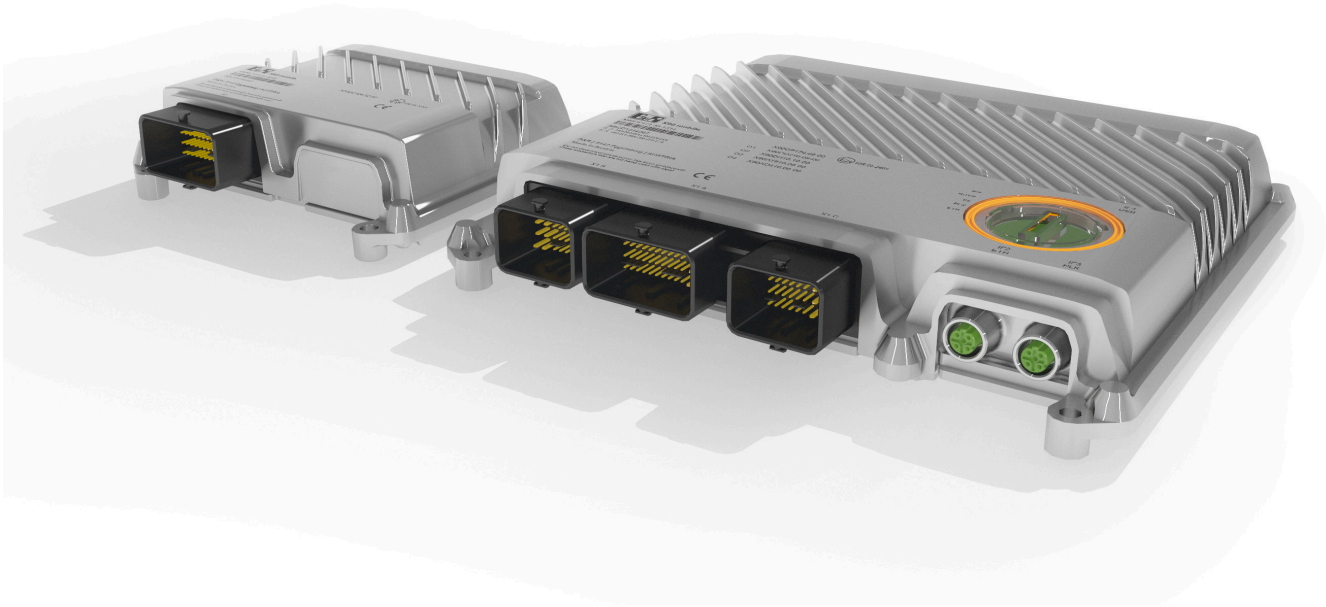
X90 mobile system

User's manual

MAX90-ENG / 2.00 (June 2022)



Translation of the original documentation

PERFECTION IN AUTOMATION
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1 Introduction

1.1 Manual history

Version	Date	Comment
2.00	July 2022	Removed all data sheets from manual. Redesigned section "Module overviews". Moved section "Safety technology" under "Safety guidelines". Replaced notation "CPU" with "controller".
1.60	August 2021	Added new section "Servicing" under "Safety guidelines". Added new section "Railroad requirements" under "International and national certifications". Corrected error in pinout for accessory "X67CA0E41.xxxx". Updated data sheets. Added new module. • X90DSI00.04-00
1.50	February 2021	Revised structure and arrangement of general sections. Moved section "X90 mobile modules". Updated section "Accessories". Updated section "International and national certifications". Updated data sheets. Added new modules. • X90BC124.32-00 • X90RO440.04-S1
1.40	June 2020	Updated safety module X90CP174.48-S1 and digital output module X90RO440.05-00.
1.30	September 2019	Updated X90 mobile modules and international and national certifications.
1.20	January 2019	Updated X90 mobile modules and International and national certifications
1.10	December 2018	Updated X90 mobile modules and accessories.
1.00	August 2018	First edition

Table: Manual history

2 Safety guidelines

Powerful and scalable automation systems (such as the X90 mobile product line), operating and control elements from B&R are ideal industry solutions in the fields of agricultural technology, construction machinery, emergency and communication vehicles as well as stationary systems. They were not designed, developed and manufactured for any use involving serious risks or hazards that could lead to death, injury, serious physical impairment or loss of any kind 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, 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 automation systems or operating/monitoring devices as control systems in conjunction with a Soft PLC (e.g. B&R Automation Runtime or similar product) or Slot PLC (e.g. X20CP1584 or similar product), the applicable safety measures (protection by protective equipment such as emergency stops) must be observed in accordance with applicable national and international regulations. This also applies to all other connected devices, such as 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). 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.

2.1 Intended use

Electronic devices are generally not failsafe. If the programmable logic controller, operating or monitoring device or uninterruptible power supply fails, the user is responsible for ensuring that connected devices, such as motors, are brought to a safe state.

2.2 Safety technology

Warning!

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 7).
- 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 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 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 stress, temperature, humidity, aggressive atmosphere).

2.5 Installation

- The devices are not ready for use and must be installed and wired according to the requirements of this documentation in order to comply with EMC limit values.
- Installation must be carried out according to the documentation using suitable equipment and tools.
- Devices are only permitted to be installed in a voltage-free state and by qualified personnel.
- General safety regulations and national accident prevention regulations must be observed.
- The electrical installation must be carried out in accordance with relevant regulations (e.g. wire cross section, fuse protection, protective ground connection).
- Take the necessary protective measures against electrostatic discharge (see "Protection against electrostatic discharge" on page 7).

2.6 Operation

2.6.1 Protection against touching electrical parts

To operate programmable logic controllers, operating and monitoring devices, and uninterruptible power supplies, certain components must carry dangerous voltage levels. Touching one of these parts can result in a life-threatening electric shock. This could lead to death, severe injury or damage to equipment.

Before turning on the programmable logic controller, operating/monitoring devices or uninterruptible power supply, the housing must be properly grounded. Ground connections must be established even when testing or operating operating/monitoring devices or the uninterruptible power supply for a short time!

Before turning the device on, all parts that carry voltage must be securely covered. During operation, all covers must remain closed.

2.7 Servicing

All X90 devices are designed to be maintenance-free and are not permitted to be opened by the user.

- Defective X90 devices cannot be repaired and must therefore be replaced.
- Option boards installed in the device are inseparably connected to the mainboard and cannot be replaced later.

2.8 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 overview

3.1 The benchmark for automation

B&R continues the concept of the X20 control and I/O system in the X90 mobile product line. This allows B&R technology to also be used in mobile and outdoor applications in very harsh environmental conditions.

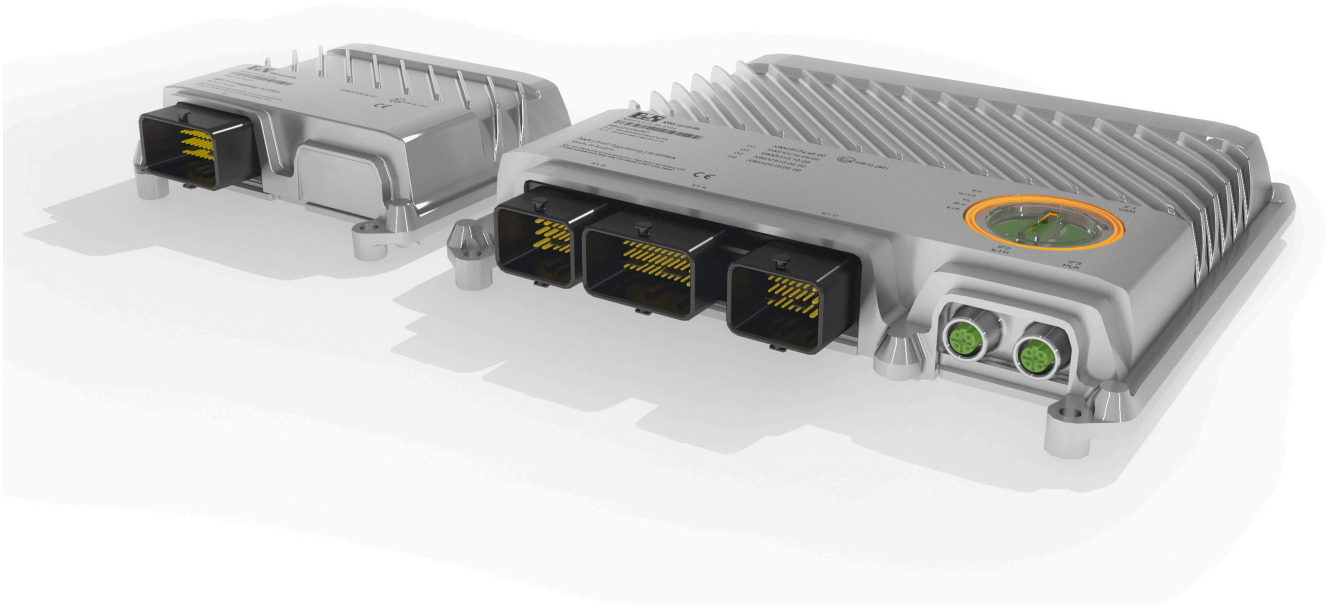
With its industrial design, the X90 mobile system is not only a remote I/O system, but a complete control solution. The different product variants are freely configured based on X90 mobile modules. The X90 mobile product line thus offers a scalable automation solution that is the perfect basis for very simple to high-performance, decentralized requirements.

X90 mobile products have IP69K protection on all sides. The robust die-cast aluminum housing, which is also used as a heat sink for power outputs, allows for surface temperatures ranging from -40 to 85°C.

The X90 mobile "Safety" variant is also equipped with a safe control system – also known as a SafeLOGIC controller. The multifunction I/Os can be used in parallel by the X90 SafeLOGIC controller and meet requirements up to SIL 2.

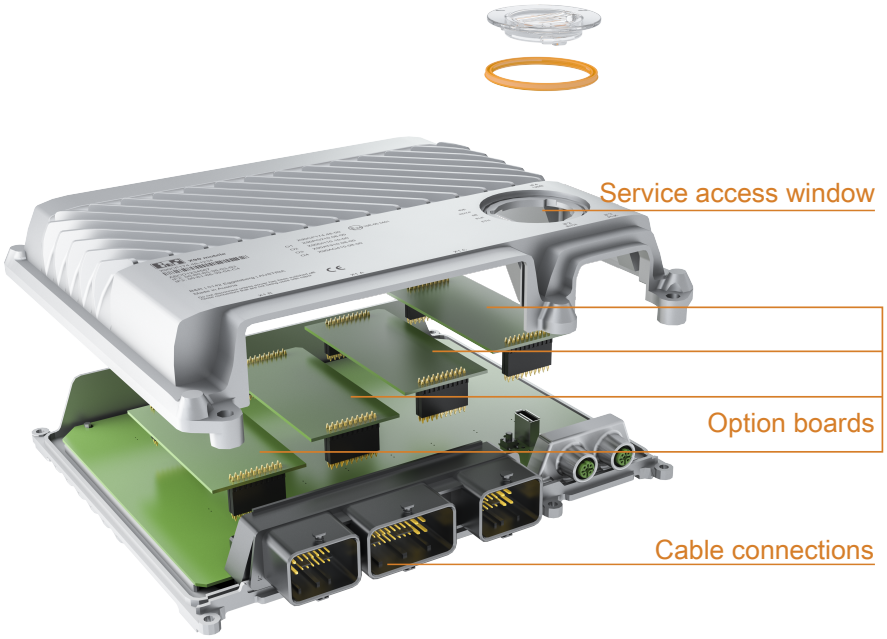
The bus controller module is a configurable CANopen slave module for sensor and actuator management. Multiple inputs and outputs are available for a wide range of tasks. For decentralized networking, Ethernet-based POWERLINK or the common CAN bus interface can be flexibly combined.

openSAFETY provides the basis for secure data transfer that meets PL e requirements.



3.1.1 Design of the X90 mobile system

The modular X90 mobile system combines maximum flexibility with optimal integration density.



The design of the aluminum upper and lower housing components ensures optimal use in all areas of mobile automation. All devices can be delivered with customized labels on request, for example with the company logo.

Service access window

Under the service access window of the X90 mobile controllers are the LED status indicators and, depending on the variant, TechGuard 0TG1000.02. The relative humidity within the housing is compensated with the pressure equalization membrane made of polytetrafluoroethylene (Teflon), which prevents the ingress of water but allows the diffusion of vapor.

Option boards

Up to 4 option modules can be used for X90 mobile controllers. These are permanently connected to the mainboard during the production process. This means that almost all requirements of a modern automation system can be met, eliminating the need for customized development.

Cable connections

Multi-header Multi-headers form the interface to the modules and thus supply the complete system. Attaching the connector is very simple: Push the connector into the female connector and secure the connection by pressing down the latch.	
M12 circular connector With the X90 mobile system, the number and type of field-assembled connectors can vary depending on the use of modules. The connectors are D-coded (Ethernet / POWERLINK). A distinction is made between screw clamp terminal blocks and cage clamp terminal blocks. The connectors are inserted into the coupling and screwed tight.	

3.1.2 Sophisticated, solid mechanics

The X90 mobile system enables a slim and intelligent solution for commercial vehicles and mobile automation. Robust design, optimal EMC protection and a modular design guarantee the stability required in industry and are the prerequisite for installing and removing the X90 mobile system on any surface with ease.

The X90 mobile system has undergone a wide variety of tests. Results confirm that the device withstands enormous environmental conditions due to its mechanics and that its performance is not impaired.

This results in the following advantages:

- Robustness due to die-cast aluminum housing
- Resistant to shock and vibration
- Optimal EMC protection
- Simple installation
- Passive cooling
- Housing temperature: -40°C to 85°C
- IP69K protection (unused connectors must be protected by suitable protective covers)

3.1.3 IP69K protection

The X90 mobile system meets all requirements up to IP69K protection and is therefore ideal for daily use in harsh conditions.

IP: Protection against contact and ingress of foreign bodies and water

First number 6: Complete protection against contact, protection against ingress of dust.

Second number 9K: Water vapor is not permitted to penetrate in harmful quantities.

3.2 X90 mobile controllers

The optimally scaled controller series covers a wide range of requirements – from standard applications to the most demanding applications with the highest performance requirements. Even cycle times of 400 µs can be used effectively.

CAN bus, Ethernet and USB are standard equipment at B&R. Networking and connecting USB devices are therefore possible at no additional cost. In addition, each controller can have a POWERLINK interface for hard real-time communication. Although most requirements are covered by the standard equipment of the controllers, there are up to 4 multipurpose slots for additional interfaces as well as input and output modules.

Increased safety

The X90 safety controller also provides a controller that meets all requirements for use in safety-critical applications up to SIL 2.

Space for options

Depending on requirements and the application, the X90 mobile controller combines exactly the components that are needed. Machine options can be easily implemented in different ways. Functions can be configured on 4 option boards.

Address assignment takes place implicitly through the slot. After the software has been created, it is valid for all variants and does not have to be changed. This is even possible with subsequent machine expansion.

Digital input modules

- Up to 10 inputs
- Current-sourcing
- Current-sinking
- Configurable thresholds
- Countable
- Encoder signal
- Diagnostics-capable

Digital output modules

- Up to 8 outputs
- Up to 4 A per output
- Safety variants possible

Analog input modules

- Up to 8 inputs
- 0 to 20 mA
- Also switchable to 0 to 32 V
- 0 to 2000 Ω
- Temperature measurement
- Ratiometric measurement
- Diagnostics-capable

Analog output modules

- Up to 8 outputs
- 0.25 to 20 mA
- 0.1 to 10 V
- Diagnostics-capable

Motor modules

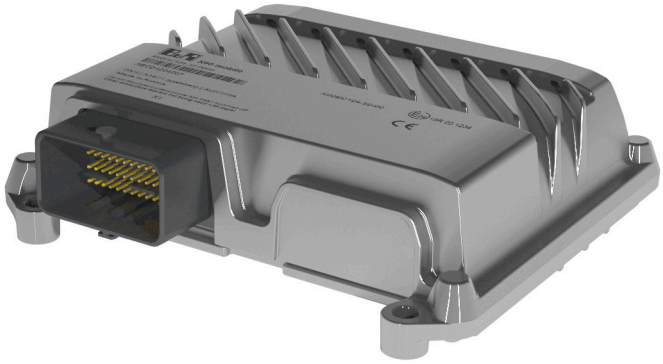
- Up to 8 outputs
- Up to 4 A per output
- Up to 1 kHz PWM
- Parallel connection of outputs
- Diagnostics-capable

Special-purpose modules

- Interface modules
- Special-purpose sensors
- Hydrostatic control
- Mixed modules
- Condition monitoring

3.3 X90 mobile bus controller

With its industrial design, the X90 mobile bus controller is not only a simple bus controller, but also a complete control unit. Bus controller module X90BC124.32-00 is a configurable CANopen slave module for sensor and actuator management, which can be easily integrated into an existing CANopen solution.



Multifunction inputs/outputs

The bus controller provides 32 multifunction inputs and outputs and is therefore an ideal solution for many applications.

Digital inputs

- Up to 32 inputs
- Current-sourcing
- Current-sinking
- Configurable thresholds
- 4 channels, countable
- Encoder signal
- Diagnostics-capable

Digital outputs

- Up to 16 outputs
- Up to 4 A per output
- Parallel connection possible

Analog inputs

- Up to 32 inputs
- 0/4 to 20 mA
- In addition, switchable to 0 to 10/32 V
- Resistance measurement
- Temperature measurement
- Ratiometric measurement
- Diagnostics-capable

LED driver

- Up to 8 LEDs
- Up to 20 mA

PWM outputs

- Up to 8 outputs
- Up to 4 A per output
- Up to 1 kHz
- Parallel connection of outputs

PVG outputs

- Up to 4 outputs
- Up to 1 kHz
- Supported types PVEA, H, S

3.4 Topology and application

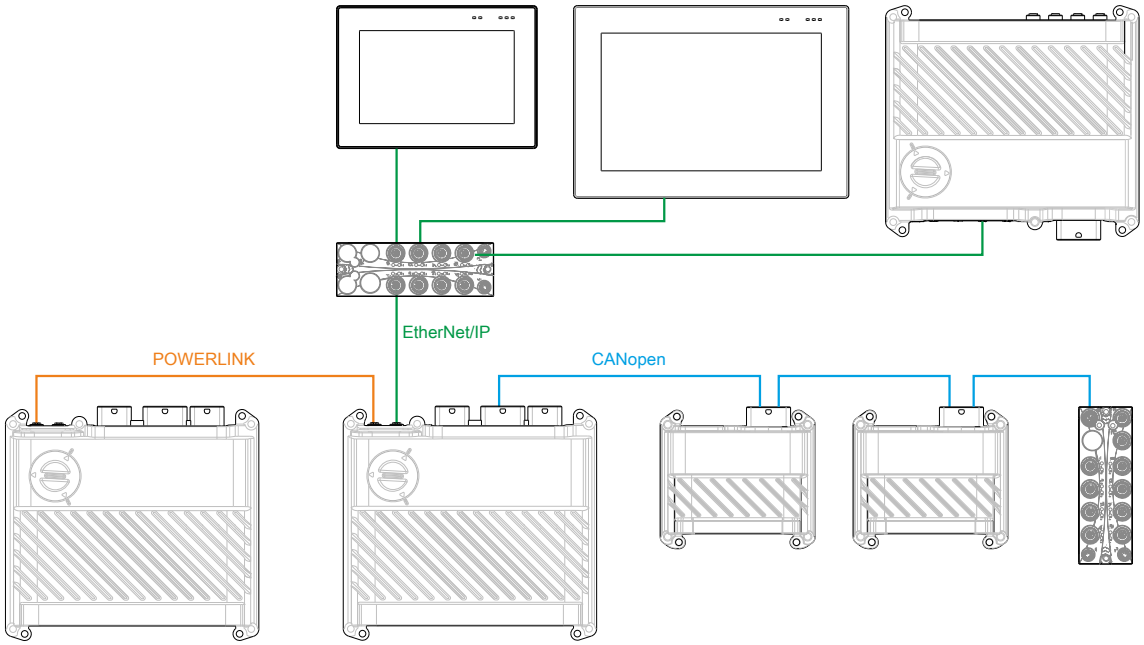
Decentralization is also becoming increasingly important in vehicle and special-purpose machine construction. The reasons for this are obvious:

- Reduction of production costs
- Simplification of the wiring harness
- Flexible expansion of machine functionality
- Reduction of maintenance costs
- Easy option handling
- Lower overall system costs

The sensors/actuators and associated control electronics are therefore connected remotely directly in the engine compartment, in the cabin or outdoors. The modular design of the B&R system makes it possible to adapt the degree of automation to customer requirements.

3.4.1 Network-capable, integrated through standard

The X90 system is ideal as a standalone solution or for expanding existing control systems.
A CANopen bus controller allows the X90 system to be used as a powerful I/O expansion unit. X90 system components are integrated, configured and programmed in the programming environment as usual using standardized EDS device description files. It does not matter whether this is a B&R or third-party system.



Bus systems used

POWERLINK

POWERLINK offers uncompromising real-time capability. A transfer rate of 100 Mbit/s and a synchronization accuracy of ±100 ns allow even the most demanding tasks in the areas of control engineering, robotics, CNC and motion control to be combined in a single network.

EtherNet/IP

EtherNet/IP is a soft real-time system. Based on the underlying TCP/IP protocols TCP and UDP, EtherNet/IP supports continuity between the company network and the plant being controlled.

CANopen

The CAN bus enjoys widespread popularity, especially in machine manufacturing. High resistance to disturbances, high-speed data transfer, ease of use and deterministic real-time behavior are some of the reasons for this success. CAN is the ideal fieldbus for applications with a manageable number of remote I/O nodes and few axes.

3.5 B&R Automation Studio

B&R Automation Studio is the only programming tool needed for all platforms. It can be used to create application software in all relevant IEC 61131-3 languages as well as C. Integrated HMI, NC and Soft CNC functionalities or web server technologies round out the possible applications.

Diversity

Despite decentralization, all I/Os can be managed in conjunction with centralized software. This saves time and money and enables a lean, intelligent solution.

3.5.1 Embedded parameter chip

Information such as module type, serial number, functionality and version number is contained in the embedded parameter chip of the X90 mobile 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 can be automated and flexible variants are made possible.

3.5.2 Flexibility for options

With the support of B&R Automation Studio, there is an optimized solution using I/O mapping.

Each I/O configuration is optimally created. However, the application software is already designed for all options. Only the I/O channels that are actually available are mapped to the application program. If an expansion is required, the additionally required hardware is simply connected and the mapping of the I/Os is changed.

It does not 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

3.5.3 Multifunction inputs and outputs

Multifunction inputs and outputs are used to cover the variability of the automation solution. Each channel can be configured individually in Automation Studio for the required function.

In this way, for example, a level sensor that previously supplied a 0 to 10 V signal can be replaced by a new sensor with a 4 to 20 mA signal without changing the control system.

Multifunction PWM outputs (MF-PWM)

- Power outputs up to 6 A
- PWM frequency configurable up to 4 kHz
- High-side and low-side outputs
- Full-bridge function
- Dither function
- Current measurement ±10 A
- Can be used as digital output
- Can be used as digital sink and source input

Multifunction digital outputs (MF-DO)

- Power outputs up to 4 A
- Current measurement
- Can be used as digital sink and source input

Multifunction analog outputs (MF-AO)

- 0 to 10 V output
- 0 to 20 mA output
- Can be used as digital sink and source input

Multifunction digital inputs (MF-DI)

- Digital sink and source input
- Countable input up to 50 kHz
- Event counter, AB incremental counter, DF counter function and ABR counter function possible

Multifunction analog inputs (MF-AI)

- 0 to 10 V input
- 0 to 32 V input
- 0 to 20 mA input / 4 to 20 mA input with open-circuit detection
- Resistance measurement 0 to 50 kΩ
- PT1000 measurement
- Diagnostics-capable digital sink and source input

Multifunction temperature inputs (MF-AT)

- PT1000 resistance measurement
- 0 to 10 V
- 0 to 32 V input
- 0 to 20 mA input
- Digital sink and source input
- High-side PWM signal output (10 mA)

3.6 Diagnostics

Errors can only be found as quickly as possible with diagnostic options.

- Visual directly on the module via LED status indicator. Different states are also displayed differently, e.g. green for OK, red for error.
- Via software in the cyclic data image. With the X90 mobile system, status data does not require any additional communication effort. The differences between theoretically possible bus speed and requirements in practical operation are minimal. All necessary status data is always transferred cyclically.
- 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.
- Special user LEDs on the X90 safety controller can be used to display additional diagnostic and system states in the application. This means that safety-critical states can be displayed visually and detected at glance.

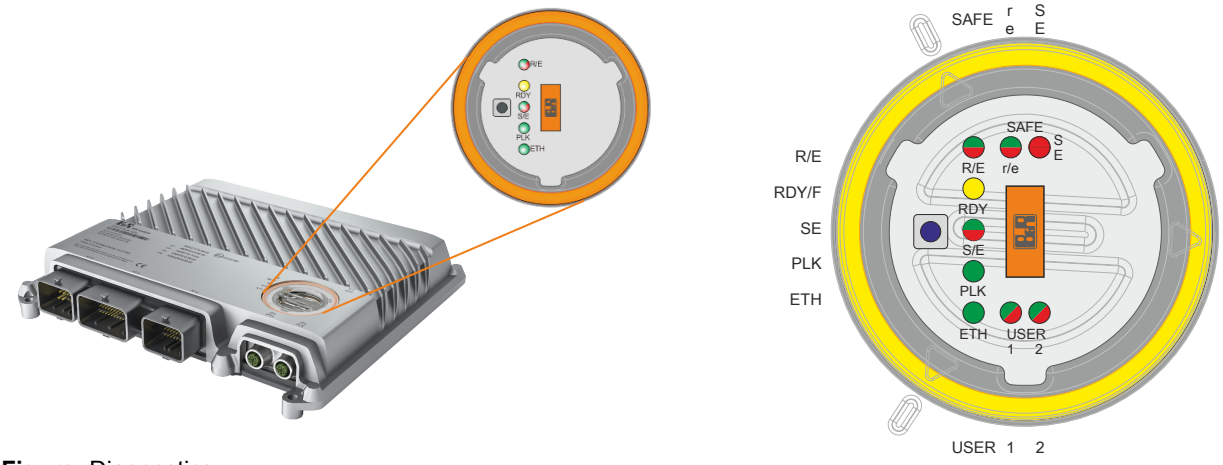


Figure: Diagnostics

4 Module overview

4.1 Model number key

Product family						
X90						Mobile automation
	Mainboard					
	B21					X90 BC120, 1x CANopen, 32x I/O (X90BC124.32-00)
	C71					X90 CP172, 300 MHz, 24x I/O (X90CP172.24-00)
	C72					X90 CP172, 300 MHz, 48x I/O (X90CP172.48-00)
	C73					X90 CP174, 650 MHz, PLK, 24x I/O (X90CP174.24-00)
	C74					X90 CP174, 650 MHz, PLK, 48x I/O (X90CP174.48-00)
	S74					X90 CP174, SL int., 650 MHz, 48x I/O (X90CP174.48-S1)
		Option board 1				
		00				Without option board
		A1				X90 AO, 4x multifunction, 12-bit (X90AO410.04-00)
		A2				X90 AO, 8x multifunction, 12-bit (X90AO410.08-00)
		D1				X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00)
		G1				X90 AI, 2x strain gauge, 24-bit (X90AISG0.02-00)
		I1				X90 IF, 3x CAN, 1x RS232 (X90IF720.04-00)
		I2				X90 IF, 3x CAN, 1x RS485 (X90IF730.04-00)
		I4				X90 DS, 4x IO-Link master (X90DSI00.04-00)
		M1				X90 SM, 1x stepper motor, 4x DI (X90SM546.01-00)
		M2				X90 SM, 2x stepper motor (X90SM546.02-00)
		P1				X90 PWM, 8x multifunction, 4 A (X90PO210.08-00)
		R1				X90 RO, 5x relay (X90RO440.05-00)
		S1				X90 safety relay 4x NO (X90RO440.04-S1)
		T1				X90 AT, 4x multifunction, 12-bit (X90AT910.04-00)
		T2				X90 AT, 8x multifunction, 12-bit (X90AT910.08-00)
			Option board 2			
			00			Without option board
			A1			X90 AO, 4x multifunction, 12-bit (X90AO410.04-00)
			A2			X90 AO, 8x multifunction, 12-bit (X90AO410.08-00)
			C1			X90 condition monitoring, 4 IEPE (X90CM480.04-00)
			D1			X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00)
			I1			X90 IF, 3x CAN, 1x RS232 (X90IF720.04-00)
			I2			X90 IF, 3x CAN, 1x RS485 (X90IF730.04-00)
			I4			X90 DS, 4x IO-Link master (X90DSI00.04-00)
			M1			X90 SM, 1x stepper motor, 4x DI (X90SM546.01-00)
			M2			X90 SM, 2x stepper motor (X90SM546.01-00)
			P1			X90 PWM, 8x multifunction, 4 A (X90PO210.08-00)
			R1			X90 RO, 5x relay (X90RO440.05-00)
			S1			X90 safety relay 4x NO (X90RO440.04-S1)
			T1			X90 AT, 4x multifunction, 12-bit (X90AT910.04-00)
			T2			X90 AT, 8x multifunction, 12-bit (X90AT910.08-00)
				Option board 3		
				00		Without option board
				A1		X90 AO, 4x multifunction, 12-bit (X90AO410.04-00)
				A2		X90 AO, 8x multifunction, 12-bit (X90AO410.08-00)
				C1		X90 condition monitoring, 4 IEPE (X90CM480.04-00)
				D1		X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00)
				I1		X90 IF, 3x CAN, 1x RS232 (X90IF720.04-00)
				I2		X90 IF, 3x CAN, 1x RS485 (X90IF730.04-00)
				I4		X90 DS, 4x IO-Link master (X90DSI00.04-00)
				M1		X90 SM, 1x stepper motor, 4x DI (X90SM546.01-00)
				M2		X90 SM, 2x stepper motor (X90SM546.02-00)
				P1		X90 PWM, 8x multifunction, 4 A (X90PO210.08-00)
				R1		X90 RO, 5x relay (X90RO440.05-00)
				S1		X90 safety relay 4x NO (X90RO440.04-S1)
				T1		X90 AT, 4x multifunction, 12-bit (X90AT910.04-00)
				T2		X90 AT, 8x multifunction, 12-bit (X90AT910.08-00)
					Option board 4	
					00	Without option board
					A1	X90 AO, 4x multifunction, 12-bit (X90AO410.04-00)
					A2	X90 AO, 8x multifunction, 12-bit (X90AO410.08-00)
					C1	X90 condition monitoring, 4 IEPE (X90CM480.04-00)
					D1	X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00)
					I1	X90 IF, 3x CAN, 1x RS232 (X90IF720.04-00)
					I2	X90 IF, 3x CAN, 1x RS485 (X90IF730.04-00)

					I4			X90 DS, 4x IO-Link master (X90DSI00.04-00)
					M1			X90 SM, 1x stepper motor, 4x DI (X90SM546.01-00)
					M2			X90 SM, 2x stepper motor (X90SM546.01-00)
					P1			X90 PWM, 8x multifunction, 4 A (X90PO210.08-00)
					R1			X90 RO, 5x relay (X90RO440.05-00)
					S1			X90 safety relay 4x NO (X90RO440.04-S1)
					T1			X90 AT, 4x multifunction, 12-bit (X90AT910.04-00)
					T2			X90 AT, 8x multifunction, 12-bit (X90AT910.08-00)
							Model	
							000	No Technology Guard / Customized Laser image
							...	Seq. number: I[0...Z][0...Z][0...Z]
Examples								
X90	B21	00 [1]	00 [1]	00 [1]	00 [1]	-	000	X90 mobile bus controller, 1 CANopen on CMC header, 32 multifunction I/Os
X90	C74	T2	D1	I1	C1	-	000	X90 CP174, 650 MHz, PLK, 48x I/O (X90CP174.48-00), X90 AT, 8x multifunction, 12-bit (X90AT910.08-00), X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00), X90 IF option board, 3x CAN, 1x RS232 (X90IF720.04-00), X90 condition monitoring, 4 IEPE (X90CM480.04-00)
X90	C71	P1	A2	00	T1	-	000	X90 CP172, 300 MHz, 24x I/O (X90CP172.24-00), X90 PWM, 8x multifunction, 4 A (X90PO210.08-00), X90 AO, 8x multifunction, 12 Bit (X90AO410.08-00), no option board 3, X90 AT, 4x multifunction, 12-bit (X90AT910.04-00)
X90	S74	D1	I1	R1	R1	-	000	X90 CP174, SL int., 650 MHz, 48x I/O (X90CP174.48-S1) X90 DI, 10x multifunction, 50 kHz (X90DI110.10-00) X90 IF option board, 3x CAN, 1x RS232 (X90IF720.04-00) 2x X90 RO, 5x relay (X90RO440.05-00)

1) Option board not available

4.2 Module overview: Alphabetical

Order number	Module type	Description	Special functions
X90AISG0.02-00	X90 mobile option board, analog input module	• 2 full-bridge strain gauge inputs, 24-bit converter resolution	• 5 kHz input filter
X90AO410.04-00	X90 mobile option board, analog output module	• 4 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source
X90AO410.08-00	X90 mobile option board, analog output module	• 8 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source
X90AT910.04-00	X90 mobile option board, temperature input module	• 4 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz
X90AT910.08-00	X90 mobile option board, temperature input module	• 8 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz
X90BC124.32-00	X90 mobile bus controller	• 1 CANopen on CMC header, 32 multifunction I/Os	• Die-cast aluminum housing
X90CM480.04-00	X90 mobile option board, vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	
X90CP172.24-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP172.48-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.24-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.48-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.48-S1	X90 mobile controller	• Integrated SafeLOGIC • ARM Cortex A9-650 • 512 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os, up to 48 of them safe	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90DI110.10-00	X90 mobile option board, digital input module	• 10 digital inputs, 9 to 32 VDC, optional sink/source	• Optional counter input 50 kHz
X90DSI00.04-00	X90 mobile option board, digital signal module	• 4x IO-Link master Also configurable as inputs or outputs	
X90IF720.04-00	X90 mobile option board, interface module	• 3x CAN • 1x RS232	
X90IF730.04-00	X90 mobile option board, interface module	• 3x CAN • 1x RS485	
X90PO210.08-00	X90 mobile option board, PWM output module	• 8 PWM outputs 9 to 32 VDC, max. 4 A 15 Hz to 1 kHz	• With current measurement (12-bit) • Optional DI 9 to 32 VDC, sink/source
X90RO440.04-S1	X90 mobile option board, digital output module	• 4 safe relays, normally open contacts 9 to 32 VDC / 2 and 4 A	• For external actuator power supply
X90RO440.05-00	X90 mobile option board, digital output module	• 5 relays, normally open contacts 9 to 32 VDC / 2 A	• For external actuator power supply
X90SM546.01-00	X90 mobile option board, stepper motor module	• 1 motor connection 4 A continuous current, 8 A peak current • 4 digital inputs	• Module power supply 15 to 60 VDC • Current reduction function • NetTime function
X90SM546.02-00	X90 mobile option board, stepper motor module	• 2 motor connections 4 A continuous current, 8 A peak current	• Module power supply 15 to 60 VDC • Current reduction function • NetTime function

4.3 Module overview: Grouped

4.3.1 X90 mobile controller

Order number	Module type	Description	Special functions
X90CP172.24-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP172.48-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.24-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.48-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.48-S1	X90 mobile controller	• Integrated SafeLOGIC • ARM Cortex A9-650 • 512 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os, up to 48 of them safe	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators

4.3.2 X90 bus controller

Order number	Module type	Description	Special functions
X90BC124.32-00	X90 mobile bus controller	• 1 CANopen on CMC header, 32 multifunction I/Os	• Die-cast aluminum housing

4.3.3 X90 safety

Order number	Module type	Description	Special functions
X90CP174.48-S1	X90 mobile controller	• Integrated SafeLOGIC • ARM Cortex A9-650 • 512 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os, up to 48 of them safe	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90RO440.04-S1	X90 mobile option board, digital output module	• 4 safe relays, normally open contacts 9 to 32 VDC / 2 and 4 A	• For external actuator power supply

4.3.4 X90 option boards

Digital inputs

Order number	Module type	Description	Special functions
X90DI110.10-00	X90 mobile option board, digital input module	• 10 digital inputs, 9 to 32 VDC, optional sink/source	• Optional counter input 50 kHz

Temperature measurement

Order number	Module type	Description	Special functions
X90AT910.04-00	X90 mobile option board, temperature input module	• 4 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz
X90AT910.08-00	X90 mobile option board, temperature input module	• 8 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz

Digital outputs

Order number	Module type	Description	Special functions
X90PO210.08-00	X90 mobile option board, PWM output module	• 8 PWM outputs 9 to 32 VDC, max. 4 A 15 Hz to 1 kHz	• With current measurement (12-bit) • Optional DI 9 to 32 VDC, sink/source
X90RO440.04-S1	X90 mobile option board, digital output module	• 4 safe relays, normally open contacts 9 to 32 VDC / 2 and 4 A	• For external actuator power supply
X90RO440.05-00	X90 mobile option board, digital output module	• 5 relays, normally open contacts 9 to 32 VDC / 2 A	• For external actuator power supply

Analog inputs

Order number	Module type	Description	Special functions
X90AISG0.02-00	X90 mobile option board, analog input module	• 2 full-bridge strain gauge inputs, 24-bit converter resolution	• 5 kHz input filter

Analog outputs

Order number	Module type	Description	Special functions
X90AO410.04-00	X90 mobile option board, analog output module	• 4 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source
X90AO410.08-00	X90 mobile option board, analog output module	• 8 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source

Condition monitoring

Order number	Module type	Description	Special functions
X90CM480.04-00	X90 mobile option board, vibration measurement	• 4 IEPE analog inputs, 51 kHz sampling frequency, 24-bit converter resolution	

Communication modules

Order number	Module type	Description	Special functions
X90IF720.04-00	X90 mobile option board, interface module	• 3x CAN • 1x RS232	
X90IF730.04-00	X90 mobile option board, interface module	• 3x CAN • 1x RS485	

Motor modules

Order number	Module type	Description	Special functions
X90SM546.01-00	X90 mobile option board, stepper motor module	• 1 motor connection 4 A continuous current, 8 A peak current • 4 digital inputs	• Module power supply 15 to 60 VDC • Current reduction function • NetTime function
X90SM546.02-00	X90 mobile option board, stepper motor module	• 2 motor connections 4 A continuous current, 8 A peak current	• Module power supply 15 to 60 VDC • Current reduction function • NetTime function

4.4 Connection overview

X90CP172.xx-00 X90CP174.xx-00 X90CP174.48-S1		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-AI	8/16						ST / SI		ST / SI	ST
MF-DI	4/8						ST / SI	ST / SI		
MF-DO	4/8	ST / SI					ST			
MF-PWM	8/16	ST / SI		ST / SI*			ST			

Only with safety controller: ST = Standard, SI = Safe, SI* = Safe (switch off only)

X90BC124.32-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-AI	12									
MF-DI	4									
MF-DO	4									
MF-PWM	8									
MF-PVG	4									

X90AISG0.02-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-AI	2								*	

* Connection for full-bridge strain gauge

X90AO410.0x-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-AI	4/8									

X90AT910.0x-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-AT	4/8			*						

* PWM signal only

X90CM480.04-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
AI	4					*				

* Connection for IEPE sensor: Vibration measurement

X90DI110.10-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-DI	10									

X90DSI00.04-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
DI	4					*				

* IO-Link master interface

X90IF7x0.04-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
CAN bus	3					*				

* CAN bus interface

X90PO210.08-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
MF-PWM	8									

X90RO440.04-S1 X90RO440.05-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
Relays	4/5	SI								

Only with safety module: SI = Safe

X90SM546.01-00 X90SM546.02-00		Output					Input			
Input/Output	Quantity	Digital	Analog	PWM	PVG	Other	Digital	Counters	Analog	Temper-ature
DI	4									
Motor bridge	1/2									

5 Dimensioning

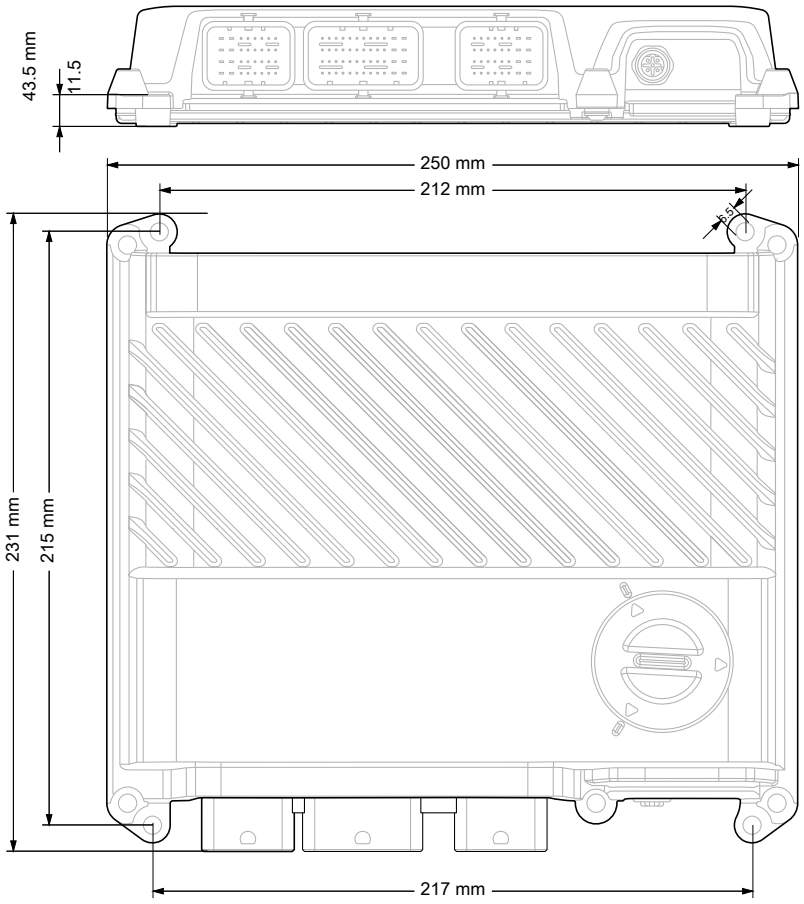
5.1 Design support

CAD support

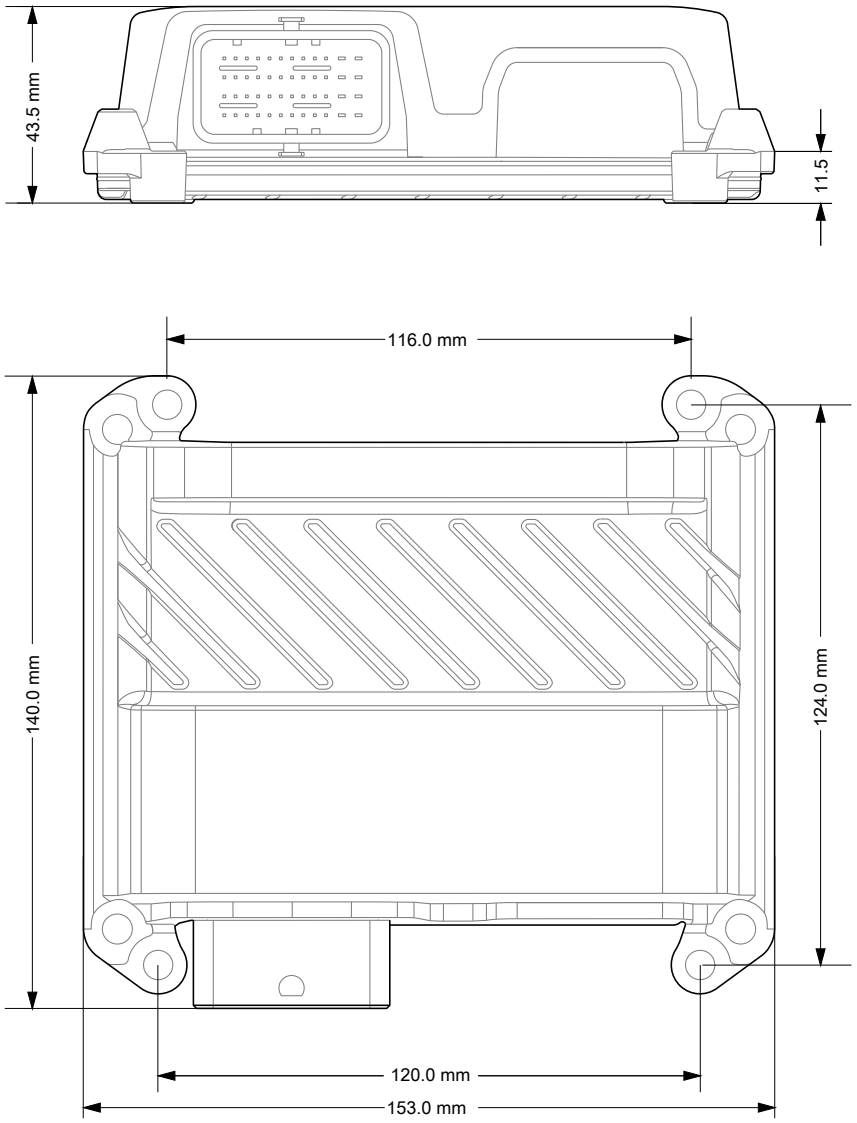
To ensure CAD support, the dimensions are included in the ECAD macros in 2D. STEP data is available to allow 3D viewing.
The STEP data can be downloaded from the B&R website (www.br-automation.com) under section "Services".

5.2 Dimension

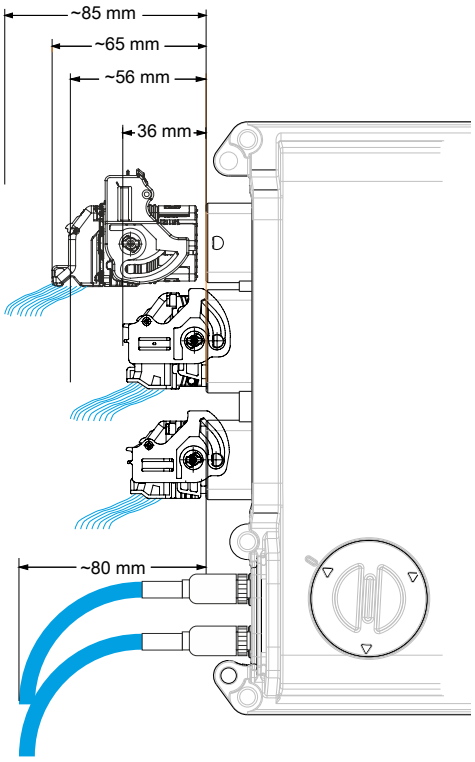
5.2.1 X90 mobile controller



5.2.2 X90 bus controller



5.2.3 Connectors and connections



5.3 Clearance

In order to ensure sufficient air circulation, a clearance of at least 10 mm must be provided. The clearances specified in section "Connectors and connections" on page 28 apply to the connector side.

The clearance is valid for all X90 mobile system variants.

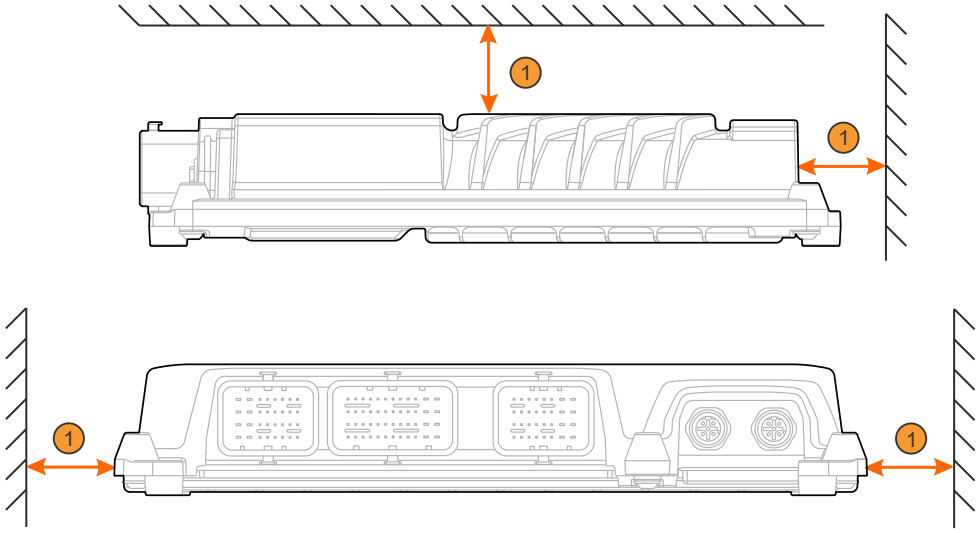


Figure: Installation instructions

1 Clearance to be observed

6 Installation and wiring

6.1 Installation/Removal

Installation

The X90 mobile system is secured with 4 suitable M6 screws to the smoothest possible surface in the holes provided for this purpose with a torque suitable for the selected screws.

A heat-dissipating installation surface is recommended to ensure improved cooling.

> **Information:**
>
> **M6 screws are not included in delivery.**

Removal

All four M6 screws must be removed.

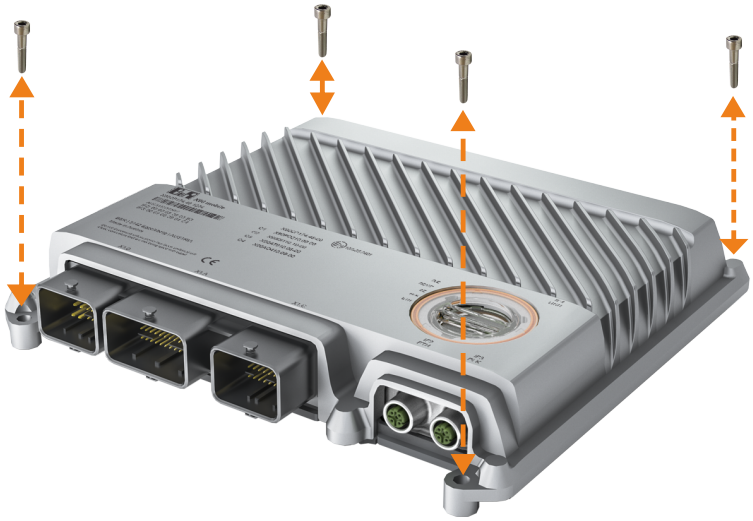


Figure: Installing and removing the X90 mobile system

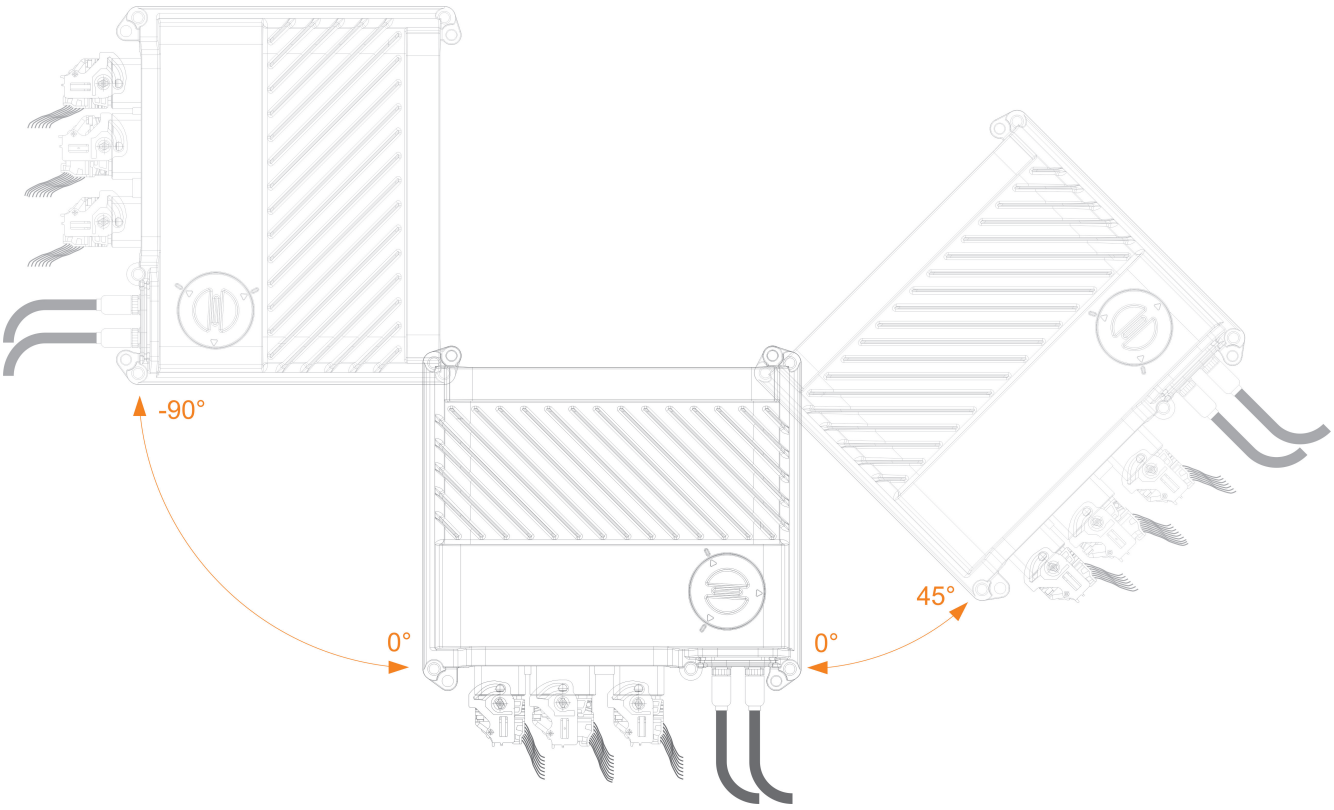
6.2 Mounting orientations

Notice!

Standing water in the cable area must be avoided in any mounting orientation.

Vertical installation

One of the following mounting orientations should be used for vertical installation:



Horizontal installation

In a horizontal mounting orientation, the orientation can be selected as required.

6.3 X90 mobile system - Connector pinout

Since different option boards can be used as needed, the pinout of Molex connectors changes. To obtain a valid pinout for the respective configuration, a corresponding Excel file is available at www.br-automation.com:

- X90 mobile control system - Configuration

6.4 Ground connection

The X90 mobile housing is electrically isolated from ground. The housing should be grounded to a chassis connected to ground (negative pole of the battery) through the screw connection.

If the X90 mobile system is not installed on a mobile machine, the ground connections must be provided via a suitable ground rail.

The ground connections should be as close as possible to the X90 mobile housing to ensure short connection lines.

6.5 Shock and vibration resistance

Notice!

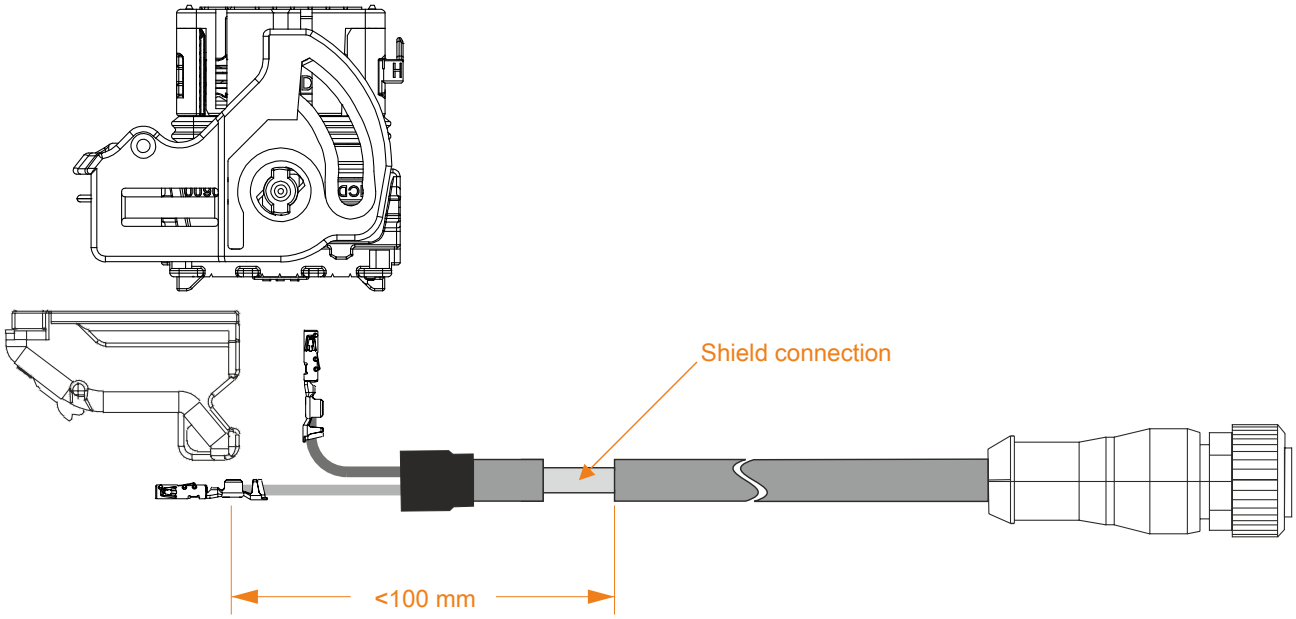
Shock and vibration resistance applies under the condition that cables are securely installed.

6.6 CANopen shielding

CAN fieldbus connections should be made using shielded cables to avoid interferences.

The following must be observed for shielding:

- The shield of the sensor lines must be applied over a large area and with low impedance in the area of the CMC header and connected to the X90 housing in the shortest possible way.
- The cable shield must extend as far as possible to the CMC header. The area of the exposed conductors of the sensor line must be kept as short as possible (<10 cm).
- The cable length between the CMC header and cable shield clamp must be kept as short as possible (<10 cm).
- For the best possible reduction of EMC interference, the X90 housing must be mounted on a well-conductive mounting plate on which the cable shields must also be placed directly.
- The X90 housing must be grounded.



6.7 IP69K protection

To ensure IP69K protection, the following must be taken into account during installation:

Notice!

- **The union nuts on female/male connectors must be tightly secured with the specified tightening torque. For information about the tightening torque, see section "Circular connectors" on page 32.**
- **Female/Male connectors that are not being used must be closed with the included protective covers.**
- **Unused pins on the multi-connector must be closed with dummy plugs.**

6.8 Circular connectors

All B&R connectors (see cables and connectors in section "Accessories" on page 38) are designed for use with X90 mobile components. In addition to field-assembled connectors, B&R also offers pre-assembled cables for fieldbuses and I/O functions.

Information:

When using third-party connectors, it is important to ensure that the contacts have a gold coating.

The connections of the X90 mobile system for POWERLINK and Ethernet are circular connectors.

Screw thread	Tightening torque	Torque wrench
M12	0.6 Nm	X67CA0Ex1. X67AC2E01

Table: System connectors and tightening torque

Notice!

To ensure IP protection, unused M12 circular connectors must be closed with suitable protective covers. 2 protective covers are included in delivery.

7 Mechanical handling

7.1 Installation - CMC mating connector X1

Information:

The following characteristics, features and limit values are obtained from the manufacturer. For more information about the product, see the manufacturer's website at www.molex.com.

All unused contacts must first be fitted with the appropriate blind plugs. The orange blind plugs must be inserted into the 1.5 mm² contacts; the white blind plugs must be inserted into the 0.6 mm² contacts. The blind plugs must be pressed in towards the housing all the way to their "head".

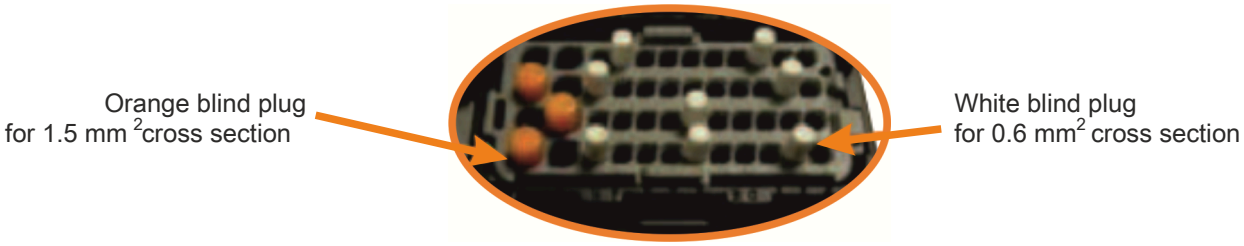


Figure: Unused pins - Blind plugs (image by Molex)

Notice!

Unused pins must be fitted with blind plugs; otherwise, the IP rating cannot be guaranteed.

Mating connector X1 is unlocked by pulling out the gray latch (with a screwdriver, for example).

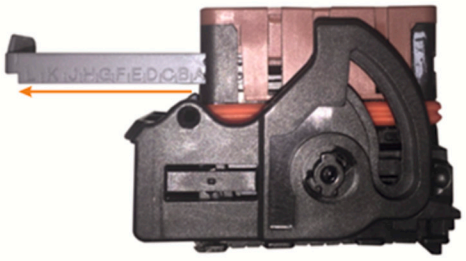


Figure: Unlocking mating connector X1

The appropriate female connector can be crimped to the cable using the crimping tool [1] or applicator[2] The following spacing is recommended for the cable length in mating connector X1:

Row	A	B	C	D	E	F	G	H	J	K	L	M
48-pin	49 mm	51 mm	53 mm	55 mm	57 mm	59 mm	61 mm	63 mm	65 mm	68 mm	75 mm	80 mm
32-pin	50 mm	52 mm	54 mm	56 mm	58 mm	60 mm	63 mm	65 mm				

Table: Recommended cable length in mating connector X1

Figure: Recommended cable length in mating connector (image by Molex)

[1] Recommended Molex accessories: 63811-9100, 63811-9200, 63811-8900, 63811-9000.
[2] Recommended Molex accessories: 63902-1900, 63902-2000, 63868-8000, 63868-8100.

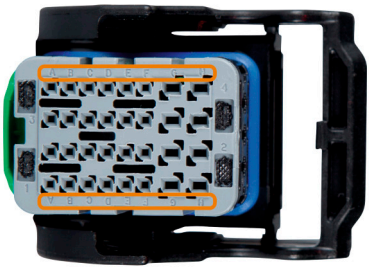


Figure: Mating connector X1 - Row specifications

Push the cable into mating connector X1 with the "push-click-pull" method while taking the latch keying into account.

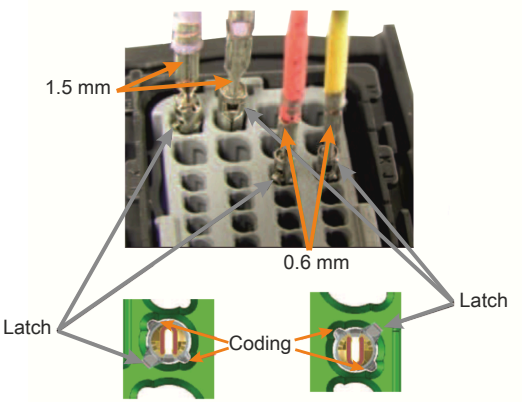


Figure: Inserting the cable (image by Molex)

Lock mating connector X1 again by pushing the gray latch back into mating connector X1.

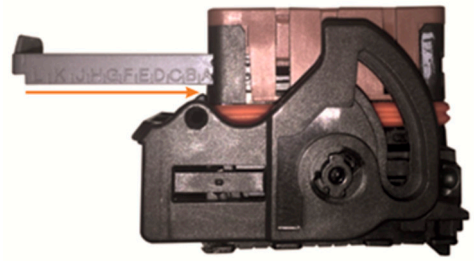


Figure: Locking mating connector X1

Information:

If the gray latch jams when trying to push it in, then a cable or blind plug is not inserted properly. The row in which this cable / blind plug is inserted can be identified from the gray latch.

Lock the wire cap to mating connector X1 (over the gray latch) and pull it over the connector until it locks into place.

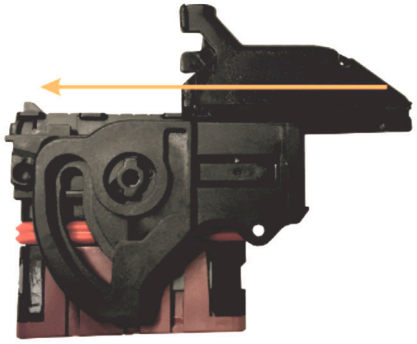


Figure: Installing the wire cap

Rotate the black latch up 90° until the latch locks onto the wire cap.

Figure: Rotating the latch

Figure: Locking the latch

The stranded wire must be protected against vibration using a cable tie through the clap on the wire cap.

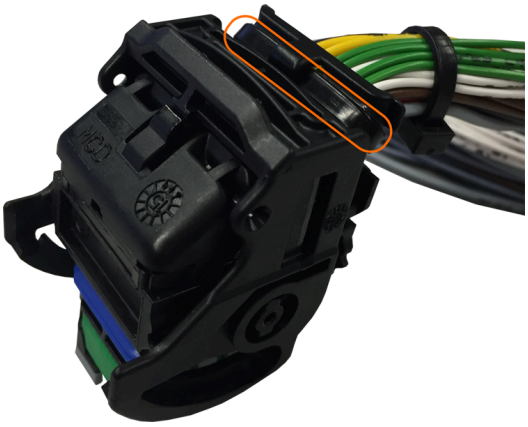


Figure: Cable tie clip

The cables for mating connector X1 must be fastened down with suitable cable clamps.

7.2 Removal - CMC mating connector X1

All cable ties / cable clamps must be removed first.

The wire cap is unlocked by pressing down on the fastening clip (with a screwdriver, for example) and then rotating the black latch down 90°.

Figure: Pressing on the fastening clip

Figure: Rotating the latch

To remove the wire cap from mating connector X1, the two locking points must be disengaged with a screwdriver. This is done by pressing the screwdriver into one of the two slots and simultaneously pressing the wire cap in the opposite direction. This procedure must then be repeated on the other side of the wire cap. The wire cap can now be removed.

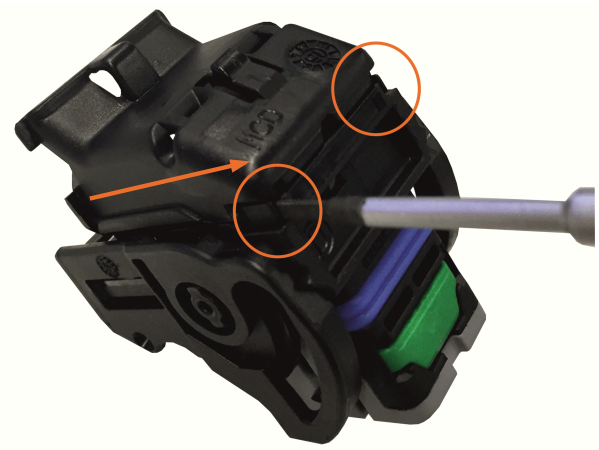


Figure: Removing the wire cap

To remove the cables, the gray latch must first be pulled out (with a screwdriver, for example).

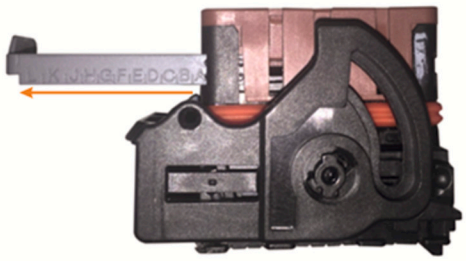


Figure: Unlocking mating connector X1

Press the cable into mating connector X1 (1). Insert the removal tool into the correct slots (2). Remove the cable (3).

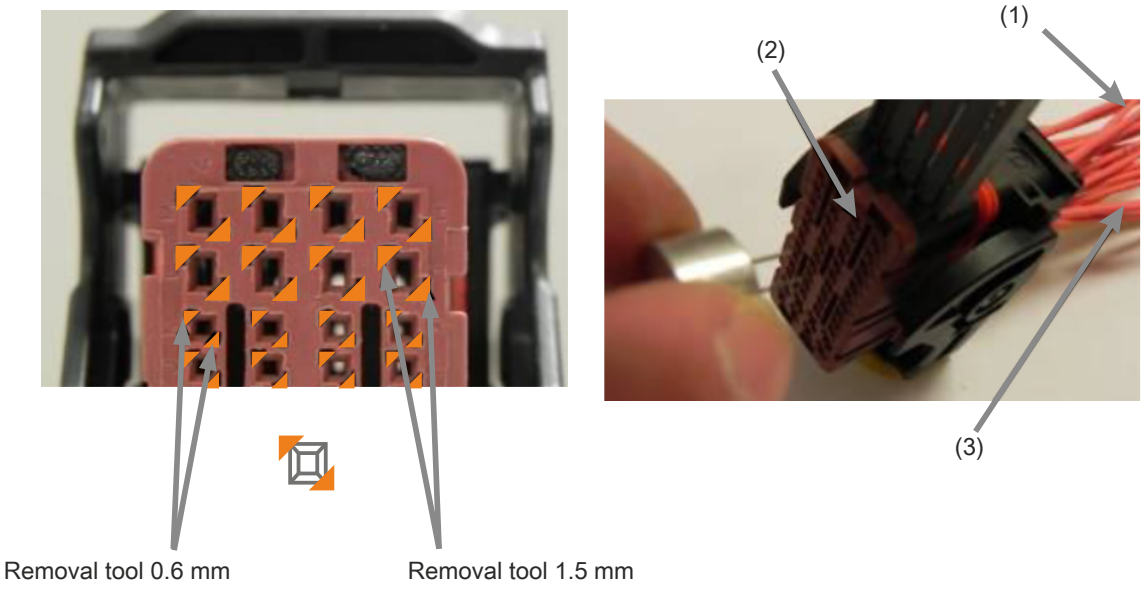


Figure: Removing the cable (image by Molex)

8 Accessories

8.1 General overview

B&R accessories

	Order number	Product ID	Page
Installation tool			
	X67ACTQMX	X67 torque wrench set, for X67 M8 and M12 connectors, for hex-head connectors	39
Pre-assembled cables			
	POWERLINK cables		
	X67CA0E41.xxxx	POWERLINK attachment cable, RJ45 and straight M12 connector	40
	X67CA0E61.xxxx	POWERLINK connection cable, straight M12 connector and straight M12 connector	40
Field-assembled connectors			
	POWERLINK		
	X67AC2E01	X67 connector, M12, 4-pin, D-coded, shielded, insulation piercing connection	43
Multi-connector accessories			
	CMC header		
	X90TB100.03-00	X90 mobile connector set, for CMC header	44
	X90TB120.01-00	X90 mobile 120, connector for CMC header, with connector contacts and dummy plugs	47
	Wiring harness		
	X90CA100.02-00	X90 mobile wiring harness for X90CP17x, including CMC connector, 2 m, for CMC header	49
	X90CA124.02-00	X90 mobile wiring harness for X90BC124, 2 m, for CMC header	53
	Breakout box		
	X90AC-BB.17-00	X90 mobile breakout box 170, for development and testing	55
	X90AC-BB.12-00	X90 mobile 120 bus controller test set, template and cable adapter for breakout box X90AC-BB.17-00 for testing X90BC124.32-00	59
Protective cover			
	X67AC0M12	X67 M12 threaded caps, 50 pcs.	61
Hub system			
	X67HB8880.L12	X67 Ethernet HUB 8x M12	62

Molex accessories

For general information about processing, see www.molex.com > Molex material number search > "Application specifications".

Order number	Product ID	Third-party manufacturer	Page
Installation tool			
63811-9100	Hand crimp tool for 22 AWG, 0.35 mm²	Molex	39
63811-9200	Hand crimp tool for 20/18 AWG, 0.5 to 0.75 mm²	Molex	
63811-8900	Hand crimp tool for 18 AWG, 0.5 to 0.75 mm²	Molex	
63811-9000	Hand crimp tool for 16/14 AWG, 1 to 2 mm²	Molex	
63902-1900	Applicator for 22 AWG, 0.35 to 0.5 mm²	Molex	39
63902-2000	Applicator for 20/18 AWG, 0.75 mm²	Molex	
63868-8000	Applicator for 18 AWG, 0.5 to 1 mm²	Molex	
63868-8100	Applicator for 16/14 AWG, 1.5 to 2 mm²	Molex	
63813-2400	Removal tool for 0.6 mm pins	Molex	39
63813-2300	Removal tool for 1.5 mm pins	Molex	

Conec accessories

For additional information about the following accessories, see www.conec.com.

Order number	Product ID	Third-party manufacturer	Page
Installation tool			
43-16211	Protective cover for M12	Conec	61
43-16212	Protective cover for M12 with loop	Conec	

8.2 Installation tool

8.2.1 Torque wrench set

Order number	Short description	Figure
	Mounting tools	
X67ACTQMX	X67 torque wrench set, for X67 M8 and M12 connectors, for hex-head connectors	

Table: X67ACTQMX - Order data

8.2.2 Extraction tool

	Extraction tool for 0.6 mm pins	Extraction tool for 1.5 mm pins
Figure		
Manufacturer	Molex	
Manufacturer's model number	63813-2400	63813-2300

Table: Extraction tool

8.2.3 Hand crimp tool

	Hand crimp tool			
Figure				
Cross section	22 AWG or 0.35 mm²	20/18 AWG or 0.5 to 0.75 mm²	18 AWG or 0.5 to 0.75 mm²	16/14 AWG or 1 to 2 mm²
Manufacturer	Molex			
Manufacturer's model number	63811-9100	63811-9200	63811-8900	63811-9000

Table: Hand crimp tool

8.2.4 Applicator

	Applicator			
Figure				
Cross section	22 AWG or 0.35 to 0.5 mm²	20/18 AWG or 0.75 mm²	18 AWG or 0.5 to 1 mm²	16/14 AWG or 1.5 to 2 mm²
Manufacturer	Molex			
Manufacturer's model number	63902-1900	63902-2000	63868-8000	63868-8100

Table: Applicator

8.3 Pre-assembled cables

8.3.1 General

	Short description, order number	
Length	Attachment cables - RJ45 to M12	Connection cables - M12 to M12
1 m	X67CA0E41.0010	X67CA0E61.0010
2 m	X67CA0E41.0020	X67CA0E61.0020
3 m	X67CA0E41.0030	
5 m	X67CA0E41.0050	X67CA0E61.0050
10 m		X67CA0E61.0100
15 m	X67CA0E41.0150 X67CA3E41.0150	X67CA0E61.0150
20 m		X67CA0E61.0200
50 m	X67CA0E41.0500	
		

Length	Tolerances for cable lengths
0 to <10 m	+10 cm
10 m to <50 m	+2% of the length

8.3.1.1 Technical data

Product ID	X67CA0E41	X67CA0E61	X67CA3E41
General information			
Note	Halogen-free		
Durability	Flame-retardant in accordance with IEC 60332-1-2		Oil resistant in accordance with EN 60811-2-1 Flame-retardant in accordance with IEC 60332-1-2 UV resistant in accordance with UL 2556
Connection	RJ45 to M12; 4-pin	M12 to M12, 4-pin	RJ45 to M12; 4-pin
Type	Attachment cables	Connection cables	
Cable cross section			
AWG	4x 22 AWG		
mm²	4x 0.34 mm²		
Cable construction			
Complete shielding	Aluminum-clad foil (overlapping), tinned copper braiding, 85% covering		
Outer sheathing			
Material	Polyurethane (PUR)		
Color	Green		
Labeling	B&R X67CA0Exx.xxxx Rev. C0[1)]		
Lines			
Wire insulation	Polyethylene (PE)		
Wire colors	White, yellow, blue, orange		
Type	Tinned copper stranded wire Fine stranded wire (7x 0.25 mm / 7x 30 AWG)		
Stranding	4-wire twisted pair		
Electrical characteristics			
Conductor resistance	≤120 Ω/km at 20°C		
Transfer properties	Category 5 / Class D up to 100 MHz in accordance with ISO/IEC 11801 (EN50173-1), ISO/IEC 24702 (EN 50173-3)		
Transfer rate	10/100 Mbit/s		
Insulation resistance	≥500 MΩ/km at 20°C		
Operating conditions			
EN 60529 protection			
Cables	IP67		
Male M12 connector	IP67, only when screwed in		
RJ45 connector	IP20, only when connected properly		
Environmental conditions			
Temperature			
Transport	-40 to 70°C		
Fixed installation	-40 to 70°C		
Flexible installation	-20 to 60°C		
Mechanical characteristics			
Dimensions	Various		
Length			
Diameter	6.5 mm ±0.2 mm		
Bend radius	≥7x outer diameter		
Drag chain data			
Acceleration	-		4 m/s²
Flex cycles	-		Min. 3 million
Speed	-		4 m/s
Weight	0.062 kg/m		0.061 kg/m

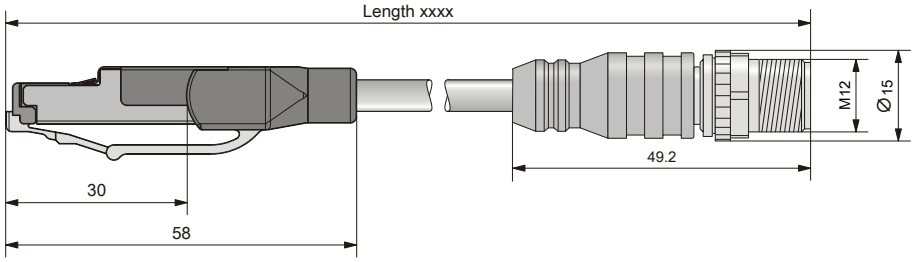
1) xx.xxxx: Group number and cable length.

8.3.1.2 X67CA0E41.xxxx and X67CA3E41.xxxx

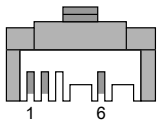
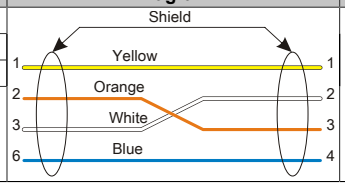
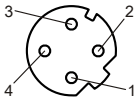
This cable is offered in 2 variants:

- X67CA0Exx: Standard variant
- X67CA3Exx: Can be used in cable drag chains

Dimensions



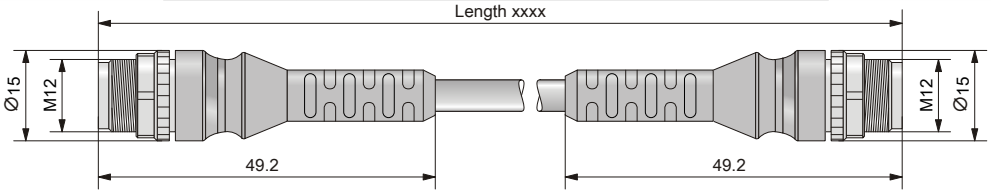
Pinout

Male RJ45 connector	Pin	Name	Diagram	M12 connector
	1 - 1	TXD		
	2 - 3	TXD\		
	3 - 2	RXD		
	6 - 4	RXD\		

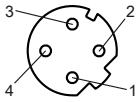
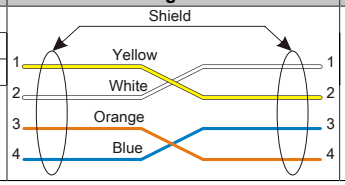
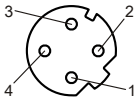
D-coded

8.3.1.3 X67CA0E61.xxxx

Dimensions



Pinout

Connector	Pin	Name	Diagram	Connector
	1 - 2	TXD		
	2 - 1	RXD		
	3 - 4	TXD\		
	4 - 3	RXD\		

D-coded

D-coded

8.4 Field-assembled connectors

8.4.1 POWERLINK/Ethernet

Order number	Short description	Figure
	POWERLINK/Ethernet	
X67AC2E01	X67 male M12 connector, 4-pin, D-keyed, shielded, insulation piercing connection	

Table: X67AC2E01 - Order data

Information:

The color of the wires on field-assembled cables used for connecting the POWERLINK bus controller may deviate from the standard.

Make sure to check the proper pinout.
For technical data and additional information about POWERLINK cables, see the corresponding documentation. This is located under the order number of the cable on the B&R website (www.br-automation.com) and can be downloaded from there.

8.5 CMC connector accessories

8.5.1 X90TB100.03-00

For more information about the following accessories, see www.molex.com.

8.5.1.1 Order data

Order number	Short description	Figure
	CMC connector	
X90TB100.03-00	X90 mobile connector set, for CMC header	

Table: X90TB100.03-00 - Order data

8.5.1.2 X90TB100.03-00 - Technical data

Order number	X90TB100.03-00
Short description	
Accessories	Set consists of: 1x mating connector X1.A, 1x mating connector X1.B, 1x mating connector X1.C, 2x cover for 32-pin mating connector, 1x wire cap for 48-pin mating connector, 30x female connector for 1.5 mm contacts, 120x female connector for 0.6 mm contacts, 60x blind plug for 0.6 mm contacts, 20x blind plug for 1.5 mm contacts
General information	
Certifications	
CE	Yes
Mechanical properties	
Weight	200 g
Vendor information	
Manufacturer	Molex
Manufacturer's product ID	Mating connector X1.A: 64320-1319 Mating connector X1.B: 64319-3218 Mating connector X1.C: 64319-1211 Wire cap for 32-pin mating connector: 64319-1201 Wire cap for 48-pin mating connector: 64320-1301 Female connector for 1.5 mm contacts: 0643221039 Female connector for 0.6 mm contacts: 0643231039 Blind plug for 0.6 mm contacts: 0643251010 Blind plug for 1.5 mm contacts: 0643251023

8.5.1.3 Set contents

Figure: Set contents

8.5.1.3.1 Mating connector

	Mating connector X1.B	Mating connector X1.A	Mating connector X1.C
Figure			
Manufacturer	Molex		
Manufacturer's model number	64319-3218	64320-1319	64319-1211
Connections	24x 0.6 mm / 8x 1.5 mm	40x 0.6 mm / 8x 1.5 mm	24x 0.6 mm / 8x 1.5 mm
Color	Gray	Brown	Black

Table: Mating connector

8.5.1.3.2 Wire cap for mating connector

	Wire cap for 32-pin mating connector	Wire cap for 48-pin mating connector
Figure		
Manufacturer	Molex	
Manufacturer's model number	64319-1201	64320-1301

Table: Wire cap for mating connector

8.5.1.3.3 Female connectors for connections

	Female connector for 0.6 mm contacts on 3-bay CMC connection unit			Female connector for 1.5 mm contacts on 3-bay CMC connection unit	
Figure					
Manufacturer	Molex				
Cross section	0.35 mm²	0.5 mm²	0.75 mm²	0.5 to 1 mm²	1 to 2 mm²
Manufacturer's model number	0643221019	0643221039	0643221029	0643231029	0643231039

Table: Female connectors for connections

8.5.1.3.4 Blind plug for contacts

	Blind plug for 0.6 mm contacts	Blind plug for 1.5 mm contacts
Figure		
Manufacturer	Molex	
Manufacturer's model number	0643251010	0643251023

Table: Blind plug for contacts

8.5.2 X90TB120.01-00

For more information about the following accessories, see www.molex.com.

8.5.2.1 Order data

Order number	Short description	Figure
	CMC connector	
X90TB120.01-00	X90 mobile 120, connector for CMC header, with connector contacts and dummy plugs	

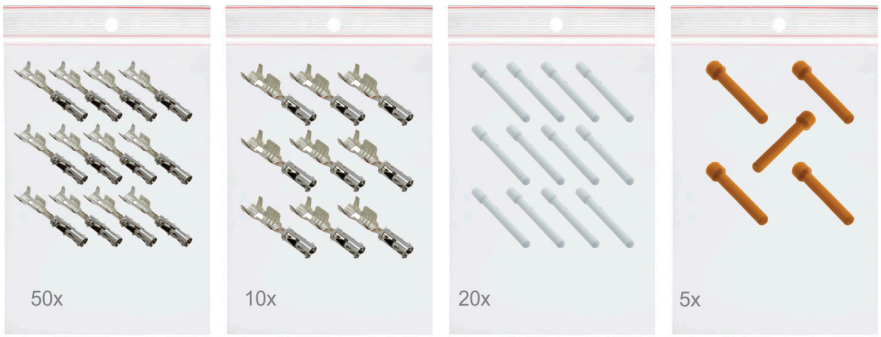
Table: X90TB120.01-00 - Order data

8.5.2.2 Technical data

Order number	X90TB120.01-00
Short description	
Accessories	Set consists of: 1x mating connector X1, 1x wire cap for 48-pin mating connector, 10x female connector for 1.5 mm contacts, 50x female connector for 0.6 mm contacts, 20x blind plug for 0.6 mm contacts, 5x blind plug for 1.5 mm contacts
General information	
Certifications	
CE	Yes
Electrical properties	
Nominal voltage	12 / 24 VDC
Max. voltage	32 VDC
Nominal current [1)]	4 A for 0.6 mm connections / 10 A for 1.5 mm connections
Ambient conditions	
Temperature	
Operation	Corresponds to the X90 module used
Mechanical properties	
Weight	100 g
Vendor information	
Manufacturer	Molex
Manufacturer's product ID	Mating connector X1: 64320-1311 Wire cap for 48-pin mating connector: 64320-1301 Female connector for 1.5 mm contacts: 0643221039 Female connector for 0.6 mm contacts: 0643231039 Blind plug for 0.6 mm contacts: 0643251010 Blind plug for 1.5 mm contacts: 0643251023

1) The respective limit data of the individual I/O channels must be taken into account!

8.5.2.3 Set contents



8.5.2.3.1 Mating connector

	Mating connector X1
Figure	
Manufacturer	Molex
Manufacturer's material number	64320-1311
Connections	40x 0.6 mm / 8x 1.5 mm
Color	Black

Table: Mating connector

8.5.2.3.2 Wire cap for mating connector

	Wire cap for 48-pin mating connector
Figure	
Manufacturer	Molex
Manufacturer's material number	64320-1301

Table: Wire cap for mating connector

8.5.2.3.3 Blind plug for contacts

	Blind plug for 0.6 mm contacts	Blind plug for 1.5 mm contacts
Figure		
Manufacturer	Molex	
Manufacturer's model number	0643251010	0643251023

Table: Blind plug for contacts

8.5.3 X90CA100.02-00

Information:

A specified clearance must be provided for sufficient air circulation when installing mating connectors.

8.5.3.1 Order data

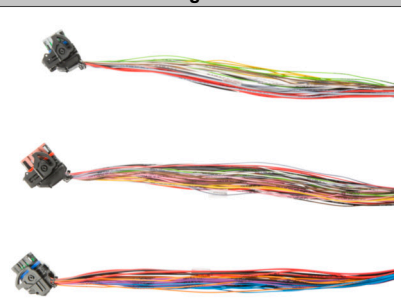
Order number	Short description	Figure
	Wire harness	
X90CA100.02-00	X90 mobile wiring harness starter set for CMC header, 2 m	

Table: X90CA100.02-00 - Order data

8.5.3.2 X90CA100.02-00 - Technical data

Order number	X90CA100.02-00
Short description	
Accessories	Set consisting of 3x wiring harness with 1x mating connector X1.A, 1x mating connector X1.B and 1x mating connector X1.C
General information	
Short description	Connection cable for mating connector X1 to wire end sleeves
Type	X90 connection cable
Cable cross section	
mm²	See chapter "Pinout"
Certifications	
CE	Yes
Cable construction	
Outer jacket	
Material	PVC
Color	See chapter "Pinout"
Labeling	At least every 25 cm
Mechanical properties	
Dimensions	
Length	2 m
Bend radius	≥15 mm
Weight	2800 g

8.5.3.3 Pinout

The CMC multi-header consists of 3 connectors: X1.A, X1.B and X1.C. For additional information, see section "Pinout" in data sheet X90CP174.24-00.

The cables for mating connector X1 must be secured with suitable cable clamps.

Mating connector X1.A - Brown

Pinout						
Pin	**Name**	**Color**	**Cross section**	**Slot**	**Channel**	**Label[1)]**
A1	Function	Brown	0.5 mm²	Option1	8	Brown A1 option1 function 8
B1	CAN1	Pink	0.5 mm²	Base	CAN_L	Brown B1 base CAN1 CAN_L
C1	CAN1	Pink	0.5 mm²	Base	CAN_H	Brown C1 base CAN1 CAN_H
D1	CAN3	Pink	0.5 mm²	Base	CAN_L	Brown D1 base CAN3 CAN_L
E1	CAN3	Pink	0.5 mm²	Base	CAN_H	Brown E1 base CAN3 CAN_H
F1	MF-DI	Green	0.35 mm²	Base	1	Brown F1 base MF-DI 1
G1	MF-DI	Green	0.35 mm²	Base	3	Brown G1 base MF-DI 3
H1	MF-AI	White	0.35 mm²	Base	4	Brown H1 base MF-AI 4
J1	MF-PWM 4A	Gray	0.5 mm²	Base	4	Brown J1 base MF-PWM 4A 4
K1	MF-PWM 4A	Gray	0.5 mm²	Base	5	Brown K1 base MF-PWM 4A 5
L1	MF-PWM 6A	Gray	1 mm²	Base	6	Brown L1 base MF-PWM 6A 6
M1	Function / Vcc / GND	Brown	1.5 mm²	Option1	9	Brown M1 option1 function / Vcc / GND 9
A2	Function	Brown	0.5 mm²	Option1	7	Brown A2 option1 function 7
B2	CAN2	Pink	0.5 mm²	Base	CAN_L	Brown B2 base CAN2 CAN_L
C2	CAN2	Pink	0.5 mm²	Base	CAN_H	Brown C2 base CAN2 CAN_H
D2	Sensor supply	Pink	0.5 mm²	Base	5 V	Brown D2 base sensor supply 5V
E2	Sensor supply	Pink	0.5 mm²	Base	5 V / 10 V	Brown E2 base sensor supply 5 V / 10 V
F2	MF-DI	Green	0.35 mm²	Base	2	Brown F2 base MF-DI 2
G2	MF-DI	Green	0.35 mm²	Base	4	Brown G2 base MF-DI 4
H2	MF-AI	White	0.35 mm²	Base	5	Brown H2 base MF-AI 5
J2	MF-AI	White	0.35 mm²	Base	7	Brown J2 base MF-AI 7
K2	Ignition +	Red	0.5 mm²	Base	KL15	Brown K2 base ignition + KL15
L2	GND	Black	1.5 mm²			Brown L2 GND
M2	MF-PWM 6 A	Gray	1 mm²	Base	7	Brown M2 base MF-PWM 6A 7
A3	MF-DO	Yellow	0.5 mm²	Base	3	Brown A3 base MF-DO 3
B3	Function	Brown	0.5 mm²	Option1	6	Brown B3 option1 function 6
C3	Enable pin	Pink	0.5 mm²	Base		Brown C3 base enable pin
D3	MF-AI	White	0.35 mm²	Base	1	Brown D3 base MF-AI 1
E3	MF-AI	White	0.35 mm²	Base	2	Brown E3 base MF-AI 2
F3	MF-AI	White	0.35 mm²	Base	3	Brown F3 base MF-AI 3
G3	Analog GND	Black	0.5 mm²			Brown G3 analog GND
H3	MF-AI	White	0.35 mm²	Base	6	Brown H3 base MF-AI 6
J3	MF-AI	White	0.35 mm²	Base	8	Brown J3 base MF-AI 8
K3	CPU power supply	Red	0.5 mm²	Base	KL30	Brown K3 base CPU supply KL30
L3	I/O power supply	Red	1.5 mm²	Base	Vcc	Brown L3 base Vcc
M3	Function / Vcc / GND	Brown	1.5 mm²	Option1	10	Brown M3 option1 function / Vcc / GND 10
A4	MF-DO	Yellow	0.5 mm²	Base	2	Brown A4 base MF-DO 2
B4	MF-DO	Yellow	0.5 mm²	Base	1	Brown B4 base MF-DO 1
C4	MF-DO	Yellow	0.5 mm²	Base	4	Brown C4 base MF-DO 4
D4	Function	Brown	0.5 mm²	Option1	4	Brown D4 option1 function 4
E4	Function	Brown	0.5 mm²	Option1	5	Brown E4 option1 function 5
F4	Function	Brown	0.5 mm²	Option1	3	Brown F4 option1 function 3
G4	MF-PWM 4A	Gray	0.5 mm²	Base	3	Brown G4 base MF-PWM 4A 3
H4	MF-PWM 4A	Gray	0.5 mm²	Base	2	Brown H4 base MF-PWM 4A 2
J4	MF-PWM 4A	Gray	0.5 mm²	Base	8	Brown J4 base MF-PWM 4A 8
K4	MF-PWM 4A	Gray	0.5 mm²	Base	1	Brown K4 base MF-PWM 4A 1
L4	GND	Black	1.5 mm²			Brown L4 GND
M4	I/O power supply	Red	1.5 mm²	Base	Vcc	Brown M4 base Vcc

Table: Mating connector X1.A - Pinout

1) Labels at least every 25 cm

Mating connector X1.B - Gray

Pinout						
Pin	**Name**	**Color**	**Cross section**	**Slot**	**Channel**	**Label[1)]**
A1	MF-DO	Yellow	0.5 mm²	Base	5	Gray A1 base MF-DO 5
B1	MF-PWM 4A	Gray	0.5 mm²	Base	16	Gray B1 base MF-PWM 4A 16
C1	MF-PWM 4A	Gray	0.5 mm²	Base	15	Gray C1 base MF-PWM 4A 15
D1	MF-PWM 4A	Gray	0.5 mm²	Base	14	Gray D1 base MF-PWM 4A 14
E1	MF-PWM 4A	Gray	0.5 mm²	Base	10	Gray E1 base MF-PWM 4A 10
F1	MF-PWM 4A	Gray	0.5 mm²	Base	9	Gray F1 base MF-PWM 4A 9
G1	I/O power supply	Red	1.5 mm²	Base	Vcc	Gray G1 base Vcc
H1	MF-PWM 6A	Gray	1 mm²	Base	11	Gray H1 base MF-PWM 6A 11
A2	MF-DO	Yellow	0.5 mm²	Base	7	Gray A2 base MF-DO 7
B2	MF-AI	White	0.35 mm²	Base	9	Gray B2 base MF-AI 9
C2	MF-AI	White	0.35 mm²	Base	12	Gray C2 base MF-AI 12
D2	Analog GND	Black	0.5 mm²	Base		Gray D2 base analog GND
E2	MF-AI	White	0.35 mm²	Base	13	Gray E2 base MF-AI 13
F2	MF-AI	White	0.35 mm²	Base	16	Gray F2 base MF-AI 16
G2	I/O power supply	Red	1.5 mm²	Base	Vcc	Gray G2 base Vcc
H2	Function / Vcc / GND	Blue	1.5 mm²	Option2	9	Gray H2 option2 function / Vcc / GND 9
A3	MF-DO	Yellow	0.5 mm²	Base	6	Gray A3 base MF-DO 6
B3	MF-AI	White	0.35 mm²	Base	10	Gray B3 base MF-AI 10
C3	MF-DI	Green	0.35 mm²	Base	5	Gray C3 base MF-DI 5
D3	MF-DI	Green	0.35 mm²	Base	7	Gray D3 base MF-DI 7
E3	MF-AI	White	0.35 mm²	Base	14	Gray E3 base MF-AI 14
F3	Function	Brown	0.5 mm²	Option1	1	Gray F3 option1 function 1
G3	GND	Black	1.5 mm²			Gray G3 GND
H3	MF-PWM 6A	Gray	1 mm²	Base	12	Gray H3 base MF-PWM 6A 12
A4	MF-DO	Yellow	0.5 mm²	Base	8	Gray A4 base MF-DO 8
B4	MF-AI	White	0.35 mm²	Base	11	Gray B4 base MF-AI 11
C4	MF-DI	Green	0.35 mm²	Base	6	Gray C4 base MF-DI 6
D4	MF-DI	Green	0.35 mm²	Base	8	Gray D4 base MF-DI 8
E4	MF-AI	White	0.35 mm²	Base	15	Gray E4 base MF-AI 15
F4	Function	Brown	0.5 mm²	Option1	2	Gray F4 option1 function 2
G4	MF-PWM 6A	Gray	1 mm²	Base	13	Gray G4 base MF-PWM 6A 13
H4	Function / Vcc / GND	Blue	1.5 mm²	Option2	10	Gray H4 option2 function / Vcc / GND 10

Table: Mating connector X1.B - Pinout

1) Labels at least every 25 cm

Mating connector X1.C - Black

Pinout						
Pin	**Name**	**Color**	**Cross section**	**Slot**	**Channel**	**Description[1)]**
A1	Function	Blue	0.5 mm²	Option2	6	Black A1 option2 function 6
B1	Function	Purple	0.5 mm²	Option3	1	Black B1 option3 function 1
C1	Function	Purple	0.5 mm²	Option3	3	Black C1 option3 function 3
D1	Function	Purple	0.5 mm²	Option3	7	Black D1 option3 function 7
E1	Function	Purple	0.5 mm²	Option3	8	Black E1 option3 function 8
F1	Function	Orange	0.5 mm²	Option4	3	Black F1 option4 function 3
G1	Function / Vcc / GND	Orange	1.5 mm²	Option4	9	Black G1 option4 function / Vcc / GND 9
H1	GND	Black	1.5 mm²			Black H1 GND
A2	Function	Blue	0.5 mm²	Option2	4	Black A2 option2 function 4
B2	Function	Blue	0.5 mm²	Option2	8	Black B2 option2 function 8
C2	Function	Purple	0.5 mm²	Option3	2	Black C2 option3 function 2
D2	Function	Purple	0.5 mm²	Option3	6	Black D2 option3 function 6
E2	Function	Orange	0.5 mm²	Option4	2	Black E2 option4 function 2
F2	Function	Orange	0.5 mm²	Option4	5	Black F2 option4 function 5
G2	GND	Black	1.5 mm²			Black G2 GND
H2	Function / Vcc / GND	Purple	1.5 mm²	Option3	9	Black H2 option3 function / Vcc / GND 9
A3	Function	Blue	0.5 mm²	Option2	5	Black A3 option2 function 5
B3	Function	Blue	0.5 mm²	Option2	7	Black B3 option2 function 7
C3	Function	Purple	0.5 mm²	Option3	4	Black C3 option3 function 4
D3	Function	Purple	0.5 mm²	Option3	5	Black D3 option3 function 5
E3	Function	Orange	0.5 mm²	Option4	1	Black E3 option4 function 1
F3	Function	Orange	0.5 mm²	Option4	4	Black F3 option4 function 4
G3	Function / Vcc / GND	Orange	1.5 mm²	Option4	10	Black G3 option4 function / Vcc / GND 10
H3	GND	Black	1.5 mm²			Black H3 GND
A4	Function	Blue	0.5 mm²	Option2	3	Black A4 option2 function 3
B4	Function	Blue	0.5 mm²	Option2	1	Black B4 option2 function 1
C4	Function	Blue	0.5 mm²	Option2	2	Black C4 option2 function 2
D4	Function	Orange	0.5 mm²	Option4	8	Black D4 option4 function 8
E4	Function	Orange	0.5 mm²	Option4	7	Black E4 option4 function 7
F4	Function	Orange	0.5 mm²	Option4	6	Black F4 option4 function 6
G4	GND	Black	1.5 mm²			Black G4 GND
H4	Function / Vcc / GND	Purple	1.5 mm²	Option3	10	Black H4 option3 function / Vcc / GND 10

Table: Mating connector X1.C - Pinout

1) Labels at least every 25 cm

8.5.4 X90CA124.02-00

8.5.4.1 Order data

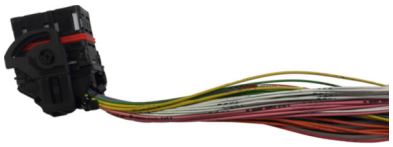
Order number	Short description	Figure
	Wire harness	
X90CA124.02-00	X90 mobile 120, wiring harness starter set for X90BC124, 2 m length, for CMC header	

Table: X90CA124.02-00 - Order data

8.5.4.2 Technical data

Order number	X90CA124.02-00
Short description	
Accessories	Wiring harness with mating connector X1
General information	
Short description	Connection cable for mating connector X1 to wire end sleeves
Type	X90 connection cable
Cable cross section	
mm²	See chapter "Pinout".
Certifications	
CE	Yes
Cable construction	
Outer jacket	
Material	PVC
Color	See chapter "Pinout".
Labeling	At least every 25 cm
Electrical properties	
Nominal voltage	12 / 24 VDC
Max. voltage	32 VDC
Nominal current [1)]	4 A for 0.6 mm connections / 10 A for 1.5 mm connections
Ambient conditions	
Temperature	
Operation	Corresponds to the X90 module used
Mechanical properties	
Dimensions	
Length	2 m
Bend radius	≥15 mm
Weight	775 g

1) The respective limit data of the individual I/O channels must be taken into account!

8.5.4.3 Pinout

Mating connector X1

Pinout					
Pin	**Description**	**Color**	**Cross section**	**Channel**	**Label[1)]**
A1	Sensor power supply	Pink	0.5 mm²	5 V / 10 V	A1 sensor supply 5/10 V
B1	GND	Black	0.5 mm²		B1 GND
C1	Logic power supply	Red	0.5 mm²		C1 logic supply
D1	MF-AI	White	0.35 mm²	12	D1 MF-AI channel 12
E1	MF-DO+	Yellow	0.5 mm²	31	E1 MF-DO+ channel 31
F1	MF-DO+	Yellow	0.5 mm²	32	F1 MF-DO+ channel 32
G1	MF-DO-	Yellow	0.5 mm²	30	G1 MF-DO- channel 30
H1	MF-PWM	Gray	0.5 mm²	24	H1 MF-PWM channel 24
J1	MF-PWM	Gray	0.5 mm²	17	J1 MF-PWM channel 17
K1	MF-PWM	Gray	0.5 mm²	18	K1 MF-PWM channel 18
L1	MF-PWM	Gray	1.0 mm²	19	L1 MF-PWM channel 19
M1	GND	Black	1.5 mm²		M1 GND
A2	Node number	Pink	0.5 mm²		A2 node-ID
B2	MF-PVG	Orange	0.5 mm²	27	B2 MF-PVG channel 27
C2	MF-AI	White	0.35 mm²	7	C2 MF-AI channel 7
D2	MF-AI	White	0.35 mm²	8	D2 MF-AI channel 8
E2	MF-PVG	Orange	0.5 mm²	26	E2 MF-PVG channel 26
F2	MF-AT	White	0.35 mm²	1	F2 MF-AT channel 1
G2	MF-AI	White	0.35 mm²	6	G2 MF-AI channel 6
H2	MF-DO-	Yellow	0.5 mm²	29	H2 MF-DO- channel 29
J2	MF-DI	Green	0.35 mm²	13	J2 MF-DI channel 13
K2	MF-PWM	Gray	0.5 mm²	22	K2 MF-PWM channel 22
L2	GND	Black	1.5 mm²		L2 GND
M2	Vcc	Red	1.5 mm²		M2 Vcc
A3	CAN_L	Pink	0.5 mm²	In	A3 CAN_L in
B3	CAN_L	Pink	0.5 mm²	Out	B3 CAN_L out
C3	MF-AI	White	0.35 mm²	11	C3 MF-AI channel 11
D3	MF-AI	White	0.35 mm²	10	D3 MF-AI channel 10
E3	MF-AI	White	0.35 mm²	9	E3 MF-AI channel 9
F3	MF-AI	White	0.35 mm²	4	F3 MF-AI channel 4
G3	Analog GND	Black	0.5 mm²		G3 analog GND
H3	MF-DI	Green	0.35 mm²	15	H3 MF-DI channel 15
J3	MF-DI	Green	0.35 mm²	16	J3 MF-DI channel 16
K3	MF-PWM	Gray	0.5 mm²	23	K3 MF-PWM channel 23
L3	Vcc	Red	1.5 mm²		L3 Vcc
M3	GND	Black	1.5 mm²		M3 GND
A4	CAN_H	Pink	0.5 mm²	In	A4 CAN_H in
B4	CAN_H	Pink	0.5 mm²	Out	B4 CAN_H out
C4	MF-PVG	Orange	0.5 mm²	25	C4 MF-PVG channel 25
D4	MF-PVG	Orange	0.5 mm²	28	D4 MF-PVG channel 28
E4	MF-AT	White	0.35 mm²	2	E4 MF-AT channel 2
F4	MF-AI	White	0.35 mm²	3	F4 MF-AI channel 3
G4	MF-AI	White	0.35 mm²	5	G4 MF-AI channel 5
H4	MF-DI	Green	0.35 mm²	14	H4 MF-DI channel 14
J4	MF-PWM	Gray	0.5 mm²	21	J4 MF-PWM channel 21
K4	MF-PWM	Gray	0.5 mm²	20	K4 MF-PWM channel 20
L4	GND	Black	1.5 mm²		L4 GND
M4	Vcc	Red	1.5 mm²		M4 Vcc

1) Labels at least every 25 cm

8.6 Breakout box

8.6.1 X90AC-BB.17-00

The basic function of the breakout box is to separate signals. To connect interface X1 of the X90 mobile system with an existing system, the connector (female / ECU side) is attached to the X90 mobile system and the interface of the system is then available on the male multipoint connector. Each pin or connection can be separated via a jumper. Signals can also be picked up or fed in here.

If a jumper is pulled, the connection between the X90 mobile system and test specimen is also disconnected. All other pins are still connected, however.

8.6.1.1 Order data

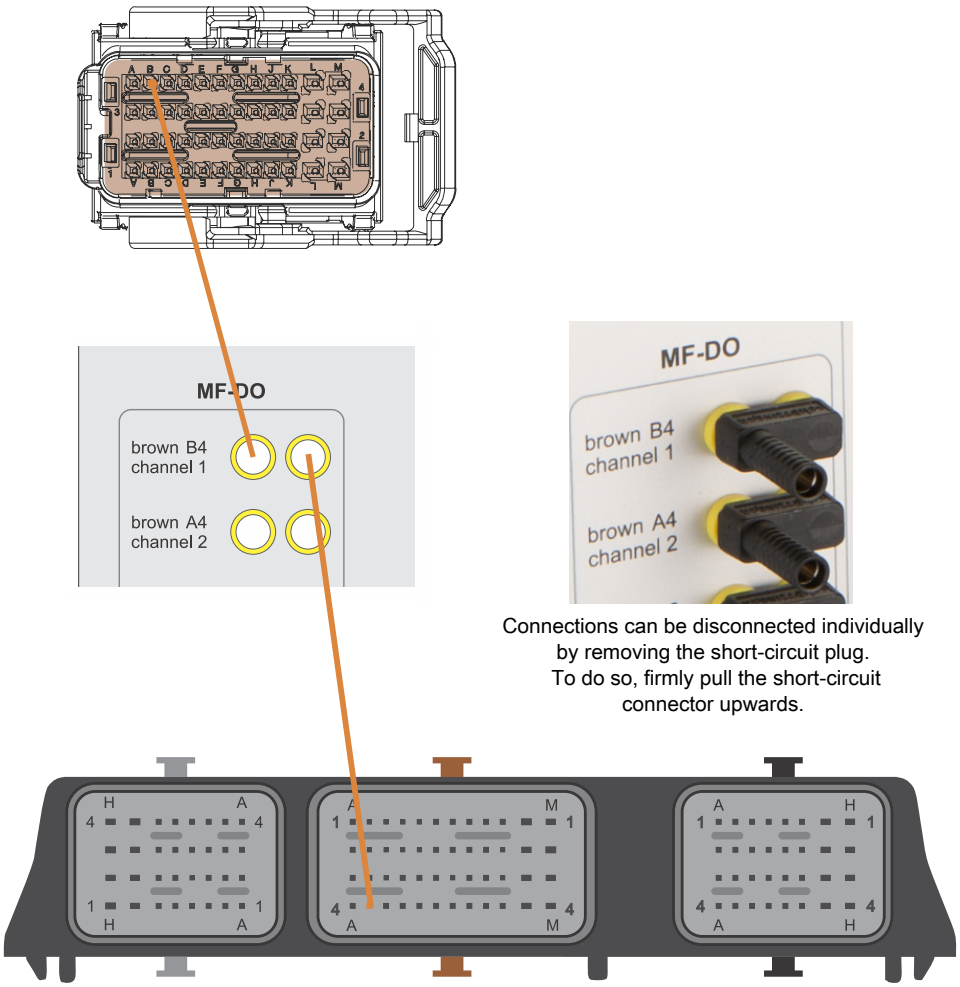
Order number	Short description	Figure
	BreakOut Box	
X90AC-BB.17-00	X90 mobile breakout box 170, for development and testing	
	Required accessories	
	BreakOut Box	
X90AC-BB.12-00	X90 mobile 120 bus controller test set, template and cable adapter for breakout box X90AC-BB.17-00 for testing X90BC124.32-00	

Table: X90AC-BB.17-00 - Order data

8.6.1.2 Technical data

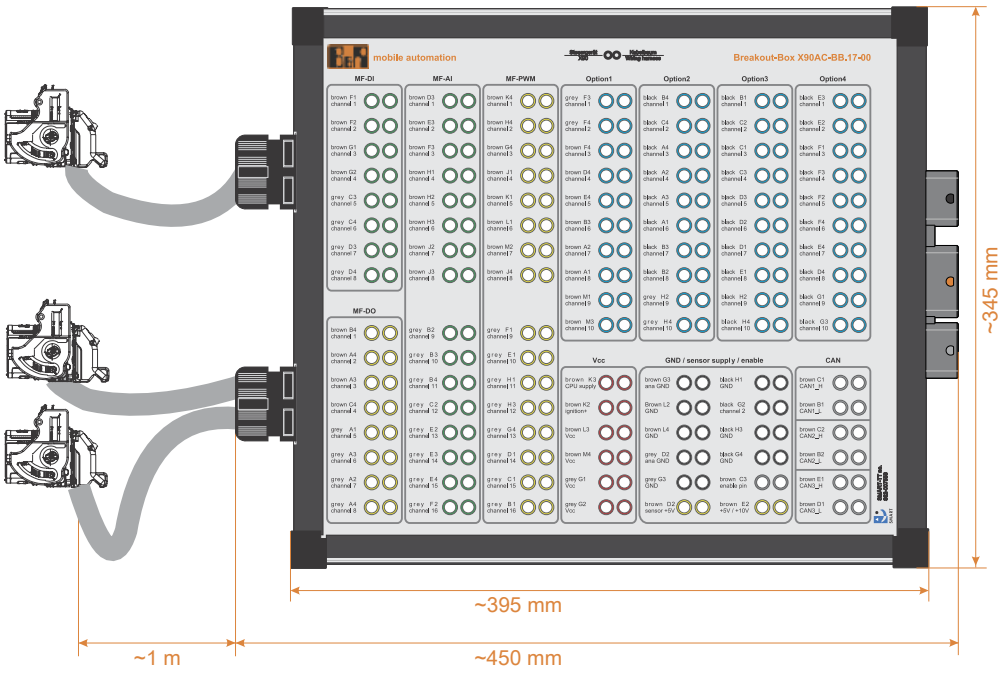
Order number	X90AC-BB.17-00
Short description	
Accessories	Breakout box for X90CP17x for commissioning and analysis purposes. Each pin of CMC connector X1 is connected to 4 mm female banana connectors. Signals can also be individually isolated by removing the jumper.
General information	
Short description	Connection cable for CMC header X1 to CMC multi-header. Connection to 4 mm female connectors, 112 short-circuit connectors included.
Cable cross section	
mm²	Power pins 1.5 mm², signal pins 0.5 mm²
Certifications	
CE	Yes
Mechanical properties	
Dimensions	
Width	340 mm
Length	460 mm plus 1 m cable
Depth	60 mm plus 25 mm short-circuit connector
Weight	Approx. 6.5 kg

8.6.1.3 Mechanics

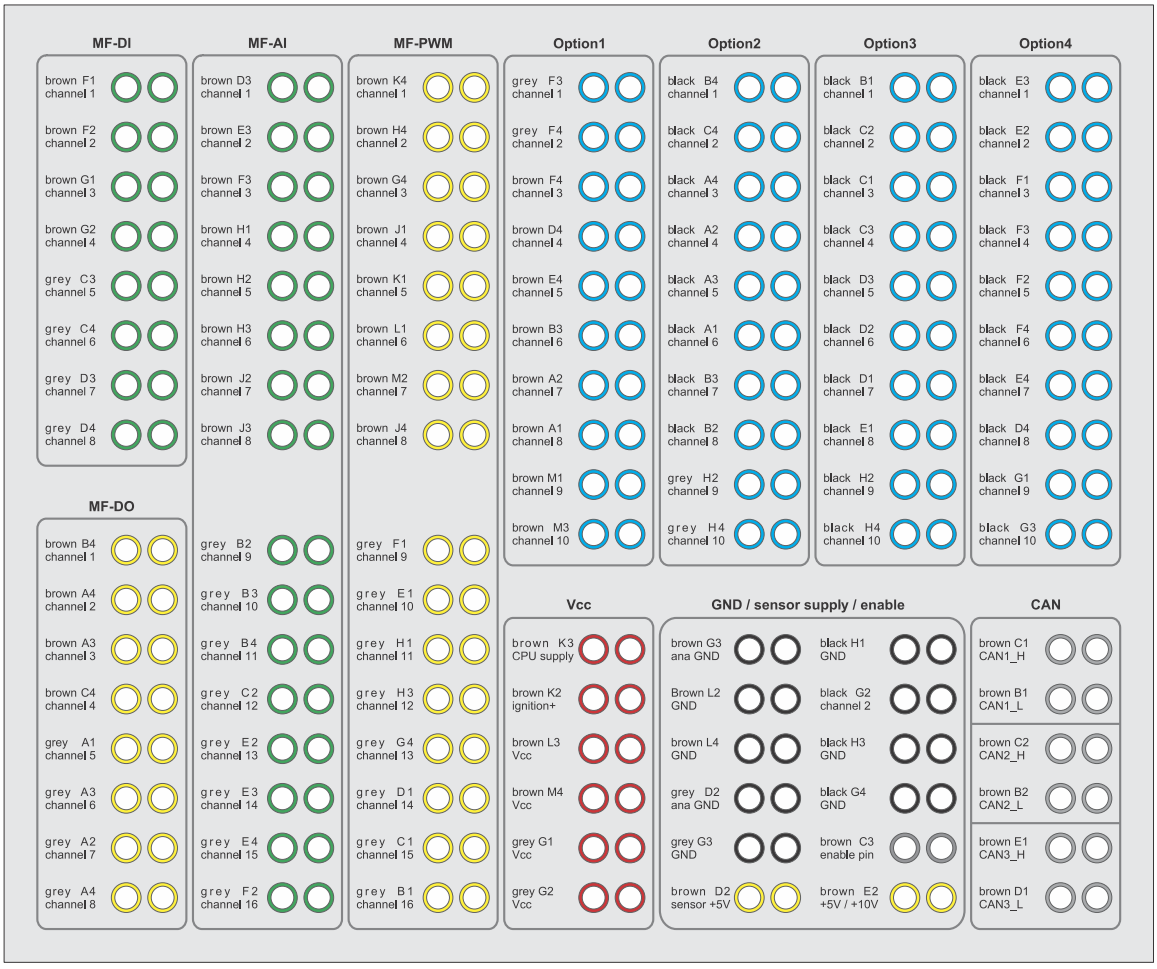


Connections can be disconnected individually by removing the short-circuit plug.
To do so, firmly pull the short-circuit connector upwards.

8.6.1.3.1 Dimensions



8.6.1.3.2 Assignment



8.6.1.4 Cleaning

The housing can be cleaned with a damp cloth; a neutral cleaning agent can be applied if necessary.

> **Note:**
>
> **The connectors and jumpers are not permitted to be cleaned with cleaning agents.**

8.6.1.5 Storage

The connection adapter must be cleaned after use.

The connector on the connector side of the X90 mobile system is connected to the male multipoint connector (wiring harness side) (to prevent contamination).

If possible, the connection adapter should be stored in protective packaging (plastic film) in order to remain protected against dust.

8.6.2 X90AC-BB.12-00

X90 mobile bus controller test set X90AC-BB.12-00 simplifies commissioning of X90 bus controller X90BC124.32-00. The X90AC-BB.17-00 X90 mobile breakout box accessory is required for use.

Test set X90AC-BB.12-00 consists of a cable adapter and a template that is connected or placed on breakout box X90AC-BB.17-00. As a result, each of the 48 pins is available on a 4 mm female connector including suitable labeling.

8.6.2.1 Order data

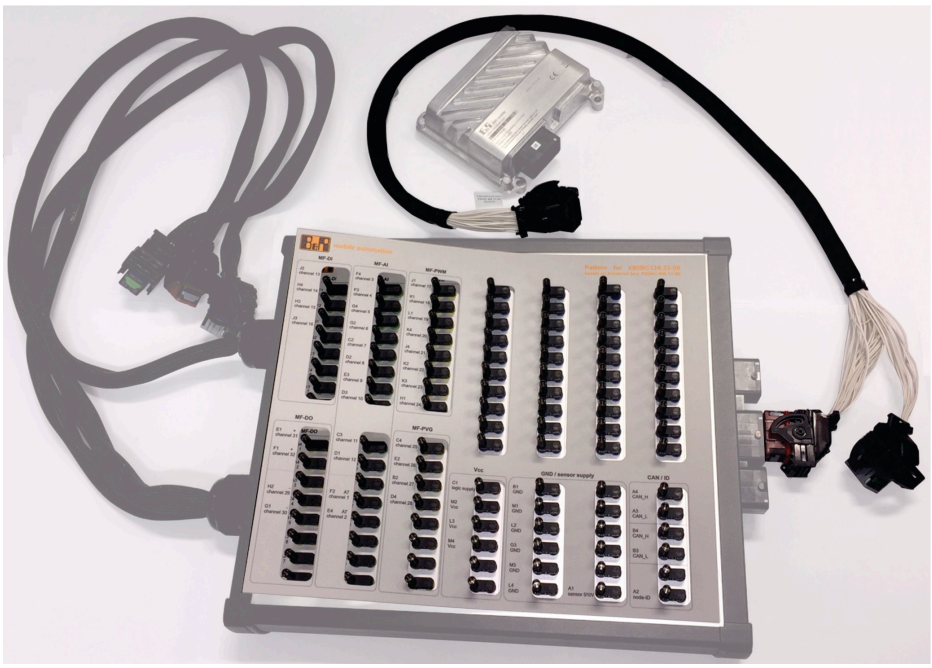
Order number	Short description	Figure
	BreakOut Box	
X90AC-BB.12-00	X90 mobile 120 bus controller test set, template and cable adapter for breakout box X90AC-BB.17-00 for testing X90BC124.32-00	

Table: X90AC-BB.12-00 - Order data

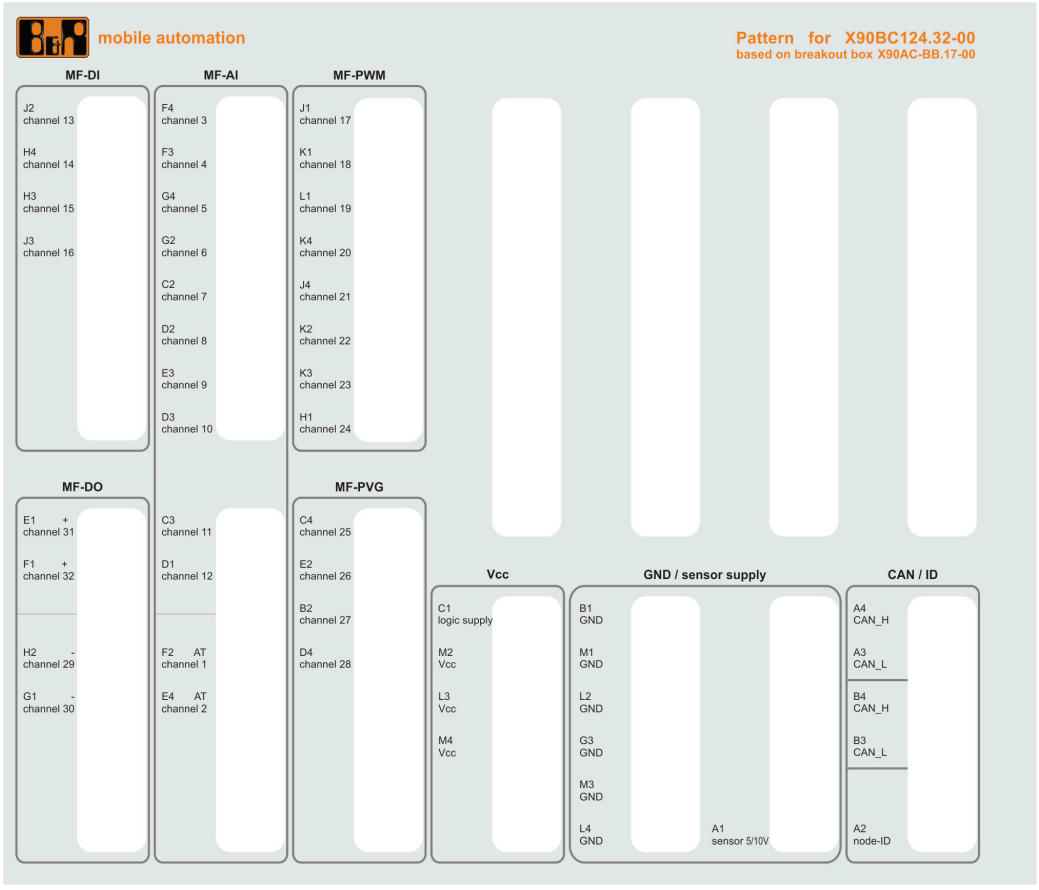
8.6.2.2 Technical data

Order number	X90AC-BB.12-00
Short description	
Accessories	Test set for commissioning bus controller X90BC124.32-00 Each pin of CMC connector X1 is connected to 4 mm female banana connectors.
General information	
Short description	Cable adapter and labeling template for X90 mobile breakout box X90AC-BB.17-00
Cable cross section	
mm²	Power pins 1.5 mm², signal pins 0.5 mm²
Certifications	
CE	Yes
Mechanical properties	
Dimensions	
Width	300 mm
Length	351 mm plus 1 m cable adapter
Weight	Approx. 0.9 kg

8.6.2.3 Mechanics



8.6.2.3.1 Pinout



8.7 Protective cover

X67AC0M12

Order number	Short description	Figure
	Threaded caps	
X67AC0M12	X67 M12 threaded caps, 50 pcs.	

Table: X67AC0M12 - Order data

Conec protective cover

For additional information about the following accessories, see www.conec.com.

	Protective cover for M12	Protective cover for M12 with loop
Figure		
Manufacturer	Conec	
Manufacturer's material number	43-16211	43-16212
Screw thread type	M12	
Color	Black	
Material	PA GF	PA GF (housing) / TPU-V (loop)
Tightening torque	0.6 Nm	
Degree of protection	IP67	

8.8 Hub system

8.8.1 X67HB8880.L12

8.8.1.1 Module description

The Ethernet hub is a standalone device that can be used universally as a hub in POWERLINK networks. It is suitable for both 100 Mbit/s (Fast Ethernet) and 10 Mbit/s networks. The hub automatically recognizes the transfer speed for the channels.

The Ethernet connections are made using D-keyed M12 connectors. All ports are equipped with auto-MDIX (auto-crossover).

The module is designed for a voltage range of 8 to 32 VDC and equipped with a power supply protected against load dump.

8.8.1.2 Order data

Order number	Short description	Figure
	Hub system	
X67HB8880.L12	X67 8-port industrial hub (layer 2), 10/100 Mbit/s with autonegotiation, automatic MDIX, 8x M12, 8-32 VDC	

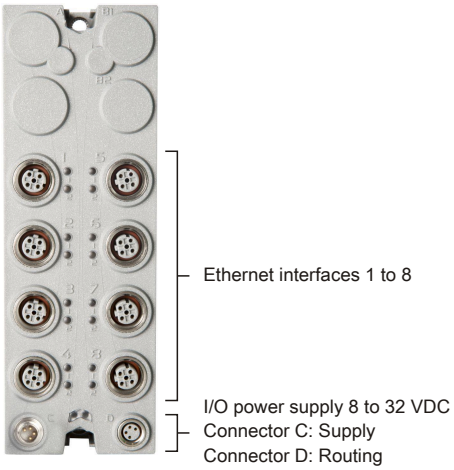
Table: X67HB8880.L12 - Order data

Required accessories
For a general overview, see section Accessories / General overview in the X67 system user's manual.

8.8.1.3 Technical data

Order number	X67HB8880.L12
Short description	
Hub	8-port industrial hub
General information	
Status indicators	Network activity for each channel, link/collision for each channel, supply voltage
Diagnostics	
Bus function	Yes, using status LED
Hub power supply	Yes, using status LED
Connection type	
Fieldbus	8x M12, D-keyed
I/O power supply	M8, 4-pin
Power consumption	
Internal	Max. 2.5 W
Certifications	
CE	Yes
UL	cULus E115267 Industrial control equipment
Interfaces	
Type	Ethernet
Standard (compliance)	ANSI/IEEE 802.3 Class II
Variant	M12 interface (male connector on the module)
Line length	Max. 100 m between 2 stations (segment length)
Transfer rate	10/100 Mbit/s
Transfer	
Physical layer	10 BASE-T/100 BASE-TX
Half-duplex	Yes
Full-duplex	No
Autonegotiation	Yes
Auto-MDI/MDIX	Yes
Hub propagation delay	0.79 to 0.86 µs
I/O power supply	
Nominal voltage	12/24 VDC
Voltage range	8 to 32 VDC
Integrated protection	Reverse polarity protection, overvoltage protection
Operating conditions	
Mounting orientation	
Any	Yes
Installation elevation above sea level	
0 to 2000 m	No limitations
>2000 m	Reduction of ambient temperature by 0.5°C per 100 m
Degree of protection per EN 60529	IP67
Ambient conditions	
Temperature	
Operation	-40 to 60°C
Derating	See section "Derating"
Storage	-40 to 85°C
Transport	-40 to 85°C
Mechanical properties	
Dimensions	
Width	53 mm
Height	155 mm
Depth	42 mm
Weight	320 g
Torque for connections	
M8	Max. 0.4 Nm
M12	Max. 0.6 Nm

8.8.1.4 Connection elements



9 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.

Special attention has been paid to reliability when used in mobile machinery for construction and agriculture, but also for industrial applications.

Information:

Certifications that apply to a particular module are available at the following places:

- **www.br-automation.com > > Technical data > General information > Certifications**
- **Data sheet > Technical data > General information > Certifications**
- **Module housing**

9.1 Overview of certifications

Mark	Explanation	Certificate authority	Region
E13	UN/ECE marking	National authorities	Europe (worldwide)
CE	CE marking	Notified bodies	Europe (EU)
open SAFETY certified product	Functional safety	Notified bodies	Europe (EU)

9.1.1 UN/ECE type approval

UN/ECE mark

Products with this mark are tested by an accredited testing laboratory in accordance with relevant UN/ECE regulations and approved by a national authority for use in motor vehicles.

Europe (worldwide)

This mark was originally only valid in Europe, but since many non-European countries have now also acceded to the ECE agreement, it is already possible to speak of a certain degree of worldwide recognition.

UN/ECE regulation applied for this purpose:

UN/ECE-R10	Regulation no. 10 of the Economic Commission for Europe of the United Nations (UNECE) - Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility.

The corresponding certificate is available for download from the B&R website.

X90 mobile controller certificate

Website > Downloads > Certificates > UN ECE-R10 > X90 (X90CP17x)

X90 mobile bus controller certificate

Website > Downloads > Certificates > UN ECE-R10 > X90 (X90BC124)

9.1.2 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 products meet the requirements of the EMC Directive and are designed for mobile machinery, outdoor and industrial applications.

Applicable standards from this directive:

EN ISO 13766-1	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical power supply - Part 1: General EMC requirements under typical electromagnetic environmental conditions
EN ISO 14982	Agricultural and forestry machinery - Electromagnetic compatibility - Test methods and acceptance criteria
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 - Emissions standard for industrial environments

The corresponding declaration of conformity is available for download from the B&R website. For information about the versions of applicable standards, see the declaration of conformity.

Declaration of conformity

Website > Downloads > Certificate > Declarations of conformity > Declaration of conformity - Industrial sector X90

Website > Downloads > Certificates > Declarations of conformity > Declaration of conformity - Mobile machinery X90

Machinery directive 2006/42/EC

Functional safety

open SAFETY certified product

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).

From this directive and other standards applied for functional safety:

SIL 2:	
IEC 61508-1, 2, 3, 4	Functional safety of electrical / electronic / programmable electronic safety-related systems - Part 1: General requirements - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements - Part 4: Definitions and abbreviations
EN 62061	Safety of machinery - Functional safety of safety-related electrical, electronic and programmable electronic control systems
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
ISO 25119-1, 2, 3, 4	Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 1: General principles for design and development - Part 2: Concept phase - Part 3: Series development, hardware and software - Part 4: Production, operation, modification and supporting processes
EN ISO 13766-2	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical systems - Part 2: Additional EMC requirements for functional safety

For information about the versions of applicable standards, see the declaration of conformity and certificate. The declaration of conformity, certificate and additional safety-related information are available for download on the B&R website.

Declaration of conformity

Website > Downloads > Certificates > Declarations of conformity > Declaration FS mobile automation X90

Certificates

Website > Downloads > Certificates > Safety technology > X90 mobile > FS Certificate X90 mobile

User's manual

Website > Downloads > Safety technology > Integrated safety technology user's manual

9.2 Overview of tests

9.2.1 EMC and electrical tests

Standard	Title	Note
UN/ECE-R10	Regulation no. 10 of the United Nations Economic Commission for Europe (UNECE) - Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility	UN/ECE type approval
EN ISO 13766-1	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical power supply - Part 1: General EMC requirements under typical electromagnetic environmental conditions	EU conformity (CE)
EN ISO 13766-2	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical power supply - Part 2: Additional EMC requirements for functional safety	EU conformity (CE)
EN ISO 14982	Agricultural and forestry machinery - Electromagnetic compatibility - Test methods and acceptance criteria	EU conformity (CE)
ISO 15003	Agricultural engineering - Electrical and electronic equipment - Testing resistance to environmental conditions	Manufacturer's specification
EN 50121-3-2	Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus	Railroad applications
EN 61131-2	Programmable controllers - Part 2: Guidance for inspection and routine testing	EU conformity (CE)
EN 61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments	EU conformity (CE)
EN 61000-6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments	EU conformity (CE)

9.2.2 Mechanical tests

Standard	Title	Note
ISO 15003	Agricultural engineering - Electrical and electronic equipment - Testing resistance to environmental conditions	Manufacturer's specification
ISO 16750-3	Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads	Manufacturer's specification
EN 61131-2	Programmable controllers - Part 2: Guidance for inspection and routine testing	EU conformity (CE)

9.2.3 Climatic loads

Standard	Title	Note
ISO 15003	Agricultural engineering - Electrical and electronic equipment - Testing resistance to environmental conditions	Manufacturer's specification
EN 61131-2	Programmable controllers - Part 2: Guidance for inspection and routine testing	EU conformity (CE)

9.2.4 Chemical resistance

Standard	Title	Note
ISO 15003	Agricultural engineering - Electrical and electronic equipment - Testing resistance to environmental conditions	Manufacturer's specification

9.2.5 Degree of protection (IP code)

Standard	Title	Note
ISO 20653	Road vehicles - Degrees of protection (IP code) - Protection of electrical equipment against foreign objects, water and access	Manufacturer's specification IP6K9K
EN 60529	Degrees of protection provided by enclosures (IP code)	Manufacturer's specification IP69(K)

9.3 Vehicle requirements

9.3.1 Requirements for immunity to disturbances

Testing	Test method per	Test values per
Electrostatic discharge (ESD)	ISO 10605	EN ISO 13766-1: Earth-moving and building construction machinery
		EN ISO 13766-2: Earth-moving and building construction machinery (Additional EMC requirements for functional safety)
		EN ISO 14982: Agricultural and forestry machinery
		ISO 15003: Agriculture engineering
Conducted transient disturbances (test pulse 1, 2a, 2b, 3a, 3b, 4, 5a, 5b)	ISO 7637-2:2004 or ISO 7637-2:2011 and ISO 16750-2:2012	B&R
		UN/ECE-R10: Vehicle approval (EMC)
		EN ISO 13766-1: Earth-moving and building construction machinery
		EN ISO 14982: Agricultural and forestry machinery
		ISO 15003: Agriculture engineering
High-frequency electromagnetic fields	ISO 11452-x	UN/ECE-R10: Vehicle approval (EMC)
		EN ISO 13766-1: Earth-moving and building construction machinery
		EN ISO 13766-2: Earth-moving and building construction machinery (Additional EMC requirements for functional safety)
		EN ISO 14982: Agricultural and forestry machinery
		ISO 15003: Agriculture engineering

Classification of operating performance

Status	During testing / After testing
A	All functions of a device/system perform as designed during and after exposure to disturbance.
B	All functions of a device/system perform as designed during exposure. However, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions shall remain class A.
C	One or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.
D	One or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple "operator/use" action.
E	One or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

Electrostatic discharge (ESD)

Testing performed per ISO 10605:2008	Test values per EN/ISO 13766-1 (general requirements)		Test values per EN/ISO 13766-2 (functional safety)	Test values per EN ISO 14982 / ISO 15003
Contact discharge (CD) on conductive accessible parts (discharge network: 330 pF + 2 kΩ)	±4 kV Status A	±6 kV Status C	±8 kV Status A or FS [1]	±4 kV Status A
Air discharge (AD) on conductive accessible parts (discharge network: 330 pF + 2 kΩ)	±4 kV Status A	±8 kV Status C	±15 kV Status A or FS [1]	±4 kV Status A

1) Requirement for functions that can cause dangerous machine behavior.

Conducted transient disturbances

Testing performed per ISO 7637-2:2004 or ISO 7637-2:2011 and ISO 16750-2:2012	Test values per B&R (12/24 V system)	Test values per UN/ECE-R10 EN ISO 14982 / ISO 15003 [3] (12/24 V system)	Test values per EN/ISO 13766-1 (12/24 V system)
Test pulse 1 Switching off inductive parallel loads (ISO 7637-2) (24 V system at Ua 27 VDC)	-450 V 5000 pulses Status C [1] **(ISO 7637-2:2004 and ISO 7637-2:2011)**	-450 V 5000 pulses Status C [1] **(ISO 7637-2:2004)**	-450 V 500 pulses Status C [1] **(ISO 7637-2:2011)**
Test pulse 2a Sudden power interruption in a device connected in parallel (ISO 7637-2) (24 V system at Ua 27 VDC)	+55 V 5000 pulses Status B [1] **(ISO 7637-2:2004 and ISO 7637-2:2011)**	+37 V 5000 pulses Status B [1] **(ISO 7637-2:2004)**	+55 V 500 pulses Status B [1] **(ISO 7637-2:2011)**
Test pulse 2b Rundown of DC motors (generator effect) (ISO 7637-2) (24 V system at Ua 27 VDC)	+20 V 10 pulses Status C [1] **(ISO 7637-2:2004 and ISO 7637-2:2011)**	+20 V 10 pulses Status C [1] **(ISO 7637-2:2004)**	+20 V 10 pulses Status C [1] **(ISO 7637-2:2011)**

Testing performed per ISO 7637-2:2004 or ISO 7637-2:2011 and ISO 16750-2:2012	Test values per B&R (12/24 V system)	Test values per UN/ECE-R10 EN ISO 14982 / ISO 15003 [3] (12/24 V system)	Test values per EN/ISO 13766-1 (12/24 V system)
Test pulse 3a / Negative transients Switching operations (e.g. relay) (ISO 7637-2) (24 V system at Ua 27 VDC)	-220 V Test time 1 hour Status A **(ISO 7637-2:2004 and ISO 7637-2:2011)**	-150 V Test time 1 hour Status A **(ISO 7637-2:2004)**	-220 V Test time 1 hour Status A **(ISO 7637-2:2011)**
Test pulse 3b / Positive transients Switching operations (e.g. relay) (ISO 7637-2) (24 V system at Ua 27 VDC)	+220 V Test time 1 hour Status A **(ISO 7637-2:2004 and ISO 7637-2:2011)**	+150 V Test time 1 hour Status A **(ISO 7637-2:2004)**	+220 V Test time 1 hour Status A **(ISO 7637-2:2011)**
Test pulse 4 / Starting curve Fluctuations in the vehicle electrical system when starting the engine (ISO 7637-2 or ISO 16750-2) (12 V system at Ub 12 VDC) (24 V system at Ub 24 VDC)	12 VDC: Level III (U_B min = 6 V) 24 VDC: Level III (U_B min = 12 V) 1 pulse Status C / B [2] **(ISO 7637-2:2004)** 12 VDC: Level I (U_B min = 8 V) 10 pulses Status A 12 VDC: Level IV (U_B min = 6 V) 10 pulses Status C 24 VDC: Level II (U_B min = 8 V) 10 pulses Status B **(ISO 16750-2:2012)**	12 VDC: Level III (U_B min = 6 V) 24 VDC: Level III (U_B min = 12 V) 1 pulse Status C / B [2] **(ISO 7637-2:2004)**	12 VDC: Level IV (U_B min = 6 V) 24 VDC: Level II (U_B min = 8 V) 10 pulses Status C / A [2] **(ISO 16750-2:2012)**
Test pulse 5a / Load dump Load dump at the alternator **without** central protection (ISO 7637-2 or ISO 16750-2) (24 V system at Ua 27 VDC)	+175 V Ri 4 Ω 350 ms 1 pulse Status C [1] **(ISO 7637-2:2004)** +202 V Ri 4 Ω 350 ms 10 pulses in 1 minute Status C [1] **(ISO 16750-2:2012)**	+123 V Ri 1 to 8 Ω 100 to 350 ms 10 ms (-5 ms) 1 pulse Status C [1] **(ISO 7637-2:2004)** (Not a requirement in UN/ECE-R10)	+151 V to +202 V Ri 1 to 8 Ω 100 to 350 ms 10 ms (-5 ms) 10 pulses in 1 minute Status C [1] **(ISO 16750-2:2012 / Table 5)**
Test pulse 5b / Load dump Load dump at the alternator **with** central protection (ISO 7637-2 or ISO 16750-2)	See test pulse 5a	Per agreement with customers (Not a requirement in UN/ECE-R10)	Per agreement with customers

1) No influence is permitted that could result in dangerous machine behavior (e.g. unintentional movement).
2) Relevant for functions of equipment/systems that are active during the motor startup phase.
3) Adjusted test values according to the best available technology.

High-frequency electromagnetic fields

Testing performed per ISO 11452-x	Test values per UN/ECE-R10 / EN ISO 13766-1 (general requirements)	Test values per EN/ISO 13766-2 (functional safety)	Test values per EN ISO 14982 / ISO 15003
ISO 11452-2 / Antenna	30 V/m 20 MHz to 800 MHz (AM) 800 MHz to 2 GHz (PM) Status A	100 V/m 20 MHz to 800 MHz (AM) 800 MHz to 1 GHz (PM) 30 V/m 1 GHz to 2 GHz (PM) (per EN ISO 13766-1) 10 V/m 2 GHz to 2.4 GHz (PM) 5 V/m 2.4 GHz to 2.7 GHz (PM) Status A or FS	30 V/m 20 MHz to 1 GHz (AM) Status A
ISO 11452-4 / BCI clamp	60 mA 20 MHz to 800 MHz (AM) 800 MHz to 2 GHz (PM) Status A	100 mA 1 MHz to 800 MHz (AM) 800 MHz to 1 GHz (PM) Status A or FS	60 mA 20 MHz to 1 GHz (AM) Status A
ISO 11452-5 / Stripline	60 V/m 20 MHz to 800 MHz (AM) 800 MHz to 2 GHz (PM) Status A	100 V/m 1 MHz to 400 MHz (AM) Status A or FS	60 V/m 20 MHz to 1 GHz (AM) Status A

9.3.2 Emission requirements

Testing	Test method per	Limit values per
Conducted transient emissions	ISO 7637-2	UN/ECE-R10: Vehicle approval (EMC)
		EN ISO 13766-1: Earth-moving and building construction machinery
Radiated emissions	EN 55025 (CISPR 25)	UN/ECE-R10: Vehicle approval (EMC)
		EN ISO 13766-1: Earth-moving and building construction machinery
		EN ISO 14982: Agricultural and forestry machinery
		ISO 15003: Agriculture engineering

Conducted transient emissions

Testing performed per ISO 7637-2	Limit values per UN/ECE-R10 / EN ISO 13766-1 (12 V / 24 V system)	
Power on (switched fast/slow)	Positive pulse amplitude Max. +75 V	Negative pulse amplitude Max. -100 V
Power off (switched fast/slow)		

Radiated emissions

Testing performed per EN 55025 (CISPR 25)	Limit values per UN/ECE-R10 / EN ISO 13766-1 / EN ISO 14982 / ISO 15003		
Electric field / Measured from 1 m	**Frequency**	**Mean**	**Quasi-peak value**
	30 MHz to 75 MHz	52 to 42 dB (µV/m)	62 to 52 dB (µV/m)
	75 MHz to 400 MHz	42 to 53 dB (µV/m)	52 to 63 dB (µV/m)
	400 MHz to 1 GHz	53 dB (µV/m)	63 dB (µV/m)

9.3.3 Mechanical conditions

Testing	Testing performed per	Test values per
Sinusoidal vibration	EN 60068-2-6	B&R
		ISO 15003: Agriculture engineering (level 2)
		EN 60721-3-5: Ground vehicle installations (class 5M3)
		DNV-GL (class B)
Random vibration	EN 60068-2-64	B&R
		ISO 15003: Agriculture engineering (level 2)
		ISO 16750-3: Road vehicles (Test VII)
		EN 60721-3-5: Ground vehicle installations (class 5M3)
Shock	EN 60068-2-27	B&R
		ISO 15003: Agriculture engineering (level 3)
		ISO 16750-3: Road vehicles
		EN 60721-3-5: Ground vehicle installations (class 5M2)

Sinusoidal vibration

Testing performed per EN 60068-2-6	Test values per B&R / ISO 15003 (level 2) / EN 60721-3-5 (class 5M3) / DNV-GL (class B)		
Sinusoidal vibration Continuous and logarithmic sweeping Sweep rate 1 octave per minute Functional testing during examination	**Frequency**	**Amplitude**	**Stress to points of resonance**
	2 to 8 Hz	Deflection 7.5 mm	Q < 2 → 90 minutes at 30 Hz Q ≥ 2 → 90 minutes at fRes
	8 to 100 Hz	Acceleration 4 g	
	100 to 500 Hz	Acceleration 4 g	Q ≥ 2 → 30 minutes at fRes
	500 to 2000 Hz	Acceleration 2 g	
	20 sweeps per axis (x, y, z)		

1 g = 10 m/s²
2 sweeps = 1 frequency cycle (fmin → fmax → fmin)

Random vibration

Testing performed per EN 60068-2-64	Test values per B&R / ISO 15003 (level 2) / ISO 16750-3 (test VII) / EN 60721-3-5 (class 5M3)		
Random vibration Testing with broadband random vibrations.	**Frequency**	**Acceleration spectral density**	**RMS acceleration value**
	10 Hz	20 m²/s³	Up to 6.5 g (RMS)
	20 Hz	36 m²/s³	
	30 Hz	36 m²/s³	
	200 Hz	3 m²/s³	
	500 Hz	1 m²/s³	
	2000 Hz	1 m²/s³	
	32 hours per axis (x, y, z)		

1 g = 10 m/s²

Shock

Testing performed per EN 60068-2-27	Test values per B&R	Test values per ISO 15003 (level 3)	Test values per ISO 16750-3	Test values per EN 60721-3-5 (class 5M2)
Shock Positive and negative pulse (half-sine) shock load in all 3 axes (x, y, z)	**Type I** Acceleration 50 g Duration 11 ms 18 shocks	**Type I** Acceleration 50 g Duration 11 ms 18 shocks	-	**Type I** Acceleration 10 g Duration 11 ms 18 shocks
	Type II Acceleration 50 g Duration 6 ms 60 shocks	-	**Type II** Acceleration 50 g Duration 6 ms 60 shocks	**Type II** Acceleration 30 g Duration 6 ms 18 shocks

1 g = 10 m/s²

9.3.4 Chemical resistance

Testing	Testing per	Limit values per
Chemical resistance	ISO 15003	B&R
		ISO 15003: Agriculture engineering

Chemical resistance

Testing media

Sequential number	Chemical name	Concentration	Specification
1	Herbicide (glyphosate)	100%	Manufacturer
2	Fungicide (boscalid, kresoxim-methyl)	0.42%	Manufacturer
3	NPK fertilizer	100%	Standard
4	Liquid lime	10%	Standard
5	Urea fertilizer	100%	Standard
6	AHL fertilizer	20%	Standard
7	Ammonia	32%	Manufacturer
8	Gasoline	100%	Standard
9	Diesel	100%	Standard
10	Radiator antifreeze (glycol)	50%	Standard
11	Motor oil	100%	Manufacturer
12	Hydraulic oil	100%	Standard
13	Gear oil	100%	Manufacturer
14	Brake fluid	100%	Manufacturer

Testing performed

Testing was performed per standard ISO 15003.

Temperature:	25°C
Humidity:	45% relative humidity
Application method:	Painting
Frequency of application:	3 applications
Exposure:	24 hours per application
Post-conditioning:	Cleaning with distilled water and subsequent storage for 100 hours

Test results

During and after testing, no relevant corrosive changes or influences on functions could be determined.

9.4 Requirements for industry

9.4.1 Requirements for immunity to disturbances

Testing	Test method per	Test values per
Electrostatic discharge (ESD)	EN 61000-4-2	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
High-frequency electromagnetic fields (HF field)	EN 61000-4-3	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
High-speed transient electrical disturbances (Burst)	EN 61000-4-4	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
Surge voltages (Surge)	EN 61000-4-5	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
Conducted induced radio-frequency fields (RF-conducted)	EN 61000-4-6	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
Power frequency magnetic fields (H field)	EN 61000-4-8	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
Voltage dips (AC) Short-term interruptions (AC) Voltage fluctuations (AC)	EN 61000-4-11	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-2: Generic standard - Immunity for industrial environments
Voltage dips (DC) Short-term interruptions (DC) Voltage fluctuations (DC)	EN 61000-4-29	EN 61131-2: Product standard - Programmable controllers
		-

Evaluation criteria for performance

Criteria	During test	After test
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. The operating mode is not permitted to change. Irreversible loss of stored data is not permitted.	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 (program or data).	The PLC system shall continue to operate as intended either 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 method per EN 61000-4-2	Test values per EN 61131-2 (zone B)	Test values per EN 61000-6-2
Contact discharge (CD) to conductive accessible parts	±4 kV Criteria B	±4 kV Criteria B
Air discharge (AD) to isolating accessible parts	±8 kV Criteria B	±8 kV Criteria B

High-frequency electromagnetic fields (HF field)

Test method per EN 61000-4-3	Test values per EN 61131-2 (zone B)	Test values per 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 method per EN 61000-4-4	Test values per EN 61131-2 (zone B)	Test values per 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 interfaces >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 method per EN 61000-4-5	Test values per EN 61131-2 (zone B)	Test values per 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 cables >30 m (line to PE)	±1 kV Criteria B	-

1) Without length limitation.

Conducted induced radio-frequency fields (RF-conducted)

Test method per EN 61000-4-6	Test values per EN 61000-6-2	Test values per EN 61131-2 (zone B)
AC mains inputs/outputs	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	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	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A
Other I/Os and interfaces >3 m	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A

Power frequency magnetic fields (H field)

Test method per EN 61000-4-8	Test values per EN 61131-2 (zone B)	Test values per EN 61000-6-2
Housing, completely wired	30 A/m 3 axes (x, y, z) 50/60 Hz [1] Criteria A	30 A/m 3 axes (x, y, z) 50/60 Hz [1] Criteria A

1) Mains frequency per manufacturer data

Voltage dips

Test method per EN 61000-4-11	Test values per EN 61131-2 (zone B)	Test values per EN 61000-6-2
AC power inputs	0% residual voltage 250/300 periods (50/60 Hz) 1) 20 attempts Criteria C	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	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	70% residual voltage 25/30 periods (50/60 Hz) 1) 20 attempts Criteria C

1) Mains frequency per manufacturer data

Short-term interruptions

Test method per EN 61000-4-11 / EN 61000-4-29	Test values per EN 61131-2 (zone B)	Test values per 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 method per EN 61000-4-11 / EN 61000-4-29	Test values per EN 61131-2 (zone B)	Test values per 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	-

9.4.2 Emission requirements

Testing	Test method per	Limit values per
Emissions related to lines	EN 55011 / EN 55022 EN 55016-2-1	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-4: Generic standard - Emissions in industrial sectors
Radiated emissions	EN 55011 / EN 55022 EN 55016-2-3	EN 61131-2: Product standard - Programmable controllers
		EN 61000-6-4: Generic standard - Emissions in industrial sectors

Emissions related to lines

Test method per EN 55011 / EN 55022 / EN 55016-2-1	Limit values per EN 61131-2 (Zone B)	Limit values per 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) Mean	150 kHz to 500 kHz 79 dB (µV) Quasi-peak value 66 dB (µV) Mean
	500 kHz to 30 MHz 73 dB (µV) Quasi-peak value 60 dB (µV) Mean	500 kHz to 30 MHz 73 dB (µV) Quasi-peak value 60 dB (µV) Mean
Telecommunications / network connection 150 kHz to 30 MHz	-	150 kHz to 500 kHz 97 to 87 dB (µV) 53 to 40 dB (µA) Quasi-peak value 84 to 74 dB (µV) 40 to 30 dB (µA) Mean
	-	500 kHz to 30 MHz 87 dB (µV) 43 dB (µA) Quasi-peak value 74 dB (µV) 30 dB (µA) Mean

Radiated emissions

Test method per EN 55011 / EN 55022 / EN 55016-2-3	Limit values per EN 61131-2 (Zone B)	Limit values per EN 61000-6-4
Electric field (measuring distance 10 m) 30 MHz to 1 GHz	30 MHz to 230 MHz 40 dB (µV/m) Quasi-peak value	30 MHz to 230 MHz 40 dB (µV/m) Quasi-peak value
	230 MHz to 1 GHz 47 dB (µV/m) Quasi-peak value	230 MHz to 1 GHz 47 dB (µV/m) Quasi-peak value
Electric field (measuring distance 3 m) 1 GHz to 6 GHz[1)]	-	1 GHz to 3 GHz[1)] 76 dB (µV/m) Peak value 56 dB (µV/m) Mean
	-	3 GHz to 6 GHz[1)] 80 dB (µV/m) Peak value 60 dB (µV/m) Mean

1) Depends on the highest internal frequency

9.4.3 Mechanical conditions

Testing	Test method per	Test values per
Sinusoidal vibration / Operation	EN 60068-2-6	B&R
		EN 61131-2: Product standard - Programmable controllers
		EN 60721-3-3 / Class 3M4
Shock/Operation	EN 60068-2-27	EN 61131-2: Product standard - Programmable controllers
		EN 60721-3-3 / Class 3M4
Sinusoidal vibration / Transport (packaged)	EN 60068-2-6	EN 60721-3-2 / Class 2M1, 2M2, 2M3
Shock/Transport (packaged)	EN 60068-2-27	EN 60721-3-2 / Class 2M1, 2M2
Free fall / Transport (packaged)	EN 60068-2-31 (replacement for EN 60068-2-32)	EN 61131-2: Product standard - Programmable controllers
		EN 60721-3-2 / Class 2M1
Toppling / Transport (packaged)	EN 60068-2-31	EN 60721-3-2 / Class 2M1, 2M2, 2M3

Sinusoidal vibration / Operation

Testing performed per EN 60068-2-6	Test values per B&R		Test values per EN 61131-2		Test values per EN 60721-3-3 / Class 3M4	
Sinusoidal vibration Continuous and logarithmic sweeping. Sweep rate 1 octave per minute.	**Frequency**	**Amplitude**	**Frequency**	**Amplitude**	**Frequency**	**Amplitude**
	2 to 9 Hz	Deflection 3.5 mm	5 to 8.4 Hz	Deflection 3.5 mm	2 to 9 Hz	Deflection 3 mm
	9 to 200 Hz	Acceleration 1 g	8.4 to 150 Hz	Acceleration 1 g	9 to 200 Hz	Acceleration 1 g
	20 sweeps per axis (x, y, z)					

1 g = 10 m/s²
2 sweeps = 1 frequency cycle (fmin → fmax → fmin)

Shock/Operation

Test method per EN 60068-2-27	Test values per EN 61131-2	Test values per EN 60721-3-3 / class 3M4
Shock/Operation Positive and negative pulse (half-sine) shock load in all 3 axes (x, y, z)	Acceleration 15 g Duration 11 ms 18 shocks	Acceleration 10 g Duration 11 ms 18 shocks

1 g = 10 m/s²

Sinusoidal vibration / Transport (packaged)

Test method per EN 60068-2-6	Test values per EN 60721-3-2 / Class 2M1		Test values per EN 60721-3-2 / Class 2M2		Test values per EN 60721-3-2 / Class 2M3	
Sinusoidal vibration / Transport (packaged) Continuous and logarithmic sweeping. Sweep rate 1 octave per minute.	**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	9 to 200 Hz	Acceleration 1 g	8 to 200 Hz	Acceleration 2 g
	200 to 500 Hz	Acceleration 1.5 g	200 to 500 Hz	Acceleration 1.5 g	200 to 500 Hz	Acceleration 4 g
	20 sweeps per axis (x, y, z)					

1 g = 10 m/s²
2 sweeps = 1 frequency cycle (fmin → fmax → fmin)

Shock/Transport (packaged)

Testing performed per EN 60068-2-27	Test values per EN 60721-3-2 / Class 2M1	Test values per EN 60721-3-2 / Class 2M2
Shock/Transport (packaged) Positive and negative pulse (half-sine) shock load in all 3 axes (x, y, z)	**Type I** Acceleration 10 g Duration 11 ms 18 shocks	**Type I** Acceleration 10 g Duration 11 ms 18 shocks
	Type II -	**Type II** Acceleration 30 g Duration 6 ms 18 shocks

1 g = 10 m/s²

Free fall / Transport (packaged)

Testing performed per EN 60068-2-31 (replacement for EN 60068-2-32)	Test values per EN 61131-2 with shipping packaging		Test values per EN 61131-2 with shipping packaging		Test values per EN 60721-3-2 / Class 2M1	
Free fall / Transport (packaged)	**Weight**	**Height**	**Weight**	**Height**	**Weight**	**Height**
	<10 kg	1 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		5 attempts		5 attempts	

Toppling / Transport (packaged)

Test method per EN 60068-2-31	Test values per EN 60721-3-2 / Class 2M1		Test values per EN 60721-3-2 / Class 2M2		Test values per 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		Topple on all edges		Topple on all edges	

9.4.4 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 from 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	Definition per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
≥IP20	First number IP**2**x	Protected against solid foreign bodies with a diameter ≥12.5 mm	Protected against touching dangerous parts with fingers
	Second number IPx**0**	Not protected.	-

Requirement per B&R	Definition per EN 60529	Meaning for the protection of equipment	Meaning for the protection of personnel
IP69(K)	First number IP**6**x	Dust-proof	Protected against touching dangerous parts with conductor.
	Second number IPx**9(K)**	Protected against high pressure and high jet water temperatures (steam jet cleaning).	-

9.5 Railroad requirements

The following modules and accessories meet the railroad requirements:

Bus controller			
Order number	**Module type**	**Description**	**Special functions**
X90BC124.32-00	X90 mobile bus controller	• 1 CANopen on CMC header, 32 multifunction I/Os	• Die-cast aluminum housing

Controllers			
Order number	**Module type**	**Description**	**Special functions**
X90CP172.24-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP172.48-00	X90 mobile controller	• ARM Cortex A9-300 • 128 MB DDR3 RAM, 16 kB FRAM, 512 MB flash memory • Interfaces: – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.24-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 24 multifunction I/Os	• Die-cast aluminum housing, • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators
X90CP174.48-00	X90 mobile controller	• ARM Cortex A9-650 • 256 MB DDR3 RAM, 32 kB FRAM, 1 GB flash memory • Interfaces: – 1 POWERLINK on M12 – 1 Ethernet 10/100BASE-T on M12 – 3 CAN on CMC header • 48 multifunction I/Os	• Die-cast aluminum housing • 4 option board slots • 2 sensor power supplies • Service access window, LED status indicators

Option boards			
Order number	**Module type**	**Description**	**Special functions**
X90AO410.04-00	X90 mobile option board, analog output module	• 4 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source
X90AO410.08-00	X90 mobile option board, analog output module	• 8 analog outputs, 12-bit, optional 0 to 10 V / 0 to 20 mA	• Optional DI, 9 to 32 VDC, sink/source
X90AT910.04-00	X90 mobile option board, temperature input module	• 4 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz
X90AT910.08-00	X90 mobile option board, temperature input module	• 8 resistance measurement inputs, Pt1000	• Optional DI, 9 to 32 VDC, sink/source • Optional AI, 0 to 10 V / 0 to 32 V, 0 to 20 mA • Optional PWM output, 9 to 32 VDC, 10 mA, 1 kHz
X90DI110.10-00	X90 mobile option board, digital input module	• 10 digital inputs, 9 to 32 VDC, optional sink/source	• Optional counter input 50 kHz
X90IF730.04-00	X90 mobile option board, interface module	• 3x CAN • 1x RS485	
X90PO210.08-00	X90 mobile option board, PWM output module	• 8 PWM outputs 9 to 32 VDC, max. 4 A 15 Hz to 1 kHz	• With current measurement (12-bit) • Optional DI 9 to 32 VDC, sink/source
X90RO440.04-S1	X90 mobile option board, digital output module	• 4 safe relays, normally open contacts 9 to 32 VDC / 2 and 4 A	• For external actuator power supply

Accessories			
Order number	**Module type**	**Description**	**Special functions**
X90TB100.03-00	X90 mobile connector set	• For CMC header	
X90TB120.01-00	X90 mobile connectors	• For CMC header • With connector contacts and dummy plug	

9.5.1 Requirements for immunity to disturbances

Test	Testing performed per	Test values per
Electrostatic discharge (ESD)	EN 61000-4-2	EN 50121-3-2 Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
High-frequency electromagnetic fields (HF field)	EN 61000-4-3	EN 50121-3-2 Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
High-speed transient electrical disturbances (Burst)	EN 61000-4-4	EN 50121-3-2 Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
Surge voltages (Surge)	EN 61000-4-5	EN 50121-3-2 Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
Conducted induced radio-frequency fields (RF-conducted)	EN 61000-4-6	EN 50121-3-2 Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus

Evaluation criteria for performance

Criteria	During testing / After testing
A	The apparatus shall continue to operate as intended during and after the test/event. No degradation of performance or loss of function is allowed. Changes of actual operating state or stored data are not allowed. If agreed between the involved parties, the normal performance level (all functions are working as specified) can be replaced by a minimum performance level.
B	The apparatus shall continue to operate as intended after the test/event. During the test/event, degradation of performance is however allowed. Changes of actual operating state or stored data are not allowed.
C	During the test/event temporary loss of function is allowed. The equipment could: • **automatically restart.** The normal performance shall be obtained within a maximum defined time. After this time the equipment shall retain the previous operating state and shall work as intended. The loss of significant data is not allowed; or • **manually restart or process controlled restart.** In this case this shall be agreed between user and supplier and/or clearly defined in the user manual. In this case the user manual shall be available to the user at the tender stage.

Electrostatic discharge (ESD)

Testing performed per EN 61000-4-2	Test values per EN 50121-3-2
Contact discharge (CD) On conductive accessible parts	±6 kV Criteria B
Air discharge (AD) On insulating accessible parts	±8 kV Criteria B

High-frequency electromagnetic fields (HF field)

Testing performed per EN 61000-4-3	Test values per EN 50121-3-2
Housing, completely wired	80 MHz to 1 GHz, 20 V/m 1.4 GHz to 2 GHz, 10 V/m 2 GHz to 2.7 GHz, 5 V/m 5.1 GHz to 6 GHz, 3 V/m Criteria A

High-speed transient electrical disturbances (Burst)

Testing performed per EN 61000-4-4	Test values per EN 50121-3-2
Connections for signal and communication lines, process measuring and control lines	±2 kV / 5 kHz Criteria A
Battery-related connections (except power source outputs), auxiliary AC power input connections (RMS value of the rated voltage ≤ 400 V)	±2 kV / 5 kHz Criteria A

Surge voltages (Surge)

Testing performed per EN 61000-4-5	Test values per EN 50121-3-2
Battery-related connections (except power source outputs), auxiliary AC power input connections (RMS value of the rated voltage ≤ 400 V)	±2 kV Line to ground Criteria B
	±1 kV Line to line Criteria B

Conducted induced radio-frequency fields (RF-conducted)

Testing performed per EN 61000-4-6	Test values per EN 50121-3-2
Connections for signal and communication lines, process measuring and control lines	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A
Battery-related connections (except power source outputs), auxiliary AC power input connections (RMS value of the rated voltage ≤ 400 V)	10 V 150 kHz to 80 MHz 80% AM (1 kHz) Criteria A

9.5.2 Operating temperature

The possible operating temperature class depends on the total current consumption of the devices. Temperature sensors are installed in the devices that ensure damage to the device due to operation above the permissible device temperature is avoided.

> **Information:**
>
> **Clearances as described in section "Clearance" on page 28 must be observed.**

Devices	Limit values of internal temperature sensors for max. operating temperature class	Total current consumption without limitations
X90CP17x.xx-00 device configurations	TemperatureCPU < 120°C TemperatureENV1 < 100°C TemperatureENV2 < 95°C TemperatureENV3 < 110°C TemperatureENV4 < 110°C Temperature < 100°C	Class OT6 up to 8 A summation current
X90BC124.32-00 device configurations	AiTemp < 105°C 1)	Class OT6 up to 2.5 A summation current

1) Must be monitored by the application.

Fast temperature change

Requirements per EN 50155	
Class H1	No requirement1)

1) Applies to:

- Temperature of the cold air around the equipment
- Temperature of the hot air around the equipment
- Temperature gradient °C/s

9.5.3 Other requirements

Swing and shock

Requirements correspond to EN 61373	
Category 1	Class B

Nominal voltage

Requirements per EN 50155	
Rated voltage 24 V	Permissible voltage range: 9 to 32 V

Useful life class

Requirements per EN 50155	
Class L2	Useful life 10 years

Protective coating

Requirements per EN 50155	
PC1	No protective coating

Supply changeover class

Requirements per EN 50155	
Class C1	Performance criterion A

Fire behavior

The fire behavior complies with the requirements per EN 45545-2.

For an overview of all tested modules and accessories, see "Railroad requirements" on page 81.

Power supply

> **Danger!**
>
> **The device is not permitted to be supplied directly by the overhead line.**

Wiring

> **Information:**
>
> **Wiring must meet the requirements of EN 50343.**

MTBF

The MTBF values are provided upon request. Please contact B&R Support.

9.6 Overview of standards

Standard	Title
UN/ECE-R10	Regulation no. 10 of the United Nations Economic Commission for Europe (UNECE) - Uniform provisions concerning the approval of vehicles with regard to electromagnetic compatibility
ISO 7637-2	Road vehicles - Electrical disturbances from conduction and coupling - Part 2: Electrical transient conduction along supply lines only
ISO 10605	Road vehicles - Test methods for electrical disturbances from electrostatic discharge
ISO 11452-2	Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 2: Absorber-lined shielded enclosure
ISO 11452-4	Road vehicles - Component test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 4: Bulk current injection (BCI)
ISO 11452-5	- Component test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 5: Stripline
EN ISO 13766-1	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical power supply - Part 1: General EMC requirements under typical electromagnetic environmental conditions
EN ISO 13766-2	Earth-moving and building construction machinery - Electromagnetic compatibility of machines with internal electrical power supply - Part 2: Additional EMC requirements for functional safety
EN ISO 13849-1	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design
EN ISO 14982	Agriculture and forestry machines - Electromagnetic compatibility - Test methods and acceptance criteria
ISO 15003	Agricultural engineering - Electrical and electronic equipment - Testing resistance to environmental conditions
ISO 16750-3	Road vehicles - Environmental conditions and testing for electrical and electronic equipment - Part 3: Mechanical loads
ISO 20653	Road vehicles - Degrees of protection (IP code) - Protection of electrical equipment against foreign objects, water and access
ISO 25119-1	Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 1: General principles for design and development
ISO 25119-2	Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 2: Concept phase
ISO 25119-3	Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 3: Series development, hardware and software
ISO 25119-4	Tractors and machinery for agriculture and forestry - Safety-related parts of control systems - Part 4: Production, operation, modification and supporting processes
EN 45545-2	Railroad applications - Fire protection on railway vehicles - Part 2: Requirements for fire behavior of materials and components
EN 50121-3-2	Railroad applications - Electromagnetic compatibility - Part 3-2: Rolling stock - Apparatus
EN 50155	Railway applications - Rolling stock - Electronic equipment
EN 50343	Railway applications - Rolling stock - Rules for installation of cabling
EN 55011 (CISPR 11)	Industrial, scientific and medical (ISM) radio-frequency equipment Electromagnetic 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 55022 (CISPR 22)	Information technology equipment Limits and methods of measurement
EN 55025 (CISPR 25)	Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers
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 (replacement for EN 60068-2-32)	Environmental testing - Part 2-31: Test procedure - Test Ec: Rough handling shocks, mainly for devices
EN 60068-2-64	Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance
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: Transportation
EN 60721-3-3	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities Section 3: Stationary use at weatherprotected locations
EN 60721-3-5	Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities Section 5: Ground vehicle installations
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

Standard	Title
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 measurement techniques - Immunity tests for 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 DC 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 controllers - Part 2: Guidance for inspection and routine testing
EN 61373	Railway applications - Rolling stock equipment - Shock and vibration tests
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

10 Environmentally friendly disposal

All B&R control components are designed to inflict as little harm on the environment as possible.

10.1 Separation of materials

It is necessary to separate out the different materials so that devices can undergo an environmentally friendly recycling process.

Component	Disposal
X90 mobile modules Cables	Electronics recycling
Cardboard/Paper packaging	Paper/Cardboard recycling

Table: Environmentally friendly separation of materials

Disposal must take place in accordance with applicable legal regulations.

11 Additional information

11.1 General data points

In addition to the registers listed in the register description, X90 controllers and option boards also have additional general data points. These are not module-specific but contain general information such as serial number and hardware variant.

11.1.1 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

11.1.2 HardwareVariant

Name:
HardwareVariant

The hardware variant of the module can be read using this data point.

Data type	Values
UINT	0 to 65,535

11.1.3 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.

Data type	Values
UINT	0 to 65,535

11.1.4 SerialNumber

Name:
SerialNumber

The unique serial number of the module or controller board can be read from this data point.

Data type	Values
UDINT	0 to 4,294,967,295

11.2 Special controller data points

The data points described in this section are not controller-specific, but contain general information.

11.2.1 DeviceID

Name:
DeviceID

The device ID of X90 controllers can be read from this data point. The UDINT value consists of the hexadecimal representation of a 4-character string.

Example

DeviceID: 1246254667 → Corresponds to 0x4A48564B → Corresponds to ANSI "JHVK"

Result: DeviceID = "KVHJ"

Data type	Values
UDINT	0 to 4,294,967,295

11.2.2 DeviceSerialNumber

Name:
DeviceSerialNumber

The device's unique serial number can be read from this data point.

Data type	Values
UDINT	0 to 4,294,967,295

Device serial number

The complete device serial number consists of the DeviceID and DeviceSerialNumber together.

The device serial number is printed on the module housing.

Example

Device ID as string = "KVHJ"

Serial number as decimal number = 0168422

Device serial number = "KVHJ0168422"

11.2.3 SystemTime

Name:
SystemTime

The starting time of a specific task class in µs 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