X20(c)SIx1x0

> ## 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 is available for download on the B&R website (www.br-automation.com).**

> ## Information:
>
> **This data sheet must be used with mapp Safety.**
> **B&R safety technology can still be used in Safety Releases ≤1.10, however. The documentation is available for download on the B&R website (www.br-automation.com).**
>
> **For additional information about mapp Safety, additional technical descriptions (e.g. connection examples and error detection) as well as generally valid contents (intended use, etc.), see section Safety technology in Automation Help.**

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 2 to 20 safe digital inputs. They are designed for a nominal voltage of 24 VDC.

The modules can be used to read in digital signals in safety-related applications up to PL e or SIL 3.

The modules are equipped with filters that are individually configurable for switch-on and switch-off behavior. The modules also provide pulse signals for diagnosing the sensor line.

These modules are designed for X20 12-pin terminal blocks.

- 2 to 20 safe digital inputs
- 2 to 4 pulse outputs
- Sink circuit
- Software input filter configurable for each channel

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)!**

2.1 Starting temperature

The starting temperature describes the minimum permissible ambient temperature in a voltage-free state at the time the coated module is switched on. This is permitted to be as low as -40°C. During operation, the conditions as specified in the technical data continue to apply.

> **Information:**
>
> **It is important to absolutely ensure that there is no forced cooling by air currents in the closed control cabinet, e.g. due to the use of a fan or ventilation slots.**

> **Information:**
>
> **The starting temperature is not supported by all modules mentioned in this data sheet. For the modules that are actually supported, see the technical data.**

3 Order data

X20SI2100 / X20SI4100   X20SI4110 / X20SI8110   X20SI9100

Order number	Short description
	Digital input modules
X20SI2100	X20 safe digital input module, 2 safe type A digital inputs, configurable input filter, 2 pulse outputs, 24 VDC
X20SI4100	X20 safe digital input module, 4 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20cSI4100	X20 safe digital input module, coated, 4 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20SI4110	X20 safe digital input module, 4 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, single-width
X20SI8110	X20 safe digital input module, 8 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, single-width
X20SI9100	X20 safe digital input module, 20 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC
X20cSI9100	X20 safe digital input module, coated, 20 safe type A 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 connected through, single-width
X20BM16	X20 bus module, for X20 SafeIO modules, with node number switch, internal I/O power supply connected through, single-width
X20BM33	X20 bus module, for X20 SafeIO modules, internal I/O power supply connected through
X20BM36	X20 bus module, for X20 SafeIO modules, with node number switch, internal I/O power supply connected through
X20cBM33	X20 bus module, coated, for X20 SafeIO modules, internal I/O power supply connected through
	Terminal blocks
X20TB52	X20 terminal block, 12-pin, safety-keyed

Table 3: X20SI2100, X20SI4100, X20cSI4100, X20SI4110, X20SI8110, X20SI9100, X20cSI9100 - Order data

4 Technical data

Order number	X20SI2100	X20SI4100	X20cSI4100	X20SI4110	X20SI8110	X20SI9100	X20cSI9100
Short description							
I/O module	2 safe type A digital inputs, 2 pulse outputs, 24 VDC	4 safe type A digital inputs, 4 pulse outputs, 24 VDC			8 safe type A digital inputs, 4 pulse outputs, 24 VDC	20 safe type A digital inputs, 4 pulse outputs, 24 VDC	
General information							
B&R ID code	0x1F15	0x1DBD	0xDD5A	0x2D13	0xE742	0xAEC8	0xDD5B
System requirements							
Automation Studio	3.0.71 or later	4.0.16 or later		4.0 or later		3.0.81.15 or later	4.0.16 or later
Automation Runtime	2.95 or later	V3.08 or later		4.0 or later		3.00 or later	V3.08 or later
SafeDESIGNER	2.58 or later	3.1.0 or later		3.4.0 or later		2.71 or later	3.1.0 or later
Safety Release	1.1 or later	1.7 or later		1.10 or later	1.7 or later	1.3 or later	1.7 or later
mapp Technology Package [1]	mapp Safety 5.7.0 or later						
Status indicators	I/O function per channel, operating state, module status						
Diagnostics							
Module run/error	Yes, using LED status indicator and software						
Inputs	Yes, using LED status indicator and software						
Blackout mode							
Scope	Module						
Function	Module functionality						
Standalone mode	No						
Max. I/O cycle time	800 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	
Additional power dissipation caused by actuators (resistive) [W] [2]	0.3	0.6		0.8		0.6	
Electrical isolation							
Channel - Bus	Yes						
Channel - Channel	No						
Certifications							
CE	Yes						
UKCA	Yes						
Functional safety	cULus FSPC E361559 Energy and industrial systems Certified for functional safety ANSI UL 1998:2013			-		cULus FSPC E361559 Energy and industrial systems Certified for functional safety ANSI UL 1998:2013	
Functional safety	IEC 61508:2010, SIL 3 EN 62061:2005/A2:2015, SIL 3 EN ISO 13849-1:2015, Cat. 4 / PL e IEC 61511:2004, SIL 3						
Functional safety	EN 50156-1:2004			-		EN 50156-1:2004	
ATEX	Zone 2, II 3G Ex nA nC IIA T5 Gc IP20, Ta (see X20 user's manual) FTZÚ 09 ATEX 0083X						
UL	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	
DNV	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)	
LR	ENV1			-		ENV1	
KR	Yes			-		Yes	
ABS	Yes			-		Yes	
BV	**EC21B** Temperature: 5 - 45°C Vibration: 0.7 g EMC: Bridge and open deck			-		**EC21B** Temperature: 5 - 45°C Vibration: 0.7 g EMC: Bridge and open deck	
EAC	Yes			-		Yes	
KC	Yes			-		Yes	-
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 [3]						
PL	PL e						
DC	>94%						
Mission time	Max. 20 years						

Table 4: X20SI2100, X20SI4100, X20cSI4100, X20SI4110, X20SI8110, X20SI9100, X20cSI9100 - Technical data

Order number	X20SI2100	X20SI4100	X20cSI4100	X20SI4110	X20SI8110	X20SI9100	X20cSI9100
IEC 61508:2010, IEC 61511:2004, EN 62061:2013							
SIL CL				SIL 3			
SFF				>90%			
PFH / PFH$_d$							
openSAFETY wired				Negligible			
openSAFETY wireless				<1*10^{-14} * Number of openSAFETY packets per hour			
Proof test interval (PT)				20 years			
Safe digital inputs							
EN ISO 13849-1:2015							
MTTFD per channel				100 years when using individual input channels, 2500 years when using input channel pairs (e.g. SI1 and SI2) or more than 2 input channels			
IEC 61508:2010, IEC 61511:2004, EN 62061:2013							
PFH / PFH$_d$ per channel				<1*10^{-10}			
PFD per channel				<2*10^{-5}			
I/O power supply							
Nominal voltage				24 VDC			
Voltage range				24 VDC -15% / +20%			
Integrated protection				Reverse polarity protection			
Safe digital inputs							
Quantity	2	4			8	20	
Variant				Type A			
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 [4]	Min. 2 mA to max. 4.59 mA. Hardware revision J0 and later: Min. 2 mA to max. 3.28 mA.			Min. 2 mA to max. 3.28 mA			
Input resistance	Min. 5.23 kΩ, hardware revision J0 and later: Min. 7.33 kΩ			Min. 7.33 kΩ			
Error detection time		100 ms				200 ms	
Insulation voltage between channel and bus				500 V$_{eff}$			
Switching threshold							
Low				<5 VDC			
High				>15 VDC			
Line length between signal source (pulse output or external signal) and input				Max. 60 m with unshielded line Max. 400 m with shielded line			
Pulse outputs							
Quantity	2			4			
Variant				Push-Pull			
Nominal output current	100 mA, hardware revision J0 and later: 50 mA			50 mA			
Output protection	Thermal shutdown of all channels in the event of overload or short circuit, hardware revision J0 and later: Shutdown of individual channels in the event of overload or short circuit [5]			Shutdown of individual channels in the event of overload or short circuit [5]			
Peak short-circuit current	300 mA, hardware revision J0 and later: 25 A for 15 µs			0.5 A for 120 µs		25 A for 5 ms, hardware revision D0 and later: 25 A for 15 µs	
Short-circuit current	100 mA$_{eff}$			15 mA$_{eff}$		100 mA$_{eff}$	
Leakage current when the output is switched off				0.1 mA			
R$_{DS(on)}$	60 Ω			80 Ω		60 Ω	
Switching voltage				I/O power supply minus voltage drop due to R$_{DS(on)}$			
Total nominal current	200 mA, hardware revision J0 and later: 100 mA	400 mA, hardware revision J0 and later: 200 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			

Table 4: X20SI2100, X20SI4100, X20cSI4100, X20SI4110, X20SI8110, X20SI9100, X20cSI9100 - Technical data

Order number	X20SI2100	X20SI4100	X20cSI4100	X20SI4110	X20SI8110	X20SI9100	X20cSI9100
Ambient conditions							
Temperature							
Operation							
Horizontal mounting orientation	0 to 60°C		-25 to 60°C	0 to 60°C			-25 to 60°C
Vertical mounting orientation	0 to 50°C		-25 to 50°C	0 to 50°C			-25 to 50°C
Derating	See section "Derating".						
Starting temperature	-	-	Yes, -40°C	-			
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.	
Pitch	25$^{+0.2}$ mm			12.5$^{+0.2}$ mm		25$^{+0.2}$ mm	

Table 4: X20SI2100, X20SI4100, X20cSI4100, X20SI4110, X20SI8110, X20SI9100, X20cSI9100 - Technical data

1)   The system requirements of the mapp Technology Package must be observed (see Automation Help).
2)   Number of outputs x $R_{DS(on)}$ x Nominal output current^2. This value also applies to sensors that are supplied via these outputs. For a calculation example, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3)   In addition, the danger notices in the technical data sheet and section "Safety technology" in Automation Help must be observed.
4)   The input current specifications refer to the switched-on state of the input.
5)   The protective function is provided for max. 30 minutes for a continuous short circuit.

Derating

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

The derating curve requires that the pulse outputs are used exclusively for supplying the safe digital inputs and not for supplying power to electronic actuators.

Module	X20SI2100	X20SI4100	X20SI4110	X20SI8110	X20SI9100
Derating bonus					
I/O power supply / Input voltage: Max. 24 VDC	+2.5°C				+5°C
I/O power supply / Input voltage: Max. 20.4 VDC	+2.5°C		+5°C		+5°C
Dummy module on the left	+0°C		+2.5°C		+0°C
Dummy module on the right	+2.5°C				
Dummy module on the left and right	+5°C				
With double PFH / PFH$_d$	+0°C		+15°C	+15°C	+0°C

Table 5: Derating bonus

1)   Hardware revision E0 and later

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.
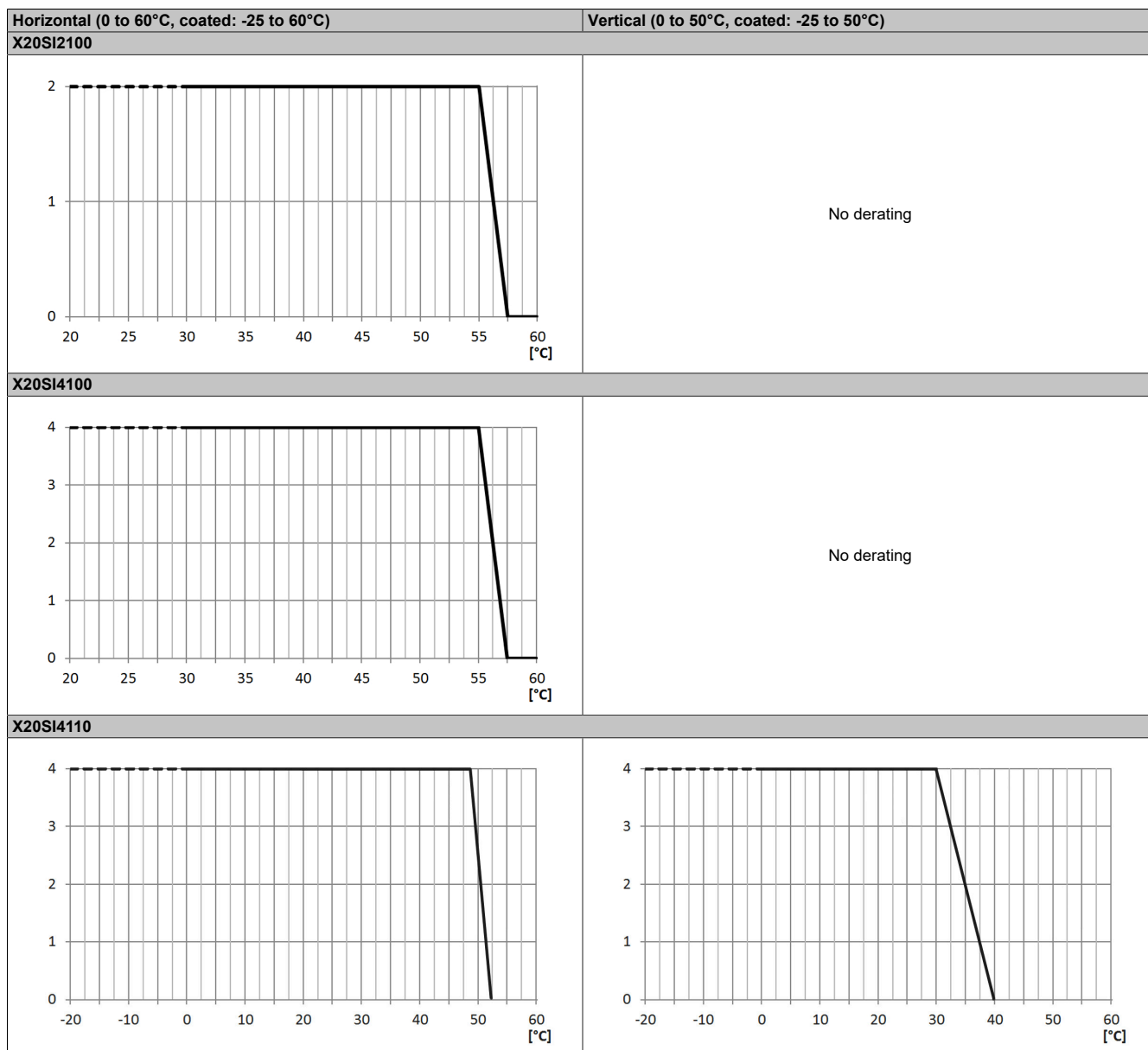
Horizontal (0 to 60°C, coated: -25 to 60°C)	Vertical (0 to 50°C, coated: -25 to 50°C)
X20SI2100	
	No derating
X20SI4100	
	No derating
X20SI4110	

Table 6: Derating in relation to operating temperature and mounting orientation

Horizontal (0 to 60°C, coated: -25 to 60°C)	Vertical (0 to 50°C, coated: -25 to 50°C)
X20SI8110	
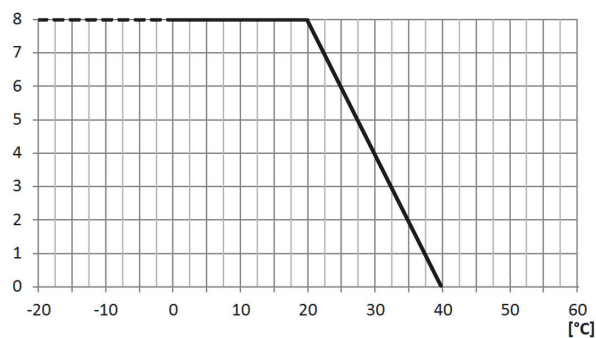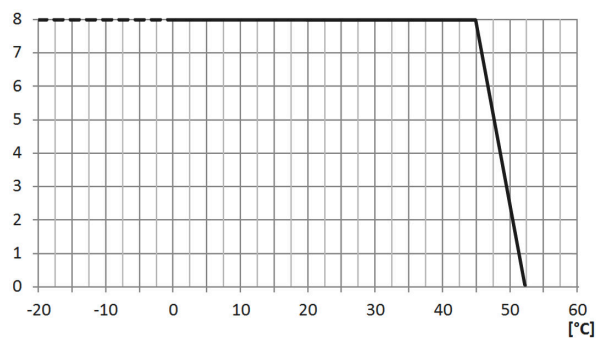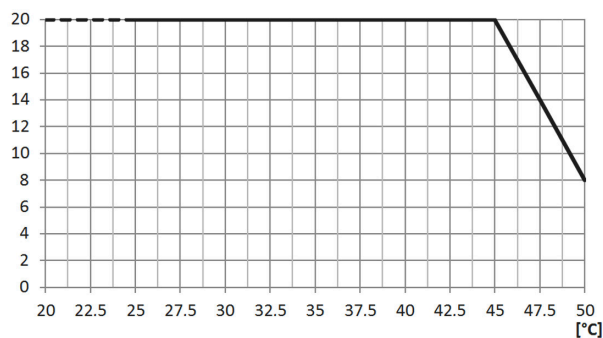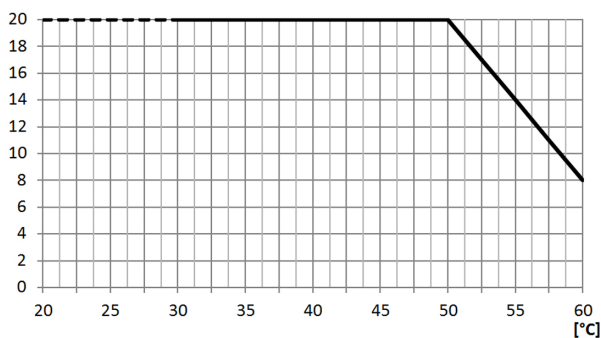
Table 6: Derating in relation to operating temperature and mounting orientation

Information:

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

Danger!

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

Information:

For additional information about installation, see section "Installation notes for X20 modules" in Automation Help.

5 LED status indicators
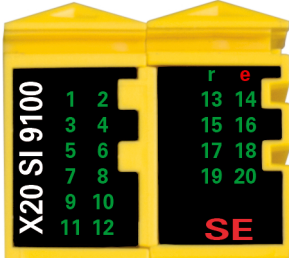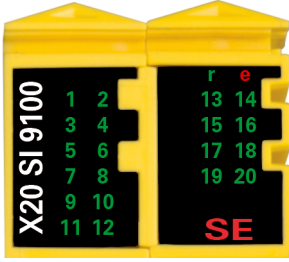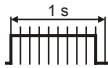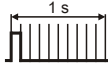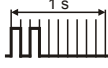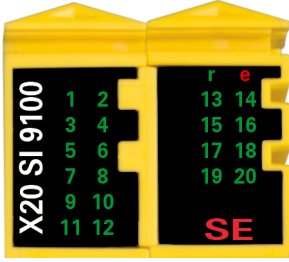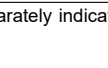
Figure	LED	Color	Status	Description
X20SI2100	r	Green	Off	No power to module
			Single flash	Mode "Reset"
			Double flash	Updating firmware
			Blinking	Mode PREOPERATIONAL
			On	Mode RUN
	e	Red	Off	Module not supplied with power or everything OK
			Pulsating	Bootloader mode
			Triple flash	Updating safety-related firmware
			On	Error or I/O component not provided with voltage
	e + r	Solid red / Single green flash		Invalid firmware
X20SI4100	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 X20SI9100, X20SI4110 and X20SI8110)	Error in dual-channel evaluation (synchronous blinking of 2 affected channels)
			All on	Error on all channels, connection to the SafeLOGIC controller not OK or startup 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 function block "Equivalent"
X20SI4110		Red	On	Warning/Error on this evaluation channel
			All on	Error on all channels, connection to the SafeLOGIC controller not OK 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 function block "Antivalent"
		Red	On	Warning/Error on this evaluation channel
			All on	Error on all channels, connection to the SafeLOGIC controller not OK or startup not yet completed
X20SI8110		Green	On	Evaluation channel set
	SE	Red	Off	Mode RUN or I/O component not provided with voltage
			[1 s pulse diagram]	Boot phase, missing X2X Link or defective processor
			[1 s pulse diagram]	Safety PREOPERATIONAL state. Modules that are not used in the SafeDESIGNER application remain in state PREOPERATIONAL.
			[1 s pulse diagram]	Safe communication channel not OK
			[1 s pulse diagram]	The firmware for this module is a non-certified pilot customer version.
			[1 s pulse diagram]	Boot phase, faulty firmware
			On	Safety state active for the entire module (= state "FailSafe")
X20SI9100	The "SE" LEDs separately indicate the status of safety processor 1 ("S" LED) and safety processor 2 ("E" LED).			

Table 7: Status indicators

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
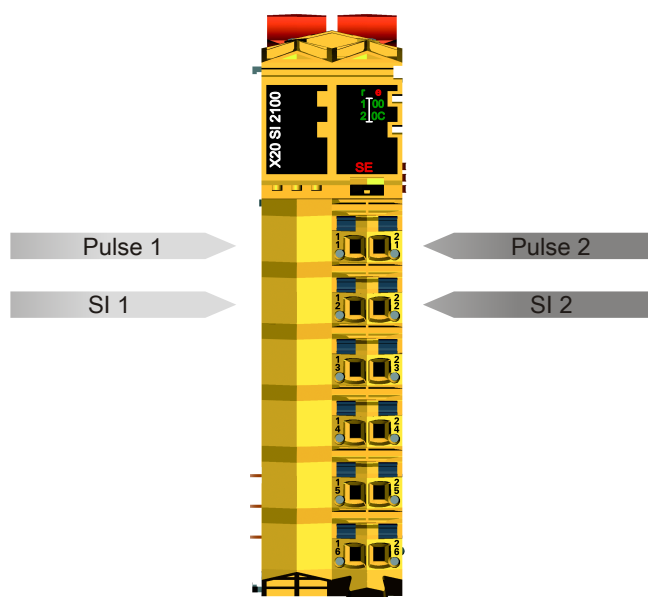
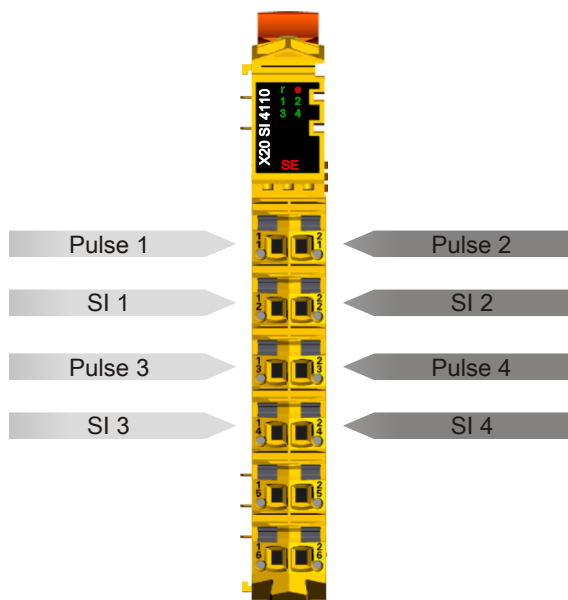Figure 1: X20SI2100 - Pinout
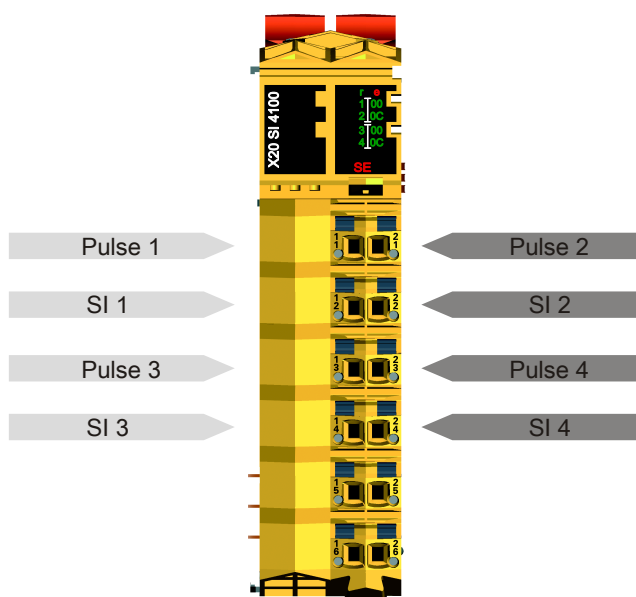
Figure 2: X20SI4100 - Pinout
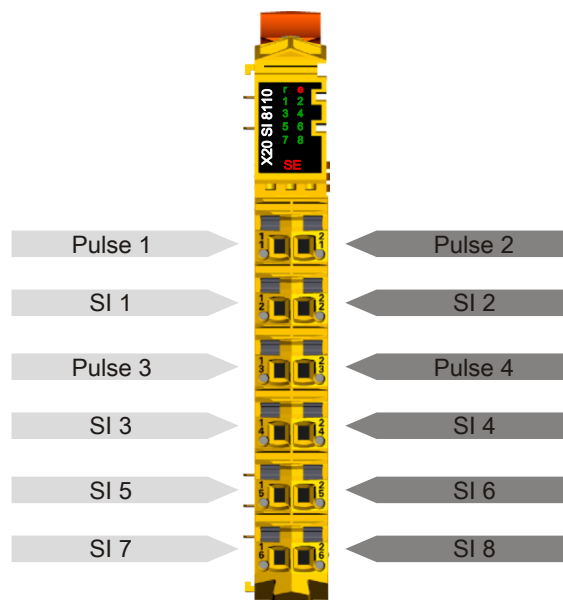

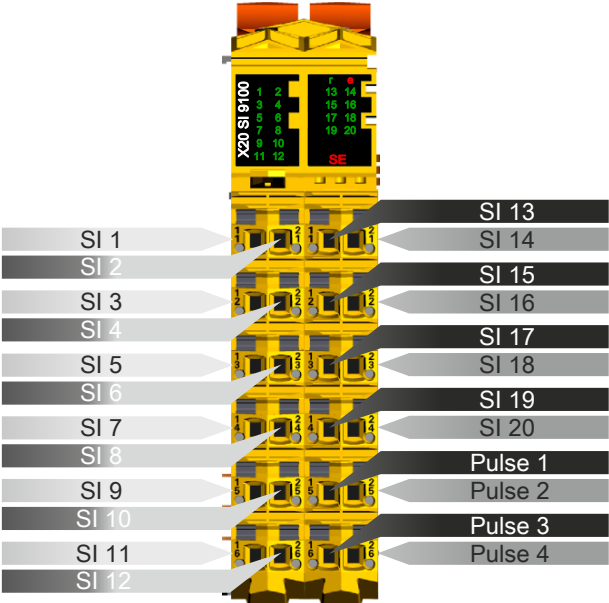Figure 3: X20SI4110 - Pinout

Figure 4: X20SI8110 - Pinout

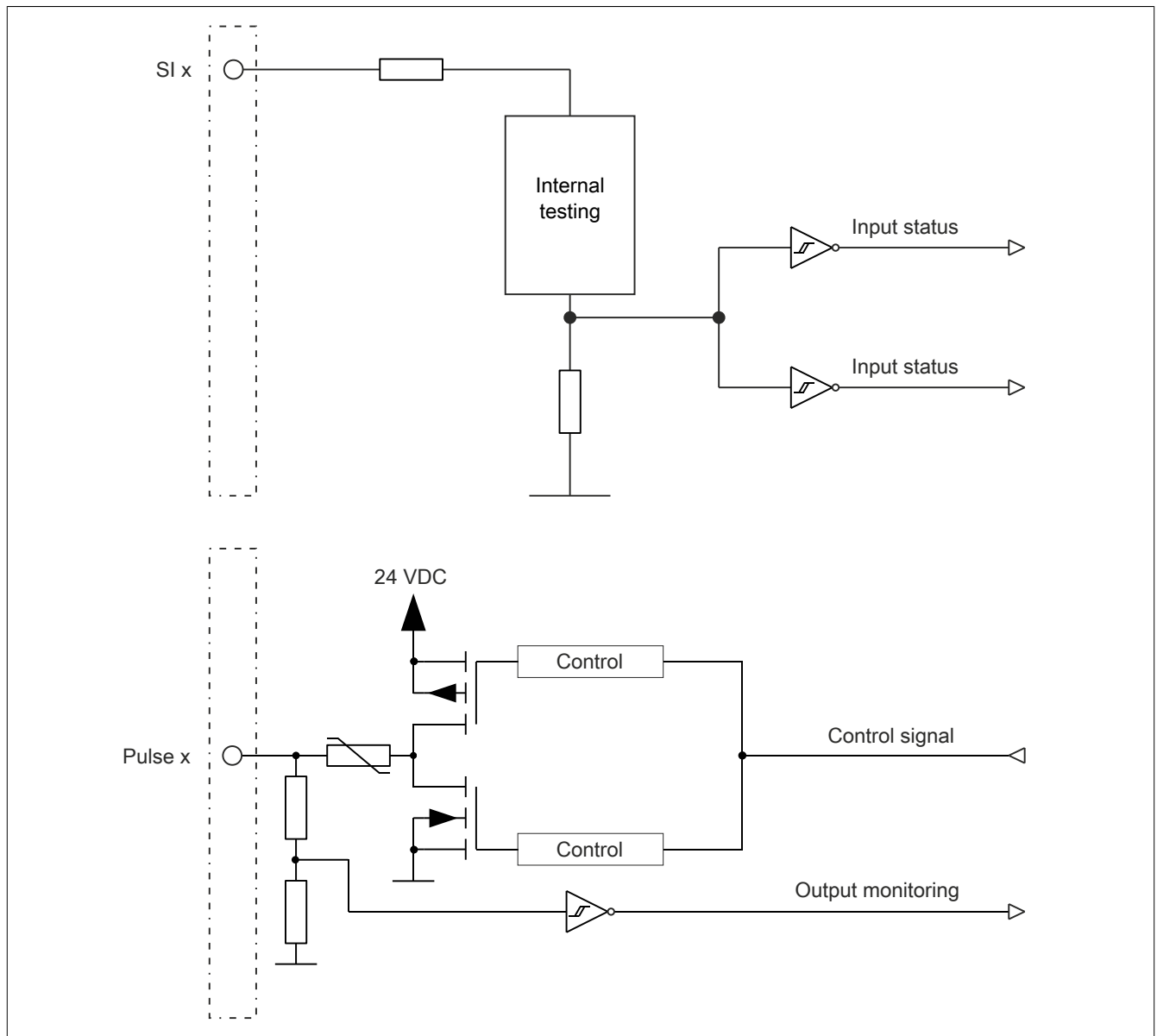Figure 5: X20SI9100 - Pinout

7 Input circuit diagram

Figure 6: Input circuit diagram

8 Register description

8.1 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 8: I/O configuration parameters: Function model

Group: General

Parameter	Description	Default value	Unit
Module supervised	System behavior when a module is missing	On	-
	Parameter value / Description		
	On / A missing module triggers service mode.		
	Off / A missing module is ignored.		
Blackout mode	This parameter enables blackout mode (see section Blackout mode in Automation Help under: Hardware → X20 system → Additional information → Blackout mode).	Off	-
	Parameter value / Description		
	On / Blackout mode is enabled.		
	Off / Blackout mode is disabled.		
Channel state information	This parameter enables/disables the channel-specific status information in the I/O mapping.	On	-
State number for dual-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	-
SafeDOMAIN ID	In applications with multiple SafeLOGIC controllers, this parameter defines the module's association with a particular SafeLOGIC controller. • Permissible values: 1 to 1000	Assigned automatically	-
SafeNODE ID	Unique safety address of the module • Permissible values: 2 to 1023	Assigned automatically	-

Table 9: I/O configuration parameters: General

8.2 Parameters in SafeDESIGNER

Group: Basic

Parameter	Description	Default value	Unit
Min. required firmware revision	This parameter is reserved for future functional expansions.	Basic release	-
Availability	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.	Permanent	-

Parameter value	Description
Permanent	This module is mandatory for the application. The module must be in OPERATIONAL mode after startup, and safe communication with 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 "Availability = Permanent". After startup, module problems are indicated by a quickly blinking "MXCHG" LED on the SafeLOGIC controller. An entry is also made in the logbook.
Optional	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 "Availability = Optional" 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 "Availability = Permanent" is set. If it is determined that the module is not physically present during startup, then the module behaves as if "Availability = Optional" is set.
Never	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 "Availability = Never" are physically present. Unlike when "Availability = Optional" is configured, the module is not started with "Availability = Never", 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.

Table 10: SafeDESIGNER parameters: Basic

Group: Safety response time

Parameter	Description	Default value	Unit
Manual configuration	This parameter makes it possible to manually and individually configure the safety response time for the module. The parameters for the safety response time are generally set in the same way for all stations involved in the application. For this reason, these parameters are configured for the SafeLOGIC controller in SafeDESIGNER. For application situations in which individual safety functions require optimal response time behavior, the parameters for the safety response time can be configured individually on the respective module. 	No	-

Parameter value	Description
Yes	Data from the module's "Safety response time" group is used to calculate the safety response time for the module's signals.
No	The parameters for the safety response time are taken from the "Safety response time" group on the SafeLOGIC controller.

Parameter	Description	Default value	Unit
Safe data duration	This parameter specifies the maximum permissible data transmission time between the SafeLOGIC controller and SafeIO module. For additional information about the actual data transmission time, see section Diagnostics and service → Diagnostics tools → Network analyzer → Editor → Calculation of safety runtime in Automation Help. The following formula can be used as the lower limit: "Value of the Network Analyzer" * 2 + SafeLOGIC cycle time * 2 The stability of the system cannot be ensured for smaller values. • 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	1	Packets
Node guarding packets	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 11: SafeDESIGNER parameters: Safety response time

Group: SafeDigitalInputxx

Parameter	Description	Default value	Unit
Pulse source	This parameter can be used to specify the pulse source for the input channel.	Pulse x	-
		Parameter value	Description		
		Pulse x	The input expects a test pulse from the pulse output (pulse x).		
		No pulse	The input does not expect a test pulse.		
		Other module	The input expects an external test pulse.		
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) At least 5 ms must be configured for "Filter on" when using DYNlink.	200000	µs
Discrepancy time	Parameter only available for odd-numbered channels. This parameter specifies for function "dual-channel evaluation" the maximum time in which the selected "Dual-channel processing mode" is permitted to be violated by one of the input channels without an error being output. • Permissible values: 0 to 10,000,000 µs (corresponds to 0 to 10 s)	50000	µs
Dual-channel processing mode	Parameter only available for odd-numbered channels. This parameter specifies the type of dual-channel evaluation. Permissible values: • Equivalent • Antivalent	Equivalent	-

Table 12: 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.

Group: PulseOutput

Parameter	Description		Default value	Unit
Pulse x mode	This parameter can be used to define the pulse pattern of the associated pulse output. Parameter "Pulse source" defines the input channel from which this pulse output is used.		Internal	-

Parameter value	Description
Internal	The channel generates a unique pulse pattern that can only be processed by input channels where this pulse output is defined as the pulse source.
External	The channel generates a pulse pattern that can be processed by all input channels where an external test pulse is defined as the pulse source.
DYNlink (hardware upgrade 2.3.0.0 or later)	The channel generates a pulse pattern that is compatible with DYNlink sensors and can be processed by input channels where this pulse output is defined as the pulse source. If several DYNlink sensors are connected in series, this setting should be used for an **even** number of sensors. For additional information, see section "DYNlink" in Automation Help.
DYNlink inverted (hardware upgrade 2.3.0.0 or later)	The channel generates a pulse pattern that is compatible with DYNlink sensors and can be processed by input channels where this pulse output is defined as the pulse source. If several DYNlink sensors are connected in series, this setting should be used for an **odd** number of sensors. For additional information, see section "DYNlink" in Automation Help.

Table 13: SafeDESIGNER parameters: PulseOutput

8.3 Channel list

Channel name	SI2100 SI4100	SI4110 SI8110	SI9100	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
ModuleOk	●	●	●	Read	-	BOOL	Indicates whether the module is physically present in the slot and configured
SerialNumber	●	●	●	Read	-	UDINT	Module serial number
ModuleID	●	●	●	Read	-	UINT	Module ID
HardwareVariant	●	●	●	Read	-	UINT	Hardware variant
FirmwareVersion	●	●	●	Read	-	UINT	Firmware version of the module
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
SafetyFWcrc1	●	●	●	(Read) [1]	-	UINT	CRC of the firmware header on safety processor 1
SafetyFWcrc2	●	●	●	(Read) [1]	-	UINT	CRC of the firmware header on safety processor 2
Bootstate	●	●	●	(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.
Diag1_Temp	●	●	●	(Read) [1]	-	INT	Module temperature in °C
oS_PropDelayStat (hardware upgrade 2.3.0.0 or later)	●	●	●	(Read) [1]	-	UDINT	Propagation delay statistics (average value of the data transmission time). The unit depends on parameter "Process data transfer rate" of the SafeLOGIC controller. • If the value of the parameter is "High", the unit is 100 μs. • If the value of the parameter is "Low", the unit is 1 ms. This value corresponds to the measurement of the forward and return channels and thus twice the theoretical runtime that is determined by the Network Analyzer.
FBInputStatexxyy	●	●	-	Read	-	USINT	State number of dual-channel evaluation (PLCopen function block "Equivalent" or "Antivalent")
FBInputStatexxyy	-	-	●	(Read) [1]	-	USINT	State number of dual-channel evaluation (PLCopen function block "Equivalent" or "Antivalent")

Within the Bootstate description:

Value	Description
0x0003	Startup communication processor OK, no communication with 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 with safety processors started
0x0024	Firmware update of safety processors
0x0040	Firmware of safety processors started
0x0440	Firmware of safety processors running
0x0840	Waiting for openSAFETY "Operational" (loading the SafeDESIGNER application or no valid application available; waiting for acknowledgments such as module replacement)
0x1040	Evaluating the configuration according to the SafeDESIGNER application
0x3440	Stabilizing cyclic openSAFETY data exchange. **Note:** If the boot state remains here, SafeDESIGNER parameters "(Default) Safe data duration" and "(Default) Additional tolerated packet loss" must be checked.
0x4040	RUN. Final state, startup completed.

Table 14: Channel list

Channel name	SI2100 SI4100	SI4110 SI8110	SI9100	Access via Automation Studio	Access via Safe-DESIGNER	Data type	Description
InputErrorStates	●	●	●	(Read) [1]	-	UDINT	Channel status, additional information for channel error
PulseOutputErrors	●	●	●	(Read) [1]	-	UDINT	Channel status, additional information for channel error
SafeModuleOK	●	●	●	Read	Read	SAFEBOOL	Indicates whether the safe communication channel is OK
SafeDigitalInputxx	●	●	●	Read	Read	SAFEBOOL	Physical channel SI xx
SafeTwoChannelInputxxyy	●	●	●	Read	Read	SAFEBOOL	Dual-channel evaluation of channel SI xx/yy
SafeInputOKxx	●	●	●	Read	Read	SAFEBOOL	Status of physical channel SI xx
SafeTwoChannelOKxxyy	●	●	●	Read	Read	SAFEBOOL	Status of dual-channel evaluation of channel SI xx/yy

Description for InputErrorStates:

Type of error
Inputs
Input stuck at high
Bit no. 0 to x = Channel 1 to x (depends on the number of channels of the module)
If a bit is set, the corresponding error has been detected on the respective channel.

Description for PulseOutputErrors:

Type of error	
Pulse outputs	
Feedback stuck at high (shorted to 24 VDC)	Feedback stuck at low (ground fault)
Bit no. 8 to 11 = Pulse 1 to 4	Bit no. 0 to 3 = Pulse 1 to 4
If a bit is set, the corresponding error has been detected on the respective channel.	

Table 14: Channel list

1) This data is accessed in Automation Studio using library ASIOACC.

9 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

10 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				
X20SI2100	X20SI4100	X20SI4110	X20SI8110	X20SI9100
400 µs	400 µs	800 µs	500 µs	800 µs

Maximum I/O update time				
X20SI2100	X20SI4100	X20SI4110	X20SI8110	X20SI9100
1750 µs + Filter time (see section "Filter" in Automation Help)	1750 µs + Filter time (see section "Filter" in Automation Help)	1750 µs + Filter time (see section "Filter" in Automation Help)	1150 µs + Filter time (see section "Filter" in Automation Help)	3350 µs + Filter time (see section "Filter" in Automation Help)

11 Version history

Version	Date	Comment
2.20	February 2024	• Chapter 4 "Technical data": Updated section Derating. • Chapter 8.2 "Parameters in SafeDESIGNER": Group "SafeDigitalInputxx": Updated description of "Filter on".
2.19	August 2023	Chapter 4 "Technical data": Updated safety characteristics.
2.18	May 2023	Chapter 4 "Technical data": • Updated certifications. • Safety characteristics: Added safe digital inputs.
2.15	August 2022	Added module X20SI4110.

2.14	May 2022	• Chapter 4 "Technical data":
		  – Safety characteristics: Editorial change for PFH / PFH$_d$
		  – Updated DNV certification.
		• Updated chapter 12 "Declaration of conformity".

2.11	August 2021	Chapter 4 "Technical data": Safe digital inputs: Input current at 24 VDC: Added footnote and min. value.
2.10	May 2021	Chapter 4 "Technical data": • Updated display of system requirements. • Safety characteristics: Updated footnote.
2.08	November 2020	Chapter 4 "Technical data": • Safe digital inputs: Added number of channels and renamed "Cable length between pulse output and input" to "Cable length between signal source (pulse output or external signal) and input". • Pulse outputs: Added number of channels.

2.07	August 2020	• Chapter 4 "Technical data":
		  – General information: Added additional power dissipation caused by actuators (resistive) [W].
		  – Updated certifications.
		  – Pulse outputs: Added R$_{DS(on)}$, removed residual voltage, updated switching voltage.
		• Chapter 8.2 "Parameters in SafeDESIGNER": Group "PulseOutput": Updated description and added new values for DYNlink.
		• Editorial changes.

2.06	May 2020	• Chapter 2 "Coated modules": Added description of starting temperature.
		• Chapter 4 "Technical data":
		  – Added footnote for system requirements.
		  – Updated certifications.
		  – Coated modules: Updated operating temperature.
		  – Coated modules: Added starting temperature.
		  – X20SI8110: Updated derating.
		• Chapter 8.3 "Channel list": Added channel "oS_PropDelayStat".
		• Editorial changes.

2.05	February 2020	Editorial changes.
2.04	November 2019	• Chapter 4 "Technical data": Updated certifications. • Editorial changes.
2.03	August 2019	Chapter 4 "Technical data": Updated certifications.
2.02	May 2019	First edition for mapp Safety

Table 15: Version history

12 Declaration of conformity

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

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Declarations of conformity for B&R products are available for download on the B&R website (www.br-automation.com).