

# MTX 14VRS

## System Description

**Project Planning Manual  
R911342640**

Edition 05



|                                |                                                                                                                                                                                                                                                                                            |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Title</b>                   | MTX 14VRS<br>System Description                                                                                                                                                                                                                                                            |
| <b>Type of Documentation</b>   | Project Planning Manual                                                                                                                                                                                                                                                                    |
| <b>Document Typecode</b>       | DOK-MTX***-SYS*DES*V14-PR05-EN-P                                                                                                                                                                                                                                                           |
| <b>Internal File Reference</b> | RS-5e64ee410d19898c0a6846a5016285f0-5-en-US-5                                                                                                                                                                                                                                              |
| <b>Change record</b>           | Edition 05, 2020-10<br>Refer to <a href="#">tab. 1-1 "Change record" on page 1</a>                                                                                                                                                                                                         |
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| <b>Editorial Department</b>    | Engineering Automation Systems Solution Integration HMI, NC Controls and Support, ReLa (TaDo/MePe)                                                                                                                                                                                         |

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# 1 About this documentation

## Editions of this documentation

| Edition | Release date | Note                                                                                                                                                                                                                                                                                                                                       |
|---------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01      | 2014-04      | First edition                                                                                                                                                                                                                                                                                                                              |
| 02      | 2014-09      | Extending the system limits of MTX                                                                                                                                                                                                                                                                                                         |
| 03      | 2015-10      | New chapter "Hand-held terminal VH2110"<br>New target CML75<br>New multi-touch display VDP15.3, 18.3, 21.3<br>New machine control panel VAM 15.1, 21.1                                                                                                                                                                                     |
| 04      | 2020-03      | New chapter "Firmware and software for the MTX CNC system"<br>New chapter "PR   VR   DR"<br>Changes in the chapter "System overview"<br>Supplements in the chapter "IndraControl controls L45, L65, L75 and L85"<br>Supplements in the chapter "Control cabinet PC VPB 40.x with VDP operating display"<br>New control cabinet PC VPB 40.4 |
| 05      | 2020-10      | Changes in the chapter "System overview", Defdb00209060 resolved                                                                                                                                                                                                                                                                           |

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 CNC 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.

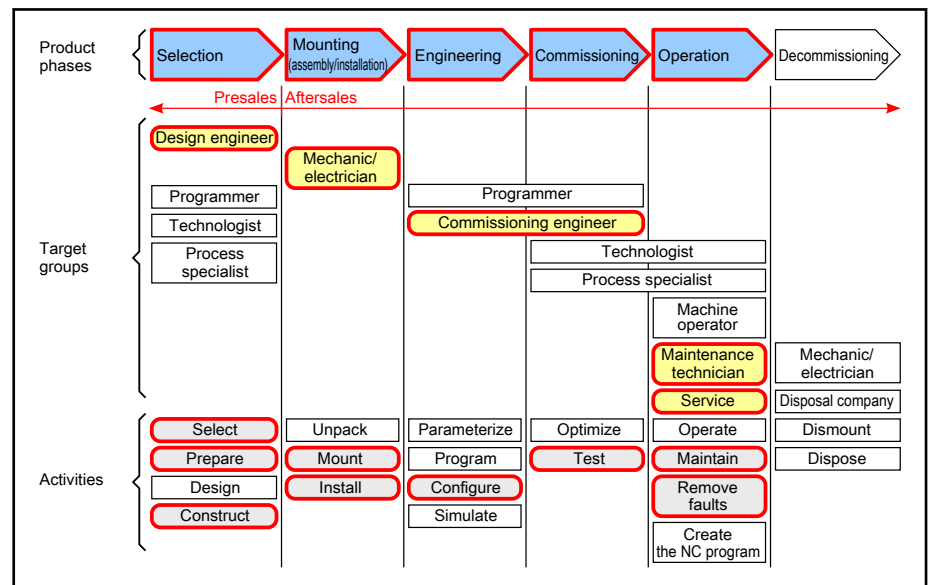


Fig. 1-1: Assigning this documentation to the target groups, product phases and target group activities

## 1.2 Required and supplementing documentation MTX

### 1.2.1 Selection/compilation

#### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTX 14VRS System Description</b><br>DOK-MTX***-SYS*DES*V14-PRRS-EN-P, R911342640<br>This documentation describes the MTX control. It includes the designs, technical data, interfaces as well as the configuration of the control components. |
| <b>MTX 14VRS SafeLogic System Overview</b><br>DOK-MTX***-SL**SYS*V14-PRRS-EN-P, R911341698<br>This documentation describes the use of the safety control SafeLogic in the MTX.                                                                   |

Tab. 1-2: MTX documentation overview - Selecting/composing

### 1.2.2 Configuration

#### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTX 14VRS Machine Parameters</b><br>DOK-MTX***-MA*PAR*V14-RERS-EN-P, R911342630<br>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.                                                                                                                                                                                                                                        |
| <b>MTX 14VRS PLC interface</b><br>DOK-MTX***-PLC*INT*V14-PRRS-EN-P, R911342622<br>This documentation describes the interface signals and the program function blocks for the integrated PLC.                                                                                                                                                                                                                                                                                                        |
| <b>MTX 14VRS Functional Description - Basics</b><br>DOK-MTX***-NC*F*BA*V14-RERS-EN-P, R911342626<br>This documentation describes the basic functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.                                                                                                                                                                                                                      |
| <b>MTX 14VRS Functional Description - Extension</b><br>DOK-MTX***-NC*F*EX*V14-RERS-EN-P, R911342628<br>This documentation describes the extended functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.                                                                                                                                                                                                                |
| <b>MTX 14VRS Functional Description - Special Functions</b><br>DOK-MTX***-NC*F*SP*V14-RERS-EN-P, R911342624<br>This documentation describes the special functions of the MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.                                                                                                                                                                                                         |
| <b>MTX Free Form Surface Milling</b><br>DOK-MTX***-FREEFORM***-APRS-EN-P, R911341435<br>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. |
| <b>MTX Conversion of MTX Projects</b><br>DOK-MTX***-PROCONV****-PRRS-EN-P, R911342484<br>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.                                                                                                                                                                        |

Tab. 1-3: MTX documentation overview - Configuring

## 1.2.3 Commissioning

### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IndraWorks 13VRS Simulation</b><br>DOK-IWORKS-SIMU****V13-APRS-EN-P, R911339256<br>This documentation describes the functions of the simulation components View3D, virtual control panel, virtual control and its operation in IndraWorks.                                                                                                                                                   |
| <b>MTX 14VRS Commissioning</b><br>DOK-MTX***-STARTUP*V14-CORS-EN-P, R911342620<br>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.                                                                                                  |
| <b>IndraWorks 14VRS Basis Libraries IndraLogic 2G</b><br>DOK-IL*2G*-BASLIB**V14-LIRS-EN-P, R911343920<br>This documentation describes the system-comprehensive PLC libraries.                                                                                                                                                                                                                   |
| <b>IndraWorks 14VRS Field Buses</b><br>DOK-IWORKS-FB*****V14-APRS-EN-P, R911341485<br>This documentation describes the field bus and local periphery connections supported by the XLC, 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. |
| <b>IndraWorks 14VRS WinStudio 7.4</b><br>DOK-IWORKS-WINSTUD*V14-APRS-EN-P, R911341585<br>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.                                            |
| <b>IndraWorks 14VRS Software Installation</b><br>DOK-IWORKS-SOFTINS*V14-CORS-EN-P, R911344286<br>This documentation describes the IndraWorks installation.                                                                                                                                                                                                                                      |
| <b>IndraWorks 14VRS Engineering</b><br>DOK-IWORKS-ENGINEE*V14-APRS-EN-P, R911343566<br>This documentation describes the use of IndraWorks in which the engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.                                                                                                  |
| <b>IndraWorks 12VRS FDT Container</b><br>DOK-IWORKS-FDT*CON*V12-APRS-EN-P, R911334398<br>This documentation describes the IndraWorks FDT Container functionality. It includes the activation of the functionality in the project and working with DTMs.                                                                                                                                         |
| <b>IndraWorks 14VRS PLC Programming System IndraLogic 2G</b><br>DOK-IWORKS-IL2GPRO*V14-APRS-EN-P, R911343571<br>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.                                                                                                  |
| <b>IndraWorks 14VRS HMI</b><br>DOK-IWORKS-HMI*****V14-APRS-EN-P, R911343569<br>This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.                                                                                                                                                          |

Tab. 1-4: MTX documentation overview - Commissioning

## 1.2.4 Operation

### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTX 09VRS Shop Floor Programming Turning and Milling</b><br>DOK-MTX***-SF*PROG*V09-AWxx-EN-P, R911324377<br>This documentation describes the operation and programming of the graphic NC programming of turning and milling as well as the workpiece simulation.                                                                                   |
| <b>MTX 12VRS Block Pre-Run</b><br>DOK-MTX***-BLK*RUN*V12-APRS-EN-P, R911334379<br>This documentation explains to the machine manufacturer how to setup the "Block pre-run" function at the machine for the end user.                                                                                                                                  |
| <b>MTX 14VRS Programming Manual</b><br>DOK-MTX***-NC**PRO*V14-RERS-EN-P, R911342634<br>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. |
| <b>MTX 14VRS Standard NC Operation</b><br>DOK-MTX***-NC*OP***V14-APRS-EN-P, R911342632<br>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.                                              |
| <b>MTX 14VRS Multitouch</b><br>DOK-MTX***-MULTI***V14-APRS-EN-P, R911384735<br>The Multitouch user interface of the NC control MTX is described in this documentation.                                                                                                                                                                                |
| <b>MTX 14VRS Standard NC Cycles</b><br>DOK-MTX***-NC*CYC**V14-PRRS-EN-P, R911342638<br>This documentation describes the application of the standard cycles of the different technologies for the MTX control.                                                                                                                                         |
| <b>MTX 14VRS NC Simulation</b><br>DOK-MTX***-NC*SIM**V14-APRS-EN-P, R911379629<br>This documentation describes the NC simulation for the MTX control.                                                                                                                                                                                                 |

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*Tab. 1-5: MTX documentation overview - Operating*

## 1.2.5 OEM Engineering

### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTX 13VRS Automation Interface</b><br>DOK-MTX***-AUT*INT*V13-APRS-EN-P, R911337274<br>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. |
| <b>MTX 14VRS OPC Communication</b><br>DOK-MTX***-OPC*COM*V14-PRRS-EN-P, R911342636<br>This documentation describes the syntax and the structure of the items for the communication with Bosch Rexroth devices.                                                                                                                            |
| <b>IndraWorks OPC UA Communication</b><br>DOK-IWORKS-OPC*UA*****-APRS-EN-P, R911379309<br>This documentation describes the OPC UA communication of the MLC and MTX control systems.                                                                                                                                                       |

*Tab. 1-6: MTX documentation overview - OEM engineering*

## 1.2.6 AddOns

### Documentation titles with type codes and part numbers

|                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MTX 11VRS Action Recorder</b><br>DOK-MTX***-ACR*****V11-APxx-EN-P, R911329943<br>This documentation describes the MTX action recorder. It includes the installation and commissioning as well as interface signals, application and operation.                                                                                                                                                                          |
| <b>MTX 14VRS Efficiency Workbench MTX cta, MTX ega</b><br>DOK-MTX***-EWB*****V14-APRS-EN-P, R911343916<br>This documentation describes the mode of operation and the area of application of the analysis tool MTX cta and MTX ega.                                                                                                                                                                                         |
| <b>MTX Remote Condition Monitoring</b><br>DOK-MTX***-RCM*****V01-APRS-EN-P, R911334383<br>This documentation describes the operation of the Remote Condition Monitoring System.                                                                                                                                                                                                                                            |
| <b>MTX visIREC User Documentation</b><br>DOK-MTX***-VISIREC*V01-APRS-EN-P, R911344242<br>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. |

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Tab. 1-7: MTX documentation overview - AddOns

## 1.3 Using safety instructions

### 1.3.1 Structure of the safety instructions

The safety instructions are structured as follows:

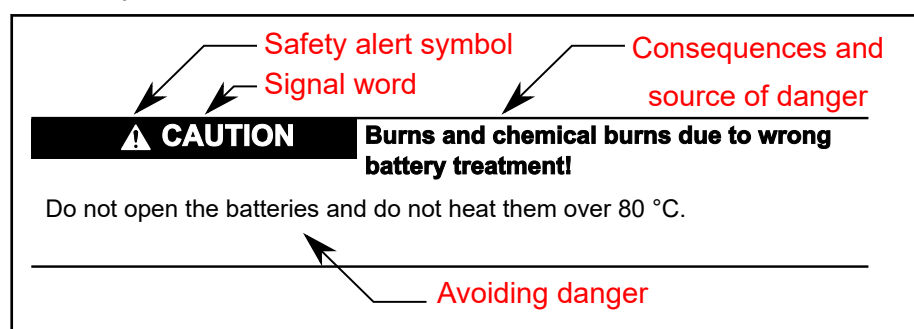


Fig. 1-2: Structure of the safety instructions

### 1.3.2 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.

---

### 1.3.3 Symbols used

Pointers are displayed as follows:



This is a note.

Tips are displayed as follows:



This is a tip.

### 1.3.4 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.

## 1.4 Names and abbreviations

| Term        | Explanation                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------|
| ACS         | Axis coordinate system                                                                                   |
| CANopen     | Field bus                                                                                                |
| CIL         | Compiled Instruction List                                                                                |
| 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

## 1.5 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](mailto: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 personal injury due to incorrect use of products.



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 dealing with Bosch Rexroth products in any way is obliged to read and consent to the relevant safety instructions and the intended use.
- The original condition of hardware products may not be altered; in other words, no structural modifications are permitted. The decompilation of software products or the alteration of source codes is not permitted.
- Do not install or operate damaged or faulty products.
- It has to be ensured that the products have been installed as described in the relevant documentation.

#### 2.1.2 Areas of application and use

For the areas of use and application of each component, also see the corresponding documents in chapter 1.

### 2.2 Unintended use

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

The device may 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 devices must not be used in any applications not expressly approved by Bosch Rexroth. Therefore, please read the information given in the general safety instructions!



## 3 Safety instructions for electric drive and control systems

### 3.1 Definitions of terms

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Application documentation</b> | 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>B sample</b>                  | 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.                                                                                                                                                                                                                                                   |
| <b>Compatibility</b>             | 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.                                                                                                                                                                                                                                                                                                                                                      |
| <b>Component</b>                 | 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.                                                                                                                                                                                                                              |
| <b>Control system</b>            | A control system comprises several interconnected control components placed on the market as a single functional unit.                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Device</b>                    | A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Drive</b>                     | A drive (electric drive) consists of a drive controller with an electric motor.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Electrical equipment</b>      | 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.                                                                                                                                                                                                                        |
| <b>Electric drive system</b>     | 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.                                                                                                                                                                                                |
| <b>Incompatibility</b>           | Incompatible new functions or incompatible functional enhancements produce a device behavior which does not correspond to the previous version.                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Installation</b>              | 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.                                                                                                                                                                                                                                                                                                        |
| <b>Machine</b>                   | 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. |
| <b>Manufacturer</b>              | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Patch</b>                                                       | A patch corrects errors in the firmware.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Product</b>                                                     | Examples of a product: Device, component, part, system, software, firmware, among other things.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Project Planning Manual</b>                                     | A Project Planning Manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Qualified personnel for handling functionally safe products</b> | Individuals configuring, commissioning and operating functionally safe products must have the knowledge specified under " <a href="#">Qualified persons</a> ". Additionally, these individuals must be familiar with technical safety concepts as well as prevailing standards and regulations in the field of functional safety.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Qualified persons</b>                                           | <p>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,</p> <ul style="list-style-type: none"> <li>• to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them.</li> <li>• to be trained or instructed to maintain and use adequate safety equipment.</li> <li>• to attend a course of instruction in first aid.</li> </ul> |
| <b>Release, firmware/Runtime release</b>                           | A new release makes available compatible functional enhancements or corrects errors in the firmware, see "RS" in AXS-V-VSRS.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Version, firmware/Runtime version</b>                           | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>User</b>                                                        | 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 mm<sup>2</sup> (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<br>Leakage current $\geq 3.5$ mA |                                  |
|-------------------------------|--------------------------------------------------------------------------------------|----------------------------------|
|                               | 1 equipment grounding conductor                                                      | 2 equipment grounding conductors |
| 1.5 mm <sup>2</sup> (16 AWG)  | 10 mm <sup>2</sup> (8 AWG)                                                           | 2 × 1.5 mm <sup>2</sup> (16 AWG) |
| 2.5 mm <sup>2</sup> (14 AWG)  |                                                                                      | 2 × 2.5 mm <sup>2</sup> (14 AWG) |
| 4 mm <sup>2</sup> (12 AWG)    |                                                                                      | 2 × 4 mm <sup>2</sup> (12 AWG)   |
| 6 mm <sup>2</sup> (10 AWG)    |                                                                                      | 2 × 6 mm <sup>2</sup> (10 AWG)   |
| 10 mm <sup>2</sup> (8 AWG)    |                                                                                      | -                                |
| 16 mm <sup>2</sup> (6 AWG)    | 16 mm <sup>2</sup> (6 AWG)                                                           | -                                |
| 25 mm <sup>2</sup> (4 AWG)    |                                                                                      | -                                |
| 35 mm <sup>2</sup> (2 AWG)    |                                                                                      | -                                |
| 50 mm <sup>2</sup> (1/0 AWG)  | 25 mm <sup>2</sup> (4 AWG)                                                           | -                                |
| 70 mm <sup>2</sup> (2/0 AWG)  | 35 mm <sup>2</sup> (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<br>CNC system  | Sercos                                 |                                  | Maximum number<br>of Sercos devices |
|-------------------------------|----------------------------------------|----------------------------------|-------------------------------------|
|                               | Maximum number<br>of NC axes           | Maximum number<br>of I/O devices |                                     |
| MTX standard L45              | 12                                     | 64                               | 76                                  |
| MTX performance<br>L65 or L75 | 64                                     | 64                               | 128                                 |
| MTX advanced L85              | for up to 250 axes<br>(from MTX 14V12) | 64                               | 250                                 |

Tab. 4-1: MTX system variants

All IndraControl controls provide CNC and PLC functionalities. The highest configuration provides an MTX advanced to control up to 250 axes (from MTX 14V12) in 60 independent CNC processing channels. The standard equipment of the controls includes interfaces to control I/Os via PROFIBUS-DP, intelligent drives via Sercos and peripheral modules via Ethernet.

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 IndraControl controls L45, L65, L75 and L85

### 5.1 Brief description



Fig. 5-1: IndraControl L65 control

The IndraControl L45, L65, L75 and L85 (Lx5) controls are the main units in the CNC control systems MTX standard L45, MTX performance L65/L75 and MTX advanced L85 control systems.

The controls are equipped with 8 digital onboard I/Os as well as Sercos, Profibus DP, Ethernet and EthernetIP interfaces. By adding more inline I/O modules as ultra compact terminals, the controls can be individually adapted to the respective task.

Due to their high performance, comprehensive PLC functions can be implemented with the CNC system MTX L85 system and up to 250 axes (from MTX 14V12) can be operated.

### 5.2 Performance data

| Name                                          | MTX standard L45 | MTX performance L65<br>MTX performance L75 | MTX advanced L85          |
|-----------------------------------------------|------------------|--------------------------------------------|---------------------------|
| Number of axes                                | max. 12          | max. 64                                    | max. 250 (from MTX 14V12) |
| Thereof spindles                              | 4                | 32                                         | max. 60                   |
| Number of interpolated axes/<br>channel       | 4/8              | 4/8                                        | 4/8                       |
| Number of NC channels                         | 2                | 3...12                                     | 3...60                    |
| PLC processing time for 1k of<br>instructions | 39 µs            | 18 µs<br>10 µs                             | 3 µs                      |
| Min. Ipo cycle                                | 1 ms             | 0.5 ms                                     | 0.25 ms                   |

Tab. 5-1: Performance data of the CNC system MTX Lx5

IndraControl controls L45, L65, L75 and L85

## 5.3 Technical data

|                           |                                                                                                                                                                                                                                                                        |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Processor</b>          | IndraControl L45: AMD LX800, 500 MHz<br>IndraControl L65: Intel Celeron M, 1 GHz<br>IndraControl L75: Intel Atom E3827, 1.75 GHz, Dual Core<br>IndraControl L85: Intel Celeron M, 1.2 GHz                                                                              |
| <b>RAM</b>                | IndraControl L45: 256 MB DRAM, 8 MB SRAM<br>IndraControl L65: 512 MB DRAM, 8 MB SRAM<br>IndraControl L75: 4096 MB DRAM, 16 MB SRAM<br>IndraControl L85: 1024 MB DRAM, 16 MB SRAM                                                                                       |
| <b>Interfaces</b>         | <ul style="list-style-type: none"> <li>• Bosch Rexroth PC104<sup>Plus</sup></li> <li>• Rexroth Inline interface</li> <li>• Ethernet connection (RJ45, 10/100 Base-T)</li> <li>• PROFIBUS DP master/slave interface</li> <li>• Sercos master/slave interface</li> </ul> |
| <b>Inputs and outputs</b> | <ul style="list-style-type: none"> <li>• 8 electrically isolated digital inputs</li> <li>• 8 electrically isolated digital outputs</li> </ul>                                                                                                                          |

Tab. 5-2: Technical data of the IndraControl Lx5

## 5.4 Power supply

### 5.4.1 General information

IndraControl Lx5 controls are supplied with 24 V DC. The following values for the operating voltage apply according to DIN EN 61131-2:

|                        |                                       |
|------------------------|---------------------------------------|
| <b>Nominal value</b>   | 24 V DC                               |
| <b>Tolerance</b>       | -15% / +20% (without residual ripple) |
| <b>Residual ripple</b> | +/-5 %                                |
| <b>U<sub>max</sub></b> | 30 V                                  |
| <b>U<sub>min</sub></b> | 19.2 V                                |

Tab. 5-3: Operating voltage according to DIN EN 61131-2

Three operating voltages must be applied apart from the 24V power supply. The power consumption from these voltages is:

|                                                               |                   |
|---------------------------------------------------------------|-------------------|
| <b>Power consumption from U<sub>LS</sub></b>                  | Max. 3 A          |
| <b>Power consumption from U<sub>M</sub> and U<sub>S</sub></b> | In total 8 A max. |

Tab. 5-4: Current consumption

### 5.4.2 Supply voltages to be connected externally

The power supply for the control modules IndraControl Lx5, any connected function modules and Inline I/O components are supplied via a power supply module on the right side of the control on slot 5. Three voltages are fed in on this slot using a black clamp terminal (PWR IN).

|                    |               |
|--------------------|---------------|
| <b>Pin contact</b> | <b>Signal</b> |
|--------------------|---------------|

|             |                                                                        |
|-------------|------------------------------------------------------------------------|
| 1.1         | + 24 V DC segment voltage ( $U_S$ )                                    |
| 1.2         | + 24 V DC power supply voltage ( $U_{LS}$ )                            |
| 1.3         | LGND (ground power supply voltage)                                     |
| 1.4 and 2.4 | FE (functional earth)                                                  |
| 2.1         | 24 V DC uninterruptible power supply (UPS); is currently not supported |
| 2.2         | + 24 V DC main supply ( $U_M$ )                                        |

Tab. 5-5: Pin assignment of the voltage terminal



By fitting or removing connectors under voltage, the control, a function module or the Inline terminal can be damaged!

Turn off the supply voltage before fitting or removing any connections!

Five LEDs are arranged on the feed module (slot 5). Description:

| LED $U_M$ | Description                                  |
|-----------|----------------------------------------------|
| Off       | 24 V main circuit supply ( $U_M$ ) missing   |
| Green     | 24 V main circuit supply ( $U_M$ ) available |

Tab. 5-6: Diagnostic LED of the main circuit supply

| LED $U_S$ | Description                                     |
|-----------|-------------------------------------------------|
| Off       | 24 V segment circuit supply ( $U_S$ ) missing   |
| Green     | 24 V segment circuit supply ( $U_S$ ) available |

Tab. 5-7: Diagnostic LED of the segment circuit supply

| LED $U_L$ | Description                                      |
|-----------|--------------------------------------------------|
| Off       | 24 V logic circuit supply ( $U_{LS}$ ) missing   |
| Green     | 24 V logic circuit supply ( $U_{LS}$ ) available |

Tab. 5-8: Diagnostic LED of the main circuit supply

| LEDs "FS" and "FN" | Description           |
|--------------------|-----------------------|
| Off                | Currently no function |

Tab. 5-9: Diagnostic LEDs "FS" and "FN"



The 7.5 V Inline voltage and the  $U_{ANA}$  24 V analog voltage are taken from the  $U_{LS}$  external 24 V voltage.

## 5.5 Ambient conditions

|                          | In operation                                                       | Storage/transport |
|--------------------------|--------------------------------------------------------------------|-------------------|
| Max. ambient temperature | +5... +55°C                                                        | -25°C to +70°C    |
| Relative humidity        | RH-2; 5% to 95% acc. to DIN EN 61131-2.<br>Condensing not allowed. |                   |

IndraControl controls L45, L65, L75 and L85

|                             | In operation                                                                                                                                                                                                             | Storage/transport                                             |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| <b>Atmospheric pressure</b> | up to 2700 m above sea level acc. to DIN 60204                                                                                                                                                                           | up to 3000 m above sea level acc. to DIN 60204                |
| <b>Mechanical strength</b>  | <ul style="list-style-type: none"> <li>Max. vibration:<br/>Frequency range: 10... 150 Hz</li> <li>Deflection: 0.075 mm<br/>at 10... 57 Hz</li> <li>Acceleration: 1 g<br/>At 57... 150 Hz</li> </ul> acc. to EN 60068-2-6 | Max. shock:<br>15 g acc. to EN 60068-2-27,<br>no malfunctions |

Tab. 5-10: Ambient conditions



Ambient air must be free of high concentrations of acids, alkaline solutions, corrosive agents, salt, metal vapors or other conducting contaminants.

Dust-free ambient air is required. Housing and installation spaces must at least have protection class IP 54 according to DIN VDE 0470-1.



#### **Danger of destruction due to overheating**

Ensure that the ambient temperature remains below 45° C.

Operation is allowed up to 55°C and if the air circulates.

If the internal temperature reaches approx. 80°C, the control switches off automatically.

When the internal temperature exceeds 70°C, a "Temp!!!" warning is displayed.

## 5.6 Interfaces

### 5.6.1 Sercos X7E1, X7E2

The Sercos devices are connected to the ports X7E1 and X7E2.

|                          |                   |
|--------------------------|-------------------|
| <b>Connector</b>         | X7E1, X/E2        |
| <b>Type</b>              | Ethernet 100BaseT |
| <b>Cable length</b>      | Max. 100 m        |
| <b>Cable type</b>        | CAT5e with S/STP  |
| <b>Transmission rate</b> | 10 or 100 Mbit/s  |

Tab. 5-11: Sercos interfaces

|            |                                                                |
|------------|----------------------------------------------------------------|
| <b>LED</b> |                                                                |
| L (link)   | On: Link to network available<br>Off: No connection to network |
| S (send)   | On: Data packages are sent<br>Off: No data is sent             |

Tab. 5-12: Diagnostic LEDs of the Sercos interfaces

## 5.6.2 Profinet X7E3, X7E4

The Profinet devices are connected to the ports X7E3 and X7E4.

|                          |                   |
|--------------------------|-------------------|
| <b>Connector</b>         | X7E3, X/E4        |
| <b>Type</b>              | Ethernet 100BaseT |
| <b>Cable length</b>      | Max. 100 m        |
| <b>Cable type</b>        | CAT5e with S/STP  |
| <b>Transmission rate</b> | 10 or 100 Mbit/s  |

Tab. 5-13: Profinet interfaces

|            |                                                                |
|------------|----------------------------------------------------------------|
| <b>LED</b> |                                                                |
| L (link)   | On: Link to network available<br>Off: No connection to network |
| S (send)   | On: Data packages are sent<br>Off: No data is sent             |

Tab. 5-14: Diagnostic LEDs of the Profinet interfaces

## 5.6.3 PROFIBUS DP master interface X7P

The IndraControl Lx5 exchanges data with the operating panels (VAM...) and the sensor and actuator level (Inline/fieldline module) via the PROFIBUS DP interface according to DIN EN 50170, part 2. Preassembled cables with variable lengths are provided. The maximum transfer rate is 12 MBauds.

|                          |                           |
|--------------------------|---------------------------|
| <b>Connector</b>         | X7P                       |
| <b>Type</b>              | RS 485                    |
| <b>Cable type</b>        | Shielded, 2-wire, twisted |
| <b>Transmission rate</b> | 10 or 100 Mbit/s          |

Tab. 5-15: Profibus DP interface

|            |                                              |
|------------|----------------------------------------------|
| <b>LED</b> | <b>Status</b>                                |
| Send       | On: Data is output<br>Off: No data is output |

Tab. 5-16: Diagnostic LED of the PROFIBUS interface

## 5.6.4 Ethernet interface X7E5

The IndraControl Lx5 control module can be connected to a network via the Ethernet interface X7E5.

|                          |                   |
|--------------------------|-------------------|
| <b>Connector</b>         | X7E5              |
| <b>Type</b>              | Ethernet 100BaseT |
| <b>Cable length</b>      | Max. 100 m        |
| <b>Cable type</b>        | CAT5e with S/STP  |
| <b>Transmission rate</b> | 10 or 100 Mbit/s  |

Tab. 5-17: Ethernet interface

IndraControl controls L45, L65, L75 and L85

| LED      | Status                                                         |
|----------|----------------------------------------------------------------|
| L (link) | On: Link to network available<br>Off: No connection to network |
| S (send) | On: Data packages are sent<br>Off: No data is sent             |

Tab. 5-18: Diagnostic LEDs of the Ethernet interface

## 5.6.5 Ready contact X2R

### General information

The "Ready" contact is opened in idle state. It is closed after the module startup.

*The contact opens again if one of the states listed below occurs:*

- The 24 V supply drops below the permitted limit.
- The internal voltages 5 V and 3.3 V drop below the permitted limit.
- The "Ready" watchdog expires.
- The "Reset" button is pressed.



Connect the "Ready" contact to the E-Stop of the machine.

### X2R connection assignment

| Terminal | Signal         |
|----------|----------------|
| 1        | Relay contact  |
| 2        | Relay contact  |
| 3        | (not assigned) |

Tab. 5-19: Pin assignment of the "Ready" contact

### Contact characteristics

|                                      |                        |
|--------------------------------------|------------------------|
| Switching capacity                   | 1 A, 60 V DC           |
| UL rating                            | 1 A, 60 V DC resistive |
| Ramp-down time                       | 0.3 ms                 |
| Bounce time                          | None                   |
| Watchdog time (only analog watchdog) | 50 ms +/- 25 %         |

Tab. 5-20: Characteristics of the "Ready" contact

The LED located next to the "Ready" contact is a dual LED in red and green. It can assume the following states:

### Meaning of the LEDs

| LED "Ready" | Description                                                                                                             |
|-------------|-------------------------------------------------------------------------------------------------------------------------|
| Off         | Watchdog has yet started<br>Ready contact opened by the software (the watchdog, however, is still triggered internally) |

|       |                                                 |
|-------|-------------------------------------------------|
| Green | "Ready" contact closed; watchdogs are triggered |
| Red   | "Ready" error; at least one watchdog responded  |

Tab. 5-21: Ready LED

## 5.6.6 Interface for the Compact Flash card

**Compact Flash** The IndraControl Lx5 housing contains a slot for a Compact Flash card. The memory card with the firmware is inserted there. In addition, data and programs are stored on this card. An operation without flash card is not possible.



### Uncontrolled movement due to operation without CF card!

⇒ Never remove the Compact Flash card if the control is being operated!

## 5.6.7 Inline bus

The IndraControl Lx5 can be supplemented with additional Rexroth Inline modules. Such modules can be used to increase the I/O unit up to 32 byte inputs and 32 byte outputs.

A maximum of 63 Rexroth Inline modules can be connected.



For more information to the Rexroth Inline module connection, refer to the documentation DOK-CONTRL-R-IL\*DIO\*\*\*-FKxx-EN-P.

## 5.6.8 Function module pin

Extension modules can be connected to the left side of the IndraControl Lx5 using the function module pin (FM bus) located there.

This 120-pin plug is a Bosch Rexroth PC104<sup>Plus</sup> to which the PC104 signals and other system-specific signals are applied.

## 5.6.9 Additional fan

The IndraControl L85 has to be operated with an additional fan. No tool is required for the installation. The fan switches on at a CPU temperature of >55°C and switches off at +42°C. The fan is controlled via the firmware and cannot be switched on or off from the application.

# 5.7 Digital onboard inputs and outputs

## 5.7.1 Address assignment of inputs and outputs

The eight digital inputs and outputs available (from left to right) on the slots 1 to 4 of the IndraControl Lx5 are defined as "fast" inputs and outputs. The address assignment of the inputs and outputs is listed in the following table:

|               |      | Eight digital inputs  |   |   |   |   |   |   |   | Eight digital outputs |   |   |   |   |   |   |   |
|---------------|------|-----------------------|---|---|---|---|---|---|---|-----------------------|---|---|---|---|---|---|---|
|               |      | 1                     |   |   |   | 2 |   |   |   | 3                     |   |   |   | 4 |   |   |   |
|               |      | 1                     | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1                     | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Byte-bit view | Byte | IX0.0 – 0.7 (default) |   |   |   |   |   |   |   | QX0.0 – 0.7 (default) |   |   |   |   |   |   |   |
|               | Bit  | 0                     | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 0                     | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

|          |                              | Eight digital inputs |     |     |     |     |     |     |     | Eight digital outputs |     |     |     |     |     |     |     |
|----------|------------------------------|----------------------|-----|-----|-----|-----|-----|-----|-----|-----------------------|-----|-----|-----|-----|-----|-----|-----|
| Terminal | Terminal point (signal)      | 1.1                  | 2.1 | 1.4 | 2.4 | 1.1 | 2.1 | 1.4 | 2.4 | 1.1                   | 2.1 | 1.4 | 2.4 | 1.1 | 2.1 | 1.4 | 2.4 |
|          | Terminal point (24 V)        | 1.2                  | 2.2 | 1.3 | 2.3 | 1.2 | 2.2 | 1.3 | 2.3 | -                     | -   | -   | -   | -   | -   | -   | -   |
|          | Terminal point (last ground) | -                    | -   | -   | -   | -   | -   | -   | -   | 1.2                   | 2.2 | 1.3 | 2.3 | 1.2 | 2.2 | 1.3 | 2.3 |

Tab. 5-22: Address assignment of inputs and outputs

5.7.2 Digital onboard inputs

The left part of the connector panel provides eight digital inputs as onboard inputs.

Slots 1 and 2:

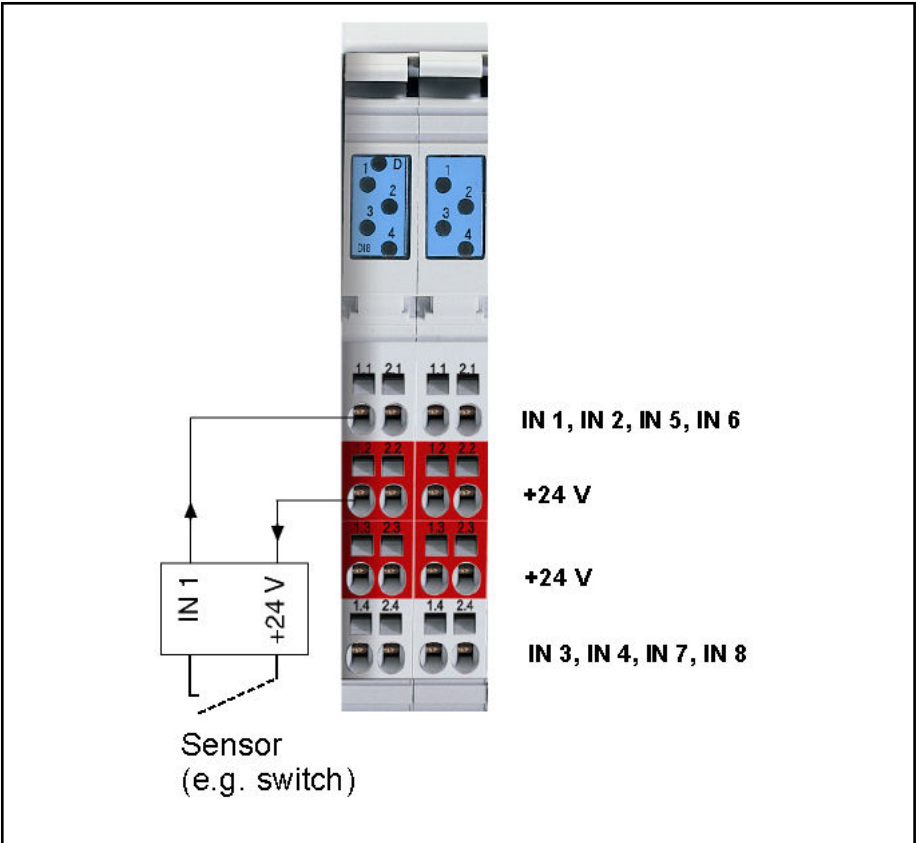


Fig. 5-2: Digital inputs

 Check the color-coding of the pins.

|                               |                   |
|-------------------------------|-------------------|
| Number of inputs              | 8                 |
| Connection method             | 2-wire connection |
| Electrical isolation to $U_s$ | No                |
| Electrical isolation to $U_L$ | Yes               |
| Reverse voltage protection    | Yes               |
| Input voltage:                |                   |
| - Nominal value at "0"        | -3 V ... -5 V     |
| - Nominal value at "1"        | 11 V ... 30 V     |

|                                                                                     |                             |
|-------------------------------------------------------------------------------------|-----------------------------|
| Input current:<br>- Nominal value at "0"<br>- Nominal value at "1"                  | < 2.5 mA<br>2.8 mA ... 6 mA |
| Delay time:<br>- at "0" to "1"<br>- at "1" to "0"                                   | Typ. 50 µs<br>Typ. 50 µs    |
| Power consumption from the 24 V supply                                              | Typ. 60 mA                  |
| Cable length (unshielded)                                                           | < 100 m                     |
| Interrupt inputs                                                                    | 8                           |
| Sensor supply                                                                       | From ULS via a PTC fuse     |
| Output voltage                                                                      | Typ. U <sub>ext.</sub> – 1V |
| Nominal current (total)                                                             | 0.2 A                       |
| Short-circuit protection, overcurrent protection                                    | Typ. 0.6 A                  |
| Criteria to connect 2-wire proximity switches:<br>Quiescent current<br>Voltage drop | < 2.5 mA<br>< 6 V           |

Tab. 5-23: Data of the digital inputs

The input terminals are provided with LEDs displaying the respective state of the inputs.

| LEDs 1, 2, 3, 4 | Description                   |
|-----------------|-------------------------------|
| Off             | The assigned input is not set |
| Yellow          | The respective input is set   |

Tab. 5-24: Status LEDs of digital inputs

An additional two-color LED (labeled with D) emits green light if 24 V voltage is present and emits red light if there is a short-circuit or overload.

| LED D | Description               |
|-------|---------------------------|
| Off   | 24 V missing              |
| Green | 24 V are present          |
| Red   | Short-circuit or overload |

Tab. 5-25: LED D

### 5.7.3 Digital outputs

Two terminal strips with a total of eight digital outputs are arranged between the digital inputs and the terminals for the voltage supply.

IndraControl controls L45, L65, L75 and L85

Slots 4 and 5:

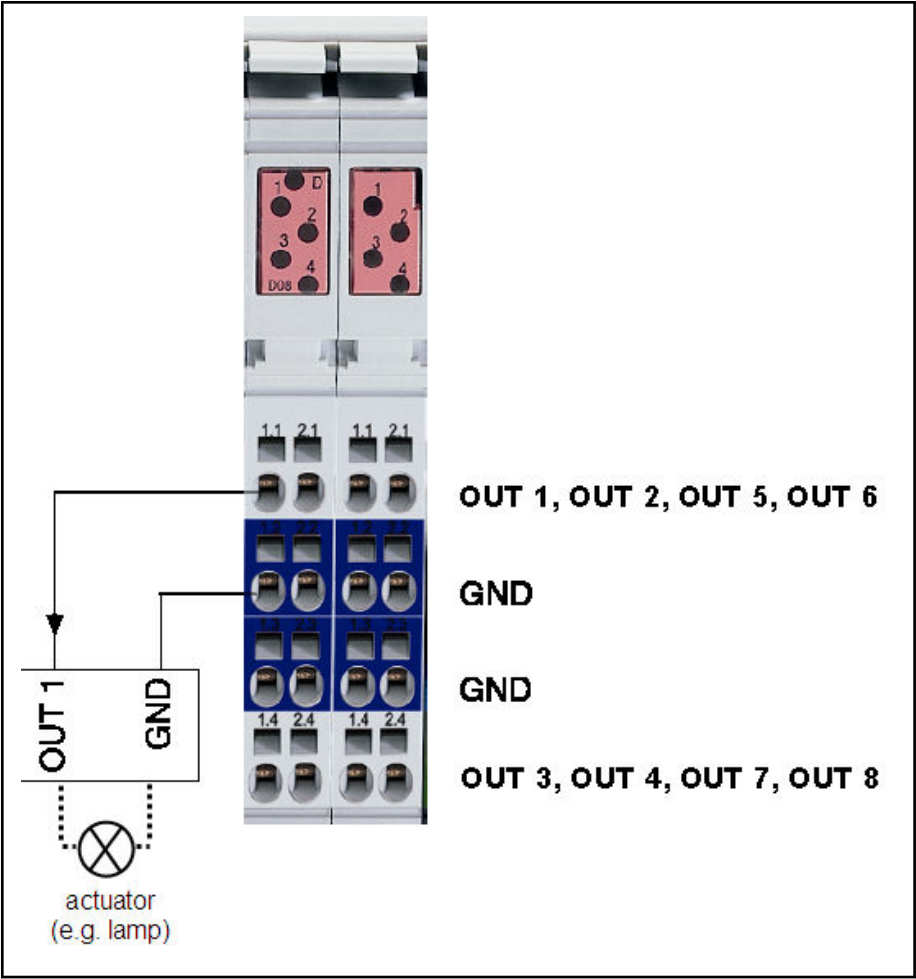


Fig. 5-3: Digital outputs



Check the color-coding of the pins.

|                                        |                                                                                                                                                            |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Number of outputs                      | 8                                                                                                                                                          |
| Connection method                      | 2-wire connection                                                                                                                                          |
| Output type                            | <ul style="list-style-type: none"><li>• Semiconductor outputs, non-saving</li><li>• Protected, with automatic restart</li><li>• Current-carrying</li></ul> |
| Electrical isolation to U <sub>S</sub> | No                                                                                                                                                         |
| Electrical isolation to U <sub>L</sub> | Yes                                                                                                                                                        |
| Output voltage, nominal value          | 24 V                                                                                                                                                       |

|                                            |                                         |
|--------------------------------------------|-----------------------------------------|
| Rated output current:                      |                                         |
| - Nominal value                            | 0.5 A                                   |
| - Maximum value DIN EN 61131-2             | $\leq 0.6$ A                            |
| - Signal 1                                 | 2 mA ... 0.6 A                          |
| - Signal 0 (leakage current)               | $\leq 0.5$ mA                           |
| UL rating                                  |                                         |
| - General purpose                          | 0.5 A                                   |
| - Tungsten                                 | 5 W                                     |
| Maximum total current of the outputs       | 2 A                                     |
| Parallel connection of outputs             | Yes, but only within one terminal       |
| Output delay time                          | $< 500$ $\mu$ s                         |
| Contactor size (at 1 Hz)                   | SG1 (6.2 W)                             |
| Lamp load (at 8 Hz)                        | 5 W                                     |
| Switching frequency:                       |                                         |
| - With ohmic load                          | 100 Hz                                  |
| - With inductive load                      | Function (contactor)                    |
| Overload protection:                       |                                         |
| - Typical current level causing switch-off | 1.2 A                                   |
| - Minimum current level causing switch-off | 0.6 A                                   |
| - Automatic restart at reduced load        | After approx. 10 ms                     |
| Display overload                           | Red collective LED for all<br>8 outputs |
| Limitation of inductive switch-off voltage | Electronically limited to (Vext – 50 V) |
| In nominal mode to                         | Typ. 26 V                               |
| Reverse voltage protection                 | Ensured without connected load          |
| Supply voltage according to EN 61131-2     | 24 V DC                                 |
| Open-circuit power consumption from US     | Typ. 50 mA                              |
| Cable length (unshielded)                  | $< 100$ m                               |

Tab. 5-26: Data of digital outputs

The output terminals are provided with LEDs displaying the respective state of the outputs.

| LEDs 1, 2, 3, 4 | Description                      |
|-----------------|----------------------------------|
| Off             | The respective output is not set |
| Yellow          | The respective output is set     |

Tab. 5-27: Status LEDs of digital outputs

An additional two-color LED (labeled with D) emits green light if 24 V voltage is present and emits red light if there is a short-circuit or overload.

IndraControl controls L45, L65, L75 and L85

| LED D | Description               |
|-------|---------------------------|
| Off   | 24 V missing              |
| Green | 24 V are present          |
| Red   | Short-circuit or overload |

Tab. 5-28: LED D



**Assembly destruction**

*If connected improperly, the assembly might be destroyed. Thus, avoid:*

- Polarity reversal with simultaneous short-circuit of the output cables
- Polarity reversal with simultaneous connection of externally polarized suppressor diodes
- Applying an external voltage > UB

The 0 V reference voltage of the connected loads must be returned to the 0 V connection of the IndraControl Lx5, i. e. a two-pin connection must be ensured. Otherwise, protection from GND breakage cannot be guaranteed.

5.8 Display and operating components

5.8.1 General information

On its front, the IndraControl Lx5 is provided with a single-line display with four operating keys as well as an LED and a reset button.

5.8.2 Display and operating keys

**Display** The display is an LCD display with 8 characters (5 x 10 point matrix).



Fig. 5-4: Display with four operating keys

**Operating keys** The following functions are assigned to the keys below:

| Key                    | Menu navigation    | Input function           |
|------------------------|--------------------|--------------------------|
| <Esc>                  | One level up       | Cancel input             |
| <Down><br>(arrow down) | One menu item down | Decrease parameter value |

| Key                | Menu navigation  | Input function           |
|--------------------|------------------|--------------------------|
| <Up><br>(arrow up) | One menu item up | Increase parameter value |
| <Enter>            | One level down   | Confirm input            |

Tab. 5-29: Functions of the operating keys

### 5.8.3 Reset button and LED

The "Reset" button and a red LED are located below the display.

#### Reset button S1

The "Reset" button can only be pressed with the help of a tool, such as the tip of a pencil.

When the "Reset" button is pressed, the entire module is reset and a forced restart is activated without having to switch off the supply voltages. At the same time, the "Ready" contact is opened.



When the "Reset" button is pressed, the running program processing is aborted.

#### Light-emitting diode

The LED displays the diagnostics/status.

### 5.8.4 Operation and status display

#### General information

The display on the operating panel of the IndraControl Lx5 provides information about the current status of the control system during boot process and operation.

#### Status menu

The status menu is enabled by simultaneously pressing <ESC> and <Enter> for approximately 4 seconds. Call the following functions subsequently via the operating panel using the <arrow down> button:

- Ethernet address (Ethernet)
- firmware version (firmware)
- CPU temperature (temp.)
- Operating hours of the control (OHC CTRL)
- Operating hours of the fan (OHC FAN)
- Control data backup of the CF card (archive)
- Hardware info (HW info)

Press <Enter> in the corresponding display to show the current status.

Click on <ESC> to go to the corresponding predecessor. Press <ESC> for approx. four seconds to exit the status menu and the display switches to "normal" mode.



After approx. 60 seconds, the display automatically switches to "normal mode" if no operation is executed.

### Setting the IP address of the control

The control is delivered by default with the IP address 192.168.142.250.

*Use the operating panel to configure*

- IP address

- firmware version (firmware)
- subnet mask and
- the gateway

Press <ESC> and <Enter> at the same time for approximately 4 seconds. This enables the configuration menu. The display changes to "Ethernet".

Press <Enter> and the set IP address is displayed.

*Display the corresponding values by using the arrow keys to toggle between*

- IP address
- Subnet
- Gateway
- MAC
- Speed

Press <Enter> again in the corresponding display to go to the editor to change the values. Therefore, use the arrow keys. Click on <ESC> to go to the corresponding predecessor.



Keep the arrow keys pressed for a longer period and the numbers start to run automatically.

Click on <Enter> to go to the next characters of the Ethernet address. These are characterized by 3 letters each as shown in the following:

|     |     |     |     |
|-----|-----|-----|-----|
| AAA | BBB | CCC | DDD |
| 192 | 168 | 142 | 250 |

Pressing <Enter> again triggers a safety prompt::

OK: ?

Save your settings with <Enter>. <ESC> cancels the process.

The Ethernet velocity and the duplex settings are determined via "auto negotiation".



The display still shows the old values and these remain applied in the control. Only after a control restart (by pressing <Reset> for example), the modified Ethernet configuration applies and is shown in the display.

## Display of the firmware version

The current firmware version of the IndraControl Lx5 can be read in the display of the operating panel.

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "Firmware" is shown in the display. Press <Enter> to display the current firmware state.



Press <ESC> for approximately 4 seconds to exit the configuration menu and the display switches to "normal mode".



In IndraWorks Engineering, find the firmware version via the "Firmware Management" dialog and, if necessary, update it there. Open the dialog the context menu of the device node "IndraMotion MTX xxx".

## Display of the CPU temperature

The current CPU temperature of the IndraControl Lx5 can be read in the display of the operating panel.

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "Temp." is shown in the display. Press <Enter> to display the current CPU temperature.

## Display of the operating hours of the control

The operating hours of the IndraControl Lx5 can be read in the display of the operating panel.

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "OHC CTRL" is shown in the display. Press <Enter> to display the operating hours of the control.

## Display of the operating hours of the fan

The operating hours of an integrated fan of the IndraControl Lx5 can be read in the display of the operating panel.

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "OHC FAN" is shown in the display. Press <Enter> to display the operating hours of the integrated fan.



If there is no fan mounted at the IndraControl Lx5, "0 h" is displayed when reading the operating hours of the fan.

## Backup and restoration of control data

### General information

A backup and a restoration of the control data on/from the CF card can be carried out via the operating panel. This function can be used to archive and restore control data (RAM file system, MACODA data, tool table, 1st tool table (XML), 2nd tool table (XML), PLC data, permanent CPL variables and system data) on the CF card if required.

Archiving file: "backup\_JJJJ-mm-dd-hh-mm-ss.tar".

Log file: "backup\_JJJJ-mm-dd-hh-mm-ss.log".

### Archiving

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "Archive" is shown in the display. Press <Enter> and the "Backup:" display is displayed. Press <Enter> and the control data is backed up on the CF card. An already existing archive is overwritten. The data backup takes several minutes and is signaled in the "Wait!" display.



Press <ENTER> to start the archiving. If the message "Error: no memory available" is output, the mount directory "cf\_user" cannot be accessed.

Please check the correct setup of the mount directory and the CF card if required.

### Restoration

When restoring control data from the CF card, press <ESC> and <Enter> simultaneously for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "Archive" is shown in the display. Press <Enter> and the "Backup:" display is displayed. Press <Arrow down> until "Restore" is displayed. By pressing

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<Enter> for 4 seconds, restoring of an archive on the CF card is started. This may take several minutes and is completed with a control "reboot".



Press <ENTER> to start the restoration. If the message "Archive not found!" is output, the restoration file "backup\_JJJJ-mm-dd-hh-mm-ss.tar" is not available or the mount access to "cf\_user" does not work.

## Display of the hardware information

Find information on the hardware of the IndraControl Lx5 in the display of the operating panel.

Press <ESC> and <Enter> at the same time for approximately 4 seconds. Thus, the display of the operating panel switches to the configuration menu. Press <Arrow down> until "HW-Info" is shown in the display. Press <Enter> and the parts number of the control (LP number), the hardware change state (hardware version) and the serial number of the control are displayed.

## Displaying information while booting

After the voltage supply has been applied, the following is displayed in the display first "SYSTEM IS BOOTING \* PLEASE WAIT". The individual boot phases are displayed after a few seconds.

*The phases are divided into the following sections:*

1. Booting the operating system: BOOT1.nn
2. Booting the firmware loader: BOOT2.nn
3. Booting the firmware modules BOOT3.nn
4. Loading the control configuration: BOOT4.nn

The FEPROM file system and the file "mtxboot.ini" with the mount point definitions belong to the control configuration.

5. Booting the control configuration: BOOT-Pnn

**The boot phases of the control are defined as follows:**

|             |                                                            |
|-------------|------------------------------------------------------------|
| <b>P -3</b> | Determining the existing hardware                          |
| <b>P -2</b> | RTOS startup, configure file systems                       |
| <b>P -1</b> | Starting RTOS monitor                                      |
| <b>P 1</b>  | Initializing the basic NCS communication                   |
| <b>P 2</b>  | Initializing TCP/IP                                        |
| <b>P 3</b>  | Initializing BAPAS database                                |
| <b>P 4</b>  | Sercos initialization                                      |
| <b>P 5</b>  | Starting NCB-TCP server                                    |
| <b>P 6</b>  | Starting Sercos startup                                    |
| <b>P 7</b>  | Mount NFS file systems                                     |
| <b>P 8</b>  | Synchronization with Sercos                                |
| <b>P 9</b>  | Sharing NCB-TCP server (communication with user interface) |
| <b>RUN</b>  | Normal operation                                           |

Tab. 5-30: Display of startup phases

## Boot lock and startup mode specification

The IndraControl Lx5 normally boots with the startup mode 0 (normal mode). If another Startup mode is to be specified, block the boot process first (boot lock).

The boot lock is enabled if, after loading the control system configuration - that is at the end of phase "Boot4.nn" - <ESC> is pressed until the display shows "BOOT-S n". The control expects that the Startup mode is entered.

The Startup mode is selected with the arrow keys. The default value is "0". Click on <Enter> to continue the booting with the selected Startup mode.

If the control is always to be started with a certain Startup mode, save the previous mode. Therefore, press <Enter> and <Arrow down> at the same time.

The following table describes the Startup modes:

| Startup mode | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0            | Normal operation<br>All existing data and file systems are retained. The root file system is checked at startup. If a defective file system is detected, a critical system error is displayed. A new empty root file system is automatically created at next startup.                                                                                                                                                                                                  |
| 1            | PLC STOP<br>The behavior corresponds to Startup mode 0 with the difference that the PLC remains in the STOP state and the PLC user program is not processed.                                                                                                                                                                                                                                                                                                           |
| 2            | Reload the PLC boot project<br>The PLC boot project is loaded from the user FEPRM. Any PLC project in the root file system is discarded. Otherwise, the behavior corresponds to the startup mode 0.                                                                                                                                                                                                                                                                    |
| 3            | Save startup<br>In rare cases, due to faulty machine parameter specifications, a control startup can be impossible. Startup mode 3 is used to carry out a startup in this error situation irrespective of the set machine parameters. A startup with the minimum configuration is executed. The machine parameters set are ignored. After the startup, the invalid machine parameter settings can be corrected and a new startup in Startup mode 0 can be carried out. |
| 4            | Delete permanent CPL variables and system data<br>The permanent CPL variables and system data are deleted. Otherwise, the behavior corresponds to Startup mode 0.                                                                                                                                                                                                                                                                                                      |
| 5            | Cold start<br>The power-up management logic is not run through. Otherwise, the behavior corresponds to Startup mode 0.                                                                                                                                                                                                                                                                                                                                                 |
| 6            | Bootstrap<br>A new root file system is created. As a result, all old file system data is lost. If an intact user FEPRM file system is available, the PLC boot project is loaded and copied to the root file system.                                                                                                                                                                                                                                                    |
| 7            | Recreating the user FEPRM file system<br>The user FEPRM is created again. As a result, all old file system data is lost. This is required for example if a user FEPRM file system is defective. The root file system is retained. The permanent CPL variables and system data are deleted.                                                                                                                                                                             |
| 8            | Identical to startup mode 9                                                                                                                                                                                                                                                                                                                                                                                                                                            |

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|    |                                                                                                                                                                                                                              |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9  | Debug mode<br>This is normally for debugging if the control does not automatically boot after a reset. After the basic monitor has been initialized, the boot loader is enabled and the subsystems are automatically loaded. |
| 10 | Debug mode (without automatic loading)<br>After the basic monitor has been initialized, the boot loader is enabled. Further loading can take place via TCP/IP.                                                               |
| 11 | Debug mode (without automatic loading)<br>The basic monitor is initialized. Further loading can take place via TCP/IP.                                                                                                       |
| 12 | Identical to Startup mode 15                                                                                                                                                                                                 |
| 13 | Identical to Startup mode 15                                                                                                                                                                                                 |
| 14 | Identical to Startup mode 15                                                                                                                                                                                                 |
| 15 | Debug mode (basic monitor start)<br>Only the basic monitor is enabled.                                                                                                                                                       |

Tab. 5-31: Startup mode

## Display of the PLC state

After complete control startup, the current PLC state is displayed in the right half of the display.

There are the following displays:

|             |                                                                                                                                        |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------|
| ---         | No PLC program loaded                                                                                                                  |
| <b>STOP</b> | PLC is in STOP state. The PLC program was stopped. If this state is directly enabled after control startup, no boot project is active. |
| <b>RUN</b>  | PLC is in RUN state. The loaded PLC program is executed.                                                                               |
| <b>BRK</b>  | The PLC is on a breakpoint. The PLC program is interrupted for debugging purposes.                                                     |
| <b>SCYC</b> | The PLC operates in single-cycle mode. Each PLC cycle has to be enabled manually.                                                      |
| <b>ERR</b>  | The PLC program was interrupted due to a runtime error.                                                                                |
| <b>???</b>  | The PLC reports an unknown state. This display refers to a firmware error and should never occur.                                      |

Tab. 5-32: Operating states of the PLC

## Display of the Sercos phases

After complete control startup, the current state of the Sercos interface is displayed on the left of the display. There are the following displays:

|             |                                                         |
|-------------|---------------------------------------------------------|
| <b>P -1</b> | The Sercos ring is not closed. No drives were detected. |
| <b>P 0</b>  | It is tried to close the Sercos ring.                   |
| <b>P 1</b>  | It is tried to identify all devices in the Sercos ring. |
| <b>P 2</b>  | The timing in the Sercos ring is determined and set.    |
| <b>P 3</b>  | The drives are parameterized.                           |
| <b>P 4</b>  | All Sercos devices are ready for operation.             |

Tab. 5-33: Display of the Sercos phases

## Error displays

Severe errors are shown on the display during operation of the control. These errors can only be eliminated with a reboot. If necessary, a suitable startup mode has to be selected before.

|           |                                                  |
|-----------|--------------------------------------------------|
| <b>SF</b> | Critical system error is pending (system fault). |
| <b>FE</b> | Boot panic error is present (fatal error).       |

Tab. 5-34: Error status display

The errors are specified more in detail by four-digit numbers. They are described in detail in the manual "Diagnostic Messages".

Furthermore, the following loading errors can be displayed:

|                                |                                                          |
|--------------------------------|----------------------------------------------------------|
| <b>ERR NoFw</b>                | No valid firmware detected                               |
| <b>ERR SRAM</b>                | Not equipped with SRAM module                            |
| <b>Check Ethernet settings</b> | Ethernet mask incorrect or gateway not in the set subnet |

Tab. 5-35: Displaying further errors



By pressing <ESC> and <Arrow up> for approximately 4 seconds or the Reset button (S1) on the operating panel, a control reboot is triggered.

## 5.9 Switching on the control

The IndraControl Lx5, is started by switching on the power supply. If "Pxx --" (no PLC boot project) or "Pxx RUN" (PLC program is executed) is displayed, the start is completed.

If an IndraControl Lx5 is switched on with a new CF memory card for the first time, "HW-INIT" is displayed after booting. Wait until the display with "PWRCYCLE" starts to flash. Switch the power supply off and on again. "Pxx --" (no PLC boot project) or "Pxx RUN" (PLC program is executed) is displayed after restart. The start is now completed.



If "HW-INIT" is displayed in the display, the control must not be switched off. If it is switched off, the Sercos connection is damaged.

## 5.10 Design

IndraControl Lx5 controls are available under the following designation:

| Type                      | Note                                                    |
|---------------------------|---------------------------------------------------------|
| CML45.1-3P-504-NA-NNN-NW  | Processor AMD LX800, 500 MHz, 256 MB DRAM, 8 MB SRAM    |
| CML65.1-3P-504-NA-NNNN-NW | Processor Intel Celeron M 1 GHz, 256 MB DRAM, 8 MB SRAM |

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| Type                      | Note                                                           |
|---------------------------|----------------------------------------------------------------|
| CML75.1-3P-905-NA-NNNN-NW | Processor Intel Atom E3827, 1.75 GHz, 4096 MB DRAM, 16 MB SRAM |
| CML85.1-3P-705-NA-NNNN-NW | Processor Intel Core2Duo 1.2 GHz, 1024 MB DRAM, 16 MB SRAM     |

Tab. 5-36: Ordering code of the IndraControl Lx5

## 5.11 Wear parts

Certain IndraControl Lx5 control components are subject to natural wear. Wear parts have a limited service life and are thus not subject to any warranty.

| Wear part | Service life         | Type                     | Part number |
|-----------|----------------------|--------------------------|-------------|
| Display   | 60.000 hours at 23°C | OPERATING PANEL STANDARD | R911293458  |
| Battery   | 5 years              | CAP01.1-B2               | R911170806  |
| Fan       | 95.000 hours at 24°C | CAL01.1-F2               | R911171153  |

Tab. 5-37: Wear parts

## 5.12 Accessories

### 5.12.1 Connector set

The following connector set is available for the power supply of the IndraControl Lx5 and for the Inline onboard I/Os:

| Type                  | Note                               |
|-----------------------|------------------------------------|
| R-IB IL CML S01-PLSET | Connector set for IndraControl Lx5 |

Tab. 5-38: Connector set R-IB IL CML S01.PLSET

### 5.12.2 Labels

The following labels are available for the Inline connectors:

| Type            | Note                         |
|-----------------|------------------------------|
| R-IB IL FIELD 2 | Labels for Inline connectors |

Tab. 5-39: Labels R-IB IL FIELD 2

## 5.13 Documentation

The following documentation provides a detailed description of the IndraControl Lx5:

DOK-CONTRL-ICL45L65L85-PRxx-EN-P

DOK-CONTRL-IC\*LX5\*\*\*\*\*-ITRS-EN-P

## 6 VPP 16.3/40.3 compact industrial PC

### 6.1 Brief description

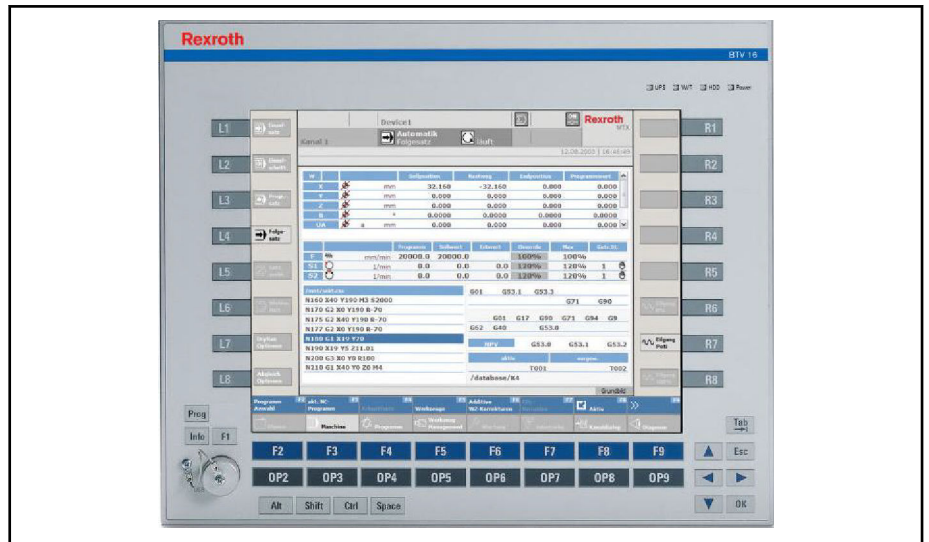


Fig. 6-1: VPP 16.3 compact industrial PC with 12" color display

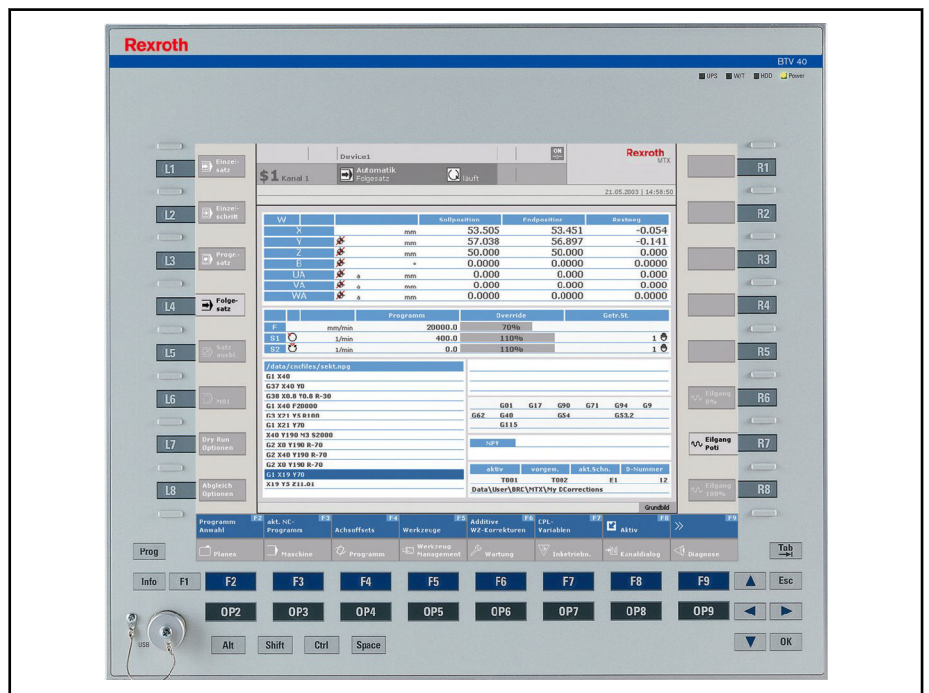


Fig. 6-2: VPP 40.3 compact industrial PC with 15" color display

VPP 16.3/40.3 operating devices are active PC-based operating and visualization terminals with a high capability for industrial environments. These PCs are mainly installed in an operator console or in a control cabinet wall. They are used for programming, visualization and operation of the CNC system MTX.

### 6.2 Field of application

The compact industrial PCs VPP 16.3/40.3 can be used for all applications from standard requirements to high-end requirements.

## 6.3 Technical data

|                    |    | VPP 16.3                                 | VPP 40.3          |
|--------------------|----|------------------------------------------|-------------------|
| Display            |    | 12" color display                        | 15" color display |
| Front panel design |    | 16 machine function keys or touch screen |                   |
| PC box             |    | 1, 2 or 4 slots                          |                   |
| Processor          | D4 | Core i5-520M, 2.4 GHz, 3 MB L2 cache     |                   |
|                    | D5 | Core i7-620M, 2.66 GHz, 4 MB L2 cache    |                   |
|                    | C3 | Celeron P4500 1.86 GHz, 2 MB L2 cache    |                   |
| Main memory        |    | 1 GB, 2 GB or 4 GB RAM                   |                   |
| Supply voltage     |    | 24 V DC                                  |                   |

Tab. 6-1: Technical data, VPP 16/40

## 6.4 Wear parts

Parts with a limited service life in the compact industrial VPP16.3/40.3 PC are not subject to warranty.

*The following components are affected:*

- Hard disk
- CMOS battery
- Fan
- Backlighting

For the service life of the individual components, refer to the documentations (see [chapter 6.7 "Documentation" on page 47](#)).

## 6.5 Variants

### 6.5.1 Control PCs with Core i5-520M Processor (D4)

| Type                          | Display/<br>Front | Slots | Random access<br>memory | Hard disk |
|-------------------------------|-------------------|-------|-------------------------|-----------|
| VPP40.3BIM-2G0NN-D4D-DN-NN-FW | 15" / 16 MKeys    | 4     | 2 GB                    | 1 x HDD   |
| VPP40.3BIM-2G0NN-D4D-FN-NN-FW | 15" / 16 MKeys    | 4     | 2 GB                    | 1 x SSD   |
| VPP40.3DEM-2G0NN-D4D-DN-NN-FW | 15"/touch         | 4     | 2 GB                    | 1 x HDD   |

Tab. 6-2: VPP 16.3/40.3 variants with Core i5-520M Processor (D4)

### 6.5.2 Control PCs with Core i7-620M Processor (D5)

| Type                          | Display/<br>Front | Slots | Random access<br>memory | Hard disk |
|-------------------------------|-------------------|-------|-------------------------|-----------|
| VPP40.3BIM-4G0NN-D5D-DN-NN-FW | 15" / 16 MKeys    | 4     | 4 GB                    | 1 x HDD   |
| VPP40.3DEM-4G0NN-D5D-DN-NN-FW | 15"/touch         | 4     | 4 GB                    | 1 x HDD   |

Tab. 6-3: VPP 16.3/40.3 variants with Core i7-620M Processor (D5)

### 6.5.3 Control PCs with Celeron P4500 Processor (C3)

| Type                          | Display/<br>Front | Slots | Random access<br>memory | Hard disk |
|-------------------------------|-------------------|-------|-------------------------|-----------|
| VPP40.3BIK-2G0NN-C3D-DN-NN-FW | 15" / 16 MKeys    | 1     | 2 GB                    | 1 x HDD   |
| VPP40.3DEK-2G0NN-C3D-DN-NN-FW | 15"/touch         | 1     | 2 GB                    | 1 x HDD   |

Tab. 6-4: VPP 16.3/40.3 variants with Celeron P4500 Processor (C3)

## 6.6 Accessories

### 6.6.1 Accessories for VPP 16.3/40.3

| Type                    | Remarks                                                                                            |
|-------------------------|----------------------------------------------------------------------------------------------------|
| 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                                   |
| RKB0019/...             | USB interface cable to connect the uninterrupted power supply; lengths: 0.5 m; 1.0 m; 3.0 m; 5.0 m |

Tab. 6-5: VPP 16.3 / 40.3 accessories

## 6.7 Documentation

The following documentation provides a detailed description of the compact industrial PCs VPP 16.3/40.3:

- DOK-SUPPL\*-VPP\*XX.3\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VAU\*01.1U\*\*-PRxx-EN-P



## 7 Control cabinet PC VPB 40.x with VDP operating display

### 7.1 Brief description

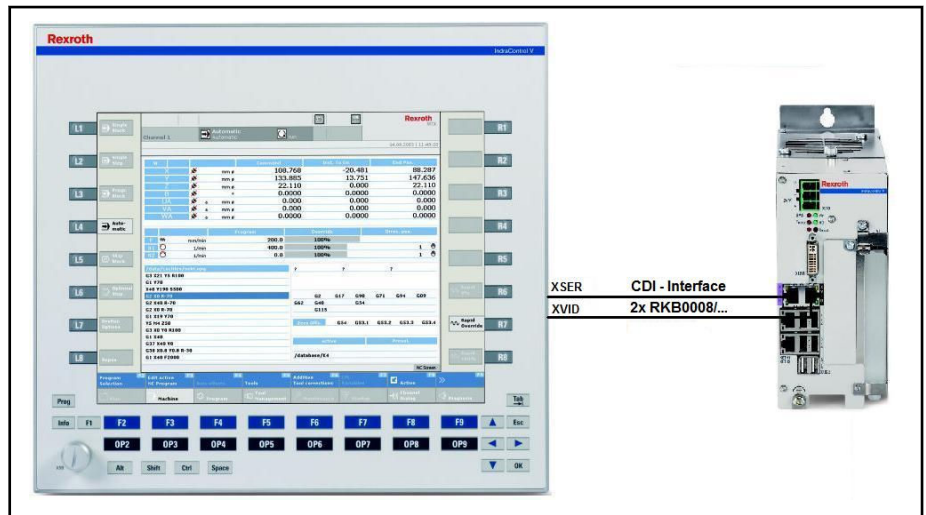


Fig. 7-1: Control cabinet PC VPB 40.3 with VDP operating display VDP 40.3

The VPB 40.x 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.x 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 interface connects the VDP and VPB 40.x.

### 7.2 Field of application

The control cabinet PC VPB 40.x is used in industrial environments with increased vibration and shock requirements.

### 7.3 Technical data

#### 7.3.1 VPB 40.3

| Name         |    | VPB40.3                                |
|--------------|----|----------------------------------------|
| PC box       |    | 1, 2 or 4 slots                        |
| Processor    | C3 | Celeron P4500, 1.86 GHz, 2 MB L2 Cache |
|              | D4 | Core i5-520M, 2.4 GHz, 3 MB L2 cache   |
|              | D5 | Core i7-620M, 2.66 GHz, 4 MB L2 cache  |
|              | D6 | Core i7-3612QE, 2.1 GHz, 6 MB L2 cache |
| Main memory  |    | 4 GB RAM                               |
| Power supply |    | 24 V DC                                |

Tab. 7-1: Technical data, VPB 40.3

## 7.3.2 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. 7-2: Technical data of the VPB 40.4

## 7.3.3 VDP 15.3, 16.3, 18.3, 21.3 and 40.3

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

Tab. 7-3: Technical data VDPs

All VDPs require a power supply of 24 V DC.

## 7.4 Wear parts

Parts with a limited service life installed in the control cabinet PC VPB40.3 and in the VDP operating displays are not subject to warranty.

*The following components are affected:*

- Hard disk
- CMOS battery
- Fan
- Backlighting

For the service life of the individual components, refer to the documentations (see [chapter 7.9 "Documentation" on page 53](#)).

## 7.5 Variants control cabinet PC VPB40.3

### 7.5.1 Core i5-520M Processor (D4)

| Type                          | Slots | RAM  | Hard disk |
|-------------------------------|-------|------|-----------|
| VPB40.3D1L-2G0NN-D4D-DN-NN-FW | 2     | 2 GB | 1 x HDD   |
| VPB40.3D1L-2G0NN-D4D-FN-NN-FW | 2     | 2 GB | 1 x SSD   |

Tab. 7-4: VPB40.3 variants with Core i5-520M processor (D4)

### 7.5.2 Core i7-620M Processor (D5)

| Type                          | Slots | RAM  | Hard disk |
|-------------------------------|-------|------|-----------|
| VPB40.3D1L-4G0NN-D5D-DN-NN-FW | 2     | 4 GB | 1 x HDD   |
| VPB40.3D1L-4G0NN-D5D-FN-NN-FW | 2     | 4 GB | 1 x SSD   |
| VPB40.3D1M-4G0NN-D5D-FN-NN-FW | 4     | 4 GB | 1 x SSD   |

Tab. 7-5: VPB40.3 variants with Core i7-620M processor (D5)

### 7.5.3 Core i7-3612QE Processor (D6)

| Type                          | Slots | RAM  | Hard disk |
|-------------------------------|-------|------|-----------|
| VPB40.3D1L-4G0NN-D6D-DN-NN-FW | 2     | 4 GB | 1 x HDD   |
| VPB40.3D1L-4G0NN-D6D-FN-NN-FW | 2     | 4 GB | 1 x SSD   |
| VPB40.3D1M-4G0NN-D6D-FN-NN-FW | 4     | 4 GB | 1 x SSD   |

Tab. 7-6: VPB40.3 variants with Core i7-3612QE processor (D6)

### 7.5.4 Celeron P4500 Processor (C3)

| Type                          | Slots | RAM  | Hard disk |
|-------------------------------|-------|------|-----------|
| VPB40.3D1L-2G0NN-C3D-DN-NN-FW | 1     | 2 GB | 1 x HDD   |

Tab. 7-7: Variants VPB40.3 with Celeron P4500 processor (C3)

## 7.6 Variants of the control cabinet PC VPB 40.4 (D7)

### 7.6.1 Core i5-6300U, 2.40 GHz

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

## Control cabinet PC VPB 40.x with VDP operating display

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

Tab. 7-8: VPB40.3 variants with Core i5-520M processor (D4)

## 7.6.2 Core i7-6820EQ, 2.80 GHz (D8)

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

Tab. 7-9: VPB40.3 variants with Core i7-3612QE processor (D6)

## 7.7 Variants of the operating displays

### 7.7.1 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. 7-10: Selection VDP 15.3, 18.3, 21.3

### 7.7.2 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. 7-11: VDP16.3 selection

### 7.7.3 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. 7-12: VDP40.3 selection

## 7.8 Accessories

### 7.8.1 Connecting Cable (CDI Interface)

The connection between the control cabinet PC VPB 40.3 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. 7-13: Connecting cable VPB 40.3 - VDP



Two connecting cables of type RKB0008/... are required for connecting a VPB 40.3 and a VDP.

### 7.8.2 VPB 40.X 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. 7-14: VPB 40.3 accessories

## 7.9 Documentation

The following documentations provide a detailed description of the control cabinet PC VPB 40.x:

- DOK-SUPPL\*-VPB\*40.3\*\*\*-PRxx-EN-P

## Control cabinet PC VPB 40.x with VDP operating display

- DOK-SUPPL\*-VPB\*40.3\*\*\*-ITRS-EN-P
- DOK-SUPPL\*-VAU\*01.1U\*\*-PRxx-EN-P
- DOK-SUPPL\*-VPB\*40.4\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VPB\*40.4\*\*\*-ITRS-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

## 8 Embedded terminal VEP40.4/50.4

### 8.1 Brief description

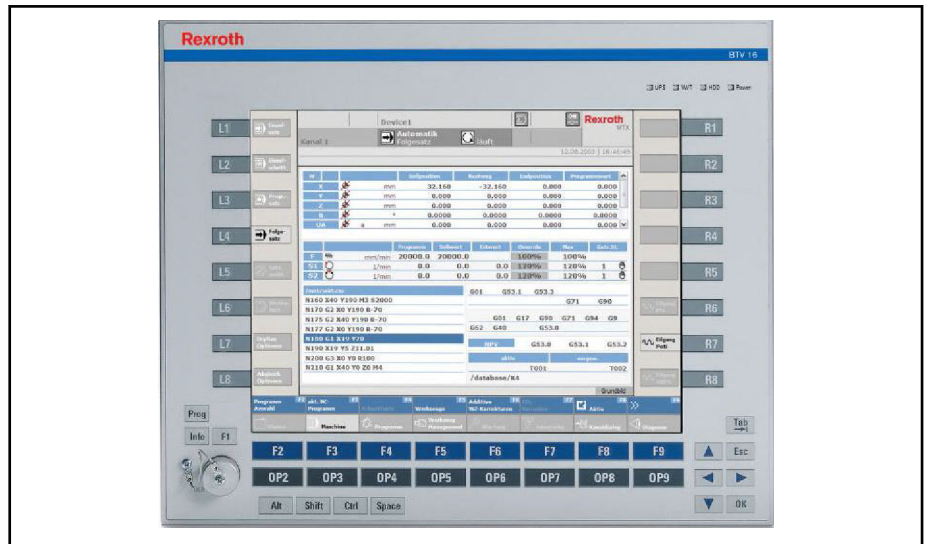


Fig. 8-1: Embedded terminal with 12" color display

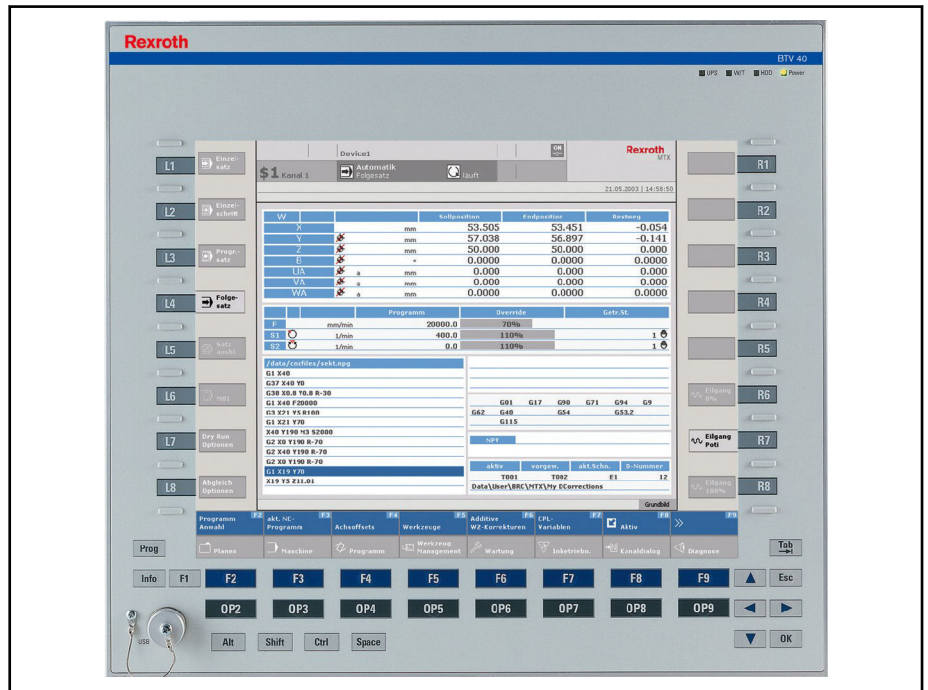


Fig. 8-2: Embedded terminal with 15" color display

The embedded terminals IndraControl VEP40.4/50.4 are PC-based operating and visualization terminals suitable for industrial applications. These PCs are mainly installed in an operator console or in a control cabinet wall. The operator panels of these industrial PCs are optimized with other modules (machine operator panel and PC keyboards) in design and construction to ideally operate and visualize a tool machine.

## 8.2 Technical data

|                    |          | VEP40.4                                                 | VEP50.4           |
|--------------------|----------|---------------------------------------------------------|-------------------|
| Display            |          | 12" color display                                       | 15" color display |
| Front panel design |          | 16 machine function keys with touch screen              |                   |
| Processor          | A2<br>MA | Intel Atom 510, min. 1.1 GHz<br>Pentium M, min. 600 MHz |                   |
| Main memory        |          | 1 GB RAM                                                |                   |
| Supply voltage     |          | 24 V DC                                                 |                   |

Tab. 8-1: Technical data VEP40.4/50.4

## 8.3 Wear parts

Parts with a limited service life in the embedded terminals VEP40.4/50.3 16.3/40.3 PC are not subject to warranty:

- CMOS battery
- LCD display

## 8.4 Variants

| Type                           | Display | Processor      | Front                                          |
|--------------------------------|---------|----------------|------------------------------------------------|
| VEP40.4BKN-512NN-A2D-NNN-NN-FW | 12"     | Intel Atom 510 | with 16 machine function keys                  |
| VEP40.4EIN-512NN-MAD-NNN-NN-FW | 12"     | Pentium M      | with 16 machine function keys and touch screen |
| VEP50.4BIN-512NN-2AD-NNN-NN-FW | 15"     | Intel Atom 510 | with 16 machine function keys                  |
| VEP50.4DFN-512NN-MAD-NNN-NN-FW | 15"     | Pentium M      | with 16 machine function keys and touch screen |

Tab. 8-2: VEP40.4/50.4 selection

## 8.5 Accessories

### 8.5.1 Accessories for VEP40.4/50.4

| Type                    | Remarks                         |
|-------------------------|---------------------------------|
| VAP01.1H-W23-024-010-NN | Power supply unit 24 V DC; 10 A |

Tab. 8-3: Accessories for the VEP40.4/50.4

### 8.5.2 Spare battery

Order the spare battery for the VEP40.4/50.4 under the following designation:

| Type       | Remarks    |
|------------|------------|
| CAP01.1-B2 | R911170806 |

Tab. 8-4: Accessories for the VEP40.4/50.4

## 8.6 Documentation

The following documentation provides a detailed description of the Embedded terminals VEP40.4/50.4:

- DOK-SUPPL\*-VEP\*XX.4\*\*\*-PRxx-EN-P

## 9 VCP small operator panel

### 9.1 Brief description

VCP small operator panels are operating and visualization terminals to operate and monitor machines. The devices can be used for different purposes due to their compact design. The communication to the higher-level control is established via a PROFIBUS interface.



Fig. 9-1: VCP 02 small operator panel



Fig. 9-2: VCP 05 small operator panel



Fig. 9-3: VCP 08 small operator panel

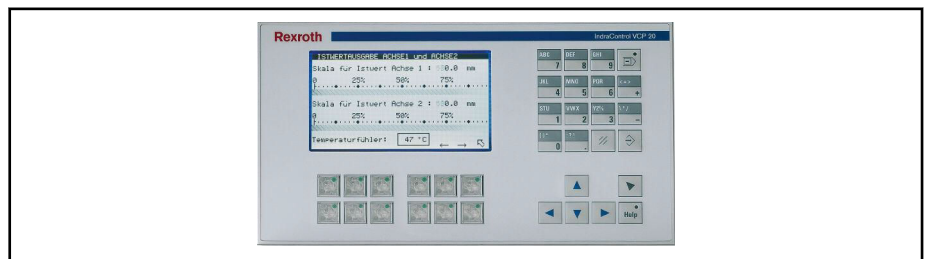


Fig. 9-4: VCP 20 small operator panel

## VCP small operator panel



Fig. 9-5: VCP 25 small operator panel



Fig. 9-6: VCP35 small operator panel

## 9.2 Technical data

|                      | VCP02                                                                   | VCP05        | VCP08        | VCP20                                  | VCP25                                  | VCP35                                  |
|----------------------|-------------------------------------------------------------------------|--------------|--------------|----------------------------------------|----------------------------------------|----------------------------------------|
| Display              | 3" graphic display, 160 x 80 pixel                                      |              |              | 5.7" graphic display, 320 x 240 pixels | 5.7" graphic display, 320 x 240 pixels | 10.4" graphic display, 640 x 480 pixel |
| Front panel          | 100 x 148 mm                                                            | 168 x 120 mm | 159 x 209 mm | 160 x 300 mm                           | 180 x 234 mm                           | 249 x 328 mm                           |
| Function/system keys | 4 / 7                                                                   | 6 / 24       |              | 16 / 22                                | Touch screen                           | Touch screen                           |
| Processor            | ARM 200 MHz                                                             |              |              |                                        |                                        |                                        |
| Application memory   | 3 MB                                                                    |              |              |                                        |                                        |                                        |
| Interfaces           | 1x Ethernet (10/100 Base T)<br>2x USB host 2.0<br>Profibus DP interface |              |              |                                        |                                        |                                        |
| Power supply         | 24 V DC                                                                 |              |              |                                        |                                        |                                        |

Tab. 9-1: Technical data, VCP small operator panel

## 9.3 Variants

The following types of VCP small operator panels are available:

- VCP02.2DRN-003-PB-NN-PW
- VCP05.2DSN-003-PB-NN-PW
- VCP08.2DTN-003-PB-NN-PW
- VCP20.2DUN-003-PB-NN-PW

- VCP25.2DVN-003-PB-NN-PW
- VCP35.2ECN-003-PB-NN-PW

## 9.4 Accessories

### 9.4.1 Connecting Cables (PROFIBUS Interface)

The communication between the VCP small operator panels and the MTX control modules is established via the PROFIBUS DP. The following assembled cables are available:

| Type          | Note                                                                                                               |
|---------------|--------------------------------------------------------------------------------------------------------------------|
| IKB0034/000,0 | Connection between IndraControl P40/P60/VAM and VCP. Cables assembled at one end; Variable length                  |
| IKB0049/000,0 | Connection between VCP and Rexroth Fieldline modules; assembled at one side, M12 female connector, variable length |

Tab. 9-2: PROFIBUS connecting cables

## 9.5 Documentation

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

- DOK-SUPPL\*-VCP\*02.2\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VCP\*05.2\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VCP\*08.2\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VCP\*20.2\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VCP\*25.2\*\*\*-PRxx-EN-P
- DOK-SUPPL\*-VCP\*35.2\*\*\*-PRxx-EN-P



## 10 Small operator panel VR21xx

### 10.1 Brief description

VR21xx 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. 10-1: 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,<br>B: 132 mm  |
| VR2107  | 7 "     | 150 mm        | 211 mm       | 46.3 mm        | H: 142 mm,<br>B: 203 mm |

Tab. 10-1: Variants VR21xx

### 10.2 Technical data

|                           | VR2104 Singletouch                                                                                             | VR2107 Singletouch                                                                         | VR2107 Multitouch                   |
|---------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------|
| Display                   | 4,3 " TFT<br>480 x 272 Pixel<br>95.0 mm x 53.8 mm x 177 mm<br>65536 colors<br>450 cd/m <sup>2</sup> brightness | 9 " TFT<br>800 x 480 Pixel<br>152.4 mm x 91.4 mm<br>262144 colors<br>350 cd/m <sup>2</sup> |                                     |
| Touch technology          | Analog resistive, 4-wire technology                                                                            |                                                                                            | Configured capacitively<br>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)<br>0.3 A (maximum)                     | 0.3 A (typically at 24 V)<br>0.4 A (maximum) | 0.4 A (typically at 24 V)<br>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. 10-2: Technical data VR21xx

## 10.3 Interfaces

### 10.3.1 Power supply X1

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

Tab. 10-3: Power supply X1

### 10.3.2 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.

### 10.3.3 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. 10-4: Ethernet interface X5

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

Tab. 10-5: Diagnostic LEDs of the Ethernet interface

### 10.3.4 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.

## 10.4 Wear parts

### 10.4.1 Backlight

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. 10-6: Half-value display times

### 10.4.2 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

## 10.5 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. 10-7: VR21xx variants

## 10.6 Documentation

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

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



## **11 PR | VR | DR**

### **11.1 Brief description**

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

### **11.2 Field of application**

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

### **11.3 Variants of control cabinet PC PR3/PR4**

#### **11.3.1 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. 11-1: 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 LTSP                                                                                                      |                                                                                                                                 |                                |                                  |
| 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<br><br>2 x RS-232/DB9<br><br>2 x RS-422/485/DB9<br><br>4G: LTE/HSPA+/GPRS and GPS<br><br>16 DI, 8 DO | 2 x Gbit/RJ-45/Intel i350<br><br>2 x RS-232/DB9<br><br>2 x RS-422/485/DB9<br><br>4 G: LTE/HSPA+/GPRS and GPS<br><br>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)<br>8 (option)                                                                                                          | 8 (standard)<br>16 (option)                                                                                                     |                                |                                  |
| Interfaces                    |                                                                                                                                     |                                                                                                                                 |                                |                                  |

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

Tab. 11-1: Technical data

## 11.4 Variants of the operating displays

### 11.4.1 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. 11-2: 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")<br>Widescreen                                                                                         | 546 mm (21")<br>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<br>2 x RS-232/DB9<br>2 x RS-422/485/DB9<br>4 G: LTE/HSPA+/GPRS and GPS<br>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)<br>2 x USB 2.0<br>2 x USB 3.0<br>1 x RS-232<br>1 x RS-232/422/485                                |                            |
| Video                         | Display port (standard)<br>Long distance video CDI+ (option)                                                         |                            |

Tab. 11-2: VR31xx

| Type                          | VR4115                                                                                                          | VR4215                            | VR4315                            | VR4121                            | VR4221                            | VR4321                            |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|
| Processor                     |                                                                                                                 |                                   |                                   |                                   |                                   |                                   |
| CPU                           | INTEL Core<br>i3-6100U<br>2 x 2.3                                                                               | INTEL Core<br>i7-6600U<br>2 x 2.6 | INTEL Core<br>i7-6600U<br>2 x 2.6 | INTEL Core<br>i3-6100U<br>2 x 2.3 | INTEL Core<br>i7-6600U<br>2 x 2.6 | INTEL Core<br>i7-6600U<br>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<br>4 G: LTE/HSPA+/GPRS and GPS                                                                   |                                   |                                   |                                   |                                   |                                   |
| mPCIe extension (external)    | 2 x Gbit/RJ-45/Intel i350<br>2 x RS-232/DB9<br>2 x RS-422/485/DB9<br>4 G: LTE/HSPA+/GPRS and GPS<br>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-<br>tion   | 8 (standard), 16 (option)                                                                                    |        |        |        |        |        |
| Interfaces         |                                                                                                              |        |        |        |        |        |
| Type               | 2 x Gbit LAN (i210)<br>1 x Gbit LAN (i219)<br>2 x USB 2.0<br>2 x USB 3.0<br>1 x RS-232<br>1 x RS-232/422/485 |        |        |        |        |        |
| Video              | Display port (standard)<br>Long distance video CDI+ (option)                                                 |        |        |        |        |        |

Tab. 11-3: VR4yxx

## 11.4.2 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. 11-3: 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")<br>Widescreen   | 470 mm (18.5")<br>Widescreen | 546 mm (21.5")<br>Widescreen |
| Colors     | 16 m                           |                              |                              |
| Resolution | 1366 * 768                     | 1366 * 768                   | 1920 * 1080                  |
| Material   | Tempered glass front           |                              |                              |
| Operation  |                                |                              |                              |
| Type       | Capacitive 10-point multitouch |                              |                              |

Tab. 11-4: Technical data DR devices

## 11.5 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. 11-5: VPB 40.3 accessories

## 11.6 Wear parts

### 11.6.1 The CMOS battery

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

## 11.7 Documentation

The following documentations provide a detailed description:

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

## 12 VAM machine operator panel

### 12.1 Brief description

The machine operator panels IndraControl 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 and 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.

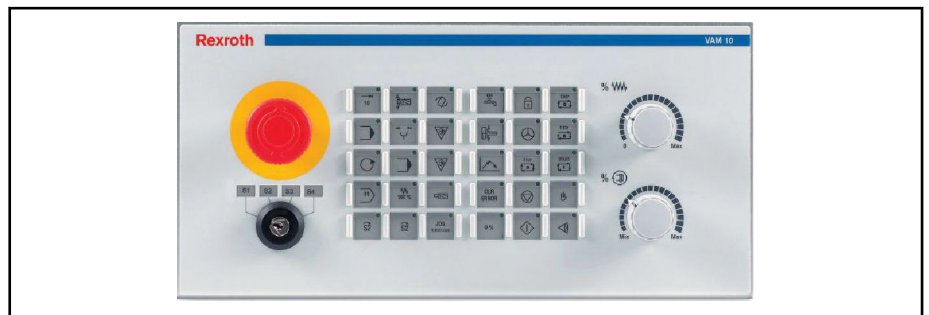


Fig. 12-1: VAM 40 machine operator panel

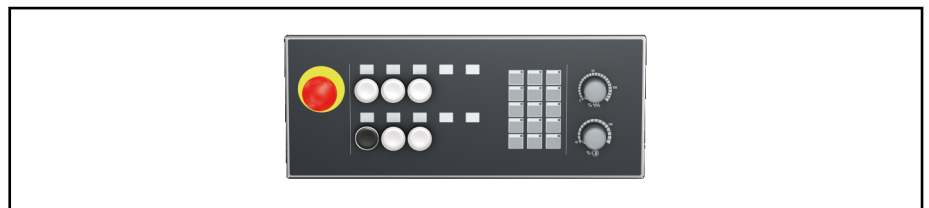


Fig. 12-2: VAM 15.1 machine operator panel

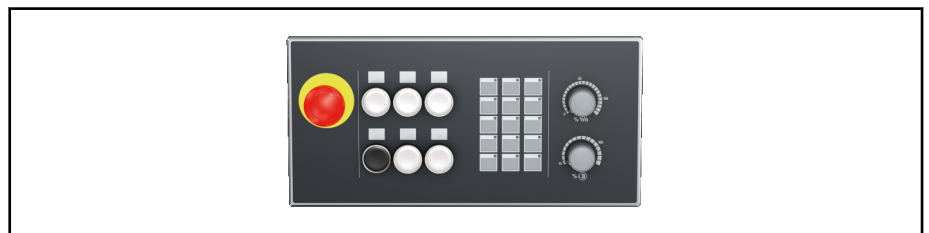


Fig. 12-3: VAM 21.1 machine operator panel

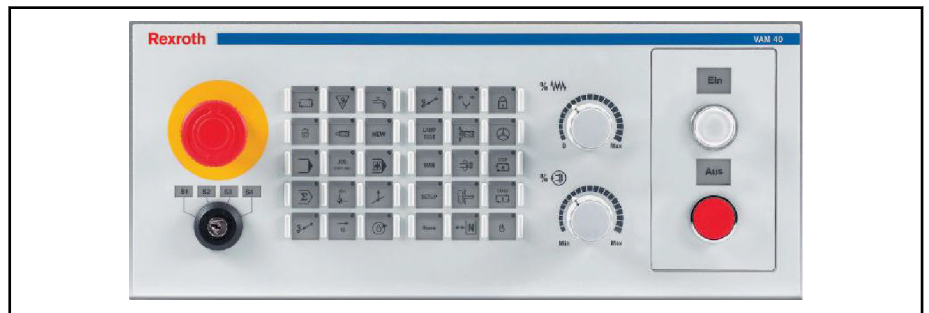


Fig. 12-4: VAM 40 machine operator panel

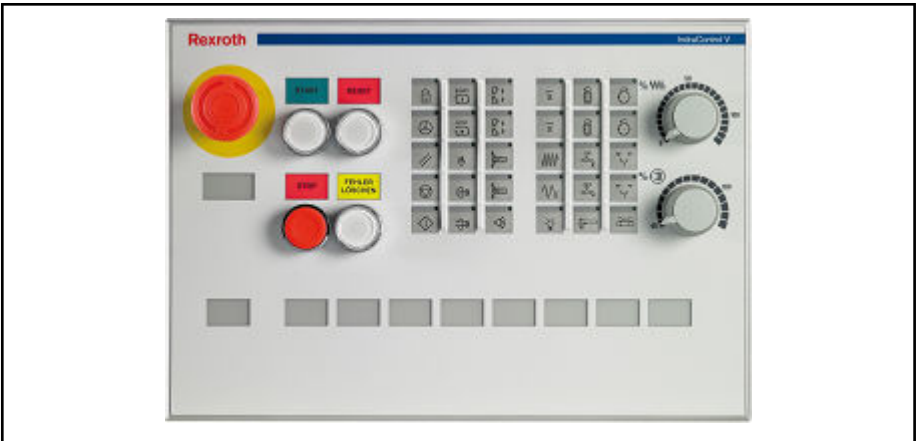


Fig. 12-5: VAM12 machine operator panel



Fig. 12-6: VAM42 machine operator panel

12.2 Variants

12.2.1 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. 12-1: Operator panels with PROFIBUS DP interface

12.2.2 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. 12-2: Operator panels with Sercos interface

## 12.3 Accessories

### 12.3.1 Connecting cables (PROFIBUS DP interface)

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

| Type          | Note                                                                                             |
|---------------|--------------------------------------------------------------------------------------------------|
| IKB0033/000,0 | Connection between VAM and IndraControl L. 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. 12-3: PROFIBUS connecting cables

### 12.3.2 Connecting cables for the Sercos interface

If the communication between the VAM machine operator panels VAM and the control modules IndraControl 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. 12-4: Sercos connecting cable

## 12.4 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



## 13 Hand-held terminal VH2110

### 13.1 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. 13-1: Hand-held terminal VH2110

### 13.2 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<br>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. 13-1: Technical data VH2110

## 13.3 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<br>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. 13-2: Housing and display VH2110

## 13.4 Spare parts, accessory parts and wear parts

| Ordering code      | 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. 13-3: Spare parts, accessory parts and wear parts VH2110

## 13.5 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 IndraControl VAC 05.1, VAC 30.2, VAC 31.1 connection module" documentation.

## 13.6 Commissioning

### 13.6.1 General information

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

### 13.6.2 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 IndraControl V-devices operating systems".

### 13.6.3 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".

### 13.6.4 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.

## 13.7 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<br>Override, connection cable 8m |

Tab. 13-4: VH2110 selection

## 13.8 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-PRRS-EN-P - Rexroth IndraControl V-Devices Operating Systems



## 14 VAK PC keyboards

### 14.1 General information

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

### 14.2 Drawer keyboards



Fig. 14-1: VAK 10.1 drawer keyboard



Fig. 14-2: 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.

### 14.3 Built-in keyboards



Fig. 14-3: VAK 11.2 built-in keyboard



Fig. 14-4: 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.

14.4 Variants

The following types of keyboards for industrial PCs are available:

| Model                                | Type               | Remarks                                |
|--------------------------------------|--------------------|----------------------------------------|
| Drawer Keyboards                     | VAK10.1E-EN-P-MPNN | Suitable for 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 | Suitable for VSP 16, VDP 16, VPP 16    |
|                                      | VAK41.2F-EN-P-NNNN | Compatible with VSP 40, VDP 40, VPP 40 |

Tab. 14-1: VAK 10/11/40/41 models

14.5 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

## 15 Rexroth inline modules

### 15.1 Brief description

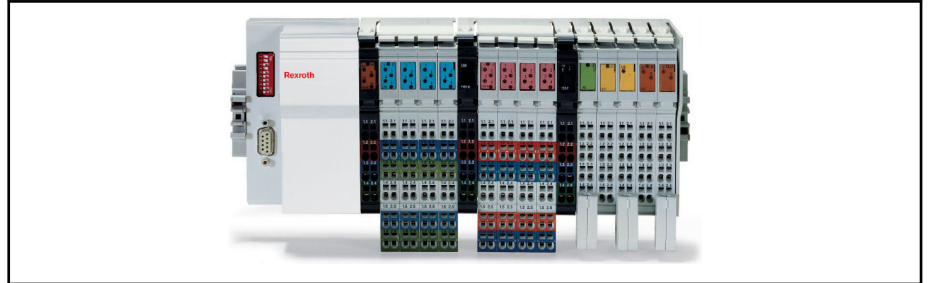


Fig. 15-1: Rexroth inline system

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.

### 15.2 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

### 15.3 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. 15-1: Bus Coupler

### 15.4 Accessories

#### 15.4.1 Connecting cables PROFIBUS DP interface

If the communication between the bus coupler the control modules IndraControl L are established via PROFIBUS DP, the following assembled cables are available:

| Type          | Note                                                                                             |
|---------------|--------------------------------------------------------------------------------------------------|
| IKB0033/000,0 | Connection between VAM and IndraControl L. 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. 15-2: PROFIBUS connecting cables*

## 15.4.2 Connecting cables Sercos interface

If the communication between the bus coupler and the control modules IndraControl 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. 15-3: Sercos connecting cable*

## 15.5 Documentation

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

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

# 16 Rexroth Fieldline modules

## 16.1 Brief description



Fig. 16-1: Rexroth Fieldline module

The input and output modules of the Rexroth Fieldline product family are designed for decentralized automation tasks under adverse ambient conditions. The modules comply with the protection degree IP65/IP67. They permit direct connection of sensors and actuators in an environment near the station. Communication with the master control is established via PROFIBUS-DP.

## 16.2 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 | Four 24 V inputs; 4 24 V/2 A outputs |
| RF-FLS PB M12 DO 8 M12-2A    | Eight 24 V/2 A outputs               |

Tab. 16-1: Module selection

## 16.3 Documentation

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

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



## 17 Firmware and software for the MTX CNC system

### 17.1 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.

### 17.2 Operating system for PC-based controls VPx 16.3/40.3

Windows 10 IoT 64 bits is installed on the MTX operating devices IndraControl 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.

#### Ordering code

| Operating system                    | Type                       | Part number |
|-------------------------------------|----------------------------|-------------|
| Windows 10 IoT Enterprise LTSC 2016 | FWA-VP4***-W10-02VRS-A0-HE | R911381746  |
|                                     | FWA-VP4***-W10-02VRS-A0-VA | R911381747  |

**VA (Value) to be used with i5 processor**

**HE (High End) to be used with i7 processor**

*Tab. 17-1: Windows operating systems for VPx 16.3/40.3*

These operating systems will no longer be used. The following operating system will be used:

#### Ordering code

| Operating system                    | Type                       | Part number |
|-------------------------------------|----------------------------|-------------|
| Windows 10 IoT Enterprise LTSC 2019 | FWA-VP4***-W10-03VRS-A0-VA | R911400798  |
|                                     | FWA-VP4***-W10-03VRS-A0-HE | R911400799  |

**VA (Value) to be used with i5 processor**

**HE (High End) to be used with i7 processor**

*Tab. 17-2: Windows operating systems for VPx 16.3/40.3*

### 17.3 Basic software for the MTX CNC system

#### 17.3.1 System-Comprehensive Basic Software

The system-comprehensive Engineering Framework IndraWorks is available in different variants for the systems MTX, IndraLogic and IndraDrive. The software is provided using a system-comprehensive basic package in a standard Suite installation. The system variants are provided as a common SWA.

*It is available under the following designation:*

- SWA-IWORKS-MTX-14VRS-D0-DVD\*\*

The following software variants can be installed for the system control CNC system MTX using software licenses:

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

- Minimum prerequisites**
- Intel Atom 510, min. 1.1 GHz
  - 4 GB RAM
  - 32 GB hard disk



Minimum requirements can limit the performance of applications such as the NC simulation!

### Recommended requirements

| Classification                   | Descriptions, requirements                                                                                                                                                                                                                                                                                                                                 | Bosch Rexroth Industrial PC                                                                                 |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| <b>Default (minimum)</b>         | Minimum requirements on simple, small machine tools: <ul style="list-style-type: none"> <li>• Processor: Intel Core ATOM x5 E3940 (Quad Core) or comparable computational load</li> <li>• RAM: 8 GB RAM</li> <li>• Hard disk: Min. 64 GB SSD</li> </ul>                                                                                                    | <ul style="list-style-type: none"> <li>• PR31/VR31</li> </ul>                                               |
| <b>Performance (recommended)</b> | Requirements on standard machine tools and more complex machining centers for a safe and high-performance operation and more requirements on the NC simulation. <ul style="list-style-type: none"> <li>• Processor: Intel Core i3, Intel Core i5 or comparable computational load</li> <li>• RAM: 8 GB RAM</li> <li>• Hard disk: Min. 64 GB SSD</li> </ul> | <ul style="list-style-type: none"> <li>• PR41/VR41</li> <li>• PR42/VR42</li> <li>• VPB 40.4 (i5)</li> </ul> |
| <b>Advanced (optimum)</b>        | Requirements on advanced machines and demanding requirements on the NC simulation: <ul style="list-style-type: none"> <li>• Processor: Intel Core i7 (Quad Core) or comparable computational load</li> <li>• RAM: 16 GB RAM</li> <li>• Hard disk: Min. 128 GB SSD</li> </ul>                                                                               | <ul style="list-style-type: none"> <li>• PR43/VR43</li> <li>• VPB40.4 (i7)</li> </ul>                       |
|                                  |                                                                                                                                                                                                                                                                                                                                                            |                                                                                                             |

Tab. 17-3:

## 17.3.3 CNC system MTX - Engineering

*The software contains the following functions:*

- Standard MTX commissioning software for the MTX control family
- Languages: English (EN) / German (DE)



This software is used for commissioning MTX standard, MTX performance and MTX advanced.

#### Ordering code

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

Tab. 17-4: Software IndraWorks Engineering

### 17.3.4 CNC system MTX - Operation 2.0

The software contains the following functions:

- Standard CNC operating software
- WinStudio Lite Runtime
- CNC online simulation
- Languages: English (EN) / German (DE)



The software is used on the PC-based controls MTX standard, MTX performance and MTX advanced. A separate PC is necessary to configure the "CNC system MTX Engineering" or the "CNC system MTX Workstation" software.

#### Ordering code

| Type                         | Part number |
|------------------------------|-------------|
| SWL-IWORKS-MTX-NNVRS-D0-OPD2 | R911374093  |

Tab. 17-5: Software IndraWorks Operation

### 17.3.5 CNC system MTX - Communication

Die software covers the following functions:

- Communication interface for customer-specific user interfaces
- Languages: English (EN) / German (DE)



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 "CNC system MTX Engineering" or the "CNC system MTX Workstation" software.

#### Ordering code

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

Tab. 17-6: Software IndraWorks Communication

### 17.3.6 CNC system MTX - Workstation 2.0

The software contains the following functions:

- CNC and PLC program creation
- WinStudio Lite to create HMI user screens
- VAM Simulator

- Control simulation for program testing
- Remote engineering and programming for the MTX standard, MTX performance and MTX advanced
- 3D viewer for an animated machine kinematics
- CNC online simulation
- Language: English (EN) / German (DE)



Die software is used for offline or remote engineering and as engineering software for the MTX standard, MTX performance and MTX advanced.

#### Ordering code

| Type                                 | Part number |
|--------------------------------------|-------------|
| SWL-IWORKS-MTX-NNVRS-D0-WORKSTATION2 | R911374095  |

Tab. 17-7: Software IndraWorks MTX workstation

## 17.4 Basic firmware for the CNC system MTX

### 17.4.1 Firmware for MTX standard L45

*The firmware for the CNC system MTX standard L45 includes 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
- Runtime module for the integrated PLC IndraLogic

*The firmware is available under the following designation:*

- FWA-CML45\*-MTX-14VRS-NN

### 17.4.2 Firmware for MTX performance L65

*The firmware for the CNC system MTX performance L65 includes the following functions:*

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

*The firmware is available under the following designation:*

- FWA-CML65\*-MTX-14VRS-NN

### 17.4.3 Firmware for MTX performance L75

*The firmware for the CNC system MTX performance L75 includes the following functions:*

- CNC runtime module for the following technologies: drilling, turning, milling and sanding.

- License to control eight axes/spindles max. and two CNC channels (extension optionally)
- 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

*The firmware is available under the following designation:*

- FWA-CML65\*-MTX-14VRS-NN

#### 17.4.4 Firmware for MTX advanced L85

*The firmware for the CNC system MTX advanced L85 includes the following functions:*

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

*The firmware is available under the following designation:*

- FWA-CML85\*-MTX-14VRS-NN

### 17.5 CNC system MTX SWW software

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

*The software*

- includes several functional extensions of the CNC and
- 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.).

*The software is ordered under the following designation:*

- SWW-IWORKS-MTX-14VRS-D0-CD650

### 17.6 Software and firmware options

#### 17.6.1 Eight servo axes - two channels and eight axes

The software is activated via a license key.

*The software includes:*

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



The control systems MTX standard and MTX micro can be extended to up to 12 axes and 2 channels.

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

The control systems MTX advanced can be extended to 250 axes and 60 channels max.

*The software is ordered under the following designation:*

- SWS-MTX\*\*\*-RUN-NNVRS-D0-08A02C

## 17.6.2 Technology package, turning level 1.1

*The software is activated via and license key and includes the following functions:*

- Main spindle synchronization feed per revolution
- constant cutting velocity
- Cylinder jacket transformation
- Spline interpolation, NURBS

### Ordering code

| Type                           | Part number |
|--------------------------------|-------------|
| SWS-MTX***-RUN-NNVRS-D0-TUR1.1 | R911347929  |

Tab. 17-8: Technology package, turning level 1.1

## 17.6.3 Machining center, level 1.1

*The software is activated via and license key and includes the following functions:*

- Main spindle synchronization
- Gantry axes
- Placements/frames (machining of angular areas)
- Spline interpolation, NURBS

### Ordering code

| Type                           | Part number |
|--------------------------------|-------------|
| SWS-MTX***-RUN-NNVRS-D0-BAZ1.1 | R911347930  |

Tab. 17-9: Machining center, level 1

## 17.6.4 Machining center, level 2.1

The software is activated via an enabling code and includes all the functions of the technology package 1.

*Additionally, the following functions are implemented:*

- 5-/6-axis transformation with TCP programming
- Jogging with active transformation
- 3D milling cutter radius correction

**Ordering code**

| Type                           | Part number |
|--------------------------------|-------------|
| SWS-MTX***-RUN-NNVRS-D0-BAZ2.1 | R911347931  |

Tab. 17-10: Machining center, level 2

## 17.6.5 Technology package producing gears/electronic gears

The software is activated via an license key and includes the electronic gear functions with the following properties:

- A slave axis can refer to a maximum of three master axes.
- Cascading coupling up to three levels.
- 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 this technology package is used together with the MTX compact or the MTX standard, only interpolation groups up to four axes are possible. When the MTX performance is used together with the software option "Interpolation group of more than four axes" (refer to [chapter 17.5 "CNC system MTX SWW software" on page 93](#)), interpolation groups can be extended up to eight axes per channel max.

**Ordering code**

| Type                         | Part number |
|------------------------------|-------------|
| SWS-MTX***-RUN-NNVRS-D0-GEAR | R911318989  |

Tab. 17-11: Technology package producing gears/electronic gears

## 17.6.6 Action Recorder ACR

The software is activated via an license key and is used for recording and archiving operations 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

**Ordering code**

| Type                        | Part number |
|-----------------------------|-------------|
| SWS-MTX***-RUN-NNVRS-D0-ACR | R911327104  |

Tab. 17-12: Action recorder ACR

## 17.6.7 Cycle Time Analyzer MTX cta

The software is intended for a specific and effective analysis and optimization of the machine cycle time.

*The following analysis windows are available:*

- Block display
- Channel display
- Diagrams
- Oscilloscope function
- Program tree
- Split menus
- Table view
- Table comparison
- Profiler
- 4D graphic

#### Ordering code

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

*Tab. 17-13: Cycle time analyzer MTX cta*

## 17.6.8 Energy Analysis MTX ega

The software is intended for a specific and effective analysis and optimization of the energy and resource consumption of a machine.

*The following analysis windows are available:*

- Diagrams
- Oscilloscope function
- Program tree
- 4D graphic
- Model editor

#### Ordering code

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

*Tab. 17-14: Energy Analysis MTX eta*

## 17.6.9 IndraWorks View3D

*The software is activated via and license key and includes the following functions:*

- Representation of 3D volume models and animation by linking process data
- Data import from CAD/CAM systems in the VRML data format

#### Ordering code

| Type                    | Part number |
|-------------------------|-------------|
| SWS-IWORKS-V3D-NNVRS-D0 | R911318428  |

*Tab. 17-15: IndraWorks View3D*

## 17.6.10 IndraWorks I-Remote

I-Remote is a high-performance software to remotely control MTX control systems.

*System features:*

- Integrated WEB server on the client PC
  - Remote control via the WEB browser using the ActiveX Control (client installation not required)
  - Hohe velocity du to data compression
  - Delta file transfer with SplitScreen and "drag-and-drop"
  - File synchronization
  - System snapshot
  - Audio support
  - Record/play function for logging
  - High-performance script language for automated processes
- Configurable safety

### Ordering code

| Type                    | Part number |
|-------------------------|-------------|
| SWS-IWORKS-REM-01VRS-D0 | R911310767  |

Tab. 17-16: *IndraWorks I-Remote*

## 17.6.11 CNC simulation with machine model

A machine model can be used in the CNC simulation. This machine model allows for collision monitoring.

### Ordering code

| Type | Part number |
|------|-------------|
| SWS- |             |

Tab. 17-17: *IndraWorks I-Remote*



# 18 Use case CNC system MTX

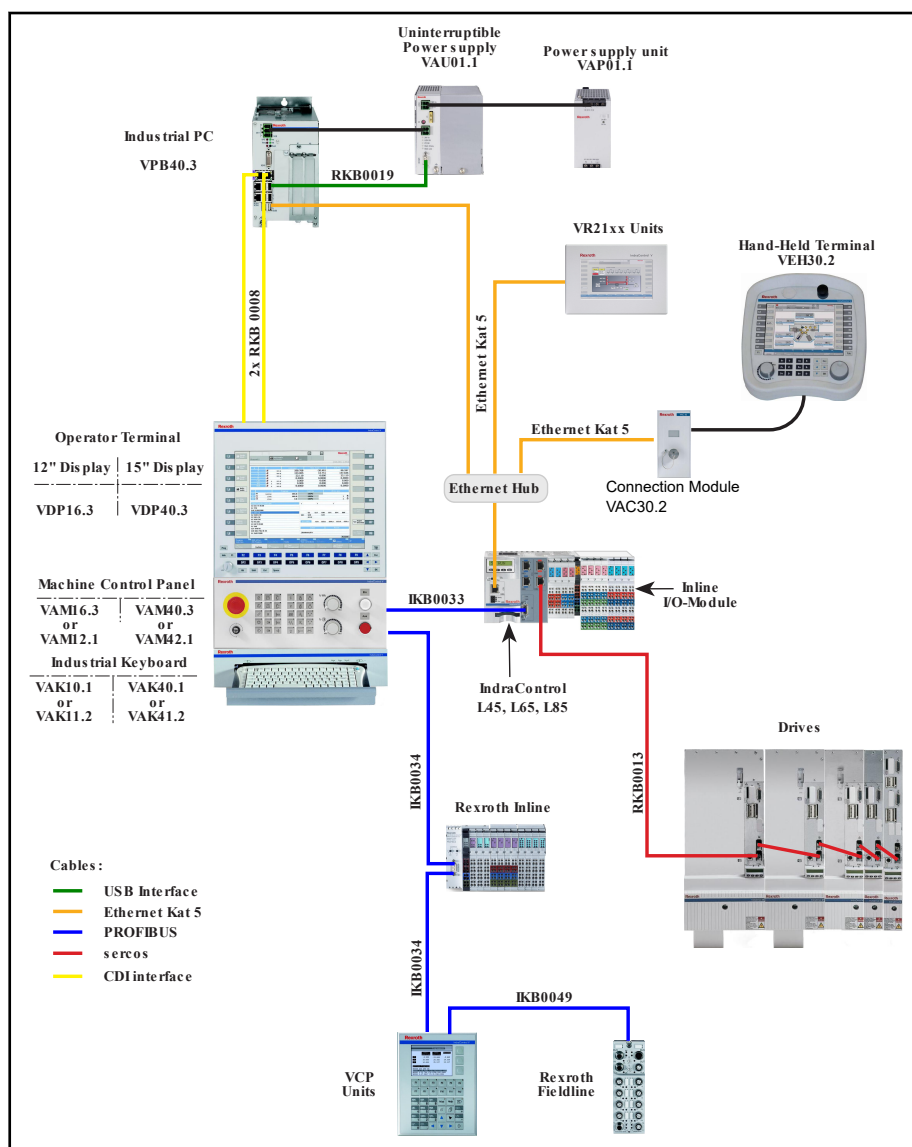


Fig. 18-1: Use case CNC system MTX



## 19 Sercos installation instruction

### 19.1 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

### 19.2 Installation planning

#### 19.2.1 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. 19-1 "Automation island consisting of a Sercos network" on page 102](#)).

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).

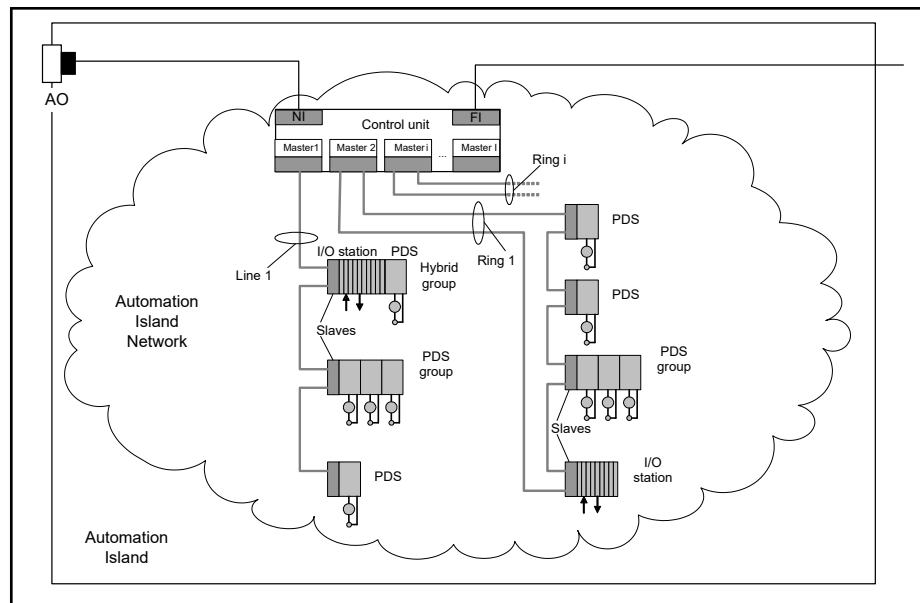


Fig. 19-1: Automation island consisting of a Sercos network



- **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

## 19.2.2 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).

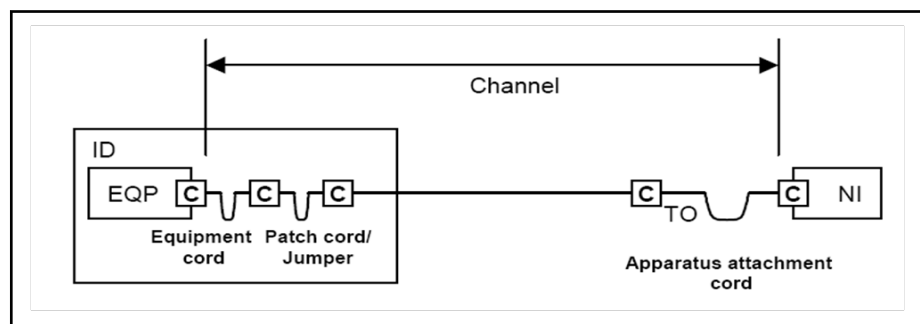


Fig. 19-2: Transmission capacity of a channel



- **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: used to establish connections between the intermediate cable, other wiring subsystems and the active device

### 19.2.3 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)<br>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 <sup>1)</sup>                          |
| Cable category according to ANSI/EIA/TIA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CAT 5e <sup>1)</sup>                         |
| <b>Cable shielding</b> <ul style="list-style-type: none"> <li>• Screened unshielded twisted pair (twisted pair cable without pair shielding and a wire mesh overall shield)</li> <li>• Screened shielded twisted pair (twisted pair cable with wire mesh pair shielding and a wire mesh overall shield) • Screened foiled</li> <li>• Screened foiled twisted pair (twisted pair cable with foil pair shielding and a wire mesh overall shield)</li> <li>• Screened foiled twisted quad pair (twisted quad-pair cable with star quad shielding and a wire mesh overall shield)</li> </ul> | S/UTP<br><br>S/STP<br><br>S/FTP<br><br>S/FTQ |

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

Tab. 19-1: Sercos network properties for symmetrical cables

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

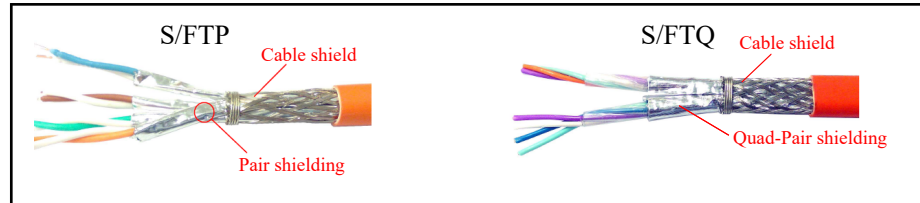


Fig. 19-3: Examples of a cable shield and pair shielding

## 19.2.4 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. 19-1 "Sercos network properties for symmetrical cables" on page 103](#) and [tab. 19-2 "Parameters of the mechanical force for symmetrical cables" on page 104](#).

#### Mechanic forces

| Properties of mechanical force         | Data <sup>1)</sup> |
|----------------------------------------|--------------------|
| Minimum bending radius, single bending | 20 – 65 mm         |
| Bending radius, multiple bending       | 50 – 100 mm        |
| Tensile forces                         | ≤ 150 N            |
| Permanent tensile forces               | ≤ 50 N             |

| Properties of mechanical force        | Data <sup>1)</sup> |
|---------------------------------------|--------------------|
| Maximum side forces                   | -- N/cm            |
| Temperature range during installation | - 20 to + 60 °C    |

<sup>1)</sup> Depending on the cable type; see data sheet of the manufacturer

Tab. 19-2: 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 RJ45, fixed length           |
| RKB0011/x,x           | R911316888 | RJ45-RJ45, IP20-IP20 | 0.5 to 100 m | Standard cable with RJ45, 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 to 100 m | Standard cable with M12, optional length         |
| RKB0044/x,x           | R911172135 | RJ45-M12, IP20-IP67  | 0.1 to 100 m | Adapter cable with RJ45 and M12, optional length |

Tab. 19-3: Sercos cable by Bosch Rexroth

## Connections within a wiring channel

### General description

|                 |                                                                                                      |
|-----------------|------------------------------------------------------------------------------------------------------|
| <b>Channel:</b> | The end-to-end transmission path between two points where application-specific devices are connected |
| <b>Link:</b>    | 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. 19-4 "Channel without coupling" on page 106](#)).

*End-to-end links without couplings are used to*

- reduce the costs for wiring

### Symmetrical wiring connections for Sercos

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

fig. 19-4 "Channel without coupling" on page 106 and fig. 19-5 "Channel with coupling" on page 106 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.

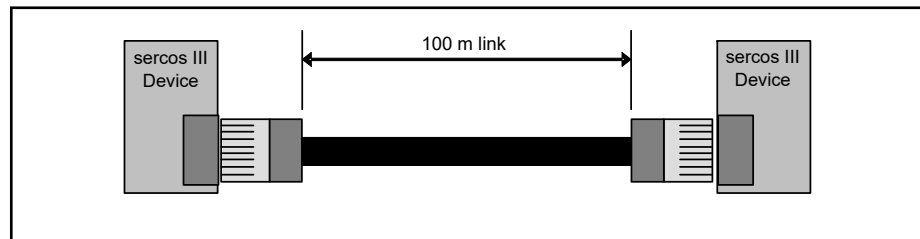


Fig. 19-4: Channel without coupling

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.

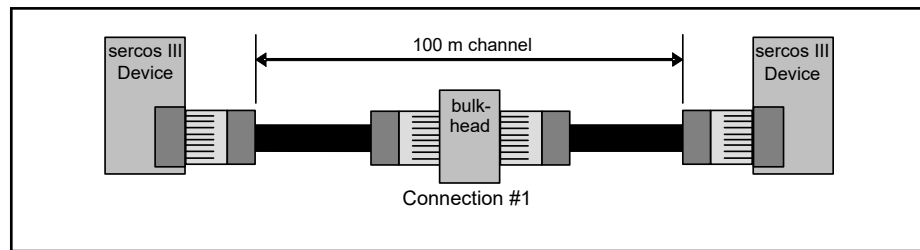


Fig. 19-5: Channel with coupling

## 19.3 Installing Sercos

### 19.3.1 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.

### 19.3.2 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.

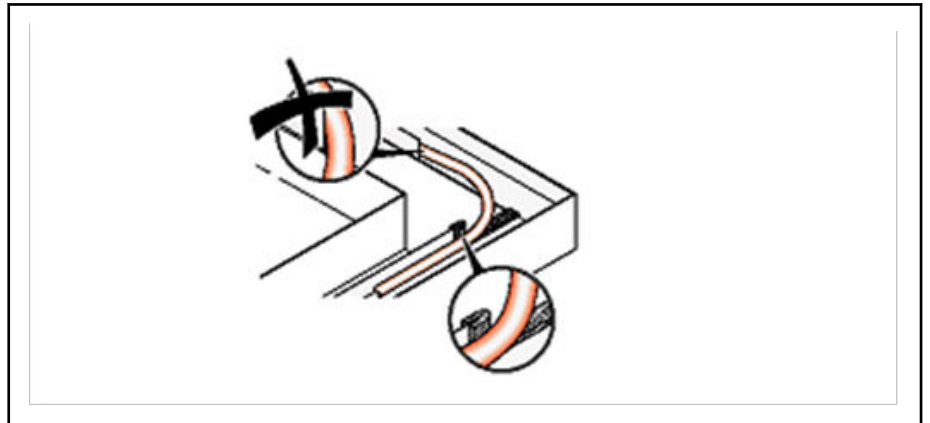


Fig. 19-6: Using edge protection

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).

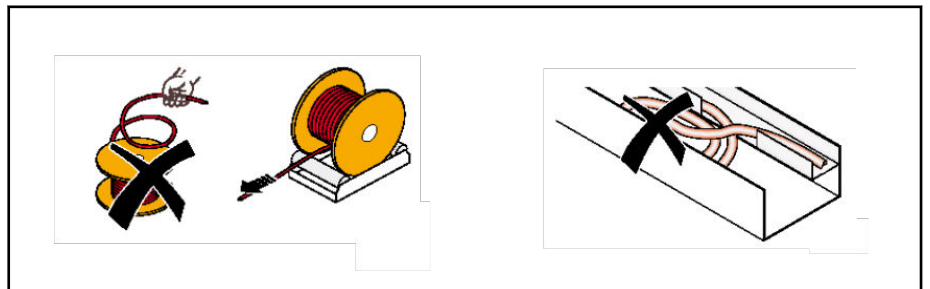


Fig. 19-7: Use an unwinding device and avoid loop formation

## 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).

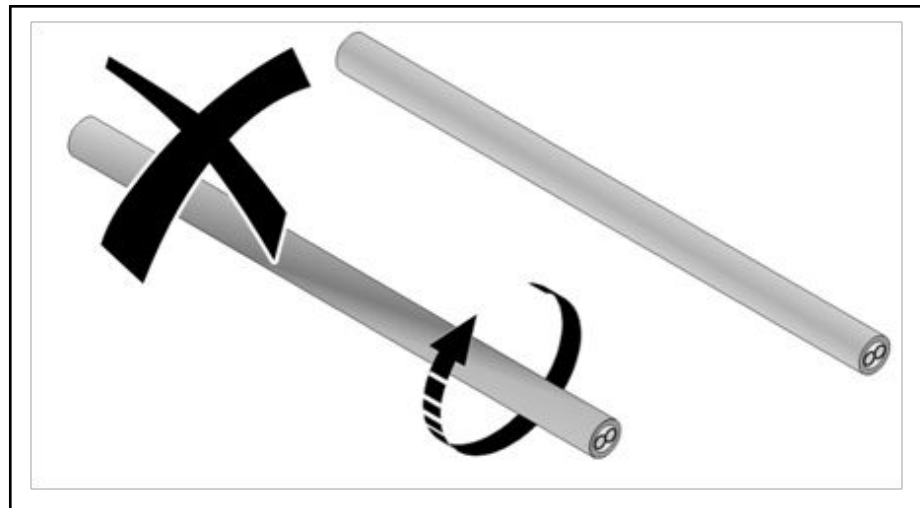


Fig. 19-8: Avoid twisting

## 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. 19-2 "Parameters of the mechanical force for symmetrical cables" on page 104](#).

## Bending radius

The minimum bending radius of a cable corresponds to the information in [tab. 19-2 "Parameters of the mechanical force for symmetrical cables" on page 104](#), 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.

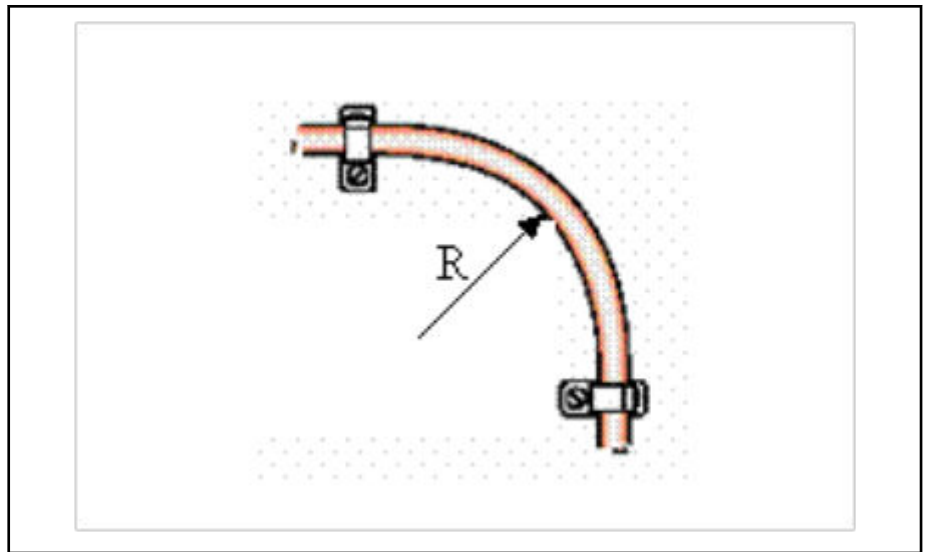


Fig. 19-9: *Complying with the minimum bending radius*

## Tensile force

The permissible tensile force of a cable corresponds to the information in [tab. 19-2 "Parameters of the mechanical force for symmetrical cables" on page 104](#), 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.

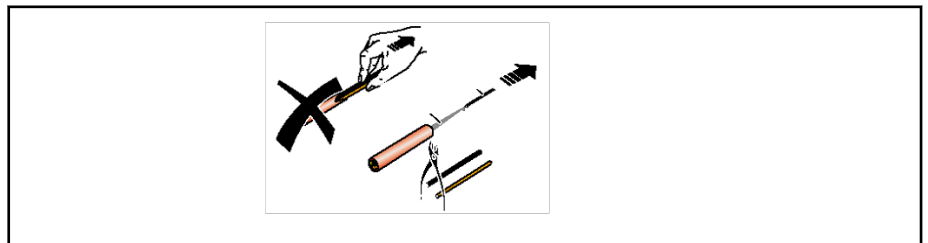


Fig. 19-10: *Do not tear at individual cores*

## 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.

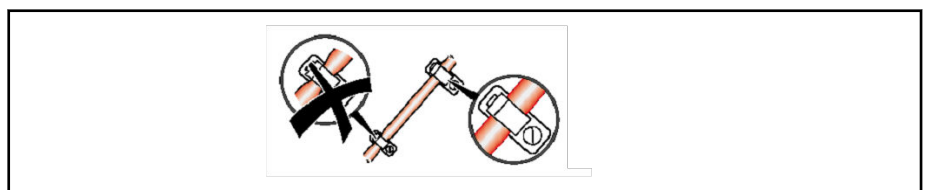


Fig. 19-11: *Use cable clamps with a large (wide) surface*

- 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. 19-12 "Separate cable ducts" on page 110](#)).



*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

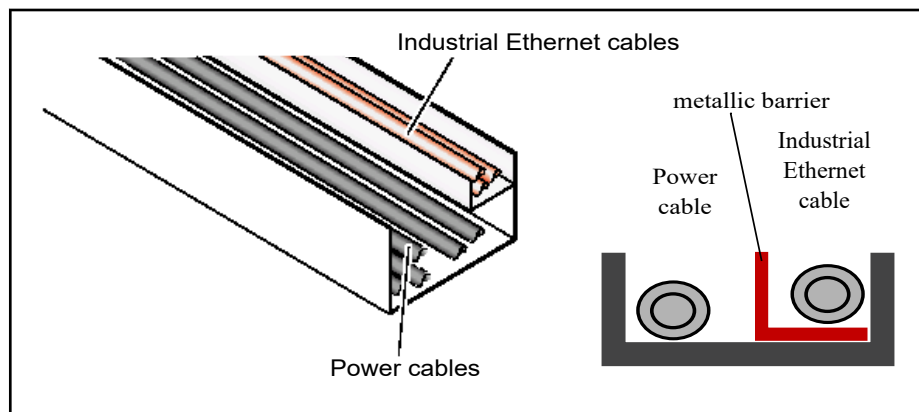


*Fig. 19-12: Separate cable ducts*

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).

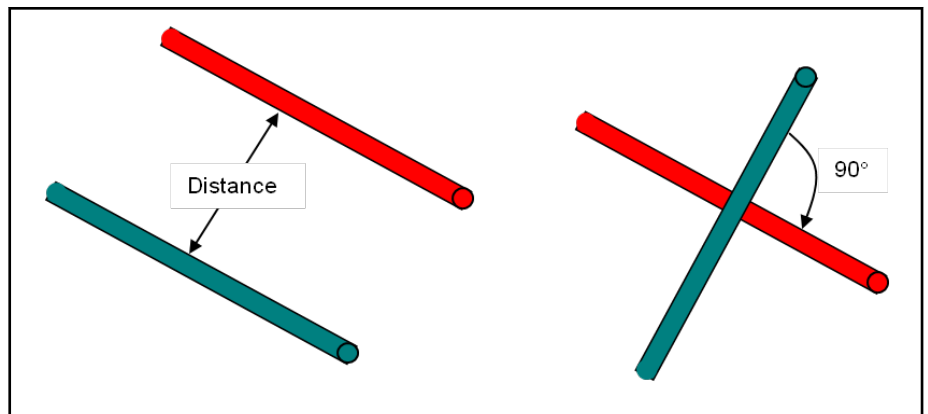


Fig. 19-13: Methods for routing

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<br>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<br>Low-voltage DC electrical power supply lines                                                | 0.15 m                                       | 0.08 m                                    |

Tab. 19-4: 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. 19-5: 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).

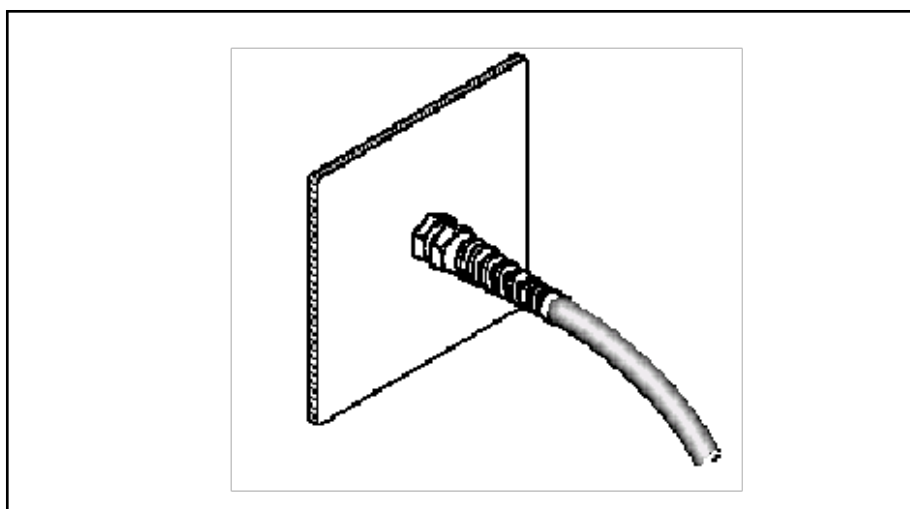


Fig. 19-14: Cable gland with bend protection

## 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. 19-15 "Spiral hose" on page 112](#)).

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.

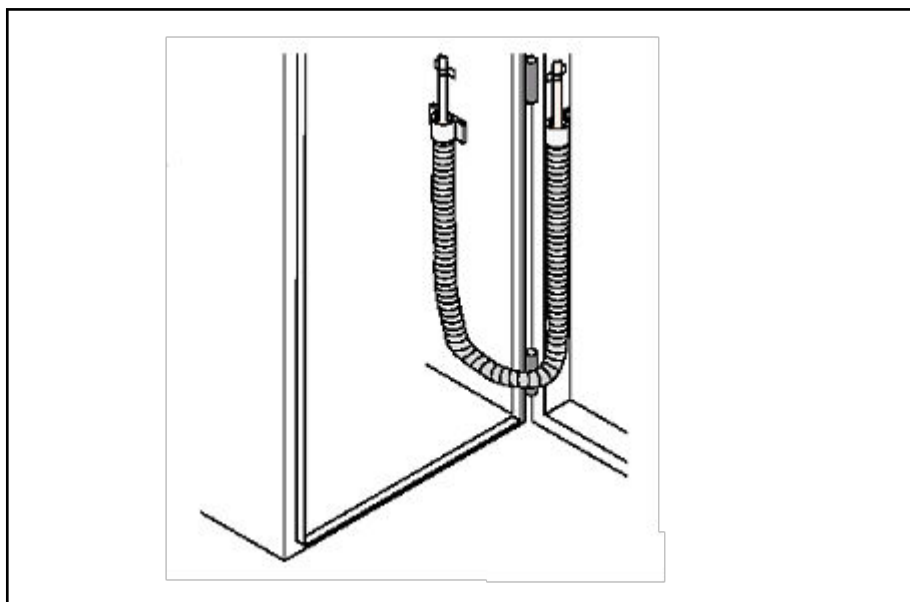


Fig. 19-15: Spiral hose

## 19.3.3 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. 19-6 "Color coding for Sercos cables with 4 cores" on page 113](#).

Shielded connectors must be installed in accordance with the procedures for the end terminal of connectors and device connection cables as specified in [tab. 19-6 "Color coding for Sercos cables with 4 cores" on page 113](#).

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

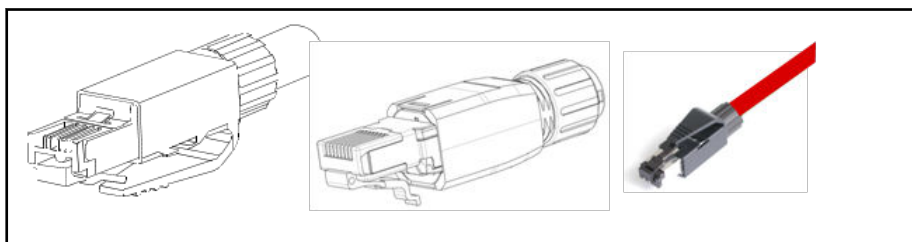


Fig. 19-16: Shielded RJ-45 connector for Sercos

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



Fig. 19-17: Shielded M12 connectors with D-coding for Sercos

[tab. 19-6 "Color coding for Sercos cables with 4 cores" on page 113](#) and [tab. 19-7 "Color coding for Sercos cables with 8 cores" on page 114](#) 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. 19-6: 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 + <sup>1)</sup> | Blue         | 4                  | -            |
| -      | 3. pair - <sup>1)</sup> | White blue   | 5                  | -            |
| +      | 4. pair + <sup>1)</sup> | White brown  | 7                  | -            |
| -      | 4. pair - <sup>1)</sup> | Brown        | 8                  | -            |

<sup>1)</sup> Not used for Sercos

*Tab. 19-7: 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).

### 19.3.4 Device installation

After consulting with the production engineer, the installation engineer must 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.

### 19.3.5 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 the 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.

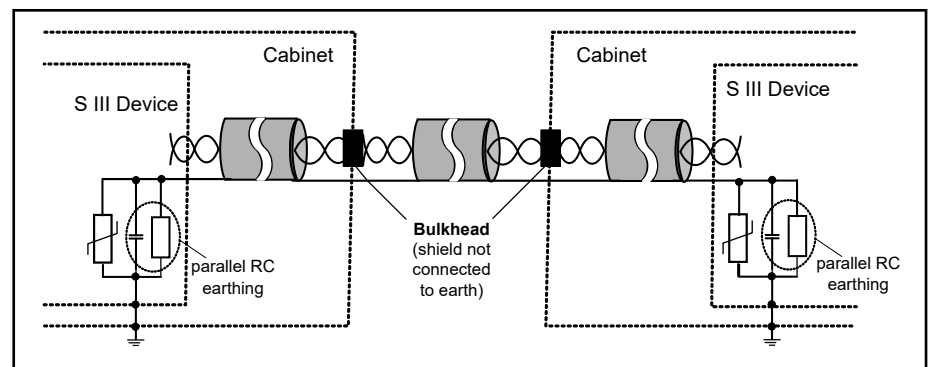


Fig. 19-18: Examples of a parallel RC grounding of the shield

## 19.4 Troubleshooting in the installation

### 19.4.1 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)

## 19.4.2 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?

## 19.4.3 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<br>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 $\Omega$ 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. 19-8: Typical problems in a network with symmetrical wiring*



## 20 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](mailto: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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