X20(c)SP1130

> ## 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 1 safe digital output. The nominal output current is 10 A. Power supply modules are used for the internal I/O power supply.

A safe digital output channel is integrated in the module for cutting off the I/O power supply of connected X20 modules in safety-related applications up to PL e or SIL 3.

The output is designed using semiconductor technology so that the safety-related characteristics do not depend on the number of operating cycles. 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.
In addition, the instructions for cutting off X20 potential groups must be observed.
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.

- 24 VDC power supply module for internal I/O power supply
- Safe cutoff of potential groups with standard outputs
- Safely switched potential can also be tapped externally
- 1 safe digital output with 10 A
- Source circuit
- Output type B
- Integrated output protection

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)!**

3 Order data

Order number	Short description	Figure
	Power supply modules	
X20SP1130	X20 power supply module, with integrated safe cutoff function, for internal I/O power supply, 24 VDC, 10 A, 1 safe type B1 digital output, 24 VDC, 10 A, without OSSD, note the list of permitted modules in the potential group	
X20cSP1130	X20 power supply module, coated, with integrated safe cutoff function, for internal I/O power supply, 24 VDC, 10 A, 1 safe type B1 digital output, 24 VDC, 10 A, without OSSD, note the list of permitted modules in the potential group	
	Required accessories	
	Bus modules	
X20BM23	X20 power supply bus module, for X20 SafeIO power supply modules, internal I/O power supply interrupted to the left	
X20BM26	X20 power supply bus module, with node number switch, internal I/O power supply interrupted to the left	
X20cBM23	X20 power supply bus module, coated, for X20 SafeIO power supply modules, internal I/O power supply interrupted to the left	
	Terminal blocks	
X20TB52	X20 terminal block, 12-pin, safety-keyed	

Table 3: X20SP1130, X20cSP1130 - Order data

4 Technical data

Order number	X20SP1130	X20cSP1130
Short description		
I/O module	1 safe type B1 digital output, 24 VDC, 10 A, without OSSD, note list of permitted modules in the potential group	
General information		
B&R ID code	0x1DBF	0xDD87
System requirements		
Automation Studio	3.0.81.15 or later	4.0.16 or later
Automation Runtime	3.00 or later	V3.08 or later
SafeDESIGNER	2.70 or later	3.1.0 or later
Safety Release	1.2 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	
Outputs	Yes, using LED status indicator and software	
Blackout mode		
Scope	Module	
Function	Module functionality	
Standalone mode	No	
Max. I/O cycle time	800 µs	
Power consumption		
Bus	0.2 W	
Internal I/O	1.5 W	
Additional power dissipation caused by actuators (resistive) [W] [2]	3	
Electrical isolation		
Channel - Bus	Yes	
Certifications		
CE	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 62061:2013, 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	
HazLoc	cCSAus 244665 Process control equipment for hazardous locations Class I, Division 2, Groups ABCD, T5	
DNV	In preparation	
EAC	Yes	-
KC	Yes	-
Safety characteristics		
EN ISO 13849-1:2015		
Category	Cat. 4	
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		
Per channel	$<1*10^{-10}$	
openSAFETY wired	Negligible	
openSAFETY wireless	$<1*10^{-14}$ * Number of openSAFETY packets per hour	
PFD	$<2*10^{-5}$	
Proof test interval (PT)	20 years	
Input I/O power supply [3]		
Input voltage	24 VDC -15% / +20%	
Fuse	Required line fuse: Max. 10 A, slow-blow	
Reverse polarity protection	No	

Table 4: X20SP1130, X20cSP1130 - Technical data

Order number	X20SP1130	X20cSP1130
Safe digital outputs		
Quantity	1	
Variant	FET, 2x positive switching, type B1, output level readable	
Nominal voltage	24 VDC	
Nominal output current	10 A	
Output protection	See section "Inrush current behavior for output channels".	
Braking voltage when switching off inductive loads	1 VDC	
Diagnostic status	Output monitoring, current measurement (shutdown in the event of overcurrent)	
Error detection time	2 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	
$R_{DS(on)}$	30 mΩ	
Switching voltage	I/O power supply minus voltage drop due to $R_{DS(on)}$	
Max. switching frequency	5 times per minute with max. 2 Hz Hardware upgrade 2.2.0.0 and later: 120 times per minute with max. 2 Hz See section "Inrush current behavior for output channels" and table "Switching inductive loads".	
Test pulse length	Without test pulse	
Max. capacitive load	1 mF	
Minimum load	15 mA	
Current on loss of ground		
I_{OUT}	<1 mA	
I_{GND}	<50 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	-25 to 60°C
Vertical mounting orientation	0 to 35°C	-25 to 35°C
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
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.	
Pitch	25$^{+0.2}$ mm	

Table 4: X20SP1130, X20cSP1130 - Technical data

1) The system requirements of the mapp Technology Package must be observed (see Automation Help).
2) $R_{DS(on)}$ x Nominal output current^2. For a calculation example, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3) If a hardware revision <B9 is used, then the power supply unit used must be able to charge a capacitance of 4 mF in a time period of 2 ms.

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.

Module	X20SP1130
Derating bonus	
At 24 VDC	+0°C
Dummy module on the left	+2.5°C
Dummy module on the right	+0°C
Dummy module on the left and right	+5°C
With double PFH / PFH$_d$	+0°C

Table 5: Derating bonus

The max. nominal output current per channel depends on the operating temperature and mounting orientation. The resulting nominal output current per channel is listed in the following table.
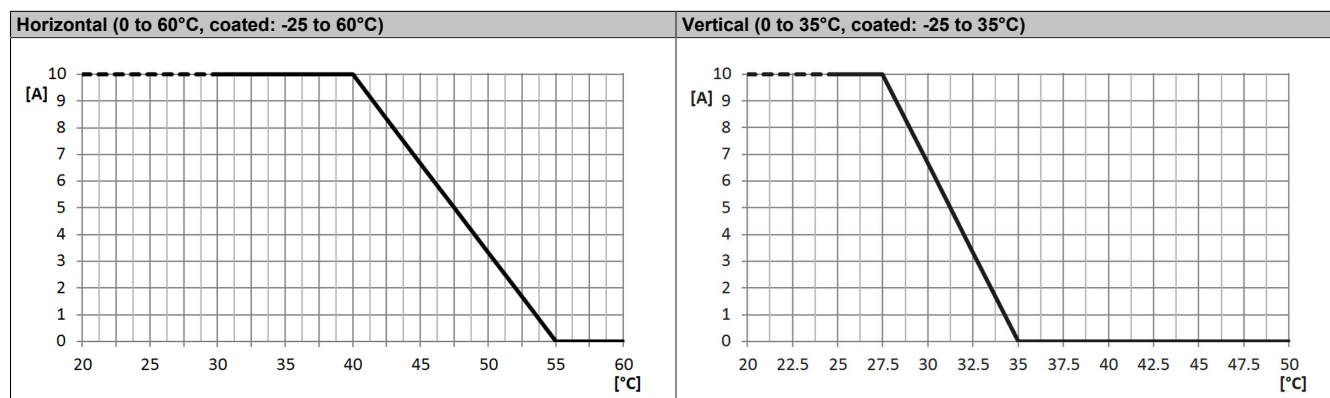
Table 6: Derating in relation to operating temperature and mounting orientation

Information:

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

Switching inductive loads

The information in this table applies exclusively to hardware upgrade 2.2.0.0 and later.

Switching inductive loads
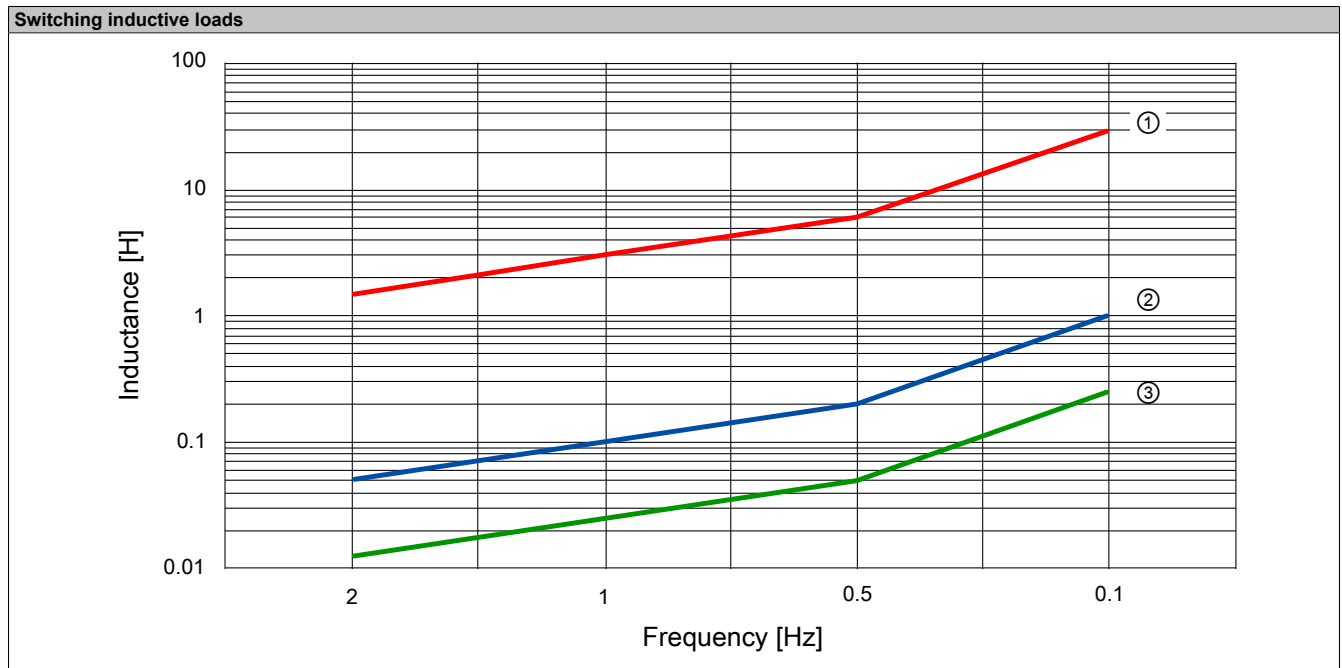
Table 7: Switching inductive loads

Legend:

①	Max. permissible output current 1 A
②	Max. permissible output current 5 A
③	Max. permissible output current 10 A

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
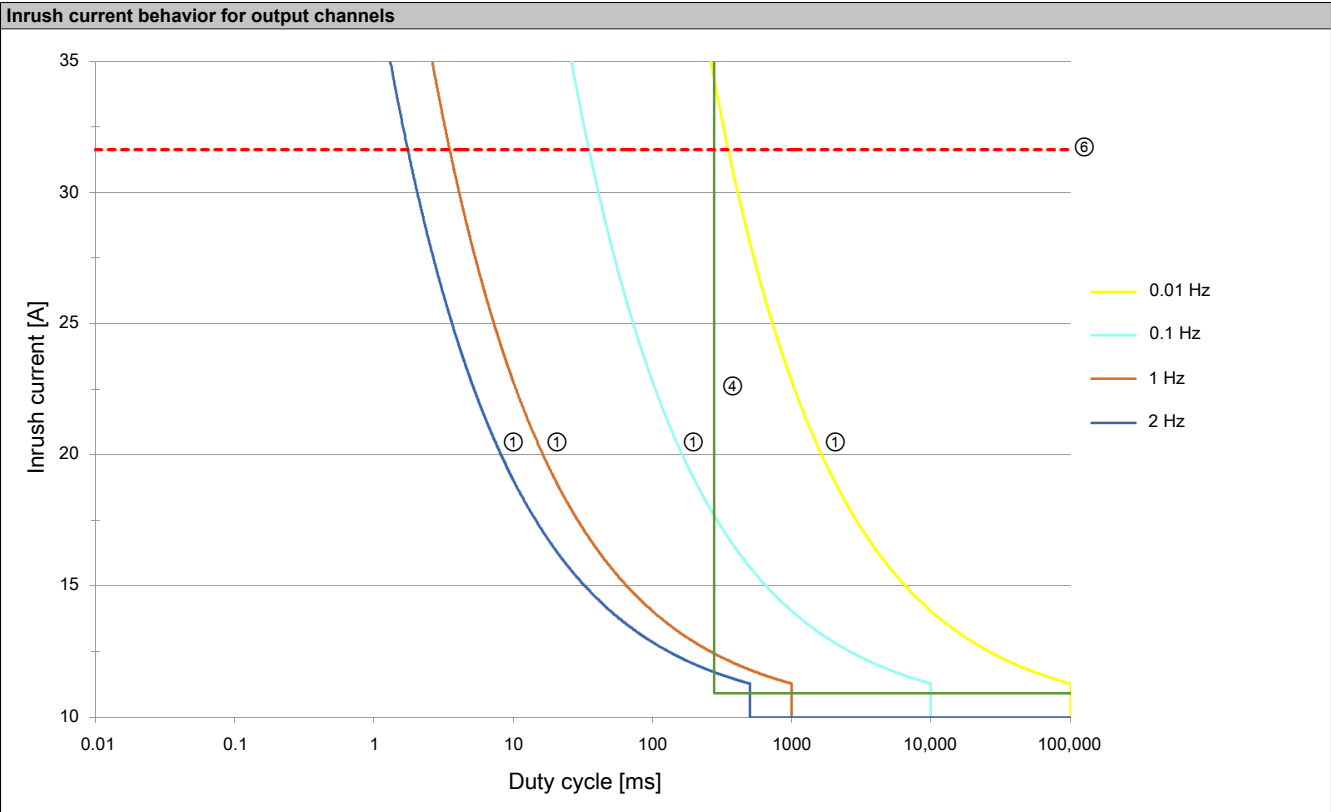
Table 8: Inrush current behavior for output channels

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.
④	**Current monitoring of the firmware - Maximum inrush current per channel** These output channels are equipped with overcurrent detection in the module's firmware. The curve shows the maximum ensured inrush current per channel. Overshooting results in the shutdown of the output channel.
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.

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.

5 LED status indicators
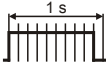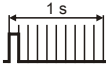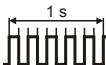
Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	Mode "Reset"
			Double flash	Updating firmware
			Blinking	Mode PREOPERATIONAL
			On	Mode RUN
	e	Red	Off	Module not supplied with power or everything OK
			Pulsating	Bootloader mode
			Triple flash	Updating safety-related firmware
			On	Error or I/O component not provided with voltage
	e + r	Solid red / Single green flash		Invalid firmware
	1	Output state of the digital output		
		Red	On	Warning/Error on output channel, 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 waveform)	Boot phase, missing X2X Link or defective processor
			(1 s waveform)	Safety PREOPERATIONAL state. Modules that are not used in the SafeDESIGNER application remain in state PREOPERATIONAL.
			(1 s waveform)	Safe communication channel not OK
			(1 s waveform)	The firmware for this module is a non-certified pilot customer version.
			(1 s waveform)	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!

6 Pinout
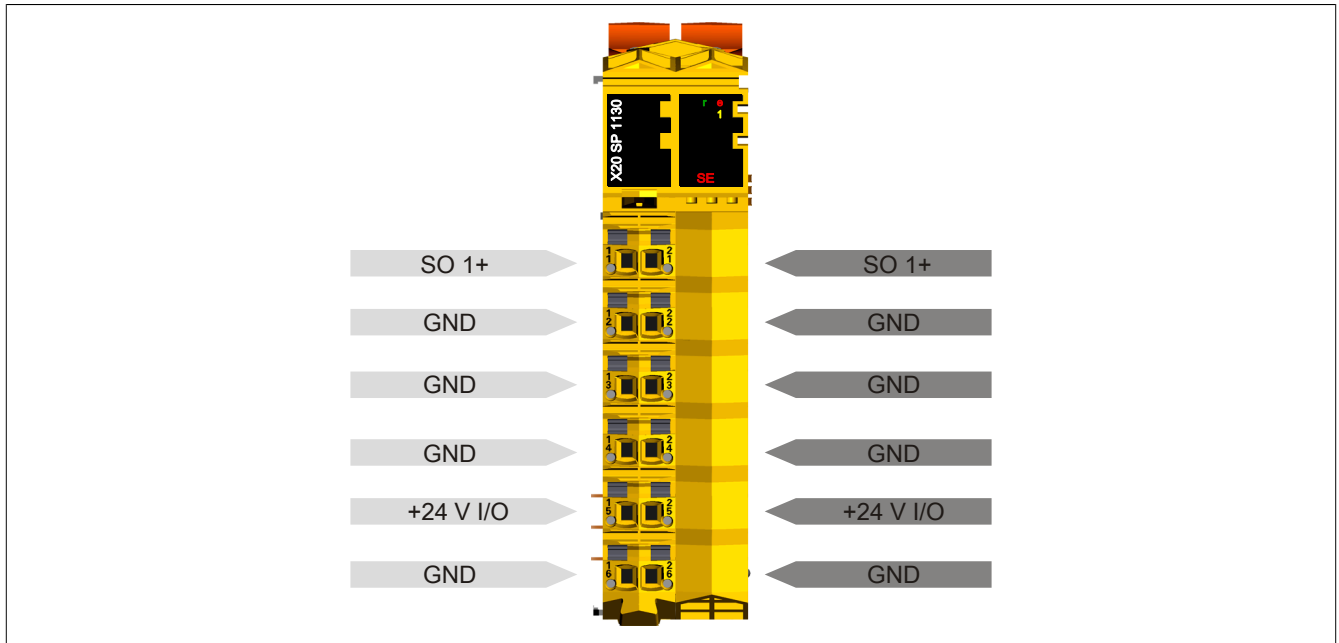
Figure 1: X20SP1130 - Pinout

7 Output circuit diagram
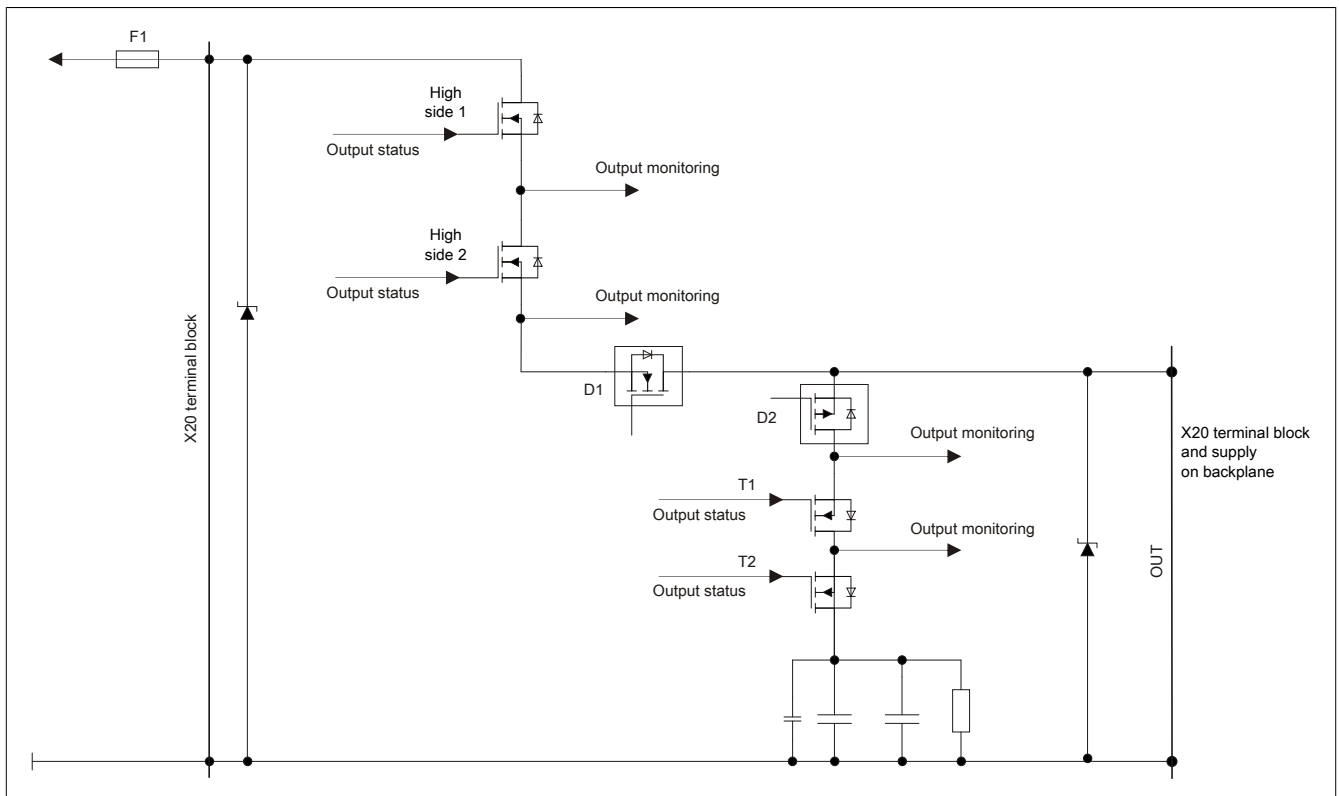
Figure 2: Output circuit diagram

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 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 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

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 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><td>**Parameter value**</td><td>**Description**</td></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

8.3 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.
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.
SafeModuleOK	Read	Read	SAFEBOOL	Indicates whether the safe communication channel is OK
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
CurrentOKxx	Read	Read	BOOL	Status of current measurement of channel SO xx
FBOutputStatexx	Read	-	USINT	State number of the error interlock for channel x. See section "Error interlock - State diagram" in Automation Help.

Table 15: 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
400 µs

Maximum I/O update time
1600 µs

11 Version history

Version	Date	Comment

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".

2.10	May 2021	Chapter 4 "Technical data": Updated display of system requirements.
2.08	November 2020	Chapter 4 "Technical data": Safe digital outputs: Added number of channels.

2.07	August 2020	• Chapter 4 "Technical data":
		
		    – General information: Added additional power dissipation caused by actuators (resistive) [W].
		    – Safe digital outputs: Added R$_{DS(on)}$, removed residual voltage, updated switching voltage.
		
		 • Editorial changes.

2.06	May 2020	• Chapter 4 "Technical data": Added footnote for system requirements. • Chapter 8.3 "Channel list": Added channel "oS_PropDelayStat". • Editorial changes.

2.05	February 2020	• Chapter 4 "Technical data":
		
		    – Safe digital outputs: Added Peak short-circuit current.
		    – Added section "Inrush current behavior for output channels" and updated technical data accordingly.
		
		 • Editorial changes.

2.04	November 2019	• Chapter 4 "Technical data":
		
		    – Updated max. switching frequency.
		    – Added table "Switching inductive loads".
		
		 • Editorial changes.

2.02	May 2019	First edition for mapp Safety

Table 16: 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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Commercial register number: FN 111651 v
Commercial registry: Regional court Ried im Innkreis
UID number: ATU62367156
Legal structure: Limited liability company
Corporate headquarters: Municipality of Eggelsberg (Upper Austria)

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