X20SC0xxx

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 4 to 8 safe digital inputs and 2 to 6 safe digital outputs. They are designed for a nominal voltage of 24 VDC.

The modules can be used to read in digital signals and control actuators 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.

The outputs are designed using semiconductor technology so that the safety-related characteristics do not depend on the number of switching cycles. The "high-side low-side" variant (output type A) is limited to actuators without reference potential (e.g. relays, valves). Type A outputs have safety-related advantages since the actuator can be cut off in its connection cable in all error scenarios. The "high-side high-side" variant (output type B) is required for actuators with reference potential (e.g. enable inputs on frequency inverters). It is important to observe the special notices for the cabling in this case. The safe digital output modules are equipped with an error interlock in the event of network errors.

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

- 4 to 8 safe digital inputs, sink circuit
- 4 pulse outputs
- Software input filter configurable for each channel
- 4 safe digital outputs, output type A with 3 A, source circuit
- 2 or 6 safe digital outputs, output type B with 50 mA or 0.2 A, source circuit
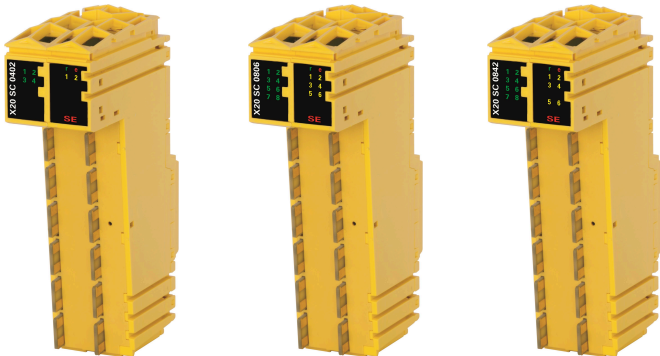- Integrated output protection

2 Order data

X20SC0402   X20SC0806   X20SC0842

Order number	Short description
	Digital mixed modules
X20SC0402	X20 safe digital mixed module, 4 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 μs
X20SC0806	X20 safe digital mixed module, 8 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 μs
X20SC0842	X20 safe digital mixed module, 8 safe type A digital inputs, configurable input filter, 4 pulse outputs, 24 VDC, 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 μs, 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 μs
	Required accessories
	Bus modules
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
	Terminal blocks
X20TB52	X20 terminal block, 12-pin, safety-keyed

Table 3: X20SC0402, X20SC0806, X20SC0842 - Order data

3 Technical data

Order number	X20SC0402	X20SC0806	X20SC0842
Short description			
I/O module	4 safe type A digital inputs, 4 pulse outputs, 24 VDC, 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	8 safe type A digital inputs, 4 pulse outputs, 24 VDC, 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	8 safe type A digital inputs, 4 pulse outputs, 24 VDC, 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs, 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs
General information			
B&R ID code	0xE7F8	0xE75A	0xE7F9
System requirements			
Automation Studio	4.0 or later		
Automation Runtime	4.0 or later		
SafeDESIGNER	3.4.0 or later		
Safety Release	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		
Outputs	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	1 ms		
Power consumption			
Bus	0.4 W		
Internal I/O	2.5 W		
Additional power dissipation caused by actuators (resistive) [W] [2]			
Safe digital HS-LS outputs	-	-	0.84
Safe digital HS-HS outputs	0.4	1.2	0.175
Pulse outputs	0.8		
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		
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		
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		
DNV	In preparation		
EAC	Yes		
Safety characteristics			
EN ISO 13849-1:2015			
Mission time	Max. 20 years		
IEC 61508:2010, IEC 61511:2004, EN 62061:2013			
PFH / PFH$_d$			
openSAFETY wired	Negligible		
openSAFETY wireless	<1*10^{-14} * Number of openSAFETY packets per hour		
Proof test interval (PT)	20 years		

Table 4: X20SC0402, X20SC0806, X20SC0842 - Technical data

X20SC0xxx

Order number	X20SC0402	X20SC0806	X20SC0842
Safe digital inputs			
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%		
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			
SIL CL	SIL 3		
SFF	>90%		
PFH / PFH$_d$ per channel	$<1*10^{-10}$		
PFD per channel	$<2*10^{-5}$		
Safe digital outputs			
EN ISO 13849-1:2015			
Category	Cat. 3 if parameter "Disable OSSD = Yes - Warning", Cat. 4 if parameter "Disable OSSD = No" [3]		
PL	PL d if parameter "Disable OSSD = Yes - Warning", PL e if parameter "Disable OSSD = No" [3]		
DC	>60% if parameter "Disable OSSD = Yes - Warning", >94% if parameter "Disable OSSD = No" [3]		
MTTFD per channel	100 years if parameter "Disable OSSD = Yes - Warning", 2500 years if parameter "Disable OSSD = No" [3]		
IEC 61508:2010, IEC 61511:2004, EN 62061:2013			
SIL CL	SIL 2 if parameter "Disable OSSD = Yes - Warning", SIL 3 if parameter "Disable OSSD = No" [3]		
SFF	>60% if parameter "Disable OSSD = Yes - Warning", >90% if parameter "Disable OSSD = No" [3]		
PFH / PFH$_d$ per channel	$<5*10^{-8}$ if parameter "Disable OSSD = Yes - Warning", $<1*10^{-10}$ if parameter "Disable OSSD = No" [3]		
PFD per channel	$<1*10^{-3}$ if parameter "Disable OSSD = Yes - Warning", $<2*10^{-5}$ if parameter "Disable OSSD = No" [3]		
I/O power supply			
Nominal voltage	24 VDC		
Voltage range	24 VDC -15% / +20%		
Integrated protection	Reverse polarity protection		
Safe digital inputs			
Quantity	4	8	
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. 3.28 mA		
Input resistance	Min. 7.33 kΩ		
Error detection time	100 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		
Safe digital HS-LS outputs			
Quantity	-	-	4
Variant	-	-	FET, 1x positive switching, 1x negative switching, type A, output level readable
Nominal voltage	-	-	24 VDC
Nominal output current	-	-	3 A
Total nominal current	-	-	10 A [5]
Output protection	-	-	See section "Inrush current behavior for output channels".
Braking voltage when switching off inductive loads	-	-	Max. 90 VDC [6]
Error detection	-	-	1 s
Insulation voltage between channel and bus	-	-	500 V$_{eff}$
Peak short-circuit current	-	-	See section "Inrush current behavior for output channels".
Leakage current when the output is switched off	-	-	<1 mA

Table 4: X20SC0402, X20SC0806, X20SC0842 - Technical data

Order number	X20SC0402	X20SC0806	X20SC0842
$R_{DS(on)}$	-	-	30 mΩ
Switching voltage	-	-	I/O power supply minus voltage drop due to $R_{DS(on)}$
Max. switching frequency	-	-	See section "Inrush current behavior for output channels".
Test pulse length	-	-	Max. 500 µs
Max. capacitive load	-	-	100 nF
Safe digital HS-HS outputs			
Quantity	2	6	2
Variant	FET, 2x positive switching, type B2, output level readable		
Nominal voltage	24 VDC		
Nominal output current	0.2 A		50 mA
Total nominal current	0.4 A	1.2 A	100 mA
Output protection	See section "Inrush current behavior for output channels".		
Braking voltage when switching off inductive loads	Max. 45 VDC		
Error detection time	1 s		
Insulation voltage between channel and bus	500 V_{eff}		
Peak short-circuit current	See section "Inrush current behavior for output channels".		
Leakage current when the output is switched off	<100 µA		<1 mA
$R_{DS(on)}$	5 Ω		35 Ω
Switching voltage	I/O power supply minus voltage drop due to $R_{DS(on)}$		
Max. switching frequency	See section "Inrush current behavior for output channels".		
Test pulse length	Max. 10 µs		Max. 500 µs
Max. capacitive load	100 nF		
Current on loss of ground			
I_{OUT}	<100 µA		
I_{GND}	<200 mA		<50 mA [7]
Pulse outputs			
Quantity	4		
Variant	Push-Pull		
Nominal output current	50 mA		
Output protection	Shutdown of individual channels in the event of overload or short circuit [8]		
Peak short-circuit current	0.5 A for 120 µs		
Short-circuit current	15 mA_{eff}		
Leakage current when the output is switched off	0.1 mA		
$R_{DS(on)}$	80 Ω		
Switching voltage	I/O power supply minus voltage drop due to $R_{DS(on)}$		
Total nominal current	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		
Vertical mounting orientation	0 to 50°C		
Derating	See section "Derating".		
Storage	-40 to 85°C		
Transport	-40 to 85°C		
Relative humidity			
Operation	5 to 95%, non-condensing		
Storage	5 to 95%, non-condensing		
Transport	5 to 95%, non-condensing		
Mechanical properties			
Note	Order 2x safety-keyed terminal block separately. Order 1x safety-keyed bus module separately.		
Pitch	25$^{+0.2}$ mm		

Table 4: X20SC0402, X20SC0806, X20SC0842 - 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 module's total nominal current is limited to 10 A. The output currents of group "Safe digital HS-HS outputs" must be included.
6)   Due to the internal protective circuit, this braking voltage only takes effect starting at a load of typ. 250 mA.
7)   The value for this module is limited to 50 mA by the nominal output current of the HS-HS outputs.
8)   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	X20SC0402	X20SC0806	X20SC0842
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	+7.5°C		+10°C
Dummy module on the left	+2.5°C		
Dummy module on the right	+0°C		
Dummy module on the left and right	+2.5°C		+5°C
4 safe inputs (SI)	+0°C	+2.5°C [2]	+0°C
For double PFH / PFH$_d$ or triple PFD	+15°C		

Table 5: Derating bonus

1) Only 4 safe inputs (SI) in use. Bonus valid only for derating curve of outputs.
2) Hardware revision E0 and later

Inputs

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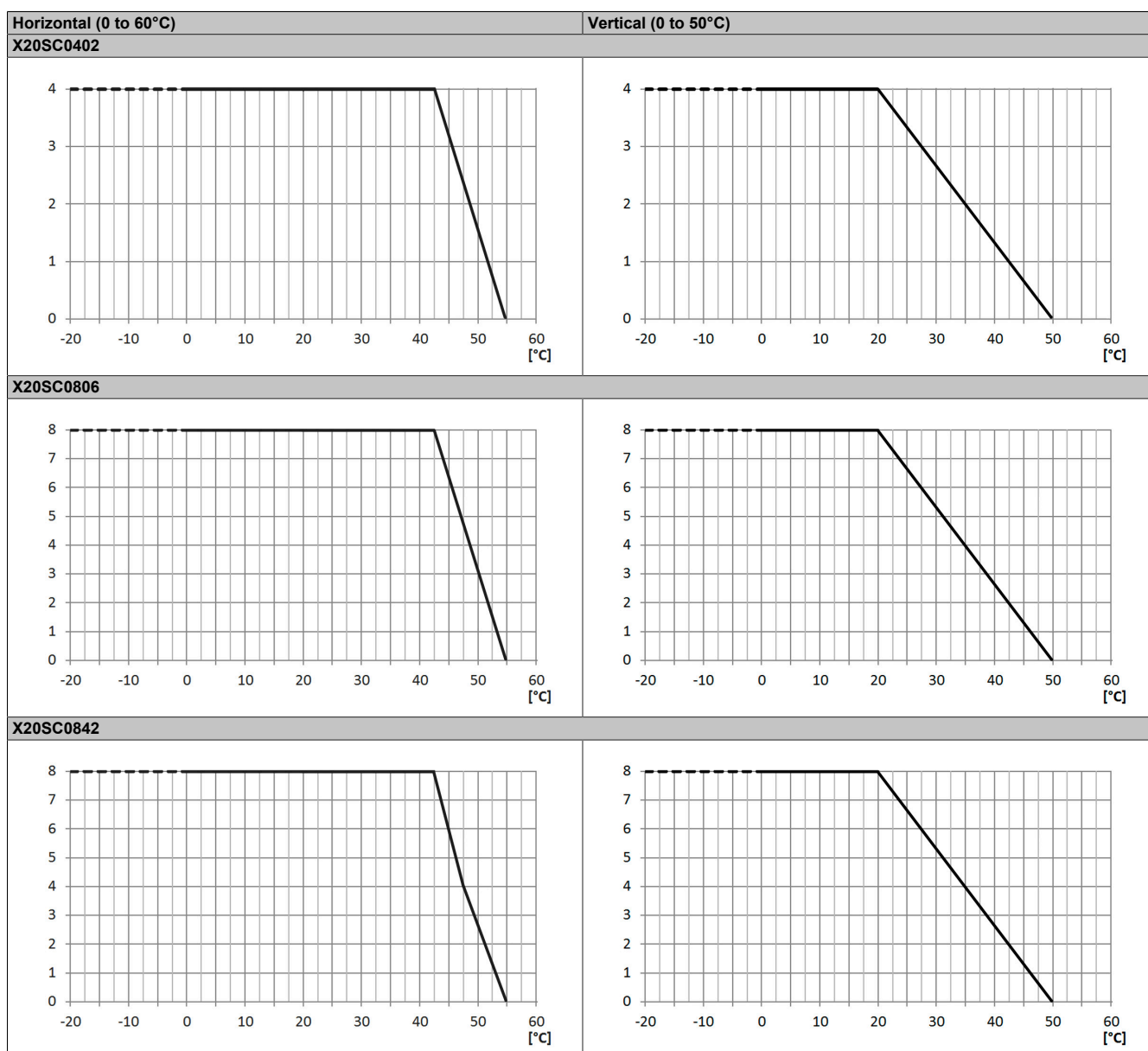
Table 6: Derating in relation to operating temperature and mounting orientation

Outputs

The maximum total nominal current depends on the operating temperature and the mounting orientation. The resulting total nominal current can be looked up in the following table.

Horizontal (0 to 60°C)	Vertical (0 to 50°C)
X20SC0402	

| **X20SC0806** | |

| **X20SC0842** | |
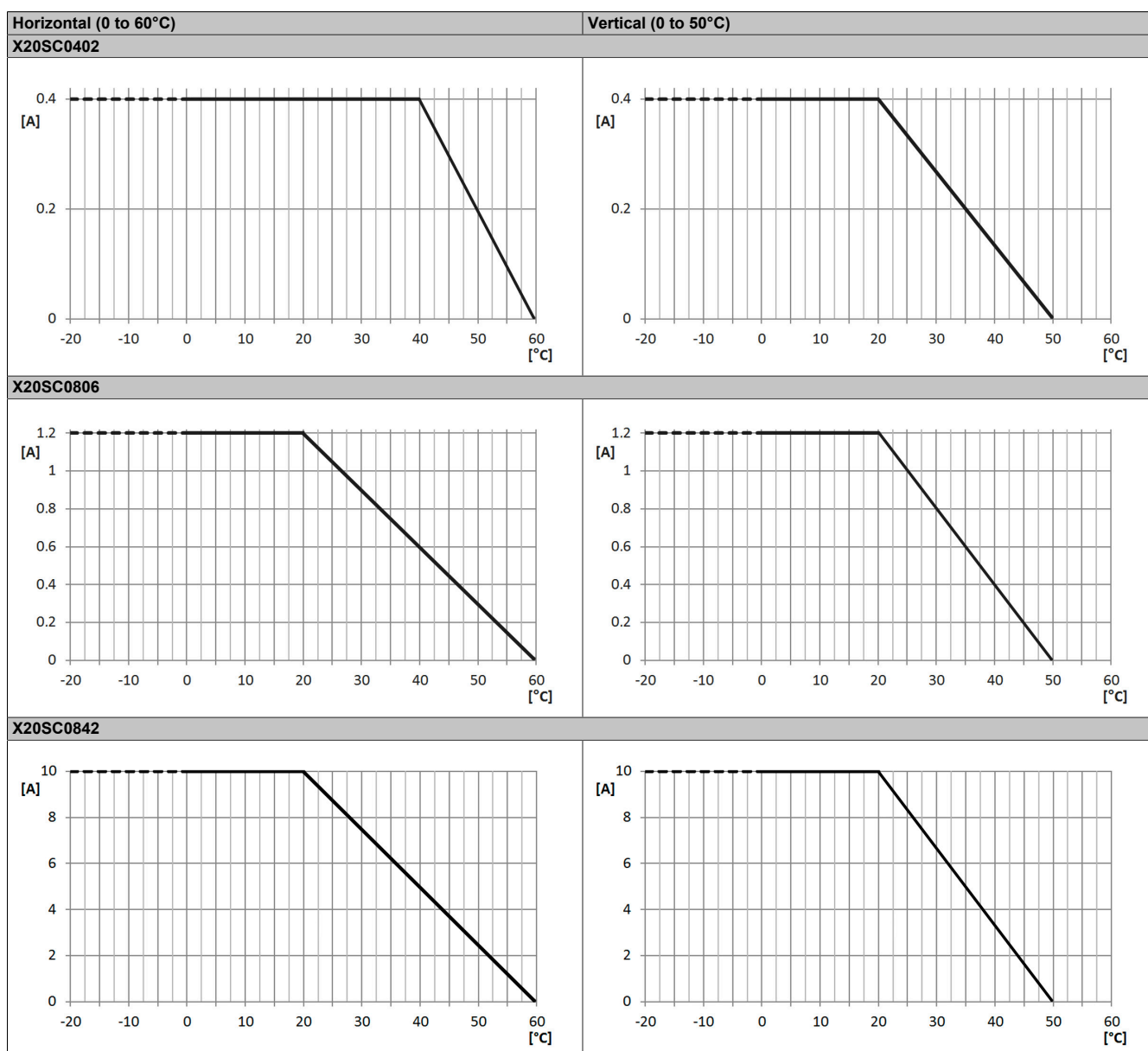
Table 7: Derating in relation to operating temperature and mounting orientation

Information:

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

Inrush current behavior for output channels

In addition to the nominal output current specified in the technical data, the output channels indicate the following possibilities for increased inrush current.

Inrush current behavior for output channels
X20SC0x0x
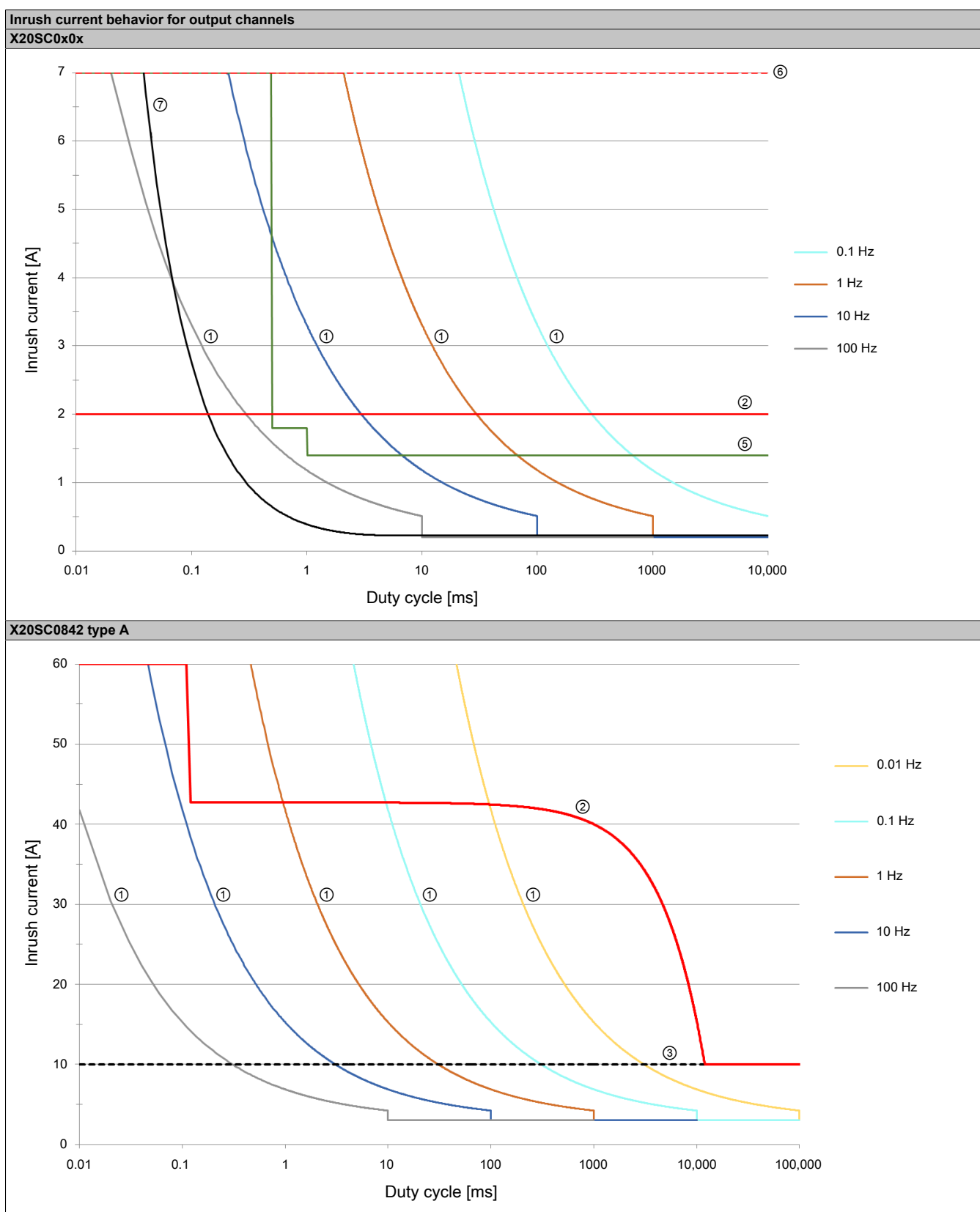
X20SC0842 type A

Table 8: Inrush current behavior for output channels

Inrush current behavior for output channels

X20SC0842 type B

Table 8: Inrush current behavior for output channels

Legend:

①	**Limits during cyclic switching operations** These curves show the maximum possible total inrush currents of all channels of the module during cyclic switching operations depending on the switching frequency. Overshooting these values results in overheating of the module.
②	**Current limiting of the power drivers per channel** These output channels are equipped with power drivers with integrated current limiting. The curve shows the maximum possible inrush current per channel. Overshooting is not possible since the power driver limits the current.
③	**Shutdown of power drivers on overload per channel** These output channels are equipped with power drivers with integrated shutdown on overload. The curve shows the maximum ensured inrush current per channel. Overshooting can result in the shutdown of the output channel.
⑤	**Current monitoring of the firmware - Maximum total inrush current** These output channels are equipped with overcurrent detection in the module's firmware. The curve shows the maximum ensured total inrush current of all channels of the module. Overshooting results in the shutdown of all of the module's output channels. In addition, when assessing the maximum possible inrush current, the melting integral of the external fuse of the potential group must of course also be taken into account.
⑥	**Component load capacity of the module** This limit shows the total inrush current from which individual components of the module are overloaded. Overshooting can result in irreparable damage to the module.
⑦	**Overcurrent shutdown of the hardware per channel** These output channels are equipped with overcurrent detection in the module's hardware. The curve shows the maximum ensured inrush current per channel. Overshooting can result in the shutdown of the output channel.

Information:

The protective function is provided for max. 30 minutes for a continuous short circuit.

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.

4 LED status indicators

Figure	LED	Color	Status	Description
	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
	1 to 8	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	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
	1 to 6	Output state of the corresponding digital output The number of channel LEDs varies depending on the number of channels on the module type.		
		Red	On	Warning/Error on an output channel
			All on	Error on all channels, connection to the SafeLOGIC controller not OK or startup not yet completed
		Orange	On	Output set
	SE	Red	Off	Mode RUN or I/O component not provided with voltage
			(1 s)	Boot phase, missing X2X Link or defective processor
			(1 s)	Safety PREOPERATIONAL state Modules that are not used in the SafeDESIGNER application remain in state PREOPERATIONAL.
			(1 s)	Safe communication channel not OK
			(1 s)	The firmware for this module is a non-certified pilot customer version.
			(1 s)	Boot phase, faulty firmware
			On	Safety state active for the entire module (= state "FailSafe")
		The "SE" LEDs separately indicate the status of safety processor 1 ("S" LED) and safety processor 2 ("E" LED).		

Table 9: 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!

5 Pinouts
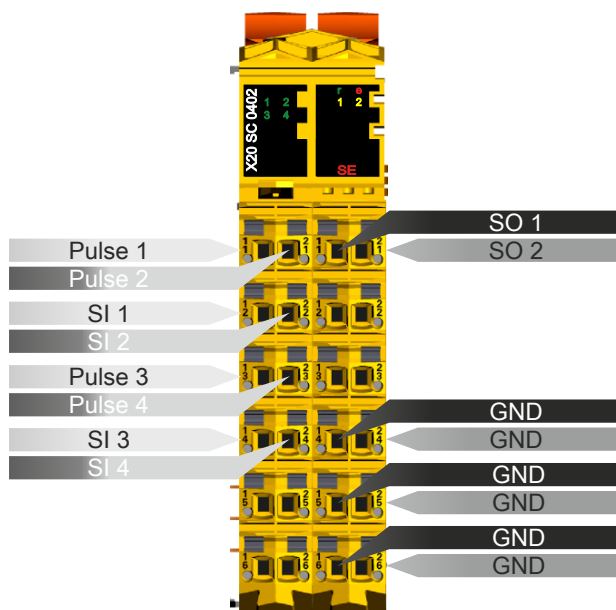
Figure 1: X20SC0402 - Pinout
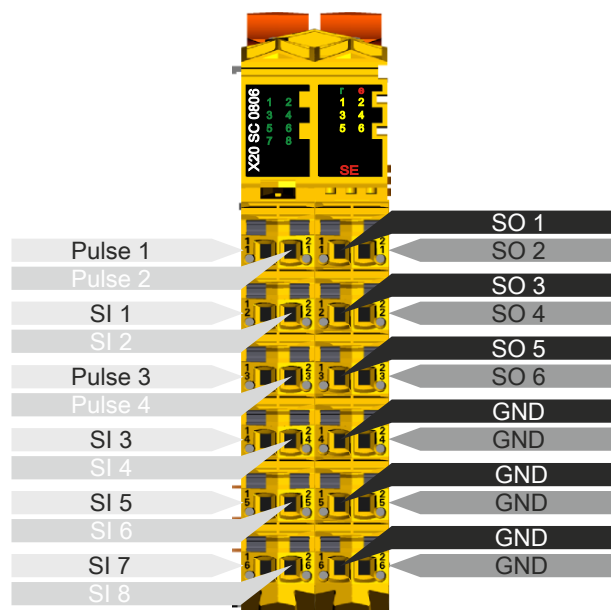
Figure 2: X20SC0806 - Pinout
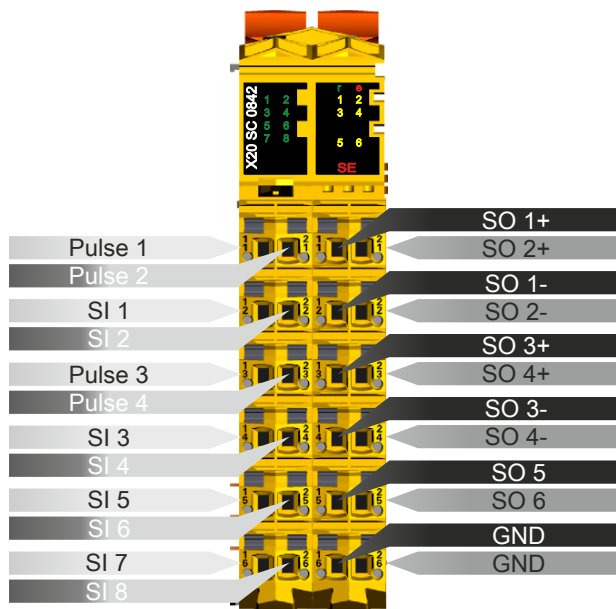
Figure 3: X20SC0842 - Pinout

6 Input circuit diagram
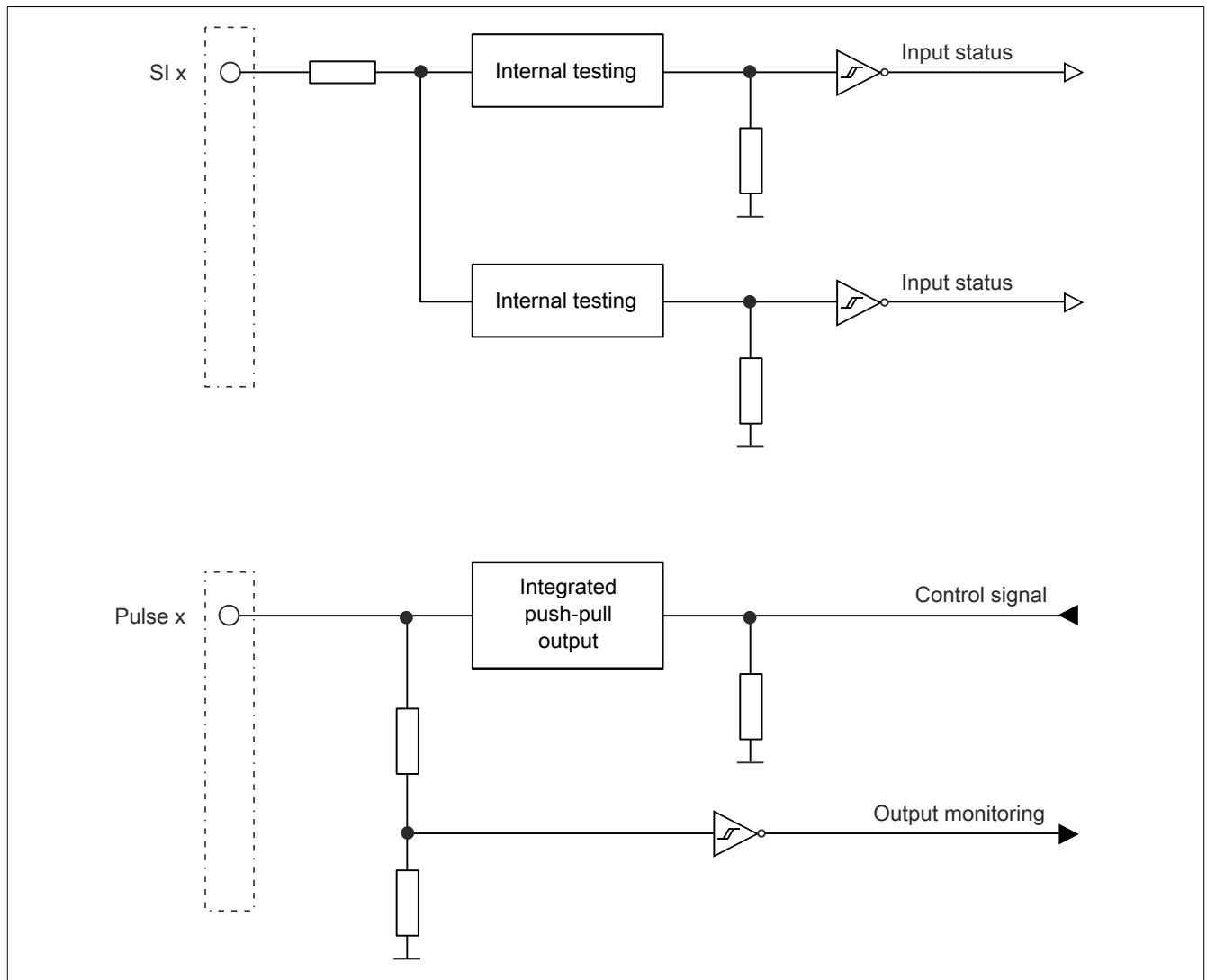
Figure 4: Input circuit diagram

7 Type A output circuit diagram

Type A digital output channels are designed for positive and GND switching inside the module.
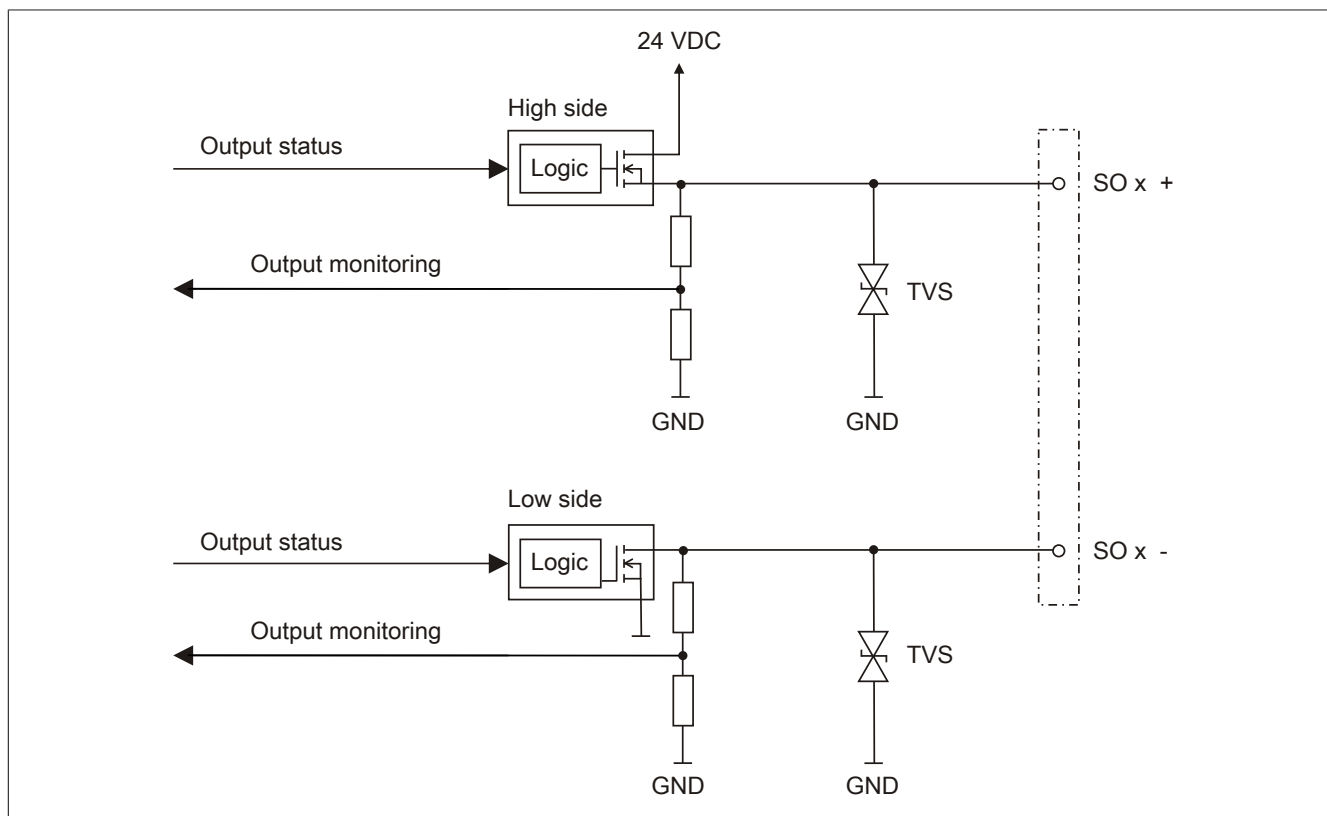
Figure 5: Type A output circuit diagram

8 Type B output circuit diagram

Type B digital output channels are designed for positive and positive switching inside the module.
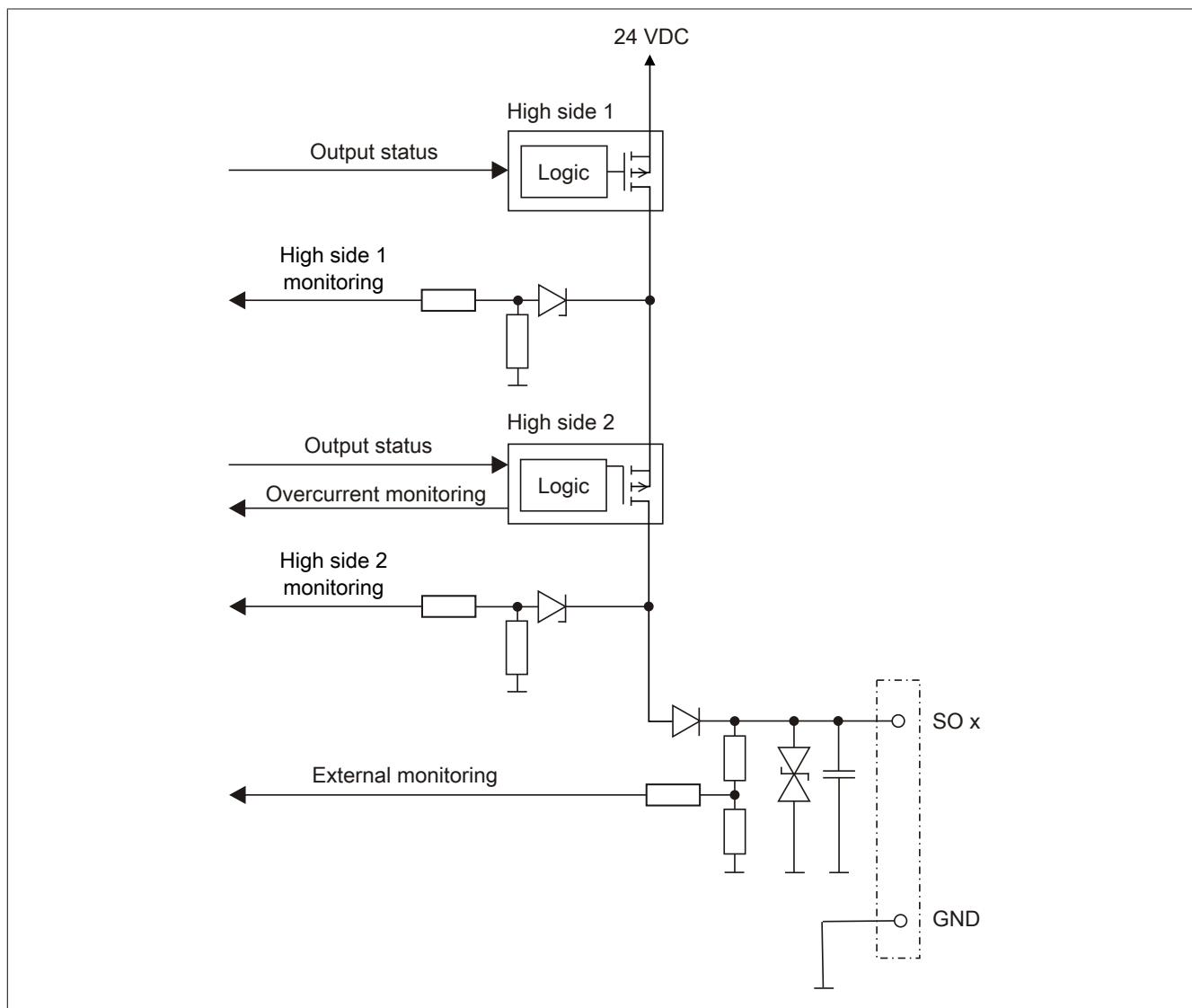
Figure 6: Type B output circuit diagram

9 Register description

9.1 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 10: 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.	Off	-
State number for start interlock on error	This parameter enables/disables the status information for the error interlock.	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 11: I/O configuration parameters: General

Group: Output signal path

Parameter	Description	Default value	Unit
Digital output xx	This parameter specifies the mode that can be used by the standard application to access the output channel.	Direct	-
	Parameter value / **Description**		
	Direct — The output channel can be accessed directly by the standard application. Signals "DigitalOutputxx" are available in the I/O mapping accordingly.		
	Via SafeLOGIC — The output channel cannot be accessed directly by the standard application. Signals "DigitalOutputxx" are not available in the I/O mapping accordingly. It is only possible for the standard application to influence the output channel via the communication channels from the CPU to the SafeLOGIC controller.		

Table 12: I/O configuration parameters: Output signal path

9.2 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 13: 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. <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Yes</td><td>Data from the module's "Safety response time" group is used to calculate the safety response time for the module's signals.</td></tr><tr><td>No</td><td>The parameters for the safety response time are taken from the "Safety response time" group on the SafeLOGIC controller.</td></tr></table>	No	-
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 14: SafeDESIGNER parameters: Safety response time

Group: Module configuration

Parameter	Description	Default value	Unit
Disable OSSD	This parameter can be used to switch off automatic testing of the output driver for all of the module's channels. <table><tr><th>Parameter value</th><th>Description</th></tr><tr><td>Yes - Warning</td><td>Automatic testing of the output driver is switched off.</td></tr><tr><td>No</td><td>Automatic testing of the output driver is enabled.</td></tr></table>	No	-

Table 15: SafeDESIGNER parameters: Module configuration

Danger!

Danger from an accumulation of errors due to missing module diagnostics

Configuring "Disable OSSD = Yes - Warning" greatly reduces the internal error detection of the module. The associated information provided in section "Detecting module-internal faults" in Automation Help must be observed.

Warning!

If the output channel is switched with an output frequency of 1.25 Hz or more for more than 8 hours in safety-related applications according to category 4 or PL e per EN ISO 13849-1, the output channel must be switched on and off for 1 second every 8 hours.

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	-
	<table><tr><td>**Parameter value**</td><td>**Description**</td></tr><tr><td>Pulse x</td><td>The input expects a test pulse from the pulse output (pulse x).</td></tr><tr><td>No pulse</td><td>The input does not expect a test pulse.</td></tr><tr><td>Other module</td><td>The input expects an external test pulse.</td></tr></table>		
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 16: 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 17: SafeDESIGNER parameters: PulseOutput

9.3 Channel list

Channel name	Access via Automation Studio	Access via SafeDESIGNER	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.

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.

Channel name	Access via Automation Studio	Access via SafeDESIGNER	Data type	Description
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")
InputErrorStates	(Read) [1]	-	UDINT	Channel status, additional information for channel error

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.

Table 18: Channel list

Channel name	Access via Automation Studio	Access via SafeDESIGNER	Data type	Description
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
DigitalOutputxx	Write	-	BOOL	Enable signal - Channel SO xx
SafeDigitalOutputxx	-	Write	SAFEBOOL	Safe channel SO xx
SafeOutputOKxx	Read	Read	SAFEBOOL	Status of channel SO xx
ReleaseOutput	-	Write	BOOL	Release signal for error interlock
PhysicalStateOutputxx	Read	Read	BOOL	Read-back value of physical channel SO xx
FBOutputStatexxyy	Read	-	USINT	State number of the error interlock for channel x. See section "Error interlock - State diagram" in Automation Help.

For PulseOutputErrors Description:

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.

For FBOutputStatexxyy Description:

Bit 7 to 4	Bit 3 to 0
Channel yy	Channel xx

Table 18: Channel list

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

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
500 µs

Maximum I/O update time for input channels
1150 µs + Filter time (see section "Filter" in Automation Help)

Maximum I/O update time for output channels
1300 µs

12 Version history

Version	Date	Comment
2.20	February 2024	• Chapter 3 "Technical data": Updated section Derating. • Chapter 9.2 "Parameters in SafeDESIGNER": Group "SafeDigitalInputxx": Updated description of "Filter on".
2.19	August 2023	Chapter 3 "Technical data": Updated safety characteristics.
2.18	May 2023	Chapter 3 "Technical data": Updated safety characteristics.
2.17	February 2023	• Chapter 3 "Technical data": – Updated certifications. – Safety characteristics: Added for safe digital outputs MTTFD (per channel), PFH/PFH$_d$ (per channel) and PFD (per channel). – Safety characteristics: Moved MTTFD (per channel), PFH/PFH$_d$ (per channel) and PFD (per channel) to section "Safe digital inputs". – Updated section "Derating". • Chapter 9.2 "Parameters in SafeDESIGNER": Group "Module configuration": Added warning notice.
2.14	May 2022	• Chapter 3 "Technical data": – Safety characteristics: Editorial change for PFH / PFH$_d$ – Updated DNV certification. • Updated chapter 13 "Declaration of conformity".
2.11	August 2021	Chapter 3 "Technical data": Safe digital inputs: Input current at 24 VDC: Added footnote and min. value.
2.10	May 2021	Chapter 3 "Technical data": • Updated display of system requirements. • Safety characteristics: Updated footnote.
2.08	November 2020	Chapter 3 "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". • Safe digital HS-LS outputs: Added number of channels. • Safe digital HS-HS outputs: Added number of channels. • Pulse outputs: Added number of channels.
2.07	August 2020	• Chapter 3 "Technical data": – General information: Added additional power dissipation caused by actuators (resistive) [W]. – Safe digital HS-LS outputs: Added R$_{DS(on)}$, removed residual voltage, updated switching voltage. – Safe digital HS-HS outputs: Added R$_{DS(on)}$, removed residual voltage, updated switching voltage. – Pulse outputs: Added R$_{DS(on)}$, removed residual voltage, updated switching voltage. • Chapter 9.2 "Parameters in SafeDESIGNER": Group "PulseOutput": Updated description and added new values for DYNlink. • Editorial changes.
2.06	May 2020	• Chapter 3 "Technical data": – Added footnote for system requirements. – Updated derating. • Chapter 9.2 "Parameters in SafeDESIGNER": Group "Module configuration": Updated danger notice. • Chapter 9.3 "Channel list": Added channel "oS_PropDelayStat".
2.05	February 2020	• Chapter 3 "Technical data": Added section "Inrush current behavior for output channels" and updated technical data accordingly. • Chapter 9.2 "Parameters in SafeDESIGNER": Group "Module configuration": Updated danger notice. • Editorial changes.
2.04	November 2019	Editorial changes.
2.02	May 2019	First edition for mapp Safety

Table 19: Version history

13 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).