	Invalid (e.g. SafeKEY blank) or startup still active (BOOT_STATE!=0x12)
0x0F	ON (startup / internal initialization) or error (check logbook)
0x33	Loading (startup / internal initialization)
0x55	Stop [Safe]
0x66	Run [Safe]
0x99	Halt [Debug]
0xAA	Stop [Debug]
0xCC	Run [Debug]
0xF0	No execution

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
Diag1_Temp	●	●	●	(Read) [1]	-	INT	Module temperature in °C
PLCopenFBKxy_state	●	-	-	Read	-	USINT	State number of dual-channel evaluation (PLCopen function block "Equivalent" or "Antivalent")
PLCopenFBKxxyy_state	-	●	-	Read	-	USINT	State number of dual-channel evaluation (PLCopen function block "Equivalent" or "Antivalent")
PLCopenFBKxxyy_state	-	-	●	(Read) [1]	-	USINT	State number of dual-channel evaluation (PLCopen function block "Equivalent" or "Antivalent")

Table 25: Channel list

Channel name	SLX210 SLX410	SLX811	SLX910	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
InputErrorStates	●	-	-	(Read) [1]	-	UINT	Channel status, additional information for channel error (see error table below)
InputErrorStates	-	●	●	(Read) [1]	-	UDINT	Channel status, additional information for channel error (see error table below)
PulseoutputErrors	-	●	●	(Read) [1]	-	UDINT	Channel status, additional information for channel error (see error table below)
SafeDigitalInputxx	●	●	●	Read	Read	SAFEBOOL	Physical channel SI xx
SafeEquivalentInputxxyy	●	-	-	Read	Read	SAFEBOOL	Dual-channel evaluation of equivalent channel SI xx/yy
SafeAntivalentInputxxyy	●	-	-	Read	Read	SAFEBOOL	Dual-channel evaluation of antivalent channel SI xx/yy
SafeTwoChannelInputxxyy	-	●	●	Read	Read	SAFEBOOL	Dual-channel evaluation of channel SI xx/yy
SafeChannelOKxx	●	-	●	Read	Read	SAFEBOOL	Status of physical channel SI xx
SafeInputOKxx	-	●	-	Read	Read	SAFEBOOL	Status of physical channel SI xx
SafeEquivalentOKxxyy	●	-	-	Read	Read	SAFEBOOL	Status of dual-channel evaluation of equivalent channel SI xx/yy
SafeAntivalentOKxxyy	●	-	-	Read	Read	SAFEBOOL	Status of dual-channel evaluation of antivalent channel SI xx/yy
SafeTwoChannelOkxxyy	-	●	●	Read	Read	SAFEBOOL	Status of dual-channel evaluation of channel SI xx/yy
BOOL1xx	●	●	●	Write	Read	BOOL	CPU to SafeLOGIC communication channel
INT1xx	●	●	●	Write	Read	INT	CPU to SafeLOGIC communication channel
UINT1xx	●	●	●	Write	Read	UINT	CPU to SafeLOGIC communication channel
DINT1xx	●	●	●	Write	Read	DINT	CPU to SafeLOGIC communication channel
UDINT1xx	●	●	●	Write	Read	UDINT	CPU to SafeLOGIC communication channel
BOOL0xx	●	●	●	Read	Write	BOOL	SafeLOGIC to CPU communication channel
INT0xx	●	●	●	Read	Write	INT	SafeLOGIC to CPU communication channel
UINT0xx	●	●	●	Read	Write	UINT	SafeLOGIC to CPU communication channel
DINT0xx	●	●	●	Read	Write	DINT	SafeLOGIC to CPU communication channel
UDINT0xx	●	●	●	Read	Write	UDINT	SafeLOGIC to CPU communication channel
SafeBOOLx	●	●	●	-	Write	SAFEBOOL	SafeLOGIC to SafeLOGIC communication channel
SafeMachineOptionxx	●	●	●	-	Read	SAFEBOOL	Internal channel for machine options

Error detail table for first **InputErrorStates** (UINT):

Type of error		
Inputs	Pulse outputs	
Input stuck at high	Feedback stuck at high (shorted to 24 VDC)	Feedback stuck at low (ground fault)
Bit no. 8 to 11 = Channel 1 to 4	Bit no. 4 to 7 = Channel 1 to 4	Bit no. 0 to 3 = Channel 1 to 4

If a bit is set, the corresponding error has been detected on the respective channel.

Error detail table for second **InputErrorStates** (UDINT):

Type of error
Inputs
Input stuck at high
Bit no. 0 to 19 = Channel 1 to 20

If a bit is set, the corresponding error has been detected on the respective channel.

Error detail table for **PulseoutputErrors** (UDINT):

Type of error	
Pulse outputs	
Feedback stuck at high (shorted to 24 VDC)	Feedback stuck at low (ground fault)
Bit no. 8 to 11 = Channel 1 to 4	Bit no. 0 to 3 = Channel 1 to 4

If a bit is set, the corresponding error has been detected on the respective channel.

Table 25: Channel list

[1] This data is accessed in Automation Studio using the ASIOACC library.

Information:

Channels for SafeLOGIC to SafeLOGIC communication: See section "Display in SafeDESIGNER"

PLCopen state diagrams

The following state diagrams illustrate the effect of the "Antivalent" and "Equivalent" PLCopen function blocks integrated in the module.

The hexadecimal value in parentheses corresponds to the state number provided via the channels "PLCopenFBKxy_state" and "PLCopenFBKxxyy_state".

The following PLCopen state diagrams show the function for the "SafeAntivalentInput0102" and "SafeEquivalentInput0102" channels. The same diagrams are valid for the "SafeAntivalentInputxxyy" and "SafeEquivalentInputxxyy" channels, but "SafeDigitalInput01" and "SafeDigitalInput02" are to be replaced by the respective input.

In addition to the PLCopen specification, the SignalOK states of channels "SafeChannelOK01" and "SafeChannelOK02" are also checked.

If the SignalOK status of at least one of the two channels is not OK, the function block goes into an error state and the output signal is set to 0.

Error state "ERROR 4" is not taken from the PLCopen specification.

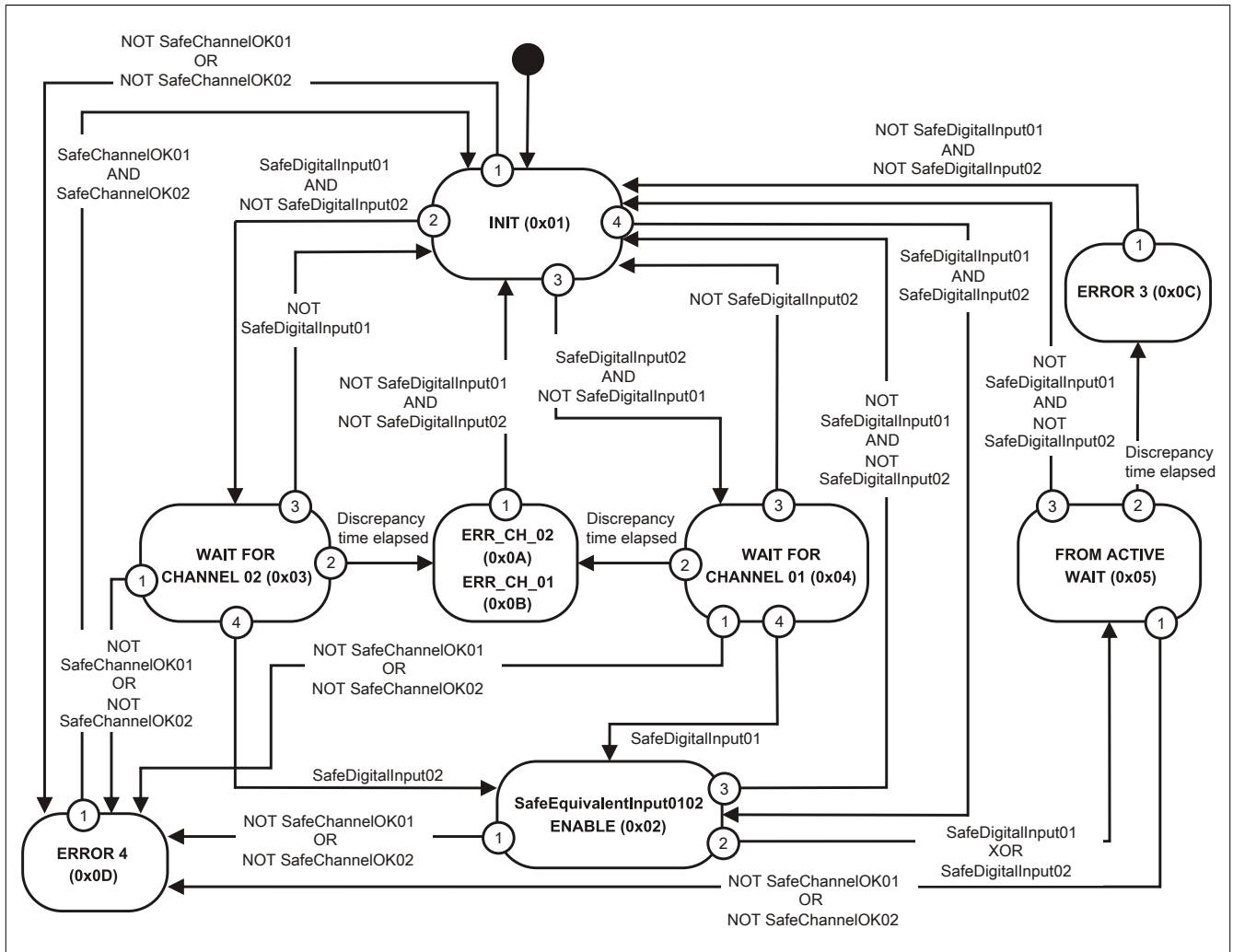Figure 13: "Antivalent" function block - State diagram

Figure 14: "Equivalent" function block - State diagram

14.5 SafeLOGIC "Info" dialog box in SafeDESIGNER

Dialog box "SafePLC info" appears if the "Info" button in dialog box "SafePLC" (control dialog box) or in dialog box "Debug" is pressed.

The dialog box shows information about the current project in the safe programming system, the project stored/ running on the safety controller, the current status of the safety controller, debugging information, etc.
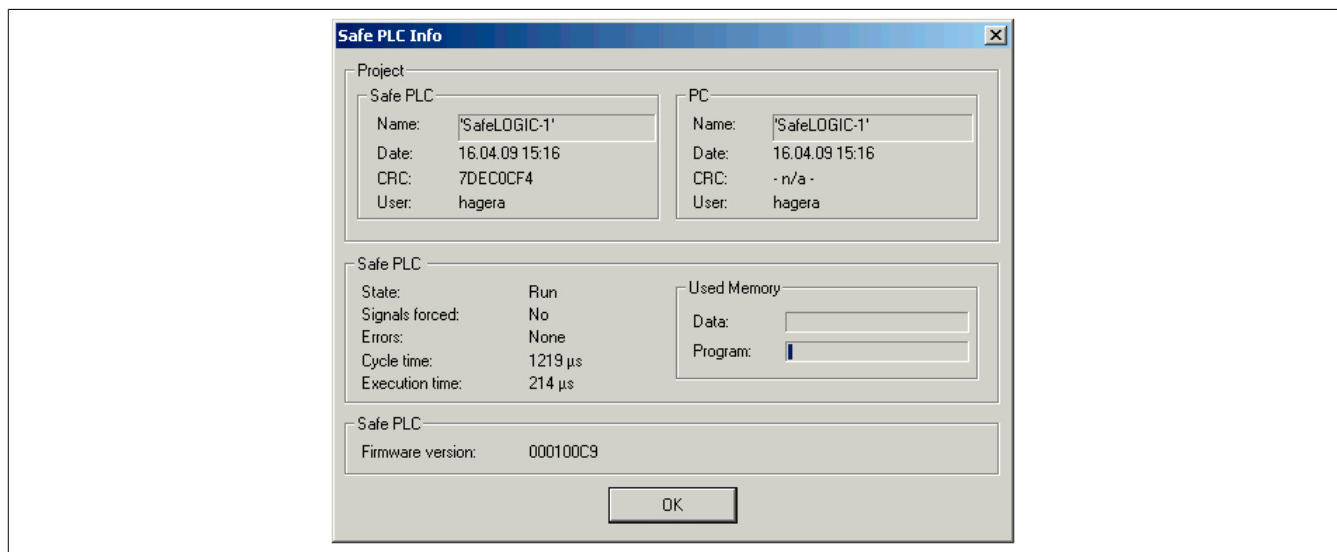
Figure 15: SafeLOGIC "Info" dialog box

Project	Project-defining data	
Safe PLC	Project data saved on the SafeKEY being used for the SafeLOGIC controller	
	Name	Name of the project
	Date	Date of the last change
	CRC	CRC
	User	User who made the last change
PC	SafeDESIGNER project data on the PC	
	Name	Name of the project
	Date	Date of the last change
	CRC	CRC, "- n/a -" if the project is not yet compiled
	User	User who made the last change
Safe PLC	**Status and information about the SafeLOGIC controller**	
State	Indicates the operating states of the safety controller.	
Signals forced	No	No variables are forced.
	Yes	Variables are forced.
Errors	Information regarding error messages present in the SafeDESIGNER message window	
Cycle time	Cycle time that is actually required, maximum value since the last power up This value is only relevant if "Safe PLC state = Run".	
Execution time	Actual application execution time This value corresponds to the "Safe PLC Cycle time" minus system and communication overhead.	
Used memory	Bar that shows the system resources being used	
	Data	Data memory for the safety application
	Program	Application memory for the safety application
Firmware version	Firmware version	

15 Maintenance scenarios

The operating elements on the SafeLOGIC controller (X20SL8xxx series) or the operating elements of the "Remote Control" in SafeDESIGNER (X20SL8xxx series and X20SLXxxx series) are available to handle the following maintenance scenarios.
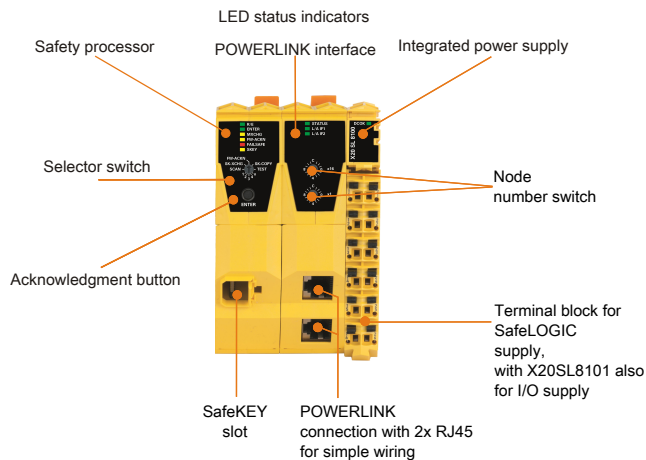
Figure 16: X20SL810x - Operating elements
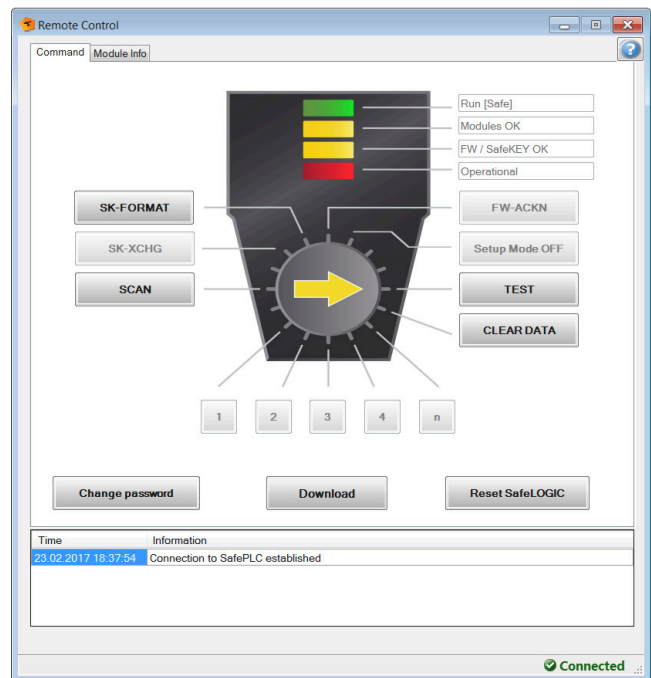
Figure 17: SafeDESIGNER -
"Remote control" operating elements

For a detailed description of operating elements, see section Operating and connection elements of the technical data sheet for X20SL8xxx-series devices.

For a detailed description of operating elements, see SafeDESIGNER section Operating elements of the Remote Control in Automation Help.

15.1 Module replacement

The SafeLOGIC controller recognizes on its own when safe modules have been replaced. Following a module replacement, the complete system (SafeLOGIC, SafeLOGIC-X system components, openSAFETY) automatically ensures that the module operates again using the correct parameters and that incompatible modules are rejected. Nevertheless, the following errors are still possible after a module replacement:

- Terminals swapped between several modules
- Wiring errors
- SafeIO modules swapped with each other

15.1.1 Terminals swapped between several modules

To determine whether terminals have been swapped between several modules, the user must test the safety function by performing a wiring test.

Danger!

The user must ensure that the wiring test can detect when terminals have been swapped.

Be sure to validate the entire safety function!

15.1.2 Wiring errors

A wiring error can occur if the wiring between the sensor or actuator and the X20 terminal is disconnected. To detect this sort of error in the wiring, the user must test the safety function by performing a wiring test.

Danger!

The user must make sure that the wiring test can detect wiring errors.

Be sure to validate the entire safety function!

15.1.3 SafeIO modules swapped with each other

Errors in the standard application can cause SafeIO modules to become swapped, which appears identical to a module replacement to the SafeLOGIC controller. To detect this error, the user must confirm the number of replaced modules. This links the number of modules replaced by the user and the replacements recognized by the system so that any additional replacements can be detected.

The user is informed of the number of detected module replacements via the MXCHG status. In the process, the module identifiers (UDIDs) on the SafeKEY or in the safety section of the CompactFlash card are compared to the UDIDs of the modules in the network.

If there are 1, 2, 3 or 4 different UDIDs, the user is provided information about the exact number of differences. The user must then check whether the number of replaced modules recognized by the SafeLOGIC controller corresponds to the actual number of replaced modules. If the values are the same, the user must confirm the number and perform a wiring test. This wiring test can be limited specifically to the modules that have been replaced.

If there are more than 4 different UDIDs, a standard message is provided indicating that there are differences on more than 4 modules. In this case, the user must perform a comprehensive wiring test for all modules.

If the number of modules indicated and the actual number of replaced modules do not match, the user must confirm the number of replacements determined by the SafeLOGIC controller and perform a comprehensive wire test for all modules.

Danger!

Be sure to validate the entire safety function!

15.1.4 Replacing an individual module

If only one module was replaced (MXCHG status indicates 1 module was replaced) and the wiring was not changed, the user can skip the wiring test because in this case the following errors can be ruled out:

- Terminals swapped between several modules
- Wiring errors
- SafeIO modules swapped with each other

Danger!

The wiring test can only be excluded if no additional changes are made when replacing an individual module (e.g. unplugging terminals, removing the wiring, etc.).

15.1.5 Confirming a module replacement

To confirm the number of the replaced modules, the correct number of modules must be selected:

- 1 - One module replaced
- 2 - Two modules replaced
- 3 - Three modules replaced
- 4 - Four modules replaced
- n - Five or more modules replaced

The replacement can be confirmed and the accompanying wiring test can be limited to the replaced modules when up to four modules are replaced. When more than four modules are replaced, a comprehensive wiring test must be performed for all modules.

Following confirmation of the module replacement, the SafeLOGIC controller immediately commences a module scan.

Danger!

The user must ensure that the wiring test can detect a wiring error or when terminals have been swapped.

Be sure to validate the entire safety function!

15.2 Other errors in module configuration

The aforementioned differences are limited exclusively to module replacements. An error – "Missing module" status – is reported if a device is missing (except when the device is defined as optional), has an incorrect hardware code or other problems are present on the module (e.g. incorrect parameters that may not be changed by the SafeLOGIC controller). This status is only indicated if a module or firmware replacement is not being indicated. This status cannot be acknowledged.

> # Danger!
>
> **It is your responsibility to ensure that all necessary repair measures are initiated after an error occurs since subsequent errors can result in a hazard!**

15.3 Acknowledging a firmware modification

A change to the firmware is indicated by the FW-ACKN status and must be confirmed using the FW-ACKN action. A firmware modification must always be concluded with full functional testing.

> # Danger!
>
> **Functional testing is only permitted to be performed by personnel familiar with the safety application and its functions and trained in the procedure of exchanging firmware.**
>
> **Be sure to validate the entire safety function!**

> # Danger!
>
> **Only use firmware versions listed in the FS certificates for B&R safety technology. These FS certificates are available for download from the B&R website at http://www.br-automation.com.**

15.4 Triggering a module scan

A module scan determines if all configured modules are present in the application and if they correspond to the project configuration. The module scan runs automatically but at large time intervals. To minimize the time it takes for the SafeLOGIC controller to recognize a newly replaced module, this function can also be triggered manually by the user. The result of the scan is described in the following sections:

- "Module replacement"
- "Other errors in module configuration"
- "Acknowledging a firmware modification"

The process itself is started using the SCAN function and indicated using the "Scanning" status. The results are reported after the "Scanning" status is completed (e.g. three modules replaced).

15.5 SafeKEY or safety section of the CompactFlash card

The following data is stored on the SafeKEY (X20SL8xxx series) or in the safety section of the CompactFlash card (X20SLXxxx series):

- SafeDESIGNER application (application and all SafeDESIGNER parameters for the modules)
- Configuration (unique module code (UDID), firmware versions of modules)
- Subsequently loadable data elements (machine options, tables, etc.)

Size of the SafeDESIGNER application on the SafeKEY

The size of the current application on the SafeKEY is calculated by SafeDESIGNER during compilation and displayed in the message window (e.g. "The safety application uses 0.688 MB (11 sectors) memory.").

Notes:

- The output only takes the size of the SafeDESIGNER application into account. Space on the data storage device used by firmware or subsequently loadable data (tables, machine options, etc.) is not taken into account.
- If the online project comparison is not needed (see Automation Help → SafeDESIGNER), the download size of the application can be reduced by disabling the following communication setting: Online → Communication settings → Download project source to SL.

15.5.1 Removing a SafeKEY (X20SL8xxx series only)

Removing a SafeKEY always results in a change to BOOT mode, and the safety application is completely shut down.

> **Information:**
>
> **Removing a SafeKEY during operation causes the SafeLOGIC controller to be restarted and all safety-related actuators to be cut off.**
>
> **Removing a SafeKEY during operation can destroy the data on the SafeKEY.**
>
> **Removing a SafeKEY during operation must therefore be avoided at all cost.**
>
> **The "Backing up the SafeKEY" sequence is not affected by this general rule.**

15.5.2 Acknowledging a SafeKEY replacement

Replacing a SafeKEY or replacing a CompactFlash card with a CompactFlash that has a modified safety section is indicated by the "FW-ACKN" status and must be acknowledged with the SK-XCHG function. Complete functional testing is then required.

> **Information:**
>
> **A SafeKEY replacement can only be acknowledged if a valid SafeDESIGNER project has already been transferred to the SafeKEY or CompactFlash card.**

> **Danger!**
>
> **Replacing a SafeKEY or CompactFlash card will enable the safety application stored on the SafeKEY or CompactFlash card. Always check the project CRC and date that the safety application project was saved on the SafeKEY or CompactFlash card.**

> **Danger!**
>
> **Be sure to validate the entire safety function!**

15.5.3 Changing the application on the SafeLOGIC controller by replacing the SafeKEY (X20SL8xxx series only)

All relevant configuration data and all application data and parameters are stored on the SafeKEY. In order to transfer the previous configuration data to a new SafeKEY when changing the application, the following sequence must be carried out.

- Set the selector switch to the SK-COPY position.
- Press the acknowledgment button - Action confirmed by the ENTER LED.
- The SafeKEY configuration data is saved on the SafeLOGIC controller. The SKEY LED blinks with each access.
- The FW-ACKN LED will flash after the copying procedure. This SafeKEY can now be replaced by the SafeKEY with the new application. 30 seconds are provided to do this. The FW-ACKN LED blink frequency increases after 20 seconds to signal the end of the replacement phase.
- The acknowledgment button must be pressed again after the new SafeKEY has been inserted. The selector switch remains on the setting SK-COPY.
- The internal, temporarily saved configuration data is saved on the new SafeKEY. A reset is then triggered automatically, and the data from the new SafeKEY is applied.
- Following the reset, the SafeKEY replacement must be acknowledged. To do this, move the selector switch to the setting SK-XCHG.
- Press the acknowledgment button - Action confirmed by the ENTER LED.
- Perform complete functional testing.

Information:

If the new SafeKEY is not acknowledged after 30 seconds, the function will end, i.e. if the function is triggered inadvertently, the copy function ends automatically after 30 seconds. If a SafeKEY is not inserted after 30 seconds, the SafeLOGIC controller switches to BOOT mode.

Danger!

This procedure enables the safety application stored on the new SafeKEY. Always check the project CRC and date that the safety application project was saved on the SafeKEY.

Danger!

Be sure to validate the entire safety function!

Information:

This sequence can also be used to create a SafeKEY backup using a second SafeKEY with an identical safety application. After executing the sequence, two identical SafeKEYs are available (backup copy).

Information:

Only data relevant to the machine is copied, not all of the safety application data.

15.6 Replacing a SafeLOGIC controller

Replacing a SafeLOGIC controller involves the same procedures as a normal module replacement. When replacing a SafeLOGIC controller, the SafeKEY from the SafeLOGIC controller being replaced must be kept in order to avoid activating an old safety-related application.

Danger!

Be sure to validate the entire safety function!

15.7 Authorization (X20SL8xxx series only)

The following functions can be blocked by the standard CPU:

- Confirming a module replacement
- Acknowledging a firmware modification
- Acknowledging a SafeKEY replacement
- Backing up the SafeKEY
- Replacing a SafeLOGIC controller

This allows actions to be executed in accordance with an application-specific user concept. This option is not possible from a safety perspective, however, since these functions are executed on the standard CPU.

The following table lists the associated objects in Index "0x2402" that can be accessed using the POWERLINK library.

| Index:Subindex	Object description	Data type	Access	Value	Description
0x2402:0x00	NumberOfEntries	USINT	R	0x22	Number of entries in this index
0x2402:0x01	EnableAuthorization	UDINT	RW	"AENA", 0x41454E41	Enables authorization
				"ADIS", 0x41444953	Disables authorization
0x2402:0x04	EnableModuleExchange	UDINT	RW	"UDID", 0x55444944	Provides authorization to acknowledge a module replacement
				All other values	Does not provide authorization to acknowledge a module replacement
0x2402:0x05	EnableFWMismatch	UDINT	RW	"FWAC", 0x46574143	Provides authorization to acknowledge a firmware replacement
				All other values	Does not provide authorization to acknowledge a firmware replacement
0x2402:0x06	EnableSKeyExchange	UDINT	RW	"SKEY", 0x534B4559	Provides authorization to acknowledge a SafeKEY replacement
				All other values	Does not provide authorization to acknowledge a SafeKEY replacement

User requests made to the SafeLOGIC controller that are not authorized by the CPU are indicated by a steadily lit ENTER LED.

16 Quick start

With the X20SLXxxx series, it is not possible to perform a direct download via the SafePLC window in SafeDESIGN-ER. The application must be downloaded using the remote interface instead. The remote interface can be accessed from the Safety View.
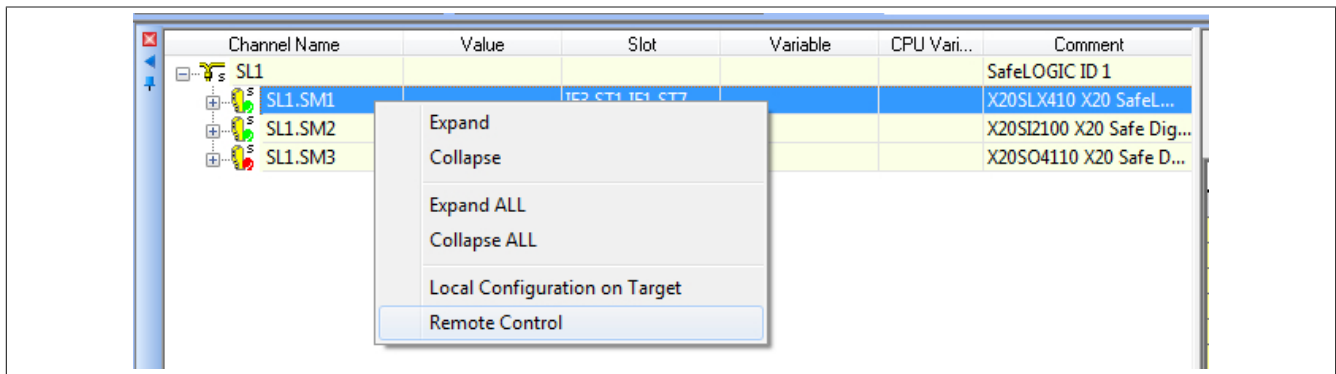
The password must be entered in order to gain access (or a new password defined at the beginning). Startup must be carried out via the remote interface, as is the case with the X20SL8xxx series via its operating elements.
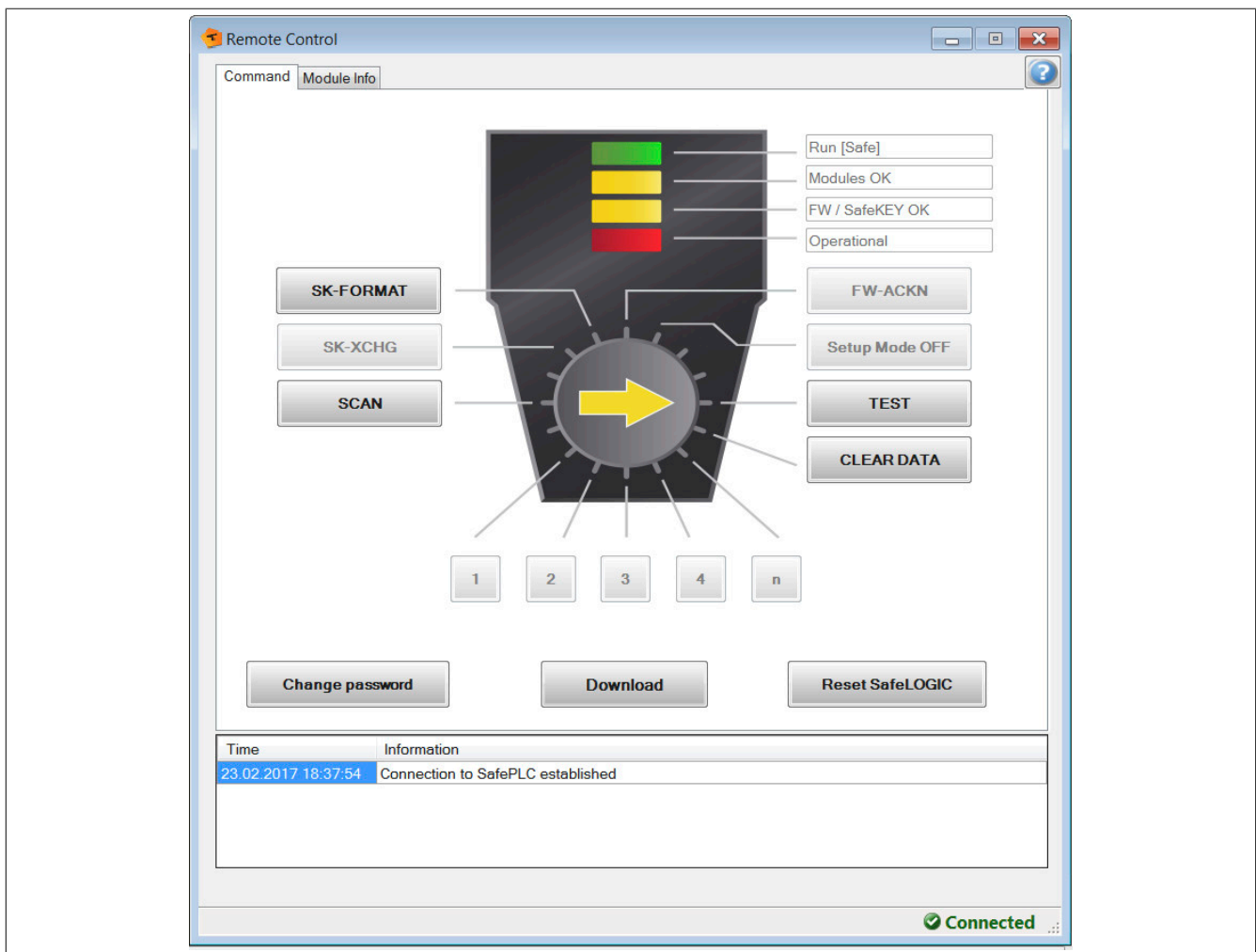
In addition, the AsSafety library can also be used for startup (see section "Operation via the AsSafety library").

Information:

The possibilities listed above are also available for the X20SL8xxx series starting with Safety Release 1.7.

16.1 Download mechanism

Downloading takes place in 2 steps – first to the CompactFlash card and then to the SafeLOGIC-X controller. "Download completed" indicates that the data has been applied during a download to the CompactFlash card.

Information:

The "Download completed" window in SafeDESIGNER is displayed already after downloading to the CompactFlash card. The download to the SafeLOGIC-X controller takes place afterward; it is completed by restarting the SafeLOGIC-X controller.

16.2 Visualization

In order to carry out maintenance scenarios, an HMI application must be created using library "AsSafety".

Information:

For details, see Solutions -> Technology Solutions in Automation Help.

16.3 Possible data loss

Data for the SafeLOGIC-X controller is stored on the CompactFlash card.

Information:

Note that this data can be lost when reformatting the CompactFlash card, for example.

16.4 Necessary resources

Automation Runtime resources are necessary for the safety system.

Information:

When converting from a SafeLOGIC controller to a SafeLOGIC-X controller, note that more Automation Runtime resources are needed for the SafeLOGIC-X controller.

17 Software functions

17.1 Operation via the AsSafety library

Information about using library "AsSafety" is available under Programming -> Libraries -> Safety -> AsSafety in Automation Help.

17.2 Automatic acknowledgment

As specified in previous chapters, automatic acknowledgment is usually not permitted. Provided that the user implements appropriate quality assurance measures and/or constraints, it is nevertheless possible to deviate from this to permit the following automatic acknowledgment.

> # Danger!
>
> **The automatic acknowledgment of SafeLOGIC controller acknowledgment requests under improper circumstances is not permitted and can lead to dangerous states.**
>
> **It is the sole responsibility of the user to assess the requirements of the safety application in order to determine whether additional measures are necessary.**

17.2.1 "SafeKEY exchange" acknowledgment request

The SafeDESIGNER application and machine option are saved in the safety section of the CompactFlash card (X20SLXxxx series) or on the SafeKEY (X20SL8xxx series). Replacing the CompactFlash card or SafeKEY may result in the unintended exchange of this data. The "SafeKEY exchange" acknowledgment request is meant to prevent this unintentional exchange of data.

It is important to ensure that the following criteria are met with regard to automatic acknowledgment that potentially involves CompactFlash cards or SafeKEYs:

- The SafeDESIGNER application must be completely validated on a reference machine.
- The machine options file must be completely validated on a reference machine.
- Sufficient measures must be implemented to prevent the SafeDESIGNER application or machine options file from being mixed up across different machine types.
- No test versions of the SafeDESIGNER application or machine options file are permitted.

Under the conditions specified, an automated update of the SafeDESIGNER application or machine options file is permitted to be implemented on the SafeLOGIC/SafeLOGIC-X controller.

17.2.2 "Firmware acknowledge" acknowledgment request

B&R Automation Runtime sees to it independently that the firmware versions stored on the CompactFlash card are transferred to the automation components in the network. This mechanism may cause other firmware versions to be enabled in the system than those that were active when the SafeDESIGNER application was validated. A change to the firmware of the safety modules always requires revalidation of the SafeDESIGNER application. The "Firmware acknowledge" acknowledgment request is meant to prevent an unintentional exchange of firmware versions.

It is important to ensure that the following criteria are met with regard to automatic acknowledgment that potentially involves CompactFlash cards:

- The firmware files installed on the safety modules must be completely validated together with the SafeDESIGNER application on a reference machine.

17.2.3 "UDID mismatch" acknowledgment request

The "UDID mismatch" request occurs in the following situations:

- When modules are exchanged by the user (e.g. during a service call). In this case, it is possible for the connection lines to be mixed up.
- When errors occur in the standard application that lead to a mix-up of modules.

To rule out these mix-ups, a wiring test must be performed after a "UDID mismatch" request is acknowledged.

The "UDID mismatch" acknowledgment request is meant to prevent the unintentional mix-up of signals caused by exchanging a module or errors in the standard application.

- Service personnel are to be informed that the mandatory wiring test when exchanging modules must be performed independently of the automatic acknowledgment of the "UDID mismatch" request.
- It is not permitted to use more than 1 module per module type in the Automation Studio application or SafeDESIGNER application.

If the last requirement cannot be met, a "UDID mismatch" acknowledgment request is not permitted to be acknowledged automatically since it would not cover the possible mix-up of signals caused by errors in the standard application.

17.3 SafeLOGIC to SafeLOGIC communication

The safety system makes it possible to exchange safety-related information between two safety controllers (SafeL-OGIC). SafeLOGIC to SafeLOGIC communication can be used to implement functions such as a global E-stop across a machine network or if a dependency exists between the safety applications on two or more machines. This makes it possible to establish a central collection point for safety information that will be responsible for distributing current values to all relevant locations.
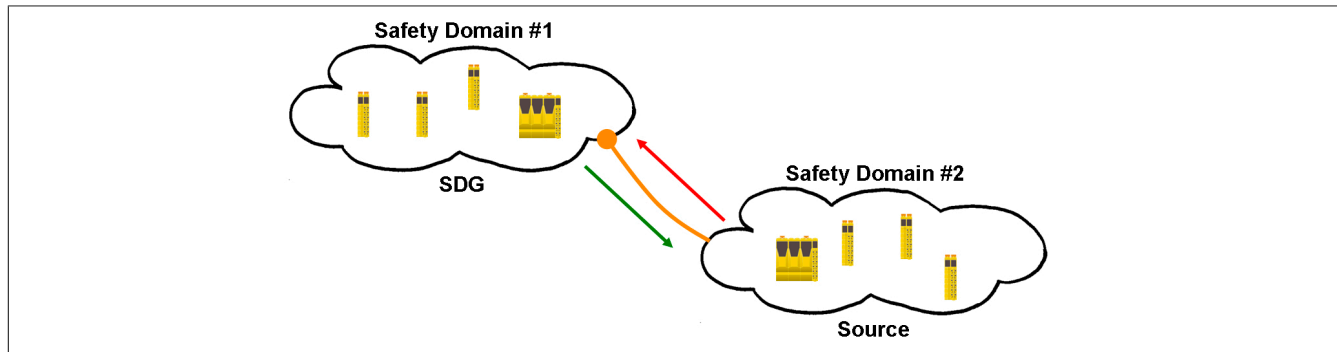
Information:

The safety domain number is taken from the SafeLOGIC ID. In order to use SafeLOGIC to SafeLOGIC communication, the SafeLOGIC IDs must be unique. This uniqueness should be taken into consideration from the very beginning.

To help with this, a SafeLOGIC controller provides a Safety Domain Gateway (SDG) that can be used to connect additional SafeLOGIC controllers (source controllers). This gateway functionality ensures communication between several safety domains. The connection between source SafeLOGIC controllers and SDG SafeLOGIC controller is indicated in the source SafeLOGIC controller's project as an additional safety module that provides additional communication channels. An SDG SL controller itself can also be used as a source controller and connected to another SDG SL controller. This can be done to achieve cascading communication relationships.

A source SL controller can also be connected several times to the same SDG SL controller, just as it is possible for the source SL controller to communicate with several SDG SL controllers. This results in several ways for SafeLOGIC to SafeLOGIC communication to take place.

17.3.1 System requirements

The following points must be taken into account for safe data exchange between at least 2 SafeLOGIC controllers:

- SafeDESIGNER <4.1: The same SafeDESIGNER versions must be used.
- SafeDESIGNER 4.1 to 4.2.1: The SafeDESIGNER versions must be within this version range.
- SafeDESIGNER 4.2.2 and later: SafeDESIGNER 3.0 or later is permitted to be used.
  The corresponding parameters in the following dialog box must be configured in order to establish a connection to the remote station.
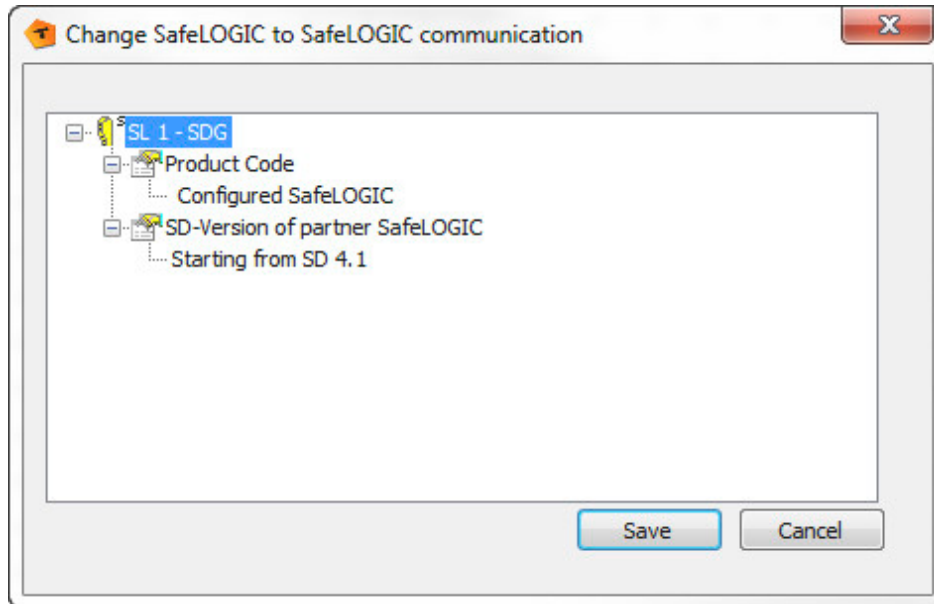
- – Configured SafeLOGIC: Remote station with which communication takes place (e.g. X20SL8100)
- – SD-Version of partner SafeLOGIC: Version with which the application on the remote station was created

17.3.2 Possibilities

The system supports various communication options. The corresponding communication type is defined via parameters in Automation Studio (see "Group: SafeLOGIC to SafeLOGIC communication").

Fixed communication
- 8 BOOL channels (1 byte) per communication direction
- One source SL controller can only communicate with one SDG SL controller
- No "any to any" constellation
- Cannot be used with SafeLOGIC-X

Extended communication (Release 1.4 or later and Automation Studio 3.0.90 or later)
- Freely configurable communication channels
- Limited to 16 channels (where 8 BOOLs count as 1 channel; other data types are calculated 1:1).
- One source SL controller can communicate with several SDG SL controllers
- "Any to any" constellation possible

17.3.3 Configuration in Automation Studio

To use SafeLOGIC to SafeLOGIC communication, a SafeLOGIC controller first needs to be configured as a source SL controller. This is done in the I/O configuration.
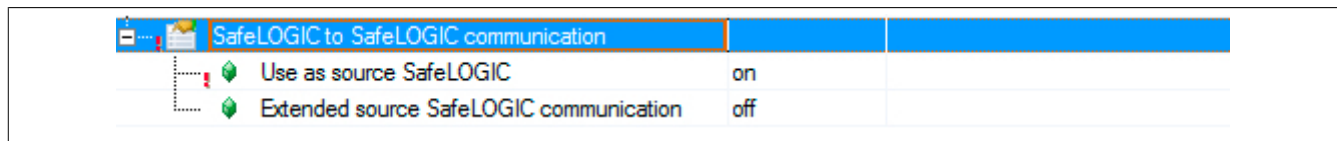

After the "Use as source SafeLOGIC" parameter has been enabled, it is possible to define the type of SafeLOGIC to SafeLOGIC communication as fixed or extended. If the "Extended source SafeLOGIC communication" parameter is not enabled, then fixed communication is used.

Information:

Changing the type of communication (fixed or extended) at a later time may result in channel overlaps in SafeDESIGNER; the communication channels must therefore be reconnected.

The source SL controller is then connected to the SDG SL controller in the next step. This is done using the connection points in Automation Studio under the I/O configuration of a SafeLOGIC controller (X20SL80x1 and X20SL81xx). Each SafeLOGIC ID (safety domain) is specified from the connection sections using the wizard in Automation Studio.
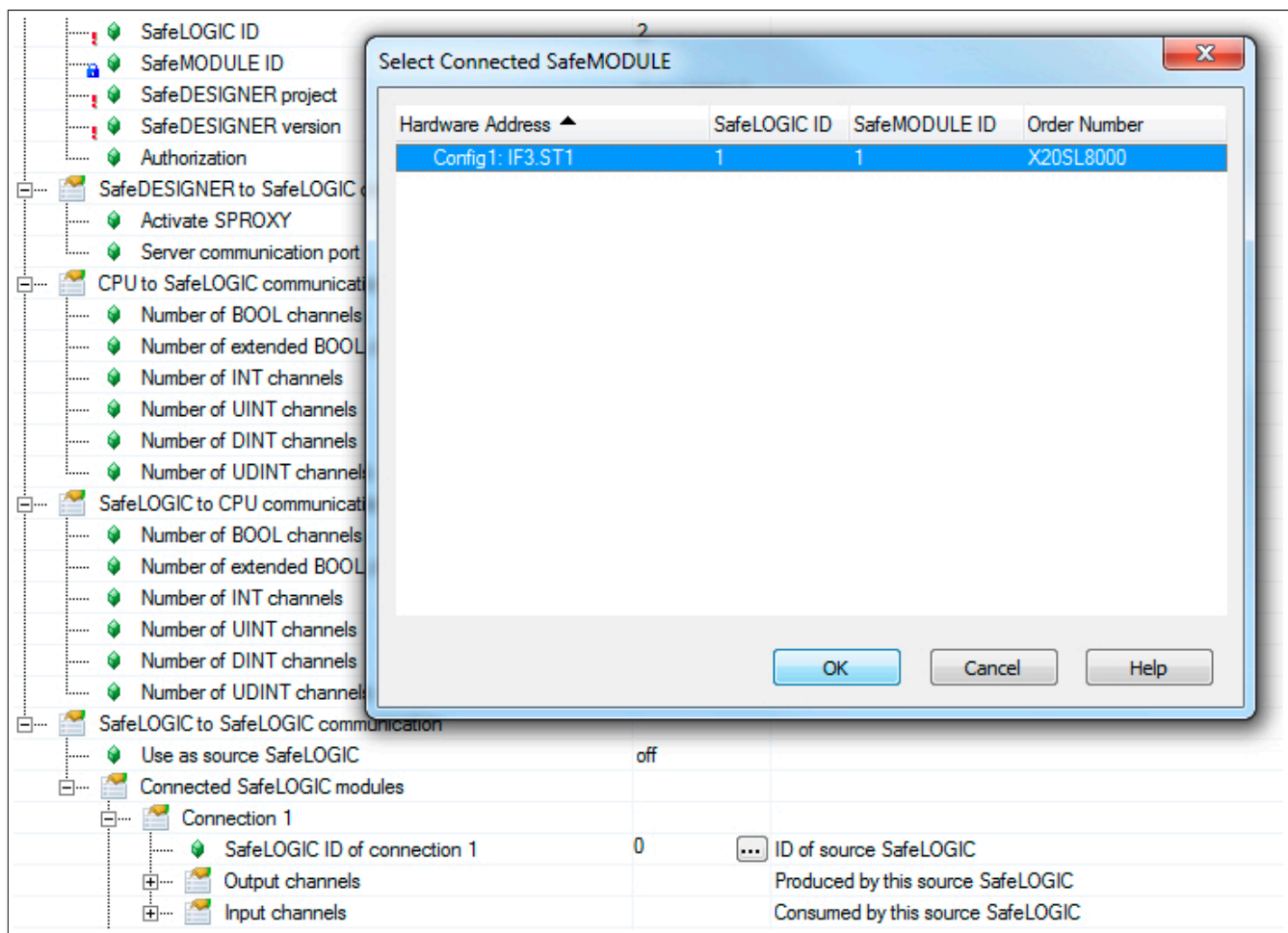
The necessary communication channels must be defined under each connection. With fixed communication, they are limited to 8 BOOL channels in each direction.

If SafeLOGIC to SafeLOGIC communication should be established between existing or separate Automation Studio projects, several things must be taken into consideration:

- SafeLOGIC IDs must be unique.
- A dummy configuration that includes all safety components must be created on the peer station.
- The dummy configuration must match the real configuration - the SafeMODULE IDs are important here.
- If the projects have multiple iCNs (intelligent controlled nodes), all iCNs must always be taken into account in the iCN project.

17.3.4 Display in SafeDESIGNER

The communication channels are also shown in the SafeDESIGNER project for the respective SafeLOGIC controller (source or SDG).

> # Danger!
> **All of the communication channels being used in the project must be mapped in both SafeDESIGNER projects using the same variable names. Channels and variable names are used to calculate a checksum that is then checked at runtime. If the checksum does not match, then the system issues a corresponding logger message in the Safety Logger and communication does not take place.**

17.3.4.1 SafeDESIGNER project – Source SL controller

In the source SL controller's SafeDESIGNER project, communication is indicated by an additional module. This module has its own node that represents the connection to this safety domain.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL2					SafeLOGIC ID 2
SL2.SM1		IF3.ST2			X20SL8000 X20 SafeLOGIC, POWERLINK V2, 24V
SL2.SM2		IF6.ST3			X20SI2100 X20 Safe Digital In, 2xI, 24V
SL2.SM3		IF6.ST4			X20SO4110 X20 Safe Digital Out, 4xO, 24 V, 0.5 A
SL1					SafeLOGIC ID 1
SL1.SM1.C1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus

If this module is selected, it is possible to configure its safety-related parameters (see section "Parameters for connection - Release 1.10 and later").

Fixed communication

The input channels sent from the SDG SL controller to the source SL controller and bit information about the status of the connection are listed under the module.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL1					SafeLOGIC ID 1
SL1.SM1.C1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus
SL2_SafeBOOL1					
SL2_SafeBOOL2					
SL2_SafeBOOL3					
SL2_SafeBOOL4					
SL2_SafeBOOL5					
SL2_SafeBOOL6					
SL2_SafeBOOL7					
SL2_SafeBOOL8					
SafeModuleOK					

The output channels sent from the source SL controller to the SDG SL controller are listed under the actual SL controller in the project in section "SafeLOGIC_SafeLOGIC".

Channel Name	Value	Slot	V...	CPU ...	Comment
SL2					SafeLOGIC ID 2
SL2.SM1		IF3.ST2			X20SL8000 X20 SafeLOGIC, POWERLINK V2, 24V
CPU_SafeLOGIC					
SafeLOGIC_SafeLOGIC					
SafeBOOL1					
SafeBOOL2					
SafeBOOL3					
SafeBOOL4					
SafeBOOL5					
SafeBOOL6					
SafeBOOL7					
SafeBOOL8					
external_MachineOptions					
SL2.SM2		IF6.ST3			X20SI2100 X20 Safe Digital In, 2xI, 24V

Extended communication

The input channels, output channels and bit information regarding the status of the connection are listed under the module.

Additional connection

If the source SL controller should be connected once again to the same SDG SL controller, an additional module underneath the same node is available with the necessary parameters and communication channels.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL2					SafeLOGIC ID 2
SL2.SM1		IF3.ST2			X20SL8000 X20 SafeLOGIC, POWERLINK V2, 24V
SL2.SM2		IF6.ST3			X20SI2100 X20 Safe Digital In, 2xI, 24V
SL2.SM3		IF6.ST4			X20SO4110 X20 Safe Digital Out, 4xO, 24 V, 0.5 A
SL1					SafeLOGIC ID 1
SL1.SM1.C1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus
SL1.SM1.C2		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus

If the source SL controller should be connected to another SDG SL controller, an additional node for the safety domain as well as a module with the necessary parameters and communication channels is available.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL2					SafeLOGIC ID 2
SL2.SM1		IF3.ST2			X20SL8000 X20 SafeLOGIC, POWERLINK V2, 24V
SL2.SM2		IF6.ST3			X20SI2100 X20 Safe Digital In, 2xI, 24V
SL2.SM3		IF6.ST4			X20SO4110 X20 Safe Digital Out, 4xO, 24 V, 0.5 A
SL1					SafeLOGIC ID 1
SL1.SM1.C1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus
SL3					SafeLOGIC ID 3
SL3.SM1.C1		IF3.ST3			X20SL8001 X20 SafeLOGIC PLUS, POWERLINK V2, 24V

17.3.4.2 SafeDESIGNER project – SDG SL controller

In the SDG SL controller's SafeDESIGNER project, communication is indicated by an additional module. This module has its own node that represents the connection to this safety domain.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL1					SafeLOGIC ID 1
SL1.SM1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus
SL1.SM2		IF6.ST1			X20SI4100 X20 Safe Digital In, 4xI, 24V
SL1.SM3		IF6.ST2			X20SO2120 X20 Safe Digital Out, 2xO, 24 V, 2A
SL2					SafeLOGIC ID 2
SL2.SM1.C1		IF3.ST2			X20SL8000

> **Information:**
>
> **No connection parameters are available in the SDG SL controller's project. They must be configured in the source SL controller's project.**

Fixed communication

The input channels, output channels and bit information regarding the status of the connection are listed under the module.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL1.SM3		IF6.ST2			X20SO2120 X20 Safe Digital Out, 2xO, 24 V, 2A
SL2					SafeLOGIC ID 2
SL2.SM1.C1		IF3.ST2			X20SL8000
SafeBOOL1					
SafeBOOL2					
SafeBOOL3					
SafeBOOL4					
SafeBOOL5					
SafeBOOL6					
SafeBOOL7					
SafeBOOL8					
SafeModuleOK					
SL2_SafeBOOL1					
SL2_SafeBOOL2					
SL2_SafeBOOL3					
SL2_SafeBOOL4					
SL2_SafeBOOL5					
SL2_SafeBOOL6					
SL2_SafeBOOL7					
SL2_SafeBOOL8					

Extended communication

The input channels, output channels and bit information regarding the status of the connection are listed under the module.

Channel Name	Slot	Comment
SL1.SM3	IF6.ST2	X20SO2120 X20 Safe Digital Out, 2xO, 24 V, 2A
SL2		SafeLOGIC ID 2
SL2.SM1.C1	IF3.ST2	X20SL8000
SL1_C01_SafeBOOL001		
SL1_C01_SafeBOOL002		
SL1_C01_SafeBOOL003		
SL1_C01_SafeBOOL004		
SL1_C01_SafeBOOL005		
SL1_C01_SafeBOOL006		
SL1_C01_SafeBOOL007		
SL1_C01_SafeBOOL008		
SL1_C01_SafeINT01		
SL1_C01_SafeUINT01		
SL1_C01_SafeDINT01		
SL1_C01_SafeUDINT01		
SafeModuleOK		
C01_SL2_SafeBOOL001		
C01_SL2_SafeBOOL002		
C01_SL2_SafeBOOL003		
C01_SL2_SafeBOOL004		
C01_SL2_SafeBOOL005		
C01_SL2_SafeBOOL006		
C01_SL2_SafeBOOL007		
C01_SL2_SafeBOOL008		
C01_SL2_SafeINT01		
C01_SL2_SafeUINT01		
C01_SL2_SafeDINT01		
C01_SL2_SafeUDINT01		

Additional connection

If the source SL controller should be connected once again to the SDG SL controller, an additional module underneath the same node is available with the necessary communication channels.

Channel Name	Value	Slot	V...	CPU ...	Comment
SL1					SafeLOGIC ID 1
SL1.SM1		IF3.ST1			X20SL8011 X20 SafeLOGIC, POWERLINK V2, SafeMC plus
SL1.SM2		IF6.ST1			X20SI4100 X20 Safe Digital In, 4xI, 24V
SL1.SM3		IF6.ST2			X20SO2120 X20 Safe Digital Out, 2xO, 24 V, 2A
SL2					SafeLOGIC ID 2
SL2.SM1.C1		IF3.ST2			X20SL8000
SL2.SM1.C2		IF3.ST2			X20SL8000

17.3.5 Parameters for connection - up to Release 1.9

Safety Release 1.4 or higher:

Cycle time parameters are also available for communication in order to define the "Worst_Case_Response_Time_us". As with communication that takes place with other safety modules, this is a timeout value that elapses whenever an error occurs (e.g. lost network connection).

> # Information:
>
> **Since SafeLOGIC to SafeLOGIC communication is represented as an additional safety module to the source SafeLOGIC controller, the parameters for the connection are available and must be configured in the source SL controller's project.**

Parameter	Value
Basic	
Min_required_FW_Rev	Basic Release
Optional	No
External_UDID	No
Safety_Response_Time	
Synchronous_Network_Only	Yes
Max_SDG_Powerlink_CycleTime_us	5000
Max_Powerlink_CycleTime_us	5000
Max_CPU_CrossLinkTask_CycleTime_us	5000
Min_SDG_Powerlink_CycleTime_us	200
Min_Powerlink_CycleTime_us	200
Min_CPU_CrossLinkTask_CycleTime_us	0
Worst_Case_Response_Time_us	100000
Max_SDG_Cycle_Time_us	5000
Min_SDG_Cycle_Time_us	1600
Slow_Connection	No

Group: Basic

Parameter	Description	Default value	Unit
Min_required_FW_Rev	This parameter is reserved for future functional expansions.	Basic Release	-
Optional	This parameter can be used to configure the module as "optional". Optional modules do not have to be present, i.e. the SafeLOGIC controller will not indicate that these modules are not present. However, this parameter does not influence the module's signal or status data.	No	-

Parameter value	Description
No	This module is mandatory for the application. The module must be in OPERATIONAL mode after startup, and safe communication to the SafeLOGIC controller must be established without errors (SafeModuleOK = SAFETRUE). Processing of the safety application on the SafeLOGIC controller is delayed after startup until this state is achieved for all modules with "Optional = No". After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.
Yes	The module is not required for the application. The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Optional = Yes" are in OPERATIONAL mode or if safe communication is properly established between these modules and the SafeLOGIC controller. After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.
Startup	This module is optional. The system determines how the module will proceed during startup. If it is determined that the module is physically present during startup (regardless of whether it is in OPERATIONAL mode or not), then the module behaves as if "Optional = No" is set. If it is determined that the module is not physically present during startup, then the module behaves as if "Optional = Yes" is set.
Not_Present (Release 1.9 and later)	The module is not required for the application. The module is ignored during startup, which means the safety application is started regardless of whether the modules with "Optional = Not_Present" are physically present. Unlike when "Optional = Yes" is configured, the module is not started with "Optional = Not_Present", which optimizes system startup behavior. After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.

Parameter	Description	Default value	Unit
External_UDID	This parameter enables the option on the module for the expected UDID to be specified externally by the CPU.	No	-

Parameter value	Description
Yes-ATTENTION	The UDID is determined by the CPU. The SafeLOGIC controller must be restarted if the UDID is changed.
No	The UDID is specified by a teach-in procedure during startup.

Table 26: SafeDESIGNER parameters: Basic

Danger!

If function "External_UDID = Yes-ATTENTION" is used, incorrect specifications from the CPU can lead to safety-critical situations.
Perform an FMEA (Failure Mode and Effects Analysis) in order to detect these situations and implement additional safety measures to handle them.

Group: Safety_Response_Time

Parameter	Description	Default value	Unit
Synchronous_Network_Only	This parameter describes the synchronization characteristics of the network being used. They are defined in Automation Studio / Automation Runtime.	Yes	-
	Parameter value / **Description**		
	Yes — In order to calculate the safety response time, networks must be synchronous and their cycle times must either be the same or an integer ratio of the cycle times.		
	No — No requirement for synchronization of the networks.		
Max_SDG_Powerlink_CycleTime_us	This parameter specifies the maximum cycle time of the POWERLINK network in which the other SafeLOGIC controller is operated. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	5000	µs
Max_Powerlink_CycleTime_us	This parameter specifies the maximum POWERLINK cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	5000	µs
Max_CPU_CrossLinkTask_CycleTime_us	This parameter specifies the maximum cycle time for copying data between the two POWERLINK networks. The value 0 means that both SafeLOGIC controllers are in the same POWERLINK network. • Permissible values: 0 to 3,000,000 µs (corresponds to 0 to 3 s)	5000	µs
Min_SDG_Powerlink_CycleTime_us	This parameter specifies the minimum cycle time of the POWERLINK network in which the other SafeLOGIC controller is operated. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	200	µs
Min_Powerlink_CycleTime_us	This parameter specifies the minimum POWERLINK cycle time used to calculate the safety response time. • Permissible values: 200 to 30,000 µs (corresponds to 0.2 to 30 ms)	200	µs
Min_CPU_CrossLinkTask_CycleTime_us	This parameter specifies the minimum cycle time for copying data between the two POWERLINK networks. The value 0 means that both SafeLOGIC controllers are in the same POWERLINK network. • Permissible values: 0 to 3,000,000 µs (corresponds to 0 to 3 s)	0	µs
Worst_Case_Response_Time_us	This parameter specifies the limit value for monitoring the safety response time. • Permissible values: 3000 to 12,500,000 µs (corresponds to 3 ms to 12.5 s) **Note:** Keep parameter "Slow_Connection" in mind when entering large values here!	100000	µs
Node_Guarding_Lifetime	This parameter specifies the maximum number of attempts to be made during the time set with parameter "Node_Guarding_Timeout_s". The purpose of these attempts is to ensure that the module is available. • Permissible values: 1 to 255 **Note** • The larger the configured value, the greater the amount of asynchronous data traffic. • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently using parameter "Worst_Case_Response_Time_us".	5	-
Max_SDG_Cycle_Time_us	This parameter specifies the maximum cycle time of the other SafeLOGIC controller used to calculate the safety response time. • Permissible values: 800 to 20,000 µs (corresponds to 0.8 to 20 ms)	5000	µs
Min_SDG_Cycle_Time_us	This parameter specifies the minimum cycle time of the other SafeLOGIC controller used to calculate the safety response time. • Permissible values: 800 to 20,000 µs (corresponds to 0.8 to 20 ms)	1600	µs
Slow_Connection	This parameter specifies whether this connection is a slow connection.	No	-
	Parameter value / **Description**		
	Yes — This is a connection with a large ratio between the SafeLOGIC cycle time and the telegram runtime (affects the parameter calculation internally). Rule of thumb: "Yes" from ratio 50:1 (telegram runtime: SafeLOGIC cycle time)		
	No — Default connection, parameter calculation unchanged		

Table 27: SafeDESIGNER parameters: Safety_Response_Time

Information:

Parameter "CPU_CrossLinkTask_CycleTime_us" is needed if the source SL and SDG SL controllers are in different networks or located on different controllers. If this is not the case, the minimum and maximum value must be set to "0".
For this parameter, the entire connection distance between the controllers must be taken into account – including copy times between the interfaces involved.

Information:

Parameter "Slow_Connection" can also be used to specify that the connection between the source SL and SDG SL controllers is slow. If a value of just a few seconds is needed for the connection timeout, then this parameter must be enabled ("Slow_Connection = Yes").

17.3.6 Parameters for connection - Release 1.10 and later

Cycle time parameters are also available for communication in order to define the maximum data transmission time. As with communication that takes place with other safety modules, this is a timeout value that elapses whenever an error occurs (e.g. lost network connection).

> **Information:**
>
> **Since SafeLOGIC to SafeLOGIC communication is represented as an additional safety module to the source SafeLOGIC controller, the parameters for the connection are available and must be configured in the source SL controller's project.**

Materialnummer:	X20SL8100
Description:	X20 SafeLOGIC, POWERLINK V2, 24V, univ.
SafeMODULE ID:	3
Import file:	-

Parameter	Value	Unit
Basic		
Min required FW Rev	Basic Release	
Optional	No	
External UDID	No	
Safety Response Time		
Synchronous Network Only	Yes	
Safe Data Duration	20000	us
Additional Tolerated Packed Loss	0	packets
Slow Connection	No	
Node Guarding Lifetime	5	iterations
Max SDG Cycle Time	5000	us
Min SDG Cycle Time	1600	us

Group: Basic

Parameter	Description	Default value	Unit
Min required FW Rev	This parameter is reserved for future functional expansions.	Basic Release	-
Optional	This parameter can be used to configure the module as "optional". Optional modules do not have to be present, i.e. the SafeLOGIC controller will not indicate that these modules are not present. However, this parameter does not influence the module's signal or status data.	No	-

Parameter value	Description
No	This module is absolutely necessary for the application. The module must be in OPERATIONAL mode after startup, and safe communication to the SafeLOGIC controller must be established without errors (SafeModuleOK = SAFETRUE). Processing of the safety application on the SafeLOGIC controller is delayed after startup until this state is achieved for all modules with "Optional = No". After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.
Yes	This module is not necessary for the application. The module is not taken into account during startup, which means the safety application is started regardless of whether the modules with "Optional = Yes" are in OPERATIONAL mode or if safe communication is properly established between these modules and the SafeLOGIC controller. After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.
Startup	This module is optional. The system determines how the module will proceed during startup. If it is determined that the module is physically present during startup (regardless of whether it is in OPERATIONAL mode or not), then the module behaves as if "Optional = No" is set. If it is determined that the module is not physically present during startup, then the module behaves as if "Optional = Yes" is set.
NotPresent	This module is not necessary for the application. The module is ignored during startup, which means the safety application is started regardless of whether the modules with "Optional = NotPresent" are physically present. Unlike when "Optional = Yes" is configured, the module is not started with "Optional = NotPresent", which optimizes system startup behavior. After startup, module problems are NOT indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is NOT made in the logbook.

Parameter	Description	Default value	Unit
External UDID	This parameter enables the option on the module for the expected UDID to be specified externally by the CPU.	No	-

Parameter value	Description
Yes-ATTENTION	The UDID is determined by the CPU. The SafeLOGIC controller must be restarted if the UDID is changed.
No	The UDID is specified by a teach-in procedure during startup.

Table 28: SafeDESIGNER parameters: Basic

Danger!

If function "External UDID = Yes-ATTENTION" is used, incorrect specifications from the CPU can lead to safety-critical situations.
Perform an FMEA (Failure Mode and Effects Analysis) in order to detect these situations and implement additional safety measures to handle them.

Group: Safety Response Time

Parameter	Description	Default value	Unit
Safe Data Duration	This parameter specifies the maximum permitted data transmission time between the SafeLOGIC controller and SafeIO module. For more information about the actual data transmission time, see section Diagnostics and service → Diagnostics tools → Network analyzer → Editor → Calculation of safety runtime of Automation Help. The cycle time of the safety application must also be added. • Permissible values: 2000 to 10,000,000 µs (corresponds to 2 ms to 10 s)	20000	µs
Additional Tolerated Packet Loss	This parameter specifies the number of additional tolerated lost packets during data transfer. • Permissible values: 0 to 10	0	Packets
Slow Connection	This parameter specifies whether this connection is classified as a slow connection. <table><tr><td>Parameter value</td><td>Description</td></tr><tr><td>Yes</td><td>This is a connection with a large ratio between the SafeLOGIC cycle time and the telegram runtime (affects the parameter calculation internally). Rule of thumb: "Yes" from ratio 50:1 (telegram runtime: SafeLOGIC cycle time)</td></tr><tr><td>No</td><td>Default connection, parameter calculation unchanged</td></tr></table>	No	-
Packets per Node Guarding	This parameter specifies the maximum number of packets used for node guarding. • Permissible values: 1 to 255 **Note** • The larger the configured value, the greater the amount of asynchronous data traffic. • This setting is not critical to safety functionality. The time for safely cutting off actuators is determined independently of this.	5	Packets
Max SDG Cycletime	This parameter specifies the maximum cycle time of the other SafeLOGIC controller used to calculate the safety response time. • Permissible values: 800 to 20,000 µs (corresponds to 0.8 to 20 ms)	5000	µs
Min SDG Cycletime	This parameter specifies the minimum cycle time of the other SafeLOGIC controller used to calculate the safety response time. • Permissible values: 800 to 20,000 µs (corresponds to 0.8 to 20 ms)	1600	µs

Table 29: SafeDESIGNER parameters: Safety Response Time

Information:

Parameter "Slow Connection" can also be used to specify that the connection between the source SL and SDG SL controllers is slow. If a value of just a few seconds is needed for the connection timeout, then this parameter must be enabled ("Slow Connection = Yes").

17.4 Setup mode

Setup mode supports the user during commissioning.

Setup mode is supported in hardware upgrade 1.10.2.x and later.
Automation Runtime B4.26 or higher is required to use setup mode.

Active setup mode is indicated by both the FAILSAFE LED (X20SL81xx series) or SE LED (X20SLXxxx series) as well as an entry in the logbook.

When setup mode is active, acknowledgment requests "SafeKEY exchange", "Firmware acknowledge" and "UDID mismatch" are no longer necessary.

Setup mode can be enabled and disabled using the operating elements of the "Remote Control" in SafeDESIGNER (X20SL81xx and X20SLXxxx series) or using the selector switch and acknowledgment button (X20SL81xx series).

Danger!

Setup mode is only permitted to be enabled during the commissioning of the machine/system.
Setup mode must be disabled during operation.

Danger!

After setup mode is ended, functional testing including a wiring test must be carried out.
If a SafeKEY or SafeLOGIC controller is replaced while setup mode is active, then setup mode will be disabled.
Functional testing must also be carried out in this case.

Functional testing is only permitted to be performed by personnel familiar with the safety application and its functions.

Be sure to validate the entire safety function!

18 Safety response time

The safety response time is the time between the arrival of the signal on the input channel and the output of the cutoff signal on the output.
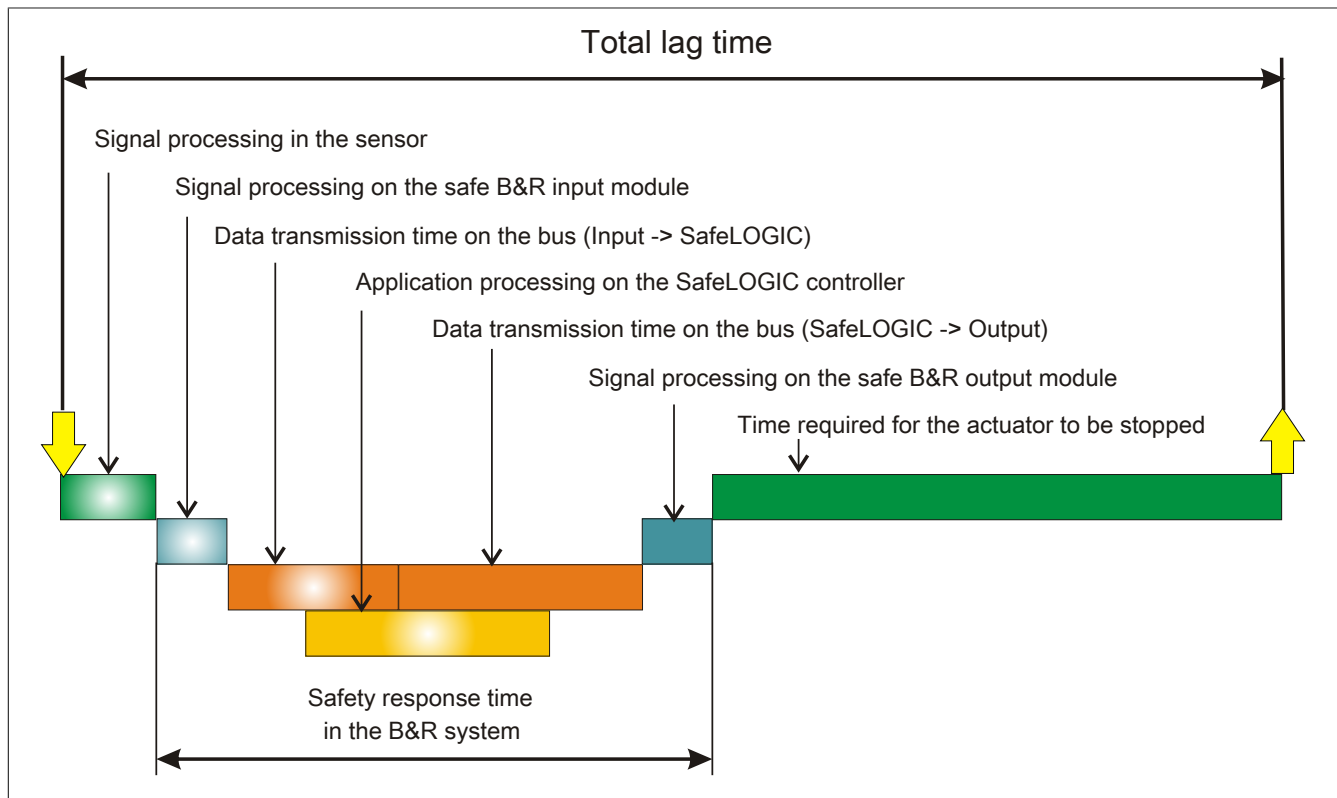
Figure 18: Total lag time

As illustrated in the figure, the safety response time in the B&R system is composed of the following partial response times:

- Signal processing on the safe B&R input module
- Data transmission time on the bus (Input -> SafeLOGIC)
- Data transmission time on the bus (SafeLOGIC -> Output)
- Signal processing on the safe B&R output module

Danger!

The following sections are dedicated exclusively to the safety response time in the B&R system. When assessing the complete safety response time, the user must include signal processing in the sensor as well as the time until the actuator is stopped.

Be sure to validate the total lag time on the system!

Information:

The safety response time in B&R products already contains all delays caused by sampling input data (sampling theorem).

18.1 Signal processing on the safe B&R input module

The maximum I/O update time in the "I/O update time" chapter for the respective module must be taken into account when processing signals in the safe B&R input module.

18.2 Data transmission time on the bus

The following relationship must be taken into consideration for the data transmission time on the bus:

- The time needed to transfer data from the input to the SafeLOGIC controller or to the output depends on the sum of the cycle times and CPU copy times in effect on the transfer line.
- POWERLINK MN (managing node, standard CPU) settings are important for the actual timing on the bus, but they cannot be used from a safety point of view since the values can be changed at any time in the course of modifications made outside of the safety application.
- In the SafeLOGIC controller, data transmission times are monitored on the bus using openSAFETY services. The time needed to process the application on the SafeLOGIC controller is taken into account in this test (system-dependent). Monitoring is defined in SafeDESIGNER using the parameters in parameter group "Safety Response Time".

Information:

The safety components located in this network segment could be cut off by the SafeLOGIC controller if modified parameters on the POWERLINK MN alter the data transmission times on the bus so that they lie outside of the SafeDESIGNER parameters defined in parameter group "Safety Response Time".

Information:

The safety components located in this network segment could be cut off by the SafeLOGIC controller if EMC disturbances cause data failures that fall outside of the SafeDESIGNER parameters defined in parameter group "Safety Response Time".

Calculating the maximum data transmission time - up to Release 1.9:

- The total max. data transmission time on the bus is calculated by adding parameter "Worst_Case_Response_Time_us" for the safe input module and parameter "Worst_Case_Response_Time_us" for the safe output module. When doing this, be sure to check parameter "Manual_Configuration". If parameter "Manual_Configuration" is set to "No", the value specified for parameter "Default_Worst_Case_Response_Time_us" is used.
- **Special case: Local inputs on the X20SLX module:**
  The total max. data transmission time on the bus is calculated by adding parameter "Cycle_Time_max_us" + 2000 μs and parameter "Worst_Case_Response_Time_us" for the safe output module. When doing this, be sure to check parameter "Manual_Configuration". If parameter "Manual_Configuration" is set to "No", the value specified for parameter "Default_Worst_Case_Response_Time_us" is used.

Calculating the maximum data transmission time - Release 1.10 and later:

The following parameters are relevant for calculating the data transmission time between the safe input module and safe output module; parameter "Manual Configuration" deserves special attention.

- Relevant parameters for "Manual Configuration = No":
    - "PacketLoss1": Parameter "Default Additional Tolerated Packet Loss" of group "Safety Response Time Defaults" of the SafeLOGIC controller
    - "DataDuration1": Parameter "Default Safe Data Duration" of group "Safety Response Time Defaults" of the SafeLOGIC controller
    - "NetworkSyncCompensation1": 12 ms
    - "PacketLoss2": Same as "PacketLoss1"
    - "DataDuration2": Same as "DataDuration1"
    - "NetworkSyncCompensation2": Same as "NetworkSyncCompensation1"

- Relevant parameters for "Manual Configuration = Yes":
    - "PacketLoss1": Parameter "Additional Tolerated Packet Loss" of group "Safety Response Time" of the safe input module
    - "DataDuration1": Parameter "Safe Data Duration" of group "Safety Response Time" of the safe input module
    - "NetworkSyncCompensation1": 12 ms
    - "PacketLoss2": Parameter "Additional Tolerated Packet Loss" of group "Safety Response Time" of the safe output module
    - "DataDuration2": Parameter "Safe Data Duration" of group "Safety Response Time" of the safe output module
    - "NetworkSyncCompensation2": Same as "NetworkSyncCompensation1"

- **Special case: Local inputs on the X20SLX module:**
    - "PacketLoss1": 0
    - "DataDuration1": Parameter "Cycle Time max" of group "Module Configuration" of the X20SLX + 2000 µs
    - "NetworkSyncCompensation1": 0 ms

- **Special case: Local outputs on the X20SLX module:**
    - "PacketLoss2": 0
    - "DataDuration2": Parameter "Cycle Time max" of group "Module Configuration" of the X20SLX + 2000 µs
    - "NetworkSyncCompensation2": 0 ms

- **Special case: Linking local inputs with local outputs on the X20SRT module:**
    - "PacketLoss1": 0
    - "PacketLoss2": 0
    - "DataDuration1": Parameter "Cycle time" of group "General"
    - "DataDuration2": Parameter "Cycle time" of group "General"
    - "NetworkSyncCompensation1": 0 ms
    - "NetworkSyncCompensation2": 0 ms

The following equation is used to calculate the maximum data transmission time between the safe input module and safe output module:

Maximum data transmission time = (PacketLoss1+1)* DataDuration1 + NetworkSyncCompensation1 + (PacketLoss2+1)* DataDuration2 + NetworkSyncCompensation2

> **Information:**
>
> **In addition to the data transmission time on the bus, the time for signal processing in the safe B&R input and output module must be taken into account (see section 18 "Safety response time").**

Information:

For more information about the actual data transmission time, see Automation Help, section Diagnostics and service → Diagnostics tools → Network analyzer → Editor → Calculation of safety runtime. The cycle time of the safety application must also be added.

18.3 Signal processing on the safe B&R output module

The maximum I/O update time in the "I/O update time" chapter for the respective module must be taken into account when processing signals in the safe B&R output module.

18.4 Minimum signal lengths

The parameters in group "Safety Response Time" in SafeDESIGNER influence the maximum number of data packets that are permitted to fail without triggering a safety response. These parameters therefore act like a switch-off filter. If several data packets are lost within the tolerated amount, safety signals may not be detected if their low phase is shorter than the determined data transmission time.

Danger!

Lost signals can result in serious safety errors. Check all signals to determine the smallest possible pulse length and make sure that it is larger than the determined data transmission time.

Suggested solution:

- The switch-on filter can be used to extend the low phase of a signal on the input module.
- Low phases of signals from the SafeLOGIC controller can be lengthened with restart interlock functions or timer function blocks.

19 Intended use

> # Danger!
>
> **Danger from incorrect use of safety-related products/functions**
>
> **Proper functionality is only ensured if the products/functions are used in accordance with their intended use by qualified personnel and the provided safety information is taken into account. The aforementioned conditions must be observed or covered by supplementary measures on your own responsibility in order to ensure the specified protective functions.**

19.1 Qualified personnel

Use of safety-related products is restricted to the following persons:

- Qualified personnel who are familiar with relevant safety concepts for automation technology as well as applicable standards and regulations
- Qualified personnel who plan, develop, install and commission safety equipment in machines and systems

Qualified personnel in the context of this manual's safety guidelines are those who, because of their training, experience and instruction combined with their knowledge of relevant standards, regulations, accident prevention guidelines and operating conditions, are qualified to carry out essential tasks and recognize and avoid potentially dangerous situations.
In this regard, sufficient language skills are also required in order to be able to properly understand this manual.

19.2 Application range

The safety-related B&R control components described in this manual were designed, developed and manufactured for special applications for machine and personnel protection. They are not suitable for any use involving serious risks or hazards that could lead to the injury or death of several people or serious environmental impact without the implementation of exceptionally stringent safety precautions. In particular, this includes the use of these devices to monitor nuclear reactions in nuclear power plants, flight control systems, air traffic control, the control of mass transport vehicles, medical life support systems and the control of weapon systems.

When using safety-oriented control components, the safety precautions applying to industrial control systems (e.g. the provision of safety devices such as emergency stop circuits, etc.) must be observed in accordance with applicable national and international regulations. The same applies for all other devices connected to the system, e.g. drives or light curtains.

The safety guidelines, information about connection conditions (nameplate and documentation) and limit values specified in the technical data must be read carefully before installation and commissioning and must be strictly observed.

19.3 Security concept

B&R products communicate via a network interface and were developed for integration into a secure network. The network and B&R products are affected by the following hazards (not a complete list):

- Unauthorized access
- Digital intrusion
- Data leakage
- Data theft
- A variety of other types of IT security breaches

It is the responsibility of the operator to provide and maintain a secure connection between B&R products and the internal network as well as other networks, such as the Internet, if necessary. The following measures and security solutions are suitable for this purpose:

- Segmentation of the network (e.g. separation of the IT and OT networks)
- Firewalls for the secure connection of network segments
- Implementation of a security-optimized user account and password concept
- Intrusion prevention and authentication systems
- Endpoint security solutions with modules for anti-malware, data leakage prevention, etc.
- Data encryption

It is the responsibility of the operator to take appropriate measures and to implement effective security solutions.

B&R Industrial Automation GmbH and its subsidiaries are not liable for damages and/or losses resulting from, for example, IT security breaches, unauthorized access, digital intrusion, data leakage and/or data theft.

Before B&R releases products or updates, they are subjected to appropriate functional testing. Independently of this, the development of customized test processes is recommended in order to be able to check the effects of changes in advance. Such changes include, for example:

- Installation of product updates
- Notable system modifications such as configuration changes
- Import of updates or patches for third-party software (non-B&R software)
- Hardware replacement

These tests should ensure that implemented security measures remain effective and that systems behave as expected.

19.4 Safety technology disclaimer

The proper use of all B&R products must be guaranteed by the customer through the implementation of suitable training, instruction and documentation measures. The guidelines set forth in system user's manuals must be taken into consideration here as well. B&R has no obligation to provide verification or warnings with regard to the customer's purpose of using the delivered product.

Changes to the devices are not permitted when using safety-related components. Only certified products are permitted to be used. Currently valid product versions in each case are listed in the corresponding certificates. Current certificates are available on the B&R website (www.br-automation.com) in the Downloads section for the respective product. The use of non-certified products or product versions is not permitted.

All relevant information regarding these safety products must be read in the latest version of the related data sheet and the corresponding safety notices observed before the safety products are permitted to be operated. Certified data sheets are available on the B&R website (www.br-automation.com) in the Downloads section for the respective product.

B&R and its employees are not liable for any damages or loss resulting from the incorrect use of these products. The same applies to misuse that may result from specifications or statements made by B&R in connection with sales, support or application activities. It is the sole responsibility of the user to check all specifications and statements made by B&R for proper application as it pertains to safety-related applications. In addition, the user assumes sole responsibility for the proper design of the safety function as it pertains to safety-related applications.

19.5 X20 system characteristics

Because all X20 safety products are seamlessly integrated into the B&R base system, the same system characteristics and user notices from the X20 system user's manual also apply to X20 safety products.

> # Warning!
>
> **Possible failure of safety function**
>
> **Malfunction of module due to unspecified operating conditions**
> **The notes for installation and operation of the modules provided in the applicable documents must be observed.**

In this regard, this means the content and user notices in the following applicable documentation must be observed for X20 safety products:

- X20 system user's manual
- Installation / EMC guide

19.6 Installation notes for X20 modules

Products must be protected against impermissible dirt and contaminants. Products are protected from dirt and contaminants up to pollution degree II as specified in the IEC 60664 standard.

Pollution degree II can usually be achieved in an enclosure with IP54 protection, but uncoated modules are NOT permitted to be operated in condensing relative humidity and temperatures under 0°C.

The operation of coated modules is allowed in condensing relative humidity.

Danger!

Pollution levels higher than specified by pollution degree II in standard IEC 60664 can result in dangerous failures. It is extremely important that you ensure a proper operating environment.

Danger!

In order to guarantee a specific voltage supply, a SELV power supply that conforms to IEC 60204 must be used to supply the bus, SafeIO and SafeLOGIC controller. This also applies to all digital signal sources that are connected to the modules.

If the power supply is grounded (PELV system), then only a GND connection is permitted for grounding. Grounding types that have ground connected to +24 VDC are not permitted.

The power supply of X20 potential groups must generally be protected using a fuse with a maximum of 10 A.
For more information, see chapter "Mechanical and electrical configuration" of the X20 or X67 user's manual.

19.7 Safe state

If an error is detected by the module (internal or wiring error), the modules enable the safe state. The safe state is structurally designed as a low state or cutoff and cannot be modified.

Danger!

Applications in which the safe state must actively switch on an actuator cannot be implemented with this module. In these cases, other measures must be taken to meet this safety-related requirement (e.g. mechanical brakes for hanging load that engage on power failure).

19.8 Mission time

All safety modules are designed to be maintenance-free. Repairs are not permitted to be carried out on safety modules.

All safety modules have a maximum mission time of 20 years.

This means that all safety modules must be taken out of service one week (at the latest) before the expiration of this 20-year time span (starting from B&R's delivery date).

Danger!

Operating safety modules beyond the specified mission time is not permitted! The user must ensure that all safety modules are replaced by new safety modules or removed from operation before their mission time expires.

20 Release information

A manual version always describes the respective range of functions for a given product set release. The following table shows the relationship between manual versions and releases.

Manual version	Valid for		
V1.141			
V1.140	**Version**	**Starting with**	**Up to**
V1.131	Product set	Release 1.2	Release 1.10
V1.130	SafeDESIGNER	2.70	4.9
V1.123	Firmware	270	399
V1.122	Upgrades	1.2.0.0	1.10.999.999
V1.121			
V1.120			
V1.111			
V1.110			
V1.103			
V1.102			
V1.101			
V1.100			
V1.92			
V1.91			
V1.90			
V1.80			
V1.71			
V1.70			
V1.64			
V1.63.2			
V1.63.1			
V1.63			
V1.62			
V1.61			
V1.60			
V1.52.1			
V1.52			
V1.51			
V1.50.1			
V1.50			
V1.42			
V1.41			
V1.40			
V1.20			
V1.10			
V1.02			
V1.01	**Version**	**Starting with**	**Up to**
V1.00	Product set	Release 1.0	Release 1.1
	SafeDESIGNER	2.58	2.69
	Firmware	256	269
	Upgrades	1.0.0.0	1.1.999.999

Table 30: Release information

21 Version history

Version	Date	Comment
1.141	April 2019	• Chapter 4 "Technical data": Updated standards. • Updated chapter 19.3 "Security concept". • Updated chapter 19.6 "Installation notes for X20 modules".
1.140	February 2019	• Chapter 3 "Order data": Added X20BM16 as an accessory. • Chapter 4 "Technical data": Limited installation elevation to 2000 m. • Chapter 14.3 "Parameters in SafeDESIGNER - Release 1.10 and later": Added filter value to danger notice. • Chapter 14.4 "Channel list": Added new channels. • Chapter 18.2 "Data transmission time on the bus": Updated calculation of maximum data transmission time. • Chapter 19 "Intended use": Added danger notice. • Added chapter "Security notes". • Chapter 19.5 "X20 system characteristics": Added warning notice. • Updated standards. • Editorial changes.

1.120	November 2017	• Chapter 4 "Technical data":
		  – Updated standards and safety characteristics.
		  – Added timing precision.
		  – Added input characteristics per EN 61131-2.
		  – Updated input resistance.
		  – Added line length between pulse output and input.
		  – Coated module: Extended temperature range.
		  – Updated derating.
		• Chapter 13 "Restart behavior": Updated description.
		• Chapter 14.3 "Parameters in SafeDESIGNER - Release 1.10 and later": Group "Safety Response Time Defaults": Updated parameter "Default Safe Data Duration".
		• Chapter 14.4 "Channel list": Added channel "SafeOsState" and updated "SLXbootState".
		• Chapter 15.5 "SafeKEY or safety section of the CompactFlash card": Updated description.
		• Chapter 17.3 "SafeLOGIC to SafeLOGIC communication": Added system requirements.
		• Chapter 17.3.6 "Parameters for connection - Release 1.10 and later": Group "Safety Response Time": Updated parameter "Safe Data Duration".
		• Chapter 18.2 "Data transmission time on the bus": Updated description and added information.
		• Chapter 19.6 "Installation notes for X20 modules": Updated danger notice.
		• Updated standards.
		• Editorial changes.

1.110	March 2017	• Chapter 4 "Technical data":
		  – Updated standards and safety characteristics.
		  – Updated "Communication with each other".
		  – Added "Max. number of SafeMOTION axes".
		  – Updated "Max. number of openSAFETY nodes".
		  – Updated "Input current at 24 VDC".
		  – Updated "Input resistance".
		• Chapter 7 "Connection examples": Added information.
		• Chapter 14.3 "Parameters in SafeDESIGNER - Release 1.10 and later":
		  – Group "Basic": Added information and new parameters.
		  – Group "Safety Response Time Defaults": Removed parameters.
		  – Group "Module Configuration": Removed parameters.
		• Chapter 14.4 "Channel list": Updated SLXioCycle.
		• Chapter 15.5.2 "Acknowledging a SafeKEY replacement": Added information.
		• Chapter 16 "Quick start": Added new subsections.
		• Chapter 17.1 "Operation via the AsSafety library": Removed content, added reference to Automation Help.
		• Chapter 17.4 "Setup mode": Added.
		• Chapter 17.3.6 "Parameters for connection - Release 1.10 and later": Removed parameters.
		• Chapter 18.2 "Data transmission time on the bus": Added information about data transmission time.
		• Chapter 19.7 "Safe state": Updated danger notice.

1.103	August 2016	• Chapter 4 "Technical data": Updated standards.
1.101	April 2016	• Chapter 11 "I/O update time": Updated. • Chapter 14.4 "Channel list": Added new channels. • Chapter 18 "Safety response time": Added information.

Table 31: Version history

Version	Date	Comment
1.100	January 2016	Merged coated/uncoated modules. Renamed documentation from X20SLXx10 to X20SLXx1x. Added X20SLX811 module. • Chapter 1 "General information": Added. • Chapter 4 "Technical data": – Updated standards. – Updated temperature range. – Updated technical data. • Revised chapter 11 "I/O update time". • Chapter 14.2 "Parameters in SafeDESIGNER - up to Release 1.9": Added parameter "Cycle_Time_typical_us". • Chapter 14.3 "Parameters in SafeDESIGNER - Release 1.10 and later": Added. • Chapter 17.2 "Automatic acknowledgment": Added. • Chapter 17.3.6 "Parameters for connection - Release 1.10 and later": Added. • Chapter 18.1 "Signal processing on the safe B&R input module": Updated description. • Chapter 18.2 "Data transmission time on the bus": Updated description with "Release 1.10 and later". • Chapter 18.3 "Signal processing on the safe B&R output module": Updated description. • Chapter 18.4 "Minimum signal lengths": Updated description. • Revised chapter 19.4 "Safety technology disclaimer". • Chapter 20 "Release information": Updated.

Table 31: Version history

Version	Date	Comment
1.91	April 2015	• Chapter 4 "Technical data": – "Safe digital inputs": - "Input current at 24 VDC": Typ. 2.48 mA - "Input resistance": Typ. 9.68 kΩ - "Max. internal cycle time": 1600 µs - "Cable length": Limited to 50 m • Chapter 8.2.3 "Connecting multi-channel sensors with contacts": Updated danger notice. • Corrected chapter 12 "Filter". • Chapter 18.1 "Signal processing on the safe B&R input module": Updated description.
1.90	October 2014	• Chapter 4 "Technical data": – "Short description": "I/O module": Adapted text to order data. – "Functionality": "Support for machine options": Added BOOL to UDINT. – "Limit values for the SafeDESIGNER application": "Max. resources available for SafeDESIGNER info window entries": Added memory for input/output data. – "Temperature": "Operation": "Horizontal mounting orientation": Extended temperature range to 60°C. – "Temperature": "Operation": Added "Derating bonus at 24 VDC". – "Temperature": "Operation": Added "Derating bonus with dummy modules". – Section "Derating": Updated description and curves. • Chapter 17.3.5 "Parameters for connection - up to Release 1.9": Group "Basic": Added parameter value "Not_Present" for "Optional". • Updated chapter 20 "Release information". • Editorial changes.
1.80	June 2014	• Chapter 4 "Technical data": – Corrected "System requirements". – Added "Safety-related characteristic values" and deleted chapter "Safety-related characteristic values". – "Functionality": "Communication with each other": Changed to X20SL8100. – "Functionality": Added following items: - "Max. number of openSAFETY nodes" - "Max. number of POWERLINK controlled nodes" - "Data exchange between CPU and SL" - "Data exchange between SL and SL" – Added "Limit values for SafeDESIGNER application". – "Pulse outputs": - "Nominal output current": Changed to 50 mA. - "Output protection": Changed to shutdown of individual channels in the event of overload or short circuit. - "Peak short-circuit current": Changed to 100 mA. - "Residual voltage": Changed to 2 VDC. - "Total nominal current": Changed to 100 mA or 200 mA. – Added danger notice. • Chapter 8.1 "Internal module errors": Updated description. • Chapter 10 "Minimum cycle time": Changed to 200 µs. • Added chapter 13 "Restart behavior". • Chapter 14.2 "Parameters in SafeDESIGNER - up to Release 1.9": Group "Safety_Response_Time_Defaults": Added parameter "Default_Node_Guarding_Lifetime". • Chapter 14.4 "Channel list": Added channel "SLXioCycle". • Added chapter "Check the version of the library being used". • Chapter 17.3.5 "Parameters for connection - up to Release 1.9": Group "Safety_Response_Time": Added parameter "Node_Guarding_Lifetime". • Chapter 18.2 "Data transmission time on the bus": Updated description. • Chapter 19.6 "Installation notes for X20 modules": Removed figure "Protecting various potential groups", updated description accordingly. • Chapter 20 "Release information": Updated.
1.71	July 2013	First edition as a product-specific manual

Table 31: Version history

22 EC declaration of conformity

This document was originally written in the German language. The German edition therefore represents the original documentation in accordance with the 2006/42/EC Machinery Directive. Documents in other languages are to be interpreted as translations of the original documentation.

Product manufacturer:

B&R Industrial Automation GmbH

B&R Strasse 1

5142 Eggelsberg

Austria

Telephone: +43 7748 6586-0

Fax: +43 7748 6586-26

office@br-automation.com

The place of jurisdiction, in accordance with article 17 of the European Convention on Courts of Jurisdiction and Enforcement, is A-4910

Ried im Innkreis, Austria, commercial register court: Ried im Innkreis, Austria

Commercial register number: FN 111651 v.

The place of fulfillment in accordance with article 5 of the European Convention on Courts of Jurisdiction and Enforcement is A-5142 Eggelsberg, Austria

VATIN: ATU62367156

The EC declarations of conformity for B&R products can be downloaded from the B&R website www.br-automation.com.