X20 PLC

Data sheets

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Order no.: **X20 PLC**

Translation of the original documentation

Publishing information

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1 X20(c)CP1301, X20CP1381 and X20CP1382

1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual
MAEMV	Installation / EMC guide

1.2 General information

The Compact controller is available with 200 MHz and 400 MHz processor performance. Depending on the variant, up to 256 MB RAM and up to 32 kB nonvolatile RAM are integrated. A permanently installed flash drive with up to 2 GB is available for the application and data storage.

All controllers are equipped with an Ethernet, USB and RS232 interface. In both performance classes, POWERLINK and CAN bus are also available as integrated interfaces. For additional fieldbus connections, each controller can be expanded with an interface module from the X20 standard portfolio. The controllers are fanless and battery-free and thus maintenance-free. 30 different digital inputs and outputs and 2 analog inputs are integrated in the devices. 1 analog input can be used for Pt1000 resistance temperature measurement.

- CPU is Intel x86 200/400 MHz compatible with integrated I/O processor.
- Ethernet, POWERLINK with poll-response chaining and onboard USB
- 1 slot for modular interface expansion
- 30 digital inputs/outputs and 2 analog inputs integrated in the device
- 1/2 GB onboard flash drive
- 128/256 MB DDR3 SDRAM
- Fanless
- No battery
- Backed-up real-time clock

1.3 Coated modules

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

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

1.4 Order data

Order number	Short description
	Compact PLCs
X20CP1301	X20 PLC, with integrated I/O, x86-200, 128 MB DDR3 RAM, 16 kB FRAM, 1 GB onboard flash drive, 1 insert slot for X20 interface modules, 1 USB interface, 1 RS232 interface, 1 Ethernet interface 10/100BASE-T, 14 digital inputs, 24 VDC, sink, 4 digital inputs, 2 µs, 24 VDC, sink, 4 digital outputs, 24 VDC, 0.5 A, source, 4 digital outputs, 2 µs, 24 VDC, 0.2 A, 4 digital inputs/outputs, 24 VDC, 0.5 A, 2 analog inputs ±10 V or 0 to 20 mA / 4 to 20 mA, 1 Pt1000 instead of an analog input, includes power supply module, 3x terminal block X20TB1F, slot cover and X20 end cover plate X20AC0SR1 (right) included
X20cCP1301	X20 PLC coated, with integrated I/O, x86-200, 128 MB DDR3 RAM, 16 kB FRAM, 1 GB onboard flash drive, 1 insert slot for X20 interface modules, 1 USB interface, 1 RS232 interface, 1 Ethernet interface 10/100BASE-T, 14 digital inputs, 24 VDC, sink, 4 digital inputs, 2 µs, 24 VDC, sink, 4 digital outputs, 24 VDC, 0.5 A, source, 4 digital outputs, 2 µs, 24 VDC, 0.2 A, 4 digital inputs/outputs, 24 VDC, 0.5 A, 2 analog inputs ±10 V or 0 to 20 mA / 4 to 20 mA, 1 Pt1000 instead of an analog input, includes power supply module, 3x terminal block X20TB1F, slot cover and X20 end cover plate X20AC0SR1 (right) included
X20CP1381	X20 PLC, with integrated I/O, x86-200, 128 MB DDR3 RAM, 16 kB FRAM, 1 GB onboard flash drive, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 CAN bus interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T, 14 digital inputs, 24 VDC, sink, 4 digital inputs, 2 µs, 24 VDC, sink, 4 digital outputs, 24 VDC, 0.5 A, source, 4 digital outputs, 2 µs, 24 VDC, 0.2 A, 4 digital inputs/outputs, 24 VDC, 0.5 A, 2 analog inputs ±10 V or 0 to 20 mA / 4 to 20 mA, 1 Pt1000 instead of an analog input, includes power supply module, 3x terminal block X20TB1F, slot cover and X20 end cover plate X20AC0SR1 (right) included
X20CP1382	X20 PLC, with integrated I/O, x86-400, 256 MB DDR3 RAM, 32 kB FRAM, 2 GB onboard flash drive, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 CAN bus interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T, 14 digital inputs, 24 VDC, sink, 4 digital inputs, 2 µs, 24 VDC, sink, 4 digital outputs, 24 VDC, 0.5 A, source, 4 digital outputs, 2 µs, 24 VDC, 0.2 A, 4 digital inputs/outputs, 24 VDC, 0.5 A, 2 analog inputs ±10 V or 0 to 20 mA / 4 to 20 mA, 1 Pt1000 instead of an analog input, includes power supply module, 3x terminal block X20TB1F, slot cover and X20 end cover plate X20AC0SR1 (right) included

Table 1: Order data

Content of delivery

Order number	Quantity	Short description
-	1	Interface module slot cover
X20AC0SR1	1	X20 end cover plate (right)
X20TB1F	3	X20 terminal block, 16-pin, 24 VDC keyed

Table 2: Content of delivery

1.5 Technical data

Order number	X20CP1301	X20cCP1301	X20CP1381	X20CP1382
Short description				
Interfaces	1x RS232, 1x Ethernet, 1x USB, 1x X2X Link		1x RS232, 1x Ethernet, 1x POWERLINK, 2x USB, 1x X2X Link, 1x CAN bus	
System module	Controller			
General information				
B&R ID code	0xE35B	0xEB58	0xE35C	0xDABB
Cooling	Fanless			
Status indicators	CPU function, Ethernet, RS232, PLC power supply, I/O power supply, I/O function per channel		CPU function, Ethernet, POWERLINK, RS232, CAN bus, CAN bus terminating resistor, PLC power supply, I/O power supply, I/O function per channel	
Diagnostics				
Outputs	Digital outputs: Yes, using LED status indicator and software (output error status)			
CPU function	Yes, using LED status indicator			
CAN bus data transfer	-	-	Yes, using LED status indicator	
RS232 data transfer	Yes, using LED status indicator			
Inputs	Analog inputs: Yes, using LED status indicator and software			
Ethernet	Yes, using LED status indicator			
I/O power supply	Yes, using LED status indicator			
POWERLINK	-	-	Yes, using LED status indicator	
Supply voltage monitoring	Yes, using LED status indicator			
Temperature	Yes, using software register			
Terminating resistor	-	-	Yes, using LED status indicator	
Support				
Controller redundancy	No			
ACOPOS support	Yes			
reACTION-capable I/O channels	No			
Visual Components support	Yes			
Power consumption without interface module and USB	4.3 W		4.8 W	5.5 W
Power consumption for X2X Link power supply [1]	0.8 W			
Power consumption [1]				
Internal I/O	2.3 W			
Additional power dissipation caused by actuators (resistive) [W]	-			
Type of signal lines	Shielded lines must be used for all high-speed digital inputs/outputs, line length: Max. 20 m			
Certifications				
CE	Yes			
UKCA	Yes			
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	Temperature: **B** (0 - 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)			
LR	ENV1			
KR	Yes			
ABS	Yes			
EAC	Yes			
CPU and X2X Link power supply				
Input voltage	24 VDC -15% / +20%			
Input current	Max. 1 A			
Fuse	Integrated, cannot be replaced			
Reverse polarity protection	Yes			
X2X Link power supply output				
Nominal output power	2 W			
Parallel connection	Yes [2]			
Redundant operation	Yes [3]			
Input I/O power supply				
Input voltage	24 VDC -15% / +20%			
Fuse	Required line fuse: Max. 10 A, slow-blow			
Output I/O power supply				
Nominal output voltage	24 VDC			
Permissible contact load	10 A			

Table 3: Technical data

Order number	X20CP1301	X20cCP1301	X20CP1381	X20CP1382
Controller				
Real-time clock	Retention for at least 300 hours, typ. 1000 hours at 25°C, 1 s resolution, -18 to 28 ppm accuracy at 25°C			
FPU	Yes			
Processor				
Type	Vx86EX			
Clock frequency	200 MHz			400 MHz
L1 cache				
Data code	16 kB			
Program code	16 kB			
L2 cache	128 kB			
Integrated I/O processor	Processes I/O data points in the background			
Modular interface slots	1			
Remanent variables	16 kB FRAM, retention >10 years [4]			32 kB FRAM, retention >10 years [4]
Shortest task class cycle time	2 ms			1 ms
Typical instruction cycle time	0.0419 µs			0.0199 µs
Standard memory				
RAM	128 MB DDR3 SDRAM			256 MB DDR3 SDRAM
Application memory				
Type	1 GB eMMC flash memory			2 GB eMMC flash memory
Data retention	10 years			
Writable data amount				
Guaranteed	40 TB			
Results for 5 years	21.9 GB/day			
Guaranteed erase/write cycles	20,000			
Error-correcting code (ECC)	Yes			
Interfaces				
Interface IF1				
Signal	RS232			
Variant	Connection via 16-pin terminal block X20TB1F			
Max. distance	900 m			
Transfer rate	Max. 115.2 kbit/s			
Interface IF2				
Signal	Ethernet			
Variant	1x RJ45 shielded			
Line length	Max. 100 m between 2 stations (segment length)			
Transfer rate	10/100 Mbit/s			
Transfer				
Physical layer	10BASE-T/100BASE-TX			
Half-duplex	Yes			
Full-duplex	Yes			
Autonegotiation	Yes			
Auto-MDI/MDIX	Yes			
Interface IF3				
Fieldbus	-	-	POWERLINK managing or controlled node	
Type	-	-	Type 4 [5]	
Variant	-	-	1x RJ45 shielded	
Line length	-	-	Max. 100 m between 2 stations (segment length)	
Transfer rate	-	-	100 Mbit/s	
Transfer				
Physical layer	-	-	100BASE-TX	
Half-duplex	-	-	Yes	
Full-duplex	-	-	POWERLINK mode: No / Ethernet mode: Yes	
Autonegotiation	-	-	Yes	
Auto-MDI/MDIX	-	-	Yes	
Interface IF4				
Type	USB 1.1/2.0			
Variant	Type A			
Max. output current	0.5 A			
Interface IF5				
Type	-	-	USB 1.1/2.0	
Variant	-	-	Type A	
Max. output current	-	-	0.1 A	
Interface IF6				
Fieldbus	X2X Link master			
Interface IF7				
Signal	-	-	CAN bus	
Variant	-	-	Connection via 16-pin terminal block X20TB1F	
Max. distance	-	-	1000 m	
Transfer rate	-	-	Max. 1 Mbit/s	
Terminating resistor	-	-	Integrated in module	
Controller	-	-	SJA 1000	

Table 3: Technical data

Order number	X20CP1301	X20cCP1301	X20CP1381	X20CP1382
Digital inputs				
Quantity	14 standard inputs, 4 high-speed inputs and 4 mixed channels, configuration as input or output using software			
Nominal voltage	24 VDC			
Input voltage	24 VDC -15% / +20%			
Input current at 24 VDC	X1 - Standard inputs: Typ. 3.5 mA X2 - Standard inputs: Typ. 2.68 mA X2 - High-speed inputs: Typ. 3.5 mA X3 - Mixed channels: Typ. 2.68 mA			
Input circuit	Sink			
Input filter				
Hardware	Standard inputs and mixed channels: ≤200 µs High-speed inputs: ≤2 µs, when used as standard inputs: ≤200 µs			
Software	Default 1 ms, configurable between 0 and 25 ms in 0.1 ms increments			
Connection type	1-wire connections			
Input resistance	X1 - Standard inputs: 6.8 kΩ X2 - Standard inputs: 8.9 kΩ X2 - High-speed inputs: 6.8 kΩ X3 - Mixed channels: 8.9 kΩ			
Additional functions	X2 - High-speed digital inputs: 2x 250 kHz event counting, 2x AB counter, ABR incremental encoder, direction/frequency, period measurement, gate measurement, differential time measurement, edge counters, edge times			
Switching threshold				
Low	<5 VDC			
High	>15 VDC			
AB incremental encoder				
Quantity	2			
Encoder inputs	24 V, asymmetrical			
Counter size	32-bit			
Input frequency	Max. 100 kHz			
Evaluation	4x			
Encoder power supply	Module-internal, max. 300 mA			
Overload characteristics of encoder power supply	Short-circuit proof, overload-proof			
ABR incremental encoder				
Quantity	1			
Encoder inputs	24 V, asymmetrical			
Counter size	32-bit			
Input frequency	Max. 100 kHz			
Evaluation	4x			
Encoder power supply	Module-internal, max. 300 mA			
Overload characteristics of encoder power supply	Short-circuit proof, overload-proof			
Event counters				
Quantity	2			
Signal form	Square wave pulse			
Evaluation	1x			
Input frequency	Max. 250 kHz			
Counter frequency	250 kHz			
Counter size	32-bit			
Edge detection / Time measurement				
Possible measurements	Period measurement, gate measurement, differential time measurement, edge counter, edge times			
Measurements per module	Each function up to 2x			
Counter size	32-bit			
Input frequency	Max. 10 kHz			
Timestamp	1 µs resolution			
Signal form	Square wave pulse			
Analog inputs				
Input	±10 V or 0 to 20 mA / 4 to 20 mA, via different terminal connections			
Input type	Differential input			
Digital converter resolution				
Voltage	±12-bit			
Current	12-bit			
Conversion time	1 channel enabled: 100 µs 2 channels enabled: 200 µs			
Output format				
Data type	INT			
Voltage	INT 0x8001 - 0x7FFF / 1 LSB = 0x0008 = 2.441 mV			
Current	INT 0x0000 - 0x7FFF / 1 LSB = 0x0008 = 4.883 µA			
Input impedance in signal range				
Voltage	20 MΩ			
Current	-			
Load				
Voltage	-			
Current	<300 Ω			

Table 3: Technical data

Order number	X20CP1301	X20cCP1301	X20CP1381	X20CP1382
Input protection	Protection against wiring with supply voltage			
Permissible input signal				
Voltage	Max. ±30 V			
Current	Max. ±50 mA			
Output of digital value during overload	Configurable			
Conversion procedure	SAR			
Input filter	Third-order low-pass filter / Cutoff frequency 1 kHz			
Max. error				
Voltage				
Gain	0.18% (Rev. <C0: 0.37%) [6]			
Offset	0.04% (Rev. <C0: 0.25%) [7]			
Current				
Gain	0 to 20 mA = 0.15% (Rev. <C0: 0.52%) / 4 to 20 mA = 0.25% [6]			
Offset	0 to 20 mA = 0.1% (Rev. <C0: 0.4%) / 4 to 20 mA = 0.15% [8]			
Max. gain drift				
Voltage	0.017 %/°C [6]			
Current	0 to 20 mA = 0.015 %/°C / 4 to 20 mA = 0.023 %/°C [6]			
Max. offset drift				
Voltage	0.008 %/°C [7]			
Current	0 to 20 mA = 0.008 %/°C / 4 to 20 mA = 0.012 %/°C [8]			
Common-mode rejection				
DC	70 dB			
50 Hz	70 dB			
Common-mode range	±12 V			
Crosstalk between channels	<-70 dB			
Nonlinearity				
Voltage	<0.025% [7]			
Current	<0.05% [8]			
Resistance measurement temperature inputs				
Quantity	1			
Input	Resistance measurement with constant current supply for 2-wire connections			
Digital converter resolution	13-bit			
Conversion time	Only temperature input enabled: 200 µs Temperature and analog input enabled: 400 µs			
Conversion procedure	SAR			
Output format	INT or UINT for resistance measurement			
Sensor				
Pt1000	-200 to 850°C			
Resistance measurement range	0.1 to 4000 Ω			
Temperature sensor resolution	1 LSB = 0x0005 = 0.16°C			
Resistance measurement resolution	1 LSB = 0x0005 = 0.49 Ω			
Input filter	First-order low-pass filter / cutoff frequency 7 Hz			
Sensor standard	EN 60751			
Common-mode range	1 V			
Linearization method	Internal			
Measurement current	1 mA			
Permissible input signal	Short-term max. ±30 V			
Max. error at 25°C				
Gain	0.3% (Rev. <C0: 1.93%) [9]			
Offset	0.15% (Rev. <C0: 0.32%) [10]			
Max. gain drift	0.023 %/°C [9]			
Max. offset drift	0.012%/°C [10]			
Nonlinearity	<0.05% [10]			
Standardized range of values for resistance measurement	0.1 to 4000.0 Ω			
Crosstalk between channels	<-70 dB			
Common-mode rejection				
50 Hz	>60 dB			
Temperature sensor normalization				
Pt1000	-200 to 850°C			
Digital outputs				
Quantity	4 standard outputs, 4 high-speed outputs and 4 mixed channels, configuration as input or output using software			
Variant	Standard outputs and mixed channels: Current-sourcing FET High-speed outputs: Push-Pull			
Nominal voltage	24 VDC			
Switching voltage	24 VDC -15% / +20%			
Nominal output current	Standard outputs and mixed channels: 0.5 A High-speed outputs: 0.2 A			
Total nominal current	Standard outputs and mixed channels: 4 A High-speed outputs: 0.8 A			
Connection type	1-wire connections			
Output circuit	Standard outputs and mixed channels: Source High-speed outputs: Sink or source			

Table 3: Technical data

Order number	X20CP1301	X20cCP1301	X20CP1381	X20CP1382
Output protection [11]	Thermal shutdown in the event of overcurrent or short circuit (see value "Short-circuit peak current") Internal freewheeling diode for switching inductive loads (see section "Switching inductive loads")			
Pulse width modulation [12]				
Period duration	5 to 65535 µs corresponds to 200 kHz to 15 Hz			
Pulse duration	0 to 100%, minimum 2.5 µs			
Resolution for pulse duration	0.1% of the configured frequency			
Diagnostic status	Standard outputs and mixed channels: Output monitoring with 10 ms delay High-speed outputs: Output monitoring with 10 µs delay			
Leakage current when the output is switched off	Standard outputs and mixed channels: 5 µA High-speed outputs: 25 µA			
$R_{DS(on)}$	140 mΩ [13]			
Residual voltage	Standard outputs and mixed channels: <0.1 V at nominal current 0.5 A High-speed outputs: <0.9 V at nominal current 0.1 A			
Peak short-circuit current	Standard outputs and mixed channels: <3 A High-speed outputs: <20 A			
Switch-on in the event of overload shutdown or short-circuit shutdown	Standard outputs and mixed channels: Approx. 10 ms (depends on module temperature) High-speed outputs: No switch-on			
Switching delay				
0 → 1	Standard outputs and mixed channels: <300 µs High-speed outputs: <3 µs			
1 → 0	Standard outputs and mixed channels: <300 µs High-speed outputs: <3 µs			
Switching frequency				
Resistive load [14]	Standard outputs and mixed channels: Max. 500 Hz High-speed outputs: 50 kHz, max. 200 kHz (see section "Switching frequency derating for high-speed digital outputs")			
Inductive load	See section "Switching inductive loads".			
Braking voltage when switching off inductive loads	Standard outputs and mixed channels: Typ. 45 VDC			
Electrical properties				
Electrical isolation	Ethernet (IF2) and X2X (IF6) isolated from each other, from other interfaces and from PLC Channel isolated from bus Channel not isolated from channel or PLC		Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC Channel isolated from bus Channel not isolated from channel or PLC	
Operating conditions				
Mounting orientation				
Horizontal	Yes			
Vertical	Yes			
Installation elevation above sea level				
0 to 2000 m	No limitation			
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m			
Degree of protection per EN 60529	IP20			
Ambient conditions				
Temperature				
Operation				
Horizontal mounting orientation	-25 to 60°C			
Vertical mounting orientation	-25 to 50°C			
Derating	See section "Switching frequency derating for high-speed digital outputs".			
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	
Storage	5 to 95%, non-condensing			
Transport	5 to 95%, non-condensing			
Mechanical properties				
Note	X20 end cover plate (right) included in delivery 3 X20 terminal blocks (16-pin) included in delivery Interface module slot cover included in delivery			
Dimensions				
Width	164 mm			
Height	99 mm			
Depth	75 mm			
Weight	300 g		310 g	

Table 3: Technical data

1) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
2) When operated in parallel, the nominal power of 2 W is not permitted to be added to the total power.
3) Up to 2 W bus load.
4) The memory size for remanent variables is configurable in Automation Studio.
5) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.
6) Based on the current measured value.
7) Based on the 20 V measurement range.
8) Based on the 20 mA measurement range.
9) Based on the current measured resistance value.
10) Based on the entire resistance measurement range.
11) For the high-speed digital outputs, derating must be taken into account at a switching frequency >50 kHz (see section "Derating for switching frequency of high-speed digital outputs"). Overtemperature protection is not provided.

12) The high-speed digital outputs can be used for pulse width modulation.
13) Only for standard outputs and mixed channels.
14) Standard outputs and mixed channels: At loads ≤1 kΩ

1.6 Operating and connection elements

X20CP1301

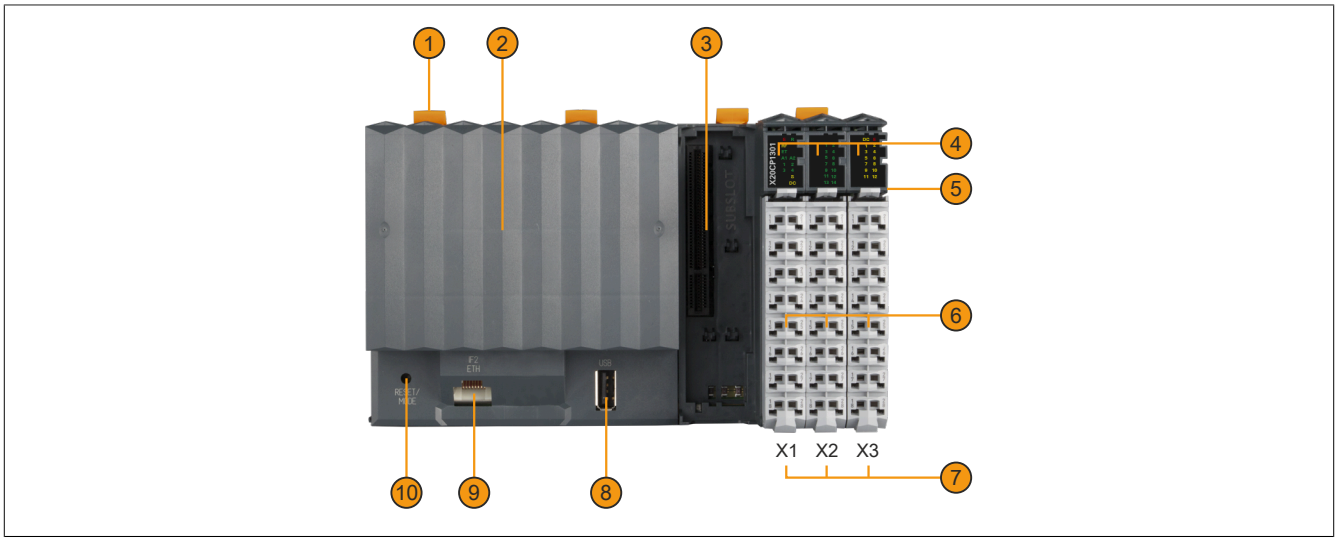


Figure 1: Operating elements for X20CP1301

1	Top-hat rail latch	2	Integrated flash drive
3	Slot for interface modules	4	LED status indicators
5	IF6 - X2X Link	6	Connections for: Power supplies, I/O channels, IF1 - RS232
7	3 integrated I/O slots: X1, X2 and X3	8	IF4 - USB
9	IF2 - Ethernet	10	Button for reset and operating mode

X20CP1381 and X20CP1382

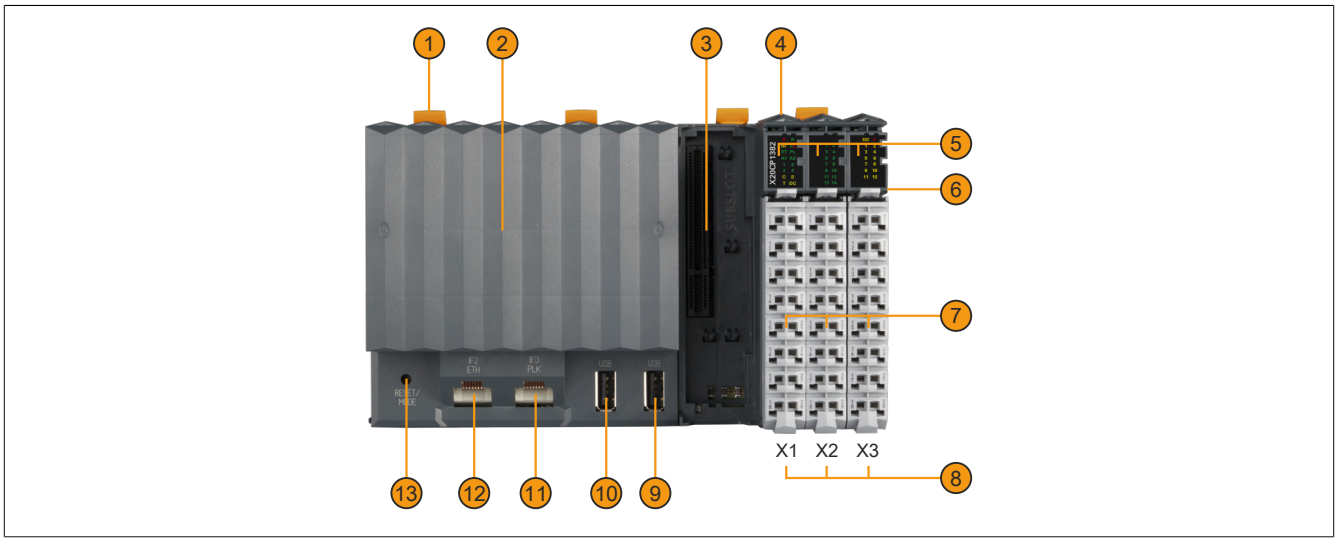


Figure 2: Operating elements for X20CP1381 and X20CP1382

1	Top-hat rail latch	2	Integrated flash drive
3	Slot for interface modules	4	Switch for CAN bus terminating resistor
5	LED status indicators	6	IF6 - X2X Link
7	Connections for: Power supplies, I/O channels, IF1 - RS232, IF7 - CAN bus	8	3 integrated I/O slots: X1, X2 and X3
9	IF5 - USB	10	IF4 - USB
11	IF3 - POWERLINK	12	IF2 - Ethernet
13	Button for reset and operating mode	-	-

1.6.1 LED status indicators

1.6.1.1 Slot X1

Figure	LED	Color	Status	Description
	E	Red	On	Operating mode SERVICE[1] or BOOT[1]
			Blinking	The "E" LED blinks red and the "RF" LED blinks yellow when there is a license violation.
			Double flash	Firmware update[2]
	R	Green	On	Application running
			Blinking	System startup: The controller is initializing the application, all bus systems and I/O modules.[2]
		Red	On	During reset
	RF	Yellow	On	Operating mode SERVICE[1] or BOOT[1]
			Blinking	The "RF" LED blinks yellow and the "E" LED blinks red when there is a license violation.
	SE	Green/Red		Status/Error LED. LED states are described in section "LED "S/E" (status/error LED)" on page 12.
	ET	Green	On	A link to the Ethernet remote station has been established.
			Blinking	A link to the Ethernet remote station has been established. The LED blinks when Ethernet activity is taking place on the bus.
	PL	Green	On	A link to the POWERLINK peer station has been established.
			Blinking	A link to the POWERLINK peer station has been established. The LED blinks when Ethernet activity is taking place on the bus.
	A1 - A2	Green	Off	Open circuit or disconnected sensor
			Blinking	Input signal overflow or underflow
			On	Analog/digital converter running, value OK
	1 - 4	Green		Input state of the corresponding digital input
	C	Yellow	On	Controller transmitting or receiving data via the CAN bus interface
	S	Yellow	On	Controller transmitting or receiving data via the RS232 interface
	T	Yellow	On	The terminating resistor integrated in the controller is switched on.
	DC	Yellow	On	Controller power supply unit OK

Table 4: LED status indicators on the integrated X1 I/O slot

1) The operating states are described in Automation Help under "Real-time operating system - Method of operation - Operating states".
2) The process can take several minutes depending on the configuration.

1.6.1.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

1.6.1.1.1.1 Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		
Green	Red	Description
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

1.6.1.1.1.2 POWERLINK V2 mode

Error message

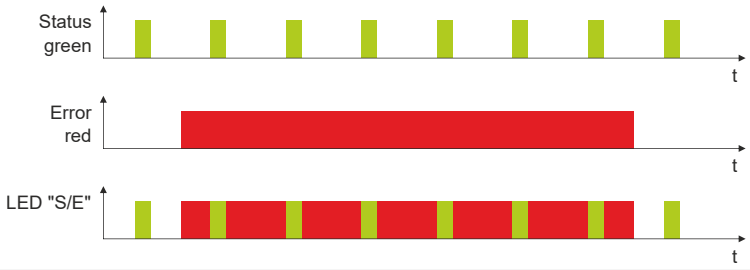
LED "S/E"		
Green	Red	Description
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE 

Table: LED "S/E" - Error message (interface in POWERLINK mode)

Interface status

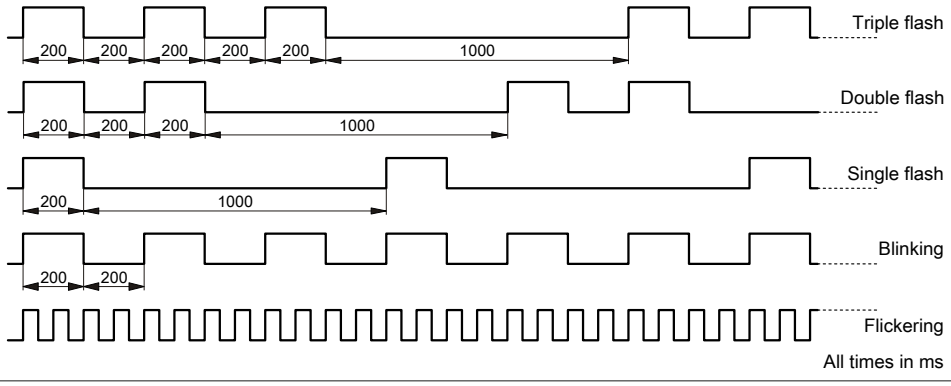
LED "S/E"		
Green	Red	Description
Off	Off	**Mode:** NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective. **Managing node (MN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. **Controlled node (CN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	**Mode:** BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. **Managing node (MN)** This mode can only be exited by resetting the controller. **Controlled node (CN)** If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. **Managing node (MN)** The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. **Controlled node (CN)** The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. **Managing node (MN)** The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. **Controlled node (CN)** The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

LED "S/E"		
Green	**Red**	**Description**
Triple flash (approx. 1 Hz)	Off	**Mode:** READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. **Managing node (MN)** Cyclic and asynchronous communication. Received PDO data is ignored. **Controlled node (CN)** The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
On	Off	**Mode:** OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	**Mode:** STOPPED The interface is in mode STOPPED. **Managing node (MN)** This mode does not occur for the MN. **Controlled node (CN)** Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

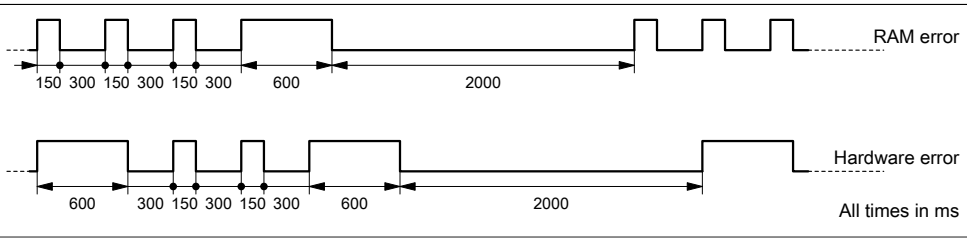
Blink times



1.6.1.1.2 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

1.6.1.2 Slot X2

Figure	LED	Color	Status	Description
	1 - 14	Green		Input state of the corresponding digital input

Table 5: LED status indicators on the integrated X2 I/O slot

1.6.1.3 Slot X3

Figure	LED	Color	Status	Description
	DC	Yellow	On	I/O power supply OK
	E	Red	Off	Everything OK
			Double flash	No power to module
	1 - 4	Yellow		Output state of the corresponding digital output
	5 - 8	Yellow		Input or output state of the corresponding digital input or output
	9 - 12	Yellow		Output state of the corresponding high-speed digital output

Table 6: LED status indicators on the integrated X3 I/O slot

1.6.2 Button for reset and operating mode

1.6.2.1 Reset

The button must be pressed for less than 2 seconds to trigger a reset. This triggers a hardware reset on the controller, which means that:

- All application programs are stopped.
- All outputs are set to zero.

The controller then boots into service mode by default. The startup mode after pressing the reset button can be set in Automation Studio:

- Service mode (default)
- Warm restart
- Cold restart
- Diagnostic mode

1.6.2.2 Operating mode

3 operating modes can be set using different button sequences:

Operating mode	Button sequence	Description
BOOT[1)]	Boot mode is enabled by the following button sequence: • Press the button for less than 2 s. The button can be released as soon as LED "R" on I/O slot X1 lights up **RED**. • Then press the button within 2 s for longer than 2 s. As soon as LED "R" goes out, the button can be released.	Boot AR is started, and the runtime system can be installed via the online interface (Automation Studio). User flash memory is erased only when the download begins.
SERVICE/RUN[1)]	Press the button for less than 2 s. The button can be released as soon as LED "R" on I/O slot X1 lights up **RED**.	Mode SERVICE/RUN: Triggering and startup behavior correspond to triggering a hardware reset (see "Reset" on page 16).
DIAGNOSE[1)]	Press the button for more than 2 s. LED "R" on I/O slot X1 lights up **RED** and then goes out. As soon as LED "R" goes out, the button can be released.	The controller is starting up in diagnostic mode. Program sections in User RAM and User FlashPROM are not initialized. After diagnostic mode, the controller always boots with a warm restart.

1) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.

1.6.3 Flash drive

This application memory is implemented as an integrated flash drive.

1.6.4 Project installation

Project installation is described in "Project management - Project installation" in Automation Help.

1.6.5 RS232 interface (IF1)

The non-electrically isolated RS232 interface is primarily intended to serve as an online interface for communication with the programming device. It is located on the X1 I/O slot.

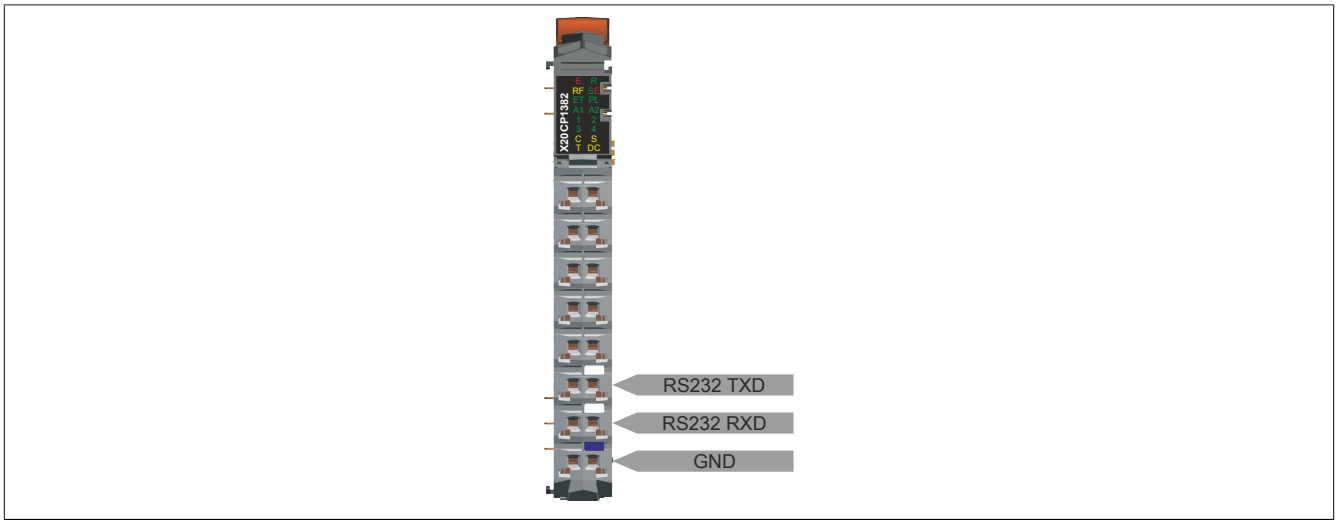
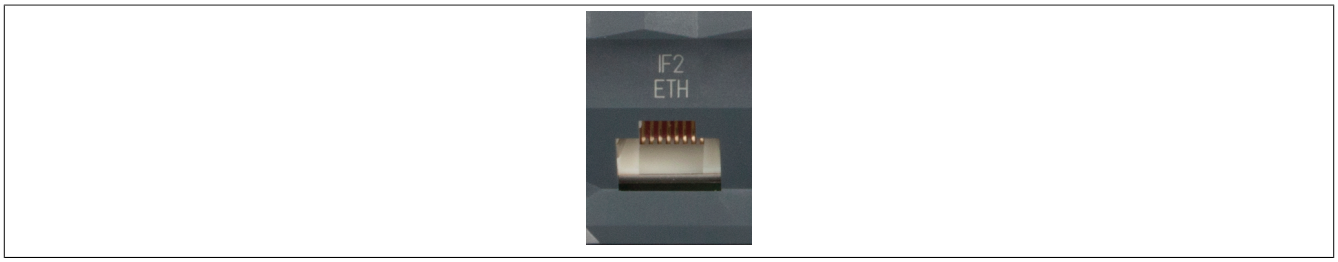


Figure 3: RS232 interface (IF1) on the X1 I/O slot - Pinout

1.6.6 Ethernet interface (IF2)



IF2 is a 10BASE-T/100BASE-TX Ethernet interface.

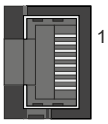
The INA2000 station number is set using the B&R Automation Studio software.

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Information:

The Ethernet interface is not suitable for POWERLINK.

When using the POWERLINK interface, the Ethernet interface is not permitted to be operated with an IP address from the POWERLINK address range.
POWERLINK address range: 192.168.100.x

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

1.6.7 POWERLINK interface (IF3)

Compact controllers X20CP1381 and X20CP1382 are equipped with a POWERLINK V2 interface.

POWERLINK

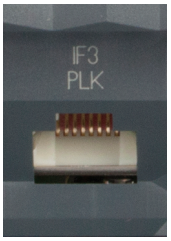
By default, the POWERLINK interface is operated as a managing node (MN). In the managing node, the node number is set to a fixed value of 240.

If the POWERLINK node is operated as a controlled node (CN), a node number from 1 to 239 can be set in the POWERLINK configuration in Automation Studio.

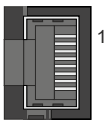
Ethernet mode

In this mode, the interface is operated as an Ethernet interface. The INA2000 station number is set using the Automation Studio software.

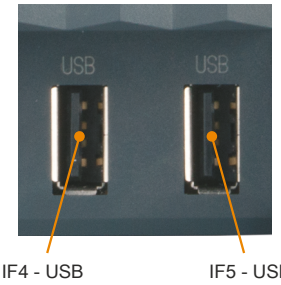
Pinout



For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

1.6.8 USB interfaces (IF4 and IF5)



IF4 and IF5 are non-galvanically isolated USB interfaces. The abbreviation USB stands for "Universal Serial Bus". Both USB interfaces support the USB 1.1 and 2.0 standards.

Information:

USB peripheral devices can be connected to the USB interfaces. Automation Runtime supports a selection of USB peripheral devices. For the supported USB classes, see the AR help documentation.

Information:

The following must be taken into account when using a USB peripheral device and grounded controller power supply (PELV):

- **Only USB peripheral devices with no connection between GND and ground are permitted to be connected. This is the case, e.g. with the USB dongle from B&R.**

Only interface IF4 is connected to the entry-level controller.

1.6.9 CAN bus interface (IF7)

With the exception of the entry-level controller, the Compact controllers are equipped with a non-galvanically isolated CAN bus interface. It is located on the integrated X1 I/O slot.

1.6.9.1 Pinout

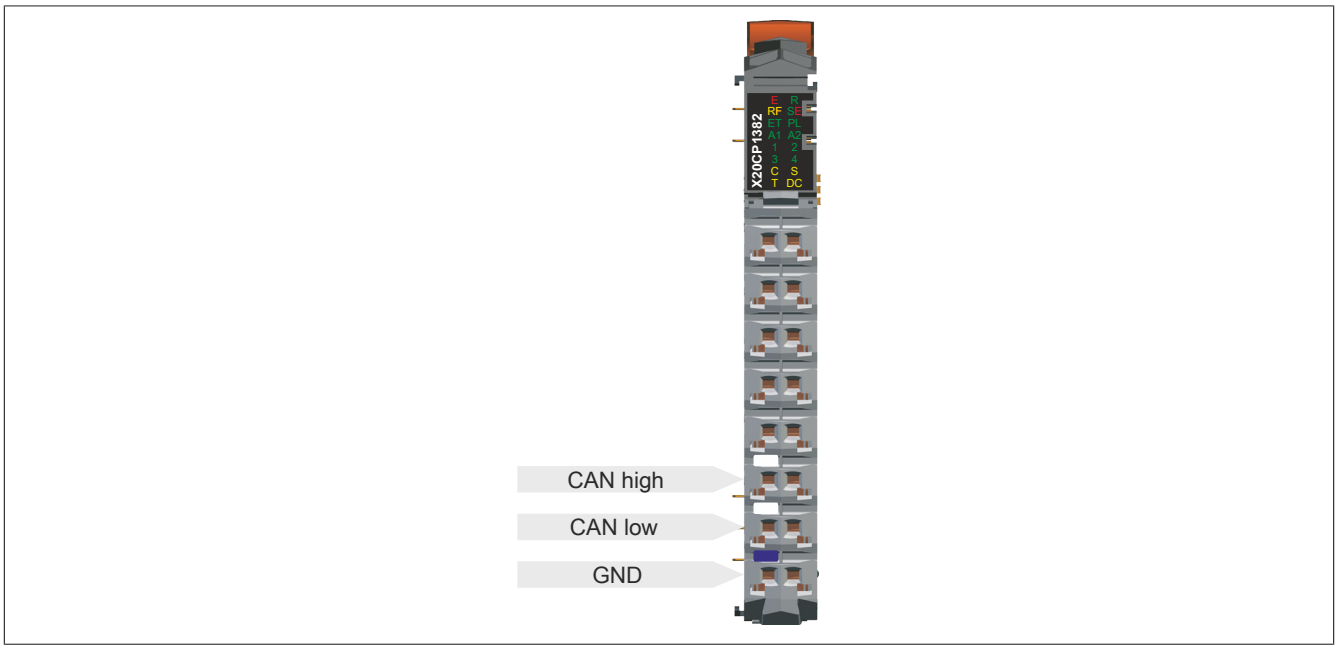


Figure 4: CAN bus interface (IF7) on the X1 I/O slot - Pinout

1.6.9.2 Terminating resistor

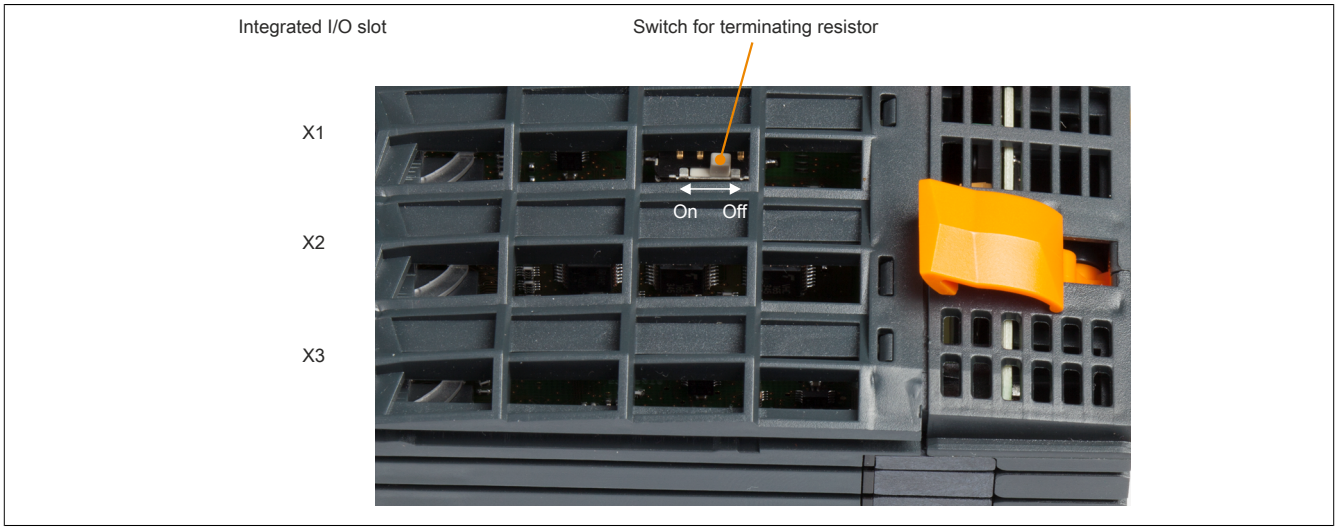


Figure 5: Switch positions for the CAN bus terminating resistor

A terminating resistor is already installed on the X1 I/O slot. The terminating resistor is switched on or off with a switch on the top of the housing. An enabled terminating resistor is indicated by LED "T".

1.6.10 Slot for interface modules

These controllers are equipped with one slot for interface modules.

Different bus or network systems can be flexibly integrated into the X20 system by selecting the appropriate interface module.

1.6.11 Data and real-time clock retention

The controllers do not use a battery. This makes them completely maintenance-free. Eliminating the backup battery was made possible by the following measures:

Data and real-time clock retention	Backup type	Note
Remanent variables	FRAM	This FRAM stores its contents ferroelectrically. Unlike normal SRAM, this does not require a battery.
Real-time clock	Gold foil capacitor	The real-time clock is backed up for approx. 1000 hours by a gold foil capacitor. The gold foil capacitor is completely charged after 3 continuous hours of operation.

1.7 Controller power supply

A power supply unit is integrated in these Compact controllers. It is equipped with a supply for the controller, X2X Link and the internal I/O power supply. The supply is galvanically isolated from X2X Link.

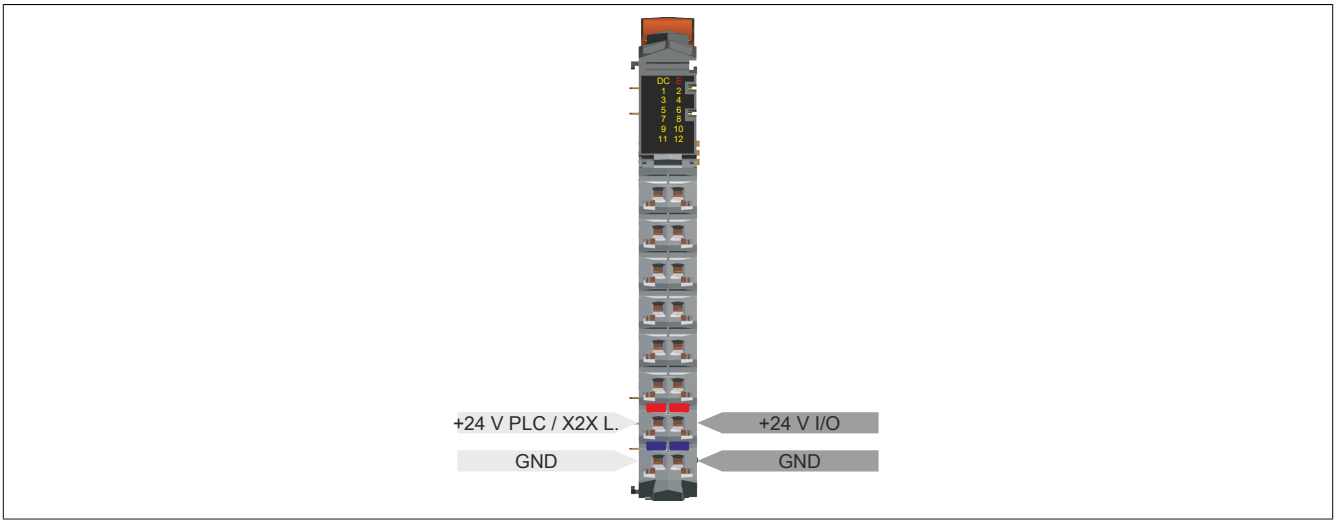
The connections are located on the X3 I/O slot.

Power supply concept of Compact controllers

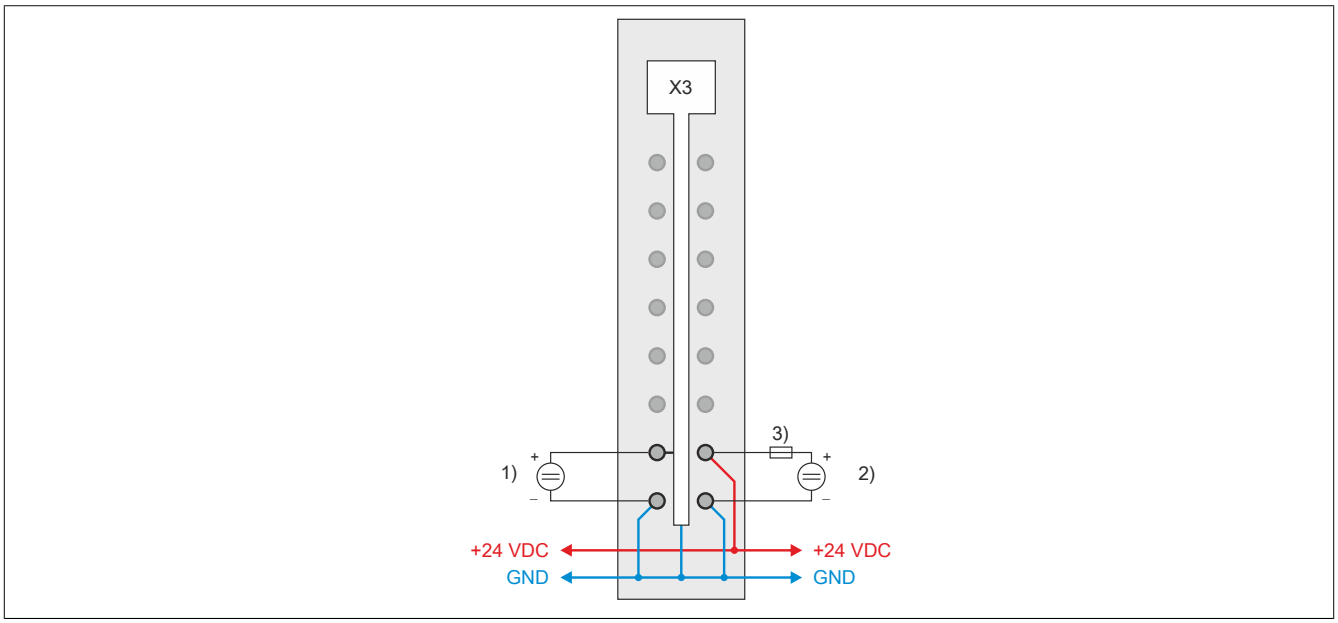
To ensure proper operation of the Compact controllers, the following points must be observed:

Power supply concept	Description
PLC and I/O GND	The GND contact is provided 5 times on the terminal blocks of the integrated I/O slots. All GND contacts are connected to one another. The GND contacts of the controller and I/O power supply therefore use the same electric potential.
Connectable X20 I/O modules	Power supply of X20 I/O modules that are connected to the Compact controller: • X2X Link: Power supply via the controller power supply • I/O channels: Supplied by the I/O power supply
Integrated X1 I/O slot	All digital and analog signals as well as the RS232 and CAN bus interface are supplied by the controller power supply. Their operation is therefore guaranteed even if there is no I/O power supply.
Integrated X2 I/O slot	• All digital signals are supplied by the controller power supply. Their operation is therefore guaranteed even if there is no I/O power supply. • The encoder power supply is supplied by the I/O power supply. If the encoder should not be included in the EMERGENCY STOP chain, it must be connected to an external power supply or it will be supplied by the controller's power supply unit.
Integrated X3 I/O slot	• All 12 digital signals are supplied by the I/O power supply. • The status messages for each channel also work without an I/O power supply. This guarantees that status messages will continue to be transferred during an emergency stop. • The state of the I/O power supply is indicated by a separate status message. **Caution!** **Channels 5 to 8 are designed as mixed channels. If one of these channels is being used, it is absolutely essential to ensure that there is no external voltage present on the I/O channel when the I/O power supply is cut off. Otherwise, power will be regenerated back to the plus terminal of the I/O power supply via the I/O channel. This will result in defective components.** **The following solutions are available for preventing power regeneration from occurring:** • **The I/O power supply of the controller is not permitted to be switched off, which allows the reference potential to be maintained.** • **If the I/O power supply is switched off anyway (e.g. as part of the emergency stop chain), then the sensor/actuator power supplies must also be switched off. This prevents potential power regeneration and protects components from being destroyed.**

Pinout



Connection example



1) Supply for the PLC / X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

1.8 Overtemperature shutdown

To prevent damage, a shutdown – reset state – of the controller takes place at 95°C board temperature.

The following errors are entered in the logbook in the event of shutdown:

Error number	Short error text
9204	PLC restart triggered by the PLC CPU's temperature monitoring.
9210	Warning: Halt/Service after watchdog or manual reset.

1.9 Local I/O channels

Compact controllers are equipped with 3 integrated I/O slots. These devices have 30 digital inputs/outputs and 2 analog inputs.

The functions of high-speed digital inputs and outputs are described in section "Functions of the high-speed digital inputs/outputs" on page 29.

The following overviews show the assignment of connections to the I/O channels and their properties.

Digital inputs/outputs

Connection	Terminal connection	Channel	Description
X1	14	DI 1	24 VDC, sink, ≤200 µs, configurable software filter
	24	DI 2	24 VDC, sink, ≤200 µs, configurable software filter
	15	DI 3	24 VDC, sink, ≤200 µs, configurable software filter
	25	DI 4	24 VDC, sink, ≤200 µs, configurable software filter
X2	11	DI 1	24 VDC, sink, ≤200 µs, configurable software filter
	21	DI 2	24 VDC, sink, ≤200 µs, configurable software filter
	...	...	...
	25	DI 10	24 VDC, sink, ≤200 µs, configurable software filter
	16	DI 11	24 VDC, sink, ≤2 µs, configurable software filter
	26	DI 12	24 VDC, sink, ≤2 µs, configurable software filter
	17	DI 13	24 VDC, sink, ≤2 µs, configurable software filter
	27	DI 14	24 VDC, sink, ≤2 µs, configurable software filter
X3	11	DO 1	24 VDC, 0.5 A, source, <300 µs
	21	DO 2	24 VDC, 0.5 A, source, <300 µs
	12	DO 3	24 VDC, 0.5 A, source, <300 µs
	22	DO 4	24 VDC, 0.5 A, source, <300 µs
	13	DI 5 / DO 5	DI: 24 VDC, sink, ≤200 µs, configurable software filter DO: 24 VDC, 0.5 A, source, <300 µs
	23	DI 6 / DO 6	DI: 24 VDC, sink, ≤200 µs, configurable software filter DO: 24 VDC, 0.5 A, source, <300 µs
	14	DI 7 / DO 7	DI: 24 VDC, sink, ≤200 µs, configurable software filter DO: 24 VDC, 0.5 A, source, <300 µs
	24	DI 8 / DO 8	DI: 24 VDC, sink, ≤200 µs, configurable software filter DO: 24 VDC, 0.5 A, source, <300 µs
	15	DO 9	24 VDC, 0.2 A, push-pull, <3 µs
	25	DO 10	24 VDC, 0.2 A, push-pull, <3 µs
	16	DO 11	24 VDC, 0.2 A, push-pull, <3 µs
	26	DO 12	24 VDC, 0.2 A, push-pull, <3 µs

Analog inputs

Connection	Terminal connection	Channel	Description
X1	11, 12, 13	AI 1	±10 V / 0 to 20 mA or 4 to 20 mA, 12-bit, 1 ms
	21, 22, 23	AI 2	±10 V / 0 to 20 mA or 4 to 20 mA, 12-bit, 1 ms

Analog input 1 can also be used for PT1000 resistance temperature measurement.

Connection	Terminal connection	Channel	Description
X1	11, 12, 13	AI 1	PT1000 resistance temperature measurement: Measurement takes place using analog input A1.

1.10 Pinouts

Slot X1

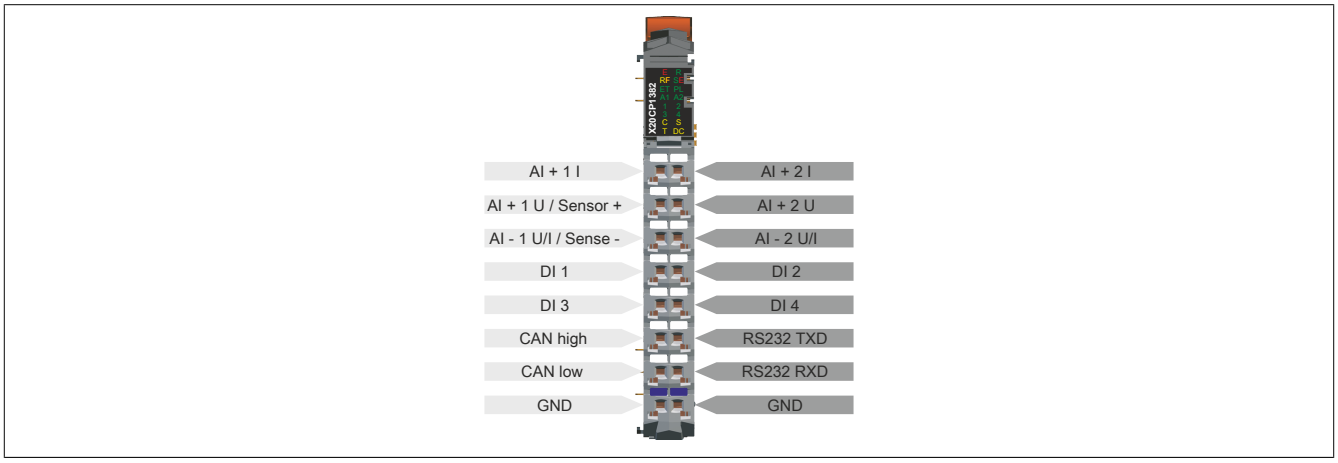


Figure 6: Pinout of the integrated X1 I/O slot

Slot X2

To prevent crosstalk, each signal line of the high-speed digital inputs should be shielded individually. The maximum cable length is 20 m.

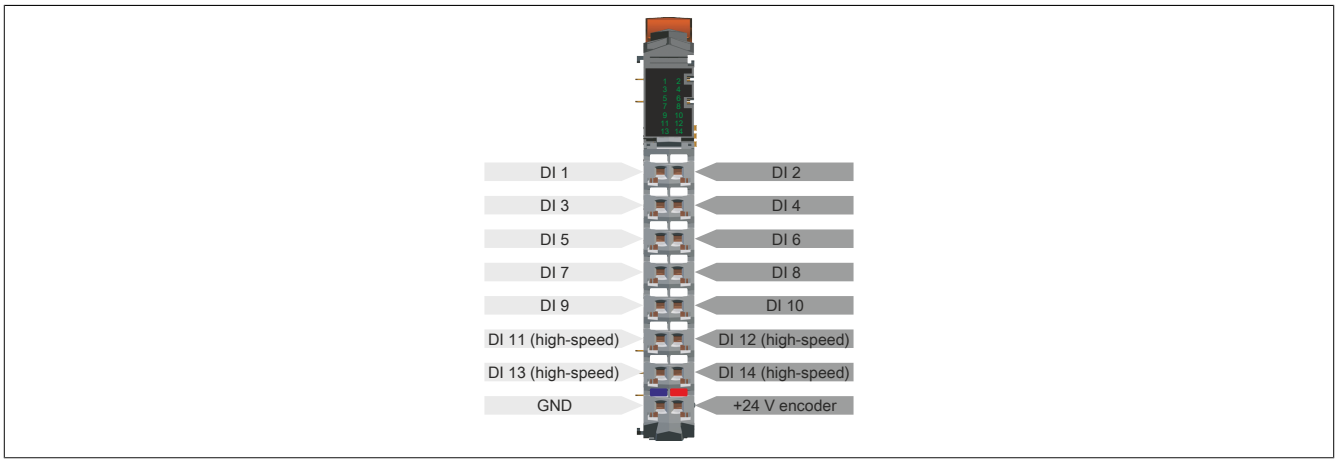


Figure 7: Pinout of the integrated X2 I/O slot

Slot X3

To ensure proper operation of the digital mixed channels (DI 5 / DO 5 to DI 8 / DO 8), it is important to observe the notes in section "Power supply concept of Compact controllers" on page 21.

To prevent crosstalk, each signal line of the high-speed digital outputs should be shielded individually. The maximum cable length is 20 m.

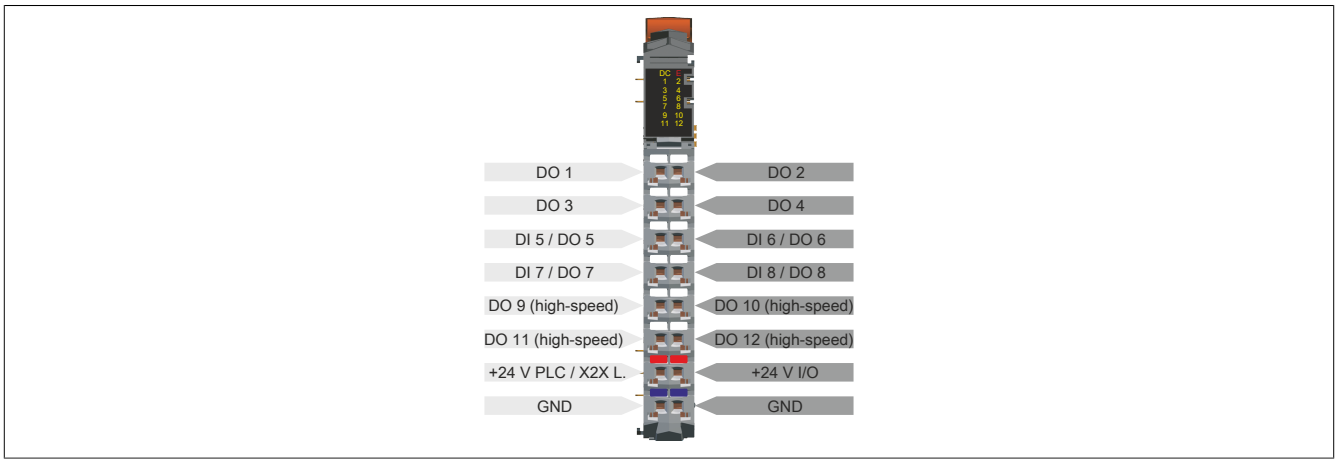


Figure 8: Pinout of the integrated X3 I/O slot

1.11 Connection examples

1.11.1 Slot X1

Voltage/Current measurement, digital inputs and CAN bus

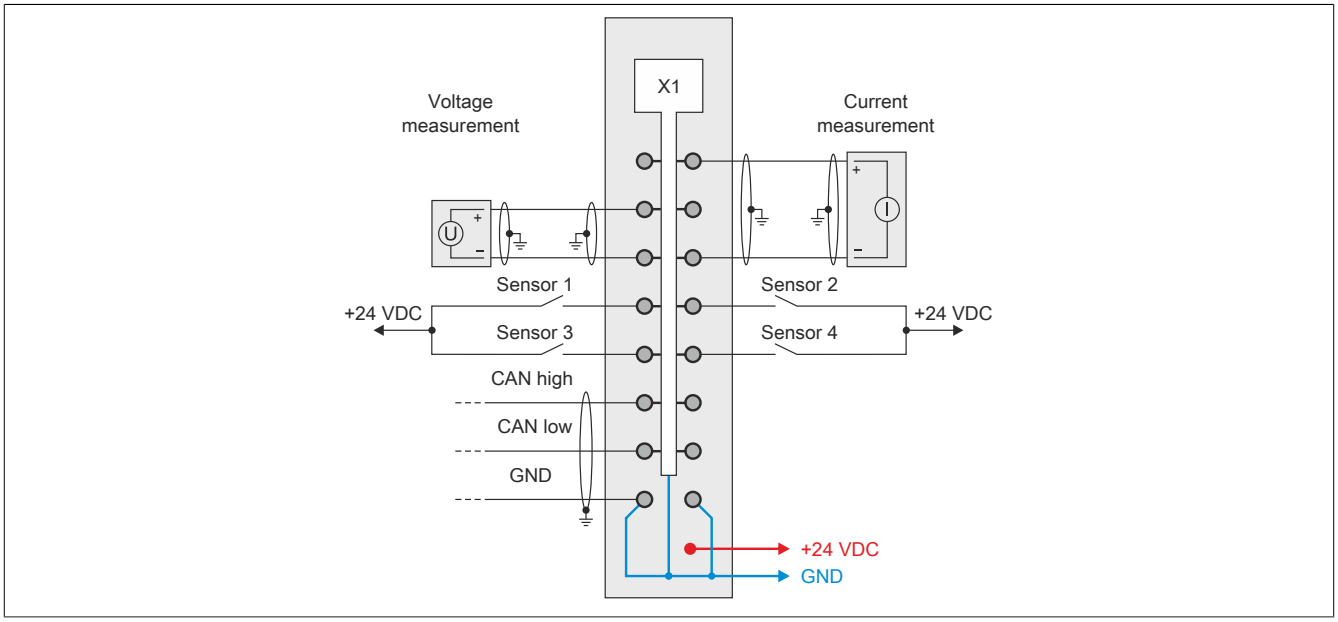


Figure 9: Connection example 1 for integrated I/O slot X1

PT1000 resistance temperature measurement, voltage measurement, digital inputs and RS232

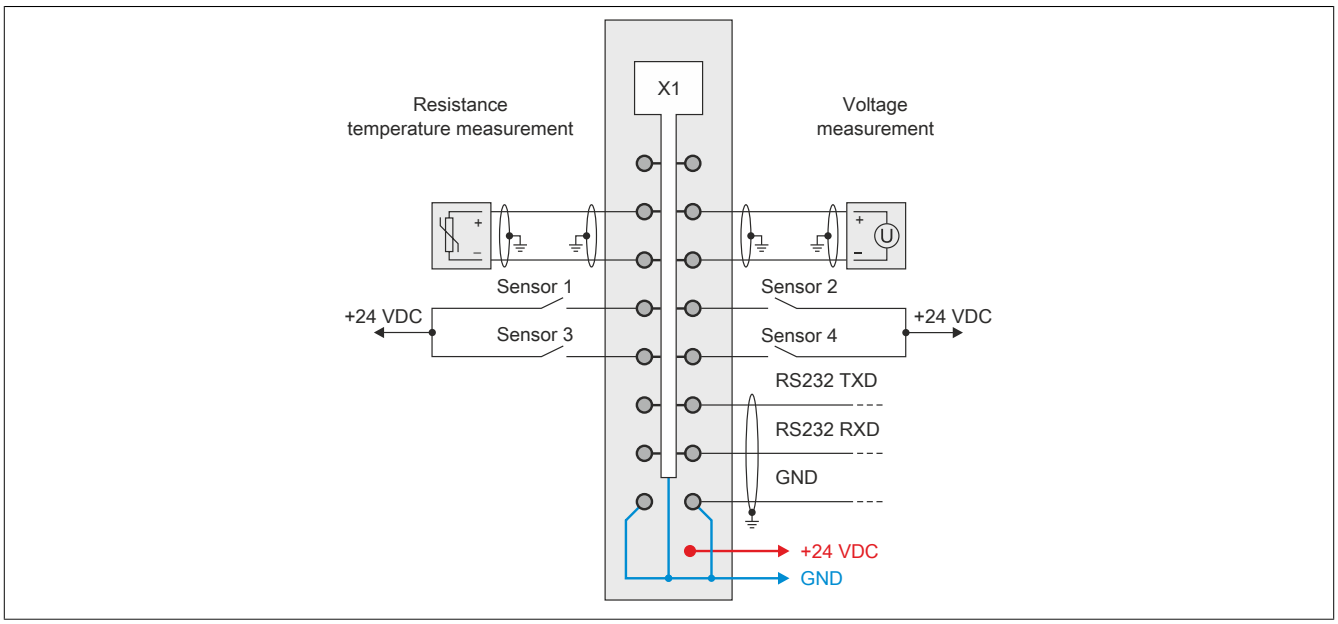


Figure 10: Connection example 2 for integrated I/O slot X1

1.11.2 Slot X2

Digital inputs and ABR incremental encoder

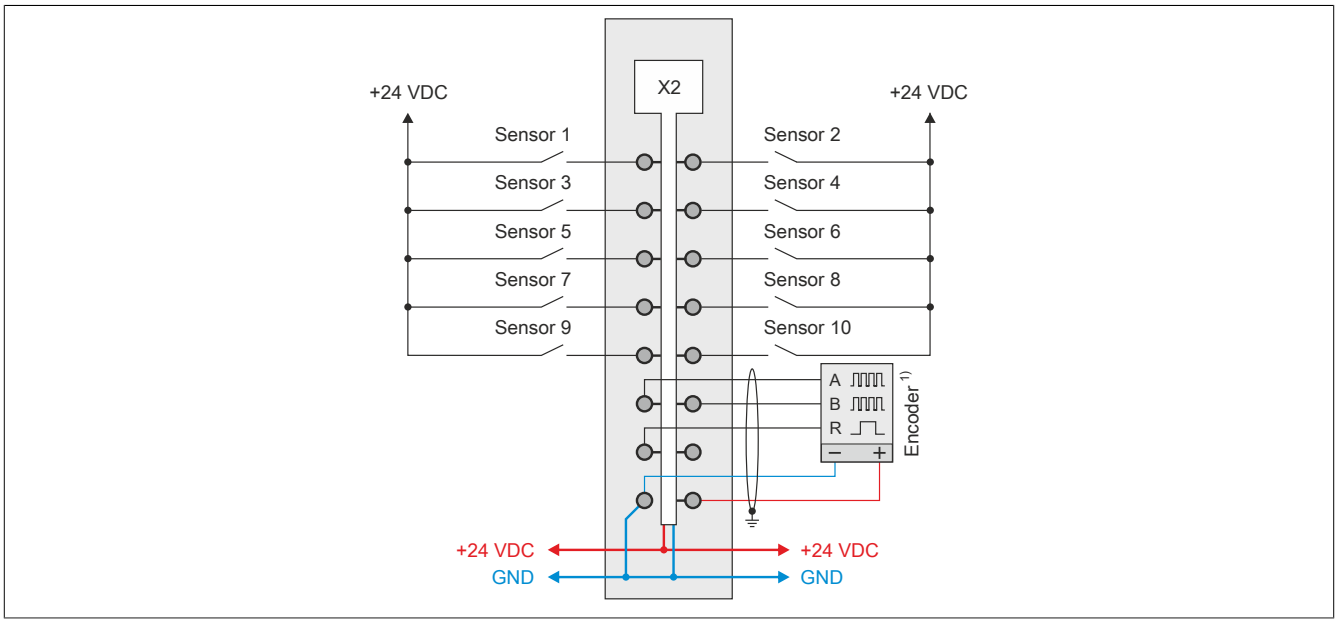


Figure 11: Connection example 1 for integrated I/O slot X2

1) Observe the cabling guidelines from the encoder manufacturer.

DI11 to DI14 are used as high-speed digital inputs.

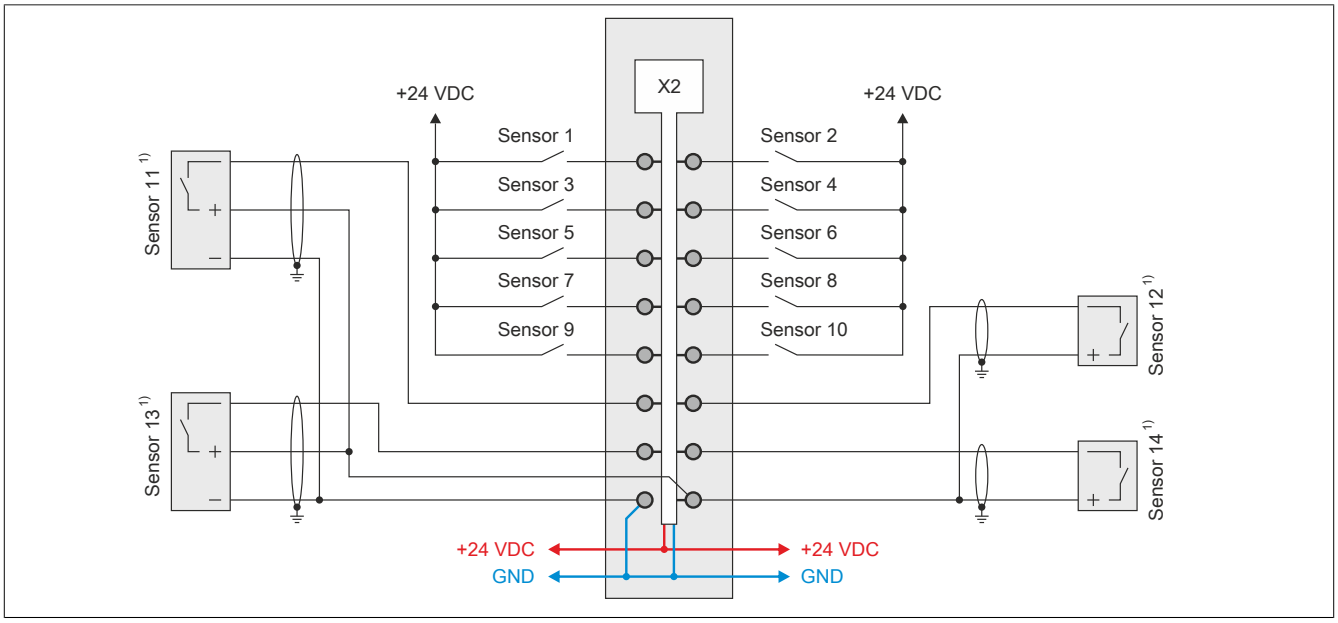


Figure 12: Connection example 2 for integrated I/O slot X2

1) Observe the cabling guidelines from the sensor manufacturer.

1.11.3 Slot X3

Digital inputs/outputs, direction/frequency (DF), PWM, PLC / X2X Link power supply and I/O power supply

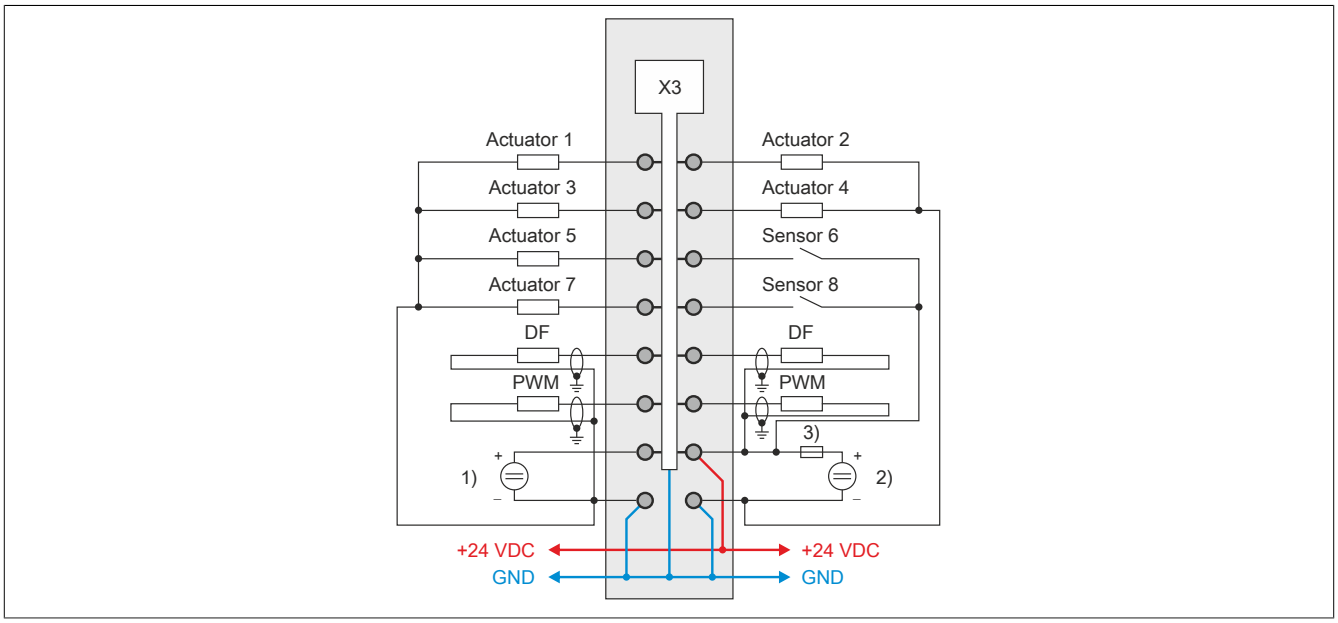


Figure 13: Connection example for integrated I/O slot X3

1) PLC / X2X Link power supply
2) I/O power supply
3) Fuse, 10 A slow-blow

1.12 Functions of the high-speed digital inputs/outputs

1.12.1 Functions of the high-speed digital inputs

Possible functions

The high-speed digital inputs DI 11 to DI 14 can be configured for the following functions. It is important to note that maximum 2 functions of the same type are possible with edge detection.

Channel	Counter function				Edge detection[1]	
DI 11	Event counter 1	A	A	D - Direction	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times
DI 12		B	B	F - Frequency	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times
DI 13	Event counter 2	A	R	R	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times
DI 14		B	E - Reference enable	E - Reference enable	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times

Table 7: Possible functions of the high-speed digital inputs DI 11 to DI 14

1) Maximum 2 functions of the same type can be configured.

Please note

The following points must be taken into account to correctly configure the high-speed digital inputs:

- The counter functions are mutually exclusive. Only one type of counter function can be selected at a time. It is not possible to select 2 event counters (DI 11 and DI 13) at the same time together with an AB or DF counter (each on DI 13 and DI 14)!
- It is possible to select a counter function and edge detection at the same time.
- A position or counter latch is possible when configuring the high-speed inputs as a 2x event counter, ABR incremental encoder or DF function.

Examples of possible configurations

Channel	Configuration 1	Configuration 2	Configuration 3	Configuration 4
DI 11	Event counter 1	• Edge counter • Edge times	A	D
DI 12	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times	B	F
DI 13	Event counter 2	A	R	R
DI 14	• Period measurement • Gate measurement • Differential time measurement	B	E - Reference enable	E - Reference enable

Channel	Configuration 5	Configuration 6	Configuration 7	Configuration 8
DI 11	Event counter 1	A	• Period measurement • Gate measurement • Differential time measurement	D - Direction
DI 12	• Edge counter • Edge times	B	• Period measurement • Gate measurement • Differential time measurement	F - Frequency
DI 13	Event counter 2	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times	• Edge counter • Edge times
DI 14	• Period measurement • Gate measurement • Differential time measurement	• Edge counter • Edge times	• Edge counter • Edge times	• Period measurement • Gate measurement • Differential time measurement

1.12.2 Functions of the high-speed digital outputs

Possible functions

High-speed digital outputs DO 9 to DO 12 can be configured for the following functions:

Channel	Function	
DO 9	PWM - Pulse width modulation	D - Direction
DO 10	PWM - Pulse width modulation	F - Frequency
DO 11	PWM - Pulse width modulation	D - Direction
DO 12	PWM - Pulse width modulation	F - Frequency

Table 8: Possible functions of high-speed digital outputs DO 9 to DO 12

Examples of possible configurations

Channel	Configuration 1	Configuration 2	Configuration 3	Configuration 4
DO 9	PWM - Pulse width modulation	D - Direction	PWM - Pulse width modulation	D - Direction
DO 10	PWM - Pulse width modulation	F - Frequency	PWM - Pulse width modulation	F - Frequency
DO 11	D - Direction	PWM - Pulse width modulation	PWM - Pulse width modulation	D - Direction
DO 12	F - Frequency	PWM - Pulse width modulation	PWM - Pulse width modulation	F - Frequency

1.13 Input/Output circuit diagram

1.13.1 Digital inputs (X1) and high-speed digital inputs (X2)

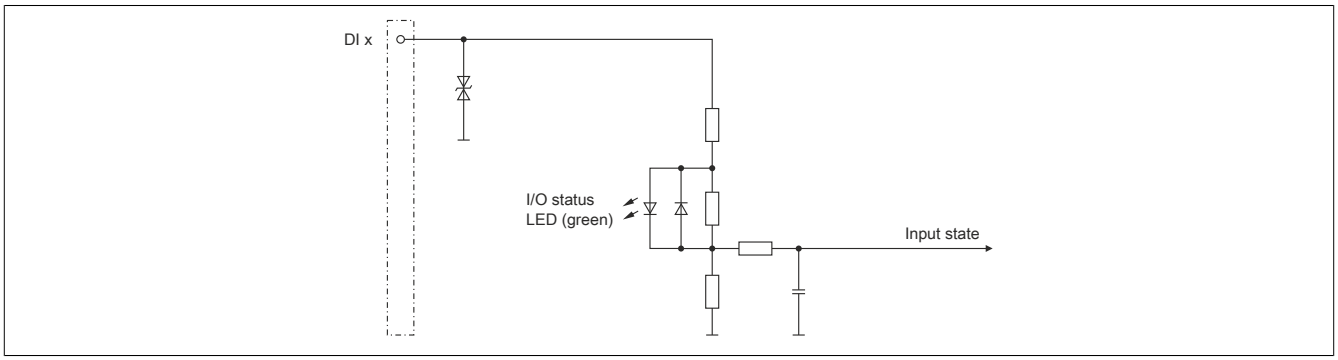


Figure 14: Input circuit diagram of the digital inputs on the integrated X1 I/O slot and the high-speed digital inputs on the integrated X2 I/O slot

1.13.2 Digital inputs (X2)

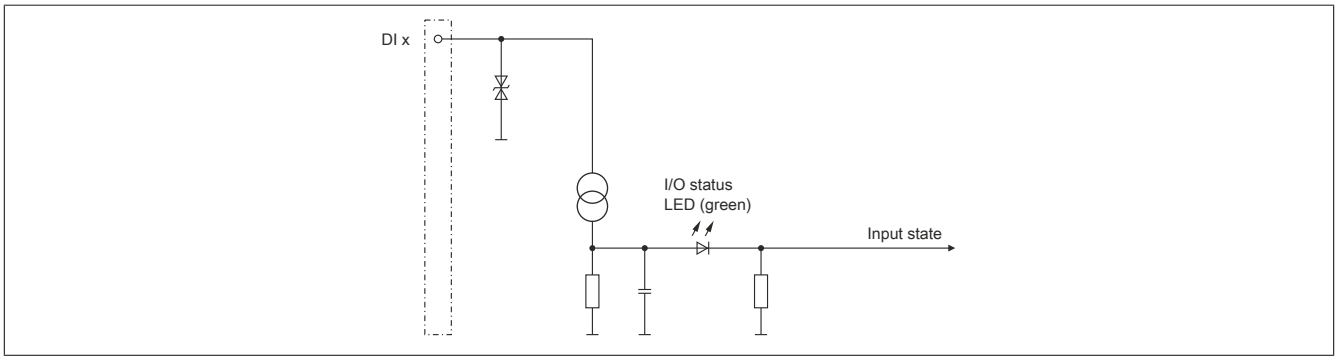


Figure 15: Input circuit diagram of the digital inputs on the integrated X2 I/O slot

1.13.3 Digital outputs (X3)

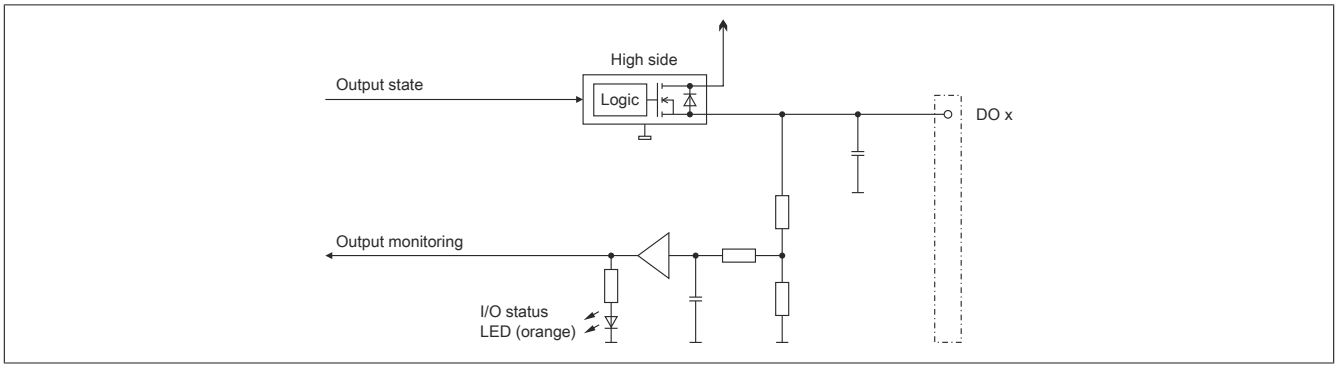


Figure 16: Output circuit diagram of the digital outputs on the integrated X3 I/O slot

1.13.4 High-speed digital outputs (X3)

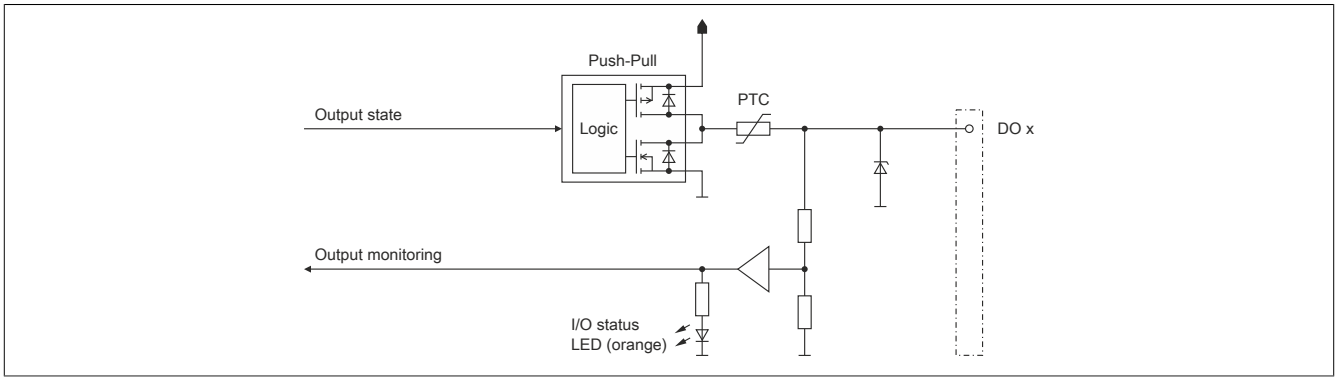


Figure 17: Output circuit diagram of the high-speed digital outputs on the integrated X3 I/O slot

1.13.5 Digital inputs/outputs (X3)

To ensure proper operation of the digital mixed channels (DI 5 / DO 5 to DI 8 / DO 8), it is important to observe the notes in section "Power supply concept of Compact controllers" on page 21.

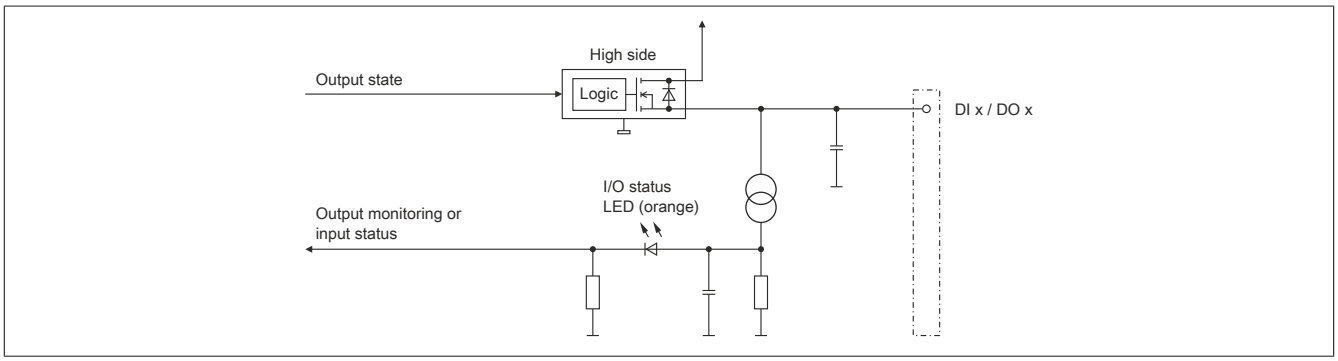


Figure 18: Input/Output circuit diagram of the digital mixed channels on the integrated X3 I/O slot

1.13.6 Analog inputs (X1)

A PT1000 resistance temperature sensor can be connected to analog input AI 1 and used for temperature measurement.

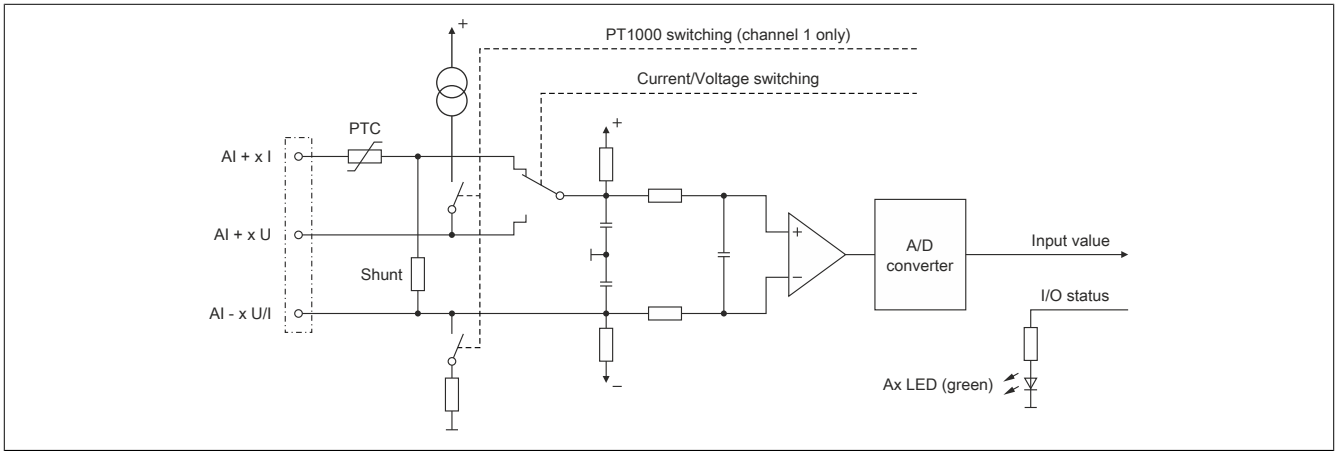


Figure 19: Input circuit diagram of the analog inputs and temperature input on the integrated X1 I/O slot

1.13.7 Encoder power supply (X2)

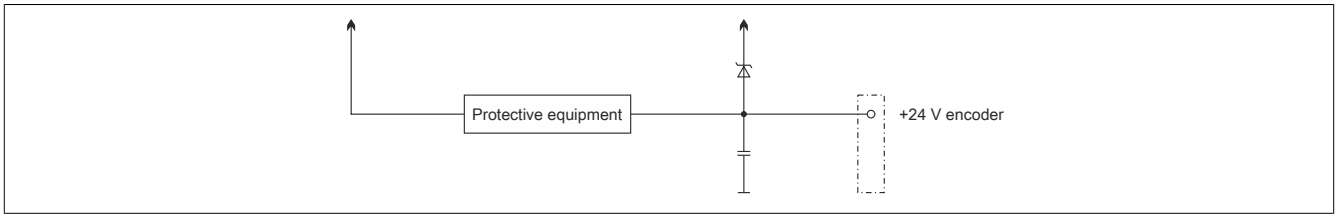


Figure 20: Circuit diagram of the encoder power supply on the integrated X2 I/O slot

1.13.8 Controller, X2X Link and I/O power supply (X3)

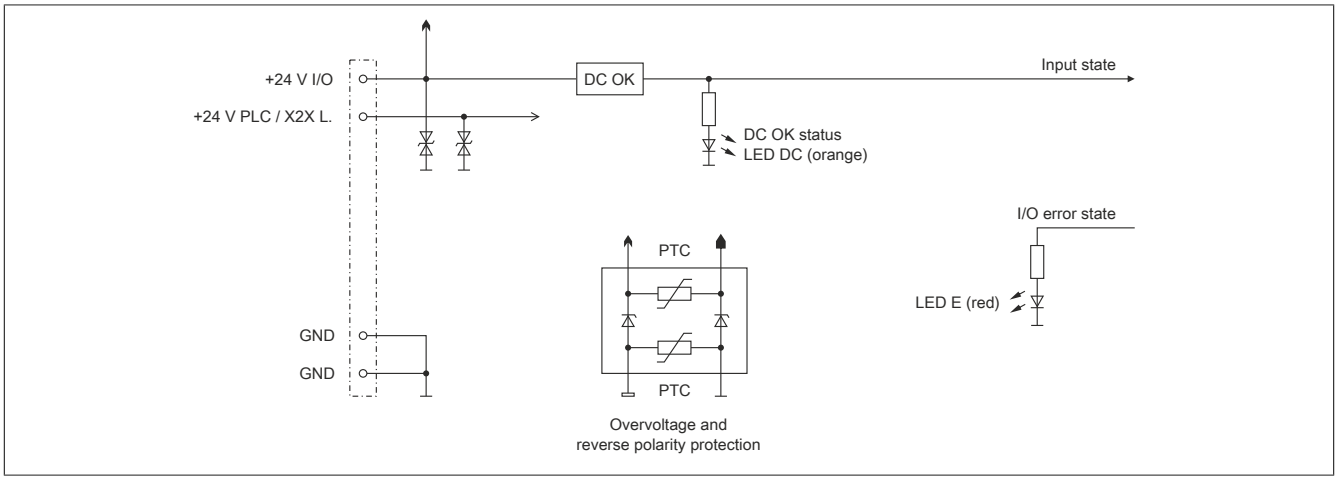


Figure 21: Circuit diagram of the PLC / X2X Link and I/O power supply on the integrated X3 I/O slot

1.14 Switching frequency derating for high-speed digital outputs

The high-speed digital outputs can be switched with a frequency of max. 200 kHz. Derating must be taken into account depending on the mounting orientation and operating temperature.

Switching frequency derating for horizontal mounting orientations

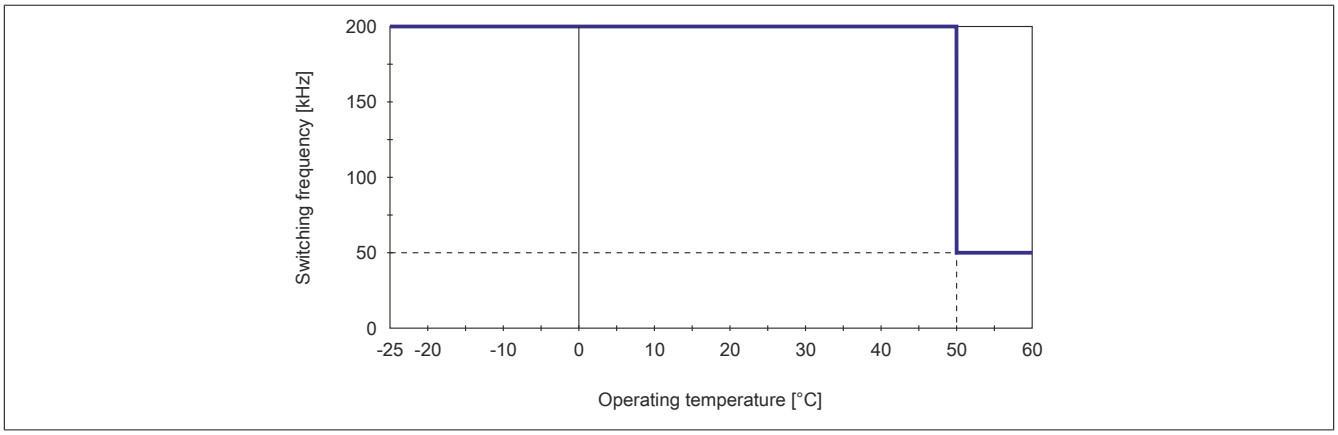


Figure 22: Switching frequency derating for high-speed digital outputs with horizontal mounting orientations

Switching frequency derating for vertical mounting orientations

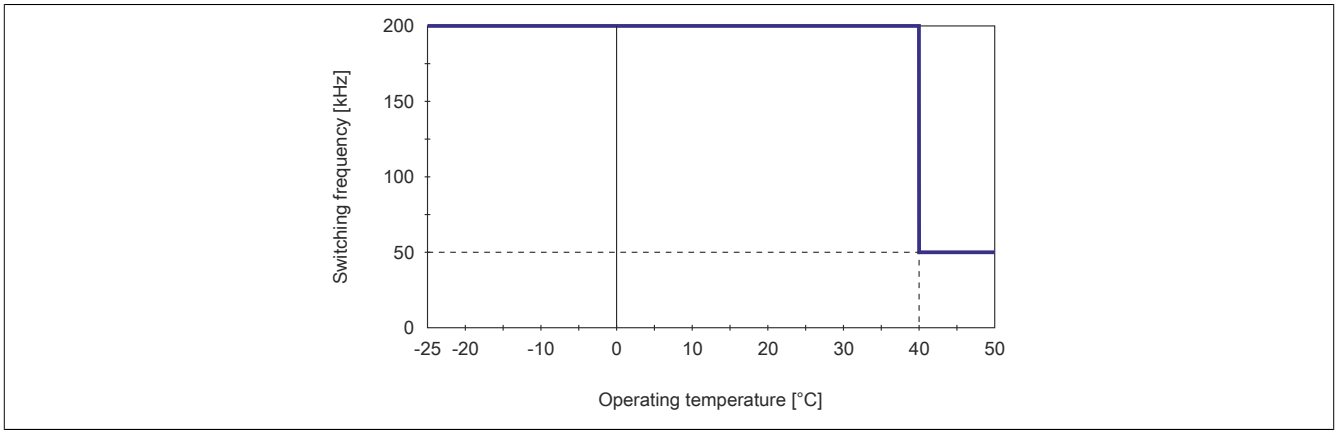
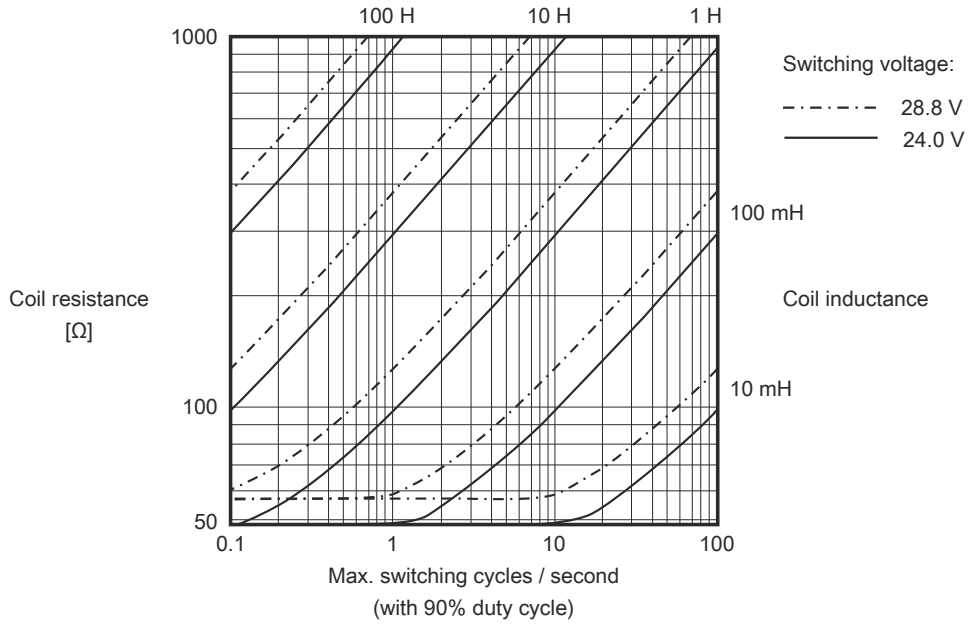


Figure 23: Switching frequency derating for high-speed digital outputs with vertical mounting orientations

1.15 Switching inductive loads



Information:

If the maximum number of operating cycles per second is exceeded, an external inverse diode must be used.

Operating conditions outside of the area in the diagram are not permitted!

1.16 Register description

1.16.1 System requirements

The following minimum versions are recommended to generally be able to use all functions:

- Automation Studio 4.1.4.96
- Automation Runtime M4.10 for X20cCP1301
- Automation Runtime D4.09 for all other variants

1.16.2 General data points

This controller is equipped with general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.

General data points are described in section "Additional information - General controller data points" in the X20 system user's manual.

1.16.3 Register overview of the I/O data points on the integrated X1 I/O slot

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
X1 - Configuration						
2048	X1CfO_DI_Filter	USINT				•
2128	X1CfO_AI_Mode	USINT				•
2112	X1CfO_AI1_Filter	USINT				•
2116	X1CfO_AI1_LowerLim	INT				•
2118	X1CfO_AI1_UpperLim	INT				•
2120	X1CfO_AI2_Filter	USINT				•
2124	X1CfO_AI2_LowerLim	INT				•
2126	X1CfO_AI2_UpperLim	INT				•
X1 - Communication						
0	Digital inputs	USINT	•			
	DigitalInput01	Bit 0				
	DigitalInput02	Bit 1				
	DigitalInput03	Bit 2				
	DigitalInput04	Bit 3				
64	AnalogInput01	INT	•			
		UINT	•			
66	AnalogInput02	INT	•			
80	StatusInput01	USINT	•			

1.16.3.1 Digital inputs

Unfiltered

The input state is recorded in a 100 µs cycle.

Filtered

The filtered state is transferred in a 100 µs cycle.

Filtering takes place asynchronously in an interval of 100 µs.

1.16.3.1.1 Digital input filter

Name:
X1CfO_DI_Filter

The filter value for all digital inputs can be configured in this register.

The filter value can be configured in steps of 100 µs.

Data type	Values	Filter
USINT	0	No software filter
	1	0.1 ms
	...	...
	250	25 ms - Higher values are limited to this value.

1.16.3.1.2 Input state of digital inputs 1 to 4

Name:
DigitalInput01 to DigitalInput04

This register contains the input state of digital inputs 1 to 4.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalInput01	0 or 1	Input status of digital input 1
...		...	
3	DigitalInput04	0 or 1	Input status of digital input 4

1.16.3.2 Analog inputs

Analog input values are recorded in a fixed interval. The time required for conversion/updating depends on the number of analog inputs and on the input signal:

Input signal	Time required for conversion/updating
1 current/voltage input	100 µs
1 temperature/resistance input	200 µs
2 current/voltage inputs	200 µs
1 current/voltage input and 1 temperature/resistance input	400 µs

1.16.3.2.1 Input values of analog inputs

Name:
AnalogInput01

This register contains the analog input value depending on the configured operating mode.

Data type	Values	Input signal
INT	-32768 to 32767	Voltage signal -10 to 10 VDC
	0 to 32767	Current signal 0 to 20 mA (with 0 to 20 mA configuration)
	-8192 to 32767	Current signal 0 to 20 mA (with 4 to 20 mA configuration)
	-2000 to 8500	PT1000 signal -200.0 to 850.0°C
UINT	0 to 40000	Resistance signal 0 to 4000.0 Ω

Name:
AnalogInput02

This register contains the analog input value depending on the configured operating mode.

Data type	Values	Input signal
INT	-32768 to 32767	Voltage signal -10 to 10 VDC
	0 to 32767	Current signal 0 to 20 mA (with 0 to 20 mA configuration)
	-8192 to 32767	Current signal 0 to 20 mA (with 4 to 20 mA configuration)

1.16.3.2.2 Status of the inputs

Name:
StatusInput01

This register holds the status of the analog inputs. A change in the monitoring status is actively transmitted as an error message. The following states are monitored depending on the settings:

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 1	Channel 1	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit
2 - 3	Channel 2	00	No error
		01	Lower limit value undershot
		10	Upper limit value overshot
		11	Open circuit
4 - 7	Reserved	0	

Limiting the analog value

In addition to the status information, the analog value is fixed to the specified limit values by default in the error state (see "Limit values" on page 43). The analog value is limited to the new values if the limit values were changed.

1.16.3.2.3 Input filter

The analog inputs are equipped with a configurable input filter.

1.16.3.2.3.1 Input ramp limiting

Input ramp limiting can only be performed in conjunction with filtering. Input ramp limiting is performed before filtering.

The difference of the input value change is checked for exceeding the specified limit. In the event of overshoot, the tracked input value is equal to the old value ± the limit value.

Configurable limit values:

Value	Limit value
0	The input value is used without limitation.
1	0x3FFF = 16383
2	0x1FFF = 8191
3	0x0FFF = 4095
4	0x07FF = 2047
5	0x03FF = 1023
6	0x01FF = 511
7	0x00FF = 255

Input ramp limiting is well suited for suppressing disturbances (spikes). The following examples show the functionality of input ramp limiting based on an input step and a disturbance.

Example 1

The input value jumps from 8000 to 17000. The diagram shows the tracked input value with the following settings:

Input ramp limiting = 4 = 0x07FF = 2047

Filter level = 2

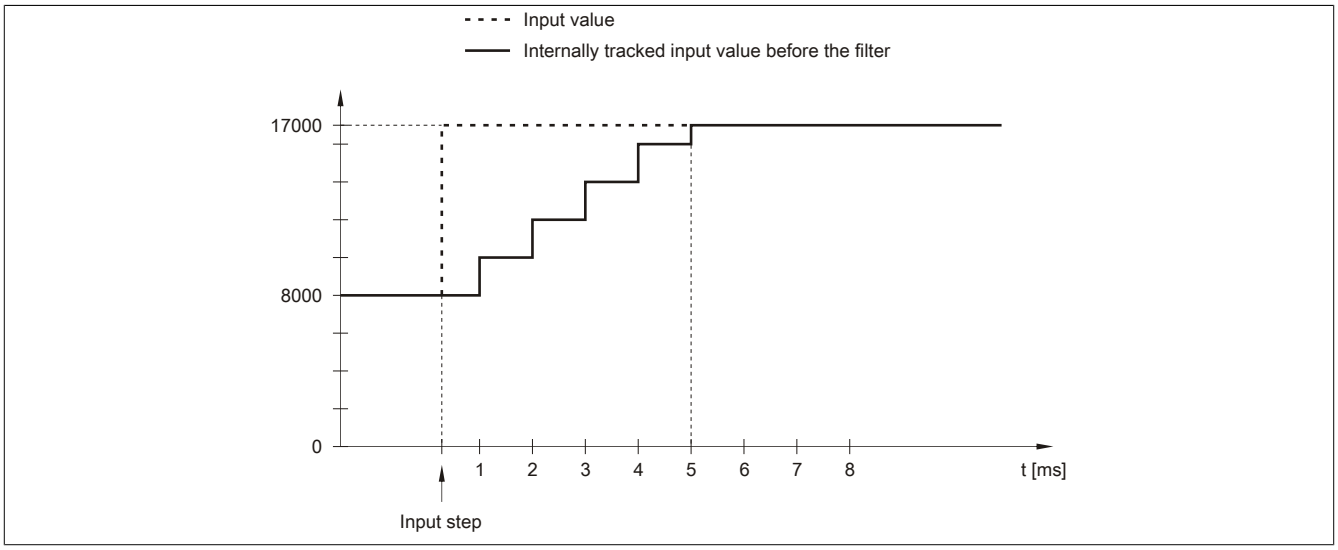


Figure 24: Tracked input value for input step

Example 2

A disturbance interferes with the input value. The diagram shows the tracked input value with the following settings:

Input ramp limiting = 4 = 0x07FF = 2047

Filter level = 2

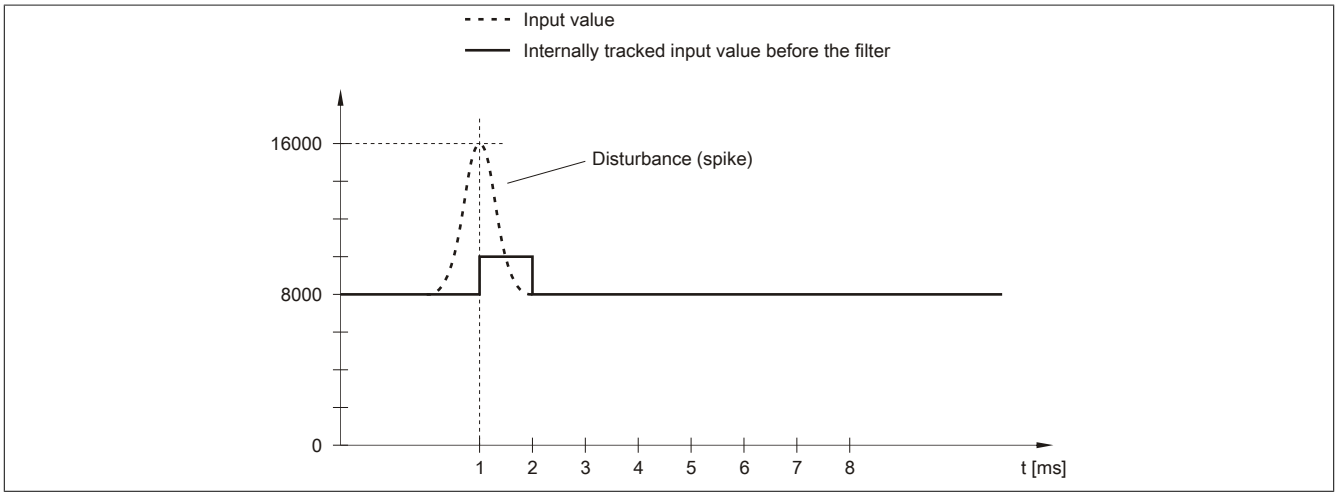


Figure 25: Tracked input value for disturbance

1.16.3.2.3.2 Filter level

A filter can be defined to prevent large input steps. This filter is used to bring the input value closer to the actual analog value over a period of several bus cycles.
Filtering takes place after any input ramp limiting has been carried out.

Formula for calculating the input value:

$$\text{Value}_{\text{New}} = \text{Value}_{\text{Old}} - \frac{\text{Value}_{\text{Old}}}{\text{Filter level}} + \frac{\text{Input value}}{\text{Filter level}}$$

Adjustable filter levels:

Value	Filter level
0	Filter switched off
1	Filter level 2
2	Filter level 4
3	Filter level 8
4	Filter level 16
5	Filter level 32
6	Filter level 64
7	Filter level 128

The following examples show the functionality of the filter based on an input step and a disturbance.

Example 1

The input value jumps from 8000 to 16000. The diagram shows the calculated value with the following settings:

Input ramp limiting = 0

Filter level = 2 or 4

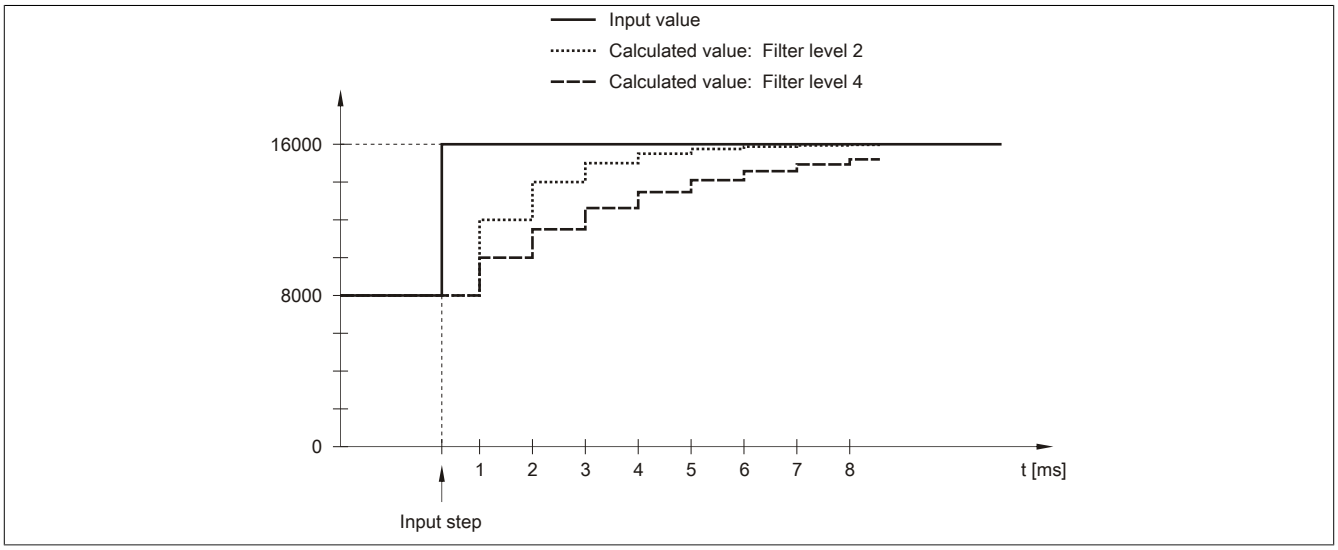


Figure 26: Calculated value during input step

Example 2

A disturbance interferes with the input value. The diagram shows the calculated value with the following settings:

Input ramp limiting = 0

Filter level = 2 or 4

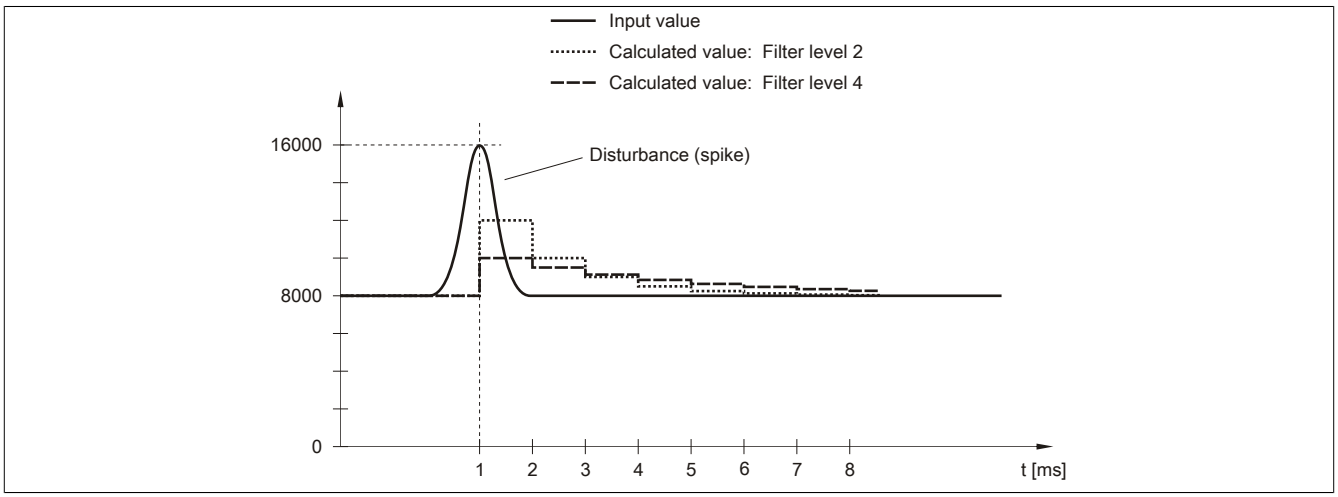


Figure 27: Calculated value during disturbance

1.16.3.2.3.3 Configuring the input filter

Name:
X1CfO_AI1_Filter
X1CfO_AI2_Filter

The filter level and input ramp limiting of the input filter are set in this register.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 2	Defines the filter level	000	Filter disabled (bus controller default setting)
		001	Filter level 2
		010	Filter level 4
		011	Filter level 8
		100	Filter level 16
		101	Filter level 32
		110	Filter level 64
		111	Filter level 128
3	Reserved	0	
4 - 6	Defines input ramp limiting	000	The input value is applied without limitation (bus controller default setting)
		001	Limit value = 0x3FFF (16383)
		010	Limit value = 0x1FFF (8191)
		011	Limit value = 0x0FFF (4095)
		100	Limit value = 0x07FF (2047)
		101	Limit value = 0x03FF (1023)
		110	Limit value = 0x01FF (511)
		111	Limit value = 0x00FF (255)
7	Reserved	0	

1.16.3.2.4 Channel type

Name:
X1CfO_AI_Mode

The type and range of signal measurement can be set in this register.

The individual channels are designed for current, voltage and resistance signals. This differentiation is made using different terminal connections and an integrated switch. The switch is automatically activated depending on the specified configuration. The following input signals can be set:

Input signal	On channel
±10 V voltage signal (default)	1 and 2
0 to 20 mA current signal	1 and 2
4 to 20 mA current signal	1 and 2
PT1000 measurement	1
Resistance measurement	1

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0 - 2	Analog input - Channel 1	000	Channel switched off
		001	±10 V voltage signal
		010	0 to 20 mA current signal
		011	4 to 20 mA current signal
		100	PT1000 measurement
		101	Resistance measurement
3	Reserved	0	
4 - 5	Analog input - Channel 2	00	Channel switched off
		01	±10 V voltage signal
		10	0 to 20 mA current signal
		11	4 to 20 mA current signal
6 - 7	Reserved	0	

1.16.3.2.5 Limit values

The input signal is monitored at the upper and lower limit values. By default, the following limits are set for each operating mode:

Limit value (default)	Voltage signal ±10 V		Current signal 0 to 20 mA		Current signal 4 to 20 mA	
Upper maximum limit value	10 V	32767 (0x7FFF)	20 mA	32767 (0x7FFF)	20 mA	32767 (0x7FFF)
Lower minimum limit value	-10 V	-32767 (0x8001)	0 mA	0[1)]	4 mA	0[2)]

Table 9: Limit values for voltage and current signals

1) The analog value is limited down to 0.
2) Due to the default limit value, the analog value is limited to a minimum of 0 at currents <4 mA.

Limit value (default)	Temperature measurement		Resistance measurement	
Upper maximum limit value	800.0°C	8000 (0x1F40)	4000.0 Ω	32767 (0x7FFF)
Lower minimum limit value	-200.0°C	-2000 (0xF830)	0 Ω	0

Table 10: Limit values for temperature and resistance measurement

Other limit values can be defined if necessary. These are activated automatically by writing the limit value register (see "Lower limit value" on page 43 and "Upper limit value" on page 43). From this point on, the analog values will be monitored and limited according to the new limits. The results of monitoring are displayed in the status register (see "Status of the inputs" on page 38).

Application example of setting limit values

If values <4 mA should be measured for a current signal with 4 to 20 mA, a negative limit value must be set: 0 mA corresponds to value -8192 (0xE000).

1.16.3.2.5.1 Lower limit value

Name:
X1CfO_AI1_LowerLim
X1CfO_AI2_LowerLim

These registers can be used to configure the lower limit value for analog values. If the analog value goes below the limit value, it is frozen at this value and the corresponding error status bit is set (see "Status of the inputs" on page 38).

Data type	Values
INT	-32768 to 32767
UINT	0 to 65535

Information:

For a 4 to 20 mA configuration, this value can be set to -8192 (corresponds to 0 mA) in order to display values <4 mA.

1.16.3.2.5.2 Upper limit value

Name:
X1CfO_AI1_UpperLim
X1CfO_AI2_UpperLim

These registers can be used to configure the upper limit value for analog values. If the analog value goes above the limit value, it is frozen at this value and the corresponding error status bit is set (see "Status of the inputs" on page 38).

Data type	Values
INT	0 to 32767
UINT	0 to 65535

1.16.4 Register overview of the I/O data points on the integrated X2 I/O slot

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
X2 - Configuration						
7168	X2CfO_EdgeDetectUnit01Mode	USINT				•
7169	X2CfO_EdgeDetectUnit01Master	USINT				•
7170	X2CfO_EdgeDetectUnit01Slave	USINT				•
7184	X2CfO_EdgeDetectUnit02Mode	USINT				•
7185	X2CfO_EdgeDetectUnit02Master	USINT				•
7186	X2CfO_EdgeDetectUnit02Slave	USINT				•
6144	X2CfO_DI_Filter	USINT				•
6528	X2CfO_CounterMode	USINT				•
6400	X2CfO_Latch01Mode	USINT				•
6401	X2CfO_Latch01Comparator	USINT				•
6416	X2CfO_Latch02Mode	USINT				•
6417	X2CfO_Latch02Comparator	USINT				•
X2 - Communication						
4096	Digital inputs	USINT	•			
	DigitalInput01	Bit 0				
	DigitalInput02	Bit 1				
	DigitalInput03	Bit 2				
	DigitalInput04	Bit 3				
	DigitalInput05	Bit 4				
	DigitalInput06	Bit 5				
	DigitalInput07	Bit 6				
	DigitalInput08	Bit 7				
4097	Digital inputs	USINT	•			
	DigitalInput09	Bit 0				
	DigitalInput10	Bit 1				
	DigitalInput11	Bit 2				
	DigitalInput12	Bit 3				
	DigitalInput13	Bit 4				
	DigitalInput14	Bit 5				
5120	EdgeDetect01Mastertime	DINT	•			
5124	EdgeDetect01Difference	DINT	•			
5128	EdgeDetect01Mastercount	INT	•			
5136	EdgeDetect02Mastertime	DINT	•			
5140	EdgeDetect02Difference	DINT	•			
5144	EdgeDetect02Mastercount	INT	•			
4384	Counter 1	USINT			•	
	Counter01Reset	Bit 0				
	Latch01Enable	Bit 1				
4352	Counter01Value	DINT	•			
4356	Counter01Latch	DINT	•			
4360	Counter01TimeChanged	DINT	•			
4364	Counter01TimeValid	DINT	•			
4368	Latch01Count	SINT	•			
4448	Counter 2	USINT			•	
	Counter02Reset	Bit 0				
	Latch02Enable	Bit 1				
4416	Counter02Value	DINT	•			
4420	Counter02Latch	DINT	•			
4424	Counter02TimeChanged	DINT	•			
4428	Counter02TimeValid	DINT	•			
4432	Latch02Count	SINT	•			

1.16.4.1 Digital inputs

Unfiltered

The input state is recorded in a 100 µs cycle.

Filtered

The filtered state is transferred in a 100 µs cycle.

Filtering takes place asynchronously in an interval of 100 µs.

1.16.4.1.1 Digital input filter

Name:
X2CfO_DI_Filter

The filter value for all digital inputs can be configured in this register.

The filter value can be configured in steps of 100 µs.

Data type	Values	Filter
USINT	0	No software filter
	1	0.1 ms
	...	...
	250	25 ms - Higher values are limited to this value.

1.16.4.1.2 Input state of digital inputs 1 to 14

Name:
DigitalInput01 to DigitalInput14

These registers contain the input state of digital inputs 1 to 14.

Data type	Values
USINT	See the bit structure.

Bit structure of register 4096:

Bit	Name	Value	Information
0	DigitalInput01	0 or 1	Input status of digital input 1
...		...	
7	DigitalInput08	0 or 1	Input status of digital input 8

Bit structure of register 4097:

Bit	Name	Value	Information
0	DigitalInput09	0 or 1	Input status of digital input 9
...		...	
5	DigitalInput14	0 or 1	Input status of digital input 14

1.16.4.2 Edge detection

Digital inputs 11 to 14 can be used for high-speed edge detection. This runs parallel to all other functions such as counters, etc. This function does not use the digital input filter.

The edge detection function allows edges to be measured with microsecond precision. 2 units are available. A master and a slave edge can be configured for each unit. At each master edge, the timestamp of the master edge and the differential time to the previous slave edge (if present) are logged. A "master count" can always be used to determine how many edges have been detected since the last task class cycle. The timestamp is based on the system time of the controller.

The combination of rising/falling edges of the channels can be used to configure the following functions for each unit:

Function	Description
Edge time	Measure an edge time
Period duration	Measure the master and differential time
Gate time	Measure the master and differential time
Time offset	Measure the master and differential time of edges on different channels

1.16.4.2.1 Edge detection unit - Mode settings

The edge detection unit must be configured according to the desired function:

Function	Description
Basic timestamp, master edge mode	The current system time is saved as the master time at the time of the edge.
Timestamp and/or differential time, master and slave edge mode	The slave edge starts the measurement and the system time is saved temporarily. When the master edge occurs, the current system time is saved as the master time and the difference between the master and slave edges is calculated.

Name:
X2CfO_EdgeDetectUnit01Mode
X2CfO_EdgeDetectUnit02Mode

These registers are used to configure the master edge basic function or the master edge with slave edge basic function:

Data type	Values	Information
USINT	0x00	Edge detection disabled on Unit0x: Time measurement not possible
	0x80	Edge detection enabled on Unit0x: Reaction only possible for master edge, no differential measurement possible
	0xC0	Edge detection enabled on Unit0x: Reaction possible for configured master and slave edges

1.16.4.2.2 Edge detection unit - Selection of master edge

Name:
X2CfO_EdgeDetectUnit01Master
X2CfO_EdgeDetectUnit02Master

These registers are used to select the source of the master edge for the respective unit. Either the rising or falling edge of one of the 4 high-speed digital input channels can be selected. Only one edge can be selected for each unit.

Data type	Values	Information
USINT	0	Digital input channel 11: Rising edge
	2	Digital input channel 12: Rising edge
	4	Digital input channel 13: Rising edge
	6	Digital input channel 14: Rising edge
	1	Digital input channel 11: Falling edge
	3	Digital input channel 12: Falling edge
	5	Digital input channel 13: Falling edge
	7	Digital input channel 14: Falling edge

1.16.4.2.3 Edge detection unit - Selection of slave edge

Name:
X2CfO_EdgeDetectUnit01Slave
X2CfO_EdgeDetectUnit02Slave

These registers define the source of the slave edge for the respective unit. Either the rising or falling edge of one of the 4 high-speed digital input channels can be selected. Only one edge can be selected for each unit.

Data type	Values	Information
USINT	0	Digital input channel 11: Rising edge
	2	Digital input channel 12: Rising edge
	4	Digital input channel 13: Rising edge
	6	Digital input channel 14: Rising edge
	1	Digital input channel 11: Falling edge
	3	Digital input channel 12: Falling edge
	5	Digital input channel 13: Falling edge
	7	Digital input channel 14: Falling edge

1.16.4.2.4 Edge detection unit - Master edge counter

Name:
EdgeDetect01Mastercount
EdgeDetect02Mastercount

The counter value of detected master edges is stored in these registers. The counter value is used to detect new measurements.

Data type	Values	Information
INT	-32768 to 32767	Running counter: Number of detected master edges

1.16.4.2.5 Edge detection unit - Master edge timestamp

Name:
EdgeDetect01Mastertime
EdgeDetect02Mastertime

The exact controller system time of the respective unit is saved to these registers when a master edge occurs. When multiple edges occur within a sampling cycle (task class), then the time of the last edge in each case is shown.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Controller system time of master edge [µs]

1.16.4.2.6 Edge detection unit - Time difference

Name:
EdgeDetect01Difference
EdgeDetect02Difference

The difference between the master edge and the slave edge of the respective unit is saved to these registers. When several measurement periods are completed within a sampling cycle (task class), then the time difference from the last measurement period is shown.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Time difference between master edge and slave edge [µs]

1.16.4.3 Counter functions

High-speed digital inputs 11 to 14 can be used for counter functions. This function does not use the digital input filter. The following functions are available. Only one of these basic configurations can be active at a time:

- 2x event counter with latch function
- 2x AB incremental counter without latch function
- DF counter function
- ABR counter function

1.16.4.3.1 Configuring the counter function

The following counter functions can be configured:

Counter function	Description
2x event counter with latch function	Input 11 for event counter 1 and input 13 for event counter 2 can be used simultaneously as event counters. Both rising and falling edges are counted. The latch function of all 4 inputs can be used.
2x AB incremental counter without latch function	Inputs 11 and 12 as AB counter 1 and inputs 13 and 14 as AB counter 2. Since no more high-speed inputs are available, the latch function is not available.
DF counter: Direction/Frequency with latch function	The D, F and R signals are linked to inputs 11, 12 and 13. Signal D defines the positive (Level = 0) or negative (Level = 1) counting direction. The latch function of all 4 inputs can be used.
ABR counter with latch function	The A, B and R signals are linked to inputs 11, 12 and 13. The latch function of all 4 inputs can be used.

Name:
X2CfO_CounterMode

This register configures the counter function:

Data type	Values	Information
USINT	0	2x event counter with latch function
	1	2x AB incremental counter without latch function
	2	DF counter with latch function
	3	ABR counter with latch function

1.16.4.3.2 Configuring the mode of the latch function

Name:
X2CfO_Latch01Mode
X2CfO_Latch02Mode

This register sets the mode of the latch function. The following latch functions can be configured:

Latch function	Description
Single shot latch mode	The latch function must be enabled/set. After a successful latch procedure the function must first be reset. Then it can be enabled again.
Continuous latch mode	The latch function must only be enabled/set as long as latching is desired.

A changed counter value on "LatchCount" indicates that the latch procedure has been performed (see "Counter value of latch events" on page 50). The counter value is stored in the latch register (see "Latched counter value" on page 50).

Data type	Values	Information
USINT	0	Single shot latch mode
	1	Continuous latch mode

1.16.4.3.3 Configuring the latch signals

Name:
X2CfO_Latch01Comparator
X2CfO_Latch02Comparator

This register defines the inputs and their level for triggering the latch procedure.

- This defines which inputs are linked to generate the latch event. All 4 digital input signals can be used for the "AND" operator.
- The "active voltage level" needed for the latch procedure can be defined to adjust for the physical signals. Configuring a high level and low level at the same time is not permitted!

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Value	Information
0	0	Input 11 high level disabled
	1	Input 11 high level enabled for comparator
1	0	Input 12 high level disabled
	1	Input 12 high level enabled for comparator
2	0	Input 13 high level disabled
	1	Input 13 high level enabled for comparator
3	0	Input 14 high level disabled
	1	Input 14 high level enabled for comparator
4	0	Input 11 low level disabled
	1	Input 11 low level enabled for comparator
5	0	Input 12 low level disabled
	1	Input 12 low level enabled for comparator
6	0	Input 13 low level disabled
	1	Input 13 low level enabled for comparator
7	0	Input 14 low level disabled
	1	Input 14 low level enabled for comparator

1.16.4.3.4 Clear counter value and enable/disable latch function

Name:
Counter01Reset
Counter02Reset
Latch01Enable
Latch02Enable

These registers clear the counter value or start the latch procedure based on the corresponding bit.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Description	Value	Information
0	Counter0xReset	0	Do not clear the counter value
		1	Clear the counter value
1	Latch0xEnable	0	Do not latch the counter value
		1	Latch the counter value
2 - 7	Reserved	0	

1.16.4.3.5 Counter value

Name:
Counter01Value
Counter02Value

The current counter values are saved in these registers.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Current counter value

1.16.4.3.6 Latched counter value

Name:
Counter01Latch
Counter02Latch

As soon as the latch conditions have been met, the contents of the respective counter value are copied to these registers.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Latched counter value

1.16.4.3.7 Counter value of latch events

Name:
Latch01Count
Latch02Count

The counter value of the latch events that have occurred is stored in these registers. This allows detection of whether a new latched counter value has been saved.

Data type	Values	Information
SINT	-128 to 127	Running counter: Number of detected latch events

1.16.4.3.8 Timestamp of last counter change

Name:
Counter01TimeChanged
Counter02TimeChanged

The controller system time at the time of the last change to the counter value is saved in these registers.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	The controller system time at the time of the last change to the counter value

1.16.4.3.9 Timestamp of last valid counter value

Name:
Counter01TimeValid
Counter02TimeValid

The controller system time at the time of the last valid counter value is saved in these registers.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Controller system time of current counter value

1.16.5 Register overview of the I/O data points on the integrated X3 I/O slot

Register	Name	Data type	Read		Write	
			Cyclic	Acyclic	Cyclic	Acyclic
X3 - Configuration						
10240	X3CfO_DI_Filter	USINT				•
10752	X3CfO_Mov01Mode	USINT				•
10756	X3CfO_Mov01SpeedLimit	UDINT				•
10768	X3CfO_Mov02Mode	USINT				•
10772	X3CfO_Mov02SpeedLimit	UDINT				•
12032	X3CfO_PhyIOConfigCh01	USINT				•
12033	X3CfO_PhyIOConfigCh02	USINT				•
12034	X3CfO_PhyIOConfigCh03	USINT				•
12035	X3CfO_PhyIOConfigCh04	USINT				•
12036	X3CfO_PhyIOConfigCh05	USINT				•
12037	X3CfO_PhyIOConfigCh06	USINT				•
12038	X3CfO_PhyIOConfigCh07	USINT				•
12039	X3CfO_PhyIOConfigCh08	USINT				•
12040	X3CfO_PhyIOConfigCh09	USINT				•
12041	X3CfO_PhyIOConfigCh10	USINT				•
12042	X3CfO_PhyIOConfigCh11	USINT				•
12043	X3CfO_PhyIOConfigCh12	USINT				•
X3 - Communication						
8192	Digital inputs	USINT	•			
	DigitalInput05	Bit 0				
	DigitalInput06	Bit 1				
	DigitalInput07	Bit 2				
	DigitalInput08	Bit 3				
8208	Digital outputs	USINT			•	
	DigitalOutput01	Bit 0				
	DigitalOutput02	Bit 1				
	DigitalOutput03	Bit 2				
	DigitalOutput04	Bit 3				
	DigitalOutput05	Bit 4				
	DigitalOutput06	Bit 5				
	DigitalOutput07	Bit 6				
	DigitalOutput08	Bit 7				
8209	Digital outputs	USINT			•	
	DigitalOutput09	Bit 0				
	DigitalOutput10	Bit 1				
	DigitalOutput11	Bit 2				
	DigitalOutput12	Bit 3				
8193	Status feedback	USINT	•			
	StatusDigitalOutput01	Bit 0				
	StatusDigitalOutput02	Bit 1				
	StatusDigitalOutput03	Bit 2				
	StatusDigitalOutput04	Bit 3				
	StatusDigitalOutput05	Bit 4				
	StatusDigitalOutput06	Bit 5				
	StatusDigitalOutput07	Bit 6				
	StatusDigitalOutput08	Bit 7				
8194	Status feedback	USINT	•			
	StatusDigitalOutput09	Bit 0				
	StatusDigitalOutput10	Bit 1				
	StatusDigitalOutput11	Bit 2				
	StatusDigitalOutput12	Bit 3				
4864	PWMPeriod09	UINT			•	
4866	PWMOutput09	INT			•	
4880	PWMPeriod10	UINT			•	
4882	PWMOutput10	INT			•	
4896	PWMPeriod11	UINT			•	
4898	PWMOutput11	INT			•	
4912	PWMPeriod12	UINT			•	
4914	PWMOutput12	INT			•	
8704	Movement 1	USINT			•	
	Mov01Enable	Bit 1				
8706	Mov01Speed	INT			•	
8708	Mov01Position	DINT	•			
8720	Movement 2	USINT			•	
	Mov02Enable	Bit 2				
8722	Mov02Speed	INT			•	
8724	Mov02Position	DINT	•			
8196	StatusInput01	BOOL	•			

1.16.5.1 Physical configuration of I/O channels

These registers are used to define the functionality of the channels. Depending on the desired configuration, the following assignments can be made with respect to the existing software and hardware:

- A physical configuration as input or output for mixed channels
- An explicit assignment as direct I/O channel: i.e. digital input or digital output
- An explicit assignment as PWM output
- An explicit assignment as D or F movement output

1.16.5.1.1 Physical configuration

Name:
X3CfO_PhyIOConfigCh01 to X3CfO_PhyIOConfigCh12

These registers are used to configure the functionality of the channels.

Data type	Values
USINT	See the bit structure.

Bit structure:

Name:
X3CfO_PhyIOConfigCh01 to X3CfO_PhyIOConfigCh04

Channels 1 to 4 are digital outputs and can only be used as direct I/O channel.

Bit	Description	Value	Information
0 - 7		0	Direct I/O operation of output

Name:
X3CfO_PhyIOConfigCh05 to X3CfO_PhyIOConfigCh08

Channels 5 to 8 are digital mixed channels and can be configured as either input or output.

Bit	Description	Value	Information
0 - 1		00	Configured as digital output
		01	Reserved
		10	Reserved
		11	Configured as digital input
2 - 7		0	Direct I/O operation of output

Name:
X3CfO_PhyIOConfigCh09 to X3CfO_PhyIOConfigCh12

Channels 9 to 12 are high-speed digital outputs and can be configured as direct I/O, PWM or movement channels.

Bit	Description	Value	Information
0 - 3	Reserved	0	
4 - 5		00	Direct I/O operation of output
		01	Output operated as PWM
		10	Reserved
		11	Output operated as D/F movement
6 - 7	Reserved	0	

1.16.5.2 Monitoring of the I/O power supply voltage

Name:
StatusInput01

The state of the I/O supply voltage is indicated in this register.

Data type	Values	Information
USINT	0	I/O power supply voltage within permissible range
	1	I/O power supply voltage not connected or outside of the permissible range

1.16.5.3 Digital inputs

Unfiltered

The input state is recorded in a 100 µs cycle.

Filtered

The filtered state is transferred in a 100 µs cycle.

Filtering takes place asynchronously in an interval of 100 µs.

1.16.5.3.1 Digital input filter

Name:
X3CfO_DI_Filter

The filter value for all digital inputs can be configured in this register.

The filter value can be configured in steps of 100 µs.

Data type	Values	Filter
USINT	0	No software filter
	1	0.1 ms
	...	...
	250	25 ms - Higher values are limited to this value.

1.16.5.3.2 Input state of digital inputs 5 to 8

Name:
DigitalInput05 to DigitalInput08

This register contains the input state of digital inputs 5 to 8.

Data type	Values
USINT	See the bit structure.

Bit structure:

Bit	Name	Value	Information
0	DigitalInput05	0 or 1	Input status of digital input 5
...		...	
3	DigitalInput08	0 or 1	Input status of digital input 8

1.16.5.4 Digital outputs

The output state is processed internally in a 100 µs cycle.

1.16.5.4.1 Switching state of digital outputs 1 to 12

Name:
DigitalOutput01 to DigitalOutput12

These registers are used to store the switching state of digital outputs 1 to 12.

Data type	Values
USINT	See the bit structure.

Bit structure:

Register 8208:

Bit	Description	Value	Information
0	DigitalOutput01	0	Digital output 1 reset
		1	Digital output 1 set
...		...	
7	DigitalOutput08	0	Digital output 8 reset
		1	Digital output 8 set

Register 8209:

Bit	Description	Value	Information
0	DigitalOutput09	0	Digital output 9 reset
		1	Digital output 9 set
...		...	
3	DigitalOutput12	0	Digital output 12 reset
		1	Digital output 12 set

1.16.5.5 Monitoring status of the digital outputs

The error states of the outputs must be programmed in the application. The status information that is read is the actual voltage state on the channel (set or reset). The error state is therefore determined by a difference between the data points "DigitalOutputxx" and the corresponding "StatusDigitalOutputxx".

At least 3 system ticks are needed internally to read the output status. This is the reason for the delay after which the earliest possible comparison is permitted to be made after a change in the status of the output.

The digital input filter is not applied to this status information.

1.16.5.5.1 Status of digital outputs 1 to 12

Name:
StatusDigitalOutput01 to StatusDigitalOutput12

These registers contain the state of digital outputs 1 to 12.

Data type	Values
USINT	See the bit structure.

Bit structure:

Register 8193:

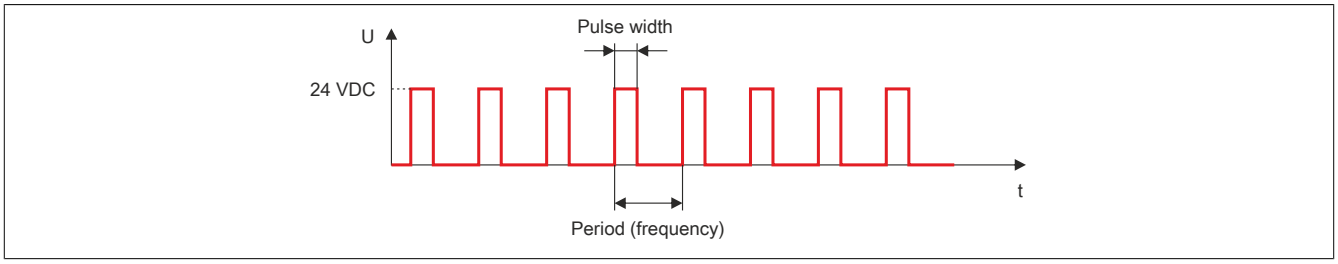
Bit	Description	Value	Information
0	StatusDigitalOutput01	0	Channel 1: Digital output reset or short circuit
		1	Channel 1: Digital output set or voltage feedback
...		...	
7	StatusDigitalOutput08	0	Channel 8: Digital output reset or short circuit
		1	Channel 8: Digital output set or voltage feedback

Register 8194:

Bit	Description	Value	Information
0	StatusDigitalOutput09	0	Channel 9: Digital output reset or short circuit
		1	Channel 9: Digital output set or voltage feedback
...		...	
3	StatusDigitalOutput12	0	Channel 12: Digital output reset or short circuit
		1	Channel 12: Digital output set or voltage feedback

1.16.5.6 Pulse width modulation (PWM) function

Digital inputs 9 to 12 can be configured as PWM outputs. 2 data points are available per channel for controlling the PWM signal.



1.16.5.6.1 Period duration of the PWM outputs

Name:
PWMPeriod09 to PWMPeriod12

These registers define the period duration, i.e. the time base for the respective PWM output. This time represents the 100% value, which can be incremented in 0.1% steps through the duty cycle.

Data type	Values	Information
UINT	5 to 65535	Period duration from 5 to 65535 µs: Corresponds to a frequency from 200 kHz to ≈15 Hz

1.16.5.6.2 Duty cycle of the PWM outputs

Name:
PWMOutput09 to PWMOutput12

The ratio of the duty cycle of the respective PWM output in relation to the period duration is set in these registers with a resolution of 0.1%.

Data type	Values	Information
INT	0 to 1000	Duty cycle of the output in 0 to 100.0%

Example: Period duration T [µs] with a duty cycle of 25% corresponds to switch-on time t_1 [µs].

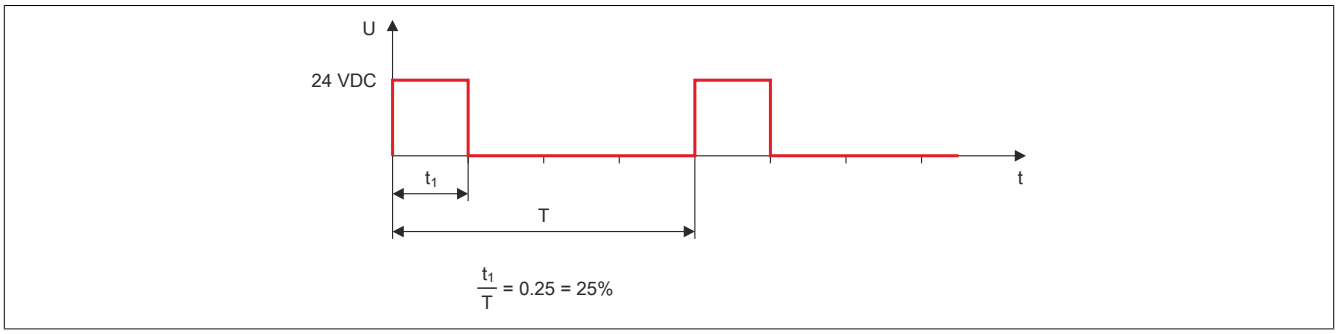


Figure 28: Switch-on time depending on the period duration and duty cycle

1.16.5.7 DF movement generator function

Digital output channels 9 to 12 can be configured as 2 independently functioning movement generators (Direction/Frequency) for stepper motor control. The movement generators are assigned to the following channels:

Movement generator	Channel	Function
1	DO 9	D: Direction
	DO 10	F: Frequency
2	DO 11	D: Direction
	DO 12	F: Frequency

The frequency is output via the respective F channel, and the direction is output via the respective D channel. The switchover between directions (movement/counter) takes place via the sign of the speed setpoint.

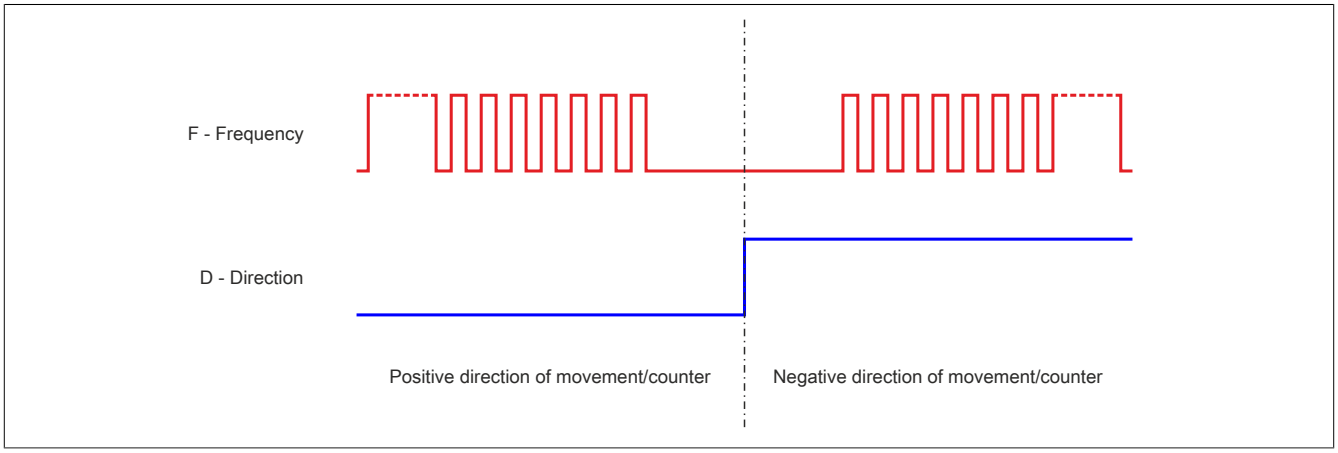


Figure 29: Frequency output via F channel, direction output via D channel

The respective output must be configured correctly in order to completely process the motion function (see "Physical configuration" on page 52).

The data points described below are available for configuring and controlling the respective movements.

1.16.5.7.1 Configuring the movement mode

Name:
X3Cfo_Mov01Mode
X3Cfo_Mov02Mode

These registers are used to configure how the speed setpoint is interpreted. The difference between the two modes is whether edges or periods are output for each increment of the setpoint.

Data type	Values	Information
USINT	0	Edge mode: Each increment generates an edge on the output.
	1	Pulse mode: Each increment generates a period on the output.

Edge mode

4 increments of the speed setpoint correspond to 2 periods on the output:

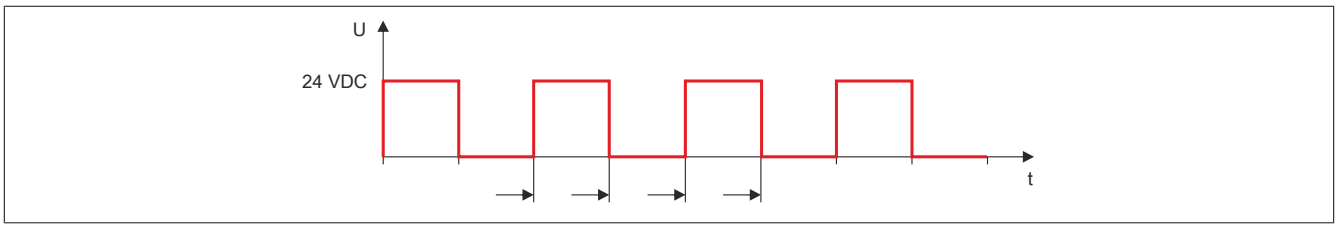


Figure 30: Interpretation of the speed setpoint with edge output for each increment

Pulse mode

2 increments of the speed setpoint correspond to 2 periods on the output:

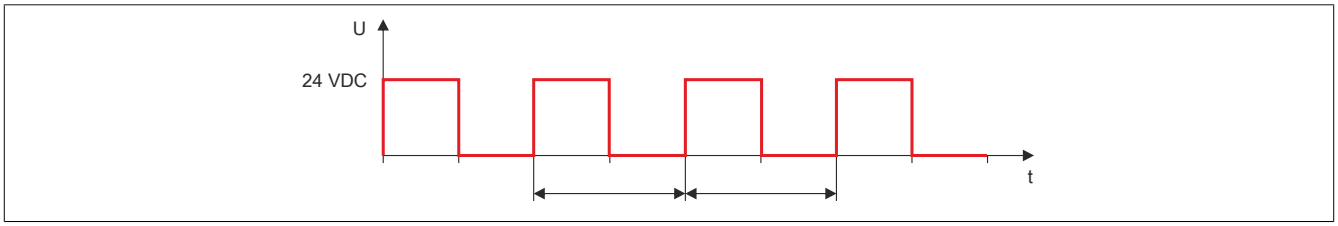


Figure 31: Interpretation of the speed setpoint with period output for each increment

1.16.5.7.2 Configuring the maximum speed of the movement

The maximum speed or output frequency of the movement is configured in order to protect the digital output, the actuator/drive being controlled and/or the mechanical system.

Name:
X3Cfo_Mov01SpeedLimit
X3Cfo_Mov02SpeedLimit

These registers are used to configure the maximum speed / output frequency permitted in the system. It is important that the limit values for edge and pulse mode are different.

Edge mode

Data type	Values	Information
UDINT	10 to 400000	Speed [increments per second]

Pulse mode

Data type	Values	Information
UDINT	5 to 200000	Speed [increments per second]

1.16.5.7.3 Activates the movement

When a movement is active, the two channels are operated according to the preset values.

Name:
Mov01Enable
Mov02Enable

These registers are used to enable or disable the motion function.

Mov01Enable

Data type	Values	Information
USINT	0	Movement 1 disabled
	2	Movement 1 enabled: The speed setpoint is being evaluated.

Mov02Enable

Data type	Values	Information
USINT	0	Movement 2 disabled
	4	Movement 2 enabled: The speed setpoint is being evaluated.

1.16.5.7.4 Speed and direction control of the movement

The following parameters are important for speed and direction control of the movement:

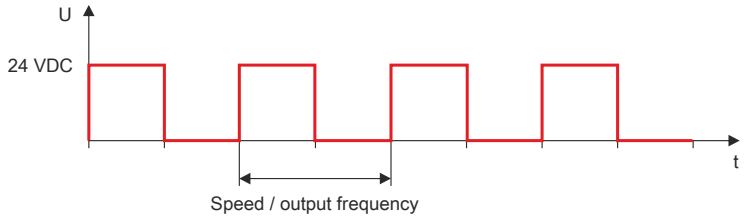
Characteristic value	Description
Speed control	The speed setpoint is specified as a percentage of the configured maximum speed: 0 to ±32767 correspond to 0 to ±100% of the configured maximum speed
Direction control	The direction of movement is defined by the sign of the speed setpoint: 0 to +32767 correspond to 0 to the maximum speed in the positive direction of movement 0 to -32767 correspond to 0 to the maximum speed in the negative direction of movement
Resolution of the speed setpoint	The resolution of the speed setpoint is: Maximum speed / 32767
Ratio: Speed / Frequency	The relationship between speed and output frequency is: (Speed setpoint / Maximum speed) * 32767 

Table 11: Parameters for speed and direction control of the movement

Name:
Mov01Speed
Mov02Speed

These registers are used to set the speed of the movement.

Data type	Values	Information
INT	0 to 32767	Speed setpoint 0 to 100%: Movement output F = 0 to maximum speed
		Positive direction of movement: Movement output D = 0
	0 to -32767	Speed setpoint 0 to 100%: Movement output F = 0 to maximum speed
		Negative direction of movement: Movement output D = 1

1.16.5.7.5 Position feedback for movement

The position feedback is represented by a fixed point value [16.16]:

- HighWord = Whole number increments
- LowWord = Positions after the decimal of the increments

Name:
Mov01Position
Mov02Position

These registers show the current position of the movement.

Data type	Values	Information
DINT	-2,147,483,648 to 2,147,483,647	Position value in fixed point format [16.16]

2 X20(c)CP168x(X) and X20(x)CP368x(X)

2.1 General information

2.1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual
MAEMV	Installation / EMC guide

Additional documentation

Document name	Title
MAREDSYS	Redundancy for control systems

2.1.2 Coated modules

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

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

2.1.3 X20CP168x(X) - Order data

Order number	Short description
	X20 PLCs
X20CP1684	X20 PLC, Atom 0.4 GHz (compatible), 512 MB DDR4 RAM, 1 MB SRAM, 1 GB onboard flash drive, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface module, including supply module. 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20cCP1684	X20c PLC, coated, Atom 0.4 GHz (compatible), 512 MB DDR4 RAM, 1 MB SRAM, 1 GB onboard flash drive, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot cover and X20 end cover plate (right) X20AC0SR1 included. Order CompactFlash separately!
X20CP1685	X20 PLC, Atom 0.8 GHz, 512 MB DDR4 RAM, 1 MB SRAM, 1 GB onboard flash drive, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface module, including supply module. 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20CP1686X	X20 PLC, Atom 1.3 GHz, 1 GB DDR4 RAM, 1 MB SRAM, 2 GB onboard flash drive, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
	Included in delivery
	Batteries
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell
	Locking plate
X20AC0SR1	X20 end cover plate, right
	Terminal blocks
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed
	Optional accessories
	Batteries
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell
	CompactFlash cards
0CFCRD.016GE.02	CompactFlash 16 GB extended temp.
0CFCRD.0512E.02	CompactFlash 512 MB extended temp.
0CFCRD.1024E.02	CompactFlash 1024 MB extended temp.
0CFCRD.2048E.02	CompactFlash 2048 MB extended temp.
0CFCRD.4096E.02	CompactFlash 4096 MB extended temp.
0CFCRD.8192E.02	CompactFlash 8 GB extended temp.

Table 12: X20CP168x(X) - Order data

Included in delivery

Order number	Short description
4A0006.00-000	Backup battery (see also "Battery" on page 79)
-	Interface module slot covers
X20AC0SR1	X20 end cover plate (right)
X20TB12	X20 terminal block, 12-pin, 24 V coding

2.1.4 X20CP368x(X) - Order data

Order number	Short description
	X20 PLCs
X20CP3684	X20 PLC, Atom 0.4 GHz (compatible), 512 MB DDR4 RAM, 1 MB SRAM, 1 GB onboard flash drive, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20CP3685	X20 PLC, Atom 0.8 GHz, 512 MB DDR4 RAM, 1 MB SRAM, 1 GB onboard flash drive, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface module, including supply module. 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20CP3686X	X20 PLC, Atom 1.3 GHz, 1 GB DDR4 RAM, 1 MB SRAM, 2 GB onboard flash drive, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20CP3687X	X20 PLC, Atom 1.6 GHz, 2 GB DDR4 RAM, 1 MB SRAM, 2 GB onboard flash drive, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included. Order CompactFlash separately!
X20cCP3687X	X20c PLC, coated, Atom 1.6 GHz, 2 GB DDR4 RAM, 1 MB SRAM, 2 GB onboard flash drive, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface (TSN) 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module. 1x terminal block X20TB12, slot covers and X20 end cover plate (right) X20AC0SR1 included. Order CompactFlash separately!
	Included in delivery
	Batteries
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell
	Locking plate
X20AC0SR1	X20 end cover plate, right
	Terminal blocks
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed
	Optional accessories
	Batteries
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell
	CompactFlash cards
0CFCRD.016GE.02	CompactFlash 16 GB extended temp.
0CFCRD.0512E.02	CompactFlash 512 MB extended temp.
0CFCRD.1024E.02	CompactFlash 1024 MB extended temp.
0CFCRD.2048E.02	CompactFlash 2048 MB extended temp.
0CFCRD.4096E.02	CompactFlash 4096 MB extended temp.
0CFCRD.8192E.02	CompactFlash 8 GB extended temp.

Table 13: X20CP368x(X) - Order data

Included in delivery

Order number	Short description
4A0006.00-000	Backup battery (see also "Battery" on page 79)
-	Interface module slot covers
X20AC0SR1	X20 end cover plate (right)
X20TB12	X20 terminal block, 12-pin, 24 V coding

2.1.5 Module description

This controller is based on Intel Atom processor technology and used for applications with the highest performance requirements. It rounds off the top end of the X20 controller product family.

The basic configuration includes USB, Ethernet, POWERLINK V2, flash drive and removable CompactFlash. The standard Ethernet interface supports gigabit communication. For even more real-time network performance, the onboard POWERLINK interface supports poll-response chaining mode (PRC).
Up to 3 more slots are available for additional interface modules to increase flexibility.

- Intel Atom processor with 400 MHz (compatible) to 1.6 GHz with integrated I/O processor
- Ethernet, POWERLINK V2 with poll-response chaining and onboard USB
- 1 or 3 slots for modular interface expansion
- CompactFlash as removable application memory
- 512 MB to 2 GB LPDDR4 SDRAM
- 1 to 2 GB onboard flash drive
- Controller redundancy possible
- Fanless

2.1.6 X2X+ support

For applications that require a short response time or high data throughput, X2X+ can be used instead of X2X Link for the X20CPx686X and X20CP3687X variants. To do so, the corresponding X2X+ bus modules must be used and lined up with each other. The X20 I/O modules can simply be connected to the X2X+ bus modules.

Information:

X2X+ is only available directly on the controller.
It is not possible to directly combine X2X+ and X2X Link in the same segment. A separate X2X Link interface module must be used for this purpose.

The following limitations currently apply to X2X+:

- **Displacement via cable is not possible.**
- **Using double-width modules is not possible.**
- **Using safety modules is not possible.**
- **Using 230 VAC modules (red) is not possible.**

Information:

For simplification purposes, only images and module IDs of X2X Link modules are used in this data sheet. The name "X2X Link" is used in the text.

2.2 Technical description

2.2.1 X20(c)CP168x(X) - Technical data

Order number	X20CP1684	X20cCP1684	X20CP1685	X20CP1686X
Short description				
Interfaces	1x RS232, 1x Ethernet, 1x POWERLINK (V2), 2x USB, 1x X2X Link			1x RS232, 1x Ethernet, 1x POWERLINK (V2), 2x USB, 1x X2X Link/X2X+
System module	Controller			
General information				
B&R ID code	0xF9EA	0x2F42	0xF9EB	0xF9EC
Cooling	Fanless			
Status indicators	CPU function, Ethernet, POWERLINK, CompactFlash, battery			
Diagnostics				
Battery	Yes, using LED status indicator and software			
CPU function	Yes, using LED status indicator			
CompactFlash	Yes, using LED status indicator			
Ethernet	Yes, using LED status indicator			
POWERLINK	Yes, using LED status indicator			
Temperature	Yes, using software register			
Support				
Controller redundancy	No			
Storage health data support [1]	Yes			
ACOPOS support	Yes			
Visual Components support	Yes			
Power consumption without interface module and USB	6.9 W			7.5 W
Power consumption for X2X Link power supply [2]	1.42 W			
Power consumption [2]				
Internal I/O	0.6 W			
Additional power dissipation caused by actuators (resistive) [W]	-			
Certifications				
CE	Yes			
UKCA	Yes			
UL	cULus E115267 Industrial control equipment	-	cULus E115267 Industrial control equipment	
CPU and X2X Link power supply				
Input voltage	24 VDC -20% / +25% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 36 W)			
Input current	Max. 1.5 A at 24 VDC			
Fuse	Integrated, cannot be replaced			
Reverse polarity protection	Yes			
X2X Link power supply output				
Nominal output power	7 W [3]			
Parallel connection	Yes [4]			
Redundant operation	Yes			
Input I/O power supply				
Input voltage	24 VDC -15% / +20% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 240 W)			
Fuse	Required line fuse: Max. 10 A slow-blow			
Output I/O power supply				
Nominal output voltage	24 VDC			
Permissible contact load	10 A			
Power supply - General information				
Status indicators	Overload, operating status, module status, RS232 data transfer			
Diagnostics				
RS232 data transfer	Yes, using LED status indicator			
Module run/error	Yes, using LED status indicator and software			
Overload	Yes, using LED status indicator and software			
Electrical isolation				
I/O supply - I/O power supply	No			
CPU/X2X Link supply - CPU/X2X Link power supply	Yes			
Controller				
CompactFlash slot	1			
Real-time clock	Nonvolatile, resolution 1 s, -20 to 20 ppm accuracy at 25°C			
FPU	Yes			

Table 14: X20CP168x(X) - Technical data

Order number	X20CP1684	X20cCP1684	X20CP1685	X20CP1686X
Processor				
Type	Atom E3915			Atom E3930
Clock frequency	400 MHz (compatible).		800 MHz	1.3 GHz
L1 cache				
Data code	24 kB			
Program code	32 kB			
L2 cache	1 MB			
Integrated I/O processor	Processes I/O data points in the background			
Modular interface slots	1			
Remanent variables	Max. 512 kB [5]			Max. 1 MB [5]
Shortest task class cycle time	400 µs		200 µs	100 µs
Typical instruction cycle time	0.0044 µs		0.0028 µs	0.0015 µs
Data buffering				
Battery monitoring	Yes			
Lithium battery	During operation: 4 years PLC switched off: Min. 2 years at 23°C ambient temperature			
Standard memory				
RAM	512 MB LPDDR4 SDRAM			1 GB LPDDR4 SDRAM
User RAM	1 MB SRAM [6]			
Application memory				
Type	1 GB eMMC flash memory			2 GB eMMC flash memory
Data retention	10 years			
Writable data amount				
Guaranteed	40 TB			
Results for 5 years	21.9 GB/day			
Guaranteed erase/write cycles	20,000			
Error-correcting code (ECC)	Yes			
Interfaces				
Interface IF1				
Signal	RS232			
Variant	Connection via 12-pin terminal block X20TB12			
Max. distance	900 m			
Transfer rate	Max. 115.2 kbit/s			
Interface IF2				
Signal	Ethernet			
Variant	1x RJ45 shielded			
Line length	Max. 100 m between 2 stations (segment length)			
Transfer rate	10/100/1000 Mbit/s			
Transfer				
Physical layer	10BASE-T/100BASE-TX/1000BASE-T			
Half-duplex	Yes			
Full-duplex	Yes			
Autonegotiation	Yes			
Auto-MDI/MDIX	Yes			
Interface IF3				
Fieldbus	POWERLINK (V2) managing or controlled node			
Type	Type 4 [7]			
Variant	1x RJ45 shielded			
Line length	Max. 100 m between 2 stations (segment length)			
Transfer rate	100 Mbit/s			
Transfer				
Physical layer	100BASE-TX			
Half-duplex	Yes			
Full-duplex	POWERLINK mode: No / Ethernet mode: Yes			
Autonegotiation	Yes			
Auto-MDI/MDIX	Yes			
Interface IF4				
Type	USB 1.1/2.0			
Variant	Type A			
Max. output current	0.5 A			
Interface IF5				
Type	USB 1.1/2.0			
Variant	Type A			
Max. output current	0.5 A			
Interface IF6				
Fieldbus	X2X Link master			X2X Link / X2X+ master
Electrical properties				
Electrical isolation	Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC			
Operating conditions				
Mounting orientation				
Horizontal	Yes			
Vertical	Yes			

Table 14: X20CP168x(X) - Technical data

Order number	X20CP1684	X20cCP1684	X20CP1685	X20CP1686X
Installation elevation above sea level				
0 to 2000 m	No limitation			
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m			
Degree of protection per EN 60529	IP20			
Ambient conditions				
Temperature				
Operation				
Horizontal mounting orientation	-25 to 60°C			
Vertical mounting orientation	-25 to 50°C			
Derating	See section "Derating".			
Storage	-40 to 70°C			
Transport	-40 to 70°C			
Relative humidity				
Operation	5 to 95%, non-condensing	Up to 100%, condensing	5 to 95%, non-condensing	
Storage	5 to 95%, non-condensing			
Transport	5 to 95%, non-condensing			
Mechanical properties				
Note	Order application memory (CompactFlash) separately Backup battery included in delivery X20 end cover plate (right) included in delivery 12-pin X20 terminal block included in delivery Interface module slot covers included in delivery			
Dimensions				
Width	150 mm			
Height	99 mm			
Depth	85 mm			
Weight	480 g [8)]			

Table 14: X20CP168x(X) - Technical data

1) For details about *storage health data*, see Automation Help.
2) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3) When operated at temperatures above 55°C, a derating of the nominal output power to 5 W for the X2X Link power supply must be taken into account.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to ensure that all power supply units operated in parallel are switched on and off simultaneously.
5) The memory size for remanent variables is configurable in Automation Studio.
6) 1 MB SRAM minus the configured remanent variables.
7) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.
8) The PLC was weighed with the battery and terminal block X20TB12. The CompactFlash card, interface module slot cover and X20 end cover plate (right) were not included in the weighing.

2.2.2 X20CP368x(X) - Technical data

Order number	X20CP3684	X20CP3685	X20CP3686X	X20CP3687X	X20cCP3687X
Short description					
Interfaces	1x RS232, 1x Ethernet, 1x POWERLINK (V2), 2x USB, 1x X2X Link		1x RS232, 1x Ethernet, 1x POWERLINK (V2), 2x USB, 1x X2X Link/X2X+		
System module	Controller				
General information					
B&R ID code	0xF9ED	0xF9EE	0xF9F9	0xF9FA	0x2F43
Cooling	Fanless				
Status indicators	CPU function, Ethernet, POWERLINK, CompactFlash, battery				
Diagnostics					
Battery	Yes, using LED status indicator and software				
CPU function	Yes, using LED status indicator				
CompactFlash	Yes, using LED status indicator				
Ethernet	Yes, using LED status indicator				
POWERLINK	Yes, using LED status indicator				
Temperature	Yes, using software register				
Support					
Controller redundancy	Yes				
Storage health data support [1]	Yes				
ACOPOS support	Yes				
Visual Components support	Yes				
Power consumption without interface module and USB	6.9 W		7.5 W	8 W	
Power consumption for X2X Link power supply [2]	1.42 W				
Power consumption [2]					
Internal I/O	0.6 W				
Additional power dissipation caused by actuators (resistive) [W]	-				
Certifications					
CE	Yes				
UKCA	Yes				
UL	cULus E115267 Industrial control equipment				-
CPU and X2X Link power supply					
Input voltage	24 VDC -20% / +25% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 36 W)				
Input current	Max. 1.5 A at 24 VDC				
Fuse	Integrated, cannot be replaced				
Reverse polarity protection	Yes				
X2X Link power supply output					
Nominal output power	7 W [3]				
Parallel connection	Yes [4]				
Redundant operation	Yes				
Input I/O power supply					
Input voltage	24 VDC -15% / +20% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 240 W)				
Fuse	Required line fuse: Max. 10 A slow-blow				
Output I/O power supply					
Nominal output voltage	24 VDC				
Permissible contact load	10 A				
Power supply - General information					
Status indicators	Overload, operating status, module status, RS232 data transfer				
Diagnostics					
RS232 data transfer	Yes, using LED status indicator				
Module run/error	Yes, using LED status indicator and software				
Overload	Yes, using LED status indicator and software				
Electrical isolation					
I/O supply - I/O power supply	No				
CPU/X2X Link supply - CPU/X2X Link power supply	Yes				
Controller					
CompactFlash slot	1				
Real-time clock	Nonvolatile, resolution 1 s, -20 to 20 ppm accuracy at 25°C				
FPU	Yes				

Table 15: X20CP368x(X) - Technical data

Order number	X20CP3684	X20CP3685	X20CP3686X	X20CP3687X	X20cCP3687X
Processor					
Type	Atom E3915		Atom E3930	Atom E3940	
Clock frequency	400 MHz (compatible).	800 MHz	1.3 GHz	1.6 GHz	
L1 cache					
Data code	24 kB				
Program code	32 kB				
L2 cache	1 MB				
Integrated I/O processor	Processes I/O data points in the background				
Modular interface slots	3				
Remanent variables	Max. 512 kB [5]		Max. 1 MB [5]		
Shortest task class cycle time	400 µs	200 µs	100 µs		
Typical instruction cycle time	0.0044 µs	0.0028 µs	0.0015 µs	0.0010 µs	
Data buffering					
Battery monitoring	Yes				
Lithium battery	During operation: 4 years PLC switched off: Min. 2 years at 23°C ambient temperature				
Standard memory					
RAM	512 MB LPDDR4 SDRAM		1 GB LPDDR4 SDRAM	2 GB LPDDR4 SDRAM	
User RAM	1 MB SRAM [6]				
Application memory					
Type	1 GB eMMC flash memory		2 GB eMMC flash memory		
Data retention	10 years				
Writable data amount					
Guaranteed	40 TB				
Results for 5 years	21.9 GB/day				
Guaranteed erase/write cycles	20,000				
Error-correcting code (ECC)	Yes				
Interfaces					
Interface IF1					
Signal	RS232				
Variant	Connection via 12-pin terminal block X20TB12				
Max. distance	900 m				
Transfer rate	Max. 115.2 kbit/s				
Interface IF2					
Signal	Ethernet				
Variant	1x RJ45 shielded				
Line length	Max. 100 m between 2 stations (segment length)				
Transfer rate	10/100/1000 Mbit/s				
Transfer					
Physical layer	10BASE-T/100BASE-TX/1000BASE-T				
Half-duplex	Yes				
Full-duplex	Yes				
Autonegotiation	Yes				
Auto-MDI/MDIX	Yes				
Interface IF3					
Fieldbus	POWERLINK (V2) managing or controlled node				
Type	Type 4 [7]				
Variant	1x RJ45 shielded				
Line length	Max. 100 m between 2 stations (segment length)				
Transfer rate	100 Mbit/s				
Transfer					
Physical layer	100BASE-TX				
Half-duplex	Yes				
Full-duplex	POWERLINK mode: No / Ethernet mode: Yes				
Autonegotiation	Yes				
Auto-MDI/MDIX	Yes				
Interface IF4					
Type	USB 1.1/2.0				
Variant	Type A				
Max. output current	0.5 A				
Interface IF5					
Type	USB 1.1/2.0				
Variant	Type A				
Max. output current	0.5 A				
Interface IF6					
Fieldbus	X2X Link master		X2X Link / X2X+ master		
Electrical properties					
Electrical isolation	Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC				

Table 15: X20CP368x(X) - Technical data

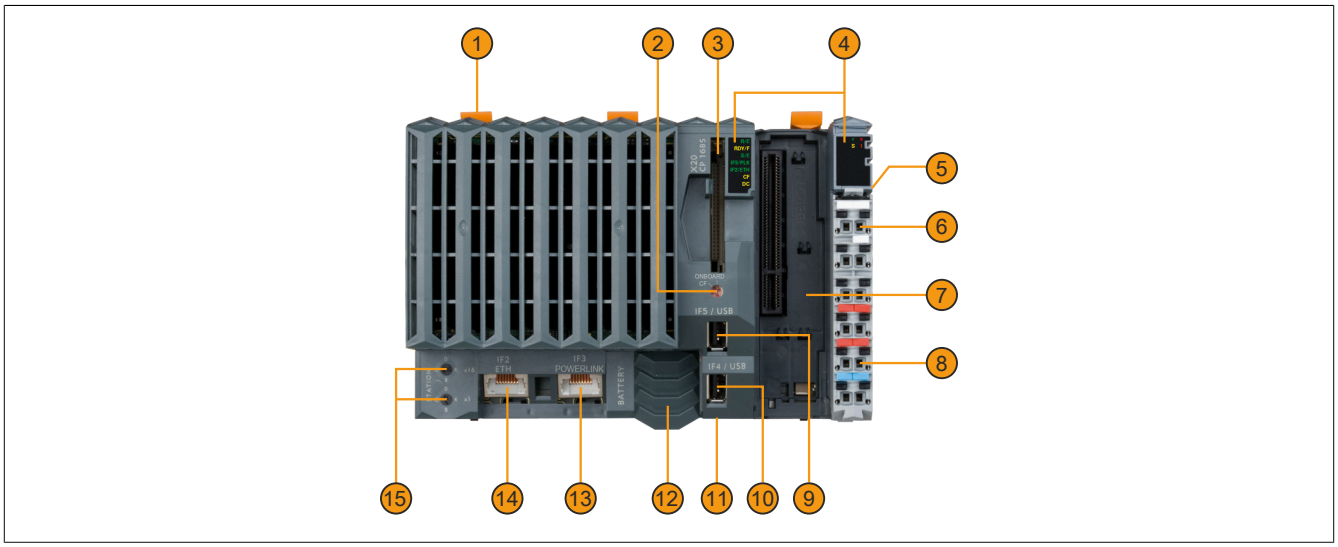
Order number	X20CP3684	X20CP3685	X20CP3686X	X20CP3687X	X20cCP3687X
Operating conditions					
Mounting orientation					
Horizontal	Yes				
Vertical	Yes				
Installation elevation above sea level					
0 to 2000 m	No limitation				
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m				
Degree of protection per EN 60529	IP20				
Ambient conditions					
Temperature					
Operation					
Horizontal mounting orientation	-25 to 60°C				
Vertical mounting orientation	-25 to 50°C				
Derating	See section "Derating".				
Storage	-40 to 70°C				
Transport	-40 to 70°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 application memory (CompactFlash) separately Backup battery included in delivery X20 end cover plate (right) included in delivery 12-pin X20 terminal block included in delivery Interface module slot covers included in delivery				
Dimensions					
Width	200 mm				
Height	99 mm				
Depth	85 mm				
Weight	530 g [8)]				

Table 15: X20CP368x(X) - Technical data

1) For details about *storage health data*, see Automation Help.
2) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3) When operated at temperatures above 55°C, a derating of the nominal output power to 5 W for the X2X Link power supply must be taken into account.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to ensure that all power supply units operated in parallel are switched on and off simultaneously.
5) The memory size for remanent variables is configurable in Automation Studio.
6) 1 MB SRAM minus the configured remanent variables.
7) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.
8) The PLC was weighed with the battery and terminal block X20TB12. The CompactFlash card, interface module slot covers and X20 end cover plate (right) were not included in the weighing.

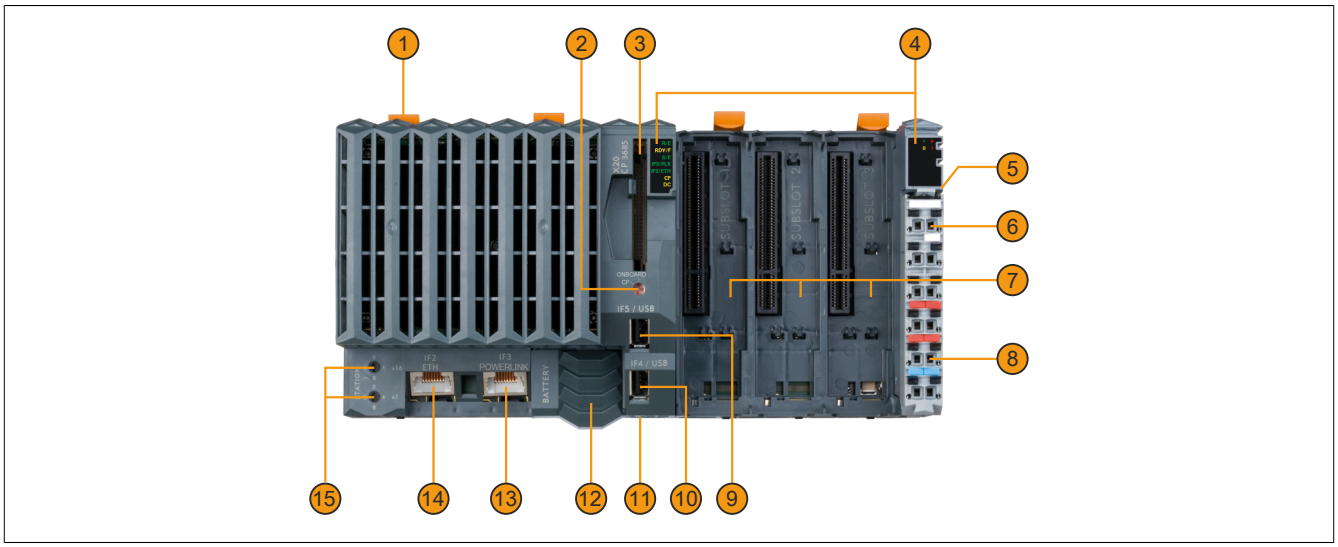
2.2.3 Operating and connection elements

X20CP168x(X)



1	Top-hat rail latch	2	Selecting application memory
3	Slot for CompactFlash	4	LED status indicators
5	IF6 - X2X Link	6	IF1 - RS232
7	Slot for interface modules	8	Terminal block for controller and I/O supply, RS232 connection
9	IF5 - USB	10	IF4 - USB
11	Reset button	12	Battery compartment
13	IF3 - POWERLINK	14	IF2 - Ethernet
15	Ethernet station address	-	-

X20CP368x(X)



1	Top-hat rail latch	2	Selecting application memory
3	Slot for CompactFlash	4	LED status indicators
5	IF6 - X2X Link	6	IF1 - RS232
7	Slots for interface modules	8	Terminal block for controller and I/O supply, RS232 connection
9	IF5 - USB	10	IF4 - USB
11	Reset button	12	Battery compartment
13	IF3 - POWERLINK	14	IF2 - Ethernet
15	Ethernet station address	-	-

2.2.3.1 LED status indicators

2.2.3.1.1 X20 controller - LED status indicators

Figure	LED	Color	Status	Description
	R/E	Green	On	Application running
			Blinking	System startup: The controller is initializing the application, all bus systems and I/O modules.[1)]
			Double flash	System startup during firmware update[1)]
		Red	On	Mode SERVICE[2)] or BOOT[2)]
			Blinking	If LED "R/E" blinks red and LED "RDY/F" blinks yellow, a license violation has occurred.
			Double flash	System startup: Installation error[3)]
	RDY/F	Yellow	On	Mode SERVICE[2)] or BOOT[2)]
			Blinking	If LED "RDY/F" blinks yellow and LED "R/E" blinks red, a license violation has occurred.
	S/E	Green/Red		Status/Error LED. LED states are described in section "LED "S/E" (status/error LED)" on page 72.
	IF3/PLK	Green	On	The link to the POWERLINK remote station is established.
			Blinking	The link to the POWERLINK remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	IF2/ETH	Green	On	The link to the Ethernet remote station is established.
			Blinking	The link to the Ethernet remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	CF	Green	On	CompactFlash inserted and detected
		Yellow	On	CompactFlash read/write access
	DC	Yellow	On	Controller power supply unit OK
		Red	On	Backup battery empty

1) This procedure can take several minutes depending on the configuration.
2) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.
3) AR 4.93 and later: The project installation (initial installation or update) via USB flash drive was aborted with an error.

2.2.3.1.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		
Green	Red	Description
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

POWERLINK V2 mode

Error message

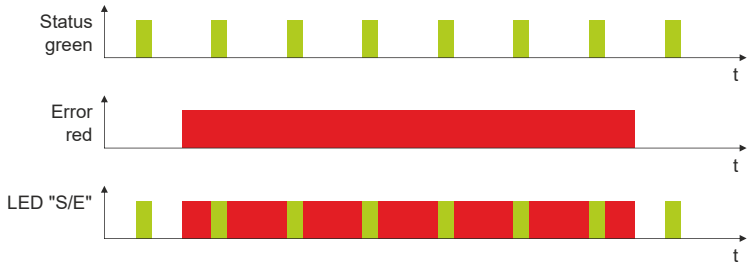
LED "S/E"		
Green	Red	Description
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE 

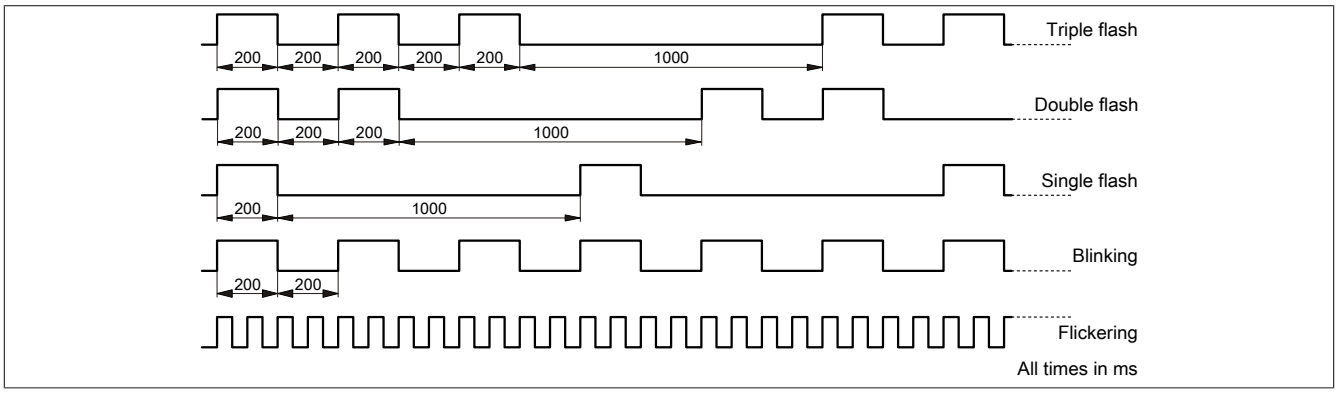
Table: LED "S/E" - Error message (interface in POWERLINK mode)

Interface status

LED "S/E"		
Green	**Red**	**Description**
Off	Off	**Mode:** NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective. **Managing node (MN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. **Controlled node (CN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	**Mode:** BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. **Managing node (MN)** This mode can only be exited by resetting the controller. **Controlled node (CN)** If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. **Managing node (MN)** The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. **Controlled node (CN)** The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. **Managing node (MN)** The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. **Controlled node (CN)** The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Triple flash (approx. 1 Hz)	Off	**Mode:** READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. **Managing node (MN)** Cyclic and asynchronous communication. Received PDO data is ignored. **Controlled node (CN)** The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
On	Off	**Mode:** OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	**Mode:** STOPPED The interface is in mode STOPPED. **Managing node (MN)** This mode does not occur for the MN. **Controlled node (CN)** Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

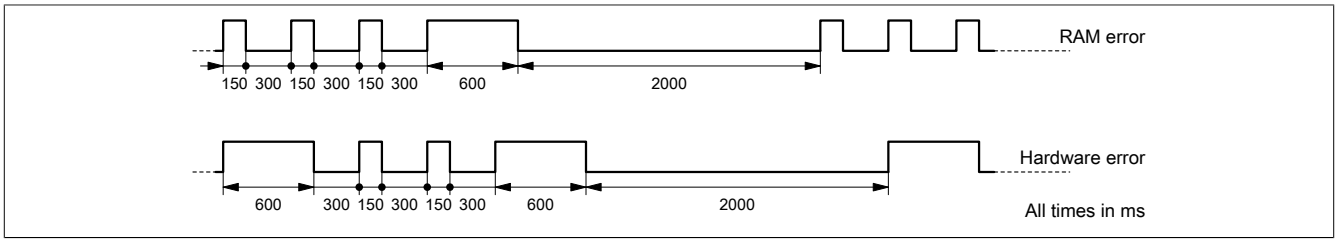
Blink times



2.2.3.1.1.2 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

2.2.3.1.2 LED status indicators for the integrated power supply unit

For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 System user's manual.

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	Mode RESET
			Blinking	Mode PREOPERATIONAL
			On	Mode RUN
	e	Red	Off	Module not supplied with power or everything OK
			Double flash	The LED indicates one of the following states: • The X2X Link power supply of the power supply unit is overloaded. • I/O power supply too low • The input voltage for the X2X Link power supply is too low.
	e + r	Solid red / Single green flash		Invalid firmware
	S	Yellow	Off	No RS232 activity
			On	The LED lights up when data is being transmitted or received via the RS232 interface.
	I	Red	Off	The X2X Link power supply is within the valid range.
			On	The X2X Link power supply of the power supply unit is overloaded.

2.2.3.2 Application memory

In order for the application project to be processed on the controller, Automation Runtime (operating system), the system components and application project must be installed on application memory. Either an integrated flash drive or removable CompactFlash card can be selected as the application memory.

2.2.3.2.1 Flash drive

This application memory is implemented as an integrated flash drive.

2.2.3.2.2 Removable CompactFlash card

The CompactFlash card is not included in delivery with the controllers; it must be ordered separately as an accessory!

Information:

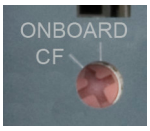
Removing the CompactFlash card during operation is not permitted.

2.2.3.2.3 Project installation

Project installation is described in "Project management - Project installation" in Automation Help.

2.2.3.2.4 Selecting application memory

The application memory is selected via a switch on the controller front.

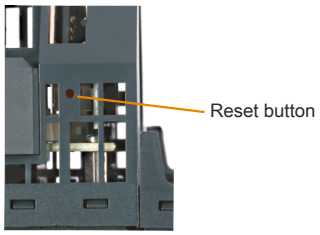


Application memory	Description
ONBOARD	The flash drive integrated in the controller is used as the application memory.
CF	The connected CompactFlash card is used as the application memory.

Information:

A switch position other than those described here is not permitted!

2.2.3.3 Button for reset and operating mode



The reset button is located below the USB interfaces on the bottom of the housing. It can be pressed with any small pointed object (e.g. paper clip).

2.2.3.3.1 Reset

The button must be pressed for less than 2 seconds to trigger a reset. This triggers a hardware reset on the controller, which means that:

- All application programs are stopped.
- All outputs are set to zero.

The controller then boots into service mode by default. The startup mode after pressing the reset button can be set in Automation Studio:

- Service mode (default)
- Warm restart
- Cold restart
- Diagnostic mode

2.2.3.3.2 Operating mode

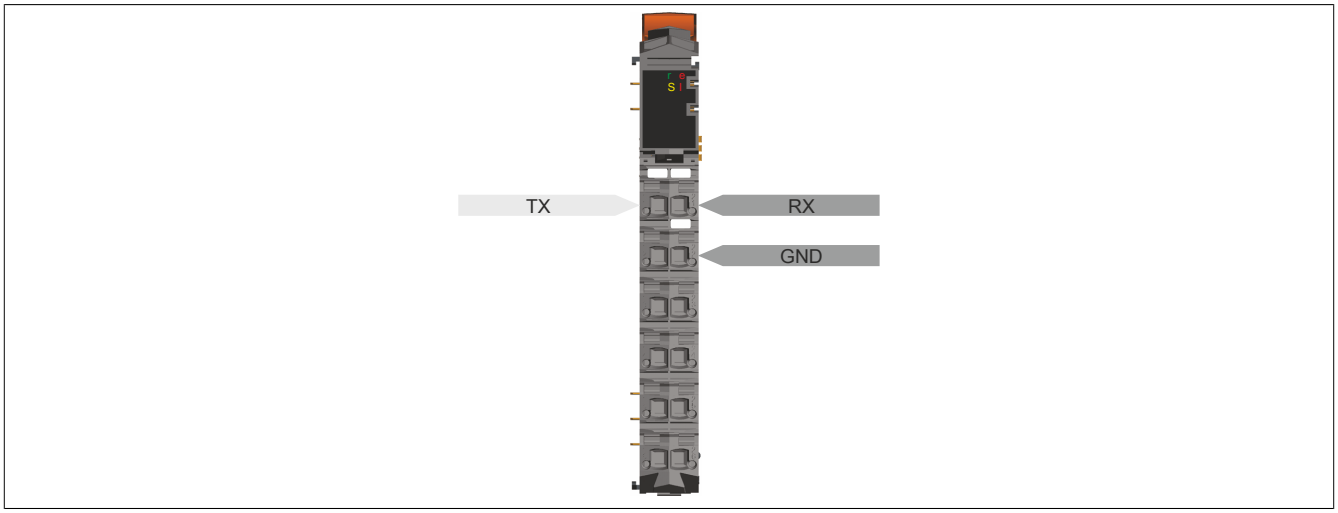
3 operating modes can be set using different button sequences:

Operating mode	Button sequence	Description
BOOT[1)]	Boot mode is enabled by the following button sequence: • Press the button for less than 2 s. As soon as LED "Error" lights **RED**, the button can be released. • Then press the button within 2 s for longer than 2 s. As soon as LED "Error" goes out, the button can be released.	Boot AR is started, and the runtime system can be installed via the online interface (Automation Studio). User flash memory is erased only when the download begins.
SERVICE/RUN[1)]	Press the button for less than 2 s. As soon as LED "Error" lights **RED**, the button can be released.	Mode SERVICE/RUN: Triggering and startup behavior correspond to triggering a hardware reset (see "Reset" on page 76).
DIAGNOSE[1)]	Press the button for more than 2 s. LED "Error" lights **RED** and then goes out. As soon as LED "Error" goes out, the button can be released.	The controller is starting up in diagnostic mode. Program sections in User RAM and User FlashPROM are not initialized. After diagnostic mode, the controller always boots with a warm restart.

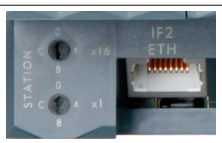
1) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.

2.2.3.4 RS232 interface (IF1)

The non-electrically isolated RS232 interface is designed as an online interface for communication with the programming device.



2.2.3.5 Ethernet interface (IF2)



IF2 is designed as a 10BASE-T/100BASE-TX/1000BASE-T gigabit-capable Ethernet interface.

The INA2000 station number of the Ethernet interface is set using the two hex switches.

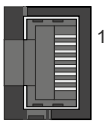
For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Information:

The Ethernet interface is not suitable for POWERLINK.

When using the POWERLINK interface, the Ethernet interface is not permitted to be operated with an IP address from the POWERLINK address range.
POWERLINK address range: 192.168.100.x

Pinout

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45 port	1	D1+	Data 1+
	2	D1-	Data 1-
	3	D2+	Data 2+
	4	D3+	Data 3+
	5	D3-	Data 3-
	6	D2-	Data 2-
	7	D4+	Data 4+
	8	D4-	Data 4-

2.2.3.6 POWERLINK interface (IF3)

The controller are equipped with a POWERLINK V2 interface.

POWERLINK

Setting in Automation Studio

By default, the POWERLINK interface is operated as a managing node (MN). In the managing node, the node number is set to a fixed value of 240.

If the POWERLINK node is operated as a controlled node (CN), a node number from 1 to 239 can be set in the POWERLINK configuration in Automation Studio.

Setting with hex switches

The POWERLINK node number can also be set with the two onboard hex switches. These are normally used to set the INA2000 station number of the Ethernet interface. Switching takes place in the POWERLINK configuration in Automation Studio.

Node numbers from 0x01 to 0xF0 are permitted.

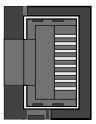
Switch position	Description
0x00	Reserved, switch position not permitted.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0	Operation as a managing node (MN).
0xF1 - 0xFF	Reserved, switch position not permitted.

Ethernet mode

In this mode, the interface is operated as an Ethernet interface. The INA2000 station number is set using the Automation Studio software.

Pinout

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Interface	Pinout		
	Pin	Ethernet	
 1 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

2.2.3.7 USB interfaces (IF4 and IF5)

IF4 and IF5 are non-galvanically isolated USB interfaces. The abbreviation USB stands for "Universal Serial Bus". Both USB interfaces support the USB 1.1 and 2.0 standards.

Information:

USB peripheral devices can be connected to the USB interfaces. Automation Runtime supports a selection of USB peripheral devices. For the supported USB classes, see the AR help documentation.

Information:

The following must be taken into account when using a USB peripheral device and grounded controller power supply (PELV):

- **Only USB peripheral devices with no connection between GND and ground are permitted to be connected. This is the case, e.g. with the USB dongle from B&R.**

2.2.3.8 Slots for interface modules

The controllers are equipped with 1 or 3 slots for interface modules.

Different bus or network systems can be flexibly integrated into the X20 system by selecting the appropriate interface module.

2.2.3.9 Battery

X20 controllers are equipped with a lithium battery. The lithium battery is located in a separate compartment and protected by a cover.

Backup battery data

Order number 4A0006.00-000 0AC201.91	 1 pcs. 4 pcs.
Short description	Lithium battery, 3 V / 950 mAh, button cell
Storage temperature	-40 to 85°C
Storage time	Max. 3 years at 30°C
Relative humidity	0 to 95% (non-condensing)

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten its service life; instead, it gives an early warning of weakened buffer capacity.

Status information "Battery OK" is available from system library function "BatteryInfo" and the controller's I/O mapping.

Replacement interval for battery

The battery should be replaced every 4 years. The replacement intervals recommended by B&R reflect the batteries' average service life and operating conditions. They do not correspond to the maximum buffer duration!

Important information about the battery exchange

The product design allows the battery to be changed when the controller is in a voltage-free state as well as when the controller is switched on. In some countries, however, changing is not permitted while operating voltage is applied. To prevent data loss, the battery must be changed within 1 min in a voltage-free state.

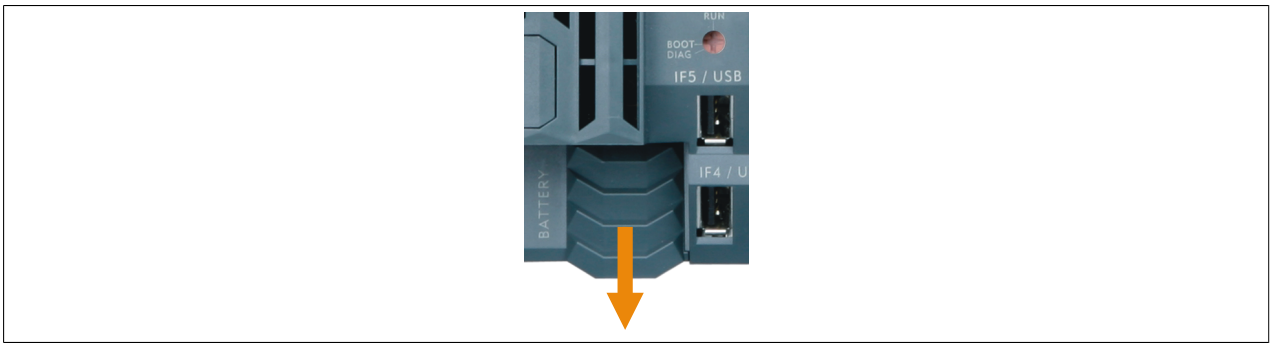
Warning!

The battery is only permitted to be replaced by a Renata CR2477N battery. The use of another battery may present a fire or explosion hazard.

The battery can explode if handled improperly. Do not recharge, disassemble or dispose of the battery in fire.

Procedure for replacing the battery

1. Perform electrostatic discharge at the top-hat rail or at the ground connection (do not reach into the power supply unit!)
2. Remove the cover for the lithium battery. Do this by sliding it down and away from the controller.



3. Push the empty battery out of the holder.
4. It is important to ensure that the new battery is not handled with moist or greasy fingers. Plastic tweezers can also be used. Do not touch the battery with pliers or metal tweezers → short circuit!
5. To insert the battery into the holder, place it with the "+" side up on the right part of the battery holder. Then press the battery into the battery holder.
6. Replace the cover.

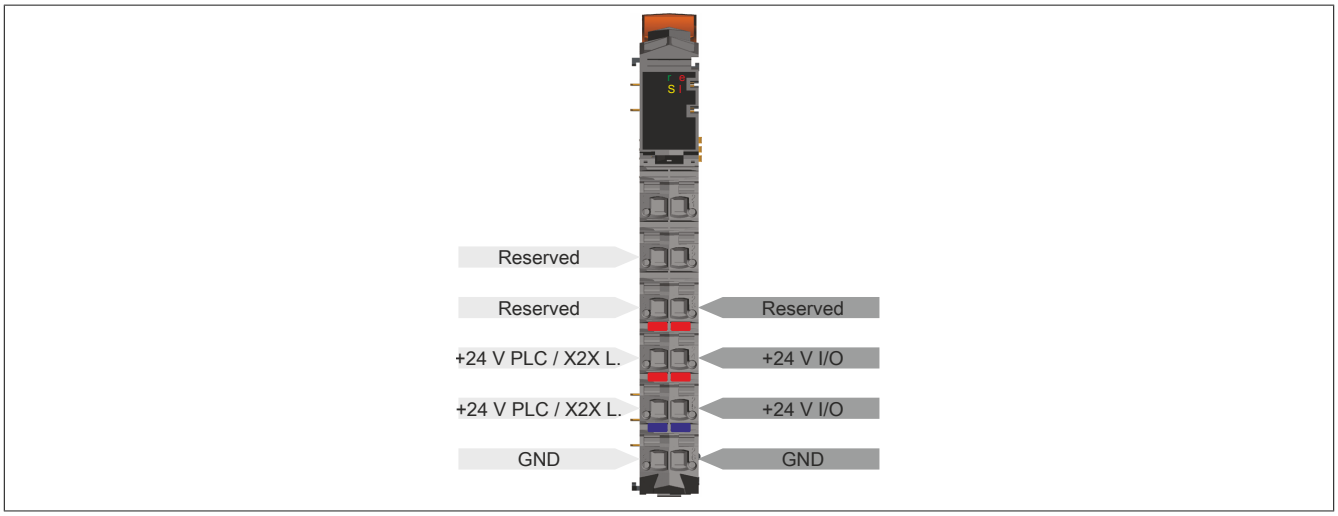
Information:

Lithium batteries are hazardous waste! Used batteries should be disposed of in accordance with applicable local regulations.

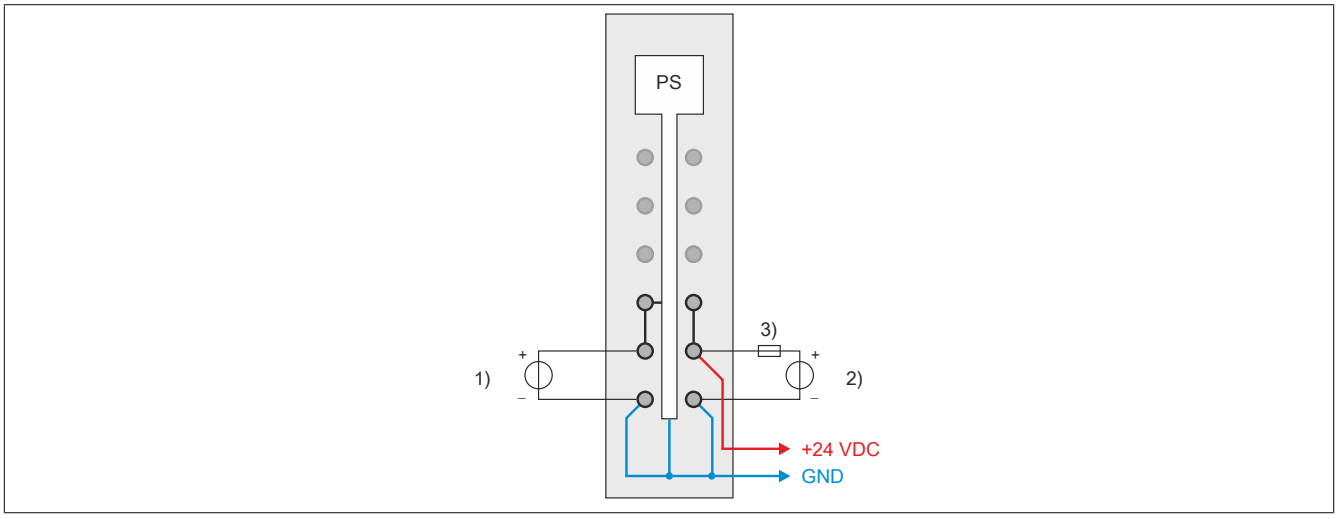
2.2.4 Controller power supply

A power supply unit is integrated in the X20 controllers. It is equipped with a supply for the controller, X2X Link and the internal I/O power supply. The bus power supply and internal I/O power supply are galvanically isolated from each other.

Integrated power supply unit - Pinout



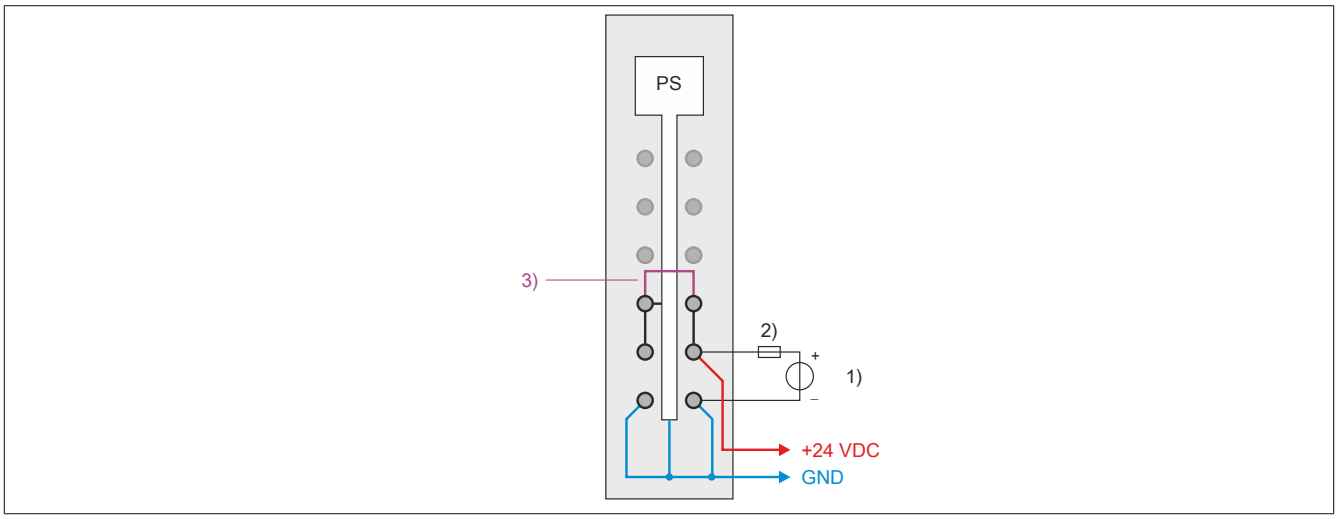
Connection example with 2 separate power supplies



1) Supply for the X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

1) Supply for the PLC or X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

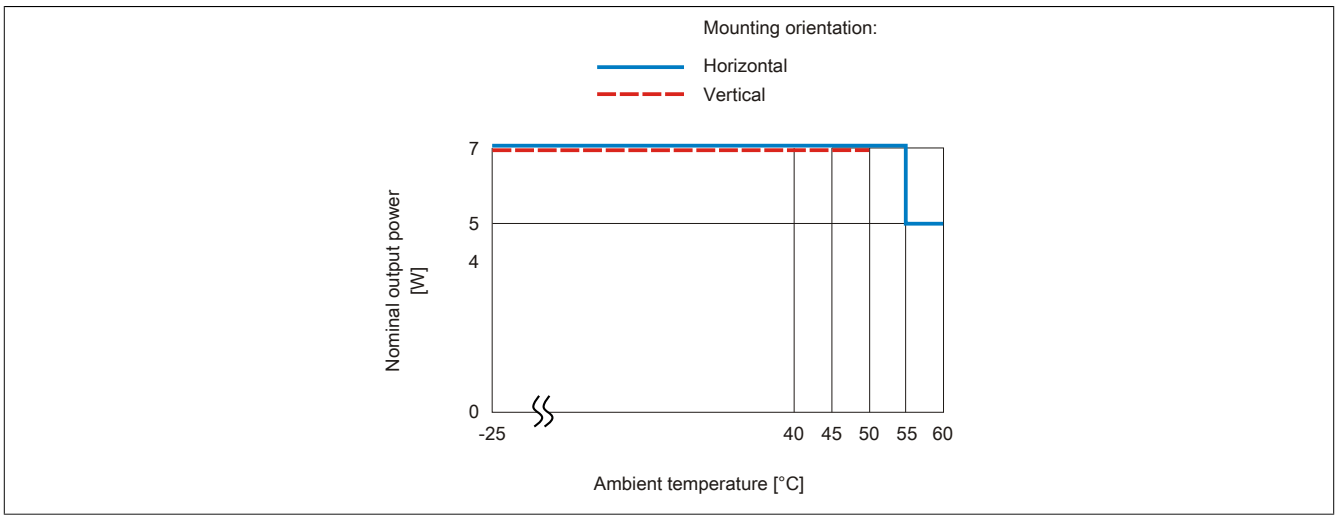
Connection example with power supply and jumper



1) Supply for the I/O power supply
2) Fuse, 10 A slow-blow
3) Jumper

2.2.5 Derating

There is no derating when operated below 55°C. Above 55°C, the nominal output power for the X2X Link power supply must be reduced to 5 W.



2.2.6 Overtemperature shutdown

To prevent damage, a shutdown – reset state – of the controller takes place at 110°C processor temperature or 95°C board temperature.

The following errors are entered in the logbook in the event of shutdown:

Error number	Short error text
9204	PLC restart triggered by the PLC CPU's temperature monitoring.
9210	Warning: Halt/Service after watchdog or manual reset.

2.2.7 System requirements

The following system requirements must be taken into account depending on whether X2X+ is used:

X2X+	System requirements
No	The following minimum versions are recommended to generally be able to use all functions: • Automation Studio 4.7 • Automation Runtime A4.73
Yes	The following minimum versions are required to use X2X+ on the X20CPx686X and X20CP3687X variants: • Automation Studio 4.11 • Automation Runtime 4.92

2.2.8 Information about migrating from the X20CPx58x to X20CPx68x(X)

The minimum hardware upgrade versions listed in the table are required to operate the following modules with X20CPx68x(X) controllers. The upgrade can be installed from Automation Studio by selecting **Tools / Upgrades** from the menu.

Order number	Minimum hardware upgrade version
X20IF10X0	1.2.2.0
X20SLXyyy	1.10.10.4

2.3 General data points

This controller is equipped with general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.

General data points are described in section "Additional information - General controller data points" in the X20 system user's manual.

2.4 UL Information

English

CAUTION!

- **The external circuits intended to be connected to this device shall be separated from MAINS supply or hazardous live voltage by reinforced or double insulation and meet the requirements of SELV/PELV (Class III) circuit of UL/CSA 61010-1, UL/CSA 61010-2-201.**
- **The module has to be built-in the final safety enclosure, which have adequate rigidity and meets the requirements with respect to spread of fire.**
- **Minimum temperature rating of the cables to be connected to the field wiring terminals: 80°C, AWG (Sol. / Str.) 28-16 / 28-16 (X2X / CPU) and AWG (Sol. / Str.) 26-12 / 26-12 (I/O). Use Copper Conductors Only.**

Information:

- **If the equipment is used in a not specified manner, the protection provided by the equipment may be impaired.**
- **For all Ethernet connections, only connections within a building are permitted, taking into account maximum lengths.**

French

Attention!

- **Les circuits externes destinés à être connectés à cet appareil doivent être séparés de l'alimentation SECTEUR ou des tensions dangereuses par une isolation renforcée ou double et satisfaire les exigences relatives aux circuits TBTS/TBTS (Classe III) spécifiées dans UL/CSA 61010-1, UL/CSA 61010-2-201.**
- **Le module doit être incorporé dans le boîtier de sécurité final. Ce dernier présente une rigidité adéquate et satisfait les exigences en matière de propagation du feu.**
- **Température minimale nominale des câbles à connecter aux bornes de câblage sur place : 80°C, AWG (Sol. / Str.) 28-16 / 28-16 (X2X / CPU) et AWG (Sol. / Str.) 26-12 / 26-12 (I/O). Utiliser des conducteurs en cuivre uniquement.**

Information:

- **Si l'équipement est utilisé d'une manière non spécifiée, la protection fournie par l'équipement peut être compromise.**
- **Pour toutes les connexions Ethernet, seules les connexions à l'intérieur d'un bâtiment sont autorisées, en tenant compte des longueurs maximales.**

3 X20EM061x and X20EM161x

3.1 General information

3.1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual
MAEMV	Installation / EMC guide

3.1.2 Order data

X20EM061x

X20EM161x

Order number	Short description
	Embedded PLC
X20EM0611	X20 Embedded PLC, Atom 0.4 GHz (compatible), 512 MB DDR4 RAM, 64 kB FRAM, 1 GB onboard flash drive, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
X20EM1611	X20 Embedded PLC, Atom 0.4 GHz (compatible), 512 MB DDR4 RAM, 64 kB FRAM, 1 GB onboard flash drive, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
X20EM0612	X20 Embedded PLC, Atom 0.8 GHz, 768 MB DDR4 RAM, 64 kB FRAM, 1 GB onboard flash drive, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
X20EM1612	X20 Embedded PLC, Atom 0.8 GHz, 768 MB DDR4 RAM, 64 kB FRAM, 1 GB onboard flash drive, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
X20EM0613	X20 Embedded PLC, Atom 1.3 GHz, 1 GB DDR4 RAM, 64 kB FRAM, 2 GB onboard flash drive, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
X20EM1613	X20 Embedded PLC, Atom 1.3 GHz, 1 GB DDR4 RAM, 64 kB FRAM, 2 GB onboard flash drive, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS485 interface, 1 POWERLINK interface, 1 Ethernet interface 10/100BASE-T
	Included in delivery
	Accessory package for X20 Embedded PLC
X20ACEMTB1	Accessories X20 Embedded PLCs: 2-pin terminal block for I/O power supply, 6-pin terminal block for RS485 interface and PLC power supply, X20 end cover plate, right (X20AC0SR1)

Table 16: X20EMx61x - Order data

Included in delivery

Order number	Short description
-	Interface module slot cover[1)]
X20ACEMTB1	Accessory package for X20 Embedded PLCs: • 2-pin terminal block for I/O power supply • 6-pin terminal block for RS485 interface and controller power supply • X20 end cover plate, right (order number X20AC0SR1)

1) For controllers with a slot for X20 interface modules.

3.1.3 General information

This compact yet powerful controller series is based on Intel Atom processor technology. The fanless, battery-free design of these controllers means they are completely maintenance-free.

The basic configuration includes USB, Ethernet, POWERLINK V2, RS485 and a flash drive. A controller with a flexibly usable slot for X20 interface modules is available for each processor variant.

- Intel Atom processor with 400 MHz (compatible) to 1.3 GHz with integrated I/O processor
- Ethernet, POWERLINK V2 with poll-response chaining, onboard USB and RS485
- Scalable: 0 or 1 slot for modular interface expansion
- 512 MB to 1 GB LPDDR4 SDRAM
- 1 to 2 GB onboard flash drive
- Fanless
- No battery

3.2 Technical description

3.2.1 X20EM061x - Technical data

Order number	X20EM0611	X20EM0612	X20EM0613
Short description			
Interfaces	1x RS485, 1x Ethernet (2-port switch), 1x POWERLINK (V2), 2x USB, 1x X2X Link		
System module	Controller		
General information			
B&R ID code	0x289B	0x289A	0x288F
Cooling	Fanless		
Status indicators	CPU function, Ethernet, POWERLINK, RS485, I/O power supply		
Diagnostics			
CPU function	Yes, using LED status indicator		
Ethernet	Yes, using LED status indicator		
I/O power supply	Yes, using software and LED status indicator		
POWERLINK	Yes, using LED status indicator		
Temperature	Yes, using software register		
Support			
Controller redundancy	No		
Storage health data support [1]	Yes		
ACOPOS support	Yes		
Visual Components support	Yes		
Power consumption	4.6 W [2]	4.7 W [2]	
Power consumption for X2X Link power supply [3]	0.6 W		
Power consumption [3]			
Internal I/O	0.56 W		
Additional power dissipation caused by actuators (resistive) [W]	-		
Certifications			
CE	Yes		
UKCA	Yes		
UL	cULus E115267 Industrial control equipment		
CPU and X2X Link power supply			
Input voltage	24 VDC -20% / +25% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 34 W)		
Input current	Max. 1.4 A at 24 VDC		
Fuse	Integrated, cannot be replaced		
Reverse polarity protection	Yes		
X2X Link power supply output			
Nominal output power	3.5 W		
Parallel connection	Yes [4]		
Redundant operation	Yes		
Input I/O power supply			
Input voltage	24 VDC -15% / +20% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 240 W)		
Fuse	Required line fuse: Max. 10 A, slow-blow		
Output I/O power supply			
Nominal output voltage	24 VDC		
Permissible contact load	10 A		
Controller			
Real-time clock	Retention for at least 300 hours, typ. 1000 hours at 25°C, 1 s resolution, <30 s/month accuracy at 25°C		
FPU	Yes		
Processor			
Type	Atom E3915		
Clock frequency	400 MHz (compatible).	800 MHz	1.3 GHz
L1 cache			
Data code	24 kB		
Program code	32 kB		
L2 cache	1 MB		
Integrated I/O processor	Processes I/O data points in the background		
Modular interface slots	0		
Remanent variables	Max. 64 kB, retention >10 years [5]		
Shortest task class cycle time	400 µs	200 µs	100 µs
Typical instruction cycle time	0.0044 µs	0.0028 µs	0.0015 µs
Standard memory			
RAM	512 MB LPDDR4 SDRAM	768 MB LPDDR4 SDRAM	1 GB LPDDR4 SDRAM

Table 17: X20EM061x - Technical data

Order number	X20EM0611	X20EM0612	X20EM0613
Application memory			
Type	1 GB eMMC flash memory		2 GB eMMC flash memory
Data retention	10 years		
Writable data amount			
Guaranteed	40 TB		
Results for 5 years	21.9 GB/day		
Guaranteed erase/write cycles	20,000		
Error-correcting code (ECC)	Yes		
Interfaces			
Interface IF2			
Signal	Ethernet		
Variant	2x shielded RJ45 (switch)		
Line length	Max. 100 m between 2 stations (segment length)		
Transfer rate	10/100 Mbit/s		
Transfer			
Physical layer	10BASE-T/100BASE-TX		
Half-duplex	Yes		
Full-duplex	Yes		
Autonegotiation	Yes		
Auto-MDI/MDIX	Yes		
Interface IF3			
Fieldbus	POWERLINK (V2) managing or controlled node		
Type	Type 4 [6]		
Variant	1x RJ45 shielded		
Line length	Max. 100 m between 2 stations (segment length)		
Transfer rate	100 Mbit/s		
Transfer			
Physical layer	100BASE-TX		
Half-duplex	Yes		
Full-duplex	POWERLINK mode: No / Ethernet mode: Yes		
Autonegotiation	Yes		
Auto-MDI/MDIX	Yes		
Interface IF4			
Type	USB 1.1/2.0		
Variant	Type A		
Max. output current	0.5 A		
Interface IF5			
Type	USB 1.1/2.0		
Variant	Type A		
Max. output current	0.5 A		
Interface IF6			
Fieldbus	X2X Link master		
Interface IF7			
Signal	RS485		
Variant	Connection via 6-pin terminal block		
Max. distance	1000 m		
Transfer rate	Max. 115.2 kbit/s		
Terminating resistor	Integrated in PLC, not switchable		
Electrical properties			
Electrical isolation	Ethernet (IF2), POWERLINK (IF3), X2X (IF6) and RS485 (IF7) isolated from each other, from other interfaces and from PLC I/O to PLC isolated from all interfaces USB (IF4 and IF5) not isolated from PLC [7]		
Operating conditions			
Mounting orientation			
Horizontal	Yes		
Vertical	Yes		
Installation elevation above sea level			
0 to 2000 m	No limitation		
>2000 m	Reduction of ambient temperature by 0.6°C per 100 m		
Degree of protection per EN 60529	IP20		
Ambient conditions			
Temperature			
Operation			
Horizontal mounting orientation	-25 to 60°C		
Vertical mounting orientation	-25 to 50°C		
Derating	-		
Storage	-40 to 70°C		
Transport	-40 to 70°C		
Relative humidity			
Operation	5 to 95%, non-condensing		
Storage	5 to 95%, non-condensing		
Transport	5 to 95%, non-condensing		

Table 17: X20EM061x - Technical data

Order number	X20EM0611	X20EM0612	X20EM0613
Mechanical properties			
Note	X20 end cover plate (right) included in delivery 2- and 6-pin terminal block included in delivery		
Dimensions			
Width	55 mm		
Height	124 mm		
Depth	92 mm		
Weight	475 g [8]		

Table 17: X20EM061x - Technical data

1) For details about *storage health data*, see Automation Help.
2) Without USB interface.
3) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to make sure that all power supply units operated in parallel are switched on and off at the same time.
5) The memory size for remanent variables is configurable in Automation Studio.
6) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.
7) The PLC power supply and USB interfaces have the same GND contact.
8) The PLC was weighed with the two terminal blocks. The X20 end cover plate (right) was not included in the weighing.

3.2.2 X20EM161x - Technical data

Order number	X20EM1611	X20EM1612	X20EM1613
Short description			
Interfaces	1x RS485, 1x Ethernet (2-port switch), 1x POWERLINK (V2), 2x USB, 1x X2X Link		
System module	Controller		
General information			
B&R ID code	0x289E	0x289D	0x289C
Cooling	Fanless		
Status indicators	CPU function, Ethernet, POWERLINK, RS485, I/O power supply		
Diagnostics			
CPU function	Yes, using LED status indicator		
Ethernet	Yes, using LED status indicator		
I/O power supply	Yes, using software and LED status indicator		
POWERLINK	Yes, using LED status indicator		
Temperature	Yes, using software register		
Support			
Controller redundancy	No		
Storage health data support [1]	Yes		
ACOPOS support	Yes		
Visual Components support	Yes		
Power consumption	5.3 W [2]	5.4 W [2]	5.5 W [2]
Power consumption for X2X Link power supply [3]	0.6 W		
Power consumption [3]			
Internal I/O	0.56 W		
Additional power dissipation caused by actuators (resistive) [W]	-		
Certifications			
CE	Yes		
UKCA	Yes		
UL	cULus E115267 Industrial control equipment		
CPU and X2X Link power supply			
Input voltage	24 VDC -20% / +25% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 34 W)		
Input current	Max. 1.4 A at 24 VDC		
Fuse	Integrated, cannot be replaced		
Reverse polarity protection	Yes		
X2X Link power supply output			
Nominal output power	3.5 W		
Parallel connection	Yes [4]		
Redundant operation	Yes		
Input I/O power supply			
Input voltage	24 VDC -15% / +20% (nominal voltage: 24 VDC) (max. input power at nominal voltage: 240 W)		
Fuse	Required line fuse: Max. 10 A, slow-blow		
Output I/O power supply			
Nominal output voltage	24 VDC		
Permissible contact load	10 A		
Controller			
Real-time clock	Retention for at least 300 hours, typ. 1000 hours at 25°C, 1 s resolution, <30 s/month accuracy at 25°C		

Table 18: X20EM161x - Technical data

Order number	X20EM1611	X20EM1612	X20EM1613
FPU	Yes		
Processor			
Type	Atom E3915		
Clock frequency	400 MHz (compatible).	800 MHz	1.3 GHz
L1 cache			
Data code	24 kB		
Program code	32 kB		
L2 cache	1 MB		
Integrated I/O processor	Processes I/O data points in the background		
Modular interface slots	1		
Remanent variables	Max. 64 kB, retention >10 years [5]		
Shortest task class cycle time	400 µs	200 µs	100 µs
Typical instruction cycle time	0.0044 µs	0.0028 µs	0.0015 µs
Standard memory			
RAM	512 MB LPDDR4 SDRAM	768 MB LPDDR4 SDRAM	1 GB LPDDR4 SDRAM
Application memory			
Type	1 GB eMMC flash memory		2 GB eMMC flash memory
Data retention	10 years		
Writable data amount			
Guaranteed	40 TB		
Results for 5 years	21.9 GB/day		
Guaranteed erase/write cycles	20,000		
Error-correcting code (ECC)	Yes		
Interfaces			
Interface IF2			
Signal	Ethernet		
Variant	2x shielded RJ45 (switch)		
Line length	Max. 100 m between 2 stations (segment length)		
Transfer rate	10/100 Mbit/s		
Transfer			
Physical layer	10BASE-T/100BASE-TX		
Half-duplex	Yes		
Full-duplex	Yes		
Autonegotiation	Yes		
Auto-MDI/MDIX	Yes		
Interface IF3			
Fieldbus	POWERLINK (V2) managing or controlled node		
Type	Type 4 [6]		
Variant	1x RJ45 shielded		
Line length	Max. 100 m between 2 stations (segment length)		
Transfer rate	100 Mbit/s		
Transfer			
Physical layer	100BASE-TX		
Half-duplex	Yes		
Full-duplex	POWERLINK mode: No / Ethernet mode: Yes		
Autonegotiation	Yes		
Auto-MDI/MDIX	Yes		
Interface IF4			
Type	USB 1.1/2.0		
Variant	Type A		
Max. output current	0.5 A		
Interface IF5			
Type	USB 1.1/2.0		
Variant	Type A		
Max. output current	0.5 A		
Interface IF6			
Fieldbus	X2X Link master		
Interface IF7			
Signal	RS485		
Variant	Connection via 6-pin terminal block		
Max. distance	1000 m		
Transfer rate	Max. 115.2 kbit/s		
Terminating resistor	Integrated in PLC, not switchable		
Electrical properties			
Electrical isolation	Ethernet (IF2), POWERLINK (IF3), X2X (IF6) and RS485 (IF7) isolated from each other, from other interfaces and from PLC I/O to PLC isolated from all interfaces USB (IF4 and IF5) and slot for X20 interface modules not isolated from PLC [7]		
Operating conditions			
Mounting orientation			
Horizontal	Yes		
Vertical	Yes		

Table 18: X20EM161x - Technical data

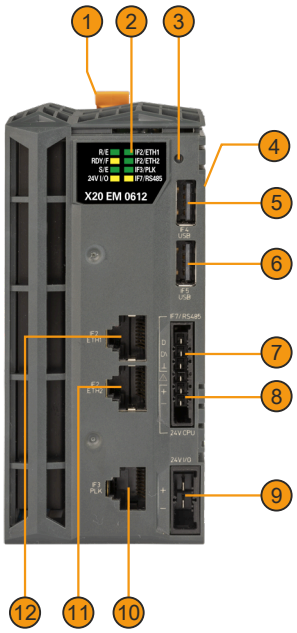
Order number	X20EM1611	X20EM1612	X20EM1613
Installation elevation above sea level			
0 to 2000 m	No limitation		
>2000 m	Reduction of ambient temperature by 0.6°C per 100 m		
Degree of protection per EN 60529	IP20		
Ambient conditions			
Temperature			
Operation			
Horizontal mounting orientation	-25 to 60°C		
Vertical mounting orientation	-25 to 50°C		
Derating	-		
Storage	-40 to 70°C		
Transport	-40 to 70°C		
Relative humidity			
Operation	5 to 95%, non-condensing		
Storage	5 to 95%, non-condensing		
Transport	5 to 95%, non-condensing		
Mechanical properties			
Note	X20 end cover plate (right) included in delivery 2- and 6-pin terminal block included in delivery Interface module slot cover included in delivery		
Dimensions			
Width	82.5 mm		
Height	124 mm		
Depth	92 mm		
Weight	530 g [8]		

Table 18: X20EM161x - Technical data

1) For details about *storage health data*, see Automation Help.
2) Without interface module and without USB interface.
3) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to make sure that all power supply units operated in parallel are switched on and off at the same time.
5) The memory size for remanent variables is configurable in Automation Studio.
6) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.
7) The PLC power supply and USB interfaces have the same GND contact.
8) The PLC was weighed with the two terminal blocks. The interface module slot cover and X20 end cover plate (right) were not included in the weighing.

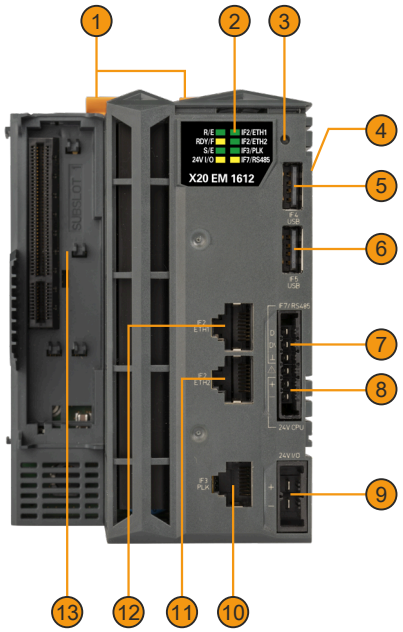
3.2.3 Operating and connection elements

X20EM061x



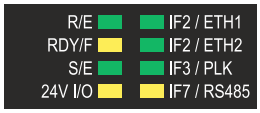
1	Top-hat rail latch	2	LED status indicators
3	Button for reset and operating mode	4	IF6 - X2X Link
5	IF4 - USB	6	IF5 - USB
7	IF7 - RS485	8	Controller and X2X Link power supply
9	I/O power supply	10	IF3 - POWERLINK
11	IF2/ETH2 - Ethernet	12	IF2/ETH1 - Ethernet

X20EM161x



1	Top-hat rail latch	2	LED status indicators
3	Button for reset and operating mode	4	IF6 - X2X Link
5	IF4 - USB	6	IF5 - USB
7	IF7 - RS485	8	Controller and X2X Link power supply
9	I/O power supply	10	IF3 - POWERLINK
11	IF2/ETH2 - Ethernet	12	IF2/ETH1 - Ethernet
13	Slot for interface modules	-	-

3.2.3.1 LED status indicators

Figure	LED	Color	Status	Description
	R/E	Green/Red	Off	Controller not supplied
		Green	On	Application running
			Blinking	System startup: The controller is initializing the application, all bus systems and I/O modules.[1]
			Double flash	System startup during firmware update[1]
		Red	On	The controller is in mode SERVICE[2] or BOOT[2], or one of the following errors is present: • Controller and X2X Link supply voltage too low • The controller has switched off due to one of the following reasons: ° Overtemperature ° Overload on the X2X bus power supply ° There is an internal defect.
			Blinking	If LED "R/E" blinks red and LED "RDY/F" blinks yellow, a license violation has occurred.
			Double flash	System startup: Installation error[3]
	RDY/F	Yellow	On	Mode SERVICE[2] or BOOT[2]
			Blinking	If LED "RDY/F" blinks yellow and LED "R/E" blinks red, a license violation has occurred.
	S/E	Green/Red		Status/Error LED. LED states are described in section "LED "S/E" (status/error LED)" on page 93.
	24 V / IO	Yellow	On	I/O power supply voltage within the valid range
		Red	Double flash	I/O supply voltage too low
	IF2 / ETH1, IF2 / ETH2	Green	On	The link to the Ethernet remote station is established.
			Blinking	The link to the Ethernet remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	IF3 / PLK	Green	On	The link to the POWERLINK remote station is established.
			Blinking	The link to the POWERLINK remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	IF7 / RS485	Yellow	On/Blinking	The module is transmitting/receiving data via the RS485 interface.

1) This process can take several minutes depending on the configuration.
2) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.
3) AR 4.93 and later: The project installation (initial installation or update) via USB flash drive was aborted with an error.

3.2.3.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

3.2.3.1.1.1 Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		
Green	Red	Description
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

3.2.3.1.1.2 POWERLINK V2 mode

Error message

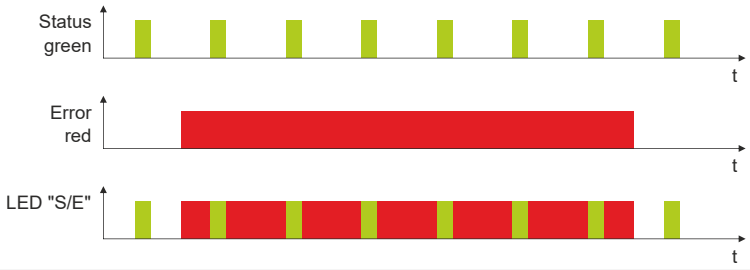
LED "S/E"		
Green	Red	Description
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE 

Table: LED "S/E" - Error message (interface in POWERLINK mode)

Interface status

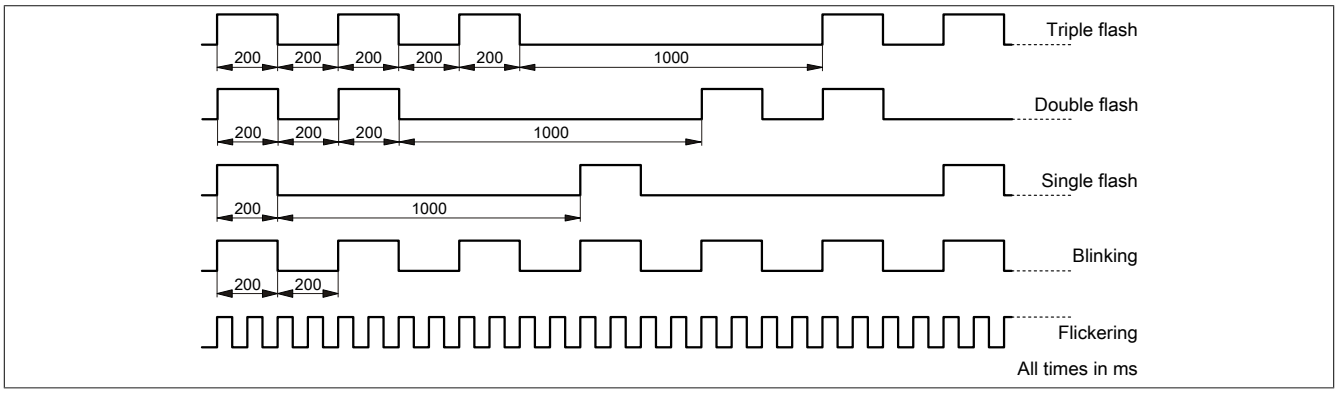
LED "S/E"		
Green	Red	Description
Off	Off	**Mode:** NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective. **Managing node (MN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. **Controlled node (CN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	**Mode:** BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. **Managing node (MN)** This mode can only be exited by resetting the controller. **Controlled node (CN)** If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. **Managing node (MN)** The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. **Controlled node (CN)** The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. **Managing node (MN)** The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. **Controlled node (CN)** The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

LED "S/E"		
Green	**Red**	**Description**
Triple flash (approx. 1 Hz)	Off	**Mode:** READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. **Managing node (MN)** Cyclic and asynchronous communication. Received PDO data is ignored. **Controlled node (CN)** The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
On	Off	**Mode:** OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	**Mode:** STOPPED The interface is in mode STOPPED. **Managing node (MN)** This mode does not occur for the MN. **Controlled node (CN)** Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

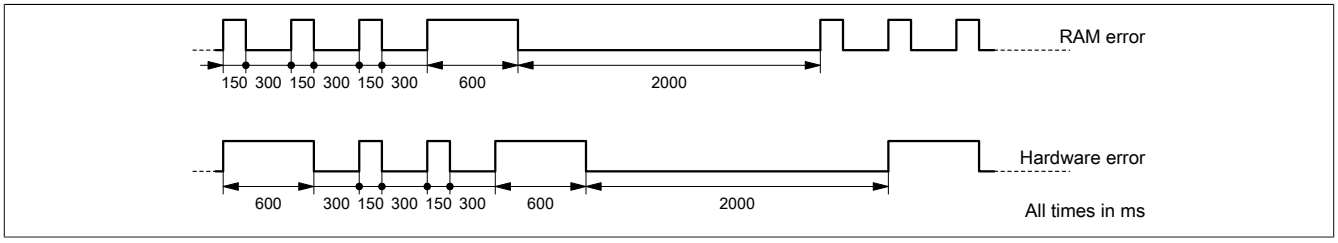
Blink times



3.2.3.1.2 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

3.2.3.2 Button for reset and operating mode

The button can be pressed with a suitable object (e.g. paper clip or ballpoint pen).

3.2.3.2.1 Reset

The button must be pressed for less than 2 seconds to trigger a reset. This triggers a hardware reset on the controller, which means that:

- All application programs are stopped.
- All outputs are set to zero.

The controller then boots into service mode by default. The startup mode after pressing the reset button can be set in Automation Studio:

- Service mode (default)
- Warm restart
- Cold restart
- Diagnostic mode

3.2.3.2.2 Operating mode

3 operating modes can be set using different button sequences:

Operating mode	Button sequence	Description
BOOT[1)]	Boot mode is enabled by the following button sequence: • Press the button for less than 2 s. As soon as LED "Error" lights **RED**, the button can be released. • Then press the button within 2 s for longer than 2 s. As soon as LED "Error" goes out, the button can be released.	Boot AR is started, and the runtime system can be installed via the online interface (Automation Studio). User flash memory is erased only when the download begins.
SERVICE/RUN[1)]	Press the button for less than 2 s. As soon as LED "Error" lights **RED**, the button can be released.	Mode SERVICE/RUN: Triggering and startup behavior correspond to triggering a hardware reset (see "Reset" on page 96).
DIAGNOSE[1)]	Press the button for more than 2 s. LED "Error" lights **RED** and then goes out. As soon as LED "Error" goes out, the button can be released.	The controller is starting up in diagnostic mode. Program sections in User RAM and User FlashPROM are not initialized. After diagnostic mode, the controller always boots with a warm restart.

1) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.

3.2.3.3 Flash drive

This application memory is implemented as an integrated flash drive.

3.2.3.4 Project installation

Project installation is described in "Project management - Project installation" in Automation Help.

3.2.3.5 Ethernet interface (IF2)

General information

IF2 is a 10BASE-T/100BASE-TX Ethernet interface.

The INA2000 station number is set using the B&R Automation Studio software.

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Information:

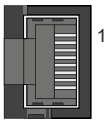
The Ethernet interface is not suitable for POWERLINK.

When using the POWERLINK interface, the Ethernet interface is not permitted to be operated with an IP address from the POWERLINK address range.
POWERLINK address range: 192.168.100.x

The interface is equipped with 2 female RJ45 connections. Both connections result in an integrated switch. This makes daisy-chain wiring easy.

The controller supports half-duplex and full-duplex communication. Mixed operation is not possible. Both connections must be operated in either half-duplex or full-duplex communication mode.

Pinout

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

3.2.3.6 POWERLINK interface (IF3)

The controller are equipped with a POWERLINK V2 interface.

POWERLINK

By default, the POWERLINK interface is operated as a managing node (MN). In the managing node, the node number is set to a fixed value of 240.

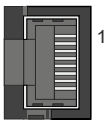
If the POWERLINK node is operated as a controlled node (CN), a node number from 1 to 239 can be set in the POWERLINK configuration in Automation Studio.

Ethernet mode

In this mode, the interface is operated as an Ethernet interface. The INA2000 station number is set using the Automation Studio software.

Pinout

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Interface	Pinout		
	Pin	Ethernet	
 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

3.2.3.7 USB interfaces (IF4 and IF5)

IF4 and IF5 are non-galvanically isolated USB interfaces. The abbreviation USB stands for "Universal Serial Bus". Both USB interfaces support the USB 1.1 and 2.0 standards.

Information:

USB peripheral devices can be connected to the USB interfaces. Automation Runtime supports a selection of USB peripheral devices. For the supported USB classes, see the AR help documentation.

Information:

The following must be taken into account when using a USB peripheral device and grounded controller power supply (PELV):

- **Only USB peripheral devices with no connection between GND and ground are permitted to be connected. This is the case, e.g. with the USB dongle from B&R.**

3.2.3.8 RS485 interface (IF7)

Complex devices can be connected to the X20 system with this serial, galvanically isolated RS485 interface. The terminals of the signals are connected to the 6-pin terminal block.

A terminating resistor is integrated in the controller and not switchable.

Interface	Pinout		
	Terminal	RS485	
	1	D	Data
	2	D\	Data\
	3	⊥	GND
	4	NC	Not permitted to be used!
6-pin male multipoint connector			

3.2.3.9 Slot for interface modules

A variant with a flexibly usable slot for X20 interface modules is available for each performance class.

Different bus or network systems can be flexibly integrated into the X20 system by selecting the appropriate interface module.

3.2.3.10 Data and real-time clock retention

The controllers do not use a battery. This makes them completely maintenance-free. Eliminating the backup battery was made possible by the following measures:

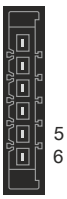
Data and real-time clock retention	Backup type	Note
Remanent variables	FRAM	This FRAM stores its contents ferroelectrically. Unlike normal SRAM, this does not require a battery.
Real-time clock	Gold foil capacitor	The real-time clock is backed up for approx. 1000 hours by a gold foil capacitor. The gold foil capacitor is completely charged after 3 continuous hours of operation.

3.2.4 Controller power supply

A power supply unit is already integrated in the controller. It is equipped with a supply for the controller, X2X Link and the internal I/O power supply. The bus power supply and internal I/O power supply are galvanically isolated from each other.

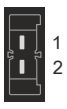
Controller and X2X Link power supply - Pinout

The terminals of the controller and X2X Link power supply are connected to the 6-pin terminal block.

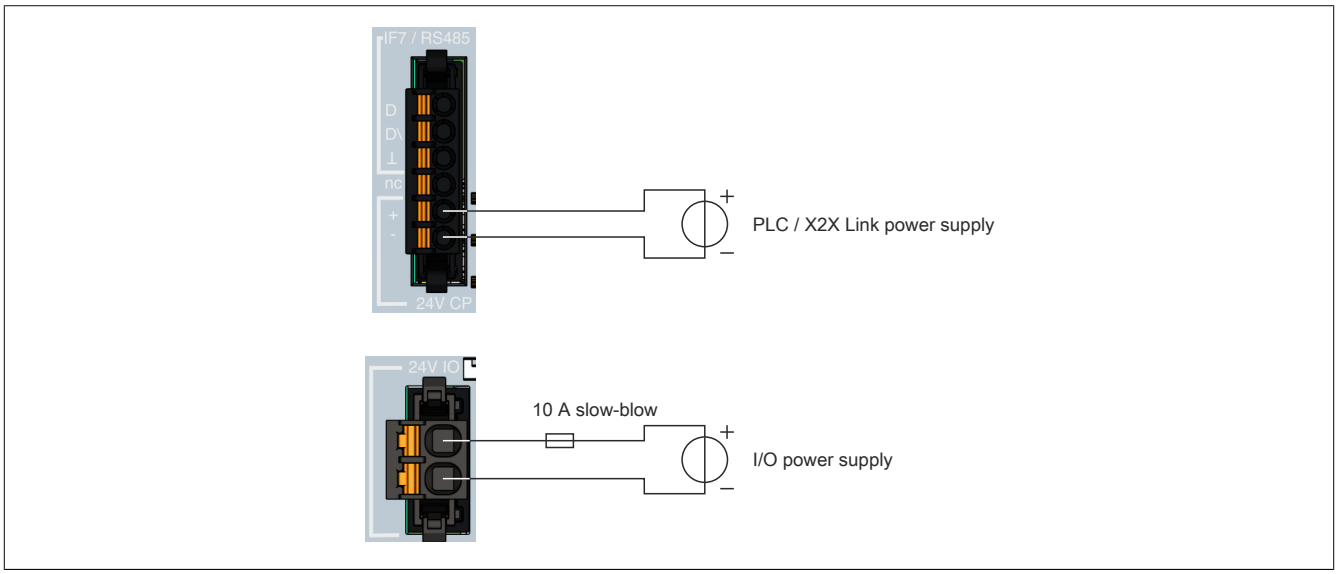
Controller and X2X Link power supply	Pinout		
	Terminal	Description	
	5	+	+24 VDC
	6	-	GND
6-pin male multipoint connector			

I/O power supply - Pinout

The terminals of the I/O power supply are connected to the 2-pin terminal block.

I/O power supply	Pinout		
	Terminal	Description	
	1	+	+24 VDC
	2	-	GND
2-pin male multipoint connector			

Connection example



3.2.5 Overtemperature shutdown

To prevent damage, a shutdown – reset state – of the controller takes place at 110°C processor temperature or 90°C board temperature.

The following errors are entered in the logbook in the event of shutdown:

Error number	Short error text
9204	PLC restart triggered by the PLC CPU's temperature monitoring.
9210	Warning: Halt/Service after watchdog or manual reset.

3.2.6 System requirements

The following minimum versions are recommended to generally be able to use all functions:

- Automation Studio 4.11
- Automation Runtime 4.92

3.2.7 Notes for operating certain modules with the embedded PLC

The minimum hardware upgrade versions listed in the table are required to operate the following modules with embedded PLCs. The upgrade can be installed from Automation Studio by selecting **Tools / Upgrades** from the menu.

Order number	Minimum hardware upgrade version
X20IF1041-1	1.3.1.0
X20IF1043-1	1.4.1.0
X20IF1051-1	1.2.4.0
X20IF1053-1	1.3.1.0
X20IF1061-1	1.8.0.0
X20IF1063-1	1.3.1.0
X20IF10A1-1	1.2.1.0
X20IF10D1-1	1.6.1.0
X20IF10D3-1	1.5.1.0
X20IF10E1-1	1.3.1.0
X20IF10E3-1	1.8.0.0
X20IF10G3-1	1.7.1.0
X20SLXyyy	1.10.10.4

3.3 General data points

This controller is equipped with general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.

General data points are described in section "Additional information - General controller data points" in the X20 system user's manual.

3.4 UL Information

English

CAUTION!

- **The external circuits intended to be connected to this device shall be separated from MAINS supply or hazardous live voltage by reinforced or double insulation and meet the requirements of SELV/PELV (Class III) circuit of UL/CSA 61010-1, UL/CSA 61010-2-201.**
- **The module has to be built-in the final safety enclosure, which have adequate rigidity and meets the requirements with respect to spread of fire.**
- **Minimum temperature rating of the cables to be connected to the field wiring terminals: 80°C, AWG (Sol. / Str.) 28-16 / 28-16 (X2X / CPU) and AWG (Sol. / Str.) 26-12 / 26-12 (I/O). Use Copper Conductors Only.**

Information:

- **If the equipment is used in a not specified manner, the protection provided by the equipment may be impaired.**
- **For all Ethernet connections, only connections within a building are permitted, taking into account maximum lengths.**

French

Attention!

- **Les circuits externes destinés à être connectés à cet appareil doivent être séparés de l'alimentation SECTEUR ou des tensions dangereuses par une isolation renforcée ou double et satisfaire les exigences relatives aux circuits TBTS/TBTS (Classe III) spécifiées dans UL/CSA 61010-1, UL/CSA 61010-2-201.**
- **Le module doit être incorporé dans le boîtier de sécurité final. Ce dernier présente une rigidité adéquate et satisfait les exigences en matière de propagation du feu.**
- **Température minimale nominale des câbles à connecter aux bornes de câblage sur place : 80°C, AWG (Sol. / Str.) 28-16 / 28-16 (X2X / CPU) et AWG (Sol. / Str.) 26-12 / 26-12 (I/O). Utiliser des conducteurs en cuivre uniquement.**

Information:

- **Si l'équipement est utilisé d'une manière non spécifiée, la protection fournie par l'équipement peut être compromise.**
- **Pour toutes les connexions Ethernet, seules les connexions à l'intérieur d'un bâtiment sont autorisées, en tenant compte des longueurs maximales.**

4 For reference only

Information:

The data sheets in this section are for reference only when the modules are already in use.

4.1 X20CP1483 and X20CP1483-1

4.1.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual
MAEMV	Installation / EMC guide

4.1.2 General information

The Intel x86-based, 100 MHz-compatible X20CP1483 represents the entry-level X20 controllers. With an optimal price/performance ratio, it has the same basic equipment as all larger controllers and offers sufficient performance for most standard applications.

USB and Ethernet are included with each controller. In addition, each controller has a POWERLINK connection for hard real-time communication.
Another slot is available for an additional interface module to increase flexibility.

- CPU is Intel x86 100 MHz, compatible with additional I/O processor.
- Onboard Ethernet, POWERLINK V1/V2 and USB
- Modular expansion of interfaces
- CompactFlash as removable application memory
- Fanless

4.1.3 Order data - X20CP148x

Order number	Short description
	X20 PLCs
X20CP1483	X20 PLC, x86 100 MHz (Intel compatible), 32 MB DRAM, 128 kB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP1483-1	X20 PLC, x86 100 MHz (Intel compatible), 64 MB DRAM, 128 kB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
	Required accessories
	CompactFlash cards
0CFCRD.016GE.02	CompactFlash 16 GB extended temp.
0CFCRD.0512E.02	CompactFlash 512 MB extended temp.
0CFCRD.1024E.02	CompactFlash 1024 MB extended temp.
0CFCRD.2048E.02	CompactFlash 2048 MB extended temp.
0CFCRD.4096E.02	CompactFlash 4096 MB extended temp.
0CFCRD.8192E.02	CompactFlash 8 GB extended temp.
	Included in delivery
	Batteries
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell
	Locking plate
X20AC0SR1	X20 end cover plate, right
	Terminal blocks
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed
	Optional accessories
	Batteries
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell

Table 19: X20CP1483, X20CP1483-1 - Order data

Included in delivery

Order number	Short description
4A0006.00-000	Backup battery (see also "Battery" on page 115)
-	Interface module slot covers
X20AC0SR1	X20 end cover plate (right)
X20TB12	X20 terminal block, 12-pin, 24 V coding

4.1.4 X20CP148x - Technical data

Order number	X20CP1483	X20CP1483-1
Short description		
Interfaces	1x RS232, 1x Ethernet, 1x POWERLINK (V1/V2), 2x USB, 1x X2X Link	
System module	Controller	
General information		
B&R ID code	0xA239	0xAEC5
Cooling	Fanless	
Status indicators	CPU function, Ethernet, POWERLINK, CompactFlash, battery	
Diagnostics		
Battery	Yes, using LED status indicator and software	
CPU function	Yes, using LED status indicator	
CompactFlash	Yes, using LED status indicator	
Ethernet	Yes, using LED status indicator	
POWERLINK	Yes, using LED status indicator	
Temperature	Yes, using software register	
Support		
ACOPOS support	Yes	
Visual Components support	Yes	

Table 20: X20CP1483, X20CP1483-1 - Technical data

Order number	X20CP1483	X20CP1483-1
Power consumption without memory card, interface module and USB	6 W	
Power consumption for X2X Link power supply [1]	1.42 W	
Power consumption [1]		
Internal I/O	0.6 W	
Additional power dissipation caused by actuators (resistive) [W]	-	
Certifications		
CE	Yes	
UKCA	Yes	
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	Temperature: **B** (0 - 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)	
LR	ENV1	
KR	Yes	
ABS	Yes	
EAC	Yes	
KC	Yes	
CPU and X2X Link power supply		
Input voltage	24 VDC -15% / +20%	
Input current	Max. 2.2 A	
Fuse	Integrated, cannot be replaced	
Reverse polarity protection	Yes	
X2X Link power supply output		
Nominal output power	7 W [2]	
Parallel connection	Yes [3]	
Redundant operation	Yes	
Input I/O power supply		
Input voltage	24 VDC -15% / +20%	
Fuse	Required line fuse: Max. 10 A, slow-blow	
Output I/O power supply		
Nominal output voltage	24 VDC	
Permissible contact load	10 A	
Power supply - General information		
Status indicators	Overload, operating status, module status, RS232 data transfer	
Diagnostics		
RS232 data transfer	Yes, using LED status indicator	
Module run/error	Yes, using LED status indicator and software	
Overload	Yes, using LED status indicator and software	
Electrical isolation		
I/O supply - I/O power supply	No	
CPU/X2X Link supply - CPU/X2X Link power supply	Yes	
Controller		
CompactFlash slot	1	
Real-time clock	Nonvolatile, resolution 1 s, -10 to 10 ppm accuracy at 25°C	
FPU	Yes	
Processor		
Type	x86 100 (compatible)	
Clock frequency	100 MHz	
L2 cache	-	
L1 cache for data and program code	16 kB	
Integrated I/O processor	Processes I/O data points in the background	
Modular interface slots	1	
Remanent variables	Max. 32 kB [4]	
Shortest task class cycle time	1 ms	
Typical instruction cycle time	0.09 µs	
Data buffering		
Battery monitoring	Yes	
Lithium battery	At least 3 years	
Standard memory		
RAM	32 MB SDRAM	64 MB SDRAM
User RAM	128 kB SRAM [5]	

Table 20: X20CP1483, X20CP1483-1 - Technical data

Order number	X20CP1483	X20CP1483-1
Interfaces		
Interface IF1		
Signal	RS232	
Variant	Connection via 12-pin terminal block X20TB12	
Max. distance	900 m	
Transfer rate	Max. 115.2 kbit/s	
Interface IF2		
Signal	Ethernet	
Variant	1x RJ45 shielded	
Line length	Max. 100 m between 2 stations (segment length)	
Transfer rate	10/100 Mbit/s	
Transfer		
Physical layer	10BASE-T/100BASE-TX	
Half-duplex	Yes	
Full-duplex	Yes	
Autonegotiation	Yes	
Auto-MDI/MDIX	Yes	
Interface IF3		
Fieldbus	POWERLINK (V1/V2) managing or controlled node	
Type	Type 4 [6)]	
Variant	1x RJ45 shielded	
Line length	Max. 100 m between 2 stations (segment length)	
Transfer rate	100 Mbit/s	
Transfer		
Physical layer	100BASE-TX	
Half-duplex	Yes	
Full-duplex	POWERLINK mode: No / Ethernet mode: Yes	
Autonegotiation	Yes	
Auto-MDI/MDIX	Yes	
Interface IF4		
Type	USB 1.1	
Variant	Type A	
Max. output current	0.5 A	
Interface IF5		
Type	USB 1.1	
Variant	Type A	
Max. output current	0.5 A	
Interface IF6		
Fieldbus	X2X Link master	
Electrical properties		
Electrical isolation	Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC	
Operating conditions		
Mounting orientation		
Horizontal	Yes	
Vertical	Yes	
Installation elevation above sea level		
0 to 2000 m	No limitation	
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m	
Degree of protection per EN 60529	IP20	
Ambient conditions		
Temperature		
Operation		
Horizontal mounting orientation	-25 to 60°C	
Vertical mounting orientation	-25 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 application memory (CompactFlash) separately Backup battery included in delivery X20 end cover plate (right) included in delivery 12-pin X20 terminal block included in delivery Interface module slot covers included in delivery	

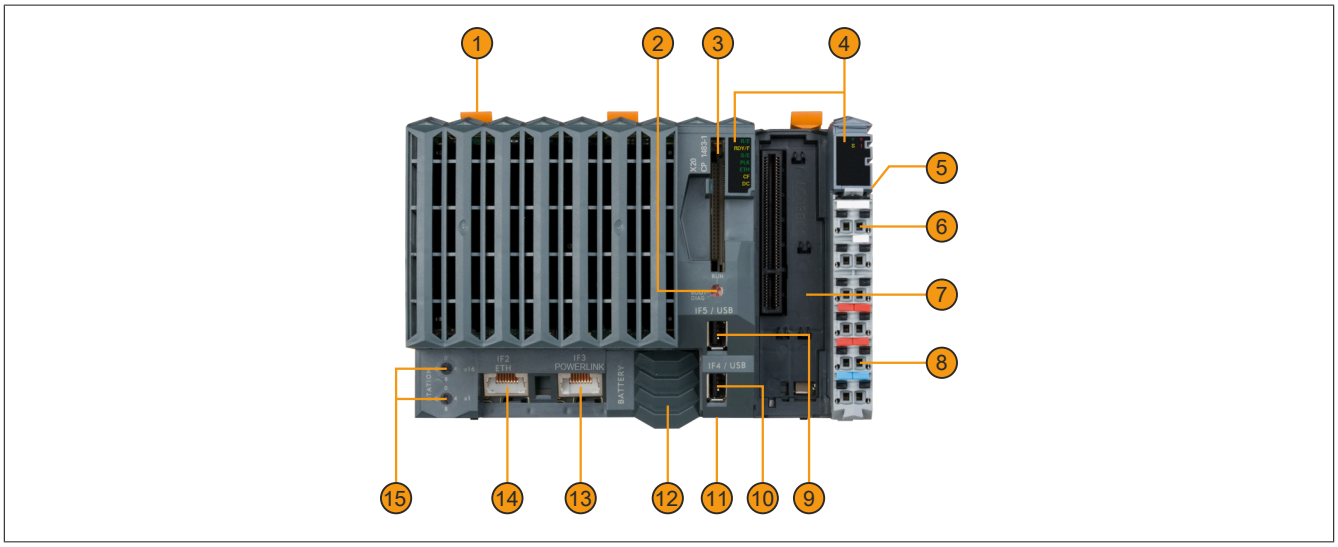
Table 20: X20CP1483, X20CP1483-1 - Technical data

Order number	X20CP1483	X20CP1483-1
Dimensions		
Width	150 mm	
Height	99 mm	
Depth	85 mm	
Weight	300 g	

Table 20: X20CP1483, X20CP1483-1 - Technical data

1) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
2) When operated at temperatures above 55°C, a derating of the nominal output power to 5 W for the X2X Link power supply must be taken into account.
3) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to make sure that all power supply units operated in parallel are switched on and off at the same time.
4) The memory size for remanent variables is configurable in Automation Studio.
5) Minus the set remanent variables.
6) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.

4.1.5 Operating and connection elements



1	Top-hat rail latch	2	Selecting application memory
3	Slot for CompactFlash	4	LED status indicators
5	IF6 - X2X Link	6	IF1 - RS232
7	Slot for interface modules	8	Terminal block for controller and I/O supply, RS232 connection
9	IF5 - USB	10	IF4 - USB
11	Reset button	12	Battery compartment
13	IF3 - POWERLINK	14	IF2 - Ethernet
15	Ethernet station address	-	-

4.1.5.1 X20 controllers - LED status indicators

Figure	LED	Color	Status	Description
	R/E	Green	On	Application running
			Blinking	System startup boot mode: The controller is initializing the application, all bus systems and I/O modules.[1)]
			Double flash	Mode BOOT (during firmware update)[1)]
		Red	On	Mode SERVICE or BOOT
			Blinking	The "R/E" LED blinks red and the "RDY/F" LED blinks yellow when there is a license violation.
	RDY/F	Yellow	On	SERVICE or BOOT mode
			Blinking	The "RDY/F" LED blinks yellow and the "R/E" LED blinks red when there is a license violation.
	S/E	Green/Red		Status/Error LED. The statuses of this LED are described in section "LED "S/E" (status/error LED)" on page 107.
	PLK	Green	On	A link to the POWERLINK peer station has been established.
			Blinking	A link to the POWERLINK peer station has been established. The LED blinks when Ethernet activity is taking place on the bus.
	ETH	Green	On	A link to the peer station has been established.
			Blinking	A link to the peer station has been established. Indicates Ethernet activity is taking place on the bus.
	CF	Green	On	CompactFlash inserted and detected
		Yellow	On	CompactFlash read/write access
	DC	Yellow	On	Controller power supply unit OK
		Red	On	Backup battery empty

1) The process can take several minutes depending on the configuration.

4.1.5.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

4.1.5.1.1.1 Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		
Green	Red	Description
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

4.1.5.1.1.2 POWERLINK V1 mode

LED "S/E"		
Green	Red	Current state of the POWERLINK node
On	Off	The POWERLINK node is running with no errors.
Off	On	A system error occurred. The type of error can be read using the PLC logbook. An irreparable problem has occurred. The system can no longer properly carry out its tasks. This state can only be changed by resetting the module.
Blinking alternately		The POWERLINK managing node has failed. This error code can only occur when operated as a controlled node. This means that the set node number lies within the range 0x01 - 0xFD.
Off	Blinking	System stop. The red blinking LED indicates an error code (see "System stop error codes" on page 109).
Off	Off	The interface is either not active or one of the following states or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective.

Table 21: LED "S/E": POWERLINK V1 mode

4.1.5.1.1.3 POWERLINK V2

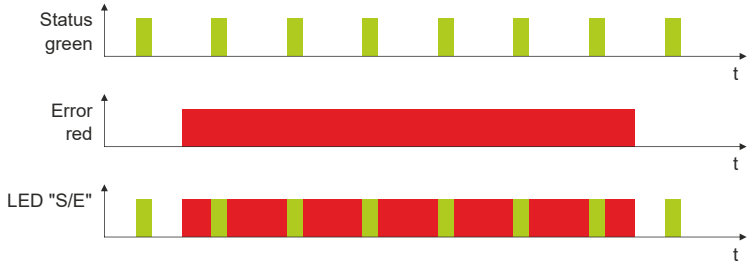
LED "S/E"		
Green	**Red**	**Description**
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE 

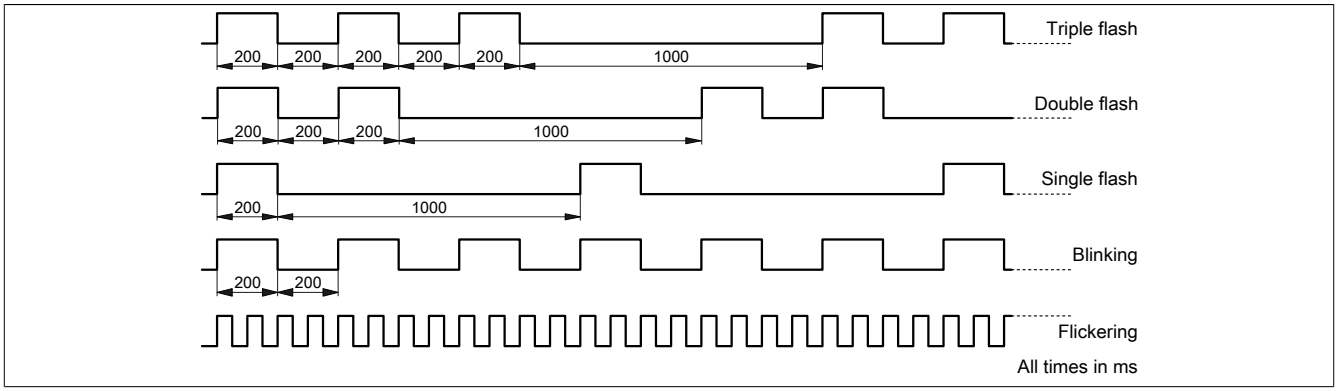
Table: LED "S/E" - Error message (interface in POWERLINK mode)

LED "S/E"		
Green	**Red**	**Description**
Off	Off	**Mode:** NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective. **Managing node (MN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. **Controlled node (CN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	**Mode:** BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. **Managing node (MN)** This mode can only be exited by resetting the controller. **Controlled node (CN)** If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. **Managing node (MN)** The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. **Controlled node (CN)** The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. **Managing node (MN)** The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. **Controlled node (CN)** The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

LED "S/E"		
Green	**Red**	**Description**
Triple flash (approx. 1 Hz)	Off	**Mode:** READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. **Managing node (MN)** Cyclic and asynchronous communication. Received PDO data is ignored. **Controlled node (CN)** The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
On	Off	**Mode:** OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	**Mode:** STOPPED The interface is in mode STOPPED. **Managing node (MN)** This mode does not occur for the MN. **Controlled node (CN)** Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.

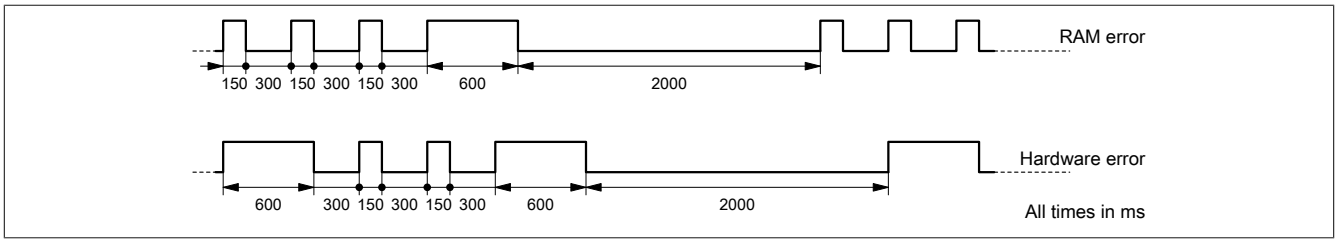
Table: LED "S/E" - Interface state (interface in POWERLINK mode)



4.1.5.1.2 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

4.1.5.2 LED status indicators for the integrated power supply unit

For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 System user's manual.

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	Mode RESET
			Blinking	Mode PREOPERATIONAL
			On	Mode RUN
	e	Red	Off	Module not supplied with power or everything OK
			Double flash	The LED indicates one of the following states: • The X2X Link power supply of the power supply unit is overloaded. • I/O power supply too low • The input voltage for the X2X Link power supply is too low.
	e + r	Solid red / Single green flash		Invalid firmware
	S	Yellow	Off	No RS232 activity
			On	The LED lights up when data is being transmitted or received via the RS232 interface.
	I	Red	Off	The X2X Link power supply is within the valid range.
			On	The X2X Link power supply of the power supply unit is overloaded.

4.1.5.3 Operating mode switch

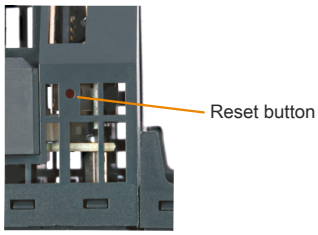
The operating mode switch is used to set the operating mode.

Switch position	Operating mode	Description
BOOT	BOOT	In this switch position, Boot AR is started and the runtime system can be installed via the online interface (B&R Automation Studio). User flash memory is erased only when the download begins.
RUN	RUN	Mode RUN
DIAG	DIAGNOSE	The controller is starting up in diagnostic mode. Program sections in User RAM and User Flash-PROM are not initialized. After diagnostic mode, the controller always boots with a warm restart.

Information:

A switch position other than those described here is not permitted!

4.1.5.4 Reset button



The reset button is located below the USB interfaces on the bottom of the housing. It can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means:

- All application programs are stopped.
- All outputs are set to zero.

The controller then starts up in service mode by default. The startup mode that follows after pressing the reset button can be set in Automation Studio.

4.1.5.5 Slot for application memory

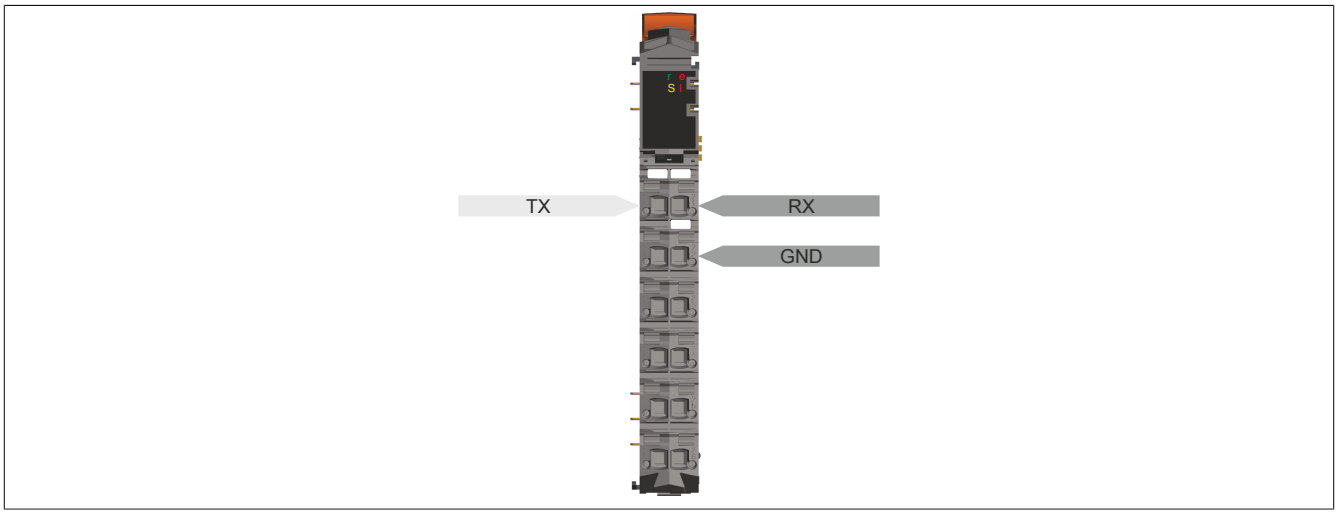
Application memory is required to operate the controllers. The application memory is provided in the form of a CompactFlash card. This is not included in delivery with the controllers; it must be ordered separately as an accessory!

Information:

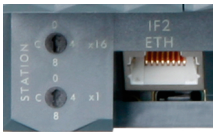
The CompactFlash card must not be removed during operation.

4.1.5.6 RS232 interface (IF1)

The non-electrically isolated RS232 interface is designed as an online interface for communication with the programming device.



4.1.5.7 Ethernet interface (IF2)



IF2 is designed as a 10BASE-T/100BASE-TX interface.

The INA2000 station number of the Ethernet interface is set using the two hex switches.

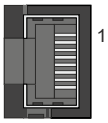
For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Information:

The Ethernet interface is not suitable for POWERLINK.

When using the POWERLINK interface, the Ethernet interface is not permitted to be operated with an IP address from the POWERLINK address range.
POWERLINK address range: 192.168.100.x

Pinout

Interface	Pinout		
	Pin	Ethernet	
 1 Shielded RJ45	1	TXD	Transmit data
	2	TXD\	Transmit data\
	3	RXD	Receive data
	4	Termination	
	5	Termination	
	6	RXD\	Receive data\
	7	Termination	
	8	Termination	

4.1.5.8 POWERLINK interface (IF3)

POWERLINK V1

Switch position	Description
0x00	Operation as managing node.
0x01 - 0xFD	Node number of the POWERLINK node. Operation as controlled node.
0xFE - 0xFF	Reserved, switch position not permitted.

POWERLINK V2

Switch position	Description
0x00	Reserved, switch position not permitted.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0	Operation as a managing node (MN).
0xF1 - 0xFF	Reserved, switch position not permitted.

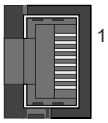
Ethernet mode

Starting with Automation Studio Version V2.5.3 and with Automation Runtime V2.90, the interface can be operated as an Ethernet interface.

The INA2000 station number can be set using the B&R Automation Studio software.

Pinout

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Interface	Pinout		
	Pin	Ethernet	
 1 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

4.1.5.9 USB interfaces (IF4 and IF5)

IF4 and IF5 are non-galvanically isolated USB interfaces. The abbreviation USB stands for "Universal Serial Bus". USB standard 1.1 is supported by both USB interfaces.

Information:

USB peripheral devices can be connected to the USB interfaces. Automation Runtime supports a selection of USB peripheral devices. For the supported USB classes, see the AR help documentation.

Information:

The following must be taken into account when using a USB peripheral device and grounded controller power supply (PELV):

- **Only USB peripheral devices with no connection between GND and ground are permitted to be connected. This is the case, e.g. with the USB dongle from B&R.**

4.1.5.10 Slots for interface modules

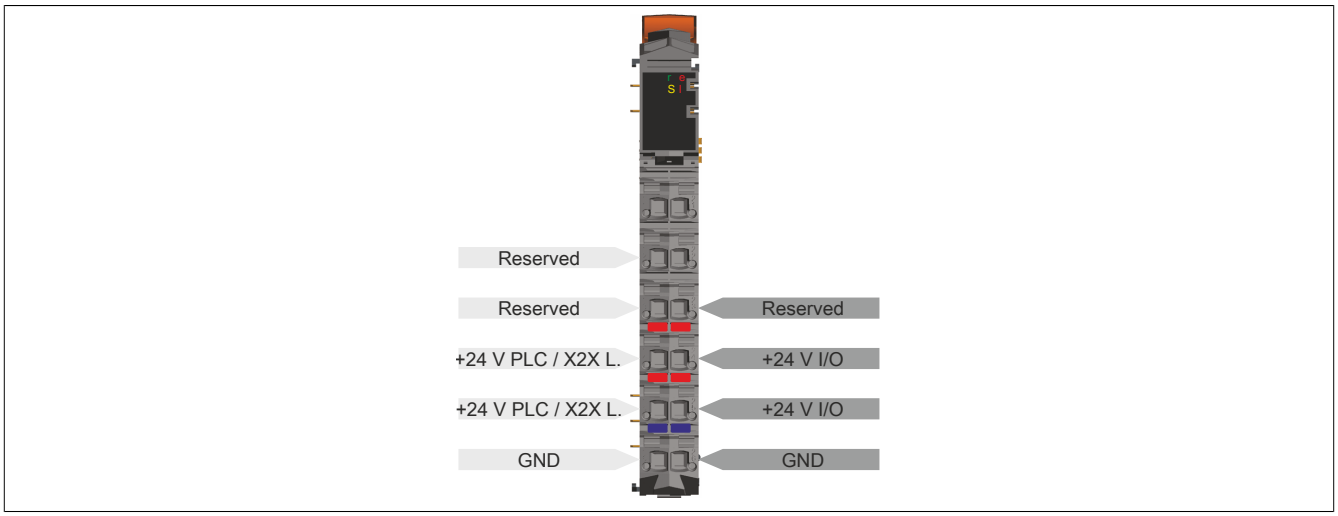
The controllers are equipped with 1 or 3 slots for interface modules.

Different bus or network systems can be flexibly integrated into the X20 system by selecting the appropriate interface module.

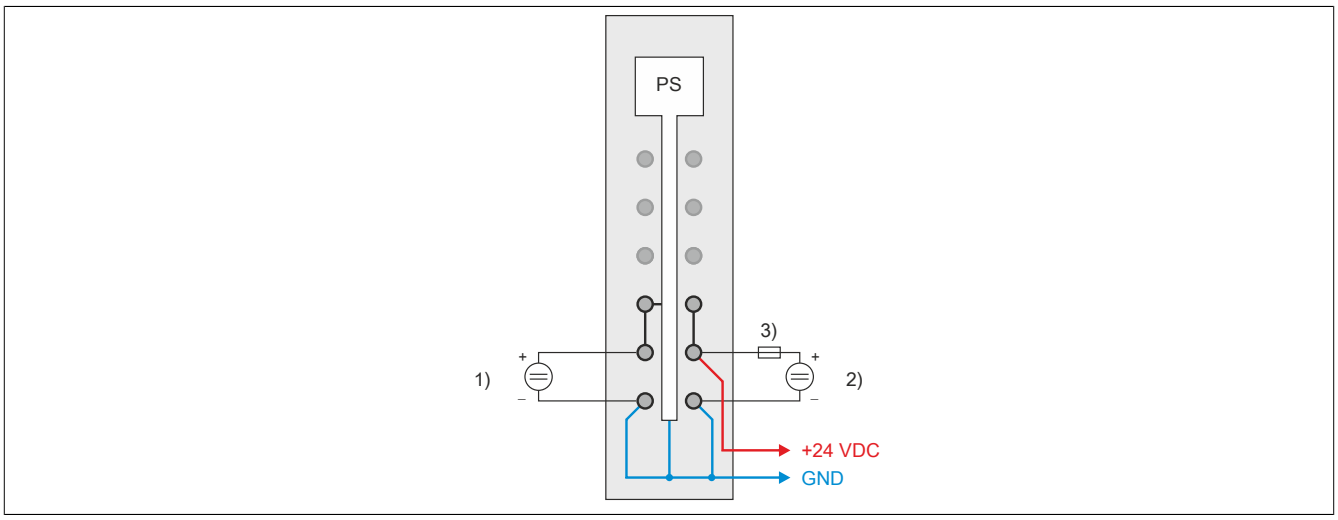
4.1.5.11 Controller power supply

A power supply unit is integrated in the X20 controllers. It is equipped with a supply for the controller, X2X Link and the internal I/O power supply. The bus power supply and internal I/O power supply are galvanically isolated from each other.

Integrated power supply unit - Pinout



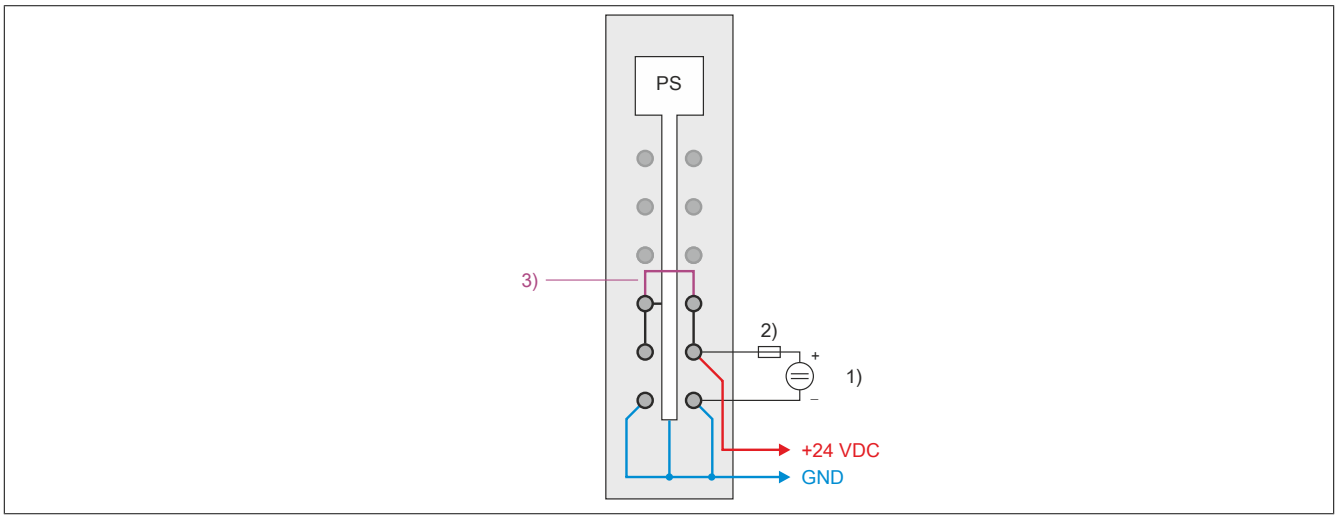
Connection example with 2 separate power supplies



1) Supply for the X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

1) Supply for the PLC or X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

Connection example with power supply and jumper



1) Supply for the I/O power supply
2) Fuse, 10 A slow-blow
3) Jumper

4.1.6 Overtemperature cutoff

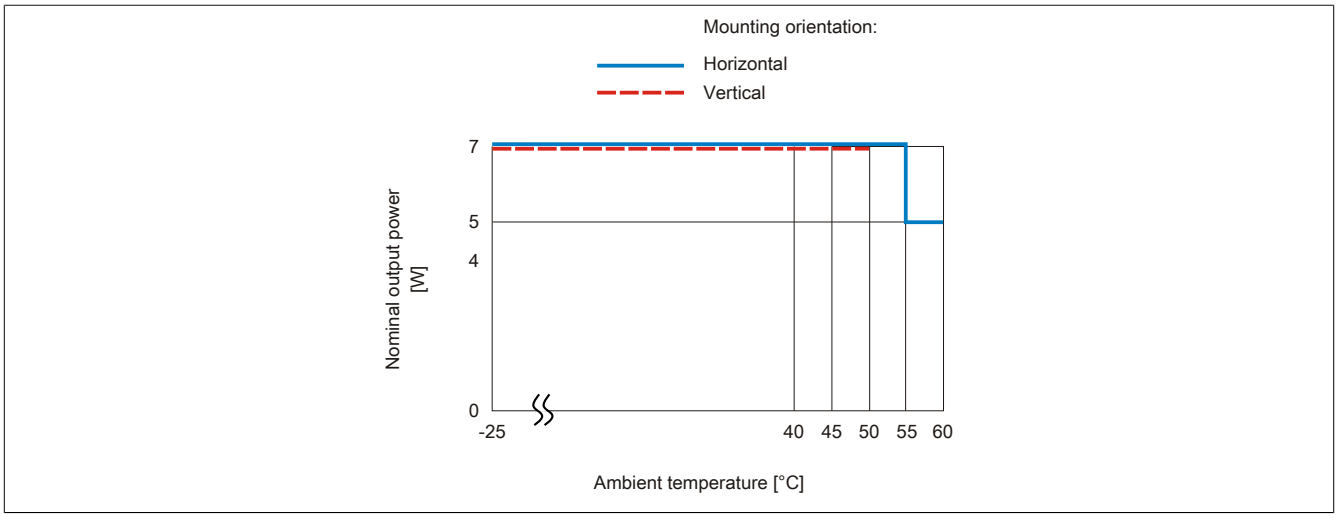
To prevent damage, a shutdown – reset state – of the controller takes place at 100° processor temperature.

The following errors are entered in the logbook:

Error number	Error description
9204	WARNING: System halted because of temperature check
9210	WARNING: Boot by watchdog or manual reset

4.1.7 Derating

There is no derating when operated below 55°C. Above 55°C, the nominal output power for the X2X Link power supply must be reduced to 5 W.



4.1.8 Battery

X20 controllers are equipped with a lithium battery. The lithium battery is located in a separate compartment and protected by a cover.

Backup battery data

Order number 4A0006.00-000 0AC201.91	 1 pcs. 4 pcs.
Short description	Lithium battery, 3 V / 950 mAh, button cell
Storage temperature	-40 to 85°C
Storage time	Max. 3 years at 30°C
Relative humidity	0 to 95% (non-condensing)

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten its service life; instead, it gives an early warning of weakened buffer capacity.

Status information "Battery OK" is available from system library function "BatteryInfo" and the controller's I/O mapping.

Replacement interval for battery

The battery should be replaced every 4 years. The replacement intervals recommended by B&R reflect the batteries' average service life and operating conditions. They do not correspond to the maximum buffer duration!

Important information about the battery exchange

The product design allows the battery to be changed when the controller is in a voltage-free state as well as when the controller is switched on. In some countries, however, changing is not permitted while operating voltage is applied. To prevent data loss, the battery must be changed within 1 min in a voltage-free state.

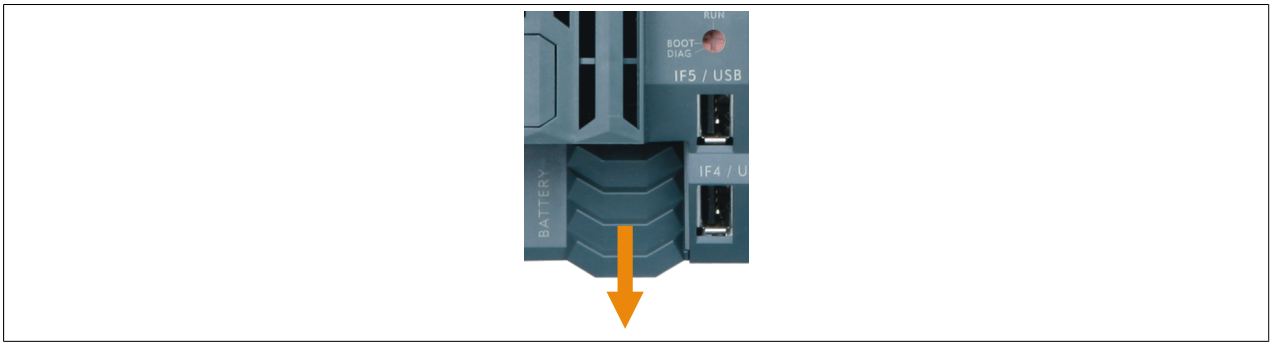
Warning!

The battery is only permitted to be replaced by a Renata CR2477N battery. The use of another battery may present a fire or explosion hazard.

The battery can explode if handled improperly. Do not recharge, disassemble or dispose of the battery in fire.

Procedure for replacing the battery

1. Perform electrostatic discharge at the top-hat rail or at the ground connection (do not reach into the power supply unit!)
2. Remove the cover for the lithium battery. Do this by sliding it down and away from the controller.



3. Push the empty battery out of the holder.
4. It is important to ensure that the new battery is not handled with moist or greasy fingers. Plastic tweezers can also be used. Do not touch the battery with pliers or metal tweezers → short circuit!
5. To insert the battery into the holder, place it with the "+" side up on the right part of the battery holder. Then press the battery into the battery holder.
6. Replace the cover.

Information:

Lithium batteries are hazardous waste! Used batteries should be disposed of in accordance with applicable local regulations.

4.1.9 Programming the system flash memory

General information

In order for the application project to be processed on the controller, Automation Runtime (operating system), the system components and application project must be installed on the CompactFlash card.

Creating a CompactFlash using a USB card reader

The easiest way to perform an initial installation is by creating a fully programmed CompactFlash card using a USB card reader.

1. Creating and configuring a project in Automation Studio
2. In Automation Studio, select **Tools / Create CompactFlash**
3. In the dialog box that opens, select a CompactFlash card and then generate it
4. Insert the finished CompactFlash card into the controller and switch on the controller's supply voltage.
5. Controller booting

For details about commissioning: See help system under "Automation Software / Getting Started"

Installation over an online connection

When delivered, the controllers are equipped with B&R Boot AR with a limited range of functions. This runtime system is started in boot mode (operating mode switch position BOOT or no/invalid CompactFlash card inserted). It initializes and controls the Ethernet interface and onboard serial RS232 interface, making it possible to download the runtime system.

1. Insert the CompactFlash card and switch on the supply voltage for the controller. If the switch is set to BOOT or if the CompactFlash is new or invalid, the controller starts with the B&R Boot AR.
2. Establish a physical online connection between the programming device (PC or industrial PC) and the controller (e.g. over an Ethernet network or the RS232 interface).
3. Before an online connection can be established via Ethernet, the controller must be assigned an IP address. Search for available B&R target system in the local network by selecting menu option **Online / Settings** from the menu in Automation Studio and then clicking the **Browse targets** button. The controller should appear in the list. If the controller has not already received an IP address from a DHCP server, right-click on it and select **Set IP parameters** from the shortcut menu. All required network configurations can be made on a temporary basis in this dialog box (they should be identical to the settings defined in the project).
4. Configure online connection in B&R Automation Studio. For details about the configuration: See help system under "Automation Software / Communication / Online communication"
5. Start the download procedure by selecting the **Services** command from the **Project** menu. Then select **Transfer Automation Runtime** from the pop-up menu. Now follow the instructions provided by B&R Automation Studio.

4.1.10 General data points

This controller is equipped with general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.

General data points are described in section "Additional information - General controller data points" in the X20 system user's manual.

4.2 X20(c)CP158x and X20(c)CP358x

4.2.1 Other applicable documents

For additional and supplementary information, see the following documents.

Other applicable documents

Document name	Title
MAX20	X20 System user's manual
MAEMV	Installation / EMC guide

Additional documentation

Document name	Title
MAREDSYS	Redundancy for control systems

4.2.2 General information

Based on Intel Atom processor technology, X20 controllers cover a wide range of requirements. The range of use extends from standard applications to applications with high performance requirements.

The entry into the series is with the Intel Atom processor 333 MHz compatible models X20CP1583 and X20CP3583. With an optimum price/performance ratio, it has the same basic features as all of the larger controllers.

The basic model includes USB, Ethernet, POWERLINK V1/V2 and replaceable CompactFlash card. The standard Ethernet interface is capable of handling communication in the gigabit range. For even more real-time network performance, the onboard POWERLINK interface supports poll response chaining mode (PRC).
Up to 3 more slots are available for additional interface modules to increase flexibility.

- Intel ATOM 1600/1000/600 Performance with integrated I/O processor
- Entry-level CPU is Intel ATOM 333 MHz-compatible with integrated I/O processor
- Onboard Ethernet, POWERLINK V1/V2 with poll response chaining and USB
- 1 or 3 slots for modular interface expansion
- CompactFlash as removable application memory
- Up to 512 MB DDR2-SRAM according to performance requirements
- Controller redundancy possible
- Fanless

4.2.3 Coated modules

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

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

4.2.4 Order data - X20CP158x

Order number	Short description
	X20 PLCs
X20CP1583	X20 PLC, Atom 333 MHz (compatible), 128 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP1584	X20 PLC, Atom 0.6 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20cCP1584	X20 PLC, coated, Atom 0.6 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP1585	X20 PLC, Atom 1.0 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP1586	X20 PLC, Atom 1.6 GHz, 512 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20cCP1586	X20 PLC, coated, Atom 1.6 GHz, 512 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 1 insert slot for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
	Required accessories
	CompactFlash cards
0CFCRD.016GE.02	CompactFlash 16 GB extended temp.
0CFCRD.0512E.02	CompactFlash 512 MB extended temp.
0CFCRD.1024E.02	CompactFlash 1024 MB extended temp.
0CFCRD.2048E.02	CompactFlash 2048 MB extended temp.
0CFCRD.4096E.02	CompactFlash 4096 MB extended temp.
0CFCRD.8192E.02	CompactFlash 8 GB extended temp.
	Included in delivery
	Batteries
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell
	Locking plate
X20AC0SR1	X20 end cover plate, right
	Terminal blocks
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed
	Optional accessories
	Batteries
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell

Table 22: X20CP1583, X20CP1584, X20cCP1584, X20CP1585, X20CP1586, X20cCP1586 - Order data

Included in delivery

Order number	Short description
4A0006.00-000	Backup battery (see also "Battery" on page 135)
-	Interface module slot covers
X20AC0SR1	X20 end cover plate (right)
X20TB12	X20 terminal block, 12-pin, 24 V coding

4.2.5 X20CP158x - Technical data

Order number	X20CP1583	X20CP1584	X20cCP1584	X20CP1585	X20CP1586	X20cCP1586
Short description						
Interfaces	1x RS232, 1x Ethernet, 1x POWERLINK (V1/V2), 2x USB, 1x X2X Link					
System module	Controller					
General information						
B&R ID code	0xD45B	0xC370	0xE21B	0xC3AE	0xC3B0	0xE21C
Cooling	Fanless					
Status indicators	CPU function, Ethernet, POWERLINK, CompactFlash, battery					
Diagnostics						
Battery	Yes, using LED status indicator and software					
CPU function	Yes, using LED status indicator					
CompactFlash	Yes, using LED status indicator					
Ethernet	Yes, using LED status indicator					
POWERLINK	Yes, using LED status indicator					
Temperature	Yes, using software register					
Support						
Controller redundancy	No					
Storage health data support [1]	Yes					
ACOPOS support	Yes					
Visual Components support	Yes					
Power consumption without interface module and USB	8.2 W	8.6 W		8.8 W	9.7 W	
Power consumption for X2X Link power supply [2]	1.42 W					
Power consumption [2]						
Internal I/O	0.6 W					
Additional power dissipation caused by actuators (resistive) [W]	-					
Certifications						
CE	Yes					
UKCA	Yes					
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	Temperature: **B** (0 - 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)					
LR	ENV1					
KR	Yes					
ABS	Yes					
EAC	Yes					
KC	-	Yes	-	Yes		-
CPU and X2X Link power supply						
Input voltage	24 VDC -15% / +20%					
Input current	Max. 1.5 A					
Fuse	Integrated, cannot be replaced					
Reverse polarity protection	Yes					
X2X Link power supply output						
Nominal output power	7 W [3]					
Parallel connection	Yes [4]					
Redundant operation	Yes					
Input I/O power supply						
Input voltage	24 VDC -15% / +20%					
Fuse	Required line fuse: Max. 10 A, slow-blow					
Output I/O power supply						
Nominal output voltage	24 VDC					
Permissible contact load	10 A					
Power supply - General information						
Status indicators	Overload, operating status, module status, RS232 data transfer					
Diagnostics						
RS232 data transfer	Yes, using LED status indicator					
Module run/error	Yes, using LED status indicator and software					
Overload	Yes, using LED status indicator and software					

Table 23: X20CP1583, X20CP1584, X20cCP1584, X20CP1585, X20CP1586, X20cCP1586 - Technical data

Order number	X20CP1583	X20CP1584	X20cCP1584	X20CP1585	X20CP1586	X20cCP1586
Electrical isolation						
I/O supply - I/O power supply			No			
CPU/X2X Link supply - CPU/X2X Link power supply			Yes			
Controller						
CompactFlash slot			1			
Real-time clock			Nonvolatile, resolution 1 s, -10 to 10 ppm accuracy at 25°C			
FPU			Yes			
Processor						
Type		Atom E620T		Atom E640T	Atom E680T	
Clock frequency	333 MHz	0.6 GHz		1 GHz	1.6 GHz	
L1 cache						
Data code			24 kB			
Program code			32 kB			
L2 cache	-		512 kB			
Integrated I/O processor			Processes I/O data points in the background			
Modular interface slots			1			
Remanent variables	Max. 64 kB [5]		Max. 256 kB [5]		Max. 1 MB [5]	
Shortest task class cycle time	800 µs	400 µs		200 µs	100 µs	
Typical instruction cycle time	0.01 µs	0.0075 µs		0.0044 µs	0.0027 µs	
Data buffering						
Battery monitoring			Yes			
Lithium battery			Min. 2 years at 23°C ambient temperature			
Standard memory						
RAM	128 MB DDR2 SDRAM		256 MB DDR2 SDRAM		512 MB DDR2 SDRAM	
User RAM			1 MB SRAM [6]			
Interfaces						
Interface IF1						
Signal			RS232			
Variant			Connection via 12-pin terminal block X20TB12		Connection made using 12-pin terminal block X20TB12	Connection via 12-pin terminal block X20TB12
Max. distance			900 m			
Transfer rate			Max. 115.2 kbit/s			
Interface IF2						
Signal			Ethernet			
Variant			1x RJ45 shielded			
Line length			Max. 100 m between 2 stations (segment length)			
Transfer rate			10/100/1000 Mbit/s			
Transfer						
Physical layer			10BASE-T/100BASE-TX/1000BASE-T			
Half-duplex			Yes			
Full-duplex			Yes			
Autonegotiation			Yes			
Auto-MDI/MDIX			Yes			
Interface IF3						
Fieldbus			POWERLINK (V1/V2) managing or controlled node			
Type			Type 4 [7]			
Variant			1x RJ45 shielded			
Line length			Max. 100 m between 2 stations (segment length)			
Transfer rate			100 Mbit/s			
Transfer						
Physical layer			100BASE-TX			
Half-duplex			Yes			
Full-duplex			POWERLINK mode: No / Ethernet mode: Yes			
Autonegotiation			Yes			
Auto-MDI/MDIX			Yes			
Interface IF4						
Type			USB 1.1/2.0			
Variant			Type A			
Max. output current			0.5 A			
Interface IF5						
Type			USB 1.1/2.0			
Variant			Type A			
Max. output current			0.5 A			
Interface IF6						
Fieldbus			X2X Link master			
Electrical properties						
Electrical isolation	Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC					

Table 23: X20CP1583, X20CP1584, X20cCP1584, X20CP1585, X20CP1586, X20cCP1586 - Technical data

Order number	X20CP1583	X20CP1584	X20cCP1584	X20CP1585	X20CP1586	X20cCP1586
Operating conditions						
Mounting orientation						
Horizontal	Yes					
Vertical	Yes					
Installation elevation above sea level						
0 to 2000 m	No limitation					
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m					
Degree of protection per EN 60529	IP20					
Ambient conditions						
Temperature						
Operation						
Horizontal mounting orientation	-25 to 60°C					
Vertical mounting orientation	-25 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		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 application memory (CompactFlash) separately Backup battery included in delivery X20 end cover plate (right) included in delivery 12-pin X20 terminal block included in delivery Interface module slot covers included in delivery					
Dimensions						
Width	150 mm					
Height	99 mm					
Depth	85 mm					
Weight	400 g					

Table 23: X20CP1583, X20CP1584, X20cCP1584, X20CP1585, X20CP1586, X20cCP1586 - Technical data

1) For details about *storage health data*, see Automation Help.
2) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3) When operated at temperatures above 55°C, a derating of the nominal output power to 5 W for the X2X Link power supply must be taken into account.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to make sure that all power supply units operated in parallel are switched on and off at the same time.
5) The memory size for remanent variables is configurable in Automation Studio.
6) 1 MB SRAM minus the configured remanent variables.
7) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.

4.2.6 Order data - X20CP358x

Order number	Short description
	X20 PLCs
X20CP3583	X20 PLC, Atom 333 MHz (compatible), 128 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP3584	X20 PLC, Atom 0.6 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20cCP3584	X20 PLC, coated, Atom 0.6 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot cover and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP3585	X20 PLC, Atom 1.0 GHz, 256 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20CP3586	X20 PLC, Atom 1.6 GHz, 512 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
X20cCP3586	X20 PLC, coated, Atom 1.6 GHz, 512 MB DDR2 RAM, 1 MB SRAM, removable application memory: CompactFlash, 3 insert slots for X20 interface modules, 2 USB interfaces, 1 RS232 interface, 1 Ethernet interface 10/100/1000BASE-T, 1 POWERLINK interface, including power supply module, 1x terminal block X20TB12, slot covers and X20 end cover plate X20AC0SR1 (right) included, order application memory separately!
	Required accessories
	CompactFlash cards
0CFCRD.016GE.02	CompactFlash 16 GB extended temp.
0CFCRD.0512E.02	CompactFlash 512 MB extended temp.
0CFCRD.1024E.02	CompactFlash 1024 MB extended temp.
0CFCRD.2048E.02	CompactFlash 2048 MB extended temp.
0CFCRD.4096E.02	CompactFlash 4096 MB extended temp.
0CFCRD.8192E.02	CompactFlash 8 GB extended temp.
	Included in delivery
	Batteries
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell
	Locking plate
X20AC0SR1	X20 end cover plate, right
	Terminal blocks
X20TB12	X20 terminal block, 12-pin, 24 VDC keyed
	Optional accessories
	Batteries
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell

Table 24: X20CP3583, X20CP3584, X20cCP3584, X20CP3585, X20CP3586, X20cCP3586 - Order data

Included in delivery

Order number	Short description
4A0006.00-000	Backup battery (see also "Battery" on page 135)
-	Interface module slot covers
X20AC0SR1	X20 end cover plate (right)
X20TB12	X20 terminal block, 12-pin, 24 V coding

4.2.7 X20CP358x - Technical data

Order number	X20CP3583	X20CP3584	X20cCP3584	X20CP3585	X20CP3586	X20cCP3586
Short description						
Interfaces	1x RS232, 1x Ethernet, 1x POWERLINK (V1/V2), 2x USB, 1x X2X Link					
System module	Controller					
General information						
B&R ID code	0xD45C	0xC3AD	0xE21D	0xC3AF	0xBF2B	0xE21E
Cooling	Fanless					
Status indicators	CPU function, Ethernet, POWERLINK, CompactFlash, battery					
Diagnostics						
Battery	Yes, using LED status indicator and software					
CPU function	Yes, using LED status indicator					
CompactFlash	Yes, using LED status indicator					
Ethernet	Yes, using LED status indicator					
POWERLINK	Yes, using LED status indicator					
Temperature	Yes, using software register					
Support						
Controller redundancy	No	Yes				
Storage health data support [1]	Yes					
ACOPOS support	Yes					
Visual Components support	Yes					
Power consumption without interface module and USB	8.2 W	8.6 W		8.8 W	9.7 W	
Power consumption for X2X Link power supply [2]	1.42 W					
Power consumption [2]						
Internal I/O	0.6 W					
Additional power dissipation caused by actuators (resistive) [W]	-					
Certifications						
CE	Yes					
UKCA	Yes					
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	Temperature: **B** (0 - 55°C) Humidity: **B** (up to 100%) Vibration: **B** (4 g) EMC: **B** (bridge and open deck)					
LR	ENV1					
KR	Yes					
ABS	Yes					
EAC	Yes					
KC	-	Yes	-	Yes		-
CPU and X2X Link power supply						
Input voltage	24 VDC -15% / +20%					
Input current	Max. 1.5 A					
Fuse	Integrated, cannot be replaced					
Reverse polarity protection	Yes					
X2X Link power supply output						
Nominal output power	7 W [3]					
Parallel connection	Yes [4]					
Redundant operation	Yes					
Input I/O power supply						
Input voltage	24 VDC -15% / +20%					
Fuse	Required line fuse: Max. 10 A, slow-blow					
Output I/O power supply						
Nominal output voltage	24 VDC					
Permissible contact load	10 A					
Power supply - General information						
Status indicators	Overload, operating status, module status, RS232 data transfer					
Diagnostics						
RS232 data transfer	Yes, using LED status indicator					
Module run/error	Yes, using LED status indicator and software					
Overload	Yes, using LED status indicator and software					

Table 25: X20CP3583, X20CP3584, X20cCP3584, X20CP3585, X20CP3586, X20cCP3586 - Technical data

Order number	X20CP3583	X20CP3584	X20cCP3584	X20CP3585	X20CP3586	X20cCP3586
Electrical isolation						
I/O supply - I/O power supply			No			
CPU/X2X Link supply - CPU/X2X Link power supply			Yes			
Controller						
CompactFlash slot			1			
Real-time clock			Nonvolatile, resolution 1 s, -10 to 10 ppm accuracy at 25°C			
FPU			Yes			
Processor						
Type		Atom E620T		Atom E640T	Atom E680T	
Clock frequency	333 MHz	0.6 GHz		1 GHz	1.6 GHz	
L1 cache						
Data code			24 kB			
Program code			32 kB			
L2 cache	-		512 kB			
Integrated I/O processor			Processes I/O data points in the background			
Modular interface slots			3			
Remanent variables	Max. 64 kB [5]		Max. 256 kB [5]		Max. 1 MB [5]	
Shortest task class cycle time	800 µs	400 µs		200 µs	100 µs	
Typical instruction cycle time	0.01 µs	0.0075 µs		0.0044 µs	0.0027 µs	
Data buffering						
Battery monitoring			Yes			
Lithium battery			Min. 2 years at 23°C ambient temperature			
Standard memory						
RAM	128 MB DDR2 SDRAM		256 MB DDR2 SDRAM		512 MB DDR2 SDRAM	
User RAM			1 MB SRAM [6]			
Interfaces						
Interface IF1						
Signal			RS232			
Variant			Connection via 12-pin terminal block X20TB12			
Max. distance			900 m			
Transfer rate			Max. 115.2 kbit/s			
Interface IF2						
Signal			Ethernet			
Variant			1x RJ45 shielded			
Line length			Max. 100 m between 2 stations (segment length)			
Transfer rate			10/100/1000 Mbit/s			
Transfer						
Physical layer			10BASE-T/100BASE-TX/1000BASE-T			
Half-duplex			Yes			
Full-duplex			Yes			
Autonegotiation			Yes			
Auto-MDI/MDIX			Yes			
Interface IF3						
Fieldbus			POWERLINK (V1/V2) managing or controlled node			
Type			Type 4 [7]			
Variant			1x RJ45 shielded			
Line length			Max. 100 m between 2 stations (segment length)			
Transfer rate			100 Mbit/s			
Transfer						
Physical layer			100BASE-TX			
Half-duplex			Yes			
Full-duplex			POWERLINK mode: No / Ethernet mode: Yes			
Autonegotiation			Yes			
Auto-MDI/MDIX			Yes			
Interface IF4						
Type			USB 1.1/2.0			
Variant			Type A			
Max. output current			0.5 A			
Interface IF5						
Type			USB 1.1/2.0			
Variant			Type A			
Max. output current			0.5 A			
Interface IF6						
Fieldbus			X2X Link master			
Electrical properties						
Electrical isolation			Ethernet (IF2), POWERLINK (IF3) and X2X (IF6) isolated from each other, from other interfaces and from PLC			
Operating conditions						
Mounting orientation						
Horizontal			Yes			
Vertical			Yes			

Table 25: X20CP3583, X20CP3584, X20cCP3584, X20CP3585, X20CP3586, X20cCP3586 - Technical data

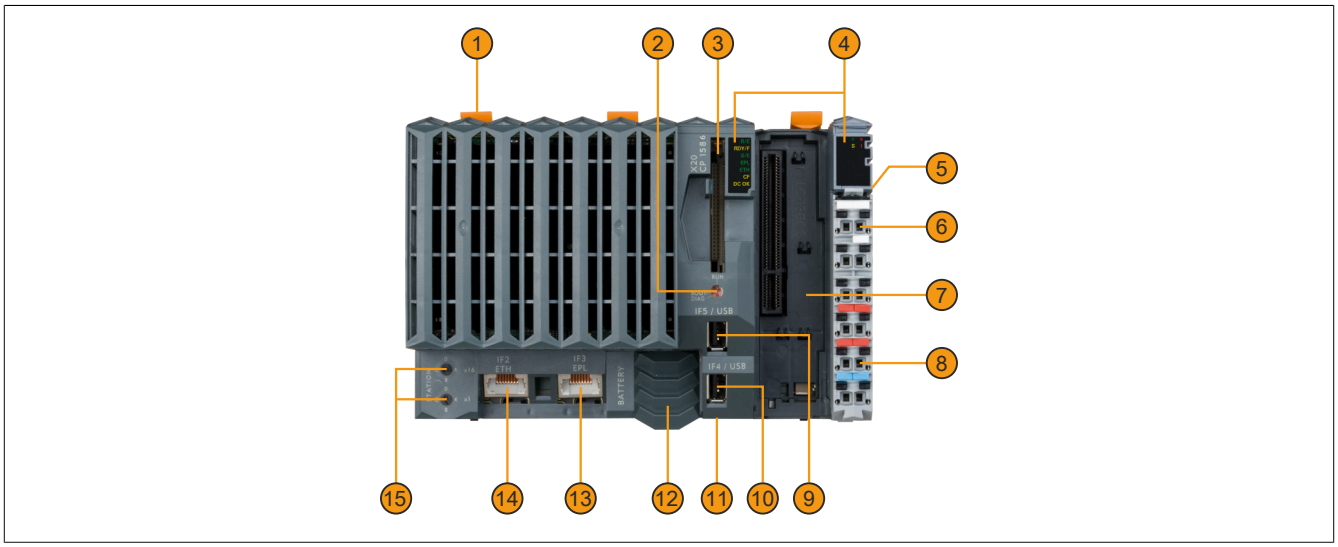
Order number	X20CP3583	X20CP3584	X20cCP3584	X20CP3585	X20CP3586	X20cCP3586
Installation elevation above sea level						
0 to 2000 m	No limitation					
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m					
Degree of protection per EN 60529	IP20					
Ambient conditions						
Temperature						
Operation						
Horizontal mounting orientation	-25 to 60°C					
Vertical mounting orientation	-25 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		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 application memory (CompactFlash) separately Backup battery included in delivery X20 end cover plate (right) included in delivery 12-pin X20 terminal block included in delivery Interface module slot covers included in delivery					
Dimensions						
Width	200 mm					
Height	99 mm					
Depth	85 mm					
Weight	470 g					

Table 25: X20CP3583, X20CP3584, X20cCP3584, X20CP3585, X20CP3586, X20cCP3586 - Technical data

1) For details about *storage health data*, see Automation Help.
2) The specified values are maximum values. For examples of the exact calculation, see section "Mechanical and electrical configuration" in the X20 system user's manual.
3) When operated at temperatures above 55°C, a derating of the nominal output power to 5 W for the X2X Link power supply must be taken into account.
4) In parallel operation, it is only permitted to expect 75% of the nominal power. It is important to make sure that all power supply units operated in parallel are switched on and off at the same time.
5) The memory size for remanent variables is configurable in Automation Studio.
6) 1 MB SRAM minus the configured remanent variables.
7) For additional information, see section "Communication / POWERLINK / General information / Hardware - IF/LS" in Automation Help.

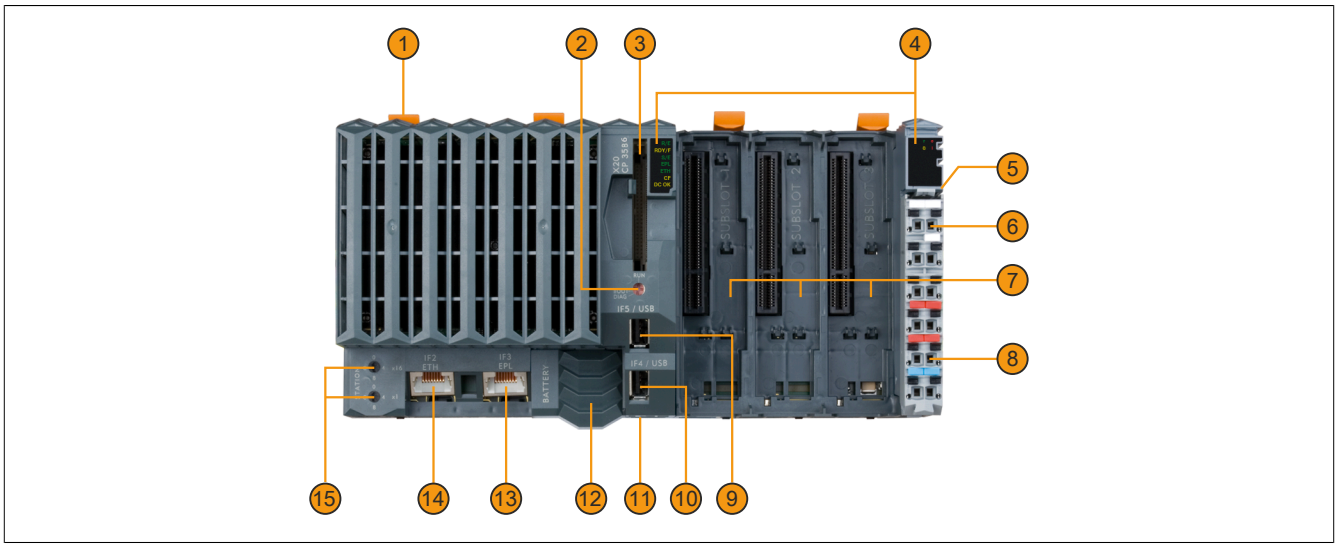
4.2.8 Operating and connection elements

X20CP158x



1	Top-hat rail latch	2	Selecting application memory
3	Slot for CompactFlash	4	LED status indicators
5	IF6 - X2X Link	6	IF1 - RS232
7	Slot for interface modules	8	Terminal block for controller and I/O supply, RS232 connection
9	IF5 - USB	10	IF4 - USB
11	Reset button	12	Battery compartment
13	IF3 - POWERLINK	14	IF2 - Ethernet
15	Ethernet station address	-	-

X20CP358x



1	Top-hat rail latch	2	Selecting application memory
3	Slot for CompactFlash	4	LED status indicators
5	IF6 - X2X Link	6	IF1 - RS232
7	Slots for interface modules	8	Terminal block for controller and I/O supply, RS232 connection
9	IF5 - USB	10	IF4 - USB
11	Reset button	12	Battery compartment
13	IF3 - POWERLINK	14	IF2 - Ethernet
15	Ethernet station address	-	-

4.2.8.1 LED status indicators

4.2.8.1.1 X20 controllers - LED status indicators

Figure	LED	Color	Status	Description
	R/E	Green	On	Application running
			Blinking	System startup: The controller is initializing the application, all bus systems and I/O modules.[1)]
			Double flash	System startup during firmware update[1)]
		Red	On	Mode SERVICE[2)] or BOOT[2)]
			Blinking	If LED "R/E" blinks red and LED "RDY/F" blinks yellow, a license violation has occurred.
			Double flash	System startup: Installation error[3)]
	RDY/F	Yellow	On	Mode SERVICE[2)] or BOOT[2)]
			Blinking	If LED "RDY/F" blinks yellow and LED "R/E" blinks red, a license violation has occurred.
	S/E	Green/Red		Status/Error LED. LED states are described in section "LED "S/E" (status/error LED)" on page 129.
	PLK	Green	On	The link to the POWERLINK remote station is established.
			Blinking	The link to the POWERLINK remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	ETH	Green	On	The link to the Ethernet remote station is established.
			Blinking	The link to the Ethernet remote station is established. The LED blinks if Ethernet activity is taking place on the bus.
	CF	Green	On	CompactFlash inserted and detected
		Yellow	On	CompactFlash read/write access
	DC	Yellow	On	Controller power supply unit OK
		Red	On	Backup battery empty

1) This process can take several minutes depending on the configuration.
2) The operating states are described in "Real-time operating system - Method of operation - Operating states" in Automation Help.
3) AR 4.93 and later: The project installation (initial installation or update) via USB flash drive was aborted with an error.

4.2.8.1.1.1 LED "S/E" (status/error LED)

This LED is a green/red dual LED and indicates the state of the POWERLINK interface. The LED states have a different meaning depending on the operating mode of the POWERLINK interface.

Ethernet mode

In this mode, the interface is operated as an Ethernet interface.

LED "S/E"		
Green	**Red**	**Description**
On	Off	The interface is operated as an Ethernet interface.

Table: LED "S/E": Interface in Ethernet mode

POWERLINK V1 mode

LED "S/E"		
Green	**Red**	**Current state of the POWERLINK node**
On	Off	The POWERLINK node is running with no errors.
Off	On	A system error occurred. The type of error can be read using the PLC logbook. An irreparable problem has occurred. The system can no longer properly carry out its tasks. This state can only be changed by resetting the module.
Blinking alternately		The POWERLINK managing node has failed. This error code can only occur when operated as a controlled node. This means that the set node number lies within the range 0x01 - 0xFD.
Off	Blinking	System stop. The red blinking LED indicates an error code (see "System stop error codes" on page 131).
Off	Off	The interface is either not active or one of the following states or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective.

Table 26: LED "S/E": POWERLINK V1 mode

POWERLINK V2 mode

Error message

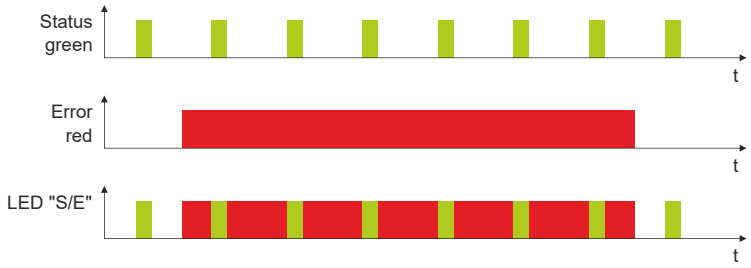
LED "S/E"		
Green	**Red**	**Description**
Off	On	The interface is in error mode (failed Ethernet frames, increased number of collisions on the network, etc.). Note: Several red blinking signals are displayed immediately after the device is switched on. These are not errors, however.
Blinking	On	If an error occurs in the following modes, then the green LED blinks over the red LED: • PRE_OPERATIONAL_1 • PRE_OPERATIONAL_2 • READY_TO_OPERATE 

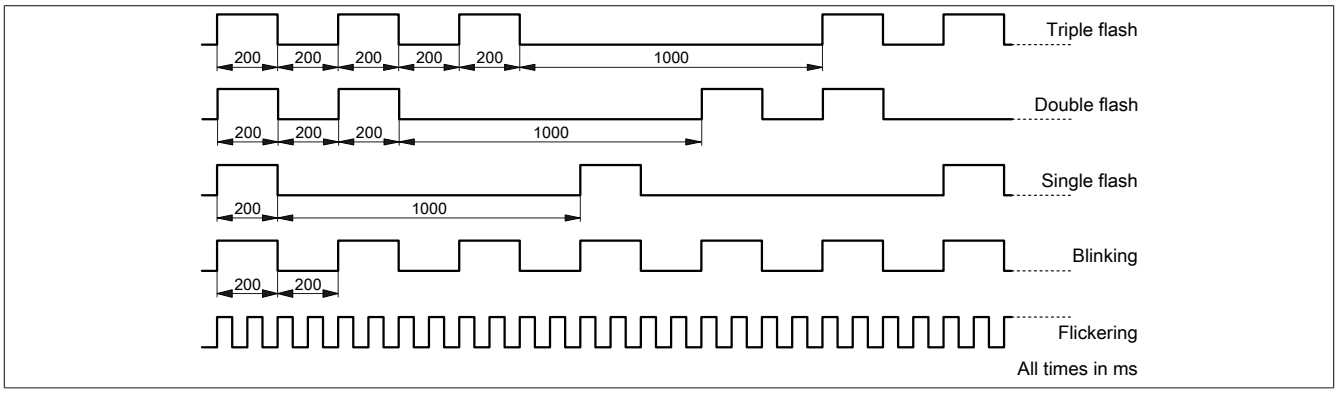
Table: LED "S/E" - Error message (interface in POWERLINK mode)

Interface status

LED "S/E"		
Green	**Red**	**Description**
Off	Off	**Mode:** NOT_ACTIVE The interface is either in mode NOT_ACTIVE or one of the following modes or errors is present: • The device is switched off. • The device is in the startup phase. • The interface or device is not configured correctly in Automation Studio. • The interface or device is defective. **Managing node (MN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode PRE_OPERATIONAL_1. If POWERLINK communication is detected before the time has elapsed, however, the MN is not started. **Controlled node (CN)** The network is monitored for POWERLINK frames. If a frame is not received within the configured time window (timeout), the interface immediately enters mode BASIC_ETHERNET. If POWERLINK communication is detected before this time expires, however, the interface immediately enters mode PRE_OPERATIONAL_1.
Flickering (approx. 10 Hz)	Off	**Mode:** BASIC_ETHERNET The interface is in mode BASIC_ETHERNET. The interface is operated in Ethernet mode. **Managing node (MN)** This mode can only be exited by resetting the controller. **Controlled node (CN)** If POWERLINK communication is detected during this mode, the interface enters mode PRE_OPERATIONAL_1.
Single flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_1 The interface is in mode PRE_OPERATIONAL_1. **Managing node (MN)** The MN is in "reduced cycle" mode. The CNs are configured in this mode. Cyclic communication is not yet taking place. **Controlled node (CN)** The CN can be configured by the MN in this mode. The CN waits until it receives an SoC frame and then switches to mode PRE_OPERATIONAL_2.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Double flash (approx. 1 Hz)	Off	**Mode:** PRE_OPERATIONAL_2 The interface is in mode PRE_OPERATIONAL_2. **Managing node (MN)** The MN starts cyclic communication (cyclic input data is not yet evaluated). The CNs are configured in this mode. **Controlled node (CN)** The CN can be configured by the MN in this mode. A command then switches the mode to READY_TO_OPERATE.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
Triple flash (approx. 1 Hz)	Off	**Mode:** READY_TO_OPERATE The interface is in mode READY_TO_OPERATE. **Managing node (MN)** Cyclic and asynchronous communication. Received PDO data is ignored. **Controlled node (CN)** The configuration of the CN is completed. Normal cyclic and asynchronous communication. The transmitted PDO data corresponds to the PDO mapping. However, cyclic data is not yet evaluated.
	On	**Controlled node (CN)** If the red LED lights up in this mode, this means that the MN has failed.
On	Off	**Mode:** OPERATIONAL The interface is in mode OPERATIONAL. PDO mapping is active and cyclic data is evaluated.
Blinking (approx. 2.5 Hz)	Off	**Mode:** STOPPED The interface is in mode STOPPED. **Managing node (MN)** This mode does not occur for the MN. **Controlled node (CN)** Output data is not being output, and no input data is being provided. This mode can only be reached and exited by a corresponding command from the MN.

Table: LED "S/E" - Interface state (interface in POWERLINK mode)

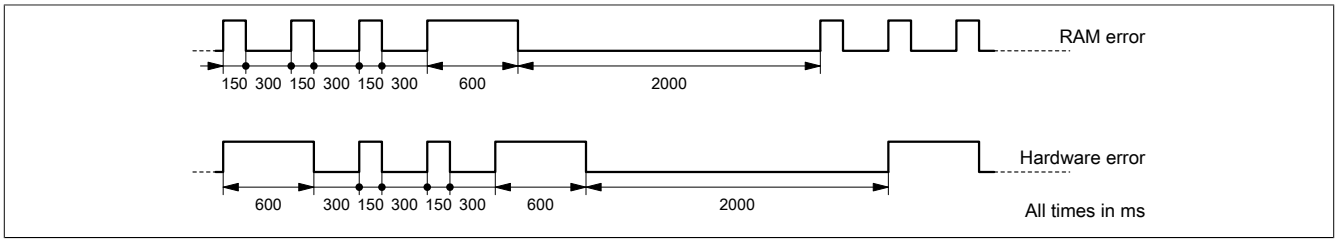
Blink times



4.2.8.1.1.2 System stop error codes

A system stop error can occur due to incorrect configuration or defective hardware.

The error code is indicated by LED "S/E" blinking red. The blinking signal of the error code consists of 4 switch-on phases with short (150 ms) or long (600 ms) duration. The error code is repeated every 2 seconds.



Error	Error description
RAM error	The device is defective and must be replaced.
Hardware error	The device or a system component is defective and must be replaced.

4.2.8.1.2 LED status indicators for the integrated power supply unit

For a description of the various operating modes, see section "Additional information - Diagnostic LEDs" in the X20 System user's manual.

Figure	LED	Color	Status	Description
	r	Green	Off	No power to module
			Single flash	Mode RESET
			Blinking	Mode PREOPERATIONAL
			On	Mode RUN
	e	Red	Off	Module not supplied with power or everything OK
			Double flash	The LED indicates one of the following states: • The X2X Link power supply of the power supply unit is overloaded. • I/O power supply too low • The input voltage for the X2X Link power supply is too low.
	e + r	Solid red / Single green flash		Invalid firmware
	S	Yellow	Off	No RS232 activity
			On	The LED lights up when data is being transmitted or received via the RS232 interface.
	I	Red	Off	The X2X Link power supply is within the valid range.
			On	The X2X Link power supply of the power supply unit is overloaded.

4.2.8.2 Operating mode switch

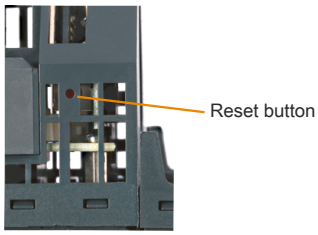
The operating mode switch is used to set the operating mode.

Switch position	Operating mode	Description
BOOT	BOOT	In this switch position, Boot AR is started and the runtime system can be installed via the online interface (B&R Automation Studio). User flash memory is erased only when the download begins.
RUN	RUN	Mode RUN
DIAG	DIAGNOSE	The controller is starting up in diagnostic mode. Program sections in User RAM and User Flash-PROM are not initialized. After diagnostic mode, the controller always boots with a warm restart.

Information:

A switch position other than those described here is not permitted!

4.2.8.3 Reset button



The reset button is located below the USB interfaces on the bottom of the housing. It can be pressed with any small pointed object (e.g. paper clip). Pressing the reset button triggers a hardware reset, which means:

- All application programs are stopped.
- All outputs are set to zero.

The controller then starts up in service mode by default. The startup mode that follows after pressing the reset button can be set in Automation Studio.

4.2.8.4 Slot for application memory

Application memory is required to operate the controllers. The application memory is provided in the form of a CompactFlash card. This is not included in delivery with the controllers; it must be ordered separately as an accessory!

Information:

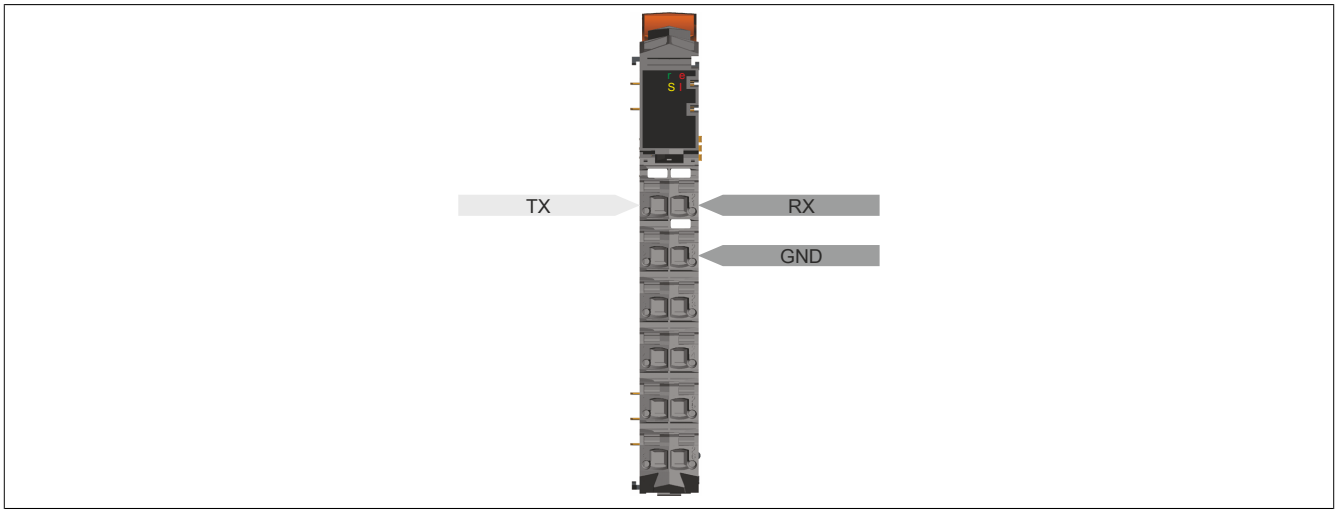
The CompactFlash card must not be removed during operation.

4.2.8.5 Project installation

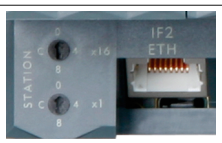
Project installation is described in "Project management - Project installation" in Automation Help.

4.2.8.6 RS232 interface (IF1)

The non-electrically isolated RS232 interface is designed as an online interface for communication with the programming device.



4.2.8.7 Ethernet interface (IF2)



The IF2 is executed as the10 BASE-T / 100 BASE-TX / 1000 BASE-T gigabit Ethernet interface.

The INA2000 station number of the Ethernet interface is set using the two hex switches.

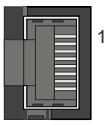
For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Information:

The Ethernet interface is not suitable for POWERLINK.

When using the POWERLINK interface, the Ethernet interface is not permitted to be operated with an IP address from the POWERLINK address range.
POWERLINK address range: 192.168.100.x

Pinout

Interface	Pinout		
	Pin	Ethernet	
 1 Shielded RJ45 port	1	D1+	Data 1+
	2	D1-	Data 1-
	3	D2+	Data 2+
	4	D3+	Data 3+
	5	D3-	Data 3-
	6	D2-	Data 2-
	7	D4+	Data 4+
	8	D4-	Data 4-

4.2.8.8 POWERLINK interface (IF3)

The controllers are equipped with a POWERLINK V1/V2 interface.

POWERLINK V1

By default, the POWERLINK interface is operated as a managing node (MN). In the managing node, the node number is set to a fixed value of 0.

If the POWERLINK node is operated as a controlled node (CN), a node number from 1 to 253 can be set in the POWERLINK configuration in Automation Studio.

POWERLINK V2

Setting in Automation Studio

By default, the POWERLINK interface is operated as a managing node (MN). In the managing node, the node number is set to a fixed value of 240.

If the POWERLINK node is operated as a controlled node (CN), a node number from 1 to 239 can be set in the POWERLINK configuration in Automation Studio.

Setting with hex switches

The POWERLINK node number can also be set with the two onboard hex switches. These are normally used to set the INA2000 station number of the Ethernet interface. Switching takes place in the POWERLINK configuration in Automation Studio.

Node numbers from 0x01 to 0xF0 are permitted.

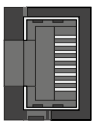
Switch position	Description
0x00	Reserved, switch position not permitted.
0x01 - 0xEF	Node number of the POWERLINK node. Operation as a controlled node (CN).
0xF0	Operation as a managing node (MN).
0xF1 - 0xFF	Reserved, switch position not permitted.

Ethernet mode

In this mode, the interface is operated as an Ethernet interface. The INA2000 station number is set using the Automation Studio software.

Pinout

For information about wiring X20 modules with an Ethernet interface, see section "Mechanical and electrical configuration - Wiring guidelines for X20 modules with Ethernet cables" in the X20 user's manual.

Interface	Pinout		
	Pin	Ethernet	
 1 Shielded RJ45	1	RXD	Receive data
	2	RXD\	Receive data\
	3	TXD	Transmit data
	4	Termination	
	5	Termination	
	6	TXD\	Transmit data\
	7	Termination	
	8	Termination	

4.2.8.9 USB interfaces (IF4 and IF5)

IF4 and IF5 are non-galvanically isolated USB interfaces. The abbreviation USB stands for "Universal Serial Bus". Both USB interfaces support the USB 1.1 and 2.0 standards.

Information:

USB peripheral devices can be connected to the USB interfaces. Automation Runtime supports a selection of USB peripheral devices. For the supported USB classes, see the AR help documentation.

Information:

The following must be taken into account when using a USB peripheral device and grounded controller power supply (PELV):

- **Only USB peripheral devices with no connection between GND and ground are permitted to be connected. This is the case, e.g. with the USB dongle from B&R.**

4.2.8.10 Slots for interface modules

The controllers are equipped with 1 or 3 slots for interface modules.

Different bus or network systems can be flexibly integrated into the X20 system by selecting the appropriate interface module.

4.2.8.11 Battery

X20 controllers are equipped with a lithium battery. The lithium battery is located in a separate compartment and protected by a cover.

Backup battery data

Order number 4A0006.00-000 0AC201.91	 1 pcs. 4 pcs.
Short description	Lithium battery, 3 V / 950 mAh, button cell
Storage temperature	-40 to 85°C
Storage time	Max. 3 years at 30°C
Relative humidity	0 to 95% (non-condensing)

The following areas are buffered:

- Remanent variables
- User RAM
- System RAM
- Real-time clock

Battery monitoring

The battery voltage is checked cyclically. The cyclic load test of the battery does not considerably shorten its service life; instead, it gives an early warning of weakened buffer capacity.

Status information "Battery OK" is available from system library function "BatteryInfo" and the controller's I/O mapping.

Replacement interval for battery

The battery should be replaced every 4 years. The replacement intervals recommended by B&R reflect the batteries' average service life and operating conditions. They do not correspond to the maximum buffer duration!

Important information about the battery exchange

The product design allows the battery to be changed when the controller is in a voltage-free state as well as when the controller is switched on. In some countries, however, changing is not permitted while operating voltage is applied. To prevent data loss, the battery must be changed within 1 min in a voltage-free state.

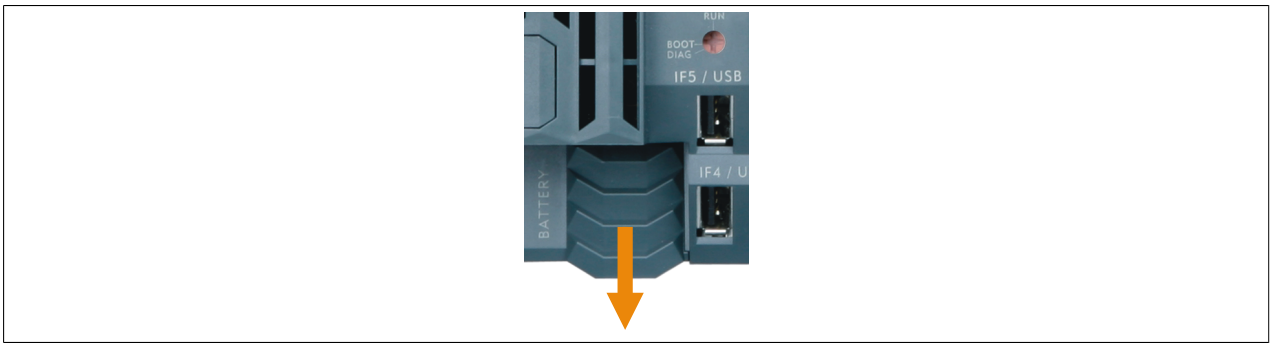
Warning!

The battery is only permitted to be replaced by a Renata CR2477N battery. The use of another battery may present a fire or explosion hazard.

The battery can explode if handled improperly. Do not recharge, disassemble or dispose of the battery in fire.

Procedure for replacing the battery

1. Perform electrostatic discharge at the top-hat rail or at the ground connection (do not reach into the power supply unit!)
2. Remove the cover for the lithium battery. Do this by sliding it down and away from the controller.



3. Push the empty battery out of the holder.
4. It is important to ensure that the new battery is not handled with moist or greasy fingers. Plastic tweezers can also be used. Do not touch the battery with pliers or metal tweezers → short circuit!
5. To insert the battery into the holder, place it with the "+" side up on the right part of the battery holder. Then press the battery into the battery holder.
6. Replace the cover.

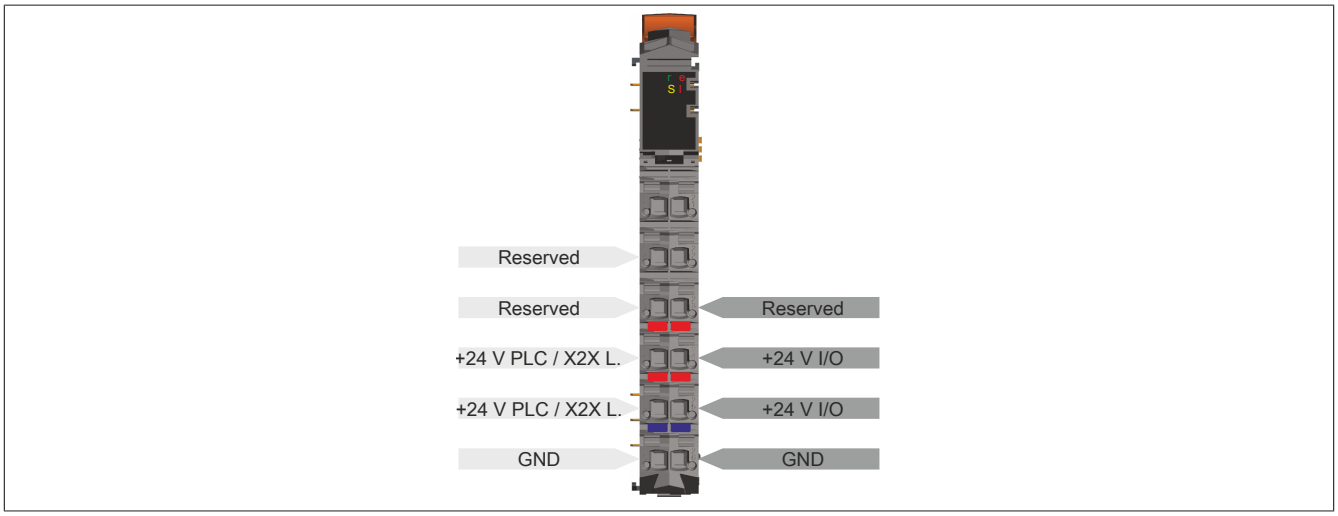
Information:

Lithium batteries are hazardous waste! Used batteries should be disposed of in accordance with applicable local regulations.

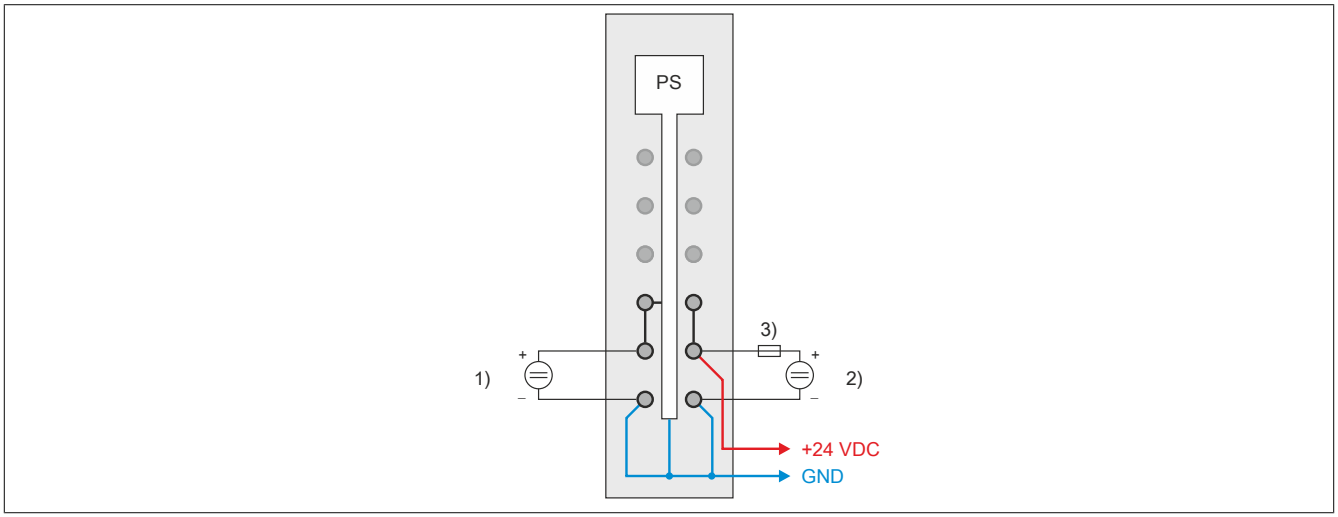
4.2.9 Controller power supply

A power supply unit is integrated in the X20 controllers. It is equipped with a supply for the controller, X2X Link and the internal I/O power supply. The bus power supply and internal I/O power supply are galvanically isolated from each other.

Integrated power supply unit - Pinout



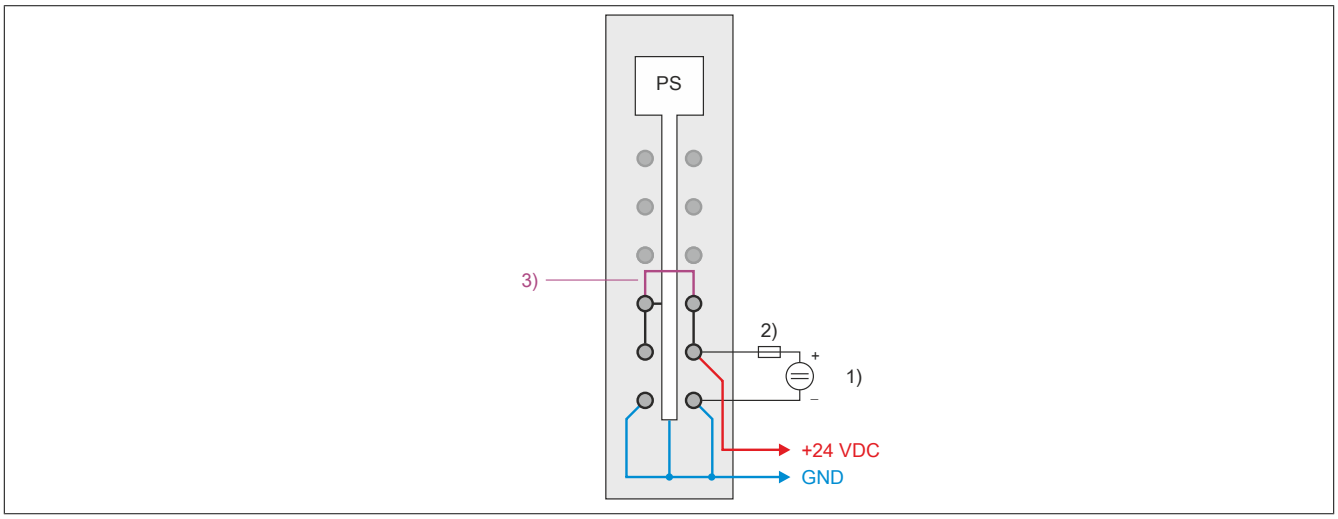
Connection example with 2 separate power supplies



1) Supply for the X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

1) Supply for the PLC or X2X Link power supply
2) Supply for the I/O power supply
3) Fuse, 10 A slow-blow

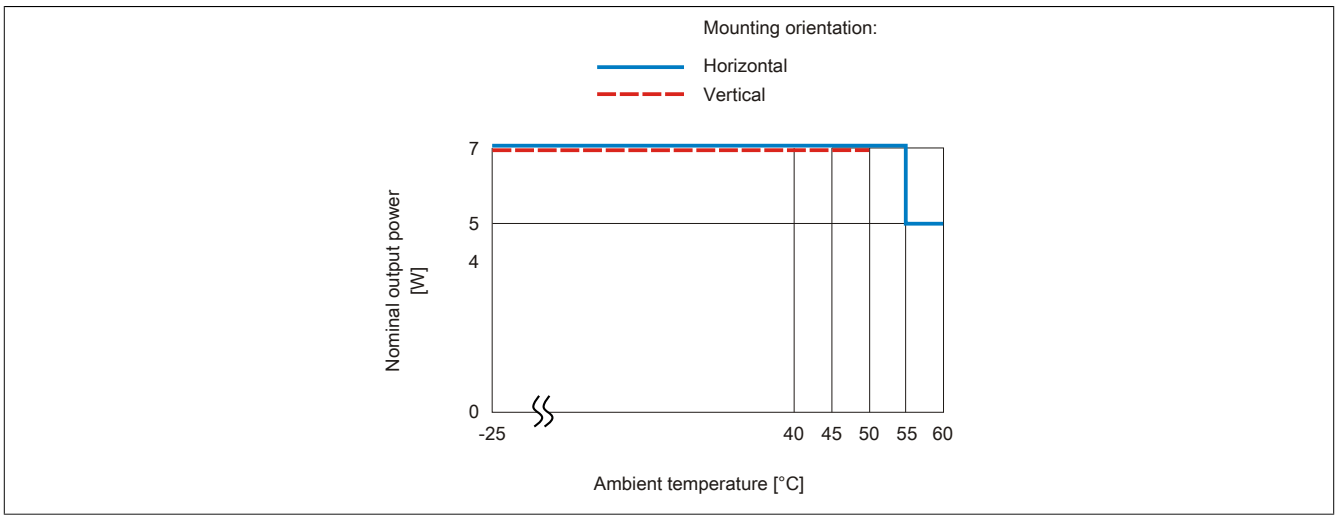
Connection example with power supply and jumper



1) Supply for the I/O power supply
2) Fuse, 10 A slow-blow
3) Jumper

4.2.10 Derating

There is no derating when operated below 55°C. Above 55°C, the nominal output power for the X2X Link power supply must be reduced to 5 W.



4.2.11 Overtemperature shutdown

To prevent damage, a shutdown – reset state – of the controller takes place at 110°C processor temperature or 95°C board temperature.

The following errors are entered in the logbook in the event of shutdown:

Error number	Short error text
9204	PLC restart triggered by the PLC CPU's temperature monitoring.
9210	Warning: Halt/Service after watchdog or manual reset.

4.2.12 Information about migrating from the X20CPx48x to the X20CPx58x

- A hardware upgrade is required for some X20 IFxxxx interface modules. This can be installed from Automation Studio by selecting **Tools / Upgrades** from the menu.
  In addition, a certain hardware revision is required for some modules. The following table provides an overview:

Order number	Minimum upgrade version	Minimum hardware revision
X20IF1020	1.1.5.1	H0
X20IF1030	1.1.5.1	I0
X20IF1041-1	-	-
X20IF1043-1	-	-
X20IF1051-1	-	-
X20IF1053-1	-	-
X20IF1061	-	E0
X20IF1061-1	-	-
X20IF1063	1.1.5.0	-
X20IF1063-1	-	-
X20IF1065	-	-
X20IF1072	1.0.5.1	-
X20IF1082	1.2.2.0	-
X20IF1082-2	1.2.1.0	-
X20IF1086-2	1.1.1.0	-
X20IF1091	1.0.5.1	-
X20IF10A1-1	-	-
X20IF10D1-1	-	-
X20IF10D3-1	-	-
X20IF10E1-1	-	-
X20IF10E3-1	-	-
X20IF10G3-1	-	-
X20IF2772	1.0.6.1	-
X20IF2792	1.0.5.1	-

Table 27: Minimum upgrade version and minimum hardware revision for X20 IFxxxx interface modules

- X20CPx58x controllers are supported starting with B&R Automation Studio V3.0.90.20.
- If an X20CPx48x should be replaced by an X20CPx58x in an existing Automation Studio configuration, the X20CPx58x may not be listed as one of the available options even though the upgrade for the controller has already been installed. In such a case, an upgrade of the X20CPx48x is required.
- Starting with Automation Runtime 4.x, USB devices are integrated in Automation Runtime dynamically so that they no longer must be configured in Automation Studio. In order to use a USB device, its internal device name must be obtained at runtime. For an example, see Automation Help for the library "AsUSB / Examples".

4.2.13 General data points

This controller is equipped with general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.

General data points are described in section "Additional information - General controller data points" in the X20 system user's manual.