

IndraMotion MTX 14VRS

System Description

Project Planning Manual
R911342640

Edition 03



Title	IndraMotion MTX 14VRS System Description
Type of Documentation	Project Planning Manual
Document Typecode	DOK-MTX***-SYS*DES*V14-PR03-EN-P
Internal File Reference	RS-5e64ee410d19898c0a6846a5016285f0-3-en-US-6

Record of revision

Edition	Release date	Note
Edition 01	2014-04	First edition
Edition 02	2014-09	Extending the system limits of MTX
Edition 03	2015-10	New chapter "Hand-held terminal VH2110" New target CML75 New multitouch display VDP15.3, 18.3, 21.3 New machine control panel VAM 15.1, 21.1

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Editorial department Machine Tool System Development GeVe (SyMu/PiGe)

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1 About this documentation

1.1 Validity of the documentation

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

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

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

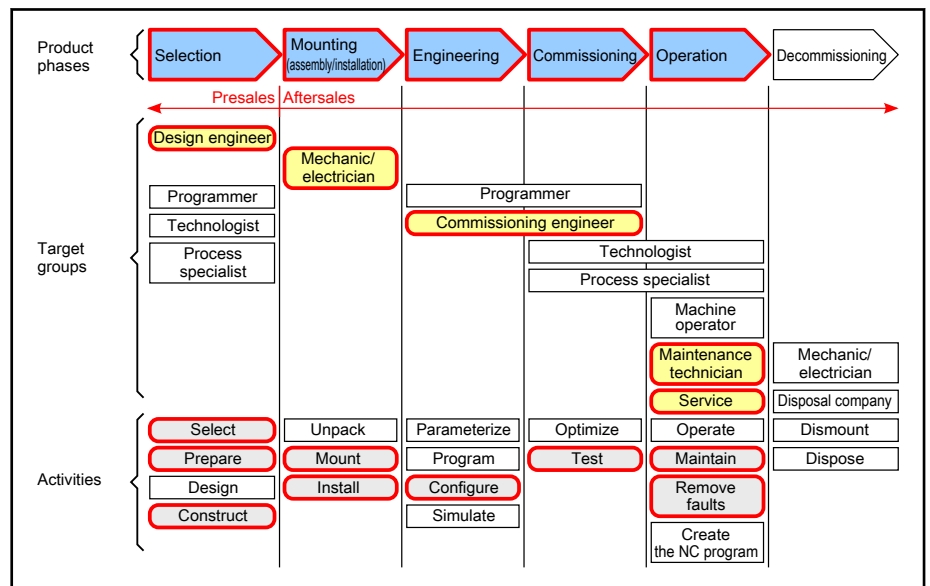


Fig. 1-1: Assigning this documentation to the target groups, product phases and target group activities

1.2 Required and supplementing documentation MTX

1.2.1 Selection/compilation

Documentation titles with type codes and part numbers

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

Tab. 1-1: MTX documentation overview - Selection/compilation

About this documentation

1.2.2 Configuration

Documentation titles with type codes and part numbers

<p>Rexroth IndraMotion MTX 14VRS Machine Parameters DOK-MTX***-MA*PAR**V14-RERS-DE-P, R911342630</p> <p>This documentation describes design and modification of the Rexroth IndraMotion MTX parameters available. It also includes the functions of the NC configurator and its operation.</p>
<p>Rexroth IndraMotion MTX 14VRS PLC Interface DOK-MTX***-PLC*INT*V14-PRRS-DE-P, R911342622</p> <p>This documentation describes interface signals and program function blocks for the integrated PLC.</p>
<p>Rexroth IndraMotion MTX Functional Description 14VRS Basics DOK-MTX***-NC*F*BA*V14-RERS-DE-P, R911342626</p> <p>This documentation describes the functions of the Rexroth IndraMotion MTX basic functions. The basic commissioning steps and the control functions are provided as description and handling instruction.</p>
<p>Rexroth IndraMotion MTX Functional Description 14VRS Extension DOK-MTX***-NC*F*EX*V14-RERS-DE-P, R911342628</p> <p>This documentation describes the extended functions of the Rexroth IndraMotion MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.</p>
<p>Rexroth IndraMotion MTX Functional Description 14VRS Special Functions DOK-MTX***-NC*F*SP*V14-RERS-DE-P, R911342624</p> <p>This documentation describes the special functions of the Rexroth IndraMotion MTX. The basic commissioning steps and the control functions are provided as description and handling instruction.</p>
<p>Rexroth IndraMotion MTX Free Form Surface Machining DOK-MTX***-FREEFORM***-APRS-DE-P, R911341435</p> <p>This documentation describes the free-form surface machining process with the MTX control. CNC programs generated by a CAD/CAM system are the basis for the entire machining process. An overview of the following topics is provided: Description of the MTX or CNC functions for free-form surface machining, NC parameterization, basic conditions when generating CNC programs with CAM software.</p>
<p>Rexroth IndraMotion MTX Converting MTX Projects DOK-MTX***-PROCONV****-PRRS-DE-P, R911342484</p> <p>This documentation provides support during the conversion of IndraMotion MTX 1.x projects to MTX 2G. The conversion process is described and potential challenges during the conversion are identified.</p>

Tab. 1-2: MTX documentation overview - Configuration

1.2.3 Commissioning

Documentation titles with type codes and part numbers

<p>Rexroth IndraWorks 13VRS Simulation DOK-IWORKS-SIMU****V13-APRS-DE-P, R911339256</p> <p>This documentation describes the functions of the simulation components View3D, virtual control panel, virtual control and its operation in IndraWorks.</p>
<p>Rexroth IndraMotion MTX 14VRS Commissioning DOK-MTX***-STARTUP*V14-CORS-DE-P, R911342620</p> <p>This documentation describes the commissioning of the IndraMotion 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.</p>

About this documentation

<p>Rexroth IndraWorks 14VRS Basic Libraries IndraLogic 2G DOK-IL*2G*-BASLIB**V14-LIRS-DE-P, R911343920 This documentation describes the system-comprehensive PLC libraries.</p>
<p>Rexroth IndraWorks 14VRS Field Buses DOK-IWORKS-FB*****V14-APRS-DE-P, R911341485 This documentation describes field bus and local periphery connections supported by the systems IndraLogic XLC, IndraMotion MLC and IndraMotion MTX. This documentation focuses on the configuration, parameterization, commissioning and diagnostics of the different periphery connections. The documentation is the basis for the online help.</p>
<p>Rexroth IndraWorks 14VRS WinStudio DOK-IWORKS-WINSTUD*V14-APRS-DE-P, R911341585 This "User Manual and Technical Reference Book" provides information for efficient working with the "Rexroth WinStudio"™ software. The document provides technical information and step-by-step instructions to create web-enabled HMI/SCADA programs.</p>
<p>Rexroth IndraWorks 14VRS Software Installation DOK-IWORKS-SOFTINS*V14-CORS-DE-P, R911344286 This documentation describes the IndraWorks installation.</p>
<p>Rexroth IndraWorks 14VRS Engineering DOK-IWORKS-ENGINEE*V14-APRS-DE-P, R911343566 This documentation describes the use of IndraWorks in which the Rexroth Engineering tools are integrated. It includes instructions on how to work with IndraWorks and how to operate the oscilloscope function.</p>
<p>Rexroth IndraWorks 12VRS FDT Container DOK-IWORKS-FDT*CON*V12-APRS-DE-P, R911334398 This documentation describes the IndraWorks FDT Container functionality. It includes the activation of the functionality in the project and working with DTMs.</p>
<p>Rexroth IndraWorks 14VRS IndraLogic 2G PLC Programming System DOK-IWORKS-IL2GPRO*V14-APRS-DE-P, R911343571 This documentation describes the PLC programming tool IndraLogic 2G and its use. It includes the basic use, first steps, visualization, menu items and editors.</p>
<p>Rexroth IndraWorks 14VRS HMI DOK-IWORKS-HMI*****V14-APRS-DE-P, R911343569 This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.</p>

Tab. 1-3: MTX documentation overview - Commissioning

1.2.4 Operation

Documentation titles with type codes and part numbers

<p>Rexroth IndraMotion MTX 09VRS Shop Floor Programming Turning and Milling DOK-MTX***-SF*PROG*V09-AWxx-DE-P, R911324377 This documentation describes the operation and programming of the graphic NC programming of turning and milling as well as the workpiece simulation.</p>
<p>Rexroth IndraMotion MTX 12VRS Block Pre-Run DOK-MTX***-BLK*RUN*V12-APRS-DE-P, R911334379 This documentation explains to the machine manufacturer how to setup the "Block pre-run" function at the machine for the end user.</p>

About this documentation

Rexroth IndraMotion MTX 14VRS Programming Manual

DOK-MTX***-NC**PRO*V14-RERS-DE-P, R911342634

This documentation describes the standard programming of the Rexroth IndraMotion 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.

Rexroth IndraMotion MTX 14VRS Standard NC Operation

DOK-MTX***-NC*OP***V14-APRS-DE-P, R911342632

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

Rexroth IndraMotion MTX 14VRS Standard NC Cycles

DOK-MTX***-NC*CYC**V14-PRRS-DE-P, R911342638

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

xx Corresponding edition
Tab. 1-4: MTX documentation overview - Operation

1.2.5 Maintenance

Documentation titles with type codes and part numbers**Rexroth IndraMotion MTX 11VRS Diagnostic Messages**

DOK-MTX***-DIAGMES*V11-RExx-DE-P, R911332311

This documentation provides an overview on errors, warnings and messages in the Rexroth IndraMotion MTX control.

xx Corresponding edition
Tab. 1-5: MTX documentation overview - Maintenance

1.2.6 OEM Engineering

Documentation titles with type codes and part numbers**Rexroth IndraMotion MTX 13VRS Automation Interface**

DOK-MTX***-AUT*INT*V13-APRS-DE-P, R911337274

This documentation describes the script-based access to IndraWorks project data via the Automation Interface. Different objects including code examples are described. The Automation Builder is also described in this manual.

Rexroth IndraMotion MTX 09VRS Integration of OEM Applications

DOK-MTX***-DEV*KIT*V09-AWxx-DE-P, R911324355

This documentation describes the integration of OEM applications in the IndraWorks MTX as well as the communication via the industrial standard OPC.

Rexroth IndraMotion MTX 14VRS OPC Communication

DOK-MTX***-OPC*COM*V14-PRRS-DE-P, R911342636

This documentation describes the syntax and the structure of the items for the communication with Bosch Rexroth devices.

Rexroth IndraMotion MTX 14VRS OPC UA Communication

DOK-MTX***-OPC*UA**V14-APRS-DE-P, R911342513

This documentation describes the OPC UA communication of the IndraMotion MTX.

xx Corresponding edition
Tab. 1-6: MTX documentation overview - OEM Engineering

1.2.7 AddOns

Documentation titles with type codes and part numbers

<p>Rexroth IndraMotion MTX 11VRS Action Recorder DOK-MTX***-ACR*****V11-APxx-DE-P, R911329943</p> <p>This documentation describes the MTX action recorder. It includes the installation and commissioning as well as interface signals, application and operation.</p>
<p>Rexroth IndraMotion MTX efficiency workbench 14VRS MTX cta, MTX ega DOK-MTX***-EWB*****V14-APRS-DE-P, R911343916</p> <p>This documentation describes the mode of operation and the area of application of the analysis tool IndraMotion MTX cta and IndraMotion MTX ega.</p>
<p>Rexroth IndraMotion MTX Remote Condition Monitoring DOK-MTX***-RCM*****V01-APRS-DE-P, R911334383</p> <p>This documentation describes the operation of the Remote Condition Monitoring System.</p>
<p>Rexroth IndraMotion MTX visIREC DOK-MTX***-VISIREC*V01-APRS-DE-P, R911344242</p> <p>This documentation describes the analysis tool visIREC. The visIREC is used to optimize the free-form surface machining process. 2D or 4D display of path-related data. 2D or 4D display of coordinate-related data. Analyzing critical areas (path and orientation deviation). Comparing the programmed and interpolated NC blocks.</p>

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

1.3 Use of the safety instructions

1.3.1 Structure of the safety instructions

The safety instructions are structured as follows:

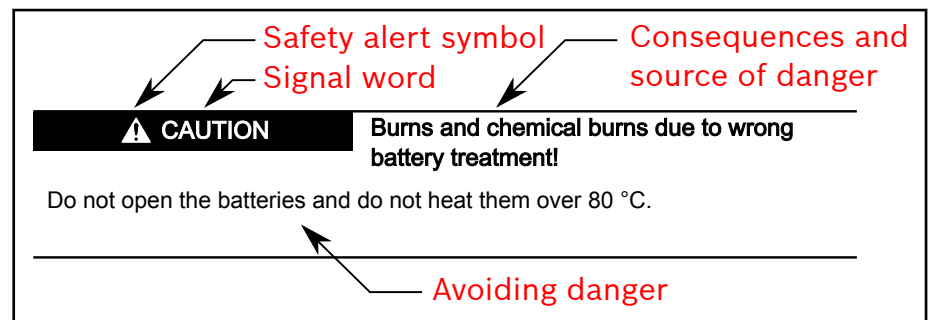


Fig. 1-2: Structure of the safety instructions

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 is used to draw attention to the safety instruction and also provides information on the severity of the hazard.

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.

About this documentation

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

1.3.3 Symbols used

Hints are represented as follows:



This is an information.

Tips are represented as follows:



This is a tip.

1.3.4 Signal graphic explanation on the device



Prior to the installation and commissioning of the device, refer to the device documentation.

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: Names and abbreviations used

About this documentation

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. 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 drives and controls

3.1 Definitions of terms

Application Documentation	Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: Operating Instructions, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Description, etc.
Component	A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.
Control system	A control system comprises several interconnected control components placed on the market as a single functional unit.
Device	A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.
Electrical equipment	Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.
Electric drive system	An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.
Installation	An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.
Machine	A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.
Manufacturer	The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual'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.
Product	Examples of a product: Device, component, part, system, software, firmware, among other things.
Project planning manual	A project planning manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.
Qualified persons	In terms of this application documentation, qualified persons are those persons 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

Safety instructions for electric drives and controls

requires. To comply with these qualifications, it is necessary, among other things,

- to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them.
- to be trained or instructed to maintain and use adequate safety equipment.
- to attend a course of instruction in first aid.

User A user is a person installing, commissioning or using a product which has been placed on the market.

3.2 General information

3.2.1 Using the Safety instructions and passing them on to others

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

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

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

3.2.2 Requirements for safe use

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

- Bosch Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.

Safety instructions for electric drives and controls

- 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!

Safety instructions for electric drives and controls

- 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).

Safety instructions for electric drives and controls

- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

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

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

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

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

3.3.2 Protective extra-low voltage as protection against electric shock

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

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

Safety instructions for electric drives and controls

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 equip-

Safety instructions for electric drives and controls

ment 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!

Hazards for persons with active medical implants or passive metallic implants, as well as for pregnant women.

- Persons with active medical implants (e.g. heart pacemakers), passive metallic implants (e.g. hip implants) and pregnant women might possibly risk hazards by electromagnetic or magnetic fields in the immediate vicinity of components of the electric drive and control system and the associated current-carrying conductors.

Entering the following areas can cause danger to these persons:

- Areas in which components of the electric drive and control system and the associated current-carrying conductors are mounted, commissioned and operated.
- Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- Before entering these areas, the above-mentioned persons should seek advice from their physician.
- Observe the occupational safety and health regulations applicable at the site of operation, for installations equipped with components of the elec-

Safety instructions for electric drives and controls

tric drive and control system and the associated current-carrying conductors.

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 Battery safety

Batteries consist of active chemicals in a solid housing. Therefore, improper handling can cause injury or property damage.

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not attempt to recharge the batteries as this may cause leakage or explosion.

Safety instructions for electric drives and controls

- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.



Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separately from other waste. Observe the national regulations of your country.

3.3.8 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 dismantling 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.

Safety instructions for electric drives and controls

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 IndraMotion 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 IndraMotion MTX can be individually scaled in terms of performance and functions.

Currently, the following system variants are available:

Control system IndraMotion	Hardware IndraControl	Sercos	
		Maximum number of axes NC axes	Maximum number of I/O devices
MTX standard L45	L45	12	32
MTX performance L65 or L75	L65 or L75	64	32
MTX advanced L85	L85	for up to 250 axes (from MTX 14V12)	32

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 control system IndraMotion MTX in no time.

IndraControl controls L45, L65 and L85

5 IndraControl controls L45, L65 and L85

5.1 Brief description



Fig. 5-1: IndraControl L65 control

The IndraControl L65, L75 und L85 controls are the main units in the CNC control systems IndraMotion 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 realized with the IndraMotion MTX L85 system and up to 250 axes (from MTX 14V12) can be operated.

5.2 Performance data

Designation	MTX standard L45	MTX performance L65 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/ channel	4/8	4/8	4/8
Number of NC channels	2	3...12	3...60
PLC processing time for 1k of instructions	39 µs	18 µs 10 µs	3 µs
Min. Ipo cycle	1 ms	0.5 ms	0.25 ms

Tab. 5-1: Performance data IndraMotion MTX Lx5

IndraControl controls L45, L65 and L85

5.3 Technical data

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

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:

Nominal value	24 V DC
Tolerance	-15% / +20% (without residual ripple)
Residual ripple	+/-5 %
U_{max}	30 V
U_{min}	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:

Power consumption from U_{LS}	Max. 3 A
Power consumption from U_M and U_S	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).

Pin contact	Signal
--------------------	---------------

IndraControl controls L45, L65 and L85

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. Condensing not allowed.	

IndraControl controls L45, L65 and L85

	In operation	Storage/transport
Atmospheric pressure	up to 2700 m above sea level acc. to DIN 60204	up to 3000 m above sea level acc. to DIN 60204
Mechanical strength	<ul style="list-style-type: none"> • Max. vibration: Frequency range: 10... 150 Hz • Deflection: 0.075 mm at 10... 57 Hz • Acceleration: 1 g At 57... 150 Hz acc. to EN 60068-2-6	Max. shock: 15 g acc. to EN 60068-2-27, 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.

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

Tab. 5-11: Sercos interfaces

LED	
L (link)	On: Link to network available OFF: No connection to network
S (send)	On: Data packages are sent OFF: No data is sent

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

IndraControl controls L45, L65 and L85

5.6.2 Profinet X7E3, X7E4

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

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

Tab. 5-13: Profinet interfaces

LED	
L (link)	On: Link to network available OFF: No connection to network
S (send)	On: Data packages are sent 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.

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

Tab. 5-15: Profibus DP interface

LED	Status
Send	On: Data is output 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.

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

Tab. 5-17: Ethernet interface

IndraControl controls L45, L65 and L85

LED	Status
L (link)	On: Link to network available OFF: No connection to network
S (send)	On: Data packages are sent OFF: No data is sent

Tab. 5-18: Diagnostic LED 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 Ready contact opened by the software (the watchdog, however, is still triggered internally)

IndraControl controls L45, L65 and L85

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 L45/L65/L85 is in operation!

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^{Plus} 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							
Slot		1				2				3				4			
	Status LED	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

IndraControl controls L45, L65 and L85

		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:

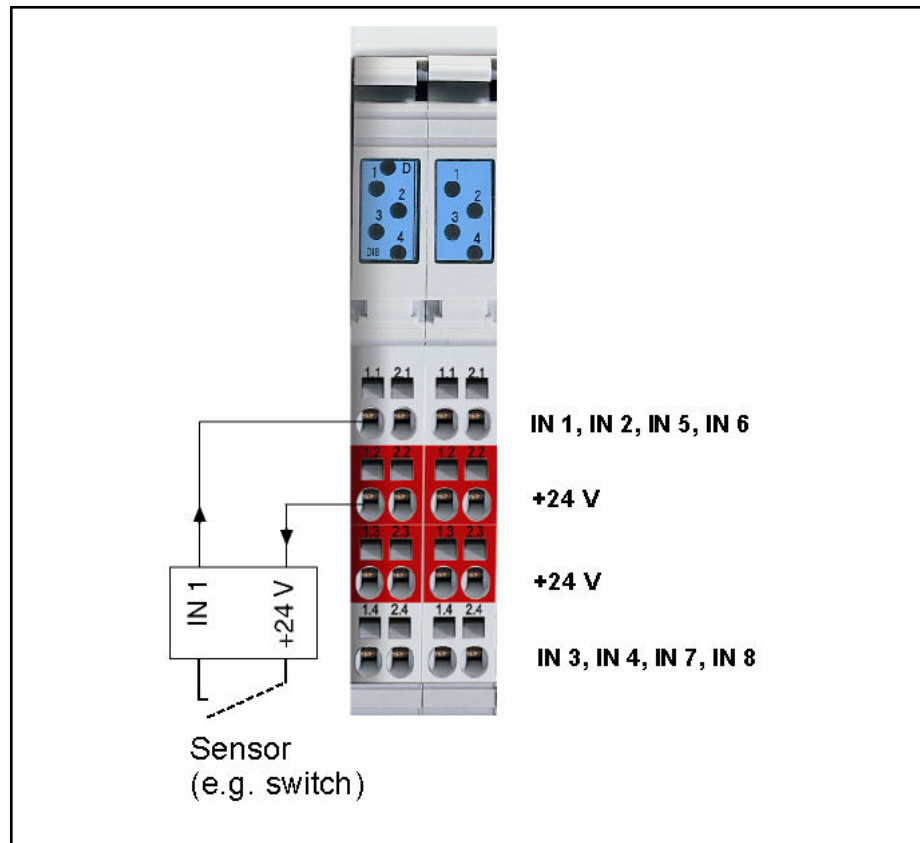


Fig. 5-2: Digital inputs



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

IndraControl controls L45, L65 and L85

Input current: - Nominal value at "0" - Nominal value at "1"	< 2.5 mA 2.8 mA ... 6 mA
Delay time: - at "0" to "1" - at "1" to "0"	Typ. 50 µs 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 _{ext.} – 1V
Nominal current (total)	0.2 A
Short-circuit protection, overcurrent protection	Typ. 0.6 A
Criteria to connect 2-wire proximity switches: Quiescent current Voltage drop	< 2.5 mA < 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 and L85

Slots 4 and 5:

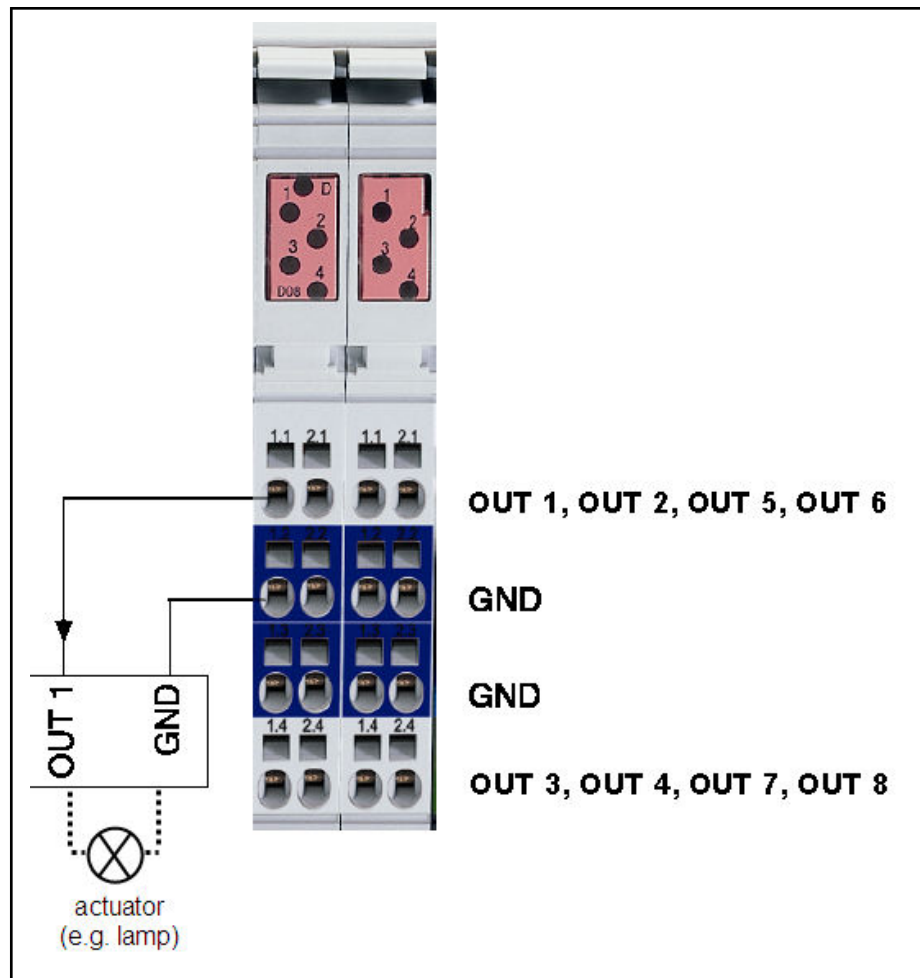


Fig. 5-3: Digital outputs



Check the color-coding of the pins.

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

IndraControl controls L45, L65 and L85

Rated output current:	
- Nominal value	0.5 A
- Maximum value DIN EN 61131-2	<= 0.6 A
- Signal 1	2 mA ... 0.6 A
- Signal 0 (leakage current)	<= 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 µs
Contact 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 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 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> (arrow down)	One menu item down	Decrease parameter value

IndraControl controls L45, L65 and L85

Key	Menu navigation	Input function
<Up> (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

IndraControl controls L45, L65 and L85

- 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".

IndraControl controls L45, L65 and L85

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. Archiving is completed with a control "reboot".

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 <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".

Display of the hardware information

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

IndraControl controls L45, L65 and L85

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 "mtxtboot.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:

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

IndraControl controls L45, L65 and L85

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 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 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	Reloading the PLC boot project The PLC boot project is loaded from the user FEPR0M. Any PLC project in the root file system is discarded. Otherwise, the behavior corresponds to the startup mode 0.
3	Save startup In rare cases, due to faulty machine parameter specifications, a control startup can be impossible. Start-up 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	Deleting permanent CPL variables and system data The permanent CPL variables and system data are deleted. Otherwise, the behavior corresponds to Startup mode 0.
5	Cold start The power-up management logic is not run through. Otherwise, the behavior corresponds to Startup mode 0.
6	Bootstrap A new root file system is created. As a result, all old file system data is lost. If an intact user FEPR0M file system is available, the PLC boot project is loaded and copied to the root file system.
7	Recreating the user FEPR0M file system The user FEPR0M is created again. As a result, all old file system data is lost. This is required for example if a user FEPR0M 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
9	Debug mode 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) 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) The basic monitor is initialized. Further loading can take place via TCP/IP.
12	Identical to Startup mode 15

IndraControl controls L45, L65 and L85

13	Identical to Startup mode 15
14	Identical to Startup mode 15
15	Debug mode (basic monitor start) 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
STOP	PLC is in STOP state. The PLC program was stopped. If this state is directly enabled after control startup, no boot project is active.
RUN	PLC is in RUN state. The loaded PLC program is executed.
BRK	The PLC is on a breakpoint. The PLC program is interrupted for debugging purposes.
SCYC	The PLC operates in single-cycle mode. Each PLC cycle has to be enabled manually.
ERR	The PLC program was interrupted due to a runtime error.
???	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:

P -1	The Sercos ring is not closed. No drives were detected.
P 0	It is tried to close the Sercos ring.
P 1	It is tried to identify all devices in the Sercos ring.
P 2	The timing in the Sercos ring is determined and set.
P 3	The drives are parameterized.
P 4	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.

SF	Critical system error is pending (system fault).
FE	Boot panic error is present (fatal error).

Tab. 5-34: Error status display


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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:

ERR NoFw	No valid firmware detected
ERR SRAM	Not equipped with SRAM module
Check Ethernet settings	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
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 designation 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.

IndraControl controls L45, L65 and L85

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

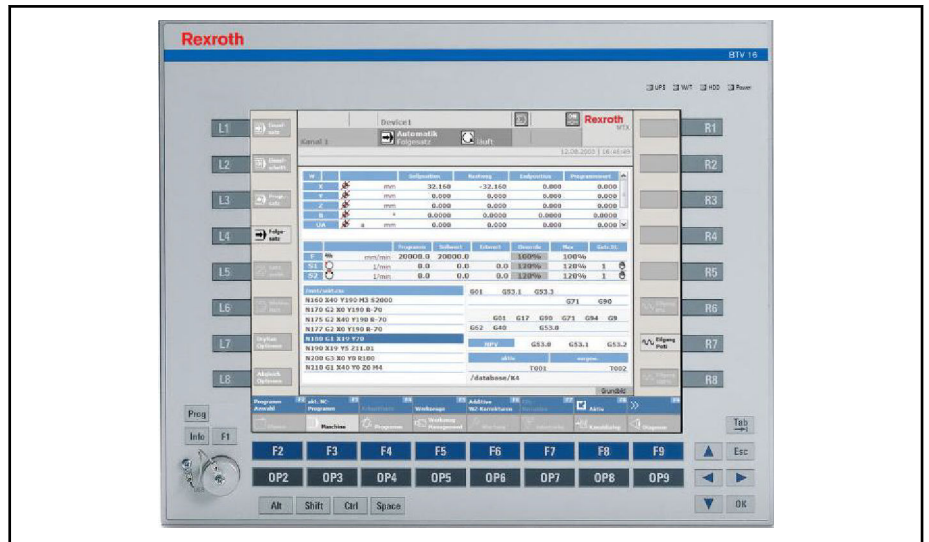


Fig. 6-1: VPP 16.3 compact industrial PC with 12" color display

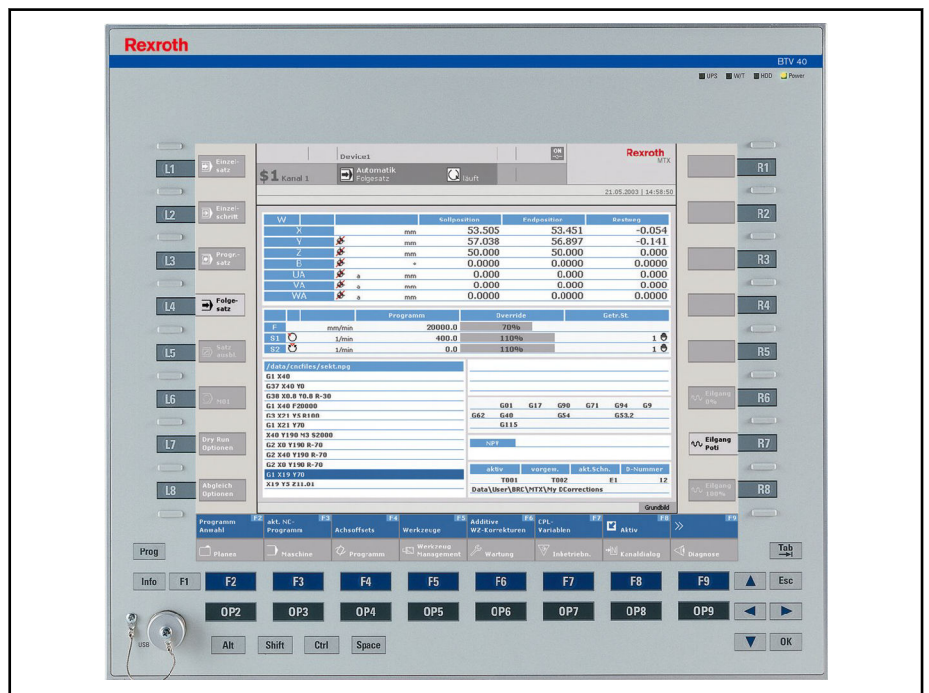


Fig. 6-2: VPP 16.3 compact industrial PC with 15" color display

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 IndraMotion MTX controls.

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.

VPP 16.3/40.3 Compact Industrial PC

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.

This relates to the following components:

- 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 51](#)).

6.5 Variants

6.5.1 Control PCs with a core i5-520M processor (D4)

Type	Display/ Front	Slots	Random access 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 a core i7-620M processor (D5)

Type	Display/ Front	Slots	Random access 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 a Celeron P4500 processor (C3)

Type	Display/ Front	Slots	Random access 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: Accessories for VPP 16.3/40.3

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 40.3 with VDP operating display

7.1 Brief description

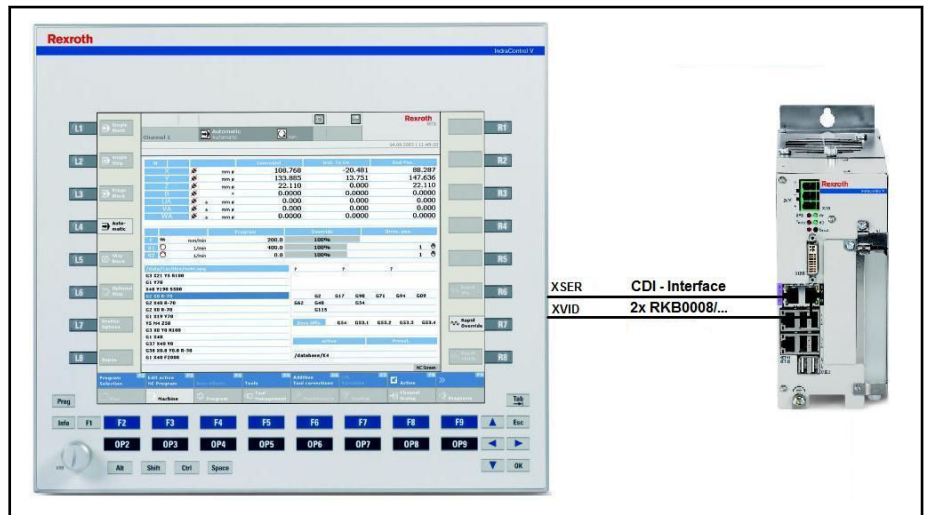


Fig. 7-1: Control cabinet PC VPB 40.3 with VDP operating display VDP 40.3

The VPB 40.3 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. The VPB 40.3 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 40.3.

7.2 Field of application

The control cabinet PC VPB 40.3 is used in industrial environments with increased vibration and shock requirements.

7.3 Technical data

7.3.1 VPB 40.3

Designation		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

Control cabinet PC VPB 40.3 with VDP operating display

7.3.2 VDP 15.3, 16.3, 18.3, 21.3 and 40.3

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

Tab. 7-2: 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
- Backlight

For the service life of the individual components, refer to the documentations (see [chapter 7.8 "Documentation" on page 56](#)).

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. 7-3: 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. 7-4: VPB40.3 variants with Core i7-620M processor (D5)

Control cabinet PC VPB 40.3 with VDP operating display

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. 7-5: 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. 7-6: Variants VPB40.3 with Celeron P4500 processor (C3)

7.6 Variants of the operating displays

7.6.1 Operating displays VDP 15.3, 18.3, 21.3

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

Tab. 7-7: Selection VDP 15.3, 18.3, 21.3

7.6.2 Operating displays VDP16.3 (12")

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

Tab. 7-8: VDP16.3 selection

7.6.3 Operating displays VDP40.3 (15")

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

Tab. 7-9: VDP40.3 selection

7.7 Accessories

7.7.1 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:

Control cabinet PC VPB 40.3 with VDP operating display

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. 7-10: Connecting cable VPB 40.3 - VDP



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

7.7.2 VSB 40.3 Accessories

Type	Note
VAP01.1H-W23-024-010-NN	Mains unit 24V DC; 10A
VAU01.1U-024-024-240-NN	Uninterrupted power supply 24V input / 24V output / 240W
RKB0019/...	USB interface cable to connect the uninterrupted power supply; lengths: 0.5m; 1.0m; 3.0m; 5.0m

Tab. 7-11: VSB 40.3 Accessories

7.8 Documentation

The following documentations provide a detailed description of the control cabinet PC VPB 40.3:

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

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

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

8 Embedded terminal VEP40.4/50.4

8.1 Brief description

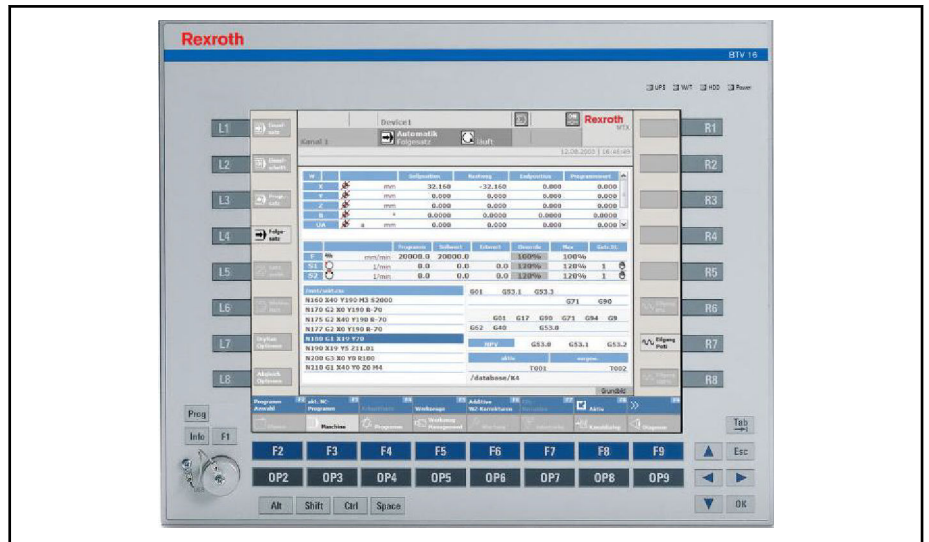


Fig. 8-1: Embedded terminal with 12" color display

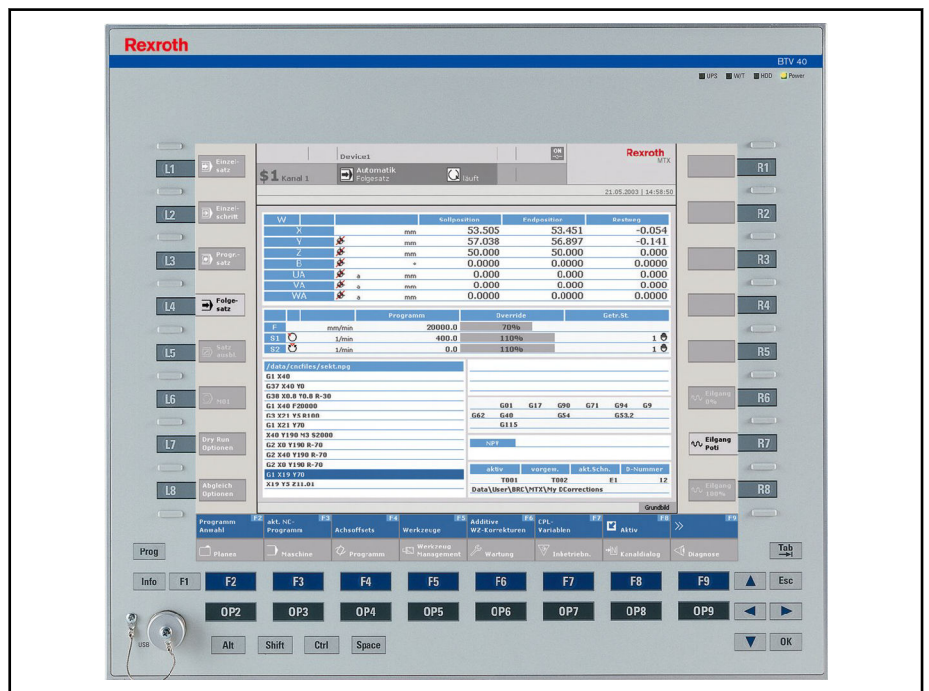


Fig. 8-2: Embedded terminal with 15" color display

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.

Embedded terminal VEP40.4/50.4

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 MA	Intel Atom 510, min. 1.1 GHz 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 VEP40.4/50.4 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

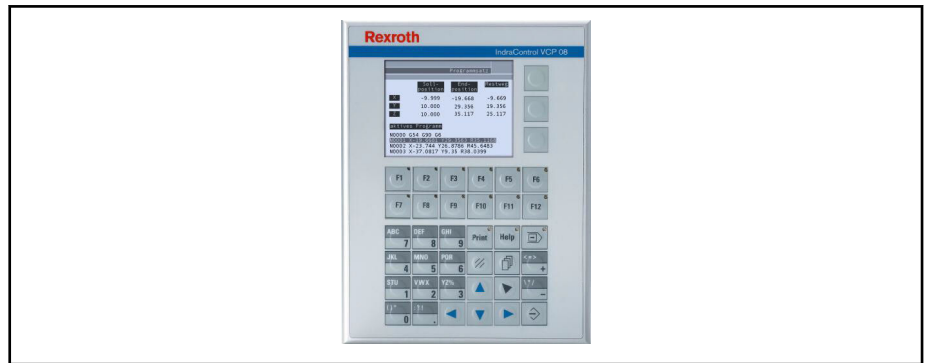


Fig. 9-3: VCP 08 small operator panel

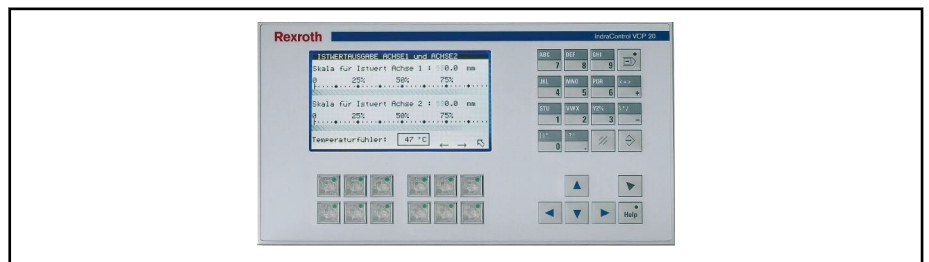


Fig. 9-4: VCP 20 small operator panel

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) 2x USB host 2.0 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, B: 132 mm
VR2107	7 "	150 mm	211 mm	46.3 mm	H: 142 mm, B: 203 mm

Tab. 10-1: Variants VR21xx

10.2 Technical data

	VR2104 Singletouch	VR2107 Singletouch	VR2107 Multitouch
Display	4,3 " TFT 480 x 272 Pixel 95.0 mm x 53.8 mm x 177 mm 65536 colors 450 cd/m ² brightness	9 " TFT 800 x 480 Pixel 152.4 mm x 91.4 mm 262144 colors 350 cd/m ²	
Touch technology	Analog resistive, 4-wire technology		Configured capacitively Touchpad
Touch activation pressure	15 g (standard) with R8 HS60 silicone rubber		
Central unit	ARM Cortex™-A8, 800 MHz with real-time clock (RTC)		
Flash memory	512 MByte		
RAM	512 MByte		
Power supply	24 V DC (SELV, PELV according to DIN EN61131)		

Small operator panel VR21xx

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

Tab. 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 Off: No communication
LED SPD 10/100 (yellow)	On: 100 MBit/s mode 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 VAM machine operator panel

11.1 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 und panel Pcs VPP. On the rear side, the devices are provided with a connector for a handwheel and a manual operating device as well as with connectors for 16 digital 24 V inputs and 8/16 digital 24 V outputs. Communication with the master control is established via PROFIBUS-DP or Sercos III.

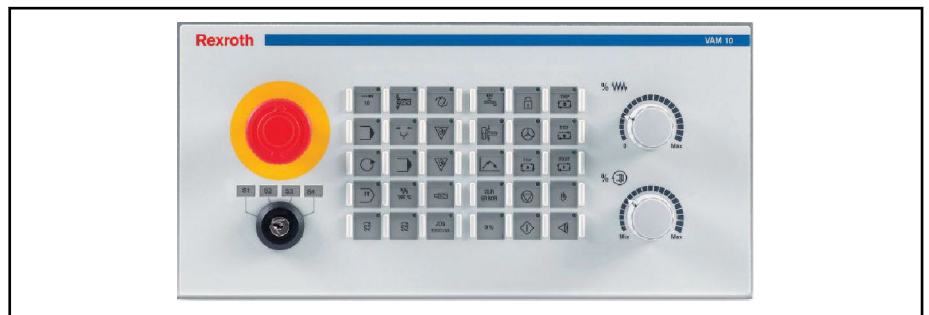


Fig. 11-1: VAM 40 machine operator panel

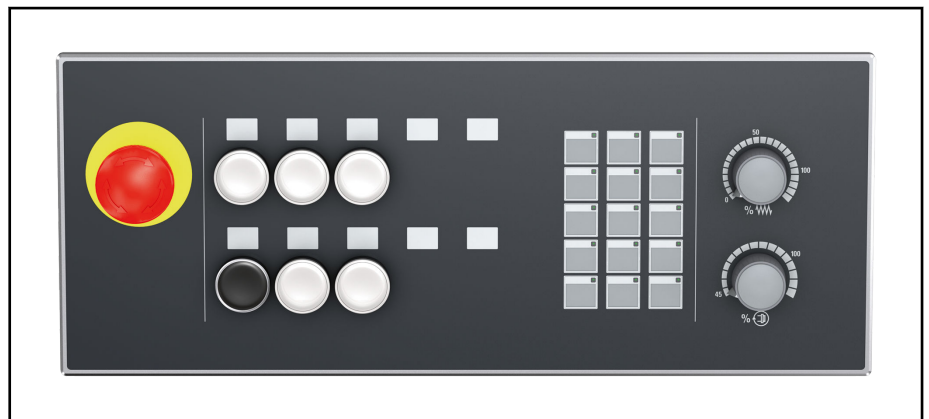


Fig. 11-2: VAM 15.1 machine operator panel

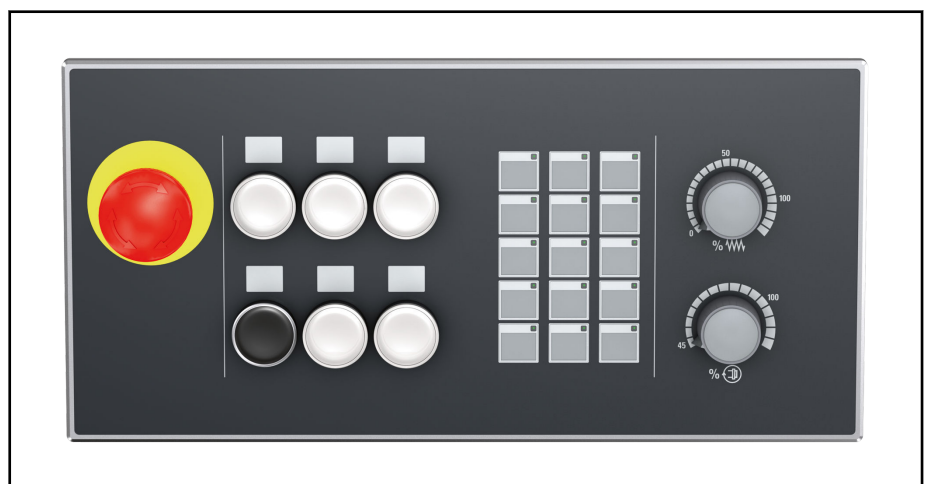


Fig. 11-3: VAM 21.1 machine operator panel

VAM machine operator panel

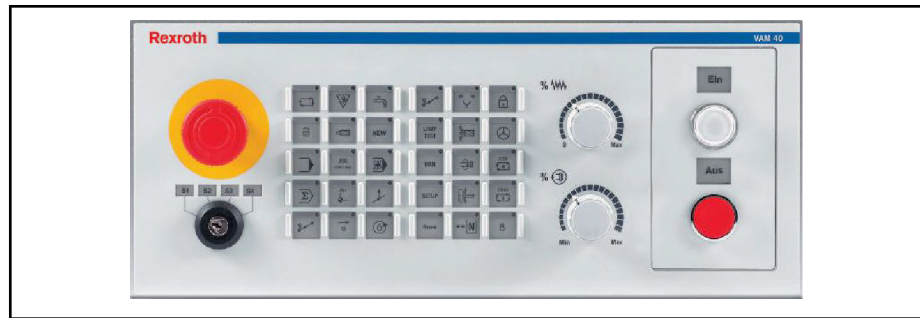


Fig. 11-4: VAM 40 machine operator panel

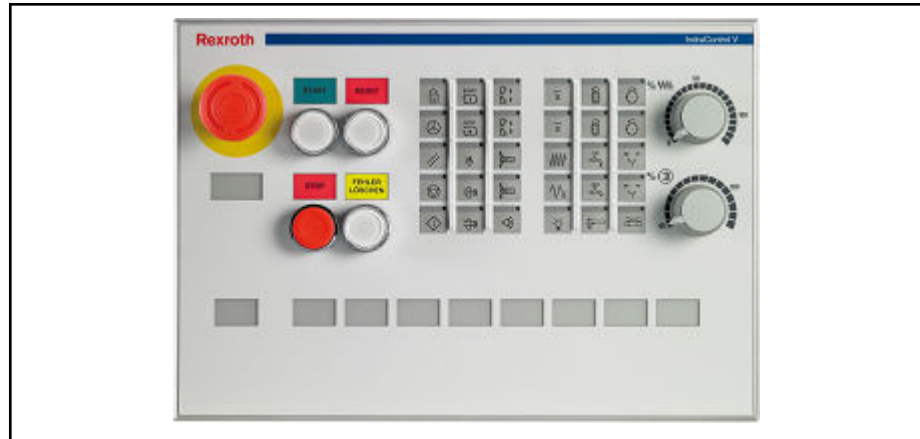


Fig. 11-5: VAM12 machine operator panel



Fig. 11-6: VAM42 machine operator panel

11.2 Variants

11.2.1 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. 11-1: Operator panels with PROFIBUS DP interface

11.2.2 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
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. 11-2: Operator panels with Sercos interface

11.3 Accessories

11.3.1 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. 11-3: PROFIBUS connecting cables

11.3.2 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. 11-4: Sercos connecting cable

11.4 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

12 Hand-held terminal VH2110

12.1 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-position 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. 12-1: Hand-held terminal VH2110

12.2 Technical data

Processor	ARM Cortex™-A9
Clock rate	1.0 Ghz
CPU cores	2
RAM	512 MB
Flash memory	512 MB
Interfaces	Ethernet: 10/100 Mbit 1x USB 2.0 OTG, externally to connect flash drives, a mouse or a keyboard
Protection class	IP53 IEC 60529, EN 60204-1, GS-ET-22 (2009)
Power supply	24 V DC (SELV, PELV according to DIN EN 61131)
Input voltage area	DC 24 V (DC +19.2 V to +30 V according to EN 61131-2)
Current consumption	0.3 A (typically at 24 V)

Hand-held terminal VH2110

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. 12-1: Technical data VH2110

12.3 Housing and display

Display	10,1", 1280 x 800 WXGA, 262144 colors
Touch	Capacitive multitouch, can be operated with two fingers
Surface of front plate	Glass
Dimensions	Width: 325 mm, height: 185 mm, depth: 59.6 mm
Plastic flame retardance test	UL94-HB
Safety components	A three position enabling button, dual circuit, wired externally EMERGENCY STOP pushbutton, dual circuit, wired externally
Standard operating elements	Override switch 15-positions, gray-coded
Connection	8m connection cable with anti-kink protection

Tab. 12-2: Housing and display VH2110

12.4 Spare parts, accessory parts and wear parts

Order designation	Part number	Description
VAC31.1C-NN	R911171822	Terminal unit with short-circuit plug for hand-held terminals with EMERGENCY STOP pushbutton
VAS01.1-003-NNN-NN	R9111173896	Wall-mounting holder (for stationary operation or as resting surface for the hand-held terminal)

Tab. 12-3: Spare parts, accessory parts and wear parts VH2110

12.5 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.

12.6 Commissioning

12.6.1 General information

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

12.6.2 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".

12.6.3 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".

12.6.4 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.

12.7 Variants

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

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

Tab. 12-4: VH2110 selection

12.8 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-DE-P - Rexroth IndraControl V-devices operating systems

13 VAK PC keyboards

13.1 General information

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

13.2 Drawer keyboards



Fig. 13-1: VAK 10.1 drawer keyboard



Fig. 13-2: 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.

13.3 Built-in keyboards



Fig. 13-3: VAK 11.2 built-in keyboard

VAK PC keyboards



Fig. 13-4: Drawer keyboard VAK 41.2

The built-in keyboards VAK 11 and VAK 41 are AT-compatible PS/2 touch screen 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.

13.4 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. 13-1: VAK 10/11/40/41 models

13.5 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

14 Rexroth inline modules

14.1 Brief description

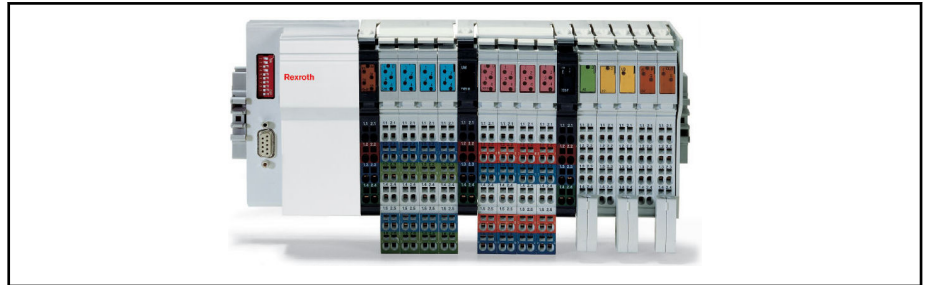


Fig. 14-1: Rexroth inline system

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.

14.2 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

14.3 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. 14-1: Bus Coupler

14.4 Accessories

14.4.1 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:

Rexroth inline modules

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. 14-2: PROFIBUS connecting cables

14.4.2 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. 14-3: Sercos connecting cable

14.5 Documentation

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

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

15 Rexroth Fieldline modules

15.1 Brief description



Fig. 15-1: 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.

15.2 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. 15-1: Module selection

15.3 Documentation

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

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

16 Application example IndraMotion MTX

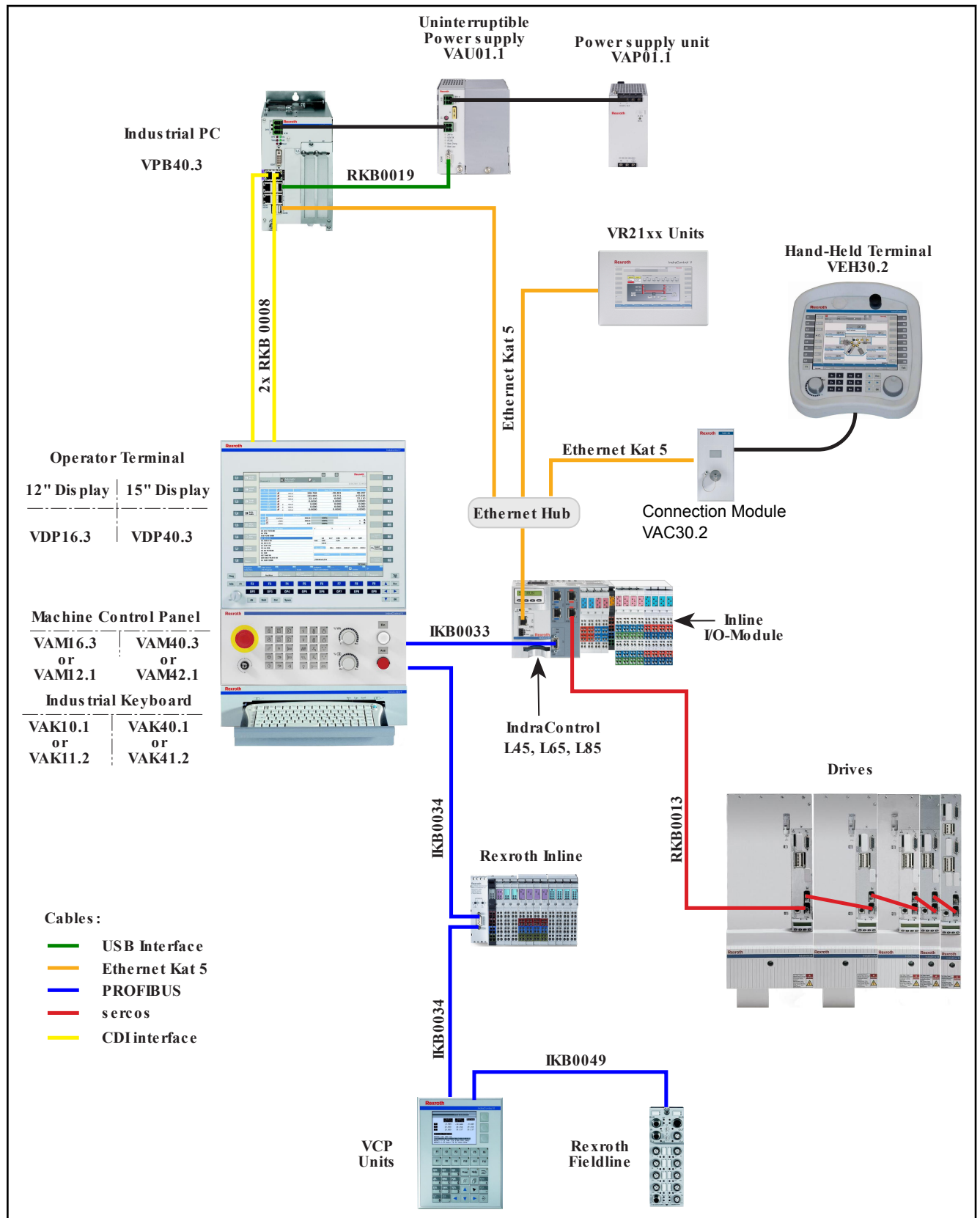


Fig. 16-1: Application example IndraMotion MTX

17 Sercos installation instruction

17.1 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

17.2 Installation planning

17.2.1 General information

The connections between the network of an automation island network and the general connections can be established using a suitable converter/adapter. The connections between automation islands, on the other hand, can be established via one or multiple field bus-field bus connections and suitable converters/ adapters or via general wiring (see [fig. 17-1 "Automation island consisting of a Sercos network" on page 84](#)).

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).

Sercos installation instruction

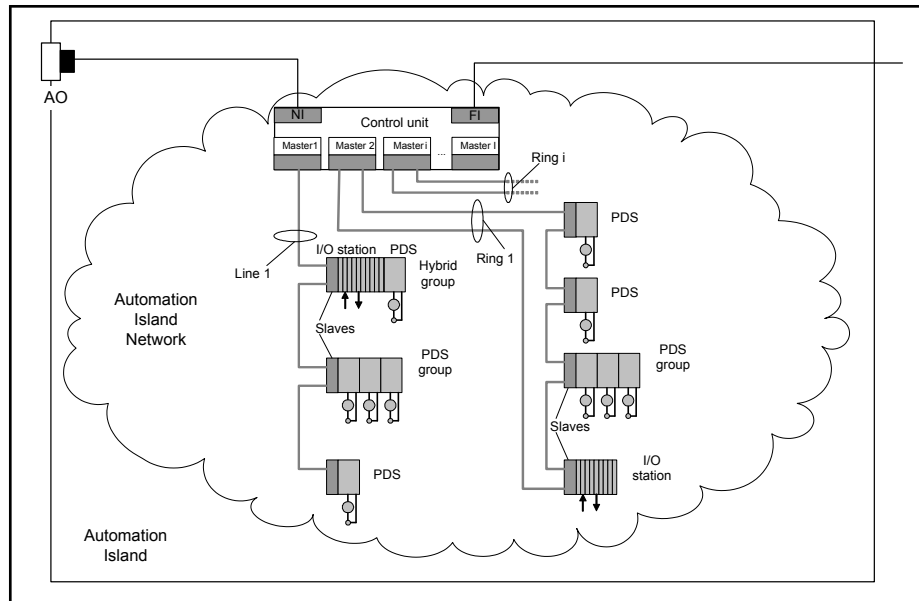


Fig. 17-1: Automation island consisting of a Sercos network



- **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

17.2.2 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).

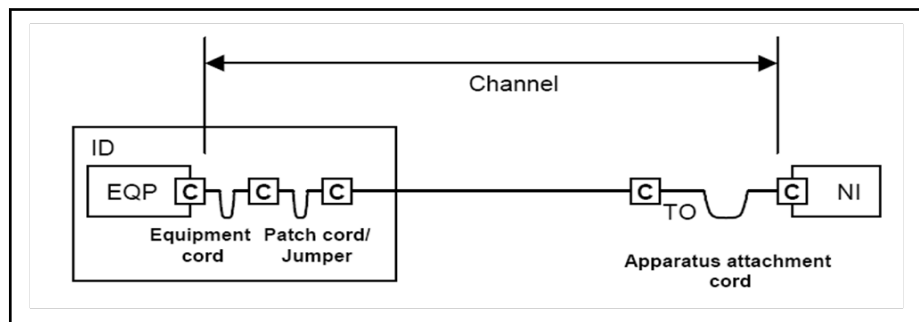


Fig. 17-2: Transmission capacity of a channel



- **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

17.2.3 Network properties for symmetrical wiring based on Ethernet

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

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

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

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

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

Tab. 17-1: Sercos network properties for symmetrical cables

Sercos installation instruction

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

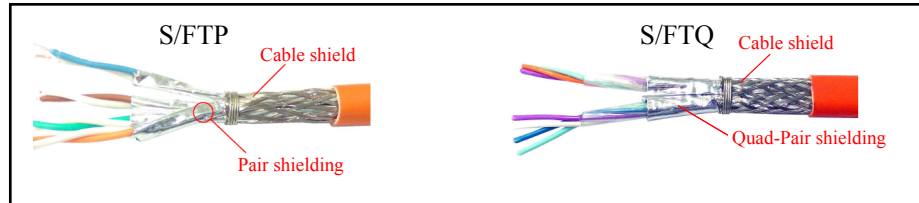


Fig. 17-3: Examples of a cable shield and pair shielding

17.2.4 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. 17-1 "Sercos network properties for symmetrical cables"](#) on page 85 and [tab. 17-2 "Parameters of the mechanical force for symmetrical cables"](#) on page 86.

Mechanic forces

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

Sercos installation instruction

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

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

Tab. 17-2: 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. 17-3: Sercos cable by Bosch Rexroth

Connections within a wiring channel

General description

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

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

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

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

The use of end-to-end links without couplings is common practice in industrial applications. End-to-end links only have two connection points (see [fig. 17-4 "Channel without coupling" on page 88](#)).

End-to-end links without couplings are used to

- reduce the costs for wiring

Sercos installation instruction

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

Symmetrical wiring connections for Sercos

fig. 17-4 "Channel without coupling" on page 88 and fig. 17-5 "Channel with coupling" on page 88 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.

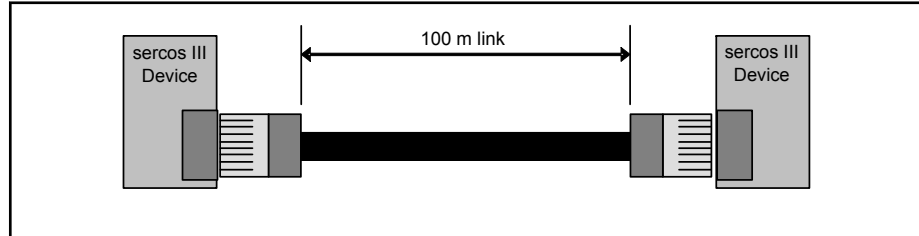


Fig. 17-4: Channel without coupling

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.

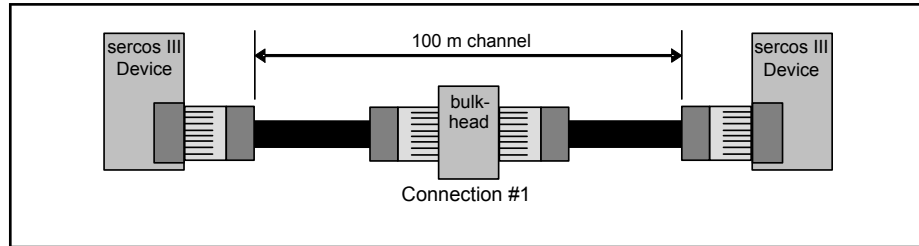


Fig. 17-5: Channel with coupling

17.3 Installing Sercos

17.3.1 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.

17.3.2 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.

Sercos installation instruction

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.

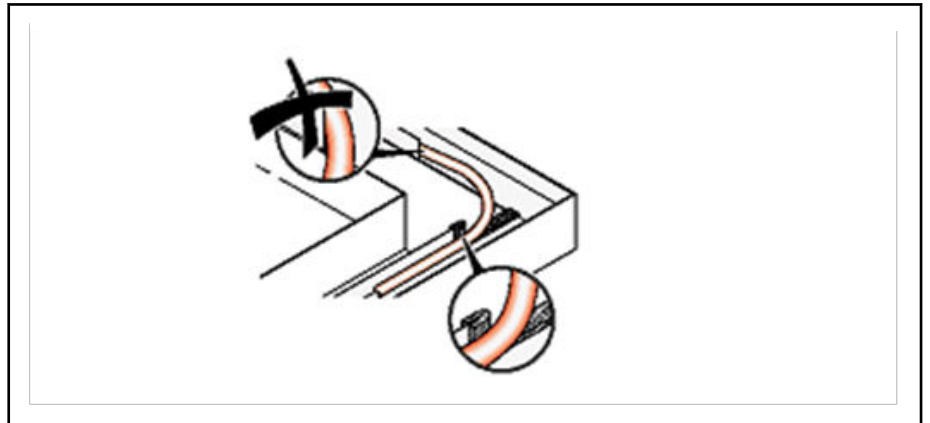


Fig. 17-6: Using edge protection

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).

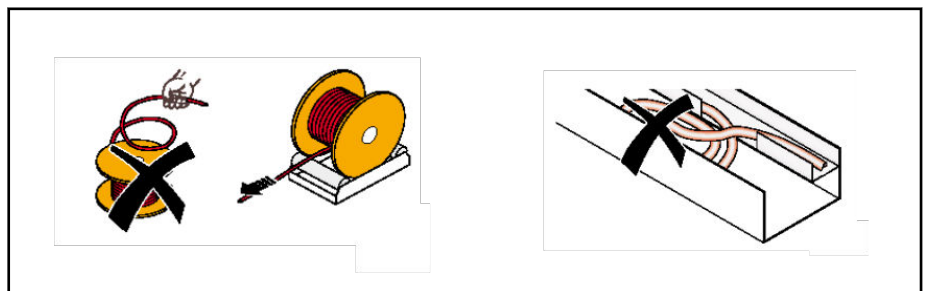


Fig. 17-7: Use an unwinning device and avoid loop formation

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).

Sercos installation instruction

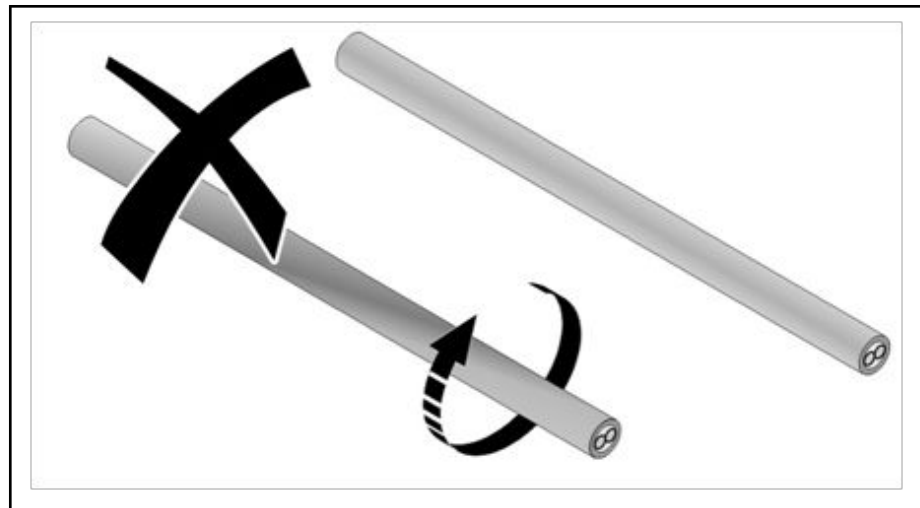


Fig. 17-8: Avoid twisting

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. 17-2 "Parameters of the mechanical force for symmetrical cables" on page 86](#).

Bending radius

The minimum bending radius of a cable corresponds to the information in [tab. 17-2 "Parameters of the mechanical force for symmetrical cables" on page 86](#), 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.

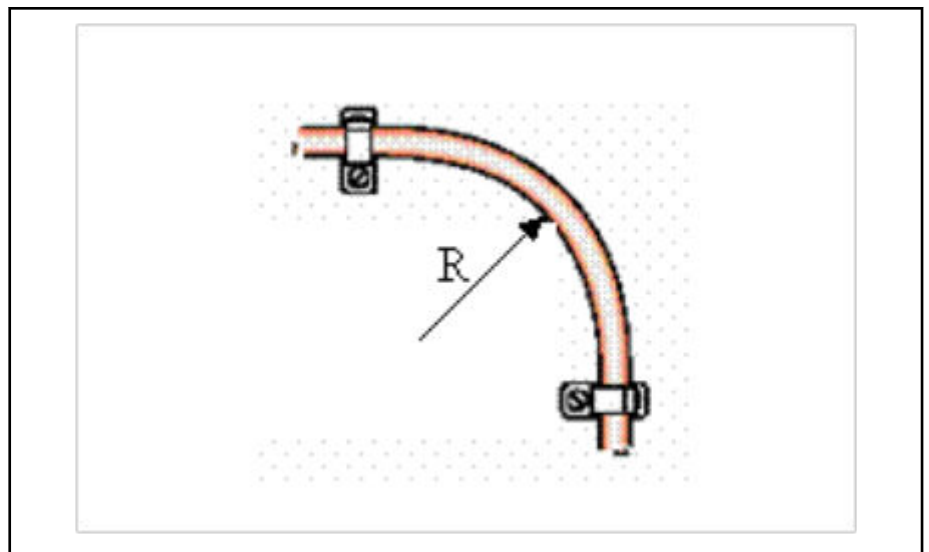


Fig. 17-9: Complying with the minimum bending radius

Tensile force

The permissible tensile force of a cable corresponds to the information in [tab. 17-2 "Parameters of the mechanical force for symmetrical cables"](#) on [page 86](#), 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.

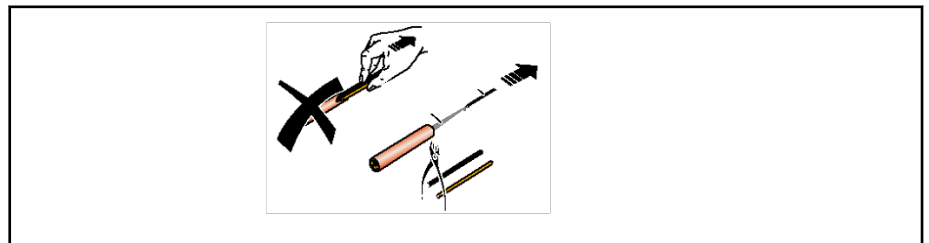


Fig. 17-10: Do not tear at individual cores

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.

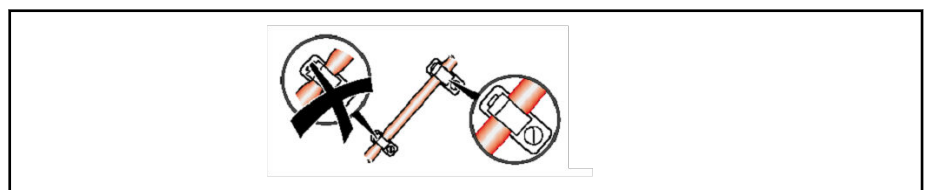


Fig. 17-11: Use cable clamps with a large (wide) surface

Sercos installation instruction

- 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. 17-12 "Separate cable ducts" on page 92](#)).



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

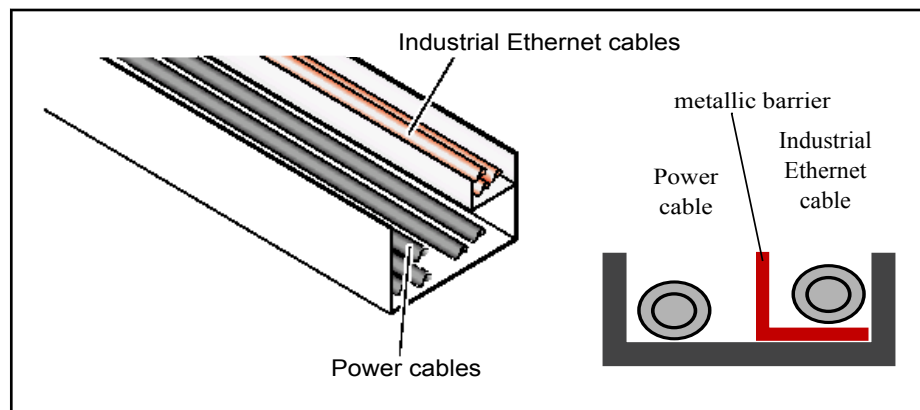


Fig. 17-12: Separate cable ducts

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).

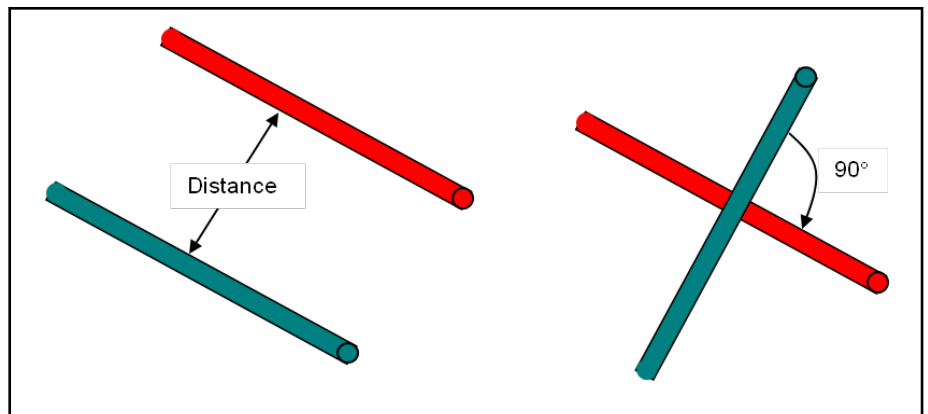


Fig. 17-13: Methods for routing

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

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

Tab. 17-4: 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. 17-5: 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).

Sercos installation instruction

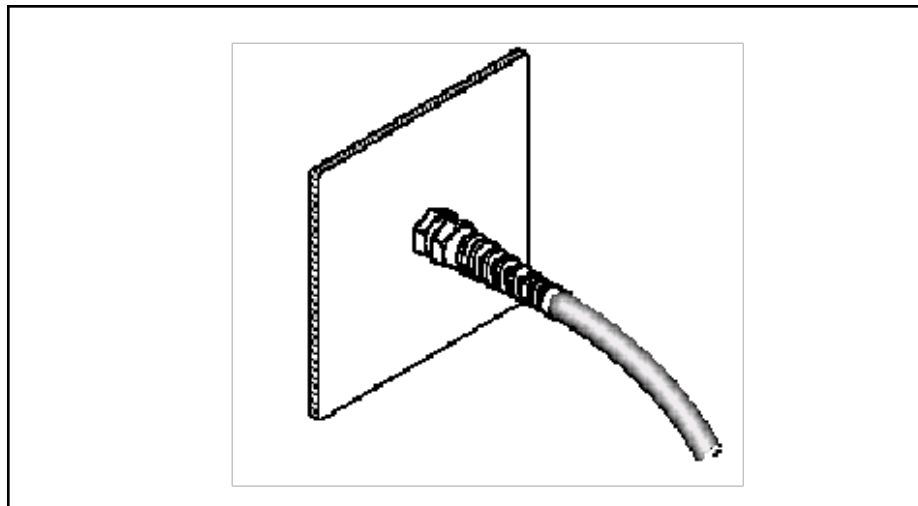


Fig. 17-14: Cable gland with bend protection

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. 17-15 "Spiral hose" on page 94](#)).

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.

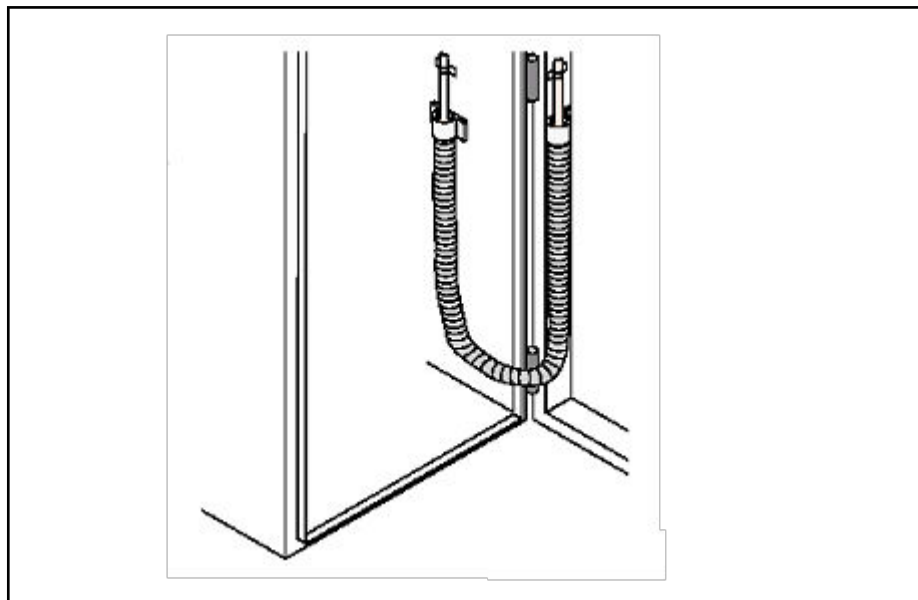


Fig. 17-15: Spiral hose

17.3.3 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

Sercos installation instruction

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. 17-6 "Color coding for Sercos cables with 4 cores" on page 95](#).

Shielded connectors must be installed in accordance with the procedures for the end terminal of connectors and device connection cables as specified in [tab. 17-6 "Color coding for Sercos cables with 4 cores" on page 95](#).

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

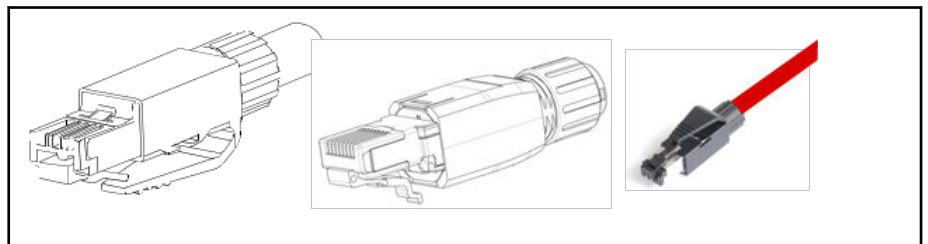


Fig. 17-16: Shielded RJ-45 connector for Sercos

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



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

[tab. 17-6 "Color coding for Sercos cables with 4 cores" on page 95](#) and [tab. 17-7 "Color coding for sercos cables with 8 cores" on page 96](#) 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. 17-6: Color coding for Sercos cables with 4 cores

Sercos installation instruction

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

1) Not used for Sercos

Tab. 17-7: 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).

17.3.4 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.

17.3.5 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.

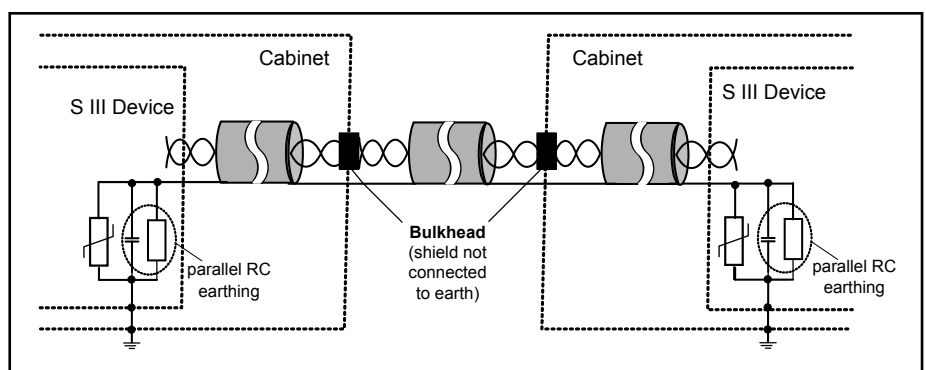


Fig. 17-18: Examples of a parallel RC grounding of the shield

17.4 Troubleshooting in the installation

17.4.1 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)

Sercos installation instruction

17.4.2 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?

17.4.3 Typical problems

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

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

Sercos installation instruction

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

Tab. 17-8: Typical problems in a network with symmetrical wiring

18 Service and support

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

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

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

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

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

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

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

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

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Notes

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R911342640