

MTX 15VRS

System Description

Project Planning Manual
R911397742

Edition 04



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1 About this documentation

Editions of this documentation

Edition	Release date	Note
01	2019-07	First edition
02	2019-10	Chapter "Firmware and software for the MTX CNC system" supplemented
03	2020-07	Updates/supplements in chapter "XM42 control Standard, Performance and Advanced" New control cabinet PC VPB 40.4 Changes in the chapter "Firmware and software for the MTX CNC system"
04	2020-11	Changes in the chapter "System overview"

Tab. 1-1: Change record

1.1 Validity of the documentation

Target group This documentation is intended for users wanting to inform themselves about the MTX control system.

Overview on target groups and product phases In the following illustration, the framed activities, product phases and target groups refer to the present documentation.

Example: The target group "Commissioning engineer" can "configure" in the product phase "Engineering" using this documentation.

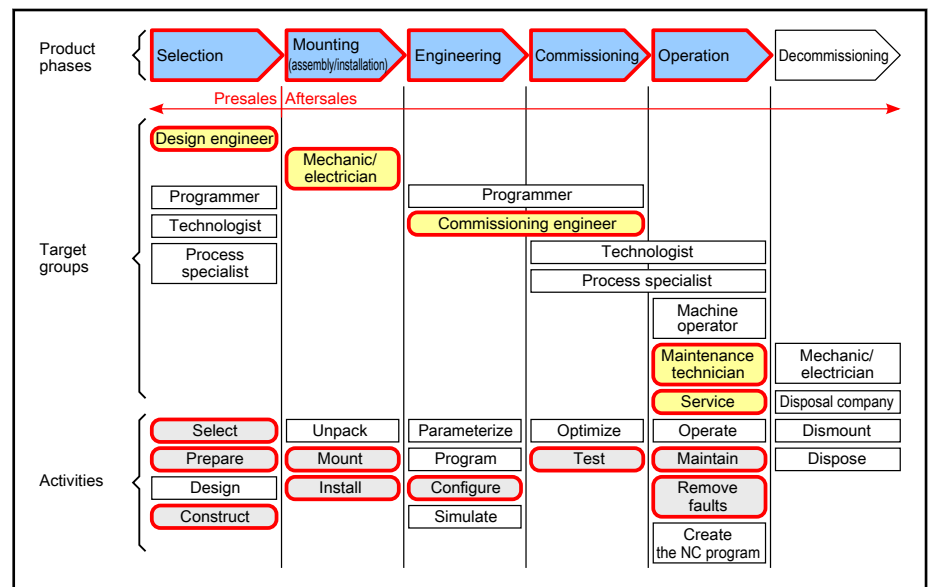


Fig. 1-1: Assigning this documentation to the target groups, product phases and target group activities

1.2 Required and supplementing documentation MTX

1.2.1 Selection/compilation

Documentation titles with type codes and part numbers

MTX 15VRS System Description DOK-MTX***-SYS*DES*V15-PRRS-EN-P, R911397742 This documentation describes the MTX control. It includes the designs, technical data, interfaces as well as the configuration of the control components.
MTX 14VRS SafeLogic System Overview DOK-MTX***-SL**SYS*V14-PRRS-EN-P, R911341698 This documentation describes the use of the safety control SafeLogic in the MTX.
IndraControl XM42 Controls DOK-CONTRL-XM4X*CTRL**-ITRS-EN-P, R911345566 This documentation describes the IndraControl XM42 controls.

RS

Corresponding edition

Tab. 1-2:

MTX documentation overview - Selecting/composing

1.2.2 Configuration

Documentation titles with type codes and part numbers

MTX 15VRS Machine Parameters DOK-MTX***-MA*PAR**V15-RERS-EN-P, R911400176 This documentation describes structure and the adjustment of available parameters of the MTX. It also includes the functions of the NC configurator and its operation.
MTX 15VRS PLC Interface DOK-MTX***-PLC*INT*V15-PRRS-EN-P, R911400172 This documentation describes the interface signals and the program function blocks for the integrated PLC.
MTX 15VRS Functional Description - Basics DOK-MTX***-NC*F*BA*V15-RERS-EN-P, R911401401 This documentation describes the basic functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
MTX 15VRS Functional Description - Extension DOK-MTX***-NC*F*EX*V15-RERS-EN-P, R911393316 This documentation describes the extended functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.
MTX 15VRS Functional Description - Special Functions DOK-MTX***-NC*F*SP*V15-RERS-EN-P, R911393309 This documentation describes the special functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.

MTX Free Form Surface Milling

DOK-MTX***-FREEFORM***-APRS-EN-P, R911341435

This documentation describes the free form surface milling process with the MTX control. CNC programs generated by a CAD/CAM system are used as basis for the entire process. Overview over the following topics: Description of the MTX or CNC function for freeform surface milling, strategy during the NC parameterization process, boundary conditions when generating CNC programs with CAM software.

MTX Conversion of MTX Projects

DOK-MTX***-PROCONV****-PRRS-EN-P, R911342484

This documentation provides support during the conversion of MTX 1.x projects to MTX 2G. This project planning manual provides information on how to convert a project and identifies potential difficulties during the conversion.

RS

Corresponding edition

Tab. 1-3:

MTX documentation overview - Configuring

1.2.3 Commissioning

Documentation titles with type codes and part numbers

MTX 15VRS Commissioning

DOK-MTX***-STARTUP*V15-CORS-EN-P, R911393281

This documentation describes the commissioning of the MTX control. Apart from a complete overview, commissioning and configuration of the axes and the user interface as well as the PLC data are described.

IndraWorks 15VRS Basic Libraries, IndraLogic 2G

DOK-IL*2G*-BASLIB**V15-LIRS-EN-P, R911398633

This documentation describes the system-comprehensive PLC libraries.

IndraWorks 15VRS Field Buses

DOK-IWORKS-FB*****V15-APRS-EN-P, R911393284

This documentation describes the field bus and local periphery connections supported by the MLC and MTX systems. The focus of this documentation lies in the configuration, parameterization, commissioning and diagnostics of different periphery connections. It is the basis for the online help.

IndraWorks 14VRS WinStudio 7.4

DOK-IWORKS-WINSTUD*V14-APRS-EN-P, R911341585

This "User Manual and Technical Reference Book" supports the user in achieving the best results with the "Rexroth WinStudio"™ software. The document provides technical information and step-by-step instructions to create web-enabled HMI/SCADA programs.

IndraWorks 15VRS Software Installation

DOK-IWORKS-SOFTINS*V15-CORS-EN-P, R911393450

This documentation describes the IndraWorks installation.

IndraWorks 15VRS Engineering

DOK-IWORKS-ENGINEE*V15-APRS-EN-P, R911393303

This documentation describes the use of IndraWorks in which the Rexroth Engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.

IndraWorks 15VRS PLC Programming System IndraLogic 2G

DOK-IWORKS-IL2GPRO*V15-APRS-EN-P, R911396137

This documentation describes the PLC programming tool IndraLogic 2G and its use. The documentation includes the basic use, first steps, visualization, menu items and editors.

IndraWorks 15VRS HMI

DOK-MLC***-HMI****V15-APRS-EN-P, R911399270

This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.

MTX 15VRS Shape Cutting Technology

DOK-MTX***-TECHCUT*V15-CORS-EN-P, R911399147

This documentation describes the shape cutting technology used by the machines to cut materials using an NC-controlled tool head.

RS

Corresponding edition

Tab. 1-4:

MTX documentation overview - Commissioning

1.2.4 Operation

Documentation titles with type codes and part numbers

MTX 12VRS Block Pre-Run

DOK-MTX***-BLK*RUN*V12-APRS-EN-P, R911334379

This documentation explains to the machine manufacturer how to setup the "Block pre-run" function at the machine for the end user.

MTX 15VRS Programming Manual

DOK-MTX***-NC**PRO*V15-RERS-EN-P, R911393318

This documentation describes the standard programming of the MTX control. Apart from the basics of NC programming, the use of NC functions according to DIN 66025 as well as the NC functions with high-level language syntax and CPL functions are described.

MTX 15VRS Standard NC Operation

DOK-MTX***-NC*OP***V15-APRS-EN-P, R911393314

This documentation describes the operation of the standard user interface of the NC control of the MTX. It includes the operation of the interface, the NC program development as well as the tool management.

MTX 15VRS Multitouch

DOK-MTX***-MULTI***V15-APRS-EN-P, R911393311

The Multitouch user interface of the NC control MTX is described in this documentation.

MTX 15VRS Standard NC Cycles

DOK-MTX***-NC*CYC**V15-PRRS-EN-P, R911394940

This documentation describes the application of the standard cycles of the different technologies for the MTX control.

MTX 15VRS NC Simulation

DOK-MTX***-NC*SIM**V15-APRS-EN-P, R911393273

This documentation describes the NC simulation for the MTX control.

MTX 15VRS Measuring Functions

DOK-MTX***-MES*FUN*V15-APRS-EN-P, R91194938

This documentation describes the measuring cycles of the MTX control.

RS

Corresponding edition

Tab. 1-5:

MTX documentation overview - Operating

1.2.5 OEM Engineering

Documentation titles with type codes and part numbers

MTX 13VRS Automation Interface DOK-MTX***-AUT*INT*V13-APRS-EN-P, R911337274 This documentation describes the script-based access to IndraWorks project data via the interface of the Automation Interface. Different objects including code examples are described. The Automation Builder is also described in this manual.
MTX 15VRS OPC Communication DOK-MTX***-OPC*COM*V15-PRRS-EN-P, R911399272 This documentation describes the syntax and the structure of the items for the communication with Bosch Rexroth devices.
IndraWorks OPC UA Communication DOK-IWORKS-OPC*UA*****-APRS-EN-P, R911379309 This documentation describes the OPC UA communication of the MLC and MTX control systems.

RS Corresponding edition
Tab. 1-6: MTX documentation overview - OEM engineering

1.2.6 AddOns

Documentation titles with type codes and part numbers

MTX 11VRS Action Recorder DOK-MTX***-ACR*****V11-APxx-EN-P, R911329943 This documentation describes the MTX action recorder. It includes the installation and commissioning as well as interface signals, application and operation.
MTX 15VRS Efficiency Workbench MTX cta, MTX ega DOK-MTX***-EWB*****V15-APRS-EN-P, R911400178 This documentation describes the mode of operation and the area of application of the analysis tool MTX cta and MTX ega.
MTX Remote Condition Monitoring DOK-MTX***-RCM*****V01-APRS-EN-P, R911334383 This documentation describes the operation of the Remote Condition Monitoring System.
MTX visIREC User Documentation DOK-MTX***-VISIREC*V01-APRS-EN-P, R911344242 This documentation describes the analysis tool visIREC used to optimize the free form surface milling process. 2D or 4D display of path-related data. 2D or 4D display of coordinate-related data. Analysis of critical areas (path and orientation deviation). Comparing the programmed NC blocks to the interpolated NC blocks.

xx / RS Corresponding edition
Tab. 1-7: MTX documentation overview - AddOns

1.3 Information representation

1.3.1 Using safety instructions

Structure of the safety instructions

The safety instructions are structured as follows:

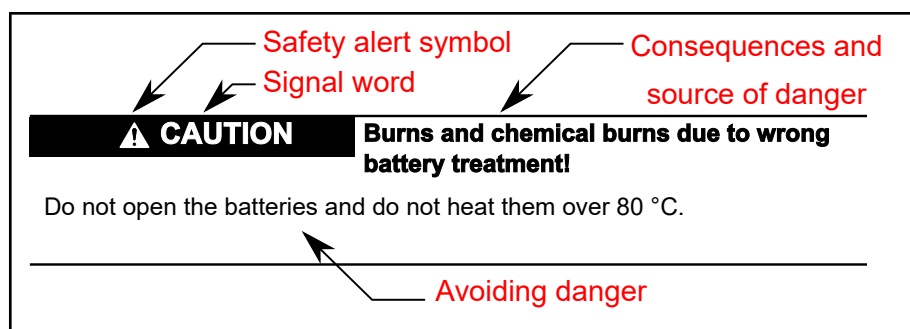


Fig. 1-2: Structure of the safety instructions

Explaining signal words and safety alert symbol

The safety instructions in this documentation contain specific signal words (danger, warning, caution, notice) and, if necessary, a safety alert symbol (according to ANSI Z535.6-2006).

The signal word draws attention to the safety instruction and indicates the risk potential.

The safety alert symbol (triangular safety reflector with exclamation marks), preceding the signal words Danger, Warning, Caution indicates hazards for persons.

DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

WARNING

In case of non-compliance with this safety instruction, death or serious injury **can** occur.

CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury can occur.

NOTICE

In case of non-compliance with this safety instruction, material damage can occur.

Symbols used

Pointers are displayed as follows:



This is a note.

Tips are displayed as follows:



This is a tip.

Explaining the signal alert symbol on the device



If this symbol is on your device, you have to observe the documentation on the device. The respective documentation informs on the type of hazard as well as the steps required to avoid this hazard.

1.3.2 Names and abbreviations

Term	Explanation
ACS	Axis coordinate system
CANopen	Field bus
DeviceNet	Field bus
Ethernet	Communication interface
F-Key	Function key
HMI	User interface
IWE	IndraWorks Engineering
IWO	IndraWorks Operation
M-key	Machine key
MCP	Machine control panel
MCS	Machine coordinate system
MDI	Manual data input
MSD	Machine status display
NC	Numerical Control
OEM	Original Equipment Manufacturer
OP-key	Operation key
POU	Program organization unit
PROFIBUS-DP	Field bus
Sercos	Sercos is a world-wide standardized digital interface used for communication between controls and drives
WCS	Workpiece coordinate system

Tab. 1-8: Terms and abbreviations

1.3.3 Customer feedback

Customer requests, comments or suggestions for improvement are of great importance to us. Please email your feedback on the documentations to Feedback.Documentation@boschrexroth.de. Directly insert comments in the electronic PDF document and send the PDF file to Bosch Rexroth.

2 Important instructions on use

2.1 Intended use

2.1.1 Introduction

Bosch Rexroth products are developed and manufactured according to the state-of-the-art. The products are tested prior to delivery to ensure operating safety and reliability.

The products may only be used as intended. If they are not used as intended, situations occur that result in damage to property or injury to persons.



Bosch Rexroth shall not assume any warranty, liability or payment of damages in case of damage resulting from a non-intended use of the products; the use shall solely bear all risks from unintended use of the products.

Before using Bosch Rexroth products, the following requirements have to be met to guarantee the intended use of the products:

- Anybody handling Bosch Rexroth products in any way is obliged to read and consent to the relevant safety instructions and the intended use.
- Hardware products may not be altered and have to remain in their original state; i.e. no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not install damaged or defective products or use them in operation.
- It has to be ensured that the products have been installed as described in the relevant documentation.



Ensure that the data present in the control or entered or read in by the user is correct before applying it to exclude unwanted axis motion. It can be the following invalid or old data:

- Part programs
- ZO tables
- Compensation tables
- Tool tables
- Permanent CPL variables
- Remanent PLC data
- Permanent system data

2.1.2 Areas of use and application

The MTX control is used to

- program contour and machining technology (path feed, spindle speed, tool change) of a workpiece.
- guide a machining tool along a programmed path.

Feed drives, spindles and auxiliary axes of a machine tool are activated via Sercos interface.



This additionally requires I/O components for the integrated PLC which - together with the actual CNC - control the machining process as a whole and also monitors this process with regard to technical safety.

It may only be operated with the explicitly specified hardware component configurations and combinations and only with the software and firmware specified in the appropriate documents and functional descriptions.

The CNC system MTX provides the perfect CNC system solution for cutting and forming for the following technologies:

- Rotate
- Milling
- Drilling
- Grinding
- Bending
- Nibbling
- Punching
- Contour cutting
- Handling

2.2 Unintended use

Using the CNC system MTX outside the above-referenced areas of application or under operating conditions other than the conditions described in the documentation and the specified technical data, is defined as "unintended use".

The CNC system MTX must not be used if ...

- it is subjected to operating conditions not corresponding to the specified ambient conditions. Operation under water, under extreme temperature fluctuations or under extreme maximum temperatures is prohibited.
- Furthermore, the CNC system MTX shall not be used for applications not expressly approved of by Bosch Rexroth. Therefore, please read the information given in the general safety instructions!
- The CNC system MTX may not be used in systems or machines connected to the internet via an unsecure network connection. Otherwise, malfunctions or a control failure can result due to unauthorized access.

3 Safety instructions for electric drive and control systems

3.1 Definitions of terms

Application documentation	Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: Operating Instructions, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Description, etc.
B sample	To a large extent, the B sample comes with the technical function. However, there are restrictions, e.g. insufficient testing. Therefore, errors or product variations are to be expected. The product may only be used after a prototype agreement was signed.
Compatibility	Compatibility of a new function or functional enhancement means that, for example, a parameter file from a previous version can be used in the new firmware.
Component	A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.
Control system	A control system comprises several interconnected control components placed on the market as a single functional unit.
Device	A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.
Drive	A drive (electric drive) consists of a drive controller with an electric motor.
Electrical equipment	Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.
Electric drive system	An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.
Incompatibility	Incompatible new functions or incompatible functional enhancements produce a device behavior which does not correspond to the previous version.
Installation	An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.
Machine	A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.
Manufacturer	The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the in-

Safety instructions for electric drive and control systems

	dividual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess the required authority to take responsibility for the product.
Patch	A patch corrects errors in the firmware.
Product	Examples of a product: Device, component, part, system, software, firmware, among other things.
Project Planning Manual	A Project Planning Manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.
Qualified personnel for handling functionally safe products	Individuals configuring, commissioning and operating functionally safe products must have the knowledge specified under " Qualified persons ". Additionally, these individuals must be familiar with technical safety concepts as well as prevailing standards and regulations in the field of functional safety.
Qualified persons	In terms of this application documentation, qualified persons are those individuals who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work requires. To comply with these qualifications, it is necessary, among other things, • to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them. • to be trained or instructed to maintain and use adequate safety equipment. • to attend a course of instruction in first aid.
Release, firmware/Runtime release	A new release makes available compatible functional enhancements or corrects errors in the firmware, see "RS" in AXS-V-VSRS.
Version, firmware/Runtime version	Compared to the previous version, a new version of a firmware contains important changes in the scope of functions. The scope of functions may also contain incompatible changes, see "VS" in AXS-V-VSRS.
User	A user is a person installing, commissioning or using a product which has been placed on the market.

3.2 General information

3.2.1 Using the Safety instructions and passing them on to others

Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Bosch Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, injury, electric shock or even death.

3.2.2 Requirements for safe use

Read the following instructions before initial commissioning of the components of the electric drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Bosch Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.
- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technology". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.
- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

The machine and installation manufacturers must

- make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,
- make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.

- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user has to comply with

- European countries: In accordance with European EN standards
- United States of America (USA):
 - National Electrical Code (NEC)
 - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
 - Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
 - International Organization for Standardization (ISO)
 - International Electrotechnical Commission (IEC)

3.2.3 Hazards by improper use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!
- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.3 Instructions with regard to specific dangers

3.3.1 Protection against contact with electrical parts and housings



This section concerns components of the electric drive and control system with voltages of **more than 50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating components of the electric drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

High electrical voltage! Danger to life, risk of injury by electric shock or serious injury!

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:
Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch any electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).
- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.

- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm² (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 mm ² (16 AWG)	10 mm ² (8 AWG)	2 × 1.5 mm ² (16 AWG)
2.5 mm ² (14 AWG)		2 × 2.5 mm ² (14 AWG)
4 mm ² (12 AWG)		2 × 4 mm ² (12 AWG)
6 mm ² (10 AWG)		2 × 6 mm ² (10 AWG)
10 mm ² (8 AWG)		-
16 mm ² (6 AWG)	16 mm ² (6 AWG)	-
25 mm ² (4 AWG)		-
35 mm ² (2 AWG)		-
50 mm ² (1/0 AWG)	25 mm ² (4 AWG)	-
70 mm ² (2/0 AWG)	35 mm ² (2 AWG)	-
...	...	...

Tab. 3-1: Minimum cross section of the equipment grounding connection

3.3.2 Protective extra-low voltage as protection against electric shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

On components of an electric drive and control system provided by Bosch Rexroth, all connections and terminals with voltages up to 50 volts are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Bosch Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV ("Protective Extra-Low Voltage").

3.3.3 Protection against dangerous movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

These errors can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring functions in the components of the electric drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

Dangerous movements! Danger to life, risk of injury, serious injury or property damage!

A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed.

As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine's range of motion and moving machine parts. Prevent personnel from accidentally entering the machine's range of motion by using, for example:
 - Safety fences
 - Safety guards
 - Protective coverings
 - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equipment works. Do not operate the machine if the emergency stopping switch is not working.
- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.

- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
 - mechanically securing the vertical axes,
 - adding an external braking/arrester/clamping mechanism or
 - ensuring sufficient counterbalancing of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety!**
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") for:
 - Maintenance and repair work
 - Cleaning of equipment
 - Long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

3.3.4 Protection against electromagnetic and magnetic fields during operation and mounting

Electromagnetic and magnetic fields!

Health hazard for persons with active implantable medical devices (AIMD) such as pacemakers or passive metallic implants.

- Hazards for the above-mentioned groups of persons by electromagnetic and magnetic fields in the immediate vicinity of drive controllers and the associated current-carrying conductors.
- Entering these areas can pose an increased risk to the above-mentioned groups of persons. They should seek advice from their physician.
- If overcome by possible effects on above-mentioned persons during operation of drive controllers and accessories, remove the exposed persons from the vicinity of conductors and devices.

3.3.5 Protection against contact with hot parts

Hot surfaces of components of the electric drive and control system. Risk of burns!

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C (140 °F)** during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can require **up to 140**

minutes! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.

- After switching chokes, supply units and drive controllers off, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

3.3.6 Protection during handling and mounting

Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

3.3.7 Protection against pressurized systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately clean up any spilled liquids from the floor due to the risk of falling!



Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Observe the national regulations of your country.

3.4 Explanation of signal words and the Safety alert symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is meant to draw the reader's attention to the safety instruction and identifies the hazard severity.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

WARNING

In case of non-compliance with this safety instruction, death or serious injury **could** occur.

CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

4 System overview

The CNC system MTX is a customized configurable CNC control system that can be used with single machines and complex high-production systems for the automated manufacturing. Due to its hardware and software, the CNC system MTX can be individually scaled in terms of performance and functions.

Currently, the following system variants are available:

Control system	Sercos		
	Maximum number of NC axes	Maximum number of I/O devices	Maximum number of Sercos devices
XM42 MTX standard	12	64	76
XM42 MTX performance	64	64	128
XM42 MTX advanced	Up to 250 axes	64	250

Tab. 4-1: CNC system MTX system variants

All controls provide CNC and PLC functionalities. In the highest stage of expansion, an XM42 MTX advanced is available to control up to 250 axes in 60 independent CNC machining channels.

Extension modules

XM42 can be extended with a maximum of 3 extension modules.

The following field bus interfaces are available for XM42:

- Sercos (Cross Communication)
- Multi-Ethernet (PN | EIP) master/slave
- Multi-Ethernet (PN | EIP) slave
- PROFIBUS master/slave
- PROFIBUS slave

and the extension module SafeLogic.

Real-time input/output modules

- Simple S20 input/output extensions
- Up to 63 modules can be added
- Fast data exchange with up to 1 μ s update

Bosch Rexroth provides industrial PCs in different models and with different screen diagonals intended for Engineering, visualization and operation of the controls. The operator panels of these industrial PCs optimized with other modules (machine operator panel and PC keyboards) in design and construction to ideally control, operate and visualize a tool machine.

Inline modules to be installed in control cabinets and field line modules to be installed in the vicinity of a machine provide scalable I/O systems with PROFIBUS-DP, DeviceNet and Sercos.

Accessories also include cable assemblies to wire the CNC control MTX in no time.

5 XM42 control standard, performance and advanced

5.1 Interfaces

5.1.1 Connection position

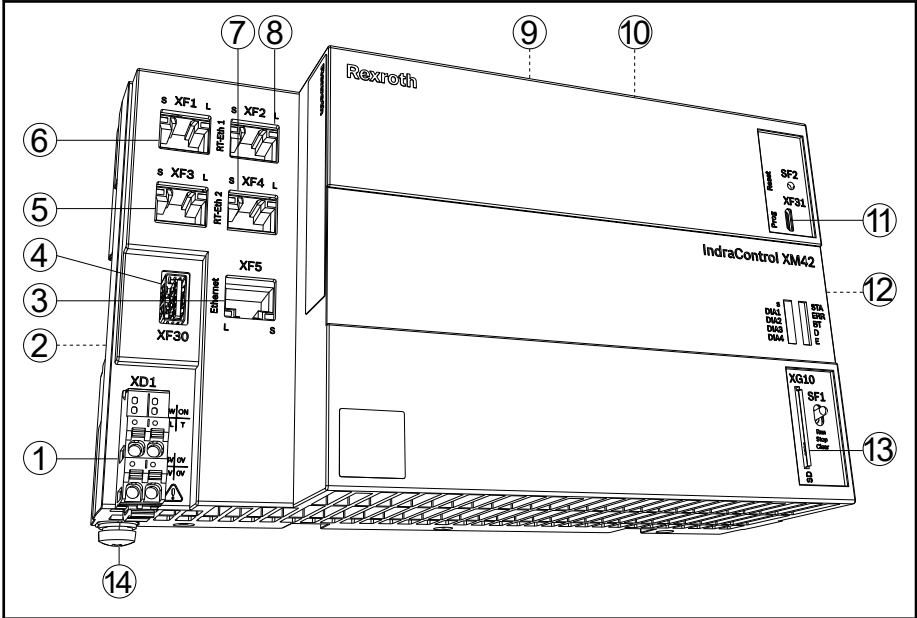


Fig. 5-1: Interfaces

NOTICE Attaching and detaching connections under voltage can damage the control!

Switch off the supply voltage before attaching or detaching any connections!

No.	Name	Connection type	Connector type (Integrated)	Mating connector and cable (From outside)
①	XD1	24 V plug U _{LS}	4-pin	(4-wire)
②	–	Extension bus	Bus base 32-pin	Bus base for extension modules 32-pin
③	XF5	Ethernet (TCP/IP, RT Ethernet)	RJ-45 socket 8-pin	RJ-45 plug (twisted pair, 4-/8-wire)
④	XF30	USB host USB 2.0	USB TYPE A-sock- et 4-pin	USB TYPE A-plug (4-wire)
⑤	XF3	Ethernet Profinet, Ethernet IP, etc.	RJ-45 socket 8-pin	RJ-45 plug (twisted pair, 8-wire)

No.	Name	Connection type	Connector type (Integrated)	Mating connector and cable (From outside)
⑥	XF1	Ethernet (Sercos)	RJ-45 socket 8-pin	RJ-45 plug (twisted pair, 8-wire)
⑦	XF4	Ethernet Profinet, Ethernet IP, etc.	RJ-45 socket 8-pin	RJ-45 plug (twisted pair, 8-wire)
⑧	XF2	Ethernet (Sercos)	RJ-45 socket 8-pin	RJ-45 plug (twisted pair, 8-wire)
⑨	XBAT	Battery case	–	–
⑩	XFAN	Fan connection	–	–
⑪	XF31	USB device USB 2.0	Micro USB socket 4-pin	Micro USB plug (4-wire)
⑫	–	S20 bus	Bus base 32-pin	Bus base for S20 I/O modules 32-pin
⑬	SG10	Slot for SD card	–	SD card
⑭	–	Grounding screw	–	–

Tab. 5-1: Control interfaces

5.1.2 Extension bus

Up to three extension modules can be freely connected at the left of the control. The extension modules have to be attached without any gaps via the bus bases on the left side of the XM control and supplied with the same 24 V supply voltage. Switch on and off the 24 V supply voltage of the extension modules synchronously with the XM control.

5.1.3 S20 interface

Up to 63 S20 modules can be connected to the S20 interface on the right of the XM control via S20 bus bases. The number of connectable modules depends on the total current consumption of the S20 modules. The XM control can provide up to 2 A for the power supply of the S20 modules.



Overloading the U_{BUS} for the S20 bus can cause a control failure.

5.1.4 Bus bases

The XM control is attached to the bus base XA-BS03. The bus base XA-BS03 connects the XM control to the S20 modules on the right control side and to the extension modules on the left control side. The bus base XA-BS03 is provided upon delivery.

5.2 Ambient conditions

Ambient temperature during operation without fan	Up to 2,000 m: -25 °C to +50 °C 2,000 m to 3,000 m: max. +45 °C
Ambient temperature during storage and transport	-25°C to +70°C
Air pressure	55 kPa to 106 kPa (up to 4,500 m above sea level)
Air humidity	5 % to 95 % acc. to DIN EN 61131-2, no condensation
Degree of protection	IP20 acc. to DIN EN 60 529
Protection class	III, DIN EN 61010-2-201
Overvoltage category	2
Contamination level	2, no condensation allowed
Mechanical tests	
Vibration resistance acc. to DIN EN 60068-2-6 ^①	Oscillations, sinusoidal in all three axes 5 Hz - 8.4 Hz with 3.5 mm amplitude 8.4 Hz - 150 Hz with 1 g peak acceleration
Shock test acc. to DIN EN 60068-2-27	Shock stress: Shock resistance in all three axes, 11 ms semi-sinusoidal 15 g
Broadband noise acc. to DIN EN 60068-2-64	20-500 Hz with 1.22 g rms ¹⁾ per axis
Electrostatic discharge	
ESD resistance acc. to DIN EN 61131-2	Criterion B
• Test voltage	6 kV for contact discharge 8 kV for air discharge

- ① The vibration stress specifications assume the use of industrial-suited RJ-45 plug connections. The "Industrial RJ-45 plug" of the company Yamaichi is recommended (Y-ConPlug-41). The cables are available as accessories (RKB0020). To avoid vibration, secure the cables using a short distance (< 20 cm). The USB interfaces XF30 and XF31 may only be used up to a vibration stress of 1 g.

Tab. 5-2: Ambient conditions

1) Root Mean Square

NOTICE**Failure of the product due to contaminated air**

- The ambient air must not contain acids, alkaline solutions, corrosive agents, salts, metal vapors and other electrically conductive contaminants in high concentrations
- The devices to be installed into the housing and installation compartments must at least comply with the degree of protection IP 54 according to DIN EN 60529.
- The device shall be provided in a suitable fire enclosure in the end-use application.

NOTICE**Defective product due to gases jeopardizing functions**

Due to the risk of corrosion, avoid sulphurous gases (e.g. sulphur dioxide (SO₂) and hydrogen sulphide (H₂S)). The product is not resistant against these gases.

NOTICE**Product failure due to overheating**

To avoid overheating and to ensure interference-free operation of the product according to the minimum distances specified in chapter Mounting, demounting and electric installation of the operating instructions XM42, circulation of the circulating air has to be ensured.



This is a product that corresponds to the limit values of the emitted interference of class A (industrial environments). This is a product that does *not* correspond to the limit values of the emitted interference of class B (residential area and small enterprises)

When using the product in residential areas or small enterprises, the operator has to take actions to prevent radio interferences (also refer to DIN EN 55022).

5.3 Technical data

Processor	IndraControl XM4: Intel® Core™ i Dual Core 6th generation
RAM	4 GByte DRAM DDR4
Connection for extension modules	Via the bus base XA-BS03
Extension bus	
Number of possible modules	3
Connection for S20 I/O	Via the bus base XA-BS03
S20 bus parameters	
Transmission rate	100 MBit/s
Number of connectable modules	Max. 63 (per station)
Max. current for the S20 bus (U _{Bus})	2 A

Communication interfaces	RJ-45 connections: • 1 × Ethernet connection (10 MB, 100 MB, 1 GB) • 2 × Sercos III master-slave interfaces • 2 × Ethernet field bus master-slave interfaces USB ports: • 1 × USB host, maximum cable length 3 m (for the functionality, refer to the system description of the respective system). The USB memory sticks with the file systems FAT16 and FAT32 are supported.  Plugging in and removing the USB memory medium at runtime is generally possible. However, it can cause a temporarily increased runtime behavior and motion cycle time exceedances or PLC and hardware watchdogs in case of a high control load. Thus, plug in or remove a USB memory medium only in an uncritical machine state (e.g. home position)! • 1 × USB device, maximum cable length 3 m (for the functionality, refer to the system description of the respective system).
SD card	Slot for SD card  Only the Rexroth SD card XA-SD02 (part no. R911175017) is approved as memory medium for the XG10 slot of XM42.  Plugging in and removing the SD card at runtime is generally possible. However, it can cause a temporarily increased runtime behavior and motion cycle time exceedances or PLC and hardware watchdogs in case of a high control load. Thus, plug in or remove the SD card only in an uncritical machine state (e.g. home position)!
Weight	1.2 kg (incl. bus base)
Dimensions	Refer to the housing dimensions (IndraControl XM42 operating instructions)

Tab. 5-3: Technical data

5.3.1 Voltage supply and current consumption

The following values apply to the operating voltage acc. to DIN EN 61131-2:

Nominal voltage at U_{LS}	24 V DC SELV/PELV
Maximum voltage range of the supply voltage allowed U_{LS}	18 V DC to 31.2 V DC (incl. all tolerances and ripple)
Current consumption of the control incl. the connected S20 I/O modules from U_{LS} at nominal voltage	Maximum 1.5 A
Current consumption of the control without the connected S20 I/O modules from U_{LS} at nominal voltage	Typically 1.0 A
Power consumption of the control incl. the connected S20 I/O modules from U_{LS} at nominal voltage	36 W max.

Power consumption of the control without the connected S20 I/O modules from U_{LS} at nominal voltage	Typically 24 W
Reverse voltage protection of the supply voltage	Diode
Fuse protection	Internal protective fuse, 4.0 A
Transient protection	Present, suppressor diodes
Pulse load up to 1,500 W	
Voltage dips at current supply interfaces	PS2 < 10 ms, evaluation criterion A
Electrical isolation 24 V supply (U_{LS}) to the functional earth	Separation between 0 V of the U_{LS} and FE (housing)

Tab. 5-4: Operating voltage and current consumption

NOTICE

Electronic damage due to polarity reversal or due to a nominal current that is too low

The power supply unit has to be able to deliver the quadruple nominal current of the protective fuse to ensure that the fuse reliably triggers in case of an error.

5.4 Performance data

Name	XM42 MTX standard	XM42 MTX performance	XM42 MTX advanced
Number of axes	max. 12	max. 64	max. 250
Thereof spindles	4	32	max. 60
Number of interpolated axes/ channel	4/8	4/8	4/8
Number of NC channels	2	3...12	3...60
Min. Ipo cycle	2 ms	0.5 ms	0.25 ms

Tab. 5-5: Performance data of the CNC system MTX XM42

6 Control cabinet PC VPB 40.4 with VDP operating display

6.1 Brief description

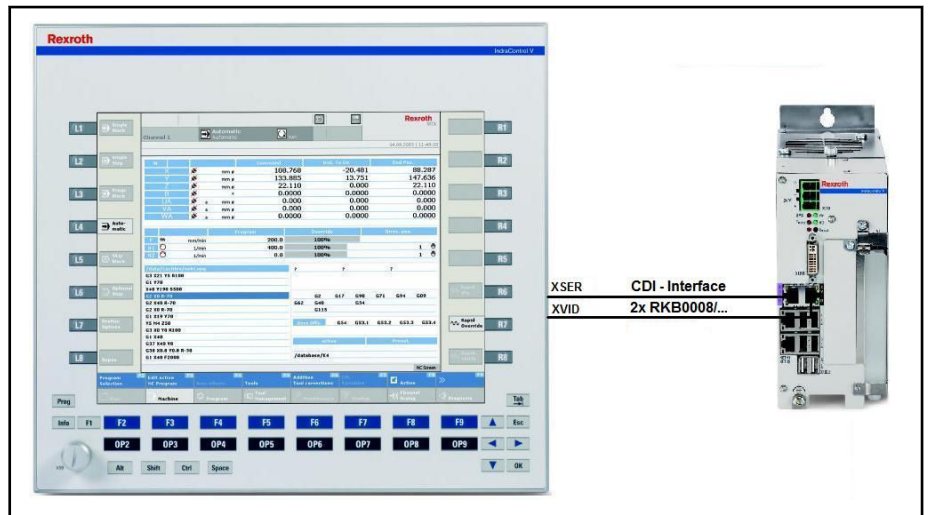


Fig. 6-1: Control cabinet PC VPB 40.4 with VDP operating display VDP 40.3

The VPB 40.4 is a high-end industrial PC that, together with the passive VDP 15.3, 16.3, 18.3, 21.3 or VDP 40.3 operating displays, provides a PC-based operation and visualization terminal with a high suitability for industrial applications. VPB 40.4 is intended for installation in a control cabinet. The VDP is designed to be installed in an operator console or a control cabinet wall. A CDI or a CDI+ interface connects the VDP and the VPB 40.4.

6.2 Field of application

The control cabinet PC VPB 40.4 is used in industrial environments with increased vibration and shock requirements.

6.3 Technical data

6.3.1 VPB 40.4

Name		VPB 40.4	
PC box		1, 2 or 4 slots	
Processor	D7	Core i5-6300U, 2.40 GHz	
		Main memory	8 GB RAM
	D8	Core i7-6820EQ, 2.80 GHz	
		Main memory	16 GB RAM
Power supply		24 V DC	

Tab. 6-1: Technical data of the VPB 40.4

6.3.2 VDP 15.3, 16.3, 18.3, 21.3 and 40.3

	True color display	Panel design
VDP 15.3	15" 1366 x 768 pixel	Multitouch
VDP 16.3	12" 800 x 600 Pixel	Machine keys Touch screen
VDP 18.3	18" 1366 x 768 Pixel	Multitouch
VDP 21.3	21" 1920 x 1080 Pixel	Multitouch
VDP 40.3	15" 1024 x 768 pixel	Machine keys Touch screen

Tab. 6-2: Technical data VDPs

All VDPs require a power supply of 24 V DC.

6.4 Wear parts

Parts with a limited service life installed in the control cabinet PC VPB40.4 and in the VDP operating displays are not subject to warranty.

The following components are affected:

- CMOS battery
- Mechanical hard disk
- SSD (Solid State Drive)
- Fan

For the service life of the individual components, refer to the documentations (see [chapter 6.8 "Documentation" on page 34](#)).

6.5 Variants of the control cabinet PC VPB 40.4 (D7)

6.5.1 Core i5-6300U, 2.40 GHz

Type	Slots	RAM	Hard disk
VPB40.4D1P-8G0NN-D7D-HN-NN-FW R911174345	2 x PCIe	8 GB	192 GB SSD
VPB40.4D1L-8G0NN-D7D-HN-NN-FW R911174216	2 x PCI	8 GB	192 GB SSD
VPB40.4D1L-8G0NN-D7D-KN-NN-FW R911174338	2 x PCI	8 GB	2 x 192 GB SSD RAID1
VPB40.4D1M-8G0NN-D7D-HN-NN-FW R911174218	4 x PCI	8 GB	192 GB SSD
VPB40.4D1N-8G0NN-D7D-HN-NN-FW R911174349	1 x PCI + 1 x PCIe	8 GB	192 GB SSD

Type	Slots	RAM	Hard disk
VPB40.4D1Q-8G0NN-D7D-HN-NN-FW R911174363	2 x PCI + 2 x PCIe	8 GB	192 GB SSD
VPB40.4D1R-8G0NN-D7D-HN-NN-FW R911174357	4 x PCIe	8 GB	192 GB SSD

Tab. 6-3: VPB40.3 variants with Core i5-520M processor (D4)

6.5.2 Core i7-6820EQ, 2.80 GHz (D8)

Type	Slots	RAM	Hard disk
VPB40.4D1P-16GNN-D8D-HN-NN-FW R911174346	2 x PCIe	16 GB	192 GB SSD
VPB40.4D1L-16GNN-D8D-HN-NN-FW R911174217	2 x PCI	16 GB	192 GB SSD
VPB40.4D1L-16GNN-D8D-KN-NN-FW R911174341	2 x PCI	16 GB	2 x 192 GB SSD RAID1
VPB40.4D1M-16GNN-D8D-HN-NN-FW R911174219	4 x PCI	16 GB	192 GB SSD
VPB40.4D1M-16GNN-D8D-MN-NN-FW R911174499	4 x PCI	16 GB	2x 192GB SSD
VPB40.4D1N-16GNN-D8D-HN-NN-FW R911174350	1 x PCI + 1 x PCIe	16 GB	192 GB SSD
VPB40.4D1Q-16GNN-D8D-HN-NN-FW R911174365	2 x PCI + 2 x PCIe	16 GB	192 GB SSD
VPB40.4D1R-16GNN-D8D-HN-NN-FW R911174359	4 x PCIe	16 GB	192 GB SSD
VPB40.4D1R-16GNN-D8D-KN-NN-FW R911174361	4 x PCIe	16 GB	2 x 192 GB SSD RAID1
VPB40.4D1R-16GNN-D8D-MN-NN-FW R911174376	4 x PCIe	16 GB	2 x 192 GB SSD

Tab. 6-4: VPB40.3 variants with Core i7-3612QE processor (D6)

6.6 Variants of the operating displays

6.6.1 Operating displays VDP 15.3, 18.3, 21.3

Type	Note
VDP15.3GAN-D1-NN-NN	VDP15.3: 15" display, multitouch
VDP18.3GBN-D1-NN-NN	VDP18.3: 18" display, multitouch with front USB
VDP21.3GKN-D1-NN-NN	VDP21.3: 21" display, multitouch portrait (vertical installation)

Tab. 6-5: Selection VDP 15.3, 18.3, 21.3

6.6.2 Operating displays VDP16.3 (12")

Type	Note
VDP16.3BKN-D1-NN-NN	Operating device with 12" color display and key front
VDP16.3DBN-D1-NN-NN	Operating device with 12" color display and touch screen

Tab. 6-6: VDP16.3 selection

6.6.3 Operating displays VDP40.3 (15")

Type	Note
VDP40.3BIN-D1-NN-NN	Operating device with 15" color display and key front
VDP40.3DFN-D1-NN-NN	Operating device with 15" color display and touch with key front
VDP40.3DEN-D1-NN-NN	Operating device with 15" color display and touch screen

Tab. 6-7: VDP40.3 selection

6.7 Accessories

6.7.1 Connecting Cable (CDI Interface)

The connection between the control cabinet PC VPB 40.4 and VDP operating device is established via the CDI interface. The following assembled cables are available:

Type	Note
RKB0008/002.5	Connecting cable VPB40.3 - VDPxx.3 2.5 m
RKB0008/005,0	Connecting cable VPB40.3 - VDPxx.3 5.0 m
RKB0008/010,0	Connecting cable VPB40.3 - VDPxx.3 10.0 m
RKB0008/015,0	Connecting cable VPB40.3 - VDPxx.3 15.0 m
RKB0008/020,0	Connecting cable VPB40.3 - VDPxx.3 20.0 m
RKB0008/025,0	Connecting cable VPB40.3 - VDPxx.3 25.0 m
RKB0008/030,0	Connecting cable VPB40.3 - VDPxx.3 30.0 m
RKB0008/035,0	Connecting cable VPB40.3 - VDPxx.3 35.0 m
RKB0008/040,0	Connecting cable VPB40.3 - VDPxx.3 40.0 m
RKB0008/050,0	Connecting cable VPB40.3 - VDPxx.3 50.0 m

Tab. 6-8: Connecting cable VPB 40.4 - VDP



Two connecting cables of type RKB0008/... are required for connecting a VPB 40.4 and a VDP.

6.7.2 VPB 40.4 accessories

Type	Note
VAP01.1H-W23-024-010-NN	Power supply unit 24 V DC; 10 A
VAU01.1U-024-024-240-NN	Uninterrupted power supply with 24 V input / 24 V output / 240 W
RKB0008/...	Connecting cable for CDI interface and CDI+ interface, lengths up to 70 m
RKB0019/...	USB interface cable to connect the uninterrupted power supply; lengths: 0.5 m; 1.0 m; 3.0 m; 5.0 m
RKB0023/...	USB connecting cable with increased noise immunity (USB2.0) lengths 1.0 m; 3.0 m

Tab. 6-9: VPB 40.3 accessories

6.8 Documentation

The following documentations provide a detailed description of the control cabinet PC VPB 40.4:

- DOK-SUPPL*-VPB*40.4***-PRxx-EN-P

- DOK-SUPPL*-VPB*40.4***-ITRS-EN-P
- DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P

The following documentations provide a detailed description of the operating displays:

- VDP 16.3/40.3:
DOK-SUPPL*-VDP*XX.3***-ITRS-EN-P
- VDP 15.3/18.3/21.3:
DOK-SUPPL*-VDPXX.3MTBU-ITRS-EN-P

7 Small operator panel VR21xx

7.1 Brief description

VR21xx are small operator panels are operating and visualization terminals to operate and monitor NC, PLC and drive data. In connection with the MTX control system, devices with a 4.3" and 7" screen are available. The operating screens are configured using Rexroth WinStudio™. The communication to the control is established via an Ethernet interface.



Fig. 7-1: VR21xx small operator panel

The following variants are supported in the MTX control system:

Variant	Display	Device height	Device width	Mounting depth	Panel out-cut
VR2104	4.3 "	100 mm	140 mm	42 mm	H: 92 mm, B: 132 mm
VR2107	7 "	150 mm	211 mm	46.3 mm	H: 142 mm, B: 203 mm

Tab. 7-1: Variants VR21xx

7.2 Technical data

	VR2104 Singletouch	VR2107 Singletouch	VR2107 Multitouch
Display	4,3 " TFT 480 x 272 Pixel 95.0 mm x 53.8 mm 65536 colors 450 cd/m ² brightness	9 " TFT 800 x 480 Pixel 152.4 mm x 91.4 mm 262144 colors 350 cd/m ²	
Touch technology	Analog resistive, 4-wire technology		Configured capacitively Touchpad
Touch activation pressure	15 g (standard) with R8 HS60 silicone rubber		
Central unit	ARM Cortex™-A8, 800 MHz with real-time clock (RTC)		
Flash memory	512 MByte		
RAM	512 MByte		
Power supply	24 V DC (SELV, PELV according to DIN EN61131)		

Small operator panel VR21xx

Current consumption	0.2 A (typically at 24 V) 0.3 A (maximum)	0.3 A (typically at 24 V) 0.4 A (maximum)	0.4 A (typically at 24 V) 0.5 A (maximum)
Connection value	4.8 W	7.2 W	9.6 W
USB interface	Per USB port, max.500 mA, total current at all USB port, max. 1A		
Weight	ca. 0.6 kg	ca. 0.8 kg	ca. 0.8 kg

Tab. 7-2: Technical data VR21xx

7.3 Interfaces

7.3.1 Power supply X1

Pin assignment	Name	Function
1		FE (functional earth)
2	0 V	0 V (GND) supply voltage
3	24 VDC	Supply voltage 24 V

Tab. 7-3: Power supply X1

7.3.2 USB interfaces X9, X10

At the small operator panel VR21xx two USB host interfaces are available. Only USB devices complying with the USB2.0 specification can be connected.



Not all USB devices are detected.

The operating system does not support all USB devices. Devices requiring a special driver not integrated in the system cannot be operated at the USB interfaces.

7.3.3 Ethernet interface X5

The VR21xx small operator panel can be connected to a network via the Ethernet interface X5:

Connector	X5
Type	Ethernet 100BaseT
Cable length	Max. 100 m
Cable type	Twisted-pair cable CAT 5 or CAT 6
Transmission rate	10 or 100 Mbit/s

Tab. 7-4: Ethernet interface X5

LED	Status
LED ACT/LNK (green)	On: Connection to network established Off: No communication
LED SPD 10/100 (yellow)	On: 100 MBit/s mode Off: 10 MBit/s mode or connection disconnected

Tab. 7-5: Diagnostic LEDs of the Ethernet interface

7.3.4 SD memory card slot

The SD memory card slot is located at the underside of the device.



Insert the memory card until the card clicks into place.

7.4 Wear parts

7.4.1 Backlighting

The backlight has a limited service life. The brightness is then decreased to 50% of the initial brightness.

The service life in the following table refers to an ambient temperature of 25 C°:

Display	Service life
4.3"	40 000 hours
7"	40 000 hours

Tab. 7-6: Half-value display times

7.4.2 Touchscreen

After 3 million dead stops, no damages or malfunctions occurred under the following conditions:

- Element dead stop: R8, HS40 silicone rubber
- Pressure dead stop: 150 g
- Frequency dead stop: 3 Hz

7.5 Variants

In connection with the MTX control system, the following small operator panels VR21xx are available:

Order designation	Display	Resolution	Touch technology
VR2104.01-00-01-N2-NNN-AA	4.3 "	480 x 272 Pixel	resistive, singletouch
VR2107.01-00-01-N2-NNN-AA	7 "	800 x 480 Pixel	resistive, singletouch
VR2107.01-00-01-N2-NNN-CA	7 "	800 x 480 Pixel	capacitive, multitouch

Tab. 7-7: VR21xx variants

7.6 Documentation

The following documentation provides a detailed description of the VR21xx small operator panels:

DOK-SUPPL*-VR21**-01**-ITRS-EN-P

8 PR | VR | DR

8.1 Brief description

New product portfolio of industry PCs as panel PCs, box PCs and displays.

8.2 Field of application

The control cabinet PC PR3/PR4 is used in industrial environments with increased vibration and shock requirements.

8.3 Variants of control cabinet PC PR3/PR4

8.3.1 General information

The box PC series consists of the housing variants PR3 and PR4 with a uniform and compact design. The latest Intel processor generations Apollo Lake and Skylake provide a high system performance but are cost-efficient at the same time. The multitude of available standard interfaces facilitates integration into different automation concepts. The extension with option modules allows for many different device configurations. The box PCs can be mounted horizontally or vertically.



Fig. 8-1: Box PCs - PR3 and PR4

- Product variants scalable with regard to performance
- High system availability and data security
- Flexible application range due to extension options and interface variety
- Real-time Ethernet communication via cycle-synchronous Intel i210 chip sets
- Universal mounting positions and options

Technical data

Type	PR3100	PR4100	PR4200	PR4300
CPU	INTEL Atom E3940 4 * 1.6 GHz	Intel Core i3-6100OU 2 * 2.3 GHz	INTEL Core i5-6300OU 2*2.4 GHz	INTEL Core i7-6600OU 2 * 2.6 GHz
GPU	Intel® HD Graphics 500	Intel® HD Graphics 5200		
Operating system	Windows 10 IoT Enterprise LTSB			
Hardware				
PCIe slots	-	1		
mPCIe slots (internal)	-	1 x (connected to integrated aerial socket)		
mPCIe slots (external)	1 x (connected to interface module)	1 x (connected to interface module)		
mPCIe extension (internal)	-	WLAN/Bluetooth 4 G: LTE/HSPA+/GPRS and GPS		
mPCIe extension (external)	2 x Gbit/RJ-45/Intel i350 WLAN 2 x RS-232/DB9 2 x RS-422/485/DB9 4G: LTE/HSPA+/GPRS and GPS 16 DI, 8 DO	2 x Gbit/RJ-45/Intel i350 2 x RS-232/DB9 2 x RS-422/485/DB9 4 G: LTE/HSPA+/GPRS and GPS 16 DI, 8 DO		
Solid State Disk SSD	32 GB/256 GB (MLC/standard)	32 GB/256 GB (MLC/standard)		
Solid State Disk SSD (RAID 1)	-	2 x 256 GB (option)		
CFast slot	1 (option)	1 (option)		
Hard disk	320 GB (option)	320 GB (option)		
Hard disk (RAID 1)	-	2 x 320 GB (option)		
Memory				
Application	4 (standard) 8 (option)	8 (standard) 16 (option)		
Interfaces				

Type	PR3100	PR4100	PR4200	PR4300
Type	2 x Gbit LAN (i210) 2 x USB 2.0 2 x USB 3.0 1 x RS-232 1 x RS-232/422/485	2 x Gbit LAN (i210) 1 x Gbit LAN (i219) 2 x USB 2.0 2 x USB 3.0 1 x RS-232 1 x RS-232/422/485		
Video	Display port (standard) Long distance video CDI+ (option)	Display port (standard) Long distance video CDI+ (option)		

Tab. 8-1: Technical data

8.4 Variants of the operating displays

8.4.1 VR3115, VR4x15, VR4x21

The VR product series unites all PR and R properties in compact panel PCs. Broad scaling, high performance and the number of extension options and standard interfaces make the panel PCs VR the ideal solution platform for all HMI-based applications. Due to the Security-by-Design by means of integrated TPM 2.0, the robust devices are ideally suited for Industry 4.0. The panel PCs can be mounted horizontally or vertically.



Fig. 8-2: Panel PCs - VRx

- High-resolution widescreen display available in 15.6 or 21 inch
- Uniform device design with low mounting depth
- High reliability due to high immunity to noise, shock and vibration resistance
- Optimized for horizontal and vertical mounting positions with easy one-man installation
- Individualized design

Technical data

Type	VR3115	VR3121
Processor		
CPU	INTEL Atom E3940 4 x 1.6	INTEL Atom E3940 4 x 1.6

Type	VR3115	VR3121
GPU	Intel® HD Graphics 5200	
Operating system	Windows 10 IoT Enterprise LTSC	
Display		
Size	396 mm (15.6") Widescreen	546 mm (21") Widescreen
Colors	16 m	
Resolution	1.366 × 768	1.920 × 1.080
Material	Tempered glass front	
Operation		
Type	Capacitive 10-point multitouch	
Hardware		
PCIe slots	-	
mPCIe slots (internal)	-	
mPCIe slots (external)	1 x (connected to interface module)	
mPCIe extension (internal)	-	
mPCIe extension (external)	2 x Gbit/RJ-45/Intel i350 WLAN 2 x RS-232/DB9 2 x RS-422/485/DB9 4 G: LTE/HSPA+/GPRS and GPS 16 DI, 8 DO	
Solid State Disk SSD	32 GB/256 GB (MLC/standard)	
Solid State Disk SSD (RAID 1)	-	
CFast slot	1 (option)	
Hard disk	320 GB (option)	
Hard disk (RAID 1)	-	
Memory		
Application	4 (standard), 8 (option)	
Interfaces		
Type	2 x Gbit LAN (i210) 2 x USB 2.0 2 x USB 3.0 1 x RS-232 1 x RS-232/422/485	
Video	Display port (standard) Long distance video CDI+ (option)	

Tab. 8-2: VR31xx

Type	VR4115	VR4215	VR4315	VR4121	VR4221	VR4321
Processor						
CPU	INTEL Core i3-6100U 2 x 2.3	INTEL Core i7-6600U 2 x 2.6	INTEL Core i7-6600U 2 x 2.6	INTEL Core i3-6100U 2 x 2.3	INTEL Core i7-6600U 2 x 2.6	INTEL Core i7-6600U 2 x 2.6
GPU	Intel® HD Graphics 5200					
Operating system	Windows 10 IoT Enterprise LTSC					
Display						
Size	396 mm (15.6") widescreen			546 mm (21") widescreen		
Colors	16 m					
Resolution	1.366 × 768			1.920 × 1.080		
Material	Tempered glass front					
Operation						
Type	Capacitive 10-point multitouch					
Hardware						
PCIe slots	1					
mPCIe slots (internal)	1 x (connected to integrated aerial socket)					
mPCIe slots (external)	1 x (connected to interface module)					
mPCIe extension (internal)	WLAN/Bluetooth 4 G: LTE/HSPA+/GPRS and GPS					
mPCIe extension (external)	2 x Gbit/RJ-45/Intel i350 2 x RS-232/DB9 2 x RS-422/485/DB9 4 G: LTE/HSPA+/GPRS and GPS 16 DI, 8 DO					
Solid State Disk SSD	32 GB/256 GB (MLC/standard)					
Solid State Disk SSD (RAID 1)	2 x 256 GB (option)					
CFast slot	1 (option)					
Hard disk	320 GB (option)					

Type	VR4115	VR4215	VR4315	VR4121	VR4221	VR4321
Hard disk (RAID 1)	2 x 320 GB (option)					
Memory						
Applica- tion	8 (standard), 16 (option)					
Interfaces						
Type	2 x Gbit LAN (i210) 1 x Gbit LAN (i219) 2 x USB 2.0 2 x USB 3.0 1 x RS-232 1 x RS-232/422/485					
Video	Display port (standard) Long distance video CDI+ (option)					

Tab. 8-3: VR4yxx

8.4.2 DR0015, DR0018, DR0021

The capacitive multitouch display DR is available in scalable sizes and variants for horizontal and vertical applications. The box PC PR connections is realized via the standard interfaces display/port/USB or the long distance interface CDI+ as single-cable solution with direct boot for distances up to 100 m. Up to three devices of the DR series can be interconnected to a multi display link.



Fig. 8-3: DR – Multi-touch displays

- High-resolution widescreen display available in 15 or 21 inch
- Capacitive multitouch with 5 finger detection for precise operation
- Anti-glare and mar-resistant panel front
- Optimized for horizontal and vertical mounting positions with easy one-man installation
- Can also be used in harsh and challenging ambient conditions
- Line network with up to three displays
- Individualized design

Technical data

Type	DR0015	DR0018	DR0021
Display			
Type	TFT		

Type	DR0015	DR0018	DR0021
Size	396 mm (15.6") Widescreen	470 mm (18.5") Widescreen	546 mm (21.5") Widescreen
Colors	16 m		
Resolution	1366 * 768	1366 * 768	1920 * 1080
Material	Tempered glass front		
Operation			
Type	Capacitive 10-point multitouch		

Tab. 8-4: Technical data DR devices

8.5 Accessories

Type	Note
VAP01.1H-W23-024-010-NN	External 24V power supply unit for V-devices
VAU02.1S-024-024-072-NN	Uninterrupted power supply DC 24 V, 72 Watt with RS-232 interface
RKB0008/...	Connecting cable for CDI+ interface lengths: 0.5 m; 1.0 m; 2.5 m; 5.0 m; 7.5 m; 10.0 m; 15.0 m; 20.0 m; 25.0 m; 30.0 m; 35.0 m; 40.0 m; 50.0 m
RKB0019/...	USB connecting cable lengths: 0.5 m; 1.0 m; 3.0 m; 5.0 m
RKB0063/...	Display port connecting cable, lengths 3 m; 5 m

Tab. 8-5: VPB 40.3 accessories

8.6 Wear parts

8.6.1 The CMOS battery

The CMOS battery type BR2032 has a service life of 5 to 7 years.

8.7 Documentation

The following documentations provide a detailed description:

- DOK-CONTRL-PR*VR*OS*... de-DE
- DOK-CONTRL-PR4*VR4**... de-DE

9 VAM machine operator panel

9.1 Brief description

The machine operator panels VAM are used to select the operating modes and to manually operate the machine. They contain the necessary control elements, such as buttons with LED displays, rotary switches for feed and spindle override, E-STOP button, key switches and machine buttons. Function and design are optimized for the operating devices VDP und panel Pcs VPP. On the rear side, the devices are provided with a connector for a handwheel and a manual operating device as well as with connectors for 16 digital 24 V inputs and 8/16 digital 24 V outputs. Communication with the master control is established via PROFIBUS-DP or Sercos III.

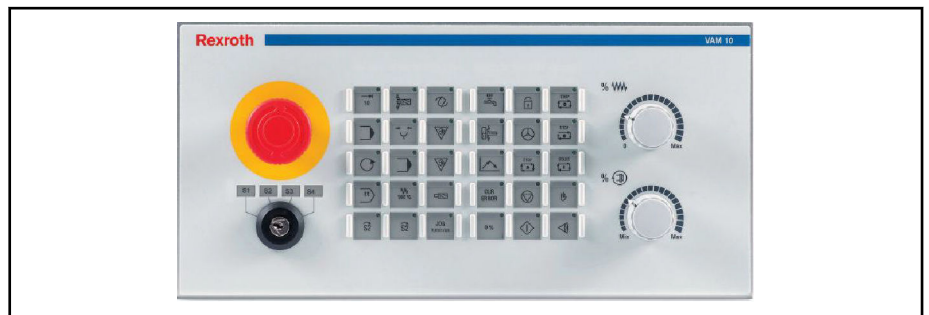


Fig. 9-1: VAM 10 machine operator panel

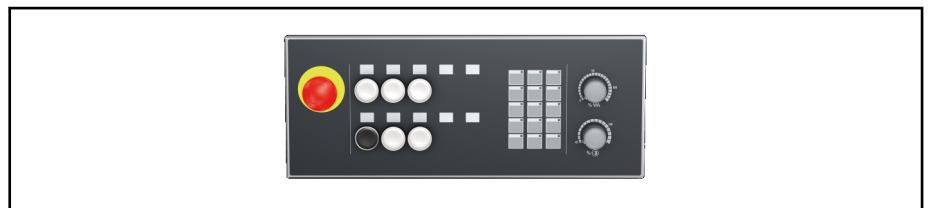


Fig. 9-2: VAM 15.1 machine operator panel

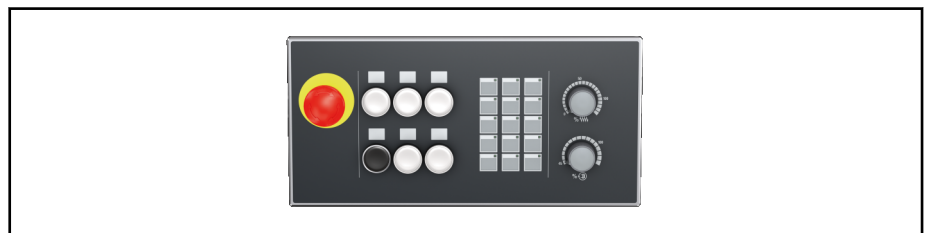


Fig. 9-3: VAM 21.1 machine operator panel

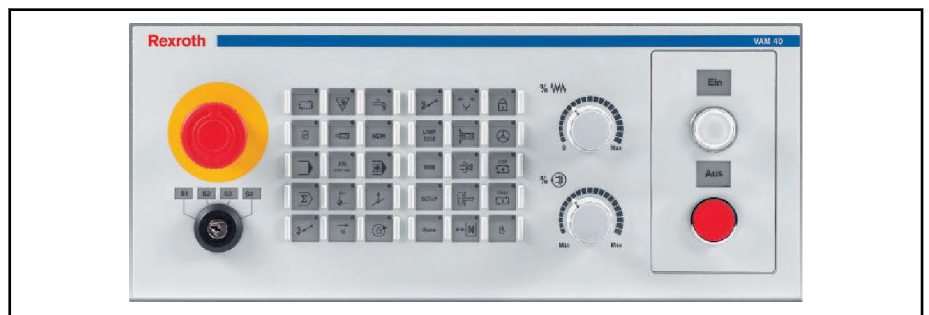


Fig. 9-4: VAM 40 machine operator panel

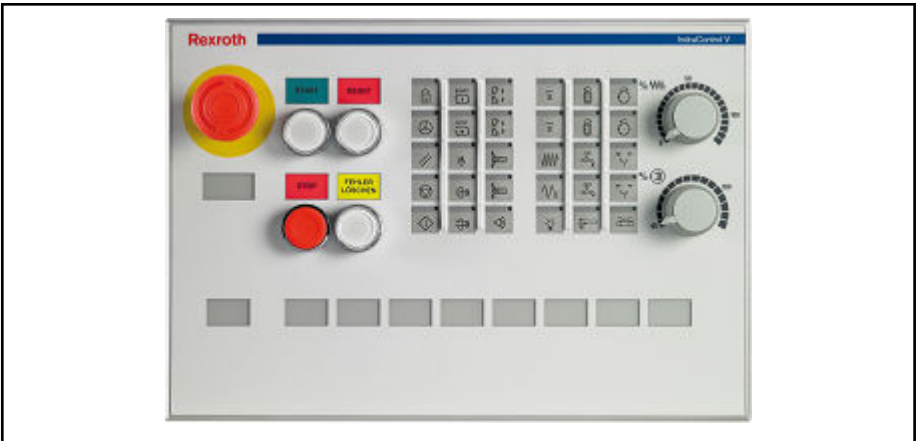


Fig. 9-5: VAM12 machine operator panel



Fig. 9-6: VAM42 machine operator panel

9.2 Variants

9.2.1 Operator panels with PROFIBUS DP interface

The following variants are available:

Type	Note
VAM10.2-PB-NA-TA-TA-VB-1608-NN	Suitable for VxP16
VAM12.1-PB-NF-NN-TB-VD-NN-1608-NN	Suitable for VxP16
VAM40.2-PB-NA-TA-TA-VB-MA-1608-NN	Suitable for VxP40
VAM42.1-PB-NF-NN-TB-VD-NN-1608-NN	Suitable for VxP40

Tab. 9-1: Operator panels with PROFIBUS DP interface

9.2.2 Operator panels with Sercos interface

The following variants are available:

Type	Note
VAM10.3-S3-NF-TA-TA-VD-1616-NN	Suitable for VxP16
VAM15.1-S3-NF-NN-TB-TAVD- NN	Compatible with VDP15.1

Type	Note
VAM21.1-S3-NF-NN-TB-TAVD- NN	Compatible with VDP21.1 portrait (vertical installation)
VAM40.3-S3-NF-TA-TA-VD-MA-1616-NN	Suitable for VxP40

Tab. 9-2: Operator panels with Sercos interface

9.3 Accessories

9.3.1 Connecting cables (PROFIBUS DP interface)

If the communication between the VAM machine operator panels VAM and the control modules L are established via PROFIBUS DP, the following assembled cables are available:

Type	Note
IKB0033/000,0	Connection between VAM and L. Cables assembled at both ends; variable length
IKB0034/000,0	Connection between VAM and other Profibus devices; cable assembled at one end; variable length

Tab. 9-3: PROFIBUS connecting cables

9.3.2 Connecting cables for the Sercos interface

If the communication between the VAM machine operator panels VAM and the control modules L is established via Sercos, the following assembled cables are available:

Type	Note
RKB0011/....	Sercos Ethernet cable; cable assembled at both ends; variable length

Tab. 9-4: Sercos connecting cable

9.4 Documentation

The following documentations describe the VAM machine operator panels:

DOK-SUPPL*-VAM*XX.2***-PRRS-EN-P

DOK-SUPPL*-VAM*XX.1***-PRxx-EN-P

10 Hand-held terminal VH2110

10.1 Brief description

The hand-held terminal VH2110 is a portable operating and visualization terminal with a 10.1" multitouch operator panel in widescreen format. The device is equipped with an EMERGENCY STOP pushbutton, an override switch and a three-step enabling button. In connection with the MTX control system, NC, PLC and drive data can be displayed and influenced. The operating screens are configured using Rexroth WinStudio™. The device is operated at a VAC31.1 connection module. The communication to the control is established via an Ethernet interface.



Fig. 10-1: Hand-held terminal VH2110

10.2 Technical data

Processor	ARM Cortex™-A9
Clock rate	1.0 GHz
CPU cores	2
RAM	512 MB
Flash memory	512 MB
Interfaces	Ethernet: 10/100 Mbit 1x USB 2.0 OTG, externally to connect flash drives, a mouse or a keyboard
Protection class	IP53 IEC 60529, EN 60204-1, GS-ET-22 (2009)
Power supply	24 V DC (SELV, PELV according to DIN EN 61131)

Hand-held terminal VH2110

Input voltage area application	DC 24 V (DC +19.2 V to +30 V according to EN 61131-2)
Current consumption	0.3 A (typically at 24 V)
Mandatory external protection	2 A fuse, inertial
Maximum power consumption	7.2 W (300 mA at 24 V)
Protection class (according to EN 61131-2 or EN 50178)	III
Weight	Approx. 1250 g (without cable)

Tab. 10-1: Technical data VH2110

10.3 Housing and display

Display	10.1", 1280 x 800 WXGA, 262144 colors
Touch	Capacitive multitouch, can be operated with two fingers
Surface of front plate	Glass
Dimensions	Width: 325 mm, height: 185 mm, depth: 59.6 mm
Plastic flame retardance test	UL94-HB
Safety components	A three position enabling button, dual circuit, wired externally EMERGENCY STOP pushbutton, dual circuit, wired externally
Standard operating elements	Override switch 15-positions, gray-coded
Connection	8m connection cable with anti-kink protection

Tab. 10-2: Housing and display VH2110

10.4 Spare parts, accessory parts and wear parts

Order designation	Part number	Description
VAC31.1C-NN	R911171822	Terminal unit with short-circuit plug for hand-held terminals with EMERGENCY STOP pushbutton
VAS01.1-003-NNN-NN	R911173896	Wall-mounting holder (for stationary operation or as resting surface for the hand-held terminal)

Tab. 10-3: Spare parts, accessory parts and wear parts VH2110

10.5 Electric connection of the hand-held terminal

The hand-held terminal VH2110 is connected to the connection module VAC31.1 via an 8m connection cable, equipped with a 17 pin connector. For more information, refer to the "Rexroth VAC 05.1, VAC 30.2, VAC 31.1 connection module" documentation.

10.6 Commissioning

10.6.1 General information

To commission the device, further parameterization or programming is required.

10.6.2 Operating system

For licensing reasons, hand-held terminals are provided with an installed Windows Embedded Compact 7 operating system and a Rexroth WinStudio Lite license. For more information about the operating system, refer to the project planning manual "Rexroth V-Devices Operating Systems".

10.6.3 Software-specific settings

The software of the hand-held terminal is configured via the "Rexroth settings" application. Temporarily call the Rexroth settings upon the start of the device or during operation via the Desktop symbol "RxSettings". Some configuration dialogs are password-protected. The default password is "12345". The user can change the password.

The software settings are described in the project planning manual "Rexroth IndraControl V-devices operating systems".

10.6.4 Project planning

To parameterize and configure a hand-held terminal VH2110, an example project is available in the IndraWorks Engineering project folder in which a VH2110 subproject is integrated. By means of the configuration tool Rexroth WinStudio™, the VH2110 project can be adjusted to customer requirements.

10.7 Variants

The hand-held terminal is available in the following variants, in connection with the MTX control system:

Type	Description
VH2110.01-00-02-N3-111-CA	EMERGENCY STOP, enabling button three-positions, dual circuit Override, connection cable 8m

Tab. 10-4: VH2110 selection

10.8 Documentation

The following documentations are available for electronic connection and configuration of the hand-held terminal VH2110:

- DOK-SUPPL*-VH*21**.01*-ITRS-EN-P - Rexroth IndraControl VH2110.01 Hand-held terminal
- DOK-SUPPL*-VAC*XX.X***-ITRS-EN-P - Rexroth IndraControl VAC 05.1, VAC 30.2, VAC 31.1 Connection modules
- DOK-GENERL-IND*CL*V*SW-PPRS-EN-P - Rexroth IndraControl V-Devices Operating Systems

11 VAK PC keyboards

11.1 General information

Drawer or built-in keyboards with touch panels are available to operate industrial PCs.

11.2 Drawer keyboards

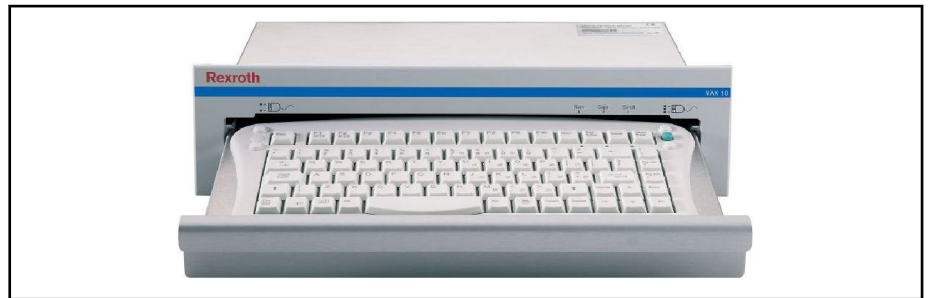


Fig. 11-1: VAK 10.1 drawer keyboard



Fig. 11-2: Drawer keyboard VAK 40.1

The drawer keyboards VAK 10.1 and VAK 40.1 are AT-compatible PS/2 keyboards with 86 keys and an integrated mouse pointer. The two keyboards differ only in the widths of their front panels. Their function and design are optimally adjusted to the operating devices of the VSP, VDP and VPP series. Navigate easily in the graphical user interfaces using the integrated mouse with its mouse buttons. The drawer is provided with slide rails and a ball-type snap lock.

11.3 Built-in keyboards



Fig. 11-3: VAK 11.2 built-in keyboard



Fig. 11-4: Drawer keyboard VAK 41.2

The built-in keyboards VAK 11 and VAK 41 are AT-compatible PS/2 touch panels with 106 keys. The two keyboards differ only in the widths of their front panels. Their functions and design are optimally adjusted to the operating devices of the VSP, VDP and VPP series and are characterized by an especially low installation depth.

11.4 Variants

The following types of keyboards for industrial PCs are available:

Model	Type	Remarks
Drawer keyboards	VAK10.1E-EN-P-MPNN	Compatible with VSP 16, VDP 16, VPP 16
	VAK40.1E-EN-P-MPNN	Compatible with VSP 40, VDP 40, VPP 40
	VAK40.1E-DE-P-MPNN	Compatible with VSP 40, VDP 40, VPP 40
Built-in keyboard (with touch panel)	VAK11.2F-EN-P-NNNN	Compatible with VSP 16, VDP 16, VPP 16
	VAK41.2F-EN-P-NNNN	Compatible with VSP 40, VDP 40, VPP 40

Tab. 11-1: VAK 10/11/40/41 models

11.5 Documentation

The following documentation provides a detailed description of the VAK 11/41 built-in keyboards:

DOK-SUPPL*-VAK*11/41**-PRxx-EN-P

The following documentation provides a detailed description of the VAK 10/40 drawer keyboards:

DOK-SUPPL*-VAK*40.1***-PRxx-EN-P

12 Rexroth inline modules

12.1 Brief description

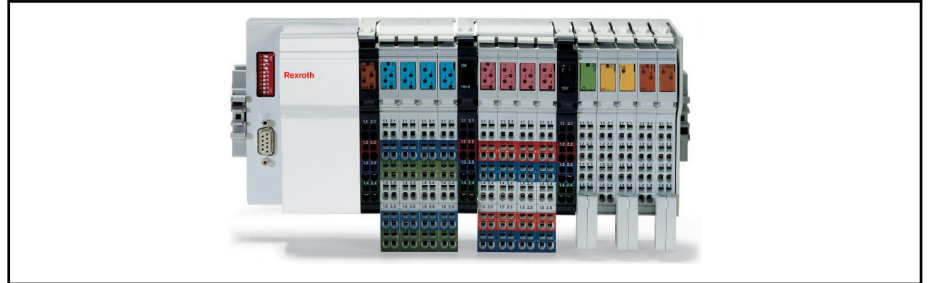


Fig. 12-1: Rexroth inline system

The Rexroth Inline system is a flexible I/O system designed to be mounted on a top hat rail in a switch cabinet. It is a modular system, i.e. it can be adjusted to the particular application. Communication with the master control is established via PROFIBUS-DP or Sercos III.

12.2 Components

The Rexroth Inline system comprises the following components:

- Field bus coupling modules
- Supply modules
- 24 V input modules
- 24 V output modules
- Relay for output modules
- Analog modules
- Counter modules
- Accessories

12.3 Bus coupler

The following variants are available:

Type	Note
R-IL PB BK DP/V1-PAC	Bus coupler with PROFIBUS DP interface
R-IL S3 BK DI8 DO4-PAC	Bus coupler with Sercos interface

Tab. 12-1: Bus coupler

12.4 Accessories

12.4.1 Connecting cables PROFIBUS DP interface

If the bus coupler communicates to the embedded CML control via Profibus DP, the following pre-assembled cables are available:

Type	Note
IKB0033/000,0	Connection between bus coupler and embedded CML control; cables assembled at both ends; variable length
IKB0034/000,0	Connection between VAM and further Profibus devices; cable assembled at one end; variable length

Tab. 12-2: PROFIBUS connecting cables

12.4.2 Connecting cable Sercos interface

If the bus coupler communicates to the embedded CML control via Sercos, the following pre-assembled cable is available:

Type	Note
RKB0011/....	Sercos Ethernet cable; cable assembled at both ends; variable length

Tab. 12-3: Sercos connecting cable

12.5 Documentation

The following documentation provides a detailed description of the Rexroth Inline system:

DOK-CONTRL-ILSYSINS***-AWxx-EN-P

13 Rexroth fieldline modules

13.1 Brief description



Fig. 13-1: Rexroth fieldline module

The input and output modules of the Rexroth fieldline product family are designed for decentralized automation tasks under adverse ambient conditions. These modules comply with degree of protection IP65/IP67. By means of these modules, sensors and actuators can be directly connected in an environment close to the station. Communication with the master control is established via PROFIBUS-DP.

13.2 Components

Three types of Rexroth fieldline modules are available:

Type	Description
RF-FLS PB M12 DI 8 M12	Eight 24 V inputs
RF-FLS PB M12 DIO 4/4 M12-2A	4 inputs 24 V; 4 outputs 24 V/2 A
RF-FLS PB M12 DO 8 M12-2A	8 outputs 24 V/2 A

Tab. 13-1: Module selection

13.3 Documentation

The following documentation provides a detailed description of the Rexroth fieldline system:

DOK-CONTRL-RF-FLS-PB**-PRxx-EN-P

14 Firmware and software for the MTX CNC system

14.1 General information

The CNC system MTX is equipped with scalable firmware and software packages covering many applications and technology functions. The individual products can be selected and enabled optionally.

14.2 Operating system for HMI devices to operate the MTX VEP*. 6/VPB40.4/PR_VR CNC systems

Windows 10 IoT 64 bits is installed on the box PCs VPB40.4/PR_VR. The operating system can be set to English, German, Italian, Spanish, Portuguese and Swedish. The MTX operating devices are provided with or without pre-installed system software.

14.3 Basic software for the MTX CNC system

14.3.1 Data carrier for the MTX CNC system

All PC-based firmware and software packages can be installed via the MTX system data carrier. The data carrier (DVD) is contained in the Rexroth product catalog and can be downloaded or order under the following designation:

SWA-IWORKS-MTX-15VRS-D0-DVD**

The MTX data carrier 15VRS can be used to install the following software packages:

- Engineering (MTX)
- Operation (MTX)
- Workstation (MTX)
- Communication (MTX)
- Efficiency Workbench (MTXewb)
- MTX encrypt
- MTX lock/unlock

The mentioned software packages are subject to license and require an additional software license.

14.3.2 System and hardware requirements to run the IndraWorks software for the CNC system MTX

Classification	Descriptions, requirements	Bosch Rexroth Industrial PC
Default (minimum)	Minimum requirements on simple, small machine tools: • Processor: Intel Core ATOM x5 E3940 (Quad Core) or comparable computational load • RAM: 8 GB RAM • Hard disk: Min. 64 GB SSD	• PR31/VR31
Performance (recommended)	Requirements on standard machine tools and more complex machining centers for a safe and high-performance operation and more requirements on the NC simulation. • Processor: Intel Core i3, Intel Core i5 or comparable computational load • RAM: 8 GB RAM • Hard disk: Min. 64 GB SSD	• PR41/VR41 • PR42/VR42 • VPB 40.4 (i5)
Advanced (optimum)	Requirements on advanced machines and demanding requirements on the NC simulation: • Processor: Intel Core i7 (Quad Core) or comparable computational load • RAM: 16 GB RAM • Hard disk: Min. 128 GB SSD	• PR43/VR43 • VPB40.4 (i7)

Tab. 14-1:

14.3.3 IndraWorks Engineering for the CNC system MTX

The software contains the following functions:

- Engineering software to configure and program CNC systems
 - MTX standard
 - MTX performance
 - MTX advanced
- WinStudio Editor and Runtime incl. Lite license to create USER screens in IndraWorks OPD
- Languages: German (DE) / English (EN) / Chinese (ZH) with license code; more languages upon request

•

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-D0-ENG	R911337570

Tab. 14-2: Software IndraWorks for the CNC system MTX

14.3.4 IndraWorks for the CNC system MTX Operation2 with integrated NC Simulation

Standard interface for CNC operation:

Die software covers the following functions:

- WinStudio Runtime incl. Lite license
- Basic NC Simulation functionality of workpiece and tools (no machine) including representation of tool path, material removal and application as well as collision detection
- Multitouch user interface (16:9 format), single touch (4:3 format)
- Languages: German (DE) / English (EN) / French (FR) / Italian (IT) / Spanish (ES) / Swedish (SV) / Chinese (ZH); more languages upon request



This software is used to operate MTX standard, MTX performance and MTX advanced. A separate PC is necessary to configure the "MTX Engineering" or "MTX Workstation2" software.

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-f2-OPD2	R911396004

Tab. 14-3: Software IndraWorks for the CNC system MTX Operation2

14.3.5 IndraWorks for the CNC system MTX Workstation2 with integrated NC Simulation

Engineering software for project planning and programming of the CNC system MTX.

Die software covers the following functions:

- Standard interface IndraWorks Operation2 for CNC operation
- WinStudio Editor and Runtime incl. Lite license
- Virtual CNC MTX Emulation "control emulation" and virtual control panel
- "VAM Simulation". Basic NC Simulation functionality of workpiece and tools (no machine) including representation of tool path
- Material removal/application and collision detection
- Languages: German (DE) / English (EN) / French (FR) / Italian (IT) / Spanish (ES) / Swedish (SV) / Chinese (ZH); more languages upon request



Die software is used for offline or engineering of MTX standard, MTX performance and MTX advanced.

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-f2-WORKSTATION2	R911396002

Tab. 14-4: Software IndraWorks for the CNC system MTX workstation2

14.3.6 IndraWorks for the CNC system MTX Communication

IndraWorks software packages to use the OPC server interface (OPC DA and DCOM) to communicate with an MTX control.

The software contains the following functions:

- The interface can be used to connect a 3rd party HMI software



The software is used for the MTX standard, MTX performance and MTX advanced with OEM user interface. No Engineering tools are available. A separate PC is necessary to configure the "MTX Engineering" software or "MTX Workstation" software.

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-D0-COM	R911331696

Tab. 14-5: Software IndraWorks for the CNC system MTX Communication

14.3.7 CNC system MTX Efficiency Workbench (ewb) to evaluate runtime data

Software to evaluate data recorded by the action recorder (firmware option: EWB recorder).

MTX Efficiency Workbench is the basic installation for:

- MTX cta cycle time analysis (SWS-MTX***-RUN-NNVRS-D0-CTA*ANALYZER-DGL)
- MTX ega energy requirements analysis (SWS-MTX***-RUN-NNVRS-D0-EGA*ANALYZER-DGL)

MTXewb software installation is freeware

14.3.8 CNC system MTX lock/unlock

The software contains the following functions:

- Locking/unlocking of the CNC system MTX
- Limiting the operating hours



This software is used to lock MTX standard, MTX performance and MTX advanced.

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-D0-UNLOCK	R911345574

Tab. 14-6: Software IndraWorks CNC system MTX lock/unlock

14.3.9 CNC system MTX encrypt

The software contains the following functions:

- Technology protection
- CNC program encryption



The software is used to encrypt MTX standard, MTX performance and MTX advanced

Ordering code

Type	Part number
SWL-IWORKS-MTX-NNVRS-D0-ENCRYPT	R911339214

Tab. 14-7: Software CNC-System MTX encrypt

14.4 Basic firmware for the CNC system MTX

14.4.1 General information

A firmware version is available for all MTX XM42. Different options are enabled, depending on the purchased hardware.

14.4.2 Firmware for the CNC system MTX XM42 standard

The firmware for the CNC system MTX standard contains the following functions:

- CNC runtime module for the following technologies: drilling, turning, milling and sanding
- License to control max. 12 axes/spindles and two CNC channels
- Interpolation groups up to four axes (optionally extendable)
- Runtime module for the integrated PLC IndraLogic

14.4.3 Firmware for the CNC system MTX XM42 performance

The firmware for the CNC system MTX performance contains the following functions:

- CNC runtime module for the following technologies: drilling, turning, milling and sanding
- License to control max. eight axes/spindles and two CNC channels (extension optional)
- Can be optionally extended to up to max. 64 axes and 12 CNC channels
- Interpolation groups up to four axes (optionally extendable)
- Runtime module for the integrated PLC IndraLogic

14.4.4 Firmware for the CNC system MTX XM42 advanced

The firmware for the CNC system MTX advanced contains the following functions:

- CNC runtime module for the following technologies: drilling, turning, milling and sanding
- License to control max. eight axes/spindles and two CNC channels (extension optional)
- Can be optionally extended to up to max. 250 axes and 60 CNC channels

- Interpolation groups up to four axes (optionally extendable)
- Runtime module for the integrated PLC IndraLogic

14.5 CNC system MTX SWW software

This software is provided as a separate product for the customer and is installed on-site.

The software

- contains several CNC function extensions
- supports interpolation groups of up to eight axes to control the path



This software is subject to export approval according to part 1 C of the export list. (EC spec.).

Ordering code

Type	Part number
SWW-IWORKS-MTX-15VRS-D0-CD650	R911395520

Tab. 14-8: Firmware option Axis extension by eight servo axes and two channels

14.6 CNC system MTX firmware options

14.6.1 8 servo axes - 2 channels and 8 axes with the control systems MTX performance and MTX advanced

The firmware option can be purchased additionally and contains the following functions:

- A license to use eight additional axes (servo axes or spindles) and two NC channels
- Multiple selection is possible



The control system MTX performance can be extended to 64 axes and 12 channels max.

The control system MTX advanced can be extended to a maximum of 250 axes and 60 channels.

Ordering code

Type	Part number
FWS-MTX-08A02C***-NNVRS-NN-NNN	R911396012

Tab. 14-9: Firmware option Axis extension by eight servo axes and two channels

14.6.2 4 servo axes with the MTX standard control system

The firmware option can be purchased additionally and contains the following function:

- A license to use four additional axes (servo axes or spindles)



The control system MTX standard can be extended to 12 axes (extension by 4 axes)

Ordering code

Type	Part number
FWS-MTX-04A00C***-NNVRS-NN-NNN	R911396014

*Tab. 14-10: Firmware option Axis extension by four axes***14.6.3 Technology package, turning level 1.1**

The firmware option can be purchased additionally and contains the following functions:

- Position-synchronous spindle operation
- Feed programming with G95 (feed per revolution)
- Programming of constant cutting velocity with G96
- Cylinder jacket transformation
- Face transformation
- Path programming with G6 (spline programming, spline interpolation, NURBS)

Ordering code

Type	Part number
FWS-MTX-TUR1.1***-NNVRS-NN-NNN	R911396018

*Tab. 14-11: Firmware option Technology package, turning level 1.1***14.6.4 Machining center, level 1.1**

The firmware option can be purchased additionally and contains the following functions:

- Position-synchronous spindle operation
- Command coupling of Gantry axes
- Placements (machining of angular areas)
- Path programming with G6 (spline programming, spline interpolation, NURBS)

Ordering code

Type	Part number
FWS-MTX-BAZ1.1***-NNVRS-NN-NNN	R911396016

*Tab. 14-12: Firmware option Technology package, machining center level 1.1***14.6.5 Machining center, level 2.1**

The firmware option can be purchased additionally and contains all functions of technology package 1.

Additionally, the following functions are implemented:

- See "Technology package Milling 1"
- 5/6 axis transformation with TCP programming
- Jogging with active transformation
- 3D milling cutter radius correction

Ordering code

Type	Part number
FWS-MTX-BAZ2.1***-NNVRS-NN-NNN	R911396017

Tab. 14-13: Firmware option Technology package, machining center level 2.1

14.6.6 Technology package Producing gear/electronic gears

System axis coupling for electronic gears with the properties:

- Linear and non-linear coupling (tables) between master and slave axes
- Up to 3 master axes can be superimposed
- Cascading couplings up to three levels is possible
- Coupling or decoupling on-the-fly or changing the coupling conditions
- Control via system data irrespective of the operation mode



The restrictions regarding axis number, interpolation groups and channel number apply in accordance with the system characteristics selected.



If the software option "Interpolation group for more than 4 axes" (see [chapter 14.5 "CNC system MTX SWW software" on page 70](#)) is use, interpolation groups can be extended to up to eight axes per channel.

Ordering code

Type	Part number
FWS-MTX-GEAR*****-NNVRS-NN-NNN	R911396019

Tab. 14-14: Firmware option technology package gear/electronic gears

14.6.7 Action recorder ACR

The firmware option can be purchased additionally and is used to record an archive operating actions and control-internal events.

The following events can be logged:

- Change of zero point offsets
- Selection of NC programs
- Occurrence of drive errors
- Occurrence of general error messages



With the action recorder ACR option, a maximum of 64 axes and 12 CNC channels can be monitored.

Ordering code

Type	Part number
FWS-MTX-ACR*****-NNVRS-NN-NNN	R911396022

Tab. 14-15: Firmware option MTX action recorder ACR

14.6.8 Technology package Contour cutting 2

The firmware option shape cutting 2 can be purchased additionally and contains the following functions:

- Retracing on programmed contour after interruption of machining program
- Gantry axes with command value coupling
- Cylinder jacket transformation
- MTX fast actions
- Laser/torch distance control with auto tuning for 2D cutting
- Dynamic and collision free positioning with leap frog
- Laser power control
- High speed cutting of matrix patterns with fly-cut
- Kerf compensation
- Standard project template for shape cutting applications

Ordering code

Type	Part number
FWS-MTX-SHC2****-NNVRS-NN-NNN	R911396571

Tab. 14-16: Firmware option Technology package Contour cutting 2

14.6.9 Technology package Fast actions

The firmware option fast actions (FA) can be purchased additionally and contains the following functions:

- Configuring fast actions in PLC and CNC
- Programming in Sercos-synchronous PLC task

Ordering code

Type	Part number
FWS-MTX-FA*****-NNVRS-NN-NNN	R911396023

Tab. 14-17: Firmware option technology package fast actions

14.6.10 MTX ewb recorder for MTX cta and MTX ega

The firmware option ewb recorder (Efficiency Workbench) can be purchased additionally and contains the following functions:

- Recording runtime data of the MTX control
- The recorded data are the basis for the cycle time or energy requirement analysis (MTX cta or MTX ega)

Ordering code

Type	Part number
FWS-MTX-EWBREC***-NNVRS-NN-NNN	R911396024

Tab. 14-18: Firmware option MTX ewb recorder for MTX cta and MTX ega

14.6.11 Technology package Volumetric error compensation VCP3A

The firmware option volumetric error compensation can be purchased additionally:

- For Cartesian machines with three axes
- Workspace up to 10m³
- An external service provider has to measure the compensation values. This service is not part of the technology package!

Prerequisite: MTX performance or MTX advanced with option > 4-axis interpolation



Product subject to export approval according to part I C of the export list. (EC spec.) position 2D202.

Ordering code

Type	Part number
FWS-MTX-VCP3A****-NNVRS-NN-NNN	R911396025

Tab. 14-19: Firmware option technology package Volumetric error compensation VCP3A

14.6.12 Technology package Volumetric error compensation VCP3A>

The firmware option volumetric error compensation can be purchased additionally:

- For Cartesian machines with three axes
- Workspace > 10m³
- An external service provider has to measure the compensation values. This service is not part of the technology package!

Prerequisite: MTX performance or MTX advanced with option > 4-axis interpolation



Product subject to export approval according to part I C of the export list. (EC spec.) position 2D202.

Ordering code

Type	Part number
FWS-MTX-VCP3A>***-NNVRS-NN-NNN	R911396026

Tab. 14-20: Firmware option technology package Volumetric error compensation VCP3A>

14.7 CNC system MTX software options

14.7.1 Cycle time analysis MTX cta (dongle)

Evaluation software with tabular and graphic representation of the recorded data for cycle time analysis of up to 64 axes in up to 12 CNC channels



To use the cycle time analysis function, install the Efficiency Workbench stored on the MTX data system carrier

Ordering code

Type	Part number
SWS-MTX***-RUN-NNVRS-D0-CTA*ANALYZER-DGL	R911328219

*Tab. 14-21: Software cycle time analysis MTX cta (dongle)***14.7.2 Energy Analysis MTX ega (dongle)**

Evaluation software with tabular and graphic representation of the recorded energy data for analysis of up to 64 axes in up to 12 CNC channels



To use the energy analysis function, install the Efficiency Workbench stored on the MTX data system carrier

Ordering code

Type	Part number
SWS-MTX***-RUN-NNVRS-D0-EGA*ANALYZER-DGL	R911331702

*Tab. 14-22: Software Energy Analysis MTX ega (dongle)***14.7.3 Virtual Machine Simulation**

The software package Virtual Machine Simulation is used for 3D simulation and visualization of machine tools within IndraWorks Operation.

The software includes the following functions:

- Tool path representation
- Material removal/application
- Collision detection

Ordering code

Type	Part number
SWS-MTX***-RUN-NNVRS-D0-VMS	R911374010

*Tab. 14-23: Software Virtual Machine Simulation***14.7.4 Virtual Machine Builder**

The Virtual Machine Builder is a standalone software to create machine models for the 3D machine simulation

The software includes the following functions:

- Design and modification of kinematics for the Virtual Machine Simulation of the MTX
- Definition of kinematic relations
- Import and modification of 3D geometry data (format: STL)
- Definition of collision relations



To use the Virtual Machine Builder, download the software from the [Product catalog](#).

Ordering code

Type	Part number
SWS-MTX***-ENG-01VRS-D0-VMB-DGL	R911394064

Tab. 14-24: Software Virtual Machine Builder

15 Use case CNC system MTX

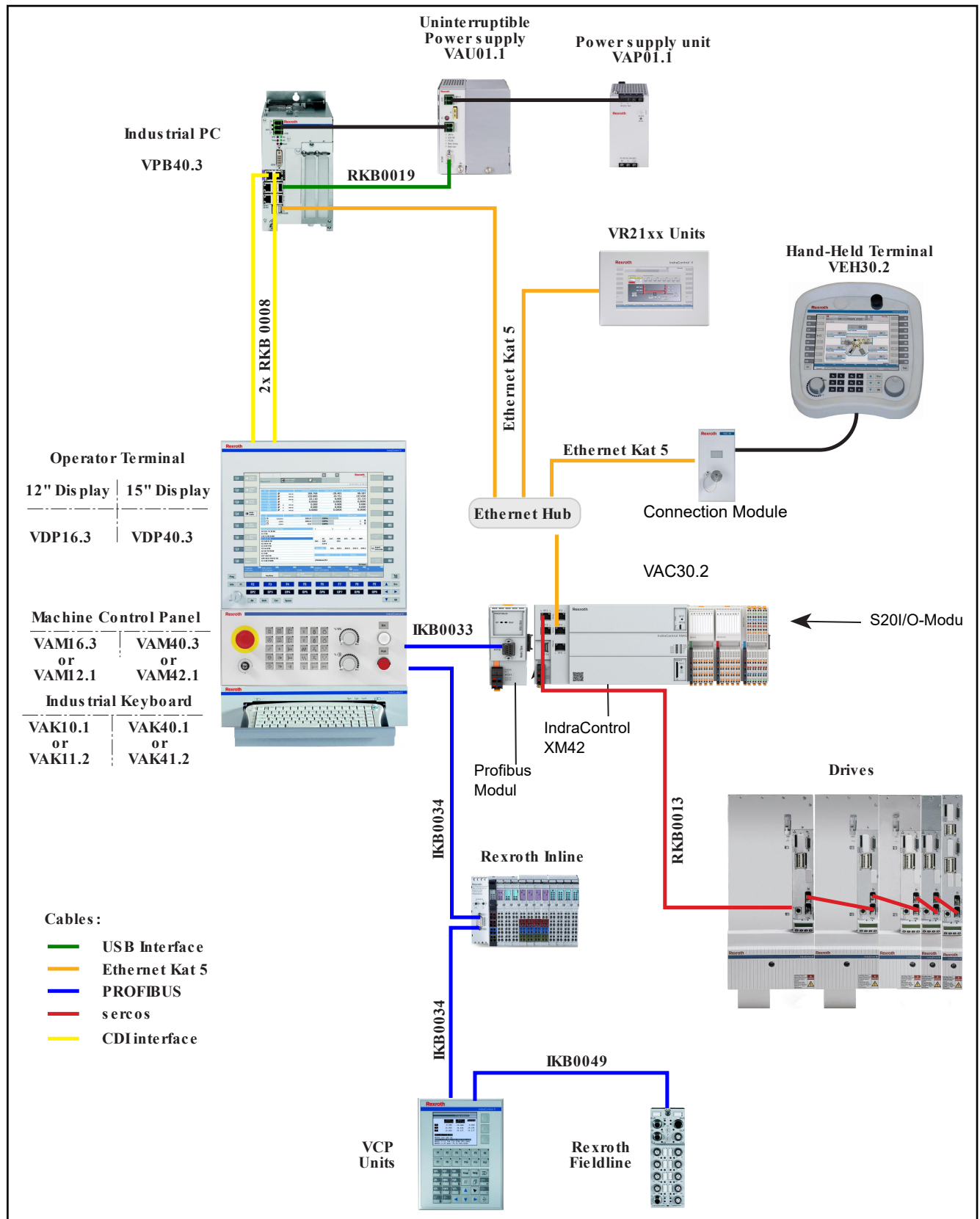


Fig. 15-1: Use case CNC system MTX

Use case CNC system MTX

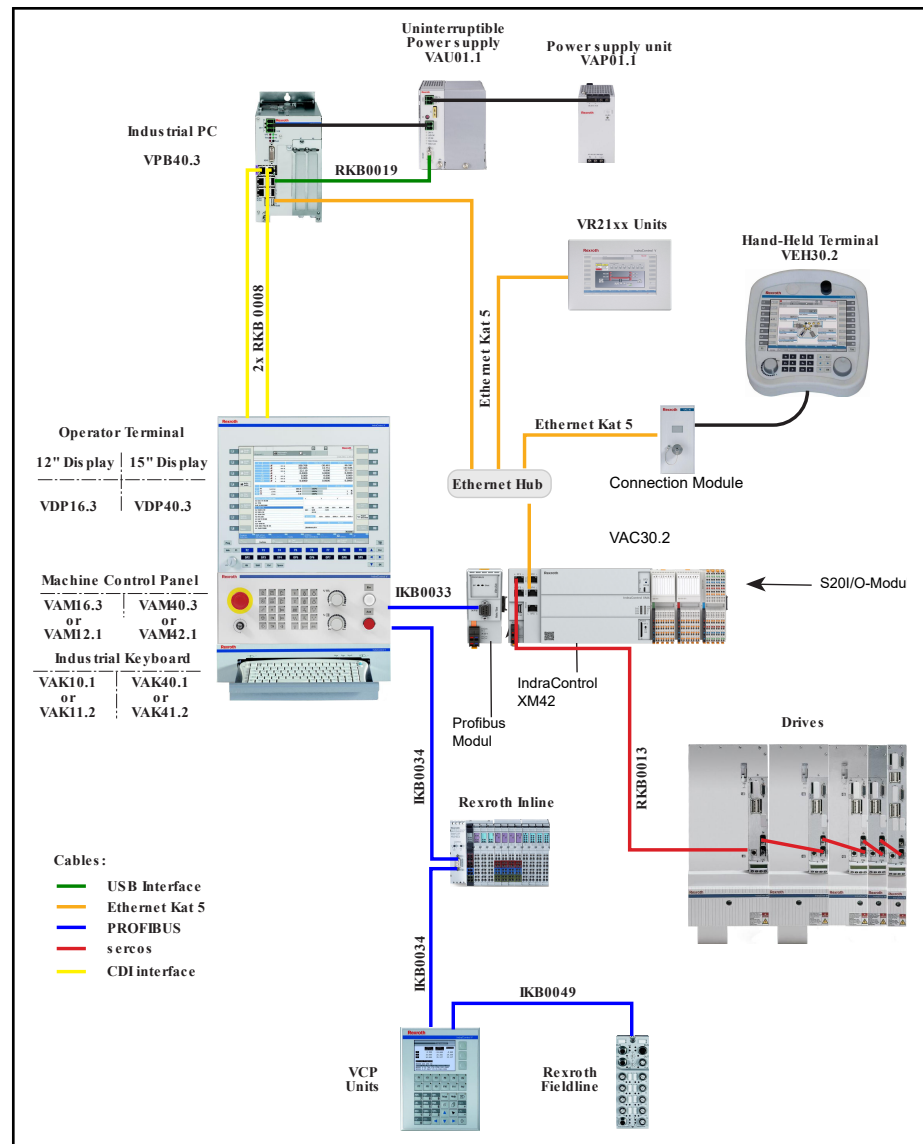


Fig. 15-2:

16 Sercos installation instruction

16.1 Scope

In premises and industrial systems, the cable infrastructure of the information technology is comparable with building automation, e.g. heating, lighting and supply network. As with other operating resources, interruptions in services can have serious consequences. Poor quality of services due to inadequate planning, use of unsuitable components, incorrect installation, poor administration or inadequate support can threaten the effectiveness of an organization.

There are four phases for successful installation of the wiring in information technology in industrial systems.

The four phases:

1. **Design** - selecting the wiring components and configuration
2. **Specification** - the detailed requirements for the wiring, its placement and the connected building automation. The specific ambient conditions and quality assurance requirements to be applied are taken into account here
3. **Implementation** - the physical installation in accordance with the specification requirements
4. **Operation** - the management of the connectivity and maintenance of the transmission capacity over the service life of the wiring

16.2 Installation planning

16.2.1 General information

The connections between the network of an automation island network and the general connections can be established using a suitable converter/adaptor. The connections between automation islands, on the other hand, can be established via one or multiple field bus-field bus connections and suitable converters/ adaptors or via general wiring (see [fig. 16-1 "Automation island consisting of a Sercos network" on page 80](#)).

Converters/adapters (e.g. routers, jumpers and gateways) should be used in general to ensure a physical conversion and protocol transformation between different field buses as defined in the relevant installation.

Automation islands based on Sercos can consist of one or multiple Sercos networks. The following figure shows an automation island (AI) consisting of a Sercos network with a network interface an optional field bus interface (FI).

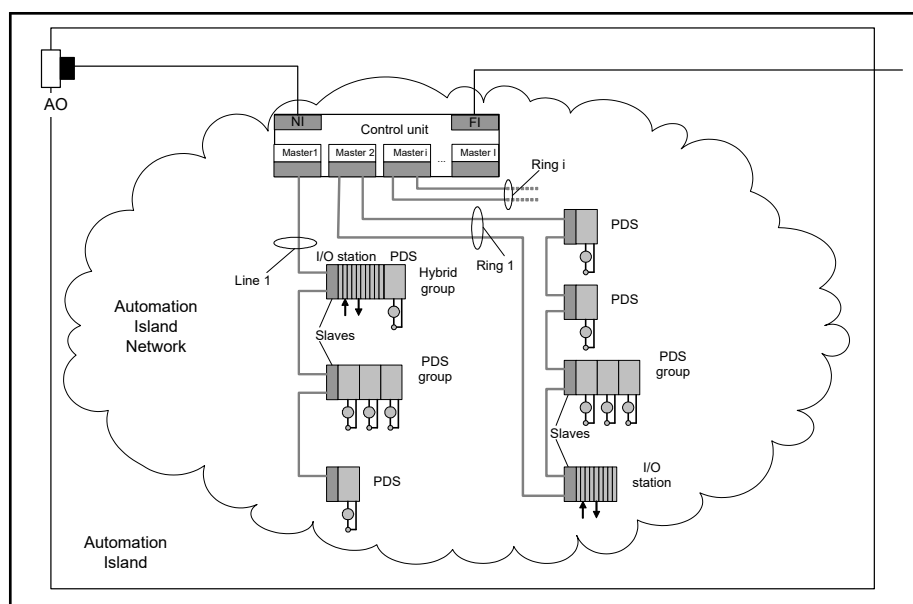


Fig. 16-1: Automation island consisting of a Sercos network



- **AO (Automation Outlet):** Fixed connection hardware where the AI network ends and which supplies the interface with which an industrial communication device is connected to the installed wiring
- **AI (Automation Island):** Combination of all systems which control, monitor and protect the process of a system
- **NI (Network Interface):** The interface between the wiring for fixing the device and the device network
- **FI (Field bus Interface):** The interface for connecting field bus devices
- **PDS:** Power drive system

16.2.2 Wiring channel

The channel is the transmission distance between active device interfaces. A typical channel consists of the wiring subsystem between the devices, as well as the lines for fixing the device and the lines for the system. For transmission over longer distances, the channel can be established by connecting two or more subsystems (once again with lines for fixing the device and the lines for the system). It is important to ensure that the generic wiring channel was designed to fulfill the required performance class for the applications to be supported. The channel does not include the relevant matching connection on the active device (see following figure).

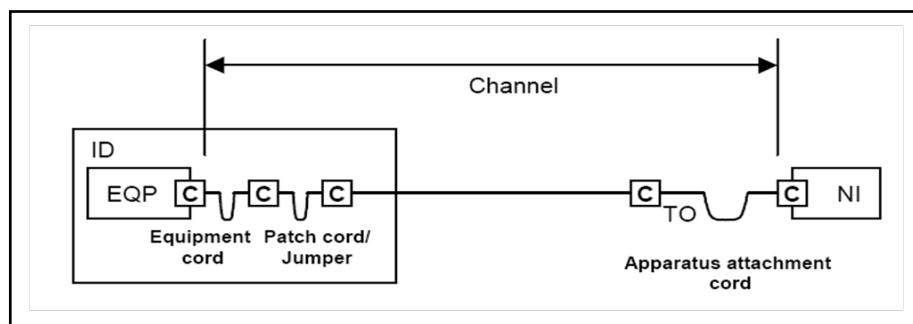


Fig. 16-2: Transmission capacity of a channel



- **EQP:** Equipment
- **TO:** Telecommunication output
- **NI:** Network interface: A fixed connection device where the intermediate cable ends and which provides the wiring interface for fixing the device
- **ID:** Intermediate distributor: is used to establish connections between the intermediate cable, other wiring subsystems and the active device

16.2.3 Network properties for symmetrical wiring based on Ethernet

Signal transmission via a symmetrical cable reduces the impact of interference or disturbances due to external electrical stray fields. The symmetrical cable has the same impedance to ground, so that stray fields or currents generate the same voltage in both cores. The symmetrical cables reduce the level of interference over the distance.

As the receiver only reacts to the difference between the cores, it is not influenced by the induced interference voltage. This is because the electromagnetic interference has the same impact on both signals. Similarities between the two signals are removed automatically at the end of the transmission path when one signal is subtracted from the other.

For symmetrical cables, the planner must use the basic network properties in accordance with the following table:

Sercos network properties	Data
Supported data rates	100 MBit/s
Supported cable length (maximum cable length)	100 m
Length of the connector cable	100 m (AWG 22)
Number of cores in the cable	4 (minimum) 8 (maximum)
Number of connections in a wiring channel	4
Cable class according to ISO/IEC 24702	D
Cable category according to ISO/IEC 24702	CAT 5 ¹⁾
Cable category according to ANSI/EIA/TIA	CAT 5e ¹⁾
Cable shielding • Screened unshielded twisted pair (twisted pair cable without pair shielding and a wire mesh overall shield) • Screened shielded twisted pair (twisted pair cable with wire mesh pair shielding and a wire mesh overall shield) • Screened foiled • Screened foiled twisted pair (twisted pair cable with foil pair shielding and a wire mesh overall shield) • Screened foiled twisted quad pair (twisted quad-pair cable with star quad shielding and a wire mesh overall shield)	S/UTP S/STP S/FTP S/FTQ

¹⁾ CAT 5 of ISO/IEC corresponds to CAT5e of ANSI

Tab. 16-1: Sercos network properties for symmetrical cables

The following image shows examples of shielding for S/FTP and S/FTQ cables.

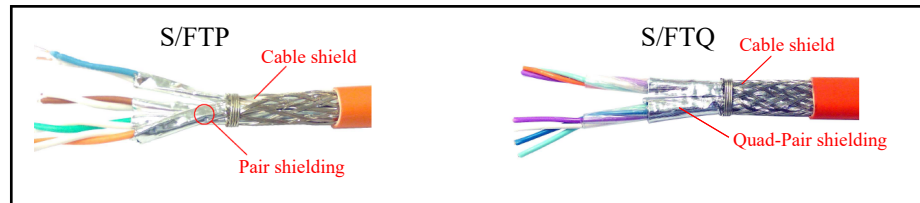


Fig. 16-3: Examples of a cable shield and pair shielding

16.2.4 Selecting and using wiring components

Cable selection

General description

The production engineer must ensure that the cables offer the necessary transmission capacity in the specified environment. Industrial cables can be subjected to extreme mechanical stress.

In these cases, the cables must be selected in accordance with the requirements of the intended application. The instructions of the relevant manufacturer must be complied with.

The production engineer may decide to use part of an existing generic wiring system for connecting automation island networks. In this case, the production engineer is responsible for ensuring that the wiring system meets the requirements for the application.

The production engineer must ensure that a system is in place to maintain the channel power over the service life of the wiring.

The production engineer must ensure that the cables to be installed are compatible and meet the following requirements:

- local regulations
- protection from lightning
- resistance against damage caused by rodents
- chemical resistance
- temperature range and humidity
- oscillations, bending and sag
- electrical interferences

If the place of use of the devices calls for special cables or connection elements, which are not covered by the requirements of this specification, the production engineer must contact Bosch Rexroth for the information required to determine which special wiring components are required.

Symmetric cables for Sercos

Symmetrical cables for Sercos must fulfill the requirements of [tab. 16-1 "Sercos network properties for symmetrical cables"](#) on page 81 and [tab. 16-2 "Parameters of the mechanical force for symmetrical cables"](#) on page 82.

Mechanic forces

Properties of mechanical force	Data ¹⁾
Minimum bending radius, single bending	20 – 65 mm
Bending radius, multiple bending	50 – 100 mm
Tensile forces	≤ 150 N

Properties of mechanical force	Data ¹⁾
Permanent tensile forces	≤ 50 N
Temperature range during installation	- 20 to + 60 °C

1) Depending on the cable type; see data sheet of the manufacturer

Tab. 16-2: Parameters of the mechanical force for symmetrical cables

Then production engineer must use the cables which are listed in the following table for Sercos and Bosch Rexroth are available

Type designation code	Part no.	Connector	Length	Comments
RKB0011/005,0	R911321548	RJ45-RJ45, IP20-IP20	5 m	Standard cable with RJ-45, fixed length
RKB0011/x,x	R911316888	RJ45-RJ45, IP20-IP20	0.5 to 100 m	Standard cable with RJ-45, optional length
RKB0013/00,25	R911317797	RJ45-RJ45, IP20-IP20	0.25 m	Standard cable, slave-slave, fixed length
RKB0013/00,35	R911317800	RJ45-RJ45, IP20-IP20	0.35 m	Standard cable, slave-slave, fixed length
RKB0013/00,55	R911317801	RJ45-RJ45, IP20-IP20	0.55 m	Standard cable, slave-slave, fixed length
RKB0043/x,x	R911172134	M12-M12, IP67-IP67	0.1 bis 100 m	Standard cable with M12, optional length
RKB0044/x,x	R911172135	RJ45-M12, IP20-IP67	0.1 bis 100 m	Adapter cable with RJ-45 and M12, optional length

Tab. 16-3: Sercos cable by Bosch Rexroth

Connections within a wiring channel

General description

Channel:	The end-to-end transmission path between two points where application-specific devices are connected
Link:	A transmission path between two points

The maximum channel lengths for wiring material to support Sercos must not be exceeded. The quality of the connection, however, depends on the length of the channel and the number of connections it contains.

The number of connections in the channel increases the noise level within the channel.

The production engineer must ensure that the impact of the number of connections within the channel is taken into account as outlined in this sub-item. The number of connections in the channel is limited to 4. If the planning requires more than 4 connections, an additional analysis may be required and channel power measurements must be carried out to ensure that the channel fulfills the requirements of the application.

The use of end-to-end links without couplings is common practice in industrial applications. End-to-end links only have two connection points (see [fig. 16-4 "Channel without coupling" on page 84](#)).

End-to-end links without couplings are used to

- reduce the costs for wiring

Sercos installation instruction

Symmetrical wiring connections
for Sercos

- to increase availability (as connections are potential error points)
- to reduce damping

fig. 16-4 "Channel without coupling" on page 84 and fig. 16-5 "Channel with coupling" on page 84 apply to the symmetrical wiring of machines or in the production area.

The following figure shows a channel without coupling with a length of 100 m and connectors installed directly on both ends of the cable.

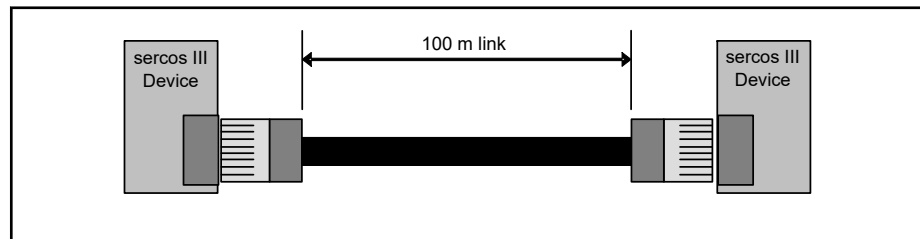


Fig. 16-4: Channel without coupling

The following figure shows a channel with a length of 100 m, which includes an intermediate plug-in connection achieved with a coupling. The number of connections in a link is limited to 4.

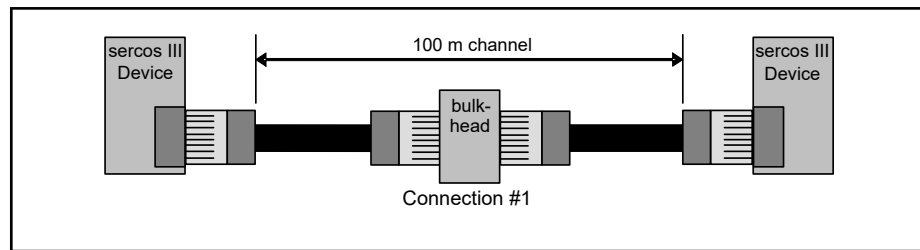


Fig. 16-5: Channel with coupling

16.3 Installing Sercos

16.3.1 General requirements

The production engineer has to create the planning documentation for the wiring. The installation must be carried out in accordance with the planning documentation for the wiring. The installation engineer must agree upon any deviations from the installation specification in advance with the production engineer. All agreed deviations must be noted in the planning documentation for the wiring. The installation personnel (referred to as "the installation engineer") must be familiar with the installation requirements for Sercos.

16.3.2 Cable installation

Storage and installation

The wiring components must be transported, stored and installed in accordance with the guidelines of the manufacturer.

Protecting communication cables from possible mechanical damage

Communication cables must not be subjected to mechanical stress which exceeds the specifications of the manufacturer. Cable ducts specified by the production engineer must be installed so that the cables are protected from damage and that the specifications of the supplier with regard to bending radius, tensile strength, crush strength and temperature range are complied with during installation.

The instructions of the cable supplier must be consulted to confirm that the selected cable duct is compatible with the cable to be installed.

Cable ducts must be specified and installed by the production engineer to rule out the risk of damage due to sharp edges or corners. Edge protection should be used as shown in the following figure. If necessary, cable ducts should provide protection from water or other contaminated liquids.

Cable ducts should always be clean and free from obstructions; all separators and jumpers should be in place prior to installing the wiring. Access points must not be blocked.

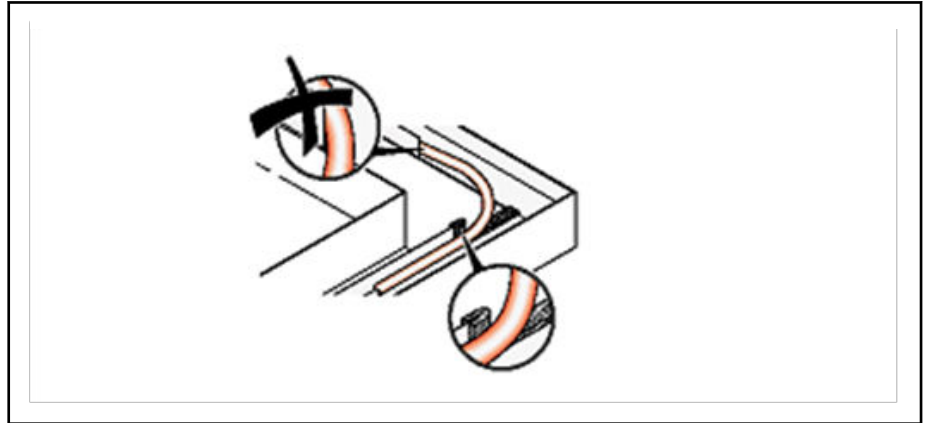


Fig. 16-6: Using edge protection

If the cable is to be installed in shared cable ducts, the installation engineer must take measures to prevent damage to the new and existing cables and structures.

Redundant cables must always be routed in separate cable ducts to prevent mutual damage caused by the same event occurring.

Avoiding the laying of loops

When pulling cables into cable ducts, a suitable method must be used for guiding the cable coil to prevent damage caused by twisting and loops forming (see following figure).

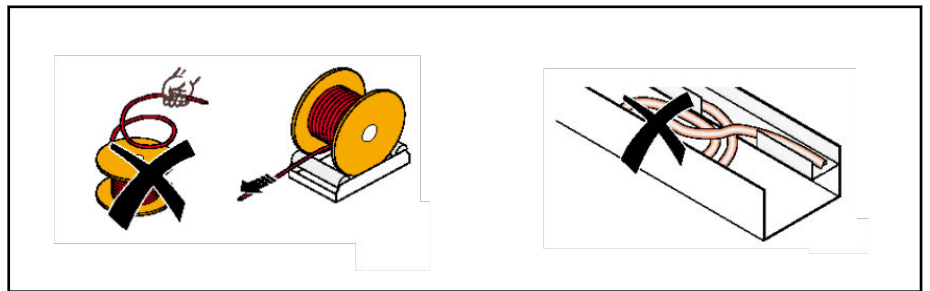


Fig. 16-7: Use an unwinding device and avoid loop formation

Twisting

Torsional stress can cause individual cable components to move, which could have a negative impact on the electrical properties of the cable. Communication cables must therefore not be twisted (as shown in the following figure), except in the case of cables which are specially designed to cope with torsional stress (e.g. in robot applications).

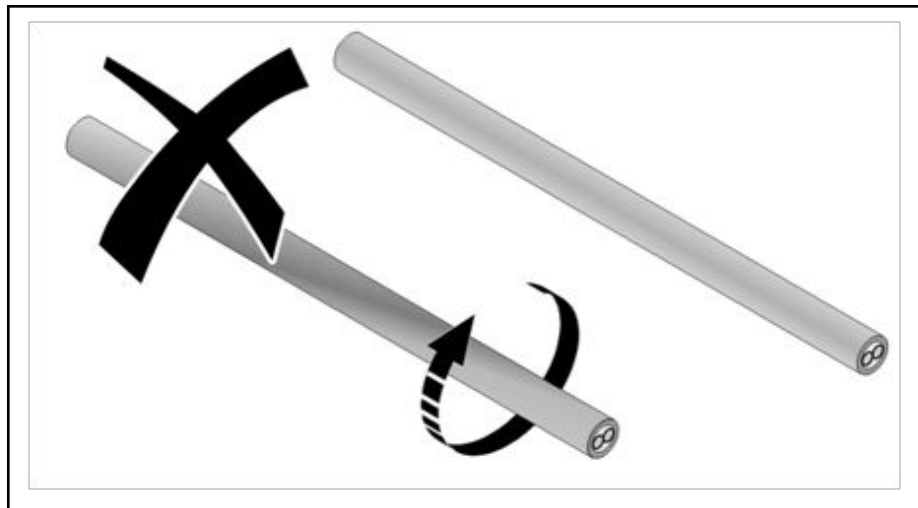


Fig. 16-8: Avoid twisting

Tensile strength (for installed cables)

When installing additional cables in cable ducts, the installation engineer must use installation methods which ensure that the tensile load limits of the installed cables are not exceeded. Mechanical forces of cables are specified in [tab. 16-2 "Parameters of the mechanical force for symmetrical cables" on page 82](#).

Bending radius

The minimum bending radius of a cable corresponds to the information in [tab. 16-2 "Parameters of the mechanical force for symmetrical cables" on page 82](#), in compliance with the data sheet of the manufacturer. The bending radius must not fall below the specification at any time.



Failure to comply with this requirement could result in a permanent reduction in the electrical capacity of the cable.



The following applies for the bending radius of a cable:

- If the cable is subjected to a tensile load, the bending radius is larger than in the installed idle state
- When bending flattened cables, the bending radius only applies for the flat side. Bending over the rounded side requires much larger radii

It is recommended to secure cables with cable clamps if they are installed at a right-angle and to use appropriate strain relief as shown in the following figure.



Do not tighten the clamps too tightly. The cable clamps may crush the cable.

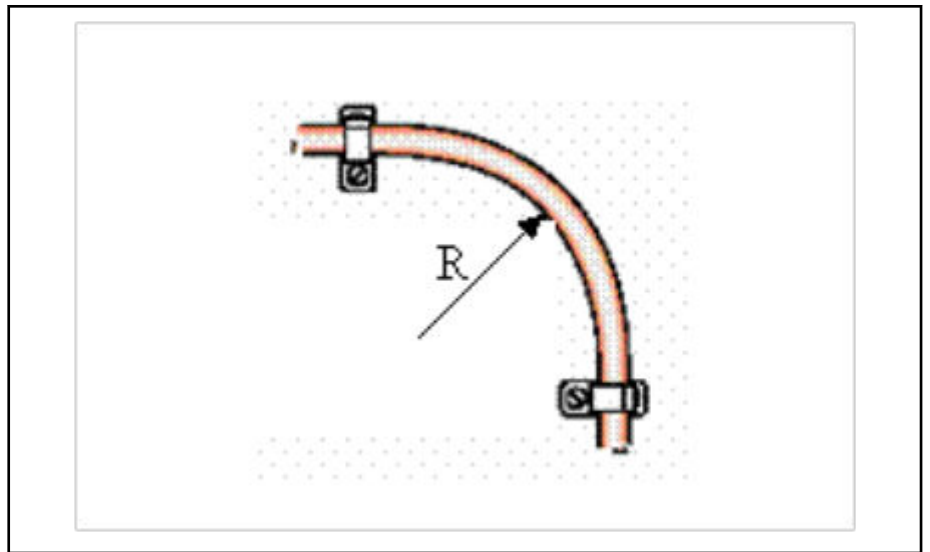


Fig. 16-9: *Complying with the minimum bending radius*

Tensile force

The permissible tensile force of a cable corresponds to the information in [tab. 16-2 "Parameters of the mechanical force for symmetrical cables"](#) on [page 82](#), in compliance with the data sheet of the manufacturer. The tensile force acting on the cable must not exceed the maximum tensile strength of the cable during handling (e.g. re-winding) or installation. Cables must not be pulled on the individual cores or optical fibers, as shown in the following figure.

Fix a handle on the end of the cable to be pulled. This helps to reduce the load on the cable while pulling the cable into the cable ducts. Wire coils should be used to reduce the load acting on the cable while it is being pulled into the cable duct.

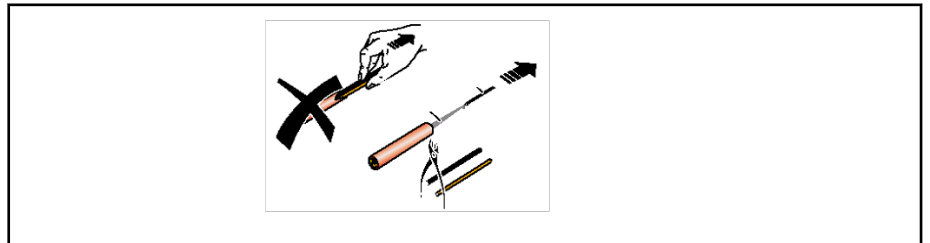


Fig. 16-10: *Do not tear at individual cores*

Fixing the strain relief

A strain relief device must be fixed at a distance of around 1 m from the connection point of all cables subjected to tensile forces (see following figure).



Cable clamps mounted on the casing shields are not adequate to serve as strain relief.

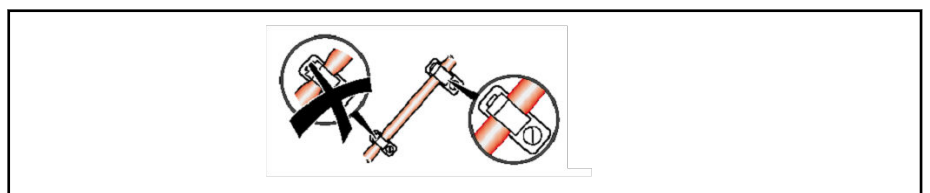


Fig. 16-11: *Use cable clamps with a large (wide) surface*

- For cables which are suspended from the ceiling in suspended applications, suitable strain relief must be in place
- Cable clamps must be used to secure cables in the correct place in control cabinets
- Cables must be secured with textile-velcro straps or plastic fixing elements with a large surface to prevent the cables from being deformed



Make sure not to tighten the clamps too tightly (e.g. when using electric tools).

Separating the electric circuits

Communication cables should be installed in a separate cable duct away from other electric circuits to reduce the effects of electromagnetic interference (EMI) on the communication cables. In shared cable ducts, communication cables must be isolated from other electric circuits using metal barriers (see [fig. 16-12 "Separate cable ducts" on page 88](#)).



Separation provides the following advantages:

- Improved electromagnetic compatibility (EMC)
- Existing cables are protected from damage caused by routing additional cables in the cable duct
- Easier localization if troubleshooting is required

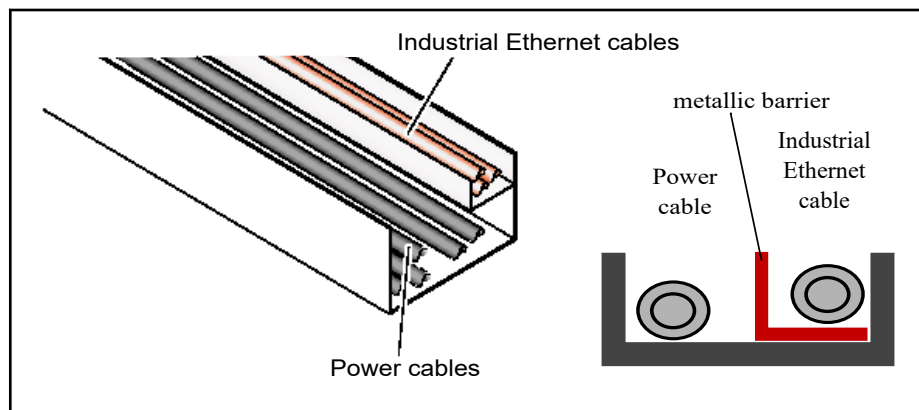


Fig. 16-12: Separate cable ducts

The risk of interference (cross-talk) is generally lower as the distance between the cables gets larger and the cable ducts where the cables run parallel are kept as short as possible. If cables from different categories have to cross each other, they should cross at a right-angle (see following figure).

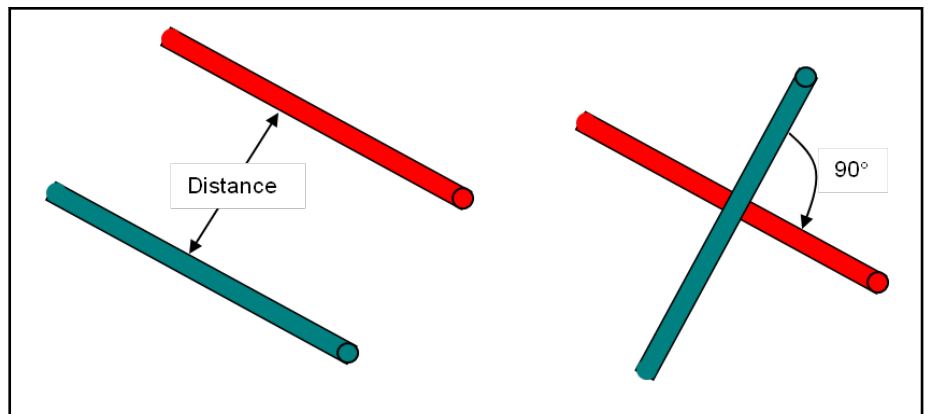


Fig. 16-13: Methods for routing

The minimum distances between power cables and Sercos cables are shown in the following tables.

Power cable (interference sources of this strength)	Distance for routing without metal isolation	Distance for routing with metal isolation
AC electrical power supply lines with more than 100 kVA Power connections (conductors) from drive amplifiers to the motors	0.6 m	0.3 m
AC electrical power supply lines with 20 A or more, but only up to 100 kVA	0.3 m	0.15 m
Conductors with less than 20 A Low-voltage DC electrical power supply lines	0.15 m	0.08 m

Tab. 16-4: Distance from interference sources

Electric lighting and electricity (voltage level)	Minimum distance
0-100 V	0.08 m
101-200 V	0.10 m
201-300 V	0.13 m
301-400 V	0.15 m

Tab. 16-5: Distance from high-voltage conductors

Installing cables in cabinets and housings

Cable glands with bend protection or other suitable methods must be used to prevent damage to cables caused by failure to comply with the minimum bending radius of the cable (see following figure).

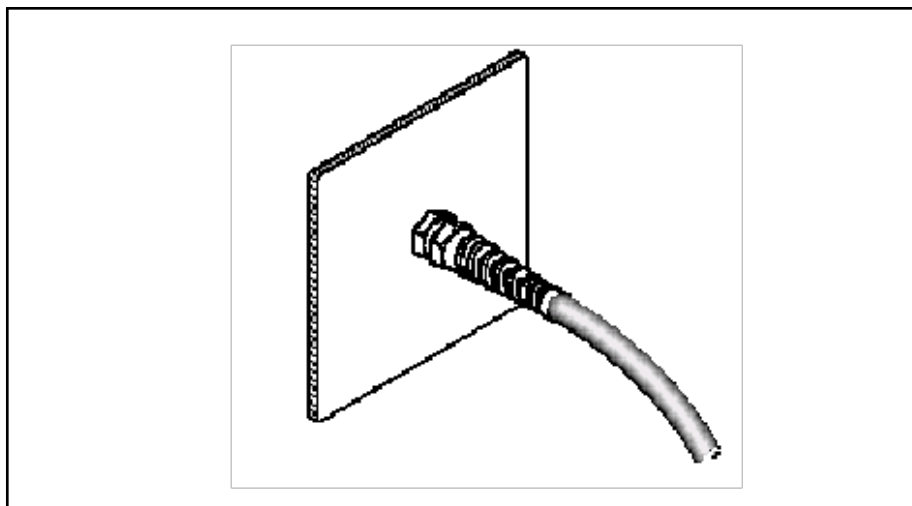


Fig. 16-14: Cable gland with bend protection

Installation on moving parts

If cables are installed on or between moving parts (e.g. doors in industrial housings/control cabinets or cable trays), they must be protected with suitable accessories to prevent the specified bending radius from being breached (see [fig. 16-15 "Spiral hose" on page 90](#)).

To enable flexible cables to be replaced during maintenance work, a plug-in connection must be mounted on each end of the cables.

Bending a cable

The cables have to be protected from bending. The cables or mechanical protection must be routed correctly.

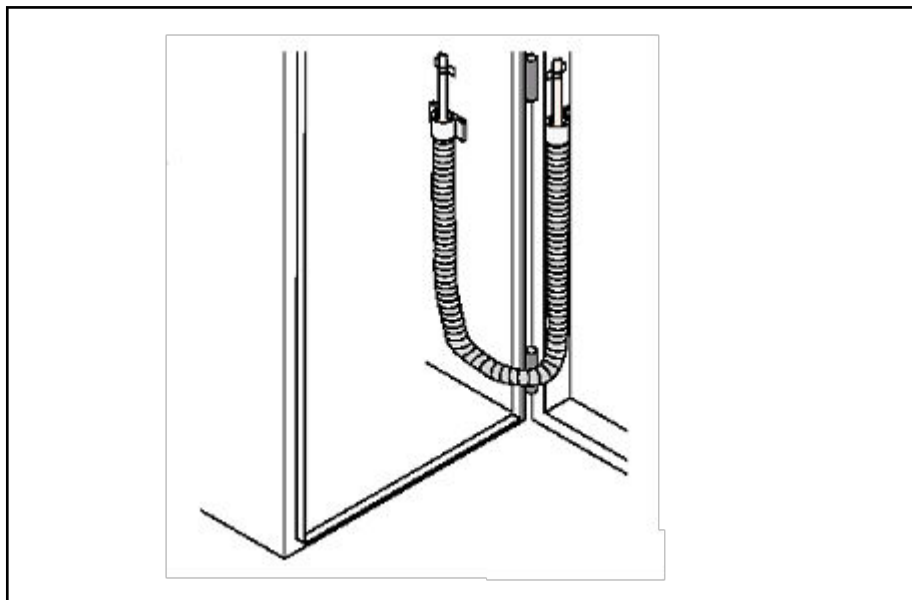


Fig. 16-15: Spiral hose

16.3.3 Connector installation

General description

The ends of the cables must be designed in accordance with the instructions of the manufacturer/supplier of the connection hardware. If special tools are

required for the end terminal, only the tools recommended by the manufacturer may be used.

Once the end terminal has been established, the cable elements must be arranged so that, in the event of a subsequent repair or extension on the installed cables, access to the individual connectors, connections and cable elements is possible with minimal disturbance to the neighboring components.

The designation of the connector pin pair must correspond to [tab. 16-6 "Color coding for Sercos cables with 4 cores" on page 91](#).

Shielded connectors must be installed in accordance with the procedures for the end terminal of connectors and device connection cables as specified in [tab. 16-6 "Color coding for Sercos cables with 4 cores" on page 91](#).

The following figure shows examples of a RJ-45 connector with protection class IP20.

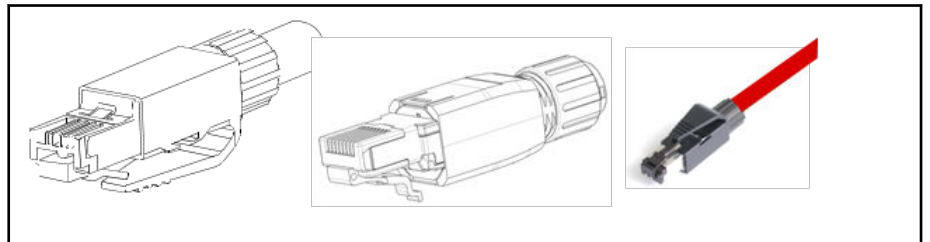


Fig. 16-16: Shielded RJ-45 connector for Sercos

The following figure shows examples of M12 connectors with D-coding with protection class IP67, which can be used for Sercos.



Fig. 16-17: Shielded M12 connectors with D-coding for Sercos

[tab. 16-6 "Color coding for Sercos cables with 4 cores" on page 91](#) and [tab. 16-7 "Color coding for Sercos cables with 8 cores" on page 92](#) show the contact arrangement and color coding of the cable for Sercos connectors.

Signal	Function	Core colors	Contact assignment	
			RJ-45	M12 D-coding
TD +	Transmission data +	Yellow (GE)	1	1
TD-	Transmission data -	Orange (OG)	2	3
RD +	Recipients' data +	White (WE)	3	2
RD -	Recipients' data -	Blue (BU)	6	4

Tab. 16-6: Color coding for Sercos cables with 4 cores

Signal	Function	Core colors	Contact assignment	
			RJ-45	M12 D-coding
TD +	Transmission data +	White orange	1	1
TD-	Transmission data -	Orange	2	3
RD +	Recipients' data +	White green	3	2
RD -	Recipients' data -	Green	6	4
+	3. pair + ¹⁾	Blue	4	-
-	3. pair - ¹⁾	White blue	5	-
+	4. pair + ¹⁾	White brown	7	-
-	4. pair - ¹⁾	Brown	8	-

¹⁾ Not used for Sercos

Tab. 16-7: Color coding for Sercos cables with 8 cores

Sercos only uses patch cables. As Sercos devices support auto-crossing however, crossover cables can be used (e.g. for service tasks).

16.3.4 Device installation

After consulting with the production engineer, the installation engineer has to add a note regarding the positioning of the devices which deviates from the planning documentation for the wiring in the wiring documentation which reflects the actual state.

Labels must be mounted in accordance with the wiring planning documentation.

16.3.5 Grounding and potential equalization for equipment, devices and cable shielding

General description

The installation engineer must ground the installation (including equipment, cable ducts, devices and cable shields) in accordance with this documentation and comply with the recommendations of IEC/TR 61000-5-2: Electromagnetic compatibility (EMC) – Part 2-5: Environment – Description and classification of electromagnetic environments.

Labels must be mounted in accordance with the wiring planning documentation.

Grounding methods

Grounding equipment (devices)

The devices must be grounded according to the following documentation:

- "Planning documentation for wiring"
- "Construction and Design of Control Cabinets" (Bosch Rexroth part number R911171506)
- "Electromagnetic Compatibility (EMC) in Drive and Control Systems" (Bosch Rexroth part number R911259814)
- This "Sercos Installation Manual by Bosch Rexroth"

If the planning documentation for the wiring specifies the use of insulated bus bars, the requirements specified by the planner must be used with the following additions: Use of connection points that provide insulated bus bars

- Use of connection points that provide insulated bus bars

- Use of insulation sections for the DIN bars if the communication components are mounted on DIN bars

Grounding the shield of Sercos communication cables

General information

If shielded cables are used, the device and the control cabinet where the field bus device is mounted must have the same ground potential; this is achieved by establishing an extensive contact to ground (use e.g. copper tape to ensure a good connection).

Shields on communication cables should not transfer compensating currents due to a difference in potential between the ground and improper ground of devices and housings. Compensating currents in the cable shield can result in interruptions in the communication network.

The following sub-item provides a description of grounding methods which have been shown to help reduce communication errors caused by potential equalization during grounding, where shields could potentially end.

Parallel RC grounding of the shield

Parallel RC grounding is defined for Sercos devices and must be provided by the device manufacturer. The following figure shows an example of how shield grounding is used in combination with cabinets.

The cable shield should be connected via the cable gland, but should not be connected to the grounding of the cabinet. If the shield is connected to the cable gland housing, the cable gland must be isolated from the cabinet.

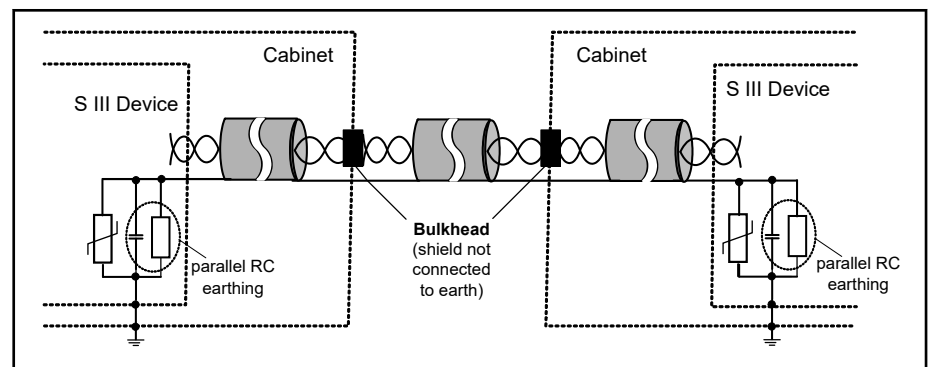


Fig. 16-18: Examples of a parallel RC grounding of the shield

16.4 Troubleshooting in the installation

16.4.1 General description

Troubleshooting starts following a network failure or power drop in the network. The first task of the team responsible for troubleshooting errors is to create the documentation and train employees who deal with troubleshooting errors.

The following points are included in the troubleshooting documentation:

- Instructions for systematic troubleshooting in networks. The instructions contain a checklist and a flow chart based on the documentation provided by the supplier
- Instructions for troubleshooting components based on the documentation provided by the supplier
- Test tools for Sercos (Sercos monitor)

16.4.2 Problem analysis

Answering the following questions should help to build up a complete overview of the problem and to ensure efficient troubleshooting of problems in the network:

- Is the complete network documentation available?
- Have changes recently been made to the network infrastructure?
- How was the problem identified?
- When was the problem identified?
- Did the affected application already run without errors?
- Which users/devices are affected by the problem?
- Did the problem occur within specific periods of time?
- Can the problem be reproduced?
- Have steps already been taken to correct the error?

16.4.3 Typical problems

Frequently occurring problems observed by the maintenance personnel are listed in the following table:

Problem	Most common cause of error	Corrective measure
Communication failure and/or high error rates	Connection is loose or defective plug-in connection (or terminal)	Broken connection must be localized and restored
	EMC impact of other devices, inadequate grounding, incorrect disconnection of emitting devices or cables	Grounding must be localized and corrected, the incorrect disconnection or shielding identified. Use optical cables Use optical cables
	Corrosion of shielding contacts	Localize damaged components and either replace them or fit them with correct shielding
	Mechanical tensions in cables or connections	Install a mechanical holder and strain relief
Connections which are temporarily interrupted and/or burst error rates	EMV impact of other devices	Analyzing the communication problem in the context of physical or environment-related events. Localizing the problem and implementing corrective measures (reduction, etc.)
	Connection is loose or defective plug-in connection (or terminal), e.g. oscillation or temperature impact	Localize damaged components and either replace them or fit them with correct shielding
	Corrosion of shielding contacts	Localize damaged components and either replace them or fit them with correct shielding
	Mechanical tensions in cables or connections	Install a mechanical holder and strain relief
	Condensing liquids in electrical contacts	Clean the plug-in connections. Either replace damaged components or fit them with correct shielding

Problem	Most common cause of error	Corrective measure
Error report from the diagnostic device for symmetrical wiring: Return loss too high	Cables or wires with the wrong wave resistance are used; e.g. a value different from 100 Ω is used for Ethernet systems	Use compatible components
Error report from the diagnostic device for symmetrical wiring: Cable too long, damping or loop resistance too large	Cables or wires with impermissibly small wire diameter or excessively long cable/wire length are used for the application. Damage is also possible	Use compatible components and cable lengths or replace the components
Error report from the diagnostic device for symmetrical wiring: NEXT, PSNEXT, ACR, PSACR, ELFEXT, PSELFEXT	Connectors, cables or wires are used, which do not meet the expected quality standard. Damage is also possible	Use compatible components and cable lengths or replace the components

Tab. 16-8: Typical problems in a network with symmetrical wiring

17 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. You can contact us **24/7**.

Service Germany Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone:	+49 9352 40 5060
Fax:	+49 9352 18 4941
E-mail:	service.svc@boschrexroth.de
Internet:	http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

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Bosch Rexroth AG

P.O. Box 13 57

97803 Lohr a.Main, Germany

Bgm.-Dr.-Nebel-Str. 2

97816 Lohr a.Main, Germany

Phone +49 9352 18 0

Fax +49 9352 18 8400

www.boschrexroth.com/electrics



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