

X20 system

User's manual
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1 General information

1.1 Manual history

Version	Date	Comment ¹⁾
4.30	January 2025	Updated book. - Section "System characteristics" - Revised section "Coated modules". - Revised section "X20 controllers". - Section "Module overviews" - Updated module lists. - Section "Dimensioning" - Removed dimension "X20 controllers with integrated I/O". - Added new dimensions for I/O modules. - Section "Installation and wiring" - Added new section "Shield connection" in section "Shielding". - Section "Mechanical handling" - Added new section "Modules with 2 locking levers". - Section "Accessories" - Added dimensions to "Shield connection clamp". - Updated section "Pre-assembled cables". - Section "Certifications" - Added new certification "CSS" added, removed "EAC". - Section "Additional information" - Added new section "EMC information". - Added new section "Open source licenses".
4.20	December 2023	Updated book. - Updated module overviews. - Section "Installation and wiring" - Added new section "Shielding and earthing". - Section "Mechanical and electrical configuration" - Removed X67 installation notes in section "Safe cutoff of a potential group". - Removed discontinued modules from calculation examples. - Section "Accessories" - Added new section "Batteries". - Section "International standards and certifications" - Added new certification "UKCA".
4.10	August 2022	Updated book. - Replaced term "CPU" with "controller". - Updated module overviews. - Section "System overview" - Removed sections "Compact CPUs" and "Fieldbus CPUs". - Added new section "Embedded controller". - Section "Dimensions" - Added new section "Embedded for controllers". - Section "Installation and wiring" - Updated section "Wiring" - Added new section "Lightning protection". - Section "Accessories" - Added new section "Embedded controllers accessories package" - Added new section "General specification of an X2X Link cable" under "X2X Link cables"s

Version	Date	Comment ¹⁾
		- Section "International standards and certifications" - Replaced standard EN 55022 with EN 55032, removed standard EN 50581. - Updated links in section "EU directives and standards".

- 1) Column "Comment" contains only the most important changes in this user's manual. Several updates, corrections and format variations are not included.

1.2 Definition of this term

Term	Description
SG4	System Generation 4 (SG4) - Controllers with Intel processors or ARM. • X20 system X20CPx48x(-1), X20(c)CP04xx(-1), X20(c)CP13xx(-RT), X20(c)CPx58x, X20CPx68x(X), X20EMx61x • Power Panels C30, C50, C70, C80 • Automation PCs APC910, APC2100, APC2200, APC3100, MPC3100 • Panel PCs PPC900, PPC2100, PPC2200, PPC3100
SG3	System Generation 3 (SG3) - Controllers with Motorola processors. • Control systems System 2003 System 2005 System 2010 • Power Panels PP15, PP21, PP35, PP41
SGC	System Generation Compact (SGC) - Controllers with Motorola processors (embedded μ P). • X20 system X20CP02xx, X20XC02xx

1.3 Abbreviations

The following abbreviations appear throughout the user's manual, for example in data tables or descriptions of pinouts.

Abbreviation	Stands for	Description
NC	Normally closed	Normally closed relay contact.
	Not connected	Used in pinout descriptions if a terminal or pin is not connected to a module.
ND	Not defined	In data tables, this stands for a value that has not been defined. This may be because a cable manufacturer does not provide certain technical data, for example.
NO	Normally open	Normally open relay contact.
TBD	To be defined	Used in technical data tables when certain information is not yet available. The value will be provided later.

1.4 Other applicable documents

Additional documentation

Document name	Title
MAREDSYS	Redundancy for control systems
reACTION Technology	reACTION Technology user's manual

2 Safety guidelines

Programmable logic controllers, operating/monitoring devices (e.g. industrial PCs, Power Panels, Mobile Panels, etc.) as well as uninterruptible power supplies have all been designed, developed and manufactured by B&R for conventional use or for use with increased safety requirements (safety technology) in industry. They were not designed, developed and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical damage or loss of any kind without the implementation of exceptionally stringent safety precautions. In particular, such risks and hazards include the use of these devices to monitor nuclear reactions in nuclear power plants, their use in flight control or flight safety systems as well as in the control of mass transportation systems, medical life support systems or weapons systems.

When using programmable logic controllers or operating/monitoring devices as control systems together with a Soft PLC (e.g. B&R Automation Runtime or comparable product) or Slot PLC (e.g. B&R LS251 comparable product), safety precautions relevant to industrial control systems (e.g. the provision of safety devices such as emergency stop circuits, etc.) must be observed in accordance with applicable national and international regulations. The same applies for all other devices connected to the system, e.g. drives.

All tasks such as the installation, commissioning and servicing of devices are only permitted to be carried out by qualified personnel. Qualified personnel are those familiar with the transport, mounting, installation, commissioning and operation of devices who also have the appropriate qualifications (e.g. IEC 60364-1). National accident prevention regulations must be observed.

The safety notices, connection descriptions (type plate and documentation) and limit values listed in the technical data are to be read carefully before installation and commissioning and must be observed.

The use of these products is restricted to the following persons:

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

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

2.1 Intended use

In all cases, applicable national and international standards, regulations and safety measures must be taken into account and observed!

The B&R products described in this manual are intended for use in industry and industrial applications. Intended use includes controlling, operating, monitoring, driving and visualizing as part of automation processes in machines and systems.

The use of B&R products is only permitted in their original condition. Modifications and extensions are only permitted if they are described in this manual.

B&R Industrial Automation GmbH assumes no any liability for damages of any kind arising from the use of B&R products outside of their intended use.

B&R products were not designed, developed and manufactured for any use involving serious risks or hazards that could result in death, injury, serious physical impairment or loss of any kind without the implementation of exceptionally stringent safety precautions.

B&R products are explicitly not intended for use in the following applications:

- Monitoring and control of thermonuclear processes
- Weapon systems control
- Flight and traffic control systems for passenger and freight transport
- Health monitoring and life support systems



Information:

The B&R products described in this manual are designed as "open equipment" (IEC 61010-1 and/or IEC 61131-2) and "open type equipment" (UL). They are therefore designated for installation in an enclosed control cabinet only.

2.2 Safety products



Information:

For safety products, the safety guidelines in section "Safety technology" in Automation Help must also be observed in addition to the information in this manual.

2.3 Protection against electrostatic discharge

Electrical assemblies that can be damaged by ElectroStatic Discharge (ESD) must be handled accordingly.

2.3.1 Packaging

- Electrical assemblies with housing
... Do not require special ESD packaging but must be handled properly (see "[Electrical assemblies with housing](#)" on page 13).
- Electrical assemblies without housing
... Are protected by ESD-suitable packaging.

2.3.2 Regulations for proper ESD handling

Electrical assemblies with housing

- Do not touch the male connector contacts on the device (bus data contacts).
- Do not touch the connector contacts of connected cables.
- Do not touch the contact tips on circuit boards

Electrical assemblies without housing

The following applies in addition to "Electrical assemblies with housing":

- All persons handling electrical assemblies and devices in which electrical assemblies are installed must be grounded.
- Assemblies are only permitted to be touched on the narrow sides or front plate.
- Always place assemblies on suitable surfaces (ESD packaging, conductive foam, etc.).



Information:

Metallic surfaces are not suitable storage surfaces.

- Assemblies must not be subjected to electrostatic discharges (e.g. due to charged plastics).
- A minimum distance of 10 cm from monitors or television sets must be maintained.
- Measuring instruments and devices must be grounded.
- Test probes of floating potential measuring instruments must be discharged briefly on suitable grounded surfaces before measurement.

Individual components

- ESD protective measures for individual components are implemented throughout B&R (conductive floors, shoes, wrist straps, etc.).
- The increased ESD protective measures for individual components are not required for handling B&R products at customer locations.

2.4 Transport and storage

During transport and storage, devices must be protected against undue stress (mechanical loads, temperature, moisture, corrosive atmospheres, etc.).

Devices contain components sensitive to electrostatic charges that can be damaged by improper handling. It is therefore necessary to provide the required protective measures against electrostatic discharge when installing or removing these devices (see ["Protection against electrostatic discharge" on page 12](#)).

2.5 Mounting orientation

- Installation must be performed according to this documentation using suitable equipment and tools.
- Devices are only permitted to be installed by qualified personnel without voltage applied.
- General safety guidelines and national accident prevention regulations must be observed.
- Electrical installation must be carried out in accordance with applicable guidelines (e.g. line cross sections, fuses, protective ground connections).
- Take the necessary steps to protect against electrostatic discharges (see ["Protection against electrostatic discharge" on page 12](#)).

2.5.1 Installing/Removing modules while the controller is running

I/O modules

I/O modules may be connected and disconnected while the controller is running under the following conditions:

- Connectors are not allowed to carry voltages and must be removed.
- Replacing a module during operation must be supported by the software; otherwise, disconnecting a module will cause an emergency stop of the controller.

IF modules

Unlike I/O modules, IF modules are NOT permitted to be installed or removed while the controller is running.



Warning!

Installing/Removing IF modules while the controller is running is not recognized by the controller or bus controller and will result in error behavior of the application.

2.6 Operation

2.6.1 Protection against touching electrical parts



Danger!

In order to operate programmable logic controllers, operating and monitoring devices and the uninterruptible power supply, it is necessary for certain components to carry dangerous voltages. Touching one of these components can result in a life-threatening electric shock. There is a risk of death, serious injury or damage to property.

Before switching on the programmable logic controllers, operating and monitoring devices and uninterruptible power supply, it must be ensured that the housing is properly connected to ground potential (PE rail). The ground connection must also be made if the operating and monitoring device and uninterruptible power supply are only connected for testing purposes or only operated for a short time!

Before switching on the device, all voltage-carrying components must be securely covered. During operation, all covers must remain closed.

2.7 Organization of notices

Safety notices

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

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

General notices

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

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

3 System features

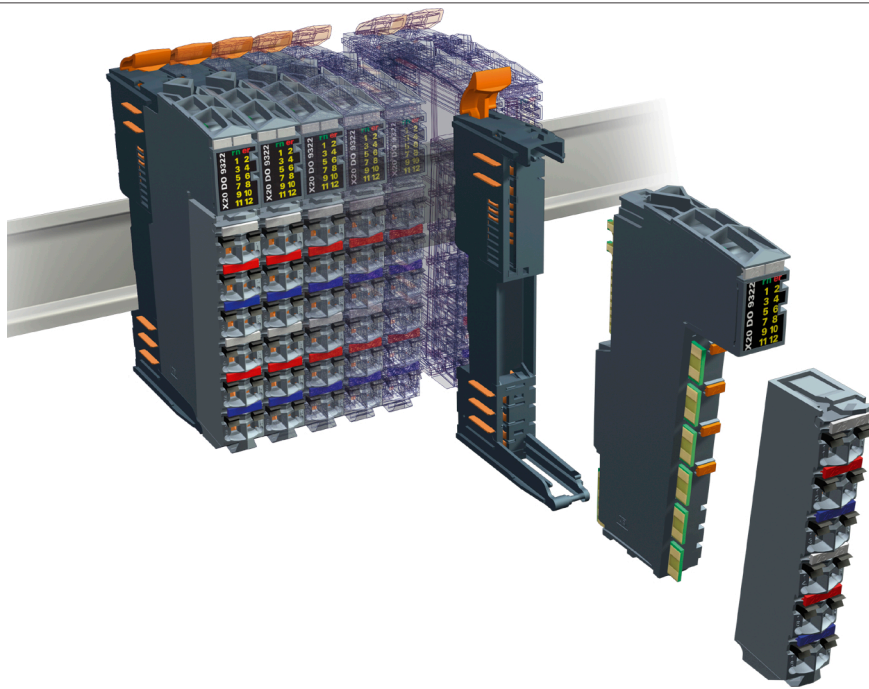
3.1 Setting the standards in automation

There are many slice-based I/O systems. In accordance with the motto "Perfection in Automation", B&R is setting new standards with the X20 system. As a result of worldwide practical experience, numerous discussions with customers, and with the goal of simple, economical and safe applicability, the X20 system is the universal solution for any automation task in machine and plant engineering.

With its well thought-out details and a sophisticated ergonomic design, the X20 system is more than a remote I/O system – it is a complete control solution. The X20 system family combines the components that are needed according to the requirements and the application.

Each module consists of 3 subcomponents – the terminal block, electronics module and bus module. This results in a system that combines many advantages:

- Pre-wiring without modules
- Hot-pluggable electronics
- Bus connector slots available for options



3.1.1 Optimized design

X20 modules consist of three submodules to provide maximum ease of use throughout their entire life cycle. This division into bus module, electronics module and terminal block has several advantages.

- **Preconfigured for different machine types**

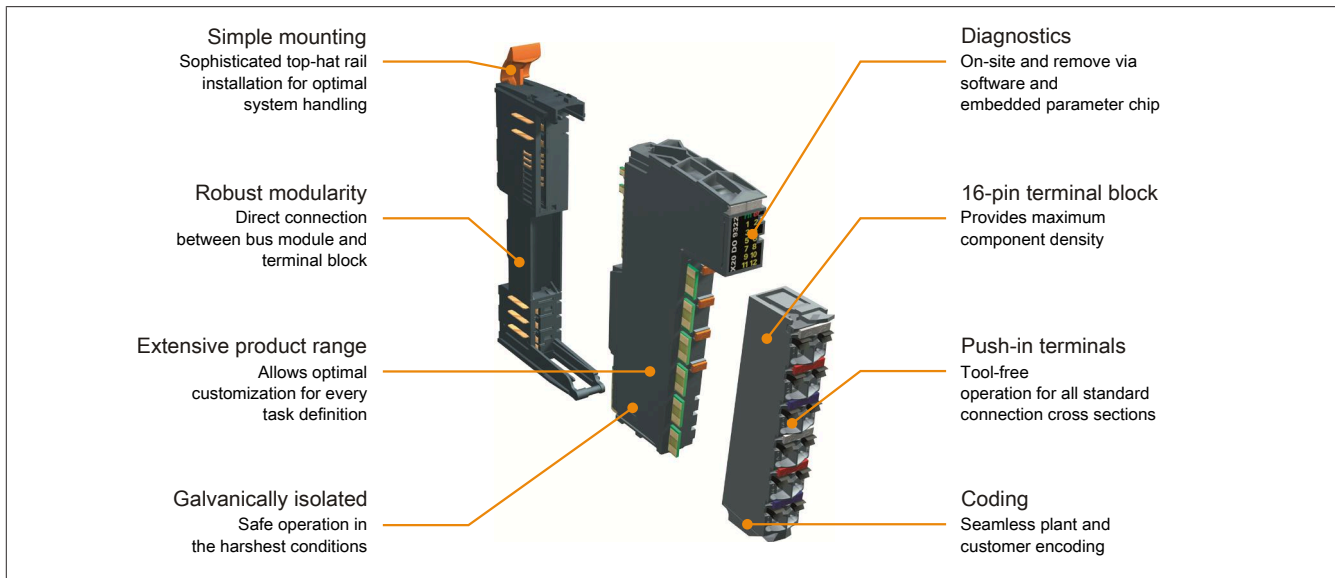
X20 bus modules are the basic platform for many machine variants. The electronics modules used determine the machine's degree of expansion. The software automatically detects this degree of expansion and makes the necessary functions available.

- **Industrial control cabinet construction**

X20 system terminal blocks are separate from the electronics module and make it possible to pre-wire the entire control cabinet. This is especially ideal for series-produced machines.

- **Easy maintenance**

X20 modules can be easily exchanged to simplify troubleshooting. The electronic modules can be exchanged without interrupting operation. The wiring remains exactly the same thanks to the separate terminal blocks. Being able to exchange the automation components quickly reduces downtime.



3.1.2 Space for options

The X20 system makes it possible to combine the exact components necessary depending on the user's demands and individual application requirements. This allows machine options to be implemented easily and flexibly. Bus modules provide the base, and are more or less a rack replacement. Depending on the option, the necessary electronics modules are then inserted in the predefined slots.

Addresses are assigned implicitly via the slot. Software that has been developed once is valid for all versions and does not need to be changed. This is even possible for later machine expansion. The I/O modules are simply inserted in the defined bus modules, and assigned to the corresponding potential groups and E-stop groups.

To prevent unwanted expansion, each module can be identified and then enabled using the application software.

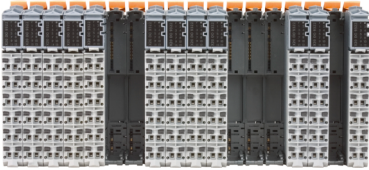
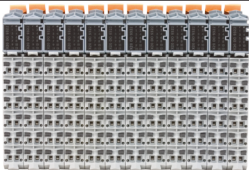
3.1.2.1 Flexibility for options

The implementation of different machine variations using free bus modules is only one of the many features that the X20 system offers. With the support of Automation Studio, there is an optimized solution using I/O mapping.

In the process, each I/O configuration is created optimally according to the actual requirements. However, the application software is designed to handle all potential options. Only the I/O channels that are actually available are mapped to the application program. If an expansion is required, then the additional hardware needed can be easily connected and the I/O mapping changed. This is possible without having to compile the application software.

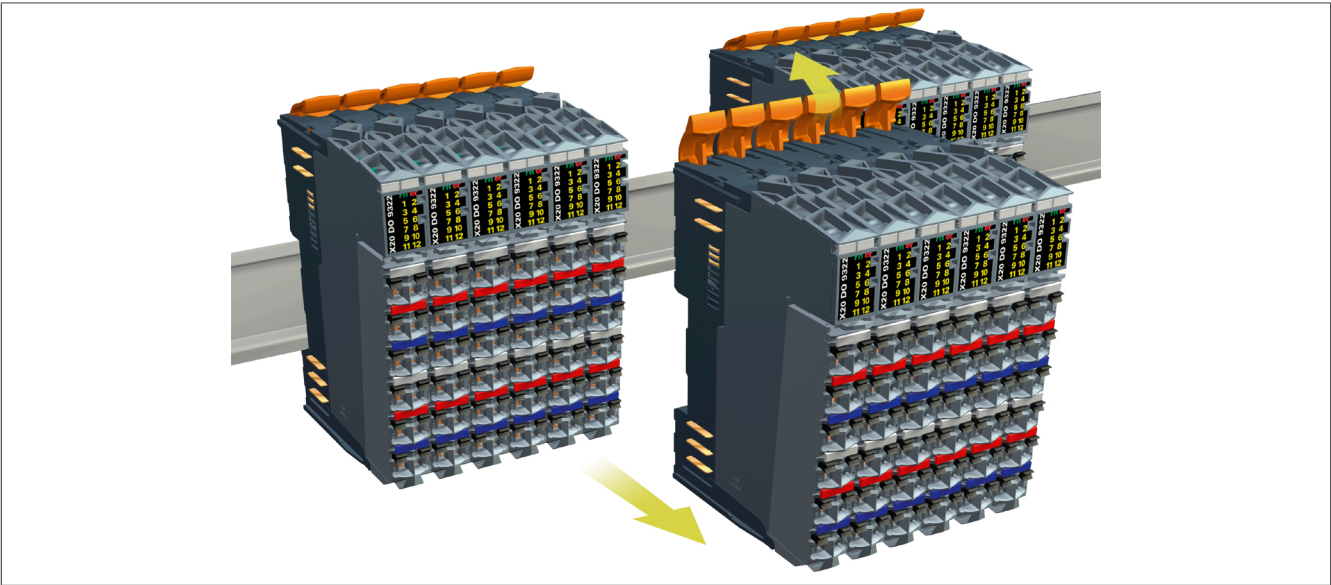
It doesn't matter where the I/O mapping list is created:

- Manually in B&R Automation Studio
- With tools, e.g. with a database or a table calculation program
- Directly from an ERP system, just like the parts list for the machine
- Automatically in the application software, depending on the hardware used

	Machine variation A The possibilities of the X20 system can be best explained using examples. This is a machine constellation with two variations, A and B. All of the necessary electronics modules for machine variation A are shown in the picture to the left. The bus modules needed for variation B are also present, but without electronic modules.
	Machine variation B Variation B shows the necessary electronic modules but the modules necessary for variation A are missing. The distribution of the free bus modules for the variations is also clear: The variable I/O modules can be very easily connected to the required electrically isolated groups and don't need to be attached in the back. The extensive process of taking apart the configuration to expand existing electrically isolated groups is also eliminated. Simply insert the electronic module and attach the terminal block.
	Machine variation A - optimized The features included in Automation Studio can also be used to achieve completely optimized hardware configurations without losing the advantage of comprehensive application software for all variations. As described earlier, simply mapping physical I/O points to the application program makes it extremely easy to optimize the hardware variations without even requiring compilation.

3.1.3 Sophisticated mechanics

B&R has many years of experience developing and producing industrial electronics. The mechanics of the X20 system are well thought out down to the last detail. A robust design, long guides and housing reinforcements guarantee the stability required in industry and are the requirements for mounting the X20 system on the top-hat rail just as easily as a rack system. This also applies to removal from the top-hat rail again.



	Unlocking mechanism with 2 positions Closed for secure fit on the top-hat rail.		Defined open position Open to remove a module or the entire system.
	Removing a single module from the system Remove or reconnect vertically.		Mount the entire system as a whole Disassembly of the complete system is just as easy.

3.1.4 Easy wiring

Industrial control cabinet construction streamlines production cycles. Prefabricated cable trees enable faster and easier assembly directly on the machine or system. The X20 system supports efficient prewiring of the entire control cabinet using separate terminal blocks. The complete X20 system configuration is mounted in the control cabinet and connected to the prewired cable trees.

The supply of the X20 modules and the supply of the sensors and actuators do not add any requirements for energy distribution. The X20 system reduces manual wiring to a minimum.

3.1.4.1 Install the wires, plug it in, and it's ready to go

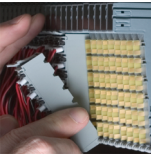
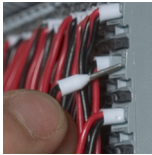
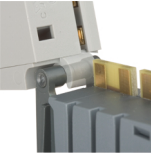
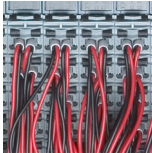
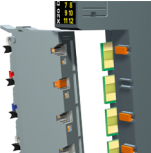
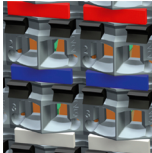
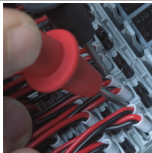
Simple, tool-free wiring for fast installation. The X20 system terminal blocks use a fully integrated and proven push-in connector system. Each terminal can also handle double wire sleeves up to a diameter of 2x 0.75 mm². The user saves time wiring the system multiple times and distributing the signals.

The wire connections can be removed with a screwdriver. Each terminal also has an access point for a measurement probe.



Notice!

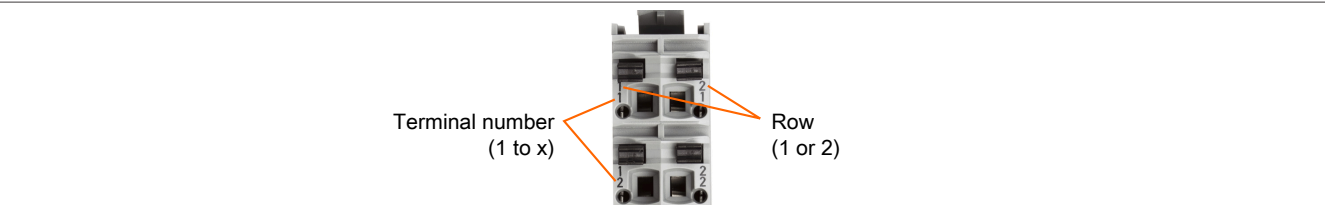
To avoid damaging the terminals, the X20AC0SD1 B&R screwdriver should be used.

	Detached The terminals can be prewired apart from the actual I/O module. This provides many advantages for control cabinet construction. Separate manufacturing, just-in-time logistics and the installation of pre-assembled systems during start-up become reality.		Tool-free Simple, tool-free wiring for fast installation. The X20 system terminals use a fully integrated and proven push-in connector system. Available with 6-pin and extremely compact 12-pin terminals.
	Coded in the system Factory coding prevents dangerous mix-ups. Coding guarantees that only parts which are permitted to be combined can be combined. Intuitively and without additional work.		Ergonomic Component density does not have to negatively affect ergonomics. With terminal spacing of more than 5 mm, this was handled optimally on the X20 system. Experience gained in the field - used in the field.
	Coded in the application Faulty terminal connections do not necessarily destroy electronics, but always result in malfunction of the system. Application coding prevents this problem.		Unmistakable Distinct forms intuitively define various functions, such as clearly assigned latching and unlatching functions for terminals. This prevents errors from the very beginning.
	Labeling Each terminal is clearly labeled, directly in the plastic. Additional label tags are available as system accessories including a printer with ECAD connection.		Easy servicing A system's strengths can be seen in its details: In addition to the terminal connector and unlocking mechanism, each terminal has an access point for a test probe. You can easily measure the terminal potential without disconnecting the wire.

3.1.4.2 Unique terminal numbering

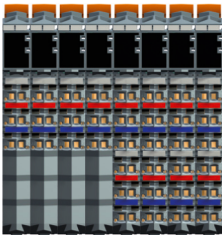
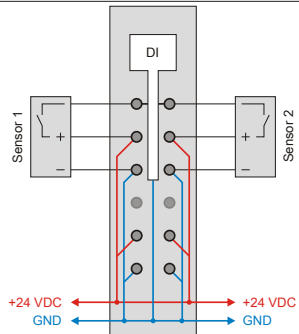
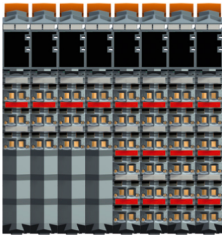
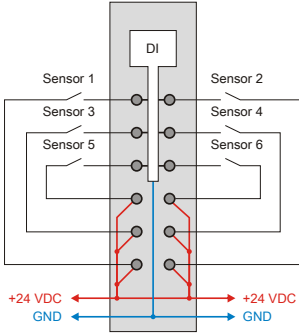
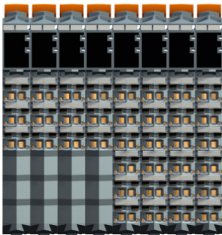
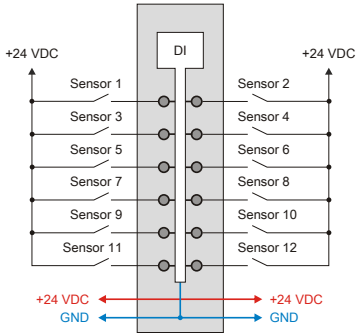
Each terminal connection is unique and can be identified by the numbers in the plastic. In this way, terminal assignments can be clearly assigned in the planning stage without any danger of mix-up.

- Upper number: Row number 1 or 2
- Lower number: Terminal numbers 1 to 3 (6-pin terminal block), 1 to 6 (12-pin terminal block), 1 to 8 (16-pin terminal block)



3.1.5 Uniform 1-wire, 2-wire, 3-wire connections

Consistent connection types for all requirements without additional jumper terminals. In addition, all connection types can be combined as desired.

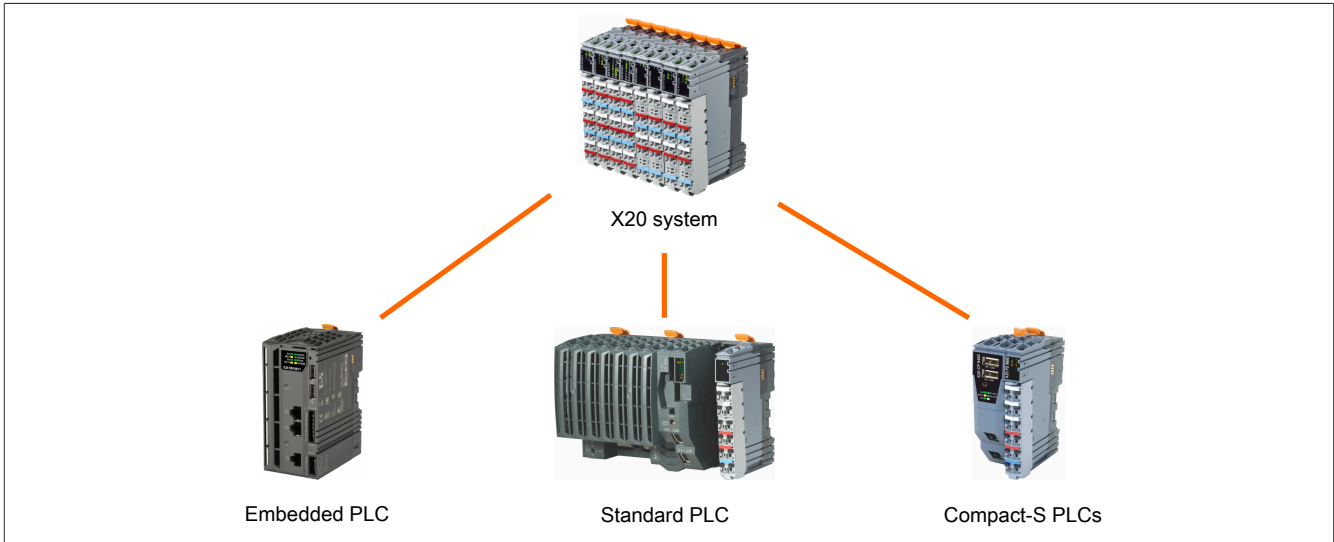
3-wire connections Integrated supply and ground for sensors and actuators.		
2-wire connections No extra terminals needed.		
1-wire connections 12 channels - results in high integration density		

3.2 Complete system

3.2.1 X20 controllers

The controller series of the X20 system cover a wide range of requirements. The area of use starts with simple applications where cycle times in the millisecond range are sufficient and extends to applications with the highest performance requirements. Even cycle times of 100 µs can be used effectively.

In terms of design, the controllers correspond to the X20 system. The X20 I/O modules are connected directly to the controller. These fit seamlessly with the controller. The entire system can thus be accommodated in the control cabinet to save space. The supply for the controller, the X2X Link power supply and the I/O modules are part of the controller. Additional power supply modules are not required.



All controllers can be divided into the following series:

- [Standard controllers](#)
- [Compact-S controllers](#)
- [Embedded controllers](#)

3.2.1.1 Properties

Connections

The direct I/O connection to an X20 controller offers all the advantages of the [remote backplane](#) without restriction, i.e. the possibility to connect the I/O segment at any point and almost as often as required using cables up to 100 m or to add modules with IP67 protection.

Programming

B&R Automation Studio is the only programming tool needed for all platforms. All relevant IEC 61131-3 languages and C can be used to create the application software.

Depending on the controller series, integrated HMI, NC and soft CNC functions or web server technologies complete the application possibilities.

Industrial strength

A broad performance spectrum, standard interfaces and additionally expandable with interface modules – the dimensions are nevertheless compact. The size and shape of the controller is adapted to the X20 modules and thus does not take up any unnecessary control cabinet space.

All processor variants are fanless and thus nearly maintenance-free.

Integrated power supply unit

A power supply unit with I/O supply terminals integrated in the controller supplies the backplane and I/O sensors or actuators. This eliminates the need for additional system components.

3.2.1.2 Controller series

To cover a wide range of requirements, X20 controllers are offered in different series.

Standard controllers

Based on Intel Atom processor technology, this series covers a wide range of requirements. The range of use extends from standard applications to applications with high performance requirements.

The basic configuration includes USB, Ethernet, POWERLINK V1/V2 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.

- CPU clock frequency from 100 to 1600 MHz
- Ethernet, POWERLINK V1/V2 with poll-response chaining and onboard 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

Compact-S controllers

The controllers in the X20 Compact-S family are available in different variants. This way, customers get the product that best meets the requirements of the machine – technically and economically.

The processor performance of the compact CPUs ranges from 166 MHz (compatible) to 667 MHz. The most economical variant is equipped with 128 MB RAM, 8 kB nonvolatile RAM and a 256 MB flash drive. The most powerful variant of the Compact-S controllers achieves cycle times down to 400 µs. It is equipped with 512 MB RAM, 64 kB nonvolatile RAM and a 2 GB internal flash drive.

With POWERLINK, Ethernet, USB and RS232, the controllers offer a wide range of communication options. An optional RS485 or CAN interface is available. If the application requires additional interfaces, the controller can be modularly expanded by 1 or 2 X20 interface slots. This allows the entire product range of X20 fieldbus interfaces to be used.

The fanless, battery-free design of Compact-S controllers means they are completely maintenance-free.

- CPU clock frequency from 166 to 667 MHz
- Depending on the variant: POWERLINK with poll-response chaining
- 2x onboard USB
- Up to 2 slots for modular interface expansions
- 128 to 256 MB DDR3 SDRAM
- 256 MB to 2 GB onboard flash drive
- Fanless with no batteries
- Width
 - Without fieldbus slot: 37.5 mm
 - 1 fieldbus slot: 62.5 mm
 - 2 fieldbus slots: 87.5 mm

Embedded controllers

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

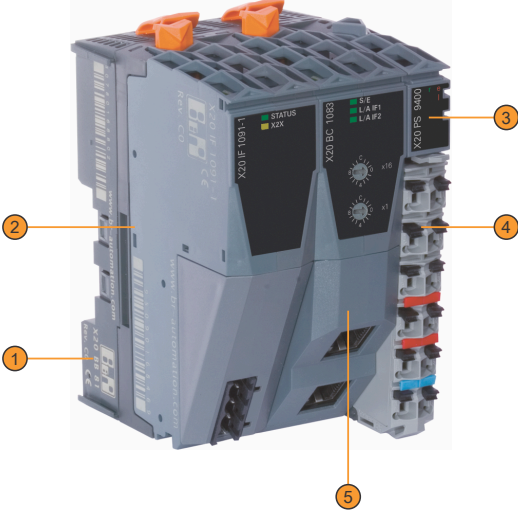
3.2.2 Bus controllers

Bus controllers consist of a base module, power supply module for providing power to the entire system and the fieldbus interface. This makes the bus controller an extremely flexible fieldbus interface.

In contrast to a controller with integrated fieldbus connection, the bus controller does not have to be programmed to transfer or receive I/O data on the fieldbus. It works simply by configuring it on the fieldbus master.

Expandable bus controllers

On expandable bus controllers, up to 2 interface or hub expansion modules can be connected depending on the bus module being used.

Standard bus controller	Expandable bus controller
 1 Bus module 2 Bus controller 3 Power supply module 4 Terminal block	 1 Bus module 2 Interface module or X20HB288x 3 Power supply module 4 Terminal block 5 Bus controller

Compact design

The power supply for the bus controller, X2X Link network and I/O modules is part of the bus controller. No additional power supply modules are required.

3.2.2.1 For all fieldbuses, integrated via standard

A bus controller allows the X20 system to be used as an efficient I/O expansion. This makes the X20 system ideal for expanding existing control systems via standard fieldbuses.

Using standardized EDS or GSD description files, the X20 system components are integrated, configured and programmed in the programming environment of a non-B&R system as usual.



















3.2.3 Safety technology

Integrated safety technology

Seamless integration of safety technology in the standard application is a reality with B&R's safety technology products. This allows fixed wiring to be replaced by safe data transfer via the existing machine bus system. Flexibly configured or programmed safety behavior can be adapted optimally to various safety situations. Complete diagnostic information about safety components accessible via the machine bus system provides detailed data about the state of the machine.

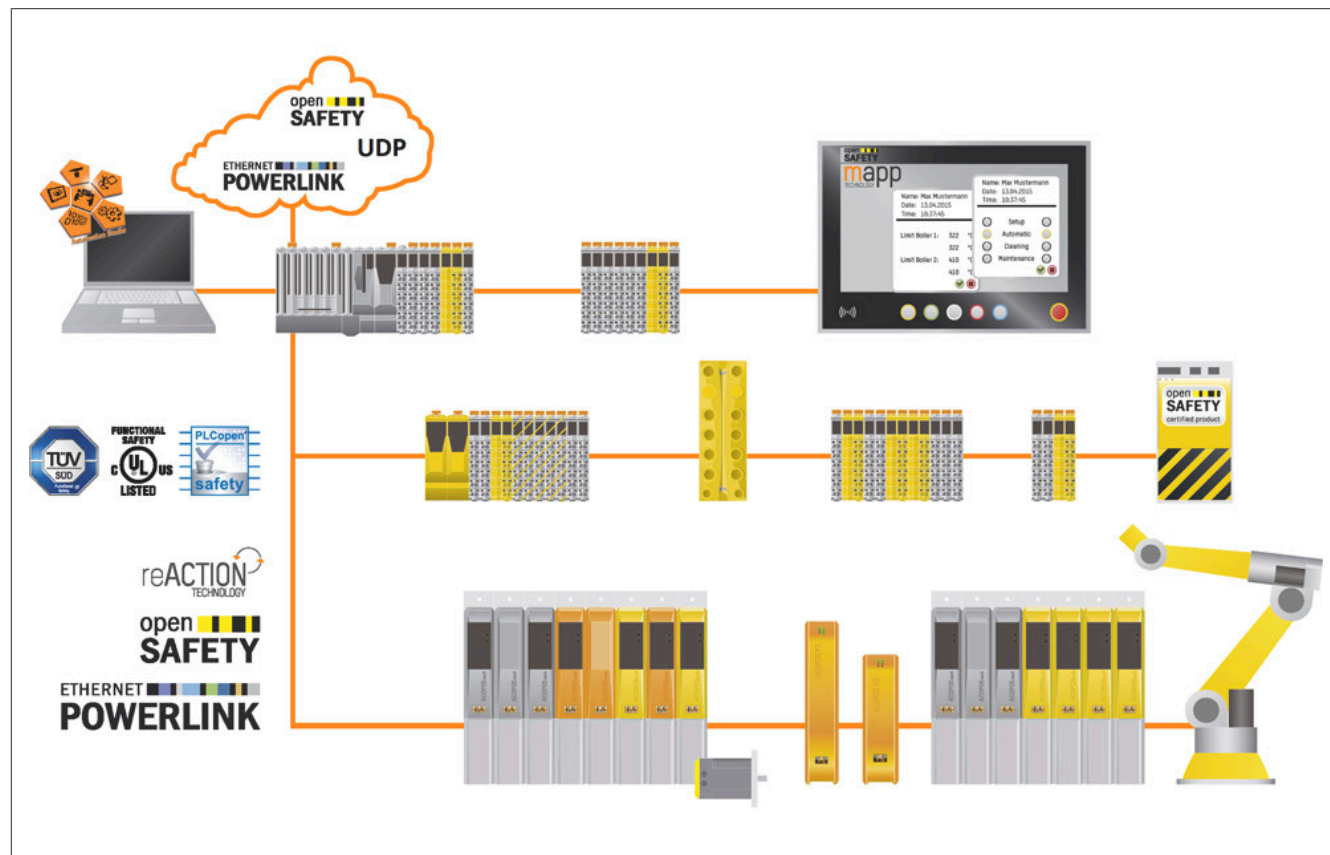


Figure 1: Use in machine manufacturing

Who knew safety could be so productive?



Conventional safety technology generally means stopping the entire machine group when even the smallest disturbance occurs. B&R's Smart Safe Reaction uses a completely different approach. Flexible safety functions such as Safe Direction or Safely Limited Increment are integral parts of the drive system and allow service work to be performed during operation. This minimizes the time and effort required for service and installation work and also eliminates the motivation to tamper with the system.

Avoid stress during maintenance

B&R safety technology even makes things easier for service personnel in cases where a component needs to be replaced. Configurations and parameters are stored centrally on the SafeLOGIC controller and distributed via the bus system using certified mechanisms. The functionality of the safety application remains intact at all times. The ability to remove and reconnect fully-wired cable terminals eliminates the error-prone task of rewiring sensors and actuators. B&R safety technology ensures that – even after many years and countless maintenance calls – a machine offers the same level of safety that it did when it was first delivered.

Individual configuration



The general approach taken with series-produced machinery is to equip it with a suite of customization options. This approach places special demands on the safety technology that cannot be met by traditional safety solutions. Smart Safe Reaction from B&R makes SafeOPTION technology manageable without compromising the safety level.

System features

Safe line integration



The average production line is a conglomeration of machines from various vendors. With integrated, network-based safety technology from B&R, the entire line is able to react to safety events in a coordinated way. Safe communication is provided by the bus-independent safety standard openSAFETY.

Global installations



Network-based safety solutions from B&R are designed to be used anywhere in the world. Integrated diagnostic functions turn any smartphone into a highly effective troubleshooting instrument able to perform rapid and precisely targeted remote service. Across global markets, international certifications guarantee smooth implementation.

Integrated safety technology products are certified for use in safety applications up to:

- EN ISO 13849, PL e
- EN 62061, SIL 3
- IEC 61508, SIL 3
- IEC 61511, SIL 3

Ultimate scalability

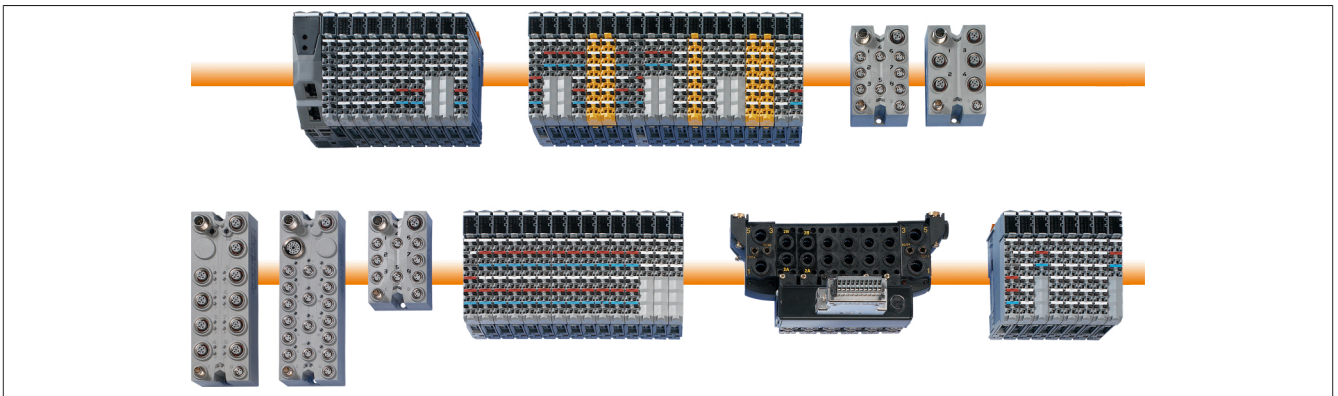


X20 SafeLOGIC, X20 SafeLOGIC-X and X90 SafeLOGIC controllers allow B&R to provide scalable and therefore continuously cost-optimized safety solutions. The hardware components and functions are fully compatible regardless of the safety controller selected.

3.2.4 Integrated valve terminal control

The XV system enables direct and vendor-independent control of valve terminals. It is a complete digital output module comparable in size and shape to a normal DSUB connector. Connected directly into the standardized multi-pin connector of the valve terminal, XV allows the valve terminal manufacturer to be freely selected.

Fully integrated into the remote backplane, it completes the X20 and X67 for complete automation solutions. You can select your automation components and distribute them as needed inside and outside the control cabinet.



3.2.5 IP67 - Then X67

The X67 is the robust version of the X20 for use outside the control cabinet. The same basic technology, with an extremely robust housing and 4 to 32 channel modules, guarantees economical solutions in the roughest conditions.

3.3 Technologies and special types

3.3.1 Backplane bus

X2X Link and X2X+ are available for the backplane bus. All modules are connected to a uniform backplane (X2X Link or X2X+) for this purpose.

The X2X Link backplane bus has a very flexible design. X2X Link bus modules can either be lined up directly or the next station can be up to 100 m away. Directly lined-up X20, X67 or XV modules can be placed at distances of up to 100 m outside of the boundaries of the control cabinet. This creates a continuous remote backplane that is used for communication between bus modules as well as via the X2X Link cable.



Information:

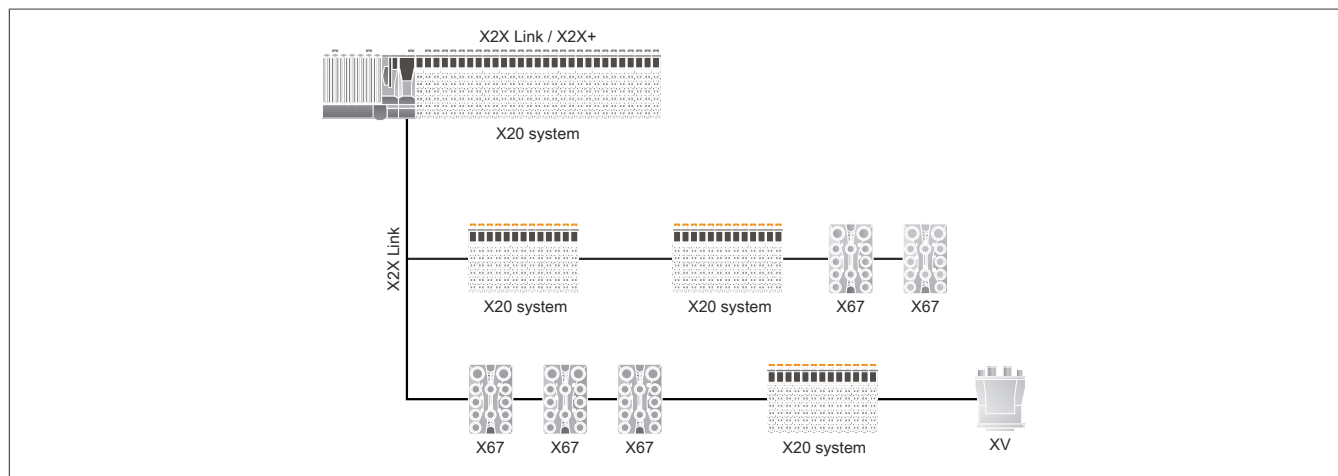
An X2X Link cable with a length of 100 m is available from B&R for custom assembly (material number: X67CA0X99.1000).

If high performance is required, the X2X+ backplane bus is used. This requires an X2X+ capable controller and X2X+ bus modules. The X2X+ bus modules are lined up directly here as well.



Information:

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. Displacement via cable is currently not possible with X2X+.



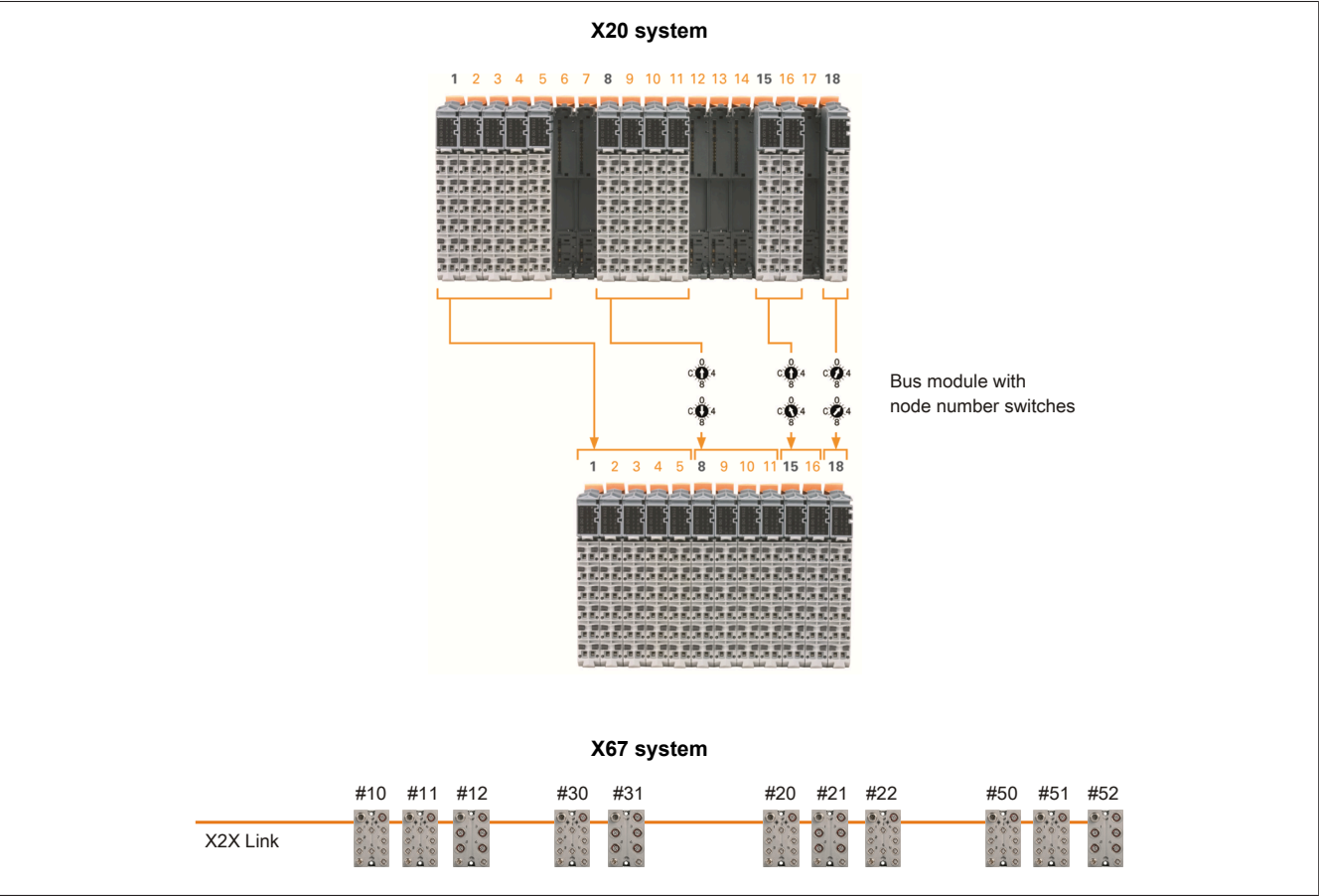
System features

3.3.1.1 Configurable X2X Link address

The remote X2X Link backplane, which connects the individual I/O modules with each other, is set up to be self-addressing. Because of this, it is not necessary to set the node numbers. The module address is assigned according to its position in the X2X Link line.

In certain cases, e.g. when configurations of modular machines change, it is necessary to define specific module groups at a fixed address, regardless of the preceding modules in the line.

For this purpose, there are modules in both the X20 system and the X67 system with node number switches that allow the X2X Link address to be set. All subsequent modules refer to this offset and use it automatically for addressing purposes.



3.3.1.2 Coding of bus modules

The locking levers of X2X bus modules are color-coded or coded with a symbol. This means that even with a fully assembled X20 System, it is clear from the outside what type of bus module it is.

X2X bus module	X2X bus module with node number switch	X2X+ bus module
Orange	Orange with symbol	Gray
		

3.3.2 Coated modules

Coated modules are X20 modules with a protective coating for the electronics component. The modules' electronics are fully compatible with the corresponding X20 modules. From an installation point of view, these modules are treated just the same as standard X20 modules.

3.3.2.1 X20c standard modules

Differences compared to uncoated X20 modules:

- Suitable for operation in adverse atmospheric conditions
- Suitable for operation in 100% humidity, condensing
- Coated modules have a different module ID than the corresponding uncoated modules.

The protective coating has been certified according to the following standards:

- Simulation of transport and storage: EN 60068-2-14, Test Nb
- Condensation: BMW GL 95011-4
- Corrosive gas: EN 60068-2-60, Method 4, exposure 21 days
- Condensation: BMW GS 95011-4



3.3.2.2 X20c safety modules

Differences compared to uncoated X20 safety modules:

- Extended temperature range [see "Environmental characteristics" on page 221](#)
- Suitable for operation in 100% humidity, condensing
- Coated modules have a different module ID than the corresponding uncoated modules.

The coating has been certified according to the following standards:

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

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



3.3.3 Redundancy

The X20 system provides the following forms of redundancy:

- Controller
- Network
- Power supply modules for X20 standalone devices and expandable POWERLINK bus controllers
- X2X Link supply

The first 3 areas are covered in user's manual "Redundancy for control systems". This user's manual is available in the Downloads section under www.br-automation.com.

For a description of the redundant X2X Link power supply, see section ["X2X Link supply" on page 113](#).

3.3.4 reACTION technology

X20 Compact controllers and some I/O modules are equipped with ultrafast reACTION Technology. This allows the I/Os integrated in the reACTION module to be controlled with response times down to 1 μ s. Particularly time-critical subtasks can be implemented with the new technology in standard hardware, simultaneously enabling a reduction in costs since the load on the controller can be optimally reduced and allowing it to be more economically dimensioned accordingly.

All of the commands that can be used for reACTION programs are provided as function blocks in special libraries (e.g. AsIORTI). Programming using the standard Function Block Diagram (FBD) editor in Automation Studio is compliant with IEC 61131-3.

Documentation for reACTION technology is included in the Automation Studio help system.



3.4 Diagnostics

Outstanding diagnostic options are needed for errors to be found quickly. The X20 system offers several levels of diagnostics:

- Direct on the module using visual LED displays. Bus status, I/O status and channel states are displayed in direct relationship to the channels or the function. The different states are displayed in different ways, e.g. green for OK, red for error.
For details, see "[Diagnostic LEDs](#)" on page 223.
- Via software in the cyclic data image. With the X20 system, status data does not result in an additional communication load, which would result in considerable differences between theoretically possible bus speeds and real requirements during operation. All necessary status data is always transferred cyclically, with no exceptions.
- Expanded diagnostic data in acyclic data traffic without loss in performance. If a problem occurs, detailed diagnostic data can be requested from the application by the respective module using an asynchronous channel. This does not result in additional communication load and cycle times remain unchanged.



3.4.1 Embedded parameter chip

Information such as module type, serial number, functionality and version number is contained in the embedded parameter chip of the X20 module. This information is automatically evaluated by the programming environment (Automation Studio) and by the application program. This prevents errors during both commissioning and service. In addition, the system configuration is automated and flexible variations are made possible.



Information:

All modules that require 0.01 W of power on the X2X Link network must be supplied via the internal I/O power supply. If the I/O power supply fails, the module shuts down and communication is lost.

In this case ModuleOk returns the value "False" and data can no longer be read.

4 Module overviews



Information:

The following overviews contain all currently available modules. Modules that have already been discontinued are not included.

4.1 Standard modules

4.1.1 Module overview: Alphabetical

Order number	Module type	Description	Special functions
X20AI1744	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 kHz input filter
X20AI1744-3	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 Hz input filter
X20AI1744-10	Analog input module	• 1 strain gauge full bridge input, 10 V, 24-bit converter resolution	• 5 kHz input filter
X20AI2222	Analog input module	• 2 analog inputs, ± 10 V, 13-bit converter resolution	
X20AI2237	Analog input module	• 2 analog inputs, ± 10 V, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • NetTime function
X20AI2322	Analog input module	• 2 analog inputs, 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution	
X20AI2437	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • NetTime function
X20AI2438	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • Supports HART protocol • NetTime function
X20AI2622	Analog input module	• 2 analog inputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AI2632	Analog input module	• 2 analog inputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• Oscilloscope functions
X20AI2636	Analog input module	• 2 analog inputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• Oversampling functions
X20AI4222	Analog input module	• 4 analog inputs, ± 10 V, 13-bit converter resolution	
X20AI4322	Analog input module	• 4 analog inputs, 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution	
X20AI4622	Analog input module	• 4 analog inputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AI4632	Analog input module	• 4 analog inputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• Oscilloscope functions
X20AI4632-1	Analog input module	• 4 analog inputs, ± 11 V or 0 to 22 mA, 16-bit converter resolution	• Oscilloscope functions
X20AI4636	Analog input module	• 4 analog inputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• Oversampling functions
X20AI8221	Analog input module	• 8 analog inputs, ± 10 V, 13-bit converter resolution	
X20AI8321	Analog input module	• 8 analog inputs, 0 to 20 mA, 12-bit converter resolution	
X20AIA744	Analog input module	• 2 full-bridge strain gauge inputs, 24-bit converter resolution	• 2.5 kHz input filter
X20AIB744	Analog input module	• 4 full-bridge strain gauge inputs, 24-bit converter resolution	• 2.5 kHz input filter

Order number	Module type	Description	Special functions
X20AO2437	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated
X20AO2438	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated • Supports HART protocol • NetTime function
X20AO2622	Analog output module	• 2 analog outputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AO2632	Analog output module	• 2 analog outputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• NetTime function
X20AO4622	Analog output module	• 4 analog outputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AO4632	Analog output module	• 4 analog outputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	
X20AO4632-1	Analog output module	• 4 analog outputs, ± 11 V or 0 to 22 mA, 16-bit converter resolution	• NetTime function
X20AO4635	Analog output module	• 4 analog outputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	• Low temperature drift
X20AP3111	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 20 mA AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3121	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 1 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3122	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 1 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function • Groundable
X20AP3131	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 5 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3132	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 5 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function • Groundable
X20AP3161	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 333 mV AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3171	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, Rogowski adjustable (μ V/A), max. 52 mV	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AT2222	Temperature input module	• 2 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20AT2311	Temperature input module	• 2 resistance measurement inputs, Pt100, resolution 0.001°C	
X20AT2402	Temperature input module	• 2 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	
X20AT4222	Temperature input module	• 4 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20AT4232	Temperature input module	• 4 resistance measurement inputs, NTC 10 k Ω , resolution 0.1°C	
X20AT6402	Temperature input module	• 6 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	
X20ATA312	Temperature input module	• 2 resistance measurement inputs, Pt100, resolution 0.01°C	• NetTime function
X20ATA492	Temperature input module	• 2 thermocouple inputs, type J, K, N, S, B, R, E, C, T	• Single channel galvanically isolated • 2x Pt1000 integrated in the terminal block • NetTime function
X20ATB312	Temperature input module	• 4 resistance measurement inputs, Pt100, resolution 0.01°C	• NetTime function
X20ATC402	Temperature input module	• 6 thermocouple inputs, type J, K, N, S, B, R, E, C, T	• 2x Pt1000 integrated in the terminal block • NetTime function

Module overviews

Order number	Module type	Description	Special functions
X20BB52	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 interface	
X20BB53	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS485 interface	
X20BB57	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 and CAN bus interface	
X20BB62	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 interface 1 slot for X20 interface module	
X20BB63	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS485 interface 1 slot for X20 interface module	
X20BB67	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 and CAN bus interface 1 slot for X20 interface module	
X20BB72	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 interface 2 slots for X20 interface modules	
X20BB77	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 and CAN bus interface 2 slots for X20 interface modules	
X20BB80	Bus bases	For base module (BC, HB ...) and power supply module	
X20BB80X	Bus controller base	For bus controller X20BC008T and power supply module	
X20BB81	Bus bases	- For base module (BC, HB ...) and power supply module 1 slot for X20 add-on module (IF, HB ...)	
X20BB82	Bus bases	- For base module (BC, HB ...) and power supply module 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20BC0043-10	Bus controllers	1 CANopen interface	
X20BC0063	Bus controllers	1 PROFIBUS DP interface 9-pin DSUB connector	
X20BC0073	Bus controllers	1 CAN I/O interface	
X20BC0083	Bus controllers	1 POWERLINK interface 2x RJ45	Integrated 2-port hub
X20BC0087	Bus controllers	1 Modbus/TCP or Modbus/UDP interface 2x RJ45	Integrated 2-port switch
X20BC0088	Bus controllers	1 EtherNet/IP interface 2x RJ45	Integrated switch
X20BC008T	Bus controllers	1 OPC UA FX Ethernet interface 2x RJ45	Integrated 2-port switch
X20BC008U	Bus controllers	1 OPC UA Ethernet interface	
X20BC00E3	Bus controllers	1 PROFINET IO interface 2x RJ45	Integrated 2-port switch
X20BC00G3	Bus controllers	1 EtherCAT interface 2x RJ45	
X20BC0143-10	Bus controllers	1 CANopen interface 9-pin DSUB connector	
X20BC1083	Bus controller	1 POWERLINK interface 2x RJ45	- Integrated 2-port hub - Supports expansion with X20 interface modules
X20BC8083	Bus controller	1 POWERLINK interface 2x RJ45	- Integrated 2-port hub - Supports expansion with X20 hub modules
X20BC8084	Bus controller	1 POWERLINK interface 2x RJ45	1x link selector for POWERLINK cable redundancy - Supports expansion with active X20 hub modules
X20BM01	Power supply bus module	24 VDC keyed - Internal I/O power supply interrupted to the left	
X20BM01X	Power supply bus module	24 VDC keyed - Internal I/O power supply interrupted to the left	X2X+
X20BM05	Power supply bus module	24 VDC keyed - Internal I/O power supply interrupted to the left	With node number switch
X20BM11	Bus module	24 VDC keyed - Internal I/O power supply connected through	
X20BM11X	Bus module	24 VDC keyed - Internal I/O power supply connected through	X2X+
X20BM12	Bus module	240 VAC keyed - Internal I/O power supply connected through	

Order number	Module type	Description	Special functions
X20BM15	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	• With node number switch
X20BM21	Power supply bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply interrupted to the left	
X20BM31	Bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply connected through	
X20BM32	Bus module	• For double-width modules • 240 VAC keyed • Internal I/O power supply connected through	
X20BR7300	Bus receiver	• CAN I/O, power supply for X2X Link and internal I/O power supply	
X20BR9300	Bus receiver	• X2X Link, supply for X2X Link and internal I/O power supply	
X20BT9100	Bus transmitter	• X2X Link, supply for internal I/O power supply	
X20BT9400	Bus transmitter	• X2X Link, supply for internal I/O power supply • X2X Link power supply for X67 modules	
X20CM0985	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A, changeover contact • 8 analog inputs, ± 480 V / 120 V, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	
X20CM0985-02	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A • 8 analog inputs, ± 480 V / 120 V, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	• Additional software functionalities
X20CM0985-1	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A • 8 analog inputs, ± 480 V / 120 V, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	• Additional software functionalities
X20CM1941	Resolver module	• 14-bit resolver input, converter up to 12-bit • ABR output	
X20CM4323	PWM module	• 4 digital outputs for switching electromechanical loads, 24 VDC	• Oversampling output functions • NetTime function
X20CM4800X	Vibration measurement	• 4 IEPE analog inputs, 50 kHz sampling frequency, 24-bit converter resolution	
X20CM4810	Vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	• Extensive vibration analysis and evaluation
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ± 10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ± 10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement
X20CM8323	PWM module	• 8 digital outputs for switching electromechanical loads, 0.6 A continuous current, 2 A peak current	• Power monitoring • Switching instant detection
X20CMR010	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • 512 kB flash memory for user data
X20CMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data
X20CMR100	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • Integrated Technology Guard
X20CMR111	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data • Integrated Technology Guard
X20CP0410	Compact-S controller	• ARM Cortex A9-166 compatible • 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive on board • Interfaces: - 2x USB - 1x RS232	

Module overviews

Order number	Module type	Description	Special functions
X20CP0411	Compact-S controller	- ARM Cortex A9-240 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T	
X20CP0420	Compact-S controller	- ARM Cortex A9-166 compatible 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T	2-Port switch
X20CP0482	Compact-S controller	- ARM Cortex A9-300 128 MB DDR3 RAM, 16 kB FRAM, 1 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0483	Compact-S controller	- ARM Cortex A9-500 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0484	Compact-S controller	- ARM Cortex A9-667 256 MB DDR3 RAM, 64 kB FRAM, 2 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0484-1	Compact-S controller	- ARM Cortex A9-667 512 MB DDR3 RAM, 64 kB FRAM, 2 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP1684	Controller	- Atom 0.4 GHz (compatible) 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP1685	Controller	- Atom 0.8 GHz 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP1686X	Controller	- Atom 1.3 GHz 1 GB DDR4 RAM, 1 MB SRAM, 2 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module
X20CP3684	Controller	- Atom 0.4 GHz (compatible) 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 3 slots for interface modules 2 USB interfaces - 2x USB - 1 RS232 1 Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module

Order number	Module type	Description	Special functions
X20CP3685	Controller	- Atom 0.8 GHz 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP3686X	Controller	- Atom 1.3 GHz 1 GB DDR4 RAM, 1 GB SRAM, 2 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module
X20CP3687X	Controller	- Atom 1.6 GHz 2 GB DDR4 RAM, 1 MB SRAM, 2 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module
X20CS1012	Interface module	• 1 M-Bus master interface	
X20CS1013	Interface module	• 1 DALI master interface	
X20CS1020	Interface module	• 1 RS232 interface	
X20CS1030	Interface module	• 1 RS422/485 interface	
X20CS1070	Interface module	• 1 CAN bus interface	
X20CS2770	Interface module	• 2 CAN bus interfaces	
X20DC1073	Digital counter module	• 1x SinCos, 1 Vpp, 400 kHz input frequency	- Encoder monitoring - NetTime function
X20DC1176	Digital counter module	• 1 ABR incremental encoder, 5 V, 600 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1178	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	- Encoder monitoring - NetTime function
X20DC1196	Digital counter module	• 1 ABR incremental encoder, 5 V, 600 kHz input frequency	• 4x evaluation
X20DC1198	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	
X20DC11A6	Digital counter module	• 1 ABR incremental encoder, 5 V, 5 MHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1376	Digital counter module	• 1 ABR incremental encoder, 24 V, 100 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC137A	Digital counter module	• 1 ABR incremental encoder, 24 V, (differential), 300 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1396	Digital counter module	• 1 ABR incremental encoder, 24 V, 100 kHz input frequency	• 4x evaluation
X20DC1976	Digital counter module	• 1 ABR incremental encoder, 5 V, (single-ended), 250 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC2190	Digital counter module	- Ultrasonic path measurement module 2 path measuring rods	• 4 path detection
X20DC2395	Digital counter module	- Optionally configurable: - 1 SSI absolute encoder, 24 V - 1 ABR incremental encoder, 24 V - 2 AB incremental encoders, 24 V - 4 event counters or 2 PWM	• Local time measurement functions
X20DC2396	Digital counter module	• 2 ABR incremental encoders, 24 V • 100 kHz input frequency	• 4x evaluation
X20DC2398	Digital counter module	2 SSI absolute encoders, 24 V 125 kbit/s, 32-bit	
X20DC4395	Digital counter module	- Optionally configurable: - 2 SSI absolute encoders, 24 V - 2 ABR incremental encoders, 24 V - 4 AB incremental encoders, 24 V - 8 event counters or 4 PWM	• Local time measurement functions
X20DI0471	Digital input module	• 10 digital inputs, 5-48 VDC, sink	
X20DI2371	Digital input module	• 2 digital inputs, 24 VDC, sink	
X20DI2372	Digital input module	• 2 digital inputs, 24 VDC, source	
X20DI2377	Digital input module	• 2 digital inputs, 24 VDC, sink	• 2 event counters, 50 kHz
X20DI4371	Digital input module	• 4 digital inputs, 24 VDC, sink	
X20DI4372	Digital input module	• 4 digital inputs, 24 VDC, source	
X20DI4375	Digital input module	• 4 digital inputs, 24 VDC, sink	• Open-circuit and short-circuit detection
X20DI4653	Digital input module	• 4 digital inputs, 100 to 240 VAC	• 240 V keyed

Module overviews

Order number	Module type	Description	Special functions
X20DI4760	Digital input module	• 4 NAMUR inputs, 8.05 V	
X20DI6371	Digital input module	• 6 digital inputs, 24 VDC, sink	
X20DI6372	Digital input module	• 6 digital inputs, 24 VDC, source	
X20DI6373	Digital input module	• 6 digital inputs, 24 VDC, sink/source	• All inputs floating
X20DI6553	Digital input module	• 6 digital inputs, 100 to 120 VAC	• 240 V keyed
X20DI8371	Digital input module	• 8 digital inputs, 24 VDC, sink	
X20DI9371	Digital input module	• 12 digital inputs, 24 VDC, sink	
X20DI9372	Digital input module	• 12 digital inputs, 24 VDC, source	
X20DID371	Digital input module	• 8 digital inputs, 24 VDC, sink	
X20DIF371	Digital input module	• 16 inputs, 24 VDC, sink	
X20DIF372	Digital input module	• 16 inputs, 24 VDC, source	
X20DM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20DMF320	Digital mixed module	• 16 digital inputs, 24 VDC, sink • 16 digital inputs/outputs, 24 VDC, 0.5 A, source • Optionally configurable: – 2 ABR incremental encoders – 2 event counters – 3 PWM outputs	
X20DO2321	Digital output module	• 2 digital outputs, 24 VDC, 0.5 A, sink	
X20DO2322	Digital output module	• 2 digital outputs, 24 VDC, 0.5 A, source	
X20DO2633	Digital output module	• 2 Triac outputs, 48 to 240 VAC, 2 A, L-switching	• Phase-angle control • 240 V keyed
X20DO2649	Digital output module	• 2 relays, changeover contacts, 240 VAC / 5 A, 24 VDC / 5 A	
X20DO4321	Digital output module	• 4 digital outputs, 24 VDC, 0.5 A, sink	
X20DO4322	Digital output module	• 4 digital outputs, 24 VDC, 0.5 A, source	
X20DO4332	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source	
X20DO4332-1	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source, PWM output	
X20DO4529	Digital output module	• 4 relays, changeover contacts, 115 VAC / 0.5 A, 24 VDC / 1 A	
X20DO4613	Digital output module	• 4 triac bus controller outputs, 48 to 240 VAC, 50 mA	• Zero-crossing detection • 240 V keyed
X20DO4623	Digital output module	• 4 digital outputs, 100 to 240 VAC, 0.5 A, source	• 240 V keyed
X20DO4633	Digital output module	• 4 Triac outputs, 48 to 240 VAC, 1 A, L-switching	• Phase-angle control • 240 V keyed
X20DO4649	Digital output module	• 4 relays, normally open contacts, 240 VAC / 5 A	
X20DO4F49	Digital output module	• 4 relays, 2x normally open contacts, 2x changeover contacts, 240 VAC / 2 A, 250 VDC / 0.28 A	
X20DO6321	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, sink	
X20DO6322	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, source	
X20DO6325	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, source	
X20DO6529	Digital output module	• 6 relays, normally open contacts, 115 VAC / 0.5 A, 30 VDC / 1 A	
X20DO6639	Digital output module	• 6 relays, normally open contacts, 240 VAC / 2 A, 30 VDC / 2 A	
X20DO8232	Digital output module	• 8 digital outputs, 12 VDC, 2 A, source	• Supply directly on module
X20DO8322	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, source	
X20DO8323	Digital output module	• 8 digital outputs, 12 to 24 V, 0.5 A, sink/source	• Full-/Half-bridge • Thermal overload protection
X20DO8331	Digital output module	• 8 digital outputs, 24 VDC, 2 A, sink	• Supply directly on module
X20DO8332	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module
X20DO8332-1	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module • Optimized for inductive loads
X20DO9321	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, sink	
X20DO9322	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, source	
X20DOD322	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, source	
X20DOF321	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, sink	
X20DOF322	Digital output module	• 16 digital outputs, 24 VDC, 0.5 A, source	
X20DS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20DS1319	Multifunctional digital signal processor	• 4 digital input channels • 4 digital inputs/outputs • Optionally configurable: – 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses – SSI absolute encoder	• NetTime function
X20DS1828	Digital signal module	• 1 HIPERFACE interface	• NetTime function

Order number	Module type	Description	Special functions
X20DS1928	Digital signal module	• 1 EnDat 2.1/2.2 interface	• NetTime function
X20DS4389	Digital signal module	• 4 digital inputs, 24 VDC • 4 digital outputs, 24 VDC, 0.1 A	• NetTime function • Oversampling I/O functions
X20DS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20DS838A	Digital signal module	• 8x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20EM0611	Embedded controller	• Atom 0.4 GHz (compatible) • 512 MB DDR4 RAM, 64 kB FRAM, • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM0612	Embedded controller	• Atom 0.8 GHz • 768 MB DDR4 RAM, 64 kB FRAM • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM0613	Embedded controller	• Atom 1.3 GHz • 1 GB DDR4 RAM, 64 kB FRAM • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 2 GB onboard flash drive
X20EM1611	Embedded controller	• Atom 0.4 GHz (compatible) • 512 MB DDR4 RAM, 64 kB FRAM, • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM1612	Embedded controller	• Atom 0.8 GHz • 768 MB DDR4 RAM, 64 kB FRAM • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM1613	Embedded controller	• Atom 1.3 GHz • 1 GB DDR4 RAM, 64 kB FRAM • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 2 GB onboard flash drive
X20ET8819	Ethernet analysis tool	• 2x RJ45	• Expandable with active hub modules
X20HB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20HB1882	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For single-mode fiber optic cable
X20HB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20HB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	
X20HB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	
X20HB2886	Hub expansion module	• Integrated active 2-port hub • 2x fiber optic cable connectors	
X20HB8815	POWERLINK TCP/IP gateway	• 2x RJ45	• Expandable with active hub modules
X20HB8880	Hub base module	• Integrated 2-port hub • 2x RJ45	
X20HB8884	Compact link selector	• Integrated Compact Link Selector function • 2x RJ45	
X20IF0000	Dummy module	• Without function	
X20IF1020	Interface module	• 1 RS232 interface, max. 115.2 kbit/s	
X20IF1030	Interface module	• 1 RS422/485 interface, max. 115.2 kbit/s	
X20IF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20IF1043-1	Interface module	• 1 CANopen slave interface	• DTM configuration
X20IF1051-1	Interface module	• 1 DeviceNet scanner (master) interface	• DTM configuration
X20IF1053-1	Interface module	• 1 DeviceNet adapter (slave) interface	• DTM configuration
X20IF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20IF1063	Interface module	• 1 PROFIBUS DP V0 slave interface, max. 12 Mbit/s	
X20IF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20IF1072	Interface module	• 1 CAN bus interface, max. 1 Mbit/s	

Module overviews

Order number	Module type	Description	Special functions
X20IF1082	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function • Integrated 2-port hub
X20IF1082-2	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function, PRC function • Integrated 2-port hub
X20IF1086-2	Interface module	• 1 POWERLINK interface, managing or controlled node • 1 fiber optic connection	• PRC function
X20IF1091	Interface module	• 1 X2X Link master interface	
X20IF1091-1	Interface module	• 1 X2X Link master interface	
X20IF10A1-1	Interface module	• 1 ASi master interface	• DTM configuration
X20IF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20IF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20IF10E1-1	Interface module	• 1 PROFINET IO controller (master) interface	• DTM configuration
X20IF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20IF10G1-1	Interface module	• 1 EtherCAT master interface	• DTM configuration
X20IF10G3-1	Interface module	• 1 EtherCAT slave interface	• DTM configuration
X20IF10X0	Interface module	• 1 redundancy link interface 1000BASE-SX	• PLC-PLC data synchronization module for controller redundancy
X20IF2181-2	Interface module	• 1x link selector for POWERLINK cable redundancy • 2x RJ45	
X20IF2772	Interface module	• 2 CAN bus interfaces, max. 1 Mbit/s	
X20IF2792	Interface module	• 1 CAN bus interface, max. 1 Mbit/s • 1 X2X Link master interface	
X20MM2436	PWM motor module	• 2 PWM motor bridges, 3 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 39 VDC ±25%
X20MM3332	Digital motor module	• 3 digital outputs, full bridge (H bridge) 3 A continuous current, 5 A peak current	• 24 VDC module power supply
X20MM4331	Digital motor module	• 4 digital outputs, half bridge 3 A continuous current, 5 A peak current	• 24 VDC module power supply
X20MM4455	PWM motor module	• 4 PWM motor bridges, 6 A continuous current, 10 A peak current • 4x 3 digital inputs 5 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC ±25%
X20MM4456	PWM motor module	• 4 PWM motor bridges, 6 A continuous current, 10 A peak current • 4x 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC ±25%
X20PD0011	Potential distributor module	• 12x GND	• Integrated fine-wire fuse
X20PD0012	Potential distributor module	• 12x 24 VDC	• Integrated fine-wire fuse
X20PD0016	Potential distributor module	• 5x GND, 5x 24 VDC	• Integrated fine-wire fuse
X20PD0053	Potential distributor module	• 6x GND, 6x 5 VDC	
X20PD2113	Potential distributor module	• 6x GND, 6x 24 VDC	• Integrated fine-wire fuse
X20PS2100	Power supply module	• For internal I/O power supply	
X20PS2110	Power supply module	• For internal I/O power supply	• Integrated fine-wire fuse
X20PS3300	Power supply module	• For X2X Link and internal I/O power supply	
X20PS3310	Power supply module	• For X2X Link and internal I/O power supply	• Integrated fine-wire fuse
X20PS4951	Power supply module	• For 4 potentiometers, ±10 V	
X20PS8002	Power supply module	• For a standalone hub and Compact Link Selector	
X20PS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	
X20PS9402	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	• Supply not galvanically isolated
X20PS9600	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	
X20PS9602	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	• Supply not galvanically isolated
X20RT8001	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs	
X20RT8201	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8202	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog outputs, ±10 V, 2 µs, 13-bit converter resolution	

Order number	Module type	Description	Special functions
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20SM1426	Stepper motor module	• 1 motor connection 1 A continuous current, 1.2 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 VDC -15% / +20%
X20SM1436	Stepper motor module	• 1 motor connection 3 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 39 VDC ±25%
X20SM1436-1	Stepper motor module	• 1 motor connection 2.5 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC ±25% • Current reduction function
X20SM1444-1	Stepper motor module	• 1 motor connection 5 A continuous current, 10 A peak current • 4 digital inputs 5 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC ±25% • Current reduction function • Quick stop / Enable function
X20SM1446-1	Stepper motor module	• 1 motor connection 5 A continuous current, 10 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC ±25% • Current reduction function
X20TB06	Terminal block	• 6-pin, 24 VDC keyed	
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	
X20TB1E	Terminal block	• 12-pin, 24 VDC keyed	• 2x integrated Pt1000 temperature sensor
X20TB1F	Terminal block	• 16-pin, 24 VDC keyed	
X20TB32	Terminal block	• 12-pin, 240 VAC keyed	
X20ZF0000	Dummy module	• Without function	• For terminal blocks X20TB06 and X20TB12
X20ZF0002	Dummy module	• Without function	• 240 VAC keyed
X20ZF000F	Dummy module	• Without function	• For terminal blocks X20TB1E and X20TB1F

4.1.2 Module overview: Grouped

4.1.2.1 Controllers

4.1.2.1.1 Standard controllers

Order number	Module type	Description	Special functions
X20CP1684	Controller	- Atom 0.4 GHz (compatible) 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP1685	Controller	- Atom 0.8 GHz 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP1686X	Controller	- Atom 1.3 GHz 1 GB DDR4 RAM, 1 MB SRAM, 2 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module
X20CP3684	Controller	- Atom 0.4 GHz (compatible) 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 3 slots for interface modules 2 USB interfaces - 2x USB - 1 RS232 - 1 Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP3685	Controller	- Atom 0.8 GHz 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP3686X	Controller	- Atom 1.3 GHz 1 GB DDR4 RAM, 1 GB SRAM, 2 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module
X20CP3687X	Controller	- Atom 1.6 GHz 2 GB DDR4 RAM, 1 MB SRAM, 2 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module

4.1.2.1.2 Embedded controllers

Order number	Module type	Description	Special functions
X20EM0611	Embedded controller	• Atom 0.4 GHz (compatible) • 512 MB DDR4 RAM, 64 kB FRAM, • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM0612	Embedded controller	• Atom 0.8 GHz • 768 MB DDR4 RAM, 64 kB FRAM • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM0613	Embedded controller	• Atom 1.3 GHz • 1 GB DDR4 RAM, 64 kB FRAM • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 2 GB onboard flash drive
X20EM1611	Embedded controller	• Atom 0.4 GHz (compatible) • 512 MB DDR4 RAM, 64 kB FRAM, • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM1612	Embedded controller	• Atom 0.8 GHz • 768 MB DDR4 RAM, 64 kB FRAM • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 1 GB onboard flash drive
X20EM1613	Embedded controller	• Atom 1.3 GHz • 1 GB DDR4 RAM, 64 kB FRAM • 1 slot for X20 interface modules • 2 USB interfaces: - 2x USB - 1 RS485 interface - 1 POWERLINK interface - 1 Ethernet interface	• 2 GB onboard flash drive

4.1.2.1.3 Compact-S controllers

Order number	Module type	Description	Special functions
X20CP0410	Compact-S controller	• ARM Cortex A9-166 compatible • 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive on board • Interfaces: - 2x USB - 1x RS232	
X20CP0411	Compact-S controller	• ARM Cortex A9-240 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash drive onboard • Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T	
X20CP0420	Compact-S controller	• ARM Cortex A9-166 compatible • 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive onboard • Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T	• 2-Port switch

Module overviews

Order number	Module type	Description	Special functions
X20CP0482	Compact-S controller	- ARM Cortex A9-300 128 MB DDR3 RAM, 16 kB FRAM, 1 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0483	Compact-S controller	- ARM Cortex A9-500 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0484	Compact-S controller	- ARM Cortex A9-667 256 MB DDR3 RAM, 64 kB FRAM, 2 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot
X20CP0484-1	Compact-S controller	- ARM Cortex A9-667 512 MB DDR3 RAM, 64 kB FRAM, 2 GB flash drive onboard - Interfaces: - 2x USB - 1x RS232 - 1 Ethernet 10/100BASE-T - 1 POWERLINK	Expandable with X20 interface slot

4.1.2.1.4 System modules and accessories

4.1.2.1.4.1 Available interface modules

The following overview shows the available interface modules for all controllers that can be operated together with interface modules.

Order number	Module type	Description	Special functions
X20IF1020	Interface module	• 1 RS232 interface, max. 115.2 kbit/s	
X20IF1030	Interface module	• 1 RS422/485 interface, max. 115.2 kbit/s	
X20IF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20IF1043-1	Interface module	• 1 CANopen slave interface	• DTM configuration
X20IF1051-1	Interface module	• 1 DeviceNet scanner (master) interface	• DTM configuration
X20IF1053-1	Interface module	• 1 DeviceNet adapter (slave) interface	• DTM configuration
X20IF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20IF1063	Interface module	• 1 PROFIBUS DP V0 slave interface, max. 12 Mbit/s	
X20IF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20IF1072	Interface module	• 1 CAN bus interface, max. 1 Mbit/s	
X20IF1082	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function • Integrated 2-port hub
X20IF1082-2	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function, PRC function • Integrated 2-port hub
X20IF1086-2	Interface module	• 1 POWERLINK interface, managing or controlled node • 1 fiber optic connection	• PRC function
X20IF1091	Interface module	• 1 X2X Link master interface	
X20IF10A1-1	Interface module	• 1 ASi master interface	• DTM configuration
X20IF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20IF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20IF10E1-1	Interface module	• 1 PROFINET IO controller (master) interface	• DTM configuration
X20IF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20IF10G1-1	Interface module	• 1 EtherCAT master interface	• DTM configuration
X20IF10G3-1	Interface module	• 1 EtherCAT slave interface	• DTM configuration
X20IF2181-2	Interface module	• 1x link selector for POWERLINK cable redundancy • 2x RJ45	
X20IF2772	Interface module	• 2 CAN bus interfaces, max. 1 Mbit/s	
X20IF2792	Interface module	• 1 CAN bus interface, max. 1 Mbit/s • 1 X2X Link master interface	

4.1.2.1.4.2 Compact-S controllers - System modules

Order number	Module type	Description	Special functions
X20BB52	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 interface	
X20BB53	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS485 interface	
X20BB57	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 and CAN bus interface	
X20BB62	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 interface • 1 slot for X20 interface module	
X20BB63	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS485 interface • 1 slot for X20 interface module	
X20BB67	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 and CAN bus interface • 1 slot for X20 interface module	
X20BB72	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 interface • 2 slots for X20 interface modules	
X20BB77	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 and CAN bus interface • 2 slots for X20 interface modules	
X20PS9600	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	
X20PS9602	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	• Supply not galvanically isolated

4.1.2.1.4.3 Terminal blocks

Order number	Module type	Description	Special functions
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	

Module overviews

4.1.2.2 Bus controller

4.1.2.2.1 Standard bus controller

Order number	Module type	Description	Special functions
X20BC0043-10	Bus controllers	• 1 CANopen interface	
X20BC0063	Bus controllers	• 1 PROFIBUS DP interface • 9-pin DSUB connector	
X20BC0073	Bus controllers	• 1 CAN I/O interface	
X20BC0083	Bus controllers	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub
X20BC0087	Bus controllers	• 1 Modbus/TCP or Modbus/UDP interface • 2x RJ45	• Integrated 2-port switch
X20BC0088	Bus controllers	• 1 EtherNet/IP interface • 2x RJ45	• Integrated switch
X20BC008T	Bus controllers	• 1 OPC UA FX Ethernet interface • 2x RJ45	• Integrated 2-port switch
X20BC008U	Bus controllers	• 1 OPC UA Ethernet interface	
X20BC00E3	Bus controllers	• 1 PROFINET IO interface • 2x RJ45	• Integrated 2-port switch
X20BC0143-10	Bus controllers	• 1 CANopen interface • 9-pin DSUB connector	

4.1.2.2.2 Expandable bus controllers

Order number	Module type	Description	Special functions
X20BC1083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 interface modules
X20BC8083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 hub modules
X20BC8084	Bus controller	• 1 POWERLINK interface • 2x RJ45	• 1x link selector for POWERLINK cable redundancy • Supports expansion with active X20 hub modules

4.1.2.2.3 System modules and accessories

4.1.2.2.3.1 Standard bus controller system modules

Order number	Module type	Description	Special functions
X20BB80	Bus bases	• For base module (BC, HB ...) and power supply module	
X20BB80X	Bus controller base	• For bus controller X20BC008T and power supply module	
X20PS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	
X20PS9402	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	• Supply not galvanically isolated

4.1.2.2.3.2 Expandable system modules for bus controllers

Order number	Module type	Description	Special functions
X20BB81	Bus bases	• For base module (BC, HB ...) and power supply module • 1 slot for X20 add-on module (IF, HB ...)	
X20BB82	Bus bases	• For base module (BC, HB ...) and power supply module • 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20HB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20HB1882	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For single-mode fiber optic cable
X20HB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20HB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	
X20HB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	
X20HB2886	Hub expansion module	• Integrated active 2-port hub • 2x fiber optic cable connectors	
X20IF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20IF1043-1	Interface module	• 1 CANopen slave interface	• DTM configuration
X20IF1051-1	Interface module	• 1 DeviceNet scanner (master) interface	• DTM configuration
X20IF1053-1	Interface module	• 1 DeviceNet adapter (slave) interface	• DTM configuration
X20IF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20IF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20IF1091-1	Interface module	• 1 X2X Link master interface	
X20IF10A1-1	Interface module	• 1 ASi master interface	• DTM configuration
X20IF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20IF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20IF10E1-1	Interface module	• 1 PROFINET IO controller (master) interface	• DTM configuration
X20IF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20IF10G1-1	Interface module	• 1 EtherCAT master interface	• DTM configuration
X20IF10G3-1	Interface module	• 1 EtherCAT slave interface	• DTM configuration
X20PS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	
X20PS9402	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	• Supply not galvanically isolated

4.1.2.2.3.3 Terminal blocks

Order number	Module type	Description	Special functions
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	

Module overviews

4.1.2.3 Hub and redundancy systems

4.1.2.3.1 Hub system

Order number	Module type	Description	Special functions
X20ET8819	Ethernet analysis tool	• 2x RJ45	• Expandable with active hub modules
X20HB8815	POWERLINK TCP/IP gateway	• 2x RJ45	• Expandable with active hub modules
X20HB8880	Hub base module	• Integrated 2-port hub • 2x RJ45	

4.1.2.3.2 Redundancy system

Order number	Module type	Description	Special functions
X20HB8884	Compact link selector	• Integrated Compact Link Selector function • 2x RJ45	
X20IF10X0	Interface module	• 1 redundancy link interface 1000BASE-SX	• PLC-PLC data synchronization module for controller redundancy

4.1.2.3.3 System modules and accessories

4.1.2.3.3.1 Hub system - System modules

Order number	Module type	Description	Special functions
X20BB80	Bus bases	• For base module (BC, HB ...) and power supply module	
X20BB81	Bus bases	• For base module (BC, HB ...) and power supply module • 1 slot for X20 add-on module (IF, HB ...)	
X20BB82	Bus bases	• For base module (BC, HB ...) and power supply module • 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20HB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20HB1882	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For single-mode fiber optic cable
X20HB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20HB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	
X20PS8002	Power supply module	• For a standalone hub and Compact Link Selector	
X20PS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	
X20PS9402	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	• Supply not galvanically isolated

4.1.2.3.3.2 Redundancy system - System modules

Order number	Module type	Description	Special functions
X20HB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	

4.1.2.3.3.3 Terminal blocks

Order number	Module type	Description	Special functions
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	

4.1.2.4 I/O modules

4.1.2.4.1 Analog outputs

±10 V

Order number	Module type	Description	Special functions
X20RT8202	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog outputs, ±10 V, 2 µs, 13-bit converter resolution	
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	

±10 V or 0 to 20 mA / 4 to 20 mA

Order number	Module type	Description	Special functions
X20AO2622	Analog output module	• 2 analog outputs, ±10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AO2632	Analog output module	• 2 analog outputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• NetTime function
X20AO4622	Analog output module	• 4 analog outputs, ±10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AO4632	Analog output module	• 4 analog outputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	
X20AO4635	Analog output module	• 4 analog outputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• Low temperature drift
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ±10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ±10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement

±11 V or 0 to 22 mA

Order number	Module type	Description	Special functions
X20AO4632-1	Analog output module	• 4 analog outputs, ±11 V or 0 to 22 mA, 16-bit converter resolution	• NetTime function

4 to 20 mA / 0 to 20 mA or 0 to 24 mA

Order number	Module type	Description	Special functions
X20AO2437	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated
X20AO2438	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated • Supports HART protocol • NetTime function

4.1.2.4.2 Analog inputs

±10 V

Order number	Module type	Description	Special functions
X20AI2222	Analog input module	• 2 analog inputs, ±10 V, 13-bit converter resolution	
X20AI2237	Analog input module	• 2 analog inputs, ±10 V, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • NetTime function
X20AI4222	Analog input module	• 4 analog inputs, ±10 V, 13-bit converter resolution	
X20AI8221	Analog input module	• 8 analog inputs, ±10 V, 13-bit converter resolution	
X20RT8201	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	

0 to 20 mA / 4 to 20 mA

Order number	Module type	Description	Special functions
X20AI2322	Analog input module	• 2 analog inputs, 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution	
X20AI2437	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • NetTime function
X20AI2438	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • Supports HART protocol • NetTime function
X20AI4322	Analog input module	• 4 analog inputs, 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution	
X20AI8321	Analog input module	• 8 analog inputs, 0 to 20 mA, 12-bit converter resolution	

±10 V or 0 to 20 mA / 4 to 20 mA

Order number	Module type	Description	Special functions
X20AI2622	Analog input module	• 2 analog inputs, ±10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AI2632	Analog input module	• 2 analog inputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• Oscilloscope functions
X20AI2636	Analog input module	• 2 analog inputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• Oversampling functions
X20AI4622	Analog input module	• 4 analog inputs, ±10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20AI4632	Analog input module	• 4 analog inputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• Oscilloscope functions
X20AI4636	Analog input module	• 4 analog inputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	• Oversampling functions
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ±10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ±10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement

±11 V or 0 to 22 mA

Order number	Module type	Description	Special functions
X20AI4632-1	Analog input module	• 4 analog inputs, ±11 V or 0 to 22 mA, 16-bit converter resolution	• Oscilloscope functions

Full-bridge strain gauge

Order number	Module type	Description	Special functions
X20AI744	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 kHz input filter
X20AI744-3	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 Hz input filter
X20AI744-10	Analog input module	• 1 strain gauge full bridge input, 10 V, 24-bit converter resolution	• 5 kHz input filter
X20AI744	Analog input module	• 2 full-bridge strain gauge inputs, 24-bit converter resolution	• 2.5 kHz input filter
X20AI744	Analog input module	• 4 full-bridge strain gauge inputs, 24-bit converter resolution	• 2.5 kHz input filter

4.1.2.4.3 Dummy modules

Order number	Module type	Description	Special functions
X20IF0000	Dummy module	• Without function	
X20ZF0000	Dummy module	• Without function	• For terminal blocks X20TB06 and X20TB12
X20ZF0002	Dummy module	• Without function	• 240 VAC keyed
X20ZF000F	Dummy module	• Without function	• For terminal blocks X20TB1E and X20TB1F

4.1.2.4.4 Condition monitoring

Order number	Module type	Description	Special functions
X20CM4800X	Vibration measurement	• 4 IEPE analog inputs, 50 kHz sampling frequency, 24-bit converter resolution	
X20CM4810	Vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	• Extensive vibration analysis and evaluation
X20CMR010	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • 512 kB flash memory for user data
X20CMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data
X20CMR100	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • Integrated Technology Guard
X20CMR111	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data • Integrated Technology Guard

4.1.2.4.5 Digital outputs

12 VDC

Order number	Module type	Description	Special functions
X20DO8232	Digital output module	• 8 digital outputs, 12 VDC, 2 A, source	• Supply directly on module

24 VDC

Order number	Module type	Description	Special functions
X20CM4323	PWM module	• 4 digital outputs for switching electromechanical loads, 24 VDC	• Oversampling output functions • NetTime function
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ± 10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ± 10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement
X20CM8323	PWM module	• 8 digital outputs for switching electromechanical loads, 0.6 A continuous current, 2 A peak current	• Power monitoring • Switching instant detection
X20DM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20DMF320	Digital mixed module	• 16 digital inputs, 24 VDC, sink • 16 digital inputs/outputs, 24 VDC, 0.5 A, source • Optionally configurable: – 2 ABR incremental encoders – 2 event counters – 3 PWM outputs	
X20DO2321	Digital output module	• 2 digital outputs, 24 VDC, 0.5 A, sink	
X20DO2322	Digital output module	• 2 digital outputs, 24 VDC, 0.5 A, source	
X20DO4321	Digital output module	• 4 digital outputs, 24 VDC, 0.5 A, sink	
X20DO4322	Digital output module	• 4 digital outputs, 24 VDC, 0.5 A, source	
X20DO4332	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source	
X20DO4332-1	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source, PWM output	
X20DO6321	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, sink	
X20DO6322	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, source	
X20DO6325	Digital output module	• 6 digital outputs, 24 VDC, 0.5 A, source	
X20DO8322	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, source	
X20DO8331	Digital output module	• 8 digital outputs, 24 VDC, 2 A, sink	• Supply directly on module
X20DO8332	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module
X20DO8332-1	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module • Optimized for inductive loads
X20DO9321	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, sink	
X20DO9322	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, source	
X20DOD322	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, source	
X20DOF321	Digital output module	• 8 digital outputs, 24 VDC, 0.5 A, sink	
X20DOF322	Digital output module	• 16 digital outputs, 24 VDC, 0.5 A, source	

Order number	Module type	Description	Special functions
X20DS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20DS1319	Multifunctional digital signal processor	• 4 digital input channels • 4 digital inputs/outputs • Optionally configurable: – 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses – SSI absolute encoder	• NetTime function
X20DS4389	Digital signal module	• 4 digital inputs, 24 VDC • 4 digital outputs, 24 VDC, 0.1 A	• NetTime function • Oversampling I/O functions
X20DS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20DS838A	Digital signal module	• 8x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20RT8001	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs	
X20RT8201	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8202	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog outputs, ±10 V, 2 µs, 13-bit converter resolution	
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	

12 to 24 V

Order number	Module type	Description	Special functions
X20DO8323	Digital output module	• 8 digital outputs, 12 to 24 V, 0.5 A, sink/source	• Full-/Half-bridge • Thermal overload protection

48 to 240 VAC

Order number	Module type	Description	Special functions
X20DO2633	Digital output module	• 2 Triac outputs, 48 to 240 VAC, 2 A, L-switching	• Phase-angle control • 240 V keyed
X20DO4613	Digital output module	• 4 triac bus controller outputs, 48 to 240 VAC, 50 mA	• Zero-crossing detection • 240 V keyed
X20DO4633	Digital output module	• 4 Triac outputs, 48 to 240 VAC, 1 A, L-switching	• Phase-angle control • 240 V keyed

100 to 240 VAC

Order number	Module type	Description	Special functions
X20DO4623	Digital output module	• 4 digital outputs, 100 to 240 VAC, 0.5 A, source	• 240 V keyed

24 / 30 VDC, 115 VAC

Order number	Module type	Description	Special functions
X20DO4529	Digital output module	• 4 relays, changeover contacts, 115 VAC / 0.5 A, 24 VDC / 1 A	
X20DO6529	Digital output module	• 6 relays, normally open contacts, 115 VAC / 0.5 A, 30 VDC / 1 A	

240 VAC - Relay

Order number	Module type	Description	Special functions
X20DO2649	Digital output module	• 2 relays, changeover contacts, 240 VAC / 5 A, 24 VDC / 5 A	
X20DO4649	Digital output module	• 4 relays, normally open contacts, 240 VAC / 5 A	
X20DO4F49	Digital output module	• 4 relays, 2x normally open contacts, 2x changeover contacts, 240 VAC / 2 A, 250 VDC / 0.28 A	
X20DO6639	Digital output module	• 6 relays, normally open contacts, 240 VAC / 2 A, 30 VDC / 2 A	

4.1.2.4.6 Digital inputs**5 to 48 VDC**

Order number	Module type	Description	Special functions
X20DI0471	Digital input module	• 10 digital inputs, 5-48 VDC, sink	

24 VDC

Order number	Module type	Description	Special functions
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ± 10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ± 10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement
X20DI2371	Digital input module	• 2 digital inputs, 24 VDC, sink	
X20DI2372	Digital input module	• 2 digital inputs, 24 VDC, source	
X20DI4371	Digital input module	• 4 digital inputs, 24 VDC, sink	
X20DI4372	Digital input module	• 4 digital inputs, 24 VDC, source	
X20DI6371	Digital input module	• 6 digital inputs, 24 VDC, sink	
X20DI6372	Digital input module	• 6 digital inputs, 24 VDC, source	
X20DI6373	Digital input module	• 6 digital inputs, 24 VDC, sink/source	• All inputs floating
X20DI8371	Digital input module	• 8 digital inputs, 24 VDC, sink	
X20DI9371	Digital input module	• 12 digital inputs, 24 VDC, sink	
X20DI9372	Digital input module	• 12 digital inputs, 24 VDC, source	
X20DID371	Digital input module	• 8 digital inputs, 24 VDC, sink	
X20DIF371	Digital input module	• 16 inputs, 24 VDC, sink	
X20DIF372	Digital input module	• 16 inputs, 24 VDC, source	
X20DM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20DMF320	Digital mixed module	• 16 digital inputs, 24 VDC, sink • 16 digital inputs/outputs, 24 VDC, 0.5 A, source • Optionally configurable: – 2 ABR incremental encoders – 2 event counters – 3 PWM outputs	
X20DS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20DS1319	Multifunctional digital signal processor	• 4 digital input channels • 4 digital inputs/outputs • Optionally configurable: – 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses – SSI absolute encoder	• NetTime function
X20DS4389	Digital signal module	• 4 digital inputs, 24 VDC • 4 digital outputs, 24 VDC, 0.1 A	• NetTime function • Oversampling I/O functions
X20DS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function

Order number	Module type	Description	Special functions
X20DS838A	Digital signal module	8x IO-Link master V1.1, also usable as digital inputs/outputs	NetTime function
X20RT8001	reACTION module	4 digital inputs, 24 VDC, <1 µs 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs	
X20RT8201	reACTION module	4 digital inputs, 24 VDC, <1 µs 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8202	reACTION module	4 digital inputs, 24 VDC, <1 µs 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs 2 analog outputs, ±10 V, 2 µs, 13-bit converter resolution	
X20RT8381	reACTION module	4 digital inputs, 24 VDC, <1 µs 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	4 digital inputs, 24 VDC, <1 µs 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	

100 to 120 VAC

Order number	Module type	Description	Special functions
X20DI6553	Digital input module	6 digital inputs, 100 to 120 VAC	240 V keyed

100 to 240 VAC

Order number	Module type	Description	Special functions
X20DI4653	Digital input module	4 digital inputs, 100 to 240 VAC	240 V keyed

NAMUR

Order number	Module type	Description	Special functions
X20DI4760	Digital input module	4 NAMUR inputs, 8.05 V	

4.1.2.4.7 Digital inputs and outputs

24 VDC

Order number	Module type	Description	Special functions
X20CM8281	Universal mixed module	4 digital inputs, 24 VDC, sink 2 digital outputs, 24 VDC, 0.5 A, source 1 analog input, ±10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution 1 analog output, ±10 V / 0 to 20 mA, 12-bit converter resolution	2 counters as event counters or for gate measurement
X20DM9324	Digital mixed module	8 digital inputs, 24 VDC, sink 4 digital outputs, 24 VDC, 0.5 A, source	
X20DMF320	Digital mixed module	16 digital inputs, 24 VDC, sink 16 digital inputs/outputs, 24 VDC, 0.5 A, source - Optionally configurable: 2 ABR incremental encoders 2 event counters 3 PWM outputs	
X20DS1119	Multifunctional digital signal processor	3 digital inputs/outputs, 5 V (symmetrical) 2 digital input channels, 24 V (asymmetrical) - Optionally configurable: - Max. 2 event counters 1 universal counter pair as AB counters or up/down counters 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse 1 SSI absolute encoder	NetTime function

Module overviews

Order number	Module type	Description	Special functions
X20DS1319	Multifunctional digital signal processor	• 4 digital input channels • 4 digital inputs/outputs • Optionally configurable: – 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses – SSI absolute encoder	• NetTime function
X20DS4389	Digital signal module	• 4 digital inputs, 24 VDC • 4 digital outputs, 24 VDC, 0.1 A	• NetTime function • Oversampling I/O functions
X20DS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20DS838A	Digital signal module	• 8x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20RT8001	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs	
X20RT8201	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8202	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog outputs, ±10 V, 2 µs, 13-bit converter resolution	
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 2 analog inputs ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 µs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 µs • 1 analog input ±10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ±10 V / 2 µs, 13-bit converter resolution	

4.1.2.4.8 Digital signal processing and preparation

Order number	Module type	Description	Special functions
X20DC1073	Digital counter module	• 1x SinCos, 1 Vpp, 400 kHz input frequency	• Encoder monitoring • NetTime function
X20DS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20DS1319	Multifunctional digital signal processor	• 4 digital input channels • 4 digital inputs/outputs • Optionally configurable: – 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses – SSI absolute encoder	• NetTime function
X20DS1828	Digital signal module	• 1 HiPERFACE interface	• NetTime function
X20DS1928	Digital signal module	• 1 EnDat 2.1/2.2 interface	• NetTime function
X20DS4389	Digital signal module	• 4 digital inputs, 24 VDC • 4 digital outputs, 24 VDC, 0.1 A	• NetTime function • Oversampling I/O functions

4.1.2.4.9 Energy metering modules

Order number	Module type	Description	Special functions
X20AP3111	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 20 mA AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3121	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 1 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3122	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 1 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function • Groundable
X20AP3131	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 5 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3132	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 5 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function • Groundable
X20AP3161	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 333 mV AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20AP3171	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, Rogowski adjustable ($\mu\text{V/A}$), max. 52 mV	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20CM0985	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A, changeover contact • 8 analog inputs, $\pm 480\text{ V} / 120\text{ V}$, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	
X20CM0985-02	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A • 8 analog inputs, $\pm 480\text{ V} / 120\text{ V}$, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	• Additional software functionalities
X20CM0985-1	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A • 8 analog inputs, $\pm 480\text{ V} / 120\text{ V}$, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	• Additional software functionalities

4.1.2.4.10 IO-Link modules

Order number	Module type	Description	Special functions
X20DS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20DS838A	Digital signal module	• 8x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function

4.1.2.4.11 Communication in the X20 electronics module

Order number	Module type	Description	Special functions
X20CS1012	Interface module	• 1 M-Bus master interface	
X20CS1013	Interface module	• 1 DALI master interface	
X20CS1020	Interface module	• 1 RS232 interface	
X20CS1030	Interface module	• 1 RS422/485 interface	
X20CS1070	Interface module	• 1 CAN bus interface	
X20CS2770	Interface module	• 2 CAN bus interfaces	

Module overviews

4.1.2.4.12 Motor controllers

Order number	Module type	Description	Special functions
X20MM2436	PWM motor module	• 2 PWM motor bridges, 3 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 39 VDC $\pm 25\%$
X20MM3332	Digital motor module	• 3 digital outputs, full bridge (H bridge) 3 A continuous current, 5 A peak current	• 24 VDC module power supply
X20MM4331	Digital motor module	• 4 digital outputs, half bridge 3 A continuous current, 5 A peak current	• 24 VDC module power supply
X20MM4455	PWM motor module	• 4 PWM motor bridges, 6 A continuous current, 10 A peak current • 4x 3 digital inputs 5 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC $\pm 25\%$
X20MM4456	PWM motor module	• 4 PWM motor bridges, 6 A continuous current, 10 A peak current • 4x 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC $\pm 25\%$
X20SM1426	Stepper motor module	• 1 motor connection 1 A continuous current, 1.2 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 VDC -15% / +20%
X20SM1436	Stepper motor module	• 1 motor connection 3 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 39 VDC $\pm 25\%$
X20SM1436-1	Stepper motor module	• 1 motor connection 2.5 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC $\pm 25\%$ • Current reduction function
X20SM1444-1	Stepper motor module	• 1 motor connection 5 A continuous current, 10 A peak current • 4 digital inputs 5 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC $\pm 25\%$ • Current reduction function • Quick stop / Enable function
X20SM1446-1	Stepper motor module	• 1 motor connection 5 A continuous current, 10 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 48 VDC $\pm 25\%$ • Current reduction function

4.1.2.4.13 reACTION I/O modules

Order number	Module type	Description	Special functions
X20RT8001	reACTION module	• 4 digital inputs, 24 VDC, <1 μs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 μs	
X20RT8201	reACTION module	• 4 digital inputs, 24 VDC, <1 μs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 μs • 2 analog inputs ± 10 V, 500 kHz sampling frequency, 13-bit converter resolution	
X20RT8202	reACTION module	• 4 digital inputs, 24 VDC, <1 μs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 μs • 2 analog outputs, ± 10 V, 2 μs, 13-bit converter resolution	
X20RT8381	reACTION module	• 4 digital inputs, 24 VDC, <1 μs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 μs • 2 analog inputs ± 10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ± 10 V / 2 μs, 13-bit converter resolution	
X20RT8401	reACTION module	• 4 digital inputs, 24 VDC, <1 μs • 4 digital inputs/outputs, 24 VDC, 0.1 A, <1 μs • 1 analog input ± 10 V, 500 kHz sampling frequency, 13-bit converter resolution • 1 analog output, ± 10 V / 2 μs, 13-bit converter resolution	

4.1.2.4.14 Other functions

Order number	Module type	Description	Special functions
X20CM4323	PWM module	• 4 digital outputs for switching electromechanical loads, 24 VDC	• Oversampling output functions • NetTime function
X20CM8281	Universal mixed module	• 4 digital inputs, 24 VDC, sink • 2 digital outputs, 24 VDC, 0.5 A, source • 1 analog input, ± 10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution • 1 analog output, ± 10 V / 0 to 20 mA, 12-bit converter resolution	• 2 counters as event counters or for gate measurement
X20CM8323	PWM module	• 8 digital outputs for switching electromechanical loads, 0.6 A continuous current, 2 A peak current	• Power monitoring • Switching instant detection
X20PS4951	Power supply module	• For 4 potentiometers, ± 10 V	

4.1.2.4.15 Temperature measurement

Resistance measurement

Order number	Module type	Description	Special functions
X20AT2222	Temperature input module	• 2 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20AT2311	Temperature input module	• 2 resistance measurement inputs, Pt100, resolution 0.001°C	
X20AT4222	Temperature input module	• 4 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20AT4232	Temperature input module	• 4 resistance measurement inputs, NTC 10 k Ω , resolution 0.1°C	
X20ATA312	Temperature input module	• 2 resistance measurement inputs, Pt100, resolution 0.01°C	• NetTime function
X20ATB312	Temperature input module	• 4 resistance measurement inputs, Pt100, resolution 0.01°C	• NetTime function
X20CMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data
X20CMR111	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data • Integrated Technology Guard

Thermocouple

Order number	Module type	Description	Special functions
X20AT2402	Temperature input module	• 2 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	
X20AT6402	Temperature input module	• 6 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	
X20ATA492	Temperature input module	• 2 thermocouple inputs, type J, K, N, S, B, R, E, C, T	• Single channel galvanically isolated • 2x Pt1000 integrated in the terminal block • NetTime function
X20ATC402	Temperature input module	• 6 thermocouple inputs, type J, K, N, S, B, R, E, C, T	• 2x Pt1000 integrated in the terminal block • NetTime function

Integrated

Order number	Module type	Description	Special functions
X20CMR010	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • 512 kB flash memory for user data
X20CMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data
X20CMR100	Cabinet monitoring module	• Integrated temperature and humidity sensor	• Production data acquisition • Integrated Technology Guard
X20CMR111	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data • Integrated Technology Guard

4.1.2.4.16 Counter functions

AB / ABR

Order number	Module type	Description	Special functions
X20CM1941	Resolver module	14-bit resolver input, converter up to 12-bit - ABR output	
X20DC1176	Digital counter module	1 ABR incremental encoder, 5 V, 600 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1196	Digital counter module	1 ABR incremental encoder, 5 V, 600 kHz input frequency	4x evaluation
X20DC11A6	Digital counter module	1 ABR incremental encoder, 5 V, 5 MHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1376	Digital counter module	1 ABR incremental encoder, 24 V, 100 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC137A	Digital counter module	1 ABR incremental encoder, 24 V, (differential), 300 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC1396	Digital counter module	1 ABR incremental encoder, 24 V, 100 kHz input frequency	4x evaluation
X20DC1976	Digital counter module	1 ABR incremental encoder, 5 V, (single-ended), 250 kHz input frequency	4x evaluation - Encoder monitoring - NetTime function
X20DC2396	Digital counter module	2 ABR incremental encoders, 24 V 100 kHz input frequency	4x evaluation

Event / Gate measurement

Order number	Module type	Description	Special functions
X20CM8281	Universal mixed module	4 digital inputs, 24 VDC, sink 2 digital outputs, 24 VDC, 0.5 A, source 1 analog input, ± 10 V or 0 to 20 mA / 4 to 20 mA, 12-bit converter resolution 1 analog output, ± 10 V / 0 to 20 mA, 12-bit converter resolution	2 counters as event counters or for gate measurement
X20DI2377	Digital input module	2 digital inputs, 24 VDC, sink	2 event counters, 50 kHz
X20DS1119	Multifunctional digital signal processor	3 digital inputs/outputs, 5 V (symmetrical) 2 digital input channels, 24 V (asymmetrical) - Optionally configurable: - Max. 2 event counters 1 universal counter pair as AB counters or up/down counters 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse 1 SSI absolute encoder	NetTime function
X20DS1319	Multifunctional digital signal processor	4 digital input channels 4 digital inputs/outputs - Optionally configurable: 2 event counters 1 universal counter pair as AB counters or up/down counters 1 linear motion generator (A/B, direction/frequency) with max. 2 reference pulses - SSI absolute encoder	NetTime function
X20DC2395	Digital counter module	- Optionally configurable: 1 SSI absolute encoder, 24 V 1 ABR incremental encoder, 24 V 2 AB incremental encoders, 24 V 4 event counters or 2 PWM	Local time measurement functions
X20DC4395	Digital counter module	- Optionally configurable: 2 SSI absolute encoders, 24 V 2 ABR incremental encoders, 24 V 4 AB incremental encoders, 24 V 8 event counters or 4 PWM	Local time measurement functions

Resolver

Order number	Module type	Description	Special functions
X20CM1941	Resolver module	14-bit resolver input, converter up to 12-bit - ABR output	

SinCos

Order number	Module type	Description	Special functions
X20DC1073	Digital counter module	1x SinCos, 1 Vpp, 400 kHz input frequency	- Encoder monitoring - NetTime function

SSI

Order number	Module type	Description	Special functions
X20DC1178	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	• Encoder monitoring • NetTime function
X20DC1198	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	
X20DC2398	Digital counter module	• 2 SSI absolute encoders, 24 V • 125 kbit/s, 32-bit	

ABR/SSI

Order number	Module type	Description	Special functions
X20DC2395	Digital counter module	• Optionally configurable: – 1 SSI absolute encoder, 24 V – 1 ABR incremental encoder, 24 V – 2 AB incremental encoders, 24 V – 4 event counters or 2 PWM	• Local time measurement functions
X20DC4395	Digital counter module	• Optionally configurable: – 2 SSI absolute encoders, 24 V – 2 ABR incremental encoders, 24 V – 4 AB incremental encoders, 24 V – 8 event counters or 4 PWM	• Local time measurement functions

Path measurement

Order number	Module type	Description	Special functions
X20DC2190	Digital counter module	• Ultrasonic path measurement module • 2 path measuring rods	• 4 path detection

4.1.2.4.17 System modules and accessories

4.1.2.4.17.1 Bus receivers and bus transmitters

Order number	Module type	Description	Special functions
X20BR7300	Bus receiver	• CAN I/O, power supply for X2X Link and internal I/O power supply	
X20BR9300	Bus receiver	• X2X Link, supply for X2X Link and internal I/O power supply	
X20BT9100	Bus transmitter	• X2X Link, supply for internal I/O power supply	
X20BT9400	Bus transmitter	• X2X Link, supply for internal I/O power supply • X2X Link power supply for X67 modules	

4.1.2.4.17.2 Bus modules

Order number	Module type	Description	Special functions
X20BM01	Power supply bus module	• 24 VDC keyed • Internal I/O power supply interrupted to the left	
X20BM01X	Power supply bus module	• 24 VDC keyed • Internal I/O power supply interrupted to the left	• X2X+
X20BM05	Power supply bus module	• 24 VDC keyed • Internal I/O power supply interrupted to the left	• With node number switch
X20BM11	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	
X20BM11X	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	• X2X+
X20BM12	Bus module	• 240 VAC keyed • Internal I/O power supply connected through	
X20BM15	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	• With node number switch
X20BM21	Power supply bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply interrupted to the left	
X20BM31	Bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply connected through	
X20BM32	Bus module	• For double-width modules • 240 VAC keyed • Internal I/O power supply connected through	

4.1.2.4.17.3 Power supply modules

Order number	Module type	Description	Special functions
X20PS2100	Power supply module	• For internal I/O power supply	
X20PS2110	Power supply module	• For internal I/O power supply	• Integrated fine-wire fuse
X20PS3300	Power supply module	• For X2X Link and internal I/O power supply	
X20PS3310	Power supply module	• For X2X Link and internal I/O power supply	• Integrated fine-wire fuse

4.1.2.4.17.4 Terminal blocks

Order number	Module type	Description	Special functions
X20TB06	Terminal block	• 6-pin, 24 VDC keyed	
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	
X20TB1E	Terminal block	• 12-pin, 24 VDC keyed	• 2x integrated Pt1000 temperature sensor
X20TB1F	Terminal block	• 16-pin, 24 VDC keyed	
X20TB32	Terminal block	• 12-pin, 240 VAC keyed	

4.1.2.4.17.5 Potential distribution modules

Order number	Module type	Description	Special functions
X20PD0011	Potential distributor module	• 12x GND	• Integrated fine-wire fuse
X20PD0012	Potential distributor module	• 12x 24 VDC	• Integrated fine-wire fuse
X20PD0016	Potential distributor module	• 5x GND, 5x 24 VDC	• Integrated fine-wire fuse
X20PD0053	Potential distributor module	• 6x GND, 6x 5 VDC	
X20PD2113	Potential distributor module	• 6x GND, 6x 24 VDC	• Integrated fine-wire fuse

4.2 Standard modules - Coated

4.2.1 Module overview: Alphabetical

Order number	Module type	Description	Special functions
X20cAI1744-3	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 Hz input filter
X20cAI2438	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • Supports HART protocol • NetTime function
X20cAI4622	Analog input module	• 4 analog inputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20cAI4632-1	Analog input module	• 4 analog inputs, ± 11 V or 0 to 22 mA, 16-bit converter resolution	• Oscilloscope functions
X20cAO2437	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated
X20cAO2438	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated • Supports HART protocol • NetTime function
X20cAO4622	Analog output module	• 4 analog outputs, ± 10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20cAO4632	Analog output module	• 4 analog outputs, ± 10 V or 0 to 20 mA, 16-bit converter resolution	
X20cAP3121	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 1 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20cAP3131	Energy metering module	• 3 analog inputs, 480 VAC, 50/60 Hz • 4 analog inputs, 5 A AC	• Calculation of active, reactive, apparent power and apparent energy • Calculation of the effective values • 240 V keyed • NetTime function
X20cAT2311	Temperature input module	• 2 resistance measurement inputs, Pt100, resolution 0.001°C	
X20cAT4222	Temperature input module	• 4 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20cAT6402	Temperature input module	• 6 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	
X20cBB52	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 interface	
X20cBB57	Bus base for Compact-S controller	• For Compact-S controller and power supply module • Base for integrated RS232 and CAN bus interface	
X20cBB80	Bus bases	• For base module (BC, HB ...) and power supply module	
X20cBB82	Bus bases	• For base module (BC, HB ...) and power supply module • 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20cBC0043-10	Bus controllers	• 1 CANopen interface	
X20cBC0083	Bus controllers	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub
X20cBC0087	Bus controllers	• 1 Modbus/TCP or Modbus/UDP interface • 2x RJ45	• Integrated 2-port switch
X20cBC00E3	Bus controllers	• 1 PROFINET IO interface • 2x RJ45	• Integrated 2-port switch
X20cBC1083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 interface modules
X20cBC8083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 hub modules
X20cBC8084	Bus controller	• 1 POWERLINK interface • 2x RJ45	• 1x link selector for POWERLINK cable redundancy • Supports expansion with active X20 hub modules
X20cBM01	Power supply bus module	• 24 VDC keyed • Internal I/O power supply interrupted to the left	
X20cBM11	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	
X20cBM12	Bus module	• 240 VAC keyed • Internal I/O power supply connected through	
X20cBM31	Bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply connected through	

Module overviews

Order number	Module type	Description	Special functions
X20cBM32	Bus module	• For double-width modules • 240 VAC keyed • Internal I/O power supply connected through	
X20cBR9300	Bus receiver	• X2X Link, supply for X2X Link and internal I/O power supply	
X20cBT9100	Bus transmitter	• X2X Link, supply for internal I/O power supply	
X20cCM0985-1	Digital and analog mixed module, multi-measurement transducer / synchronization module	• 5 digital outputs, 24 VDC, 0.5 A, source • 1 relay, 1 A • 8 analog inputs, ± 480 V / 120 V, 16-bit converter resolution • 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	• Additional software functionalities
X20cCM4810	Vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	• Extensive vibration analysis and evaluation
X20cCMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data
X20cCP0410	Compact-S controller	• ARM Cortex A9-166 compatible • 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive on board • Interfaces: - 2x USB - 1x RS232	
X20cCS1020	Interface module	• 1 RS232 interface	
X20cCS1030	Interface module	• 1 RS422/485 interface	
X20cDC1196	Digital counter module	• 1 ABR incremental encoder, 5 V, 600 kHz input frequency	• 4x evaluation
X20cDC1198	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	
X20cDC1396	Digital counter module	• 1 ABR incremental encoder, 24 V, 100 kHz input frequency	• 4x evaluation
X20cDC2190	Digital counter module	• Ultrasonic path measurement module • 2 path measuring rods	• 4 path detection
X20cDC2395	Digital counter module	• Optionally configurable: - 1 SSI absolute encoder, 24 V - 1 ABR incremental encoder, 24 V - 2 AB incremental encoders, 24 V - 4 event counters or 2 PWM	• Local time measurement functions
X20cDI4371	Digital input module	• 4 digital inputs, 24 VDC, sink	
X20cDI4375	Digital input module	• 4 digital inputs, 24 VDC, sink	• Open-circuit and short-circuit detection
X20cDI4760	Digital input module	• 4 NAMUR inputs, 8.05 V	
X20cDI6371	Digital input module	• 6 digital inputs, 24 VDC, sink	
X20cDI9371	Digital input module	• 12 digital inputs, 24 VDC, sink	
X20cDI9372	Digital input module	• 12 digital inputs, 24 VDC, source	
X20cDIF371	Digital input module	• 16 inputs, 24 VDC, sink	
X20cDM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20cDO2633	Digital output module	• 2 Triac outputs, 48 to 240 VAC, 2 A, L-switching	• Phase-angle control • 240 V keyed
X20cDO4332	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source	
X20cDO4332-1	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source, PWM output	
X20cDO4649	Digital output module	• 4 relays, normally open contacts, 240 VAC / 5 A	
X20cDO6529	Digital output module	• 6 relays, normally open contacts, 115 VAC / 0.5 A, 30 VDC / 1 A	
X20cDO6639	Digital output module	• 6 relays, normally open contacts, 240 VAC / 2 A, 30 VDC / 2 A	
X20cDO8332	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module
X20cDO9321	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, sink	
X20cDO9322	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, source	
X20cDOF322	Digital output module	• 16 digital outputs, 24 VDC, 0.5 A, source	
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: - Max. 2 event counters - 1 universal counter pair as AB counters or up/down counters - 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse - 1 SSI absolute encoder	• NetTime function
X20cDS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function
X20cHB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20cHB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20cHB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	

Order number	Module type	Description	Special functions
X20cHB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	
X20cHB2886	Hub expansion module	• Integrated active 2-port hub • 2x fiber optic cable connectors	
X20cHB8815	POWERLINK TCP/IP gateway	• 2x RJ45	• Expandable with active hub modules
X20cHB8880	Hub base module	• Integrated 2-port hub • 2x RJ45	
X20cHB8884	Compact link selector	• Integrated Compact Link Selector function • 2x RJ45	
X20cIF1030	Interface module	• 1 RS422/485 interface, max. 115.2 kbit/s	
X20cIF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20cIF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20cIF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20cIF1072	Interface module	• 1 CAN bus interface, max. 1 Mbit/s	
X20cIF1082-2	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function, PRC function • Integrated 2-port hub
X20cIF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20cIF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20cIF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20cIF10X0	Interface module	• 1 redundancy link interface 1000BASE-SX	• PLC-PLC data synchronization module for controller redundancy
X20cIF2181-2	Interface module	• 1x link selector for POWERLINK cable redundancy • 2x RJ45	
X20cMM2436	PWM motor module	• 2 PWM motor bridges, 3 A continuous current, 3.5 A peak current • 4 digital inputs 24 VDC, configurable as an incremental encoder	• Module power supply 24 to 39 VDC $\pm 25\%$
X20cPS2100	Power supply module	• For internal I/O power supply	
X20cPS3300	Power supply module	• For X2X Link and internal I/O power supply	
X20cPS8002	Power supply module	• For a standalone hub and Compact Link Selector	
X20cPS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	
X20cPS9600	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	

4.2.2 Module overview: Grouped

4.2.2.1 Controllers

4.2.2.1.1 Standard controllers

Order number	Module type	Description	Special functions
X20CP1684	Controller	- Atom 0.4 GHz (compatible) 512 MB DDR4 RAM, 1 MB SRAM, 1 GB flash drive onboard 1 slot for interface module - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- Removable application memory: CompactFlash - Including power supply module
X20CP3687X	Controller	- Atom 1.6 GHz 2 GB DDR4 RAM, 1 MB SRAM, 2 GB flash drive onboard 3 slots for interface modules - Interfaces: - 2x USB - 1x RS232 - 1x Ethernet (TSN) 10/100/1000BASE-T - 1 POWERLINK	- X2X+ - Removable application memory: CompactFlash - Including power supply module

4.2.2.1.2 Compact-S controllers

Order number	Module type	Description	Special functions
X20cCP0410	Compact-S controller	- ARM Cortex A9-166 compatible 128 MB DDR3 RAM, 8 kB FRAM, 256 MB flash drive on board - Interfaces: - 2x USB - 1x RS232	

4.2.2.1.3 System modules and accessories

4.2.2.1.3.1 Available interface modules

The following overview shows the available interface modules for all controllers that can be operated together with interface modules.

Order number	Module type	Description	Special functions
X20clF1030	Interface module	• 1 RS422/485 interface, max. 115.2 kbit/s	
X20clF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20clF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20clF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20clF1072	Interface module	• 1 CAN bus interface, max. 1 Mbit/s	
X20clF1082-2	Interface module	• 1 POWERLINK interface, managing or controlled node	• Ring redundancy function, PRC function • Integrated 2-port hub
X20clF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20clF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20clF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20clF2181-2	Interface module	1x link selector for POWERLINK cable redundancy 2x RJ45	

4.2.2.1.3.2 Compact-S controllers - System modules

Order number	Module type	Description	Special functions
X20cBB52	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 interface	
X20cBB57	Bus base for Compact-S controller	- For Compact-S controller and power supply module - Base for integrated RS232 and CAN bus interface	
X20cPS9600	Power supply module	• For Compact-S controllers, X2X Link and internal I/O power supply	

4.2.2.1.3.3 Terminal blocks

Order number	Module type	Description	Special functions
X20TB12	Terminal block	• 12-pin, 24 VDC keyed	

4.2.2.2 Bus controller

4.2.2.2.1 Standard bus controller

Order number	Module type	Description	Special functions
X20cBC0043-10	Bus controllers	• 1 CANopen interface	
X20cBC0083	Bus controllers	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub
X20cBC0087	Bus controllers	• 1 Modbus/TCP or Modbus/UDP interface • 2x RJ45	• Integrated 2-port switch
X20cBC00E3	Bus controllers	• 1 PROFINET IO interface • 2x RJ45	• Integrated 2-port switch

4.2.2.2.2 Expandable bus controllers

Order number	Module type	Description	Special functions
X20cBC1083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 interface modules
X20cBC8083	Bus controller	• 1 POWERLINK interface • 2x RJ45	• Integrated 2-port hub • Supports expansion with X20 hub modules
X20cBC8084	Bus controller	• 1 POWERLINK interface • 2x RJ45	• 1x link selector for POWERLINK cable redundancy • Supports expansion with active X20 hub modules

4.2.2.2.3 System modules and accessories

4.2.2.2.3.1 Standard bus controller system modules

Order number	Module type	Description	Special functions
X20cBB80	Bus bases	• For base module (BC, HB ...) and power supply module	
X20cPS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	

4.2.2.2.3.2 Expandable system modules for bus controllers

Order number	Module type	Description	Special functions
X20cBB82	Bus bases	• For base module (BC, HB ...) and power supply module • 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20cHB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20cHB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20cHB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	
X20cHB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	
X20cHB2886	Hub expansion module	• Integrated active 2-port hub • 2x fiber optic cable connectors	
X20cIF1041-1	Interface module	• 1 CANopen master interface	• DTM configuration
X20cIF1061-1	Interface module	• 1 PROFIBUS DP V0/V1 master interface	• DTM configuration
X20cIF1063-1	Interface module	• 1 PROFIBUS DP V1 slave interface	• DTM configuration
X20cIF10D1-1	Interface module	• 1 EtherNet/IP scanner (master) interface	• DTM configuration
X20cIF10D3-1	Interface module	• 1 EtherNet/IP adapter (slave) interface	• DTM configuration
X20cIF10E3-1	Interface module	• 1 PROFINET IO device (slave) interface	• DTM configuration
X20cPS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	

4.2.2.3 Hub and redundancy systems

4.2.2.3.1 Hub system

Order number	Module type	Description	Special functions
X20cHB8815	POWERLINK TCP/IP gateway	• 2x RJ45	• Expandable with active hub modules
X20cHB8880	Hub base module	• Integrated 2-port hub • 2x RJ45	

4.2.2.3.2 Redundancy system

Order number	Module type	Description	Special functions
X20cHB8884	Compact link selector	• Integrated Compact Link Selector function • 2x RJ45	
X20cIF10X0	Interface module	• 1 redundancy link interface 1000BASE-SX	• PLC-PLC data synchronization module for controller redundancy

4.2.2.3.3 System modules and accessories

4.2.2.3.3.1 Hub system - System modules

Order number	Module type	Description	Special functions
X20cBB80	Bus bases	• For base module (BC, HB ...) and power supply module	
X20cBB82	Bus bases	• For base module (BC, HB ...) and power supply module • 2 slots for 2 X20 add-on modules (IF, HB ...)	
X20cHB1881	Hub expansion module	• Integrated 1-port hub • 1x fiber optic cable connector	• For multimode fiber optic cables
X20cHB2880	Hub expansion module	• Integrated 2-port hub • 2x RJ45	
X20cHB2881	Hub expansion module	• Integrated 2-port hub • 2x fiber optic cable connectors	
X20cPS8002	Power supply module	• For a standalone hub and Compact Link Selector	
X20cPS9400	Power supply module	• For the bus controller, X2X Link and internal I/O power supply	

4.2.2.3.3.2 Redundancy system - System modules

Order number	Module type	Description	Special functions
X20cHB2885	Hub expansion module	• Integrated active 2-port hub • 2x RJ45	

4.2.2.4 I/O modules

4.2.2.4.1 Analog outputs

±10 V or 0 to 20 mA / 4 to 20 mA

Order number	Module type	Description	Special functions
X20cAO4622	Analog output module	• 4 analog outputs, ±10 V or 0 to 20 mA / 4 to 20 mA, 13-bit converter resolution	
X20cAO4632	Analog output module	• 4 analog outputs, ±10 V or 0 to 20 mA, 16-bit converter resolution	

4 to 20 mA / 0 to 20 mA or 0 to 24 mA

Order number	Module type	Description	Special functions
X20cAO2437	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated
X20cAO2438	Analog output module	• 2 analog outputs, 4 to 20 mA / 0 to 20 mA or 0 to 24 mA, 16-bit converter resolution	• Single channel galvanically isolated • Supports HART protocol • NetTime function

4.2.2.4.2 Analog inputs

0 to 20 mA / 4 to 20 mA

Order number	Module type	Description	Special functions
X20cAI2438	Analog input module	• 2 analog inputs, 4 to 20 mA, 16-bit converter resolution	• Single-channel galvanically isolated and with its own sensor power supply • Supports HART protocol • NetTime function

Full-bridge strain gauge

Order number	Module type	Description	Special functions
X20cAI1744-3	Analog input module	• 1 full-bridge strain gauge input, 24-bit converter resolution	• 5 Hz input filter

4.2.2.4.3 Condition monitoring

Order number	Module type	Description	Special functions
X20cCM4810	Vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	• Extensive vibration analysis and evaluation
X20cCMR011	Cabinet monitoring module	• Integrated temperature sensor, moisture sensor and accelerometer • 2 inputs for external Pt1000 • 2 digital inputs, 24 V • 1 digital output, 24 V, 0.5 A,	• Production data acquisition • 512 kB flash memory for user data

4.2.2.4.4 Digital outputs

24 VDC

Order number	Module type	Description	Special functions
X20cDM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20cDO4332	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source	
X20cDO4332-1	Digital output module	• 4 digital outputs, 24 VDC, 2 A, source, PWM output	
X20cDO8332	Digital output module	• 8 digital outputs, 24 VDC, 2 A, source	• Supply directly on module
X20cDO9321	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, sink	
X20cDO9322	Digital output module	• 12 digital outputs, 24 VDC, 0.5 A, source	
X20cDOF322	Digital output module	• 16 digital outputs, 24 VDC, 0.5 A, source	
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20cDS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function

Module overviews

48 to 240 VAC

Order number	Module type	Description	Special functions
X20cDO2633	Digital output module	• 2 Triac outputs, 48 to 240 VAC, 2 A, L-switching	• Phase-angle control • 240 V keyed

24 / 30 VDC, 115 VAC

Order number	Module type	Description	Special functions
X20cDO6529	Digital output module	• 6 relays, normally open contacts, 115 VAC / 0.5 A, 30 VDC / 1 A	

240 VAC - Relay

Order number	Module type	Description	Special functions
X20cDO4649	Digital output module	• 4 relays, normally open contacts, 240 VAC / 5 A	
X20cDO6639	Digital output module	• 6 relays, normally open contacts, 240 VAC / 2 A, 30 VDC / 2 A	

4.2.2.4.5 Digital inputs

24 VDC

Order number	Module type	Description	Special functions
X20cDI4371	Digital input module	• 4 digital inputs, 24 VDC, sink	
X20cDI6371	Digital input module	• 6 digital inputs, 24 VDC, sink	
X20cDI9371	Digital input module	• 12 digital inputs, 24 VDC, sink	
X20cDI9372	Digital input module	• 12 digital inputs, 24 VDC, source	
X20cDIF371	Digital input module	• 16 inputs, 24 VDC, sink	
X20cDM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20cDS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function

NAMUR

Order number	Module type	Description	Special functions
X20cDI4760	Digital input module	• 4 NAMUR inputs, 8.05 V	

4.2.2.4.6 Digital inputs and outputs

24 VDC

Order number	Module type	Description	Special functions
X20cDM9324	Digital mixed module	• 8 digital inputs, 24 VDC, sink • 4 digital outputs, 24 VDC, 0.5 A, source	
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20cDS438A	Digital signal module	• 4x IO-Link master V1.1, also usable as digital inputs/outputs	• NetTime function

4.2.2.4.7 Digital signal processing and preparation

Order number	Module type	Description	Special functions
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function

4.2.2.4.8 Energy metering modules

Order number	Module type	Description	Special functions
X20cAP3121	Energy metering module	3 analog inputs, 480 VAC, 50/60 Hz 4 analog inputs, 1 A AC	- Calculation of active, reactive, apparent power and apparent energy - Calculation of the effective values 240 V keyed - NetTime function
X20cAP3131	Energy metering module	3 analog inputs, 480 VAC, 50/60 Hz 4 analog inputs, 5 A AC	- Calculation of active, reactive, apparent power and apparent energy - Calculation of the effective values 240 V keyed - NetTime function
X20cCM0985-1	Digital and analog mixed module, multi-measurement transducer / synchronization module	5 digital outputs, 24 VDC, 0.5 A, source 1 relay, 1 A 8 analog inputs, ± 480 V / 120 V, 16-bit converter resolution 3 analog inputs, 5 A / 1 A AC, 16-bit converter resolution	Additional software functionalities

4.2.2.4.9 IO-Link modules

Order number	Module type	Description	Special functions
X20cDS438A	Digital signal module	4x IO-Link master V1.1, also usable as digital inputs/outputs	NetTime function

4.2.2.4.10 Communication in the X20 electronics module

Order number	Module type	Description	Special functions
X20cCS1020	Interface module	1 RS232 interface	
X20cCS1030	Interface module	1 RS422/485 interface	

4.2.2.4.11 Motor controllers

Order number	Module type	Description	Special functions
X20cMM2436	PWM motor module	2 PWM motor bridges, 3 A continuous current, 3.5 A peak current 4 digital inputs 24 VDC, configurable as an incremental encoder	Module power supply 24 to 39 VDC $\pm 25\%$

4.2.2.4.12 Temperature measurement

Resistance measurement

Order number	Module type	Description	Special functions
X20cAT2311	Temperature input module	2 resistance measurement inputs, Pt100, resolution 0.001°C	
X20cAT4222	Temperature input module	4 resistance measurement inputs, Pt100, Pt1000, resolution 0.1°C	
X20cCMR011	Cabinet monitoring module	- Integrated temperature sensor, moisture sensor and accelerometer 2 inputs for external Pt1000 2 digital inputs, 24 V 1 digital output, 24 V, 0.5 A,	- Production data acquisition 512 kB flash memory for user data

Thermocouple

Order number	Module type	Description	Special functions
X20cAT6402	Temperature input module	6 thermocouple inputs, type J, K, N, S, B, R, resolution 0.1°C	

Integrated

Order number	Module type	Description	Special functions
X20cCMR011	Cabinet monitoring module	- Integrated temperature sensor, moisture sensor and accelerometer 2 inputs for external Pt1000 2 digital inputs, 24 V 1 digital output, 24 V, 0.5 A,	- Production data acquisition 512 kB flash memory for user data

4.2.2.4.13 Counter functions

AB / ABR

Order number	Module type	Description	Special functions
X20cDC1196	Digital counter module	1 ABR incremental encoder, 5 V, 600 kHz input frequency	4x evaluation
X20cDC1396	Digital counter module	1 ABR incremental encoder, 24 V, 100 kHz input frequency	4x evaluation

Event / Gate measurement

Order number	Module type	Description	Special functions
X20cDS1119	Multifunctional digital signal processor	• 3 digital inputs/outputs, 5 V (symmetrical) • 2 digital input channels, 24 V (asymmetrical) • Optionally configurable: – Max. 2 event counters – 1 universal counter pair as AB counters or up/down counters – 1 linear motion generator (A/B, direction/frequency) with 1 reference pulse – 1 SSI absolute encoder	• NetTime function
X20cDC2395	Digital counter module	• Optionally configurable: – 1 SSI absolute encoder, 24 V – 1 ABR incremental encoder, 24 V – 2 AB incremental encoders, 24 V – 4 event counters or 2 PWM	• Local time measurement functions

SSI

Order number	Module type	Description	Special functions
X20cDC1198	Digital counter module	• 1 SSI absolute encoder, 5 V, 1 Mbit/s, 32-bit	

ABR/SSI

Order number	Module type	Description	Special functions
X20cDC2395	Digital counter module	• Optionally configurable: – 1 SSI absolute encoder, 24 V – 1 ABR incremental encoder, 24 V – 2 AB incremental encoders, 24 V – 4 event counters or 2 PWM	• Local time measurement functions

Path measurement

Order number	Module type	Description	Special functions
X20cDC2190	Digital counter module	• Ultrasonic path measurement module • 2 path measuring rods	• 4 path detection

4.2.2.4.14 System modules and accessories

4.2.2.4.14.1 Bus receivers and bus transmitters

Order number	Module type	Description	Special functions
X20cBR9300	Bus receiver	• X2X Link, supply for X2X Link and internal I/O power supply	
X20cBT9100	Bus transmitter	• X2X Link, supply for internal I/O power supply	

4.2.2.4.14.2 Bus modules

Order number	Module type	Description	Special functions
X20cBM01	Power supply bus module	• 24 VDC keyed • Internal I/O power supply interrupted to the left	
X20cBM11	Bus module	• 24 VDC keyed • Internal I/O power supply connected through	
X20cBM12	Bus module	• 240 VAC keyed • Internal I/O power supply connected through	
X20cBM31	Bus module	• For double-width modules • 24 VDC keyed • Internal I/O power supply connected through	
X20cBM32	Bus module	• For double-width modules • 240 VAC keyed • Internal I/O power supply connected through	

4.2.2.4.14.3 Power supply modules

Order number	Module type	Description	Special functions
X20cPS2100	Power supply module	• For internal I/O power supply	
X20cPS3300	Power supply module	• For X2X Link and internal I/O power supply	

4.3 Safety module

4.3.1 Module overview - Safety - Alphabetical

Order number	Module type	Description	Special functions
X20BM13	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	Single-width
X20BM16	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	- Single-width - With node number switch
X20BM23	Power supply bus module	- For X20 SafeIO power supply modules - Internal I/O power supply interrupted to the left	
X20BM26	Power supply bus module	- For X20 SafeIO power supply modules - Internal I/O power supply interrupted to the left	With node number switch
X20BM33	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	
X20BM36	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	With node number switch
X20SA4430	Safe current input module	2x 2 safe type A analog inputs, 4 to 20 mA	Channels individually galvanically isolated
X20SC0402	Safe digital mixed module	4 safe type A digital inputs 4 pulse outputs, 24 VDC 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0806	Safe digital mixed module	8 safe type A digital inputs 4 pulse outputs, 24 VDC 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0842	Safe digital mixed module	8 safe type A digital inputs 4 pulse outputs, 24 VDC 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SC2212	Safe digital mixed module	6 safe type A digital inputs 6 pulse outputs, 24 VDC 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20SC2432	Safe digital mixed module	2 safe type A digital inputs 2 pulse outputs, 24 VDC 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	
X20SD1207	Safe digital counter module	1 safe type A digital counter channel, 7 kHz, 24 VDC	
X20SI2100	Safe digital input module	2 safe type A digital inputs 2 pulse outputs, 24 VDC	
X20SI4100	Safe digital input module	4 safe type A digital inputs 4 pulse outputs, 24 VDC	
X20SI8110	Safe digital input module	8 safe type A digital inputs 4 pulse outputs, 24 VDC	Single-width
X20SI9100	Safe digital input module	20 safe type A digital inputs 4 pulse outputs, 24 VDC	
X20SL8100	SafeLOGIC controller	- Safety controller - openSAFETY gateway 1 POWERLINK interface - Controlled node, integrated 2-port hub	- Exchangeable application memory: SafeKEY - Including power supply module
X20SL8101	SafeLOGIC with X20 bus controller	- Safety controller - openSAFETY gateway 1 POWERLINK interface - Controlled node, integrated 2-port hub	- Exchangeable application memory: SafeKEY - Including power supply module for internal I/O power supply and X2X Link power supply
X20SL8110	SafeLOGIC controller	- Safety controller - openSAFETY gateway 1 POWERLINK interface 1 slot for an X20 interface module - Controlled node, integrated 2-port hub	- Exchangeable application memory: SafeKEY - Including power supply module
X20SLX210	Safe digital input module	- Safety controller, openSAFETY 10 SafeNODEs 4 SafeMOTION axes 2 safe type A digital inputs 2 pulse outputs, 24 VDC	
X20SLX402	Safe digital mixed module	- Safety controller, openSAFETY 10 SafeNODEs 4 SafeMOTION axes 4 safe type A digital inputs 4 pulse outputs, 24 VDC 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX410	Safe digital input module	- Safety controller, openSAFETY 10 SafeNODEs 4 SafeMOTION axes 4 safe type A digital inputs 4 pulse outputs, 24 VDC	

Module overviews

Order number	Module type	Description	Special functions
X20SLX806	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX811	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC	• Single-width
X20SLX842	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SO2110	Safe digital output module	• 2 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20SO2120	Safe digital output module	• 2 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20SO2530	Safe digital output module	• 2 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	
X20SO4110	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20SO4120	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20SO6300	Safe digital output module	• 6 safe type B1 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SO6530	Safe digital output module	• 6 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	
X20SP1130	Safe power supply module	• For internal I/O power supply, 24 VDC, 10 A • 1 safe type B1 digital output, 24 VDC, 10 A, without OSSD	• With integrated safe cutoff function
X20SRT402	Safe digital mixed module reACTION Technology	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT806	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT842	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	• 150 µs safety cycle time
X20ST4492	Safe temperature input module	• 2x 2 safe analog inputs for thermocouples, type: J, K, N, S, R, C, T, resolution 0.1°C • 1x 2 safe analog inputs for Pt100/Pt1000 sensors	• Channel pairs galvanically isolated • Temperature sensor integrated in terminal block X20TB5E
X20TB52	Safety terminal block	• 12-pin, safety-keyed	
X20TB5E	Safety terminal block	• 16-pin, safety-keyed	• 2x integrated Pt1000 temperature sensor
X20TB5F	Safety terminal block	• 16-pin, safety-keyed	
X20TB72	Safety terminal block	• 12-pin, 240 VAC, safety-keyed	

4.3.2 Module overview - Safety - Grouped

4.3.2.1 SafeLOGIC controller

4.3.2.1.1 SafeLOGIC controller

Order number	Module type	Description	Special functions
X20SL8100	SafeLOGIC controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module
X20SL8101	SafeLOGIC with X20 bus controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module for internal I/O power supply and X2X Link power supply
X20SL8110	SafeLOGIC controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • 1 slot for an X20 interface module • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module

4.3.2.1.2 SafeLOGIC-X controller

Order number	Module type	Description	Special functions
X20SLX210	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 2 safe type A digital inputs • 2 pulse outputs, 24 VDC	
X20SLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX410	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SLX806	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX811	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC	• Single-width
X20SLX842	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	

4.3.2.2 SafeIO modules

4.3.2.2.1 Analog inputs

Order number	Module type	Description	Special functions
X20SA4430	Safe current input module	• 2x 2 safe type A analog inputs, 4 to 20 mA	• Channels individually galvanically isolated

4.3.2.2.2 Digital outputs

24 VDC

Order number	Module type	Description	Special functions
X20SC0402	Safe digital mixed module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0806	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0842	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20SLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX806	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX842	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SO2110	Safe digital output module	• 2 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20SO2120	Safe digital output module	• 2 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20SO4110	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20SO4120	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20SO6300	Safe digital output module	• 6 safe type B1 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SP1130	Safe power supply module	• For internal I/O power supply, 24 VDC, 10 A • 1 safe type B1 digital output, 24 VDC, 10 A, without OSSD	• With integrated safe cutoff function
X20SRT402	Safe digital mixed module reACTION Technology	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT806	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT842	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	• 150 µs safety cycle time

48 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20SC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	

230 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20SQ2530	Safe digital output module	• 2 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	
X20SQ6530	Safe digital output module	• 6 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	

4.3.2.2.3 Digital inputs

Order number	Module type	Description	Special functions
X20SC0402	Safe digital mixed module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0806	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0842	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20SC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	
X20SI2100	Safe digital input module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC	
X20SI4100	Safe digital input module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SI8110	Safe digital input module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC	• Single-width
X20SI9100	Safe digital input module	• 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SLX210	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 2 safe type A digital inputs • 2 pulse outputs, 24 VDC	
X20SLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX410	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SLX806	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX811	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC	• Single-width

Module overviews

Order number	Module type	Description	Special functions
X20SLX842	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20SRT402	Safe digital mixed module reACTION Technology	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT806	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT842	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	• 150 µs safety cycle time

4.3.2.2.4 Digital inputs and outputs

24 VDC

Order number	Module type	Description	Special functions
X20SC0402	Safe digital mixed module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0806	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SC0842	Safe digital mixed module	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20SLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20SLX806	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	

Order number	Module type	Description	Special functions
X20SLX842	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	
X20SRT402	Safe digital mixed module reACTION Technology	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT806	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT842	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	• 150 µs safety cycle time

48 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20SC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	

4.3.2.2.5 reACTION I/O modules

Order number	Module type	Description	Special functions
X20SRT402	Safe digital mixed module reACTION Technology	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT806	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 6 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	• 150 µs safety cycle time
X20SRT842	Safe digital mixed module reACTION Technology	• 8 safe type A digital inputs • 4 pulse outputs, 24 VDC • 4 safe type A digital outputs, 24 VDC, 3 A, OSSD <500 µs • 2 safe type B2 digital outputs, 24 VDC, 50 mA, OSSD <500 µs	• 150 µs safety cycle time

4.3.2.2.6 Temperature measurement

Order number	Module type	Description	Special functions
X20ST4492	Safe temperature input module	• 2x 2 safe analog inputs for thermocouples, type: J, K, N, S, R, C, T, resolution 0.1°C • 1x 2 safe analog inputs for Pt100/Pt1000 sensors	• Channel pairs galvanically isolated • Temperature sensor integrated in terminal block X20TB5E

4.3.2.2.7 Counter function

Order number	Module type	Description	Special functions
X20SD1207	Safe digital counter module	• 1 safe type A digital counter channel, 7 kHz, 24 VDC	

4.3.2.2.8 System modules and accessories

4.3.2.2.8.1 Bus modules

Order number	Module type	Description	Special functions
X20BM13	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	Single-width
X20BM16	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	- Single-width - With node number switch
X20BM23	Power supply bus module	- For X20 SafeIO power supply modules - Internal I/O power supply interrupted to the left	
X20BM26	Power supply bus module	- For X20 SafeIO power supply modules - Internal I/O power supply interrupted to the left	With node number switch
X20BM33	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	
X20BM36	Bus module	- For X20 SafeIO modules - Internal I/O power supply connected through	With node number switch

4.3.2.2.8.2 Power supply modules

Order number	Module type	Description	Special functions
X20SP1130	Safe power supply module	- For internal I/O power supply, 24 VDC, 10 A 1 safe type B1 digital output, 24 VDC, 10 A, without OSSD	With integrated safe cutoff function

4.3.2.2.8.3 Terminal blocks

Order number	Module type	Description	Special functions
X20TB52	Safety terminal block	12-pin, safety-keyed	
X20TB5E	Safety terminal block	16-pin, safety-keyed	2x integrated Pt1000 temperature sensor
X20TB5F	Safety terminal block	16-pin, safety-keyed	
X20TB72	Safety terminal block	12-pin, 240 VAC, safety-keyed	

4.4 Safety module - Coated

4.4.1 Module overview - Safety - Alphabetical

Order number	Module type	Description	Special functions
X20cBM33	Bus module	• For X20 SafeIO modules • Internal I/O power supply connected through	
X20cSA4430	Safe current input module	• 2x 2 safe type A analog inputs, 4 to 20 mA	• Channels individually galvanically isolated
X20cSC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20cSC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	
X20cSD1207	Safe digital counter module	• 1 safe type A digital counter channel, 7 kHz, 24 VDC	
X20cSI4100	Safe digital input module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSI9100	Safe digital input module	• 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSL8100	SafeLOGIC controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module
X20cSL8101	SafeLOGIC with X20 bus controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module for internal I/O power supply and X2X Link power supply
X20cSLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20cSLX410	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSO2530	Safe digital output module	• 2 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	
X20cSO4110	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20cSO4120	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20cSO6300	Safe digital output module	• 6 safe type B1 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20cSO6530	Safe digital output module	• 6 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	

4.4.2 Module overview - Safety - Grouped

4.4.2.1 SafeLOGIC controller

4.4.2.1.1 SafeLOGIC controller

Order number	Module type	Description	Special functions
X20cSL8100	SafeLOGIC controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module
X20cSL8101	SafeLOGIC with X20 bus controller	• Safety controller • openSAFETY gateway • 1 POWERLINK interface • Controlled node, integrated 2-port hub	• Exchangeable application memory: SafeKEY • Including power supply module for internal I/O power supply and X2X Link power supply

4.4.2.1.2 SafeLOGIC-X controller

Order number	Module type	Description	Special functions
X20cSLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20cSLX410	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	

4.4.2.2 SafeIO modules

4.4.2.2.1 Analog inputs

Order number	Module type	Description	Special functions
X20cSA4430	Safe current input module	• 2x 2 safe type A analog inputs, 4 to 20 mA	• Channels individually galvanically isolated

4.4.2.2.2 Digital outputs

24 VDC

Order number	Module type	Description	Special functions
X20cSC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20cSLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20cSO4110	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	• Current monitoring
X20cSO4120	Safe digital output module	• 4 safe type A digital outputs, 24 VDC, 2 A, OSSD <500 µs	• Current monitoring
X20cSO6300	Safe digital output module	• 6 safe type B1 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	

48 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20cSC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	

230 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20cSO2530	Safe digital output module	• 2 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	
X20cSO6530	Safe digital output module	• 6 relays with 1 normally open contact each, 230 VAC / 6 A, 24 VDC / 6 A	

4.4.2.2.3 Digital inputs

Order number	Module type	Description	Special functions
X20cSC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20cSC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	
X20cSI4100	Safe digital input module	• 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSI9100	Safe digital input module	• 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	
X20cSLX410	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC	
X20cSLX910	Safe digital input module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 20 safe type A digital inputs • 4 pulse outputs, 24 VDC	

4.4.2.2.4 Digital inputs and outputs**24 VDC**

Order number	Module type	Description	Special functions
X20cSC2212	Safe digital mixed module	• 6 safe type A digital inputs • 6 pulse outputs, 24 VDC • 2 safe type B1 digital outputs, 24 VDC, 0.5 A, OSSD <500 µs	
X20cSLX402	Safe digital mixed module	• Safety controller, openSAFETY • 10 SafeNODEs • 4 SafeMOTION axes • 4 safe type A digital inputs • 4 pulse outputs, 24 VDC • 2 safe type B2 digital outputs, 24 VDC, 0.2 A, OSSD <10 µs	

48 VAC / 24 VDC

Order number	Module type	Description	Special functions
X20cSC2432	Safe digital mixed module	• 2 safe type A digital inputs • 2 pulse outputs, 24 VDC • 2 relays with 1 normally open contact each, 48 VAC / 6 A, 24 VDC / 6 A	

4.4.2.2.5 Counter function

Order number	Module type	Description	Special functions
X20cSD1207	Safe digital counter module	• 1 safe type A digital counter channel, 7 kHz, 24 VDC	

4.4.2.2.6 System modules and accessories**4.4.2.2.6.1 Bus modules**

Order number	Module type	Description	Special functions
X20cBM33	Bus module	• For X20 SafeIO modules • Internal I/O power supply connected through	

5 Dimensioning

5.1 Design support

5.1.1 CAD support

To ensure CAD support, the dimensions are included in the ECAD macros in 2D. STEP data is available to allow 3D viewing.

The STEP data can be downloaded from the B&R website (www.br-automation.com) in the Downloads section for the respective module.

5.1.2 Macros for ECAD systems

The electronics in a machine must be designed in a way that optimizes use of available space and materials. Graphic ECAD systems have proven themselves as the right tool for this job.

Every module in the X20 system is delivered with pre-designed electronic descriptions of the mechanical dimensions, electrical signals and module functions. These macros can be loaded directly to proven ECAD systems. The wiring plans are automatically applied by the configuration and programming system, Automation Studio. Design and changes are immediately reflected at all levels of development. This saves time for the more important tasks and prevents errors right from the start. The accelerated development, programming, maintenance and documentation involved with the X20 system mean lower costs, enhanced quality and increased sales by earlier entry into the market.

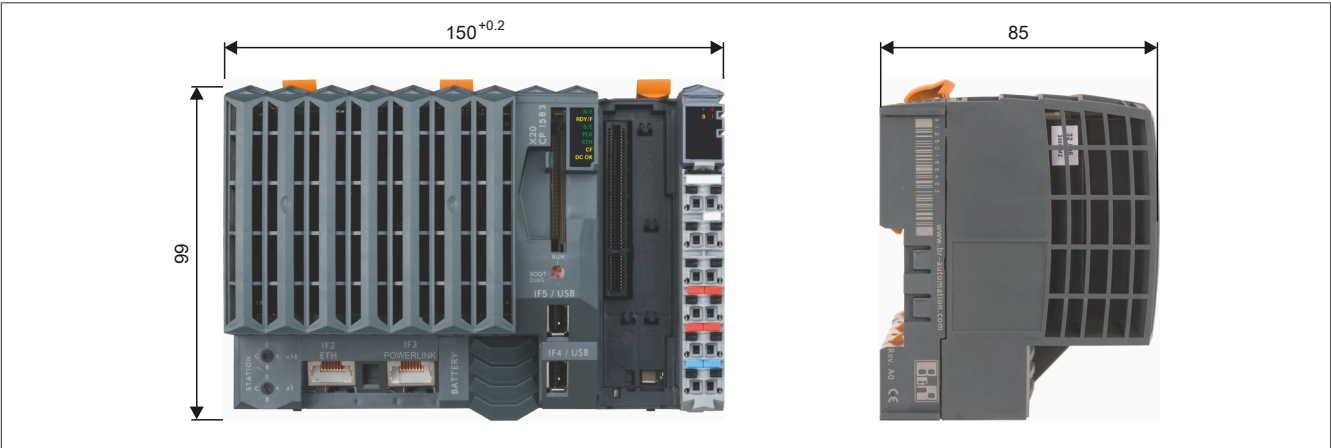
5.1.3 Printing support

System printers and standard identification labels are supported by the appropriate printer software. Printing can be done manually from table calculations or directly from ECAD software (all methods are supported). The software and printer systems correspond with the Weidmüller standard.

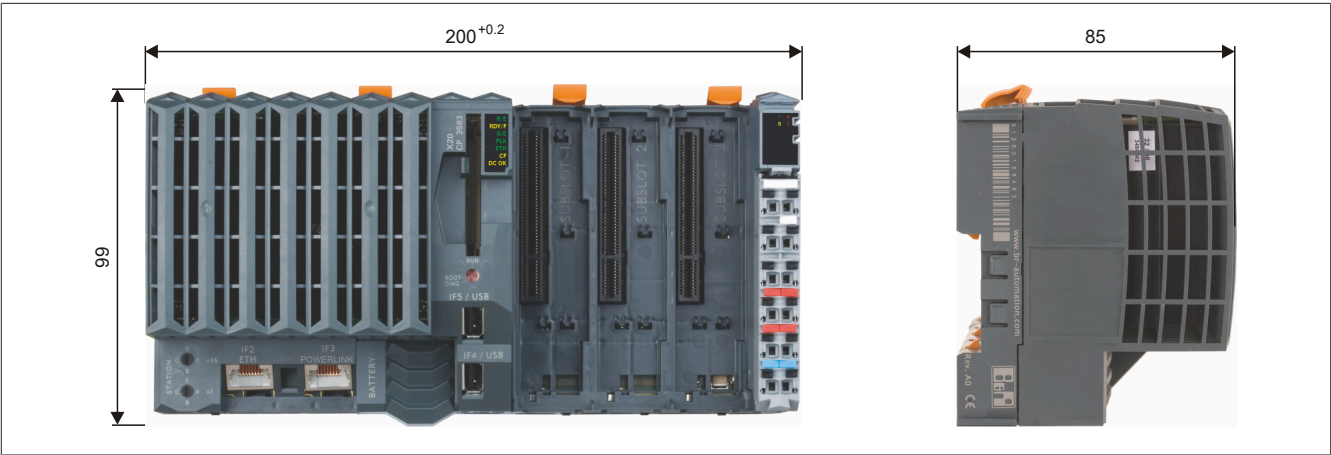
5.2 Dimensions

5.2.1 X20 controllers

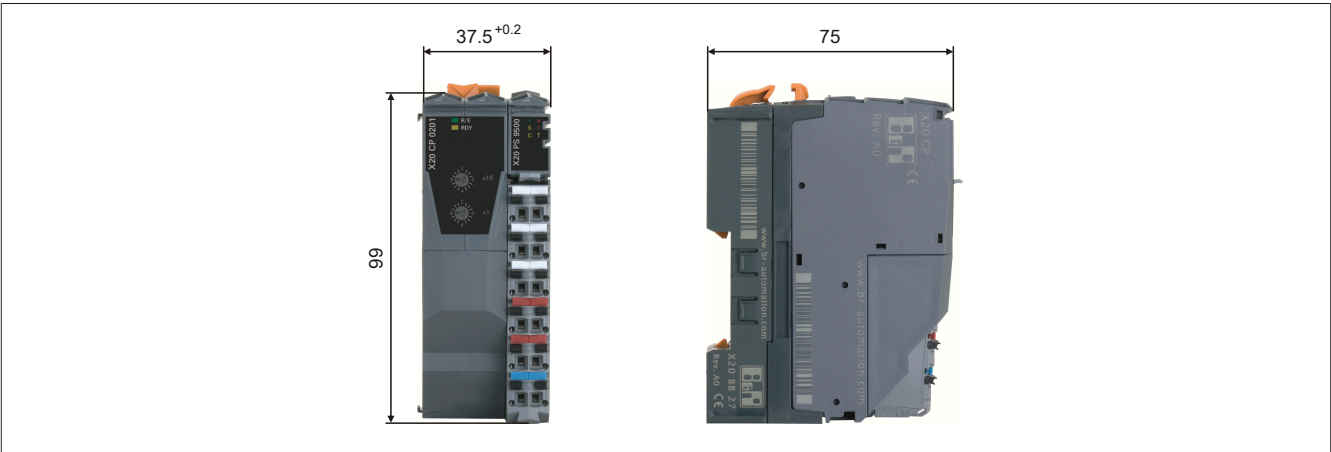
With 1 additional slot for interface modules



With 3 additional slots for interface modules

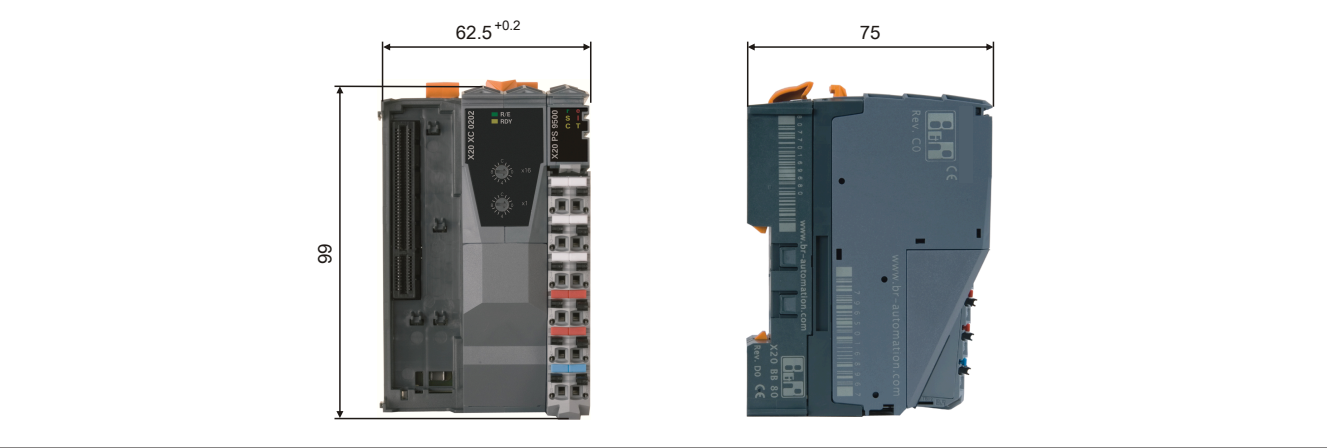


5.2.2 Compact-S controllers and bus controllers

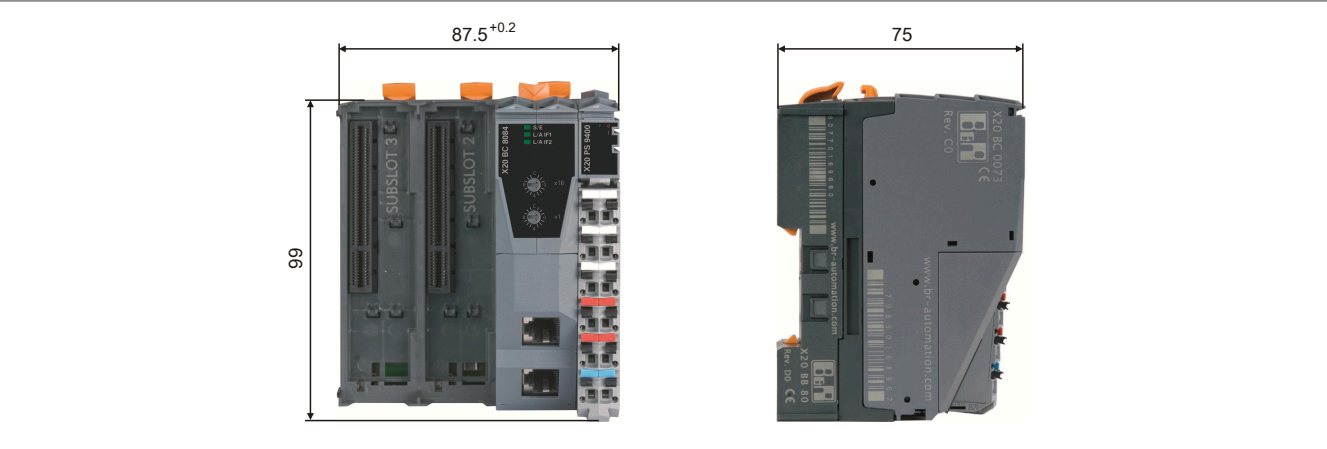


5.2.3 Compact-S controllers and expandable bus controller

With 1 additional slot for interface modules

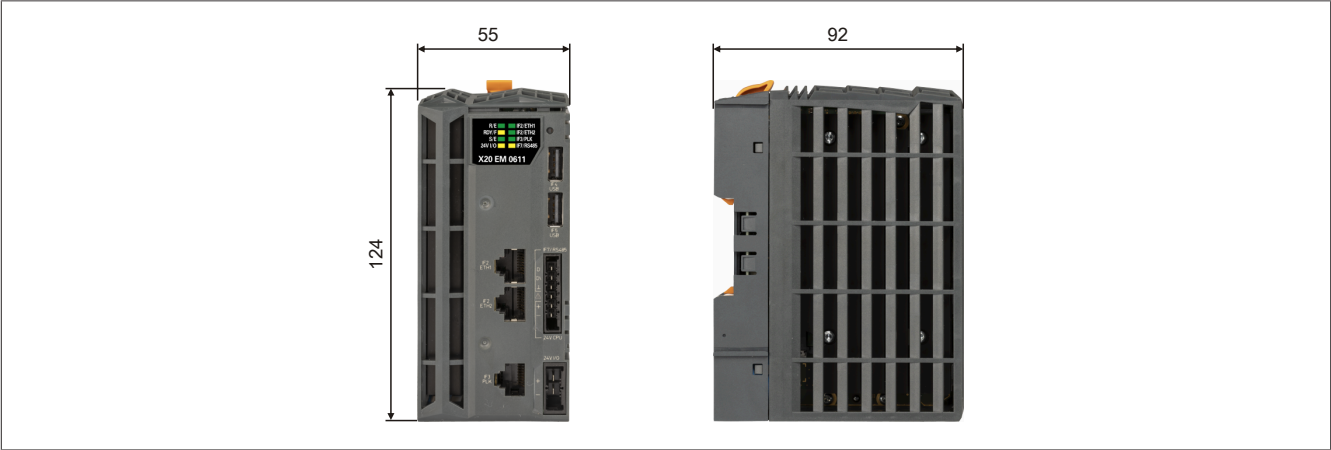


With 2 additional slots for interface modules

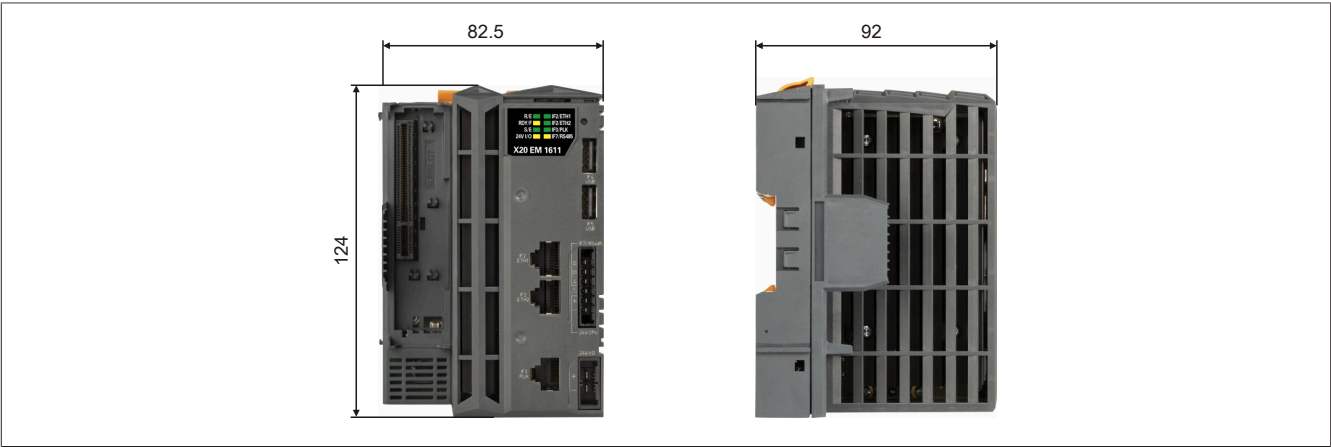


5.2.4 Embedded for controllers

Without additional slot for interface modules



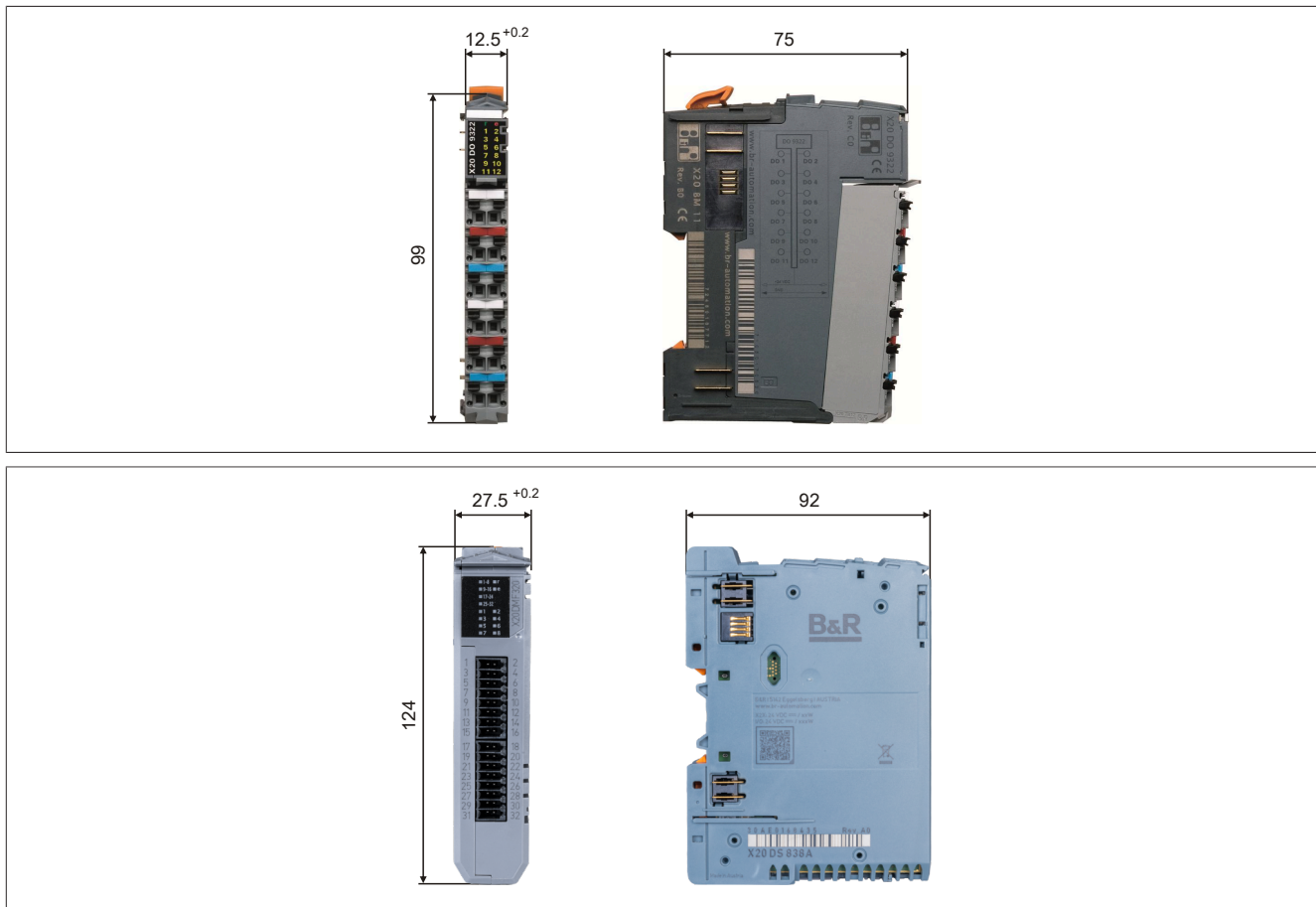
With 1 additional slot for interface modules



5.2.5 I/O modules

The I/O modules are available in 2 construction types. The pitch of the modules is specified in the technical data in the data sheets.

The pitch is an integer multiple of the module width specified in the following diagrams.



5.2.6 End cover plates

In addition to the dimensions for controllers and modules specified in this section, end cover plates can be added to the right and left sides of a module block. The following space must be provided for this:

- **Right side:** 5 mm
- **Left side:** 3.5 mm

6 Installation and wiring

6.1 Installation

A top-hat rail that must comply with standard EN 60715 (TH35-7.5) is required to install the PLC. This top-hat rail is conductively secured to the rear panel of the control cabinet. It is important to note the following points:

- The top-hat rail must have a clean and well-conducting surface.
- The top-hat rail is screwed to the conductive rear panel of the control cabinet every 10 cm.
- Connect the rear panel of the control cabinet to ground with good conductivity ($\geq 16 \text{ mm}^2$).

The complete system including all individual modules is hung in the desired location on the top-hat rail with the unlocking mechanisms open and locked in place by closing the unlocking mechanisms. Finally, the modules are equipped with the prewired terminal blocks.

Installation methods

- [Vertical installation](#)
- [Horizontal installation](#)
- [Oblique installation](#)
- [Face-up installation](#)



Information:

Other installation methods are not permitted.

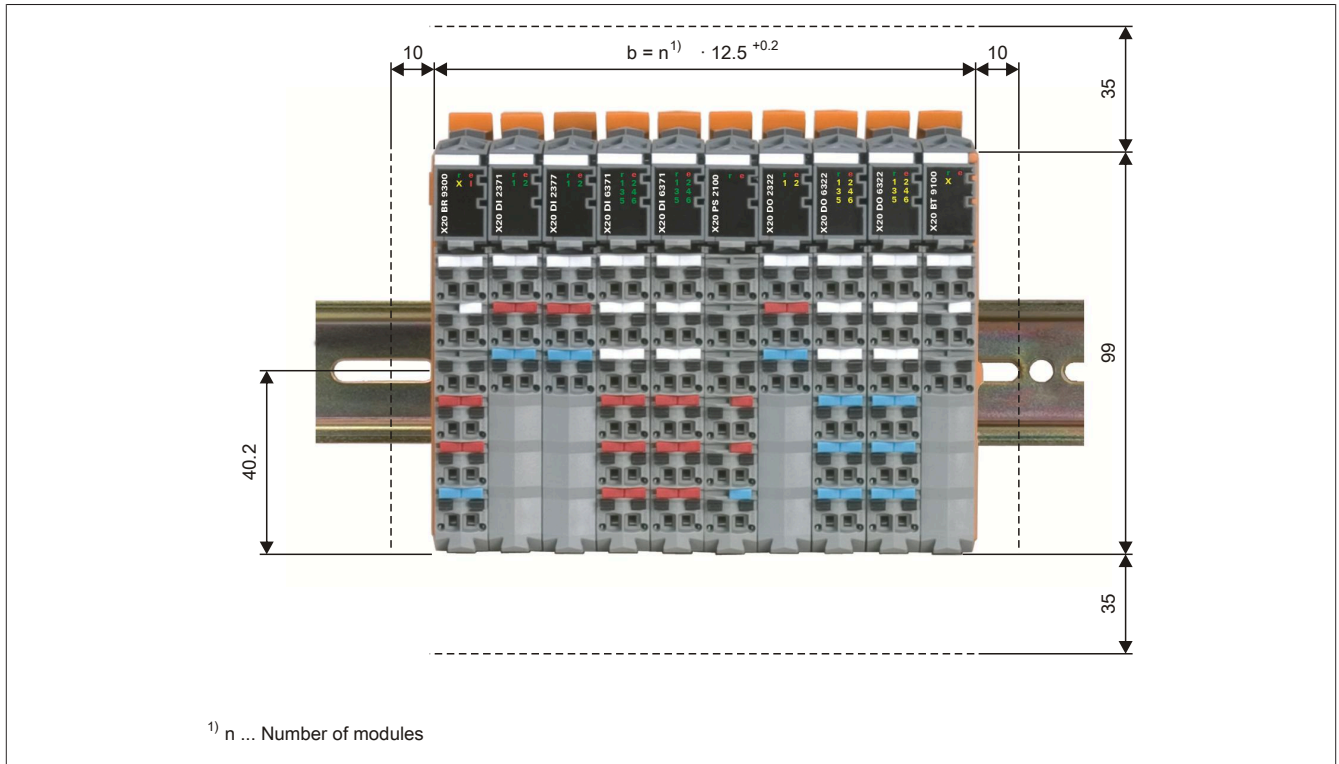


Notice!

The module must be installed in a final safety enclosure that meets UL/CSA/IEC 61010-1 and UL/CSA/IEC 61010-2-201 requirements for a fire enclosure.

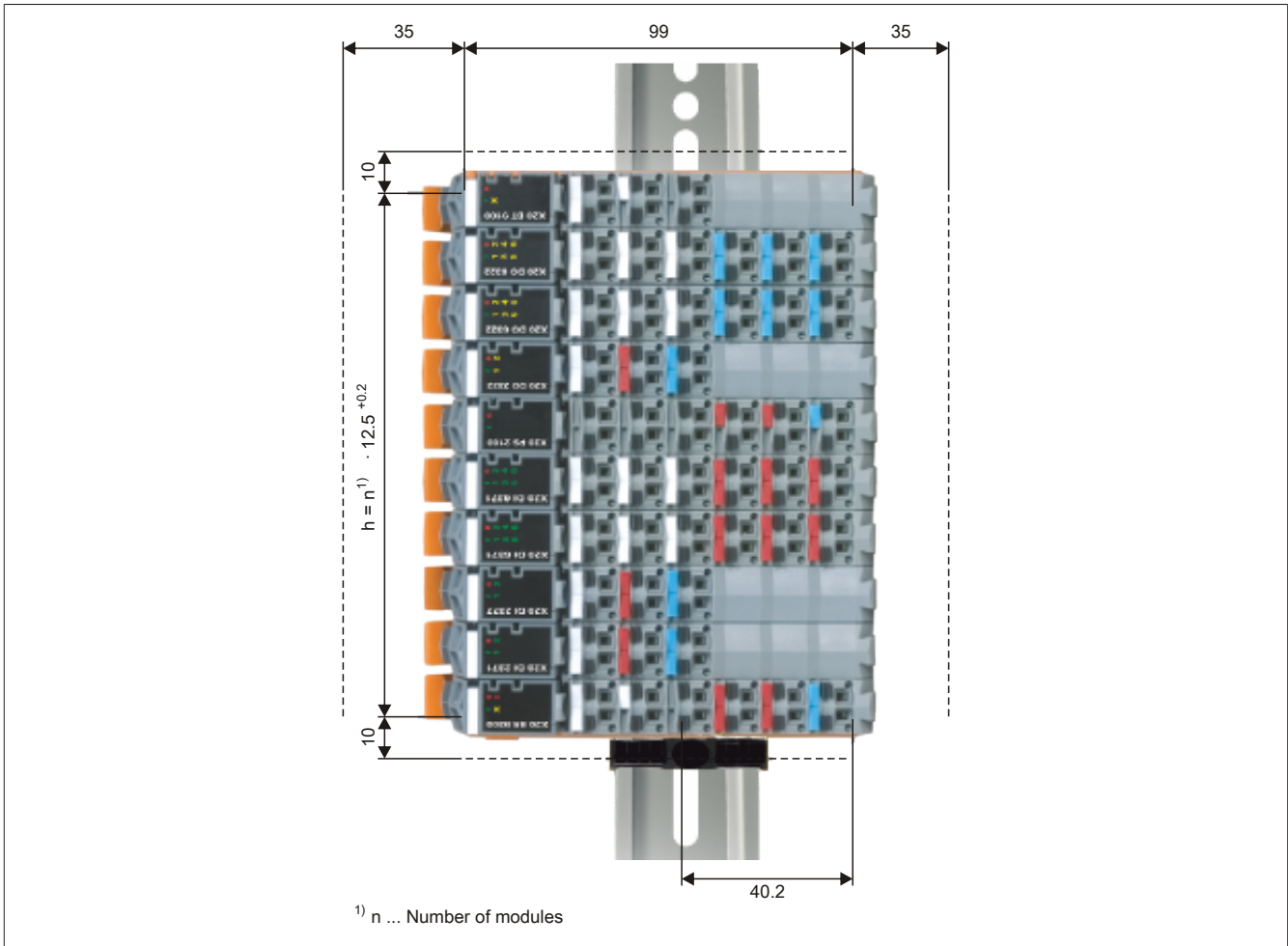
In all cases, applicable national and international standards, regulations and safety measures must be taken into account and observed.

6.1.1 Horizontal installation



For optimal cooling and air circulation, there must be at least 35 mm free space above the modules. To the left and right of the X20 system, there must be at least 10 mm of free space. Underneath the modules, 35 mm space must be left free for I/O and power supply cabling.

6.1.2 Vertical installation



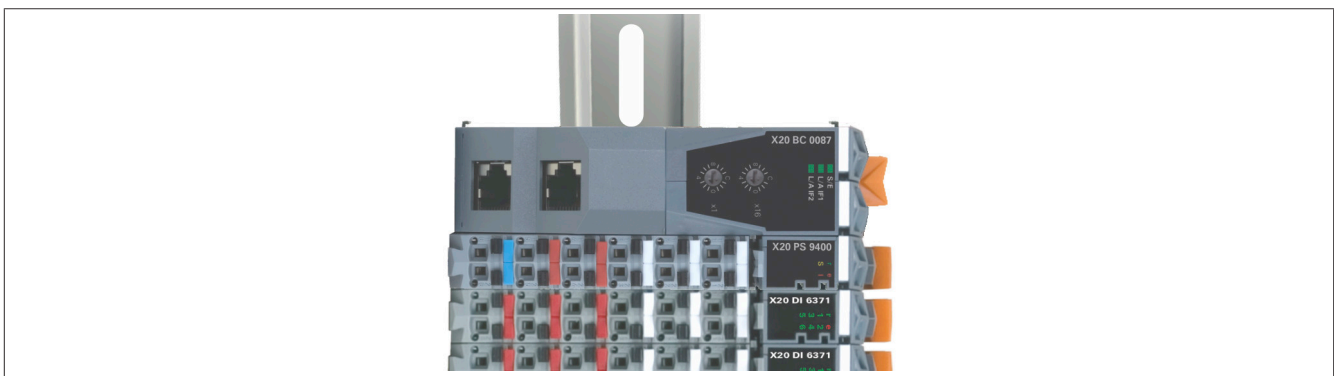
For optimal cooling and air circulation, there must be at least 35 mm free space to the left of the modules. Above and below the X20 system, there must be at least 10 mm of free space. To the right of the modules, 35 mm space must be left free for I/O and power supply cabling.

The modules must be arranged so that the controller is on the lower end of the system. The temperature range is limited to -25 to 50°C when modules are mounted vertically.



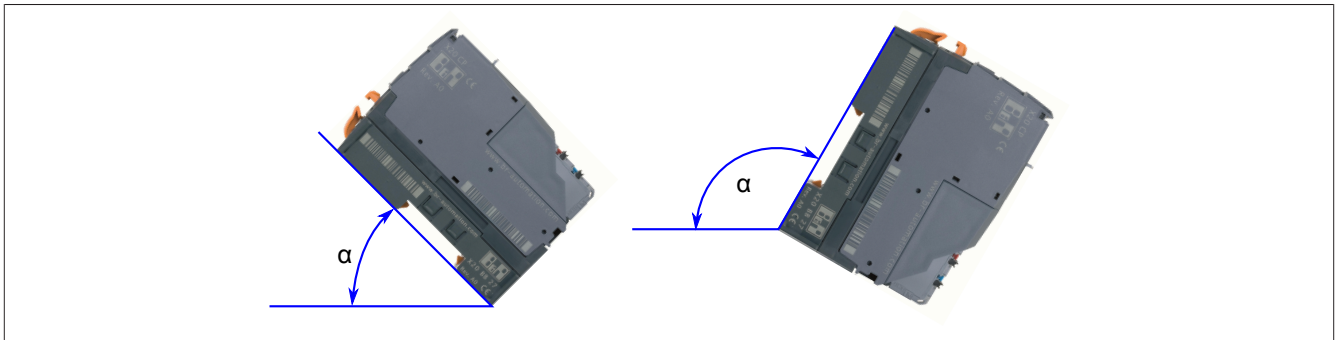
Information:

The controller must be secured against slipping with an end clamp.



When using an overhead bus controller or controller, an additional derating of 5°C based on the vertical installation must be observed. The additional derating only applies to the bus controller, controller and associated power supply unit.

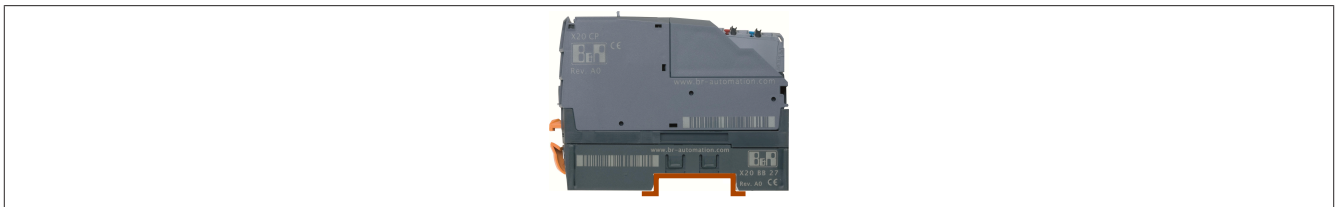
6.1.3 Oblique installation



For oblique installation, the derating depends on angle α .

- $\alpha < 70^\circ$: An additional derating of 15°C based on the horizontal installation must be observed (corresponds to [lying installation](#)).
- $\alpha \geq 70^\circ$ and $< 90^\circ$: No additional derating (corresponds to [horizontal installation](#))
- $\alpha \geq 90^\circ$ and $\leq 120^\circ$: An additional derating of 15°C based on the horizontal installation must be observed (corresponds to [face-up installation](#)).
- $\alpha > 120^\circ$: Not permitted

6.1.4 Face-up installation



An additional derating of 15°C based on the horizontal installation must be observed when installing with the top-hat rail at the bottom.

6.1.5 Installation with increased vibration requirements (4 g)

The following additional measures are necessary to fulfill increased vibration requirements regardless of whether X20 modules are installed horizontally or vertically:

1. Apply foam tape along the entire length of the module configuration under the top edge.
2. Use special end clamps to the left and right to provide additional fixation (supplement foam tape as shown in the image).
3. For controllers with replaceable battery, foam tape must be applied to the inside of the battery cover to additionally secure the battery in place.
4. If slots are free, use dummy housings to ensure that the controller is held effectively in place.
5. Proper strain relief on all wires

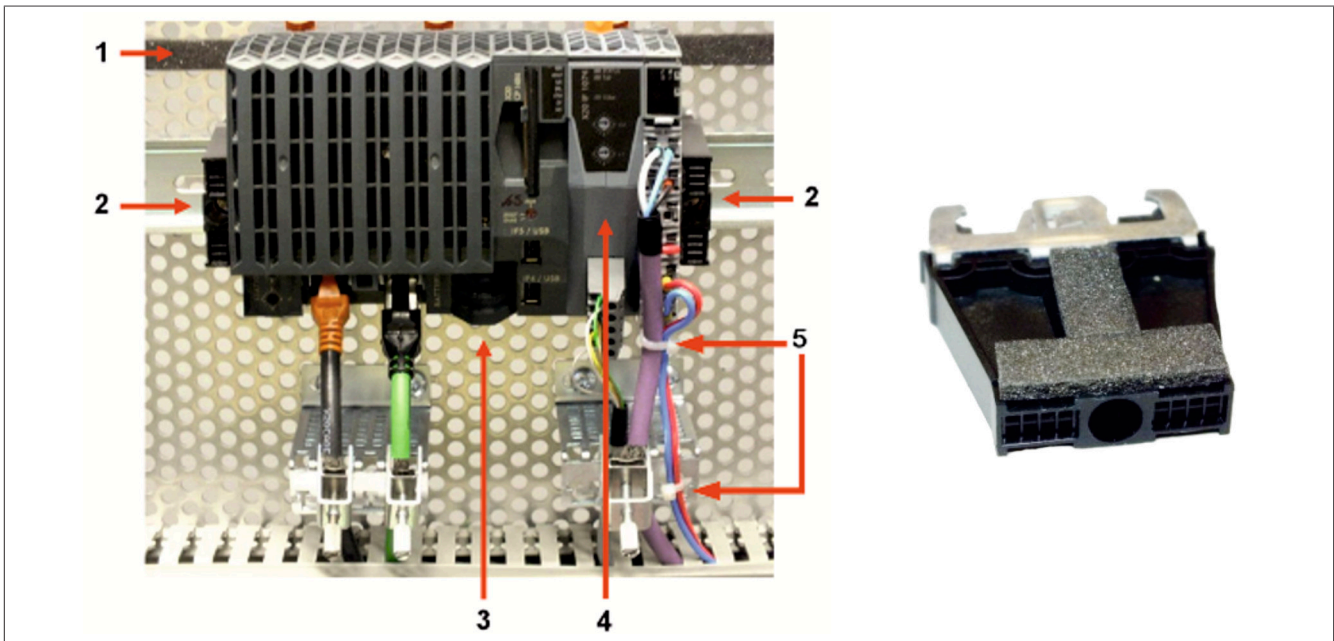


Figure 2: X20 system - Installation with increased vibration requirements (4 g) and end clamp



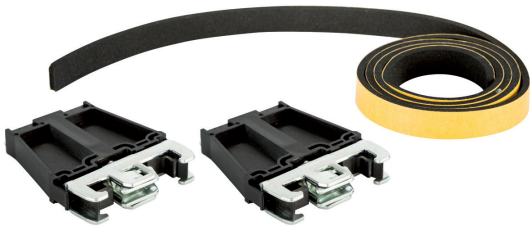
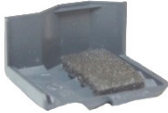
Notice!

The attachable end cover plates for some X20 modules should be removed for "installation with increased vibration requirements (4 g)"!



Figure 3: X20 system - Removing the end cover plates

Required accessories

Beschreibung	Abbildung
1x Set X20AC0RF1 comprising 2x end clamps for mounting rail TH35 (add foam tape) and 1x foam tape 12 x 3 x 1000 mm (height x width x length)	
Apply foam tape (L = 15 mm) to the battery cover on controllers.	
Use X20IF0000 dummy module in empty slots	

6.1.6 Strain relief

Strain relief can be achieved in several ways. 2 options are described in the following sections.

6.1.6.1 Strain relief via terminal block and cable tie



Figure 4: Strain relief using cable ties

The terminal blocks of the X20 System are equipped with a bracket. If required, a cable tie can be passed through this bracket for strain relief.

Cable tie dimensions:

Width	$\leq 4.0 \text{ mm}$
Thickness	$\leq 1.2 \text{ mm}$

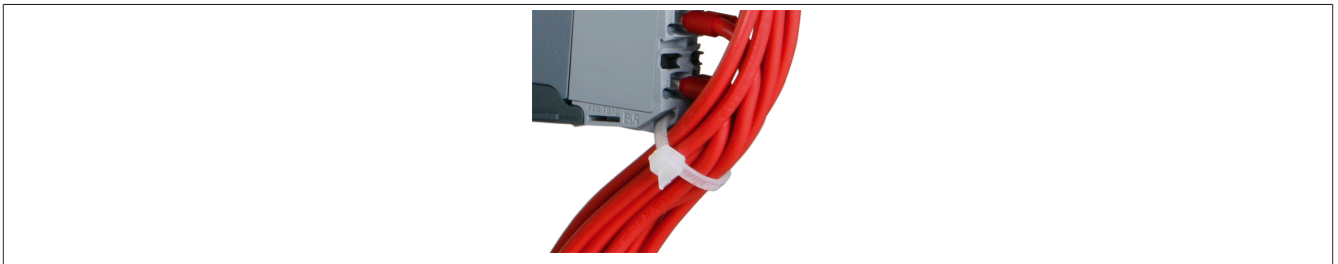


Figure 5: Slots through which the cable ties are fed

6.1.6.2 Strain relief via shielding bracket

A shielding bracket and a ground terminal or cable tie can be used for strain relief.

Here is an example with a ground terminal:

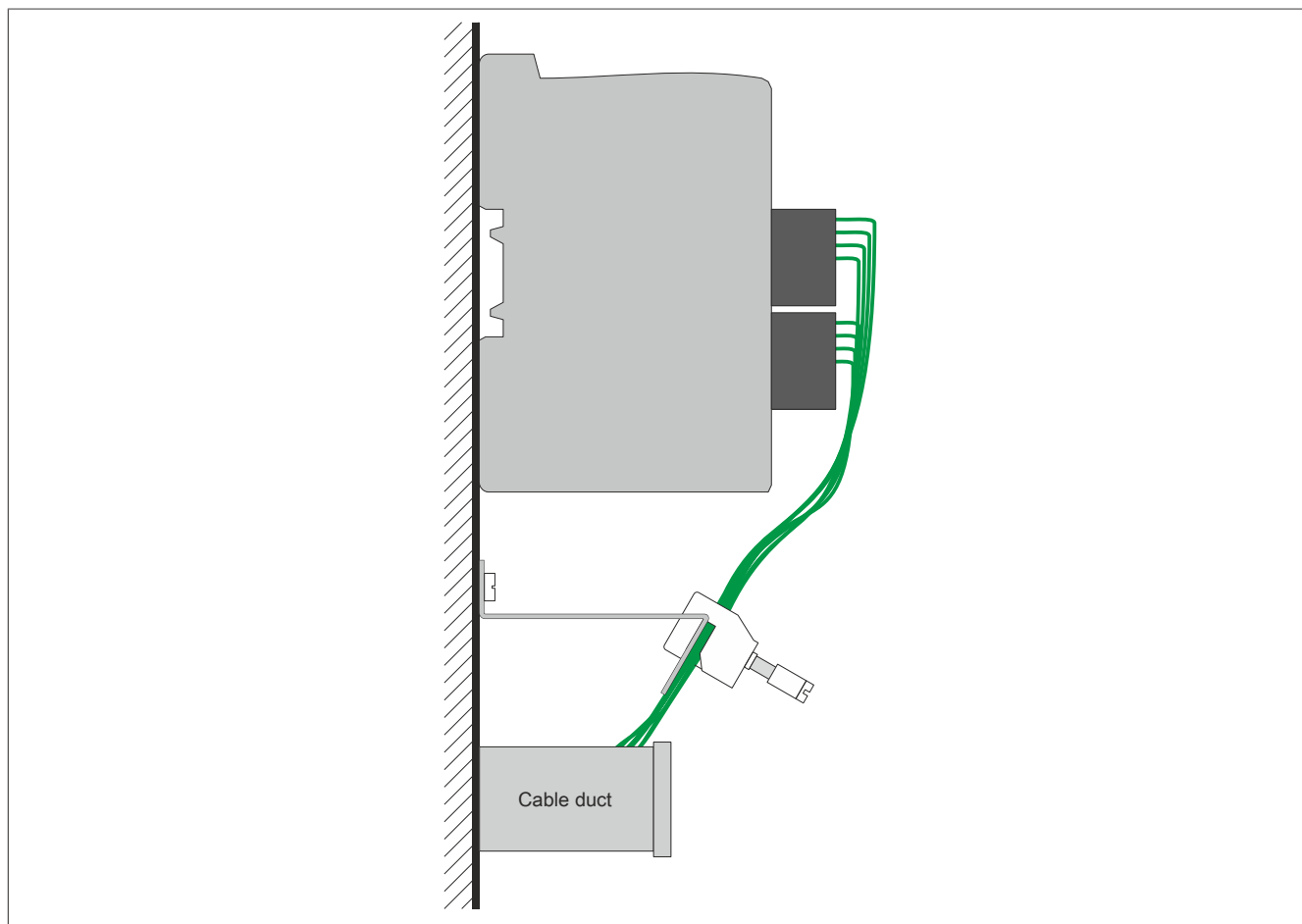
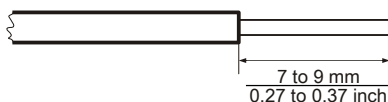


Figure 6: Strain relief via shielding bracket and ground terminal

6.2 Wiring

In order to achieve a secure connection in the terminal blocks, wires must be stripped accordingly.



Information:

The wire stripping length is not permitted to be more or less than 7 to 9 mm.

Connection cross sections

The following table shows the possible wire cross sections and connection types for the various terminal blocks:

	X20TB06 X20TB12	X20TB1E X20TB1F	X20TB32
Single-wire			
mm ²	0.08 to 2.50	0.08 to 1.50	0.08 to 2.50
AWG	28 to 14	28 to 16	28 to 14
Fine-stranded			
mm ²	0.25 to 2.50	0.25 to 1.50	0.25 to 2.50
AWG	24 to 14	24 to 16	24 to 14
With wire end sleeves			
mm ²	0.25 to 1.50	0.25 to 0.75	0.25 to 1.50
AWG	24 to 16	24 to 20	24 to 16
With double wire end sleeves			
mm ²	Up to 2x 0.75	-	Up to 2x 0.75
AWG	Up to 2x 21	-	Up to 2x 21



Information:

To avoid damaging the push-in terminal blocks, B&R screwdriver [X20AC0SD1](#) should be used.

6.3 Lightning and surge protection



Information:

Lines at risk of lightning strikes must be fitted with suitable overvoltage protection.

The circuits must be limited to overvoltage category II per IEC 60664-1 or according to other information in the module data sheet.

For the design of your electrical system, see ABB documentation "[Global guide to surge protection](#)".

6.3.1 USA/Canada

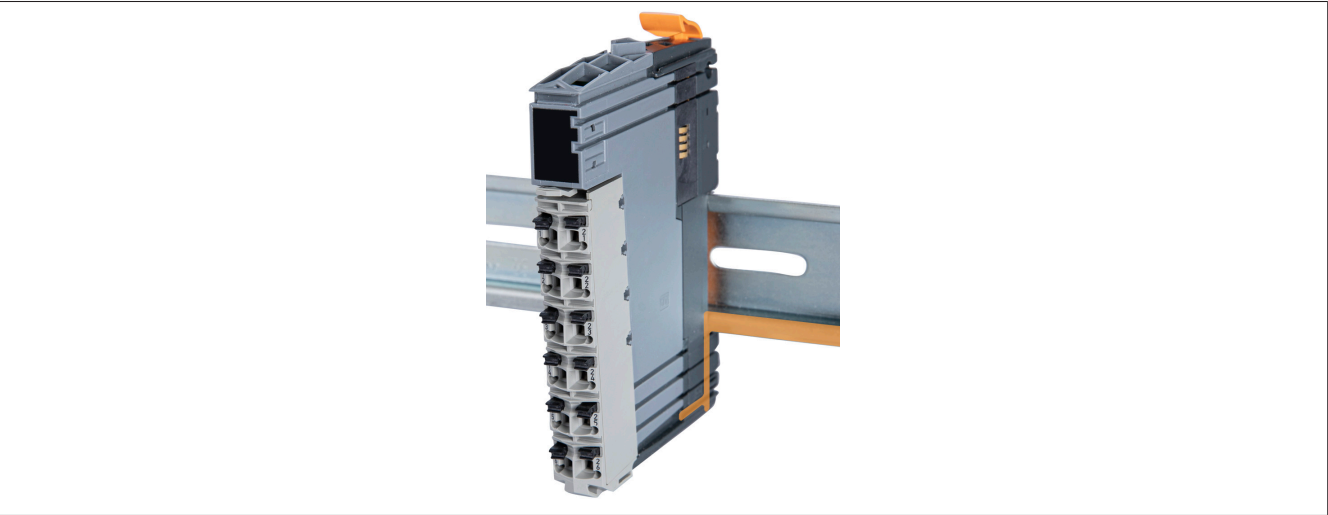
Electrical installations must comply with the relevant requirements of the National Electrical Code® (ANSI/NFPA-70 (NEC®) and, where applicable, Canadian Electrical Code (CEC), CE Code, or CSA C22.1. This applies specifically to electrical communication lines that are routed outside of a building and are considered to be at risk of lightning strike (see ANSI/NFPA-70 (NEC®) 2020 Edition - Part III Protection 805.90 Protective Devices).

6.4 Shielding and grounding

Schematic diagram

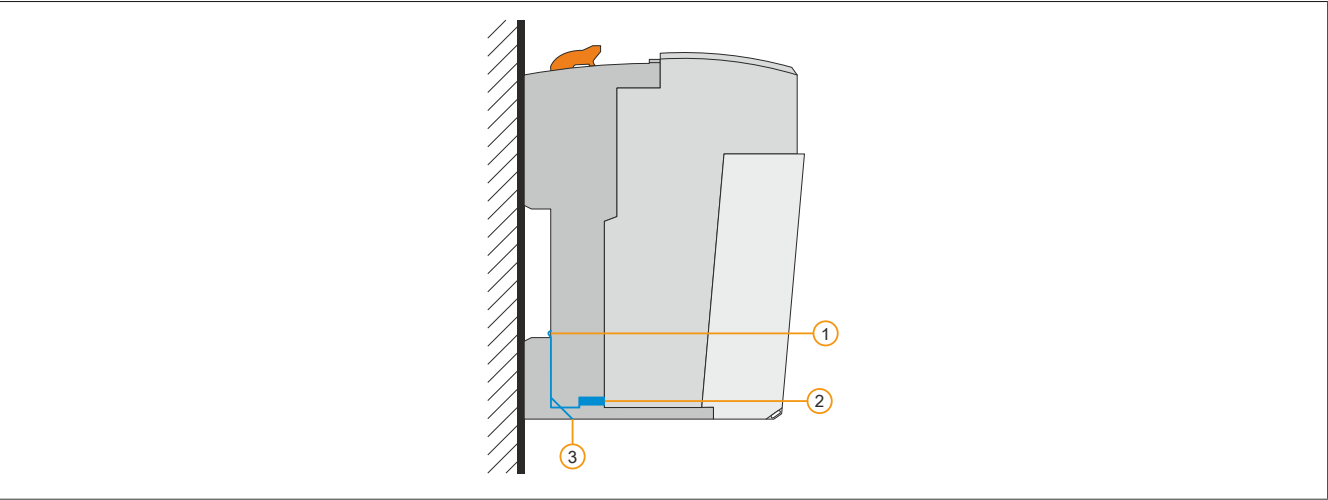
All components of the X20 system carry a ground conductor. The last link in the chain is the bus modules, which make contact with the top-hat rail via the ground connection on the back of the bus module. A good conductive contact between the X20 modules, top-hat rail and control cabinet is mandatory.

The following figure shows schematically the path of the current via the earth leakage. The current path is drawn in orange.



Grounding bracket

The following sketch shows the position of the grounding bracket inside the bus module.



1	Contact to the top-hat rail	2	Contact to the I/O module
3	Contact to the ground connection	-	-

6.4.1 X20 cable shield clamp

The X20 cable shield clamp (model number X20AC0SG1) is latched to the terminal block and connected to the bus module's ground connection using a cable lug. Cable ties are used to press the shield against the grounding plate.

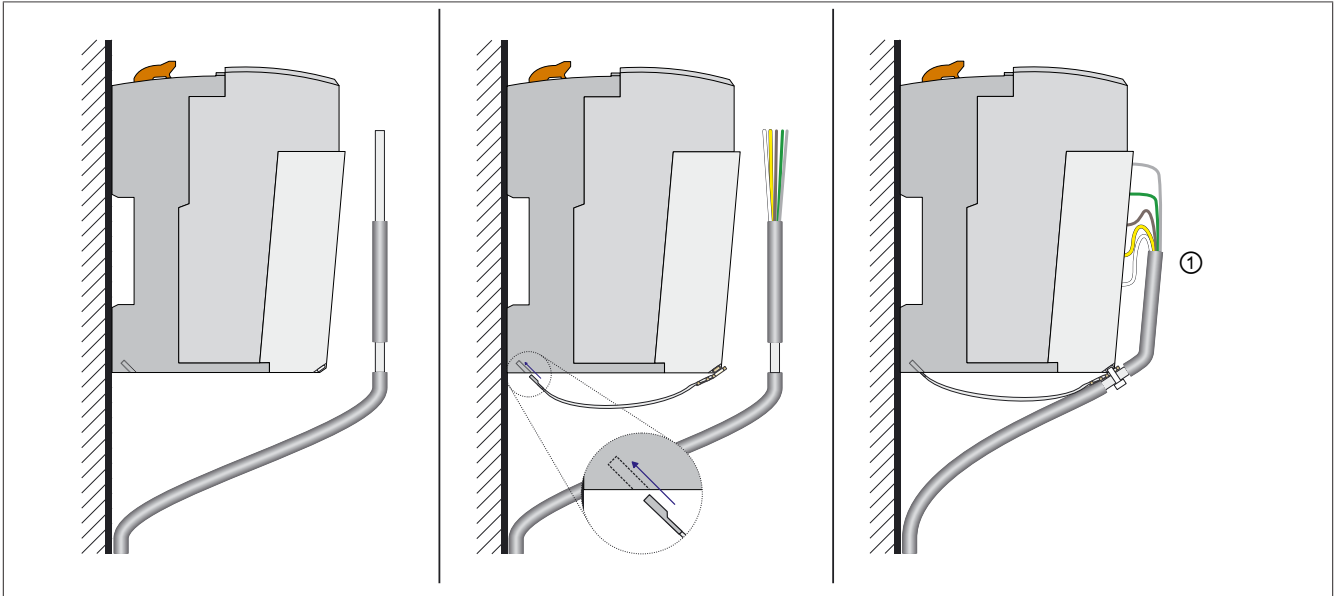


Figure 7: Shielding via X20 cable shield clamp

To reduce the EMC emissions most effectively, the cable shield must be as long as possible after the cable tie (see ① in the diagram above).

6.5 Shielding

In principle, the shield must be grounded in all shielded cables:

- Analog signals (inputs and outputs)
- Interface modules
- Counter modules
- X2X Link cables
- Fieldbus connections (PROFIBUS DP, CAN bus, etc.)

In general, the following guidelines apply for shielding:

- The X20 top-hat rail must always be mounted to a conductive backplane.
- Shielded cables must be grounded on both sides.

6.5.1 Direct shielding connection

The shield is twisted and connected to the bus module's ground connection using a cable lug (2.8 x 0.5 mm). The cable is additionally secured to the terminal block using a cable tie (stress relief).

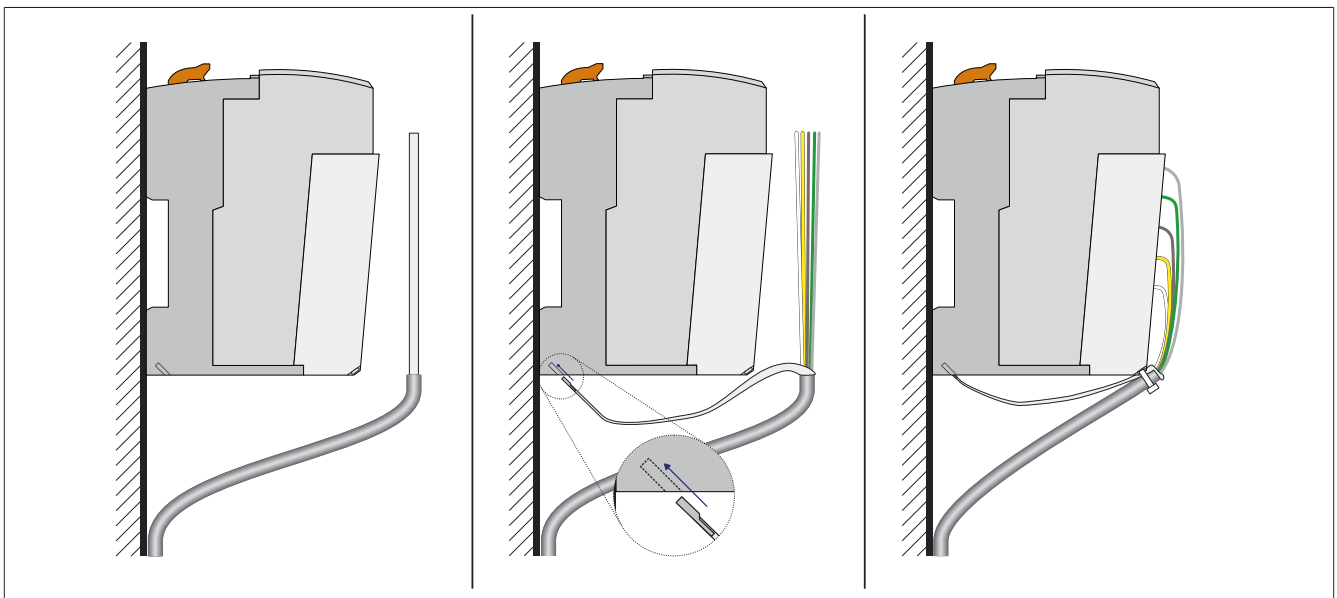


Figure 8: Direct shielding connection



Information:

The ground connection should be made as short and with as little resistance as possible.

6.5.2 Shield connection

The following points must be observed:

- The ground connection should be made as short as possible with good conductivity.
- Shield connection clamps allow the shield to be applied on special shielding brackets underneath the controller.
- Observe the bend radius.
- Clamp to the backplane (optional).

To reduce EMC emissions as much as possible, the area where the wires are stripped must be kept as short as possible (extend the cable shield as far as possible).

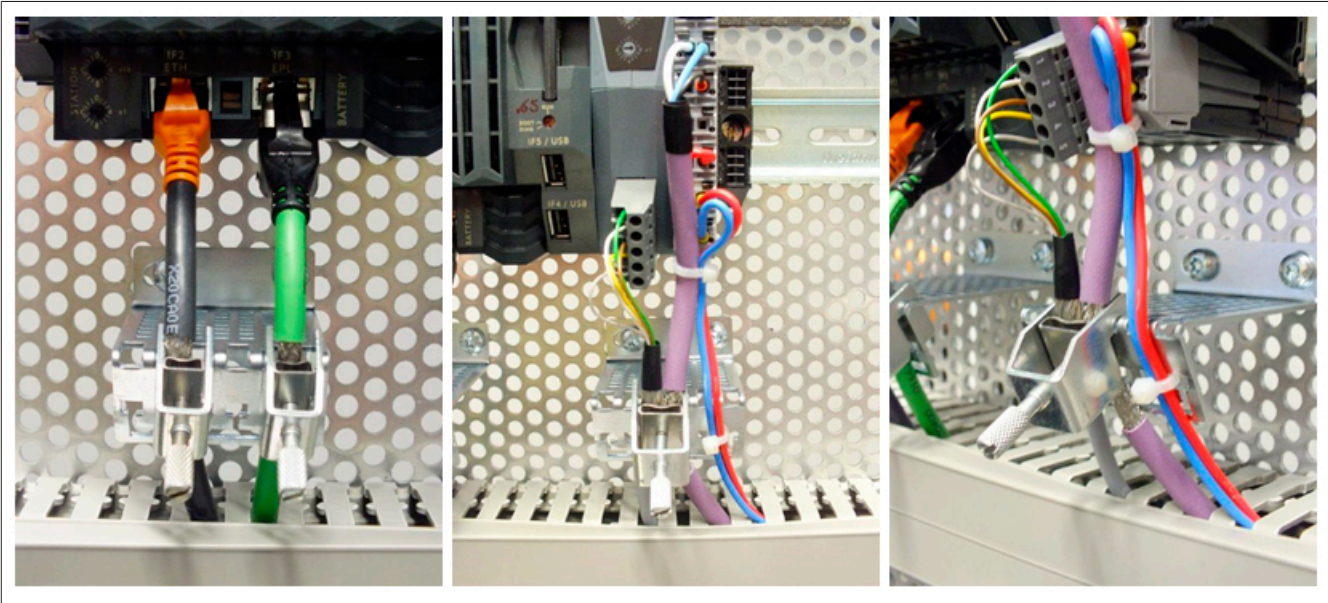


Figure 9: X20 cable shield

B&R recommends always solidly connecting the shield to a well-grounded and good conductive backplane using **shielding clamps** combined with the **X20 shielding brackets** accessories.

6.5.3 X20 shielding bracket

Order data

	
Order number	Short description
	Shielding bracket
X20AC0SF7.0010	X20 shielding bracket 66 mm 10 pcs.
X20AC0SF9.0010	X20 shielding bracket 88 mm 10 pcs.

Table 1: X20AC0SF7.0010, X20AC0SF9.0010 - Order data

Installation and wiring

The X20 shielding bracket is installed underneath the X20 system. The shield is pressed against the shielding bracket using ground terminals from another manufacturer (e.g. PHOENIX or WAGO) or a cable tie.

2 lengths are available depending on the application:

Model number	Length	Application
X20AC0SF7.0010	66 mm	- I/O modules - Power supply modules - Onboard interfaces on controllers
X20AC0SF9.0010	88 mm	- Interface modules - Bus controller modules - Controllers in the form of an interface module

6.5.3.1 Dimensions

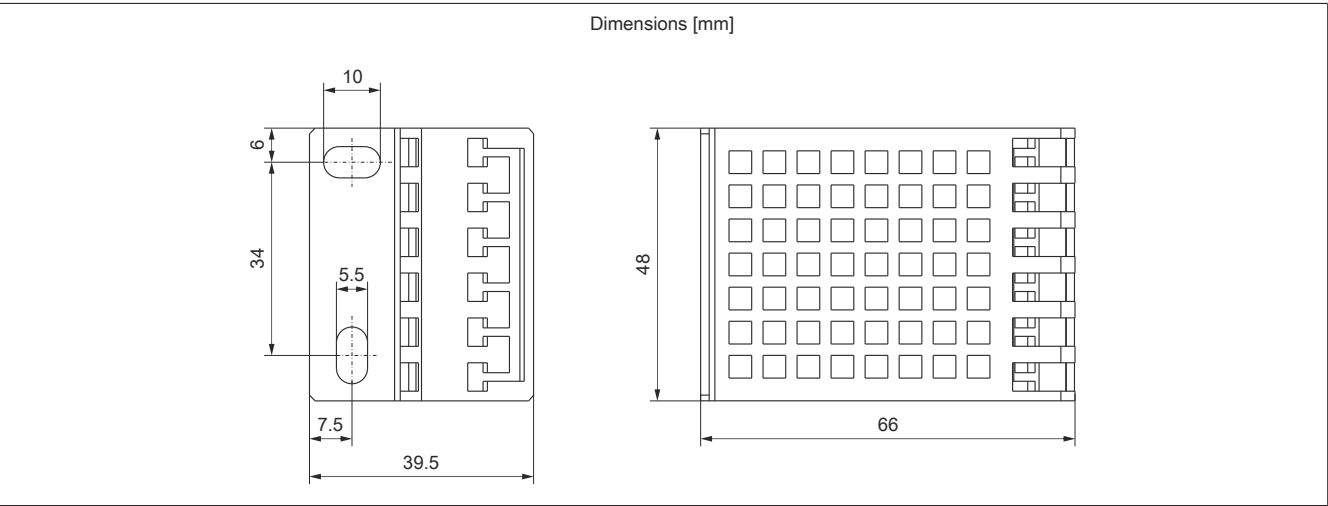


Figure 10: X20AC0SF7.0010 - Dimensions

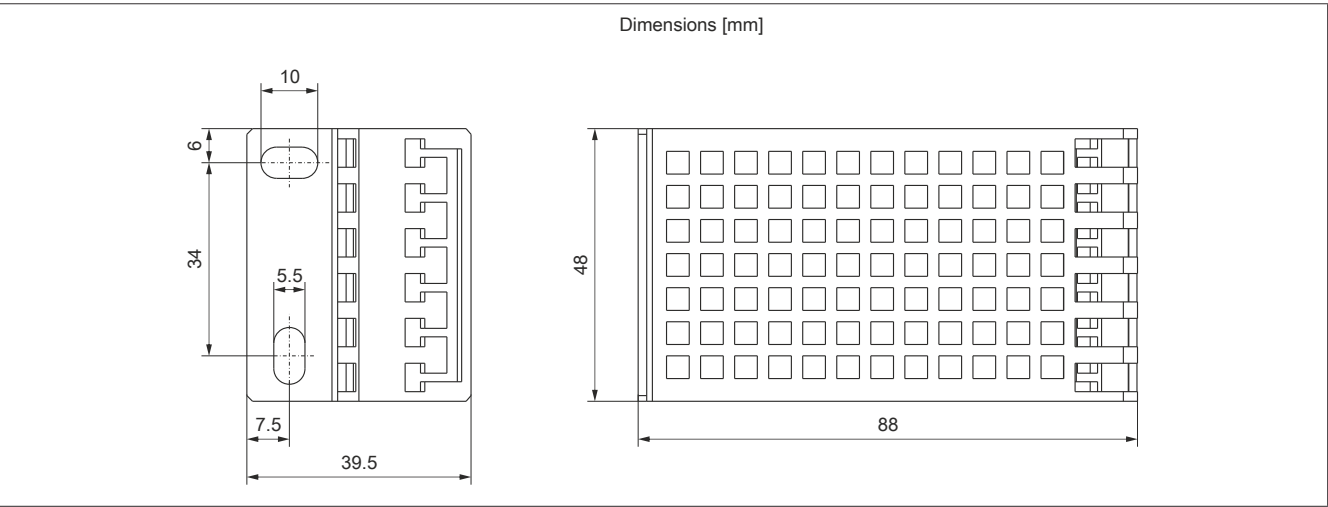


Figure 11: X20AC0SF9.0010 - Dimensions

Package contents

- 10 pcs. X20 shielding bracket
- Installation template

6.5.3.2 Usage examples

X20AC0SF7.0010 - 66 mm shielding bracket

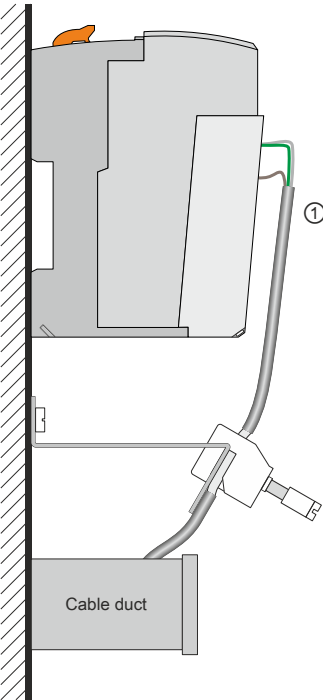
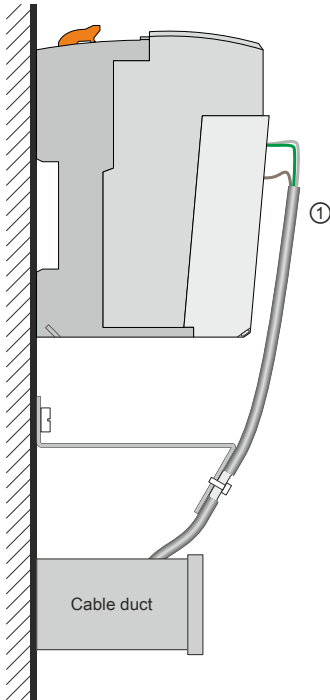
Attaching the shield with a ground terminal	Attaching the shield with a cable tie
	

Table 2: Cable shielding via X20 shielding bracket

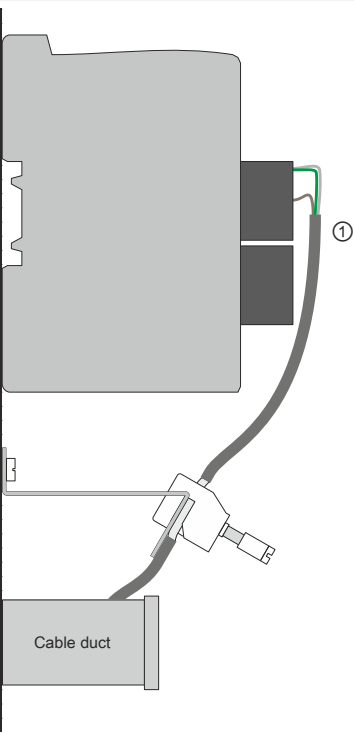
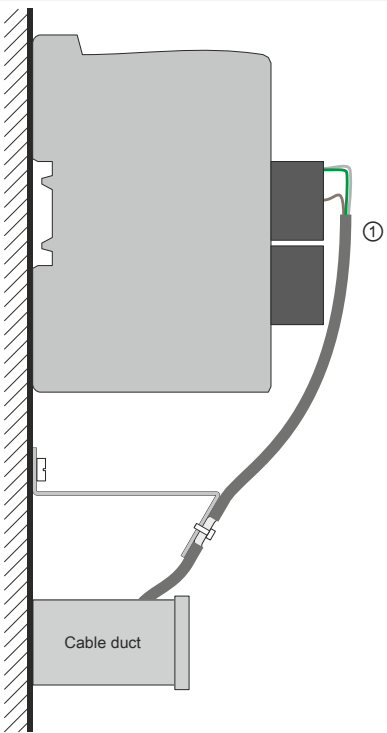
Shield fixing with ground terminal	Shield fixing with cable tie
	

Table 3: Cable shielding via X20 shielding bracket

For the best possible reduction of EMC radiation, the cable shield must extend upwards as far as possible after the cable has been attached to the shielding bracket (see marking ① in the above diagram).

X20AC0SF9.0010 - 88 mm shielding bracket

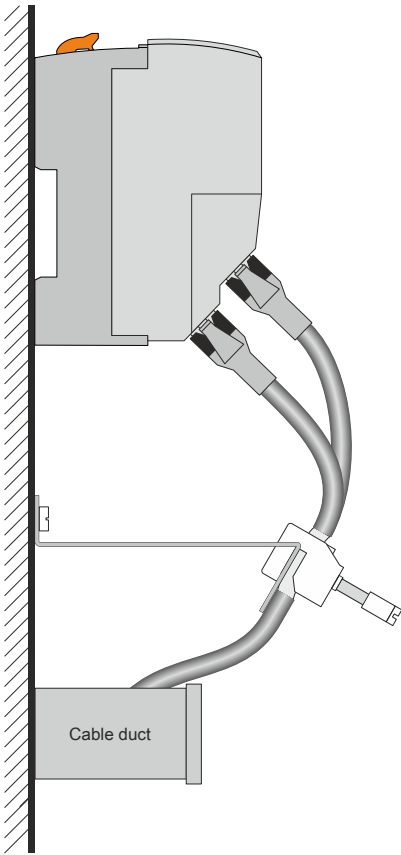
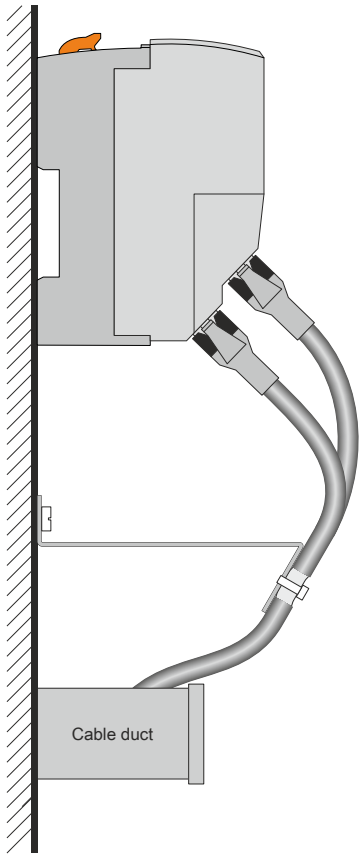
Attaching the shield with a ground terminal	Attaching the shield with a cable tie
	

Table 4: Cable shielding via X20 shielding bracket



Notice!

A minimum distance of 35 mm must be maintained from the X20 module to the shielding bracket.
Larger distances may result from the bend radii of the cables.

6.5.4 Shielding via top-hat rail or busbar

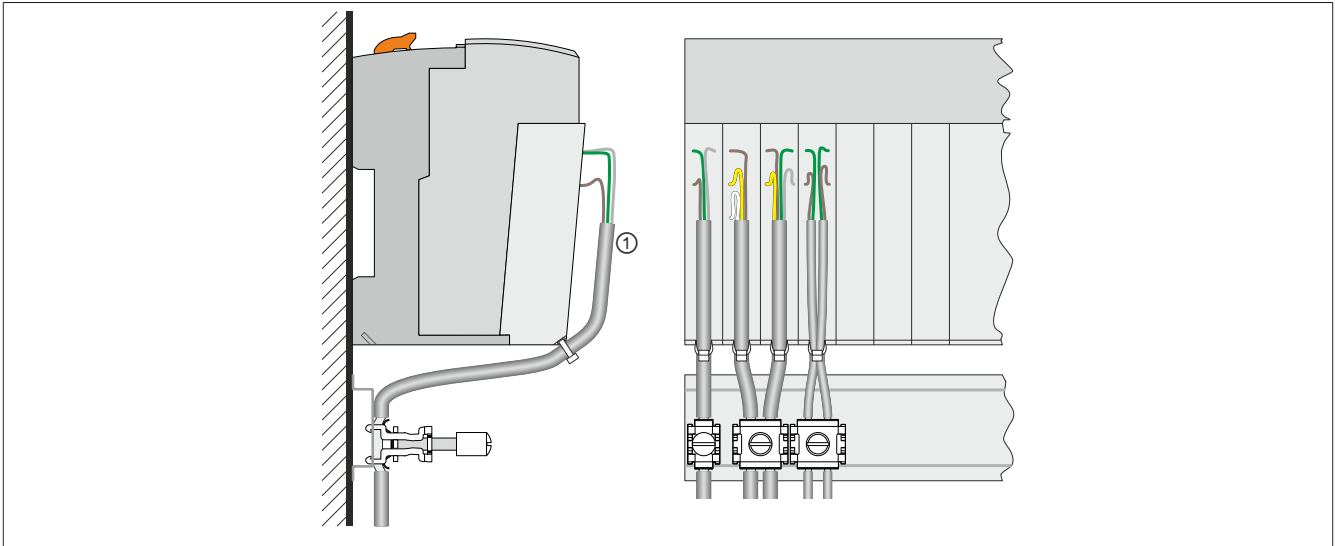


Figure 12: Shielding via top-hat rail or bus bar

Grounding terminals from other manufacturers (such as GOGATEC) can be used to achieve shielding right on the top-hat rail or on special bus bars directly below the controller.

- B&R recommends always using a grounding terminal via the top-hat rail to connect the X2X Link cable shield directly with the conductive and grounded backplane. This will generally exceed the specified EMC minimal requirements.
- The shielded cables from other modules can be grouped and clamped together. This may also be necessary due to space limitations. A different number of cables can be grounded together with a single terminal depending on the grounding terminals being used.

To reduce the EMC emissions most effectively, the cable shield must be as long as possible after the cable tie (see ① in the diagram above).

6.6 Wiring guidelines for X20 modules with Ethernet cable

A number of X20 modules are based on Ethernet technology. POWERLINK cables offered by B&R can be used for the necessary wiring.

Model number	Connection type
X20CA0E61.xxxx	Connection cable - RJ45 to RJ45
X20CA3E61.xxxx	RJ45 to RJ45 connection cable, can be used in drag chains
X67CA0E41.xxxx	Attachment cable - RJ45 to M12
X67CA3E41.xxxx	RJ45 to M12 attachment cable, can be used in cable drag chains

The following cabling guidelines must be observed:

- Use CAT5 SFTP cables.
- Observe minimum cable bend radius (see data sheet for the cable).
- Secure the cable underneath the bus controller. The cable must be secured vertically under the RJ45 connector on the bus controller.



Information:

Using POWERLINK cables offered by B&R satisfies the EN 61131-2 product standard.
For any further requirements, the customer must take additional measures.

Wiring diagram

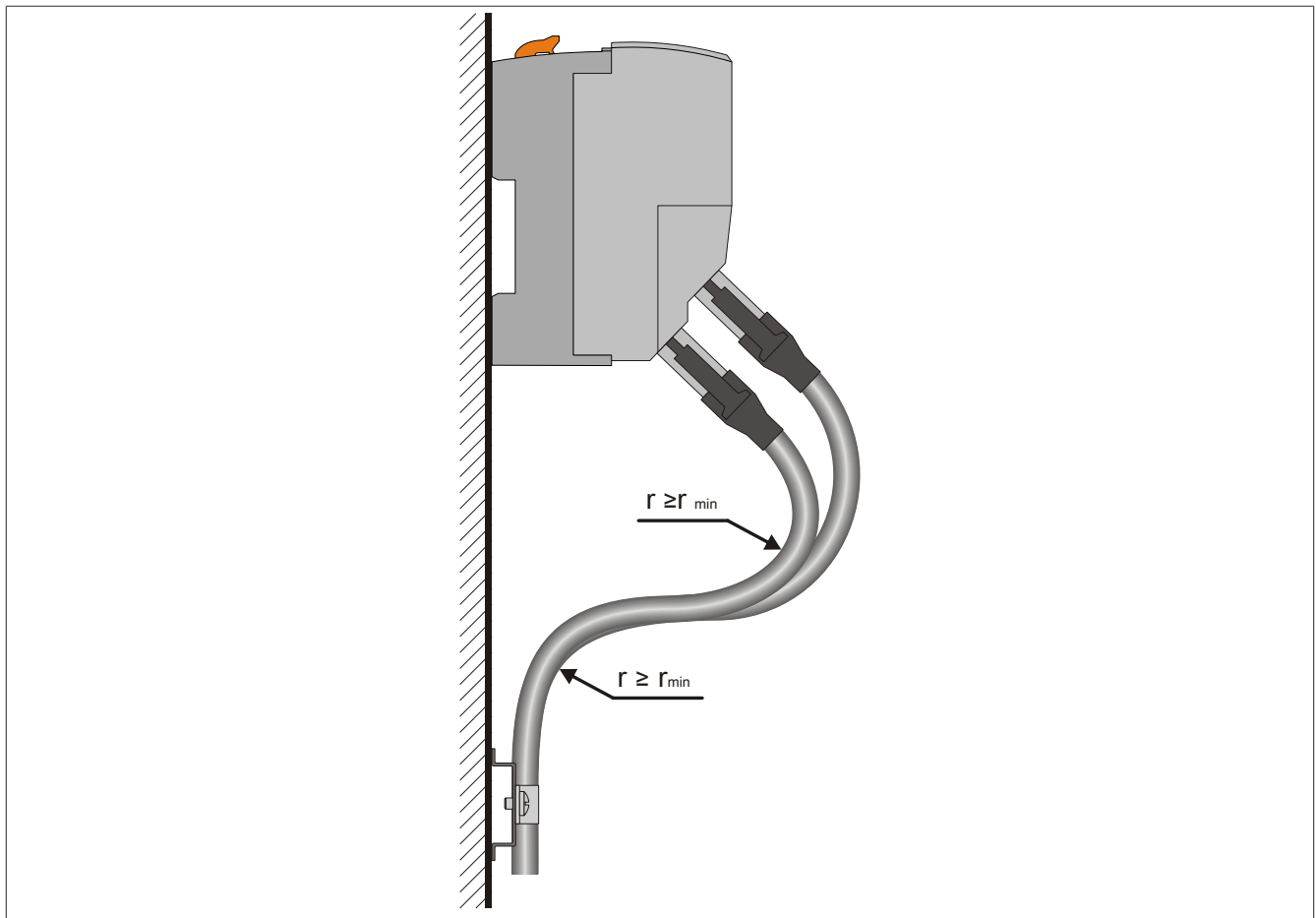


Figure 13: Wiring diagram for X20 modules with an Ethernet cable

7 Mechanical and electrical configuration

7.1 X20 system configuration

The X20 system is designed so that can be connected to standard fieldbuses (with a bus controller) or the remote X2X Link backplane (with a bus receiver). The connection to the next station is made with a bus transmitter. Supply modules and I/O modules are placed between the bus receiver or bus controller and the bus transmitter as needed.

The power supply system used in the X20 systems is described in the section ["Power supply concept" on page 110](#).

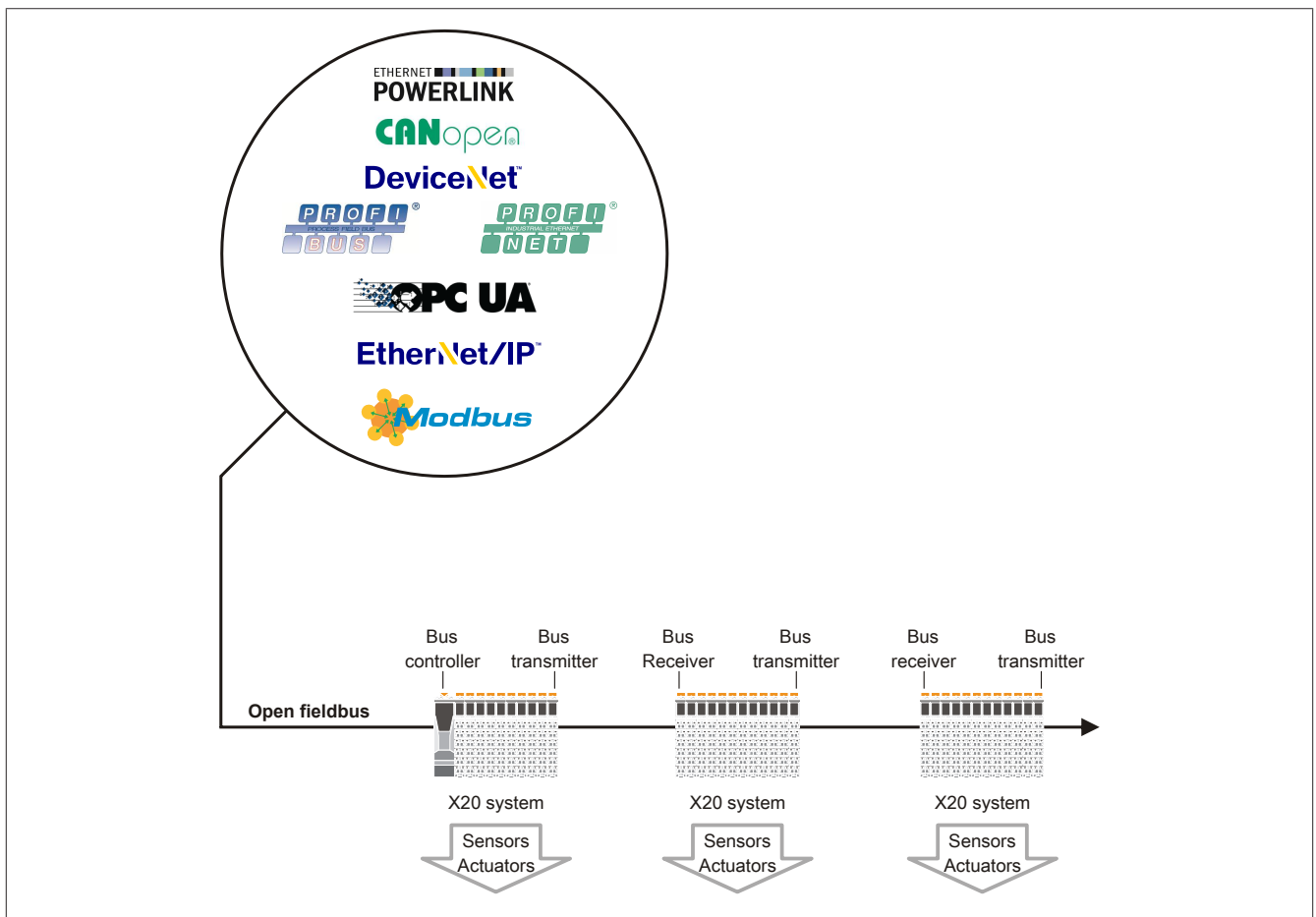


Figure 14: X20 system configuration

7.1.1 Fieldbus connection

A variety of bus controllers are available to connect X20 modules to existing control systems via standard fieldbus technologies like POWERLINK, DeviceNet, PROFIBUS, CANopen, Modbus TCP or EtherNet/IP. Fieldbus configurations transparently integrate the X20 system into the third-party development environment.

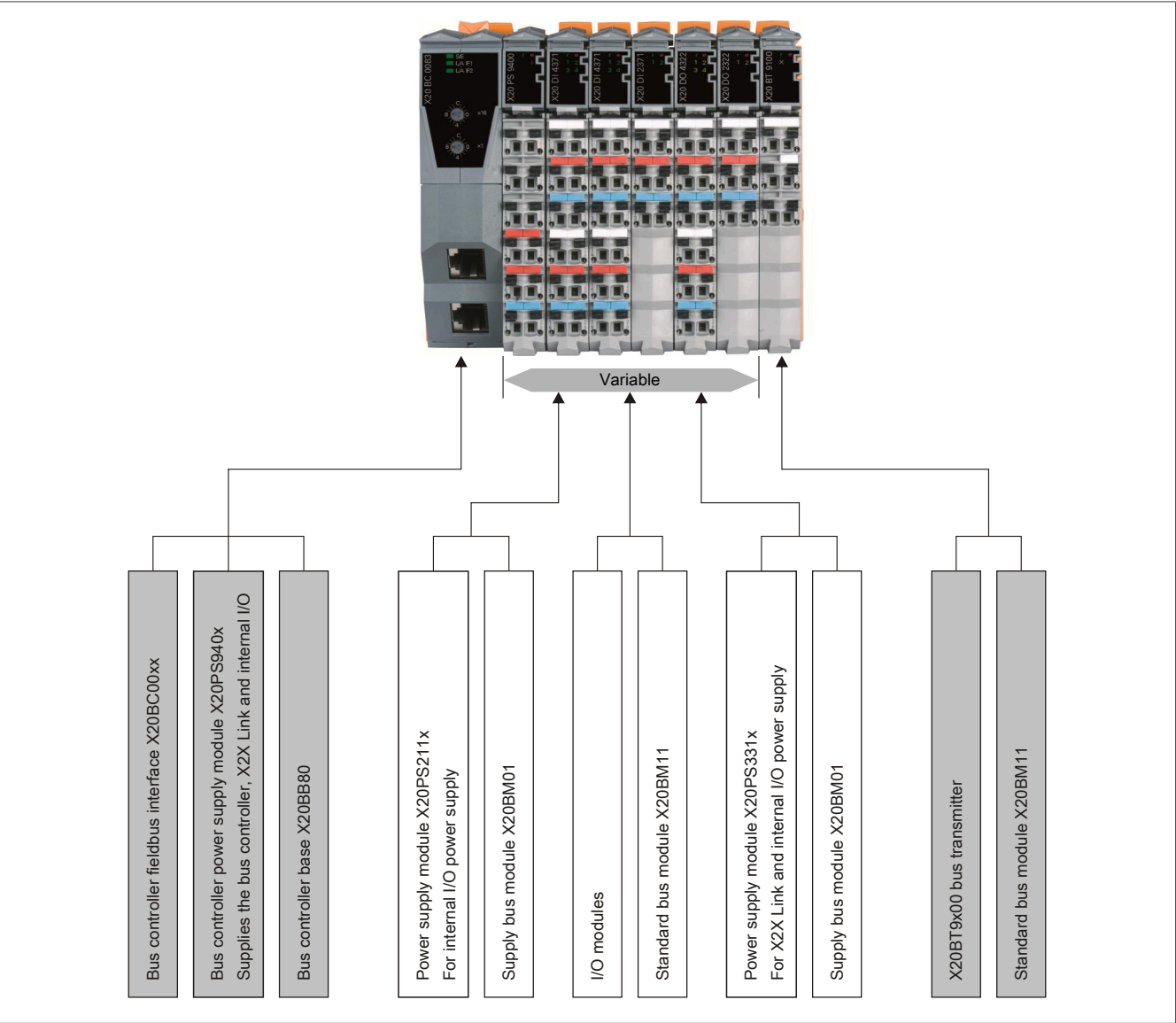


Figure 15: X20 system configurator for fieldbus connection

7.1.2 Connection to X2X Link backplane

The bus receiver X20BR9300 is used to connect the X20 system directly to the remote X2X Link backplane.

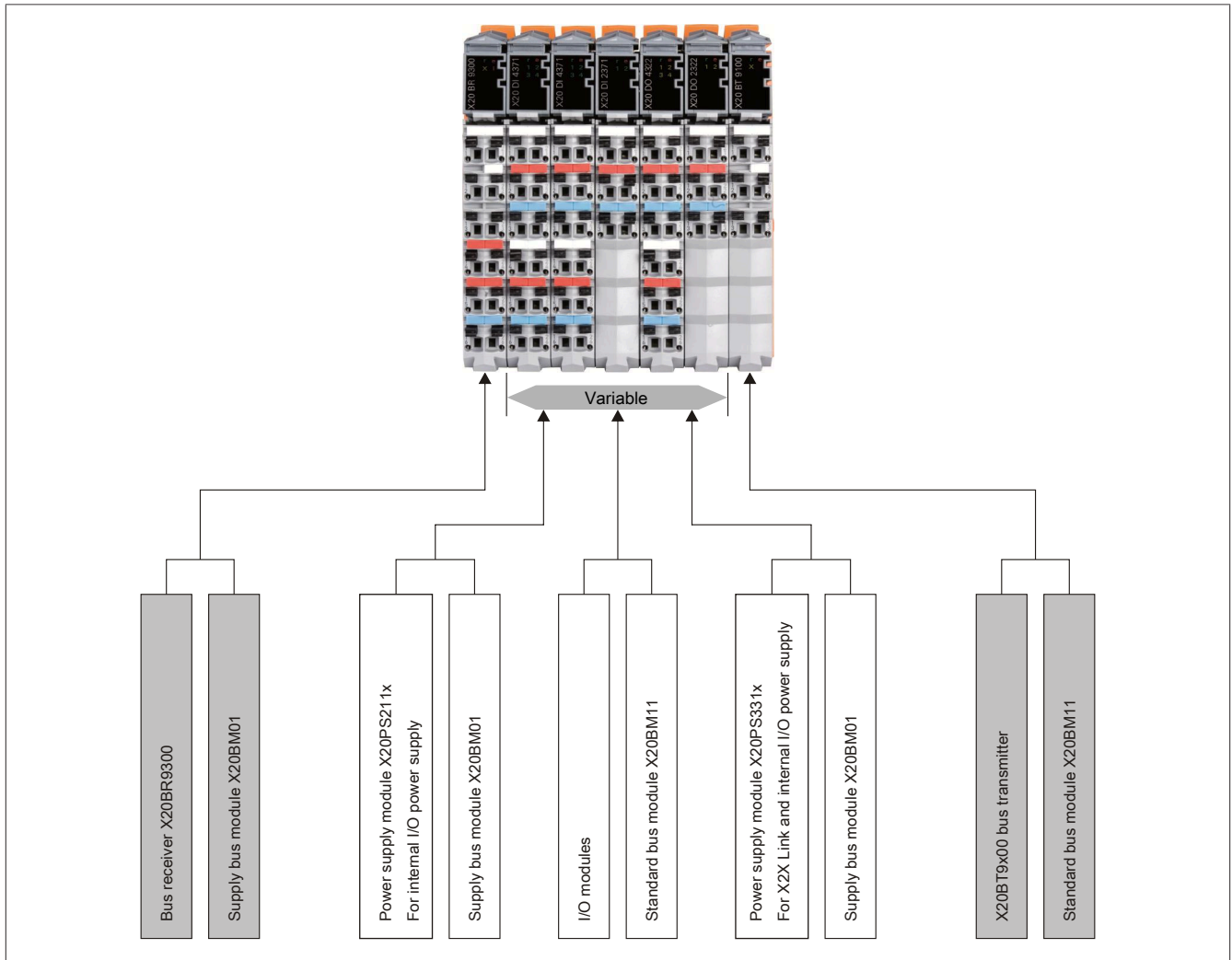


Figure 16: X20 system configurator for connection to X2X Link backplane

7.2 Power supply concept



Danger!

In order to ensure a defined power supply, a SELV or PELV power supply unit per IEC 61010-2-201 must be used for the bus, SafeIO and SafeLOGIC power supply. This also applies to all digital signal sources that are connected to the modules.

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



Notice!

Primary circuits from which the connected secondary voltages are generated must be limited to overvoltage category II and are permitted to have a maximum system voltage of 300 V.

All connected circuits must meet the requirements for SELV/PELV circuits (Class III) per UL/CSA/IEC 61010-1, 61010-2-201.

7.2.1 Bus module rack replacement

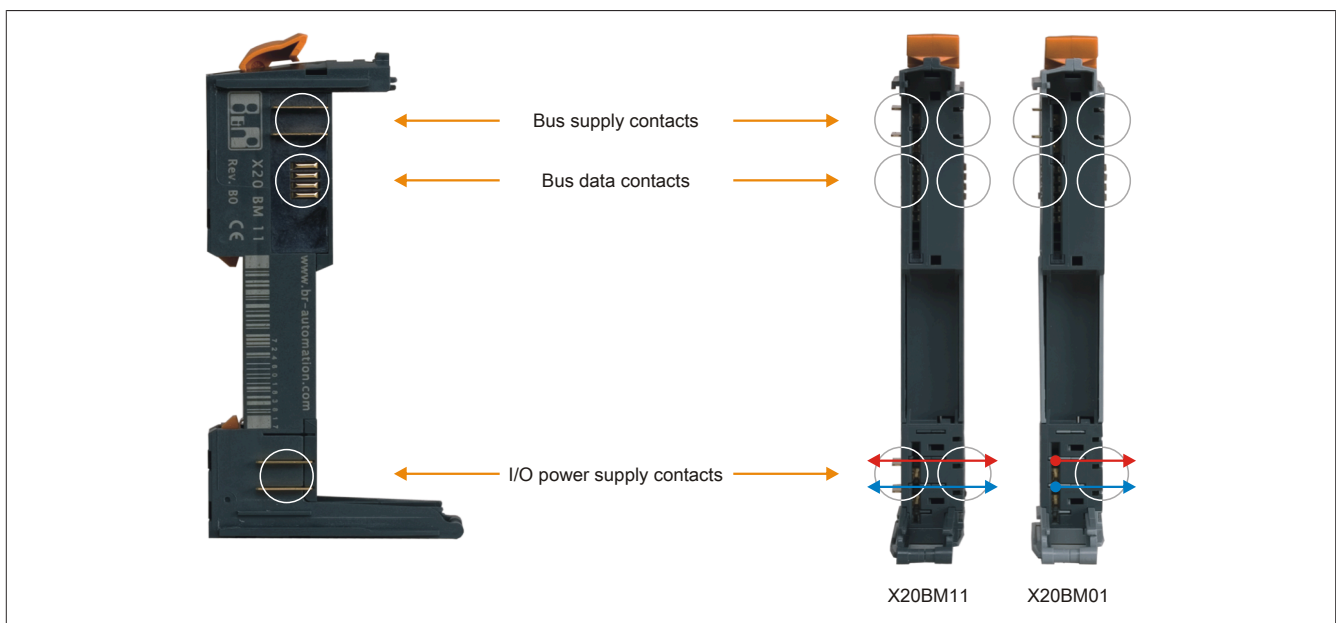


Figure 17: The bus module replaces the rack in the X20 system

The bus module is the backbone of the X20 system regarding the bus supply and bus data as well as the I/O supply for the electronics modules. Each bus module is an active bus station, even without an electronics module. There are two variations of the bus module:

- Interconnected I/O supply
- I/O supply isolated to the left (for power supply modules)

7.2.2 X20 system infrastructure

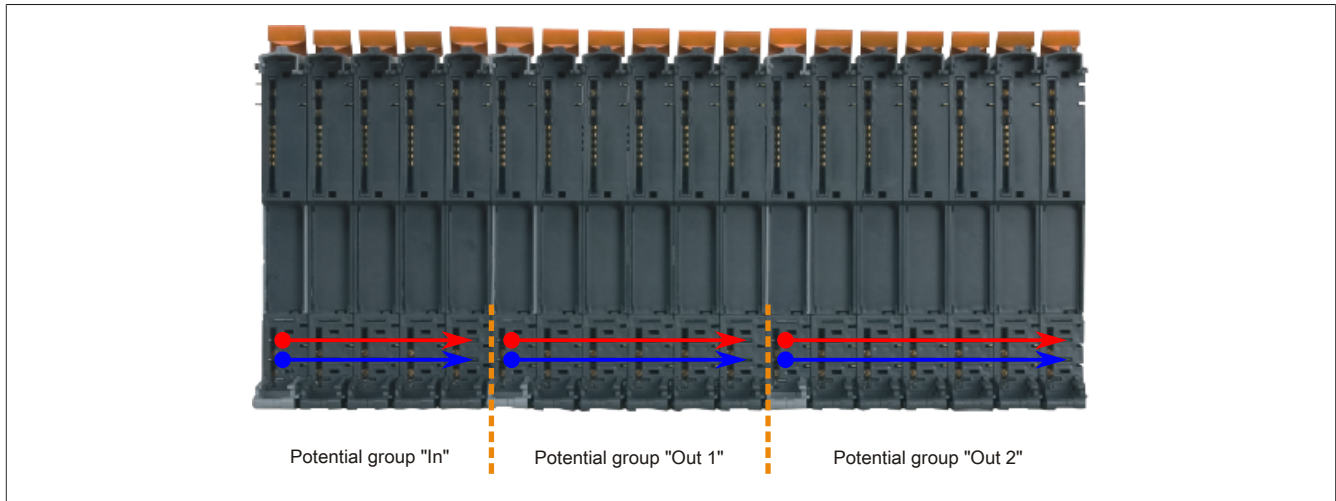


Figure 18: Simple implementation of different potential groups

Different potential groups can be implemented with the appropriate arrangement of supply bus modules, (e.g. for input groups or different emergency stop circuits on the outputs). The I/O power supply is fed by power supply modules.

7.2.3 Bus supply

Because the remote X2X Link backplane and I/O electronics are completely electrically isolated, the X2X Link power supply needs to be fed in at certain intervals. This is initially handled by the bus receiver. A supply module for X2X Link must be added to refresh the supply after approximately 30 modules (for an example calculation, see ["Calculating the power requirements" on page 131](#)). On the same module, a separate feed for the I/O power supply can also be connected.

7.2.4 Potential groups

The I/O supply is connected via the bus modules, and the supply is fed in using corresponding power supply modules. This makes it possible to implement simple potential groups (e.g. for input groups or different output groups). For isolation, the corresponding bus module is also necessary, which provides isolation of the internal I/O supply.

7.2.5 Output modules with supply

Generally, a power supply module is also necessary for current output modules with many channels, such as the 8 channel output module with 2 amp outputs. This is not the case with the X20 system. With this module, the supply is provided directly on the module, thereby saving power supply modules and construction width.

7.2.6 Bus receiver with supply

The X20BR9300 bus receiver for the X20 system is equipped with a supply for X2X Link as well as for the internal I/O supply. This eliminates the need for an additional power supply module.

7.2.7 Supply module for internal I/O supply

The first I/O modules in an X20 system are supplied by the bus receiver. The internal I/O supply is refreshed via the X20PS2100 power supply module.

7.2.8 Power supply module for internal I/O supply and bus supply

The X2X Link is fed by the X20BR9300 bus receiver. After approx. 30 modules (see section ["Calculating the power requirements" on page 131](#) for a calculation example), the supply must be "refreshed". The X20PS3300 power supply module is used for this. This module is equipped with a feed for X2X Link as well as for the internal I/O power supply.

7.2.9 Bus transmitter with supply

The X20BT9100 bus transmitter has an integrated I/O supply feed. This saves a power supply module for the last potential group.

7.2.10 Internal I/O power supply failure (ModuleOk)

The ModuleOk status for monitoring the X20 modules is made up of different module parameters.



Information:

All modules that require 0.01 W of power on the X2X Link network must be supplied via the internal I/O power supply. If the I/O power supply fails, the module shuts down and communication is lost.

In this case, ModuleOk returns the value "False" and data can no longer be read from the ["embedded parameter chip"](#).

7.2.11 X20 system power supply

The power supply for the X20 system is provided by B&R 24 VDC power supplies. B&R power supplies ensure that control systems are reliably supplied even when operated at the minimum mains input voltage or when maximum power is output even in the event of temporary power failures (≤ 10 ms).

The power to be provided by the B&R power supply must be calculated (see ["Dimensioning the external 24 VDC power supply" on page 146](#)).

7.2.12 X2X Link supply

The X2X Link remote backplane is supplied separately from the I/O points. This ensures that the remote backplane does not fail if there is a power failure on the I/O side, for example during an emergency stop. After approx. 30 modules, it is necessary to "refresh" with a power supply module for X2X Link.

To achieve increased supply security, it is possible to set up a redundant X2X Link power supply. To do so, the necessary X2X Link power must be determined and then covered by the corresponding quantity plus at least one additional X2X Link power supply module. This guarantees the functionality of the remote backplane even if the X2X Link power supply fails.

Please note the following for the correct calculation:

- To determine the necessary X2X Link power, calculate using 75% of the power supply module's rated power during parallel operation.



Information:

This must be done for all power supply modules at the same time for a non-redundant X2X Link power supply or when completely turning the X2X supply of an X20 module block on/off.

7.2.12.1 Example for extended X2X Link supply

It is possible to set up potential groups through the use of different supplies for the power supply modules.

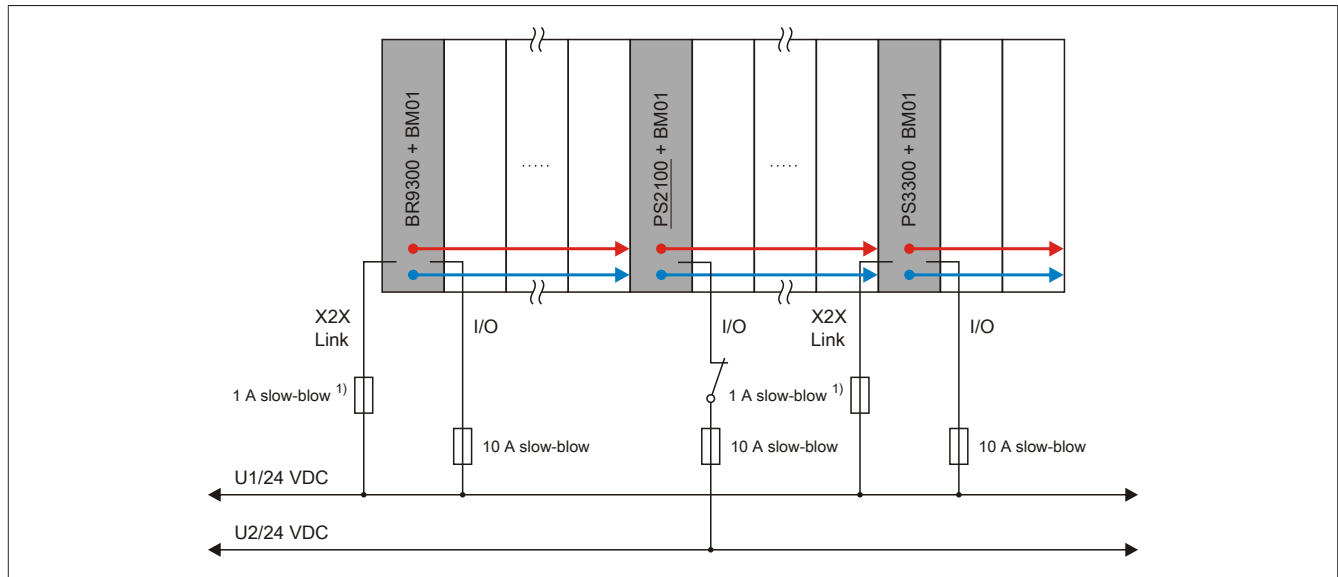


Figure 19: Example for extended X2X Link supply

1) Recommended for line protection.

The X20PS3300 power supply module supplies both the X2X Link and I/O; the X20PS2100 power supply module only supplies the I/O.

7.2.12.2 Example for redundant X2X Link supply

Multiple X20PS3300 power supply modules can be set up in parallel. It is possible to set up potential groups through the use of different supplies.

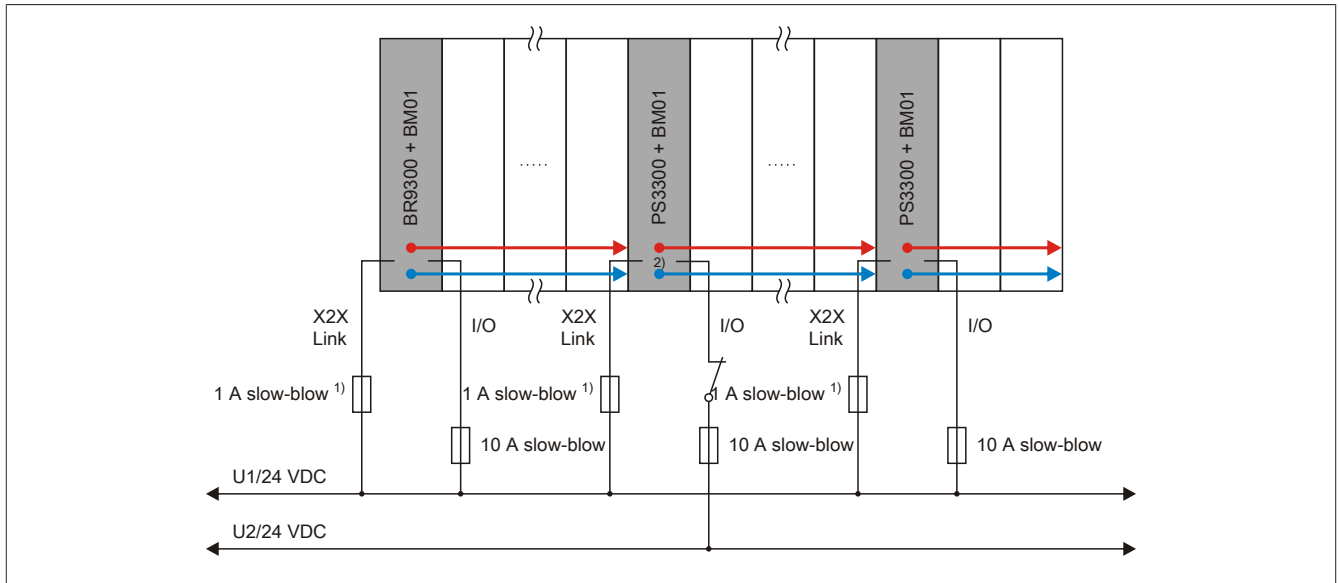


Figure 20: Example for redundant X2X Link supply

1) Recommended for line protection.

2) With separate supplies, the two reference potentials (GND_1 and GND_2) are combined via the terminal block on the PS3300.

The X20PS3300 power supply module supplies both X2X Link and the I/O.

7.3 X20 system protection

The protection for the X20 system depends on the supply concept.

7.3.1 Potential groups

Using the X20BM01 bus module and organizing the power supply bus modules accordingly allows various potential groups to be implemented (e.g. for input groups or various power circuits for the outputs).

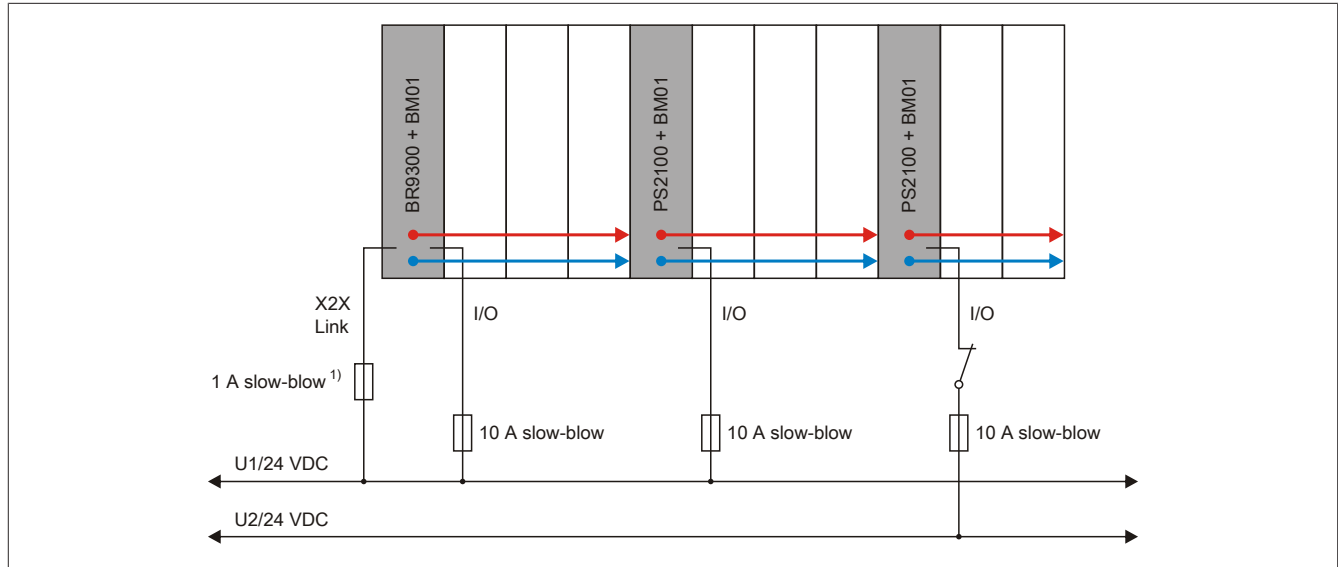


Figure 21: Protecting various potential groups

1) Recommended for line protection.

7.3.2 Supply via bus transmitter

The bus transmitter has an integrated internal I/O power supply feed. This saves a power supply module for the last potential group.

It is important to note that this potential group is isolated from the remaining potential groups by an I/O module with bus module X20(c)BM01.

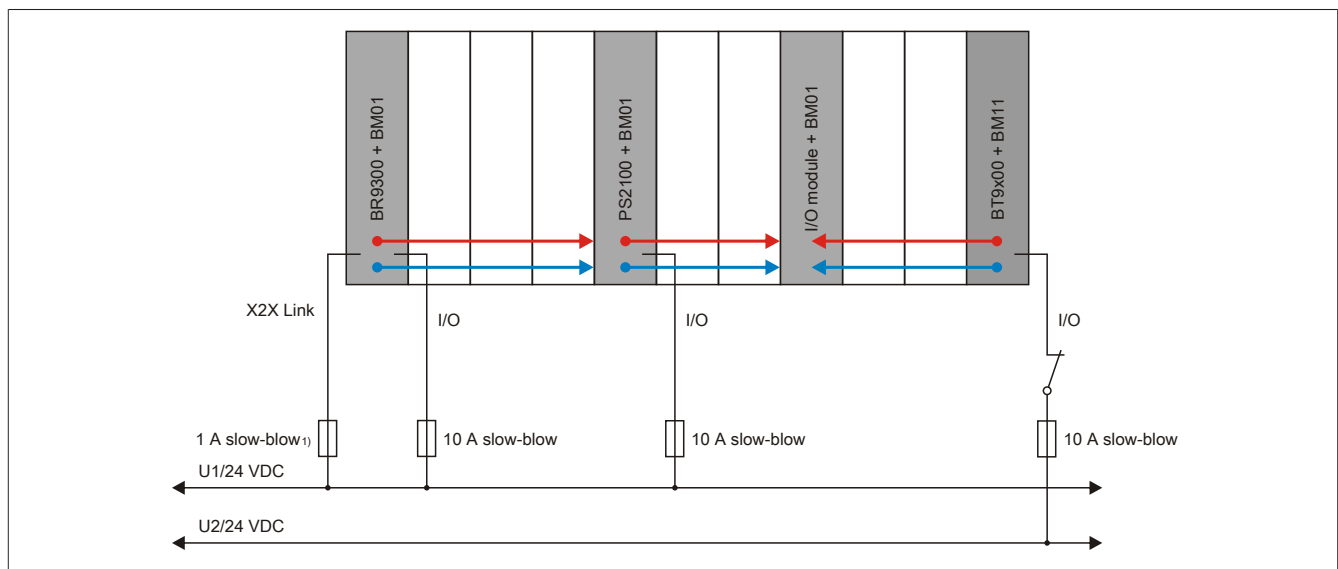


Figure 22: Fuse protection when supplied via bus transmitter

1) Recommended for line protection.

7.4 Safe cutoff of a potential group



Information:

B&R keeps user's manuals as current as possible. From a safety standpoint however, the current certified version of the document must be used.

The current certified document is available for download under [Website > Downloads > Certificates > Safety technology > X20, X67 > Safe cutoff of potential groups](#).

7.4.1 Description of function

The operating principle "Safe cutoff of a potential group" enables the user to execute safety-related functions within a B&R system in combination with an external safety relay.

The safety function is limited to cutting off or interrupting the power to connected actuators.

Functionality

An external safety relay is connected to the I/O power supply for the potential group or an X20SP1130 power supply module is used. When the functional safe state is requested or state "Failsafe" occurs, then this feed cuts off the I/O power supply of the potential group. The power is then also cut off for all actuators connected to this potential group. However, module-internal energy storage devices (e.g. capacitors) remain charged and must be taken into account in the assessment of the safety function.

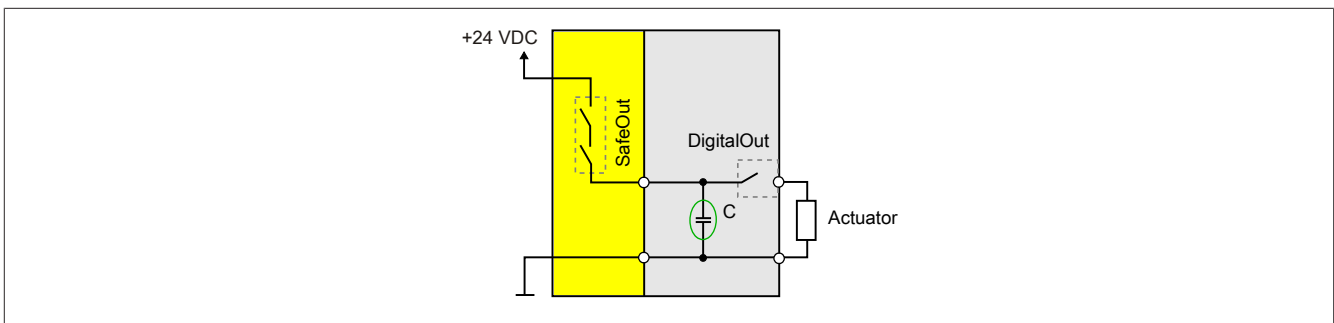


Figure 23: Functionality with internal energy storage

7.4.2 Scope of application / Standards referenced

The operating principle is confined to machine manufacturing applications and therefore implicitly to the following standards:

- EN ISO 13849-1:2015 / EN ISO 13849-2:2012

Requirements of other standards are not taken into consideration.

7.4.3 Intended use



Danger!

Danger from incorrect use of safety-related products/functions

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

7.4.3.1 Qualified personnel

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

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

Qualified personnel in the context of this manual's safety guidelines are those who, because of their training, experience and instruction combined with their knowledge of relevant standards, regulations, accident prevention guidelines and operating conditions, are qualified to carry out essential tasks and recognize and avoid potentially dangerous situations.

In this regard, sufficient language skills are also required in order to be able to properly understand this manual.

7.4.3.2 Area of application

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

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

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

7.4.3.3 Cybersecurity disclaimer for products

B&R products communicate via a network interface and were developed for secure connection with internal and, if necessary, other networks such as the Internet.



Information:

In the following, B&R products are referred to as "product" and all types of networks (e.g. internal networks and the Internet) are referred to as "network".

It is the sole responsibility of the customer to establish and continuously ensure a secure connection between the product and the network. In addition, appropriate security measures must be implemented and maintained to protect the product and entire network from any security breaches, unauthorized access, interference, digital intrusion, data leakage and/or theft of data or information.

B&R Industrial Automation GmbH and its subsidiaries are not liable for damages and/or losses in connection with security breaches, unauthorized access, interference, digital intrusion, data leakage and/or theft of data or information.

The aforementioned appropriate security measures include, for example:

- Segmentation of the network (e.g. separation of the IT network from the control network¹⁾)
- Use of firewalls
- Use of authentication mechanisms
- Encryption of data
- Use of anti-malware software

Before B&R Industrial Automation GmbH releases products or updates, they are subjected to appropriate functional testing. Independently of this, we recommend that our customers develop their own test processes in order to be able to check the effects of changes in advance. Such changes include, for example:

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

These tests should ensure that implemented security measures remain effective and that systems in the customer's environment behave as expected.

¹⁾ The term "control network" refers to computer networks used to connect control systems. The control network can be divided into zones, and there can be several separate control networks within a company or site. The term "control systems" refers to all types of B&R products such as controllers (e.g. X20), HMI systems (e.g. Power Panel T30), process control systems (e.g. APROL) and supporting systems such as engineering workstations with Automation Studio.

7.4.3.4 Safety technology disclaimer

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

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

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

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

7.4.3.5 Installation notes for X20 safety modules

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

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

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



Danger!

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



Danger!

In order to ensure a defined power supply, a SELV or PELV power supply unit per IEC 61010-2-201 must be used for the bus, SafeIO and SafeLOGIC power supply. This also applies to all digital signal sources that are connected to the modules.

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

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

Module functionality is no longer guaranteed at voltages outside the range of the supply voltage or I/O voltage specified in the technical data.

Up to a voltage of 60 VDC (SELV power supply unit), it is ensured that no dangerous error occurs.

7.4.3.6 Safe state

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

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

The following limitations exist when using SafeMOTION modules:

- A SafeMOTION module basically corresponds to a safe node.²⁾ Additionally, each drive module equates to **one POWERLINK node**.
- The safe state is implemented in B&R safety modules by cutting off the output. This is a design feature of the modules and cannot be changed.
This is particularly important for SafeMOTION modules since the safe state cuts off the torque on the motor!



Danger!

After the safe state (STO) is enabled or in state FAIL SAFE, the drive is not supplied with power; the motor therefore no longer exerts torque or force.

If the motor was moving before STO is activated, it is only stopped by a safe motor holding brake (if available) or by the friction of the complete system!



Danger!

Situations involving external forces (e.g. suspended loads) can result in dangerous movements!

If this poses a safety risk, then the user must implement the necessary equipment to eliminate the risk (e.g. mechanical brakes)! This equipment must correspond to the required safety level!



Danger!

The safety response time must be taken into consideration since this has a substantial effect on the residual distances and remaining times to be considered!

In order to calculate the total safety response time, the user must validate the rundown time of the complete system! .

7.4.4 System-specific information

The operating principle applies to a potential group.

All potential groups are generally only permitted to be supplied by 1 power supply module. The possible further processing of the power supply on the module is not permitted to result in multiple supply instances.

In the X20 system, only modules of type X20BM01, X20BM23 and X20BM26 that ensure the interruption of the internal I/O power supply to the left are permitted to be used as bus modules for power supply modules. On modules X20PS9400 and X20PS3300, only the I/O power supply (+24 V I/O) is permitted to be switched with the safety relay. The bus power supply (+24 V BC/X2X L.) must be isolated.

When using module X67PS1300 to supply power to the X67 potential group, only the I/O power supply (+24 V I/O) is permitted to be switched with the safety relay. The bus power supply (+24 V BC/X2X L.) must be isolated.

The operating principle is limited to the modules listed in the following certificate.



Certificate

[Website > Downloads > Certificates > Safety technology > X20, X67 > Safe cutoff of potential groups](#)

²⁾ ACOPOSmulti SafeMOTION inverter modules: A SafeMOTION module is integrated into a single-axis inverter module, i.e. **one safe node**. A 2-axis inverter module has two integrated SafeMOTION modules, i.e. **two safe nodes**.

7.4.5 Safety guidelines

This section provides a summary of safety notices for the user.



Danger!

Failure of the safety function due to misuse

Observe the following safety guidelines. Failure to observe any of the following notices can result in the failure of the safety function and may result in serious injury.

- When using the operating principle, it is the user's responsibility to adhere to the relevant standards and safety directives. In addition, the guidelines for proper use must be observed.
- For all potentials supplying the modules, SELV/PELV power supplies must be used.
- The potential groups for which the operating principle is applied are only permitted to contain modules listed from certificate "Safe cutoff of potential groups".
- Uncoated X20 modules in which the operating principle is used are not permitted to be operated in condensing air humidity or at temperatures below 0°C.
- It is not permitted to mix modules from different systems (X20, X67, 7XV) within a potential group.
- It is not permitted to install multiple power supplies in a potential group (particularly with regard to power supply modules that also supply the bus supply).
- Ensure that the upstream safety relay is wired properly.
- Ensure that ALL sensors and actuators connected to the potential group are wired properly.
- Note possible impairments of the safety function due to the internal energy storage devices. If this is sufficient to enable a connected actuator and subsequently results in a dangerous state, the protection objective is not given and alternatives or supplementary measures must be installed.
- The switch-off time must be verified by a control measurement!
- For modules with isolated I/O potential for sensors and actuators, the upstream safety relay must shut off the supply for both the sensors and actuators.
- The ground connections should be used as functional ground and not as protective ground and must not be connected to the 24 V supply voltage (GND is permitted). In addition, no protective components are permitted to be used between the ground and the 24 V supply voltage.

7.4.5.1 Capacitances within the potential group

The module-internal capacitances remain charged at the time of shutdown. The total capacitance of the potential group results from the sum of the capacitances of the individual modules, upstream external safety relay and actuator.

$$C_{total} = \sum_{i=1}^n C_i$$

The capacitances of the corresponding B&R modules are listed in the certificate.



Certificate

[Website > Downloads > Certificates > Safety technology > X20, X67 > Safe cutoff of potential groups](#)

At the time a safety function is requested, it is not ensured that the standard outputs are enabled. If an output is disabled at the time of the request, the affected module-internal capacitances remain permanently charged. If the output is enabled by the standard application, an unexpected voltage peak occurs on the output.

In connection with the supply voltage, the total capacitance present in the system results in a charge that must be taken into account during cutoff. In the worst case scenario, it can be assumed that the total capacitance present in the system buffers each output present in the potential group. This behavior is not permitted to result in a safety-critical state due to actuators in the potential group; alternatives or supplementary corrective measures must be installed.

7.4.5.2 Potential group structure

The potential group is only permitted to be made up of modules listed in the following certificate. Modules not listed in this certificate endanger the "absence of feedback" of the external cutoff and therefore the safety function.



Certificate

[Website > Downloads > Certificates > Safety technology > X20, X67 > Safe cutoff of potential groups](#)

To ensure clarity and that the external cutoff is triggered when a fault occurs, installing multiple power supply sources in a potential group is not permitted.

SELV/PELV power supplies must be used for both the bus supply (X2X) and the I/O power supply; otherwise, safety-related malfunctions can occur due to overvoltages.

For modules with isolated I/O potential for sensors and actuators, the upstream safety relay must shut off the supply for both the sensors and actuators; otherwise, feedback cannot be excluded.

7.4.5.3 Circuit examples

Single-channel without feedback

The following example shows a load being cutoff using the emergency stop safety function. Only safe actuators such as motors or input "Enable" of an ACOPOS/ACOPOSmulti drive are permitted to be used as the load in this case.

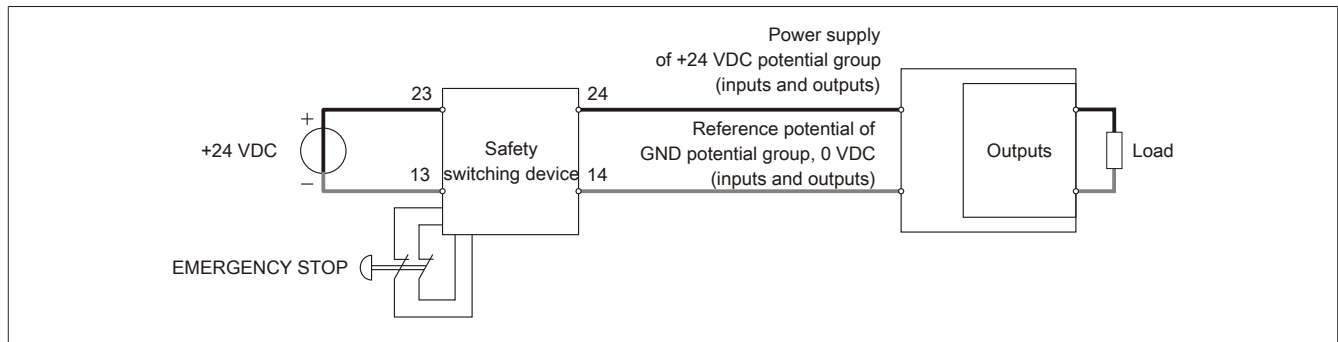


Figure 24: Circuit example: 1-channel without feedback

Provided that the external components being used (emergency stop switch, safety relay, load) satisfy the respective requirements, this example can achieve PL e (performance level as specified in EN ISO 13849-1:2015).

Dual-channel with feedback

The following example shows a load being cutoff using the emergency stop safety function. Feedback allows errors in the actuator to also be detected, and a cutoff is also possible if a fault event occurs due to the full dual-channel design. Whether or not 2 fully isolated potential groups – as shown in the example – are necessary depends on the application and how the safety solution is designed.

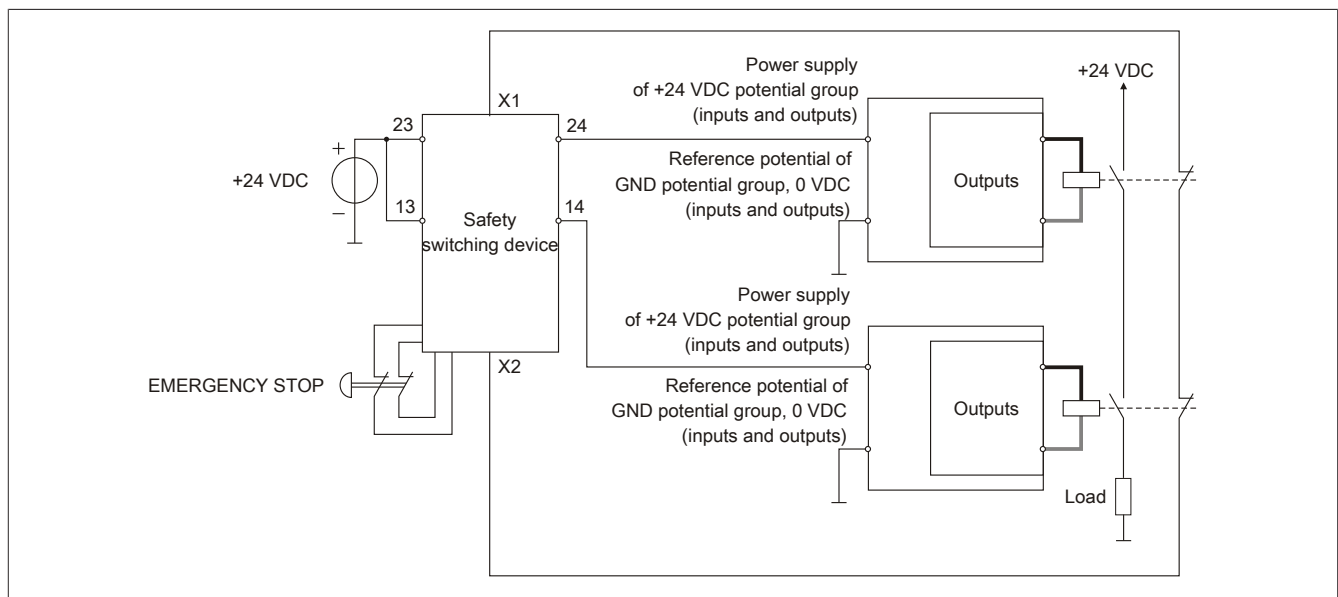


Figure 25: Circuit example: 2-channel with feedback

Provided that the external components being used (emergency stop switch, safety relay, load) satisfy the respective requirements, this example can achieve PL e.

Example with power supply module X20SP1130

The following examples show a load being cut off using safe power supply module X20SP1130 along with safe input module X20SI4100 and the "emergency stop" safety function.

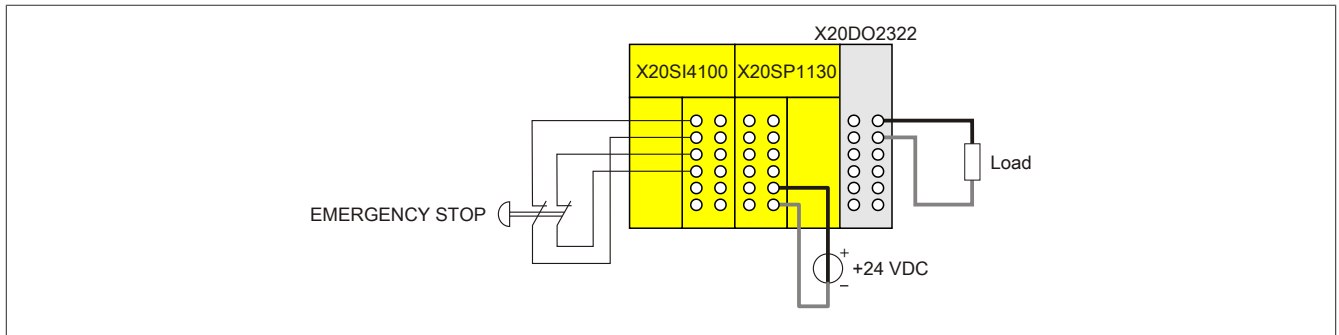


Figure 26: Circuit example with power supply module X20SP1130

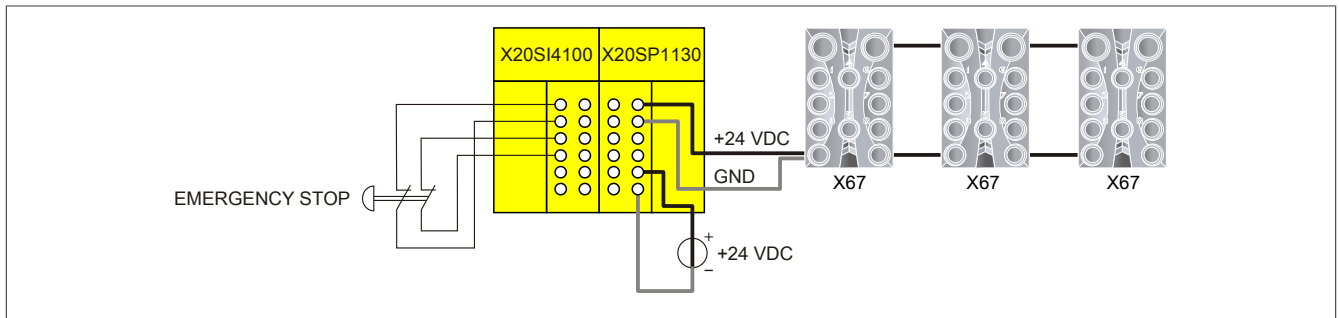


Figure 27: Circuit example with power supply module X20SP1130 and X67

Provided that the external components being used (emergency stop switch, load) satisfy the respective requirements, these examples can achieve PL e.

7.4.5.4 Wiring information

The operating principle "Safe cutoff of a potential group" only applies to the B&R modules being used. All other parts of the safety chain such as the application, upstream sensors or downstream actuators are NOT included in this principle.

For this reason, it is important to take the following points into account:

- Ensure proper wiring of the safety relays with the I/O supply. A short circuit between the output of the safety relay and an external 24 V voltage source can cause an unintended supply of 24 V to the internal supply voltage of the potential group. As a result, the safety function can no longer be ensured, i.e. **ALL** channels of the potential group can no longer be switched off by the upstream safety relay.
- Ensure proper wiring of **ALL** input and output channels of the potential group and the connected sensors or actuators. A short circuit between an input or output of the potential group and an external 24 V voltage source can cause the unintended feedback of 24 V to the internal supply voltage of the potential group. As a result, the safety function can no longer be ensured, i.e. **ALL** output channels of the potential group can no longer be switched off by the upstream safety relay.
- In accordance with EN ISO 13849-2:2012, appendix D.2, table D.4, a short circuit between any 2 conductors can be excluded, provided that:
 - They are permanently installed and protected against external damage (e.g. using a cable duct or armored conduit)
 - OR they are in separate plastic-sheathed cables
 - OR they are installed within an electrical enclosure. This requires that the lines as well as the area for electrical equipment meet the respective requirements [see EN 60204-1]
 - OR they are individually shielded with a ground connection.

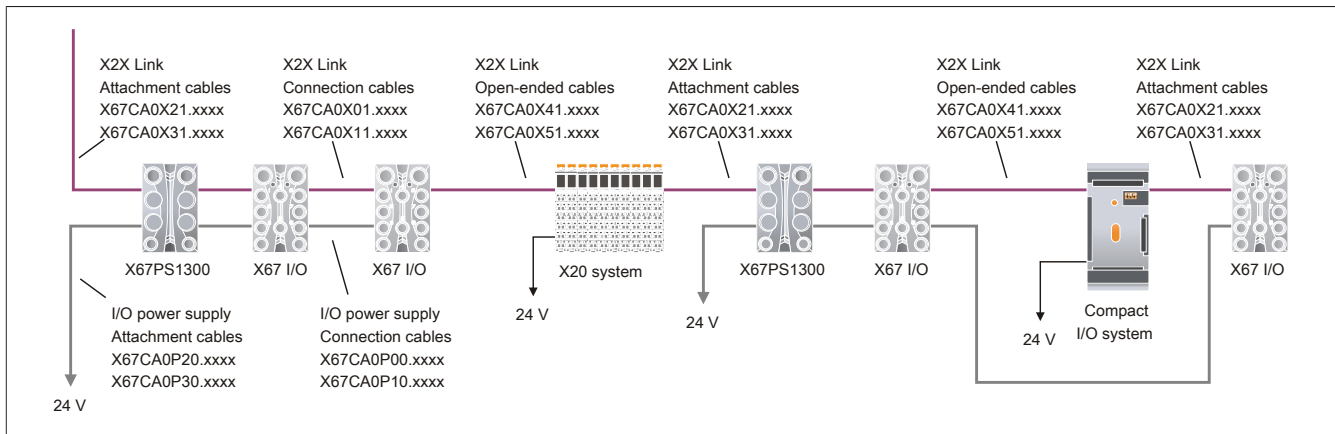
7.5 Combining X2X Link systems

The X2X Link provides a complete remote backplane, which is used for communicating between bus modules and over the X2X Link cable. Systems based on X2X Link can be combined with one another as needed.

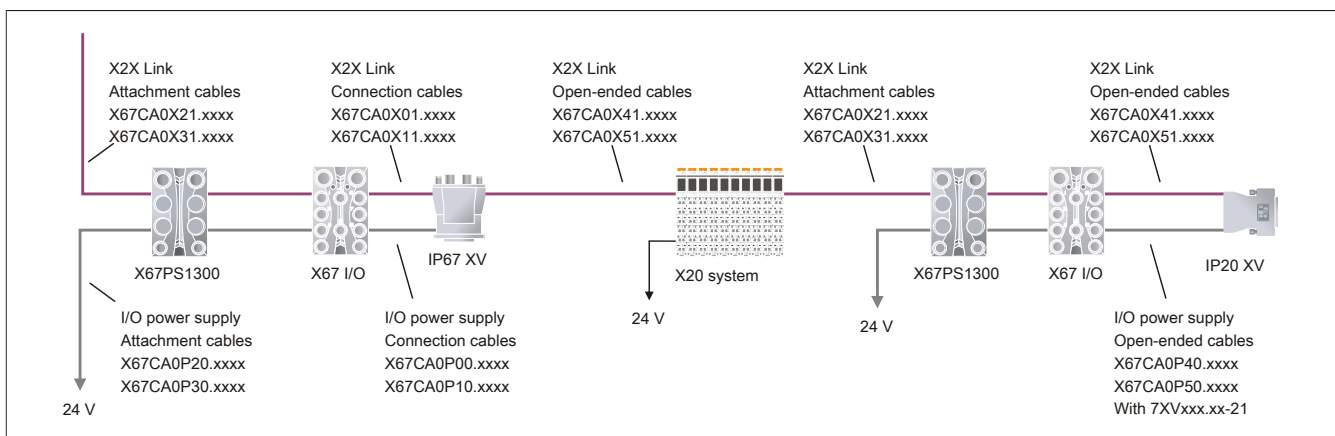
7.5.1 Connection overviews

The following connection overviews illustrate combinations of different systems that are based on X2X Link. The model numbers indicate which standard cables available from B&R can be used to connect with one another.

Combining X20, X67 and compact I/O system



Combining X20, X67 and valve terminal connections

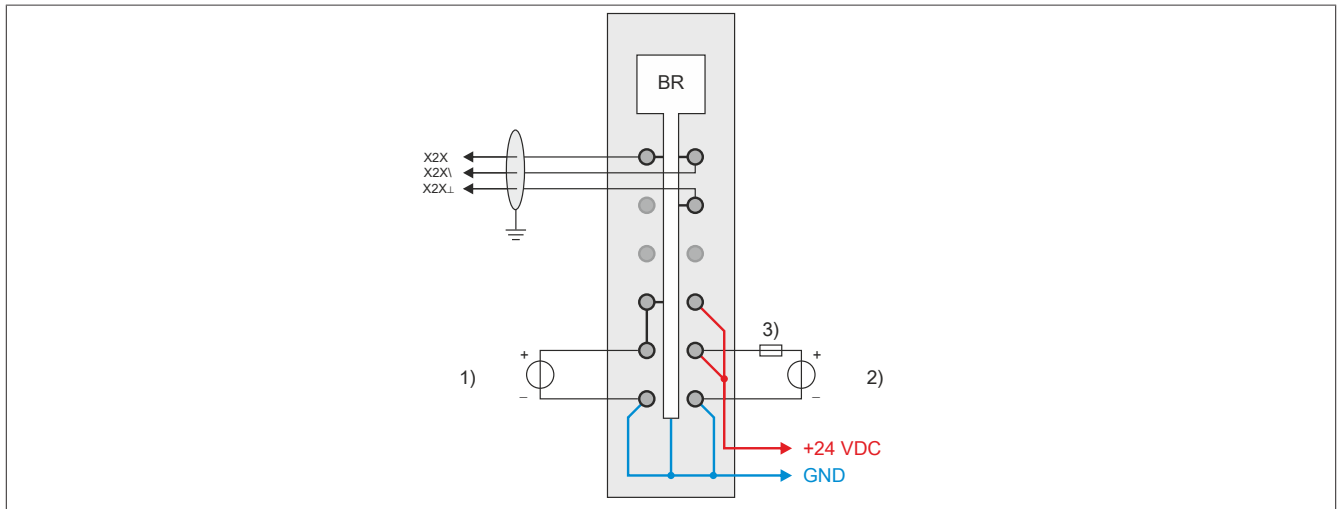


7.5.2 Connection examples

7.5.2.1 X20 system

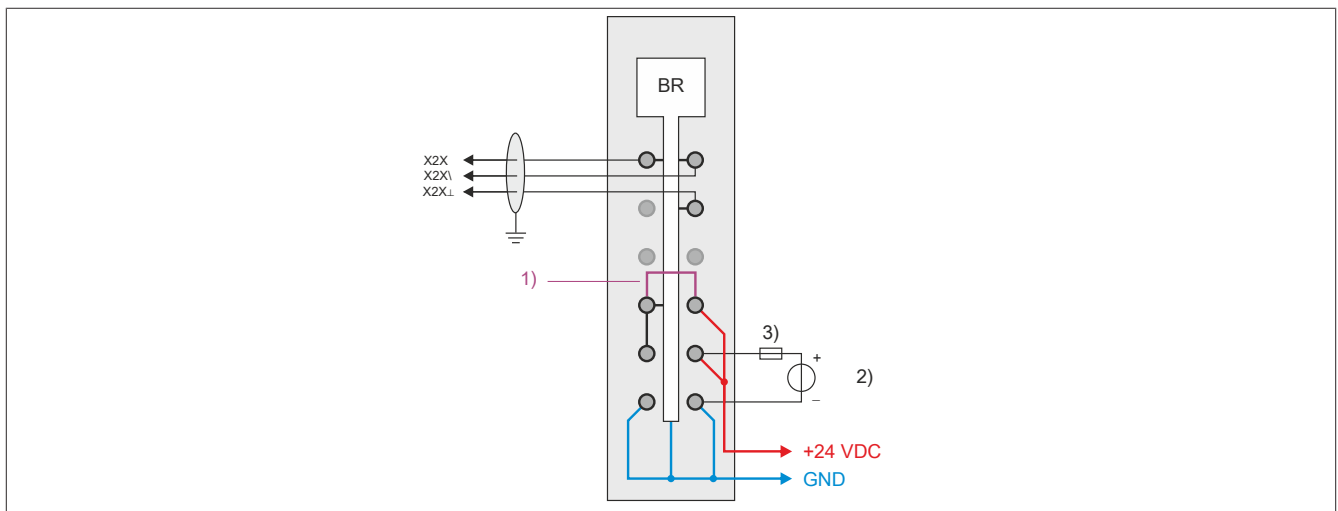
Bus receiver X20BR9300

With 2 isolated power supplies



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

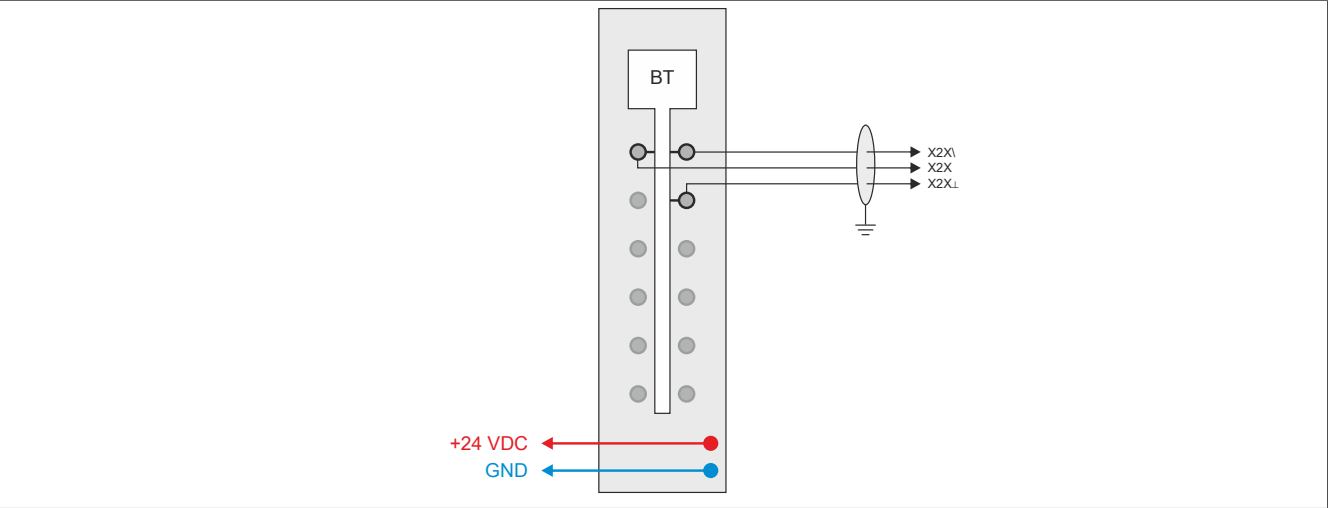
With 1 power supply and jumper



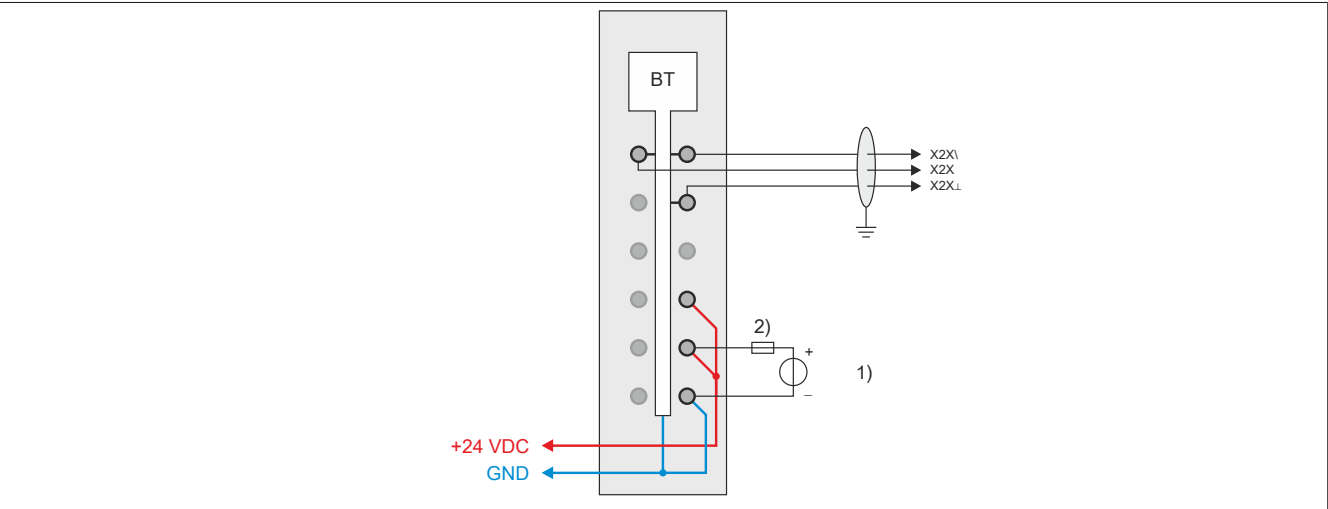
- 1) Jumper
- 2) Supply for the I/O power supply
- 3) Fuse, 10 A slow-blow

Bus transmitter X20BT9100

Without supply for internal I/O power supply

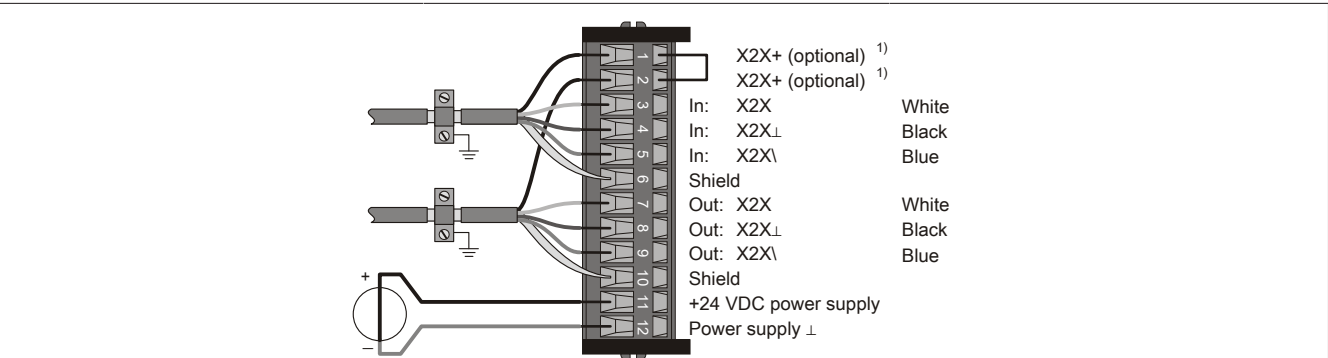


With supply for internal I/O power supply



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

7.5.2.2 Compact I/O system



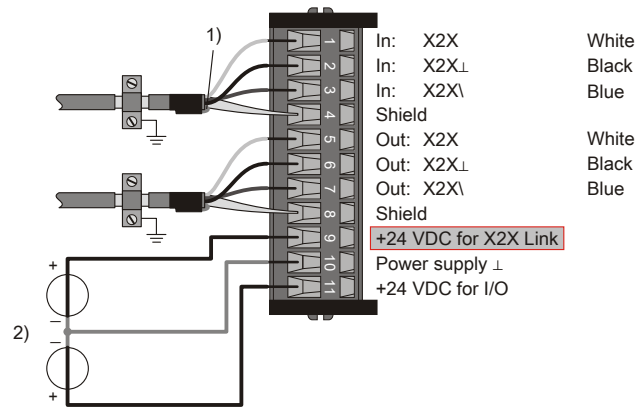
- 1) Used to forward the X2X Link power supply when using IP67 modules.

Signal	Cable type	Model number
X2X Link In	Open-ended cables ¹⁾	X67CA0X41.xxxx
		X67CA0X51.xxxx
X2X Link Out	Attachment cables ¹⁾	X67CA0X21.xxxx
		X67CA0X31.xxxx
X2X Link in/out	Cable for custom assembly	X67CA0X99.1000

- 1) Bridge for X2X+ in connection with X67 modules.

7.5.2.3 Valve connection

Connection example with 7XVxxx.xx-11/-12

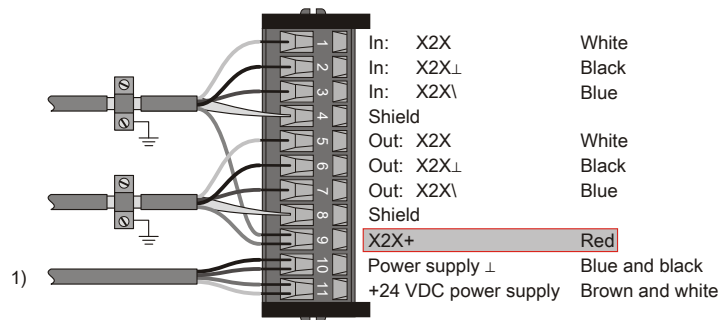


- 1) Bend the red wire end backwards and insulate it (e.g. with heat shrink tubing).
 2) X2X Link and I/O power supply

Signal	Cable type	Model number
X2X Link In	Open-ended cables ¹⁾	X67CA0X41.xxxx
		X67CA0X51.xxxx
X2X Link Out	Attachment cables ¹⁾	X67CA0X21.xxxx
		X67CA0X31.xxxx
X2X Link in/out	Cable for custom assembly	X67CA0X99.xxxx

- 1) In connection with X67 modules.

Connection example with 7XVxxx.xx-21

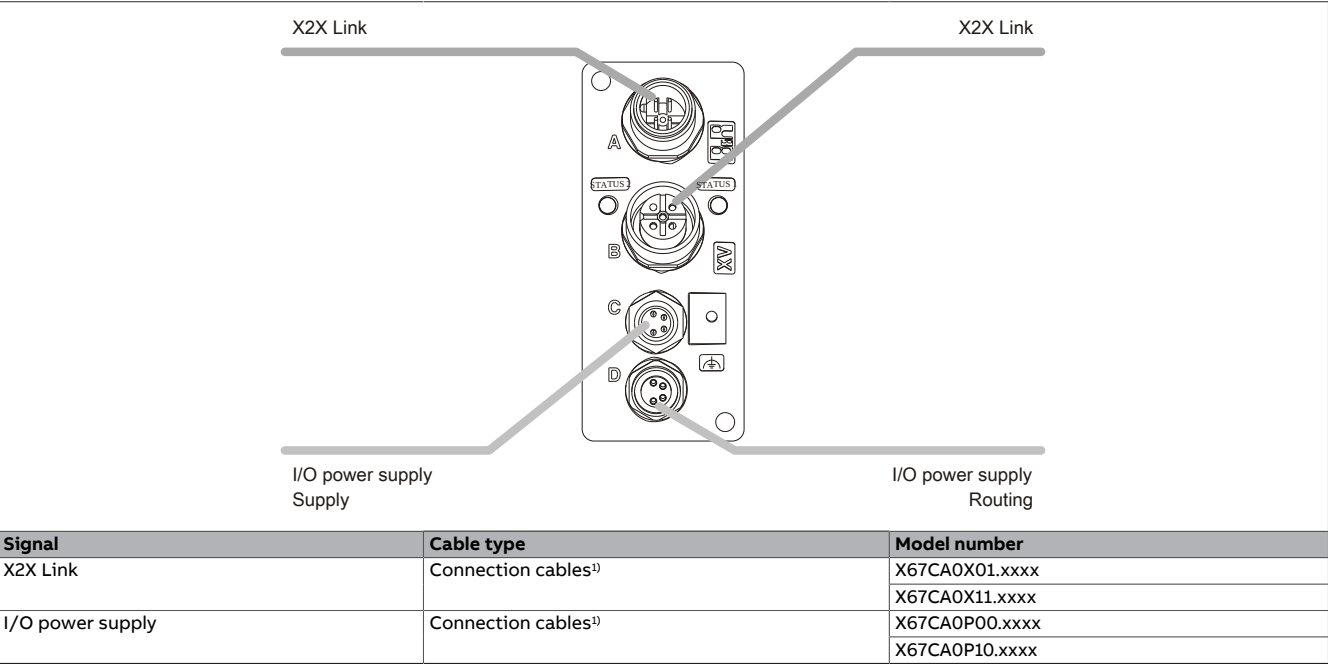


- 1) I/O power supply

Signal	Cable type	Model number
X2X Link In	Open-ended cables ¹⁾	X67CA0X41.xxxx
		X67CA0X51.xxxx
X2X Link Out	Attachment cables ¹⁾	X67CA0X21.xxxx
		X67CA0X31.xxxx
X2X Link in/out	Cable for custom assembly	X67CA0X99.xxxx
I/O power supply	Open-ended cables ¹⁾	X67CA0P40.xxxx
		X67CA0P50.xxxx

- 1) In connection with X67 modules.

Connection example with 7XVxxx.xx-51/-62



1) In connection with X67 modules.

7.6 Calculating the power requirements

The power requirements are calculated based on the power consumption of the individual modules listed in the respective data sheets. Due to the separate power supplies, the power requirements of the **X2X Link power supply** and **I/O power supply** must be calculated independently of one another.

For the power consumption of both areas, see the technical data. This makes it possible to quickly yet clearly establish the power requirements for a certain hardware configuration. The power consumption values of individual modules should then be subtracted from the power provided by the power supply module. The sum is not permitted to be less than zero.

The following entries in the technical data are used for the calculation:

X2X Link power supply

- **General information - Power consumption - Bus**

This entry refers to the power consumption needed to operate the X2X Link network. The power consumption of the I/O modules and bus base modules are taken into account in the calculation.

I/O power supply

- **General information - Power consumption - Internal I/O**

This entry refers to the power consumption needed to operate the actual I/O module as well as the inputs and outputs.

- **Sensor power supply - Power consumption**

This entry contains the power consumption needed by the I/O module to provide power to connected sensors, for example.

- **Actuator power supply - Power consumption**

This entry contains the power consumption needed by the I/O module to provide power to connected actuators, for example.

The power consumption of I/O modules whose power is supplied externally does not need to be taken into account.



Information:

All modules that require 0.01 W of power on the X2X Link network must be supplied via the internal I/O power supply. If the I/O power supply fails, the module shuts down and communication is lost.

In this case, ModuleOk returns the value "False" and data can no longer be read from the "embedded parameter chip".



Information:

The I/O power actually needed can vary depending on the application. In order to properly calculate the power requirements for the respective application, additional specifications such as simultaneity of the outputs, actual required output current, etc. must be taken into account.

7.6.1 Overview of the bus and I/O power supply

The power necessary to operate the X20 system is provided by the power supplied modules, X20 controllers, bus receivers and bus transmitters.

Module	Power supplied to internal I/O	Power supplied to bus
X20CPx68xX	+240 W	+7 W
X20BR7300	+240 W	+2 W
X20BR9300	+240 W	+7 W
X20PS2100	+240 W	(-0.2 W) ¹⁾
X20PS2110	+144 W	(-0.2 W) ¹⁾
X20PS3300	+240 W	+7 W
X20PS3310	+144 W	+7 W
X20PS9xxx	+240 W	+7 W
X20SP1130	+240 W	(-0.2 W) ¹⁾

1) This module does not provide extra power to the bus (X2X Link) but requires power itself for operation.

Bus transmitter

When calculating the power balance for bus transmitters, it is important to know whether they are only being used as such or are also being used as an I/O power supply module.

Material number	Power supplied to internal I/O		Bus power
	When operated as a bus transmitter	When operated as a bus transmitter and I/O power supply module	
X20BT9100	(-0.1 W)	+240 W	(-0.5 W) ¹⁾
X20BT9400	(-0.1 W)	+240 W	(-0.5 W) ¹⁾

1) This module does not provide extra power to the bus (X2X Link) but requires power itself for operation.



Information:

If the bus or I/O power consumption of the connected modules exceeds the available power, additional power supply modules must be added (see ["X20 system infrastructure" on page 111](#)).

7.6.2 Example: Controllers and modules

Calculating the power balance for the bus and I/O power supply of a module block with X20 controller.

Supply power of the controller

Module	Power supplied to bus	Power supplied to the I/O power supply
X20CP3685	+7 W	+240 W

Power requirements of the modules

Module	Bus power supply requirements		I/O power supply requirements	
	Bus modules	I/O modules	Internal I/O	Sensor/Actuator power supply
X20CP3685 ¹⁾	-	-	-0.60 W	-
X20BM11 + X20DI9371	-0.13 W	-0.18 W	-1.75 W	0.00 W
X20BM33 + X20SI9100	-0.13 W	-0.40 W	-1.60 W	0.00 W
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM33 + X20SI4100	-0.13 W	-0.32 W	-1.25 W	0.00 W
X20BM11 + X20DO4322	-0.13 W	-0.16 W	-0.49 W	Max. -12 W (actuator power supply) Max. -48 W (digital outputs) ²⁾
X20BM11 + X20DI4371	-0.13 W	-0.14 W	-0.59 W	Max. -12 W (sensor power supply)
Subtotal	-0.91 W	-1.22 W	-8.48 W	Max. -72 W
Total power requirements	-2.13 W		-80.48 W	

1) The power requirements of the power supply module (controller) do not have to be taken into account in this calculation.

2) Nominal power at 24 VDC and 2 A.

Calculating the power balance

	Bus power supply	I/O power supply
Controller supply	+7 W	+240 W
Total power requirements	-2.13 W	-80.48 W
Remaining power	+4.87 W	+159.52 W

The power comparison indicates that the power provided by the controller power supply module is sufficient. Additional power supply modules are not necessary.

7.6.3 Example: Bus controller and modules

Calculating the power balance for the bus and I/O power supply of a module block with bus controller.

Power supplied by the power supply module

Module	Power supplied to bus	Power supplied to the I/O power supply
X20PS9400	+7 W	+240 W

Power requirements of the modules

Module	Bus power supply requirements		I/O power supply requirements	
	Bus modules	I/O modules	Internal I/O	Sensor/Actuator power supply
X20PS9400 ¹⁾	-	-	-0.60 W	-
X20BB81 + X20BC8083 + X20HB2880	-0.50 W	-2.00 W -1.17 W	-	0.00 W
X20BM33 + X20SI9100	-0.13 W	-0.40 W	-1.60 W	0.00 W
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM33 + X20SO2530	-0.13 W	-0.26 W	-1.15 W	0.00 W
X20BM33 + X20SO4120	-0.13 W	-0.25 W	-1.30 W	Max. -120 W (digital outputs) ²⁾
X20BM33 + X20DO8322	-0.13 W	-0.26 W	-0.80 W	Max. -96 W (digital outputs) ³⁾
X20BM11 + X20DI2371	-0.13 W	-0.12 W	-0.29 W	Max. -12 W (sensor power supply)
Subtotal	-1.41 W	-4.48 W	-7.94 W	Max. -228 W
Total power requirements	-5.89 W		-235.94 W	

1) The power requirements of the power supply module do not have to be taken into account in this calculation.

2) Nominal power at 24 VDC and 5 A.

3) Nominal power at 24 VDC and 4 A.

Calculating the power balance

	Bus power supply	I/O power supply
Power supplied by the power supply module	+7 W	+240 W
Total power requirements	-5.89 W	-235.94
Remaining power	+1.11 W	+4.06

The power comparison indicates that the power provided by the power supply module is sufficient. Additional power supply modules are not necessary.

7.6.4 Example: Potential groups

With a larger number of I/O modules, the power provided by a power supply module would no longer be sufficient to operate all modules. In this case, the modules must be divided into potential groups.

Example of module group on bus receiver X20BR9300.

Power supplied by the bus receiver

A power supply module is already integrated in the bus receiver.

Module	Power supplied to bus	Power supplied to the I/O power supply
X20BR9300	+7 W	+240 W

Power requirements of the entire module group

Module	Bus power supply requirements		I/O power supply requirements	
	Bus modules	I/O modules	Internal I/O	Sensor/Actuator power supply
X20BM01 + X20BR9300 ¹⁾	-0.13 W	-	-0.60 W	-
X20BM11 + X20DI9371	-0.13 W	-0.18 W	-1.75 W	0.00 W
X20BM33 + X20SI9100	-0.13 W	-0.40 W	-1.60 W	0.00 W
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM33 + X20SI4100	-0.13 W	-0.32 W	-1.25 W	0.00 W
X20BM11 + X20DO4322	-0.13 W	-0.16 W	-0.49 W	Max. -12 W (actuator power supply) Max. -48 W (digital outputs) ²⁾
X20BM11 + X20DI4371	-0.13 W	-0.14 W	-0.59 W	Max. -12 W (sensor power supply)
X20BM33 + X20SI9400	-0.13 W	0.40 W	-1.60 W	0.00 W
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM33 + X20SO2530	-0.13 W	-0.26 W	-1.15 W	0.00 W
X20BM33 + X20SO4120	-0.13 W	-0.25 W	-1.30 W	Max. -120 W (digital outputs) ³⁾
X20BM11 + X20DO8322	-0.13 W	-0.26 W	-0.80 W	Max. -96 W (digital outputs) ⁴⁾
X20BM11 + X20DI2371	-0.13 W	-0.12 W	-0.29 W	Max. -12 W (sensor power supply)
Subtotal	-1.95 W	-2.53 W	-15.81 W	Max. -300 W
Total power requirements	-4.48 W		-315.81 W	

1) The power requirements of the bus receiver do not have to be taken into account in this calculation.

2) Nominal power at 24 VDC and 2 A.

3) Nominal power at 24 VDC and 5 A.

4) Nominal power at 24 VDC and 4 A.

Calculating the power balance

	Bus power supply	I/O power supply
Power supplied by the bus receiver	+7 W	+240 W
Total power requirements	-4.48 W	-315.81 W
Remaining power	+2.52 W	-75.81 W

The power comparison indicates that the power provided by the bus receiver is insufficient. As additional power supply module is necessary to ensure the missing 75.81 W for the I/O power supply.

For this reason, the module group is divided into 2 potential groups.

Potential group 1

Power supplied by the bus receiver

A power supply module is already integrated in the bus receiver.

Module	Power supplied to bus	Power supplied to the I/O power supply
X20BR9300	+7 W	+240 W

Power requirements of the modules

Module	Bus power supply requirements		I/O power supply requirements	
	Bus modules	I/O modules	Internal I/O	Sensor/Actuator power supply
X20BM01 + X20BR9300 ¹⁾	-0.13 W	-	-0.60 W	-
X20BM11 + X20DI9371	-0.13 W	-0.18 W	-1.75 W	0.00 W
X20BM33 + X20SI9100	-0.13 W	-0.40 W	-1.60 W	0.00 W
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20DO4322	-0.13 W	-0.16 W	-0.49 W	Max. -12 W (actuator power supply) Max. -48 W (digital outputs) ²⁾
X20BM11 + X20DI4371	-0.13 W	-0.14 W	-0.59 W	Max. -12 W (sensor power supply)
X20BM11 + X20AI4622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20AO2622	-0.13 W	-0.01 W	-1.10 W	0.00 W
X20BM11 + X20DO8322	-0.13 W	-0.26 W	-0.80 W	Max. -96 W (digital outputs) ²⁾
X20BM11 + X20DI2371	-0.13 W	-0.12 W	-0.29 W	Max. -12 W (sensor power supply)
Subtotal	-1.43 W	-1.30 W	-10.52 W	Max. -180 W
Total power requirements	-2.73 W		-190.52 W	

1) The power requirements of the bus receiver do not have to be taken into account in this calculation.

2) Nominal power at 24 VDC and 2 A.

3) Nominal power at 24 VDC and 4 A.

Potential group 2

Power supplied by the power supply module

Module	Power supplied to bus	Power supplied to the I/O power supply
X20SP1130	-	+240 W

Power requirements of the modules

Module	Bus power supply requirements		I/O power supply requirements	
	Bus modules	I/O modules	Internal I/O	Sensor/Actuator power supply
X20BM23 + X20SP1130 ¹⁾	-0.13 W	-0.2 W	-1.50 W	-
X20BM33 + X20SI4100	-0.13 W	-0.32 W	-1.25 W	0.00 W
X20BM33 + X20SI9100	-0.13 W	-0.40 W	-1.60 W	0.00 W
X20BM33 + X20SO2530	-0.13 W	-0.26 W	-1.15 W	0.00 W
X20BM33 + X20SO4120	-0.13 W	-0.25 W	-1.30 W	Max. -120 W (digital outputs) ²⁾
Subtotal	-0.65 W	-1.43 W	-6.80 W	Max. -120 W
Total power requirements	-2.08 W		-126.80 W	

1) The power requirements of the power supply module do not have to be taken into account in this calculation.

2) Nominal power at 24 VDC and 5 A.

Mechanical and electrical configuration

Power balance for the bus power supply

	Bus power supply
Power supplied by the bus receiver	+7 W
Power balance of potential group 1	-2.73 W
Power balance of potential group 2	-2.08 W
Remaining power	+2.19 W

The power comparison indicates that the power provided by the bus receiver is sufficient. Additional power supply modules for the bus power supply are not necessary.

Power balance for the I/O power supply

Potential group 1

	I/O power supply
Power supplied by the bus receiver	+240 W
Total power requirements	-190.52 W
Remaining power	+49.48 W

Potential group 2

	I/O power supply
Power supplied by the power supply module	+240 W
Total power requirements	-126.80 W
Remaining power	+113.20 W

The power comparison indicates that the power provided by the power supply modules is now sufficient for both potential groups.

7.7 Power dissipation of power supply module

Power supply modules are used to supply power to an X20 system. The power supply modules are either a separate module or part of a controller or bus controller.

The power consumed by the power supply modules is passed on to the X20 system, taking into consideration its own power requirements and the effectiveness of the power supplies. The data sheets for the power supply modules list their own power requirements and power dissipation (as maximum power consumption). With the formulas in the following sections, the exact power consumption can also be calculated. This calculation is explained using an example.

The following image shows where the power supply module uses power for its own requirements. It also shows where the power supply module uses power to supply the system and where power dissipation occurs.

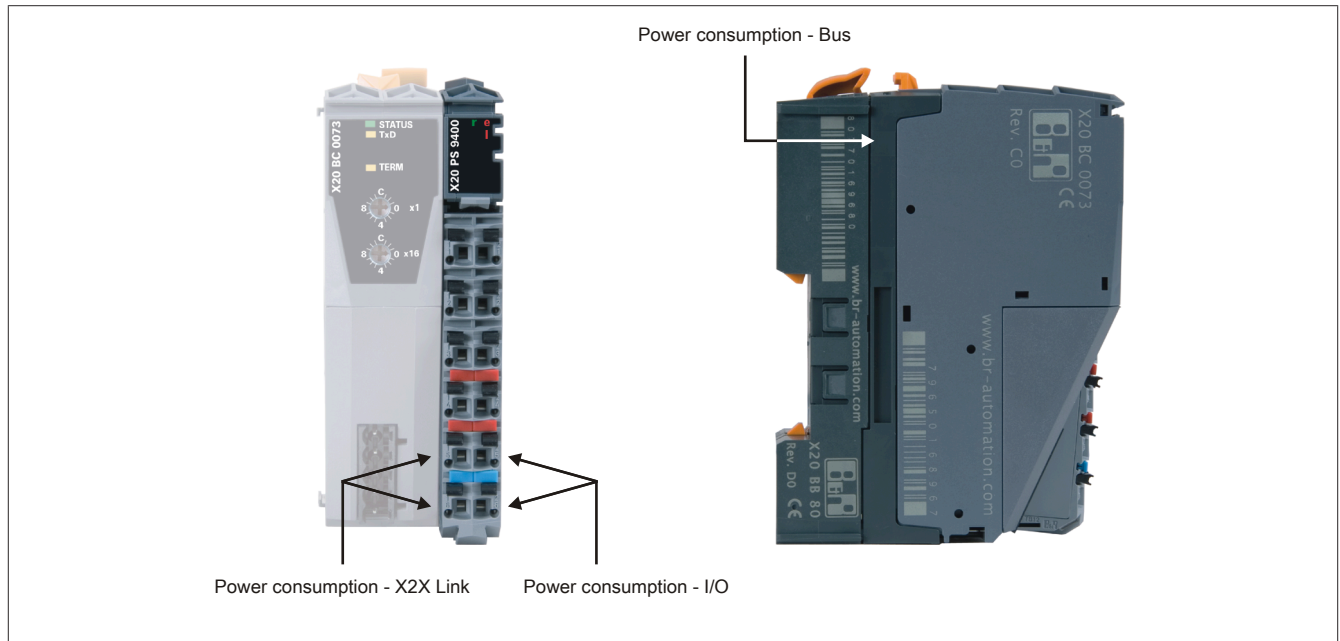


Figure 28: Power supply modules draw power at up to 3 supply points

7.7.1 Power consumption of power supply modules

The following table contains an overview of the power consumed by the power supply modules. The exact power requirements can be calculated using the formulas specified.

Module	Bus			I/O-internal power consumption [W]
	Power consumption [W]	Internal power consumption of X2X Link [W]	Total power consumption [W]	
X20PS3300, X20PS9400, X20PS9600, X20CP168x(X), X20CP368x(X), X20SL8101	0.2	$0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$1.42 \geq 0.2 + 0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20EMx61x Without parallel operation	-	$0.17 \cdot \Sigma P_{X2X_{X20}}$	$0.6 \geq 0.17 \cdot \Sigma P_{X2X_{X20}}$	$0.56 \geq 0.11 + I_{IO}^2 \times 0.0045$
X20EMx61x With parallel operation	-	$\frac{0.17 \cdot \Sigma P_{X2X_{X20}}}{2 \cdot n - 1}$	$0.45 \geq \frac{0.17 \cdot \Sigma P_{X2X_{X20}}}{2 \cdot n - 1}$	$0.56 \geq 0.11 + I_{IO}^2 \times 0.0045$
X20PS3310	0.2	$0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$1.42 \geq 0.2 + 0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$0.82 \geq 0.1 + I_{IO}^2 \times 0.02$
X20BR9300	0.4	$0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$1.62 \geq 0.4 + 0.8 + \frac{0.06 \cdot \Sigma P_{X2X_{X20}}}{n}$	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20PS9402, X20PS9602	0.2	$0.6 + \frac{0.12 \cdot \Sigma P_{X2X_{X20}}}{n = 1}$	$1.64 \geq 0.2 + 0.6 + \frac{0.12 \cdot \Sigma P_{X2X_{X20}}}{n = 1}$	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20PS2100	0.2	-	0.2	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20PS2110	0.2	-	0.2	$0.82 \geq 0.1 + I_{IO}^2 \times 0.02$
X20SP1130	0.2	-	0.2	$4.5 \geq 1.5 + I_{IO}^2 \times 0.03$
X20BT9100	0.5	-	0.5	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20BT9400	0.5	$0.5 + \frac{0.147 \cdot \Sigma P_{X2X_{X67}}}{n = 1}$	$1.38 \geq 0.5 + 0.5 + \frac{0.147 \cdot \Sigma P_{X2X_{X67}}}{n = 1}$	$0.6 \geq 0.1 + I_{IO}^2 \times 0.005$
X20BR7300	0.8	$0.15 \cdot \Sigma P_{X2X_{X20}}^{1)}$	$1.1 \geq 0.8 + 0.15 \cdot \Sigma P_{X2X_{X20}}^{1)}$	$1.5 \geq I_{IO}^2 \times 0.015$
X20PS8002	-	$0.5 + \frac{0.12 \cdot P_{Out}}{n = 1}$	$1.34 \geq 0.5 + \frac{0.12 \cdot P_{Out}}{n = 1}$	-
X20PD2113	0.12	-	0.12	$1.15 \geq 0.28 + I_{IO}^2 \times 0.02$

1) $P_{X2X_{X20}}$ must be taken into account with 0 W in parallel operation.

$\Sigma P_{X2X_{X20}}$...	Sum of the bus power consumption of all modules in the X20 System (Compact-S controller, Compact controller, Fieldbus controller, BC, BR, I/O, BM, BT)
$\Sigma P_{X2X_{X67}}$...	Sum of the bus power consumption of all I/O modules in the X67 System
P_{Out} ...	Sum of the power consumption of all modules supplied by the power supply module (HB)
n ...	Number of all power supply modules in the X20 System with X2X Link power supply
I_{IO} ...	I/O summation current of all I/O modules supplied by this power supply module (max. 10 A)

X20PS2110 and X20PS3110:

With these modules, the summation current is not permitted to exceed 6 A.

X20PD2113:

If the module is used as a power supply module for the I/O power supply, I_{IO} corresponds to the summation current of all I/O modules supplied by the X20PD2113 (max. 10 A).

7.7.2 Example

Calculation of the total internal power consumption of bus receiver X20BR9300 using the following hardware configuration:

Module	Bus module power [W]	Bus power [W]	I/O-internal power [W]
X20BR9300	0	0 0	0 0
X20DI4371	0.13 0.13	0.14 0.14	0.59 0.59
X20DI2371	0.13 0.13	0.12 0.12	0.29 0.29
X20DO4322	0.13 0.13	0.16 0.16	0.49 0.49
X20DO4322	0.13 0.13	0.16 0.16	0.49 0.49
X20BT9100	0.13 0.13	0.50 0.50	0.10 0.10
Sum	0.65 0.65	1.08 1.08	1.96 1.96

2 power values have to be calculated in order to determine the entire internal power consumption of the bus receiver.

- Internal X2X Link power consumption of the X20BR9300
- Internal I/O power consumption of the X20BR9300

7.7.2.1 Calculating the internal X2X Link power consumption of the X20BR9300

Bus power consumption of all modules in the X20 system

In order to calculate the internal X2X Link power consumption of the X20BR9300, the sum of the bus power consumption of all modules in the X20 system is required.

The sum for the example configuration is calculated using the following formula. The bus module of the X20BR9300 does not have to be taken into account in the calculation. The power consumption of the bus module is already included in the constant 0.8 (see formula below).

A power consumption of 0.13 W for each bus module must be included in the calculation for the 4 I/O modules and bus transmitter.

$$\sum P_{X2X_{X20}} = P_{X2XBus_{BR9300}} + \sum P_{X2XBus_{IOMod}} + \sum P_{X2XBus_{Busmod}} = 0.4 + 1.08 + 5 \cdot 0.13 = 2.13 \text{ W}$$

Internal X2X Link power consumption of the X20BR9300

The internal X2X Link power consumption of the X20BR9300 is calculated using the following formula. Since X2X Link is only supplied by the X20BR9300 bus receiver, the factor is $n = 1$:

$$P_{X2Xint_{BR9300}} = 0.8 + \frac{0.06 \cdot \sum P_{X2X_{X20}}}{n} = 0.8 + \frac{0.06 \cdot 2.13}{1} = 0.8 + 0.13 = 0.93 \text{ W}$$

7.7.2.2 Calculating the internal I/O power consumption of the X20BR9300

The I/O summation current of all I/O modules supplied by the X20BR9300 is needed to calculate the internal I/O power consumption. The I/O summation current is composed of 3 parts:

- Internal power consumption of the I/O modules
- Sum of the output currents
- Sum of the actuator currents

Internal power consumption of the I/O modules

The current that results from the internal consumption of the I/O modules is calculated according to the following formula:

$$I_{IO_{int}} = \frac{P_{IO_{int}}}{U} = \frac{1.96}{24} = 0.082 \text{ A}$$

Sum of output and actuator currents

Two X20DO4322 modules are included in the example configuration. The following images show which outputs are wired and how high the output current and actuator current are per channel.

Connections and currents of the first X20DO4322:

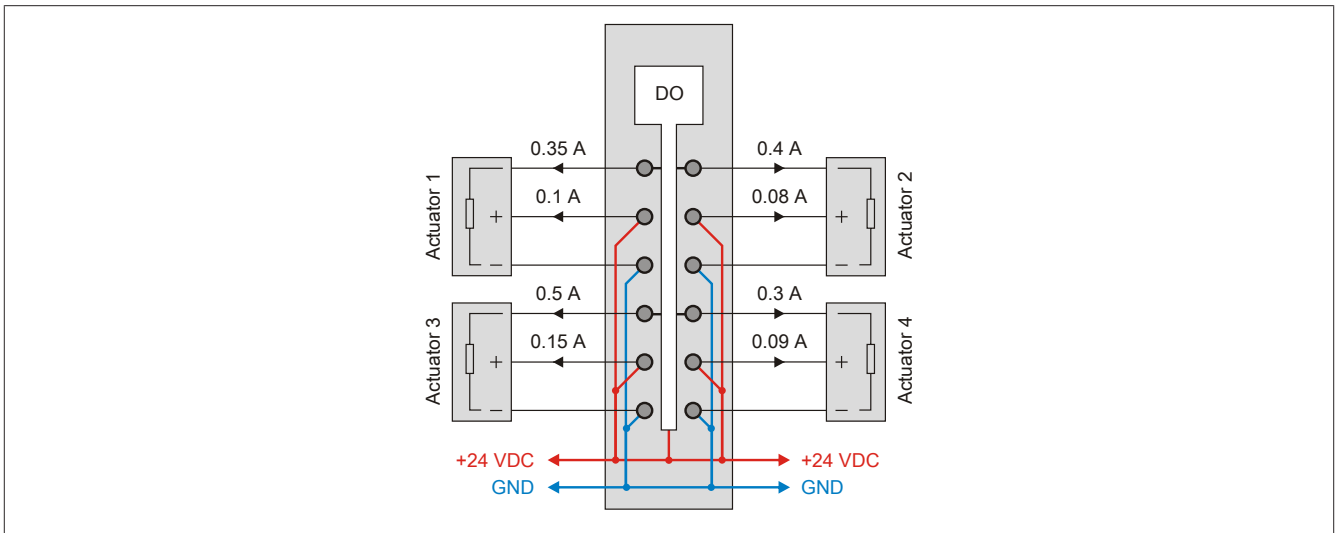


Figure 29: Connections and currents of the first X20DO4322

Connections and currents of the second X20DO4322:

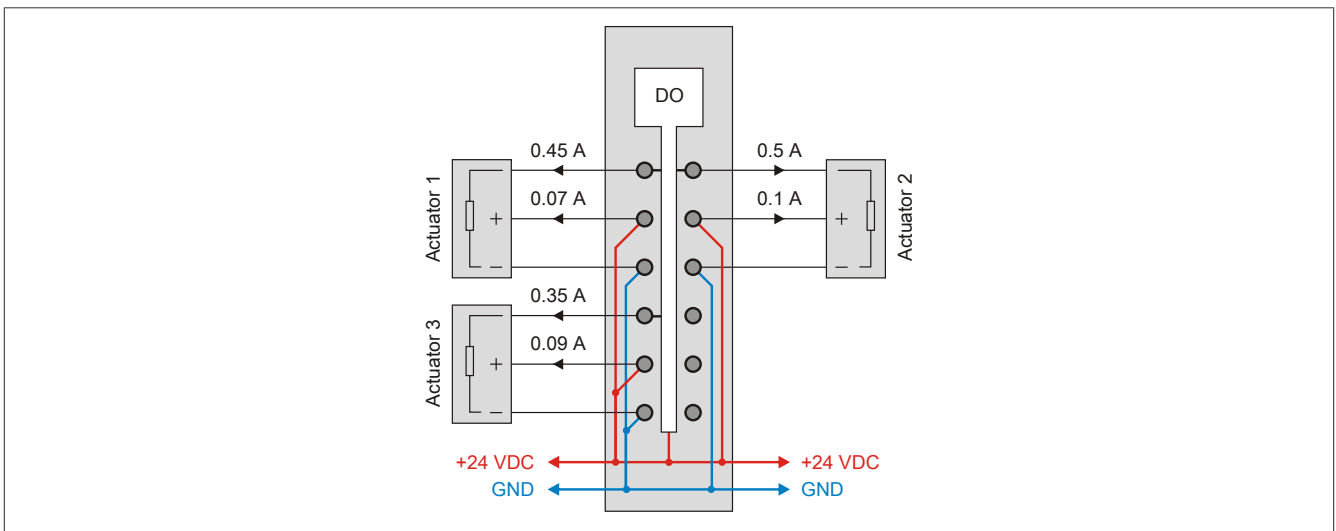


Figure 30: Connections and currents of the second X20DO4322

Calculating the sum of the output currents:

$$I_{DO} = I_{DO_1} + I_{DO_2} = 0.35 + 0.4 + 0.5 + 0.3 + 0.45 + 0.5 + 0.35 = 2.85 \text{ A}$$

Calculating the sum of the actuator currents:

$$I_{Actuator} = I_{Actuator_1} + I_{Actuator_2} = 0.1 + 0.08 + 0.15 + 0.09 + 0.07 + 0.1 + 0.09 = 0.68 \text{ A}$$

Calculating the I/O summation current

The I/O summation current is calculated from the sum of all 3 partial currents.

$$I_{IO} = I_{IO_{int}} + I_{DO} + I_{Actuator} = 0.082 + 2.85 + 0.68 = 3.612 \text{ A}$$

Calculating the internal I/O power consumption of the X20BR9300

The internal I/O power consumption is calculated using the following formula:

$$P_{IO_{int. BR9300}} = 0.1 + I_{IO}^2 \cdot 0.005 = 0.1 + 3.612^2 \cdot 0.005 = 0.17 \text{ W}$$

7.7.2.3 Total internal power consumption of the X20BR9300

The following 3 power values must be added together to calculate the total internal power consumption of the X20BR9300:

- Power consumption - Bus
- Power consumption - X2X Link (internal)
- Power consumption - I/O-internal

$$P_{BR9300_{int. Tot}} = P_{X2XBus_{BR9300}} + P_{X2X_{int. BR9300}} + P_{IO_{int. BR9300}} = 0.4 + 0.93 + 0.17 = 1.5 \text{ W}$$

7.8 Power dissipation calculation of I/O modules

Some modules require that neighboring modules are not permitted to exceed a certain power dissipation during operation.

7.8.1 Example: Operation of module X20SM1436

The power dissipation of the immediate neighboring modules of the SM module is not permitted to exceed 1 W. A maximum power dissipation of 1.8 W is permitted for the next modules.

	X20 module Power dissipation ≤ 1.8 W	Neighboring module Power dissipation ≤ 1 W	SM1436 Operation with current derating (3.0 A)	Neighboring module Power dissipation ≤ 1 W	X20 module Power dissipation ≤ 1.8 W	
--	---	---	---	---	---	--

7.8.2 Calculation of the power dissipation of I/O modules adjacent to the X20SM1436

The power dissipation of I/O modules consists of the following power values:

- Power consumption - Bus module
- Power consumption - Bus
- Power consumption - I/O-internal
- Power consumption - I/O-external
- Additional power dissipation caused by actuators (resistive)

Immediate neighboring modules

The table describes the calculation of the power dissipation of I/O modules that can be operated directly next to the SM module. The power dissipation of these modules is not permitted to exceed 1 W.

Power value	X20AI2622	X20AT2402	X20DI4372	X20DO4322
Power consumption - Bus module [W]	0.13	0.13	0.13	0.13
Power consumption - Bus [W]	0.01	0.01	0.14	0.16
Power consumption - I/O-internal [W]	0.8	0.72	0.59	0.49
Power consumption - I/O-external [W]	-	-	-	-
Additional power dissipation caused by actuators (resistive) [W]	-	-	-	0.21
Power dissipation of the I/O module [W]	0.94	0.86	0.86	0.99

All modules have a power dissipation ≤ 1 W and can therefore be operated directly next to module X20SM1436.

Modules in the 2nd row

The table describes the calculation of the power dissipation of I/O modules that can be operated in the 2nd row next to the SM module. The power dissipation of these modules is not permitted to exceed 1.8 W.

Power value	X20AI4632	X20AT4222	X20DI8371	X20DO6322
Power consumption - Bus module [W]	0.13	0.13	0.13	0.13
Power consumption - Bus [W]	0.01	0.01	0.18	0.18
Power consumption - I/O-internal [W]	1.5	1.1	-	0.71
Power consumption - I/O-external [W]	-	-	1.2	-
Additional power dissipation caused by actuators (resistive) [W]	-	-	-	0.31
Power dissipation of the I/O module [W]	1.64	1.24	1.51	1.33

All modules have a power dissipation ≤ 1.8 W and can therefore be operated in the 2nd row next to module X20SM1436.

7.9 Calculation of the additional power dissipation resulting from actuators

Calculation of power dissipation when specifying $R_{DS(on)}$

Explaining output load with an X20DO4332 example

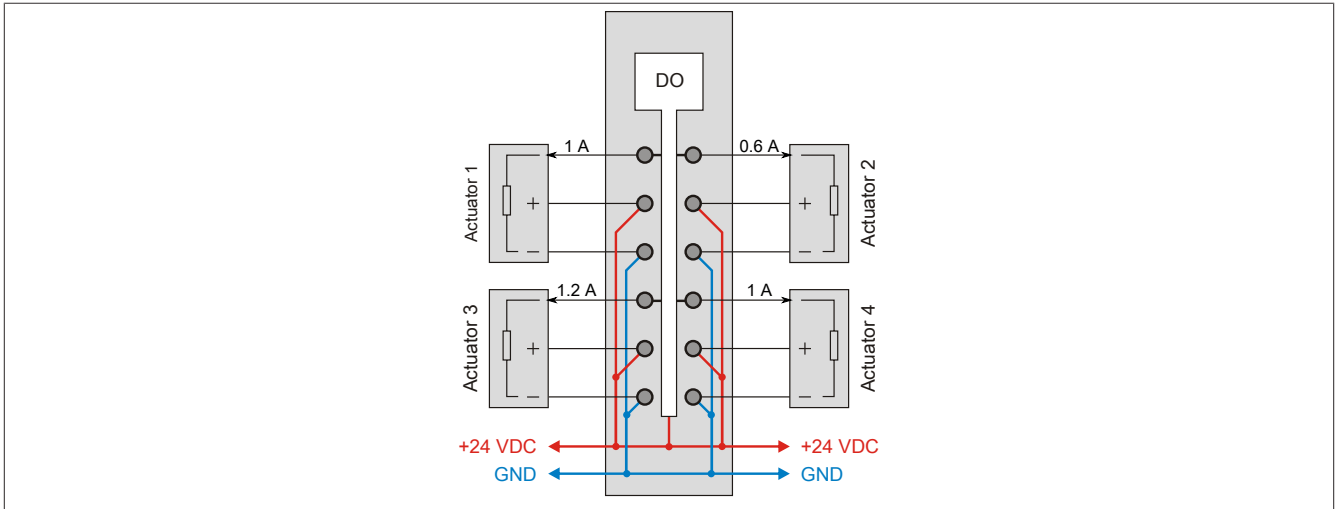


Figure 31: Calculation of power dissipation when specifying $R_{DS(on)}$

Theoretically highest power dissipation resulting from actuators:

Number of outputs * $R_{DS(on)}$ * nominal output current² = power dissipation

$$4 * 140 \text{ m}\Omega * 2 \text{ A}^2 = 2.24 \text{ W}$$

Power dissipation resulting from actuators in this example:

$$140 \text{ m}\Omega * (1 \text{ A}^2 + 0.6 \text{ A}^2 + 1.2 \text{ A}^2 + 1 \text{ A}^2) = 0.532 \text{ W}$$

Power dissipation calculation when specifying the residual voltage

Explaining output load with an X20DO4623 example

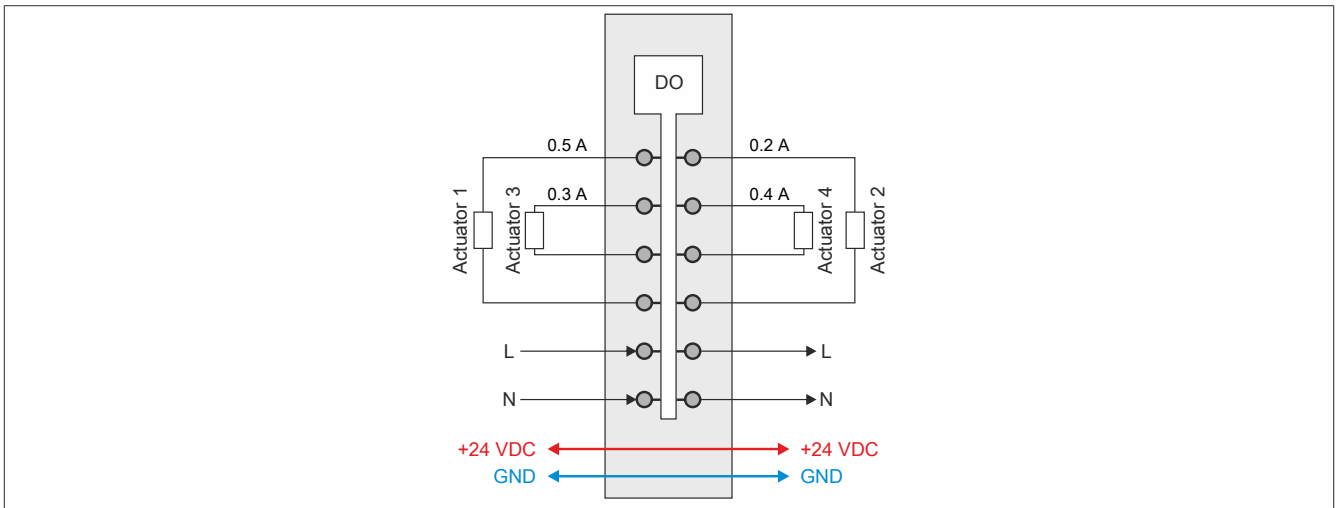


Figure 32: Power dissipation calculation when specifying the residual voltage

Theoretically highest power dissipation resulting from actuators:

Number of outputs * residual voltage * nominal output current = power dissipation

$$4 * 1.6 \text{ V} * 0.5 \text{ A} = 3.2 \text{ W}$$

Power dissipation resulting from actuators in this example:

$$1.6 \text{ V} * (0.5 \text{ A} + 0.2 \text{ A} + 0.3 \text{ A} + 0.4 \text{ A}) = 2.24 \text{ W}$$

Power dissipation calculation when specifying the contact resistance

Explaining output load with an X20DO4649 example

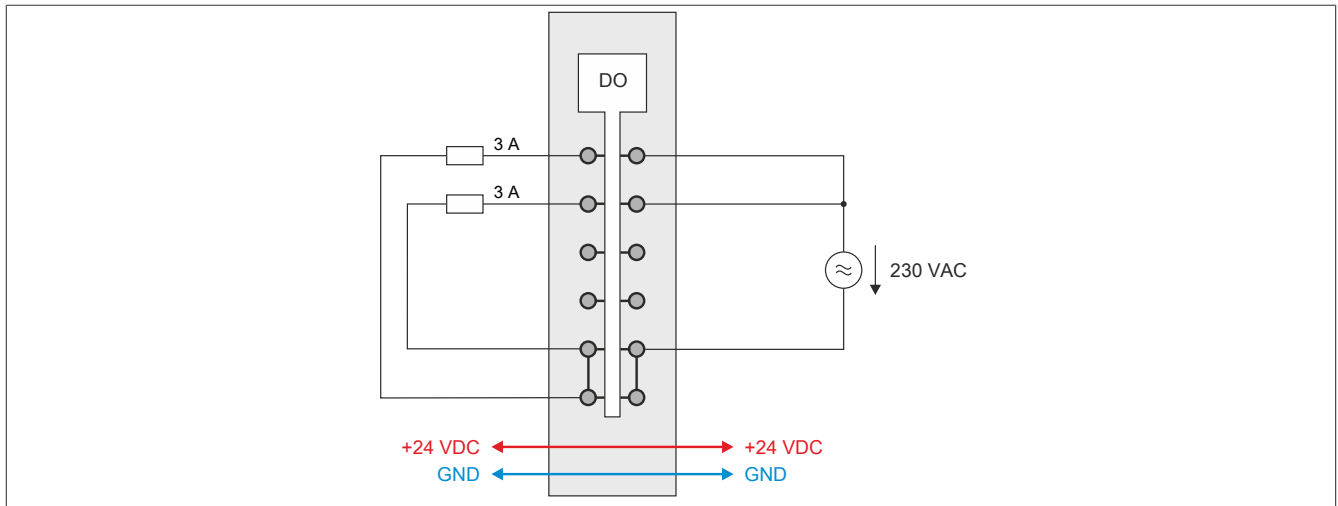


Figure 33: Power dissipation calculation when specifying the contact resistance

Theoretically highest power dissipation resulting from actuators:

Number of outputs * contact resistance * nominal output current² = power dissipation

$$4 * 100 \text{ m}\Omega * 5 \text{ A}^2 = 10 \text{ W}$$

Power dissipation resulting from actuators in this example:

$$100 \text{ m}\Omega * (3 \text{ A}^2 + 3 \text{ A}^2) = 1.8 \text{ W}$$

7.10 Dimensioning the external 24 VDC power supply

X20 systems are provided with external 24 VDC power supplies. The following examples illustrate how to determine the power to be provided.

7.10.1 X20BRx300 bus receivers and X20PS33xx power supply modules

Calculation example with bus receiver X20BR9300

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Example for calculating the power requirements: See "Example: Potential groups" on page 134.	2.73 W	188.77 W
Power consumption of the X20BR9300	For the value, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.62 W	-
Subtotal		4.35 W	188.77 W
Total power requirements		193.12 W	

The external 24 VDC power supply must provide 193.12 W.

7.10.2 Power supply modules X20PS9400 and X20PS9402

Calculation example with X20PS9400, X20BC0083 and X20BB80

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Example for calculating the power requirements: See "Example: Bus controller and modules" on page 133. In the example for calculating the power requirements, expandable bus controller X20BC8083 is used with 1-hub expansion module X20HB2880. If X20BC0083 is used, there is no need for a 1-hub expansion module and the following values are included in the calculation: - X20BB80: -0.25 W - X20BC0083: -2 W	4.47 W	235.94 W
Power consumption of the X20PS9400	For the value, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	-
Subtotal		5.89 W	235.94 W
Total power requirements		241.83 W	

The external 24 VDC power supply must provide 241.83 W.

Calculation example with X20PS9400, X20BC8083, X20HB2880 and X20BB81

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Example for calculating the power requirements: See "Example: Bus controller and modules" on page 133.	5.89 W	235.94 W
Power consumption of the X20PS9400	For the value, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	-
Subtotal		7.31 W	235.94 W
Total power requirements		243.25 W	

The external 24 VDC power supply must provide 243.25 W.

7.10.3 X20CPx68x controllers

Calculation example with X20CP3685 and 3 interface modules

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Example for calculating the power requirements: See " Example: Controllers and modules " on page 132.	2.13 W	78.73 W
Power consumption of X20CP3685 without interface module and USB	For the value, see the technical data in the data sheet: General information - Power consumption without interface module and USB	6.9 W	-
Power consumption for generating the X2X Link power supply	For the value, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	-
2x USB interface	3 W must be taken into account for each USB interface used	6 W	-
Power consumption of the X20IF1091	For the value, see the technical data in the data sheet: General information - Power consumption	0.97 W	-
Power consumption of the X20IF10E1-1		2 W	-
Power consumption of the X20IF10E3-1		2 W	-
Power consumption of X20CP3685 per interface module	The controller consumes 0.6 W per interface module. Power consumption of 3 interface modules: $3 \times 0.6 \text{ W} = 1.8 \text{ W}$	1.8 W	-
Subtotal		23.22 W	78.73 W
Total power requirements		101.95 W	

The external 24 VDC power supply unit must provide 101.95 W.

7.10.4 Compact-S controllers X20CP04xx

7.10.4.1 Compact-S controller without interface module

The first part of this example shows the calculation of the power balance for the bus and I/O power supply of a Compact-S controller without an interface module. Dimensioning the external 24 VDC power supply unit is explained in the second part.

Power supplied by the power supply module

Module	Power supplied to the bus	Power supplied to the I/O power supply
X20PS9600	+7 W	+240 W

Power requirements of the Compact-S controller

Module	Bus power supply requirements	I/O power supply requirements
X20PS9600	-	-0.6 W
X20BB52	-0.55 W	-
X20CP0410	-2.2 W	-
2x USB interface	-2 W ¹⁾	-
Total power requirements	-4.75 W	-0.6 W

1) $2 \times 5 \text{ V} \times 0.2 \text{ A} = 2 \text{ W}$

Power balance for the bus supply

The power requirements of the Compact-S controller are completely covered by the bus power supply. In a power balance, it must be checked whether the power supply module covers the power balance of the Compact-S controller.

	Bus power supply
Power supplied by the power supply module	+7 W
Total power requirements	-4.75 W
Remaining power	+2.25 W

The power comparison indicates that the power provided by the power supply module is sufficient. Additional power supply modules are not necessary.

External 24 VDC power supply

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Examples for calculating the power requirements: See " Calculating the power requirements " on page 131. The following values are assumed for this example: - Bus power supply: 3.67 W - I/O power supply: 192.51 W	3.67 W	192.51 W
Power consumption of the X20PS9600	For the values, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	0.6 W
Power requirements of the Compact-S controller	The values calculated in section " Power requirements of the Compact-S controller " on page 148 are used for the bus and I/O power supply.	4.75 W	-
Subtotal		9.84 W	193.11 W
Total power requirements		202.95 W	

The external 24 VDC power supply must provide 202.95 W.

7.10.4.2 Compact-S controller with 1 interface module

The first part of this example shows the calculation of the power balance for the bus and I/O power supply of a Compact-S controller with an interface module. Dimensioning the external 24 VDC power supply unit is explained in the second part.

Power supplied by the power supply module

Module	Power supplied to the bus	Power supplied to the I/O power supply
X20PS9600	+7 W	+240 W

Power requirements of the Compact-S controller

Module	Bus power supply requirements	I/O power supply requirements
X20PS9600	-	-0.6 W
X20BB62	-0.94 W	-
X20CP0410	-2.2 W	-
2x USB interface	-2 W ¹⁾	-
X20IF1063-1	-1.8 W	-
Total power requirements	-6.94 W	-0.6 W

1) $2 \times 5 \text{ V} \times 0.2 \text{ A} = 2 \text{ W}$

Power balance for the bus supply

The power requirements of the Compact-S controller are completely covered by the bus power supply. In a power balance, it must be checked whether the power supply module covers the power balance of the Compact-S controller.

	Bus power supply
Power supplied by the power supply module	+7 W
Total power requirements	-6.94 W
Remaining power	+0.06 W

The power comparison indicates that the power provided by the power supply module is sufficient. Additional power supply modules are not necessary.

External 24 VDC power supply

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Examples for calculating the power requirements: See "Calculating the power requirements" on page 131 . The following values are assumed for this example: • Bus power supply: 3.67 W • I/O power supply: 192.51 W	3.67 W	192.51 W
Power consumption of the X20PS9600	For the values, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	0.6 W
Power requirements of the Compact-S controller	The values calculated in section "Power requirements of the Compact-S controller" on page 149 are used for the bus and I/O power supply.	6.94 W	-
Subtotal		12.03 W	193.11 W
Total power requirements		205.14 W	

The external 24 VDC power supply must provide 205.14 W.

7.10.4.3 Compact-S controller with 2 interface modules

Calculating the power balance for the bus and I/O power supply of a Compact-S controller with 2 interface modules is shown in the first part of this example. Dimensioning the external 24 VDC power supply unit is explained in the second part.

Power supplied by the power supply module

Module	Power supplied to the bus	Power supplied to the I/O power supply
X20PS9600	+7 W	+240 W

Power requirements of the Compact-S controller

Module	Bus power supply requirements	I/O power supply requirements
X20PS9600	-	-0.6 W
X20BB72	-1.17 W	-
X20CP0410	-2.2 W	-
2x USB interface	-2 W ¹⁾	-
X20IF1043-1	-1.1 W	-
X20IF1063-1	-1.8 W	-
Total power requirements	-8.27 W	-0.6 W

1) $2 \times 5 \text{ V} \times 0.2 \text{ A} = 2 \text{ W}$

Power balance for the bus supply

The power requirements of the Compact-S controller are completely covered by the bus power supply. In a power balance, it must be checked whether the power supply module covers the power balance of the Compact-S controller.

	Bus power supply
Power supplied by the power supply module	+7 W
Total power requirements	-8.27 W
Remaining power	-1.27 W

The power comparison indicates that the power provided by the power supply module is insufficient. An additional X20PS3300 power supply module is required (see ["Hardware configuration" on page 151](#)).

External 24 VDC power supply

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Examples for calculating the power requirements: See "Calculating the power requirements" on page 131 . The following values are assumed for this example: - Bus power supply: 3.67 W - I/O power supply: 192.51 W	3.67 W	192.51 W
Power consumption of the X20PS9600	For the values, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	0.6 W
Power requirements of the Compact-S controller	The values determined in section "Power requirements of the Compact-S controller" on page 150 are used for the bus and I/O power supply.	8.27 W	-
Subtotal		13.36 W	193.11 W
Total power requirements		206.47 W	

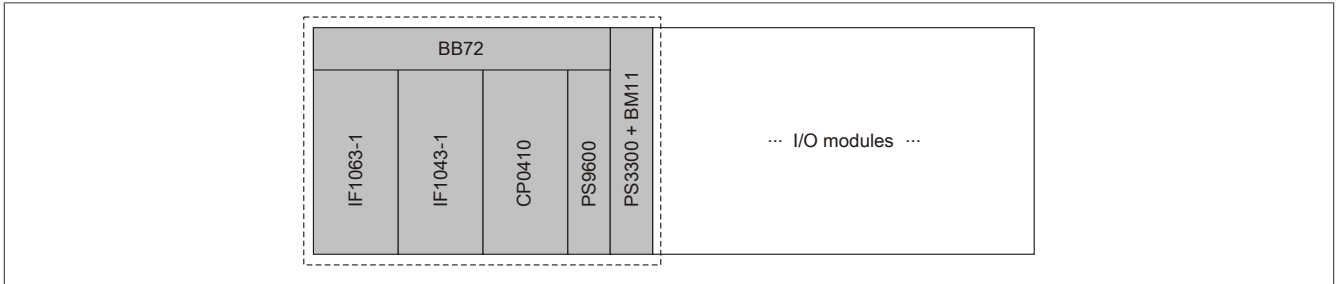
The external 24 VDC power supply must provide 206.47 W.

Hardware configuration

To provide sufficient power for the bus power supply, X20PS3300 power supply modules can be connected in parallel via bus module X20BM11. It is important to note that in order to determine the necessary bus power supply in parallel operation, 75% of the nominal power of the power supply modules must be calculated.

Example for calculating the bus power for 1 X20PS9600 and 1 X20PS3300:

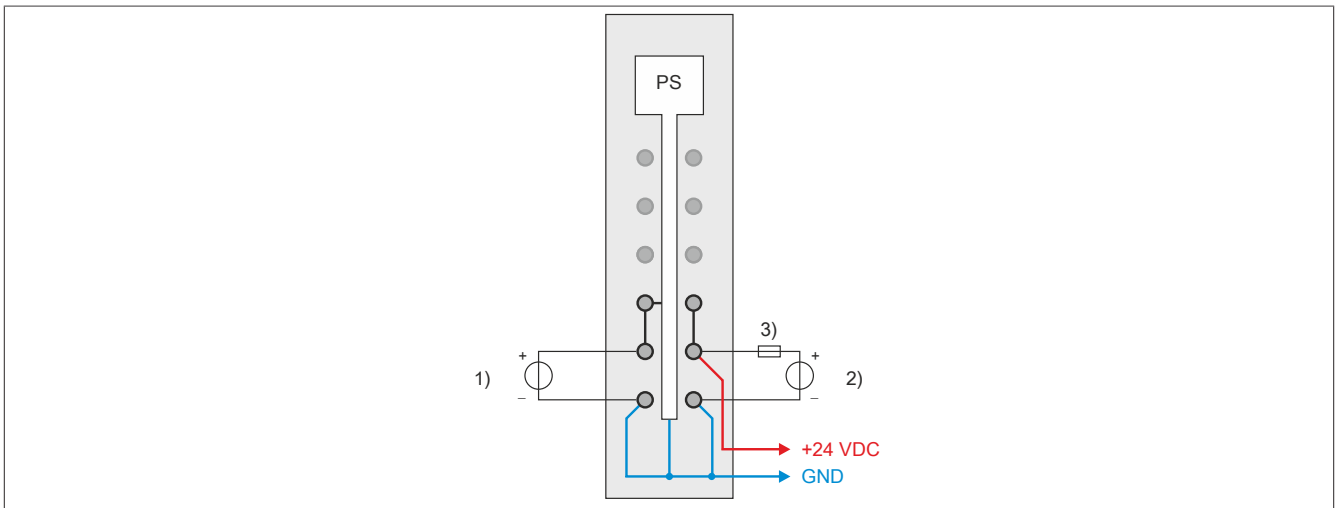
$$\text{Bus power} = 2 \times 7 \text{ W} \times 0.75 = 10.5 \text{ W}$$



Connection example for power supply modules

X20PS9600

The X20PS9600 is connected by default.

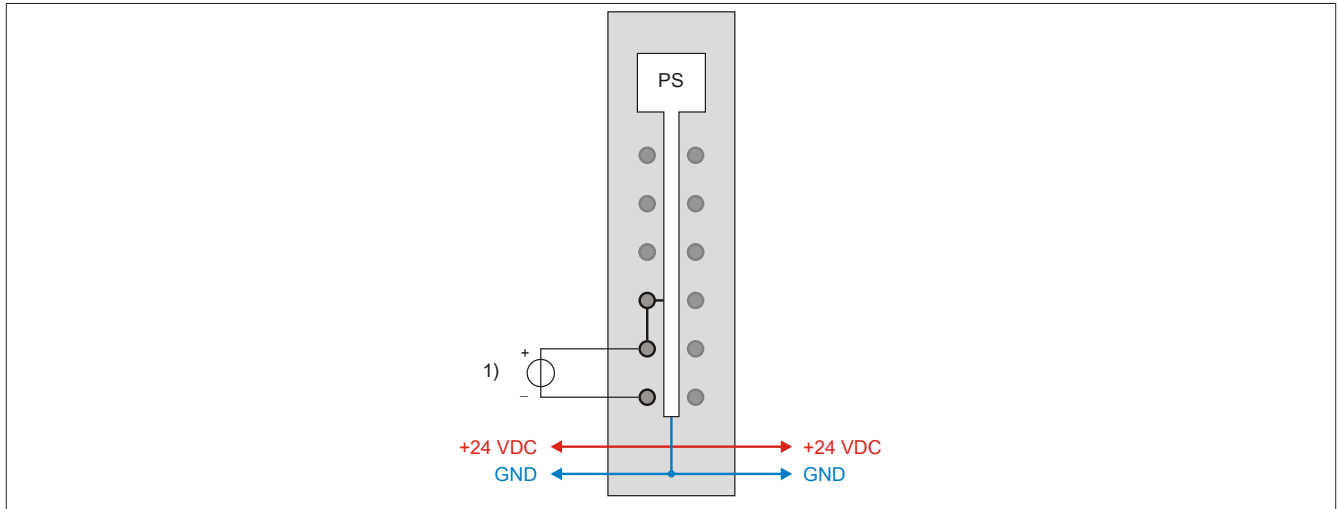


- 1) Supply for the PLC or X2X Link power supply
- 2) Supply for the I/O power supply
- 3) Fuse, 10 A slow-blow

Mechanical and electrical configuration

X20PS3300

Power supply module X20PS3300 is operated with bus module X20BM11. Only the controller / X2X Link power supply is connected. By using bus module X20BM11, the I/O power supply of power supply module X20PS9600 is connected through to the I/O modules.



1) Controller/X2X Link power supply

7.10.5 SafeLOGIC controller X20SL81xx

7.10.5.1 SafeLOGIC controller X20SL8100

For dimensioning the external 24 VDC power supply, only the power consumption of the SafeLOGIC controller must be taken into account.

Power	Description	Requirements
Power consumption of X20SL8100	For the value, see the technical data in the data sheet: General information - Power consumption	4.3 W

The external 24 VDC power supply must provide 4.3 W.

7.10.5.2 SafeLOGIC controller X20SL8101

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Bus power supply	I/O power supply
Power consumption of the bus and I/O modules	Example for calculating the power requirements: See "Example: Controllers and modules" on page 132	2.13 W	78.73 W
Power consumption of X20SL8101	For the value, see the technical data in the data sheet: General information - Power consumption	5.3 W	-
Power consumption for generating the X2X Link power supply	For the value, see the technical data in the data sheet: General information - Power consumption of the X2X Link power supply	1.42 W	-
Subtotal		8.85 W	78.73 W
Total power requirements		87.58 W	

The external 24 VDC power supply must provide 87.58 W.

7.10.5.3 SafeLOGIC controller X20SL8110

Calculation example with interface module X20IF10E3-1

For dimensioning the external 24 VDC power supply, the following power values are included in the calculation:

Power	Description	Requirements
Power consumption of X20SL8110	For the value, see the technical data in the data sheet: General information - Power consumption	3.9 W
Power consumption of the X20IF10E3-1	For the value, see the technical data in the data sheet: General information - Power consumption	2 W
Power consumption of the X20SL8110 for the interface module	The controller consumes 0.6 W for the operation of the interface module.	0.6 W
Total power requirements		6.5 W

The external 24 VDC power supply must provide 6.5 W.

8 Mechanical handling

8.1 Solid mechanics

With all the advantages that the three-part modularity of the X20 system offers, one emphasis has always been solid mechanical design.

Its robust design, long guides and strengthened housing guarantee the stability it needs in industrial environments. These features allow the X20 system to be mounted on a top-hat rail with the same ease as a rack system. They also make it just as simple to remove it from the rail.

The following sections describe the mechanical handling of the X20 system step-by-step with the aid of pictures.

8.2 Number of mating cycles

The modules of the X20 system are divided into three parts. A module is made up of 3 basic elements:

- Bus module
- Electronic module
- Terminal block

The number of mating cycles between the respective basic elements is specified at 50.

Basic element	Number of mating cycles
Bus module ↔ Bus module	50
Bus module ↔ Electronic module	
Electronic module ↔ Terminal block	

Table 5: Number of mating cycles between the respective basic elements

8.3 Assembling an X20 system

There are several ways to assemble an X20 system. Two methods are described below:

Assembling an X20 system	Description
Variant 1	The X20 system is completely assembled and then installed on the top-hat rail.
Variant 2	The X20 system is installed and assembled directly on the top-hat rail.

Table 6: Two of the several methods for assembling an X20 system



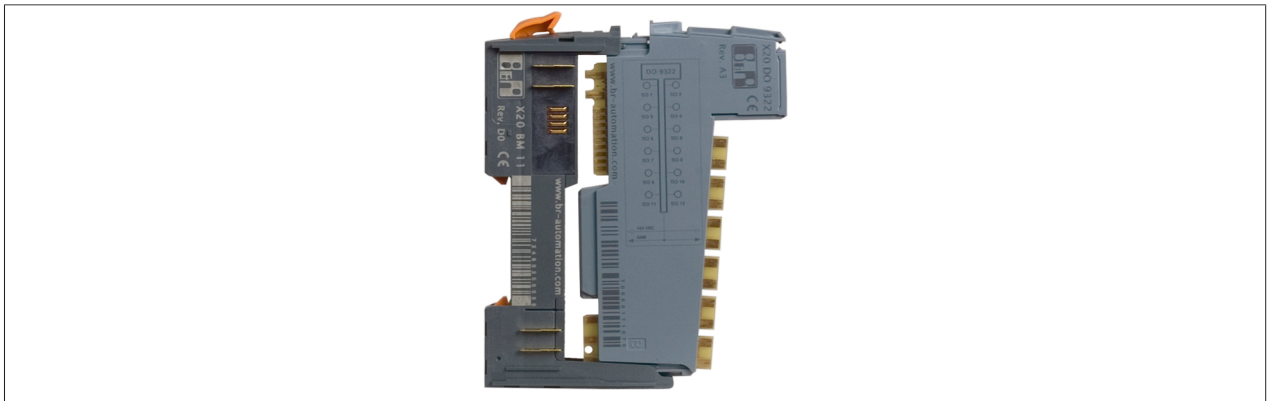
Information:

- Store X20 modules in the protective packaging until immediately before assembly.
- Only touch X20 modules on the housing.
- Take necessary protective measures against electrostatic discharge (see also "[Protection against electrostatic discharge](#)" on page 12).

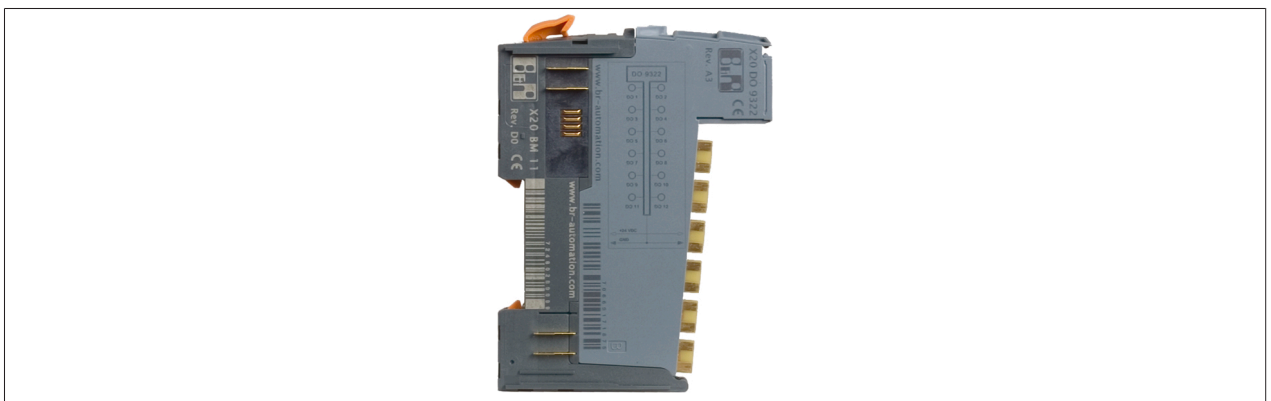
8.3.1 Variant 1

The X20 system is completely assembled and then installed on the top-hat rail.

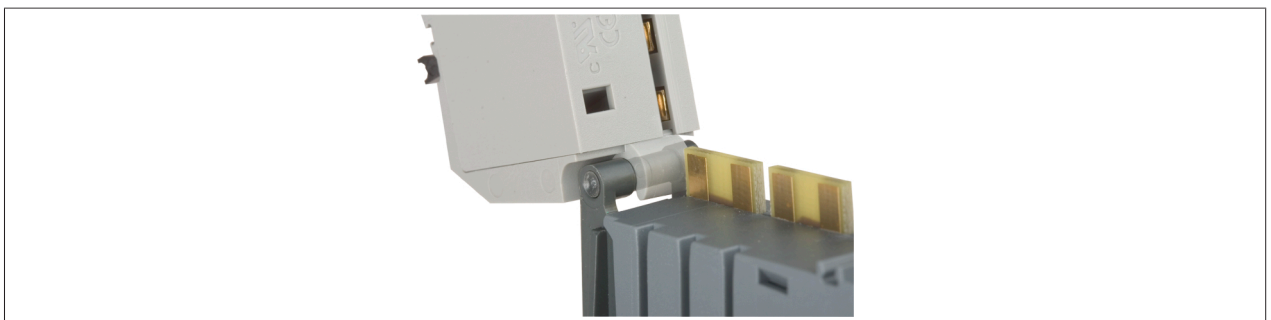
1. Remove X20 modules from protective packaging. Check modules for obvious mechanical damages.
2. Insert electronic module in the guides on the bus module.



3. Push the electronic module and the bus module flush together.

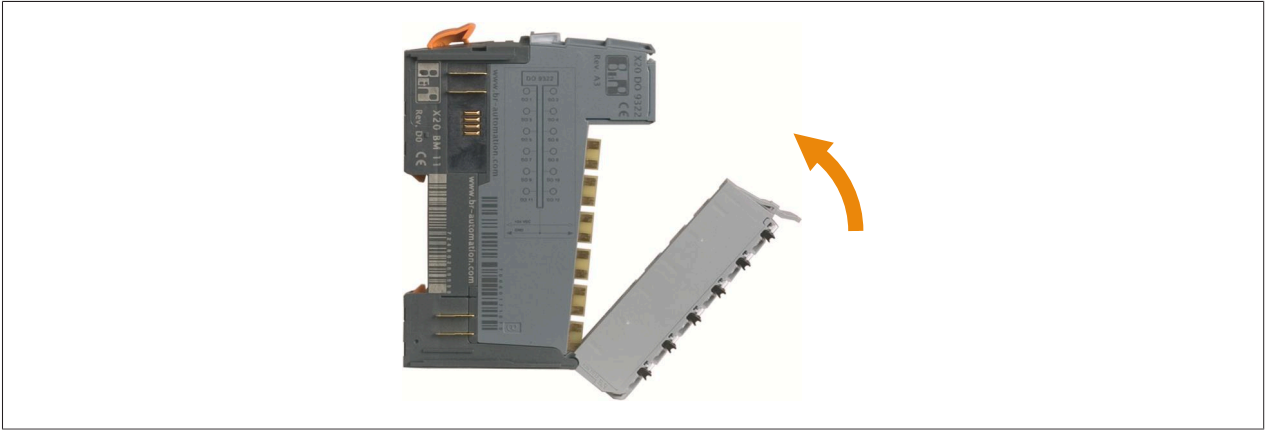


4. Hang the bottom edge of the terminal block in its place on the bus module.

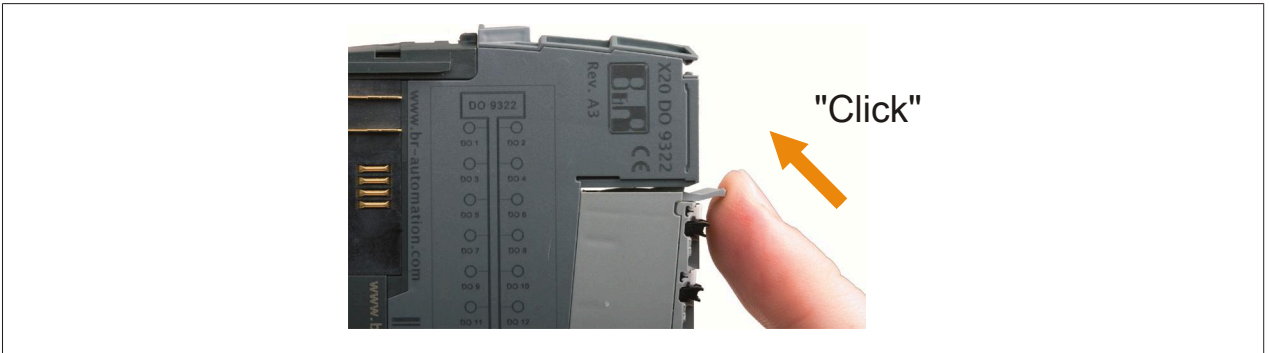


Mechanical handling

5. Rotate the terminal block up into place.



6. The terminal block latch must close with an audible click. If the latch does not catch, the lever must be pushed up.

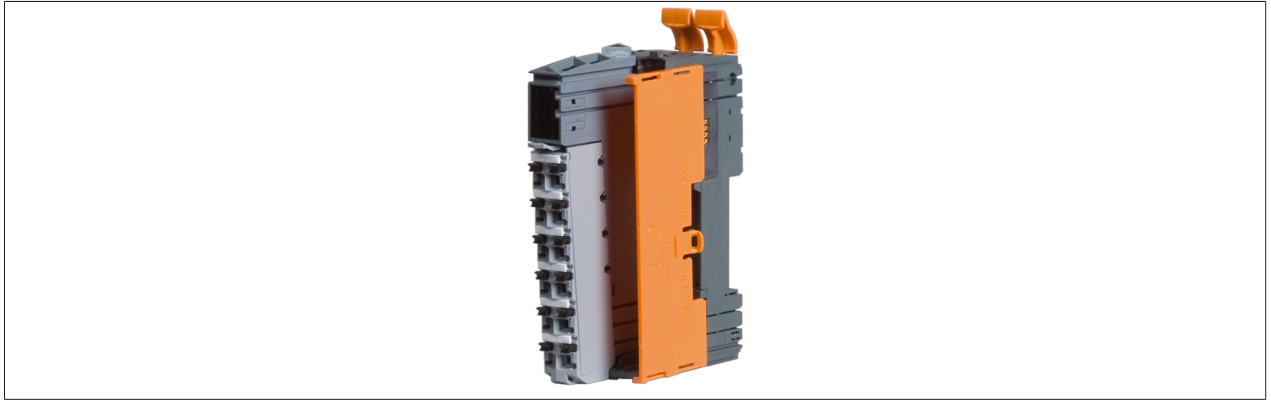


7. Individual X20 modules should be assembled from left to right (viewed from front) to form the complete X20 system. To do this, connect the right module from behind to the guides for the left bus module.



8. Slide the right module forward until the two modules fit flush together.
9. Proceed like this until the second to last module.
10. For the last module, only insert the bus module in the guides of the left bus module.
11. Slide the right bus module forward until the two bus modules fit flush together.

12. Insert the right locking plate into the guides on the bus module from the front and push it all the way in.



13. Insert the electronic module into the bus module and push firmly so that the two modules fit flush together.
14. Hang the bottom of the terminal block in its place on the bus module and push it up into place. The terminal block latch must close with an audible click.
15. Lay the left locking plate on the left module and insert it in the guides. Finally, slide the locking plate forward.

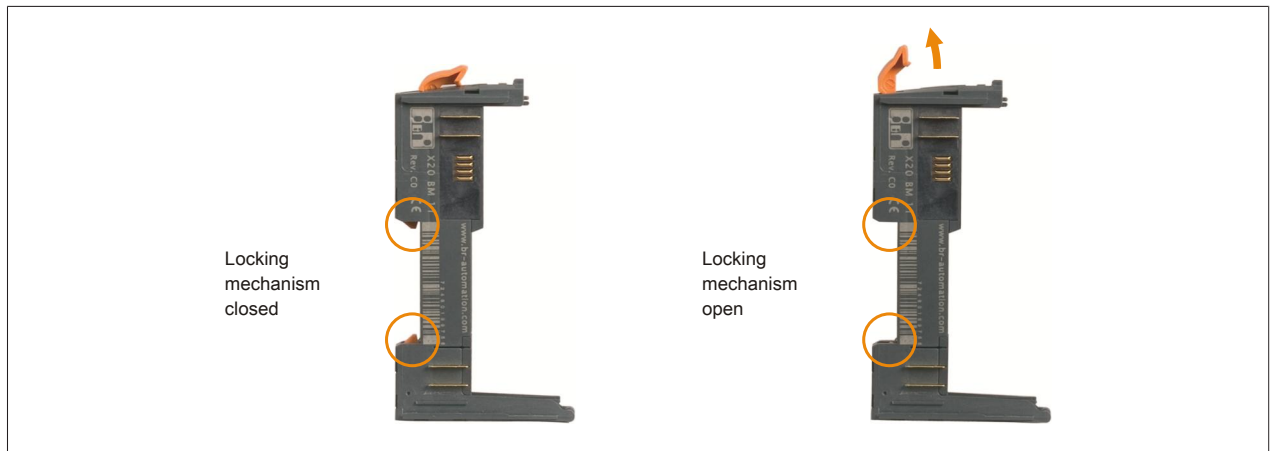


16. The procedure for hanging the X20 system on the top-hat rail is described in section ["Installing the X20 system on the top-hat rail"](#) on page 161.

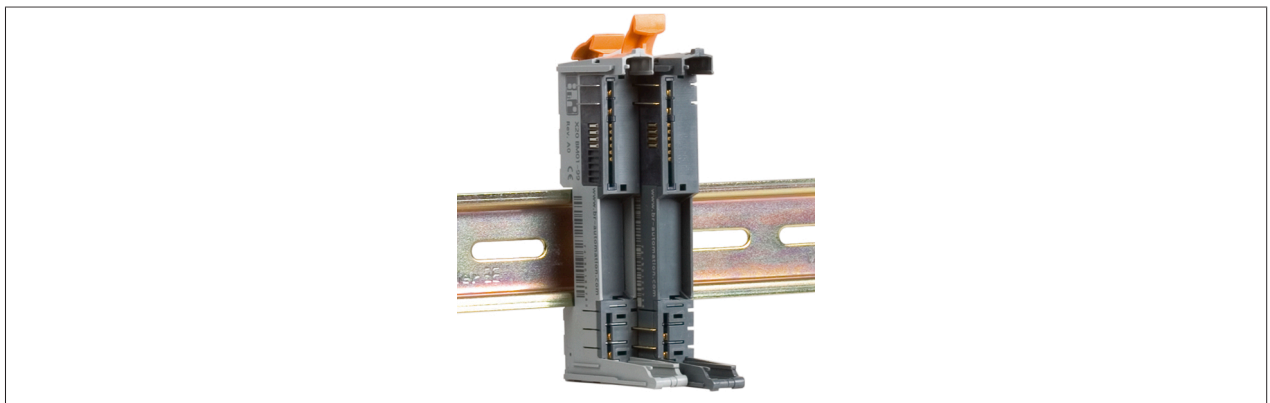
8.3.2 Variant 2

The X20 system is installed and assembled directly on the top-hat rail.

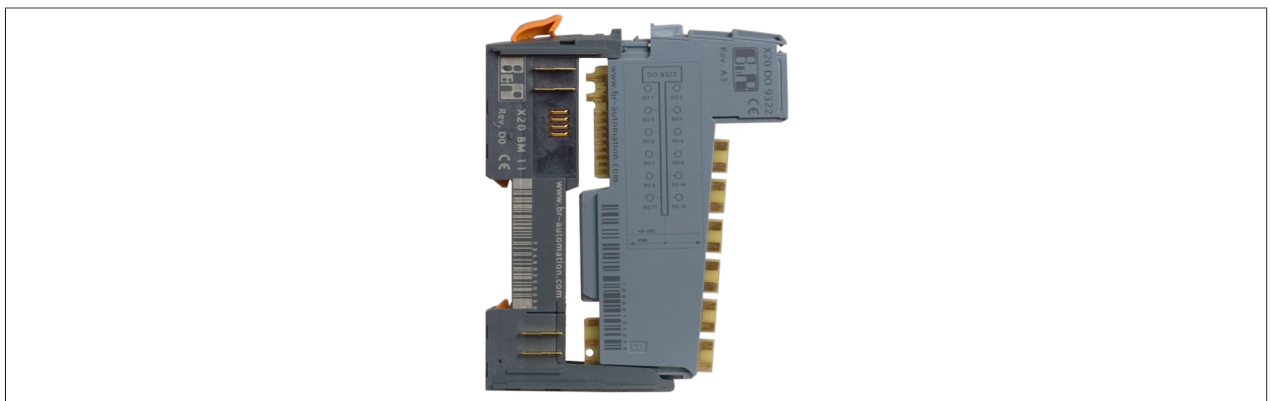
1. Remove X20 modules from protective packaging. Check modules for obvious mechanical damages.
2. Push the locking lever all the way up on all of the bus modules. This opens the locking mechanism for top-hat rail installation.



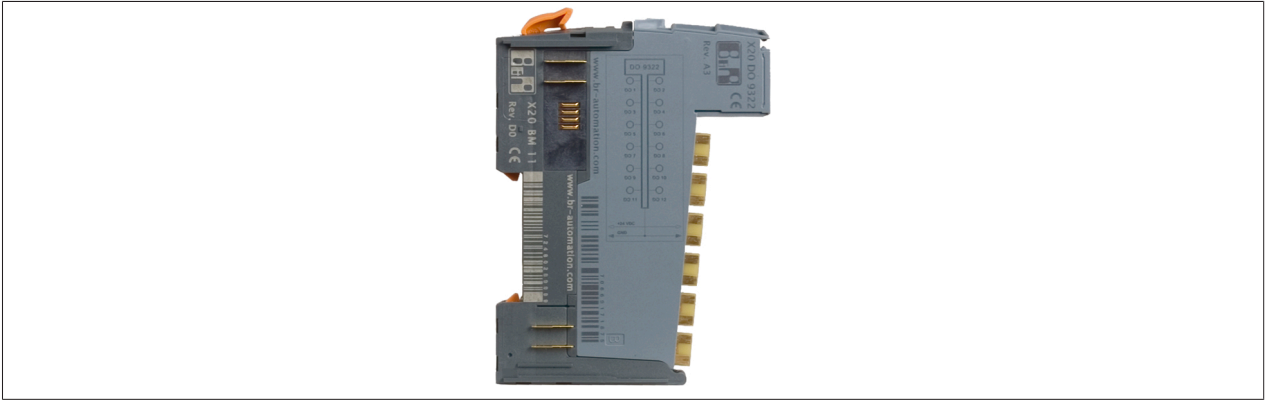
3. Hang the first bus module in the desired position on the top-hat rail and close the locking mechanism by pushing the lever down.
4. Insert the next bus module in the guides of the previously mounted bus module.



5. Slide the bus module in against the top-hat rail and secure it by pushing down the locking lever.
6. Proceed like this with the rest of the bus modules.
7. Insert the corresponding electronic module in the guides on the leftmost bus module.



8. Push the electronic module and the bus module flush together.



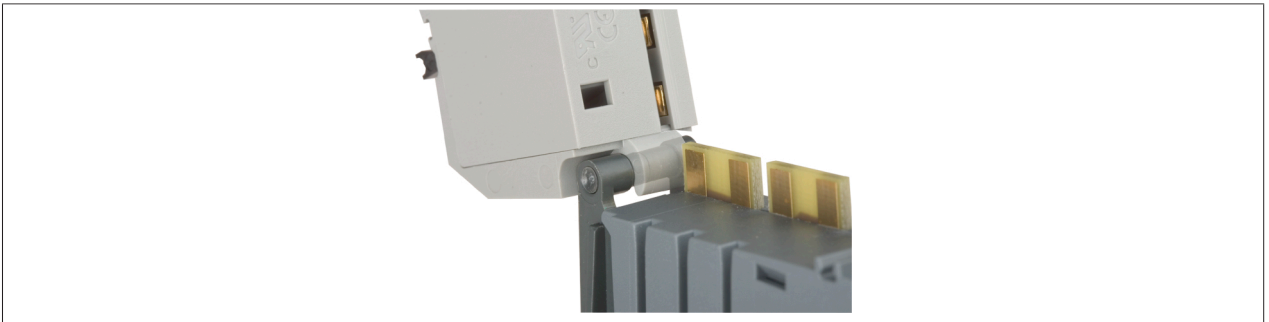
9. Proceed like this until the second to last electronic module.

10. Insert the right locking plate into the guides from the front and push it in all the way.

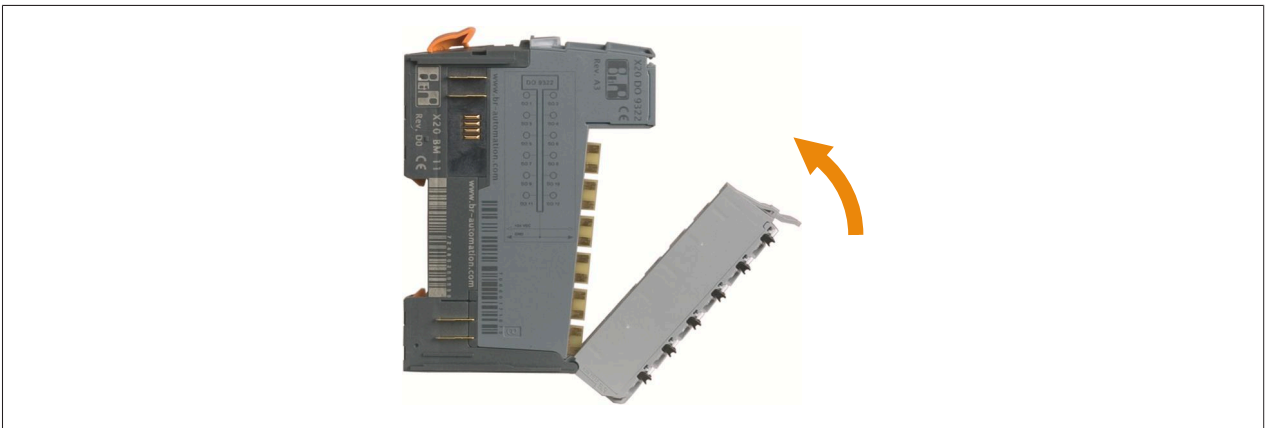


11. Insert the electronic module into the bus module and push firmly so that the two modules fit flush together.

12. Hang the terminal block in its place on the leftmost bus module.

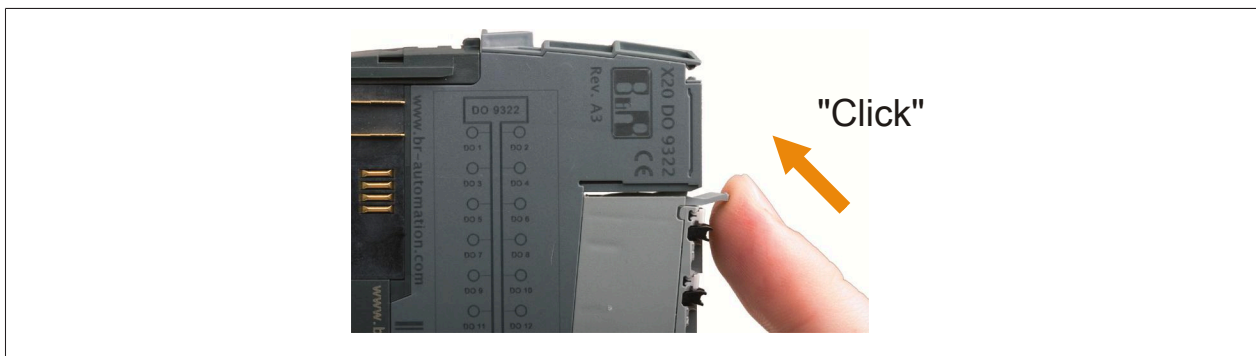


13. Rotate the terminal block up into place.



Mechanical handling

14. The terminal block latch must close with an audible click. If the latch does not catch, the lever must be pushed up.



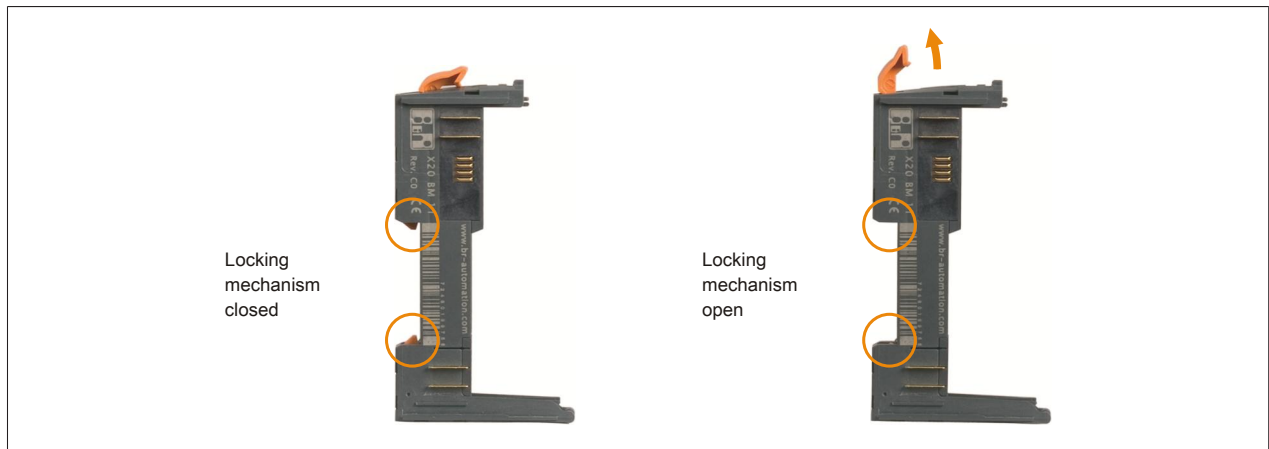
15. Proceed like this with the rest of the terminal blocks.
16. Lay the left locking plate on the left module and insert it in the guides. Finally, slide the locking plate forward.



8.4 Installing the X20 system on the top-hat rail

Complete the following steps to install an assembled X20 system on the top-hat rail.

1. Push the locking lever all the way up on all of the bus modules. This opens the locking mechanism for top-hat rail installation.

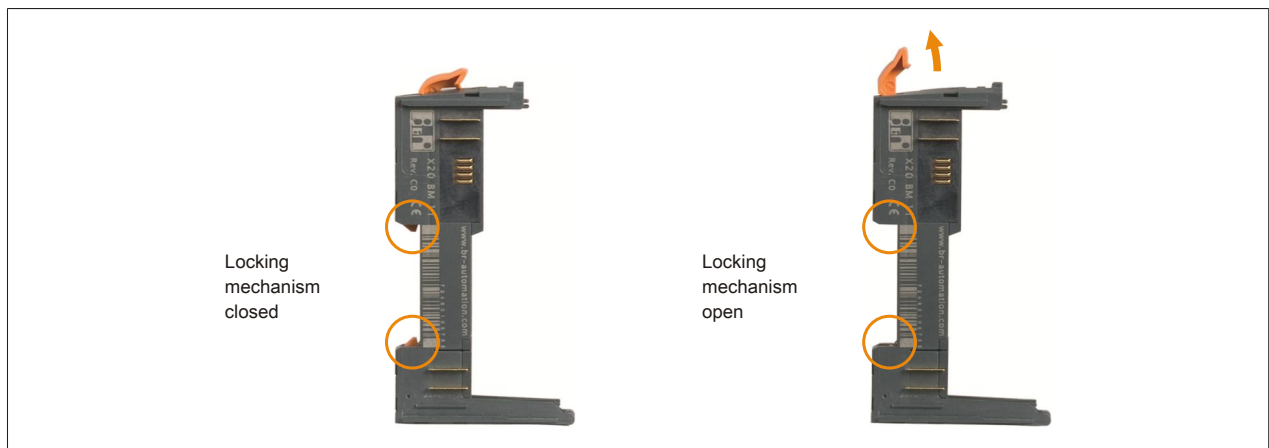


2. Hang the X20 system in the desired position on the top-hat rail and close the locking mechanism by pushing the lever down.

8.5 Removing the X20 system from the top-hat rail

8.5.1 Remove the entire system from the top-hat rail

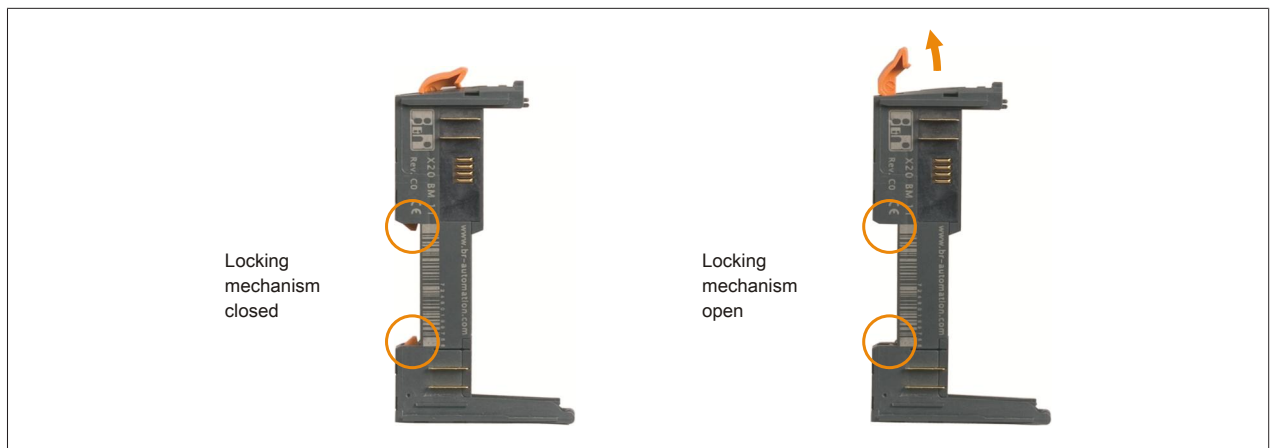
1. Push the locking lever all the way up on all of the bus modules. This opens the locking mechanism for top-hat rail installation.



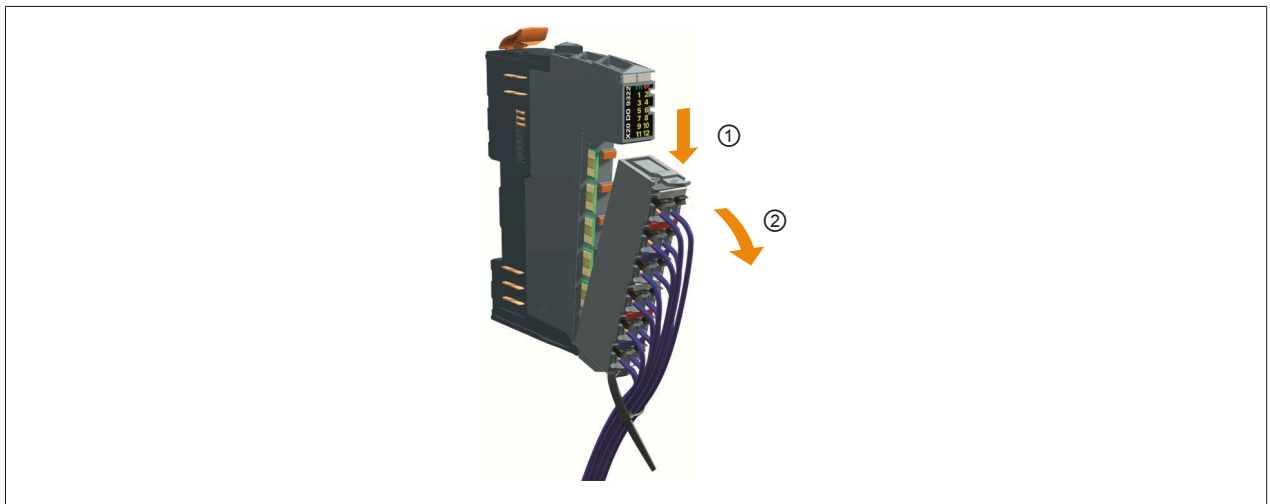
2. Remove the X20 system from the top-hat rail.

8.5.2 Removing a block of modules from the top-hat rail

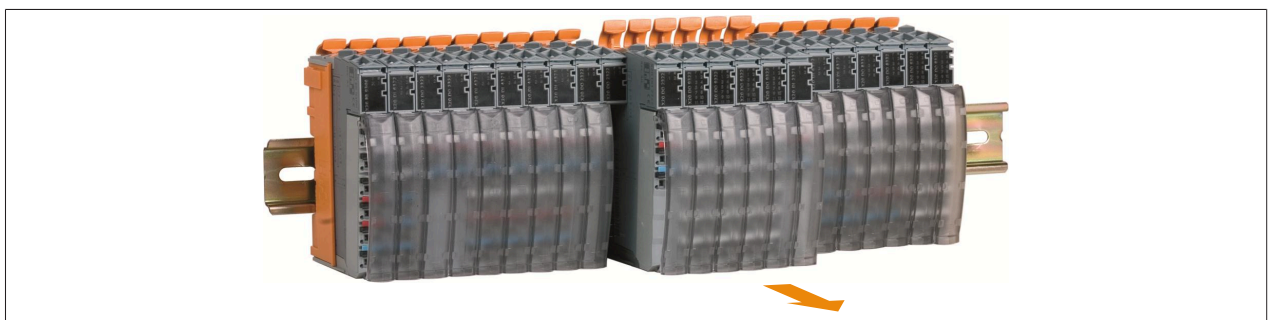
1. Push the locking lever all the way up on all of the modules that you wish to remove from the top-hat rail. This opens the locking mechanism for top-hat rail installation.



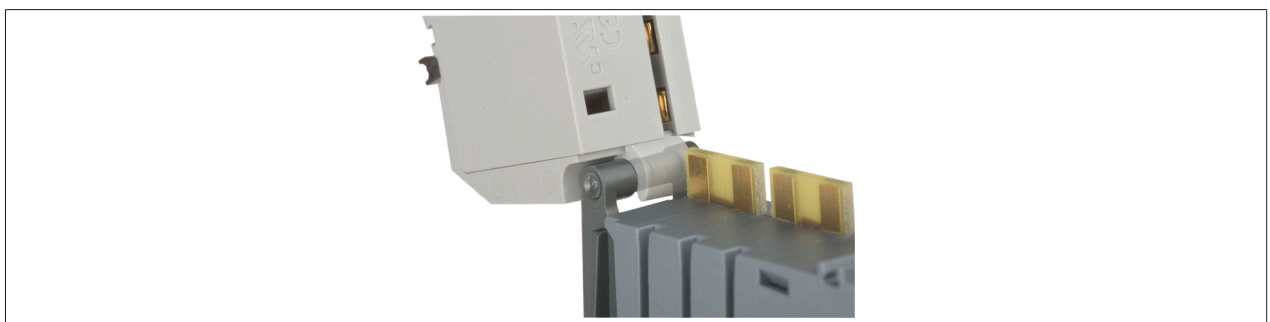
2. The terminal block must be removed from the module to the left of the module block that is to be removed. To do this, push down on the locking lever on the terminal block ① and rotate the terminal block out and down ②.



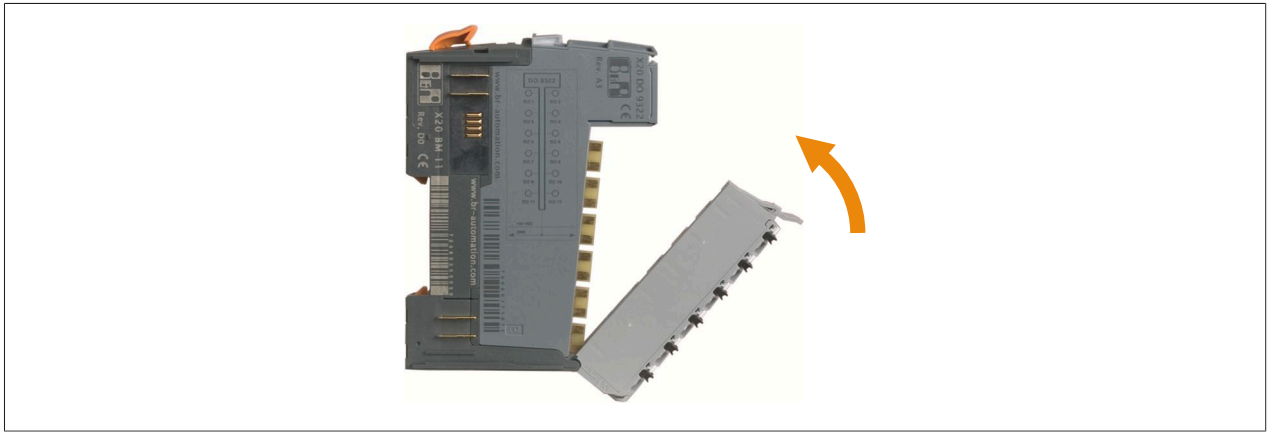
3. Remove the module block from the top-hat rail.



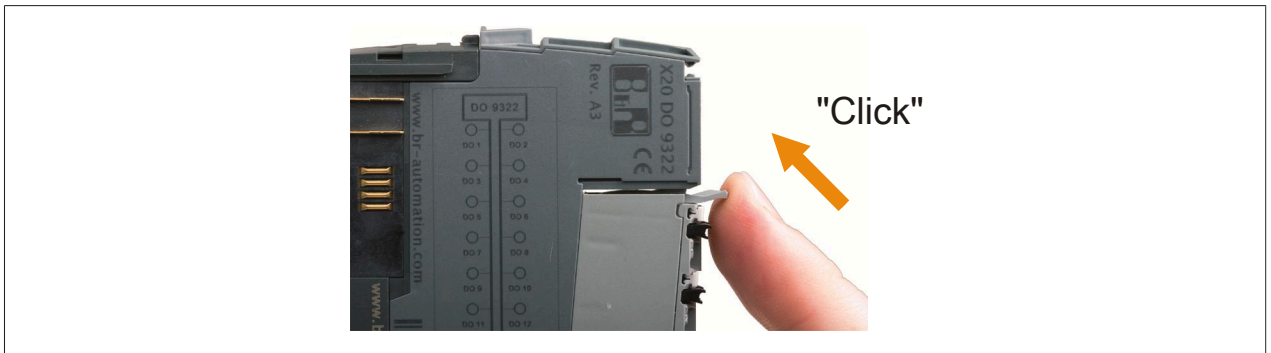
4. Put the removed terminal block back on the module. To do this, hang the bottom in place in the bus module.



5. Rotate the terminal block up into place.



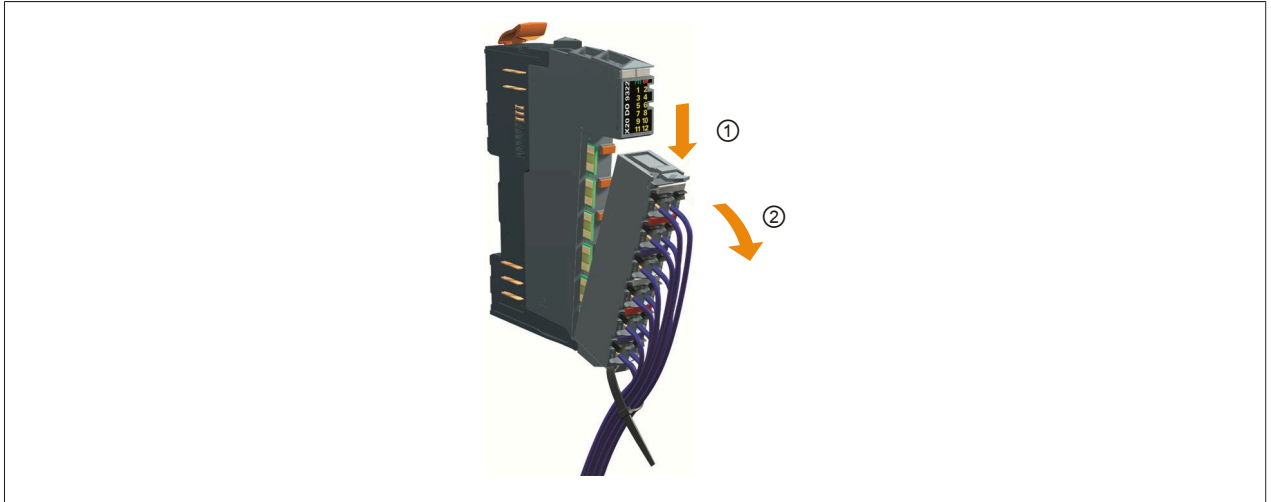
6. The terminal block latch must close with an audible click. If the latch does not catch, the lever must be pushed up.



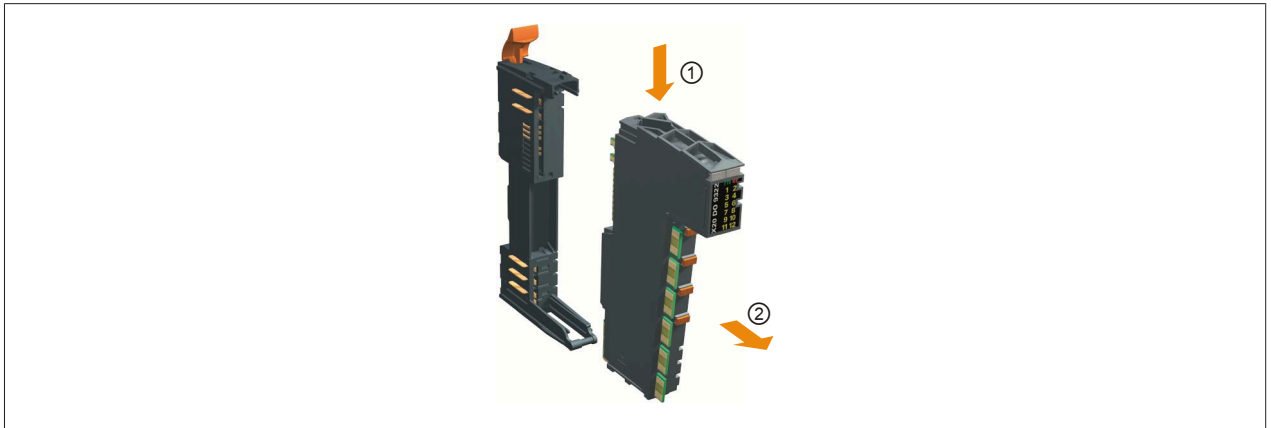
8.6 Expanding an X20 system

If you want to expand an existing X20 system to the right, the right locking plate must be removed.

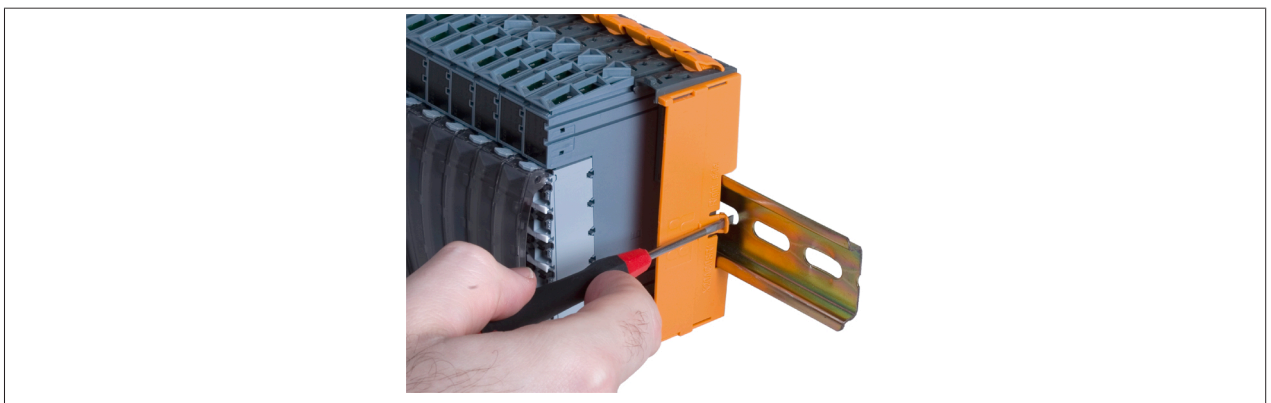
1. Remove the terminal block from the rightmost module. To do this, push down on the locking lever on the terminal block ① and rotate the terminal block out and down ②.



2. Push down on the electronic module's locking lever ① and remove the electronic module ②.



3. Use a screwdriver to lift the locking lever of the right locking plate and pull the locking plate off of the bus module.



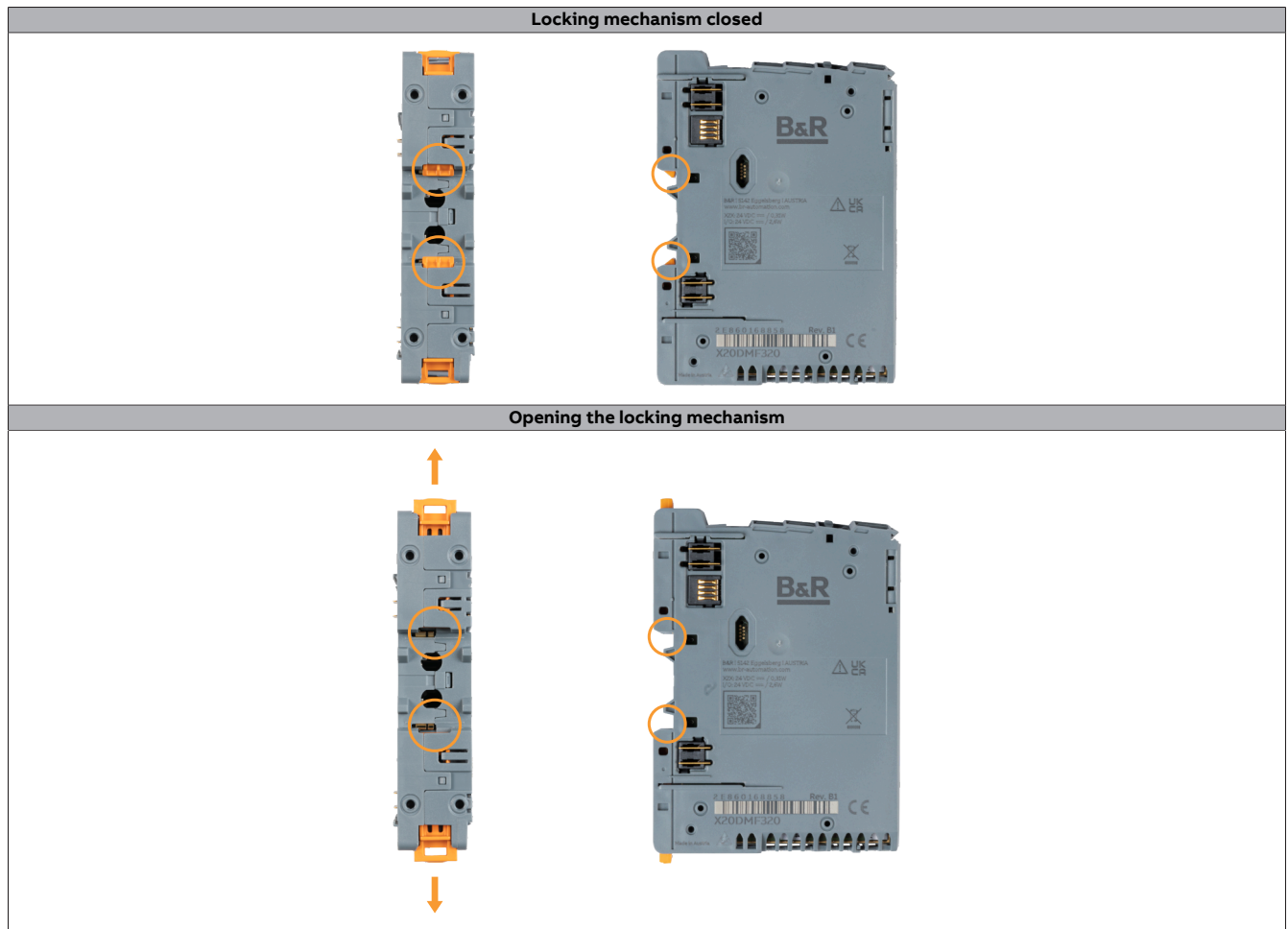
4. Additional modules can now also be installed as described in assembly method 2 (see ["Variant 2" on page 158](#)).

8.7 Modules with 2 locking levers

For modules with 2 locking levers, these must be operated separately.

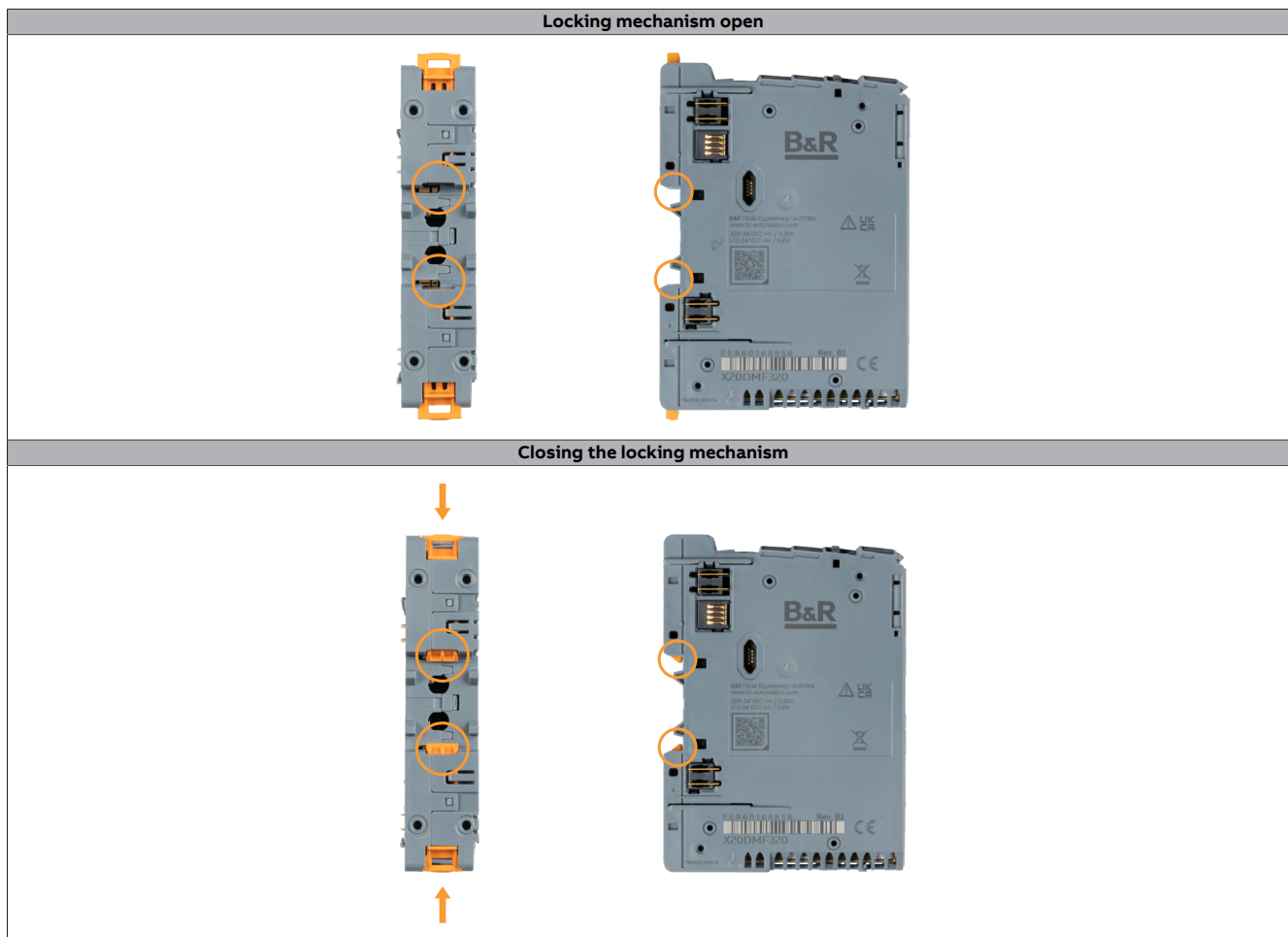
8.7.1 Opening the locking levers

To open the locking mechanism, press the respective lever upwards or downwards.



8.7.2 Closing the locking levers

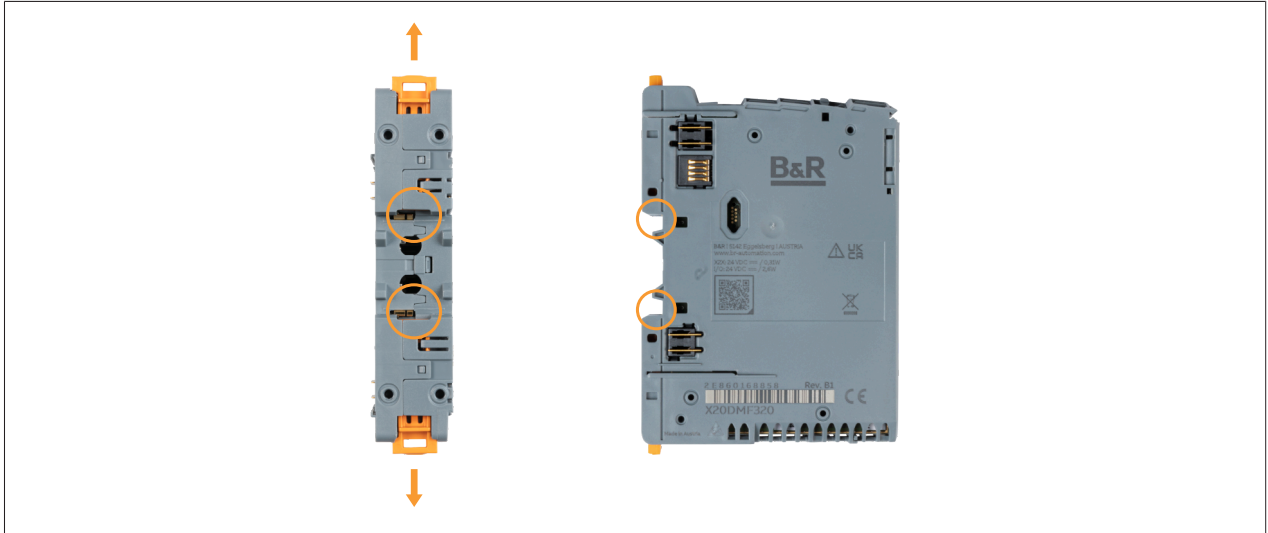
To close the locking mechanism, press the respective lever downwards or upwards.



8.7.3 Installing the module on a top-hat rail

The following steps must be carried out to install the module on the top-hat rail:

1. Remove the protective packaging from the X20 modules. Check the modules for obvious mechanical damage.
2. For all modules, press the locking lever all the way up or all the way down. This opens the locking mechanism for top-hat rail installation.



3. Hook the first module into the top-hat rail at the desired position and close the locking mechanism by pressing the respective locking lever downwards or upwards.
4. Connect the next module into the guides of the already installed module.



5. Slide the module up to the top-hat rail and close the locking mechanism by pressing the respective locking lever downwards or upwards.
6. Continue with the remaining modules as described above.

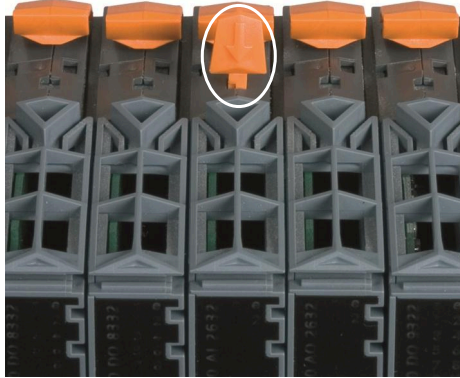
8.8 Installing accessories

8.8.1 Additional locking mechanisms

Some specific areas require additional locking mechanisms to prevent accidental release of the mechanical components.

8.8.1.1 Accessory locking clips

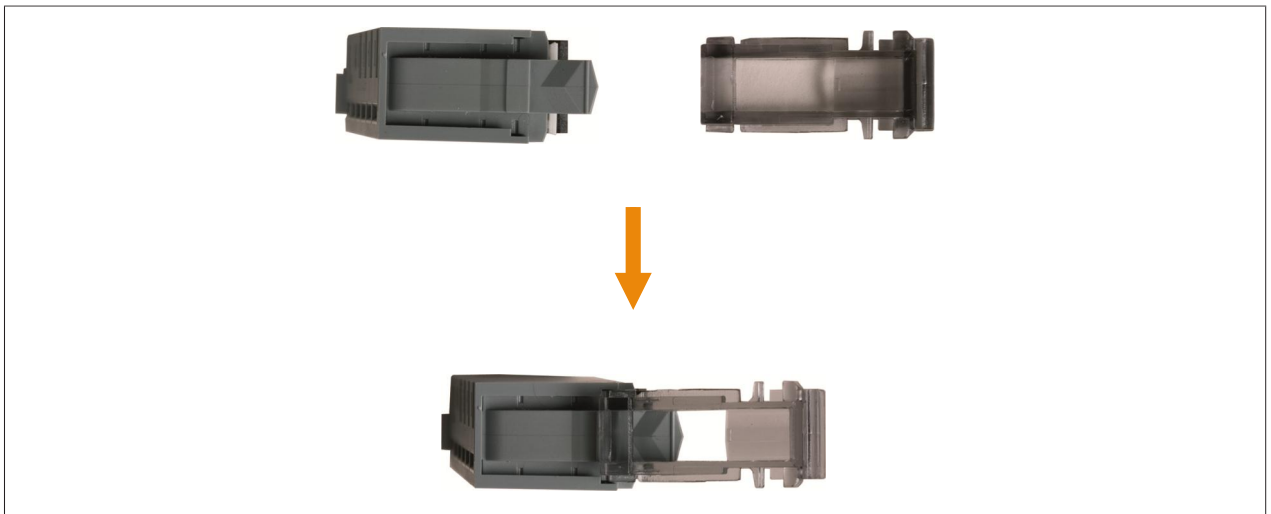
The accessory locking clip attaches the electronic module to the bus module. The locking clip is inserted in the appropriate opening on the module and pushed down.



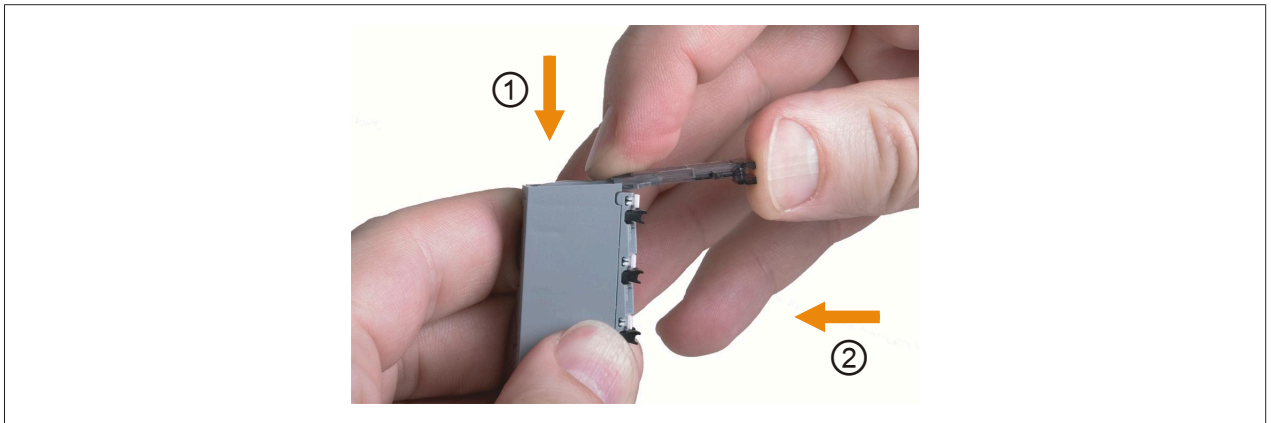
8.8.1.2 Terminal locking clip

The terminal locking clip attaches the terminal block securely to the electronic module.

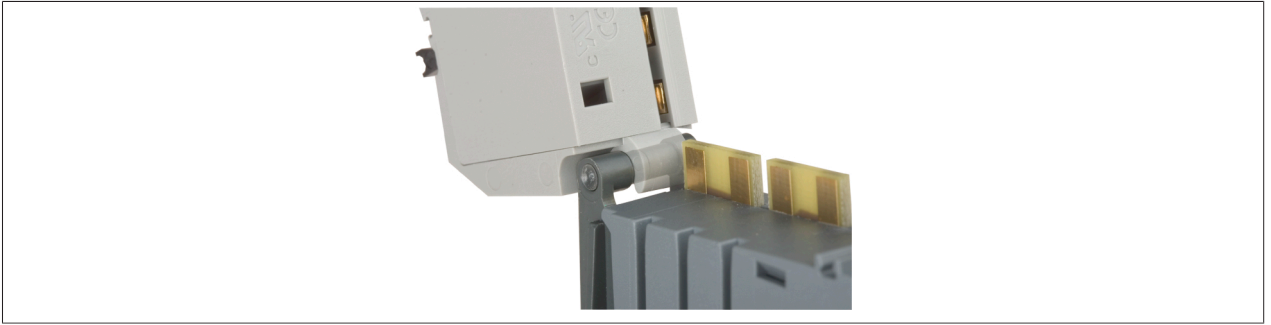
1. Set the terminal locking clip on the terminal block locking lever as shown.



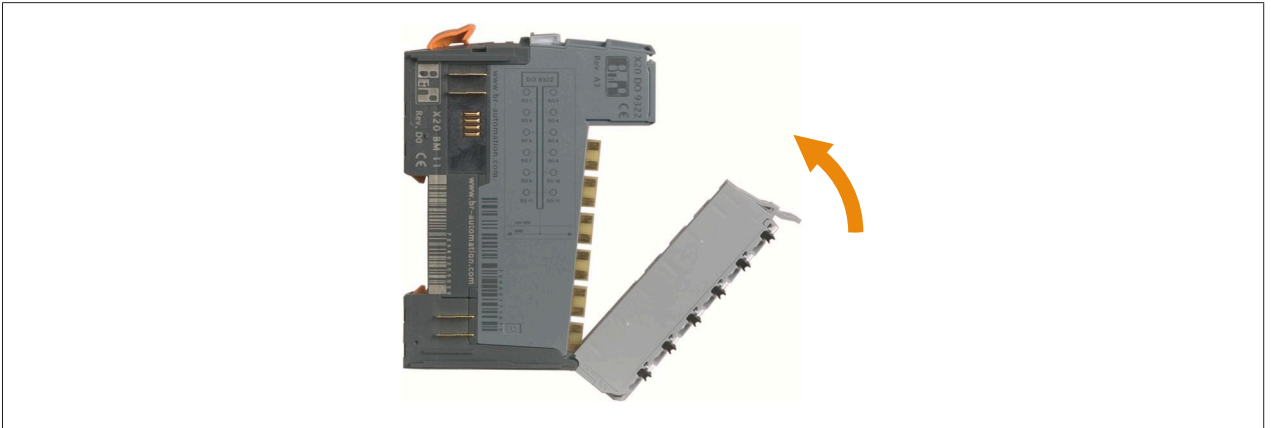
2. Push down and hold the terminal locking clip and the locking lever with your index finger ①. Finally, slide the terminal locking clip forward with your thumb ②.



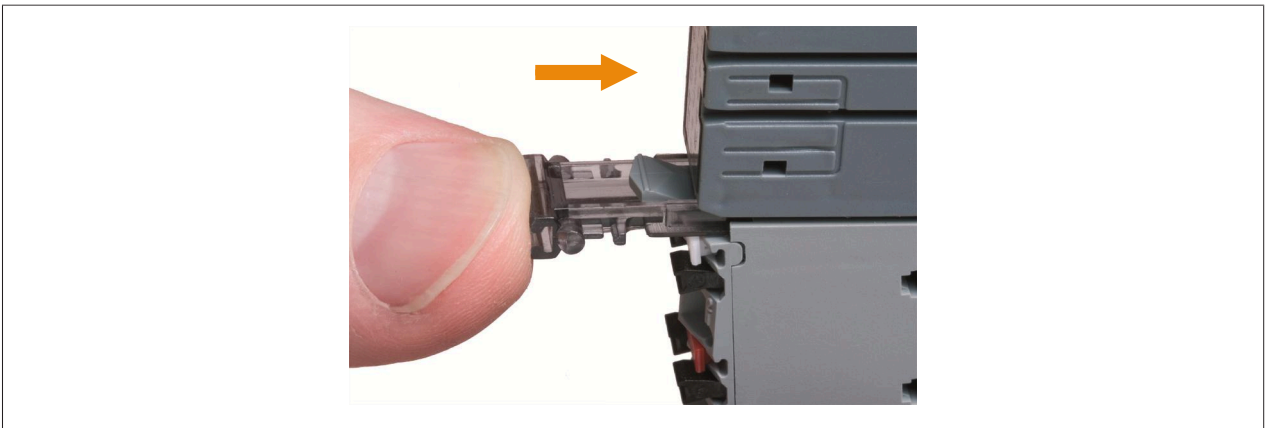
3. Hang the bottom edge of the terminal block in its place on the bus module.



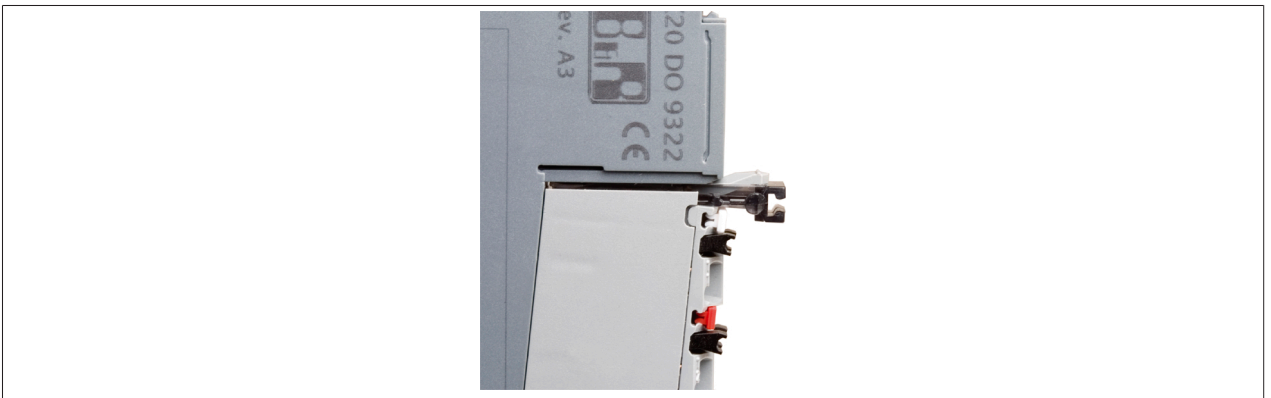
4. Rotate the terminal block up into place.



5. Secure the terminal block in the electronic module by pushing in the terminal locking clip.



6. Installed terminal locking clip.

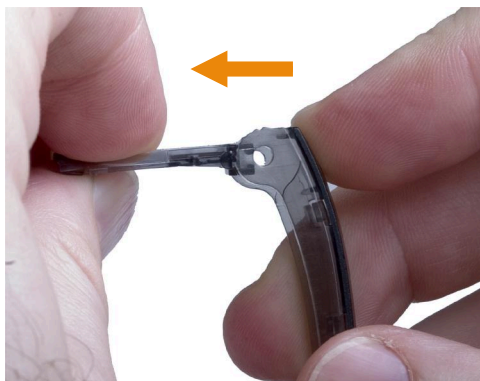


7. To remove the terminal block, pull the terminal locking clip out again.

8.8.2 Plain text tag for X20 modules

Tags are available for X20 modules into which plain text slide-in labels can be inserted. The tags are attached to the terminal locking clips.

1. Hold the plain text tag at a 90° angle to the terminal locking clip.
2. Push the plain text tag into the terminal locking clip's slot until it clicks into place.

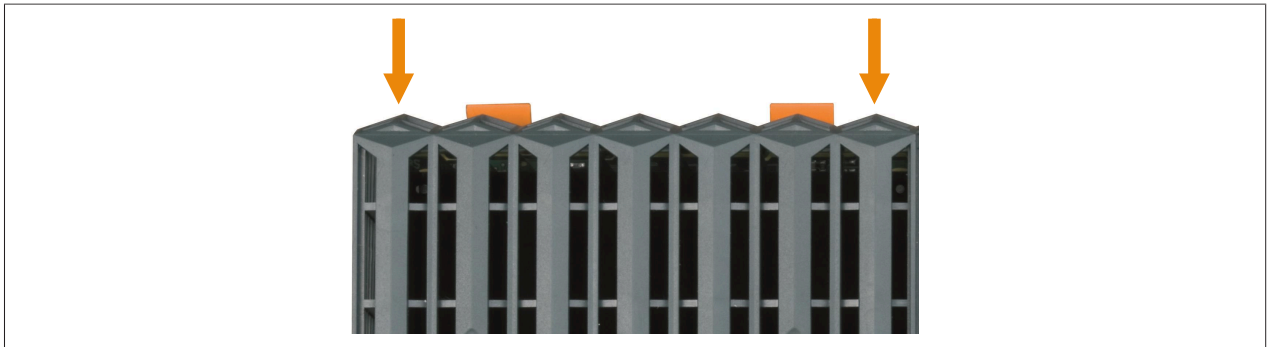


8.8.3 Plain text tag for X20 controllers

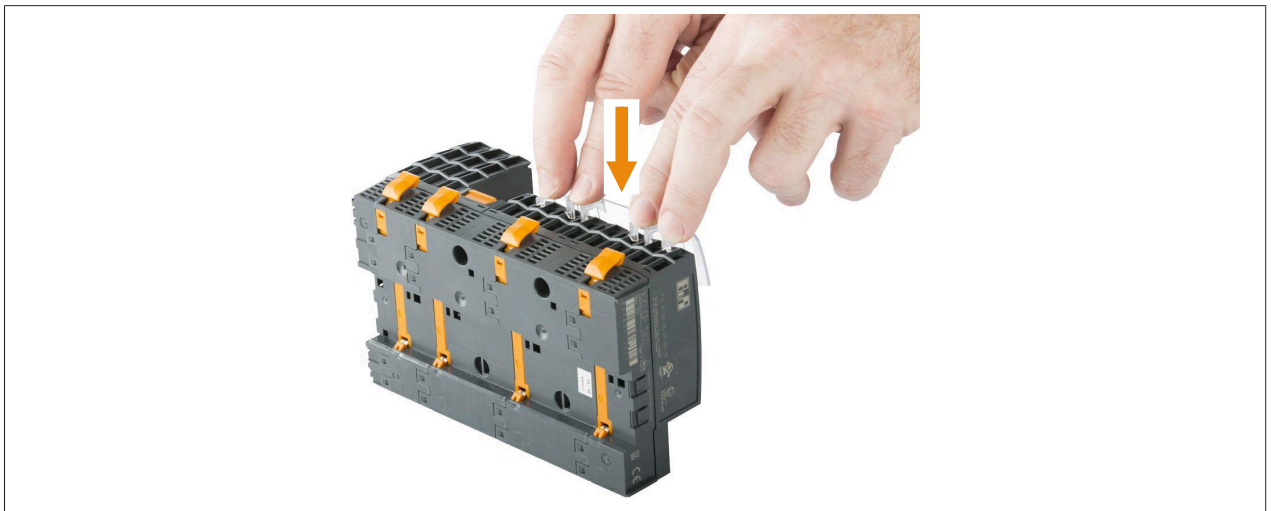
Plain text labels are available for the X20 controllers. The tags are placed on the housing of the controller.

Installation

1. Place the plain text tag on the housing so that the outer clips rest on raised edges.

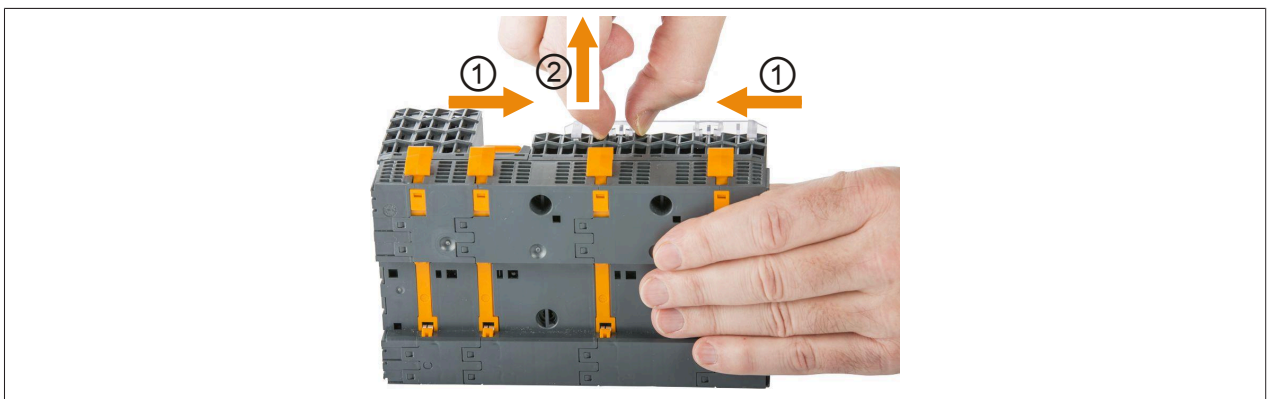


2. Press the plain text tag down until the clips latch into place.



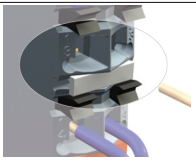
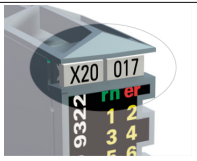
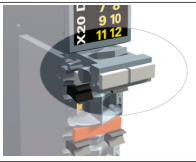
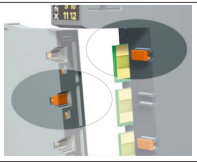
Removal

1. Pinch the clips together ① to release them while lifting the tag off of the housing ②.



8.9 Label tags

Label tags can serve the following purposes:

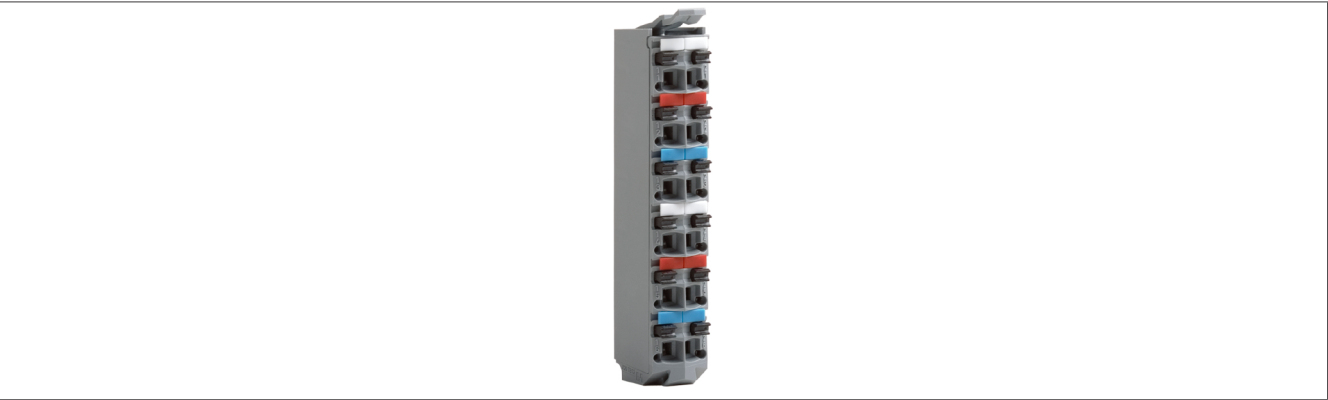
	Labeling the terminal connection		Labeling the module
	Labeling the terminal blocks		Labeling the terminals

The labeling tool is needed to attach the label tags.

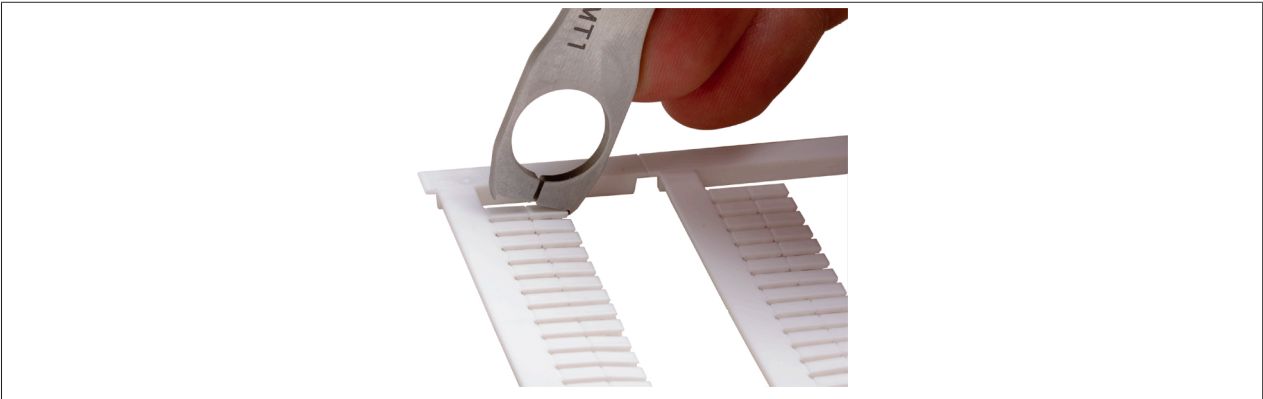


8.9.1 Labeling the terminal connection

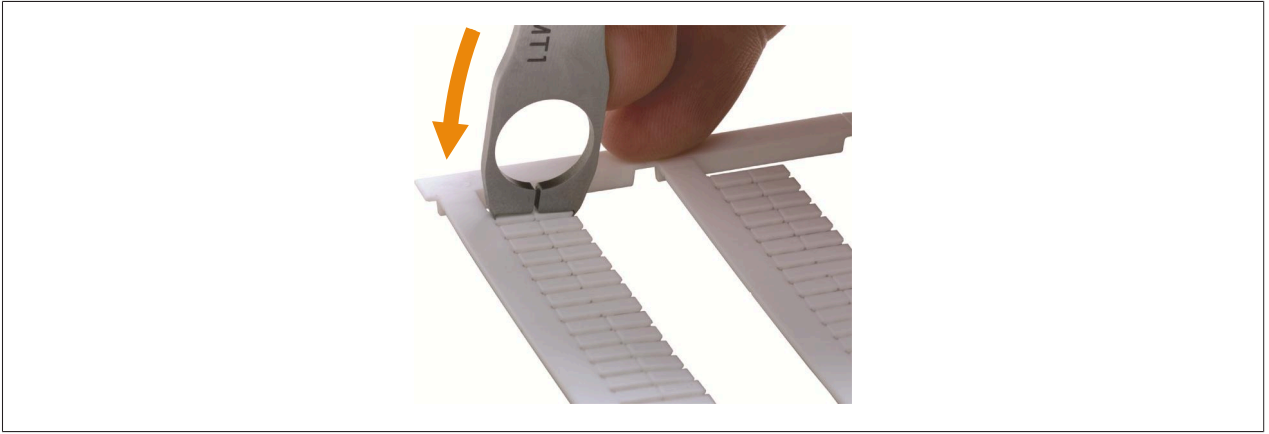
This section explains how to label the terminal connection. The terminal connection, terminal blocks and modules are labeled in a similar manner.



- 1. Grip the desired label tags with the double-width cutters of the labeling tool.



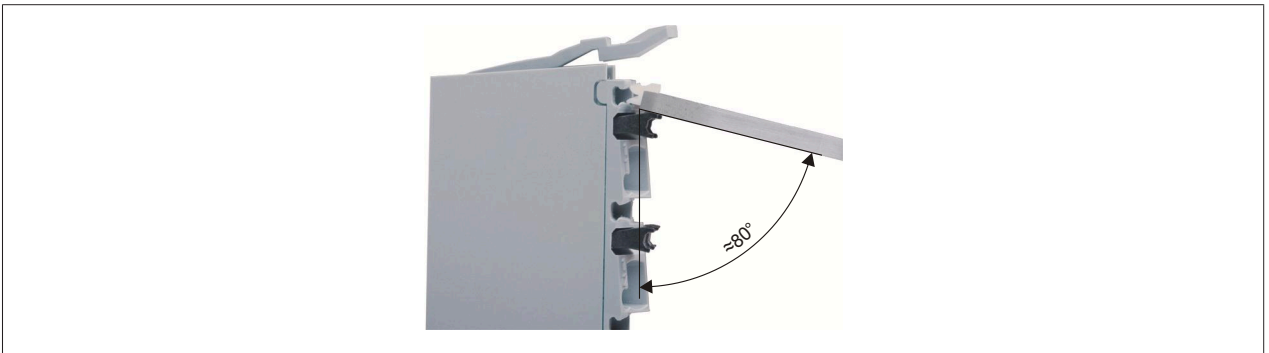
2. Press with the labeling tool to separate the label tags.



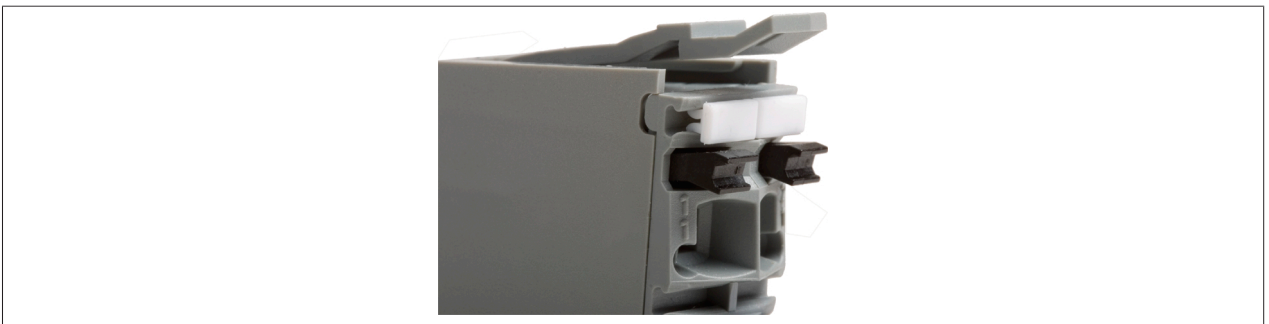
3. Center the label tags over the slot on the terminal block.



4. Hold the labeling tool at approximately an 80° angle to the terminal block.

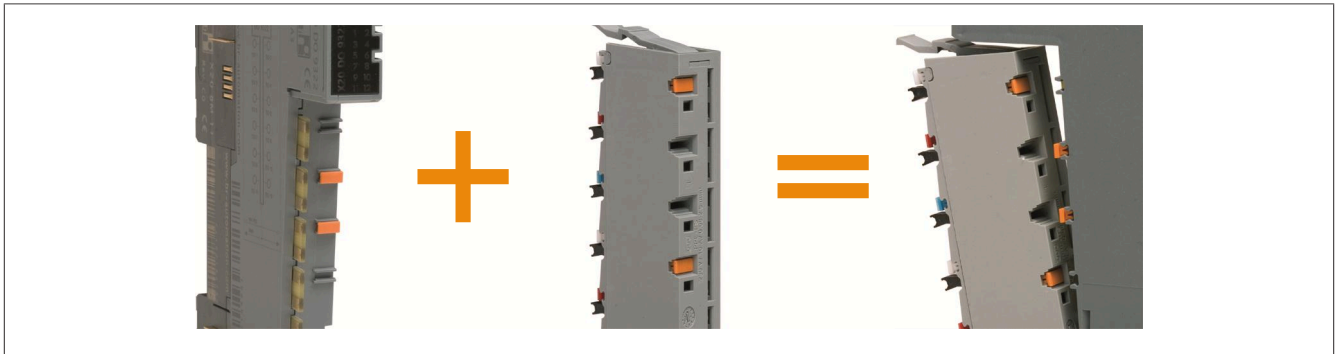


5. Press with the labeling tool to insert the feet of the label tags into the slot.
6. Inserted label tag.

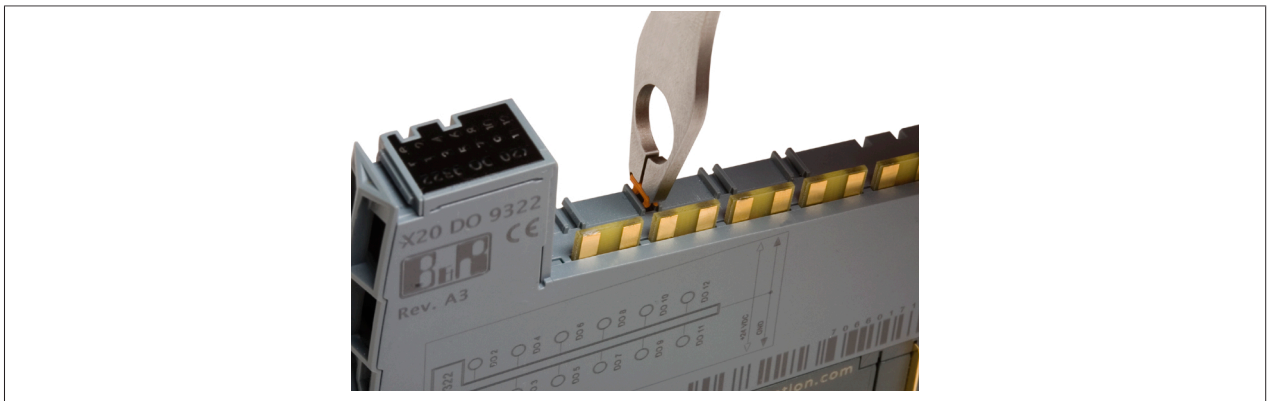


8.9.2 Labeling the terminals

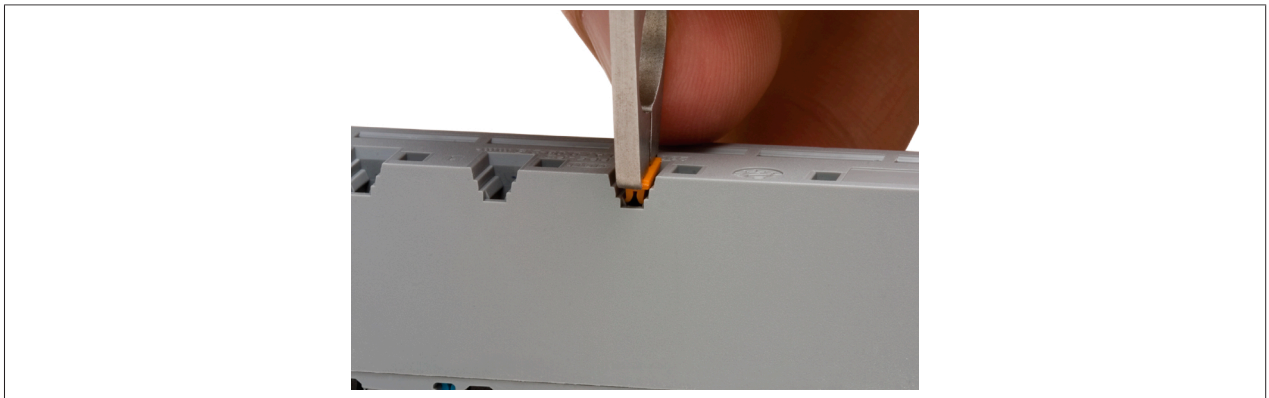
To prevent errors, the X20 terminal blocks can be coded. This helps prevent terminal blocks from being inserted in the wrong electronic module.



1. Remove a label tag with the single-width cutter of the labeling tool (compare with "[Labeling the terminal connection](#)" on page 172).
2. Center the label tag over the slot on the electronic module.



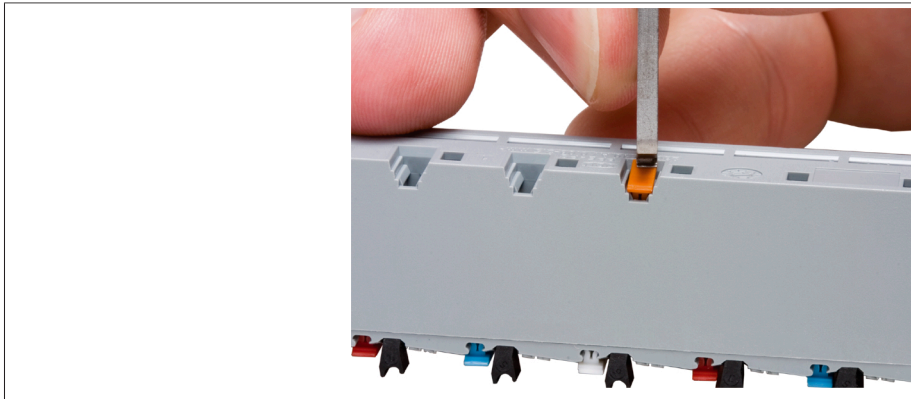
3. Hold the labeling tool at a 90° angle to the electronic module and press to insert the label's feet into the slot.
4. Remove a label tag with the single-width cutter of the labeling tool.
5. Set the label tag in the slot on the back of the terminal block as shown.



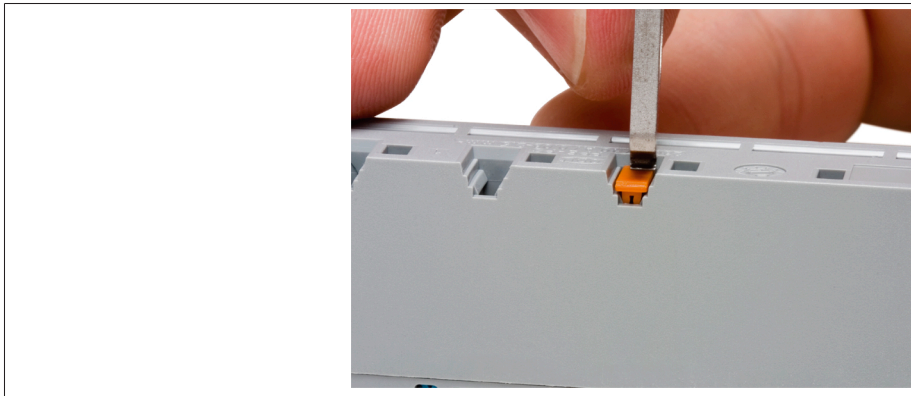
6. Use the labeling tool to push the left feet of the label into the slot.



7. With the labeling tool, press the right feet of the label into the slot.



8. Inserted label for terminal coding.



8.10 Labeling options for the X20 system

The following components can be individually labeled for the X20 system:

- X20 modules
- X20 controllers
- Terminal connections

8.10.1 Labeling X20 modules

The following components are required for labeling X20 modules:

- Tag holder
- Plain text tag for X20 modules
- Slide-in labels

Tag holder

The plain text tags are put on the tag holders. The tag holders are also used for terminal locking.

Order number	Short description	Figure
	Tag holder, terminal locking clip	
X20AC0SC1	X20 terminal locking clip and tag holder for plain text tag	
X20AC0SC1.0100	X20 terminal locking clip and tag holder for plain text tag, 100 pcs. per package	

Plain text tags and slide-in labels

Slide-in labels are available for the plain text tags. A template file is available on the B&R website in the "Downloads" tab under the model number for the X20 slide-in labels, X20AC0LB2.0100. This template is in Excel format and allows you to enter the desired texts for the slide-in labels.

Order number	Short description	Figure
	Plain text cover	
X20AC0SH1	X20 plain text tag	
X20AC0SH1.0100	X20 plain text tag, package of 100 pcs.	
	X20 legend strips	
X20AC0LB2.0100	X20 slide-in labels for X20 plain text tags, paper, white, perforated, 88 strips on A4 sheets, 100 sheets per package	

Example photo



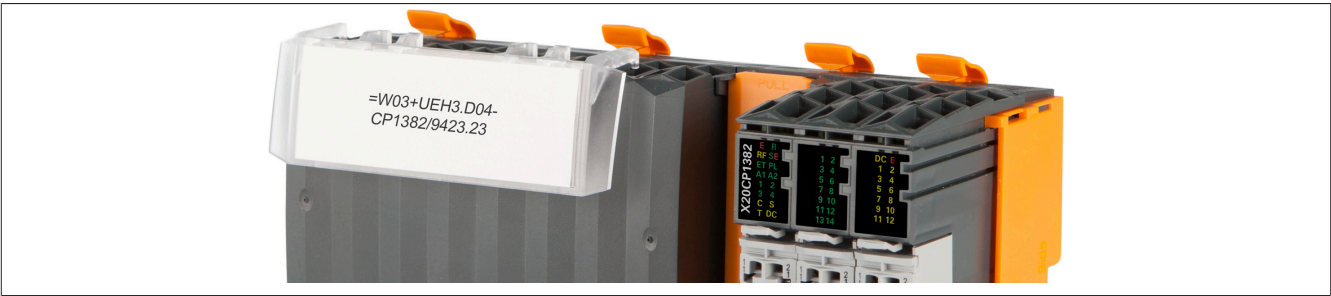
8.10.2 Labeling X20 controllers

Plain text tag

The plain text tag is labeled with commercially available adhesive labels. The adhesive labels are not available as accessories.

Order number	Short description	Figure
	PLC label	
X20AC0SH2.0010	X20 PLC labels, 10 pcs.	

Example photo



8.10.3 Labeling terminal connections

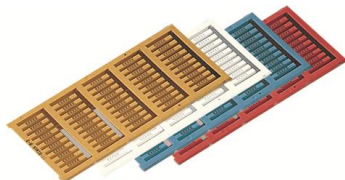
The following components are required for labeling terminal connections:

- Terminal label
- Labeling tool

Terminal label

Each terminal connection is identified clearly directly on the terminal. Label tags can also be installed to label terminals individually.

The labeling tool is needed for the installation.

		
X20AC0M0x / X20AC0M1x		X20AC0M21
	Blank X20 labels (10.4 x 2.4 mm)	
X20AC0M01	Blank X20 labels, white, set for 16 modules	
X20AC0M02	Blank X20 labels, red, set for 16 modules	
X20AC0M03	Blank X20 labels, blue, set for 16 modules	
X20AC0M04	Blank X20 labels, orange, set for 16 modules	
	Printed X20 labels (10.4 x 2.4 mm)	
X20AC0M11	Printed X20 labels, white, set for 16 modules, label: Module (1 to 16), terminal (1 to 192)	
X20AC0M12	Printed X20 labels, red, set for 16 modules, label: +24 V	
X20AC0M13	Printed X20 labels, blue, set for 16 modules, label: GND	
X20AC0M14	Printed X20 labels, orange, set for 16 modules, label: Module (module 1 to 16), terminal (1 to 192)	
	Blank X20 labels, 10 pcs. per package (10.4 x 2.4 mm)	
X20AC0M01.0010	Blank X20 labels, white, set for 16 modules, 10 pcs. per package	
X20AC0M02.0010	Blank X20 labels, red, set for 16 modules, 10 pcs. per package	
X20AC0M03.0010	Blank X20 labels, blue, set for 16 modules, 10 pcs. per package	
X20AC0M04.0010	Blank X20 labels, orange, set for 16 modules, 10 pcs. per package	
	Printed X20 labels, 10 pcs. per package (10.4 x 2.4 mm)	
X20AC0M11.0010	Printed X20 labels, white, set for 16 modules, 10 pcs. per package, label: Module (module 1 to 16), terminal (1 to 192)	
X20AC0M12.0010	Printed X20 labels, red, set for 16 modules, 10 pcs. per package, label: +24 V	
X20AC0M13.0010	Printed X20 labels, blue, set for 16 modules, 10 pcs. per package, label: GND	
X20AC0M14.0010	Printed X20 labels, orange, set for 16 modules, 10 pcs. per package, label: Module (module 1 to 16), terminal (1 to 192)	
	Blank X20 labels, large (10.4 x 7.0 mm)	
X20AC0M21	Blank X20 labels, large, white, set for 48 modules	
X20AC0M21.0010	Blank X20 labels, large, white, set for 48 modules, 10 pcs. per package	

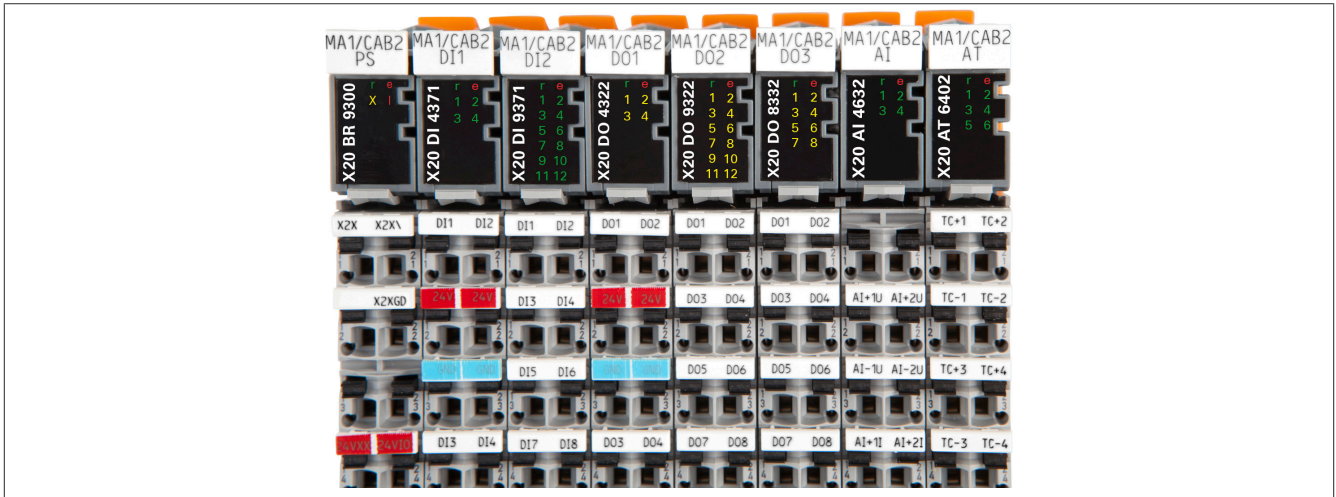
Labeling tool

The labeling tool is needed to attach the tag labels.

Order number	Short description	Figure
X20AC0MT1	X20 labeling tool, for X20 tag label system	

Table 9: X20AC0MT1 - Order data

Example photo



Printing terminal labels

Assembly order

B&R offers the assembly of the X20 system as a service. Based on an assembly order, the X20 system is completely assembled at B&R and shipped to the customer. If requested by the customer, the labels are printed and the terminal connections are marked accordingly.

Print by yourself

The terminal labels can also be printed by the user. The PrintJet CONNECT printer from Weidmüller can be used for this.

9 Accessories

9.1 Additional equipment for X20 modules and controllers

The following additional equipment is available for X20 modules and controllers:

X20 modules Plain text tag, accessory locking clip and tag holder that also serves as a terminal locking clip

X20 controller Plain text tag

Installation of these accessories is described in section ["Installing accessories" on page 168](#).

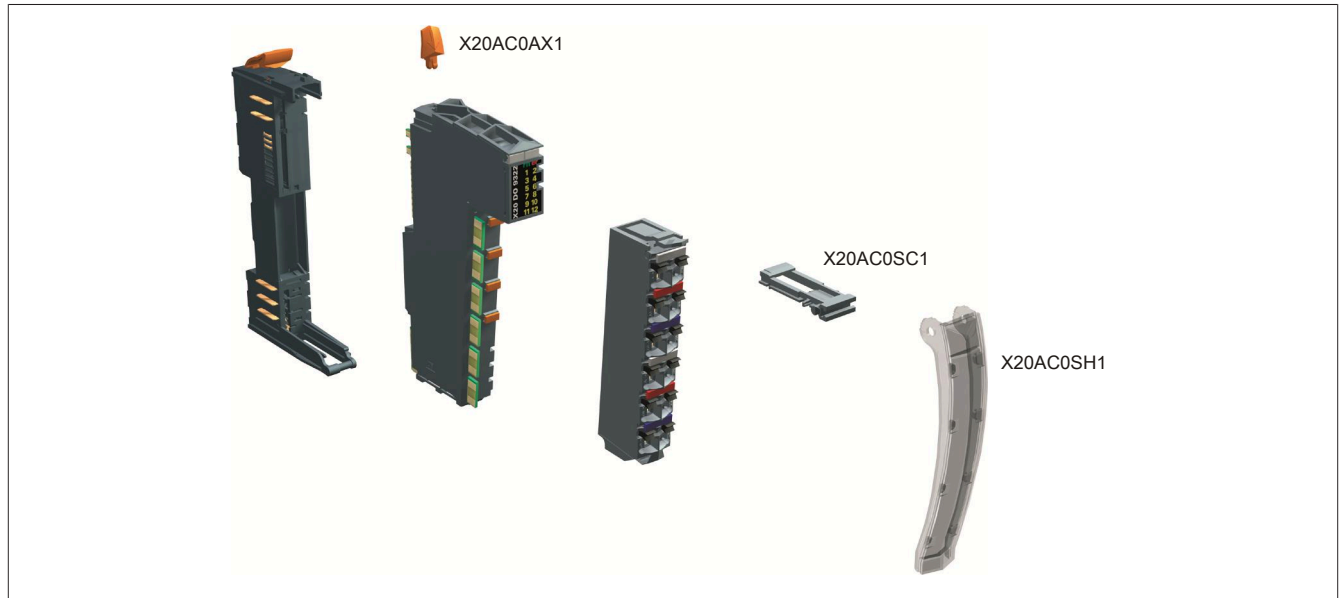


Figure 34: Additional equipment for X20 modules



Figure 35: Additional equipment for X20 controllers

9.1.1 Tag holder, terminal locking clip

Order number	Short description	Figure
	Tag holder, terminal locking clip	
X20AC0SC1	X20 terminal locking clip and tag holder for plain text tag	
X20AC0SC1.0100	X20 terminal locking clip and tag holder for plain text tag, 100 pcs. per package	

9.1.2 Plain text tag for X20 modules

A template file is available for X20 slide-in labels on the B&R website in the "Downloads" section under order number X20AC0LB2.0100. This template is in Excel format and makes it possible to enter the desired texts for the slide-in labels.

Order number	Short description	Figure
	Plain text cover	
X20AC0SH1	X20 plain text tag	
X20AC0SH1.0100	X20 plain text tag, package of 100 pcs.	
	X20 legend strips	
X20AC0LB2.0100	X20 slide-in labels for X20 plain text tags, paper, white, perforated, 88 strips on A4 sheets, 100 sheets per package	

9.1.3 Plain text tag for X20 controller

The plain text tag is labeled with commercially available adhesive labels. The adhesive labels are not available as accessories.

Order number	Short description	Figure
	PLC label	
X20AC0SH2.0010	X20 PLC labels, 10 pcs.	

9.1.4 Embedded controllers accessories package

Order number	Short description	Figure
	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 12: X20ACEMTB1 - Order data

Accessories

9.1.5 Accessory locking clips

Order number	Short description	Figure
	Accessory locking clip	
X20AC0AX1	X20 accessory locking clip	
X20AC0AX1.0100	X20 accessory locking clip, 100 pcs. per package	

9.1.6 Batteries

Replacement batteries for X20CPx68x controllers.

Order number	Short description	Figure
	Batteries	
0AC201.91	Lithium batteries 4 pcs., 3 V / 950 mAh button cell	
4A0006.00-000	Lithium battery, 3 V / 950 mAh, button cell	

Table 13: 0AC201.91, 4A0006.00-000 - Order data

9.2 Locking plates

The locking plate protects the modules on the outside against dirt and damage.

Order number	Short description	Figure
	End cover plate	
X20AC0SL1	X20 end cover plate (left)	
X20AC0SR1	X20 end cover plate (right)	
X20AC0SL1.0010	X20 end cover plate (left), 10 pcs. per package	
X20AC0SR1.0010	X20 end cover plate (right), 10 pcs. per package	

9.3 Cover for interface modules

The cover protects the slots for interface modules from dirt and damage.

Order number	Short description	Figure
	Interface module slot cover	
X20AC0IC1.0010	X20 cover for interface module slot, 10-pc. package	

Table 14: X20AC0IC1.0010 - Order data

9.4 Cable shield clamp

For information on use, see section ["X20 cable shield clamp" on page 99](#).

Model number	Short description	Figure
	Cable shield clamp	
X20AC0SG1.0010	X20 cable shield grounding clamp, 10 pcs. per package	
X20AC0SG1.0100	X20 cable shield grounding clamp, 100 pcs. per package	

9.5 Shielding bracket

The X20 shielding bracket provides an easy and space-saving way to ground the cable shielding (see ["X20 shielding bracket" on page 101](#)).

Order number	Short description	Figure
	Shielding bracket	
X20AC0SF7.0010	X20 shielding bracket 66 mm 10 pcs.	
X20AC0SF9.0010	X20 shielding bracket 88 mm 10 pcs.	

Table 15: X20AC0SF7.0010, X20AC0SF9.0010 - Order data

9.6 End clamp set

Order number	Short description	Figure
	End clamp set	
X20AC0RF1	X20 end clamp set for high vibrations	

Table 16: X20AC0RF1 - Order data

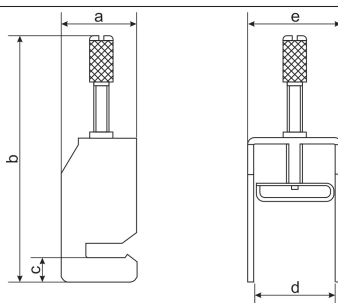
9.7 Shield connection clamp



Order number	Short description
	Shield connection clamp
X20AC0SA08.0010	X20 shield connection clamp 3 to 8 mm, 10 pieces
X20AC0SA14.0010	X20 shield connection clamp 3 to 14 mm, 10 pieces
X20AC0SA20.0010	X20 shield connection clamp 5 to 20 mm, 10 pieces
X20AC0SA35.0010	X20 shield connection clamp 20 to 35 mm, 10 pieces

Table 17: X20AC0SA08.0010, X20AC0SA14.0010, X20AC0SA20.0010, X20AC0SA35.0010 - Order data

Dimensions

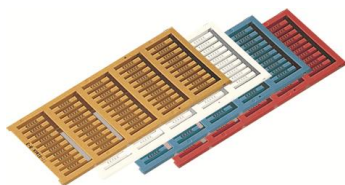


Material number	a	b	c	d	e
X20AC0SA08.0010	19.5 mm	Max. 48.7 mm	6.5 mm	9 mm	12 mm
X20AC0SA14.0010	19.5 mm	Max. 59.3 mm	6.5 mm	14 mm	17 mm
X20AC0SA20.0010	19.5 mm	Max. 75 mm	6.5 mm	21 mm	24 mm
X20AC0SA35.0010	20 mm	Max. 106.5 mm	6.5 mm	36 mm	40 mm

9.8 Terminal labeling

Each terminal connection is identified clearly directly on the terminal. It is also possible to attach tags to label the terminals individually.

The labeling tool is needed for attachment (see ["Label tags" on page 172](#)). For information about printing terminal labels, see ["Printing support" on page 84](#).



X20AC0M0x / X20AC0M1x



X20AC0M21

	Blank X20 tag labels (10.4 x 2.4 mm)
X20AC0M01	Blank X20 tag labels, white, set for 16 modules
X20AC0M02	Blank X20 tag labels, red, set for 16 modules
X20AC0M03	Blank X20 tag labels, blue, set for 16 modules
X20AC0M04	Blank X20 tag labels, orange, set for 16 modules
	Printed X20 tag labels (10.4 x 2.4 mm)
X20AC0M11	Printed X20 tag labels, white, set for 16 modules, label text: Module (modules 1 to 16), terminal (1 to 192)
X20AC0M12	Printed X20 tag labels, red, set for 16 modules, label text: +24 V
X20AC0M13	Printed X20 tag labels, blue, set for 16 modules, label text: GND
X20AC0M14	Printed X20 tag labels, orange, set for 16 modules, label text: Module (modules 1 to 16), terminal (1 to 192)
	Blank X20 tag labels, 10 pcs. per package (10.4 x 2.4 mm)
X20AC0M01.0010	Blank X20 tag labels, white, set for 16 modules, 10 pcs. per package
X20AC0M02.0010	Blank X20 tag labels, red, set for 16 modules, 10 pcs. per package
X20AC0M03.0010	Blank X20 tag labels, blue, set for 16 modules, 10 pcs. per package
X20AC0M04.0010	Blank X20 tag labels, orange, set for 16 modules, 10 pcs. per package
	Printed X20 tag labels, 10 pcs. per package (10.4 x 2.4 mm)

X20AC0M11.0010	Printed X20 tag labels, white, set for 16 modules, 10 pcs. per package, label text: Module (modules 1 to 16), terminal (1 to 192)
X20AC0M12.0010	Printed X20 tag labels, red, set for 16 modules, 10 pcs. per package, label text: +24 V
X20AC0M13.0010	Printed X20 tag labels, blue, set for 16 modules, 10 pcs. per package, label text: GND
X20AC0M14.0010	Printed X20 tag labels, orange, set for 16 modules, 10 pcs. per package, label text: Module (modules 1 to 16), terminal (1 to 192)
Blank X20 tag labels, large (10.4 x 7.0 mm)	
X20AC0M21	Blank X20 tag labels, large white, set for 48 modules
X20AC0M21.0010	Blank X20 tag labels, large white, set for 48 modules, 10 pcs. per package

9.9 Labeling tool

The labeling tool is needed to attach the tag labels.

Order number	Short description	Figure
	Labeling tool	
X20AC0MT1	X20 labeling tool, for X20 tag label system	

Table 18: X20AC0MT1 - Order data

9.10 Screwdriver

This screwdriver has been specially designed for use with terminal blocks X20TB1E and X20TB1F to prevent possible damage to the terminals.

Order number	Short description	Figure
	Screwdriver	
X20AC0SD1	B&R screwdriver	

Table 19: X20AC0SD1 - Order data

9.11 Accelerometers

9.11.1 Order data

Order number	Short description	Figure
	Sensors	
0ACS100A.00-1	Accelerometer, nominal sensitivity 100 mV/g, top exit	
0ACS100A.90-1	Accelerometer, nominal sensitivity 100 mV/g, side exit	
	Required accessories	
	Sensor cable	
0ACC0020.01-1	Cable for accelerometer, length 2 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC0050.01-1	Cable for accelerometer, length 5 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC0100.01-1	Cable for accelerometer, length 10 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC0150.01-1	Cable for accelerometer, length 15 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC0200.01-1	Cable for accelerometer, length 20 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC0500.01-1	Cable for accelerometer, length 50 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	
0ACC1000.01-1	Cable for accelerometer, length 100 m, 2x 0.34 mm ² , female M12 connector on the sensor side, can be used in cable drag chains, UL listed	

Table 20: 0ACS100A.00-1, 0ACS100A.90-1 - Order data

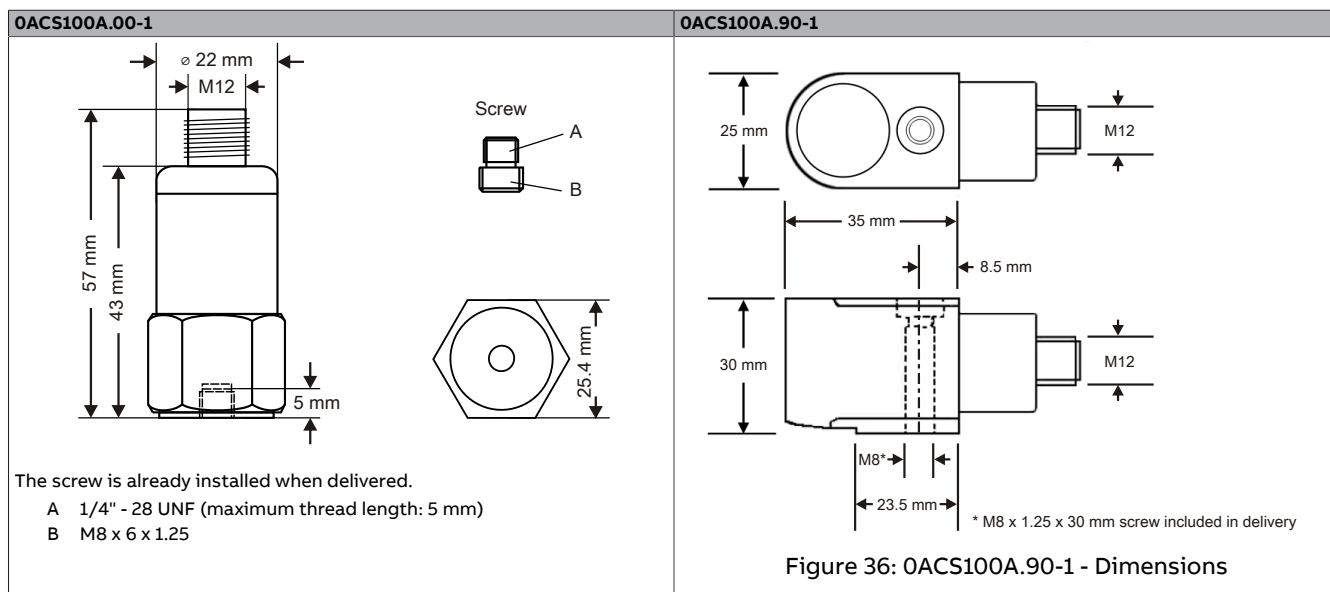
9.11.2 Technical data

Order number	OACS100A.00-1		OACS100A.90-1
Sensor properties ¹⁾			
Natural resonance (installed)	22 kHz (rated)		
Sensitivity	100 mV/g ±10% nominal 80 Hz at 22°C		
Frequency response	2 Hz to 10 kHz ±5% 0.8 Hz to 15 kHz ±3 dB		
Isolation	Isolated base		
Measurement range	±50 g		
Cross-sensitivity	<5%		
Electrical properties			
Electrical disturbances	Max. 0.1 mg		
Broadband resolution	0.2 mg (200 µg) over 1 Hz to 15 kHz		
Spectral noise	10 Hz to 10 µg/Hz 100 Hz to 4 µg/Hz 1 kHz to 3 µg/Hz		
Current range	0.5 to 8 mA		
Bias voltage	10 to 12 VDC		
Settling time	2 s		
Output impedance	Max. 200 Ω		
Housing isolation	>10 ⁸ Ω at 500 V		
Operating conditions			
Degree of protection per EN 60529	IP67		
Ambient conditions			
Temperature			
Operation	-55 to 140°C		
Max. shock resistance	5000 g		
Emitted interferences	EN 61000-6-4:2001		
Immunity to interference	EN 61000-6-2:1999		
Mechanical properties			
Housing			
Material	Stainless steel		
Installation	M8 x 1.25 x 6 mm bolt, pre-assembled on the sensor	M8 x 1.25 x 33 mm screw, included in delivery	
Weight	110 g	170 g	
Measurement element	PZT piezoelectric crystal (lead zirconate titanate)		
Measurement execution	Compressed		
Tightening torque	8 Nm		
Connectors	M12		

Table 21: OACS100A.00-1, OACS100A.90-1 - Technical data

1) The sensor is precalibrated at the factory. Recalibration is not necessary.

9.11.3 Dimension



9.11.4 Pinout

	Pin	Description
	1	Not assigned
	2	18 to 30 V (brown)
	3	Not assigned
	4	0 V (blue)

9.11.5 Installation direction

OACS100A.00-1	OACS100A.90-1
B&R vibration sensor OACS100A.00-1 is designed for measurements in the longitudinal axis.	B&R vibration sensor OACS100A.90-1 is designed for measurements in the transverse axis.

9.11.6 Frequency response

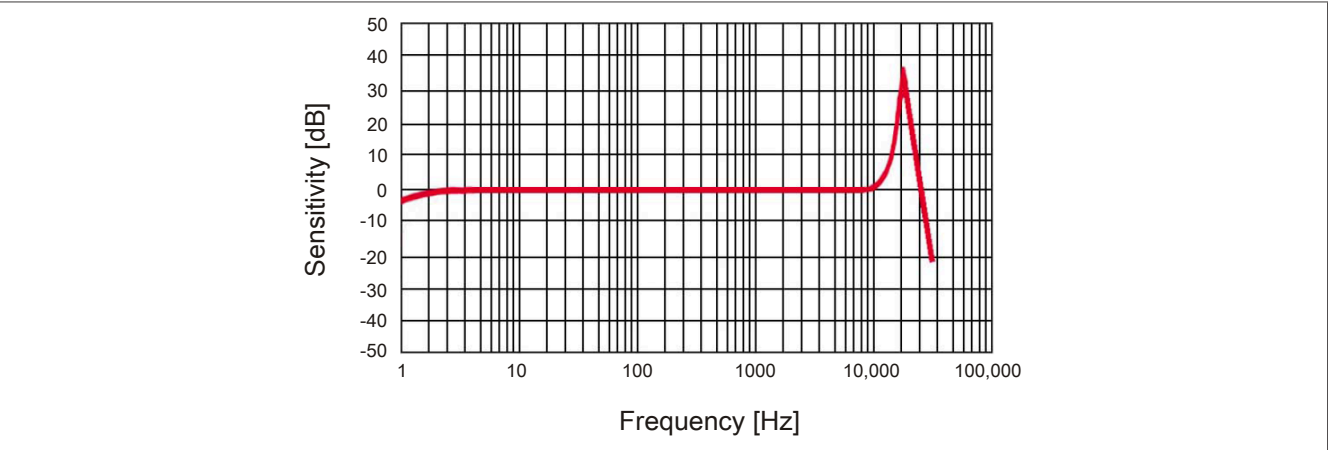


Figure 37: OACS100A.x0-1 - Frequency response

9.12 Safety Technology Guarding

9.12.1 Order data

Material number	Short description	Figure
	Accessories	
X20MK0223	X20 SafeKEY, 8 MB, for the X20SL81xx series, exclusively for mapp Safety	
X20cMK0223	X20 SafeKEY, coated, 8 MB, for X20SL81xx series, exclusive for mapp Safety	

Table 22: X20MK0223, X20cMK0223 - Material numbers

9.12.2 Technical data

Order number	X20MK0223		X20cMK0223
General information			
Memory size	8 MB		
Application memory			
Guaranteed erase/write cycles	100,000		
Certifications			
CE	Yes		
UKCA	Yes		
UL	cULus E115267 Industrial control equipment		
DNV	Temperature: B (0 to 55°C) Humidity: B (up to 100%) Vibration: B (4 g) EMC: B (bridge and open deck)		
CCS	Yes		-
LR	ENV1		
KR	Yes		
ABS	Yes		
BV	EC33B Temperature: 5 - 55°C Vibration: 4 g EMC: Bridge and open deck		
Operating conditions			
Mounting orientation			
Horizontal	Yes		
Vertical	Yes		
Installation elevation above sea level	0 to 2000 m, no limitation		
Degree of protection per EN 60529	IP20		
Ambient conditions			
Temperature			
Operation			
Horizontal mounting orientation	0 to 60°C		-25 to 60°C
Vertical mounting orientation	0 to 60°C		-25 to 60°C
Derating	-		
Storage	-40 to 85°C		
Transport	-40 to 85°C		

Table 23: X20MK0223, X20cMK0223 - Technical data

9.13 OCFCRD.xxxxE.02

9.13.1 Order data

Order number	Short description	Figure
	CompactFlash cards	
OCFCRD.0512E.02	CompactFlash 512 MB extended temp.	
OCFCRD.1024E.02	CompactFlash 1024 MB extended temp.	
OCFCRD.2048E.02	CompactFlash 2048 MB extended temp.	
OCFCRD.4096E.02	CompactFlash 4096 MB extended temp.	
OCFCRD.8192E.02	CompactFlash 8 GB extended temp.	
OCFCRD.016GE.02	CompactFlash 16 GB extended temp.	

Table 24: OCFCRD.0512E.02, OCFCRD.1024E.02, OCFCRD.2048E.02, OCFCRD.4096E.02, OCFCRD.8192E.02, OCFCRD.016GE.02 - Order data

9.13.2 Technical data



Caution!

A sudden power failure can result in data loss. In very rare cases, the mass storage device may also become damaged.

In order to prevent data loss or damage, the use of a UPS is recommended.



Information:

The following specifications, properties and limit values apply only to this accessory and may deviate from those that apply to the complete system. For the complete system in which this accessory is installed, the data specified for that complete system applies.

Order number	OCFCRD. 0512E.02	OCFCRD. 1024E.02	OCFCRD. 2048E.02	OCFCRD. 4096E.02	OCFCRD. 8192E.02	OCFCRD. 016GE.02
General information						
Capacity	512 MB	1024 MB	2048 MB	4096 MB	8192 MB	16 GB
Data retention	10 years (when new) to 1 year (end of service life)					
Data reliability	<1 unrecoverable error per 10 ¹⁷ bits read					
Lifetime monitoring	Yes					
MTBF	>3,000,000 hours (at 25°C)					
Servicing	None					
Supported operating modes	Up to UDMA6 / MDMA4 / PIO6					
Continuous reading						
Typical	32.2 MB/s	64.1 MB/s	62.9 MB/s	62 MB/s	64.3 MB/s	64.4 MB/s
Continuous writing						
Typical	19.9 MB/s	29 MB/s	28.6 MB/s	37.5 MB/s	39.0 MB/s	43.6 MB/s
Certifications						
CE	Yes					
UKCA	Yes					
UL	cULus E115267					
	Industrial control equipment					
DNV	Temperature: B (0 to 55°C)					
	Humidity: B (up to 100%)					
	Vibration: B (4 g)					
	EMC: B (bridge and open deck)					
Endurance						
SLC flash memory	Yes					
Erase/Write cycles						
Guaranteed	100,000					
Wear leveling	Global, dynamic and static					
Error-correcting code (ECC)	Yes					

Table 25: OCFCRD.0512E.02, OCFCRD.1024E.02, OCFCRD.2048E.02, OCFCRD.4096E.02, OCFCRD.8192E.02, OCFCRD.016GE.02 - Technical data

Order number	OCFCRD. 0512E.02	OCFCRD. 1024E.02	OCFCRD. 2048E.02	OCFCRD. 4096E.02	OCFCRD. 8192E.02	OCFCRD. 016GE.02
S.M.A.R.T. support	Yes					
Storage health data support ¹⁾	Yes					
Support						
Hardware	X20CPxxxx					
Ambient conditions						
Temperature						
Operation	-40 to 85°C					
Storage	-50 to 100°C					
Transport	-50 to 100°C					
Relative humidity						
Operation	Max. 85% at 85°C					
Storage	Max. 85% at 85°C					
Transport	Max. 85% at 85°C					
Vibration						
Storage	20 g peak, 10 to 2000 Hz					
Transport	20 g peak, 10 to 2000 Hz					
Shock						
Storage	1500 g peak (JESD ₂₂ , method B ₁₁₀)					
Transport	1500 g peak (JESD ₂₂ , method B ₁₁₀)					
Mechanical properties						
Dimensions						
Width	42.8 ±0.10 mm					
Length	36.4 ±0.15 mm					
Height	3.3 ±0.10 mm					
Weight	10 g					

Table 25: OCFCRD.0512E.02, OCFCRD.1024E.02, OCFCRD.2048E.02, OCFCRD.4096E.02, OCFCRD.8192E.02, OCFCRD.016GE.02 - Technical data

1) For details about storage health data, see Automation Help.

9.13.3 Dimensions

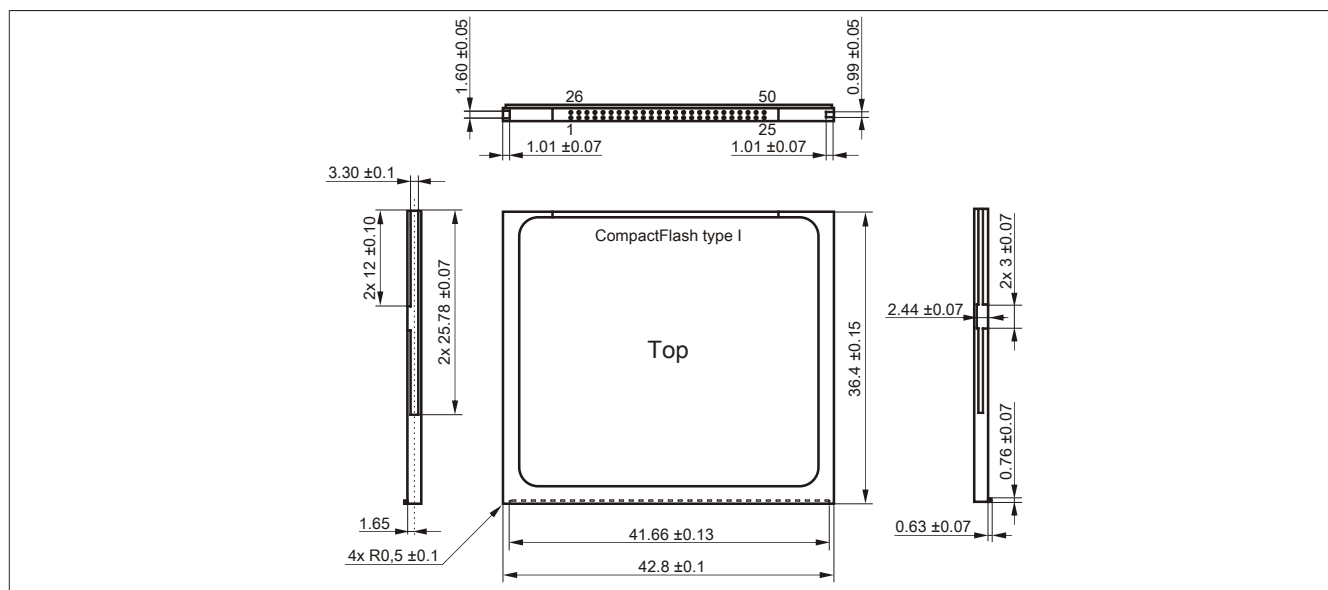


Figure 38: CompactFlash card type I dimensions

9.13.4 Temperature/Humidity diagram for operation and storage

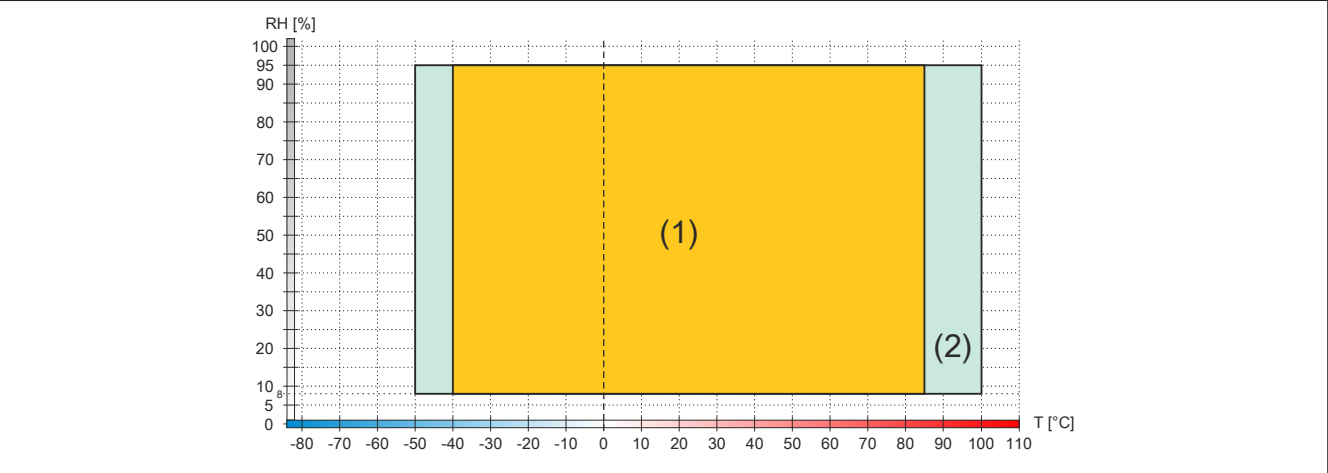


Figure 39: OCFCRD.xxxxE.01 CompactFlash cards - Temperature/Humidity diagram

Diagram legend			
(1)	Operation	T [°C]	Temperature in °C
(2)	Storage and transport	RH [%]	Relative humidity (RH) in percent and non-condensing

9.14 Pre-assembled cables

9.14.1 X20 POWERLINK cables

POWERLINK cables				
Length	X20 to X20		X20 to X67	
0.2 m	X20CA0E61.00020			
0.25 m	X20CA0E61.00025			
0.3 m	X20CA0E61.00030			
0.35 m	X20CA0E61.00035			
0.4 m	X20CA0E61.00040			
0.5 m	X20CA0E61.00050			
1 m	X20CA0E61.00100			X67CA0E41.0010
1.5 m	X20CA0E61.00150			
2 m	X20CA0E61.00200			X67CA0E41.0020
3 m				X67CA0E41.0030
5 m	X20CA0E61.00500			X67CA0E41.0050
10 m	X20CA0E61.01000		X20CA3E61.0100	
15 m	X20CA0E61.01500		X20CA3E61.0150	X67CA0E41.0150
20 m	X20CA0E61.02000		X20CA3E61.0200	
30 m		X20CA0E61.0300		
40 m		X20CA0E61.0400		
50 m		X20CA0E61.0500		X67CA0E41.0500
100 m		X20CA0E61.1000		
				

Length	Tolerances for cable lengths
X20CA0E61.xxxx	
20 to 100 m	+2% of the length
X20CA0E61.xxxxx	
0.2 to 0.5 m	+0.01 m
1 to 5 m	+0.04 m
6 to 20 m	+1% of the length
X67CAxE41.xxxx	
0 to 10 m	+0.01 m
10 m to 50 m	+2% of the length

9.14.1.1 Technical data

Product ID	X20CA0E61.xxxxx	X20CA0E61.xxxx	X20CA3E61.xxxx	X67CA0E41.xxxx
Short description				
Accessories	POWERLINK/Ethernet connection cable RJ45 to RJ45		POWERLINK/Ethernet connection cable RJ45 to RJ45, can be used in cable drag chains	POWERLINK/Ethernet connection cable RJ45 to M12
General information				
Durability	Flame-retardant per IEC 60332-3-24 ROHS 2011/65/EU	Flame-retardant per IEC 60332-1-2 ROHS 2011/65/EU		Flame-retardant, RoHS-compliant Acid, alkali and oil resistant Salt water resistant UV and ozone resistant ¹⁾
Type	Connection cables			
Cable cross section				
AWG	4x 2x 26 AWG	4x 22 AWG		
mm²	4x 2x 0.14 mm²	4x 0.34 mm²		
Cable construction				
Inner jacket	Halogen-free, flame-retardant			
Outer jacket				
Material	PVC	Polyurethane (PUR) GN		Polyurethane (PUR)
Color	Black (RAL 9005)	Green		

Table 26: X20CA0E61.xxxxx, X20CA0E61.xxxx, X20CA3E61.xxxx, X67CA0E41.0010 - Technical data

Accessories

Product ID	X20CA0E61.xxxx	X20CA0E61.xxxx	X20CA3E61.xxxx	X67CA0E41.xxxx
Wires				
Wire insulation	Polyethylene (PE)			FRNC (Flame-Retardant Non-Corrosive)
Wire colors	Blue-white, blue, orange-white, orange, green-white, green, brown-white, brown	White, yellow, blue, orange		
Shield	Overlapping aluminum-clad foil, tinned copper braiding, 85% coverage			
Type	Tinned copper strand 26/7 AWG	Tinned copper strand 22/7 AWG		Tinned copper stranded wire Fine stranded wire (7x 0.25 mm / 7x 30 AWG)
Stranding	Pair stranding - 4 pairs Blue-white with blue, orange-white with orange, green-white with green, brown-white with brown	Complete stranding 4 wires to the star quad		
Electrical properties				
Operating voltage	Max. 125 V	Max. 60 V for PoE		
Test voltage				
Wire - Wire	1000 V	2000 V		
Wire - Shield	1000 V	2000 V		
Conductor resistance	≤145 Ω/km at 20°C	≤120 Ω/km at 20°C		
Transfer properties	Category 5 per EN 50288-2-2 (2004) / IEC 61156-6 (2002)	Category 5 / Class D up to 100 MHz per ISO/IEC 11801 (EN 50173-1), ISO/IEC 24702 (EN 50173-3)		
Transfer rate	10/100/1000 Mbit/s	10/100 Mbit/s		
Insulation resistance	≥5 GΩ/km at 20°C	≥500 MΩ/km at 20°C		
Operating conditions				
Degree of protection per EN 60529				
Cables	IP65			IP67
Male M12 connector	-			IP67, only when screwed in
RJ45 connector	IP20, only when properly connected			
Ambient conditions				
Temperature				
Transport	-40 to 80°C	-50 to 70°C		-50 to 75°C ²⁾
Fixed installation	-40 to 80°C	-40 to 70°C		-40 to 75°C ³⁾
Flexible installation	-10 to 60°C	-20 to 60°C		-30 to 70°C ⁴⁾
Mechanical properties				
Dimensions				
Length	Different			
Diameter	6.7 mm ±0.2 mm	6.5 mm ±0.2 mm		
Bend radius				
Fixed installation	≥4x outer diameter	≥3x outer diameter		≥4x outer diameter ⁵⁾
Flexible installation	≥8x outer diameter	≥7x outer diameter		≥8x outer diameter ⁶⁾
Drag chain data				
Acceleration	-	4 m/s ²		3 m/s ²
Flex cycles	-	Min. 3 million		
Speed	-	4 m/s		3 m/s
Bend radius	-	200 mm		
Weight	0.058 kg/m	0.062 kg/m	0.061 kg/m	0.064 kg/m

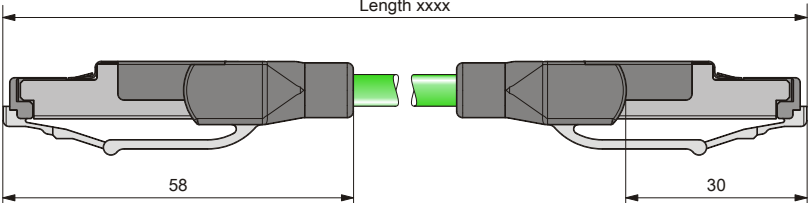
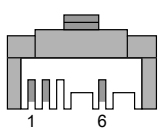
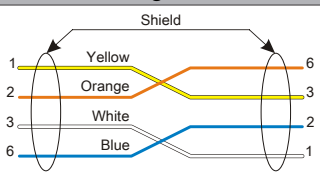
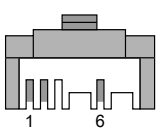
Table 26: X20CA0E61.xxxxx, X20CA0E61.xxxx, X20CA3E61.xxxx, X67CA0E41.0010 - Technical data

- 1) Up to version <D0: Flame-retardant per IEC 60332-1-2; RoHS 2011/65/EU
- 2) Up to version <D0: -50 to 70°C
- 3) Up to version <D0: -40 to 70°C
- 4) Up to version <D0: -20 to 60°C
- 5) Up to version <D0: ≥3x outer diameter
- 6) Up to version <D0: ≥7x outer diameter

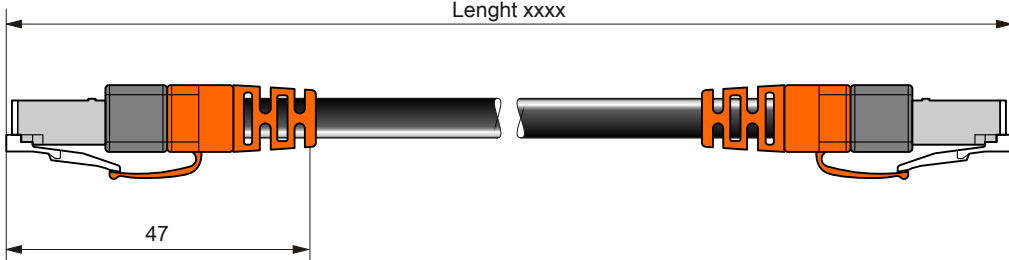
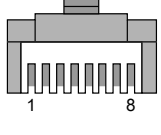
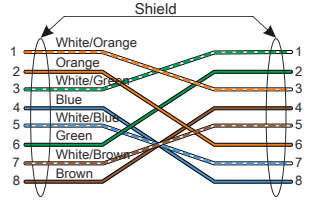
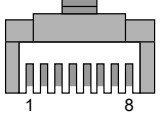
9.14.1.2 X20CA0E61.xxxx and X20CA3E61.xxxx

This cable is offered in 2 variants:

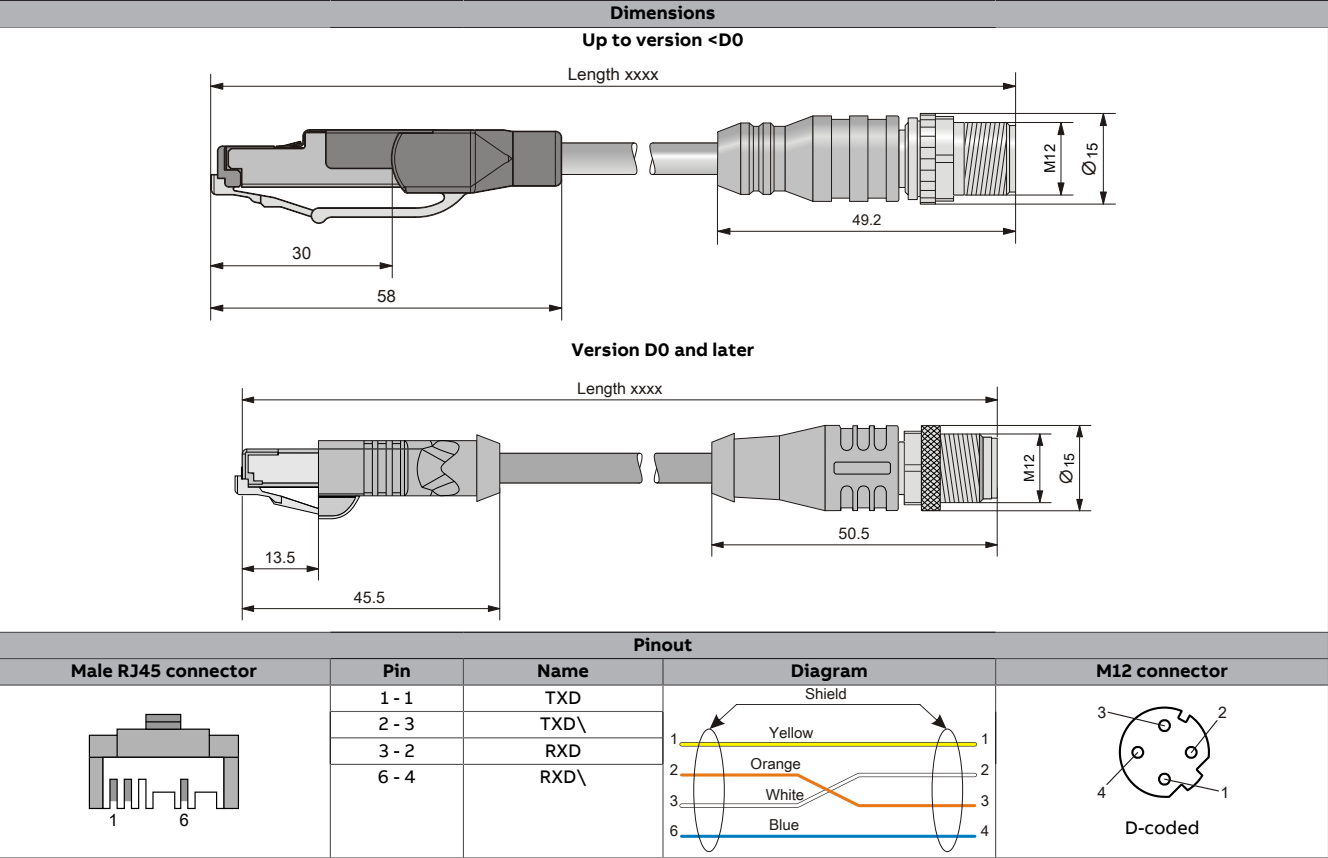
- X20CA0E61: Standard design
- X20CA3E61: Can be used in cable drag chains

Dimensions				
				
RJ45 connector	Pin	Name	Diagram	RJ45 connector
	1 - 3	TXD		
	2 - 6	TXD\		
	3 - 1	RXD		
	6 - 2	RXD\		

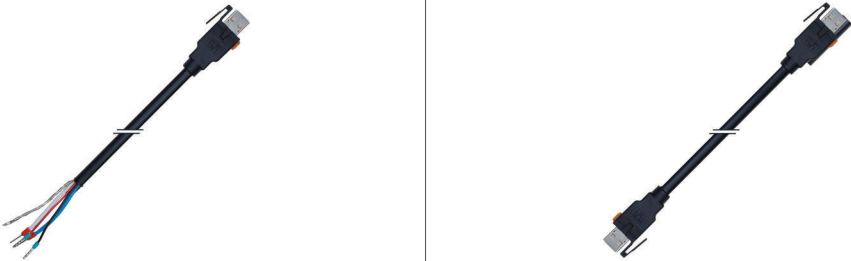
9.14.1.3 X20CA0E61.xxxxx

Dimensions				
				
Male RJ45 connector	Pin	Name	Diagram	Male RJ45 connector
	1 - 3	TXD		
	2 - 6	TXD\		
	4 - 8	RXD		
	6 - 2	RXD\		

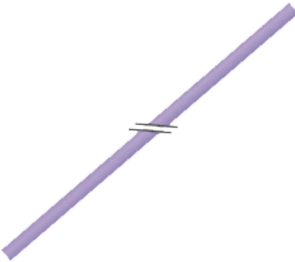
9.14.1.4 X67CA0E41.xxxx



9.14.2 X2X Link cables

Length	Short description, model number	
	Attachment cables	Connection cables
0.3 m		X20CA0X68.0003
1 m	X20CA0X48.0010	X20CA0X68.0010
2 m	X20CA0X48.0020	X20CA0X68.0020
5 m	X20CA0X48.0050	X20CA0X68.0050
10 m	X20CA0X48.0100	X20CA0X68.0100
20 m	X20CA0X48.0200	
		

Length	Tolerances for cable lengths
0 to <10 m	+10 cm
10 m to <50 m	+2% of the length

Length	Short description, model number	
	X2X Link cable for custom assembly	
100 m	X67CA0X99.1000	
500 m	X67CA0X99.5000	
		

9.14.2.1 General specifications for X2X Link cables

When using a non-B&R cable for field wiring, it is important that the cable satisfies the following general specifications. For X2X Link segments up to 30 m, any cable that meets these specifications can be used. Cable lengths over this value must be inspected and approved by B&R.

	Data line	Supply line
Wires	2 x 0.25 mm ² (AWG 24), stranded wire	2 x 0.34 mm ² (AWG 22), stranded wire
Cable construction	Pair stranding, paired shield, aluminum foil	
Conductor resistance	Approx. 90 Ω/km	Approx. 55 Ω/km
Wave impedance	120 - 150 Ω	
Operating capacitance	<40 pF/m	
Cable shield	Tinned copper wire braiding, optical coverage ≥85%	

Table 27: General specifications for X2X Link cables

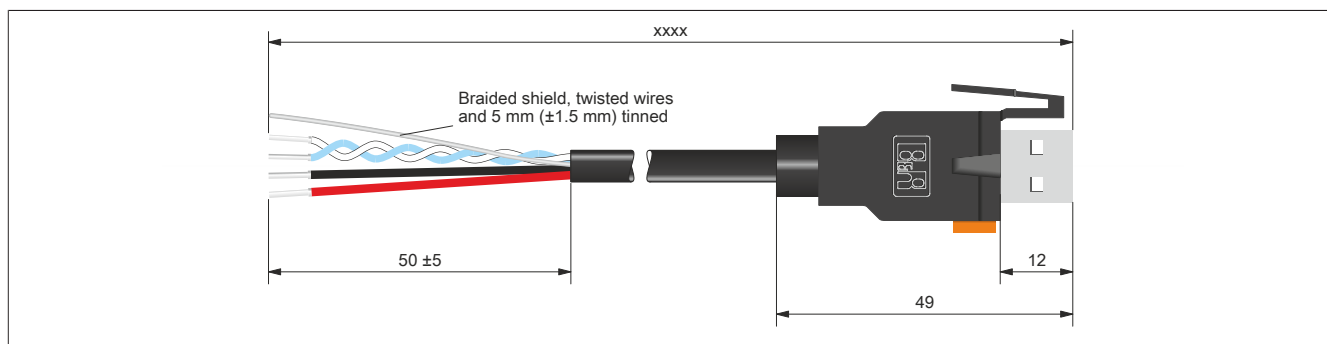
9.14.2.2 Technical data

Product ID	X20CA0X48	X20CA0X68	X67CA0X99
General information			
Note			Halogen-free
Durability	Flame-retardant according to VW-1 and FT1		Flame-retardant
Connection	USB A, male		-
Type	Attachment cables	Connection cables	-
Cable cross section			
Data cables			
AWG	2x 24 AWG		
mm²	2x 0.25 mm²		
Supply lines			
AWG	2x 22 AWG		
mm²	2x 0.34 mm²		
RoHS-compliant ¹⁾	Yes		
Cable construction			
Signal lines			
Shield	Paired shield with aluminum foil		
Stranding	Twisted pair wires		
Cable stranding	7/36 (28 AWG) with filler		0.35 mm² (22 AWG) with filler
Complete shielding	Tinned copper braiding, coverage >85%		
Outer sheathing			
Material	Polyvinyl chloride(PVC)		Thermoplastic polyurethane (TPU)
Color	Black		Violet
Labeling	"B&R" + Model number + Revision number		B&R X67CA0X99.xxxx
Lines			
Type	Tinned copper stranded wire		Tinned copper ETB1 Data line: Fine stranded wire (19x 0.13 mm) Supply line: Fine stranded wire (19x 0.15 mm)
Wire colors			
Data cables	Blue, white		
Supply lines	Red, black		
Wire insulation			
Data cables	Polyethylene foam		Cell polyethylene (PE)
Supply lines	SR PVC		Polyethylene (PE)
Electrical characteristics			
Operating voltage	30 V		Max. 2500 VAC
Degree of insulation	-		Category II in accordance with IEC 61076-2
Conductor resistance	Data line: <93.2 Ω/km at 20°C Supply line: <55 Ω/km at 20°C		Data line: ≤78 Ω/km Supply line: ≤55 Ω/km
Operating conditions			
EN 60529 protection			
Connector/Coupling	IP20, only when connected properly		-
Environmental conditions			
Temperature	-25 to 80°C		-40 to 80°C
Fixed installation	-25 to 80°C		-40 to 80°C
Flexible installation	-20 to 80°C		-25 to 60°C
Mechanical characteristics			
Dimensions			
Length	Various		
Diameter	7 mm ± 0.19 mm		6.9 mm ±0.2 mm
Bend radius	≥8x outer diameter		≥15x outer diameter
Drag chain data			
Acceleration	-		Max. 4 m/s²
Flex cycles	-		Min. 2 million
Speed	-		Max. 3 m/s
Weight	-		0.063 kg/m

Table 28: X20CA0Xx8 / x67CA0X99 - Technical data

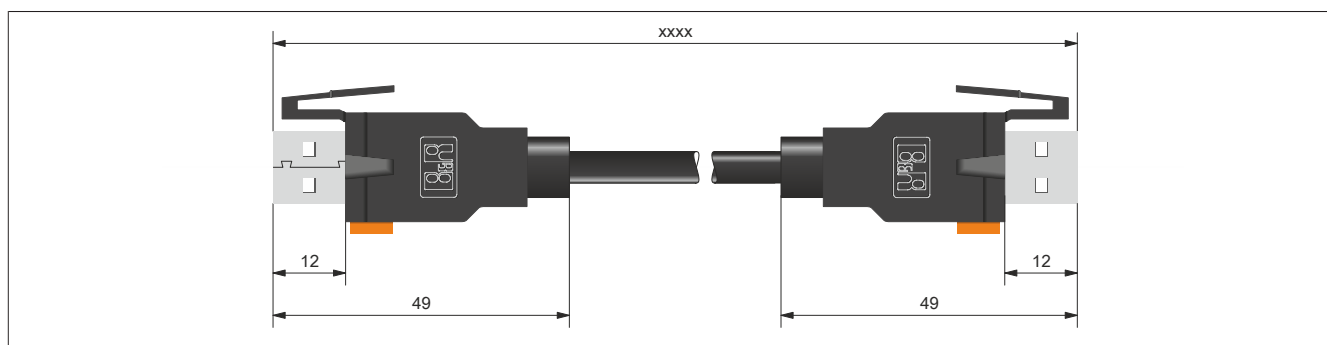
- 1) RoHS (Restriction of the use of certain Hazardous Substances) limits the use of the following substances in electrical and electronic devices: lead, mercury, cadmium, chrome VI as well as flame-retardant polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE).

9.14.2.3 X20CA0X48.xxxx



Pinout				
Open	Pin	Name	Wire color	Male connector
For custom Wiring	1	X2X+	Red	Shield 1 4 Keying for X3A
	2	X2X\	Blue	
	3	X2X	White	
	4	X2X.L	Black	
	Male connector	SHLD	Shield	

9.14.2.4 X20CA0X68.xxxx



Pinout				
Male connector	Pin	Name	Wire color	Male connector
Shield 1 4	1	X2X+	Red	Shield 1 4
	2	X2X\	Blue	
	3	X2X	White	
	4	X2X.L	Black	
	Male connector	SHLD	Shield	

9.14.2.5 X67CA0X99.xxxx

Dimensions			
Pinout			
	Description	Wire colors	
For custom Wiring	X2X+	Red	For custom Wiring
	X2X	White	
	X2X.L	Black	
	X2X\	Blue	
	SHLD	-	

Accessories

9.14.3 Sensor cables

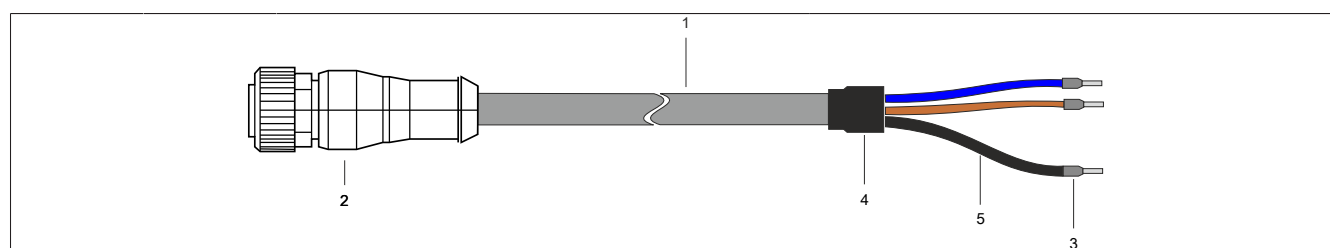
9.14.3.1 Order data

Model number	Length	Short description
0ACC0020.01-1	2 m	Cable for accelerometer, 2x 0.34 mm ² , 1x 0.25 mm ² , M12 female connector on sensor side, 1x 25 mm ² shield connection, can be used in cable drag chains, UL/CSA listed
0ACC0050.01-1	5 m	
0ACC0100.01-1	10 m	
0ACC0150.01-1	15 m	
0ACC0200.01-1	20 m	
0ACC0500.01-1	50 m	
0ACC1000.01-1	100 m	

9.14.3.2 Technical data

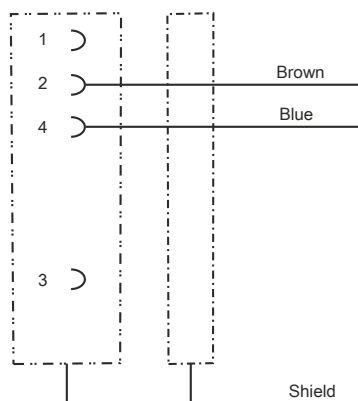
Name	OACC0xx0.01-1
General information	
Number of pins	3
Cable length	x
Characteristic values of the wire	
Cable type	PUR halogen-free black shielded
AWG signal lead	22
Conductor design signal lead	42x 0.10 mm
Wire diameter incl. insulation	1.27 mm ±0.02 mm
Wall thickness insulation	≥0.21 mm (wire insulation) Approx. 1.1 mm (outer jacket)
External diameter of cable	5.9 mm ±0.15 mm
Insulation resistance	≥100 GΩ·km (at 20°C)
Conductor resistance	Max. 58 Ω/km (at 20°C)
Shielding	Braided copper wires
Cable weight	44 kg/km
Smallest bend radius, fixed	29.5 mm
Smallest bend radius, movable	59 mm
Number of flex cycles	4000000
Bend radius	59 mm
Travel path	10 m
Movement speed	3 m/s
Acceleration	10 m/s²
Ambient temperature (during operation)	-40°C ... 80°C (cable, inflexible installation) -25°C ... 80°C (cable, flexible installation)
Degree of protection per EN 60529	IP67

9.14.3.3 Sensor cables with female M12 connector



Pos.	Pieces	Description	Note
1	1	Sensor cable	2x 0.34 mm² (1501702 3x 0.34)
2	1	Female M12 connector (axial)	Female M12 connector (M12x1 A-keyed)
3	2	Wire end sleeve (2x sensor cables)	3203066 AI 0.34-8 TQ
4	1	Heat shrink tubing	
5	1	Shield connection	1x 0.25 mm² black
6	1	Wire end sleeve (1x shield connection)	3200632 AI 0.25-12 BU

9.14.3.4 Cable diagram



10 International and national certifications

Products and services from B&R comply with applicable regulations, directives and standards. These are national, European and international regulations, mainly from organizations such as ISO, IEC and CENELEC. We are committed to ensuring the reliability of our products in industrial environments.



Information:

Certifications that apply to a particular module are available at the following places:

- B&R website (www.br-automation.com) > Product page > Technical data > General information > Certifications
(The product page is found by searching for the order number.)
- On the side of the module housing

Changes and new certifications are available promptly in electronic form on the B&R website (www.br-automation.com).

10.1 Overview of certifications

Mark	Explanation	Certificate authority	Region
	CE marking	Notified bodies	Europe (EU)
	UK Conformity Assessed (UKCA)	Notified bodies	United Kingdom (UK)
	Functional safety (CE)	Notified bodies	Europe (EU)
	Explosion protection (CE)	Notified bodies	Europe (EU)
	Underwriters Laboratories Inc. (UL) (certification for US and Canada)	UL	Canada USA
	Canadian Standards Association (CSA) (certification for US and Canada)	CSA	Canada USA
	Det Norske Veritas (DNV)	DNV	Germany Norway
	CHINA CLASSIFICATION SOCIETY (CCS)	CCS	China
	American Bureau of Shipping (ABS)	ABS	USA
	Korean Register of Shipping (KR)	KR	Korea
	Lloyd's Register (LR)	LR	Great Britain
	Korean Conformity (KC)	Radio Research Agency (RRA)	Korea
	Regulatory Compliance Mark (RCM)	ACMA	Australia Oceania

10.2 EU directives and standards (CE)

CE marking



Europe (EU)

The respective product complies with all applicable EU directives and relevant harmonized standards.

Certification of these products is performed in cooperation with accredited testing laboratories.

EMC directive 2014/30/EU

All devices meet the protection requirements of the "Electromagnetic Compatibility" directive and are designed for typical industrial use.

Applicable standards from this directive:

EN 61131-2	Programmable controllers - Part 2: Equipment requirements and tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments

Low voltage directive 2014/35/EU

The low voltage directive applies to electrical equipment with a nominal voltage from 50 to 1000 VAC and from 75 to 1500 VDC.

All devices within the area of application of this directive satisfy the its protection requirements.

Applicable standard from this directive:

EN 61131-2	Programmable controllers - Part 2: Equipment requirements and tests
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The corresponding declaration of conformity is available for download on the B&R website. The editions of the applied standards are located in the respective declaration of conformity.



CE declaration of conformity

[Website > Downloads > Certificates > Declarations of conformity > EU > X20 system > Declaration of conformity PLC X20](#)

UK Conformity Assessed (UKCA)

The corresponding declaration of conformity is available for download on the B&R website. The editions of the applied standards are located in the respective declaration of conformity.



United Kingdom (UK)

All directives applicable to the respective product and their relevant standards are met.

Products with this marking are permitted to be imported into Great Britain (England, Wales, Scotland).



UKCA declaration of conformity

[Website > Downloads > Certificates > Declarations of conformity > EU > X20 system > UK Declaration PLC X20](#)

Machinery directive 2006/42/EC**Functional safety****Europe (EU)**

In accordance with the machinery directive, safety technology products are designed, developed, tested and labeled for special applications providing protection to machinery and personnel.

Certification of these products is performed exclusively in cooperation with EU-authorized bodies (Notified Bodies).

Applicable standards from this directive:**SIL 3:**

IEC 61508-1	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 1: General requirements
IEC 61508-2	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61508-3	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 3: Software requirements
IEC 61508-4	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations
EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
IEC 61511-1	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements

PL e, Cat. 4:

EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 61131-2	Programmable logic controllers - Part 2: Equipment requirements and tests

Declarations of conformity, certificates and any other safety-related documentation can be downloaded from the B&R website. For information about the versions of applicable standards, see the declaration of conformity.

**Declaration of conformity**

[Website > Downloads > Certificates > Declarations of conformity > X20 system > EU declaration of conformity FS PLC X20](#)

**Certificates**

[FS EN 50156 certificate - SafeLOGIC, SafeIO](#)
[FS certificate - SafeDESIGNER, SafeLOGIC, SafeIO](#)
[Safe cutoff of potential groups](#)

**User's manual**

[Website > Downloads > Safety technology > Integrated safety technology user's manual](#)

ATEX directive 2014/34/EU

ATEX / Zone 2



II 3G Ex nA nC IIA T5 Gc

Europe (EU)

Products with this mark are suitable for use in potentially explosive atmospheres.

The X20 system is certified for use in environments with explosive gases with a normal level of safety (Zone 2).

Certification of these products is performed exclusively in cooperation with EU-authorized bodies (Notified Bodies).

Each module is also accompanied by an information sheet providing detailed installation and safety guidelines.

Applicable standards from this directive:

EN 60079-0

Explosive atmospheres
Part 0: Equipment - General requirements

EN 60079-15

Explosive atmospheres
- Part 15: Equipment protection by type of protection "n"

The declaration of conformity and certificate can be downloaded from the B&R website. For information about the versions of applicable standards, see the declaration of conformity.



Declaration of conformity

[Website > Downloads > Certificates > Declarations of conformity > X20 system > EU declaration of conformity ATEX X20](#)



Certificate

[Website > Downloads > Certificates > ATEX > X20 > FTZÙ 09 ATEX 0083X](#)

10.2.1 Overview of standards

Standard	Description
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN 55011 (CISPR 11)	Industrial, scientific and medical equipment - Radio frequency disturbance characteristics - Limits and methods of measurement
EN 55016-2-1 (CISPR 16-2-1)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-1: Methods of measurement of disturbances and immunity - Conducted disturbance measurements
EN 55016-2-3 (CISPR 16-2-3)	Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements
EN 55032 (CISPR 32)	Electromagnetic compatibility of multimedia equipment - Emission requirements
EN 60068-2-6	Environmental testing - Part 2-6: Procedures - Test Fc: Vibration (sinusoidal)
EN 60068-2-27	Environmental testing - Part 2-27: Test procedure - Test Ea and guidance: Shock
EN 60068-2-31 ¹⁾	Environmental testing - Part 2-31: Test procedure - Test Ec: Rough handling shocks, mainly for devices
EN 60079-0	Explosive atmospheres Part 0: Equipment - General requirements
EN 60079-15	Explosive atmospheres - Part 15: Equipment protection by type of protection "n"
EN 60529	Degrees of protection provided by enclosures (IP code)
EN 60664-1	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests
EN 60721-3-2	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 2: Transport and handling
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather-protected locations
EN 61000-4-2	Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test
EN 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test
EN 61000-4-5	Electromagnetic compatibility (EMC) - Part 4-5: Testing and measuring techniques - Surge immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
EN 61000-4-8	Electromagnetic compatibility (EMC) - Part 4-8: Testing and measuring techniques - Power frequency magnetic field immunity test
EN 61000-4-11	Electromagnetic compatibility (EMC) - Part 4-11: Testing and measuring techniques - Voltage dips, short interruptions and voltage variations
EN 61000-4-29	Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments
EN 61131-2	Programmable logic controllers - Part 2: Guidance for inspection and routine testing
IEC 61508-1	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 1: General requirements
IEC 61508-2	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems
IEC 61508-3	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 3: Software requirements
IEC 61508-4	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 4: Definitions and abbreviations
IEC 61511-1	Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements
EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems

1) Replacement for EN 60068-2-32

10.2.2 Requirements for immunity to disturbances

Immunity	Test carried out in accordance with	Requirements in accordance with
Electrostatic discharge (ESD)	EN 61000-4-2	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
High-frequency electromagnetic fields (HF field)	EN 61000-4-3	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
High-speed transient electrical disturbances (Burst)	EN 61000-4-4	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
Surge voltages (Surge)	EN 61000-4-5	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
Conducted disturbances	EN 61000-4-6	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
Magnetic fields with electrical frequencies	EN 61000-4-8	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
Voltage dips (AC) Short-term interruptions (AC) Voltage fluctuations (AC)	EN 61000-4-11	EN 61131-2: Product standard - Programmable logic controllers EN 61000-6-2: Generic standard - Immunity to disturbances in industrial sectors
Short-term interruptions (DC) Voltage fluctuations (DC)	EN 61000-4-29	EN 61131-2: Product standard - Programmable logic controllers

Evaluation criteria for performance

Criteria	During testing	After testing
A	The PLC system shall continue to operate as intended. No loss of function or performance.	The PLC system shall continue to operate as intended.
B	Degradation of performance accepted. No change of operating mode. No irreversible loss of stored data.	The PLC system shall continue to operate as intended. Temporary degradation of performance must be self-recoverable.
C	Loss of functions accepted, but no destruction of hardware or software (programme or data).	The PLC system shall continue to operate as intended automatically, after manual restart or power off/power on.
D	Degradation or failure of functionality that can no longer be restored.	PLC system permanently damaged or destroyed.

Electrostatic discharge (ESD)

Test carried out in accordance with EN 61000-4-2	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
Contact discharge (CD) to conductive external parts		±4 kV Criteria B
Air discharge (AD) to insulating external parts		±8 kV Criteria B

High-frequency electromagnetic fields (HF field)

Test carried out in accordance with EN 61000-4-3	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
Housing, completely wired	80 MHz to 1 GHz, 10 V/m 1.4 GHz to 2 GHz, 3 V/m 2 GHz to 2.7 GHz, 1 V/m Criteria A	80 MHz to 1 GHz, 10 V/m 1.4 GHz to 6 GHz, 3 V/m Criteria A

High-speed transient electrical disturbances (Burst)

Test carried out in accordance with EN 61000-4-4	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC mains inputs >3 m	±2 kV / 5 kHz Criteria B	±2 kV / 5 kHz or 100 kHz Criteria B
AC mains outputs >3 m	±2 kV / 5 kHz Criteria B	±2 kV / 5 kHz or 100 kHz ¹⁾ Criteria B
AC other I/Os >3 m	±2 kV / 5 kHz Criteria B	-
DC mains inputs/outputs >3 m	±2 kV / 5 kHz Criteria B	±1 kV / 5 kHz or 100 kHz Criteria B
Other I/Os and interface >3 m	±1 kV / 5 kHz Criteria B	±1 kV / 5 kHz or 100 kHz Criteria B

1) Without length limitation

Surge voltages (Surge)

Test carried out in accordance with EN 61000-4-5	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC mains inputs/outputs (line to line)	±1 kV Criteria B	±1 kV Criteria B
AC mains inputs/outputs (line to PE)	±2 kV Criteria B	±2 kV Criteria B
DC mains inputs/outputs >30 m (line to line)	±0.5 kV Criteria B	±0.5 kV ¹⁾ Criteria B
DC mains inputs/outputs >30 m (line to PE)	±0.5 kV Criteria B	±1 kV ¹⁾ Criteria B
Signal connections, unshielded >30 m (line to PE)	±1 kV Criteria B	±1 kV Criteria B
All shielded lines >30 m (line to PE)	±1 kV Criteria B	-

1) Without length limitation

Conducted disturbances

Test carried out in accordance with EN 61000-4-6	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC mains inputs/outputs		10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A
DC mains inputs/outputs		10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A
Other I/Os and interfaces		10 V ¹⁾ 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A

1) Only for connections with a permitted line length >3 m.

Magnetic fields with electrical frequencies

Test carried out in accordance with EN 61000-4-8	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
Housing, completely wired		30 A/m 3 axes (x, y, z) 50/60 Hz ¹⁾ Criteria A

1) Mains frequency per manufacturer data

Voltage dips

Test carried out in accordance with EN 61000-4-11	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC power inputs	0% residual voltage 250/300 periods (50/60 Hz) ¹⁾ 20 attempts Criteria C	
	40% residual voltage 10/12 periods (50/60 Hz) ¹⁾ 20 attempts Criteria C	
	70% residual voltage 25/30 periods (50/60 Hz) ¹⁾ 20 attempts Criteria C	

1) Mains frequency per manufacturer data

Short-term interruptions

Test carried out in accordance with EN 61000-4-11 / EN 61000-4-29	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC power inputs	0% residual voltage 0.5 periods (50/60 Hz) ¹⁾ 20 interruptions Criteria A	0% residual voltage 1 period (50/60 Hz) ¹⁾ 3 interruptions Criteria B
DC power inputs	0% residual voltage ≥10 ms (PS2) 20 interruptions Criteria A	-

1) Mains frequency per manufacturer data

Voltage fluctuations

Test carried out in accordance with EN 61000-4-11 / EN 61000-4-29	Requirements in accordance with EN 61131-2 / Zone B	Requirements in accordance with EN 61000-6-2
AC power inputs	-15% / +10% Test duration per 30 minutes Criteria A	-
DC power inputs	-15% / +20% Test duration per 30 minutes Criteria A	-

10.2.3 Emission requirements

Phenomenon	Test carried out in accordance with	Limits in accordance with
Emissions related to lines	EN 55011 / EN 55032 EN 55016-2-1	EN 61131-2: Product standard - Programmable logic controllers
		EN 61000-6-4: Generic standard - Emissions in industrial sectors
Radiated emissions	EN 55011 / EN 55032 EN 55016-2-3	EN 61131-2: Product standard - Programmable logic controllers
		EN 61000-6-4: Generic standard - Emissions in industrial sectors

Emissions related to lines

Testing performed per EN 55011 / EN 55032 / EN 55016-2-1	Limits in accordance with EN 61131-2 / Zone B	Limits in accordance with EN 61000-6-4
AC mains connection 150 kHz to 30 MHz	150 kHz to 500 kHz 79 dB (μV) quasi-peak value 66 dB (μV) average value	
	500 kHz to 30 MHz 73 dB (μV) quasi-peak value 60 dB (μV) average value	
Telecommunications / network connection 150 kHz to 30 MHz	-	150 kHz to 500 kHz 97 to 87 dB (μV) quasi-peak value 53 to 40 dB (μA) quasi-peak value 84 to 74 dB (μV) average value 40 to 30 dB (μA) average value
	-	500 kHz to 30 MHz 87 dB (μV) quasi-peak value 43 dB (μA) quasi-peak value 74 dB (μV) average value 30 dB (μA) average value

Radiated emissions

Testing performed per EN 55011 / EN 55032 / EN 55016-2-3	Limits in accordance with EN 61131-2 / Zone B	Limits in accordance with EN 61000-6-4
Electric field / Measured from 10 m 30 MHz to 1 GHz	30 MHz to 230 MHz 40 dB (μV/m) quasi-peak value	
	230 MHz to 1 GHz 47 dB (μV/m) quasi-peak value	
Electric field / Measured from 3 m 1 GHz to 6 GHz ¹⁾	-	1 GHz to 3 GHz ¹⁾ 76 dB (μV/m) peak value 56 dB (μV/m) average value
	-	3 GHz to 6 GHz ¹⁾ 80 dB (μV/m) peak value 60 dB (μV/m) average value

1) Depending on highest internal frequency

10.2.4 Mechanical conditions

Testing	Test carried out in accordance with	Requirements in accordance with
Vibration (sinusoidal) / Operation	EN 60068-2-6	EN 61131-2: Product standard - Programmable logic controllers EN 60721-3-3 / Class 3M4
Shock / Operation	EN 60068-2-27	EN 61131-2: Product standard - Programmable logic controllers EN 60721-3-3 / Class 3M4
Vibration (sinusoidal) / Transport (packaged)	EN 60068-2-6	EN 60721-3-2 / Class 2M1 EN 60721-3-2 / Class 2M2 EN 60721-3-2 / Class 2M3
Shock / Transport (packaged)	EN 60068-2-27	EN 60721-3-2 / Class 2M1 EN 60721-3-2 / Class 2M2
Free fall / Transport (packaged)	EN 60068-2-31 ¹⁾	EN 61131-2: Product standard - Programmable logic controllers EN 60721-3-2 / Class 2M1
Toppling / Transport (packaged)	EN 60068-2-31	EN 60721-3-2 / Class 2M1 EN 60721-3-2 / Class 2M2 EN 60721-3-2 / Class 2M3

1) Replacement for EN 60068-2-32

Vibration (sinusoidal) / Operation

Test carried out in accordance with EN 60068-2-6	Requirements in accordance with EN 61131-2		Requirements in accordance with EN 60721-3-3 / Class 3M4	
Vibration (sinusoidal) / Operation ¹⁾	Frequency	Amplitude	Frequency	Amplitude
	5 to 8.4 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3 mm
	8.4 to 150 Hz	Acceleration 1 g ²⁾	9 to 200 Hz	Acceleration 1 g ²⁾
	20 sweeps for each axis ³⁾			

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute

2) 1 g = 10 m/s²

3) 2 sweeps = 1 frequency cycle (fmin → fmax → fmin)

Shock / Operation

Test carried out in accordance with EN 60068-2-27	Requirements in accordance with EN 61131-2	Requirements in accordance with EN 60721-3-3 / Class 3M4
Shock / Operation ¹⁾	Acceleration 15 g Duration 11 ms 18 shocks	Acceleration 10 g Duration 11 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z)

Vibration (sinusoidal) / Transport (packaged)

Test carried out in accordance with EN 60068-2-6	Requirements in accordance with EN 60721-3-2 / Class 2M1		Requirements in accordance with EN 60721-3-2 / Class 2M2		Requirements in accordance with EN 60721-3-2 / Class 2M3	
Vibration (sinusoidal) / Transport (packaged) ¹⁾	Frequency	Amplitude	Frequency	Amplitude	Frequency	Amplitude
	2 to 9 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3.5 mm	2 to 8 Hz	Deflection 7.5 mm
	9 to 200 Hz	Acceleration 1 g ²⁾	9 to 200 Hz	Acceleration 1 g ²⁾	8 to 200 Hz	Acceleration 2 g ²⁾
	200 to 500 Hz	Acceleration 1.5 g ²⁾	200 to 500 Hz	Acceleration 1.5 g ²⁾	200 to 500 Hz	Acceleration 4 g ²⁾
20 sweeps for each axis ³⁾						

1) Uninterrupted duty with movable frequency in all 3 axes (x, y, z); 1 octave per minute

2) 1 g = 10 m/s²

3) 2 sweeps = 1 frequency cycle (fmin → fmax → fmin)

Shock / Transport (packaged)

Test carried out in accordance with EN 60068-2-27	Requirements in accordance with EN 60721-3-2 / Class 2M1	Requirements in accordance with EN 60721-3-2 / Class 2M2
Shock / Transport (packaged) ¹⁾	Type I Acceleration 10 g Duration 11 ms 18 shocks	
	Type II -	Type II Acceleration 30 g Duration 6 ms 18 shocks

1) Pulse (half-sine) stress in all 3 axes (x, y, z)

Free fall / Transport (packaged)

Tests in accordance with EN 60068-2-31	Requirements in accordance with EN 61131-2 with shipping packaging		Requirements in accordance with EN 61131-2 with shipping packaging		Requirements in accordance with EN 60721-3-2 / Class 2M1	
Free fall / Transport (packaged)	Weight	Height	Weight	Height	Weight	Height
	<10 kg	1.0 m	<10 kg	0.3 m	<20 kg	0.25 m
	10 to 40 kg	0.5 m	10 to 40 kg	0.3 m	20 to 100 kg	0.25 m
	>40 kg	0.25 m	>40 kg	0.25 m	>100 kg	0.1 m
5 attempts						

1) Replacement for EN 60068-2-32

Toppling / Transport (packaged)

Test carried out in accordance with EN 60068-2-31	Requirements in accordance with EN 60721-3-2 / Class 2M1		Requirements in accordance with EN 60721-3-2 / Class 2M2		Requirements in accordance with EN 60721-3-2 / Class 2M3	
Toppling / Transport (packaged)	Weight	Required	Weight	Required	Weight	Required
	<20 kg	Yes	<20 kg	Yes	<20 kg	Yes
	20 to 100 kg	-	20 to 100 kg	Yes	20 to 100 kg	Yes
	>100 kg	-	>100 kg	-	>100 kg	Yes
Topple on all edges						

10.2.5 Electrical safety**Overvoltage category**

Requirement per EN 61131-2	Definition per EN 60664-1
Overvoltage category II	Equipment of "Overvoltage category II" is energy-consuming equipment to be supplied by the fixed installation.

Pollution degree

Requirement per EN 61131-2	Definition per EN 60664-1
Pollution degree 2	Only non-conductive pollution occurs. Occasionally, however, temporary conductivity caused by condensation is to be expected.

Protection rating provided by enclosure (IP code)

Requirement per EN 61131-2	Meaning of codes per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
≥IP20	First number IP2x	Protected against solid foreign bodies with a diameter ≥12.5 mm.	Protected against touching dangerous parts with fingers.
	Second number IPx0	Not protected.	-

10.3 UL / CSA



Underwriters Laboratories (UL)

Products with this mark are tested by Underwriters Laboratories and listed as "industrial control equipment" in category NRAQ (programmable controllers) with file number E115267.

The mark is valid for the USA and Canada and facilitates the certification of your machines and systems in this economic area.

Standards applied:

UL 508
UL 61010-1

UL 61010-2-201

CSA C22.2 No. 142-M1987
CSA C22.2 No. 61010-1

CSA C22.2 No. 61010-2-201

Standard for industrial control equipment

Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

Standard for safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-201: Particular requirements for control equipment

Process control equipment

Safety requirements for electrical equipment for measurement, control and laboratory use - Part 1: General requirements

Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-201: Particular requirements for control equipment



Certificate

[Website > Downloads > Certificates > UL > X20 > E115267 UL Certificate of Compliance - X20](#)

CSA HazLoc



Canadian Standards Association (CSA)

Products with this mark are certified by the Canadian Standard Association and suitable for use in potentially explosive atmospheres.

The products are listed in CLASS 2258 (Process control equipment - For hazardous locations) with file number 244665.

The X20 system has a hazardous locations certification for class I, division 2.

Each certified module is accompanied by an information sheet providing detailed installation and safety guidelines.

The mark is valid for the USA and Canada and facilitates the certification of your machines and systems in this economic area.

Standards applied:

CSA C22.2 No. 0-M1991
CSA C22.2 No. 142-M1987
CSA C22.2 No. 213-M1987
UL Std No. 916:2007
ANSI/ISA 12.12.01:2007

General requirements - Canadian electrical code part II

Process control equipment

Nonincendive electrical equipment for use in class I, division 2 hazardous locations

Energy management equipment

Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Division 1 and 2 Hazardous (Classified) Locations



Certificate

[Website > Downloads > Certificate > HazLoc > CSA > X20, X67 > 244665 CSA HazLoc Certificate of Compliance - X20, X67](#)

10.4 Offshore/Maritime

ABS



USA

American Bureau of Shipping

Products are suitable for use in the maritime sector in accordance with ABS regulations (ABS rules).

Standards applied:

ABS rules



Certificate

[Website > Downloads > Certificates > Maritime > ABS > X20 > ABS certificate of product design assessment - X20 I/O series](#)

CCS



China

CHINA CLASSIFICATION SOCIETY

Products are suitable for use in maritime environments in accordance with the guidelines set forth by the Chinese Register of Shipping.

Standards applied:

CCS-Rules for Classification

Chapter 2, Part Seven of China Classification Society Rules for Classification of Sea-going Steel Ships 2023 and its Change Notices



Certificate

[Website > Downloads > Certificates > Maritime > CCS > X20 > Certificate of type approval](#)

DNV



**Germany
Norway**

Det Norske Veritas

A selected portfolio from B&R has DNV type approval and is therefore suitable for maritime applications.

DNV maritime certificates (type approval) are generally accepted by other classification societies during ship acceptance procedures.

For corresponding environmental categories, see the technical data for the respective product.

Standards applied:

DNV-CG-0339

Environmental test specification for electrical, electronic and programmable equipment and systems



Certificate

[Website > Downloads > Certificates > Maritime > DNV > X20 > DNV type approval certificate - X20](#)

KR



Korean Register of Shipping

Products are suitable for use in maritime environments in accordance with the guidelines set forth by the Korean Register of Shipping.

Standards applied:

List of Approved Manufacturers and Type Approved Equipment (Pt. 6, Ch. 2, Art. 301 of the Rules for Classification, Steel Ships).



Certificate

[Website > Downloads > Certificates > Maritime > KR > X20 > KR type approval certificate MIL39390-AC003 \(X20 system\)](#)

LR



15/20082

Great Britain

Lloyd's Register

Products are suitable for use in maritime environments in accordance with the guidelines set forth by the Lloyd's Register classification society.

Certification has taken place for marine, offshore and industrial applications for environmental categories ENV1, ENV2 and ENV3.

Safety technology assemblies are certified for ENV1 and ENV2

These environmental categories are defined in Lloyd's Register's type approval system,
test specification number 1-2015.

Covered standard:

Test Specification Number 1-2015 Lloyd's Register's type approval system



Certificate

[Website > Downloads > Certificates > Maritime > LR > X20 / Power Panels T30 / T50 > Lloyd's Register](#)

Additional tests



Information:

In addition, testing is performed on shipping classes per IACS E10 and IEC 60945 section 1c.

10.5 Other certifications

KC



Korean Conformity (KC)

Products with this marking have been tested by an accredited testing laboratory and approved for import to the Korean market (based on EU compliance).

RCM



Regulatory Compliance Mark (RCM)

Products with this marking have been tested by an accredited testing laboratory and certified by the ACMA. This marking is valid in Australia/Oceania and simplifies the certification of your machines and systems in these areas (based on EU compliance).

11 Environmentally friendly disposal

All B&R control components are designed to inflict as little harm on the environment as possible.

11.1 Separation of materials

It is necessary to separate different materials so the device can undergo an environmentally friendly recycling process.

Component	Disposal
X20 modules Cables	Electronic recycling
Cardboard/paper packaging	Paper/Cardboard recycling

Table 29: Environmentally friendly separation of materials

Disposal must comply with applicable legal regulations.

12 Additional information

12.1 EMC information

12.1.1 Electromagnetic compatibility (EMC)

This refers to the ability of a device or system to function satisfactorily in its electromagnetic environment without introducing unacceptable electromagnetic disturbances into this environment, which also includes other devices.

12.1.2 Interference

Automation systems are generally affected by conducted and radiated electromagnetic interference in their operating locations.

These are then adjusted in test standards and tested for resistance to these disturbances during conformity testing of the products.

Conducted interference via

- Supply lines
- Process wiring
- Communication lines
- Grounding

Radiated interference via

- Openings in metal housings
- Plastic housings (no shielding effect)

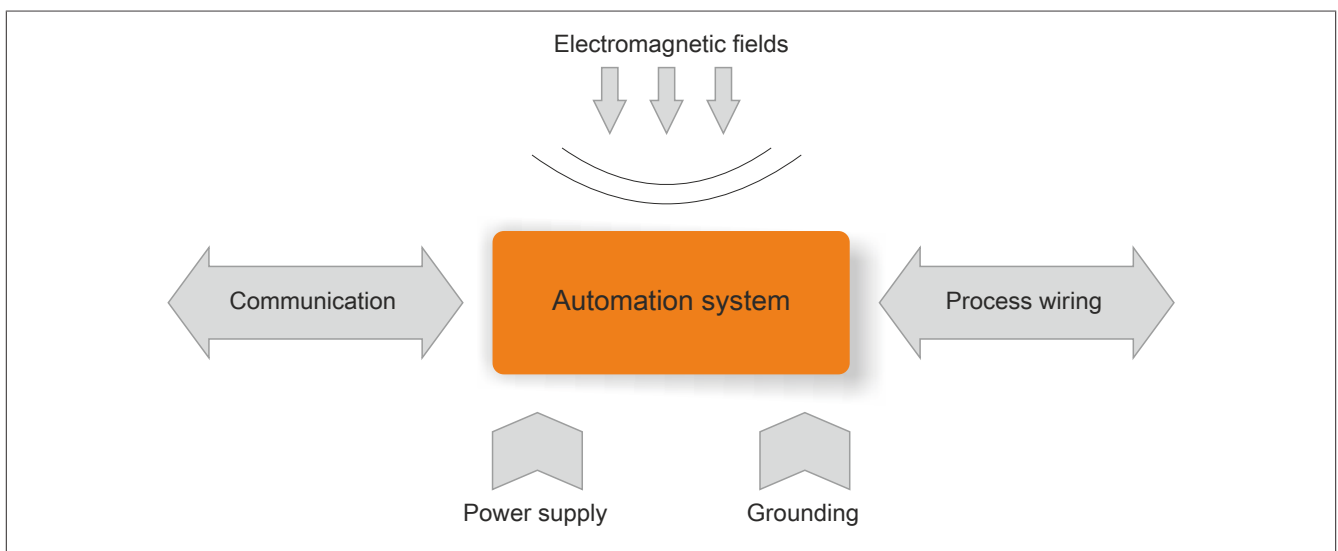


Figure 40: Interference

12.1.3 Types of couplings

Direct coupling

- Clocked modules
- Startup of a motor
- Differences in potential

Capacitive coupling (electric field)

- Wires running in parallel
- Static discharge

Inductive coupling (magnetic field)

- Mains wires running in parallel, connected wires
- Transformers, motors, etc.

Radiative coupling (electromagnetic field)

- Radio transmitters (mobile telephony, citizens band radio)
- Radio links (welding equipment)

12.1.4 Wiring basics

Wiring arrangement

- Spatial separation of supply lines and signal lines
- Always cross wires from individual categories at right angles
- Ground unused wires on both sides
- Lay wires along the reference surface as much as possible
- Avoid ground loops as much as possible
- Lay outgoing and return lines together along the entire length
- Lay ground and power supply lines together
- Lay cables in a metallic tray as close to the side walls as possible

Shielded lines

- The cable shield should extend as close as possible to the end of the cable.
- The cable shield should be grounded over as wide an area as possible.
- The cable shield should always be grounded on both sides.
- The cable shield should be grounded when routing into the control cabinet and again directly at the connector.

Grounding

- Good conducting connection of all conductive machine components over a wide area
- Connection to ground potential dimensioned with sufficient strength ($\geq 16 \text{ mm}^2$ to the control cabinet, $\geq 4 \text{ mm}^2$ to the products)
- Centralized star-shaped grounding point (no loops)

12.1.5 Application-specific measures

When installing the X20 System, no additional measures regarding leakage currents and filters are generally required.

However, specific applications may require this:

12.1.5.1 Switching inductive loads (coils, contactors, relays)

- A load-dependent protective circuit for the outputs is required for various modules. Inductive loads with DC voltage can create voltage reflections that can result in overshoot. This can damage the output devices or shorten their service life.
- Interference suppression of contactor coils

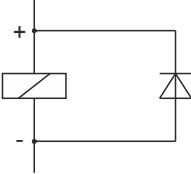
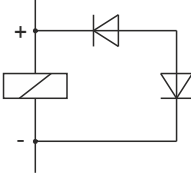
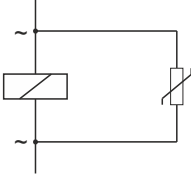
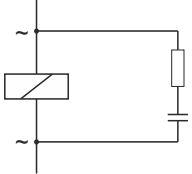
Inductive DC loads		Inductive AC loads	
With diode	With Z-diode	With varistor	With RC element
			

Table 30: Application-specific measures



Notice!

For the use of UL-listed in North and South America, a varistor of UL category "VZCA (surge-protective devices) / Type 2" corresponding to the inductive load is required.

12.1.5.2 Lighting with fluorescent tubes

- Additional interference suppression for control cabinet lighting with fluorescent tubes

12.1.6 Shielded lines

Shielded lines for guaranteeing disturbance-free operation are essential for many applications, for example:

- Fieldbus modules (Ethernet, POWERLINK, X2X Link, CAN bus, etc.)
- reACTION Technology modules
- Analog modules (inputs and outputs)
- Counter modules/functions
- PWM outputs
- Safety technology (safety modules)
- Temperature measurement modules
- Motor control
- ACOPOSinverter
- etc.

For all details regarding wiring in accordance with regulations, see the respective user's manual. If not described otherwise, grounding on both sides is preferred. A shield connection on both sides generally provides optimal damping of all coupled interference frequencies.

The use of a shield connection on only one side is not permitted with potential differences. Possible potential differences must be prevented using an equipotential bonding conductor.

12.1.6.1 Recommended cables

Cables available from B&R are recommended for wiring. All available variants and lengths are available in section [Accessories](#) or on the B&R website.

For example: Ethernet/POWERLINK

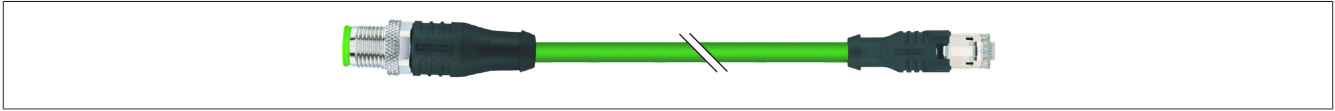


Figure 41: X20/67 cable

(B&R material number: X67CA0E41.xxxx, length specifications: 1 m (xxx = 0010) to 50 m (xxx = 0500)).

The following wiring guidelines must be observed:

- Use CAT 5 SF/UTP industrial data cables.
- Observe the minimum cable bend radius (see data sheet for the cable).
- Fasten the cable underneath the bus controller. The cable must be fastened vertically under the female RJ45 connector on the bus controller.
- The customer must implement additional measures in the event of further requirements.

12.1.7 X2X Link settings

To improve the EMC radiation of the X2X Link network, the following settings must be made in Automation Studio:

- 1) Setting the number of stations: By default, the value is set to 64 stations. This value should be set to the number of stations actually present; otherwise, the X2X Link master will search for unavailable stations and amplify the signal.
- 2) Reduce the cable length: Reduce the cable length to the cable length you are actually using.

12.1.8 Environmental characteristics

The table below contains general environmental characteristics.

The product-specific data sheets contain more detailed information about any reduced ambient conditions (derating). These are available under the order number of the respective product on the B&R website (www.br-automation.com) and can be downloaded from there.

The specifications must be checked and taken into account.

Additional information

General requirements

Characteristics		Specification	
Ambient temperature during operation	All standard modules, all coated modules, all coated safety modules	-25 to 60°C	Horizontal mounting orientation
		-25 to 50°C	Vertical mounting orientation
	All safety modules	0 to 60°C	Horizontal mounting orientation
		0 to 50°C	Vertical mounting orientation
Relative humidity during operation	All standard modules, all safety modules	Up to 95%	non-condensing
	All coated modules, all coated safety modules	Up to 100%	Condensing possible
Operating elevation	All modules	0 to 2000 m	Installation at elevations above sea level
		>2000 m	See data sheet.
Resistance to vibration during operation (EN 60068-2-6)	All modules	1 g	Requirement in accordance with EN 61131-2
Shock resistance during operation (EN 60068-2-27)	All modules	15 g	Requirement in accordance with EN 61131-2
Overvoltage category (EN 60664-1)	All modules	II	Requirement in accordance with EN 61131-2
Pollution degree (EN 60664-1)	All modules	2	Requirement in accordance with EN 61131-2
Protection rating (IP code) (EN 60529)	All modules	IP20	Control cabinet installation required

1 g = 10 m/s²

In addition to the general specifications in this table, the technical data of the respective products must be checked and any necessary derating must be taken into account!

Vibration and shock resistance values are valid only under the condition that the connection lines are installed properly and components are mounted correctly.

Definitions per EN 60664-1

Overvoltage category II: Energy-consuming equipment supplied from the fixed installation.
Overvoltage category III: Equipment in fixed installations and for cases in which special requirements are placed on the reliability and availability of the equipment.
Pollution degree 2: Only non-conductive pollution occurs. Temporary conductivity caused by condensation must occasionally be expected, however.

Degree of protection provided by enclosure (IP code) per EN 60529

IP20 protection	First number IP2x	Protection against ingress of solid foreign bodies ≥12.5 mm diameter.
	Second number IPx0	Not protected against ingress of water with harmful effects.
IP65 protection	First number IP6x	Dust-proof
	Second number IPx5	Protected against water jets
IP67 protection	First number IP6x	Dust-proof
	Second number IPx7	Protected against temporary submersion

12.2 Open source licenses

The controllers in the X20CP*68*, X20CP04* and X20EM* product families contain open source projects as part of their platform firmware. These include:

- Coreboot
- U-Boot

For detailed information about the open source project versions used for the individual X20 product versions as well as their license conditions, see the Downloads section of the respective product on the [B&R website \(https://www.br-automation.com\)](https://www.br-automation.com).

The Downloads section contains a ZIP file named "Open_Source_Licenses_X20CPx68x_X20EMx_<DATE>.zip", where <DATE> is the respective creation date of the ZIP file.

12.3 Diagnostic LEDs

LEDs for diagnostics are located at the top of most X20 I/O modules. The following LEDs are available depending on the module to indicate the operating state:

- LEDs "r" (green) and "e" (red)
- LED "s" (red/green) LED

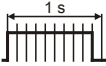
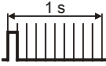
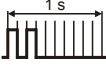
Additional LEDs are module-specific and usually indicate the state of I/O channels. Green LEDs are usually used for inputs, while orange LEDs are usually used for outputs. These I/O LED status indicators are only operational in mode RUN on some modules.

Operating states and error states

The following table provides a complete description of all operating states and error states for X20 I/O modules. The operating state and error state actually indicated by the I/O module depends on the type of module as well as how it is being used.

	LED	Description	Note
r/e/s LEDs			
	All LEDs off	No power to module	The module does not have power.
	Module status: Green LED		
	Single flash (red LED = Off)	Mode RESET	No connection to the X2X Link master, or the X2X Link master is not yet running. Some modules remain in single flash mode during a firmware update.
		Not configured	The module was connected behind bus receiver X20BR7300, but it is not configured. ²⁾
	Single flash (red LED = On)	Invalid firmware	Invalid firmware: Occurs when a firmware update has been interrupted. The firmware is reloaded as soon as the X2X Link master is active again. It is only loaded if the module is also entered in the configuration, however.
	Double flash	BOOT mode (mode RESET with communication)	Firmware update. A firmware update usually only takes place once after the module has been replaced or if new firmware has been loaded to the master controller during a project update.
			 Depending on the configuration, a firmware update can take several minutes.
	Not configured		
			The module was connected behind bus receiver X20BR7300, but it is not configured. ²⁾
	Blinking	Mode PREOPERATIONAL	Modules whose slot is configured for a different module (or none at all) remain in mode PREOPERATIONAL. Possible errors: • Incorrect module connected or slot not configured • Incorrect slot number for bus modules with node number switches
	Blinking quickly	Mode SYNC	Module synchronizing with X2X Link network
	On	Mode RUN	No error
	Error status: Red LED (green LED = On)		
	Off		Everything OK
	On	Fatal error	It is not possible for the module to continue functioning correctly. Possible errors: • Power supply outside warning range • Operating temperature outside permissible range
			 Monitoring for fatal errors is not integrated into all modules.
	Single flash or blinking	I/O channel error	An error or warning is present on one or more I/O channels. Which channel error on the module is being indicated depends on the module and can be determined with the respective module description.
	Double flash	System errors	A system error occurred in the module. The cause of error depends on the module and can be determined with the respective module description.
	Triple flash	I/O error and system error	An I/O error and system error occurred at the same time.
	Single flash, inverted ¹⁾	Fatal error and I/O error	A fatal error and I/O error occurred at the same time.
	Double flash, inverted ¹⁾	Fatal error and system error	A fatal error and system error occurred at the same time.
	Triple flash, inverted ¹⁾	Fatal error, I/O error and system error	A fatal error, I/O error and system error occurred at the same time.

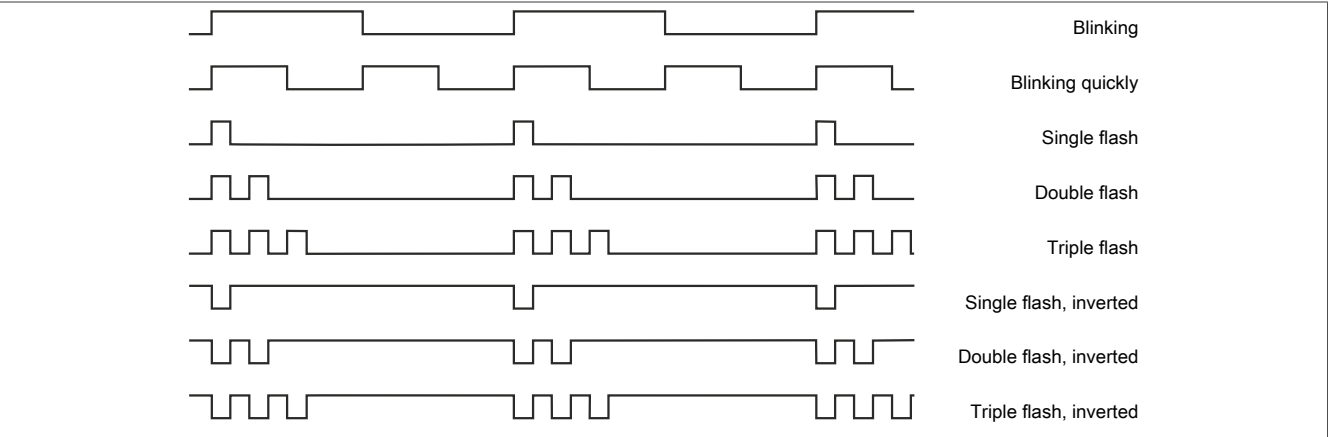
Additional information

	LED	Description	Note
	Safety SE-LED		
	Off		Mode RUN or I/O component not provided with voltage
	Single flash, inverted		Boot phase, missing X2X Link or defective processor
	Single flash		Safety PREOPERATIONAL state. Modules that are not used in the SafeDESIGNER application remain in state PREOPERATIONAL.
	Double flash		Safe communication channel not OK
	Flashes		The firmware for this module is a non-certified pilot customer version.
	Blinking		Boot phase, faulty firmware
	On		Safety state active for the entire module (state "FailSafe")

- 1) Only on modules that monitor for fatal errors.
2) The blinking behavior (single or double flash) depends on the X20 module being used.

LED status indicators - Blinking patterns

The blinking patterns shown in this image specify only the principle ratio between the switch-on and switch-off time for the LED. The actual ratio of blink times to each other can vary depending on the module.



12.4 Using I/O modules on the bus controller

If an I/O module is used after a bus controller, the X2X module registers and functions that can be used depend on the bus controller used.

- **Non-configurable bus controllers**

By default, "Function model 254 - Bus controller" is used here. This includes:

- **CAN I/O bus controllers:** X20BC0073, X67BC7321, X67BC7321-1

- **PROFIBUS bus controllers**

Only the X2X module registers listed in the PROFIBUS user's manual can be used for the supported modules. The PROFIBUS user's manual can be downloaded from the B&R website.

- **PROFINET bus controllers**

Only the X2X module registers listed in the GSDML file can be used for the supported modules. This file can be downloaded from the B&R website. The PDF document included in the GSDML package lists all available X2X module registers.

- **Using the automatic configuration**

With all other bus controllers, "Function model 254 - Bus controller" is used by default when using the automatic configuration.

- **Fully configurable bus controllers**

When operating an I/O module on a fully configurable bus controller (e.g. X20BC0043-10), all available functions and registers of the respective I/O module can be used. In this case, "Function model 0 - Standard" is used as the default setting when adding X2X modules in Automation Studio.

If additional function models are available in the I/O module (e.g. "Function model OSP" for digital output modules), they can also be used as long as it makes sense to use them with the bus controller. Full configurations for CANopen, Modbus, EtherCAT, EtherNet/IP and POWERLINK can be made with Automation Studio V4.3 or later.



Information:

Automation Studio can be downloaded at no cost from the B&R website (www.br-automation.com). The evaluation license is permitted to be used to create complete configurations for fieldbus bus controllers at no cost.

Overview of possible configuration types

	CANopen	EtherNet/IP	PROFIBUS	OPC UA	EtherCAT
	X20BC0043-10 X20BC0143-10 X67BC4321-10 X67BC4321.L08-10 X67BC4321.L12-10	X20(c)BC0088 X67BCD321.L12	X20BC0063 X67BC6321 X67BC6321.L08 X67BC6321.L12	X20BC008U	X20BC00G3 X67BCG321.L12
Automatic configuration	•	•		•	•
Full configuration	•	•	•	•	•
	Modbus	PROFINET	CAN I/O	POWERLINK	
	X20(c)BC0087 X67BCJ321.L12	X20(c)BC00E3 X67BCE321.L12	X20BC0073 X67BC7321-1	e.g. X20BC0083 e.g. X67BC8321-1	
Automatic configuration	•		•	•	
Full configuration	•	•		•	

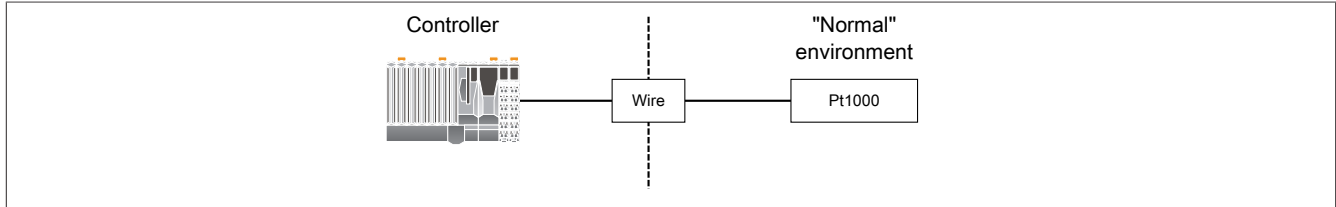
12.5 Temperature modules - measurement methods

Depending on the area to be measured, there are two different methods for determining the temperature.

Method 1: Direct measurement using measurement resistor

The temperature module measures an electrical value that makes it possible to directly infer the current absolute temperature.

Measurement of the absolute temperature in a "normal" environment.



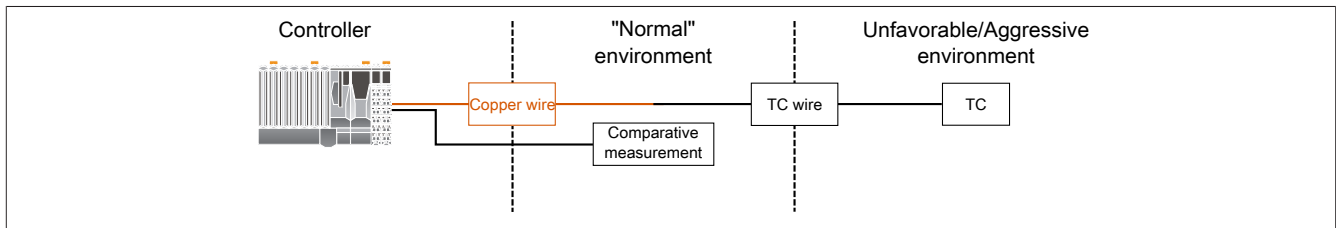
A measurement resistor often used in this method is the PT1000. Measuring the electrical resistance can be used to determine the absolute temperature at the measurement point for a temperature range of approximately -200°C to 850°C.

Method 2: Indirect measurement using thermocouples

Thermocouples are primarily used whenever it is not possible to use measurement resistors, for example because the environment directly around the measurement point contains aggressive gases.

This method of measuring bears on the basics of the thermoelectric effect. The module measures an electrical voltage, which can then be used to derive the difference in temperature.

Measurement of the temperature difference between a "normal" and aggressive environment.



Thermocouple modules from B&R prepare the temperature value at the measurement point as an absolute value. The measured temperature difference is referenced against another temperature that is usually measured directly at another location (see method 1).



Information:

In the best case, the temperature at the location where the thermocouple crosses an inexpensive copper cable is used as the reference or compensation value.

12.6 General data points

In addition to the registers listed in the register description, X20 modules also have other more general data points. These registers are not specific to the module but contain general information such as serial number and hardware version.

12.6.1 FirmwareVersion

Name:

FirmwareVersion

The firmware version of the module can be read using this data point.

The last two positions correspond to the number after the decimal point.

Example: 345 corresponds to 3.45.

Data type	Values	Information
UINT	1 to 99	Release version of older modules or developmental versions of new modules
	100 to 29999	Release version
	30000 to 59999	Test version

12.6.2 HardwareVariant

Name:

HardwareVariant

The hardware variant of the module can be read using this data point.

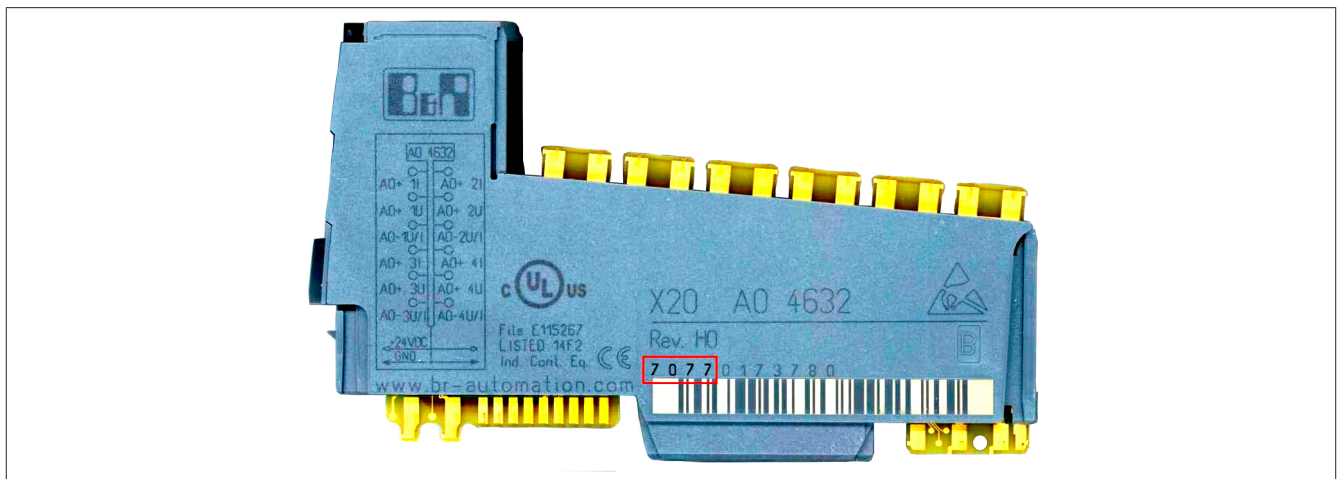
Data type	Values
UINT	0 to 65535

12.6.3 ModuleID

Name:

ModuleID

The module ID of the module can be read using this data point. For the module hardware ID, see the respective module documentation. In addition, a serial number is printed on each electronics module; the module hardware ID corresponds to the first four positions of the serial number. (See figure: Hardware ID is also colored black.)



Data type	Values
UINT	0 to 65535



Information:

IDs starting with 9999 are printed as hexadecimal numbers and must be converted to their decimal values for comparison!

Additional information

12.6.4 ModuleOK

Name:

ModuleOK

Whether the module is physically present in the slot or not can be read from this register.

Data type	Value	Information
BOOL	0	Module not ready for operation
	1	Module connected and configured

12.6.5 SerialNumber

Name:

SerialNumber

The module's unique serial number can be read using this data point.

The complete serial number is made up of **ModuleID** and SerialNumber as follows: Serial number = (Hardware ID * 1E+7) + SerialNumber

The serial number is printed in decimal form on the module's housing.

Example

Hardware ID = (decimal) 1213

Serial number = (decimal) 671339

Module serial number = $1213 * 10000000 + 671339 = 12130671339$

Data type	Values
UDINT	0 to 4,294,967,295

12.6.6 StaleData

Name:

StaleData

Whether the transferred data originates from the current cycle or a previous cycle can be read using this data point.

This error can result from cycle times that are too short or disturbances in module communication, for example.



Information:

This data point is only valid if **ModuleOK** = 1.

Data type	Value	Information
BOOL	0	Data originates from the current cycle
	1	Data does not originate from the current cycle

12.7 General controller data points

Although X20 controllers do not normally have a register description, they do have several general data points. These are not controller-specific; instead, they contain general information such as system time and heat sink temperature.



Information:

Some data points and data types are controller-specific. Not every X20 controller provides all data points.

12.7.1 BatteryStatusCPU

Name:

BatteryStatusCPU

The state of the battery contained in the controller can be read from this data point.

Data type	Values	Information
USINT	0	Battery voltage too low or battery missing
	1	Battery OK

12.7.2 ModeSwitch

Name:

ModeSwitch

The operating mode of the controller can be read from this data point.

Data type	Values	Information
USINT	0	Mode BOOT ¹⁾
	1 to 2	Reserved ²⁾
	4	Mode RUN
	3 to 14	Reserved ²⁾
	15	Mode DIAG ¹⁾

1) Value cannot be read since data points can only be evaluated in mode RUN.

2) Currently also used for mode RUN.

12.7.3 StatusInput01

Name:

StatusInput01

The state of the supply voltage can be read from this data point.

Data type	Values	Information
BOOL	0	Supply voltage OK
	1	Supply voltage outside valid range

12.7.4 StorageWear

Name:

StorageWear

The condition of the data storage medium can be read out in percent from this data point. For a detailed description of the "storage health data" function, see Automation Help.

Data type	Values	Information
UINT	0 to 100	0%
		New data storage medium
		90%
	>100	Threshold value warning: Have a new data storage medium ready.
		100%
	65535	Expected service life: Replace the data storage medium.
		Expected service life exceeded: Replace the data storage medium.
		The condition of the data storage medium cannot be determined:
		- The data storage medium is not supported. - No condition data is available.

Additional information

12.7.5 SupplyCurrent

Name:
SupplyCurrent

This register displays the bus power supply current measured at a resolution of 0.1 A.

Data type	Values	Information
USINT	0 to 255	Current in 1/10 A

12.7.6 SupplyVoltage

Name:
SupplyVoltage

This register indicates the bus supply voltage measured at a resolution of 0.1 V.

Data type	Values	Information
USINT	0 to 255	Voltage in 1/10 V

12.7.7 SystemTime

Name:
SystemTime

The starting time of a specific task class in μ s can be read from this data point. The system time is latched at the beginning of the cycle of the task class that contains this data point.



Information:

Because the DINT counter overflows and resets approximately every 70 minutes, it is only possible to read out the relative system time.

Data type	Values
DINT	-2,147,483,648 to 2,147,483,647

12.7.8 TemperatureCPU

Name:
TemperatureCPU

The internal temperature of the CPU can be read from this data point. The data type depends on the controller family:

- UINT: Older controller families (e.g. X20CPx48x), temperature range starting at 0°C
- INT: Newer controller families (e.g. X20CPx58X, Compact-S controllers), temperature range starting at -20°C.

Data type	Values	Information
UINT	0 to 65535	Temperature in 1/10°C
INT	-32768 to 32767	

12.7.9 TemperatureENV

Name:
TemperatureENV

The temperature of the CPU heat sink can be read from this data point. The data type depends on the controller family:

- UINT: Older controller families (e.g. X20CPx48x), temperature range starting at 0°C
- INT: Newer controller families (e.g. X20CPx58X, Compact-S controllers), temperature range starting at -20°C.

Data type	Values	Information
UINT	0 to 65535	Temperature in 1/10°C
INT	-32768 to 32767	

12.8 Blackout mode

Blackout mode allows users to continue execution of the application in lower-level subsystems if components of the B&R system fail. In this way, the B&R system – independently of redundancy technology – makes it possible to respond to system-critical situations based on the specific application.

The use of blackout-capable modules is recommended for the following requirements:

- Exit routines on system failure, e.g. to enable the opening of a press if the system fails.
- Stopping or controlled setting of an output on system failure, e.g. to automatically close inflow valves.
- Deceleration sequences on system failure, e.g. to reduce motor speeds before transmitting a stop command.

If blackout-capable modules are configured accordingly, blackout mode will be carried out if the network connection to the higher-level controller is interrupted.

As soon as the network disturbance has been corrected, blackout mode is stopped by the modules and bumpless synchronization with the network takes place.

Requirements for operation

The following requirements must be met in order to use blackout mode:

- The module being used must support blackout mode.
- Parameter "Blackout mode" must be enabled in Automation Studio.

12.8.1 Areas of use

Through the use of blackout-capable modules, a part of the control system can also remain functional if a disturbance in the network or X2X Link connection between the modules occurs.

12.8.1.1 Loss of POWERLINK connection

Initial situation

Several stations in an application are connected to the controller via network cables. A fault occurs that interrupts data transfer between the controller and stations.

Effect

Non-blackout modules are reset and operated according to their default characteristics.

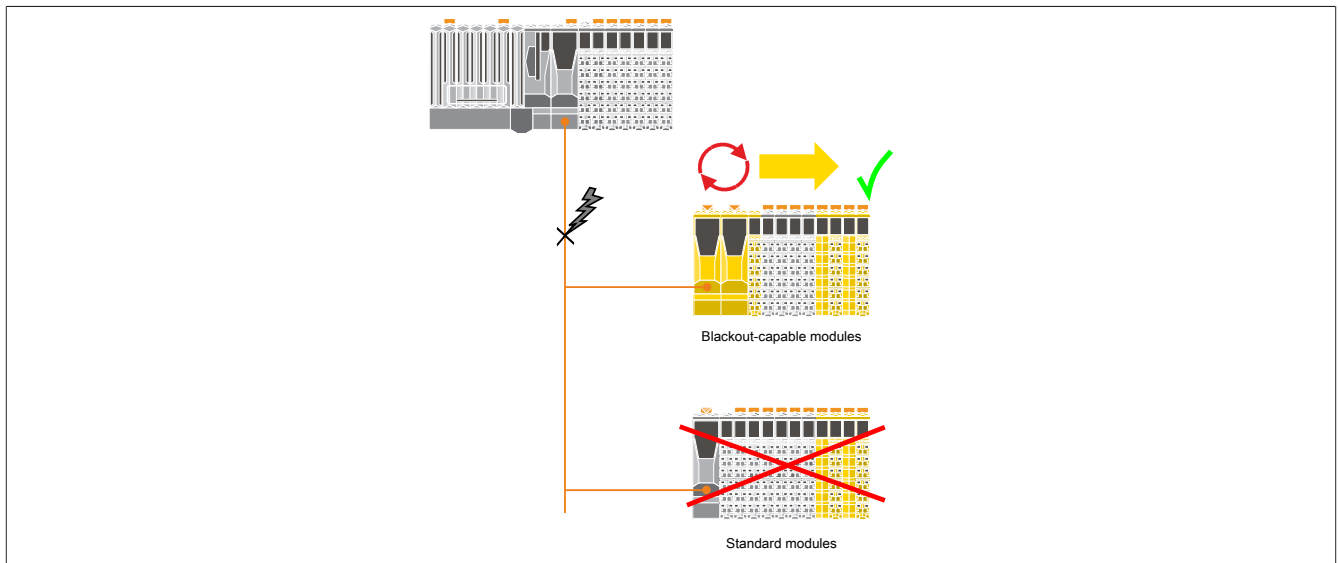
Blackout-capable modules show the following behavior:

- The programmed function continues to be executed.
- Subordinate networks continue to work.
- Data from the controller is initialized with "0".
- After the disturbance has been corrected, the module bumplessly returns to the higher-level network.



Warning!

Blackout mode causes data from the controller to be initialized with "0". If blackout mode is used in combination with "output inversion", this can result in the unintentional setting of outputs.



12.8.1.2 Loss of X2X Link connection

Initial situation

Modules in an application are connected to the network via X2X Link cables. A defect in the X2X Link cable causes the data transfer between the controller and modules to be interrupted.

Effect

Non-blackout modules are reset and operated according to their default characteristics.

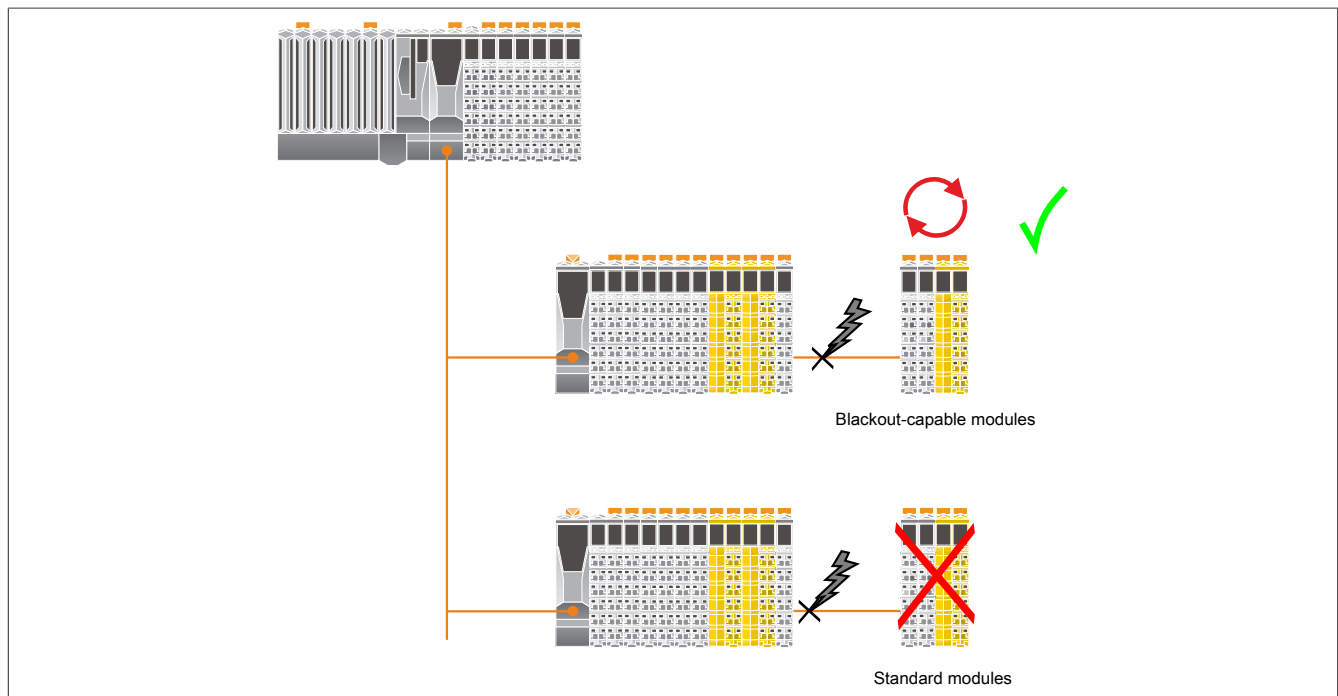
Blackout-capable modules show the following behavior:

- The programmed function continues to be executed.
- Subordinate networks continue to work.
- Data from the controller is initialized with "0".
- After the disturbance has been corrected, the module bumplessly returns to the higher-level network.



Warning!

Blackout mode causes data from the controller to be initialized with "0". If blackout mode is used in combination with "output inversion", this can result in the unintentional setting of outputs.



12.8.2 Programming blackout mode

Blackout mode cannot be detected by the blackout-capable modules themselves. If it is necessary to program specific blackout behavior in an application, an indirect method must therefore be chosen.

One possibility is to implement a counter in the blackout-capable module's higher-level controller and query it cyclically. Blackout mode would make itself noticeable in this case by a counter value that no longer changes or a counter value of zero.

Blackout-capable modules can be divided into 2 categories:

- **Programmable modules**
The blackout function is programmed using existing function blocks. In other words, the existing technologies for application programming or reACTION Technology are used.
The blackout function is executed largely independently of other system components.
- **Standard function modules**
These modules are not programmable and maintain their default behavior in blackout mode.

12.8.3 Standalone function

The standalone function is an extension of blackout mode. After switching on the power supply, blackout mode is enabled immediately regardless of whether a network connection exists. This means that after switching on the power supply, the module begins executing the most recently saved configuration or application without waiting for activity or synchronization with a higher-level controller or SafeLOGIC controller.

As soon as the network is active, bumpless synchronization between the module and existing network takes place.



Warning!

Standalone modules act identically to blackout mode on system startup and until the network connection is established. Their use therefore requires extreme caution!

Requirements for operation

The following requirements must be met in order to use the standalone function:

- The module being used must support the standalone function.
- Parameter "Standalone mode" must be enabled in Automation Studio.
- For the standalone function on the bus controller (e.g. X20SL8101), blackout mode is enabled for at least 1 module on the local X2X Link network.
- The module must have been operated with a controller at least once in order to have a valid configuration.



Information:

The DNA and standalone functions are not permitted to be combined in a POWERLINK network. If the standalone function should be used, node numbers must be assigned manually to all devices in the network.



Warning!

The following aspects need to be taken into account in particular:

- **The module must be clearly (and permanently) identified to highlight its distinctive behavior from the standard.**
- **Service technicians must be well-versed with the special characteristics of these modules.**
- **Before connecting the terminal block to a module with an enabled standalone function, at least one of the following conditions must be met:**
 - **It must be ensured that the module is really meant to be operated with the standalone function and the configuration on the module has been checked for correctness.**
 - **The flashing sequence of the module indicates the "normal, network-connected operational state" of the module.**

12.8.3.1 Area of application

Initial situation

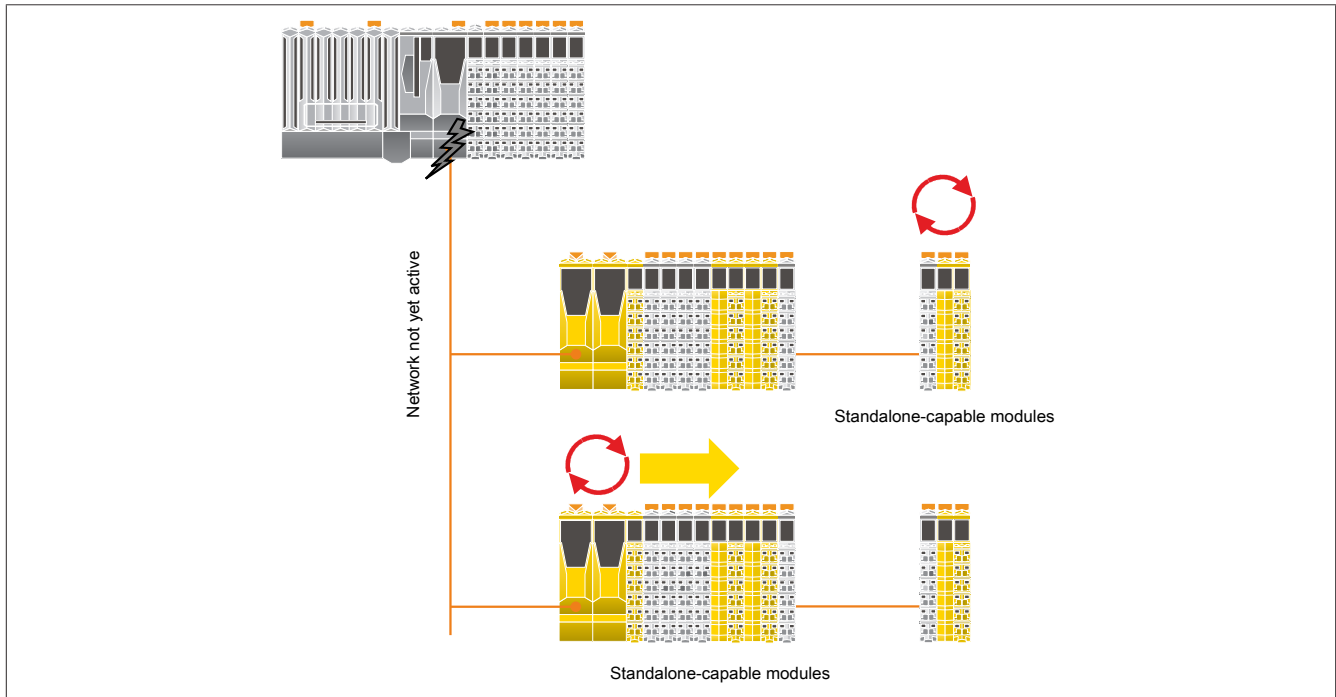
Several stations in an application are connected to the controller via network cables. After the entire system has been switched off and on, a fault results in the network connection not being established.

Effect

Non-standalone modules are put into the active state only after application startup.

Standalone-capable modules show the following behavior:

- The boot procedure is started without waiting on a higher-level network.
- The module behaves identically to blackout mode.
- As soon as the network becomes active, it is bumplessly added to the higher-level network.



12.9 NetTime Technology

NetTime refers to the ability to precisely synchronize and transfer system times between individual components of the controller or network (controller, I/O modules, X2X Link, POWERLINK, etc.).

This allows the moment that events occur to be determined system-wide with microsecond precision. Upcoming events can also be executed precisely at a specified moment.



12.9.1 Time information

Various time information is available in the controller or on the network:

- System time (on the PLC, Automation PC, etc.)
- X2X Link time (for each X2X Link network)
- POWERLINK time (for each POWERLINK network)
- Time data points of I/O modules

The NetTime is based on 32-bit counters, which are increased with microsecond resolution. The sign of the time information changes after 35 min, 47 s, 483 ms and 648 μ s; an overflow occurs after 71 min, 34 s, 967 ms and 296 μ s.

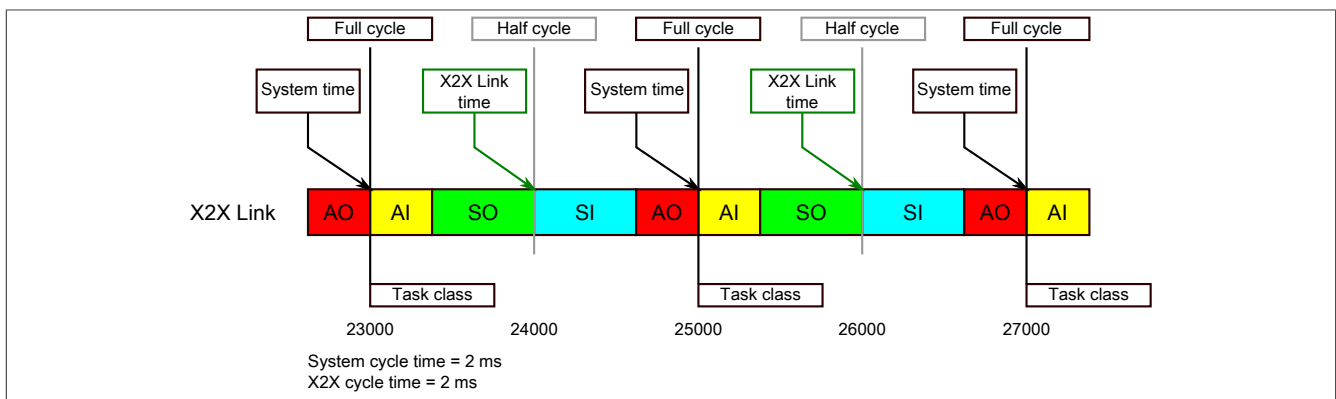
The initialization of the times is based on the system time during the startup of the X2X Link, the I/O modules or the POWERLINK interface.

Current time information in the application can also be determined via library `AsIOTime`.

12.9.1.1 Controller data points

The NetTime I/O data points of the controller are latched to each system clock and made available.

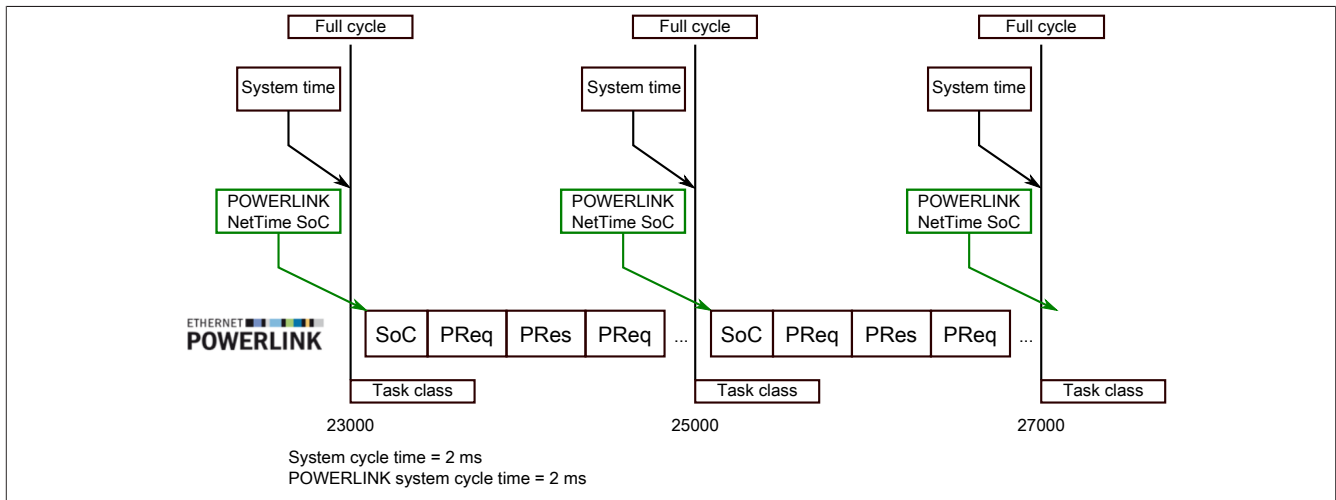
12.9.1.2 X2X Link - Reference time point



The reference time point on the X2X Link network is always calculated at the half cycle of the X2X Link cycle. This results in a difference between the system time and the X2X Link reference time point when the reference time is read out.

In the example above, this results in a difference of 1 ms, i.e. if the system time and X2X Link reference time are compared at time 25000 in the task, then the system time returns the value 25000 and the X2X Link reference time returns the value 24000.

12.9.1.3 POWERLINK - Reference time point

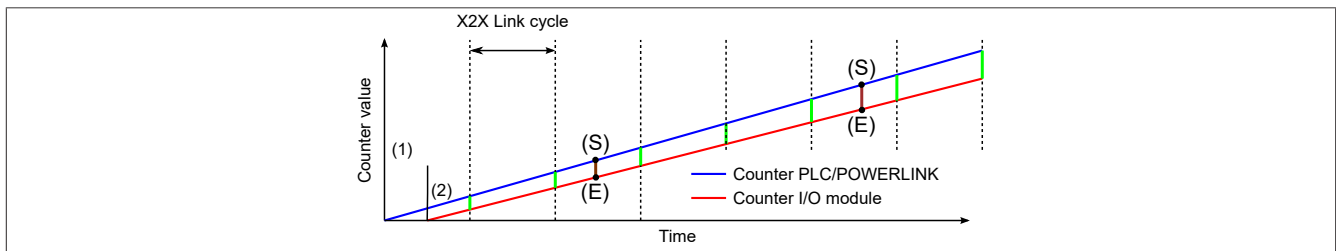


The POWERLINK reference time point is always calculated at the start of cycle (SoC) of the POWERLINK network. The SoC starts 20 μ s after the system clock due to the system. This results in the following difference between the system time and the POWERLINK reference time:

POWERLINK reference time = System time - POWERLINK cycle time + 20 μ s

In the example above, this means a difference of 1980 μ s, i.e. if the system time and POWERLINK reference time are compared at time 25000 in the task, then the system time returns the value 25000 and the POWERLINK reference time returns the value 23020.

12.9.1.4 Synchronization of system time/POWERLINK time and I/O module



At startup, the internal counters for the controller/POWERLINK (1) and the I/O module (2) start at different times and increase the values with microsecond resolution.

At the beginning of each X2X Link cycle, the controller or POWERLINK network sends time information to the I/O module. The I/O module compares this time information with the module's internal time and forms a difference (green line) between the two times and stores it.

When a NetTime event (E) occurs, the internal module time is read out and corrected with the stored difference value (brown line). This means that the exact system moment (S) of an event can always be determined, even if the counters are not absolutely synchronous.

Note

The deviation from the clock signal is strongly exaggerated in the picture as a red line.

12.9.2 Timestamp functions

NetTime-capable modules provide various timestamp functions depending on the scope of functions. If a timestamp event occurs, the module immediately saves the current NetTime. After the respective data is transferred to the controller, including this precise moment, the controller can then evaluate the data using its own NetTime (or system time), if necessary.

For details, see the respective module documentation.

12.9.2.1 Time-based inputs

NetTime Technology can be used to determine the exact moment of a rising edge at an input. The rising and falling edges can also be detected and the duration between 2 events can be determined.



Information:

The determined moment always lies in the past.

12.9.2.2 Time-based outputs

NetTime Technology can be used to specify the exact moment of a rising edge on an output. The rising and falling edges can also be specified and a pulse pattern generated from them.



Information:

The specified time must always be in the future, and the set X2X Link cycle time must be taken into account for the definition of the moment.

12.9.2.3 Time-based measurements

NetTime Technology can be used to determine the exact moment of a measurement that has taken place. Both the starting and end moment of the measurement can be transmitted.

12.10 Flatstream communication

12.10.1 Introduction

B&R offers an additional communication method for some modules. "Flatstream" was designed for X2X and POWERLINK networks and allows data transfer to be adapted to individual demands. Although this method is not 100% real-time capable, it still allows data transfer to be handled more efficiently than with standard cyclic polling.

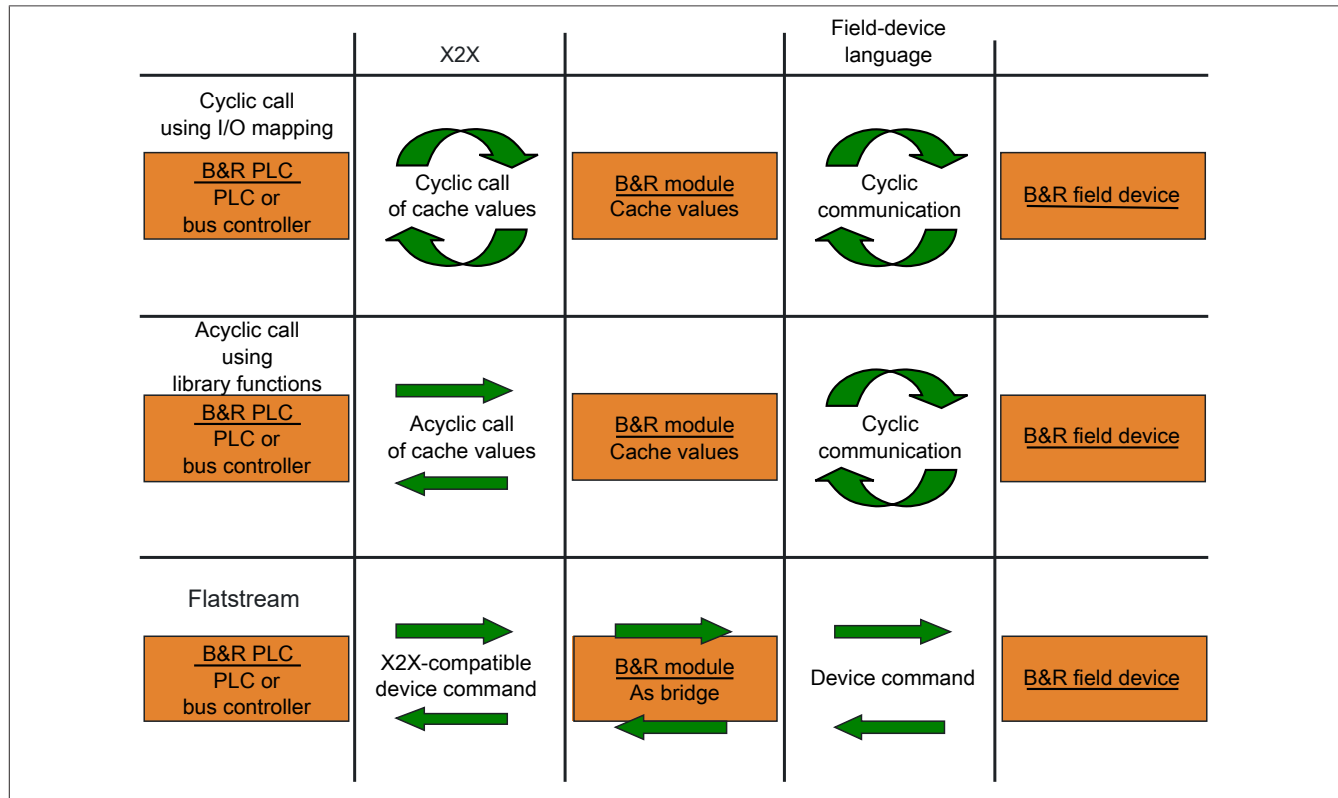


Figure 42: 3 types of communication

Flatstream extends cyclic and acyclic data queries. With Flatstream communication, the module acts as a bridge. The module is used to pass controller requests directly on to the field device.

12.10.2 Message, segment, sequence, MTU

The physical properties of the bus system limit the amount of data that can be transmitted during one bus cycle. With Flatstream communication, all messages are viewed as part of a continuous data stream. Long data streams must be broken down into several fragments that are sent one after the other. To understand how the receiver puts these fragments back together to get the original information, it is important to understand the difference between a message, a segment, a sequence and an MTU.

Message

A message refers to information exchanged between 2 communicating partner stations. The length of a message is not restricted by the Flatstream communication method. Nevertheless, module-specific limitations must be considered.

Segment (logical division of a message):

A segment has a finite size and can be understood as a section of a message. The number of segments per message is arbitrary. So that the recipient can correctly reassemble the transferred segments, each segment is preceded by a byte with additional information. This control byte contains information such as the length of a segment and whether the approaching segment completes the message. This makes it possible for the receiving station to interpret the incoming data stream correctly.

Sequence (how a segment must be arranged physically):

The maximum size of a sequence corresponds to the number of enabled Rx or Tx bytes (later: "MTU"). The transmitting station splits the transmit array into valid sequences. These sequences are then written successively to the MTU and transferred to the receiving station where they are lined up together again. The receiver stores the incoming sequences in a receive array, obtaining an image of the data stream in the process.

With Flatstream communication, the number of sequences sent are counted. Successfully transferred sequences must be acknowledged by the receiving station to ensure the integrity of the transfer.

MTU (Maximum Transmission Unit) - Physical transport:

MTU refers to the enabled USINT registers used with Flatstream. These registers can accept at least one sequence and transfer it to the receiving station. A separate MTU is defined for each direction of communication. OutputMTU defines the number of Flatstream Tx bytes, and InputMTU specifies the number of Flatstream Rx bytes. The MTUs are transported cyclically via the X2X Link network, increasing the load with each additional enabled USINT register.

Properties

Flatstream messages are not transferred cyclically or in 100% real time. Many bus cycles may be needed to transfer a particular message. Although the Rx and Tx registers are exchanged between the transmitter and the receiver cyclically, they are only processed further if explicitly accepted by register "InputSequence" or "OutputSequence".

Behavior in the event of an error (brief summary)

The protocol for X2X and POWERLINK networks specifies that the last valid values should be retained when disturbances occur. With conventional communication (cyclic/acyclic data queries), this type of error can generally be ignored.

In order for communication to also take place without errors using Flatstream, all of the sequences issued by the receiver must be acknowledged. If Forward functionality is not used, then subsequent communication is delayed for the length of the disturbance.

If Forward functionality is being used, the receiving station receives a transmission counter that is incremented twice. The receiver stops, i.e. it no longer returns any acknowledgments. The transmitting station uses SequenceAck to determine that the transfer was faulty and that all affected sequences must be repeated.

12.10.3 The Flatstream principle

Requirements

Before Flatstream can be used, the respective communication direction must be synchronized, i.e. both communication partners cyclically query the sequence counter on the remote station. This checks to see if there is new data that should be accepted.

Communication

If a communication partner wants to transmit a message to its remote station, it should first create a transmit array that corresponds to Flatstream conventions. This allows the Flatstream data to be organized very efficiently without having to block other important resources.

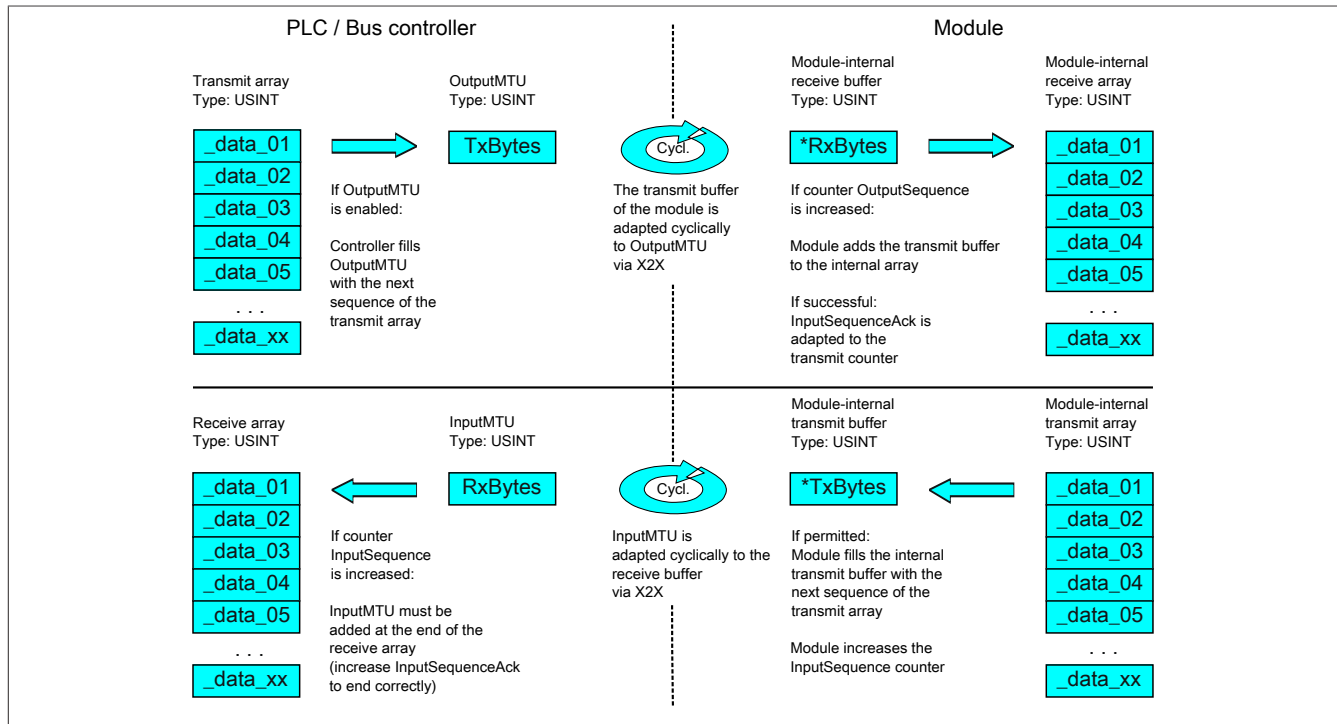


Figure 43: Flatstream communication

Procedure

The first thing that happens is that the message is broken into valid segments of up to 63 bytes, and the corresponding control bytes are created. The data is formed into a data stream made up of one control bytes per associated segment. This data stream can be written to the transmit array. The maximum size of each array element matches that of the enabled MTU so that one element corresponds to one sequence. If the array has been completely created, the transmitter checks whether the MTU is permitted to be re-filled. It then copies the first element of the array or the first sequence to the Tx byte registers. The MTU is transported to the receiver station via X2X Link and stored in the corresponding Rx byte registers. To signal that the data should be accepted by the receiver, the transmitter increases its SequenceCounter. If the communication direction is synchronized, the remote station detects the incremented SequenceCounter. The current sequence is appended to the receive array and acknowledged by SequenceAck. This acknowledgment signals to the transmitter that the MTU can now be refilled.

If the transfer is successful, the data in the receive array will correspond 100% to the data in the transmit array. During the transfer, the receiving station must detect and evaluate the incoming control bytes. A separate receive array should be created for each message. This allows the receiver to immediately begin further processing of messages that are completely transferred.

12.10.4 Registers for Flatstream mode

5 registers are available for configuring Flatstream. The default configuration can be used to transmit small amounts of data relatively easily.



Information:

The controller communicates directly with the field device via registers "OutputSequence" and "InputSequence" as well as the enabled Tx and RxBytes bytes. For this reason, the user must have sufficient knowledge of the communication protocol being used on the field device.

12.10.4.1 Flatstream configuration

To use Flatstream, the program sequence must first be expanded. The cycle time of the Flatstream routines must be set to a multiple of the bus cycle. Other program routines should be implemented in Cyclic #1 to ensure data consistency.

At the absolute minimum, registers "InputMTU" and "OutputMTU" must be set. All other registers are filled in with default values at the beginning and can be used immediately. These registers are used for additional options, e.g. to transfer data in a more compact way or to increase the efficiency of the general procedure.

The Forward registers extend the functionality of the Flatstream protocol. This functionality is useful for substantially increasing the Flatstream data rate, but it also requires quite a bit of extra work when creating the program sequence.



Information:

In the rest of this description, the names "OutputMTU" and "InputMTU" do not refer to the registers names. Instead, they are used as synonyms for the currently enabled Tx or Rx bytes.



Information:

Registers are described in section "Flatstream communication" in the respective data sheets.

12.10.4.2 Flatstream operation

When using Flatstream, the communication direction is very important. For transmitting data to a module (output direction), Tx bytes are used. For receiving data from a module (input direction), Rx bytes are used. Registers "OutputSequence" and "InputSequence" are used to control or secure communication, i.e. the transmitter uses them to give instructions to apply data and the receiver confirms a successfully transferred sequence.



Information:

Registers are described in section "Flatstream communication" in the respective data sheets.

12.10.4.2.1 Format of input and output bytes

Name:

"Format of Flatstream" in Automation Studio

On some modules, this function can be used to set how the Flatstream input and output bytes (Tx or Rx bytes) are transferred.

- **Packed:** Data is transferred as an array.
- **Byte-by-byte:** Data is transferred as individual bytes.

12.10.4.2.2 Transporting payload data and control bytes

The Tx and Rx bytes are cyclic registers used to transport the payload data and the necessary control bytes. The number of active Tx and Rx bytes is taken from the configuration of registers "OutputMTU" and "InputMTU", respectively.

In the user program, only the Tx and Rx bytes from the controller can be used. The corresponding counterparts are located in the module and are not accessible to the user. For this reason, the names were chosen from the point of view of the controller.

- "T" - "Transmit" → Controller transmits data to the module.
- "R" - "Receive" → Controller receives data from the module.

12.10.4.2.2.1 Control bytes

In addition to the payload data, the Tx and Rx bytes also transfer the necessary control bytes. These control bytes contain additional information about the data stream so that the receiver can reconstruct the original message from the transferred segments.

Bit structure of a control byte

Bit	Name	Value	Information
0 - 5	SegmentLength	0 - 63	Size of the subsequent segment in bytes (default: Max. MTU size - 1)
6	nextCBPos	0	Next control byte at the beginning of the next MTU
		1	Next control byte directly after the end of the current segment
7	MessageEndBit	0	Message continues after the subsequent segment
		1	Message ended by the subsequent segment

SegmentLength

The segment length lets the receiver know the length of the coming segment. If the set segment length is insufficient for a message, then the information must be distributed over several segments. In these cases, the actual end of the message is detected using bit 7 (control byte).



Information:

The control byte is not included in the calculation to determine the segment length. The segment length is only derived from the bytes of payload data.

nextCBPos

This bit indicates the position where the next control byte is expected. This information is especially important when using option "MultiSegmentMTU".

When using Flatstream communication with MultiSegmentMTUs, the next control byte is no longer expected in the first Rx byte of the subsequent MTU, but transferred directly after the current segment.

MessageEndBit

"MessageEndBit" is set if the subsequent segment completes a message. The message has then been completely transferred and is ready for further processing.



Information:

In the output direction, this bit must also be set if one individual segment is enough to hold the entire message. The module will only process a message internally if this identifier is detected.

The size of the message being transferred can be calculated by adding all of the message's segment lengths together.

Flatstream formula for calculating message length:

Message [bytes] with ME)	Segment lengths (all CBs without ME) + Segment length (of the first CB		CB	Control byte
			ME	MessageEndBit

12.10.4.2.3 Communication status

The communication status is determined via registers "OutputSequence" and "InputSequence".

- OutputSequence contains information about the communication status of the controller. It is written by the controller and read by the module.
- InputSequence contains information about the communication status of the module. It is written by the module and should only be read by the controller.

12.10.4.2.3.1 Relationship between OutputSequence and InputSequence

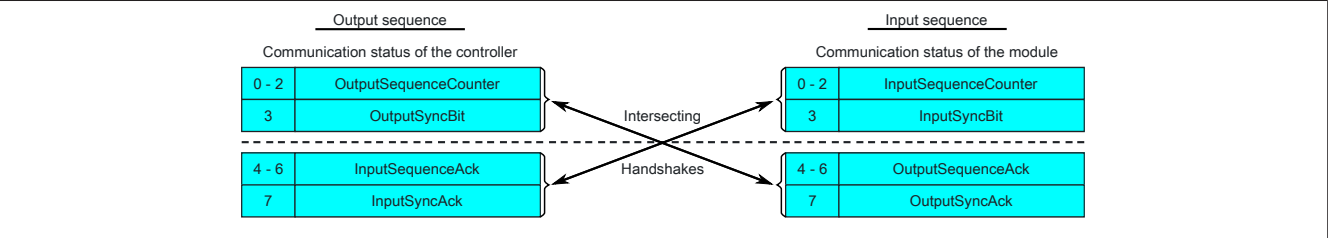


Figure 44: Relationship between OutputSequence and InputSequence

Registers OutputSequence and InputSequence are logically composed of 2 half-bytes. The low part indicates to the remote station whether a channel should be opened or whether data should be accepted. The high part is to acknowledge that the requested action was carried out.

SyncBit and SyncAck

If SyncBit and SyncAck are set in one communication direction, then the channel is considered "synchronized", i.e. it is possible to send messages in this direction. The status bit of the remote station must be checked cyclically. If SyncAck has been reset, then SyncBit on that station must be adjusted. Before new data can be transferred, the channel must be resynchronized.

SequenceCounter and SequenceAck

The communication partners cyclically check whether the low nibble on the remote station changes. When one of the communication partners finishes writing a new sequence to the MTU, it increments its SequenceCounter. The current sequence is then transmitted to the receiver, which acknowledges its receipt with SequenceAck. In this way, a "handshake" is initiated.

Information:

If communication is interrupted, segments from the unfinished message are discarded. All messages that were transferred completely are processed.

12.10.4.3 Synchronization

During synchronization, a communication channel is opened. It is important to make sure that a module is present and that the current value of SequenceCounter is stored on the station receiving the message. Flatstream can handle full-duplex communication. This means that both channels / communication directions can be handled separately. They must be synchronized independently so that simplex communication can theoretically be carried out as well.

Synchronization in the output direction (controller as the transmitter):

The corresponding synchronization bits (OutputSyncBit and OutputSyncAck) are reset. Because of this, Flatstream cannot be used at this point in time to transfer messages from the controller to the module.

Algorithm

1) The controller must write 000 to OutputSequenceCounter and reset OutputSyncBit. The controller must cyclically query the high nibble of register "InputSequence" (checks for 000 in OutputSequenceAck and 0 in OutputSyncAck). The module does not accept the current contents of InputMTU since the channel is not yet synchronized. The module matches OutputSequenceAck and OutputSyncAck to the values of OutputSequenceCounter and OutputSyncBit.
2) If the controller registers the expected values in OutputSequenceAck and OutputSyncAck, it is permitted to increment OutputSequenceCounter. The controller continues cyclically querying the high nibble of register "OutputSequence" (checks for 001 in OutputSequenceAck and 0 in InputSyncAck). The module does not accept the current contents of InputMTU since the channel is not yet synchronized. The module matches OutputSequenceAck and OutputSyncAck to the values of OutputSequenceCounter and OutputSyncBit.
3) If the controller registers the expected values in OutputSequenceAck and OutputSyncAck, it is permitted to increment OutputSequenceCounter. The controller continues cyclically querying the high nibble of register "OutputSequence" (checks for 001 in OutputSequenceAck and 1 in InputSyncAck). Note: Theoretically, data can be transferred from this point forward. However, it is still recommended to wait until the output direction is completely synchronized before transferring data. The module sets OutputSyncAck. The output direction is synchronized, and the controller can transmit data to the module.

Synchronization in the input direction (controller as the receiver):

The corresponding synchronization bits (InputSyncBit and InputSyncAck) are reset. Because of this, Flatstream cannot be used at this point in time to transfer messages from the module to the controller.

Algorithm

The module writes 000 to InputSequenceCounter and resets InputSyncBit. The module monitors the high nibble of register "OutputSequence" and expects 000 in InputSequenceAck and 0 in InputSyncAck.
1) The controller is not permitted to accept the current contents of InputMTU since the channel is not yet synchronized. The controller must match InputSequenceAck and InputSyncAck to the values of InputSequenceCounter and InputSyncBit. If the module registers the expected values in InputSequenceAck and InputSyncAck, it increments InputSequenceCounter. The module monitors the high nibble of register "OutputSequence" and expects 001 in InputSequenceAck and 0 in InputSyncAck.
2) The controller is not permitted to accept the current contents of InputMTU since the channel is not yet synchronized. The controller must match InputSequenceAck and InputSyncAck to the values of InputSequenceCounter and InputSyncBit. If the module registers the expected values in InputSequenceAck and InputSyncAck, it sets InputSyncBit. The module monitors the high nibble of register "OutputSequence" and expects 1 in InputSyncAck.
3) The controller is permitted to set InputSyncAck. Note: Theoretically, data could already be transferred in this cycle. If InputSyncBit is set and InputSequenceCounter has been increased by 1, the values in the enabled Rx bytes must be accepted and acknowledged (see also "Communication in the input direction"). The input direction is synchronized, and the module can transmit data to the controller.

12.10.4.4 Transmitting and receiving

If a channel is synchronized, then the remote station is ready to receive messages from the transmitter. Before the transmitter can send data, it must first create a transmit array in order to meet Flatstream requirements.

The transmitting station must also generate a control byte for each segment created. This control byte contains information about how the subsequent part of the data being transferred should be processed. The position of the next control byte in the data stream can vary. For this reason, it must be clearly defined at all times when a new control byte is being transmitted. The first control byte is always in the first byte of the first sequence. All subsequent positions are determined recursively.

Flatstream formula for calculating the position of the next control byte:

Position (of the next control byte) = Current position + 1 + Segment length

Example

3 autonomous messages (7 bytes, 2 bytes and 9 bytes) are being transmitted using an MTU with a width of 7 bytes. The rest of the configuration corresponds to the default settings.

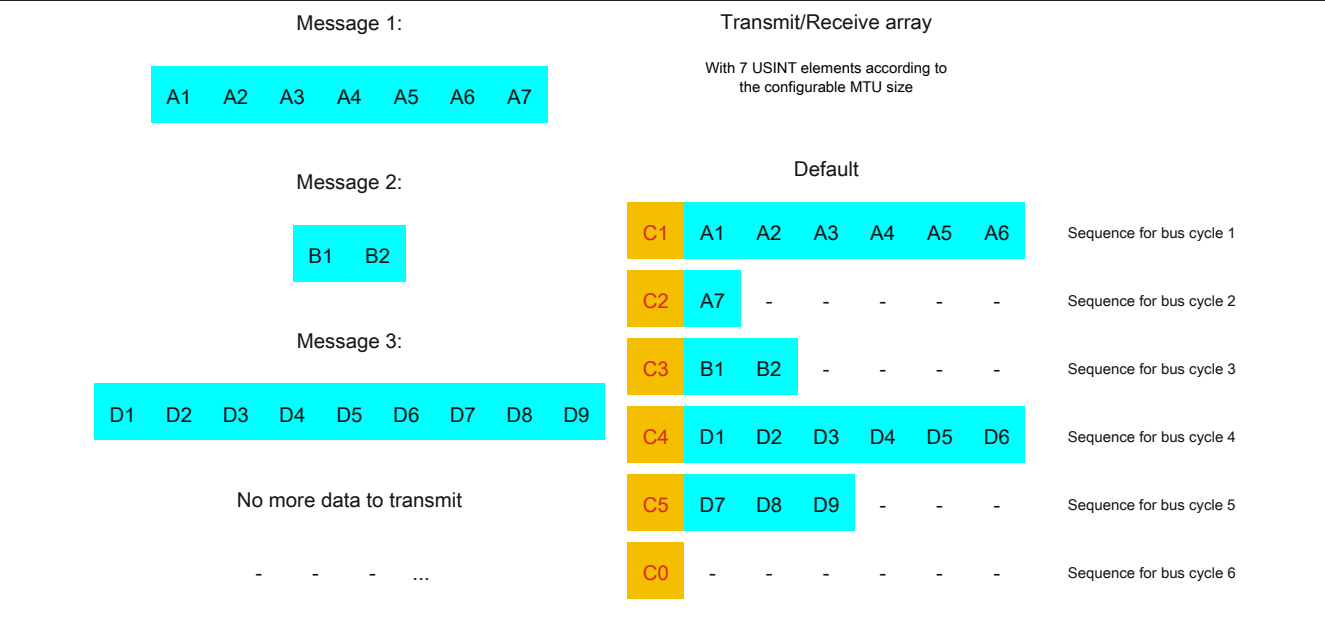


Figure 45: Transmit/Receive array (default)

The messages must first be split into segments. In the default configuration, it is important to ensure that each sequence can hold an entire segment, including the associated control byte. The sequence is limited to the size of the enable MTU. In other words, a segment must be at least 1 byte smaller than the MTU.

MTU = 7 bytes → Max. segment length = 6 bytes

- Message 1 (7 bytes)
 - ⇒ First segment = Control byte + 6 bytes of data
 - ⇒ Second segment = Control byte + 1 data byte
- Message 2 (2 bytes)
 - ⇒ First segment = Control byte + 2 bytes of data
- Message 3 (9 bytes)
 - ⇒ First segment = Control byte + 6 bytes of data
 - ⇒ Second segment = Control byte + 3 data bytes
- No more messages
 - ⇒ C0 control byte

A unique control byte must be generated for each segment. In addition, the C0 control byte is generated to keep communication on standby.

C0 (control byte 0)			C1 (control byte 1)			C2 (control byte 2)		
- SegmentLength (0)	=	0	- SegmentLength (6)	=	6	- SegmentLength (1)	=	1
- nextCBPos (0)	=	0	- nextCBPos (0)	=	0	- nextCBPos (0)	=	0
- MessageEndBit (0)	=	0	- MessageEndBit (0)	=	0	- MessageEndBit (1)	=	128
Control byte	Σ	0	Control byte	Σ	6	Control byte	Σ	129

Table 31: Flatstream determination of the control bytes for the default configuration example (part 1)

C3 (control byte 3)			C4 (control byte 4)			C5 (control byte 5)		
- SegmentLength (2)	=	2	- SegmentLength (6)	=	6	- SegmentLength (3)	=	3
- nextCBPos (0)	=	0	- nextCBPos (0)	=	0	- nextCBPos (0)	=	0
- MessageEndBit (1)	=	128	- MessageEndBit (0)	=	0	- MessageEndBit (1)	=	128
Control byte	Σ	130	Control byte	Σ	6	Control byte	Σ	131

Table 32: Flatstream determination of the control bytes for the default configuration example (part 2)

12.10.4.4.1 Transmitting data to a module (output)

When transmitting data, the transmit array must be generated in the application program. Sequences are then transferred one by one using Flatstream and received by the module.



Information:

Although all B&R modules with Flatstream communication always support the most compact transfers in the output direction, it is recommended to use the same design for the transfer arrays in both communication directions.

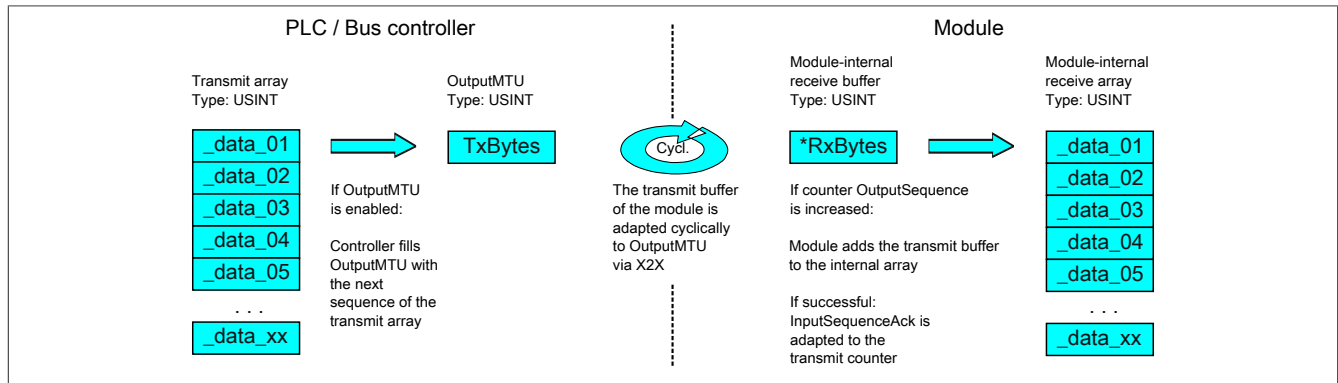


Figure 46: Flatstream communication (output)

Message smaller than OutputMTU

The length of the message is initially smaller than OutputMTU. In this case, one sequence would be sufficient to transfer the entire message and the necessary control byte.

Algorithm

Cyclic status query: - The module monitors OutputSequenceCounter.
0) Cyclic checks: - The controller must check OutputSyncAck. → If OutputSyncAck = 0: Reset OutputSyncBit and resynchronize the channel. - The controller must check whether OutputMTU is enabled. → If OutputSequenceCounter > InputSequenceAck: MTU is not enabled because the last sequence has not yet been acknowledged.
1) Preparation (create transmit array): - The controller must split up the message into valid segments and create the necessary control bytes. - The controller must add the segments and control bytes to the transmit array.
2) Transmit: - The controller transfers the current element of the transmit array to OutputMTU. → OutputMTU is transferred cyclically to the module's transmit buffer but not processed further. - The controller must increase OutputSequenceCounter.
Reaction: - The module accepts the bytes from the internal receive buffer and adds them to the internal receive array. - The module transmits acknowledgment and writes the value of OutputSequenceCounter to OutputSequenceAck.
3) Completion: - The controller must monitor OutputSequenceAck. → A sequence is only considered to have been transferred successfully if it has been acknowledged via OutputSequenceAck. In order to detect potential transfer errors in the last sequence as well, it is important to make sure that the length of the Completion phase is run through long enough.
Note: To monitor communication times exactly, the task cycles that have passed since the last increase of OutputSequenceCounter should be counted. In this way, the number of previous bus cycles necessary for the transfer can be measured. If the monitoring counter exceeds a predefined threshold, then the sequence can be considered lost. (The relationship of bus to task cycle can be influenced by the user so that the threshold value must be determined individually.) - Subsequent sequences are only permitted to be transmitted in the next bus cycle after the completion check has been carried out successfully.

Message larger than OutputMTU

The transmit array, which must be created in the program sequence, consists of several elements. The user must arrange the control and data bytes correctly and transfer the array elements one after the other. The transfer algorithm remains the same and is repeated starting at the point *Cyclic checks*.

General flowchart

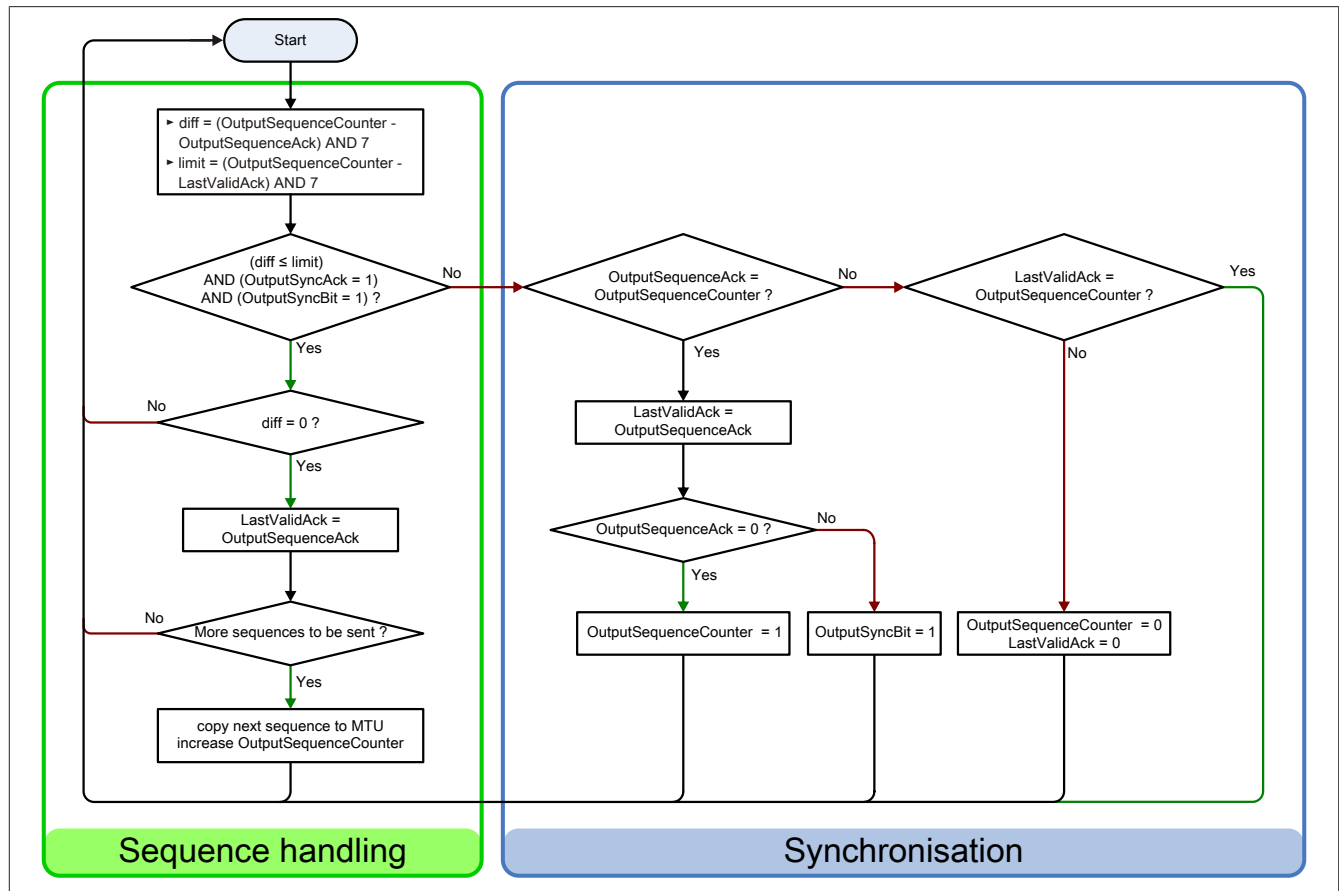


Figure 47: Flowchart for the output direction

12.10.4.4.2 Receiving data from a module (input)

When receiving data, the transmit array is generated by the module, transferred via Flatstream and must then be reproduced in the receive array. The structure of the incoming data stream can be set with the mode register. The algorithm for receiving the data remains unchanged in this regard.

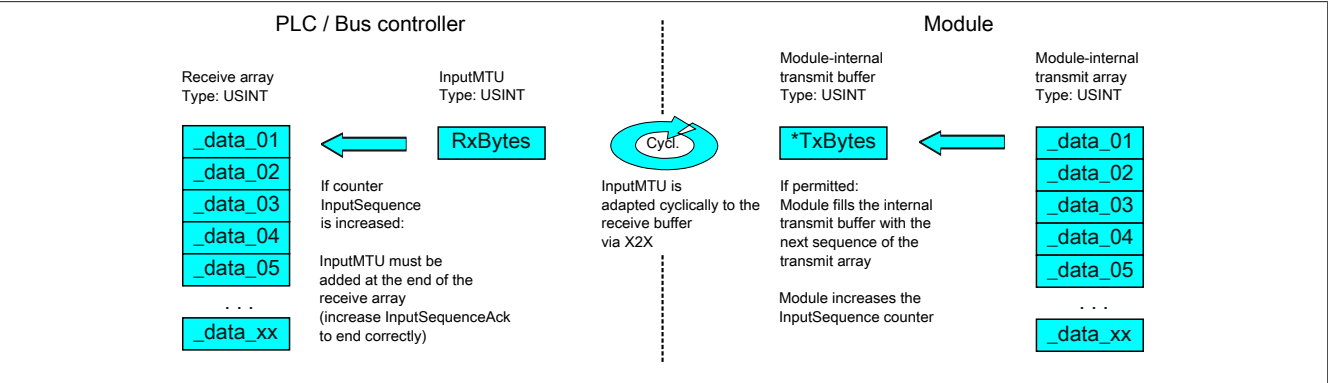


Figure 48: Flatstream communication (input)

Algorithm

0) Cyclic status query: - The controller must monitor InputSequenceCounter.
Cyclic checks: - The module checks InputSyncAck. - The module checks InputSequenceAck.
Preparation: - The module forms the segments and control bytes and creates the transmit array.
Action: - The module transfers the current element of the internal transmit array to the internal transmit buffer. - The module increases InputSequenceCounter.
1) Receiving (as soon as InputSequenceCounter is increased): - The controller must apply data from InputMTU and append it to the end of the receive array. - The controller must match InputSequenceAck to InputSequenceCounter of the sequence currently being processed.
Completion: - The module monitors InputSequenceAck. → A sequence is only considered to have been transferred successfully if it has been acknowledged via InputSequenceAck. - Subsequent sequences are only transmitted in the next bus cycle after the completion check has been carried out successfully.

General flowchart

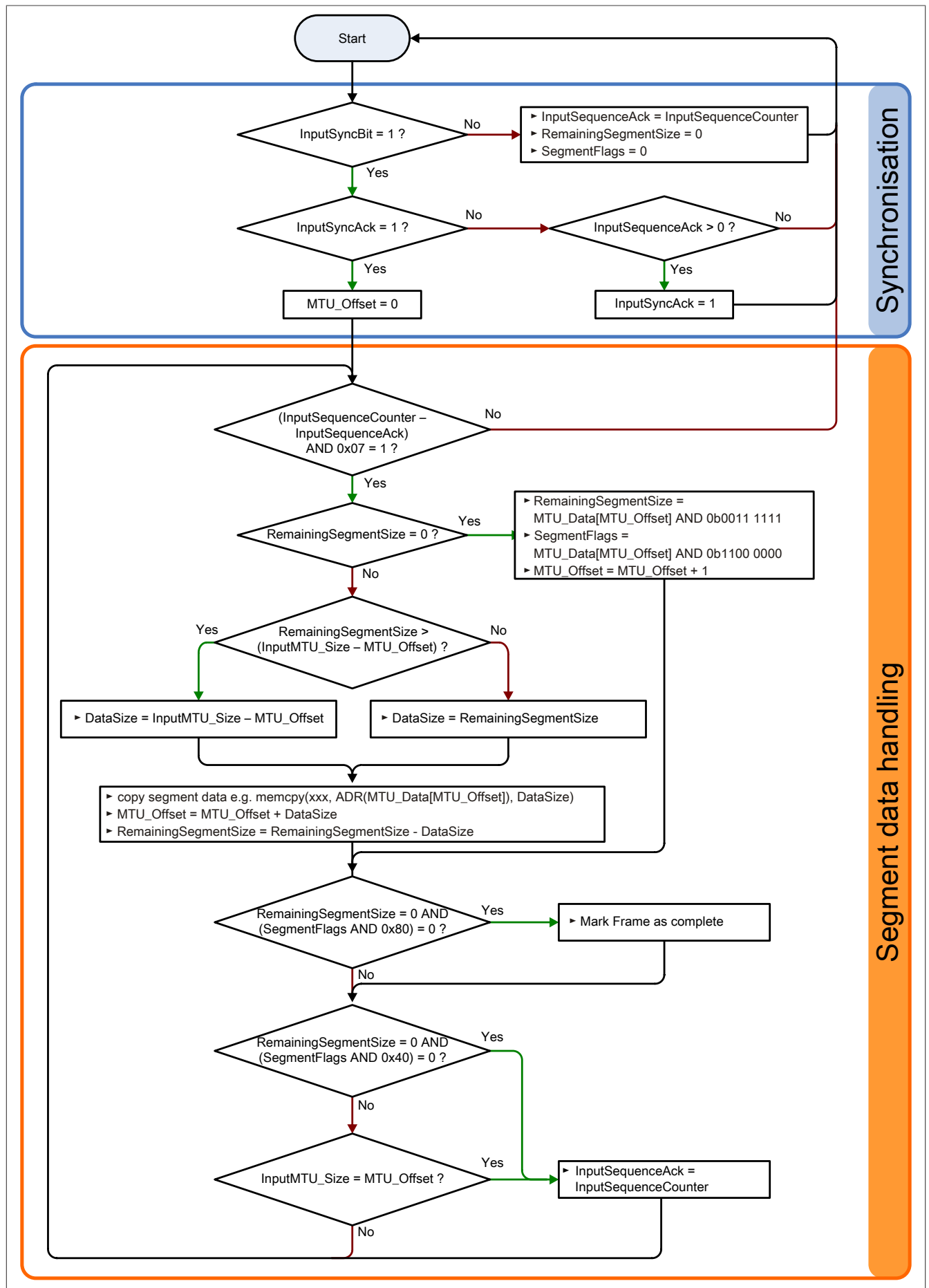


Figure 49: Flowchart for the input direction

12.10.4.4.3 Details

It is recommended to store transferred messages in separate receive arrays.

After a set MessageEndBit is transmitted, the subsequent segment should be added to the receive array. The message is then complete and can be passed on internally for further processing. A new/separate array should be created for the next message.



Information:

When transferring with MultiSegmentMTUs, it is possible for several small messages to be part of one sequence. In the program, it is important to make sure that a sufficient number of receive arrays can be managed. The acknowledge register is only permitted to be adjusted after the entire sequence has been applied.

If SequenceCounter is incremented by more than one counter, an error is present.

In this case, the receiver stops. All additional incoming sequences are ignored until the transmission with the correct SequenceCounter is retried. This response prevents the transmitter from receiving any more acknowledgments for transmitted sequences. The transmitter can identify the last successfully transferred sequence from the remote station's SequenceAck and continue the transfer from this point.



Information:

This situation is very unlikely when operating without "Forward" functionality.

Acknowledgments must be checked for validity.

If the receiver has successfully accepted a sequence, it must be acknowledged. The receiver takes on the value of SequenceCounter sent along with the transmission and matches SequenceAck to it. The transmitter reads SequenceAck and registers the successful transmission. If the transmitter acknowledges a sequence that has not yet been dispatched, then the transfer must be interrupted and the channel resynchronized. The synchronization bits are reset and the current/incomplete message is discarded. It must be sent again after the channel has been resynchronized.

12.10.4.5 Flatstream mode

In the input direction, the transmit array is generated automatically. Flatstream mode offers several options to the user that allow an incoming data stream to have a more compact arrangement. These include:

- [Standard](#)
- [MultiSegmentMTU allowed](#)
- [Large segments allowed:](#)

Once enabled, the program code for evaluation must be adapted accordingly.



Information:

All B&R modules that offer Flatstream mode support options "Large segments" and "MultiSegmentMTU" in the output direction. Compact transfer must be explicitly allowed only in the input direction.

Standard

By default, both options relating to compact transfer in the input direction are disabled.

1. The module only forms segments that are at least one byte smaller than the enabled MTU. Each sequence begins with a control byte so that the data stream is clearly structured and relatively easy to evaluate.
2. Since a Flatstream message is permitted to be any length, the last segment of the message frequently does not fill up all of the MTU's space. By default, the remaining bytes during this type of transfer cycle are not used.

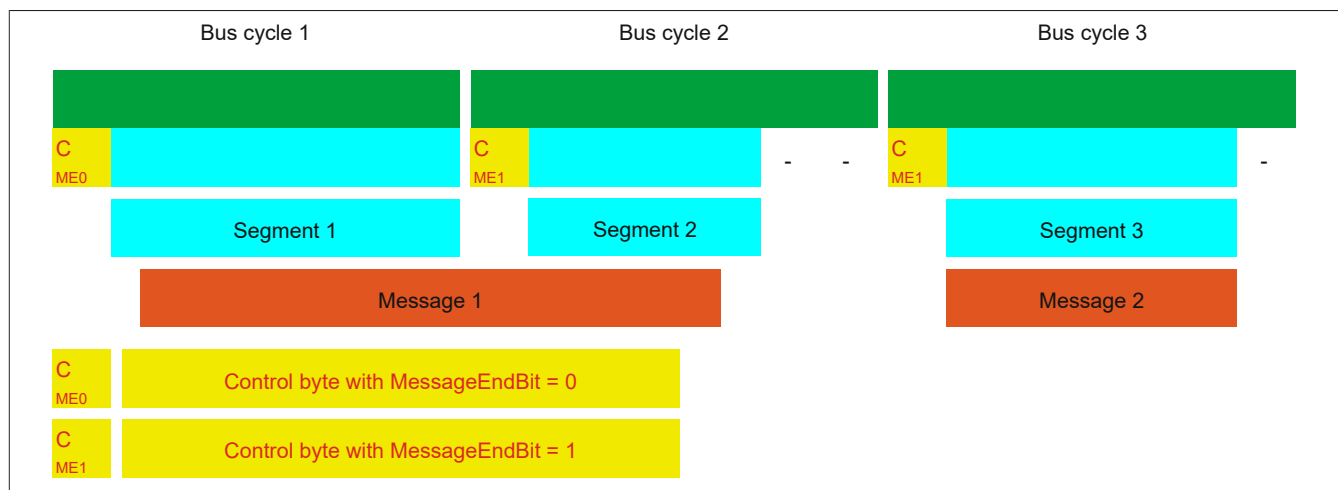


Figure 50: Message arrangement in the MTU (default)

MultiSegmentMTU allowed

With this option, InputMTU is completely filled (if enough data is pending). The previously unfilled Rx bytes transfer the next control bytes and their segments. This allows the enabled Rx bytes to be used more efficiently.

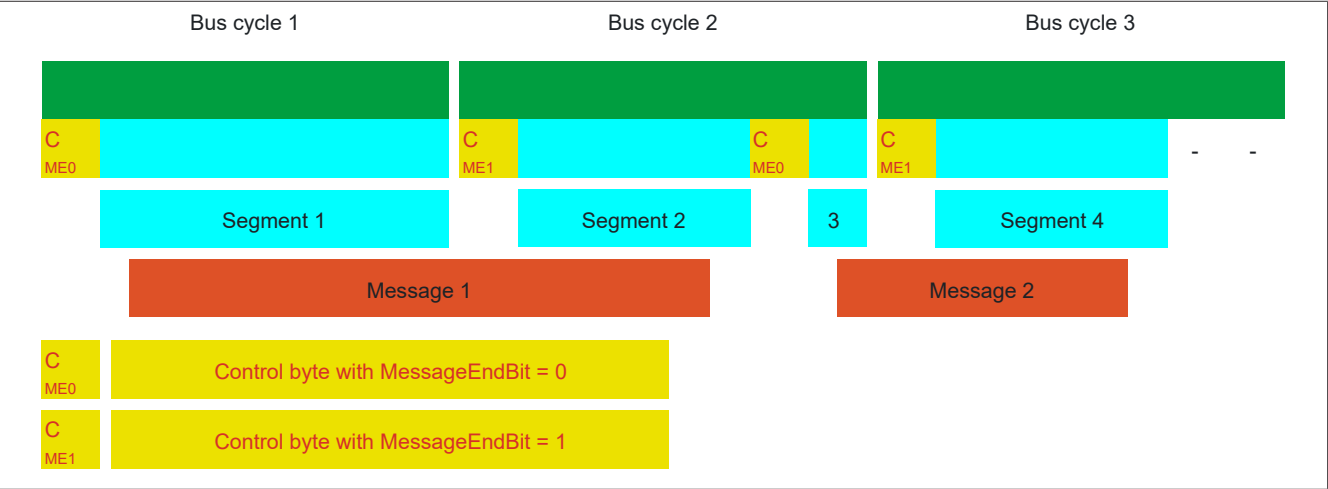


Figure 51: Arrangement of messages in the MTU (MultiSegmentMTU)

Large segments allowed:

When transferring very long messages or when enabling only very few Rx bytes, then a great many segments must be created by default. The bus system is more stressed than necessary since an additional control byte must be created and transferred for each segment. With option "Large segments", the segment length is limited to 63 bytes independently of InputMTU. One segment is permitted to stretch across several sequences, i.e. it is possible for "pure" sequences to occur without a control byte.



Information:

It is still possible to split up a message into several segments, however. If this option is used and messages with more than 63 bytes occur, for example, then messages can still be split up among several segments.

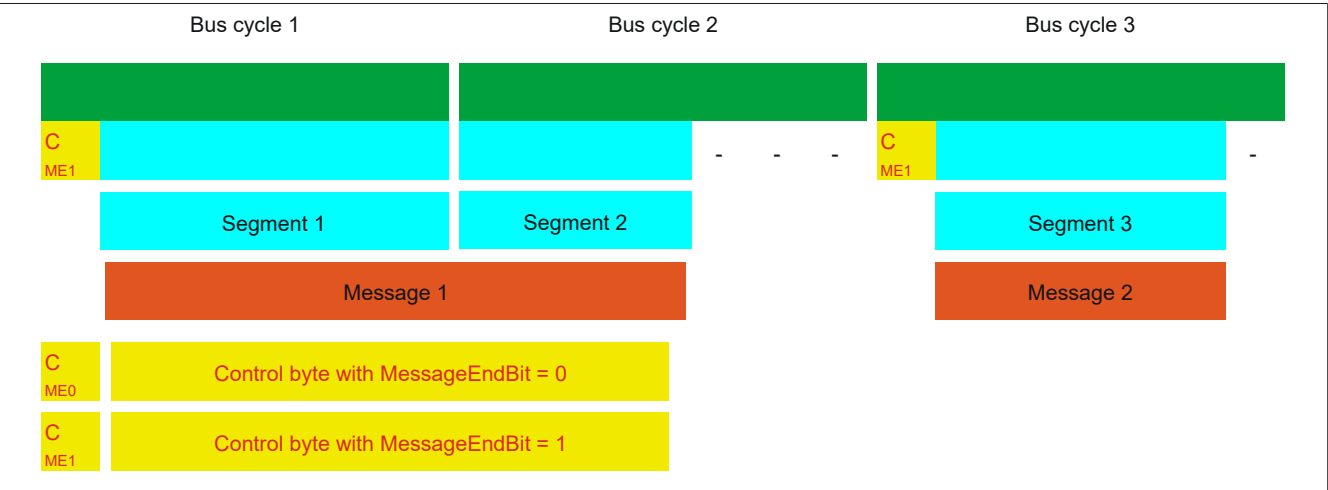


Figure 52: Arrangement of messages in the MTU (large segments)

Using both options

Using both options at the same time is also permitted.

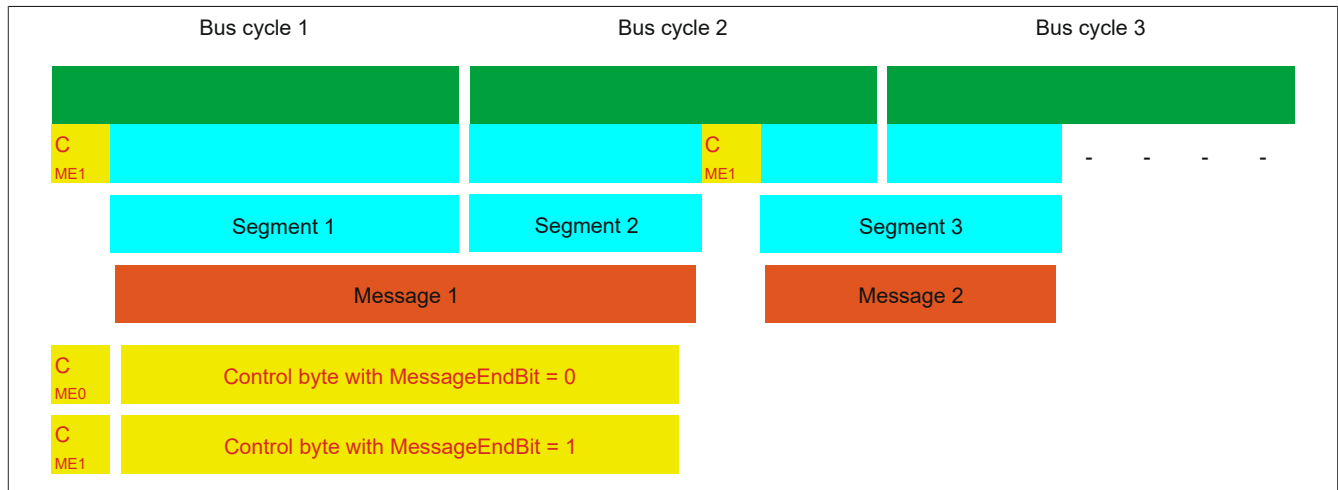


Figure 53: Arrangement of messages in the MTU (large segments and MultiSegmentMTU)

12.10.4.6 Adjusting the Flatstream

If the way messages are structured is changed, then the way data in the transmit/receive array is arranged is also different. The following changes apply to the example given earlier.

MultiSegmentMTU

If MultiSegmentMTUs are allowed, then "open positions" in an MTU can be used. These "open positions" occur if the last segment in a message does not fully use the entire MTU. MultiSegmentMTUs allow these bits to be used to transfer the subsequent control bytes and segments. In the program sequence, the "nextCB-Pos" bit in the control byte is set so that the receiver can correctly identify the next control byte.

Example

3 autonomous messages (7 bytes, 2 bytes and 9 bytes) are being transmitted using an MTU with a width of 7 bytes. The configuration allows the transfer of MultiSegmentMTUs.

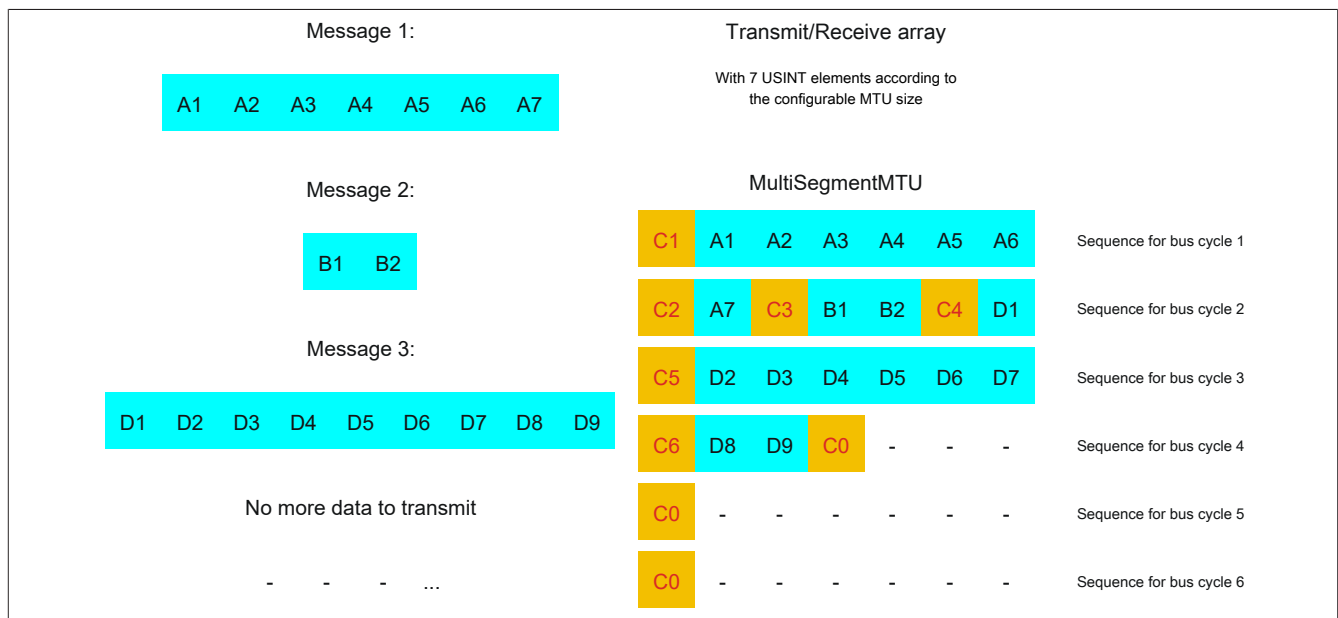


Figure 54: Transmit/Receive array (MultiSegmentMTU)

Additional information

The messages must first be split into segments. As in the default configuration, it is important for each sequence to begin with a control byte. The free bits in the MTU at the end of a message are filled with data from the following message, however. With this option, the "nextCBPos" bit is always set if payload data is transferred after the control byte.

MTU = 7 bytes → Max. segment length = 6 bytes

- Message 1 (7 bytes)
 - ⇒ First segment = Control byte + 6 bytes of data (MTU full)
 - ⇒ Second segment = Control byte + 1 byte of data (MTU still has 5 open bytes)
- Message 2 (2 bytes)
 - ⇒ First segment = Control byte + 2 bytes of data (MTU still has 2 open bytes)
- Message 3 (9 bytes)
 - ⇒ First segment = Control byte + 1 byte of data (MTU full)
 - ⇒ Second segment = Control byte + 6 bytes of data (MTU full)
 - ⇒ Third segment = Control byte + 2 bytes of data (MTU still has 4 open bytes)
- No more messages
 - ⇒ C0 control byte

A unique control byte must be generated for each segment. In addition, the C0 control byte is generated to keep communication on standby.

C1 (control byte 1)			C2 (control byte 2)			C3 (control byte 3)		
- SegmentLength (6)	=	6	- SegmentLength (1)	=	1	- SegmentLength (2)	=	2
- nextCBPos (1)	=	64	- nextCBPos (1)	=	64	- nextCBPos (1)	=	64
- MessageEndBit (0)	=	0	- MessageEndBit (1)	=	128	- MessageEndBit (1)	=	128
Control byte	Σ	70	Control byte	Σ	193	Control byte	Σ	194

Table 33: Flatstream determination of the control bytes for the MultiSegmentMTU example (part 1)



Warning!

The second sequence is only permitted to be acknowledged via SequenceAck if it has been completely processed. In this example, there are 3 different segments within the second sequence, i.e. the program must include enough receive arrays to handle this situation.

C4 (control byte 4)			C5 (control byte 5)			C6 (control byte 6)		
- SegmentLength (1)	=	1	- SegmentLength (6)	=	6	- SegmentLength (2)	=	2
- nextCBPos (6)	=	6	- nextCBPos (1)	=	64	- nextCBPos (1)	=	64
- MessageEndBit (0)	=	0	- MessageEndBit (1)	=	0	- MessageEndBit (1)	=	128
Control byte	Σ	7	Control byte	Σ	70	Control byte	Σ	194

Table 34: Flatstream determination of the control bytes for the MultiSegmentMTU example (part 2)

Large segments

Segments are limited to a maximum of 63 bytes. This means they can be larger than the active MTU. These large segments are divided among several sequences when transferred. It is possible for sequences to be completely filled with payload data and not have a control byte.



Information:

It is still possible to subdivide a message into several segments so that the size of a data packet does not also have to be limited to 63 bytes.

Example

3 autonomous messages (7 bytes, 2 bytes and 9 bytes) are being transmitted using an MTU with a width of 7 bytes. The configuration allows the transfer of large segments.

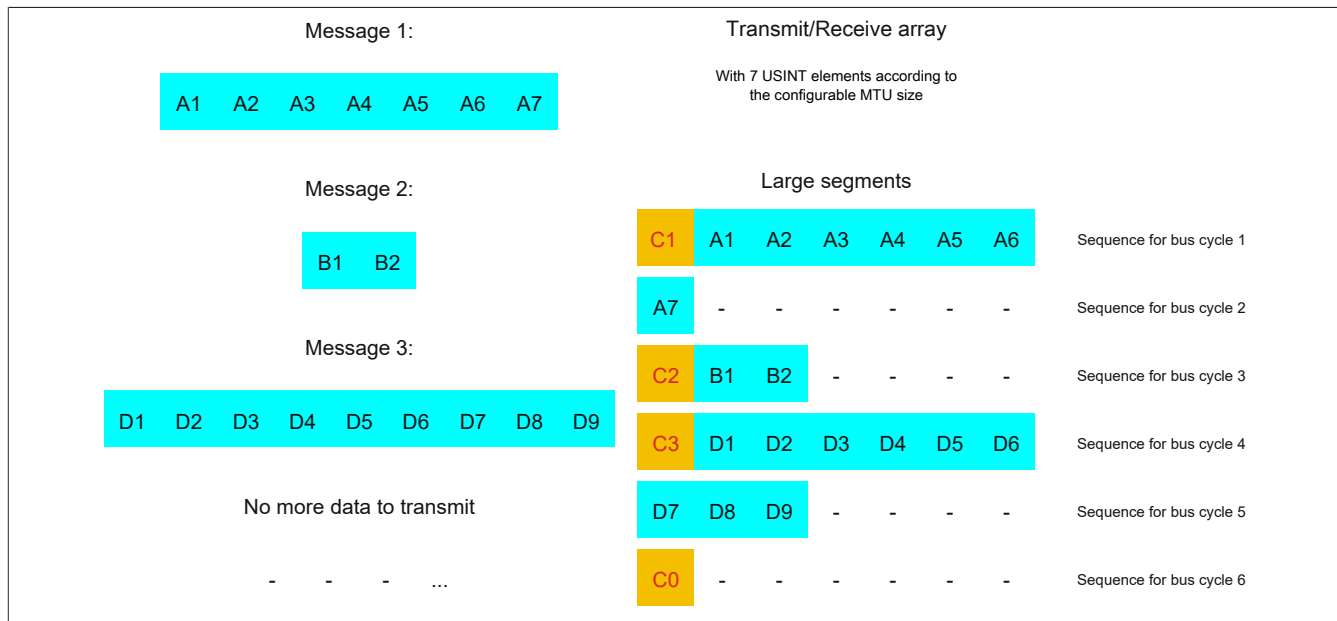


Figure 55: Transmit/receive array (large segments)

The messages must first be split into segments. The ability to form large segments means that messages are split up less frequently, which results in fewer control bytes generated.

Large segments allowed → Max. segment length = 63 bytes

- Message 1 (7 bytes)
 - ⇒ First segment = Control byte + 7 bytes of data
- Message 2 (2 bytes)
 - ⇒ First segment = Control byte + 2 bytes of data
- Message 3 (9 bytes)
 - ⇒ First segment = Control byte + 9 bytes of data
- No more messages
 - ⇒ C0 control byte

A unique control byte must be generated for each segment. In addition, the C0 control byte is generated to keep communication on standby.

C1 (control byte 1)			C2 (control byte 2)			C3 (control byte 3)		
- SegmentLength (7)	=	7	- SegmentLength (2)	=	2	- SegmentLength (9)	=	9
- nextCBPos (0)	=	0	- nextCBPos (0)	=	0	- nextCBPos (0)	=	0
- MessageEndBit (1)	=	128	- MessageEndBit (1)	=	128	- MessageEndBit (1)	=	128
Control byte	Σ	135	Control byte	Σ	130	Control byte	Σ	137

Table 35: Flatstream determination of the control bytes for the large segment example

Additional information

Large segments and MultiSegmentMTU

Example

3 autonomous messages (7 bytes, 2 bytes and 9 bytes) are being transmitted using an MTU with a width of 7 bytes. The configuration allows transfer of large segments as well as MultiSegmentMTUs.

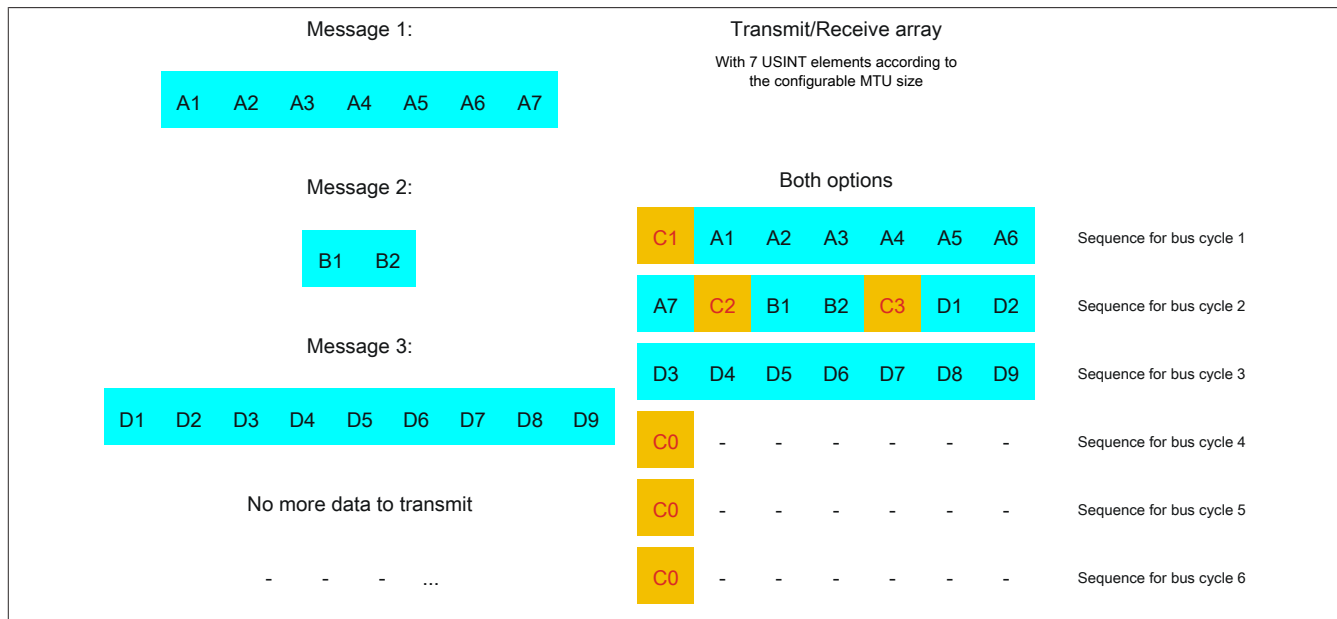


Figure 56: Transmit/Receive array (large segments and MultiSegmentMTU)

The messages must first be split into segments. If the last segment of a message does not completely fill the MTU, it is permitted to be used for other data in the data stream. Bit "nextCBPos" must always be set if the control byte belongs to a segment with payload data.

The ability to form large segments means that messages are split up less frequently, which results in fewer control bytes generated. Control bytes are generated in the same way as with option "Large segments".

Large segments allowed → Max. segment length = 63 bytes

- Message 1 (7 bytes)
 - ⇒ First segment = Control byte + 7 bytes of data
- Message 2 (2 bytes)
 - ⇒ First segment = Control byte + 2 bytes of data
- Message 3 (9 bytes)
 - ⇒ First segment = Control byte + 9 bytes of data
- No more messages
 - ⇒ C0 control byte

A unique control byte must be generated for each segment. In addition, the C0 control byte is generated to keep communication on standby.

C1 (control byte 1)			C2 (control byte 2)			C3 (control byte 3)		
- SegmentLength (7)	=	7	- SegmentLength (2)	=	2	- SegmentLength (9)	=	9
- nextCBPos (0)	=	0	- nextCBPos (0)	=	0	- nextCBPos (0)	=	0
- MessageEndBit (1)	=	128	- MessageEndBit (1)	=	128	- MessageEndBit (1)	=	128
Control byte	Σ	135	Control byte	Σ	130	Control byte	Σ	137

Table 36: Flatstream determination of the control bytes for the large segment and MultiSegmentMTU example

12.10.5 Example of function "Forward" with X2X Link

Function "Forward" is a method that can be used to substantially increase the Flatstream data rate. The basic principle is also used in other technical areas such as "pipelining" for microprocessors.

12.10.5.1 Function principle

X2X Link communication cycles through 5 different steps to transfer a Flatstream sequence. At least 5 bus cycles are therefore required to successfully transfer the sequence.

	Step I	Step II	Step III	Step IV	Step V
Actions	Transfer sequence from transmit array, increase Sequence-Counter	Cyclic synchronization of MTU and module buffer	Append sequence to receive array, adjust SequenceAck	Cyclic synchronization MTU and module buffer	Check SequenceAck
Resource	Transmitter (task to transmit)	Bus system (direction 1)	Recipients (task to receive)	Bus system (direction 2)	Transmitter (task for Ack checking)

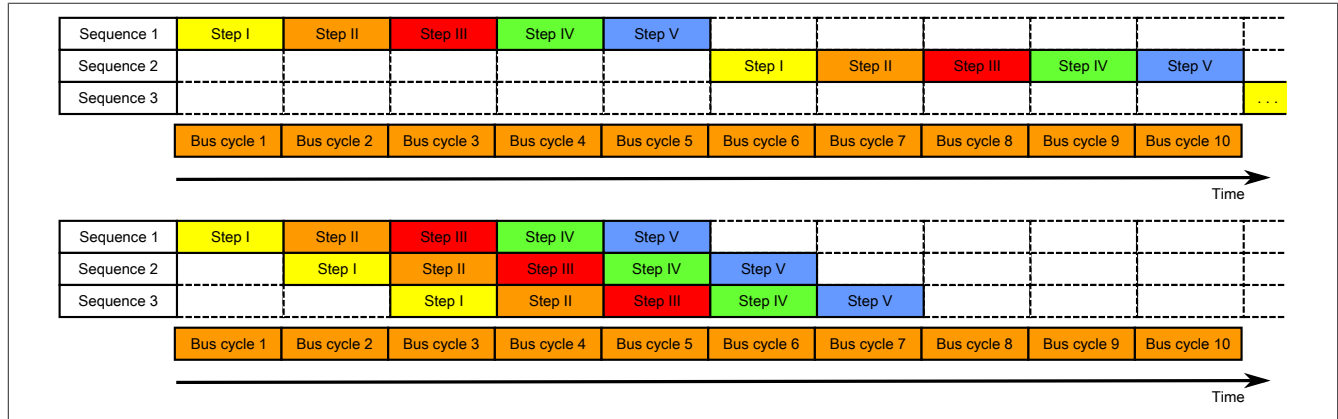


Figure 57: Comparison of transfer without/with Forward

Each of the 5 steps (tasks) requires different resources. If Forward functionality is not used, the sequences are executed one after the other. Each resource is then only active if it is needed for the current sub-action. With Forward, a resource that has executed its task can already be used for the next message. The condition for enabling the MTU is changed to allow for this. Sequences are then passed to the MTU according to the timing. The transmitting station no longer waits for an acknowledgment from SequenceAck, which means that the available bandwidth can be used much more efficiently.

In the most ideal situation, all resources are working during each bus cycle. The receiver must still acknowledge every sequence received. Only when SequenceAck has been changed and checked by the transmitter is the sequence considered as having been transferred successfully.

12.10.5.2 Configuration

The Forward function must only be enabled for the input direction. Flatstream modules have been optimized in such a way that they support this function. In the output direction, the Forward function can be used as soon as the size of OutputMTU is specified.



Information:

Registers are described in section "Flatstream communication" in the respective data sheets.

12.10.5.2.1 Delay time

The delay time is specified in microseconds. This is the amount of time the module must wait after sending a sequence until it is permitted to write new data to the MTU in the following bus cycle. The program routine for receiving sequences from a module can therefore be run in a task class whose cycle time is slower than the bus cycle.

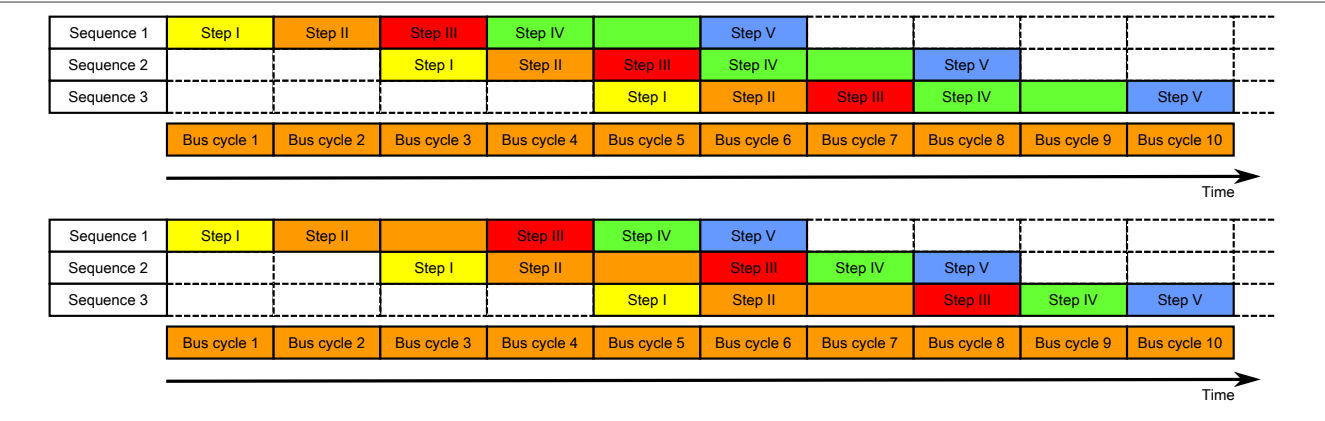


Figure 58: Effect of ForwardDelay when using Flatstream communication with the Forward function

In the program, it is important to make sure that the controller is processing all of the incoming InputSequences and InputMTUs. The ForwardDelay value causes delayed acknowledgment in the output direction and delayed reception in the input direction. In this way, the controller has more time to process the incoming InputSequence or InputMTU.

12.10.5.3 Transmitting and receiving with Forward

The basic algorithm for transmitting and receiving data remains the same. With the Forward function, up to 7 unacknowledged sequences can be transmitted. Sequences can be transmitted without having to wait for the previous message to be acknowledged. Since the delay between writing and response is eliminated, a considerable amount of additional data can be transferred in the same time window.

Algorithm for transmitting

Cyclic status query: - The module monitors OutputSequenceCounter.
0) Cyclic checks: - The controller must check OutputSyncAck. → If OutputSyncAck = 0: Reset OutputSyncBit and resynchronize the channel. - The controller must check whether OutputMTU is enabled. → If OutputSequenceCounter > OutputSequenceAck + 7, then it is not enabled because the last sequence has not yet been acknowledged.
1) Preparation (create transmit array): - The controller must split up the message into valid segments and create the necessary control bytes. - The controller must add the segments and control bytes to the transmit array.
2) Transmit: - The controller must transfer the current part of the transmit array to OutputMTU. - The controller must increase OutputSequenceCounter for the sequence to be accepted by the module. - The controller is then permitted to transmit in the next bus cycle if the MTU has been enabled.
The module responds since OutputSequenceCounter > OutputSequenceAck: - The module accepts data from the internal receive buffer and appends it to the end of the internal receive array. - The module is acknowledged and the currently received value of OutputSequenceCounter is transferred to OutputSequenceAck. - The module queries the status cyclically again.
3) Completion (acknowledgment): - The controller must check OutputSequenceAck cyclically. → A sequence is only considered to have been transferred successfully if it has been acknowledged via OutputSequenceAck. In order to detect potential transfer errors in the last sequence as well, it is important to make sure that the algorithm is run through long enough.
Note: To monitor communication times exactly, the task cycles that have passed since the last increase of OutputSequenceCounter should be counted. In this way, the number of previous bus cycles necessary for the transfer can be measured. If the monitoring counter exceeds a predefined threshold, then the sequence can be considered lost (the relationship of bus to task cycle can be influenced by the user so that the threshold value must be determined individually).

Algorithm for receiving

0) Cyclic status query: - The controller must monitor InputSequenceCounter.
Cyclic checks: - The module checks InputSyncAck. - The module checks if InputMTU for enabling. → Enabling criteria: InputSequenceCounter > InputSequenceAck + Forward
Preparation: - The module forms the control bytes / segments and creates the transmit array.
Action: - The module transfers the current part of the transmit array to the receive buffer. - The module increases InputSequenceCounter. - The module waits for a new bus cycle after time from ForwardDelay has expired. - The module repeats the action if InputMTU is enabled.
1) Receiving (InputSequenceCounter > InputSequenceAck): - The controller must apply data from InputMTU and append it to the end of the receive array. - The controller must match InputSequenceAck to InputSequenceCounter of the sequence currently being processed.
Completion: - The module monitors InputSequenceAck. → A sequence is only considered to have been transferred successfully if it has been acknowledged via InputSequenceAck.

Details/Background

1. Illegal SequenceCounter size (counter offset)

Error situation: MTU not enabled

If the difference between SequenceCounter and SequenceAck during transmission is larger than permitted, a transfer error occurs. In this case, all unacknowledged sequences must be repeated with the old SequenceCounter value.

2. Checking an acknowledgment

After an acknowledgment has been received, a check must verify whether the acknowledged sequence has been transmitted and had not yet been unacknowledged. If a sequence is acknowledged multiple times, a severe error occurs. The channel must be closed and resynchronized (same behavior as when not using Forward).



Information:

In exceptional cases, the module can increment OutputSequenceAck by more than 1 when using Forward.

An error does not occur in this case. The controller is permitted to consider all sequences up to the one being acknowledged as having been transferred successfully.

3. Transmit and receive arrays

The Forward function has no effect on the structure of the transmit and receive arrays. They are created and must be evaluated in the same way.

12.10.5.4 Errors when using Forward

In industrial environments, it is often the case that many different devices from various manufacturers are being used side by side. The electrical and/or electromagnetic properties of these technical devices can sometimes cause them to interfere with one another. These kinds of situations can be reproduced and protected against in laboratory conditions only to a certain point.

Precautions have been taken for transfer via X2X Link in case such interference should occur. For example, if an invalid checksum occurs, the I/O system will ignore the data from this bus cycle and the receiver receives the last valid data once more. With conventional (cyclic) data points, this error can often be ignored. In the following cycle, the same data point is again retrieved, adjusted and transferred.

Using Forward functionality with Flatstream communication makes this situation more complex. The receiver receives the old data again in this situation as well, i.e. the previous values for SequenceAck/SequenceCounter and the old MTU.

Loss of acknowledgment (SequenceAck)

If a SequenceAck value is lost, then the MTU was already transferred properly. For this reason, the receiver is permitted to continue processing with the next sequence. The SequenceAck is aligned with the associated SequenceCounter and sent back to the transmitter. Checking the incoming acknowledgments shows that all sequences up to the last one acknowledged have been transferred successfully (see sequences 1 and 2 in the image).

Loss of transmission (SequenceCounter, MTU):

If a bus cycle drops out and causes the value of SequenceCounter and/or the filled MTU to be lost, then no data reaches the receiver. At this point, the transmission routine is not yet affected by the error. The time-controlled MTU is released again and can be rewritten to.

The receiver receives SequenceCounter values that have been incremented several times. For the receive array to be put together correctly, the receiver is only permitted to process transmissions whose SequenceCounter has been increased by one. The incoming sequences must be ignored, i.e. the receiver stops and no longer transmits back any acknowledgments.

If the maximum number of unacknowledged sequences has been sent and no acknowledgments are returned, the transmitter must repeat the affected SequenceCounter and associated MTUs (see sequence 3 and 4 in the image).

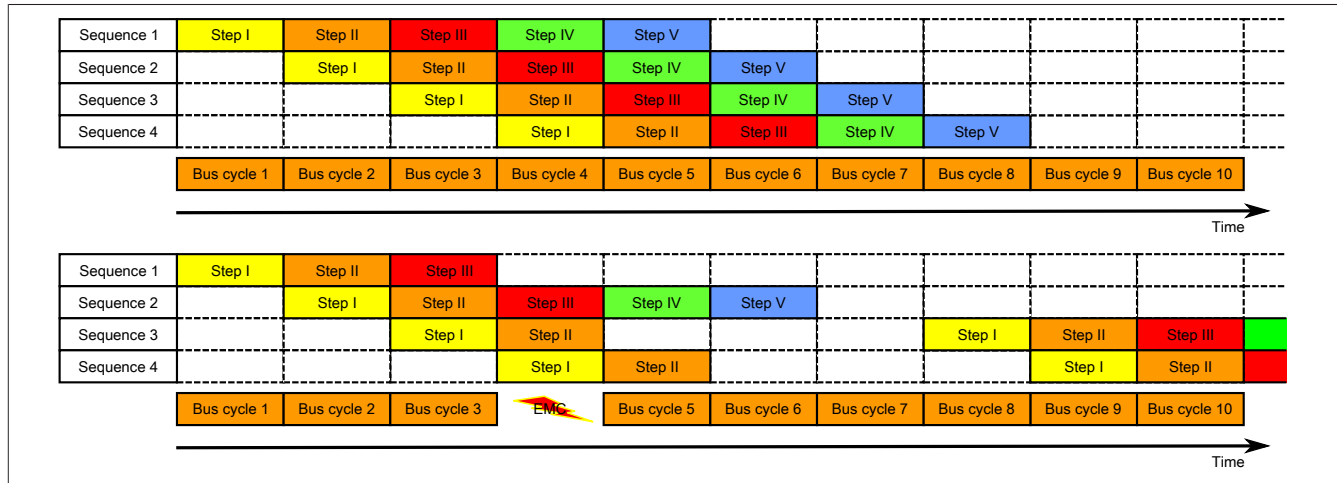


Figure 59: Effect of a lost bus cycle

Loss of acknowledgment

In sequence 1, the acknowledgment is lost due to disturbance. Sequences 1 and 2 are therefore acknowledged in Step V of sequence 2.

Loss of transmission

In sequence 3, the entire transmission is lost due to disturbance. The receiver stops and no longer sends back any acknowledgments.

The transmitting station continues transmitting until it has issued the maximum permissible number of unacknowledged transmissions.

5 bus cycles later at the earliest (depending on the configuration), it begins resending the unsuccessfully sent transmissions.