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IndraLogic XLC
IndraMotion MLC 14VRS

System Overview

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IndraMotion MLC 14VRS
System Overview

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Refer to tab. 1-1 "Change Record" on page 1

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Editorial Department Automation Systems Development XLC System Development GeKue (MiNi/MePe)

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1 About this documentation

Editions of this documentation

Edition	Release Date	Note
01	2014-11	**First edition**
02	2015-09	**Update**: "Axes", supplements
03	2017-03	**Update**: • System overview on hardware (XM12) • System overview on extension modules • Visualization devices (IndraControl VPB40.3/VH21) • System overview on RoCo • Real-time Ethernet hardware description • Sercos III, general information on cross communication • Sercos III Optical ring adaptation
04	2017-06	**Update**: • System overview hardware (IndraControl XM12 removed) • Chapter “Remote support” (I-remote removed / note on documentation “Remote support")
05	2018-06	**Supplement**: • Control hardware/VPB40.4, see chapter 4.5 "Technical data of the IndraMotion MLC" on page 26 • Function modules for Hardware basis IndraControl, see chapter 9.4 "CrossComm Sercos III (CFL01.1-R3) - Sercos III cross communication" on page 117 • Extension modules for hardware basis, see chapter 10.2 "Information on extension modules" on page 145 **Removed**: "IndraControl L25" IndraLogic L25 controls are not supported from IndraWorks 14V22, see chapter 4.2 "IndraControl L25 is not supported anymore from version 14V22" on page 19

Edition	Release Date	Note
06	2018-10	**Supplement**: • IndraControl XM42, refer to fig. 4-3 "IndraControl XM42" on page 23 • IndraControl VPB40.4, refer to chapter 6.3 "IndraControl VPB40.4" on page 78 **Update**: • Control variants of the IndraMotion MLC, refer to chapter 4.3 "Control variants of the IndraMotion MLC" on page 21 • Technical data of the IndraMotion MLC, refer to chapter 4.5 "Technical data of the IndraMotion MLC" on page 26 • IndraControl XM – Overview/connections, refer to chapter 6.2.1 "Overview" on page 69 – Operating elements and displays, refer to chapter 6.2.6 "Operating elements and displays" on page 75 • HydraulicDrive HDB, supported firmware, refer to chapter 7.7.2 "Firmware" on page 100
07	2020-02	**New**: • chapter 11.9 "Multi-touch panel PC, control cabinet PC and display – VR/PR/DR " on page 182 • chapter 8.5 "Rexroth S67E" on page 113 **Removed**: • Chapter "Rexroth IndraControl S67"

Tab. 1-1: Change Record

1.1 Validity of the documentation

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: In the product phase "Selection", the target group "Design engineer" can execute the activities "Select, Prepare, Design, Construct" using this documentation.

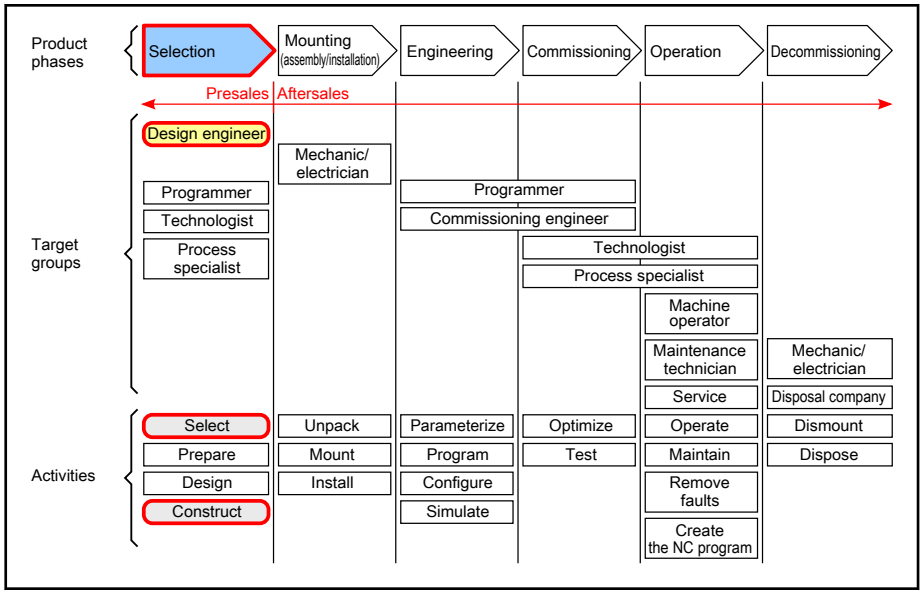


Fig. 1-1: Assigning the present documentation to the target groups, product phases and activities of the target group

Purpose This documentation provides an overview on hardware/software components of the automation systems IndraLogic XLC/IndraMotion MLC in the corresponding version.

The project planning manual supports the user in selecting, configuring and designing the control systems IndraLogic XLC/IndraMotion MLC.

This project planning manual does not provide any instructions for the machine operation integrated into an IndraLogic XLC/IndraMotion MLC. For information on the operation, refer to the instructions of the respective machine.

Qualification Required qualification: Individual who is able to assess the tasks assigned and to identify possible safety risks owing to qualification in the subject, knowledge and experience. The individual should also be familiar with the standards and regulations.

Availability This project planning manual is not part of the product delivery.

1.2 Required and supplementing documentation XLC/MLC

Documentation titles with type codes and part numbers

System overview
IndraLogic XLC IndraMotion MLC 14VRS System Overview
DOK-XLCMLC-SYSTEM**V14-PRRS-EN-P, R911341504
This documentation provides an overview on the possible hardware/software components of the automation systems IndraLogic XLC and IndraMotion MLC of the mentioned version. The documentation facilitates assembling a system.

Tab. 1-2: XCL/MLC documentation overview - System overview

First steps
IndraMotion MLC 14VRS First Steps
DOK-MLC***-F*STEP**V14-CORS-EN-P, R911341517
This documentation describes the first steps of the IndraMotion MLC and the RobotControl. It includes the hardware and software prerequisites as well as the creation of a project.
IndraLogic XLC 14VRS First Steps
DOK-XLC***-F*STEP**V14-CORS-EN-P, R911341489
This documentation describes the first steps of the IndraLogic XLC. It includes the hardware and software prerequisites as well as the creation of a project.
Rexroth IndraLogic XLC IndraMotion MLC 14VRS Project Conversion
DOK-XLCMLC-PROCONV*V14-APRS-EN-P, R911341494
This documentation describes the project conversion of the IndraMotion MLC.

Tab. 1-3: XCL/MLC documentation overview - First steps

Engineering
IndraWorks 14VRS Software Installation
DOK-IWORKS-SOFTINS*V14-CORS-EN-P, R911344286
This documentation describes the IndraWorks installation.
IndraWorks 14VRS Engineering
DOK-IWORKS-ENGINEE*V14-APRS-EN-P, R911343566
This documentation describes the application 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.
IndraLogic XLC IndraMotion MLC 14VRS Function Description
DOK-XLCMLC-FUNC****V14-APRS-EN-P, R911341700
This documentation describes wizards, context menus, dialogs, control commissioning, device configuration and functionalities of the IndraMotion MLC.

Tab. 1-4: XCL/MLC documentation overview - Engineering

Diagnostics and service
IndraLogic XLC IndraMotion MLC 14VRS Diagnostics
DOK-XLCMLC-DIAG****V14-RERS-EN-P, R911341481
This documentation includes all control diagnostics implemented in the control systems IndraLogic XLC and IndraMotion MLC.
IndraLogic XLC IndraMotion MLC 14VRS Parameters
DOK-XLCMLC-PARAM***V14-RERS-EN-P, R911341479
This documentation describes the parameters of the XLC/MLC systems as well as the interaction between parameterization and programming. It includes the axis parameters, control parameters, kinematic parameters, touch probe parameters and programmable limit switch parameters.
IndraLogic XLC IndraMotion MLC 14VRS Commissioning
DOK-XLCMLC-STARTUP*V14-CORS-EN-P, R911341502
This documentation describes the steps to commission and service the IndraMotion MLC and IndraLogic XLC systems. It includes checklists for frequent tasks and a detailed description of the steps.

Diagnostics and service
WebAssistant DOK-GENERL-WEB*ASSIST*-APRS-EN-P, R911381469 This documentation describes the WebAssistant. The WebAssistant is a webbased diagnostic tool used to access a control system via an Ethernet highspeed connection. The WebAssistant allows OEMs, end users and service engineers to access and to remotely diagnose a system. A PC with Internet Explorer version 11 or higher, Firefox version 45 or above or Google Chrome version 54 or above is required. The following control variants are supported: • IndraMotion MLC L45/L65/L75/XM21/XM22/XM42/VPx • IndraLogic XLC L45/L65/L75/VEP
IndraWorks IndraMotion Service Tool DOK-IWORKS-IMST*******-APRS-EN-P, R911341383 This documentation describes the IndraMotion Service Tool (IMST). IMST is a web-based diagnostic tool used to access a control system via an Ethernet high-speed connection. The IMST allows OEMs, end users and service engineers to access and remotely diagnose a system. The PC has to use at least Internet Explorer 8, Firefox 3.5 or a higher version. The following control variants are supported: • IndraMotion MLC L45/L65/L75/XM21/XM22/XM42/VPx • IndraLogic XLC L45/L65/L75

Tab. 1-5: XLC/MLC documentation overview - Diagnostics and service

Firmware
Rexroth IndraDrive MPx-20, Functions [1)] DOK-INDRV*-MP*-20VRS**-AP01-EN-P, R911345608 This documentation describes all functional properties of the IndraDrive firmware in the variants MPB-20, MPM-20, MPC-20 and MPE-20.
Rexroth IndraDrive MPx-16 to MPx-20 und PSB, Parameters DOK-INDRV*-GEN1-PARA**-RERS-EN-P, R911328651 This documentation contains the descriptions of all parameters implemented in the firmware for drive controllers of the IndraDrive range. It supports the drive controller parameterization.
Rexroth IndraDrive MPx-16 to MPx-20 and PSB, Diagnostic Messages DOK-INDRV*-GEN1-DIAG**-RERS-EN-P, R911326738 This documentation contains the descriptions of all diagnostic messages implemented in the following firmware products: • Drive controller firmware variants MPx-16 to MPx-20 • PSB firmware variants for "HMU05" and "KMV03" type supply units • Firmware variants for "HMV01" type supply units It assists machine operators and installation programmers with troubleshooting.
Hardware
Rexroth IndraDrive Control Sections CSB02, CSE02, CSH02, CDB02 DOK-INDRV*-Cxx02******-PRRS-EN-P, R911338962
Rexroth IndraDrive Cs Drive Systems with HCS01 DOK-INDRV*-HCS01******-PRRS-EN-P, R911322210

Rexroth IndraDrive Mi Drive Systems with KCU02, KSM02, KMS02/03, KMV03
DOK-INDRV*-KCU02+KSM02-PRxx-EN-P, R911335703
Rexroth IndraDrive ML Drive Systems with HMU05
DOK-INDRV*-Hxx05******-PRxx-EN-P, R911344279

1) In preparation

Tab. 1-6: Overview of documentations for drive controllers

PLC
IndraWorks 14VRS PLC Programming System IndraLogic 2G
DOK-IWORKS-IL2GPRO*V14-APRS-EN-P, R911343571
This documentation describes the PLC programming tool IndraLogic 2G and its usage. It includes the basic use, first steps, visualization, menu items and editors.
IndraWorks 14VRS Basic Libraries IndraLogic 2G
DOK-IL*2G*-BASLIB**V14-LIRS-EN-P, R911343920
This documentation describes the system-comprehensive PLC libraries.
IndraLogic XLC IndraMotion MLC 14VRS PLCopen Libraries
DOK-XLCMLC-FUNLIB**V14-LIRS-EN-P, R911341491
This documentation describes the function blocks, functions and data types of the RIL_CommonTypes, ML_Base and ML_PLCopen libraries for the IndraLogic XLC/IndraMotion MLC. It also includes the error reactions of function blocks.

Tab. 1-7: XCL/MLC documentation overview - PLC

Field buses
IndraWorks 14VRS Field Buses
DOK-IWORKS-FB******V14-APRS-EN-P, R911341485
This documentation describes the field bus and local periphery connections supported by the IndraLogic XLC, IndraMotion MLC and IndraMotion MTX systems. The focus of this documentation is on the configuration, parameterization, commissioning and the diagnostics of the different periphery connections. This documentation is the basis for the online help.
IndraWorks 14VRS Field Buses Libraries
DOK-IWORKS-FB*LIB**V14-LIRS-EN-P, R911343575
This documentation describes the field bus libraries: RIL_ProfibusDP_02, RIL_ProfibusDPSlave, RIL_ProfinetIO, RIL_ProfinetIODevice, RIL_EtherNetIPAdapter, RIL_MappingList, RIL_SERCOSIII, RIL_Inline including their diagnostics and error reactions of the function blocks.
Rexroth IndraWorks 12VRS FDT Container
DOK-IWORKS-FDT*CON*V12-APRS-EN-P, R911334398
This documentation describes the IndraWorks FDT Container functionality. It includes the activation of the functionality in the project and working with DTMs.
Sercos System Manual for I/O Devices
DOK-CONTRL-ILS3*******-APxx-EN-P, R911333512
This documentation describes the configuration, parameterization, commissioning and diagnostics of I/O devices with a Sercos interface.

xx Corresponding edition

Tab. 1-8: XCL/MLC documentation overview - Field buses

HMI
IndraWorks 14VRS HMI
DOK-IWORKS-HMI*****V14-APRS-EN-P, R911343569
This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.
IndraWorks 14VRS WinStudio 7.4
DOK-IWORKS-WINSTUD*V14-APRS-EN-P, R911341585
This "User Manual and Technical Reference Book" facilitates working with the "Rexroth WinStudio" software for optimal results. This document provides technical information and step-by-step instructions to create web-enabled HMI/SCADA programs.
Rexroth IndraLogic XLC IndraMotion MLC 14VRS HMI Connection
DOK-XLCMLC-HMI*****V14-APRS-EN-P, R911341497
This documentation describes the visualization systems supported by the IndraLogic XLC and IndraMotion MLC and their connection.

Tab. 1-9: XCL/MLC documentation overview - HMI

Technology
IndraLogic XLC IndraMotion MLC 14VRS Generic Application Template
DOK-XLCMLC-TF*GAT**V14-APRS-EN-P, R911341487
This documentation provides a structured template to the IndraLogic PLC programmer. This template can be used to add and edit the PLC programming code. It includes the template, the template wizard and example applications.
IndraMotion MLC 14VRS Technology Libraries
DOK-MLC***-TF*LIB**V14-LIRS-EN-P, R911341511
This documentation describes the function blocks, functions and data types of the "ML_TechInterface.library", "ML_TechMotion.library", "RMB_TechCam.library" and "ML_TechBase.library". It also includes libraries for the winder functionality, register controller functionality and CrossCutter functionality.
IndraWorks 14VRS Energy Efficiency Management
DOK-IWORKS-4EE*****V14-APRS-EN-P, R911339229
This documentation describes the HMI connection of the energy management system and the function blocks, functions and data types of the "RIL_4EE " library. The documentation also includes the error reactions of the function blocks.
Rexroth IndraMotion MLC 14VRS RegisterControl (Library)
DOK-MLC***-REGI*CO*V14-LIRS-EN-P, R911341509
This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.
IndraMotion MLC 14VRS RegisterControl (Application Description)
DOK-MLC***-REGI*CO*V14-APRS-EN-P, R911341507
This documentation describes the application of the integrated register control for a rotogravure printing machine. The components of the mark stream sensor, the HMI application and the error recovery options are described. This instruction provides information on how to operate the register control, react to errors and query diagnostics. This documentation is written for machine setters and machine operators.
Rexroth IndraMotion MLC 14VRS Winder Function Application
DOK-MLC***-TF*WIND*V14-APRS-EN-P, R911341513
This application-related system documentation describes the application of the winder technology functions.

Technology
Rexroth IndraWorks CamBuilder 13VRS
DOK-IWORKS-CAMBUIL*V13-APRS-EN-P, R911336291
This documentation describes the basic principles and operation of the CamBuilder, the cam editing tool.
IndraMotion MLC 14VRS Robot Control V2
DOK-MLC***-ROCO****V14-RERS-EN-P, R911341588
This documentation provides information about the Robot Control V2. The focus is on PLCopen programming. The program structure, variables, functions, motion statements and the required system parameters are described. This documentation also includes the description of the "ML_Robot" library. Robot Control V2 is supported by a kinematic interface. The components of this interface are described in the "ML_KinTech" library.

Tab. 1-10: XCL/MLC documentation overview - Technology

Open Core Engineering - OCE
IndraLogic XLC IndraMotion MLC 14VRS First Steps MLPI (online help)
DOK-XLCMLC-MLPI****V14-CORS-EN-E, R911341033
This document describes the installation and the commissioning of the MLPI interface.
IndraLogic XLC IndraMotion MLC 14VRS Automation Interface (online help)
DOK-XLCMLC-AUT*INT*V14-APRS-EN-E, R911341499
This documentation describes the script-based access to IndraWorks project data via the interface of the Automation Interface.

Tab. 1-11: XCL/MLC documentation overview - Open Core Engineering - OCE

SafeLogic
IndraWorks SafeLogic 14VRS First Steps
DOK-IWORKS-SL*STEP*V14-CORS-EN-P, R911341520
This documentation describes the initial commissioning of the Safety function module and its external Safety periphery. Taking the example of a project, all required steps to commission a simple Safety application are executed.
IndraLogic XLC IndraMotion MLC 14VRS SafeLogic System Overview
DOK-XLCMLC-SL**SYS*V14-PRRS-EN-P, R911341696
This documentation describes the project planning, configuration, creation and commissioning of safety-related devices.
IndraWorks 14VRS SafeLogic - Project Configuration, Version 1.2.0.0.
DOK-IWORKS-SL**PRJ*V14-APRS-EN-P, R911341694
This documentation describes the configuration of Safety applications.
IndraControl CFL01.1-F1 Safety Function Module
DOK-CONTRL-SL**FM*****-ITRS-EN-P, R911336576
This documentation is provided with the hardware and describes the commissioning, the installation, the decommissioning and disposal of the hardware.

Tab. 1-12: XCL/MLC documentation overview - SafeLogic

Hardware
Rexroth IndraControl L45/L65/L85 Control
DOK-CONTRL-ICL45L65L85-PRxx-EN-P, R911332116
This documentation describes the IndraControl L45/L65/L85 controls.
Rexroth IndraControl Lxx 14VRS Function Modules
DOK-CONTRL-FM*LXX**V14-APRS-EN-P, R911341583
This documentation describes all function modules of the Lxx controls including engineering and diagnostics.

Hardware
IndraControl XM21, XM22 Controls
DOK-CONTRL-IC*XM2*****-ITRS-EN-P, R911340667
This documentation describes the IndraControl XM21/XM22 controls.
IndraControl XM42 Controls
DOK-CONTRL-XM4X*CTRL**-ITRS-EN-P, R911345566
This documentation describes the IndraControl XM42 controls.
IndraControl XFE 01.1 Extension Modules Profibus, RT-Ethernet, Sercos, CAN
DOK-CONTRL-XFE**EXTMOD-ITRS-EN-P, R911345570
This documentation describes all extension modules of the XM controls.

xx Corresponding edition

Tab. 1-13: XCL/MLC documentation overview - Hardware

Hydraulics
Rexroth IndraMotion MLC 14VRS Hydraulic Functions
DOK-MLC***-TF*HMOT*V14-LIRS-EN-P, R911341907
This documentation describes the function blocks, functions and data types of the MH_TechHydrBase and MH_TechHydrMotion libraries. The documentation also includes the error reactions of the function blocks.
Rexroth IndraLogic XLC IndraMotion MLC 14VRS Sequential Programming
DOK-XLCMLC-SEQPROG*V14-LIRS-EN-P, R911341909
This documentation describes the sequential programming options, also when using GAT, and the MH_HydrControlProg library.

Tab. 1-14: XCL/MLC documentation overview - Hydraulics

1.3 Documentation structure

For information on the intended use of the IndraLogic XLC/IndraMotion MLC, refer to chapter 2 "Important instructions on use" on page 13.

For a brief overview on the IndraLogic XLC/IndraMotion MLC systems, refer to chapter 3 "Brief description" on page 15.

For an overview on hardware and technical system data, refer to chapter 4 "Control hardware" on page 19.

For an overview on firmware and software, refer to chapter 5 "Firmware/software control" on page 45.

For the interfaces and operating elements of both the hardware variants IndraControl L and IndraControl XM, refer to chapter 6 "Ports and operating elements" on page 53.

For a brief overview on the drive system "IndraDrive", refer to chapter 7 "IndraDrive and HydraulicDrive – Drive technology" on page 81.

For an overview on the I/O components for IndraLogic XLC/IndraMotion MLC, refer to chapter 8 "I/O periphery" on page 101.

For information on the available function modules for the IndraControl L for the systems IndraLogic XLC/IndraMotion MLC, refer to chapter 9 "Function modules based on the IndraControl L hardware" on page 115.

For the extension modules based on the IndraControl XM hardware and available for the IndraMotion MLC, refer to chapter 10 "Extension modules for XM controls" on page 145.

For an overview on the visualization devices for the IndraLogic XLC/ IndraMotion MLC, refer to chapter 11 "Industrial PCs, terminals and displays" on page 153.

For notes on the supported axis types and drive types of the IndraLogic XLC/ IndraMotion MLC systems, refer to chapter 12 "Axis types and axis operating types" on page 245.

For an ordering example of the IndraLogic XLC/IndraMotion MLC systems, refer to chapter 13 "Ordering example" on page 281.

For information on the Bosch Rexroth customer service help desk, refer to chapter 14 "Service and support" on page 285.

1.4 Information representation

1.4.1 Safety instructions

Safety instructions in the documentation contain certain signal words ("Danger", "Warning", "Caution", "Notice") and sometimes a safety alert symbol (according to ANSI Z535.6-2006).

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

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

The safety instructions are represented as follows in this documentation:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

1.4.2 Symbols used

Note Notes are represented as follows:

☞ This is a note for the user.

Tip Tips are represented as follows:



This is a tip for the user.

1.4.3 Terms and abbreviations

Term	Explanation
OEM	Original Equipment Manufacturer
IndraMotion MLC	Compact Motion Logic systems with Motion, Robot and Logic Control functionalities
IndraLogic XLC	Compact PLC system with integrated Motion functionality
IndraWorks Engineering Framework	Project planning and commissioning tool of Bosch Rexroth
ATEX	ATEX is a synonym for the ATEX guidelines of the European Union. The term ATEX derives from the French term for ATmosphère EXplosive. The directive currently comprises two guidelines in the field of explosion prevention. That is the ATEX equipment directive 94/9/EC and the ATEX workplace directive 1999/92/EC
UL	Underwriters Laboratories Inc., US organization to certify electrotechnical products
CSA	The Canadian Standards Association (CSA) or Association Canadienne de Normalisation is a non-governmental, technical standards organization with the stated aim of developing standards. Products independently tested and certified by the CSA meet recognized standards for safety
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
DIN	German Institute for Standardization (Deutsches Institut für Normung e. V.
ISO	International Organization for Standardization
Hiperface®	HIPERFACE is a standard developed by Max Stegmann GmbH
EnDat	EnDat is a standard developed by Johannes Heidenhain GmbH
IndraDrive	Drive controller
Sercos	Sercos (serial real-time communication system) is an internationally standardized general automation bus
FDT	Field Device Tool It is a manufacturer-comprehensive concept in automation technology to parameterize field devices of different manufacturers with only one program
DTM	Device Type Manager It is a manufacturer-comprehensive concept in automation technology to parameterize field devices of different manufacturers with only one program

SDDML	Sercos Device Description Markup Language XML-based device description language for Sercos III devices
GSDML	Generic Station Description Markup Language XML-based device description language for Profibus and Profinet devices

Tab. 1-15: Names and abbreviations used

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

The Bosch Rexroth products represent state-of-the-art developments and manufacturing. The products are tested prior to delivery to ensure operating safety and reliability.

The products may only be used as intended. If the products are not used as intended, situations can occur that result in damage to property or personal injury due to an 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, ensure that all prerequisites are met to ensure the intended use of the products:

- Anybody dealing with Bosch Rexroth products 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. It its not permitted to decompile software products or alter source codes.
- Do not install damaged or defective products or use them in operation
- It has to be ensured that the products have been installed as described in the relevant documentation

2.1.2 Areas of use and application

The IndraLogic XLC/IndraMotion MLC system is intended for Motion/Logic applications.

☞ The IndraLogic XLC/IndraMotion MLC system can only be used with the accessories and mounting parts listed in this documentation. Components that are not expressly mentioned must neither be attached nor connected. The same applies to cables and lines.

It may only be operated with the hardware component configurations and combinations expressly specified and with the software and firmware indicated and specified in the respective documentation and functional descriptions.

The IndraLogic XLC/IndraMotion MLC system is intended for use in single- and multi-axis drive and control tasks.

To allow for application-specific requirements of the IndraLogic XLC/ IndraMotion MLC system, various device types with different design and interfaces are provided.

Typical application areas of the IndraLogic XLC/IndraMotion MLC system:

- Handling and mounting systems
- Food and packaging machines
- Printing and processing machines

The control systems IndraLogic XLC/IndraMotion MLC must only be operated under the mounting and installation conditions, the position, and the ambient conditions (temperature, degree of protection, moisture, EMC, etc.) specified in the related documentations.

2.2 Unintended use

Using the IndraLogic XLC/IndraMotion MLC system in applications other than the systems specified or described in the documentation and technical data is considered as "unintended".

The IndraLogic XLC/IndraMotion MLC system cannot be used if it is subject to the following conditions:

- Operating conditions which do not correspond to the specified ambient conditions. For example, operation under water, under extreme temperature fluctuations or extreme maximum temperatures is prohibited
- For applications not expressly approved by Bosch Rexroth

3 Brief description

3.1 IndraMotion MLC

Using the compact Rexroth Motion Logic System IndraMotion MLC, users enjoy full freedom with regard to continuous and modern machine automation. Innovative software and firmware functions, simple engineering and open system interfaces ensure maximum flexibility in all Motion applications.

By combining MotionControl, Robot Control and LogicControl with technology functions, synchronizing multi-axis applications is very easy and freely scalable for centralized or decentralized solutions on a flexible control platform. Motion functions, such as master axes, electronic gears, cams and the innovative FlexProfile for complex motion sequences can be quickly and transparently used.

With RobotControl, there is a complete functionality of multi-axis path interpolation in space. Ready-to-use kinematics with corresponding transformations and integrated belt synchronization simplify the implementation of your applications.

The intuitively operated engineering framework IndraWorks and the PLCopen-compliant software interface with standardized IEC 61131-3-compliant function blocks simplify integration into different machine concepts.

Your benefits

- Intuitive engineering with the IndraWorks software framework
- Integrated runtime system with Motion, Robot and Logic Control
- High-performance real-time Ethernet Sercos III for a standardized system networking
- Extended Ethernet communication via Profinet and Ethernet/IP
- Comprehensive IEC 61131-3- and PLCopen-compliant software libraries
- Innovative FlexProfile Motion function for complex motion sequences
- Intuitively operable visualization solutions

3.2 IndraLogic XLC

IndraLogic XLC is a complete PLC-based control system for general automation tasks. Based on the compact device family of the embedded control IndraControl L, it can be used in versatile applications and is a safe investment for the future. IndraLogic XLC provides high flexibility with different solutions in centralized and decentralized automation topologies. Users benefit from the complete integration and the interplay of the most modern control elements.

By combining Motion and LogicControl with technology functions, synchronizing multi-axis applications is very easy and freely scalable for centralized or decentralized solutions on a flexible control platform. Motion functions, such as master axes, electronic gears, cams and the innovative FlexProfile for complex motion sequences can be quickly and transparently used.

The intuitively operated engineering framework IndraWorks and the PLCopen-compliant software interface with standardized IEC 61131-3-compliant function blocks simplify integration into different machine concepts.

Your benefits

- Intuitive engineering with the IndraWorks software framework

- Highly functional Motion and LogicControl for single-axis and multi-axis applications
- High-performance real-time Ethernet Sercos III for a standardized system networking
- Extended Ethernet communication via Profinet and Ethernet/IP
- Comprehensive IEC 61131-3- and PLCopen-compliant software libraries
- Intuitively operable visualization solutions

3.3 Topology

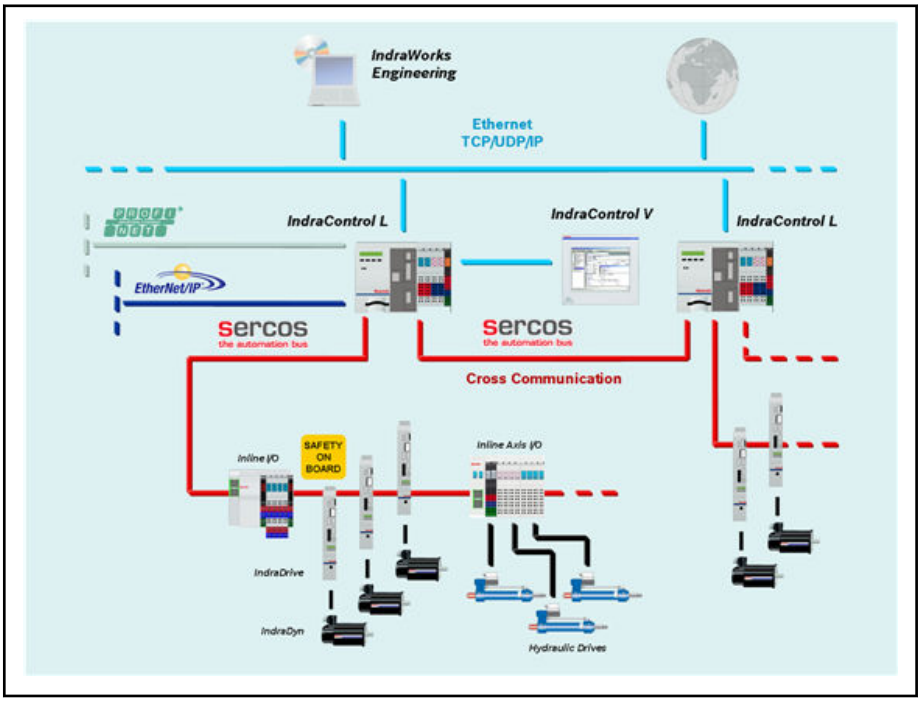


Fig. 3-1: Example topology of an IndraMotion MLC

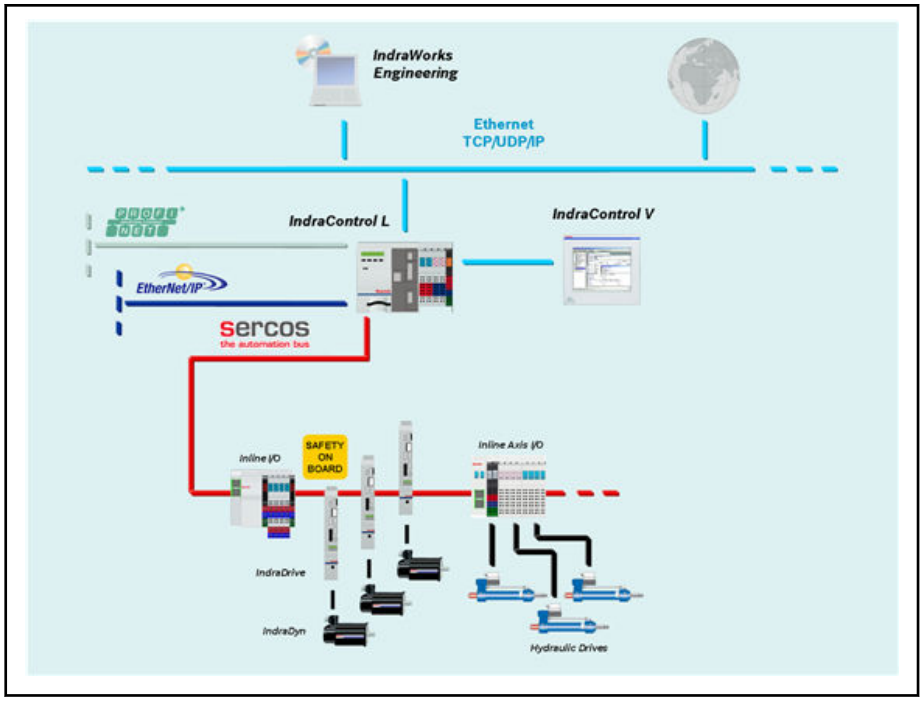


Fig. 3-2: Example topology of an IndraLogic XLC

4 Control hardware

4.1 General information

With regard to its hardware, the IndraMotion MLC is based on the IndraControl L device family (variants L45/L65/L75) and IndraControl XM (variants XM21/XM22/XM42) according to performance and functions.

With regard to its hardware, the IndraLogic XLC is based on the IndraControl L device family (variants L45/L65/L75) according to performance and functions. Optionally, the Sercos III communication interface is supported.

These controls can be used as a universal hardware platform for Motion and Logic applications.

4.2 IndraControl L25 is not supported anymore from version 14V22

In version 14V22, the control type IndraControl L25 is not supported anymore.

Creating, logging in or online switching of an IndraControl L25 is not possible anymore from compatibility mode 14V22!

IndraControl L25 can only be configured in compatibility mode ≤14V20.

Starting with version 14V22, the following alternatives are available:

Create new project with IndraControl L25 in compatibility mode

If a new project is to be created with IndraControl L25 from IndraWorks 14V22, a compatibility mode ≤14V20 has to be selected when creating the project to be able to create and configure the control in the project.

See chapter "Compatibility mode" in the application description "IndraWorks 14VRS Engineering"/ part number R911343566 in the Rexroth media directory.

Convert existing project with IndraControl L25 to a compatibility mode ≤14V20

IndraControl L25 projects created prior to version 14V22 can only be configured in compatibility mode ≤14V20 from version 14V22.

In the following, it is described how to convert an existing project to compatibility mode ≤14V20 to still be able to configure the project.

This work flow describes the procedure for the device node.

For more objects in the project such as "General Module Folder", "IndraDrive", "VEH/VEP", "Cam Pool" etc., the following work flow can also be used.

1. Open the project.
2. Select the device node in the Project Explorer and call the **Export...** command in the context menu.

   → The Export wizard opens.
3. Enter a file path to save the export file in the Export wizard (temporary storage location).
4. Start the export using the "**Complete**" button.
5. Close the project.

6. Create a new project.

   In the "Create new project" dialog, select the compatibility mode version in which IndraControl L25 has been configured.

   → The project node is created in the Project Explorer.

7. Select the project node in the Project Explorer and call the **Import...** command in the context menu.

   → The Import wizard opens.

8. Select the created export file in the Import wizard.
9. Start the import using the "**Complete**" button.

   → The device node is created in the Project Explorer.

Convert existing project with IndraControl L25 to a different control type



By converting the control type, the real control has to be replaced!

By converting the control type from IndraControl L25 to a supported control type, e.g. IndraControl L45, the project can be configured by retaining the original firmware version, e.g. 14V20.

Benefit: the project or the application do not have to be converted (functions, libraries etc. are retained).

Proceed as follows:

1. Open the project.
2. Select the device node in the Project Explorer and call the **Properties...** command in the context menu.

   → The "Properties" dialog opens.

3. Change to the "Hardware/communication" tab.
4. **Important!**

   Enter the firmware version of the current control in the "Firmware release" field. This information is required in step 6!
5. In the "Device type" field, select a control type that is supported from version 14V22, e.g. ** L45.
6. In the "Firmware release" field, select the firmware version, entered in step 4.
7. Complete the conversion with "**OK**".

   → The control type is now converted and subsequently displayed in the Project Explorer.

4.3 Control variants of the IndraMotion MLC

IndraControl L45/L65/L75

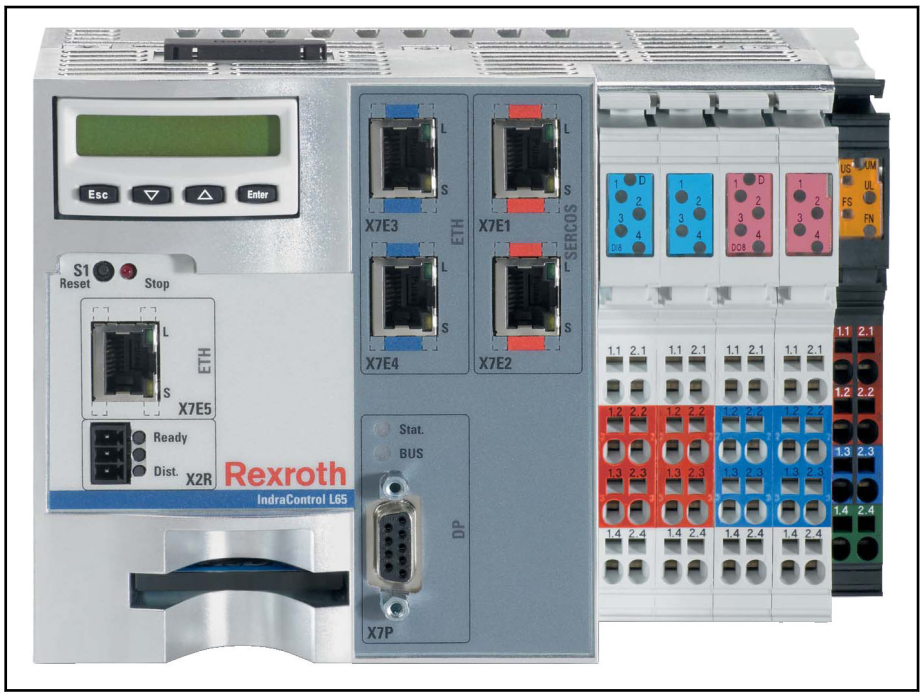


Fig. 4-1: IndraControl L45/L65/L75

IndraControl XM21/XM22



Fig. 4-2: IndraControl XM22

IndraControl XM42



Fig. 4-3: IndraControl XM42

IndraControl VPB40.4

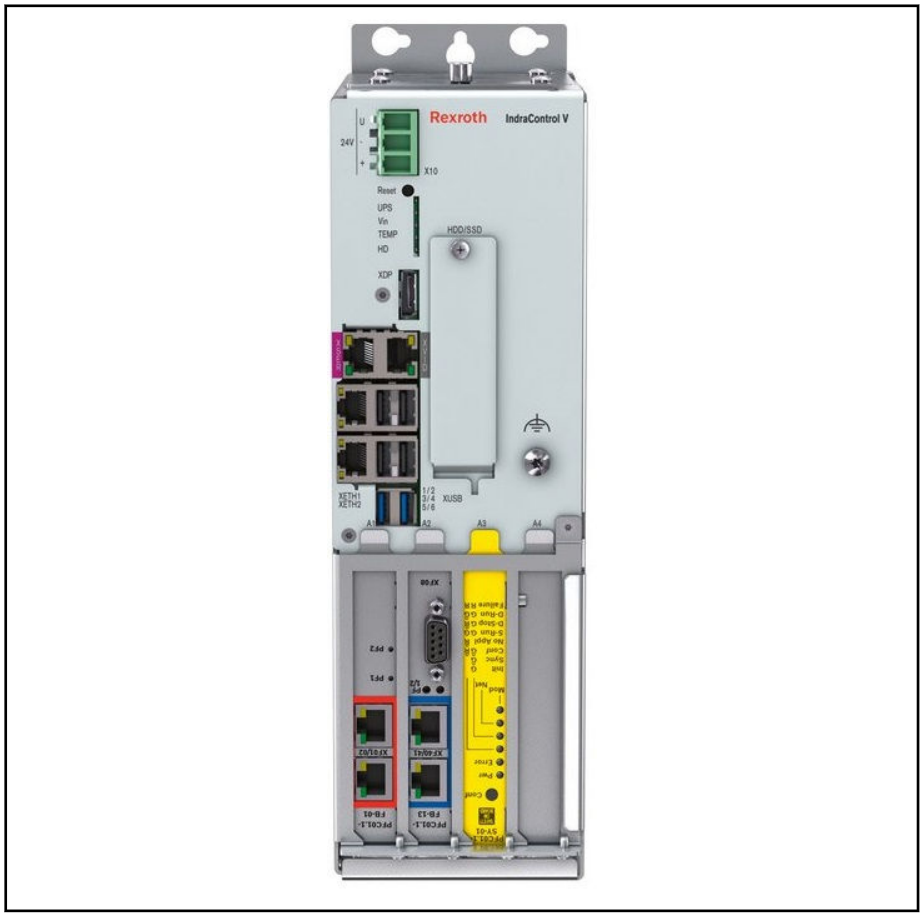


Fig. 4-4: IndraControl VPB 40.4

The IndraMotion MLC supports the following device variants:

Description	Hardware type code	Remarks
IndraControl L45 (medium performance segment)		
IndraControl CML45.1	CML45.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 256 MB RAM
IndraControl CML45.1 (with 8 MB S-RAM)	CML45.1-3P-504-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 256 MB RAM, 8 MB SRAM battery-buffered
IndraControl L65 (upper performance segment)		
IndraControl CML65.1	CML65.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 256 MB RAM
IndraControl CML65.1 (with 8 MB S-RAM)	CML65.1-3P-504-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 256 MB RAM, 8 MB SRAM battery-buffered
IndraControl L75 (upper performance segment)		
IndraControl CML75.1	CML75.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 256 MB RAM
IndraControl XM21 (lower performance segment)		
IndraControl XM21	XM2100.01-...	Ethernet, Sercos III, RT-Ethernet (Profinet/Ethernet IP), 512 MB RAM
IndraControl XM22 (medium performance segment)		
IndraControl XM22	XM2200.01-...	Ethernet, Sercos III, RT-Ethernet (Profinet/Ethernet IP), 512 MB RAM
IndraControl XM42 (upper performance segment)		
IndraControl XM42	XM4203.21-...	Ethernet, Sercos III, RT-Ethernet (Profinet/Ethernet IP), 2 GB RAM
IndraControl VPB40.4 (upper performance segment)		
IndraControl VPB40.4	VPB40.4D1R-4G0NN-D5D-DN-NN-FW	Ethernet, RT-Ethernet (Profinet/ Ethernet IP), Profibus, Sercos III, 1 GB RAM

Tab. 4-1: Control hardware variants

The following axis types are supported:

- Real axes (interpolation either in the control or in the drive)

- Virtual axes (interpolation only in the control)
- Link axes (Sercos II via function module) (only CML)
- Controller axes

4.4 Control variants of the IndraLogic XLC

IndraControl L45/L65/L75

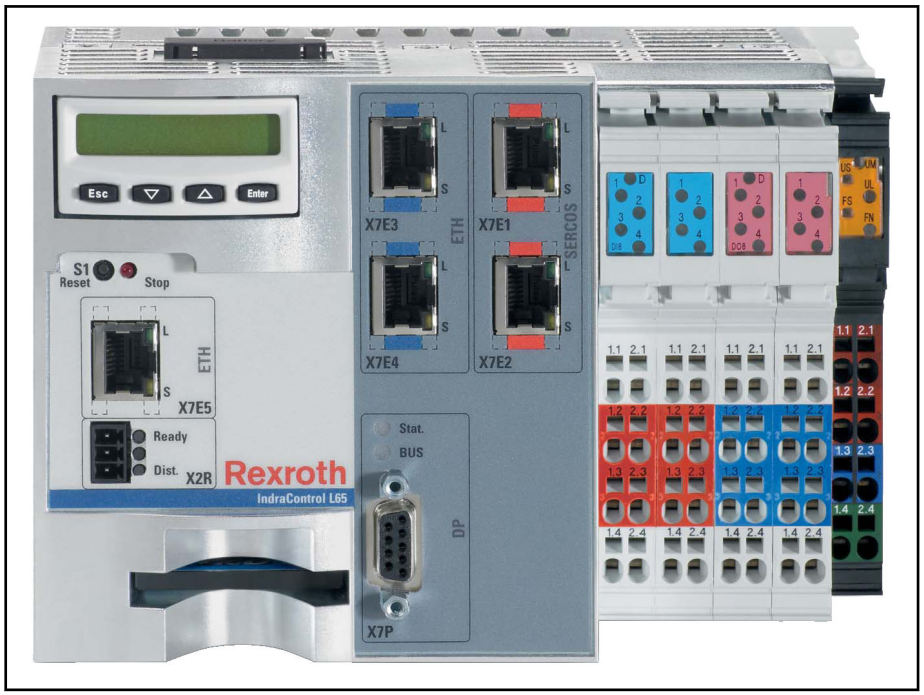


Fig. 4-5: IndraControl L45/L65/L75

The IndraLogic XLC based on the IndraControl L supports the following device variants:

Description	Hardware type code	Remarks
IndraControl L45 (medium performance segment)		
IndraControl CML45.1	CML45.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, Sercos III, 256 MB RAM
IndraControl CML45.1	CML45.1-NP-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, 256 MB RAM
IndraControl L65 (upper performance segment)		
IndraControl CML65.1	CML65.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, Sercos III, 256 MB RAM
IndraControl CML65.1	CML65.1-NP-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, 256 MB RAM

Description	Hardware type code	Remarks
IndraControl L75 (upper performance segment)		
IndraControl CML75.1	CML75.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, Sercos III, 512 MB RAM
IndraControl CML75.1	CML75.1-NP-500-NA-NNNN-NW	Ethernet, RT-Ethernet (Profinet/Ethernet IP), Profibus, 512 MB RAM

Tab. 4-2: Control hardware variants

The following axis types are supported:

- Real axes (interpolation either in the control or in the drive)
- Virtual axes (interpolation only in the control)
- Encoder axes

4.5 Technical data of the IndraMotion MLC

Control

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
System				
Runtime system	Integrated MotionLogic system	●/●/●	●/●/●	●
Multi-tasking		●/●/●	●/●/●	●
Data management	Code, data, remanent data, user data	●/●/●	●/●/●	●
Storage	Boot project	●/●/●	●/●/●	●
	PLC project a zipped archive file	●/●/●	●/●/●	●
	User data in internal memory and removable storage	Removable storage	Internal memory	SSD hard drive
Support	Extension modules	●/●/●	●/●/●	●
	System events	●/●/●	●/●/●	●
Measuring probe		●/●/●	-/-/-	-

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
User memory for PLC application(s)	Total: Code, data	dynamic (up to maximum RAM available)	dynamic (up to maximum RAM available)	dynamic (up to maximum RAM available)
Remanent memory (PLC and system)	Total: system, user	256KB/256KB/ 256KB	128KB/ 128KB/4MB	2 MB
Onboard diagnostics and settings				
Status display (booting, Sercos, testing)		Display	LED	IndraControl Systray
Errors, warnings, messages, system reset		Display, buttons	LED or operation mode switch	IndraControl Systray
Ethernet settings (IP address)		Display, buttons	First Touch	First Touch/
Voltage monitoring, watchdog		LED	LED	LED/ IndraControl Systray
Ready for operation relay output		●/●/●	-/-/-	-
Interface onboard				
Sercos III	Master	●/●/●	●/●/●	●
Profibus	Master	○/○/○	-/-/-	-
	Slave	○/○/○	-/-/-	-
Profinet I/O	Controller (master)	○/○/○	-/-/○	-
	Device (slave)	○/○/○	-/-/○	-
Ethernet IP	Scanner (master)	○/○/○	-/-/○	-
	Adapter (slave)	○/○/○	○/○/○	○
Ethernet TCP/IP		100 MBit/s	1000 MBit/s	1000 MBit/s
Safety CPU		-/-/-	-/-/-	-
Field bus and technology modules				
Max. number		4/4/4	3/3/3	3

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Master axis link Sercos III		○/○/○	○/○/○	-
Master axis link Sercos II		○/○/○	-/-/-	-
Real-time Ethernet/ Profibus		○/○/○	○/○/○	○
Programmable limit switch		○/○/○	-/-/-	-
SRAM (RoCo)		○/○/○	-/-/-	-
Fast I/O		○/○/○	-/-/-	-
Safety CPU		○/○/○	○/○/○	○
HMI communication interfaces				
BRWS		●/●/●	●/●/●	●
OPC-UA		●/●/●	●/●/●	●
OPC-DA		●/●/●	●/●/●	●
OPC-IwSCP		●/●/●	●/●/●	●

● Default
○ Option
- Not available

I/O

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
On board the control hardware				
Fast digital inputs	Interruptible, typ. 50 µs	8/8/8	-/-/-	-
Fast digital outputs	0.5 A, typ. 500 µs	8/8/8	-/-/-	-
Locally mountable on the control hardware				
Fast digital inputs (FAST I/O function module)	Interruptible, typ. 40 µs	Max. 16 inputs per module and configuration	-/-/-	-

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Fast digital outputs (FAST I/O function module)	0.5 A, typ. 70 µs	Max. 16 outputs per module and configuration	-/-/-	-
Inline (digital, analog, relays, technology)	64 bytes, max. 512 I/Os	○/○/○	-/-/-	-
S20		-/-/-	○/○/○	-
Decentrally integrated via Inline (bus coupler)				
Sercos III	Onboard	○/○/○	○/○/○	○
Profibus	Onboard/function module	○/○/○	○/○/○	○
Profinet	Onboard/function module	○/○/○	○/○/○	○
Decentrally integrated via IndraControl S20 (bus coupler)				
Sercos III	Onboard	○/○/○	○/○/○	○
Profibus	Onboard/function module	○/○/○	○/○/○	○
Profinet	Onboard/function module	○/○/○	○/○/○	○
Ethernet IP	Onboard/function module	○/○/○	○/○/○	○
Decentrally integrated via Fieldline (bus coupler)				
Profibus	Onboard/function module	○/○/○	○/○/○	○
Decentrally integrated via IndraControl S67 (bus coupler)				
Sercos III	Onboard	○/○/○	○/○/○	○
Profibus	Onboard/function module	○/○/○	○/○/○	○

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Profinet	Onboard/function module	○/○/○	○/○/○	○
Ethernet IP	Onboard/function module	○/○/○	○/○/○	○

● Default
○ Option
- Not available

Communication

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Interfaces				
Sercos III	Real-time Ethernet bus	●/●/●	●/●/●	●
	Max. number of Sercos devices (drives + I/O)	253/253/253	253/253/253	253
	Max. number of drives	32/64/64	40/40/99	99
	Max. number of I/Os in case of max. number of axes	221/189/189	213/213/154	154
Sercos II (via function module)	Real-time Motion bus	○/○/○	-/-/-	-
Cross communication/master axis link (via function module)	Sercos II	○/○/○	-/-/-	-
	Sercos III	○/○/○	○/○/○	-
	Number of controls in the link	64/64/64	64/64/64	-
Profibus	Master	●/●/●	○/○/○	○
	Slave	●/●/●	○/○/○	○
Profinet I/O	Controller (master)	●/●/●	○/○/○	○
	Device (slave)	●/●/●	○/○/○	○

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Ethernet IP	Scanner (master)	○/○/○	○/○/○	○
	Adapter (slave)	○/○/○ X7E5	○/○/○ XF5	○ XETH2
USB device	Communication interface Engineering	-/-/-	●/●/● XF31	-

● Default
○ Option
- Not available

Firmware

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
LogicControl				
Runtime system	Integrated MotionLogic system	●/●/●	●/●/●	●
IndraLogic 2G kernel	IEC 61131-3-compliant with object-oriented extensions	●/●/●	●/●/●	●
Freely configurable tasks	Cyclic, free, event-controlled	20/20/20	20/20/20	20
External event tasks	Synchronous to the Sercos cycle	1/1/1	1/1/1	1
Program organization	IEC 61131-3	●/●/●	●/●/●	●
Motion commands	PLCopen	●/●/●	●/●/●	●
Min. PLC cycle time	Synchronous to the system cycle (ms)	1/1/1	1/1/1	1
	Synchronous to the Sercos cycle (ms)	0.5/0.25/0.25	1/0.5/0.25	0.25
Min. Motion cycle time	Command value generator (ms)	1/0.5/0.5	2/1/0.25	0.5
PLC processing times				

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Typical processing time for 1000 instructions	Command mix Real, Integer, Boolean, etc. (µs)	40/7/6	22/10/2	2
	Bit operations (µs)	50/10/7	34/17/4	4
	Word operations (µs)	26/6/5	10/5 /1	1
MotionControl				
Maximum number of axes	Real, virtual, encoder, link	64/64/64	40/40/99	99
Axis types	Real axes (Servo drives)	●/●/●	●/●/●	●
	Virtual axes (Virtual master)	●/●/●	●/●/●	●
	Encoder axes (real master)	●/●/●	●/●/●	●
	Link axes (cross communication)	○/○/○	○/○/○	-
	Controller axes (Real axes with controller in PLC)	●/●/●	●/●/●	●
Positioning	Single-axis	●/●/●	●/●/●	●
Electronic gears		●/●/●	●/●/●	●

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Electronic cams	Data point tables (drive-internal, 1,024 data points max.)	4/4/4	4/4/4	4
	Electronic MotionProfile (control-internal, MotionProfiles with a maximum of 16 segments)	2/2/2	2/2/2	2
	FlexProfile (control-internal, master/ time-based MotionProfiles with 16 segments max.)	4/4/4	4/4/4	4
Motion command according to PLCopen (selection)	MC_MoveAbsolute	●/●/●	●/●/●	●
	MC_MoveRelative	●/●/●	●/●/●	●
	MC_MoveVelocity	●/●/●	●/●/●	●
	MC_Home	●/●/●	●/●/●	●
	MC_CamIn, MC_CamOut	●/●/●	●/●/●	●
	MC_GearIn, MC_GearOut	●/●/●	●/●/●	●

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Synchronization ELS - Electronic "Line" Shaft	Dynamic synchronization	●/●/●	●/●/●	●
	Master axis cascading	●/●/●	●/●/●	●
	Velocity synchronization	●/●/●	●/●/●	●
	Phase synchronization	●/●/●	●/●/●	●
	Electronic MotionProfile (control-internal, MotionProfiles with 16 segments max.)	2/2/2	2/2/2	2
	FlexProfile (control-internal, master/ time-based MotionProfiles with 16 segments max.)	4/4/4	4/4/4	4
	Number of control data point tables (max. 1,024 data points)	99/99/99	99/99/99	99
	Number of data point tables per real IndraDrive axis (max. 1,024 data points)	8/8/8 of which four have reduced resolution (max. 128 data points)	8/8/8 of which four have reduced resolution (max. 128 data points)	8 of which four have reduced resolution (max. 128 data points)

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Diagnostics (status, warning, error)	Function blocks (software)	●/●/●	●/●/●	●
	Parameter access: diagnostic memory (software)	●/●/●	●/●/●	●
	Locally via display (control hardware)	●/●/●	●/●/●	●
	Axis monitoring (E.g. performance, encoder, limit values)	●/●/●	●/●/●	●
	Diagnostic memory (64 kB, max. 999 messages)	●/●/●	●/●/●	●
Extended system functions (selection)				
Programmable limit switch		●/●/●	●/●/●	●
PID controller		●/●/●	●/●/●	●
Temperature controller		●/●/●	●/●/●	●
Robot Control				
Number of axes for each kinematics		16/16/16	16/16/32	16
Multi-axis kinematics	Incl. auxiliary axes	16/16/16	16/16/32	16
Kinematic transformations		●/●/●	●/●/●	●
Interpolation methods LINEAR, CIRCULAR, PTP		●/●/●	●/●/●	●
Configurable block transitions		●/●/●	●/●/●	●
Override		●/●/●	●/●/●	●

		IndraControl L45/L65/L75	IndraControl XM21/XM22/ XM42	IndraControl VPP40.4
Teach-in function		●/●/●	●/●/●	●
Blending in space		●/●/●	●/●/●	●
Late blending (late blending)		●/●/●	●/●/●	●
Belt synchronization		●/●/●	●/●/●	●
Jogging/single step		●/●/●	●/●/●	●
Velocity limitation	For path and axes	●/●/●	●/●/●	●
Acceleration limitation	For path and axes	●/●/●	●/●/●	●
Safe zones		●/●/●	●/●/●	●
Technology functions (selection)				
Printed mark controller		●/●/●	●/●/●	●
FlyingShear		●/●/●	●/●/●	●
Measuring Wheel		●/●/●	●/●/●	●
Measuring probe	Control	●/●/●	-/-/-	-
	Drive	●/●/●	●/●/●	●
Programmable limit switch		●/●/●	●/●/●	●
CrossCutter		●/●/●	●/●/●	●
Sag controller		●/●/●	●/●/●	●
Winders		●/●/●	●/●/●	●
Tension controller		●/●/●	●/●/●	●
Web-based engineering				
IndraMotion Service Tool		●/●/●	●/●/●	●
IndraControl First Touch		-/-/-	●/●/●	●

● Default
○ Option
- Not available

4.6 Technical data of the IndraLogic XLC

Control

		IndraControl L45/L65/L75
System		
Runtime system	Integrated MotionLogic system	●/●/●
Multi-tasking		●/●/●
Data management	Code, data, remanent data, user data	●/●/●
Storage	Boot project	●/●/●
	PLC project a zipped archive file	●/●/●
	User data in internal memory and removable storage	●/●/●
Support	Function modules	4/4/4
	System events	●/●/●
Measuring probe		●/●/●
User memory	Total: Code, data	dynamic (up to maximum RAM available)
Remanent memory	Total: system, user	256KB/256KB/256KB
Onboard diagnostics and settings		
Status display (booting, Sercos, testing)	Display	●/●/●
Errors, warnings, messages, system reset	Display, buttons	●/●/●
Ethernet settings (IP address)	Display, buttons	●/●/●
Voltage monitoring, watchdog	LED	●/●/●

		IndraControl L45/L65/L75
Ready for operation relay output		●/●/●
Onboard interfaces		
Sercos III	Master	○/○/○
Profibus	Master	●/●/●
	Slave	●/●/●
Profinet I/O	Controller (master)	●/●/●
	Device (slave)	●/●/●
Ethernet IP	Scanner (master)	-/-/-
	Adapter (slave)	●/●/●
Ethernet TCP/IP 100 MBit/s		●/●/●
Function modules		
Max. number		4/4/4
Master axis link Sercos III		-/-/-
Master axis link Sercos II		-/-/-
Real-time Ethernet/ Profibus		○/○/○
Programmable limit switch		○/○/○
SRAM (RoCo)		-/-/-
Fast I/O		○/○/○
Safety CPU		○/○/○
HMI communication interfaces		
BRWS		●/●/●
OPC-UA		●/●/●
OPC-DA		○/○/○
OPC-IwSCP		○/○/○

● Default
○ Option
- Not available

I/O

		IndraControl L45/L65/L75
On board the control hardware		
Fast digital inputs	Interruptible, typ. 50 µs	8/8/8
Fast digital outputs	0.5 A, typ. 500 µs	8/8/8
Locally mountable on the control hardware		
Fast digital inputs (FAST I/O function module)	Interruptible, typ. 40 µs	Max. 16 inputs per module and configuration
Fast digital outputs (FAST I/O function module)	0.5 A, typ. 70 µs	Max. 16 outputs per module and configuration
Inline (digital, analog, relays, technology)	64 bytes, max. 512 I/Os	○/○/○
Decentrally integrated via Inline (bus coupler)		
Sercos III	Onboard	○/○/○
Profibus	Onboard/function module	○/○/○
Profinet	Onboard/function module	○/○/○
Decentrally integrated via IndraControl S20 (bus coupler)		
Sercos III	Onboard	○/○/○
Profinet	Onboard/function module	○/○/○
Decentrally integrated via Fieldline (bus coupler)		
Profibus	Onboard/function module	○/○/○
Decentrally integrated via IndraControl S67 (bus coupler)		
Sercos III	Onboard	○/○/○
Profibus	Onboard/function module	○/○/○
Profinet	Onboard/function module	○/○/○

● Default
○ Option

Communication

		IndraControl L45/L65/L75
Interfaces		
Sercos III	Real-time Ethernet bus	○/○/○
	Max. number of Sercos devices (drives + I/O)	253/253/253
	Max. number of drives	32/64/64
	Max. number of I/Os in case of max. number of axes	221/189/189
Sercos II (via function module)	Real-time Motion bus	-/-/-
Master axis link	Sercos III	-/-/-
Profibus	Master	●/●/●
	Slave	●/●/●
Profinet I/O	Controller (master)	●/●/●
	Device (slave)	●/●/●
Standard Ethernet	Ethernet TCP/UDP/IP	●/●/● X7E5
Ethernet IP	Scanner (master)	-/-/-
	Adapter (slave)	●/●/● X7E5

● Default
○ Option
- Not available

Firmware

		IndraControl L45/L65/L75
LogicControl		
Runtime system	Integrated MotionLogic system	●/●/●
IndraLogic 2G kernel	IEC 61131-3-compliant with object-oriented extensions	●/●/●

		IndraControl L45/L65/L75
Freely configurable tasks	Cyclic, free, event-controlled	20/20/20
External event tasks	Synchronous to the Sercos cycle	1/1/1
Program organization	Acc. to IEC 61131-3	●/●/●
Motion commands	Acc. to PLCopen	●/●/●
Min. PLC cycle time	Synchronous to the system cycle	1/1/1 ms
	Synchronous to the Sercos cycle	0.5/0.25/0.25 ms
Min. Motion cycle time	Command value generator	1/0.5/0.5 ms
PLC processing times		
Typical processing time for 1000 instructions	Command mix Real, Integer, Boolean, etc. (µs)	40/7/6
	Bit operations (µs)	50/10/7
	Word operations (µs)	26/6/5
MotionControl		
Maximum number of axes	Real, virtual, encoder, link	32/64/64
Axis types	Real axes (Servo drives)	●/●/●
	Virtual axes (Virtual master)	●/●/●
	Encoder axes (real master)	●/●/●
Positioning	Single-axis	●/●/●
Electronic gears		●/●/●

		IndraControl L45/L65/L75
Electronic cams	Data point tables (drive-internal, 1,024 data points max.)	4/4/4
	Electronic MotionProfile (control-internal, MotionProfiles with a maximum of 16 segments)	2/2/2
	FlexProfile (control-internal, master/time-based MotionProfiles with 16 segments max.)	4/4/4
Motion command according to PLCopen (selection)	MC_MoveAbsolute	●/●/●
	MC_MoveRelative	●/●/●
	MC_MoveVelocity	●/●/●
	MC_Home	●/●/●
	MC_CamIn, MC_CamOut	●/●/●
	MC_GearIn, MC_GearOut	●/●/●

		IndraControl L45/L65/L75
Synchronization ELS - Electronic Line Shaft	Dynamic synchronization	●/●/●
	Master axis cascading	●/●/●
	Velocity synchronization	●/●/●
	Phase synchronization	●/●/●
	Electronic MotionProfile (control-internal, MotionProfiles with 16 segments max.)	2/2/2
	FlexProfile (control-internal, master/time-based MotionProfiles with 16 segments max.)	4/4/4
	Number of control data point tables (max. 1,024 data points)	99/99/99
	Number of data point tables per real IndraDrive axis (max. 1,024 data points)	8/8/8 of which four have reduced resolution (max. 128 data points)

		IndraControl L45/L65/L75
Diagnostics (status, warning, error)	Function blocks (software)	●/●/●
	Parameter access: diagnostic memory (software)	●/●/●
	Locally via display (control hardware)	●/●/●
	Axis monitoring (E.g. performance, encoder, limit values)	●/●/●
	Diagnostic memory (64 kB, max. 999 messages)	●/●/●
Extended system functions (selection)		
Programmable limit switch		●/●/●
PID controller		●/●/●
Temperature controller		●/●/●
Web-based engineering		
IndraMotion Service Tool		●/●/●

● Default

5 Firmware/software control

5.1 Firmware IndraMotion MLC

The IndraMotion MLC firmware based on the IndraControl L hardware has to be ordered device specifically. For the system solutions based on the IndraControl XM and IndraControl VPB, the firmware cannot be ordered separately.

The following hardware variants and the corresponding firmware are available for the IndraMotion MLC:

Description	Hardware type code	Firmware type codes
IndraMotion MLC based on IndraControl L45		
IndraControl CML45.1	CML45.1-3P-500-NA-NNNN-NW	FWA-CML45*-MLC-14VRS-D0
IndraControl CML45.1 (with 8 MB S-RAM)	CML45.1-3P-504-NA-NNNN-NW	
IndraMotion MLC based on IndraControl L65		
IndraControl CML65.1	CML65.1-3P-500-NA-NNNN-NW	FWA-CML65*-MLC-14VRS-D0
IndraControl CML65.1 (with 8 MB S-RAM)	CML65.1-3P-504-NA-NNNN-NW	
IndraMotion MLC based on IndraControl L75		
IndraControl CML75.1	CML75.1-3P-500-NA-NNNN-NW	FWA-CML75*-MLC-14VRS-D0

Tab. 5-1: Firmware for the control hardware variants

5.2 Firmware IndraLogic XLC

The IndraLogic XLC firmware has to be ordered device-specifically.

The following hardware variants and the corresponding firmware are available for the IndraLogic XLC:

Description	Hardware type code	Firmware type codes
IndraLogic XLC based on the IndraControl L45		
IndraControl CML45.1 (without Sercos III)	CML45.1-NP-500-NA-NNNN-NW	FWA-CML45*-XLC-14VRS-D0
IndraControl CML45.1 (with Sercos III)	CML45.1-3P-500-NA-NNNN-NW	
IndraLogic XLC based on the IndraControl L65		

Description	Hardware type code	Firmware type codes
IndraControl CML65.1 (without Sercos III)	CML65.1-NP-500-NA-NNNN-NW	FWA-CML65*-XLC-14VRS-D0
IndraControl CML65.1 (with Sercos III)	CML65.1-3P-500-NA-NNNN-NW	
IndraLogic XLC based on the IndraControl L75		
IndraControl CML75.1 (without Sercos III)	CML75.1-NP-500-NA-NNNN-NW	FWA-CML75*-XLC-14VRS-D0
IndraControl CML75.1 (with Sercos III)	CML75.1-3P-500-NA-NNNN-NW	

Tab. 5-2: Firmware for the control hardware variants

5.3 Software

The IndraLogic XLC and IndraMotion MLC are continuously engineered using the "IndraWorks Engineering" software framework. IndraWorks Engineering contains among others the following integrated elements:

- Project management
- Configurators for system periphery and communication
- Logic programming
- HMI configuration
- Diagnostics
- User management

The following IndraWorks Engineering software is available:

Description	Type code
IndraWorks Engineering data carriers (DVD)	SWA-IWORKS-ML*-14VRS-D0-DVD** SWA-IWORKS-XLC-14VRS-D0-DVD**
IndraWorks Engineering single license	SWL-IWORKS-ML*-14VRS-D0-ENG SWL-IWORKS-XLC-14VRS-D0-ENG
25 single licenses for IndraWorks Engineering	SWL-IWORKS-ML*-14VRS-D0-ENG*M25 SWL-IWORKS-XLC-14VRS-D0-ENG*M25
Version-comprehensive single license of IndraWorks Engineering for IndraMotion MLC/ IndraLogic XLC	SWL-IWORKS-ML*-NNVRS-D0-ENG SWL-IWORKS-XLC-NNVRS-D0-ENG
25 version-comprehensive single licenses of IndraWorks Engineering for IndraMotion MLC/ IndraLogic XLC (multi-license package)	SWL-IWORKS-ML*-NNVRS-D0-ENG*M25 SWL-IWORKS-XLC-NNVRS-D0-ENG*M25

Tab. 5-3: IndraWorks software

All components are automatically installed. IndraWorks WinStudio is installed in the "WinStudio Lite" version.

In addition to the standard IndraLogic libraries, libraries with PLCopen function blocks and technology functions are available:

- PLCopen function blocks
- The AxisInterface facilitates the access to axes. It provides a structure-based interface (library: ML_TechInterface.library)
- The Generic Application Template (GAT) enables the simple and fast development of clearly structured Logic and Motion applications

  The GAT is available in four variants for the target system IndraMotion MLC:

  – AxisInterface: For simple axis motions
  – GAT^{compact}: For simple applications with few axes
  – GAT with central state machine: For flexible, modular machine concepts
  – GAT with decentral state machine: For flexible, modular machine concepts

  The GAT is available in two variants for the IndraLogic XLC target system:

  – AxisInterface: For simple axis motions
  – GAT^{compact}: For simple applications with few axes
- Technology-based function blocks extend the basic functionality of the target systems IndraMotion MLC and IndraLogic XLC and provide application-specific functionalities such as cam function blocks, programmable limit switch, PID controller and a secure key transmission (library: ML_TechMotionBase.library)
- Technology motion function blocks extend the basic functionality of the IndraMotion MLC and provide application-specific functionalities like FlyingShear, CrossCutter, RegisterController etc. (library: ML_TechMotion.library)
- Functions supporting hydraulic components when using an IndraMotion MLC provide the following tools:

  – Sequential programming for motion sequences
  – Force-controlled traversing and adjustment of several hydraulic cylinders

5.4 Software add-ons

The following additional software is available for the IndraMotion MLC and IndraLogic XLC:

Description	Type code
IndraWorks Operation	
Version-related	
IndraWorks Operation single license with activation code	SWL-IWORKS-ML*-14VRS-D0-OPD
25 IndraWorks Operation single licenses with activation code	SWL-IWORKS-ML*-14VRS-D0-OPD*M25
Version-comprehensive	
IndraWorks Operation single license with activation code	SWL-IWORKS-ML*-NNVRS-D0-OPD
25 IndraWorks Operation single licenses with activation code	SWL-IWORKS-ML*-NNVRS-D0-OPD-M25
CamBuilder	
Version-related	
CamBuilder single license	SWS-IWORKS-CAM-14VRS-D0
25 CamBuilder single licenses	SWS-IWORKS-CAM-14VRS-D0*M25
Version-comprehensive	
CamBuilder single license	SWS-IWORKS-CAM-NNVRS-D0
25 CamBuilder single licenses	SWS-IWORKS-CAM-NNVRS-D0-M25
TeamServer	
TeamServer single license	SWL-IWORKS-ML*-14VRS-D0-TEAMSERVER
TeamClient	
TeamClient single license	SWS-IWORKS-VCS-14VRS-D0
10 TeamClient single licenses	SWS-IWORKS-VCS-14VRS-D0-M10
25 TeamClient single licenses	SWS-IWORKS-VCS-14VRS-D0-M25
OPC server	
Version-comprehensive	
IndraWorks Communication (OPC server) single license	SWL-IWORKS-ML*-NNVRS-D0-COM
25 IndraWorks Communication (OPC server) single licenses	SWL-IWORKS-ML*-NNVRS-D0-COM*M25

Description	Type code
WinStudio visualization engineering license	
WinStudio 07VRS runtime single license WIN CE, 512 K variables	SWS-WINSTU-RUD-07VRS-D0-512K
WinStudio 07VRS runtime single license WIN CE, 64 K variables	SWS-WINSTU-RUD-07VRS-D0-64K
WinStudio 07VRS runtime single license WIN CE, 4 K variables	SWS-WINSTU-RUD-07VRS-D0-4K
WinStudio 07VRS Engineering single license WIN CE, 1.5 K variables	SWS-WINSTU-RUD-07VRS-D0-1K5
WinStudio visualization runtime license	
WinStudio 07VRS runtime single license WIN CE, 4 K variables	SWS-WINSTU-RUN-07VRS-D0-WCE4K
WinStudio 07VRS Runtime single license WIN CE, 1.5 K variables	SWS-WINSTU-RUN-07VRS-D0-WCE1K5
WinStudio 07VRS runtime single license WIN CE with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE4K-1CL
WinStudio 07VRS runtime single license WIN CE with web client, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE1K5-1CL
WinStudio 07VRS runtime multi-license 4x WIN CE with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE4K-4CL
WinStudio 07VRS runtime multi-license 4x WIN CE with web client, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE1K5-4CL
WinStudio 07VRS runtime multi-license 8x WIN CE with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE4K-8CL
WinStudio 07VRS runtime multi-license 8x WIN CE with web client, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-WCE1K5-8CL
WinStudio 07VRS runtime single license WIN XP, Windows 7 and XPe, 4 K variables	SWS-WINSTU-RUN-07VRS-D0-4K
WinStudio 07VRS runtime single license WIN XP, Windows 7 and XPe, 1.5 K variables	SWS-WINSTU-RUN-07VRS-D0-1K5
WinStudio 07VRS runtime single license WIN XP, Windows 7 and XPe with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-4K-1CL

Description	Type code
WinStudio 07VRS runtime single license WIN XP, Windows 7 and XPe, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-1K5-1CL
WinStudio 07VRS runtime multi-license 4x WIN XP, Windows 7 and XPe with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-4K-4CL
WinStudio 07VRS runtime multi-license 4x WIN XP, Windows 7 and XPe with web client, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-1K5-4CL
WinStudio 07VRS runtime multi-license 8x WIN XP, Windows 7 and XPe with web client, 4 K variables	SWS-WINSTU-RUW-07VRS-D0-4K-8CL
WinStudio 07VRS runtime multi-license 8x WIN XP, Windows 7 and XPe with web client, 1.5 K variables	SWS-WINSTU-RUW-07VRS-D0-1K5-8CL

Tab. 5-4: Additionally available software

5.5 Diagnostics and service tools

5.5.1 First touch

The "First Touch" commissioning tool interactively commissions and maintains IMLC controls based on the XM control family. The commissioning tool can run on most of the modern web browsers.

☞ The commissioning tool "First Touch" is only available in English.

Supported web browsers:

- Chrome 3+
- FireFox 9+
- Internet Explorer 8+

The standard URL of the First Touch website is https://192.168.1.1/. The First Touch website communicates via the encrypted http protocol. After entering the URL, confirm the corresponding safety certificate before the website can be loaded.

5.5.2 Remote support

General information

Remote support means that IT systems or machines are remotely accessed for maintenance and repair.

Virtual Network Computing, VNC, is a software that displays the screen content of a remote system (server) to a local system (client) and sends keyboard and mouse movements to the remote system. Working on the remote system is thus like working in front of it. VNC implements the Remote Frame Buffer Protocol and can thus be used platform-independently in contrast to other remote support softwares. VNC uses the client-server model. The serv-

er program provides screen outputs and input options via mouse and keyboard representing and using the client program. As of 1998, VNC is published as open source. The original VNC is subject to GNU General Public License.

Prerequisites:

A TCP/IP connection has to be possible between the client system and the server system using a defined port.

Further information

Further information

For a detailed description of the remote support software "UltraVNC", refer to the following documentations:

- Application Description Remote Support Software UltraVNC: DOK-IWORKS-REMOTE**V14-APRS-EN-E (R911382628)

6 Ports and operating elements

6.1 IndraControl L

6.1.1 Overview

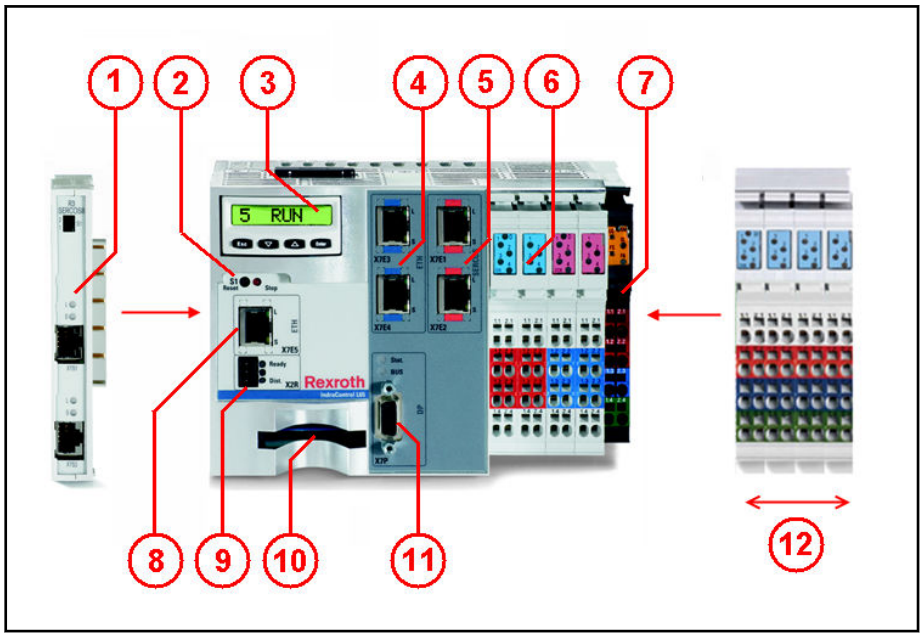


Fig. 6-1: Example figure of IndraControl L45/65/L75

No.	Function	Description
1	Function Modules	On the left side of IndraControl L, up to four extension modules can be connected via the function module plug
2	Reset button and status LED	Reset button for resetting the control and status LED for displaying the status of the control
3	Display with operating keys	Integrated display with operating keys to display diagnostic and status information and to operate and parameterize the control. Among other functions, the display can be used to make Ethernet settings for the Ethernet interface
4	Real-time Ethernet interfaces X7E3/ X7E4	Field bus connection for Ethernet-based bus systems
5	Ethernet interfaces X7E1/X7E2 *	Ethernet interfaces to connect Sercos III drives and I/Os
6	Onboard I/O	Eight digital inputs and eight digital outputs. The onboard inputs can be used as "Interrupt" inputs
7	Power supply	24 V power supply for the IndraControl L and any connected Inline and function modules

No.	Function	Description
8	Ethernet interface X7E5	Standard Ethernet interface for a TCP/IP network. This interface can be used for the following functions: • Programming interface • Connect visualization devices • control-control communication
9	Ready contact X2R	Ready contact to connect the IndraControl L to the E-Stop loop of the system
10	Slot for Compact Flash card	This slot accepts the memory card with the system firmware. User data and programs are also stored on this card. The control cannot be operated without Compact Flash card
11	Profibus DP interface X7P	Field bus interface for Profibus DP. The interface can be configured using the application either as master or slave
12	Rexroth Inline I/O	The I/O area of the IndraControl L can be extended up to 64 bytes of inputs/outputs (512 I/O) by adding more Rexroth Inline I/O modules. Up to 63 Rexroth Inline terminals can be connected. For more information on the connection of Rexroth Inline terminals, refer to the documentation "Automation Terminals of the Rexroth Inline Product Family", DOK-CONTRL-ILSYSINS***-AWxx-EN-P, R911317021 xx - Edition

* Only IndraControl L with Sercos III

Tab. 6-1: Ports and operating elements on the IndraControl Lxx

NOTICE

The IndraControl L, a function module or an Inline terminal can be damaged by plugging in or loosening live connections!

Disconnect the power supply before attaching or loosening connections!

6.1.2 Interfaces

Ethernet Interface X7E5

X7E5 Ethernet network connection

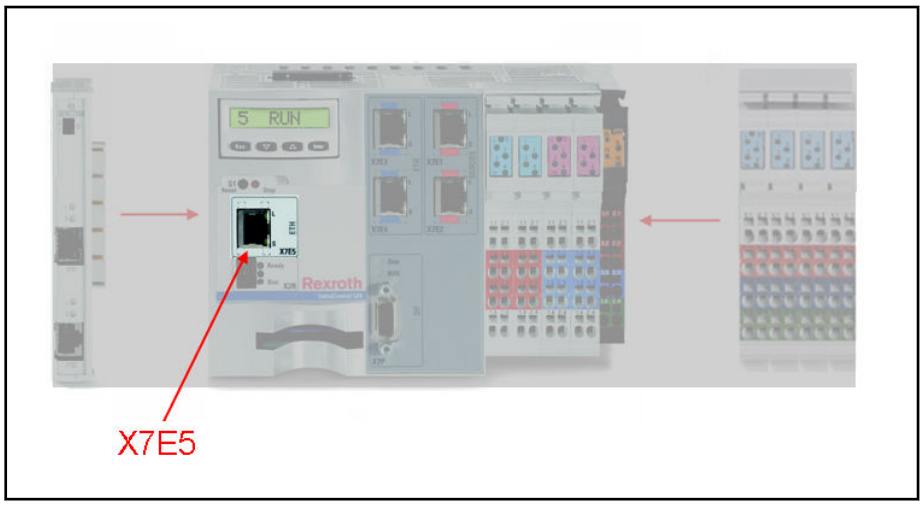


Fig. 6-2: Ethernet interface X7E5

The IndraControl L can be connected to an Ethernet network via the X7E5 port.

The connection conditions defined in IEEE 802.3 for 100BaseT apply.

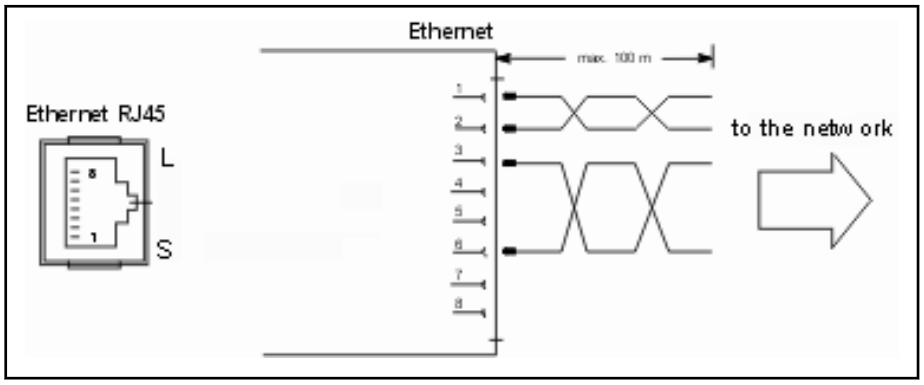


Fig. 6-3: Ethernet interface X7E5

RJ45, socket, 8-pin	
Type	Ethernet 100BaseT
Cable length	100 m max.
Cable type	CAT5e with S/STP
Transmission rate	10 or 100 MBit/s

Tab. 6-2: Pin assignment of the RJ45 female connector

LED	**Status**
L (link)	On: Link to network provided Off: No connection to network
S (Send)	On: Data packages are sent Off: No data is sent

Tab. 6-3: Status and diagnostic displays of the Ethernet interface

Bosch Rexroth recommends the use of a category 5 STP cable.

This port is provided for the programming device network!

Real-time Ethernet interfaces X7E3 / X7E4

X7E3/X7E4 real-time Ethernet network port

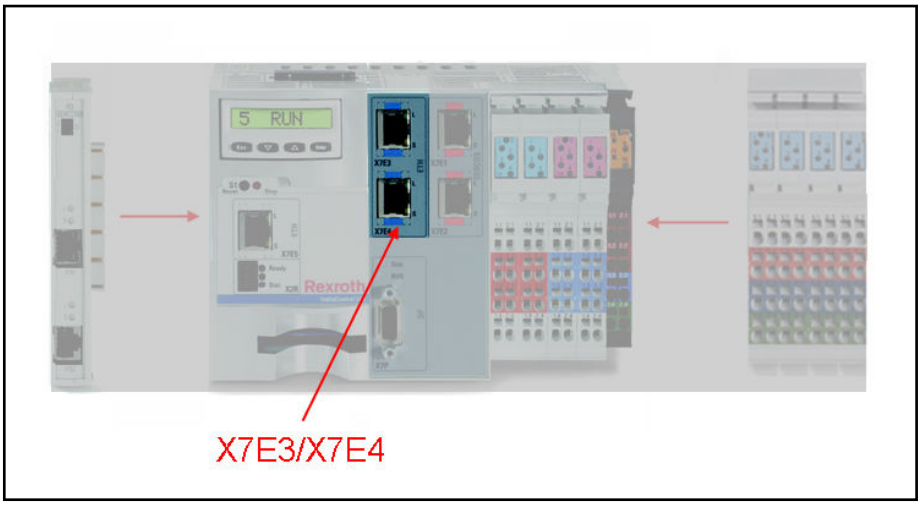


Fig. 6-4: Real-time Ethernet interfaces X7E3/X7E4

The IndraControl L45/L65/L75 can be connected to an Ethernet network via the X7E3 and X7E4 ports.

The connection conditions defined in IEEE 802.3 for 100BaseT apply.

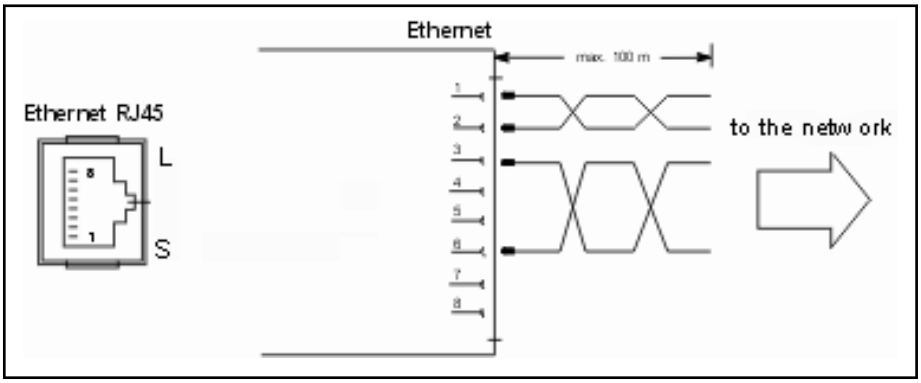


Fig. 6-5: Ethernet interfaces X7E3/X7E4

RJ45, socket, 8-pin	
Type	Ethernet 100BaseT
Cable length	100 m max.
Cable type	CAT5e with S/STP
Transmission rate	10 or 100 MBit/s

Tab. 6-4: Pin assignment of the RJ45 female connector

LED	Status
L (link)	On: Link to network provided Off: No connection to network
S (Send)	On: Data packages are sent Off: No data is sent

Tab. 6-5: Status and diagnostic displays of the Ethernet interfaces

Bosch Rexroth recommends the use of a category 5 STP cable.

As in the configuration in the application software, these ports can be used for Ethernet/IP and Profinet.

Sercos III X7E1/X7E2 (only IndraControl L with Sercos III)

X7E1 / X7E2 Sercos III Interfaces

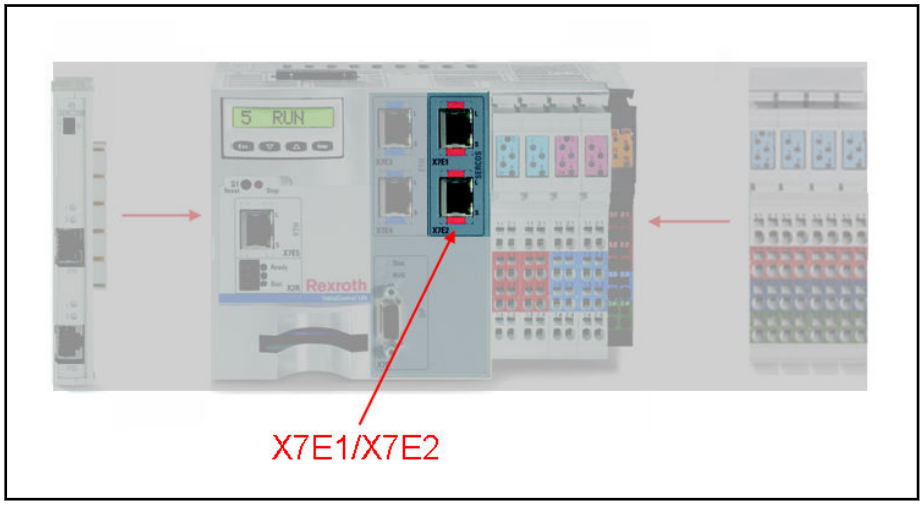


Fig. 6-6: Sercos III interfaces X7E1/X7E2

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

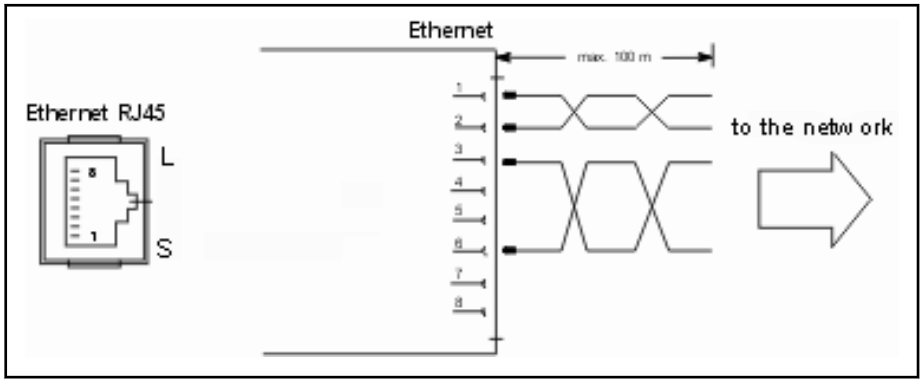


Fig. 6-7: Sercos III interface X7E1/X7E2

RJ45, socket, 8-pin	
Type	Ethernet 100BaseT
Cable length	100 m max.
Cable type	CAT5e with S/STP
Transmission rate	100 MBit/s

Tab. 6-6: Pin assignment of the RJ45 female connector

LED	Status
L (link)	On: Link to network provided Off: No connection to network
S (Send)	On: Data packages are sent Off: No data is sent

Tab. 6-7: Status and diagnostic displays of the Ethernet interface

Profibus DP X7P

X7P Profibus DP interface

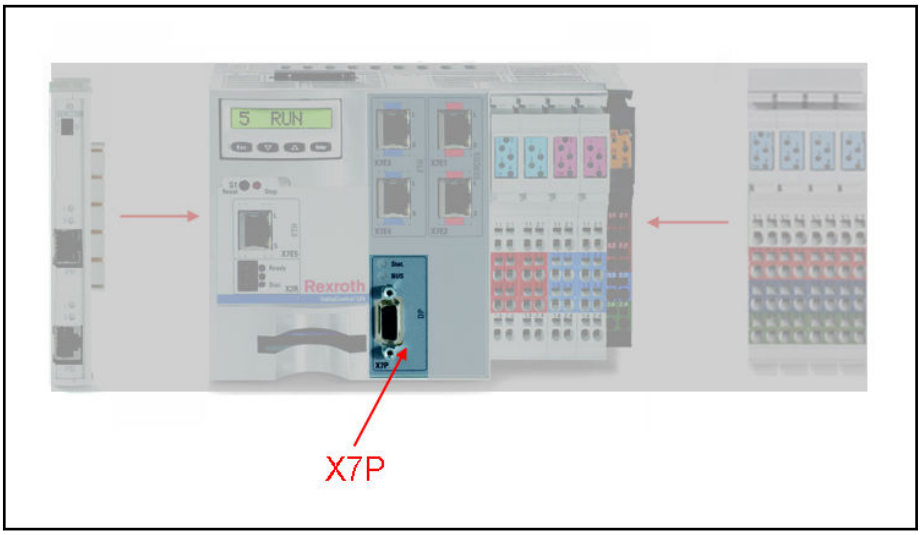


Fig. 6-8: Profibus DP interface X7P

A Profibus DP interface according to DIN EN 50170, Part 2 is available on the IndraControl L45/L65/L75.

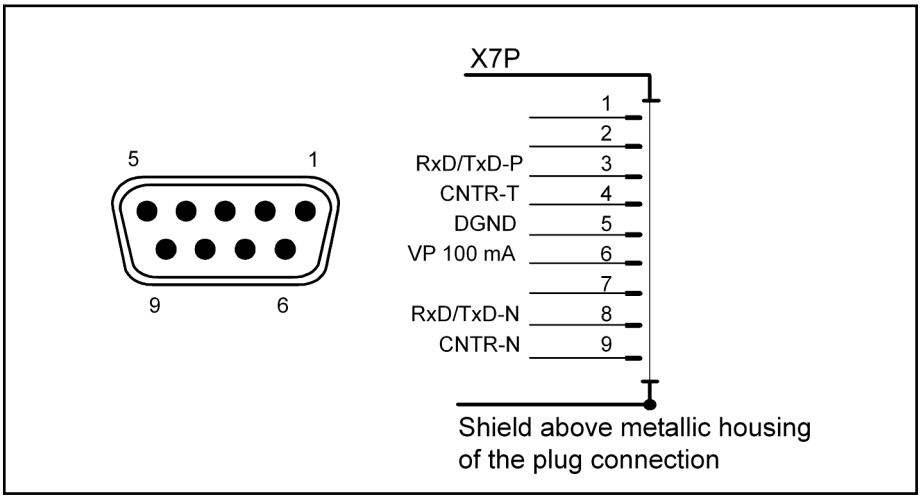


Fig. 6-9: Profibus DP interface X7P

D-Sub female connector, 9-pin	
Type	RS485
Cable type	Shielded, twisted 2-wire
Transmission rate	10 or 100 MBit/s

Tab. 6-8: Pin assignment of D-Sub female connector

The two LEDs displaying the interface state are located above the Profibus DP interface:

LED identification	Color	State	Description
Stat.	Green	Constantly on Acyclically on Cyclically on	Communication Not configured Configured
Bus	Red	Constantly on Flashing	No connection Slave diagnostics

Tab. 6-9: Profibus status display by LED

The bus cable is specified in EN 50 170, Part 8-2 as cable type A and must meet the following cable parameters:

Wave resistance at a frequency of 3 to 20 MHz	135 to 156 Ohm
Operating capacity	<= 30 pF/m
Loop resistance	<= 110 Ohm/km
Outer diameter	> 0.64 mm
Wire cross-section	> 0.34 mm^2

Tab. 6-10: Profibus DP cable parameters

The following length extensions of a bus segment for the respective transmission rates result from the cable parameters specified in the table and given for a standard cable of cable type A:

Transmission rate in Kbit/s	9.6	19.2	45,45	93.75	187.5	500	1500	3000	6000	12000
Max. segment length in m	1200	1200	1200	1200	1000	400	200	100	100	100

Tab. 6-11: Maximum segment length depending on transmission rate

Ready contact

Ready contact X2R

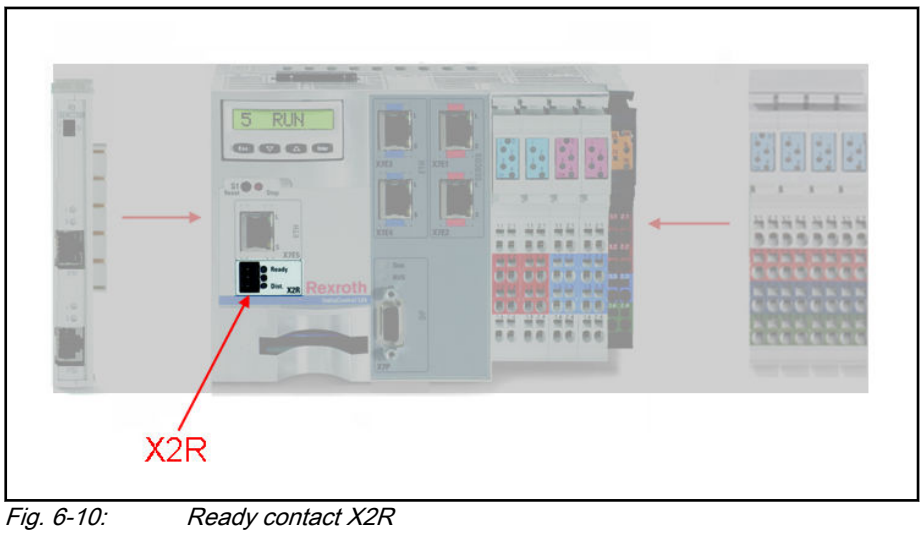


Fig. 6-10: Ready contact X2R

The pins 1 and 2 of the 3-pin X2R pin connector are the ports for the Ready contact.

☞ Use only copper wires to connect the connection terminal.

The Ready contact have a single-channel design.

Relay characteristic values (photo-MOS relay)	
Switching capacity	1 A, 60 V DC
UL rating	1 A, 60 V DC resistive
Drop-out time	0.3 ms
Bounce time	None
Watchdog time (only analog WD)	50 ms ± 25 %

Tab. 6-12: Characteristic values of the Ready contact

The Ready contact is open in an idle state. The ready contact is closed after the component startup. The contact is re-opened in one of the following states:

- The 24 V DC power supply falls below the permitted limit
- The internal 5 V and 3.3 V voltage falls below the permitted limit
- The Ready watchdog is executed
- The Reset button is pressed

The LED positioned adjacent to the Ready contact is a double LED with green and red colors. The LED can assume the following states:

Ready "LED"	Meaning
Off	Watchdog not yet started or Ready contact opened by software (the watchdog remains triggered internally)
Green	Ready contact closed. Watchdogs triggered
Red	Ready error. At least one watchdog responded

Tab. 6-13: Ready LED

The "Dist." LED has currently no function.

CF slot

Slot for firmware

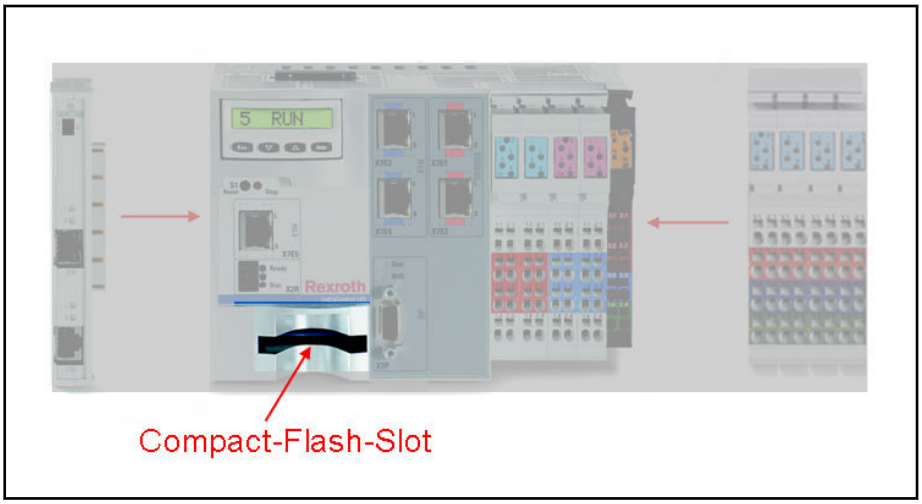


Fig. 6-11: Compact flash slot

A slot for a Compact Flash card is located on the IndraControl L. This slot accepts the memory card with the firmware. Data and programs are also stored on this card. Operation without a Compact Flash card is not possible.

⚠ WARNING **Uncontrolled motion by operating without Compact Flash card!**

Never remove the Compact Flash card while the IndraControl L is running!

6.1.3 Inline Bus

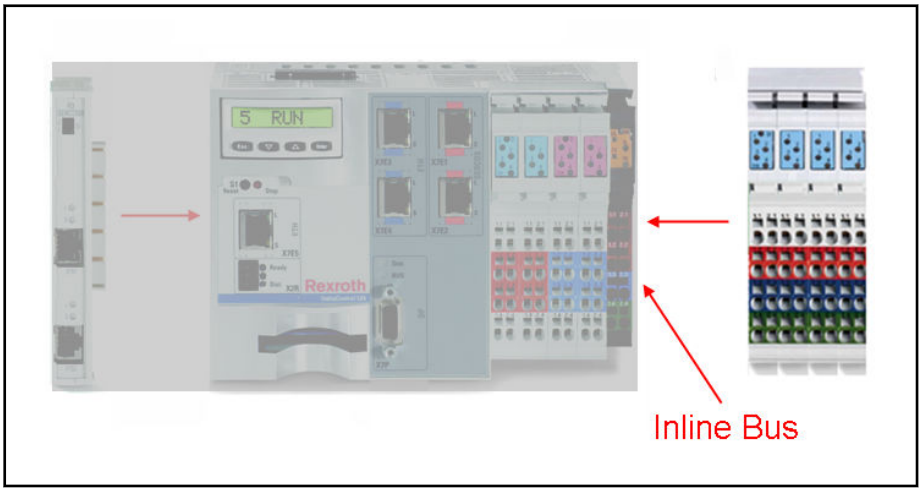


Fig. 6-12: Inline bus

The IndraControl L can be extended on the right using more Rexroth Inline terminals. The I/O unit can be extended up to 64 bytes of inputs/outputs using these terminals.

6.1.4 Function module plug

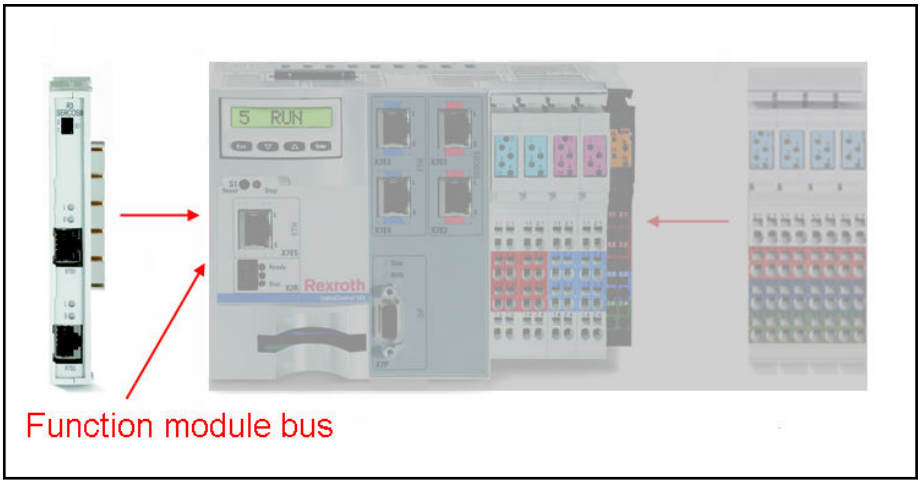


Fig. 6-13: Function module bus

On the left side of IndraControl L, up to four extension modules can be connected via the function module plug.

This 120-pin plug is a Bosch Rexroth PC104Plus plug at which the PC104 signals and additional system-specific signals have to be present. Thus, only function modules developed for the IndraControl L can be connected to this plug.

6.1.5 Digital onboard inputs and outputs (IndraControl L45/L65/L75 only)

General information

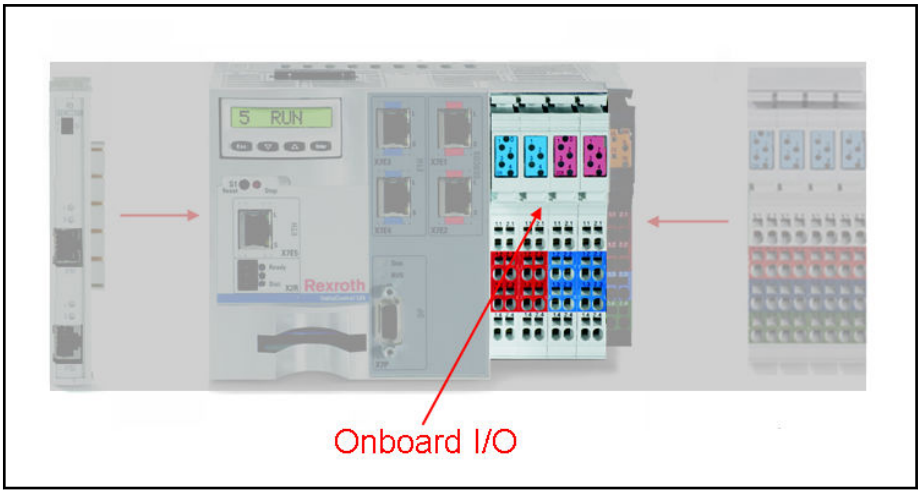


Fig. 6-14: Onboard I/O

Digital onboard inputs

There are eight digital inputs on the left half of the plug panel available as onboard inputs on the IndraControl L45/L65/L75.

Slots 1 and 2

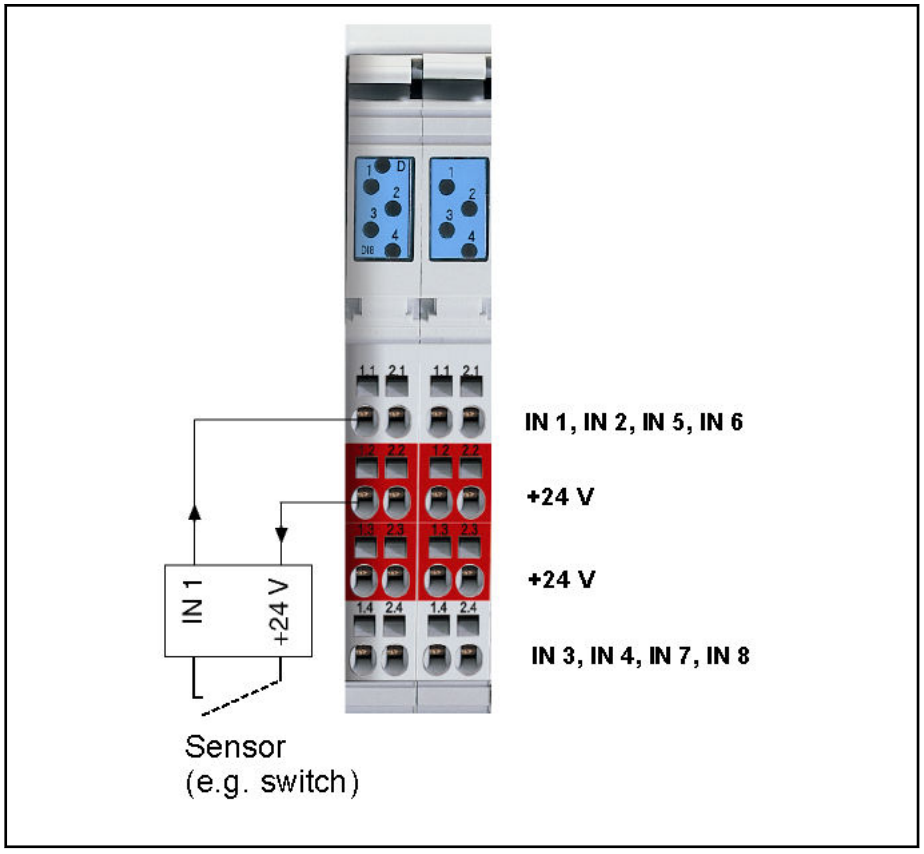


Fig. 6-15: Digital inputs

Note the color coding on the plugs!

Number of inputs	8
Connection method	2-wire
Electrical insulation from U_S	No
Electrical insulation from U_L	Yes
Reverse voltage protection	Yes
Input voltage: - Nominal value at "0" - Nominal value at "1"	 -3 V ... -5 V 11 V ... 30 V
Input current: - Nominal value at "0" - Nominal value at "1"	 < 2.5 mA 2.8 mA ... 6 mA
Delay time: - at "0" after "1" - at "1" after "0"	 Typ. 50 µs Typ. 50 µs
Power input from 24 V supply	Typ. 60 mA
Cable length (unshielded)	< 100 m
Interrupt inputs	8

Sensor supply	From U_{LS} via a polyfuse
Output voltage	Typ. U_{ext} - 1V
Nominal current (total)	0.2 A
Short circuit, overload protection	Typ. 0.6 A
Criteria to connect of 2-wire proximity switches: Quiescent current Voltage drop	 < 2.5 mA < 6 V

Tab. 6-14: Data of the digital inputs

The LEDs of the input terminals display the respective input state.

LED 1, 2, 3, 4	Meaning
Off	Corresponding input not set
Yellow	Corresponding input set

Tab. 6-15: Status LED of digital inputs

Another dual-colored LED (identified with a D) is green at 24 V and switches to red in the event of a short circuit or overload.

LED D	Meaning
Off	24 V missing
Green	24 V applied
Red	Short circuit or overload

Tab. 6-16: LED D

Digital onboard outputs

Two terminal strips with a total of eight digital outputs on the IndraControl L45/L65/L75 are located between the digital inputs and the terminal for the voltage supply.

Slots 3 and 4

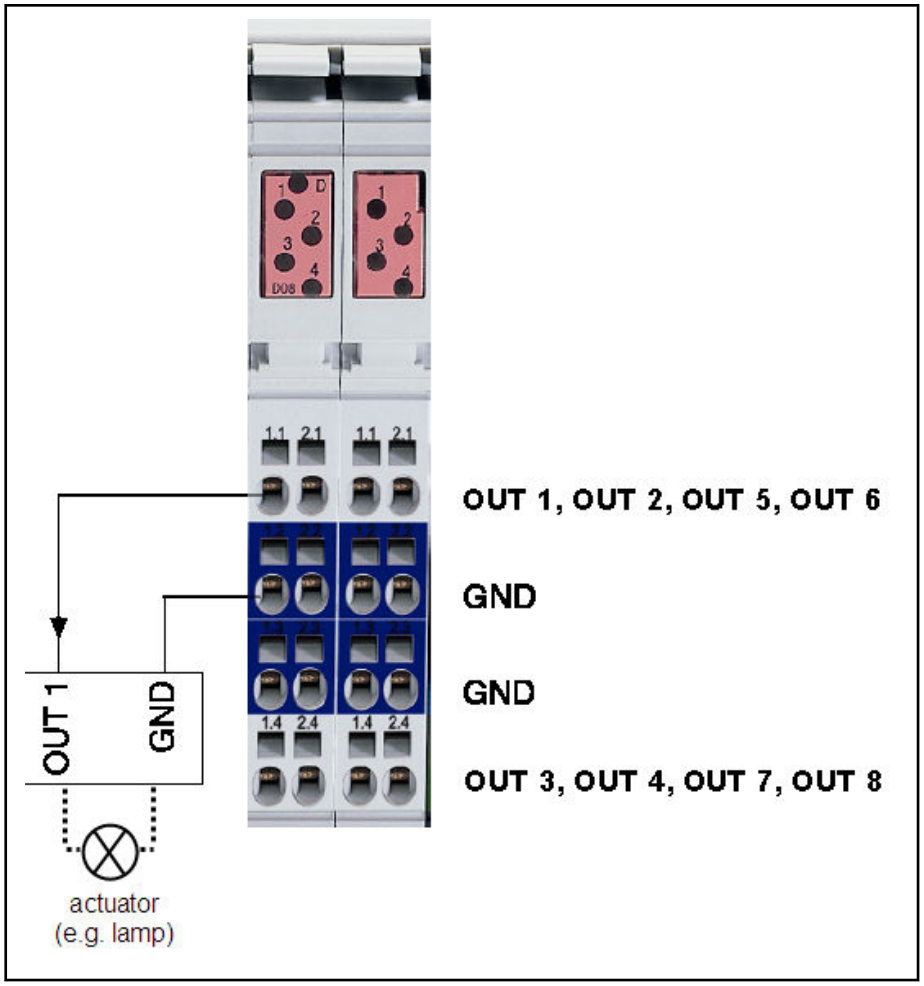


Fig. 6-16: Digital outputs

Note the color coding on the plugs!

Number of outputs	8
Connection method	2-wire
Output type	• Semiconductor outputs, non-saving • Protected, with automatic restart • Current-carrying
Electrical insulation from U_S	No
Electrical insulation from U_L	Yes
Output voltage, nominal value	24 V

Rated output current: - Nominal value - Maximum values acc. to DIN EN 61131-2 - Signal 1 - Signal 0 (leakage current) UL rating - General purpose - Tungsten	 0.5 A <= 0.6 mA 2 mA ... 0.6 A <= 0.5 mA 0.5 A 5 W
Maximum total current of outputs	2 A
Parallel connection of outputs	Yes but only within a terminal
Output delay time	< 500 µs
Contactor size (at 1 Hz)	SG1 (6.2 W)
Lamp load (at 8 Hz)	5 W
Switching frequency • With ohmic load • With inductive load	 100 Hz Function (protection)
Overload protection: • Typical current level causing switch-off • Minimum current level causing switch-off • Automatic restart at reduced load	 1.2 A 0.6 A after approx. 10 ms
Display overload	Red group LED for all Eight outputs
Voltage reduced on circuit interruption In nominal mode	Electronic at (V_{ext} - 50 V) Typ. 26 V
Reverse voltage protection	Guaranteed without connected load
Supply voltage according to EN 61131-2	24 V DC
Idle stop power consumption from US	Typ. 50 mA
Cable length (unshielded)	< 100 m

Tab. 6-17: Data of digital outputs

The LEDs of the output terminals display the respective output state.

LED 1, 2, 3, 4	Meaning
Off	Corresponding output not set
Yellow	Corresponding output set

Tab. 6-18: Status LED of digital outputs

Another dual-colored LED (identified with a D) is green at 24 V and switches to red in the event of a short circuit or overload.

LED D	Meaning
Off	24 V missing
Green	24 V applied
Red	Short circuit or overload

Tab. 6-19: LED D

NOTICE **Destruction of the assembly**

The assembly can be destroyed due to incorrect and improper connection. Therefore, avoid the following:

- Polarity reversal with a simultaneous short circuit of the output lines
- Polarity reversal with simultaneous connection of externally poled suppressor diodes
- Connection of an external voltage > UB

The 0 V reference of the connected loads has to be fed back to the 0 V port of the IndraControl L. Thus, a 2-pin connection has to be ensured. Otherwise, a GND short circuit proof is not guaranteed.

6.1.6 Power supply

Power supplies connected externally

General information

PWR IN

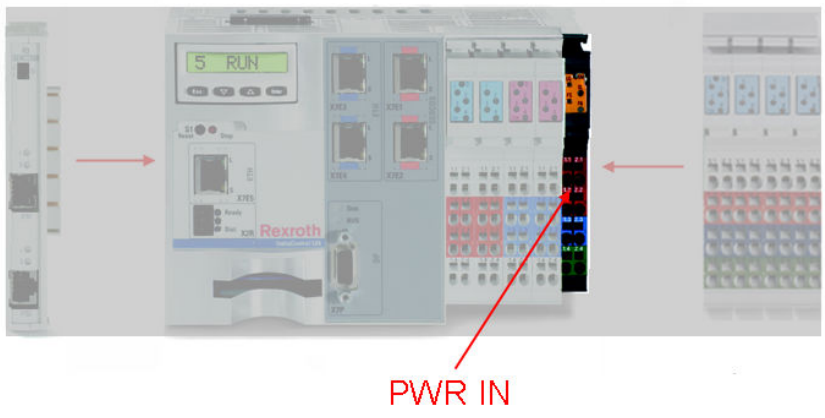


Fig. 6-17: Power supply connection

The power for the IndraControl L, any connected function modules and Inline terminals is supplied using the black " PWR IN terminal" on the right side of the IndraControl L.

Note the color coding on the plugs.

Only the feeder connector from the R-IB IL CML S01-PLSET plug set, available as an accessory for IndraControl L, can be used to connect the operating voltage. The R-IB IL SCN-PWR IN-CP plug available for other infeed terminals is not permitted for use with the IndraControl L!

Plug contact	Signal
1.1	+24 VDC segment voltage (U_S)
1.2	+24 VDC supply voltage (U_{LS})
1.3	LGND (ground power supply)
1.4 and 2.4	FE (functional earth)
2.1	+24 VDC uninterruptable power supply (UPS) is currently not supported
2.2	+24 VDC primary voltage (U_M)
2.3	PGND (primary ground and segment voltage)

Tab. 6-20: Plug assignment on the voltage terminal

Five LEDs are located at the top edge. The LEDs have the following meaning:

LED "U_M"	Meaning
Off	Main circuit supply missing
Green	24 V power supply U_M for the main circuit present

Tab. 6-21: Diagnostic LED of the infeed terminal

LED "U_S"	Meaning
Off	Segment circuit supply missing
Green	24 V power supply U_{LS} for the segment circuit is present

Tab. 6-22: Diagnostic LED of the segment terminal

LED "U_L"	Meaning
Off	Power supply U_{LS} missing
Green	24 V power supply U_{LS} present

Tab. 6-23: Diagnostic LED of the power supply

LEDs "FS" and "FN"	Meaning
	Currently no function

Tab. 6-24: LEDs FS and FN

The 7.5 V Inline voltage and the +24 V analog voltage U_{ANA} derive from the external +24 V voltage U_{LS}.

For more information, refer to "Rexroth IndraControl L45/L65/L85 control", see chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3.

6.1.7 Operating elements and displays

A display with operating keys to display diagnostic and status information and to operate and parameterize the control is located in the top part of the control. The display can also be used to enter the Ethernet interface settings.

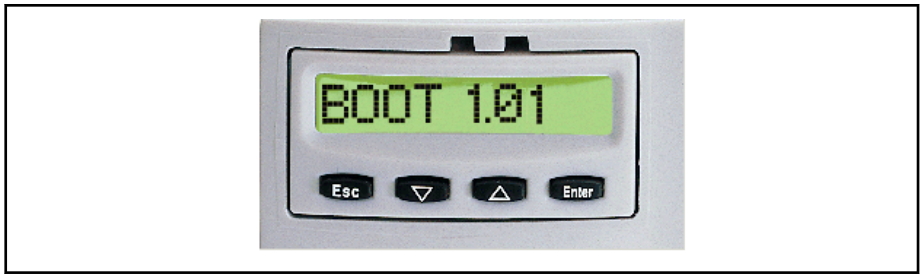


Fig. 6-18: Display with operating keys

The following figure shows the standard menu of the display:

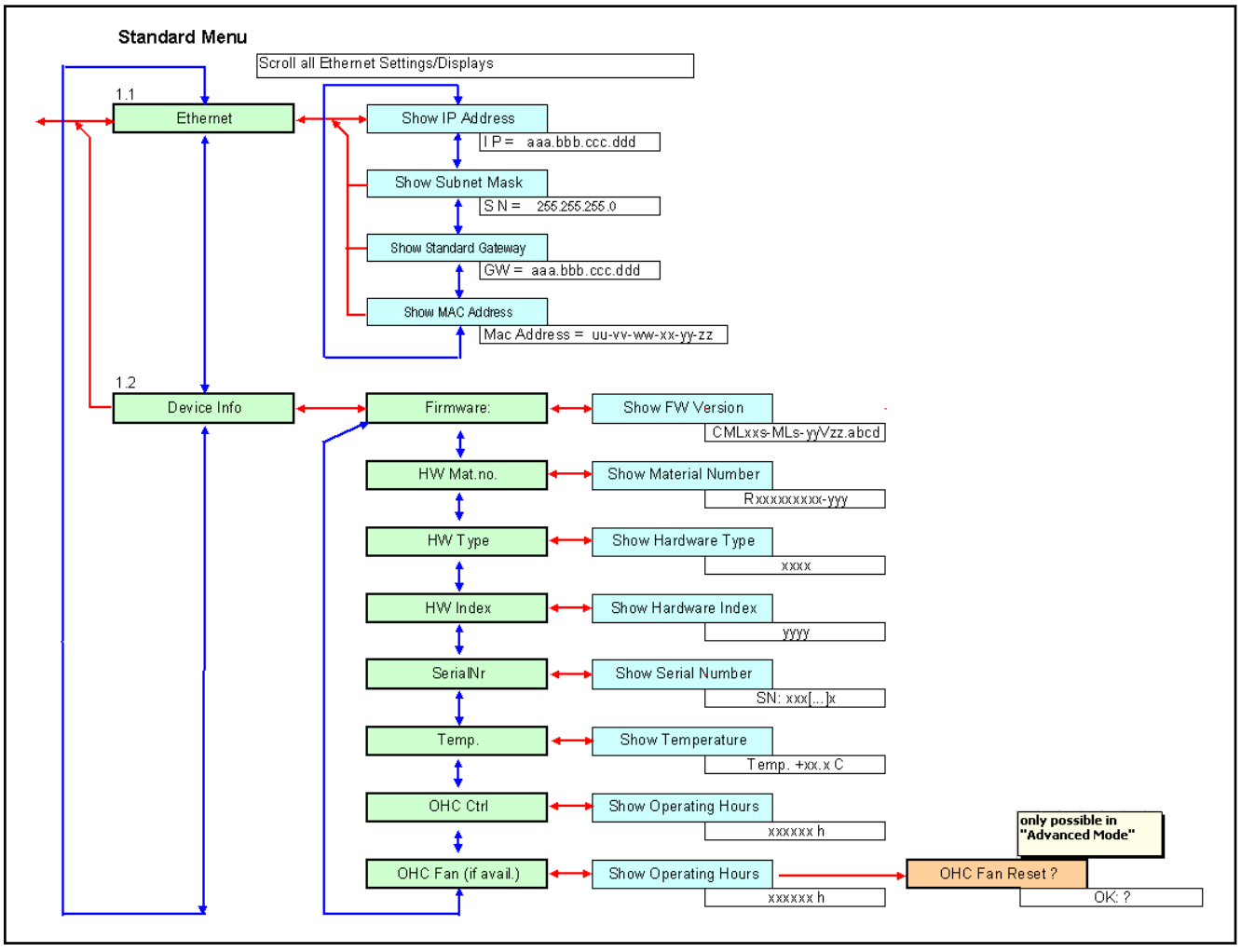


Fig. 6-19: Standard menu overview to operate display and keyboard

6.2 IndraControl XM

6.2.1 Overview

The "IndraControl XM" hardware basis is not provided for IndraLogic XLC.

The connection names for IndraControl XM21, IndraControl XM22 and IndraControl XM42 are completely harmonized. Compared to the IndraControl XM21 und IndraControl XM22, the IndraControl XM42 is provided with the additional connections XF3 and XF4 and with a real-time Ethernet connection for Profinet or Ethernet IP. The available functionality corresponds to the extension module XFE01.1-FB-03.

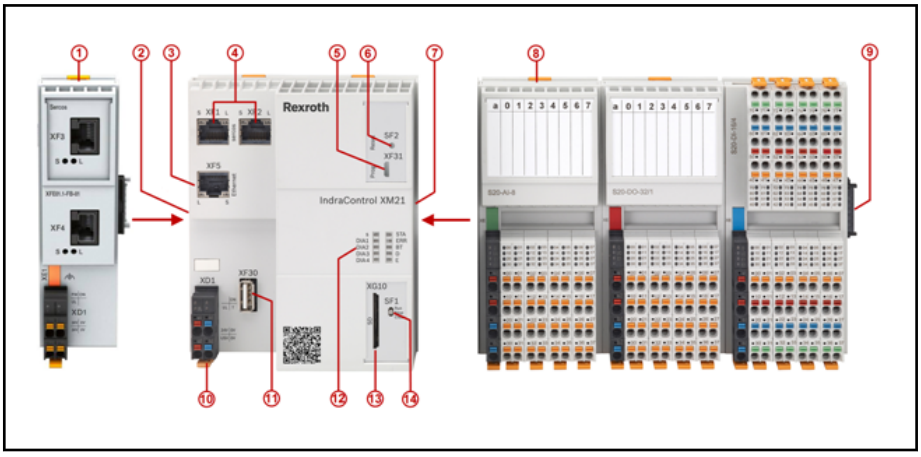


Fig. 6-20: Example figure: IndraControl XM21, S20 I/O modules and extension modules

No.	Function	Description
1	Extension module	In this example: Extension module: Sercos
2	Extension bus interface	There is an extension bus interface at the left side of the IndraControl XM. Extension modules can be connected via extension bus base modules via this interface
3	Ethernet interface XF5	Ethernet engineering interface: • TCP/IP, RT-Ethernet • Max. Transfer rate 100 Mbit/s
4	Ethernet interfaces XF1/XF2	RT-Ethernet interface Sercos III or EtherCAT
5	Micro USB port XF31	Ethernet engineering interface via micro USM device connection: • IP Address: 192.168.234.234 (cannot be changed) • Max. Transfer rate 11 Mbit/s **Note**: The transmission rate can be limited by the USB host support of the PC and the USB cable used! Connection problems between the control and the engineering PC can result.
6	Reset button SF2	The reset button has the following functions: • Resetting the control • Triggering the fallback mode • Triggering the initial firmware

No.	Function	Description
7	S20 interface	Up to 63 S20 modules can be connected to the S20 interface on the right side of the IndraControl XM via S20 bus base modules
8	S20 I/O modules	The number of connectable modules depends on the total current consumption of S20 modules. The IndraControl XM can provide up to 2 A for the power supply of the S20 modules
9	S20 bus base module	Connection for more S20 bus base modules
10	Power supply connector XD1	Connection of 24 V power supply
11	USB connection XF30	USB host port for USB mass storage medium (FAT, FAT32)
12	LED display block of 10	These LEDs display the IndraControl XM states
13	Slot for SD card XG10	This slot accepts the memory card with the system firmware. User data and programs are also stored on this card
14	Operation mode switch SF1	The menu items of the initial firmware are selected via the operation mode switch SF1
	Ethernet interfaces XF3/XF4 (only IndraControl XM42)	RT-Ethernet interface Profinet or Ethernet IP

* The Ethernet interfaces XF3/XF4 are **only** available for XM4.

Tab. 6-25: Ports and operating elements on the IndraControl XM

6.2.2 Interfaces

Ethernet interface XF5

XF5 Ethernet network connection

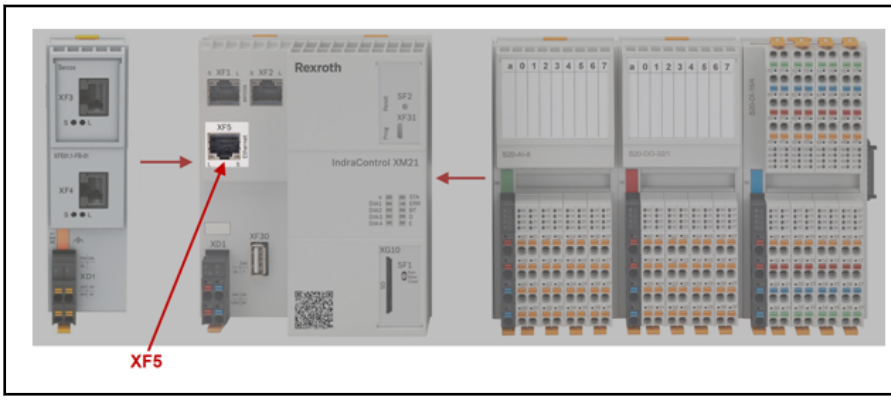


Fig. 6-21: Ethernet interface XF5

The IndraControl XM can be connected to an Ethernet network via the XF5 port.

The connection conditions defined in IEEE 802.3 for 100BaseT apply.

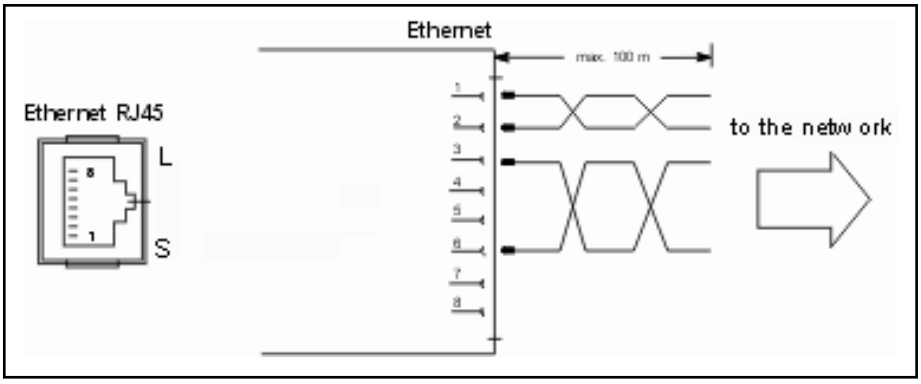


Fig. 6-22: Pin assignment of the Ethernet interface XF5

RJ45, socket, 8-pin	
Type	Ethernet 100BaseT
Cable length	Max. 100 m
Cable type	CAT5e with S/STP
Transmission rate	10 or 100 MBit/s

Tab. 6-26: Pin assignment of the RJ45 female connector

LED	Status
L (link)	On: Link to network provided Off: No network connection
S (Send)	On: Data packages are sent Off: No data is sent

Tab. 6-27: Status and diagnostic displays of the Ethernet interface

Bosch Rexroth recommends the use of a category 5 STP cable.

This port is provided for the programming device network!

Sercos III XF1 / XF2

XF1 / XF2 Sercos III Interfaces

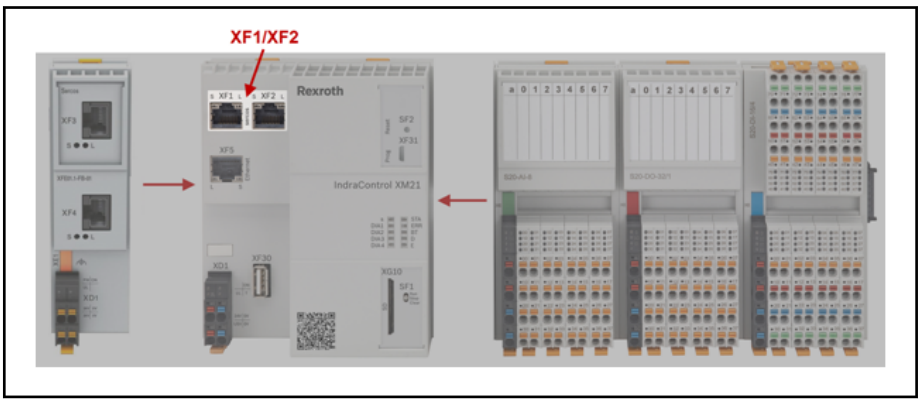


Fig. 6-23: Sercos III interfaces XF1/XF2

The Sercos III devices are connected to the XF1 and XF2 ports.

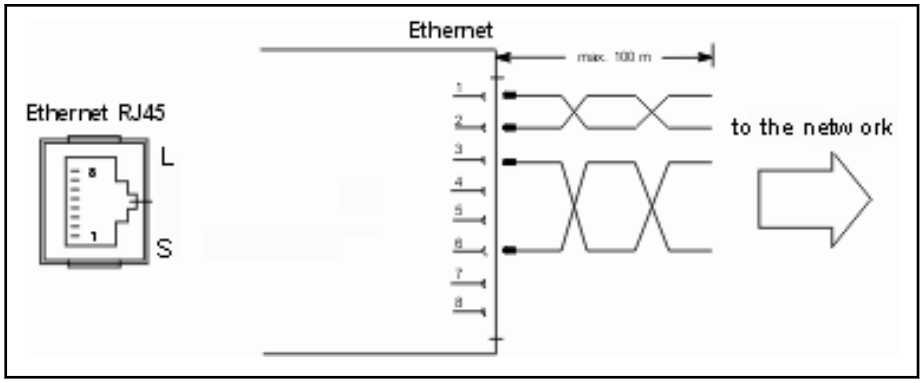


Fig. 6-24: Sercos III interface XF1/XF2

RJ45, socket, 8-pin	
Type	Ethernet 100BaseT
Cable length	Max. 100 m
Cable type	CAT5e with S/STP
Transmission rate	100 MBit/s

Tab. 6-28: Pin assignment of the RJ45 female connector

LED	Status
L (link)	On: Link to network provided Off: No network connection
S (Send)	On: Data packages are sent Off: No data is sent

Tab. 6-29: Status and diagnostic displays of the Ethernet interface

SD card slot

Slot for firmware

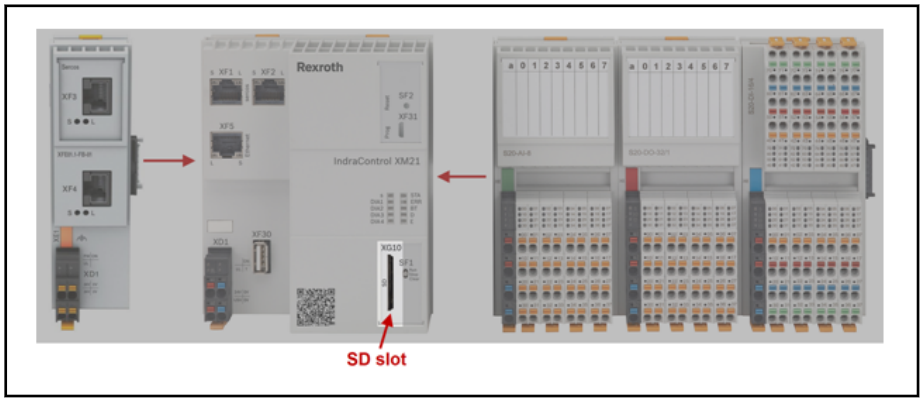


Fig. 6-25: SD card slot

The IndraControl XM has a lot for an SD card. and accepts the memory card with the firmware. Data and programs are also stored on this card.

⚠ WARNING **Uncontrolled motion caused by operation without SD card!**

Do not remove the SD card as long as the IndraControl XM is running!

6.2.3 S20 Bus

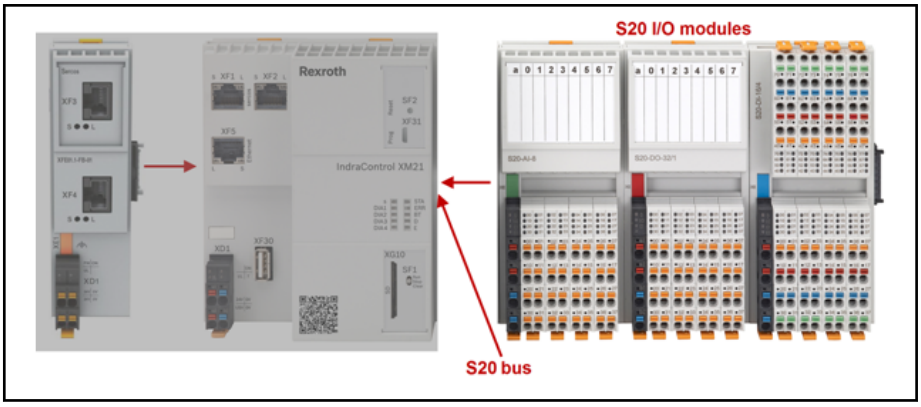


Fig. 6-26: S20 bus

The IndraControl XM can be extended with up to 63 S20 I/O modules on the right via the S20 bus.



An S20 bus base module is required for each S20 module.

6.2.4 Extension bus

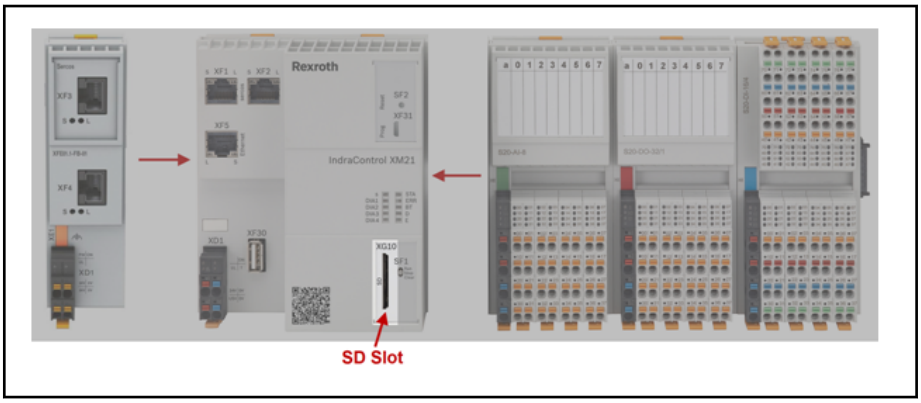


Fig. 6-27: Extension bus

Different extension modules can be connected at the left of the IndraControl XM via the extension bus.



An extension bus base module is required for each extension module.

The following extension modules are currently available:

- Extension module: Sercos
- Extension module: Safe Logic
- Extension module: Profibus Master
- Extension module: Profibus slave
- Extension module: RT-Ethernet Master
- Extension module: RT-Ethernet slave

6.2.5 Power supply

Power supplies connected externally

General information

Power supply connector XD1

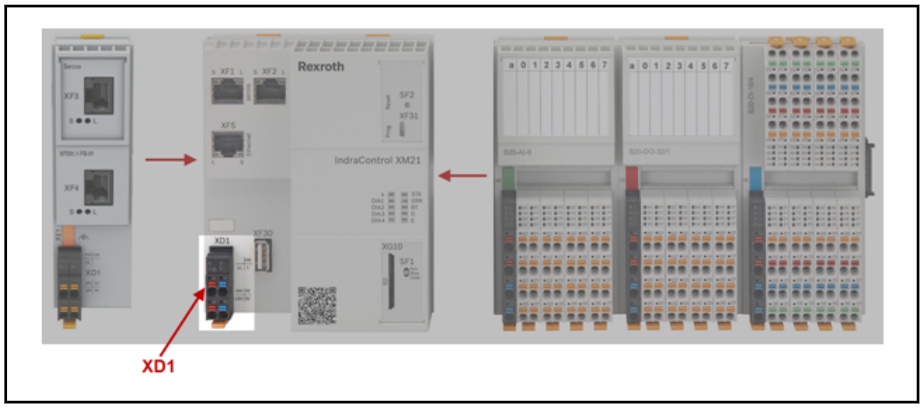


Fig. 6-28: Power supply connector XD1

The voltage supply for the IndraControl XM, possible connected extension modules and S20 I/O modules is provided via the 24 V voltage supply connection XD1.

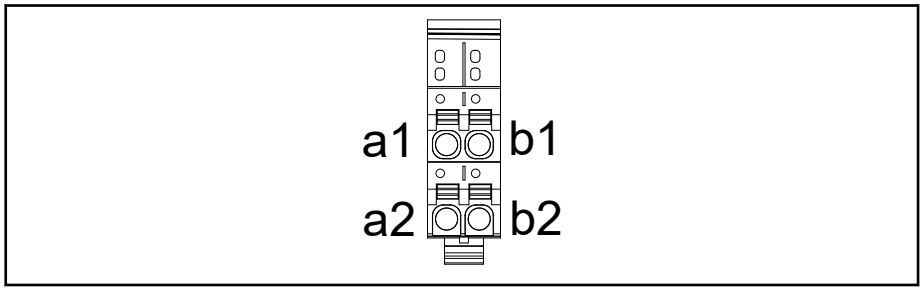


Fig. 6-29: Power supply connector XD1

Plug contact	Signal	Function
a1, a2	U_L +24 V	+24 V DC power supply (U_L)
b1, b2	U_L 0 V	0 V DC supply voltage (U_L)

Tab. 6-30: Pin assignment of the power supply connector XD1

6.2.6 Operating elements and displays

Reset button SF2

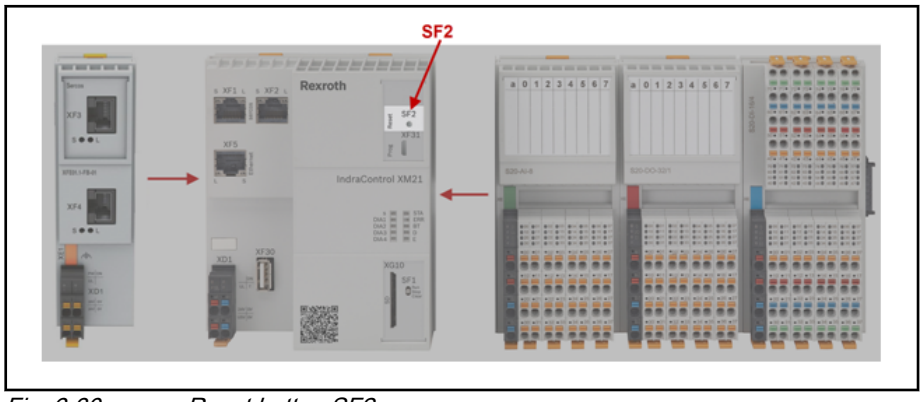


Fig. 6-30: Reset button SF2

The "Reset" button has the following functions:

- A voltage cycle (reset) is triggered when pressing the "Reset" button at control runtime
- The "Reset" button has two functions that can be triggered if the "Reset" button is pressed when applying the supply voltage:
  - Press "Reset" button < 5 seconds: Triggering the fallback mode
  - Press "Reset" button > 5 seconds until the DIA3 and DIA4 LEDs flash alternately: Triggering the initial firmware



The "Reset" button can only be actuated with a sharp tool (e. g. pencil).

Operation mode switch SF1

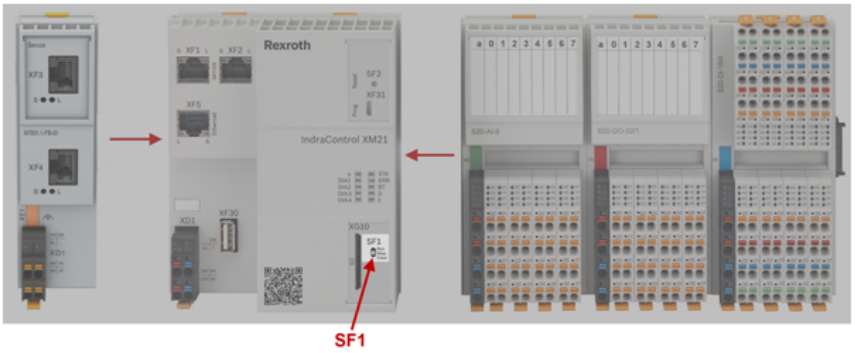


Fig. 6-31: Operation mode switch SF1

The operating concept of XM controls is implemented via the operation mode switch SF1. LEDs provide respective feedback.



For more information on the operation mode switch SF1, refer to the documentation "Rexroth IndraLogic XLC IndraMotion MLC 14VRS Functional Description", chapter "IndraMotion MLC XM - Commissioning" (see chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3.

Operating and error displays at LED block of 10

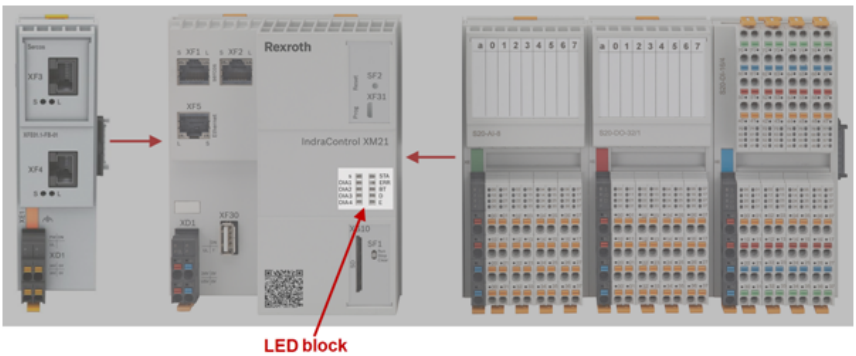


Fig. 6-32: LED display block of 10

Display in normal mode

The following functions are assigned to the LEDs when the system firmware is running:

LED	Color	Function
s	Green	Sercos status
DIA1	Green	Used as feedback for the operation mode switch
DIA2	Green	Basic diagnostics by the system
DIA3	Red	Booting
DIA4	Red	Booting
STA	Red/ green	RUN/STOP
ERR	Red/ green	Error status (warning, error)
BT	Red/ green	Boot status
D	Red/ green	Onboard S20: Diagnostics S20 bus
E	Red/ green	Onboard S20: Error/warning S20 devices

Tab. 6-31: LED block of 10

The displayed device states depend on the firmware and are described in the functional description of the IndraMotion MLC.

“Initial Firmware" display

For the initial firmware, the LEDs indicate the states of the following functions:

LED	Function	Color	Status
DIA2	Store core dump on SD card or USB medium (for diagnostic purposes)	Green/orange flashing	In process
		Green	Done
		Red	Errors
DIA3, DIA4	Operating system state	Alternatingly flashing in red	Initial firmware is active
ERR	Reset to delivery state	Red	Function selected/ processed
		Red, flashing	Confirm selection
BT	Reset user name/password	Red	Function selected/ processed
		Red, flashing	Confirm selection
D	Delete network configuration	Red	Function selected/ processed
		Red, flashing	Confirm selection

LED	Function	Color	Status
E	Start First Touch	Red	Function selected/ processed
		Red, flashing	Confirm selection
		Green	First Touch running

Tab. 6-32: LED states

For more information on the LED states, refer to the documentation "Rexroth IndraLogic XLC IndraMotion MLC 14VRS Functional Description", chapter "IndraMotion MLC XM - Commissioning" (see chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3.

Operating and error displays on the power supply connector XD1

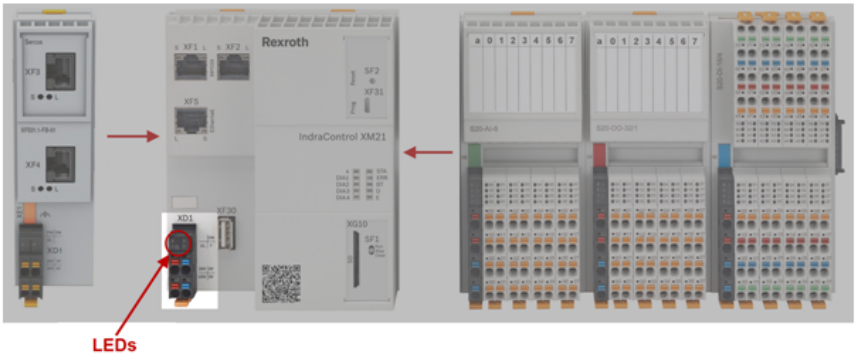


Fig. 6-33: LEDs on power supply connector XD1

The following table describes the LEDs on the power supply connector XD1.

LED	Color	Function
U_L	Green	24 V supply voltage connected and within the permitted range
ON	Green	All FPGAs (Field Programmable Gate Array) in the system are ready for operation. If this LED is not on, an error is present and the user has to trigger a "fallback"chapter 6.2.6 "Operating elements and displays" on page 75
T	Red	Max. temperature exceeded. The power supply unit switched off the control

Tab. 6-33: Functions and LEDs on the XD1 plug

6.3 IndraControl VPB40.4

6.3.1 Overview

The "IndraControl VPB40.4" hardware basis is not provided for IndraLogic XLC.

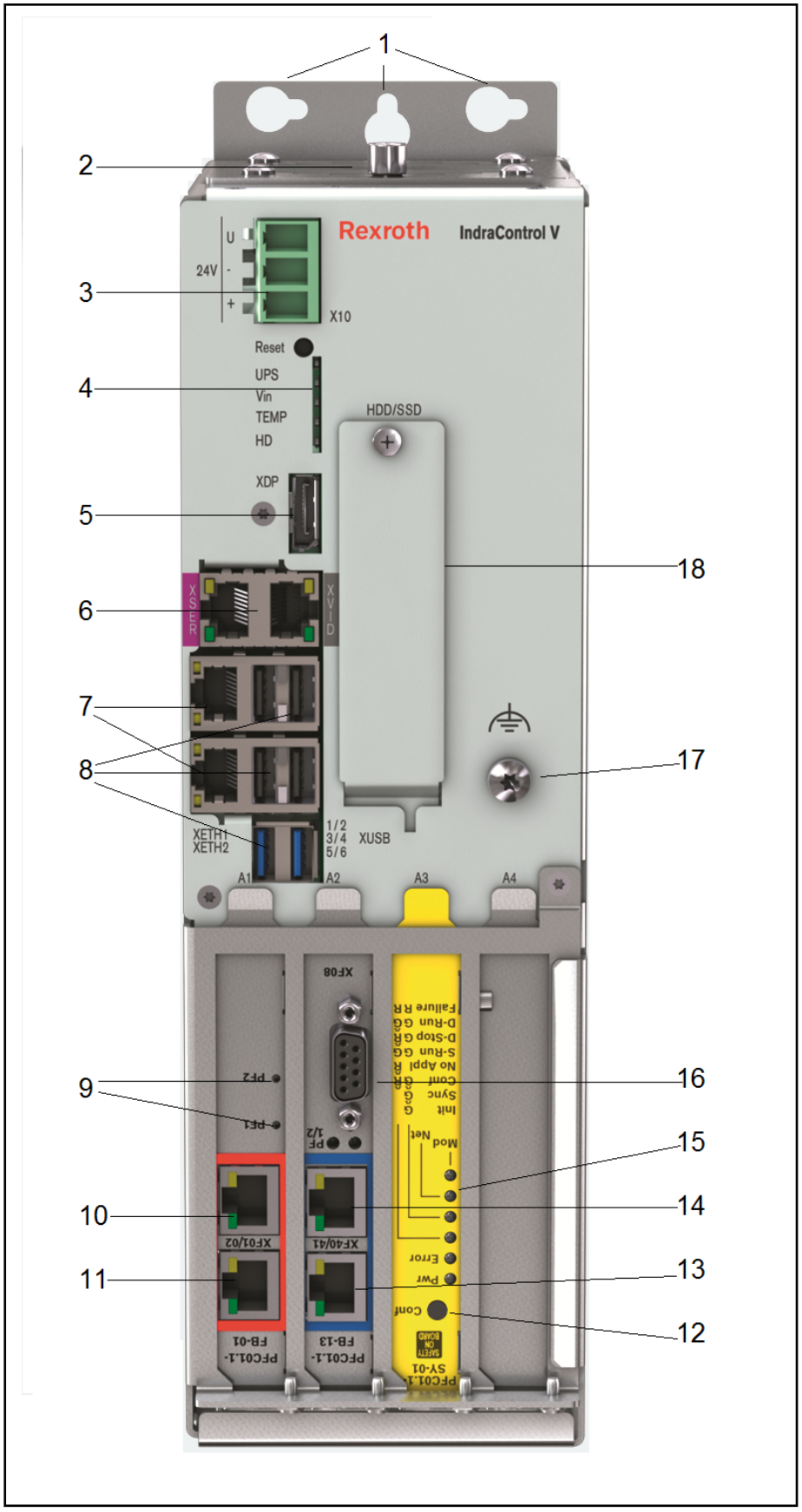


Fig. 6-34: IndraControl VPB40.4 with "PFC extension modules"

Figure no.	Function	Description
1	Fastening	Holder for rack mounting
2	Fan	Temperature check
3	Power supply connector X10	Connection of 24 V power supply
4	LED	Diagnostic PC
5	XDP	Graphics connector DVI
6	XSER	Graphics connector CDI
7	XETH1/XETH2	The XETH1 connection is reserved for the Windows operating system. The connection XETH2 is configured for the integrated control
8	XUSB 1-6	USB port. USB interfaces are only accessed via the Windows operating system
9	PF1/PF2	Extension module PFC01.1-FB-01: Diagnostic LED
10	XF1	Extension module PFC01.1-FB-01: RT-Ethernet interface Sercos III or EtherCAT
11	XF2	Extension module PFC01.1-FB-01: RT-Ethernet interface Sercos III or EtherCAT
12	Conf	Extension module PFC01.1-SY-01: Acknowledgement button SafeLogic
13	XF40	Extension module PFC01.1-FB-13: RT-Ethernet interface Profinet or Ethernet IP
14	XF41	Extension module PFC01.1-FB-13: RT-Ethernet interface Profinet or Ethernet IP
15	LED	Extension module PFC01.1-SY-01: Diagnostics
16	XF08	Extension module PFC01.1-FB-01: Profibus DP connection
17	Connection	Grounding
18	HDD/SSD	SSD hard drive

Tab. 6-34: Ports and operating elements - IndraControl VPB40.4

7 IndraDrive and HydraulicDrive – Drive technology

7.1 General information

The drive solution IndraDrive creates a modular system with versatile use by combining the product advantages:

- Scalable in power and function
- Continuous in technology, engineering and operation
- Complete synchronous and asynchronous motor portfolio

IndraDrive has a number of application benefits such as:

- Easy implementation from frequency converters to high-end servo applications using a common platform for open-loop and closed-loop
- Scalable scope of power and functions due to a free combination of controls and power sections
- Wide power spectrum from 100 W to 630 kW
- Integrated safety engineering according to EN 13849-1 category 3 PL d and EN 62061 SIL 2 for safe halt and safe motion
- Common intermediate circuit to exchange energy at multi-axis operation
- Energy-saving mains feedback

Rexroth IndraDrive is provided in two variants:

- Compact converter system
  - IndraDrive Cs (see chapter 7.2.1 "Brief description" on page 81)
- Modular inverter system
  - Control sections

    We provide control sections from standard to high-end applications tailored for your personal use case. Certified safety engineering and standardized interfaces meet all your requirements.
    - BASIC OPEN LOOP
    - BASIC UNIVERSAL - Single-axis
    - BASIC UNIVERSAL - Double-axis

The motor line IndraDyn covers all requirements of the modern factory automation with their manifold designs:

- Synchronous and asynchronous servo motors
- Servo motors for hazardous areas according to ATEX and UL/CSA
- Synchronous and asynchronous motors for high-speed applications such as motor spindles

7.2 Compact system IndraDrive Cs

7.2.1 Brief description

IndraDrive Cs integrates power and control section in one device. It is characterized by its space-saving design and excellent performance data. Due to the default support of the most common encoder types, the encoder system and motor system can be freely selected.



Fig. 7-1: Compact system IndraDrive Cs

7.2.2 Technical data

Technical features

- Two series for direct mains connection to 110 - 230 VAC or 200 - 500 VAC
- Suitable for motors from 0.05 to 3.5 kW continuous power
- Complete, scalable drive program
- Provides the complete functionality of the IndraDrive drive family
- Digital inputs/outputs and analog input on board
- Intelligent control panel with programming module function allows device exchange without PC
- Integrated safety engineering STO (Safe Torque Off) according to EN 13849-1 Cat. 4 PL e and EN 62061 SIL 3
- Integrated braking resistance. An external braking resistance can also be connected

Converter	**Size 1**						**Size 2**	
Type	**HCS01.1E W0003**	**HCS01.1E W0006**	**HCS01.1E W0009**	**HCS01.1E W0013**	**HCS01.1E W0005**	**HCS01.1E W0008**	**HCS01.1E W0018**	**HCS01.1EW 0028**
Performance data								
Mains connection voltage	3 AC 110 … 230 V				3 AC 200 … 500 V			
Continuous current	1.4 A_{eff}	2.3 A_{eff}	3 A_{eff}	4.4 A_{eff}	2 A_{eff}	2.7 A_{eff}	7.6 A_{eff}	11.5 A_{eff}
Maximum current	3.3 A_{eff}	6 A_{eff}	9 A_{eff}	13 A_{eff}	5 A_{eff}	8 A_{eff}	18 A_{eff}	28 A_{eff}

Mechanical continuous power	100 W	200 W	400 W	750 W	400 W	750 W	1500 W	3500 W
Mechanical data								
Width	50 mm						70 mm	
Height with/ without cooling body	160/215 mm						213/268 mm	
Depths with/without control panel	196/220 mm							
Mass	0.72 kg						1.7 kg	

Tab. 7-1: Technical data of the IndraDrive Cs

7.2.3 Firmware

The following firmware versions of the IndraDrive CS are supported by the IndraMotion MLC and IndraLogic XLC:

- FWA-INDRV*-MPB-16VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPE-16VRS-D5-1-SNC-NN
- FWA-INDRV*-MPE-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPE-18VRS-D5-1-SNC-NN

7.2.4 Documentation

The following documentation provides comprehensive descriptions of the IndraDrive M HMV devices:

- Rexroth IndraDrive Cs Drive Systems with HCS01, DOK-INDRV*-HCS01******-PRxx-EN-P

  xx - Edition

7.3 IndraDrive Control Section

7.3.1 Brief description

All IndraDrive control sections - from the simple frequency converter to the high-end servo drive with integrated MotionControl - can be combined with all IndraDrive C converters (see chapter 7.4 "IndraDrive C converters" on page 88) and IndraDrive M inverters (see chapter 7.5 "IndraDrive M inverters" on page 92).

The control sections differ in performance, function and configuration. Anything is possible with different firmware versions and control panels. This flexible system concept provides an optimum solution for your individual application in terms of technology and economy.

IndraDrive Basic control section

These control sections are the economical solution for all standard applications with moderate requirements in terms of control quality and interface flexibility. A standard encoder interface for IndraDyn motors is already on

board for the BASIC control sections. The BASIC UNIVERSAL control sections are provided with another option slot.

- BASIC UNIVERSAL - Single axis CSB01.1C-SE-ENS-NNN-L2-S-NN-FW
- BASIC UNIVERSAL - Double axis CDB01.1C-SE-ENS-EN2-NNN-MA1-S2-S-NN-FW



Fig. 7-2: IndraDrive BASIC UNIVERSAL control section

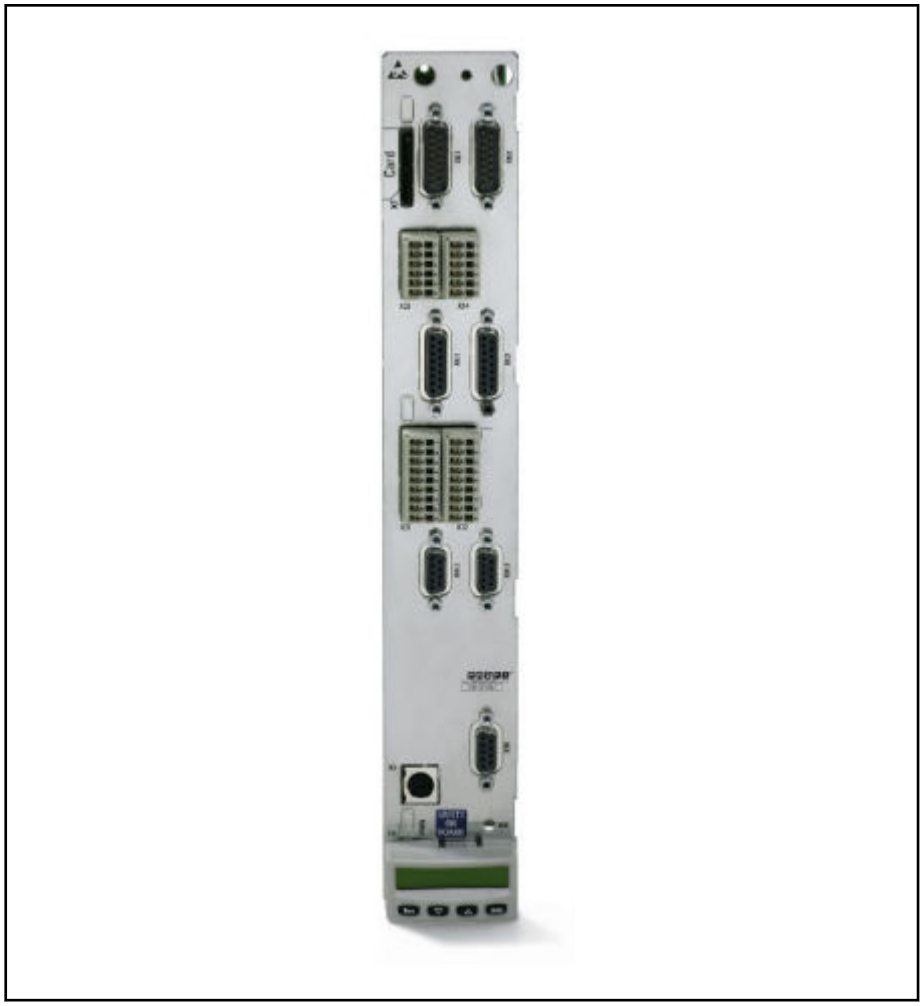


Fig. 7-3: Control section IndraDrive BASIC UNIVERSAL double axis

IndraDrive Advanced control section

These control sections meet the highest requirements in terms of control quality. Virtually all applications are performed with a wide range of interfaces for communication and encoders as well as analog or digital inputs and outputs.

- ADVANCED CSH01.1C-SE-ENS-EN2-NNN-S2-S-NN-FW



Fig. 7-4: IndraDrive ADVANCED control section

7.3.2 Technical data

IndraDrive control sections

	BASIC UNIVERSAL	BASIC UNIVERSAL double axis	BASIC ADVANCED
Master communication			
Profibus	○	○	○
Sercos II	○	○	○
Sercos III	○	○	○
Configurations			
Option 1	●	●/●	●
Option 2	●	●/●	●
Option 3	-	-	●
Option: Safety engineering	●	●/●	●
Slot for multimedia card	●	●/●	●

	BASIC UNIVERSAL	BASIC UNIVERSAL double axis	BASIC ADVANCED
Encoder interfaces			
IndraDyn motors MSK, MKE, MAD und MAF, Hiperface®, 1 VSS and 5 V TTL	●	○	○
Motors: MHD and MKD	○	○	○
EnDat 2.1, 1 VSS and 5 V TTL	○	○	○
Cycle times			
Current control	125 µs		62.5 µs
Velocity control	250 µs		125 µs
Position control	500 µs		250 µs
PWM frequency			
4/8 kHz	●/●	●/●	●/●
12/16 kHz	-/-	-/-	●/●
Inputs/outputs			
Digital inputs/ Thereof to be used for touch probes	5/1	18/2	7/2
Digital inputs/ outputs	3	4	4
Analog inputs	-	1	1
Analog outputs	-	2	2
Relay outputs	1	1	1
Control voltage data			
Control voltage	24 V DC		
Power consumption without options	6.5 W	7.5 W	6 W
Continuous current without options	0.27 A	0.31 A	0.25 A

● Default
○ Option

Tab. 7-2: Technical data of IndraDrive control sections

7.3.3 Firmware

The following firmware versions of the control section are supported by the MLC system:

- FWA-INDRV*-MPB-20VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-20VRS-D5-1-SNC-NN

- FWA-INDRV*-MPM-20VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-21VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-21VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-21VRS-D5-1-SNC-NN

7.3.4 Documentation

The following documentations provide comprehensive descriptions of the IndraDrive M CSH devices:

- Rexroth IndraDrive Drive Controllers Control Sections CSB01, CSH01, CDB01 CSB01, CSH01, CDB01, DOK-INDRV*-CSH********-PRxx-EN-P
  xx - Edition

7.4 IndraDrive C converters

7.4.1 Brief description

The converters of the IndraDrive C series combine inverters and supply in one device. The compact design contains additional mains connections and is thus especially suitable for single-axis applications.



Fig. 7-5: IndraDrive HCS02 converters



Fig. 7-6: IndraDrive HCS03 converters

7.4.2 Technical data

Performance data

- Power range from 1.5 kW to 630 kW with maximum currents from 12 A to 210 A
- High overload capacity
- Compact design for single-axis applications
- Option to connect inverters for cost-effective solutions
- Direct mains connection from 200 V to 500 V

IndraDrive C – Compact converters HCS02

Type	HCS02.1E-W0012	HCS02.1E-W0028	HCS02.1E-W0054	HCS02.1E-W0070
Performance data				
Continuous current	4.5 A	11.3 A	20.6 A	28.3 A
Maximum current	11.5 A	28.3 A	54 A	70.8 A

Type	HCS02.1E-W0012	HCS02.1E-W0028	HCS02.1E-W0054	HCS02.1E-W0070
Intermediate circuit continuous power with/without choke	2.1/2.1 kW	5.1/5.1 kW	7/10 kW	9/14 kW
Maximum power with/without choke	5/5 kW	8/10 kW	12/16 kW	14/19 kW
Mains connection voltage	3 AC 200 ... 500 V, 1 AC 200 ... 250 V (±10 %)			
Mains input continuous current	6 A	13 A	19 A	30 A
Power dependency from the supply voltage	at U_{LN} < 400 V: 1 % power reduction per 4 V at U_{LN} > 400 V: 1 % power gain per 5 V			
Intermediate circuit connection	-	•	•	•
Intermediate circuit capacity	135 µF	270 µF	405 µF	675 µF
Braking resistance				
Braking resistance	Internal	Internal	Internal/external	Internal/external
Maximum braking energy consumption	1 kWs	5 kWs	9 kWs	13 kWs
Continuous braking power	0.05 kW	0.15 kW	0.35/3.8 kW	0.5/5.5 kW
Maximum braking power	4 kW	10 kW	18 kW	25 kW
Control voltage data				
Control voltage data, internal	DC 24 V (not to supply the motor holding brake)			
Control voltage, external	24 V DC ±20 % (24 DC ±5 % at supply of the motor holding brake)			
Power consumption without control section and motor holding brake	12 W	14 W	23 W	23 W
Continuous current without control section and motor holding brake	0.5 A	0.6 A	1 A	1 A

Type	HCS02.1E-W0012	HCS02.1E-W0028	HCS02.1E-W0054	HCS02.1E-W0070
Mechanical data				
Width	65 mm	65 mm	105 mm	105 mm
Height	290 mm	352 mm		
Depth	252 mm			
Mass	2.9 kg	3.8 kg	6.7 kg	6.8 kg

● Default

Tab. 7-3: IndraDrive C HCS02 converters

IndraDrive C – Compact converters HCS03

Type	HCS03.1E-W0070	HCS03.1E-W0100	HCS03.1E-W0150	HCS03.1E-W0210
Performance data				
Continuous current	45 A	73 A	95 A	145 A
Maximum current	70 A	100 A	150 A	210 A
Intermediate circuit continuous power with/without choke	13/25 kW	24/42 kW	34/56 kW	42/85 kW
Maximum power with/without choke	20/40 kW	33/59 kW	54/89 kW	68/124 kW
Mains connection voltage	3 AC 400 ... 500 V (+10 %/-15 %)			
Mains input continuous current	50 A	80 A	106 A	146 A
Power dependency from the supply voltage	at U_{LN} < 400 V: 1 % power reduction per 4 V			
Intermediate circuit connection	●	●	●	●
Intermediate circuit capacity	940 µF	1.440 µF	1.880 µF	4.700 µF
Brake chopper				
Continuous braking power	13.2 kW	18.9 kW	25.2 kW	42.6 kW
Maximum braking power	42 kW	63 kW	97 kW	137 kW
Control voltage data				

Type	HCS03.1E-W0070	HCS03.1E-W0100	HCS03.1E-W0150	HCS03.1E-W0210
Control voltage data, internal	DC 24 V (not to supply the motor holding brake)			
Control voltage, external	24 V DC ±20 % (24 DC ±5 % at supply of the motor holding brake)			
Power consumption without control section and motor holding brake	22.5 W	25 W	25 W	30 W
Continuous current without control section and motor holding brake	0.9 A	1 A	1 A	1.3 A
Mechanical data				
Width	125 mm	225 mm	225 mm	350 mm
Height	440 mm			
Depth	309 mm			
Mass	13 kg	20 kg	20 kg	38 kg

- Default

Tab. 7-4: IndraDrive C HCS03 converters

7.4.3 Documentation

The following documentations provide comprehensive descriptions of the IndraDrive M HMV devices:

- Rexroth IndraDrive Drive Controllers HCS04.2E, DOK-INDRV*-HCS04.2****-PRxx-EN-P
- Rexroth IndraDrive Drive Controllers Power Sections HCS02, DOK-INDRV*-HCS02*UL***-IBxx-EN-P
- Rexroth IndraDrive Drive Controllers Power Sections HCS03, DOK-INDRV*-HCS03*UL***-IBxx-EN-P
- Rexroth IndraDrive C Drive Controllers HCS02.1, HCS03.1, DOK-INDRV*-FU*********-IBxx-EN-P

xx - Edition

7.5 IndraDrive M inverters

7.5.1 Brief description

Multi-axis applications are the core business of the modular IndraDrive M. Supply devices provide the required intermediate circuit voltage for inverters. Compact single-axis or double-axis inverters and supply devices with integrated mains connection components allow space-saving solutions for big axis groups in particular.



Fig. 7-7: IndraDrive M HMS



Fig. 7-8: IndraDrive M HMD

7.5.2 Technical data

Performance data

- Single-axis inverters with maximum currents from 20 A to 350 A
- Double-axis inverters with maximum currents from 12 A to 36 A
- Space-saving design for multi-axis applications
- Feeding via supply unit or inverter
- Energy exchange via common intermediate circuit
- Option to connect converters for cost-effective solutions

IndraDrive M – Modular single-axis inverters HMS01 and HMS02

Type	HMS01.1 NW0020-A- 07-NNNN	HMS01.1 NW0036-A- 07-NNNN	HMS01.1 NW0054-A- 07-NNNN	HMS01.1 NW0070-A- 07-NNNN	HMS01.1 NW0110-A- 07-NNNN	HMS01.1 NW0150-A- 07-NNNN	HMS01.1 NW0210-A- 07-NNNN	HMS01.1 NW0350-A- 07-NNNN	HMS02.1 NW0028-A- 07-NNNN	HMS02.1 NW0054-A- 07-NNNN
Performance data										
Continuous current	12.1 A	21.3 A	35 A	42.4 A	68.5 A	100 A	150 A	250 A	13.8 A	25 A
Maximum current	20 A	36 A	54 A	70 A	110 A	150 A	210 A	350 A	28 A	54 A

Type	HMS01.1 NW0020- A- 07- NNNN	HMS01.1 NW0036- A- 07- NNNN	HMS01.1 NW0054- A- 07- NNNN	HMS01.1 NW0070- A- 07- NNNN	HMS01.1 NW0110- A- 07- NNNN	HMS01.1 NW0150- A- 07- NNNN	HMS01.1 NW0210- A- 07- NNNN	HMS01.1 NW0350- A- 07- NNNN	HMS02.1 NW0028- A- 07- NNNN	HMS02.1 NW0054- A- 07- NNNN
Intermediate circuit capacity	-								0.14 mF	0.27 mF
Control voltage data										
Control voltage, external	24 V DC ±20 % (24 DC ±5 % at supply of the motor holding brake)									
Power consumption without control section and motor holding brake	10 W	15 W	10 W	16 W	34 W	23 W	75 W	218 W	13 W	17 W
Continuous current without control section and motor holding brake	0.4 A	0.7 A	0.4 A	0.7 A	1.4 A	1 A	3.1 A	9.1 A	0.5 A	0.7 A
Mechanical data										
Width	50 mm	50 mm	75 mm	100 mm	125 mm	150 mm	200 mm	350 mm	50 mm	75 mm
Height	440 mm								352 mm	
Depth	309 mm								252 mm	
Mass	5.3 kg	5.3 kg	6.7 kg	7.9 kg	11 kg	12.7 kg	18.4 kg	31.7 kg	3.5 kg	5 kg

Tab. 7-5: IndraDrive M HMS converter

IndraDrive M – Modular double-axis inverters HMD01

Type	HMD01.1NW0012- A- 07- NNNN	HMD01.1NW0020- A- 07- NNNN	HMD01.1NW0036- A- 07- NNNN
Performance data			
Continuous current	7 A	10 A	20 A
Maximum current	12 A	20 A	36 A
Control voltage data			
Control voltage, external	DC 24 V ±20 % (DC 24 V ±5 % at supply of the motor holding brake)		
Power consumption without control section and motor holding brake	17 W	17 W	11 W

Type	HMD01.1NW0012- A- 07-NNNN	HMD01.1NW0020- A- 07-NNNN	HMD01.1NW0036- A- 07-NNNN
Continuous current without control section and motor holding brake	0.7 A	0.7 A	0.5 A
Mechanical data			
Width	50 mm	50 mm	75 mm
Height	440 mm		
Depth	309 mm		
Mass	5.5 kg	5.7 kg	7.5 kg

Tab. 7-6: IndraDrive M HMD converter

7.5.3 Documentation

The following documentations provide comprehensive descriptions of the IndraDrive M HMV devices:

- Rexroth IndraDrive Drive Controllers Power Sections HMS01, DOK-INDRV*-HMS01*UL***-IBxx-EN-P
- Rexroth IndraDrive Drive Controllers Power Sections HMS02, DOK-INDRV*-HMS02*UL***-IBxx-EN-P
- Rexroth IndraDrive Drive Controllers Power Sections HMD01, DOK-INDRV*-HMD01*UL***-IBxx-EN-P

xx - Edition

7.6 IndraDrive M supply units

7.6.1 Brief description

The highest energy yield is achieved with feedback-capable supply units. Apart from the mains feedback in regenerative mode of the drives, these devices are featured with sinusoidal mains currents, a total power factor of 0.99 and a controlled intermediate circuit.



Fig. 7-9: IndraDrive M HMV

7.6.2 Technical data

Performance data

- Power range from 15 kW to 120 kW
- Direct mains connection from 400 V to 480 V
- Energy-saving mains feedback
- Integrated mains contactor
- Integrated braking resistance

IndraDrive M – Modular supply units HMV01 and HMV02

Type	HMV01.1 EW0030-A-07 - NNNN	HMV01.1 EW0075-A-07 - NNNN	HMV01.1 EW0120-A-07 - NNNN	HMV01.1 RW0018-A-07 - NNNN	HMV01.1 RW0045-A-07 - NNNN	HMV01.1 RW0065-A-07 - NNNN	HMV01.1 RW0120-A-07 - NNNN	HMV02.1 RW0015-A-07 - NNNN
Performance data								
Intermediate circuit continuous power with/ without choke	18/30 kW	45/75 kW	72/120 kW	-/18 kW	-/45 kW	-/65 kW	-/120 kW	-/15 kW
Maximum power	45 kW	112 kW	180 kW	45 kW	112 kW	162 kW	180 kW	29 kW
Mains connection voltage	3 AC 400 ... 480 V (+10 %/-15 %)							
Mains input continuous current	51 A	125 A	200 A	26 A	65 A	94 A	181 A	23 A
Power dependency from the supply voltage	at U_{LN} < 400 V: 1 % power reduction per 4 V							
	at U_{LN} > 400 V: 1 % power gain per 4 V			in case of U_{LN} > 400 V: No increase in power				
Intermediate circuit capacity	1.410 µF	3.760 µF	5.640 µF	705 µF	1.880	2.820	4.950	700
Intermediate circuit voltage range	DC 435 … 710 V			DC 750 V (controlled)				
Braking resistance								
Braking resistance	Internal						External	Internal
Max. braking energy consumption	100 kWs	250 kWs	500 kWs	80 kWs	100 kWs	150 kWs	-	40 kWs
Continuous braking power	1.5 kW	2 kW	2.5 kW	0.4 kW	0.4 kW	0.4 kW	-	0.3 kW
Max. braking power	36 kW	90 kW	130 kW	36 kW	90 kW	130 kW	-	33 kW
Control voltage data								
Control voltage, external	24 V DC ±5 %							
Power consumption	25 W	30 W	55 W	31 W	41 W	108 W	224 W	27 W
Continuous current	1 A	1.3 A	2.3 A	1.3 A	1.9 A	4.5 A	13 A	1.1 A
Mechanical data								
Width	150 mm	250 mm	350 mm	175 mm	250 mm	350 mm	350 mm	150 mm
Height	440 mm							352 mm
Depth	309 mm							252 mm
Mass	13.5 kg	22 kg	32 kg	13.5 kg	20 kg	31 kg	34.5 kg	9.5 kg

Tab. 7-7: IndraDrive M HMV supply units

7.6.3 Documentation

The following documentations provide comprehensive descriptions of the IndraDrive M HMV devices:

- Rexroth IndraDrive Supply Units HMV01, DOK-INDRV*-HMV01*UL***-IBxx-EN-P
- Rexroth IndraDrive Supply Units HMV02, DOK-INDRV*-HMV02*UL***-IBxx-EN-P

xx - Edition

7.7 HydraulicDrive HDB

7.7.1 Brief description

HydraulicDrive controller devices with a MultiEthernet interface (ET) or the option module "Sercos III" (S3) can be operated at the Sercos bus of the control. Axis control is supported in open-loop and closed-loop operation.

The following table provides an overview on the different control methods supported in the different operation modes by the different device variants:

Operation mode	Control type	Device variant	Position encoder available	Sensor technology	Required basic package
Direct valve control	Open loop traversing	HDB, HDS	Yes		Closed-loop
			No		Open-loop
Flow control	Flow control	HDB	No	Internal pressure sensors	Open-loop
Pressure control/valve control (p/Q)	Open loop-controlled operation incl. changeover logic in pressure control	HDB	No	Pressure sensor	Open-loop
Pressure/flow control	Flow control incl. changeover logic in pressure control	HDB	No	Internal pressure sensors	Open-loop
Position control	Position control incl. alternating control (force control)	HDB, HDS	Yes	Pressure sensors or force sensor	Closed-loop
Drive-controlled positioning, positioning block mode	Position control incl. alternating control (force control)	HDB	Yes	Pressure sensors or force sensor	Closed-loop
Torque/force control	Torque/force control	HDB, HDS	No	Pressure sensors or force sensor	Open-loop
		HDB, HDS	Yes	Pressure sensors or force sensor	Closed-loop
Force control/valve control	Open loop-controlled operation incl. alternating control (force/torque control)	HDB	No	Pressure sensors or force sensor	Open-loop
Velocity control	Velocity control incl. alternating control (force control)	HDB, HDS	Yes	Pressure sensors or force sensor	Closed-loop

Tab. 7-8: Overview of operation modes and possible types of controls

7.7.2 Firmware

The following firmware versions of the HydraulicDrives are supported by the MLC system:

- FWA-HYDRV*-HDB-20VRS-D5
- FWA-HYDRV*-HDC-20VRS-D5
- FWA-HYDRV*-HDM-20VRS-D5

7.7.3 Documentation

The following documentation provides comprehensive descriptions of the HydraulicDrive devices in the Rexroth Media directory:

- HydraulicDrive HDx-20 Functions
  Refer to the documentation: **RD-30338-FK**
- HydraulicDrive HDx-20 Diagnostic Description
  Refer to the documentation: **RD-30330-WA**
- HydraulicDrive HDx-20 Parameter Description
  Refer to the documentation: **RD-30330-PA**

8 I/O periphery

8.1 General information

The following I/O components extend the IndraMotion MLC and IndraControl XLC based on the hardware IndraControl L:

- Central Rexroth Inline I/Os (Inline terminals mounted on the control, maximum 512 inputs/outputs) (see "Modules" on page 105)
- Decentral Rexroth Inline I/O via Sercos, Profibus DP and Profinet (see chapter 8.3.2 "Inline terminals" on page 105)
- Decentral Rexroth Block I/O via Profibus DP and Sercos (see chapter 8.3.1 "Inline block I/O modules" on page 102)
- Decentral Rexroth IndraControl S20 I/O via Profinet and Sercos (see chapter 8.4 "Rexroth IndraControl S20" on page 107)
- Decentralized Rexroth block S67E I/O modules via Profinet or Sercos III (see chapter 8.5 "Rexroth S67E" on page 113)
- Function modules (see chapter 9 "Function modules based on the IndraControl L hardware" on page 115)
- HMI devices (see chapter 11 "Industrial PCs, terminals and displays" on page 153)

The following I/O components extend the IndraMotion MLC based on the hardware IndraControl XM:

- Central Rexroth IndraControl S20 I/O; can be directly connected to the control via S20 bus base modules (see "S20 I/O modules" on page 110)
- Decentral Rexroth IndraControl S20 I/O via Sercos (Profibus and Profinet via extension modules) (see chapter 8.4 "Rexroth IndraControl S20" on page 107)
- Decentral Rexroth Block I/O via Profibus DP and Sercos (see chapter 8.3.1 "Inline block I/O modules" on page 102)
- Decentral Rexroth Inline I/O via Sercos (Profibus DP and Profinet via extension modules) (see chapter 8.3.2 "Inline terminals" on page 105)
- Decentral Rexroth block I/O via Sercos (Profibus DP via extension modules) (see chapter 8.3.1 "Inline block I/O modules" on page 102)
- Extension modules can be directly connected via extension bus base modules (see chapter 10 "Extension modules for XM controls" on page 145)
- HMI devices (see chapter 11 "Industrial PCs, terminals and displays" on page 153)

8.2 FDT/DTM

FDT (Field Device Tool) is a manufacturer-independent concept to configure, parameterize, diagnose and manage field devices. The FDT functionality of IndraWorks is called FDT Container.

The IW FDT Container is used to integrate 3rd party engineering tools that are provided by the device manufacturer as DTMs (device type managers). It is based on the FDT standards 1.2 and 1.2.1 of the FDT Group.

FDT/DTM is available for the bus systems Profibus, Profinet and Sercos.

8.3 Rexroth Inline I/O

8.3.1 Inline block I/O modules

Digital I/O Block I/O modules can be integrated into all common field bus systems using the integrated bus coupler. Compared to compact control cabinets, the ready module minimizes costs and represents an ideal solution for the installation in compact control cabinets.

Profibus coupler

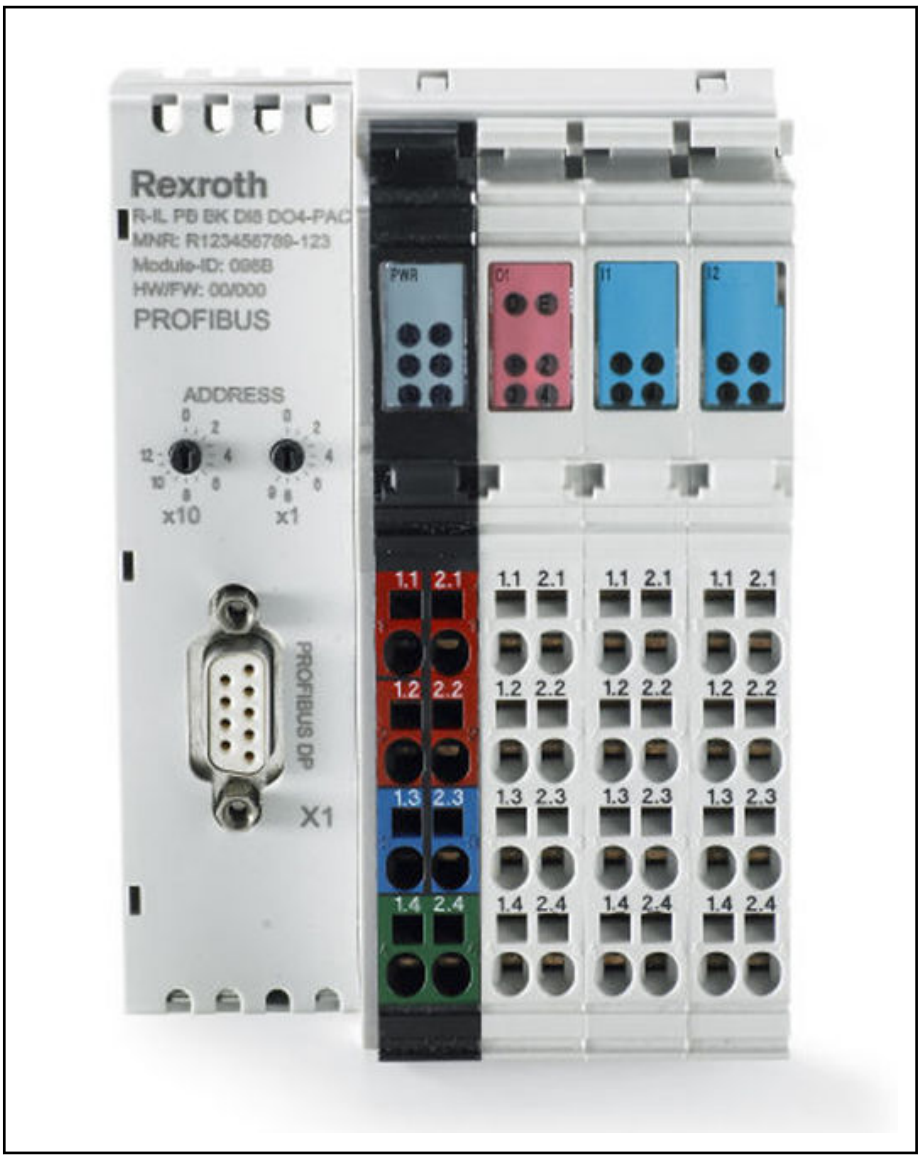


Fig. 8-1: Rexroth Profibus Inline coupler

The field bus coupler is used to integrate Inline I/O modules in Profibus DP systems. Profibus structurally permits the connection of up to 125 field bus couplers with 61 additional I/O modules each. The maximum number depends on the DP master and the user data of the connected I/O modules.

Type code: R-IL PB BK DI8 DO4-PAC

Properties:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A

- Extendable with modules by up to 61 external I/O modules
- Maximum of 244 bytes in each data direction of the process data
- Parameterization and configuration via GSD including diagnostics

For a detailed description, refer to the manual: DOK-CONTRL-ILPBBK-DI8DO-AW.

Profinet coupler

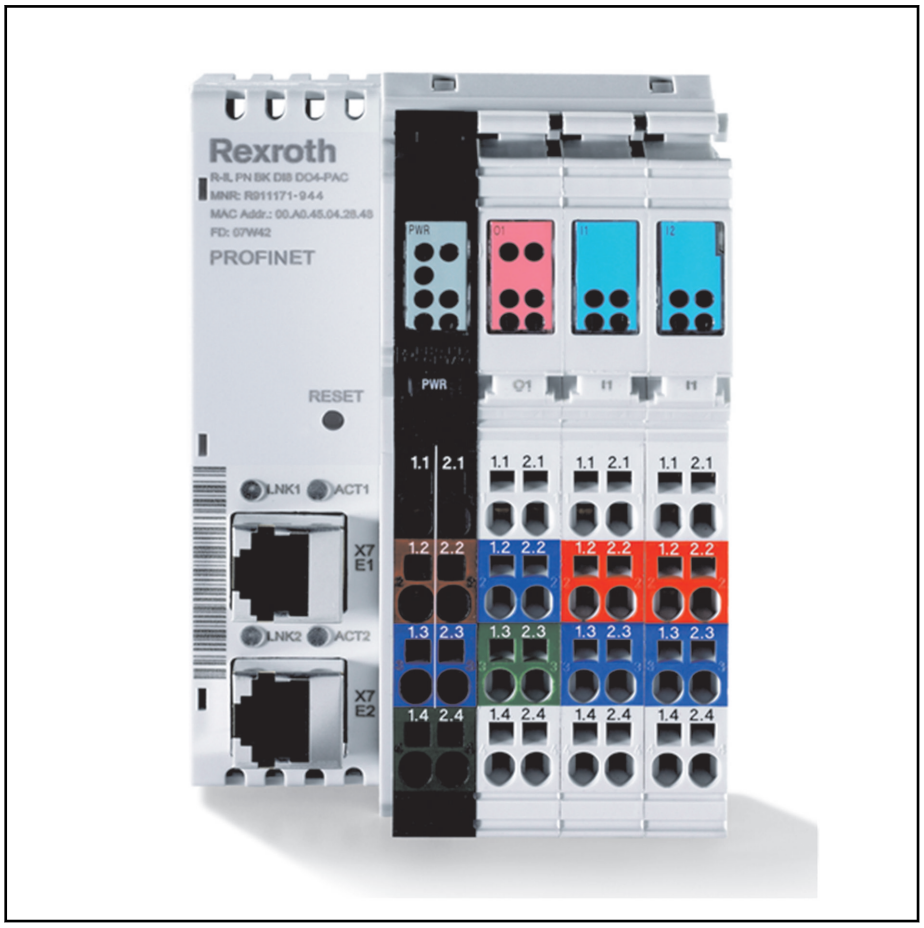


Fig. 8-2: Rexroth Profinet Inline coupler

The field bus coupler is used to integrate Inline I/O modules in Profinet systems. Profinet structurally permits the connection of up to 255 field bus couplers with 61 additional I/O modules each. The maximum number depends on the Profinet controller and the user data of the connected I/O modules.

Type code: R-IL PN BK DI8 DO4-PAC

Properties:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A
- Extendable with modules by up to 61 external I/O modules
- Maximum of 512 bytes in each data direction of the process data
- Parameterization and configuration via GSDML including diagnostics

For more information, refer to the data sheet: DOK-CONTRL-ILPNBKDIO**-DA.

Sercos III coupler



Fig. 8-3: Rexroth Sercos III Inline coupler

The field bus coupler is used to integrate Inline I/O modules in Sercos III systems. Sercos structurally permits the connection of up to 255 field bus couplers with 61 I/O modules each. The maximum number depends on the user data of the I/O modules.

Type code: R-IB IL S3 BK DI8 DO4-PAC

Properties:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A
- Extendable with modules by up to 61 external I/O modules
- Maximum of 512 bytes in each data direction of the process data
- Parameterization and configuration via SDDML including diagnostics

For more information, refer to the data sheet: DOK-CONTRL-ILS3BKDI8DO-KB.

Documentation

The following data sheets are available for the Block I/O modules:

- Rexroth Inline Block IO for Sercos III with Digital Inputs and Outputs: DOK-CONTRL-S3AI4AO2***-KB.

- Rexroth Inline Block IO for Sercos III with Analog Inputs and Outputs: DOK-CONTRL-S3AI4AO2***-KB.
- Rexroth Inline Block IO Module for Profibus: DOK-CONTRL-PBDI16/DO16-KB.

8.3.2 Inline terminals

Modules

The Rexroth Inline system consists of the following components:

Type code	Brief description
Digital input modules	
R-IB IL 24 DI 2-PAC	Digital input module; 24 V DC; 2 inputs
R-IB IL 24 EDI 2-DES	Digital input module; DC 24 V; 2 inputs; DESINA diagnostics
R-IB IL 24 DI 4-PAC	Digital input module; 24 V DC; 4 inputs
R-IB IL 24 DI 8-PAC	Digital input module; 24 V DC; 8 inputs
R-IB IL 24 DI 16-PAC	Digital input module; DC 24 V; 16 inputs
R-IB IL 24 DI 32/HD-PAC	Digital input module; 24 V DC; 32 inputs
R-IB IL 24 DI 16-NPN-PAC	Digital input module; DC 24 V; 16 inputs; npn-switching
R-IB IL 24 DI 32/HD-NPN-PAC	Digital input module; 24 V DC; 32 inputs; npn-switching
R-IB IL 24 DI 8/HD-PAC	Digital input module; 24 V DC; 8 inputs
Digital output modules	
R-IB IL 24 DO 2-2A-PAC	Digital output module; 24 V DC / 2.0 A; 2 outputs
R-IB IL 24 DO 4-PAC	Digital output module; 24 V DC / 0.5 A; 4 outputs
R-IB IL 24 DO 8-PAC	Digital output module; 24 V DC / 0.5 A; 8 outputs
R-IB IL 24 DO 8-2A	Digital output module; 24 V DC / 2.0 A; 8 outputs
R-IB IL 24 DO 8-2A-PAC	Digital output module; 24 V DC / 2.0 A; 8 outputs
R-IB IL 24 DO 16-PAC	Digital output module; DC 24 V / 0.5 A; 16 outputs
R-IB IL 24 DO 32/HD-PAC	Digital output module; 24 V DC / 0.5 A; 32 outputs
R-IB IL 24 DO 2-NPN-PAC	Digital output module; 24 V DC / 0.5 A; 2 outputs; npn-switching
R-IB IL 24 DO 8-NPN-PAC	Digital output module; DC 24 V / 0.5 A; 8 outputs; npn-switching
R-IB IL 24 DO 32/HD-NPN-PAC	Digital output module; DC 24 V / 0.5 A; 32 outputs, npn-switching
R-IB IL 24 DO 8/HD-PAC	Digital output module; 24 V DC / 0.5 A; 8 outputs
Relay modules	
R-IB IL 24/230 DOR 1/W	1 relay changeover contact
R-IB IL 24/230 DOR 1/W-PAC	1 relay changeover contact
R-IB IL 24/230 DOR 4/W	4 relay changeover contacts
R-IB IL 24/230 DOR 4/W-PAC	4 relay changeover contacts

Type code	Brief description
Analog modules	
R-IB IL AI 2/SF-PAC	Analog input module; voltage; 2 inputs
R-IB IL AI 2/SF-230-PAC	Analog input module; voltage 230V; 2 inputs
R-IB IL AI 4/EF-PAC	Analog input module; difference; 4 inputs
R-IB IL AI 8/SF-PAC	Analog input module; voltage; 8 inputs
R-IB IL AI 8/IS-PAC	Analog input module; current; 8 inputs
R-IB IL TEMP 4/8 RTD-PAC	Analog input module; resistance sensor; 8 inputs
R-IB IL TEMP 2 RTD-PAC	Analog input module; resistance sensor; 2 inputs
R-IB IL TEMP 2 UTH-PAC	Analog input module; temperature sensor; 2 inputs
R-IB IL SGI 2/F-PAC	Analog input module; strain gauges; 2 inputs
R-IB IL AO 1/SF-PAC	Analog output module; voltage; 1 output
R-IB IL AO 1/SF/CN-PAC	Analog output module; voltage; 1 output
R-IB IL AO 2/U/BP-PAC	Analog output module; voltage; 2 outputs
R-IB IL AO 2/SF-PAC	Analog output module; voltage; 2 outputs
R-IB IL AO 2/SF/CN-PAC	Analog output module; voltage; 2 outputs
Supply modules	
R-IB IL PWR IN-PAC	Power supply module of the logic voltage/ segment voltage
R-IB IL PWR IN/R-PAC	Power supply module of the logic voltage
R-IB IL PWR-IN/2F-D-PAC	Power supply module of the power supply
R-IB IL 24 SEG-PAC	Power supply module of the segment voltage
R-IB IL 24 SEG/F-PAC	Power supply module of the segment voltage
R-IB IL 24 SEG/F-D-PAC	Power supply module of the segment voltage
Communication and technology modules	
R-IB IL CNT-PAC	Counter module; 4 inputs
R-IB IL RS232-PRO-PAC	Communication module; serial RS232 interface
R-IB IL RS485/422-PRO-PAC	Communication module; serial RS485 interface
R-IB IL INC-IN-PAC	Detecting incremental encoders; 1 input
R-IB IL SSI-PAC	Positioning terminal; single-turn, multi-turn absolute value encoder; 1 input
R-IB IL PWM/2-PAC	Pulse width modulator; 2 PWM outputs
R-IB IL SSI-IN-PAC	Detecting absolute value encoders; 1 input
R-IB IL 24 IOL 4 DI 12-PAC	4 IO-Link ports; 12 digital inputs

Tab. 8-1: I/O module and supply module

For a detailed description of the Rexroth Inline system, refer to the manual: DOK-CONTRL-ILSYSINS***-AW

8.4 Rexroth IndraControl S20

Profibus coupler

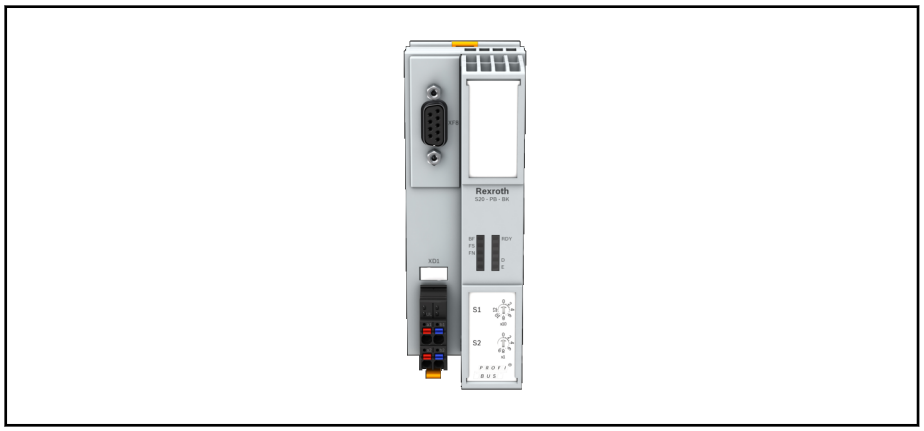


Fig. 8-4: Rexroth Profibus S20 coupler

The field bus coupler is used to integrate S20 I/O modules into Profibus systems. Profibus structurally permits the connection of up to 125 field bus couplers with 63 I/O modules each. The maximum number depends on the Profibus master used and on the user data of the connected I/O modules.

Properties:

- Extendable with modules by up to 63 external I/O modules
- Maximum of 488 bytes (max. of 244 bytes IN - max. of 244 bytes OUT) of process data
- Supports the safe I/O modules S20-PSDx
- Parameterization and configuration via GSD including diagnostics

For more information on the Rexroth Profibus S20 coupler, refer to the data sheet: DOK-CONTRL-S20*PB*BK**-DA.

Profinet coupler

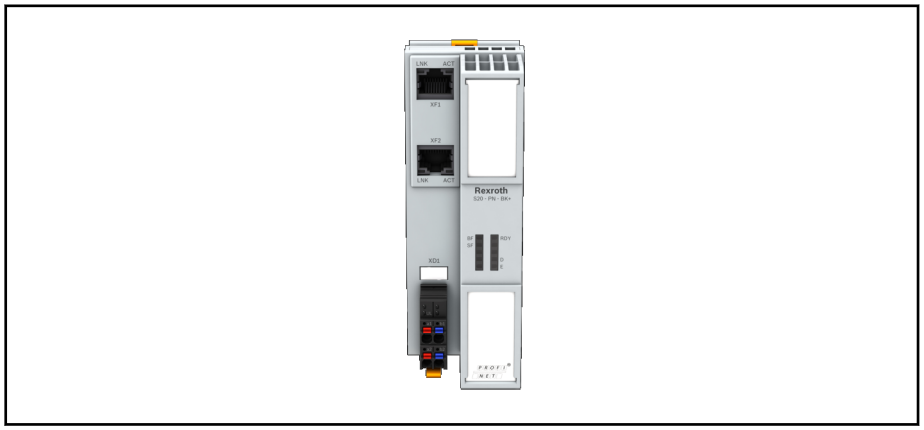


Fig. 8-5: Rexroth Profinet S20 coupler

The field bus coupler is used to integrate S20 I/O modules in Profinet systems. Profinet structurally permits the connection of up to 255 field bus couplers with 63 I/O modules each. The maximum number depends on the Profinet controller and the user data of the connected I/O modules.

Properties:

- Extendable with modules by up to 63 external I/O modules
- Maximum of 524 bytes (max. of 262 bytes `IN` - max. of 262 bytes `OUT`) of process data
- Supports the safe I/O modules S20-PSDx

- Parameterization and configuration via GSDML including diagnostics

For more information on the Rexroth Profinet S20 coupler, refer to the data sheet: DOK-CONTRL-S20*PN*BK+*-DA.

Sercos III coupler



Fig. 8-6: Rexroth Sercos III S20 coupler

The field bus coupler is used to integrate S20 I/O modules in Sercos III systems.

Sercos structurally permits the connection of up to 511 field bus couplers with 63 I/O modules each.

The maximum number depends on the Sercos III master used and on the provided user data of the connected I/O modules.

Properties:

- a Sercos synchronous-capable operation with the corresponding modules
- Extendable with modules up to 63 external I/O modules
- Maximum of 1485 bytes in each data direction of the process data
- Supports the safe I/O modules S20-SSDx
- Parameterization and configuration via SDDML including diagnostics

For more information on the Rexroth Sercos III S20 coupler, refer to the data sheet: DOK-CONTRL-S20*S3*BK+*-DA.

Ethernet (ModbusTCP) coupler

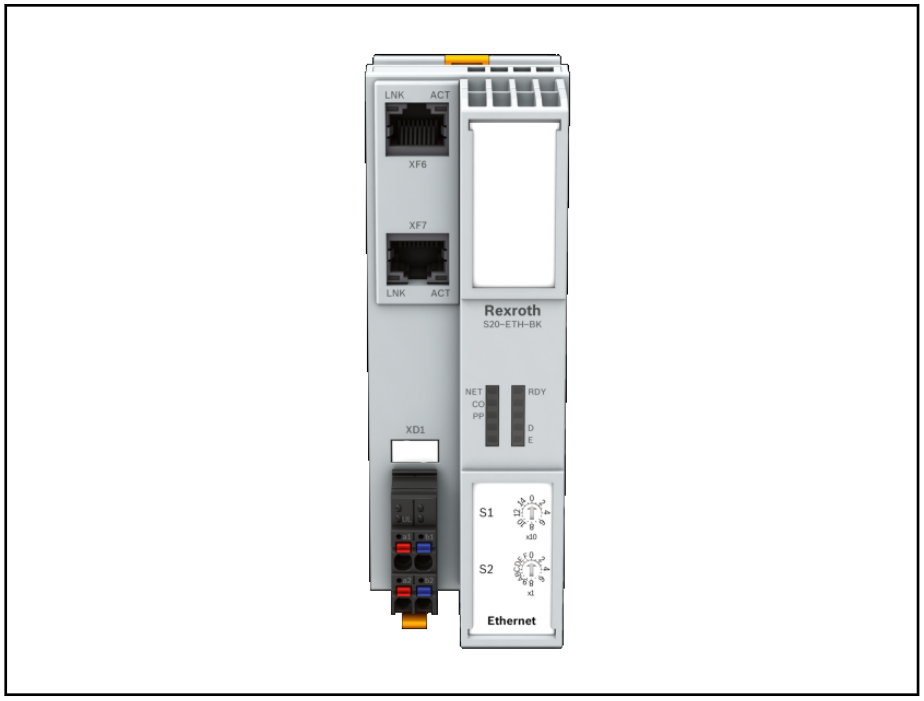


Fig. 8-7: Rexroth Ethernet S20 coupler

The field bus coupler is used to integrate S20 I/O modules into Ethernet systems.

The maximum number of I/O modules depends on the user data of the connected I/O modules.

Properties

- Extendable with modules by up to 63 external I/O modules
- Supports ModbusTCP (UDP)

For more information on the Rexroth Ethernet S20 coupler, refer to the data sheet: DOK-CONTRL-S20*ETH*BK*-DA.

Ethercat coupler

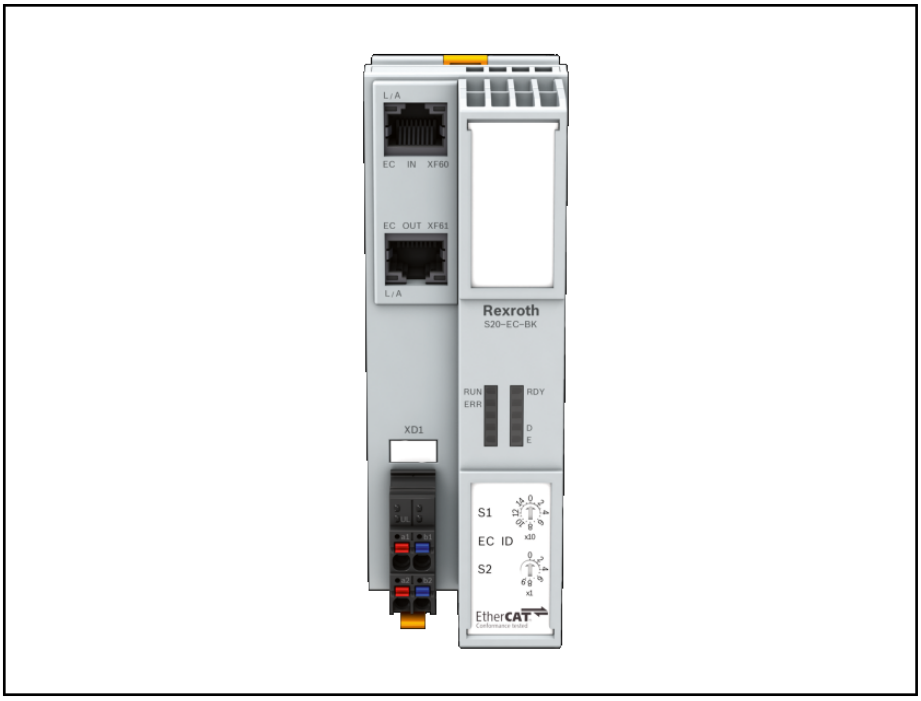


Fig. 8-8: Rexroth Ethercat S20 coupler

The field bus coupler is used to integrate S20 I/O modules into Ethercat systems.

Ethercat structurally permits the connection of up to 511 field bus couplers with 63 I/O modules each.

The maximum number depends on the Ethercat master used and on the provided user data of the connected I/O modules.

Properties:

- An Ethercat DC-synchronous operation is possible if suitable I/O modules are used
- Extendable with modules by up to 63 external I/O modules
- Maximum of 1024 bytes of process data in each data direction
- Parameterization and configuration via ESI including diagnostics

For more information on the Rexroth Ethercat S20 coupler, refer to the data sheet: DOK-CONTRL-S20*EC*BK**-DA.

S20 I/O modules

The following modules are available as extension modules:

Type code	Brief description
Digital input modules	
S20-DI-16/1	Digital input module; DC 24 V; 16 inputs; 1-wire technology
S20-DI-16/1-HS	Digital input module; 24 V DC; 16 fast inputs; 1-wire technology; synchronous
S20-DI-16/4	Digital input module; DC 24 V; 16 inputs; 2-, 3-, 4-wire connection technology
S20-DI-32/1	Digital input module; DC 24 V; 32 inputs; 1-wire connection technology

Type code	Brief description
S20-DI-32/1-S	Digital input module; 24 V DC; 32 inputs; 1-wire connection technology, narrow
S20-DI-64/1	Digital input module; 24 V DC; 64 inputs; 1-wire connection technology
Digital output modules	
S20-DO-16/1	Digital output module; DC 24 V / 0.5 A; 16 outputs; 1-wire connection technology
S20-DO-16/3	Digital output module; DC 24 V / 0.5 A; 16 outputs; 2-, 3-wire connection technology
S20-DO-32/1	Digital output module; 24 V DC / 0.5 A; 32 outputs; 1-wire technology
S20-DO-64/1	Digital output module; 24 V DC / 0.5 A; 64 outputs; 1-wire technology
S20-DO-8/2-2A	Digital output module; DC 24 V / 2 A; 8 outputs; 2-wire technology
Digital input/output modules	
S20-DIDO-8/1	Digital input/output module; 24 V DC; 8 inputs; 8 outputs; 1-wire technology
S20-DIDO-2/1-OVS	Digital input/output module; 24 V DC; 2 inputs; 2 outputs; 1-wire technology; oversampling, synchronous
S20-DI-16/4-DO-8/3-HS	Digital input/output module; 24 V DC; 16 fast inputs; 8 fast outputs; 2-, 3-, 4-wire connection technology, synchronous
Analog modules	
S20-AI-4-U	Analog input module; voltage; 4 inputs; 2-wire connection technology
S20-AI-4-I	Analog input module; current; 4 inputs; 2-wire connection technology
S20-AI-8	Analog input module; voltage/current; 8 inputs; 2-wire connection technology
S20-AO-4	Analog output module; voltage/current; 4 outputs; 2-wire connection technology
S20-AO-8	Analog output module; voltage/current; 8 outputs; 2-wire connection technology
S20-AIAO-2	Analog input/output module; voltage/current; 2 inputs; 2 outputs; 2-wire connection technology
S20-AI-4-RTD	Analog input module, connection of resistive temperature measuring resistances, 4 inputs, 2-, 3-, 4-wire technology
S20-AI-4-UTD	Analog input module; connection of different thermocouples, 4 inputs, 2-wire technology

Type code	Brief description
S20-AI-8-RTD	Analog input module, connection of resistive temperature measuring resistances, 8 inputs, 2-, 3-, 4-wire technology
S20-AI-8-UTH	Analog input module, connection of different thermocouples, 8 inputs, 2-wire technology
Function modules	
S20-AI6-AO2-SSI2	Function module; 2 SSI interfaces for absolute value encoder; 6 analog inputs; 2 analog outputs
S20-SSI-AO-1/1	Function module; 1 SSI interface for absolute value encoder; 1 analog output; 0-10 V, ±10 V, 0-5 V, ±5 V 0-20 mA, 4-20 mA, ±20 mA
S20-CNT-INC-2/2	Function module; 2 counter inputs; 2 incremental value encoder inputs; 300 kHz 32 bits
S20-INC-2	Function module, two-channel module for the bus-synchronous position analysis of incremental value sensors; 2 Latch inputs, 2 reference inputs
S20-SGI-2	Function module: dual-channel module for strain gauges and load cells
S20-PWM-2/2	Function module; 2 PWM outputs
S20-PWM-4-T	Function module; especially when using solenoid valves
Communication modules	
S20-RS-UNI	Communication module; One serial input and output interface in RS-485/422 or RS-232 design; transmission rate can be set up to 250000 Baud
S20-IOL-8	Communication module for IO-Link v1.1; 8 IO-Link ports
S20-KNX-1	Communication module for EIB/KNX bus; 1000 data points
S20-DALI-2-PWR	Communication module for DALI bus; 2 separate masters with voltage supply
Power module	
S20-PWR	Feeding module for the logic supply U_{Bus} (4 A)

Tab. 8-2: S20 I/O modules



For the IndraMotion MLC based on the hardware IndraControl, XM S20 I/O modules can be directly connected via S20 bus base modules.

S20 bus base module

An S20 bus base module is required for each S20 module (refer to the following figure).

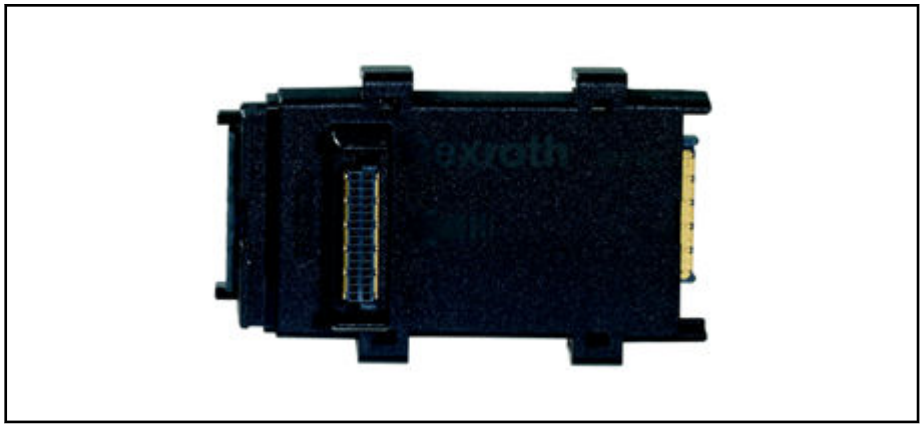


Fig. 8-9: S20 bus base module

8.5 Rexroth S67E

Profinet coupler with I/O Link master

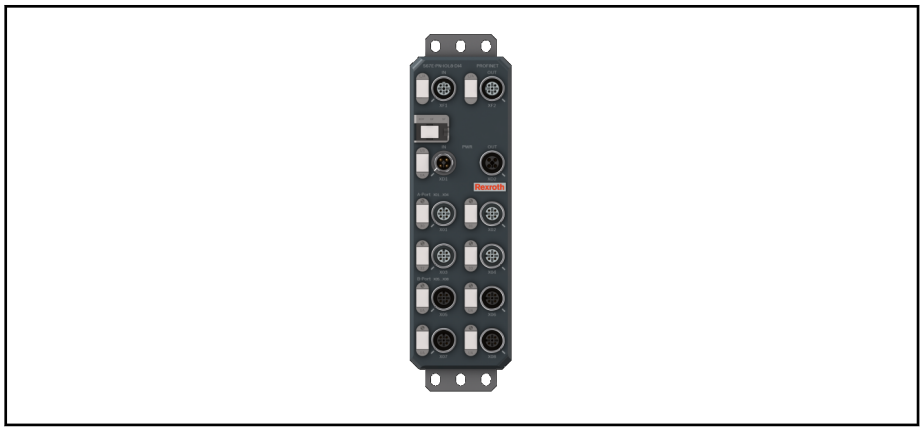


Fig. 8-10: Rexroth IO-Link master S67E-PN-IOL8-DI4-M12-6P

The field bus IO-Link master S67E-PN-IOL8-DI4-M12-6P is used to integrate IO-Link devices into Profinet systems.

Profinet structurally permits the connection of up to 255 field bus IO-Link masters with 8 I/O modules each.

The maximum number depends on the Profinet controller and the user data of the connected I/O modules.

Properties:

- Eight digital inputs, type 1, 24 V DC
- IO-Link ports 4x class A, 4x class B (2A per port)
- Parameterization and configuration via GSDML including diagnostics
- Operating mode switches and address switch switches

For a detailed description, refer to the manual: DOK-CONTRL-S67E*PN*IOL-AP.

Sercos III coupler with I/O Link master

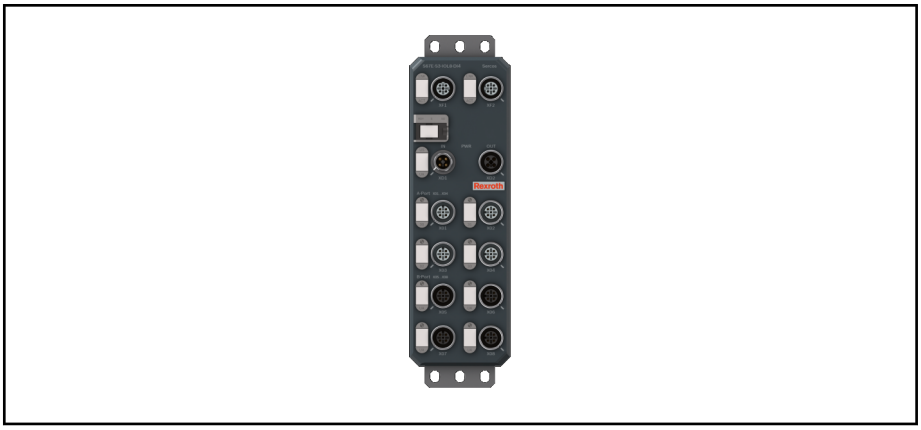


Fig. 8-11: Rexroth IO-Link master S67E-S3-IOL8-DI4-M12-6P

The field bus IO-Link master S67E-S3-IOL8-DI4-M12-6P is used to integrate IO-Link devices into Sercos III systems.

Sercos structurally permits the connection of up to 511 field bus IO-Link masters with 8 I/O modules each.

The maximum number depends on the Sercos III master used and on the user data of the connected I/O modules.

Properties:

- Eight digital inputs, type 1, 24 V DC
- IO-Link ports 4x class A, 4x class B (2A per port)
- Parameterization and configuration via SDDML including diagnostics
- Operating mode switches and address switch switches

For a detailed description, refer to the manual: DOK-CONTRL-S67E*S3*IOL-AP

9 Function modules based on the IndraControl L hardware

9.1 Supported function modules

The following table lists the function modules and the respective systems supporting them.

Function module	IndraLogic XLC (without Sercos)	IndraLogic XLC (with Sercos)	IndraMotion MLC	IndraMotion MTX
RT-Ethernet/Profibus DP (CFL01.1-TP)	X	X	X	X
Fast I/O (CFL01.1-E2)	X	X	X	-
PLS (CFL01.1-N1)	-	X	X	-
Sercos II (CFL01.1-Q2)	-	-	X	-
CrossComm Sercos II (CFL01.1-Q2)	-	-	X	-
CrossComm Sercos III (CFL01.1-R3)	-	-	X	-
SRAM module (CFL01.1-Y1)	-	-	X	-
Safety CPU (CFL01.1-F1)	X	X	X	X

Tab. 9-1: Supported function modules

9.2 Connecting to the control

To extend the functionality of the IndraMotion MLC and IndraLogic XLC, up to four function modules can be connected at the function module bus on the left of the control.

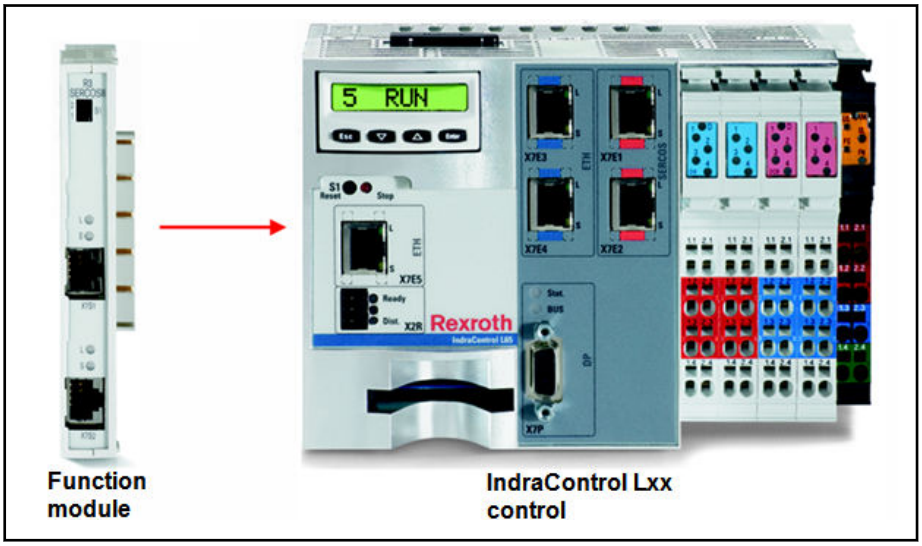


Fig. 9-1: Connecting a function module to the control (in this example an IndraMotion MLC L65)

The address of the function module is set via a BCD-coded DIP switch (address switch S1) at the module.

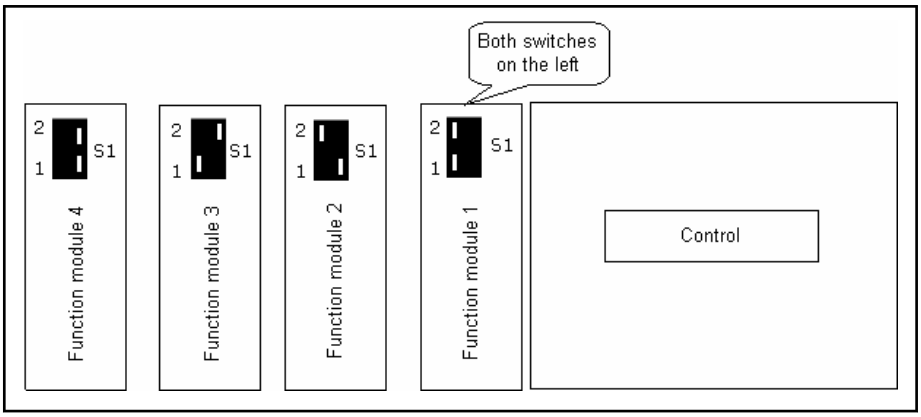


Fig. 9-2: Address settings for four function modules (max. number)

The following address settings are mandatory for the connected function modules:

- 1. module (closest to the control): Address 0
- 2. module: Address 1
- 3. module: Address 2
- 4. module: Address 3

The Safety function module has no address switch. It always has to be the last module at the control.

NOTICE **Do not connect function modules if voltage is applied!**

To mount a function module, disconnect the IndraControl L from the supply voltage.

Available function modules for IndraMotion MLC and IndraLogic XLC are described in the following.

9.3 Characteristics of the Sercos interface

The Sercos function modules are only supported by the IndraMotion MLC.

To allow cross or master communication, the following function modules that provide this functionality:

- Sercos II (CFL01.1-Q2) with optical waveguide (OWG), double ring/ single ring as master communication
- CrossComm Sercos II (CFL01.1-Q2) as cross communication
- CrossComm Sercos III (CFL01.1-R3) as cross communication (C2C)

providing this functionality.

For Sercos III, the cross communication is also called C2C (control to control communication).

Type	Part number	Master communication	Cross communication
Sercos II	R911170009	Sercos II (CFL01.1-Q2)	CrossComm Sercos II (CFL01.1-Q2)
Sercos III	R911170008	-	CrossComm Sercos III (CFL01.1-R3)

Tab. 9-2: Using function modules

The following configurations can be made with Sercos II and Sercos III function modules:

	Configuration	1. module	2. module	Function Onboard
IndraMotion MLC	A	-	-	Master communication
	B	Sercos III CrossComm	-	Master communication
	C	Sercos II CrossComm	-	Master communication
	D	Sercos II Master communication	-	Deactivated
	E	Sercos II Master communication	Sercos II CrossComm	Deactivated
	F	Sercos II CrossComm	Sercos II Master communication	Deactivated

Master communication Master communication
CrossComm Cross communication

Tab. 9-3: Configuration options for Sercos II and Sercos III function modules

☞ Only the configuration options listed here are supported.

The IndraMotion MLC detects the Sercos modules during startup. Thus, the modules can also be plugged to the positions 2 and/or 4. The parameterized functionality in the function module bus command configuration (C-0-0040) is decisive for the function.

The function module bus command configuration specifies, whether the configuration C or D (one module) or E or F (two modules) are selected for the Sercos II function modules.

9.4 CrossComm Sercos III (CFL01.1-R3) - Sercos III cross communication

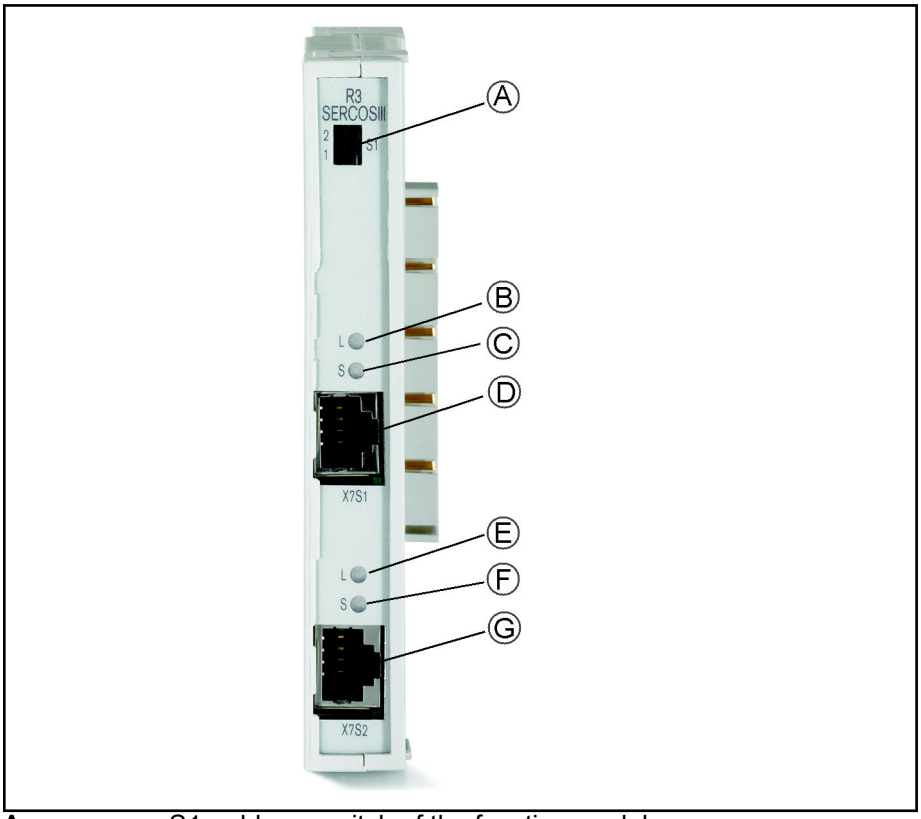
For more information on cross communication between controls, see chapter 10.3.1 "General information on cross communication between controls" on page 145

For more information about the link as line, double line or ring, see chapter 10.3.3 "Link as line, double line or ring" on page 149

9.4.1 Hardware description

Front view

The following figure shows the front view of the CrossComm Sercos III (CFL01.1-R3) function module.



A	S1, address switch of the function module
B	L, link port 1
C	S, status port 1
D	X7S1, port 1 (RJ45)
E	L, link port 2
F	S, status port 2
G	X7S2, port 2 (RJ45)

Fig. 9-3: Front view of the CrossComm Sercos III (CFL01.1-R3) function module

The function module CrossComm Sercos III (CFL01.1-R3) can be ordered with the part number R911170008.

Displays and ports

Link displays

The status of the link is displayed at CrossComm Sercos III (CFL01.1-R3) via the LEDs " L" (green LED: Link) or "S" (yellow LED: Status).

The following combinations are possible:

- Link LED on, Status LED flashing: Error-free state
- Link LED on; Status LED on: Ready to restore hotplug or redundancy
- Link LED on, Status LED off: A link error occurred Link ring is in phase 0
- Link LED off, Status LED off: Link is not configured or cables are not plugged in

Ports X7S1 - Connection of Sercos III port 1 (RJ45).

X7S2 - Connection of Sercos III port 2 (RJ45).

9.4.2 CrossComm Sercos III (CFL01.1-R3) – More information

For more information on the cross link, refer to the chapter "Cross communication between controls - CrossComm Sercos III" in the functional description DOK-XLCMLC-FUNC****V14-APRS-EN-P provided in the Rexroth Media directory using the part number **R911341700**

9.5 CrossComm Sercos II (CFL01.1-Q2) - Sercos II cross communication

9.5.1 General information on cross communication

In order to distribute the master axis positions of various IndraMotion MLCs across local axes in various drive rings, the controls are connected to a link. Cross communication in this link enables the configured master axis positions to be distributed across selected local link axes in the various controls.

The interconnection of the controls is executed using the CrossComm Sercos II (CFL01.1-Q2) function module. All function modules are connected by a fiber optic cable ring to form the link.

☞ Except for the IndraMotion MLC controls with CrossComm Sercos II (CFL01.1-Q2) function modules, only PPC controls can be used together with a DAQ04 assembly in a common cross link.

Maximum of 64 controls in the link

When using the CrossComm Sercos II (CFL01.1-Q2) function module, up to 64 IndraMotion MLC can be interconnected to a link.

Maximum of 128 master axes in the link

For each control, the actual positions of up to two local axes can be made public in the link. A link with a maximum of 64 link devices thus produces a maximum of 128 different master positions.

Cycle time in the link can be selected

The link cycle time can be specified with three different values.

The actual maximum number of devices and master axes in the link depends on this specification.

Cycle time specification	Number of devices	Number of master axes
2 ms	≤ 16	≤ 32
4 ms	≤ 32	≤ 64
8 ms	≤ 64	≤ 128

Tab. 9-4: Typical link cycle times with the function module CrossComm Sercos II (CFL01.1-Q2)

The cycle time that can actually be reached depends mainly on the number of drives in the individual drive rings and the functionalities activated in the individual controls.

☞
- The settings for the link cycle time **must** be identical to all IndraMotion MLCs in the link
- The cycle time in the link ring and in the drive ring of each link device **have to** be identical

FOC single ring or double ring

The link can be established with either a single or a double optical fiber cable ring.

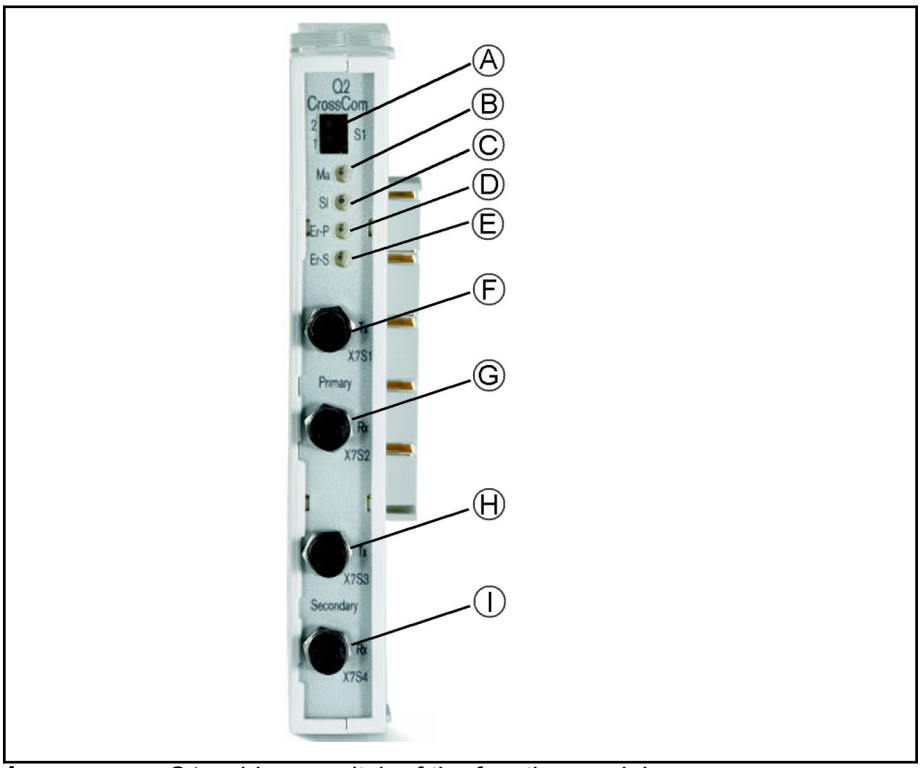
The double ring provides:

- Higher error tolerance as a failed transmission path between two controls is tolerated for example
- Greater availability, even when a control is switched off, cross communication with the rest of the drive rings remains established for example

9.5.2 Hardware description

Front view

The following figure shows the front view of the CrossComm Sercos II (CFL01.1-Q2) function module.



A S1, address switch of the function module
B Ma, master connection
C SI, slave connection
D Er-P, error primary ring
E Er-S, error secondary ring
F X7S1, Tx primary ring
G X7S2, Rx primary ring
H X7S3, Tx secondary ring
I X7S4, Rx secondary ring

Fig. 9-4: Front view of the CrossComm Sercos II (CFL01.1-Q2) function module

The function module can be ordered via the part number R911 170 009.

Displays and ports

Link displays On the CrossComm Sercos II (CFL01.1-Q2), the "Ma" LEDs (green) and the "SI" LEDs (yellow), master/slave indicate an active link.

Distortion displays The distortion displays for CrossComm Sercos II (CFL01.1-Q2) (red LEDs "Er-P" or "Er-S"), error primary/secondary ring can check the quality of the received optical signal.

FOC connections

The transmitters of the primary or secondary ring are connected to X7S1 or X7S3 and the receivers to X7S2 or X7S4.

9.5.3 Link as Single or Double Ring

First, the link is planned, configured and parameterized via IndraWorks and the controls are switched to operating mode.

On each IndraMotion MLC in the parameterized link, the active link is indicated with the "Ma" or "SI" LEDs (exactly one link master and several link slaves).

The "Er-P" and "Er-S" distortion displays have to be checked and, if necessary, the transmitting power of the physical predecessor has to be corrected or the fiber optic cable has to be checked for damage.

In case of the parameterized single ring (primary ring only), the "Er-S" distortion display is on. This state is correct.

Single ring: Primary ring

For a single ring, only the primary ring is used. The secondary ring is not connected.

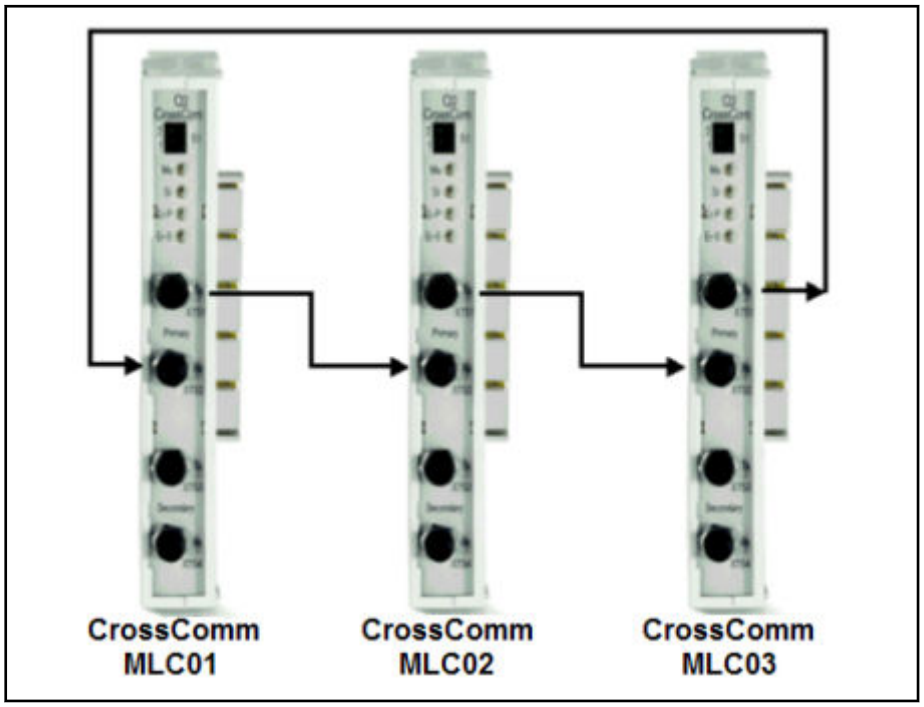


Fig. 9-5: FOC connection in the single ring

Primary ring, secondary ring

In general, the primary ring is used for communication. The redundant signals are transmitted via the secondary ring.

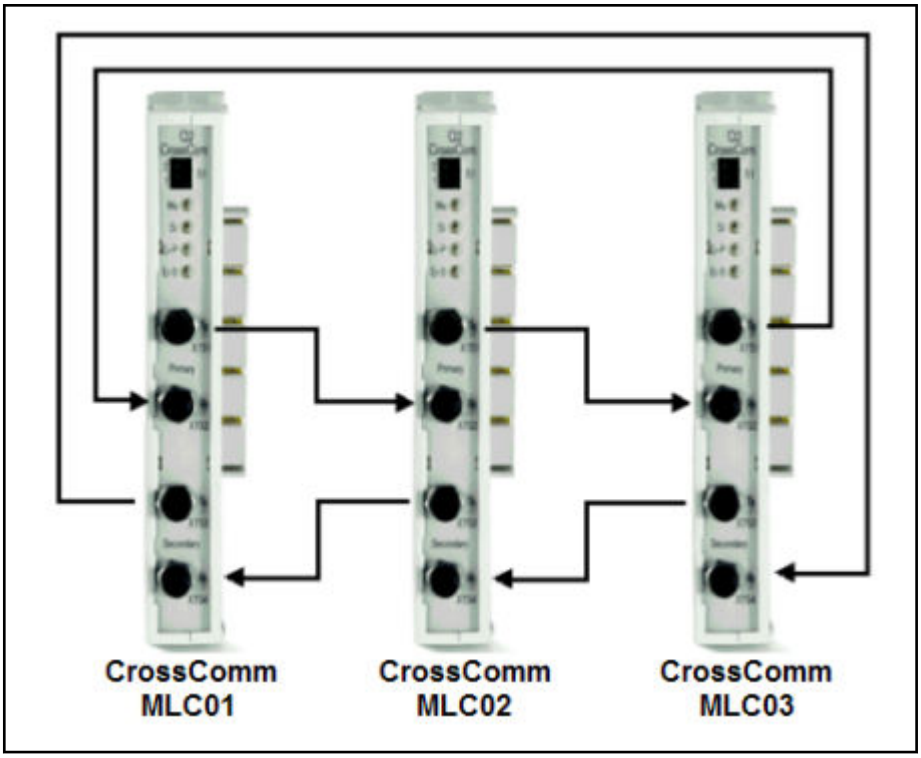


Fig. 9-6: FOC connections in the double ring

☞ As shown above, the secondary ring has to be connected in opposite direction.

9.5.4 Optical adjustment of the ring(s)

The optical transmitting power might have to be adjusted depending on the length of a fiber optic cable in the link ring.

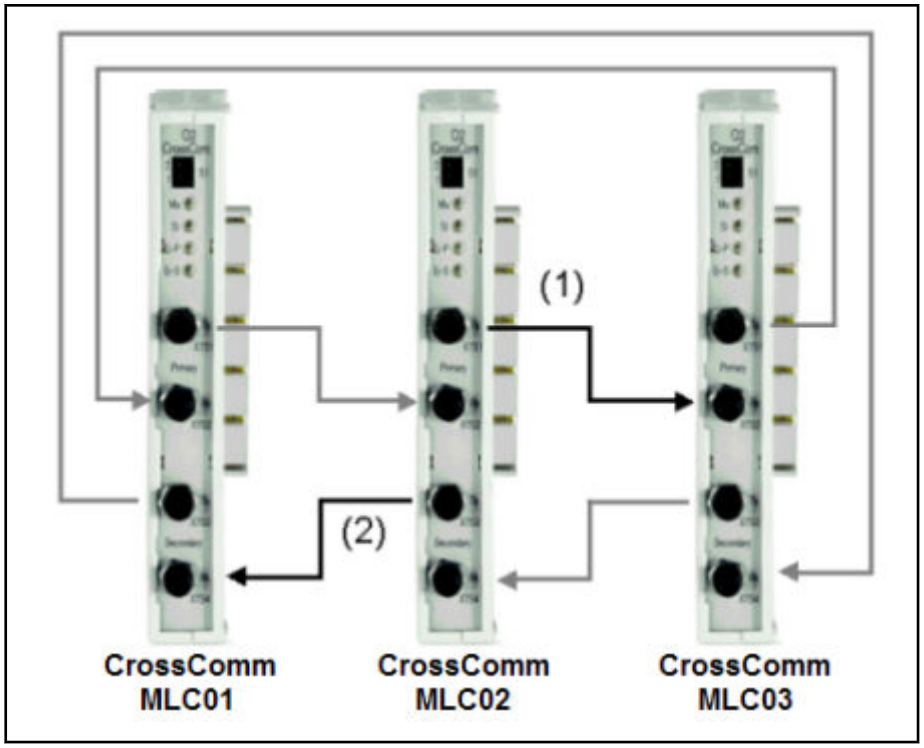


Fig. 9-7: MLC 02 transmission cables

Optical transmitting power single ring

The transmitting power is set in parameter "C-0-0702, C2C, OWG length".

The length entered in the first list element refers to the optical fiber cable (1) between the current and the subsequent CrossComm Sercos II (CFL01.1-Q2) function module in the primary/single ring.

Optical transmitting power double ring

The transmitting power is set via IndraWorks in parameter "C-0-0702, C2C, OWG length".

The length entered in the first list element refers, as with the single ring, to the optical fiber cable between the current and the subsequent CrossComm Sercos II (CFL01.1-Q2) function module in the primary ring (1).

The length entered in the second list element is relevant for the secondary ring (2).

9.6 Sercos II (CFL01.1-Q2) – Master communication

9.6.1 General information on master communication

With the function module Sercos II (CFL01.1-Q2), Sercos II drives can be connected to the IndraMotion MLC equipped with an onboard Sercos III interface.

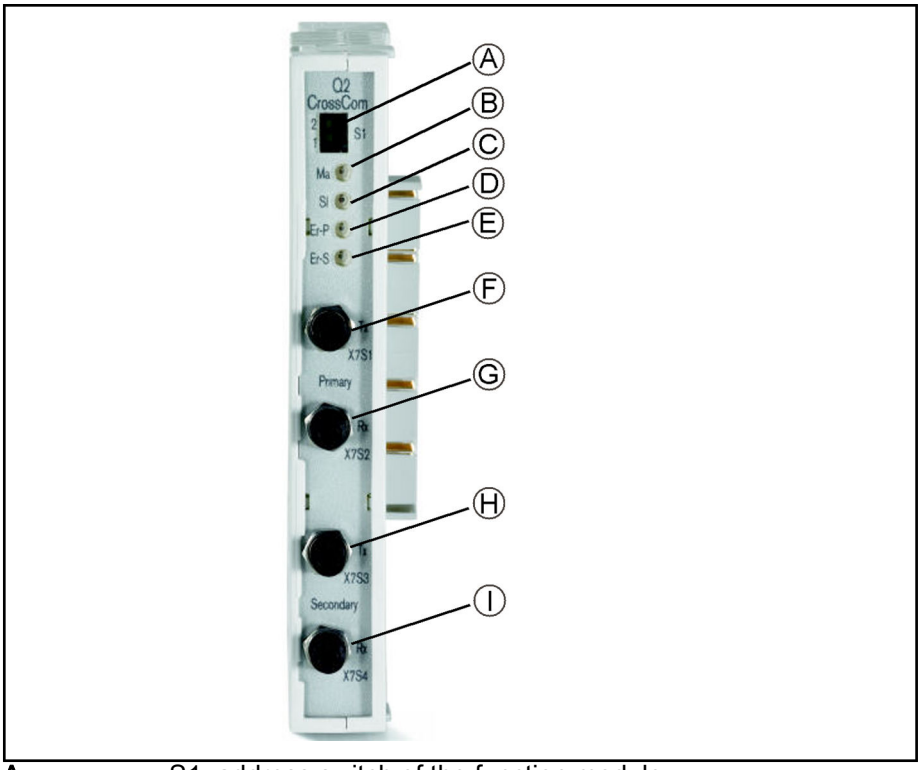
Use optical fiber cables to connect the Sercos II drives to the primary ring of the function module.

☞ The module for the master communication has to be always plugged on the right in front of the cross link module.

9.6.2 Hardware description

Front view

The following figure shows the front view of the Sercos II function module.



A S1, address switch of the function module
B Ma, master connection
C SI, slave connection
D Er-P, error primary ring
E Er-S, error secondary ring
F X7S1, Tx primary ring
G X7S2, Rx primary ring
H X7S3, Tx secondary ring
I X7S4, Rx secondary ring

Fig. 9-8: Front view of the Sercos II (CFL01.1-Q2) function module

The function module can be ordered via the part number R911 170 009.

Displays and ports

Status displays At Sercos II (CFL01.1-Q2), the Ma LED (green) indicates an active ring.

Distortion displays The distortion displays for Sercos II (CFL01.1-Q2) (red LED Er-P), error primary ring, can be used to check the quality of the optical reception signal.

FOC connections X7S1 is the transmitter connection and X7S2 the receiver connection of the primary ring.

X7S3 is the transmitter connection and X7S4 the receiver connection of the secondary ring.

9.7 S-RAM Modules (CFL01.1-Y1) - Memory Extension for the IndraMotion MLC

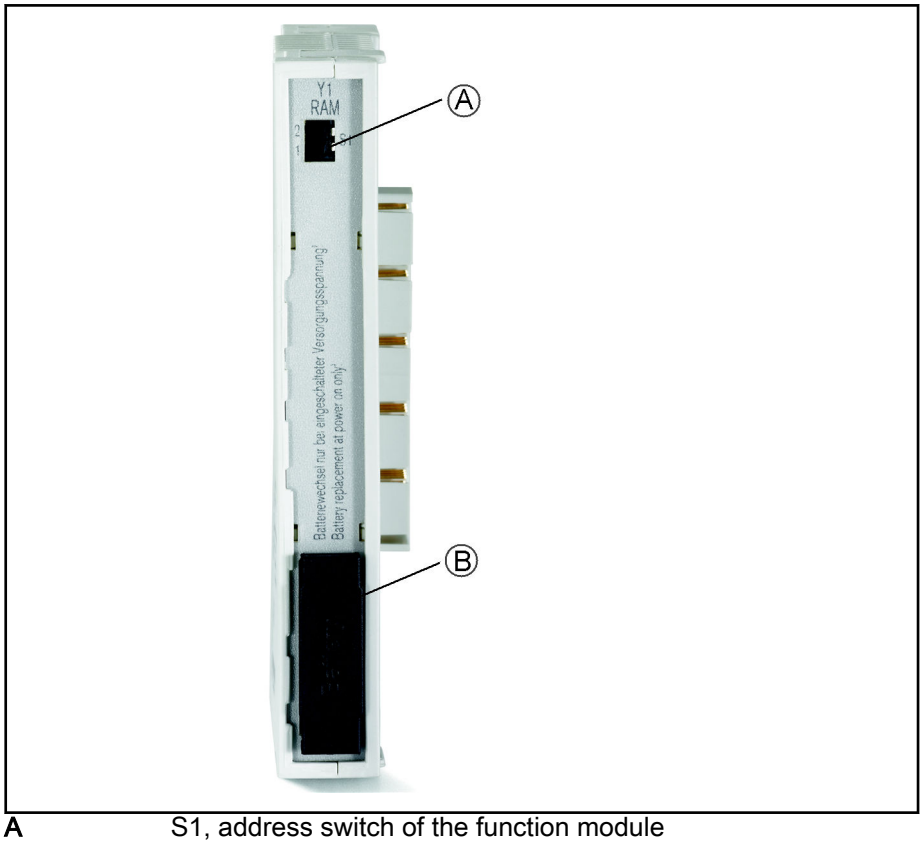
9.7.1 General Information

The 8 MByte S-RAM module (CFL01.1-Y1) stores kinematic programs for the IndraMotion MLC control without onboard S-RAM.

9.7.2 Hardware description

Front view

The following figure shows the front view of the S-RAM function module.



A S1, address switch of the function module
B Battery

Fig. 9-9: Front view of the S-RAM module (CFL01.1-Y1)

The function module can be ordered under the parts number R911170007.

Battery

Battery Buffer

Data is managed via a CR2450 3V lithium battery (Sony CR2450 is UL approved (parts no.: 1070 923 243).

With typical buffer streams, the battery capacity lasts for approx. 4.2 years.

Battery monitoring

During operation, the battery is charged every 24 hours and the battery voltage is checked. Based on experience, a buffer of at least one month is guaranteed once it has fallen below the limit value.

The fact that it has fallen below the limit value is entered in the IndraWorks Engineering diagnostic memory and error memory and displayed on the IndraMotion MLC display.

Battery replacement

The battery compartment is located on the front side of the S-RAM module (CFL01.1-Y1) under the black cover labeled "Battery".

To prevent data loss when exchanging the battery, the device has to be switched on.

9.8 PLS (CFL01.1-N1) - Programmable limit switch

9.8.1 General information

The programmable limit switch function block "MC_DigitalCamSwitch" of the "ML_TechMotionBase" library is supplemented by a hardware-based programmable limit switch function module (PLS = **P**rogrammable **L**imit **S**witch).

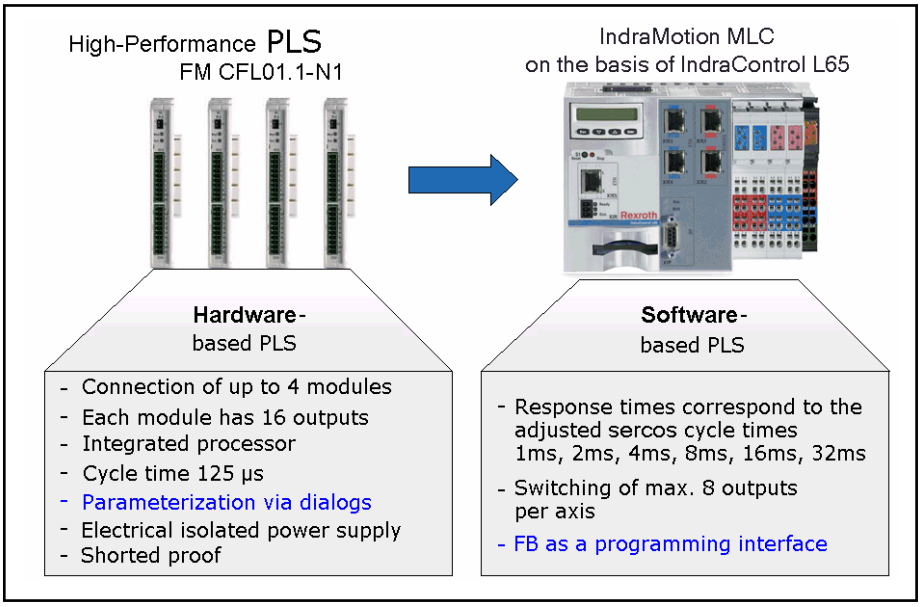
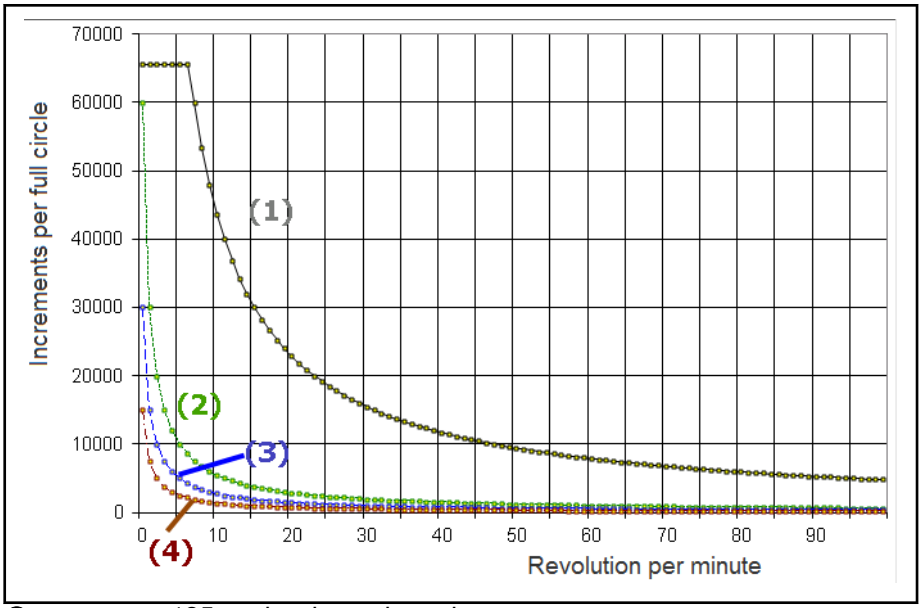


Fig. 9-10: Comparing hardware- and software-based programmable limit switches

Differences between hardware- and software-based PLS

- Cycle time of 125 µs irrespective of the Sercos cycle time (1...32 ms)
- Parameterizing via dialogs instead of function blocks as programming interface



① 125 µs, hardware-based
② 1 ms, Sercos cycle time, software-based
③ 2 ms, Sercos cycle time, software-based
④ 4 ms, Sercos cycle time, software-based

Fig. 9-11: Resolution as function of speed and cycle time

There can be small differences between software- and hardware-based variants.

9.8.2 Working principle of the hardware-based PLS

The hardware-based PLS works according to the following principle:

Axis/switch track/output

A (reference) axis is assigned to a switch track.

The switch track follows the motion of this axis.

Each switch track controls an output.

A maximum of 8 (reference) axes can be used in a PLS to control the 16 switch tracks. Thus, one (reference) axis can control all 16 switch tracks max. and not more than 8 (reference) axes can use the 16 switch tracks.

Every switch track, depending on its direction, can be assigned to the number of acting switches required. Altogether, 64 switches are available.

The direction dependency is the common feature of all switch tracks.

Scaling of the reference axis and direction of motion

- Rotary, constant direction of rotation

  One axis revolution corresponds to a full switch track circle. The direction-dependent effective switch tracks switch precisely once per axis revolution

- Rotary, changing direction of rotation

  One axis revolution corresponds to a full switch track circle. The direction-dependent effective switches switch either in a clockwise or counter-clockwise direction or in both directions of rotation

- Translatory, changing direction of motion

The full switch track circle is theoretically cut in two and unrolled across the distance to be covered. The direction-dependent effective switches switch either in a forward or backward direction or in both directions

Operating states of switch tracks

In addition to their direction-dependent effect, the switches can be operated in two different switch track modes:

- Position-related mode

  The rising and/or falling edge of the active switch, along with the correction times and correction distances, determine the status of the switch track

- Time-related mode

  Based on the rising edge of the active switch (and possible corrections), the switch remains active for a specified time (increments of 125 µs to 1 s).

  If a following switch becomes active during this period, the effect of the first switch is prolonged for the same period of time.

  Example: With the application of adhesive, the edge of the switch determines the start of the adhesive flow. The duration determines the amount of adhesive.

To compensate for internal processing times and delay in the devices connected, separate integral action times can be defined for switching each switch track on and off (dead time compensation).

Each switch has its own switch-on and switch-off position (switch-on, switch-off angle).

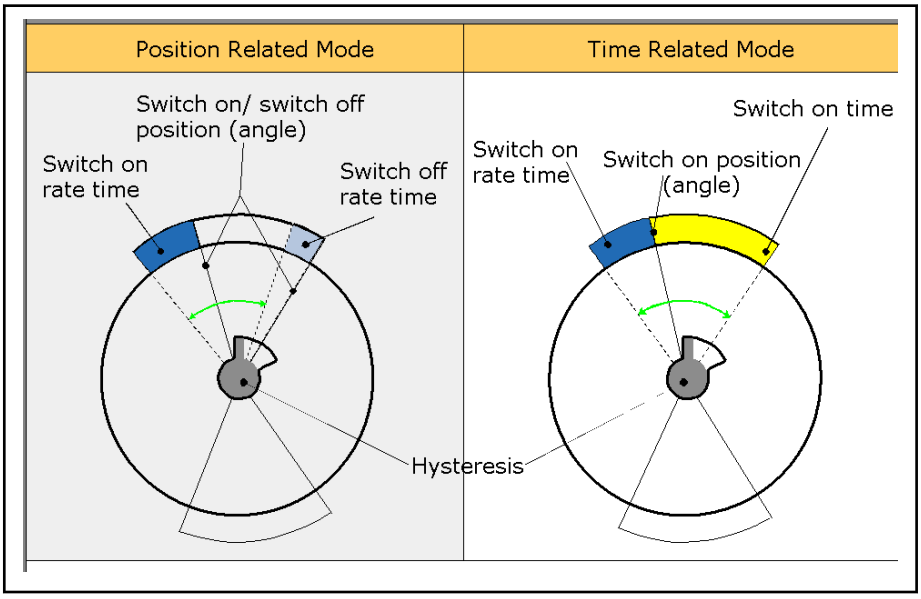


Fig. 9-12: PLS operating states

To prevent the output from becoming unsteady when the switch-on or switch-off position is reached, the hysteresis can be defined with respect to the direction (positive or negative hysteresis value).

Negative hysteresis:

- In a positive direction, the switch-on and switch-off positions determine whether the switch track (its assigned output register) is switched on or off
- In a negative direction the switch-on and switch-off positions, minus the hysteresis value, determine whether the switch track (its assigned output register) is switched on or off

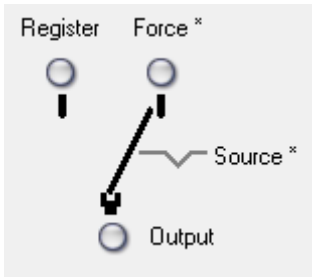
Positive hysteresis:

- In a positive direction, the switch-on and switch-off positions plus the hysteresis value determine whether the switch track (its assigned output register) is switched on or off
- In a negative direction, the switch-on and switch-off positions determine whether the switch track (its assigned output register) is switched on or off

The result (active or inactive) from axis motion, switch track properties and switch positions or switch position and switched-on duration is given at one bit of the programmable limit switch register respectively (16 switch tracks result in a 2*8 bit "Register".

PLC postprocessing

The values located in the "Register" can be postprocessed with PLC support.



Tab Programmable limit switch data
Force PLC data
Source Decision bit "Register" or "Force"
Output Output data after manipulation

Fig. 9-13: Postprocessing switching principle

Depending on the "Source" bit, the "Output" bit is either the

- "Register" bit

  or the

- "Force" bit

Example:

Up to now, the switch track running time-related mode was considered for the "application of adhesive".

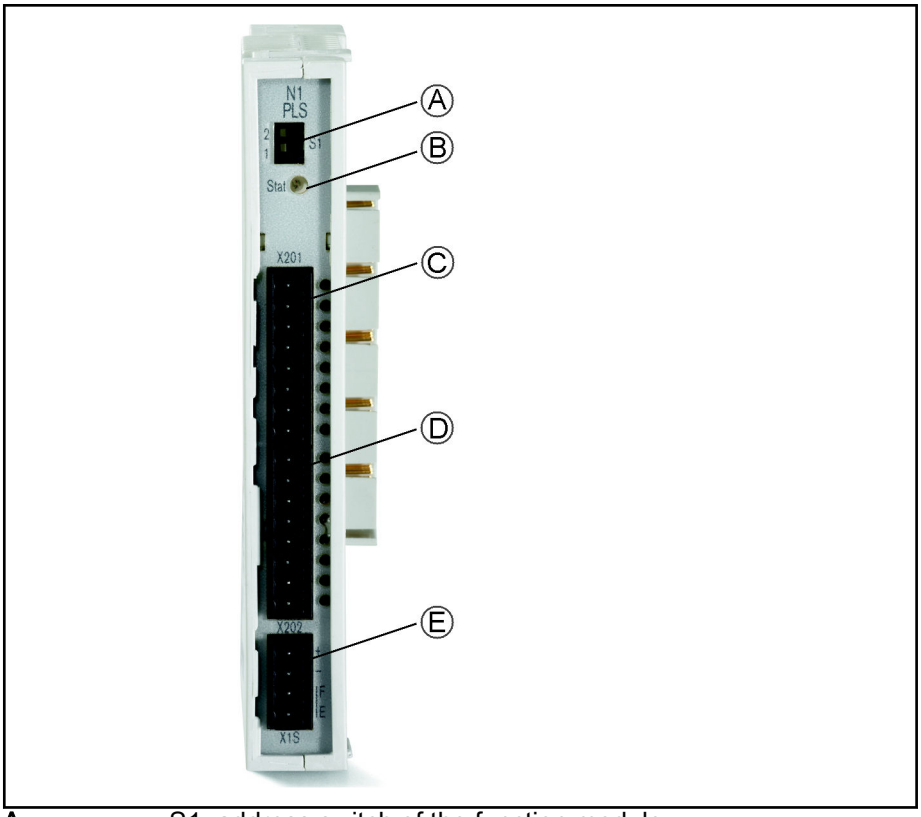
Now, a PLC-controlled cleaning cycle is to be performed, independently of the programmable limit switch.

The PLC releases the cleaning fluid and the adhesive nozzle is enabled via the "Output" bit by the PLC.

9.8.3 Hardware description

Front view

The following figure shows the front view of the PLS function module.



A S1, address switch of the function module
B Stat., Status display
C X201, digital outputs 1..8 (incl. status LEDs)
D X202, digital outputs 9..16 (incl. status LEDs)
E X1S, load supply of the outputs

Fig. 9-14: Front view of the PLS function module (CFL01.1-N1)

The function module can be ordered under parts number R 911 170 012.

Displays and Ports

XS1 Infeed terminal for external 24 V voltage supply.

Stat Status display of the function module:

- Green - Power supply available
- Red - Short circuit or overload
- Off - No power supply

X2O1 Digital outputs 1..8 (incl. status LED).

X2O2 Digital outputs 9.0.16 (incl. status LED).

Addressing

The assignment of the PLS address begins with the module nearest to the control. Modules of other types are skipped when the PLS addresses are assigned. The PLS module can be in any slot.

Example with 3 PLS and 1 S-RAM function module:

Type	Function module address	PLS address
PLS (CFL01.1-N1)	0	PLS1
S-RAM modules (CFL01.1-Y1)	1	-

Type	Function module address	PLS address
PLS (CFL01.1-N1)	2	PLS2
PLS (CFL01.1-N1)	3	PLS3

Tab. 9-5: Example of address assignment

9.9 Fast I/O (CFL01.1-E2)

9.9.1 General information

The Fast I/O (CFL01.1-E2) is used for quick reading (e.g. touch probe) of up to 16 inputs and for the issuing up to 16 outputs.

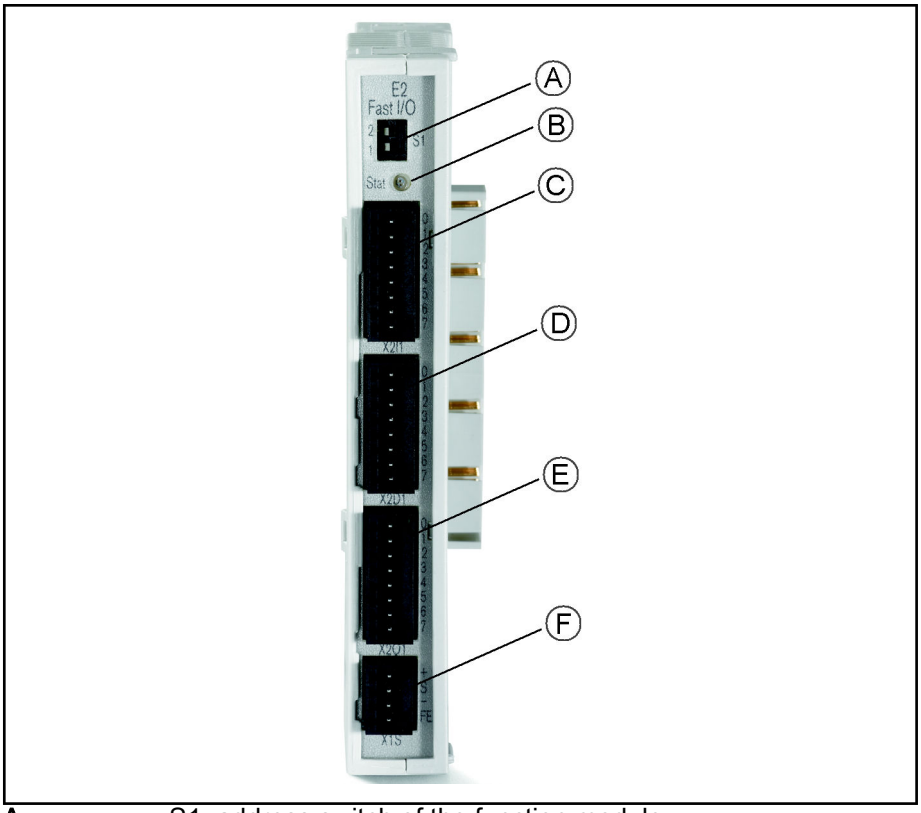
Every Fast I/O function module is equipped as follows:

- Eight inputs
- Eight inputs/outputs (selectable bit by bit)
- Eight outputs
- Connection of DC 24 V power supply and FE
- LED status display for power failure and overload
- current per output is 500 mA when nominal voltage is 24 V

9.9.2 Hardware description

Front view

The following figure shows the front view of the Fast I/O function module.



A S1, address switch of the function module
B Stat, status display of the function module
C X2I1, digital inputs
D X2D1, digital inputs/outputs
E X2O1, digital outputs
F X1S, power supply and FE

Fig. 9-15: Fast I/O function module (CFL01.1-E2)

The function module can be ordered under the following parts number R911 170 012.

Displays and ports

Ports

Input plug X2I1 connection	Input/output plug X2D1 connection	Output plug X2O1 connection
Input 0	Input/output 0	Output 0
Input 1	Input/output 1	Output 1
Input 2	Input/output 2	Output 2
Input 3	Input/output 3	Output 3
Input 4	Input/output 4	Output 4
Input 5	Input/output 5	Output 5
Input 6	Input/output 6	Output 6
Input 7	Input/output 7	Output 7

Tab. 9-6: Input and output connectors X2I1, X2D2 and X2O1

Power supply plug X1S connection
24 V (+)
S (sensor supply)
GND (-)
FE

Tab. 9-7: Power supply connector X1S



The function module has to be grounded with two 0.5 mm^2 conductors at the FE plug and socket connections. These conductors have to have a length of maximum 0.5 m.

The functional earth (FE) is used for discharging disturbances. The functional earth does not protect from electrical shocks.

Displays

The status LED shows three states:

Stat.-LED	Meaning
Green	- Power supply present - Assembly is ready for use
Red	- No power supply - Short circuit or overload at one or several outputs - PCI interface defective (assembly defective) - Watchdog error (system does not address the assembly)
Off	- No power supply to control

Tab. 9-8: States of the status LED

Wiring the assembly

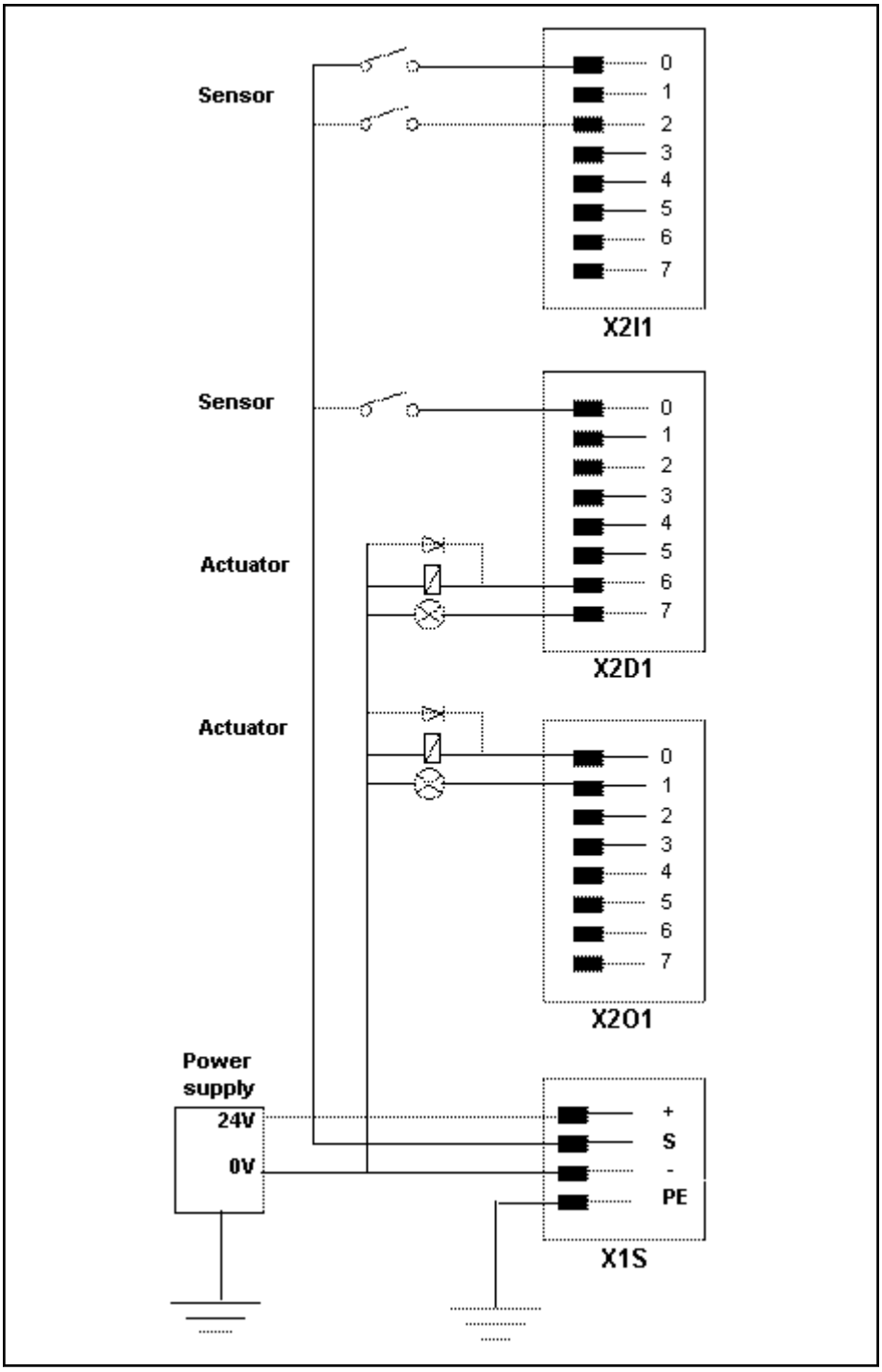


Fig. 9-16: Wiring the assembly

NOTICE **Destruction of the assembly by improper connection!**

- Avoid polarity reversal with simultaneous short-circuit of the output lines
- Avoid polarity reversal with simultaneous connection of externally polarized suppressor diodes
- Do not apply an external voltage greater than the supply voltage
- Do not connect sensors to an external voltage. Supply sensors from the sensor supply (X1S)

Digital Inputs X2I1, X2D1

Number of inputs	16 (8 can be selected bit by bit as input or output)
Connection method	1-wire
Input types	Type 1, according to EN 61131-2
Electrical isolation to the logic supply	Yes
Reverse voltage protection	Yes
Input voltage: Nominal value at "0" Nominal value at "1"	 -3 V ...+5 V 11 V … 30 V
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. 40 µs, max. 50 µs Typ. 40 µs, max. 50 µs
Cable length (unshielded)	< 100 m
Sensor supply (connection "S") Output voltage, nominal value Nominal current (total) Short-circuit protection, overcurrent protection	 24 V 0.2 A Typ. 1.2 A

Tab. 9-9: Data of the digital inputs

Digital Outputs X2I1, X2D1

Number of outputs	16 (8 can be selected bit by bit as input or output)
Connection method	1-wire
Output type	• Semiconductor outputs, non-saving • Protected, with automatic restart • Current-carrying
Electrical isolation to the logic supply	Yes
Output voltage, nominal value	24 V

Rated output current: Nominal value Maximum value acc. to DIN EN 61131-2 1 signal 0 signal (leakage current) UL rating: - General purpose - Tungsten	 0.5 A ≤ 0.6 A 2 mA ... 0.6 A ≤ 0.5 mA 0.5 A 5 W
Parallel connection of outputs	Yes, but only within one half byte (0-3; 4-7, etc.)
Maximum total current of outputs	4 A
Output delay time (ohmic load) At "0" to "1" At "1" to "0"	 Typ. 70 µs, max. 95 s Typ. 70 µs, max. 75 µs
Contactor size (at 1 Hz) (inductive load)	SG1 (6.2 W)
Lamp load (at 8 Hz)	5 W
Overload protection: - Typical current level, causing switch-off - Minimum current level, causing switch-off - Automatic restart at reduced load	 1.2 A 0.6 A After approx. 10 ms
Display overload	Red status LED for all 16 outputs
Voltage reduced on circuit interruption In nominal mode	Electronic at (V_{ext} - 50 V) Typ. 26 V
Reverse voltage protection	Guaranteed without connected load
Supply voltage according to EN 61131-2	24 V DC
Idle current consumption from 24 V	Typ. 50 mA
Cable length (unshielded)	< 100 m

Tab. 9-10: Data of digital outputs



The response time (turnaround time) of the bus to write the output to read the modified input value is

- for 1 ms cycle time - approx. 1 ms
- for 2 ms cycle time - approx. 2 ms

Connection of inductive loads

Interference levels may cause malfunctions of the installation. Very high noise levels are triggered by cable breakages, by removing a pin to the inductive load (such as solenoid valves, contactors) or the deactivation by a

mechanical contact. These levels can spread by galvanic, inductive or capacitive coupling in the system and lead to malfunctions of the installation or other installations. To reduce the noise level, a corresponding suppressor element (free-wheeling diodes, varistors, RC elements) has to be connected directly to the inductive load. In particular, suppressor circuits have to be present if a switch is planned in series to the inductive load, e.g. for safety locks.

All standard suppressor elements can be used.

GND breakage security

If the GND line to the function module breaks, a leakage current of up to 25 mA per output might flow. In case of parallel connected outputs, the current multiplies accordingly.

Thus, there is no reliable protection from GND breakage.

Peripheral Voltage X1S

The following values of the peripheral voltage comply with DIN EN 61131-2:

Nominal value	24 VDC
Tolerance	-15 %/+20 % (without residual ripple)
Residual ripple	+/-5 %
U_{max}	30 V
U_{min}	19.2 V
Current consumption	max. 4 A

Tab. 9-11: Peripheral voltage according to DIN EN 61131-2

External power supply unit

The power supply unit has to have a safe separation according to DIN EN 50 178, section 5.2.18.1. Transformers have to be designed with a safe separation according to DIN EN 60 742.

The 24 V supply voltage is then an extra-low voltage with safe separation according to DIN EN 50 178, section 5.2.8.1. This voltage is designed either as safety extra-low voltage (SELV) without ground connection of the reference conductor or as protective extra-low voltage (PELV) with ground connection of the reference conductor.

A three-phase power supply unit with easy full-bridge rectification is sufficient. The ripple voltage content must not exceed 5 %.

All 24 V voltage supply lines have to be:

- Laid such that they are isolated from lines carrying higher voltages or
- insulated to a particularly high degree, with the insulation designed for the highest existing voltage (see EN 60 204-1:

All peripherals, e.g. digital sensors/actuators connected to the function module interfaces also have to meet the criteria regarding safe isolation of electric circuits.

9.10 RT-Ethernet/Profibus DP (CFL01.1-TP)

9.10.1 General information

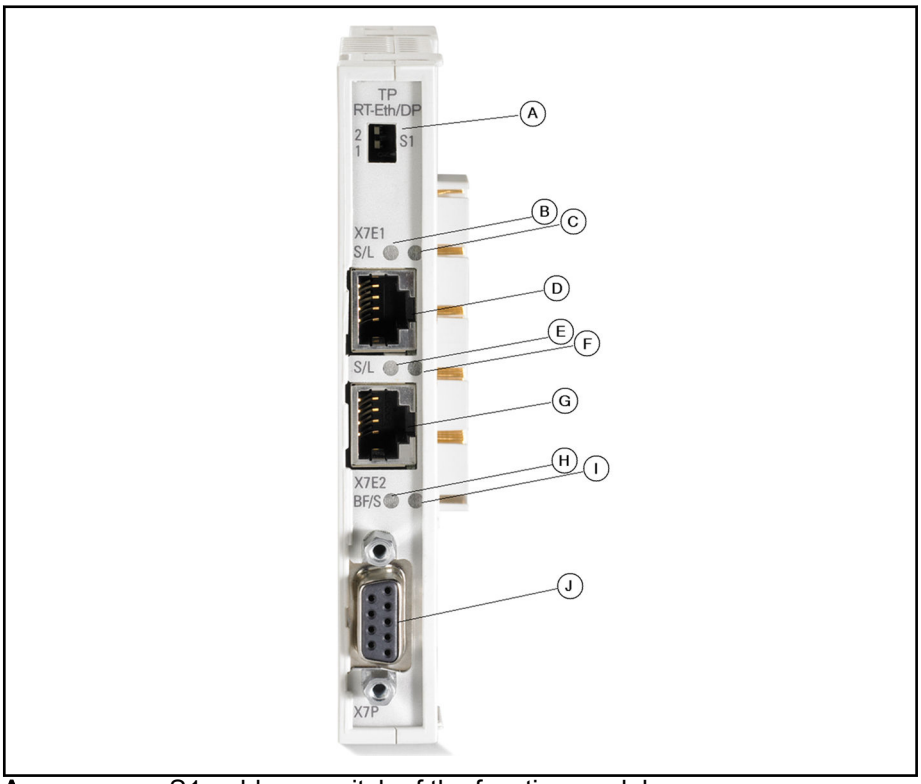
The function module is equipped with a real-time Ethernet and Profibus DP master or DP slave functionality. Depending on the configuration, the different Ethernet protocols on the module can be executed together with the Profibus DP. Profinet RT and Ethernet/IP is available as field bus Ethernet protocol. Parallel to the field bus Ethernet protocol, it is possible to communi-

cate via the field bus interface configuration "Standard TCP/IP", this is e.g. required for communication with DTMs.

9.10.2 Hardware description

Front view

The following figure shows the front view of the RT Ethernet function module.



A S1, address switch of the function module
B, E S, Status display Ethernet port 1-2
C, F L, Link display Ethernet port 1-2
D, G X7E1, X7E2, Ethernet RJ-45 sockets port 1-2
H BF, Bus error display DP port
I S, Status display DP port
J X7P, Profibus DP connecting socket

Fig. 9-17: Function module RT-Ethernet/Profibus DP (CFL01.1-TP)

The function module can be ordered with the part number R911170832.

Connections and displays

X7E1/2 Ethernet interfaces

Pin	Meaning
1	TD+
2	TD-
3	RD+
4	Reserved
5	Reserved
6	RD-

Pin	Meaning
7	Reserved
8	Reserved

Tab. 9-12: Pin assignment of RJ45 socket X7E1/2

X7P Profibus DP interfaces

Pin	Meaning
1	n. c.
2	n. c.
3	RxD/TxD-P
4	CNTR-P
5	DGND
6	VP
7	n. c.
8	RxD/TxD-N
9	n. c.

Tab. 9-13: Pin assignment of the 9-pin Sub-D socket X7P

☞ Cable fixing during installation is required!

Use only copper wires.

For further descriptions and possible settings, please refer to the system-specific manual.

LED displays

Ethernet LEDs	Color	Status	Description
L	Green	On	Ethernet connection detected
		Off	No Ethernet connection
S	Yellow	Flashing	Ethernet data traffic
		Off	No Ethernet data traffic

Tab. 9-14: Ethernet LEDs

Profibus DP LEDs	Color	Status	Description
Stat	Green	On	Bus communication
		Acyclic	No configuration
		Cyclic	Configured
		Off	Bus communication stopped
BUS	Red	On	No DP connection
		Flashing	Slave diagnostics
		Off	No bus errors

Tab. 9-15: Profibus DP LEDs

9.11 Safety function module (CFL01.1-F1)

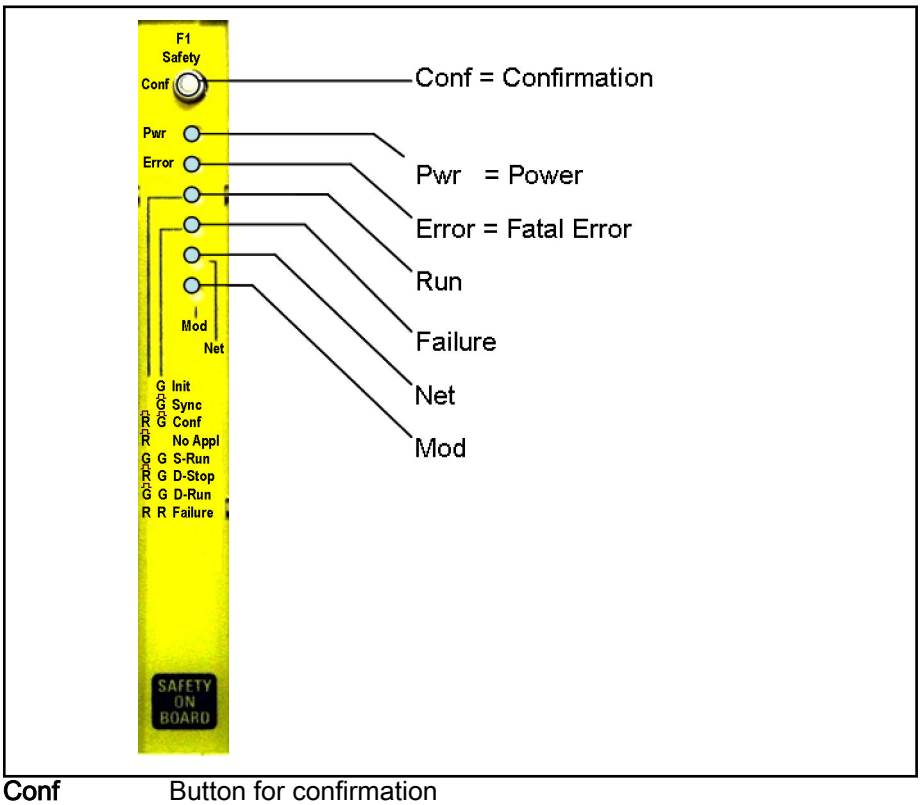
9.11.1 General information

The function module contains a Safety PLC control according to SIL3. The Safety PLC control can communicate via "ProfiSafe" and "CIP Safety on Sercos" with safe inputs and outputs.

9.11.2 Hardware description

Front view

The following figure shows the front view of the Safety function module.



Conf	Button for confirmation
Pwr	Status display of the power supply
Error	Status display of the error
Run, Failure	Status display of the operating state
Net, Mod	Status display of the CIP Safety on Sercos

Fig. 9-18: Function module Safety CPU (CFL01.1-F1)

The function module can be ordered using the part number R911170129 .

Ports and displays

Display LEDs

The meanings of the display LEDs are listed in the following tables:

LED	Color/status	Description
Pwr	Off	No power supply from the standard control
	Red	Error: The voltage monitoring of the Safety function module switched off the safe logic voltage.
	Green	All internal voltages of the Safety function module are within the permitted range
Error	Off	The Safety function module is ready
	Red	The Safety function module is not ready. This LED is on by default during the initialization phase and goes off automatically after approximately one minute If the LED is still on after the initialization or if it is permanently switched on during operation, integrated self-tests determined a "fatal error" (e.g. hardware error). The Safety function module is then probably defective and has to be replaced

Tab. 9-16: LEDs for operational readiness

LED "Run" (Color/status)	LED "Failure" (Color/status)	Operating state of the Safety function module
Off	Off	No power supply or hardware reset
Off	Green	Initialization phase; first part (ca. 30s)
Red	Off	Initialization phase; second part (ca. 10s)
Red, flashing	Off	Ready For Download The Safety function module does not contain any valid application or a download is not yet completed
Red	Green, flashing	Prompt to press the "Conf" button
Red	Green	SAFETY STOP
Green	Green	SAFETY RUN
Red, flashing	Green	DEBUG STOP
Green, flashing	Green	DEBUG RUN or SERVICE RUN
Red	Red	FAILURE STOP Exceptional state of the Safety function module due to an internal error. The different displays are used to pinpoint errors
Red	Red, flashing	
Red, flashing	Red, flashing	

LED "Run" (Color/status)	LED "Failure" (Color/status)	Operating state of the Safety function module
Red, flashing	Green, flashing	Firmware update
Green, flashing	Red, flashing	Special operating mode for Bosch Rexroth Service employees

Tab. 9-17: Display of the operating state of the Safety function module

LED	Color/status	Description
Mod	Off	No power supply
	Green, flashing	Standby state
	Green	Normal mode
	Red, flashing	Error that can be eliminated
	Red	Error that cannot be eliminated
	Red/green, flashing	Self-test or configuration
Net	Off	No power supply
	Green, flashing	No valid bus connection
	Green	Bus connection OK
	Red, flashing	Timeout
	Red	Critical connection error
	Red/green, flashing	Communication error

Tab. 9-18: Special displays for CIP Safety on Sercos

9.11.3 Documentation

The following manuals are available for the Safety function module and its use:

Title	Type code/part number	Description
Rexroth IndraControl CFL01.1-F1 Safety Function Module	DOK-CONTRL-SL**FM*****-ITxx-EN-P R911336576	Operating Instructions This manual guides the technical staff of the machine manufacturer through a safe mounting and electrical installation of the Safety function module
Rexroth IndraWorks 14VRS SafeLogic Project Configuration	DOK-IWORKS-SL**PRJ*V14-APxx-EN-P R911341694	Application Description This documentation is intended as guideline when creating of a safety-related application

Title	Type code/part number	Description
Rexroth IndraWorks SafeLogic 14VRS First Steps	DOK-IWORKS-SL*STEP*V14-COxx-EN-P R911341520	Commissioning Manual This documentation includes descriptions on the following topics: • Creation and use of a safety application • Basics of the data exchange between the safety and the standard application of the IndraLogic XLC/ IndraMotion MLC/IndraMotion MTX 14VRS • Information on diagnostics and troubleshooting • Programming under SafeLogic
Rexroth IndraLogic XLC IndraMotion MLC 14VRS SafeLogic System Overview	DOK-XLCMLC-SL**SYS*V14-PRxx-EN-P R911341696	Project Planning Manual This documentation describes the project planning and configuration of safety-related devices in the systems IndraLogic XLC and IndraMotion MLC
Rexroth IndraMotion MTX 14VRS SafeLogic System Overview	DOK-MTX***-SL**SYS*V14-PRxx-EN-P R911341698	Project Planning Manual This documentation describes the project planning and configuration of safety-related devices in the IndraMotion MTX
Rexroth IndraControl L45, L65 and L85 controls	DOK-CONTRL-IC*LX5*****-ITxx-EN-P R911336525	Operating Instructions This manual instructs the technical staff of the machine manufacturer on a safe mechanical and electrical mounting and commissioning

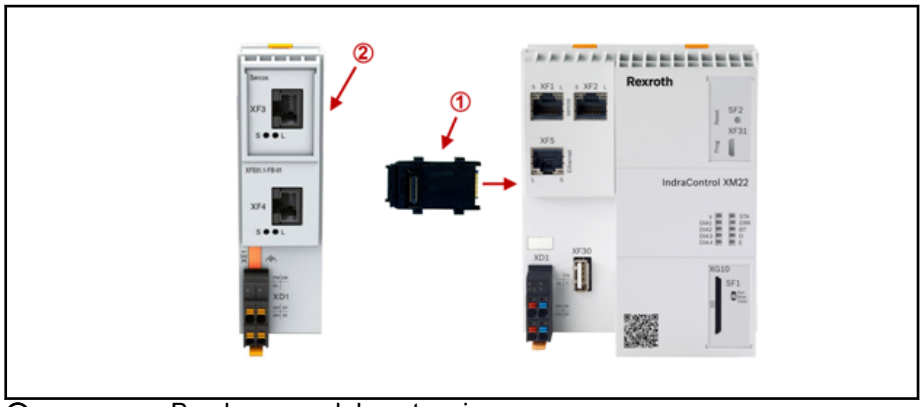
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Tab. 9-19: Supplementing documentation

10 Extension modules for XM controls

10.1 General information

To extend the XM functionality, extension modules can be connected to the extension bus connection of the control on the left side of the XM via extension bus base modules.



① Bus base module extension
② Extension module

Fig. 10-1: Connecting an extension module to the XM control

10.2 Information on extension modules

The following table lists ordering information on the extension modules:

Name	Type code	Part number
Extension module Sercos III / cross communication	XFE01.1-FB-01	R911173396
Extension module Profibus DP master/ slave	XFE01.1-FB-10	R911173398
Extension module Profibus DP slave only	XFE01.1-FB-11	R911173936
Extension module RT-Ethernet (ProfiNet RT / EtherNet/IP) master/slave	XFE01.1-FB-03	R911173397
Extension module RT-Ethernet (ProfiNet RT / EtherNet/IP) slave only	XFE01.1-FB-04	R911173937
Extension module: Safe Logic	XFE01.1-SY-01	R911173399

Tab. 10-1: Ordering information on extension modules

10.3 CrossComm Sercos III (XFE01.1-FB-01) - Cross communication between controls

10.3.1 General information on cross communication between controls

In order to distribute the master axis positions of various MLC controls across local axes in various drive rings, the controls are interconnected to a link. The cross communication distributes the configured master axis positions to locally selected axes in the different controls.

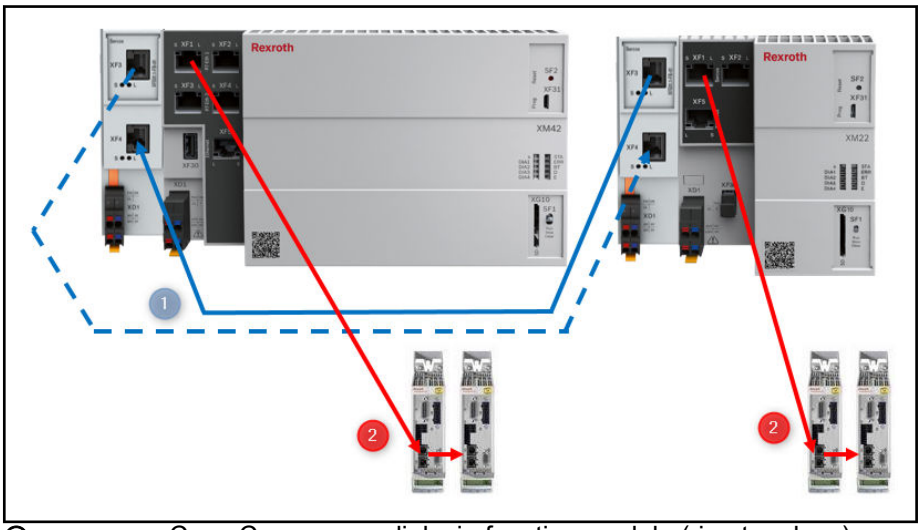
The cross communication of the controls is carried out with the **CrossComm Sercos III** function module.

- in case of IndraControl L-controls by means of the **CFL01.1-R3** function module
- in case of IndraControl XM-controls by means of the **XFE01.1-FB-01** function module

Hardware	
Cable	Ethernet CAT5
Ports	2 x RJ45
Transmission rate	100 MBit
Maximum cable lengths between two controls	100 m
CrossComm via Sercos III	
Maximum number of controls in the link	64
Maximum number of master axes in the link	128
Min. link cycle time	1 ms (depending on the number of controls and master axes as well the control hardware)
Max. link cycle time	8 ms

Tab. 10-2: Technical data CrossComm via Sercos III

To use Sercos III for master communication (onboard) and the cross link via the function module, the following function module assignment is assumed:



① CrossComm cross link via function module (ring topology)
② Sercos III master communication (onboard)

Fig. 10-2: CrossComm topology

Maximum of 64 controls in the link

When using the CrossComm Sercos III function module, up to 64 MLC controls can be interconnected to a link.

Controls of type L and XM can also be used in combination.

Maximum of 128 master axes in the link

For each MLC control, the actual positions of any local axes can be produced in the link. There is a maximum of 128 different master positions allowed in the link for all link devices.

Cycle time in link

The link cycle time is specified in the link master. At link startup, the master informs its slaves about the link cycle time via Sercos III.

The cycle time that can actually be achieved depends mainly on the control types used, the number of drives in the individual drive rings, the number of controls/master axes in the link and the functionalities activated in the individual controls.

- The cycle time in the link ring and in the drive ring of each link device **must** be identical. That means that the parameters "C-0-0400, Motion, cycle time, command value", "C-0-0503, sercos master, cycle time" and "C-0-0700, C2C, cycle time (Tcyc), command value" have to be identical
- The highest cycle time in the drive rings of all link devices therefore specifies the link cycle time
- Example: 2 ms is the minimum motion cycle time for the XM21 control. The link cycle time ≥ 2 ms **must** be selected if one XM21 is used.

Line(s) or ring

The link can be operated either as line, double line or ring (see chapter 10.3.3 "Link as line, double line or ring" on page 149).

The ring topology provides the following advantages:

- Higher error tolerance as a failed transmission path between two controls is tolerated for example
- Greater availability, even when a control is switched off, cross communication with the rest of the drive rings remains established for example

Compatibility of different MLC versions in the Sercos III cross communication Cross communication

Functional extensions and optimizations can change the transferred data in the Sercos III link. Thus, it is not always possible to connect controls with different firmware versions. The following table shows the coupling options.

	Slave ≤ MLC11VRS	Slave ≥ MLC12VRS
Master ≤ MLC11VRS	Yes	Yes
Master ≥ MLC12VRS	No	Yes

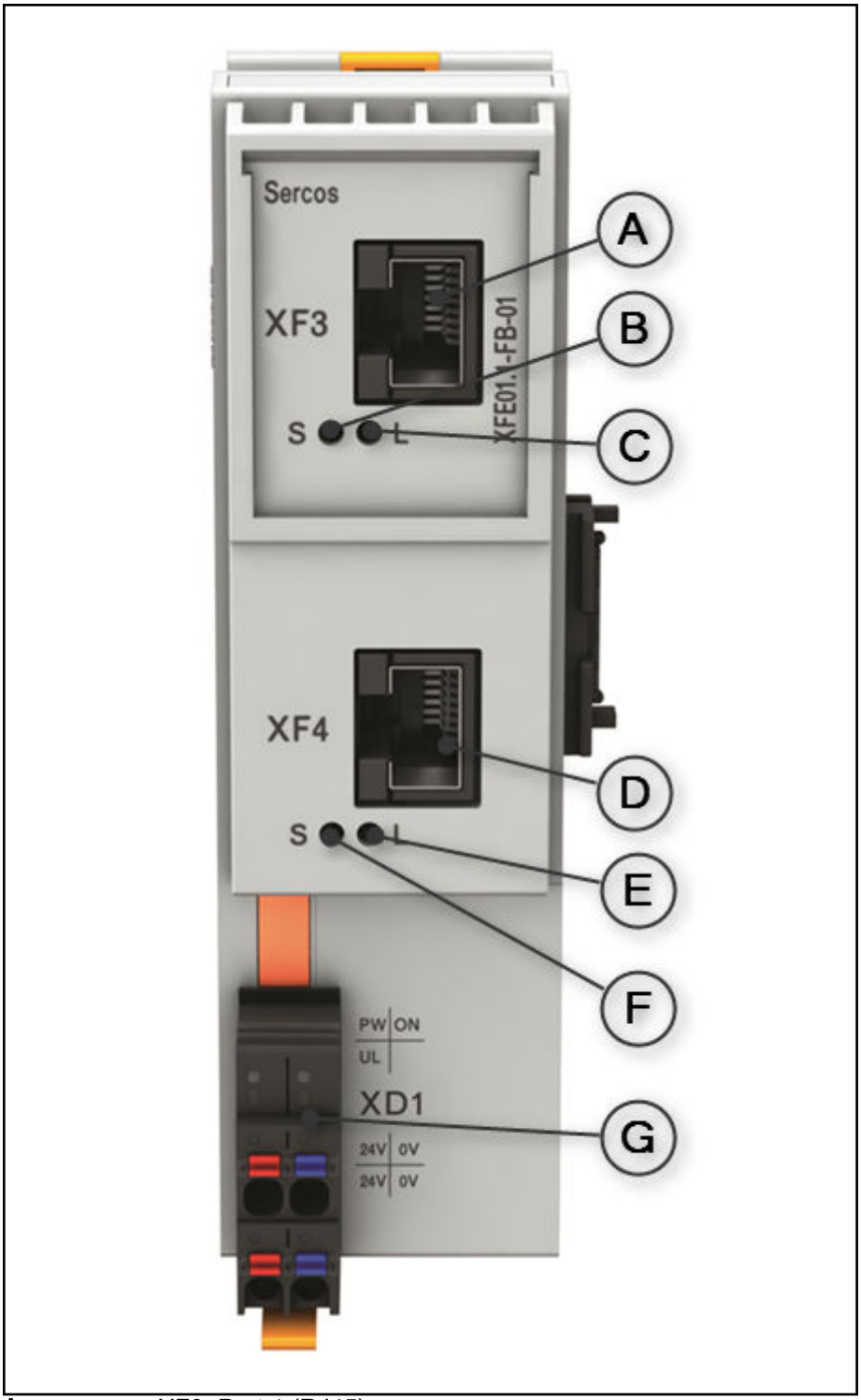
Tab. 10-3: Sercos III cross communication: Compatibility of different MLC versions

When coupling incompatible versions, the later version reports the error "F0280023, Incompatible C2C device found".

10.3.2 Hardware description

Front view

The following figure shows the front view of the CrossComm Sercos III (XFE01.1-FB-01) function module.



A	XF3, Port 1 (RJ45)
B	S, status port 1
C	L, link port 1
D	XF4, Port 2 (RJ45)
E	L, link port 2
F	S, status port 2
G	24V Power supply connection XD1

Fig. 10-3: Front view of the CrossComm Sercos III (XFE01.1-FB-01) function module

The function module CrossComm Sercos III (XFE01.1-FB-01) can be ordered with the part number R911173396.

Displays and ports

Link displays

The status of the link is displayed at CrossComm Sercos III (XFE01.1-FB-01) via the LEDs " L" (green LED: Link) or "S" (yellow LED: Status).

The following combinations are possible:

Link LED	Status LED	Status:
On	Flashing	Error-free state
On	On	Ready for hot plug or for restoring redundancy
On	Off	A link error occurred. Link ring is in phase 0
Off	Off	Link is not configured or cables are not plugged in

Tab. 10-4: CrossComm Sercos III (XFE01.1-FB-01) - Link displays

Ports

XF3 - Connection of Sercos III port 1 (RJ45).

XF4 - Connection of Sercos III port 2 (RJ45).

10.3.3 Link as line, double line or ring

First, the link is planned, configured and parameterized via IndraWorks. The controls are switched to the operating mode. The LEDs "Link" and "Status" indicate the current status.

The link can be operated as line, double line or ring.

- With a line, the master is located either at the beginning **or** at the end of the line
- With a ring or a double line, the master is located at any position between the slaves

Double line and line

With double lines and lines, the participating controls have to be interconnected. The use of X7S1 and X7S2 (CFL01.1-R3) or XF3 and XF4 (XFE01.1-FB-01) ports is user-defined.

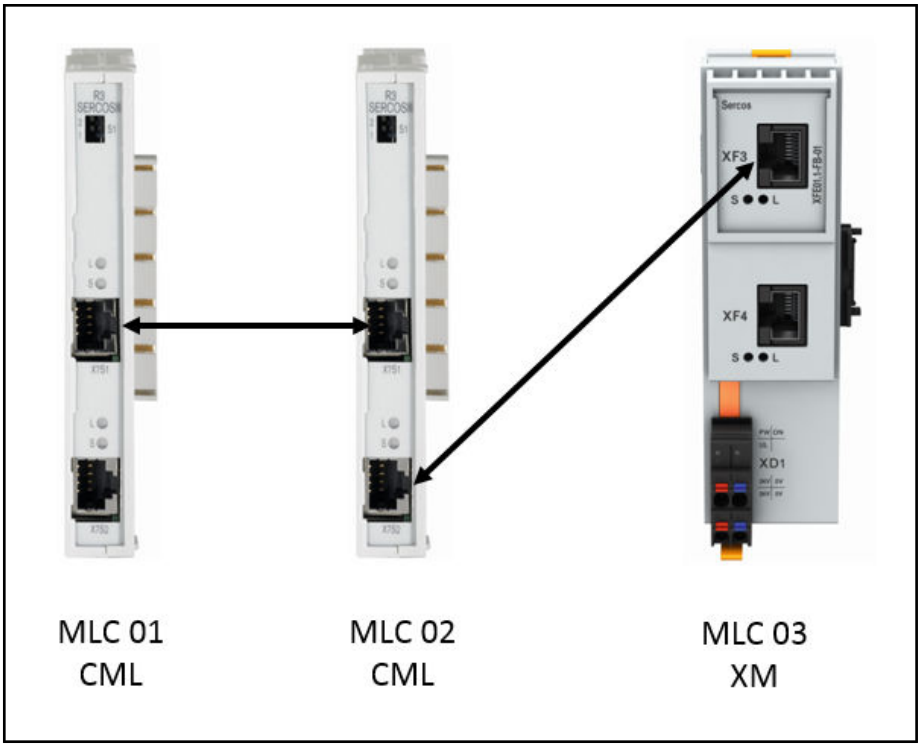


Fig. 10-4: Wiring example: Line, (Sercos III (CFL01.1-R3, XFE01.1-FB-01))

If only one port is assigned at the link master, the link master is the final device in a line. In the example, this is the case if either "MLC 01" or "MLC 03" is the link master.

As device in the middle, as in the example "MLC 02", the link master assigned both ports and thus supports a double line.

Ring The line illustrated above is converted into a ring by completing the missing connection..

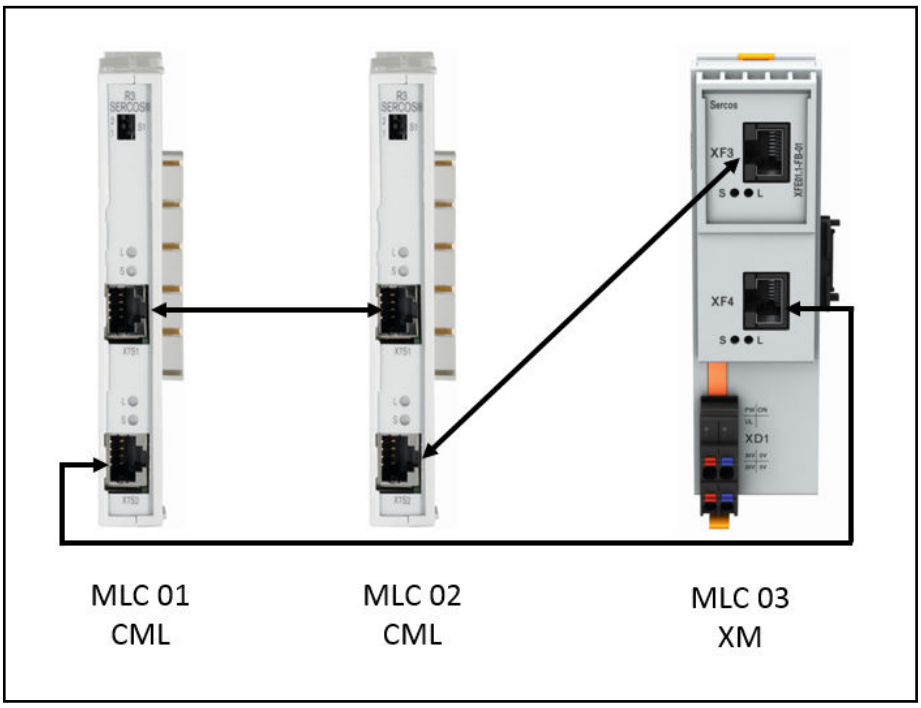


Fig. 10-5: Wiring example: Ring, (Sercos III (CFL01.1-R3, XFE01.1-FB-01))

10.3.4 CrossComm Sercos III (XFE01.1-FB-01) – More information

For more information on the cross link, refer to the chapter "Cross communication between controls - CrossComm Sercos III" in the functional description DOK-XLCMLC-FUNC****V14-APRS-EN-P provided in the Rexroth Media directory using the part number **R911341700**

11 Industrial PCs, terminals and displays

11.1 General information

Devices of the V/VR/PR series integrate all necessary functions for an efficient automation starting with a user-friendly operation and a clear and transparent visualization, over integrated controls up to diagnostics. Together with field-tested Bosch Rexroth system solutions, you get a complete automation solution for:

- Transfer machines
- Printing and processing machines
- Food and packaging machines
- Forming machines
- Wood working machines
- Textile machines
- Handling and mounting systems

The following models of the V/VR/PR series are available:

- Control-based
  - chapter 11.2 "Small operating panel – VCP" on page 154
  - chapter 11.3 "Hand-held terminal – VCH" on page 158
  - chapter 11.4 "Hand-held terminal – VH 2110.01" on page 161
- Embedded PC-based
  - chapter 11.5 " Small control panels – VR 21" on page 163
  - chapter 11.6 "Embedded devices – VEP" on page 168
- PC-based
  - chapter 11.7 "Panel PC – VPP" on page 174
  - chapter 11.8 "Multi touch panel PC – VPP" on page 178
  - chapter 11.10 "Control cabinet PC with display – VPB/VDP" on page 206
  - chapter 11.9 "Multi-touch panel PC, control cabinet PC and display – VR/PR/DR " on page 182
- PC-based
- Control panels
  - chapter 11.11 "Profibus machine control panels – VAM 10.2 / 40.2" on page 216
  - chapter 11.13 "Sercos machine control panels – VAM 10.3 / 40.3" on page 231
  - chapter 11.12 "Profibus machine control panels – VAM 12.1 / 42.1" on page 222
  - chapter 11.14 "Sercos machine control panels – VAM 15.1 / 21.1" on page 235
- Keyboards
  - chapter 11.15 "PC keyboards VAK" on page 243

11.2 Small operating panel – VCP

11.2.1 Brief description

The small operating panels of the VCP device series are operating and visualization terminals to operate and monitor machines. The devices are suitable for a number of different applications due to their compact design. It is communicated with the superordinate control via Profibus DP or Ethernet interface.



Fig. 11-1: Small operating panel VCP 02



Fig. 11-2: Small operating panel VCP 05



Fig. 11-3: Small operating panel VCP 08

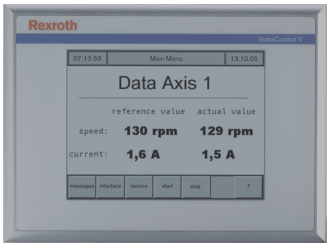


Fig. 11-4: Small operating panel VCP 11

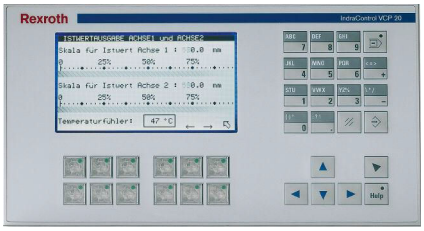


Fig. 11-5: Small operating panel VCP 20

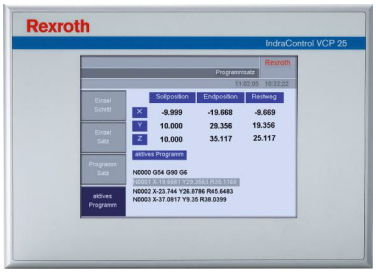


Fig. 11-6: Small operating panel VCP 25



Fig. 11-7: Small operating panel VCP 35

11.2.2 Technical data

	VCP 02	VCP 05	VCP 08	VCP 11	VCP 20	VCP 25	VCP 35
Display	3" graphic display, 160 x 80 pixels		3.8" graphic display, 320 x 240 pixels	3.8" graphic display, 320 x 240 pixels	5.7" graphic display, 320 x 240 pixels	5.7" graphic display, 320 x 240 pixels	10.4" graphic display, 640 x 480 pixels
Front panel	100 x 148 mm	168 x 120 mm	159 x 209 mm	96 x 130 mm	160 x 300 mm	180 x 234 mm	249 x 328 mm
Function/system keys	4 / 7	6 / 24	15 / 24	Touch screen	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 RS232/RS485 (option)						
Voltage supply	24 V DC						

Tab. 11-1: Technical data of the VCP small operating terminal

11.2.3 Variants

The small operating panels of the VCP device series are available in the following designs:

Type	Remarks
VCP02.2DRN-003-NN-NN-PW	Keys, communication via Ethernet
VCP02.2DRN-003-PB-NN-PW	Keys, communication via Profibus DP
VCP02.2DRN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP05.2DSN-003-NN-NN-PW	Keys, communication via Ethernet
VCP05.2DSN-003-PB-NN-PW	Keys, communication via Profibus DP
VCP05.2DSN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP08.2DTN-003-NN-NN-PW	Keys, communication via Ethernet
VCP08.2DTN-003-PB-NN-PW	Keys, communication via Profibus DP
VCP08.2DTN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP11.2DWN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP11.2DWN-003-PB-NN-PW	Touch screen, communication via Profibus DP
VCP11.2DWN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP11.2ECN-003-NN-NN-PW	TFT
VCP11.2ECN-003-PB-NN-PW	TFT with Profibus DP slave
VCP20.2DUN-003-NN-NN-PW	Keys, communication via Ethernet
VCP20.2DUN-003-PB-NN-PW	Keys, communication via Profibus DP
VCP20.2DUN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP25.2DVN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP25.2DVN-003-PB-NN-PW	Touch screen, communication via Profibus DP
VCP25.2DVN-003-SR-NN-PW	Keys, communication via serial interfaces
VCP35.2ECN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP35.2ECN-003-PB-NN-PW	Touch screen, communication via Profibus DP
VCP35.2ECN-003-SR-NN-PW	Keys, communication via serial interfaces

Tab. 11-2: VCP device variants

11.2.4 Accessories

Connecting cables

The VCP small operator panels communicate with the controls either using Profibus DP or Ethernet. The following cable is available for Profibus DP:

Type	Note
IKB0034/000,0	Connection between control and VCP; ready-made cables on one side, variable length

Tab. 11-3: Profibus connecting cable

The following cables are available to communicate via Ethernet:

Type	Note
RKB0008/002,5	Bus-cable, ready-made Ethernet cable, ready-made 100-Base-T, CAT 6+, UL, drag chain-compatible, cable length 2.5 m
RKB0008/005,0	As above, cable length 5 m
RKB0008/010,0	As above, cable length 10 m
RKB0008/015,0	As above, cable length 15 m
RKB0008/020,0	As above, cable length 20 m
RKB0008/025,0	As above, cable length 25 m
RKB0008/030,0	As above, cable length 30 m
RKB0008/035,0	As above, cable length 35 m
RKB0008/040,0	As above, cable length 40 m
RKB0008/050,0	As above, cable length 50 m

Tab. 11-4: Ethernet connecting cable

Battery kit

A battery kit is available under the following name:

Type	Note
VAS04.1-001-002-NN	Battery kit

Tab. 11-5: Battery kit for VCP devices

11.2.5 Documentation

The following documentation provides comprehensive descriptions of the VCP small operator panels:

- Rexroth IndraControl VCP 02.2
  (DOK-SUPPL*-VCP*02.2***-PRRS-EN-P)
- Rexroth IndraControl VCP 05.2
  (DOK-SUPPL*-VCP*08.2***-PRRS-EN-P)
- Rexroth IndraControl VCP 08.2
  (DOK-SUPPL*-VCP*08.2***-PRRS-EN-P)
- Rexroth IndraControl VCP 11.2
  (DOK-SUPPL*-VCP*20.2***-PRRS-EN-P)
- Rexroth IndraControl VCP 20.2
  (DOK-SUPPL*-VCP*20.2***-PRRS-EN-P)
- Rexroth IndraControl VCP 25.2

(DOK-SUPPL*-VCP*25.2***-PRRS-EN-P)

- Rexroth IndraControl VCP 35.2
  (DOK-SUPPL*-VCP*35.2***-PRRS-DE-P)

11.3 Hand-held terminal – VCH

11.3.1 Brief description

Operating, setting up, parameterizing and diagnosing from anywhere - IndraControl VCH 08 makes it possible using Ethernet TCP/IP. When connecting and removing, the "Stop" function is automatically bridged and guarantees trouble-free operation.

Low weight and optimum design allow to work without effort and provide excellent operating comfort.

The integrated 3-stage enabling button and the Stop button of a 2-circuit design are integrated by the VAC 30 switch-on box and thus ensure maximum safety.

Special features:

- Safety functions for humans and machine
- Handles with integrated enabling and stop buttons
- Robust construction for industrial use
- Ergonomically optimized for a safe and comfortable handling
- Brilliant 3.8“ graphic display and an all-purpose usable membrane keyboard for convenient operation and visualization



Fig. 11-8: IndraControl VCH 08

11.3.2 Field of application

The VCH 08 is designed for handling applications.

11.3.3 Technical data

	VCH 08
Display	3.8" gray scale, 320 x 240 pixels
Front panel design	15 function keys 25 system keys 40 operating keys
Enabling button	Number: 2 2-circuit, 3-stage
Stop button	Number: 1 2-circuit
Handwheels	Number: 1 (option)
Override potentiometer	Number 1: (Option)
Processor	CPU PXA 270/416 MHZ (standard)
Memory	64 MB (application) 64 MB (flash)

Tab. 11-6: Technical data of the VCH 08

11.3.4 Variants

The following VCH 08 variants are available:

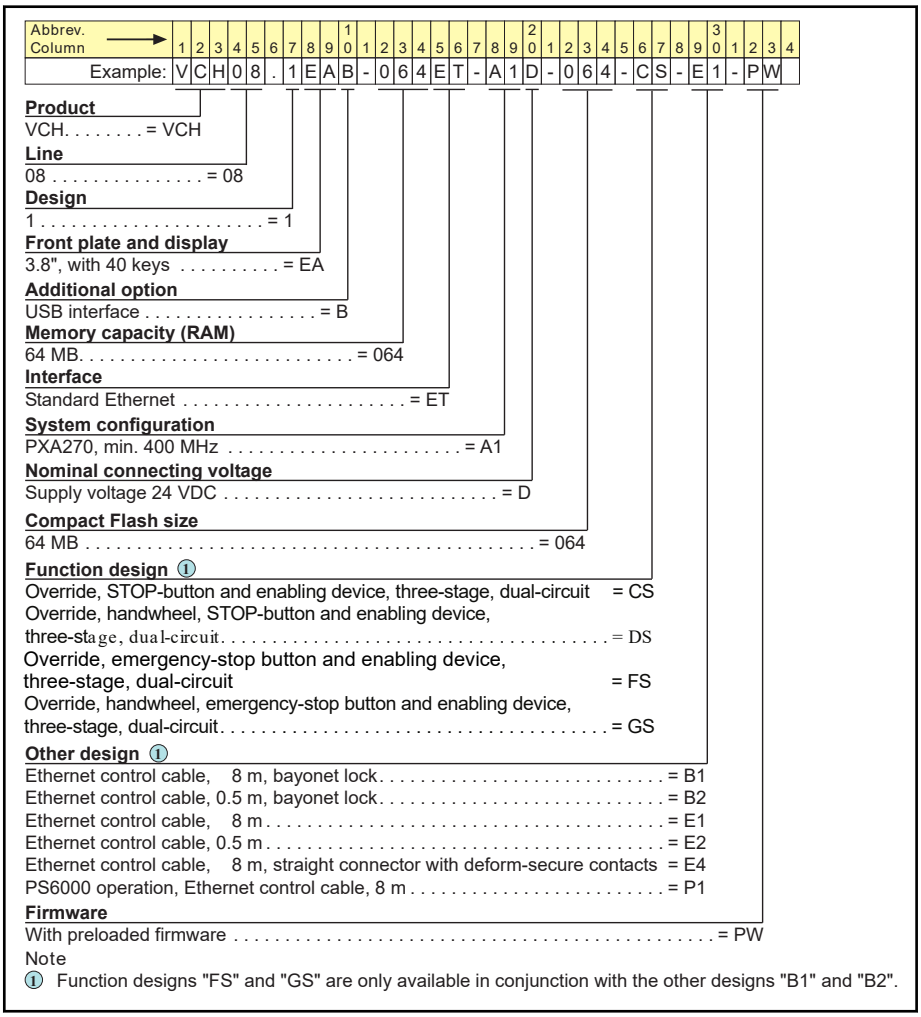


Fig. 11-9: Type code VCH 08.1

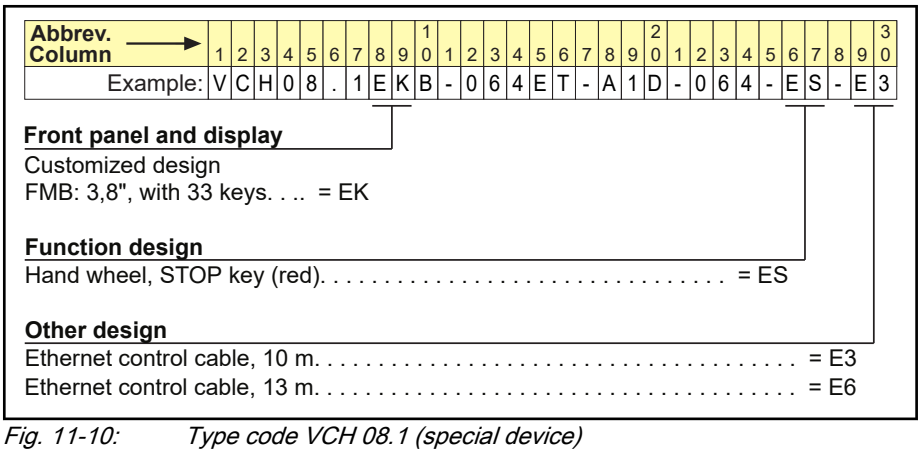


Fig. 11-10: Type code VCH 08.1 (special device)

11.3.5 Accessories

The following accessories are available for the VCH 08:

Type	Remarks
VAS01.1-002-NNN-NN	Wall bracket VAS 01
VAC30.2N-NN	VAC 30

Tab. 11-7: Accessories for the VCH 08

11.3.6 Documentation

The following documentation is available for the comprehensive description of the VCH 08 hand-held terminal:

- Rexroth IndraControl VCH 08.1 Hand-Held Terminal
  (DOK-SUPPL*-VCH*08.1***-PRRS-EN-P)
- Rexroth IndraControl VCH 08.1 Hand-Held Terminal
  (DOK-SUPPL*-VCH*08*****-ITRS-EN-P)
- IndraControl V-Devices Operation Systems
  (DOK-GENERL-IND* CL*V*SW-PRRS-EN-P)
  Rexroth IndraControl VAC 05.1, VAC 30.2, VAC 31.1 Connection Modules
  (DOK-SUPPL*-VAC*XX.X***-ITRS-EN-P)

11.4 Hand-held terminal – VH 2110.01

11.4.1 Brief description

Operation, setup, parameterization and diagnosing, irrespective of the location - use the VH 2110.01 (via Ethernet TCP/IP).

The integrated enabling button and the 2-circuit-executed E-STOP button are blended via the connection module VAC 31.1 and ensure safety.

Special features:

- Safety functions for humans and machine
- Robust construction for industrial use
- Brilliant 10.1“ LCD display with multi-touch glass front for a comfortable operation and visualization



Fig. 11-11: VH 2110.01

11.4.2 Field of application

The VH 2110.01 hand-held terminal is designed for the use in handling applications.

11.4.3 Technical data

Housing	Aluminum housing brushed plastic handles
Degree of protection of the housing	IP 54
Display	10.1" LCD display, 1280 x 800 pixel WXGA
Surface of the front panel	Glass
Touch	Capacitive multi touch. Can be operated with two fingers
Enabling switch (Enabling control)	Number: 1 2-circuit, 3-stage
E-STOP button	Number: 1 2-circuit, engaged
Override potentiometer	Number: 1 16-stage Gray code via UDP protocol
Interfaces	Ethernet 10/100 MBit 1 × USB 2.0 OTG, external to connect memory sticks, mouse or keyboard
Voltage supply	24 V DC (via VAC connection module VAC31.1C-NN)
Processor	ARM Cortex™-A9
RAM	512 MB RAM

Bulk memory	512 MB Flash
Connecting cable	8 m (with anti-kink protection) to the connection module VAC 31.1 via bayonet connector
Operating system	Windows embedded compact 7
Visualization	WinStudio
Weight	Approx. 1250 g (without cable)

Tab. 11-8: Technical data VH 2110.01

The mobile hand-held terminal VH 2110.01 was developed according to the industrial standards DIN EN 61131-2, 61000-6-2 and 61000-6-3.

11.4.4 Accessories

The following accessories are available for VH 2110.01:

Type	Remarks
VAC31.1C-NN	Connection module VAC 31.1 without bridging the E-STOP button

Tab. 11-9: Accessories for VH 2110.01

11.4.5 Documentation

The following documentation is available for VH 2110.01:

- VH 2110.01 Hand-held terminal
  (DOK-SUPPL*-VH*21**.01*-ITRS-EN-P)
- VAC 05.1, VAC 30.2, VAC 31.1 Connection Modules, DOK-SUPPL*-VAC*XX.X***-ITRS-EN-P

11.5 Small control panels – VR 21

11.5.1 Brief description

The small control panels of the VR21 series are operating and visualization terminals to operate and monitor machines. The devices are suitable for a number of different applications due to their compact design. The devices are available with screen diagonals of 4.3", 7" and 9". Configuring operating screens using Rexroth WinStudio. Communication with a parent control takes place via Ethernet interface.

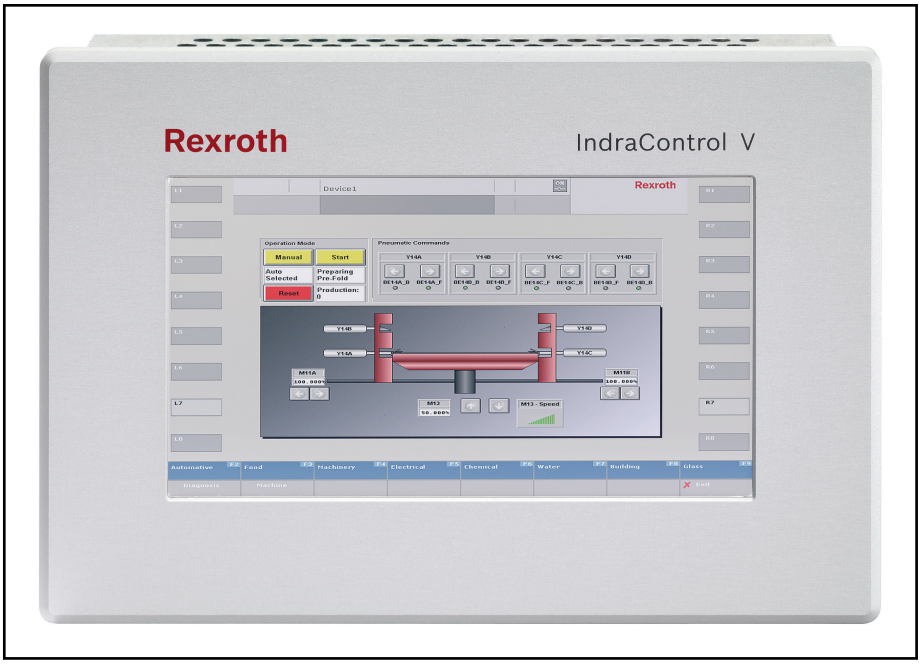


Fig. 11-12: Small control panel VR2104

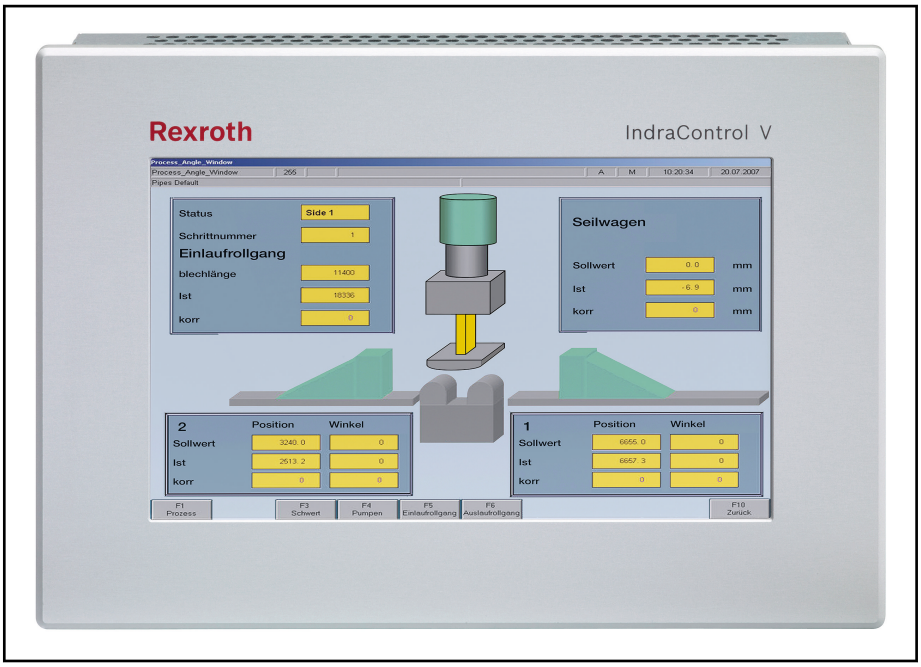


Fig. 11-13: Small control panel VR2107

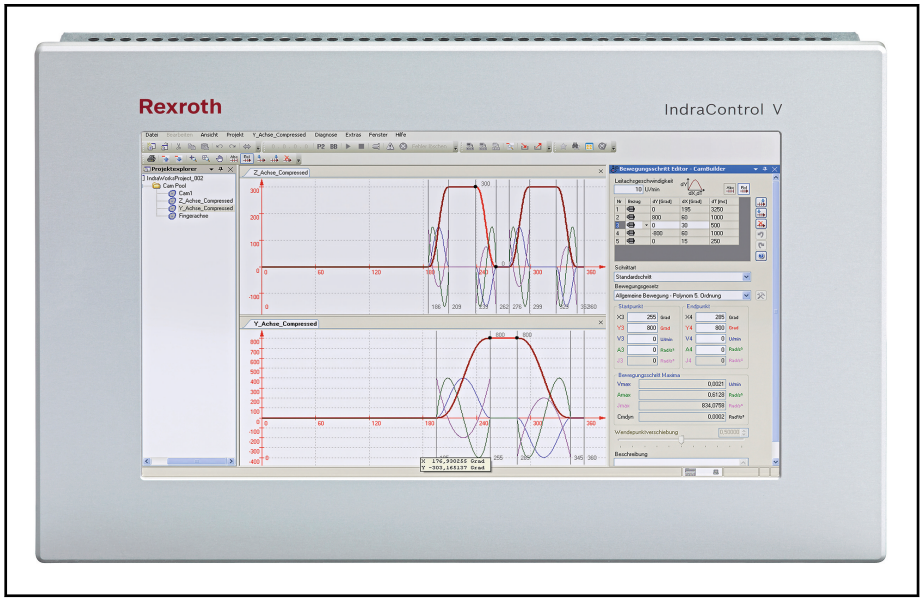


Fig. 11-14: Small control panel VR2109

11.5.2 Variants

VR 21 devices are available in different variants. The devices differ in display size and in the touch technology (single touch and multi touch).

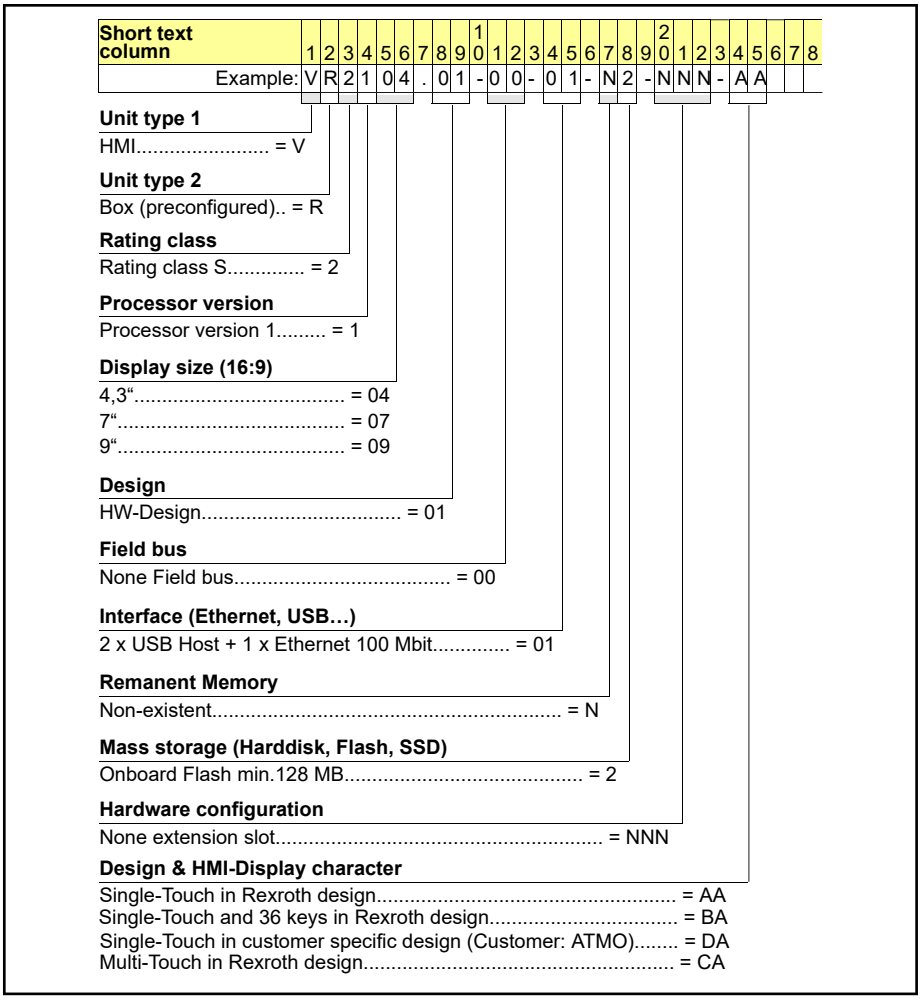


Fig. 11-15: Type code VR 21

11.5.3 Technical data

VR 21 single touch

	VR2104 single touch	VR2107 single touch	VR2109 single touch
Display	107.95 mm TFT (4.3") 480 × 272 pixels 65536 colors Brightness 450 cd/m^2 Display size 53.8 × 95 (H × W)	177.8 mm TFT (7") 800 × 480 pixels 262144 colors Brightness 350 cd/m^2 Display size 91.4 × 152.4 (H × W)	228.6 mm TFT (9") 800 × 480 pixels 16.77 millions of color Brightness 360 cd/m^2 Display size 117 × 195 (H × W)
Touch technology	Analog resistive, 4-wire-technology		
Touch activation pressure	15 g (standard) with R8 HS60 silicone rubber		
Housing	Sheet steel, electroplated		
Front panel material	Aluminum, brushed, naturally anodized		
Degree of protection	Front panel IP 65 acc. to DIN EN 60 529, rear panel IP 20		
Central unit	ARM Cortex™-A8, 800 MHz with real-time clock		

	VR2104 single touch	VR2107 single touch	VR2109 single touch
Flash memory	256 MBytes		
LPDDR memory	512 MBytes		
Power supply	24 V DC		
Current consumption	0.2 A (typical for 24 V) 0.3 A (maximum)	0.3 A (typical for 24 V) 0.4 A (maximum)	0.6 A (typical for 24 V) 0.7 A (maximum)
Connected load	4.8 W	7.2 W	14.4 W
Fuse	Semiconductor fuse, self-resetting		
Reverse voltage protection	Integrated		
USB	2 x USB Max. 500 mA for each USB socket Total current at all USB sockets is up to 1 A		
Weight	Ca. 0.6 kg	Ca. 0.8 kg	Ca. 1.3 kg

Tab. 11-10: Technical data of the VR 21 single touch

VR 21 Multi Touch

	VR2107 multi touch	VR2109 multi touch
Display	177.8 mm TFT (7") 800 × 480 pixels 262144 colors Brightness 350 cd/m^2 Display size 91.4 × 152.4 (H × W)	228.6 mm TFT (9") 800 × 480 pixels 16.77 millions of color Brightness 360 cd/m^2 Display size 117 × 195 (H × W)
Touch technology	Projected capacitive, operable with fingers (touch)	
Touch activation pressure	15 g (standard) with R8 HS60 silicone rubber	
Housing	Sheet steel, electroplated	
Front panel material	Aluminum, brushed, naturally anodized	
Surface of the front panel	Glass	
Degree of protection	Front panel IP 65 acc. to DIN EN 60 529 Rear panel IP 20	
Central unit	ARM Cortex^{TM}-A8, 800 MHz with real-time clock	
Flash memory	256 MBytes	
LPDDR memory	512 MBytes	
Power supply	24 V DC	
Current consumption	0.4 A (typical for 24 V) 0.5 A (maximum)	0.7 A (typical for 24 V) 0.8 A (maximum)
Connected load	9.6 W	16.8 W
Fuse	Semiconductor fuse, self-resetting	
Reverse voltage protection	Integrated	

	VR2107 multi touch	VR2109 multi touch
USB	2 x USB Max. 500 mA for each USB socket Total current at all USB sockets is up to 1 A	
Weight	Ca. 0.8 kg	Ca. 1.3 kg

Tab. 11-11: Technical data of the VR 21 multi touch

11.5.4 Accessories and spare parts

The following external power supply unit is available for VR 21:

Type	Part number	Remarks
VAP01.1H-W23-024-010-NN	R911171065	External 24 V power supply unit for devices of the V series

Tab. 11-12: External 24 V power supply unit for devices of the V series

11.5.5 Documentation

The following documentation is available for the small control panel VR21

- VR 21 Operator panel
  (DOK-SUPPL*-VR21**.01**-ITRS-EN-P)
- V-devices operating systems
  (DOK-GENERL-IND*CL*V*SW-PRRS-EN-P)
- VAP 01.1 power supply unit
  (DOK-SUPPL*-VAP*01.1H**- ITRS-EN-P)

11.6 Embedded devices – VEP

11.6.1 Brief description

The embedded devices of the VEP series allow to operate the machine easily and conveniently using a touch screen or a virtual keyboard. These VEP devices, similar to PCs, use only embedded components for a robust design.

Due to the large number of interfaces and slots, VEP devices ideally adapt to the machine and system requirements.

Special features:

- Compact device design for the installation in control cabinets or on a support arm
- Non-hard drive hardware without rotating media
- Visualization, operation and monitoring with WinStudio/Operation Desktop visualization software

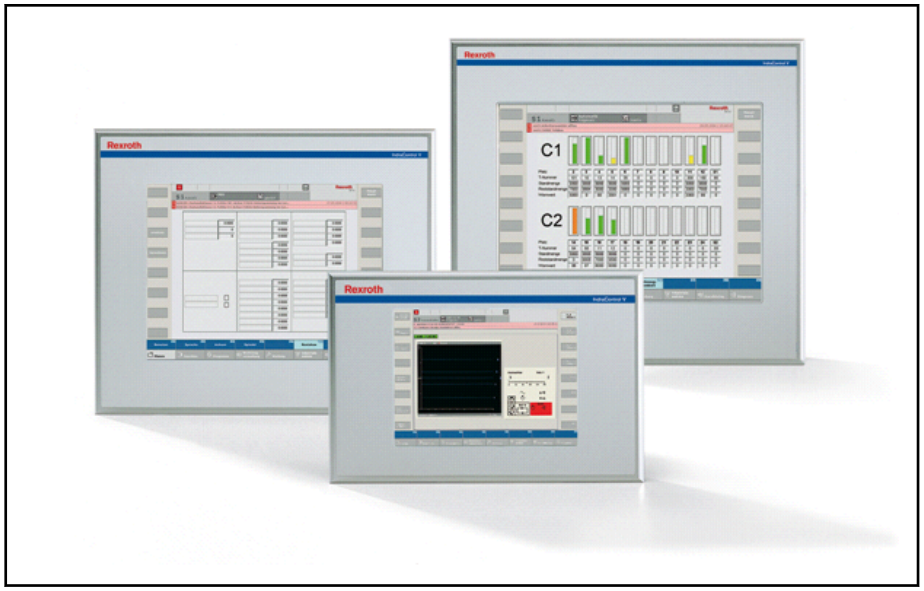


Fig. 11-16: VEP xx.4/xx.5 variants

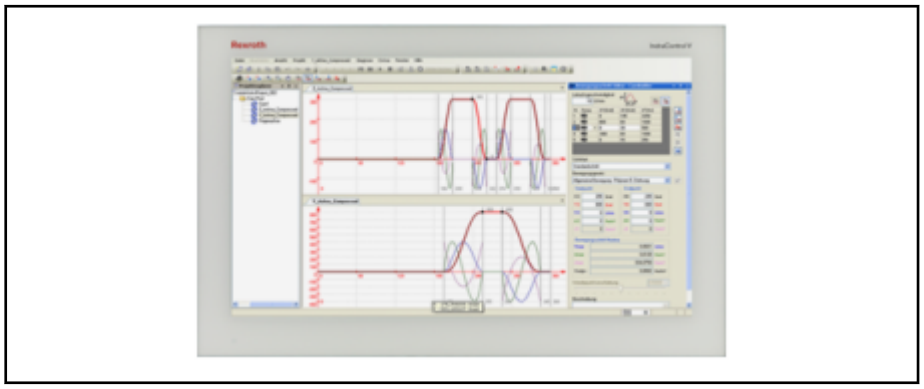


Fig. 11-17: VEP 15.6 Multi touch

11.6.2 Field of application

The standard industrial operating terminals VEP are primarily used for all tasks in the PC-based automation.

11.6.3 Technical data

VEP xx.4

	VEP 30.4	VEP 40.4	VEP 50.4
Display	8.4” color display	12" color display	15" color display
Operation	Touch control	Touch control or touch and key control	Touch control or touch and key control
Keyboard	Virtual keyboard		
Interfaces	2 x USB 2.0 - Connection (type A) 2 x (Intel Celeron) or 1 x (Intel Atom) Ethernet port (RJ 45, 10/100 Base-T)		
Processor	Intel Celeron 600Mhz / Intel Atom 1.1 GHz		
Main memory	512MB / 1 GB		
Compact Flash	2 CF socket / equipped with 1GB CF card or 4 GB CF card		

Supply voltage	24 V DC
Operating system	Windows CE 6.0 / Windows XPe

Tab. 11-13: Technical data of the VEP 30.4/40.4/50.4

VEP xx.5

	VEP 30.5	VEP 40.5	VEP 50.5
Display	8.4” color display	12" color display	15" color display
Operation	Touch control	Touch control or touch and key control	Touch control or touch and key control
Keyboard	Virtual keyboard		
Interfaces	2 x USB 2.0 - Connection (type A) 2 x Ethernet ports (RJ 45, 10/100 Base-T)		
Field bus	-		
Processor	Atom N455 1.66 GHz		
Main memory	2 GB		
Compact Flash	Equipped with 2 CF socket / 4 GB CF card		
Supply voltage	24 V DC		
Operating system	Windows XPe / Windows 7e		

Tab. 11-14: Technical data of the VEP 30.5 / 40.5 / 50.5

VEP 15.6

	VEP 15.6
Display	396 mm TFT (15") 1366 × 768 pixels 16.7 millions of color
Operation	Multi touch
Surface of the front panel	Thermally tempered glass
Degree of protection	Front panel IP 65 acc. to DIN EN 60 529 Front type 1 acc. to NEMA (UL) Built-in device: Rear panel IP 20 Housing device: IP65
Voltage supply	24 V DC (use a 24 V industrial power supply unit acc. to DIN EN 60742, classification VDE 0551, for example VAP01.1H-W23-024-010-NN, part number R911171065)
Current consumption	1.5 A at 24 V DC
Power loss	36 W
USB	USB 2.0, max. 0.5 A/connection USB 3.0, max. 0.9 A/connection
Weight	Housing devices: Approx. 5.54 kg Housing devices: Approx. 7.04 kg

Tab. 11-15: Technical data of the VEP 15.6

11.6.4 Variants

The following operator terminal VEP xx.4 variants are available:

Abbrev. Column →	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Example:	V	E	P	3	0	.	4	E	F	U	-	5	1	2	3	C	-	M	B	D	-	1	G	0	-	N	N	-	F	W

Product
VEP..... = VEP

Line
30..... = 30
40..... = 40
50..... = 50

Design
4..... = 4

Front panel and display
Rexroth design
8,4", Touch screen with switching elements= DP
8,4", Touch screen with front USB.....= EF
8,4", Touch screen and
machine function keys, with front USB..... = EK

12", with 16 machine function keys..... = BK
12", Touch screen..... = DB
12", Touch screen with front USB and
machine function keys..... = EI

15“, with 16 machine function keys ..... = BI
15", Touch screen..... = DE
15“, Touch screen and 16
machine function keys (MTX)..... = DF

Customized design
Bosch:8,4" Touch screen without front USB= AO
Bosch:12" Touch screen without front USB = AP
Bosch:15" Touch screen without front USB = AQ

Additional option
Without..... = N
Short-time UPS..... = U

Memory capacity
256 MB..... = 256
512 MB..... = 512
1 GB..... = 1G0

Interface ①
Not equipped..... = NN
DN-NN..... = NB
P2-NN..... = NC
DN-33..... = 3B
P2-33..... = 3C

System configuration
Celeron M, min. 600 MHz..... = MA
Celeron M, min. 1 GHz..... = MB
Intel Atom, min. 1,1 GHz..... = A2

Supply voltage
DC 24 V..... = D

Compact Flash size
Without Compact Flash..... = NN
e.g. 1 GB..... = 1G0

Other design
None..... = NN
In the system housing..... = CG

Firmware and Software
Denotes that firmware and software must be ordered as separate subposition..... = FW

Note
① Interface:
NN = Not equipped
33 = 2 x Sercos III
DN = Devicenet - NETX
P2 = Profibus-DP Master module - NETX

Fig. 11-18: VEP xx.4 variants

The following operator terminal VEP xx.5 variants are available:

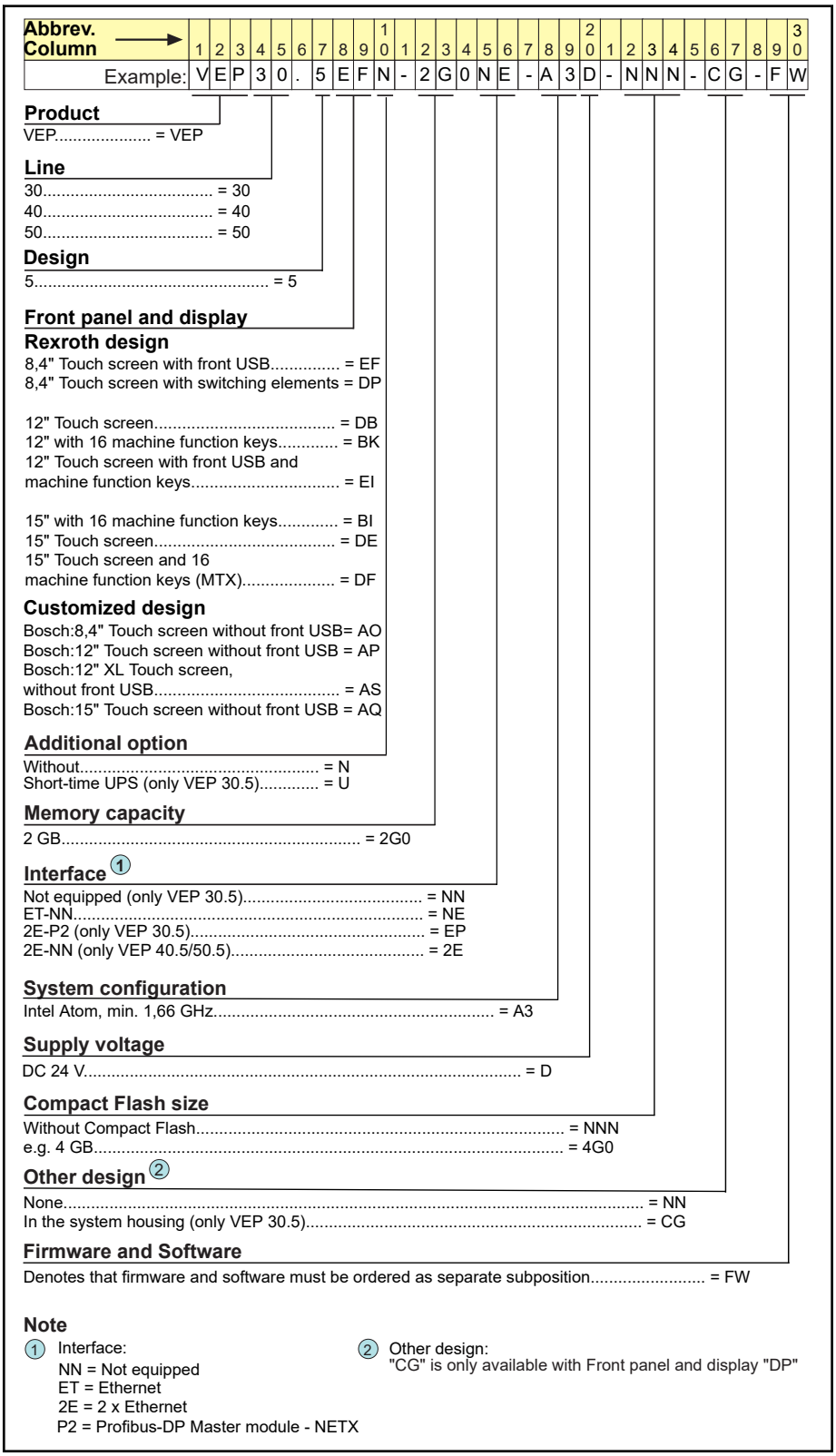


Fig. 11-19: VEP xx.5 variants

The following operator terminal VEP 15.6 variants are available:

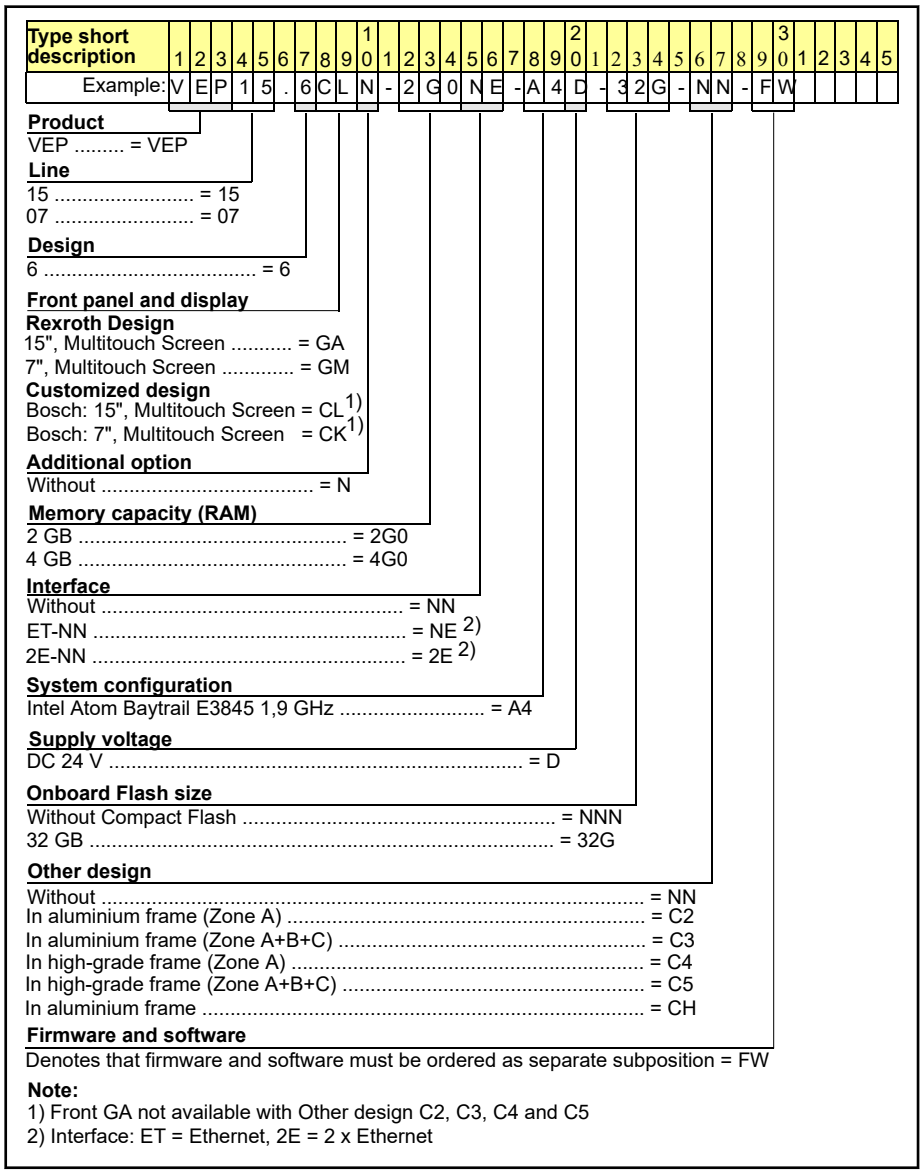


Fig. 11-20: VEP 15.6 variants

11.6.5 Wear parts

Parts with a limited service life are installed in the industrial operator terminals VEP and are therefore not subject to warranty.

This applies to the following components:

- CF card
- Battery
- Backlight
- Display

11.6.6 Accessories

The following accessories are available for VEP devices:

Type	Remarks
CFM01.1-01G0-N-LBA-NN-NW	Compact flash module 1 GByte (VEP xx.4/xx.5)
CFM01.1-04G0-N-LBA-NN-NW	Compact flash module 4 GByte (VEP xx.4/xx.5)
CFM01.1-08G0-N-LBA-NN-NW	Compact flash module 8 GByte (VEP xx.4/xx.5)
CFM02.1-16G0-E-LBA-NN-NW	CFAST card 16 GB (VEP 15.6)
VAK40.1E-DE-U-MPNN	VAK 40 (drawer keyboard USB, DE)
VAK40.1E-EN-U-MPNN	VAK 40 (drawer keyboard USB, EN)
VAP01.1H-W23-024-010-NN	External 24 V power supply unit for devices of the V series

Tab. 11-16: Accessories for VEP devices

11.6.7 Documentation

The following documentation is available for a detailed description of the compact industrial PC VEP:

- VEP **.4 Embedded terminal
  (DOK-SUPPL*-VEP**.4****-PRRS-EN-P)
- VEP **.4 Embedded terminals
  (DOK-SUPPL*- VEP*XX.4***-ITRS-EN-P)
- VEP xx.5 Embedded terminals
  (DOK-SUPPL*- VEP*XX.5***-ITRS-EN-P)
- VEP 07.6/15.6 Multi touch operator display - Housing and built-in devices,
  (DOK-SUPPL*-VEPXX.6MTHU-ITRS-EN-P)
- VAK 10.1, VAK 40.1 Drawer Keyboard
  (DOK-SUPPL*-VAK*X0.1***-ITRS-EN-P)
- V-devices operating systems
  (DOK-GENERL-IND* CL*V*SW-PRRS-EN-P)
- VAP 01.1 power supply unit
  (DOK-SUPPL*-VAP*01.1H**-ITRS-EN-P)

11.7 Panel PC – VPP

11.7.1 Brief description

The VPP panel PCs are active PC-based operating and visualization terminals with excellent industrial capability. The panel PCs are predominantly mounted on a control panel or on the wall of a control cabinet.

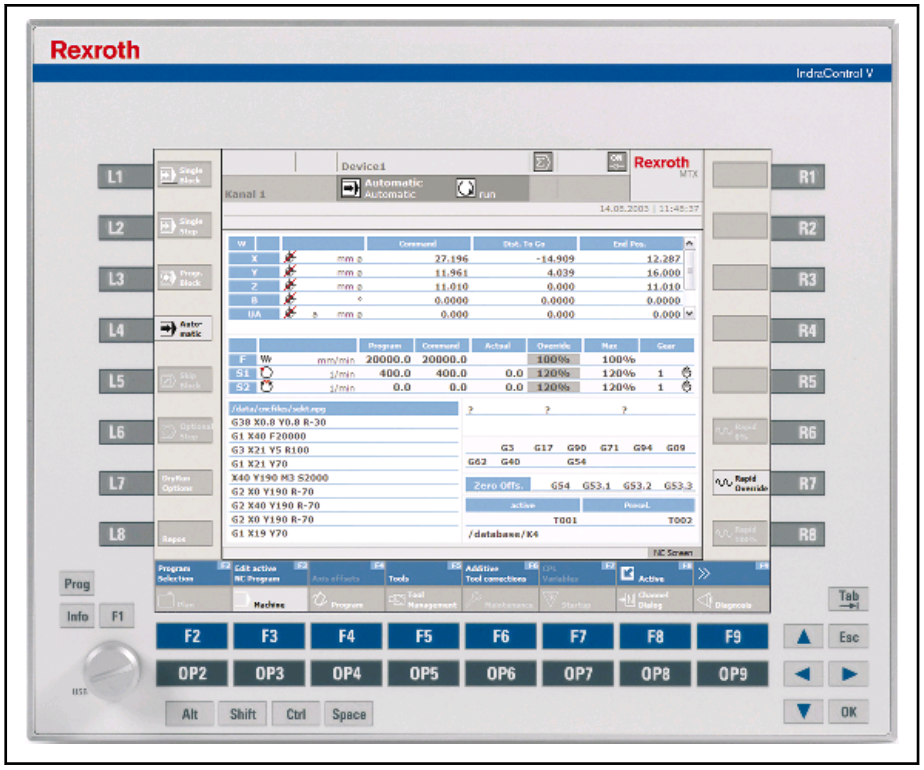


Fig. 11-21: Panel PC VPP xx.3 with color display

11.7.2 Field of application

The panel PCs of the VPP xx.3 series are used in standard applications up to high-end applications.

11.7.3 Operating system

Due to licensing reasons, the devices of the VPP xx.3 series are only delivered with an already installed operating system (either Windows XP Professional or Windows Embedded Standard 7 P).

11.7.4 Technical data

	VPP 16.3	VPP 40.3	VPP 60.3
Display	12" color display	15" color display	19" color display
Front panel design	16 machine function keys Front USB port		
PC box	1, 2 or 4 slots		
Processor	Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz		
RAM	2 GB (max. 4 GB)		
HDD hard disk	320 GB SATA, alternatively 2 × 320 GB (RAID1) or 192 GB SSD		
Optional drives	DVD writer (for 4-slot variant)		

Interfaces	6 × USB port (type A) 2 x Ethernet port (RJ 45, 10/100/1000 Base-T) 1 × VGA port
Voltage supply	24 V DC

Tab. 11-17: Technical data for the VPP 16.3/40.3/60.3

11.7.5 Variants

VPP xx.3 variants are available:

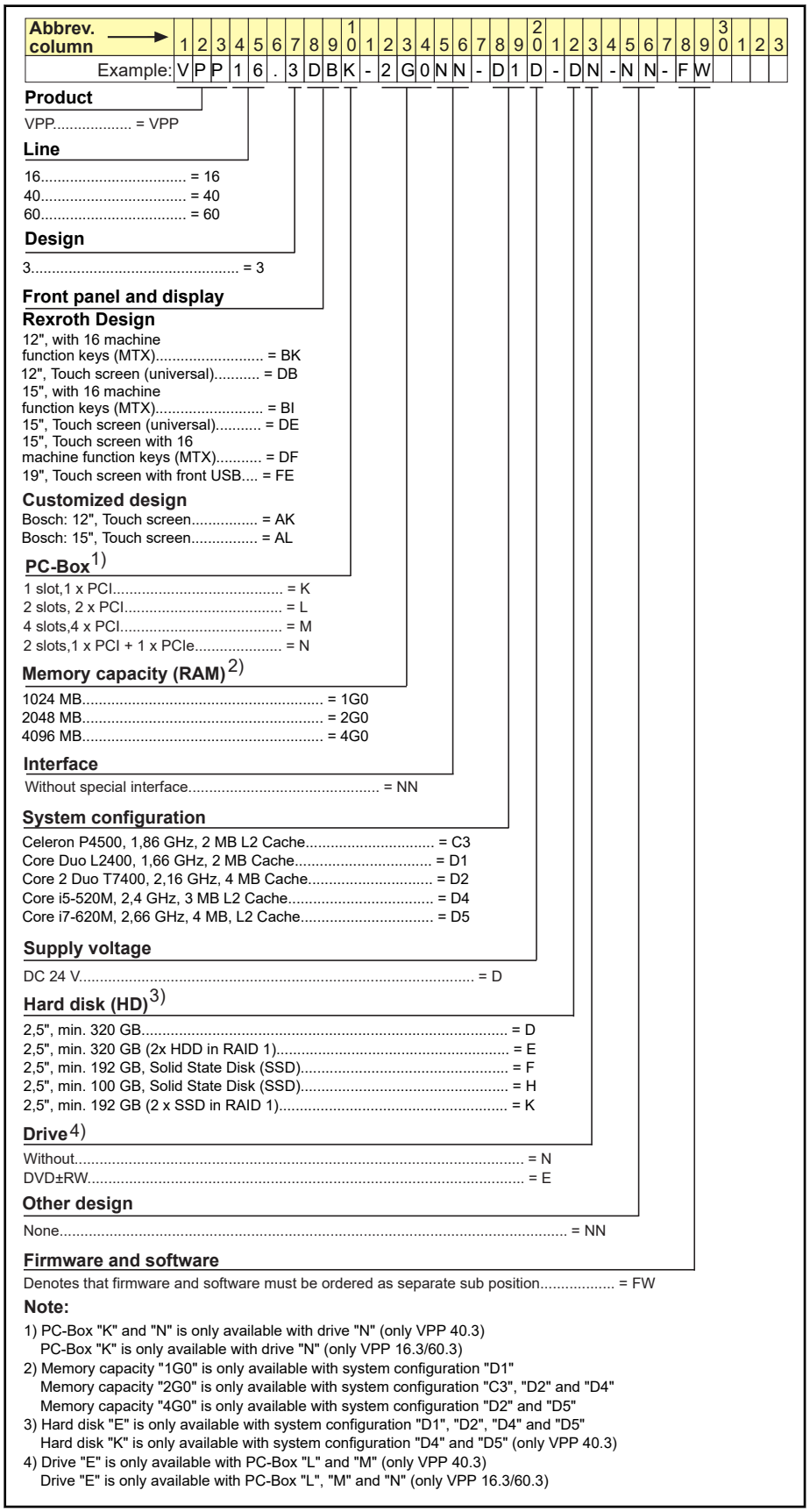


Fig. 11-22: Type code VPP xx.3

11.7.6 Wear parts

Parts with a limited service life are installed in the panel PC of the VPP 16.3/40.3 series and are therefore not subject to warranty.

This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Backlight

11.7.7 Accessories

The following accessories are available for VPP devices:

Type	Remarks
VAP01.1H-W23-024-010-NN	External 24 V power supply unit for devices of the V series
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0050/00...	USB interface cable to connect the UPS; lengths: 1.0 m; 3.0 m

Tab. 11-18: Accessories for VPP xx.3

11.7.8 Documentation

The following documentation is available for the detailed description of the panel PC VPP xx-.3:

- VPP 16.3/40.3/60.3 panel PC
  (DOK-SUPPL*-VPP*XX.3***-PRRS-EN-P)
- VAP 01.1 power supply unit
  (DOK-SUPPL*-VAP*01.1H**-ITRS-EN-P)
- VAU 01.1U USV with USB interface
  (DOK-SUPPL*-VAU*01.1U**-PRRS-EN-P)
- VAU 01.1 USV with communication interface
  (DOK-SUPPL*-VAU*01.1X**-ITRS-EN-P)

11.8 Multi touch panel PC – VPP

11.8.1 Brief description

The multi touch panel PC of the VPP 15.3 series is an active PC-based operating and visualization terminal with excellent industrial capability and multi-touch front. The VPP 15.3 multi touch device is predominantly installed in a control panel or a control cabinet wall.

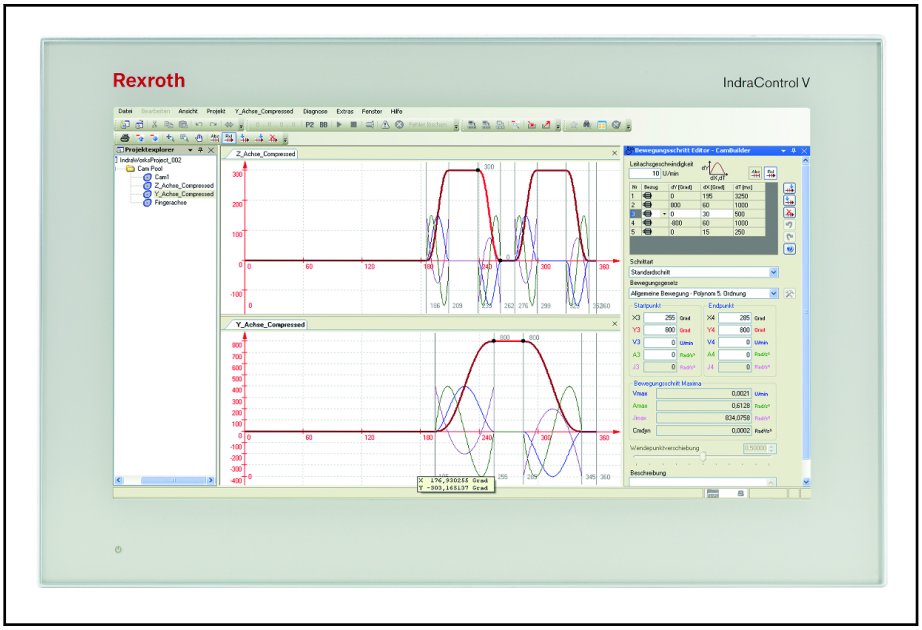


Fig. 11-23: VPP 15.3 multi touch

11.8.2 Field of application

The VPP 15.3 multi touch device is used for standard applications up to high-end requirements.

11.8.3 Operating system

Due to licensing reasons, the VPP 15.3 multi touch device is only delivered with the already installed operating system Windows Embedded Standard 7 P.

11.8.4 Technical data

	VPP15.3GAK-4G0NN-D5D-HN-NN-FW **VPP15.3GIK-4G0NN-D5D-HN-NN-FW**
Front	
Display	396 mm TFT (15") 1366 × 768 pixels 16.7 millions of color
Operation	Multi touch
Surface of the front panel	Thermally tempered glass
Degree of protection	Device P 65 acc. to DIN EN 60 529 Front type 1 acc. to NEMA (UL)
PC box	
Processor	Core i7-620M, 2.66 GHz, 4 MB L2 cache
User memory (RAM)	4096 MB
Hard drive	At least 100 GB Solid State Disk (SSD) 2.5"

	VPP15.3GAK-4G0NN-D5D-HN-NN-FW VPP15.3GIK-4G0NN-D5D-HN-NN-FW
Voltage supply	24 V DC (use a 24 V industrial power supply unit acc. to DIN EN 60742, classification VDE 0551, for example VAP01.1H-W23-024-010-NN, part number R911171065)
Slots	1 × PCI
USB ports	6 × USB 2.0 Maximum of 500 mA for each USB port. Maximum of total current of 1 A at all USB ports
Ethernet interfaces	2 × RJ45, socket, 8-pin
VGA interface	1 × HD socket, 15-pin
Current consumption	Max. 5 A
Power loss	Max. 120 W
Weight	Approx. 7.5 kg

Tab. 11-19: Technical data VPP 15.3 Multitouch

11.8.5 Variants

The VPP 15.3 multi touch device is available in the following variants:

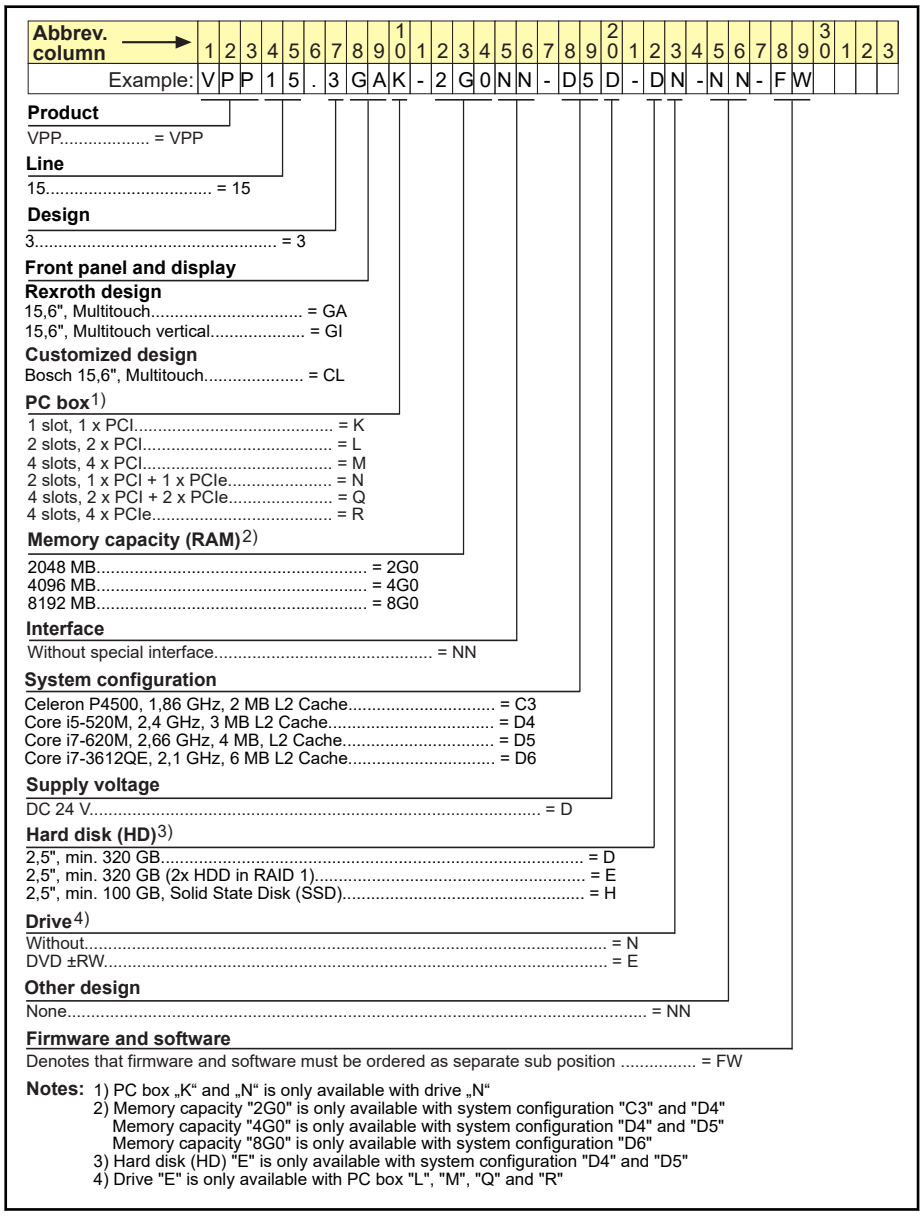


Fig. 11-24: Type code VPP 15.3 Multitouch

11.8.6 Wear parts

Parts with a limited service life are installed in the VPP 15.3 multi touch device and are therefore not subject to warranty.

This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Backlight

11.8.7 Accessories

The following accessories are available for the VPP 15.3 multi touch device:

Type	Remarks
VAP01.1H-W23-024-010-NN	External 24 V power supply unit for devices of the V series
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0050/003,0	USB connecting cable with increased noise immunity; length 3 m

Tab. 11-20: Accessories for VPP 15.3 multi touch device

11.8.8 Documentation

For a detailed description of the VPP 15.3 multi touch device, refer to the following documentation:

- VPP 15.3 Multi touch panel PC - Built-in device DOK-SUPPL*-VPP*XX.3*MT-ITxx-EN-P
- VAP 01.1 power supply unit, DOK-SUPPL*-VAP*01.1H**-ITxx-EN-P
- VAU 01.1U USV with USB interface, DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P
- VAU 01.1 USV with communication interface, DOK-SUPPL*-VAU*01.1X**-ITxx-EN-P

11.9 Multi-touch panel PC, control cabinet PC and display – VR/PR/DR

11.9.1 Brief description

Due to the 6th generation of Intel processors of different performance classes, the control cabinet PCs and the panel PCs of the series PR and VR generation provide a well-graded system for the most versatile tasks including industry 4.0 applications with a high data throughput. Multi-touch displays of the DR series are provided to visualize and operate the control cabinet PCs.

11.9.2 Area of application

The control cabinet PCs of the PR series can be mounted horizontally and vertically. To ensure an adequate visualization and operation, the high-resolution and capacitive multi-touch widescreen displays of the DR series are provided in different sizes from 12 to 21 inches. Control cabinet PC and display can either be connected using a display port/USB or the CDI+ interface. Thus, only one long cable (up to 100 meters) is required to connect up to three multi-touch displays without repeater. The panel PCs of the VR series combine the features of the PR and DR series in one device and are especially designed for HMI-based applications.

The devices are intended for the following use cases:

- Operator terminals, visualization terminals and programming terminals with an integrated soft control in stand-alone machines
- Operator terminals, visualization terminals and programming terminals for connected controls in the control cabinet PC

11.9.3 Operating systems

The devices of the series PR and VR are provided with Windows 10 IoT Enterprise LTSx upon delivery.

11.9.4 PC device series PR30/VR30

Technical data

PC box

CPU	Celeron 3955U 2.00 GHz Dual Core
GPU	Intel® HD Graphics 510
Memory	DDR4, 4 GB RAM
Audio	Analog output
Bulk memory	• 32 GByte or 256 GByte SSD
Mini PCIe (internal)	2 × Mini PCIe • mPCIe interface modules • WLAN or G4 extension
PCIe slot	No slot!
Ethernet ports	2 × Gbit i210 with synchronous cycle 1 × Gbit i219
Serial ports	1 × RS-232 1 × RS-232, RS-422, RS-485
Serial port speed	115 kbps max.
USB	2 × USB 2.0 2 × USB 3.0
Display port	1 × DP
CDI+tx	1 × CDI+tx operating display connection at a large distance
TPM	TPM 2.0 (onboard) chip: INFINEON_SLB 9665TT2.0
RTC battery	Button cell BR2032
Mounting	Front uprights mounting
Input voltage	24 V DC +25 %, -20 % with IEC 61131-2
Power consumption	70 W max.
Weight	4.6 kg
Degree of protection	IP20

Tab. 11-21: Technical data of the PC box

Panel PC

Display	396 mm TFT (15") 1366 × 768 pixels 16.2 million colors
Weight	Approx. 8.7 kg
Operation	Projected capacitive 10-point multitouch

Surface of the front panel	Chemically strengthened front glass
Degree of protection	Front panel IP 66

Tab. 11-22: Technical data of the VR3015

Optical characteristic values

TFT

The maximum permissible number and type of pixel errors of TFT displays depends on the manufacturer and is defined by the respective incoming inspection of the vendor.

Input system or multi-touch front

The maximum permissible number, type and size of defects on the front, on the glass or between the display and the front - such as trapped dust, dirt and scratches is defined in the FT quality guideline.

Ordering information

Accessories and spare parts

For ordering information on accessories and spare parts, refer to chapter "Spare parts, accessories and wear parts" on page 187

Type code

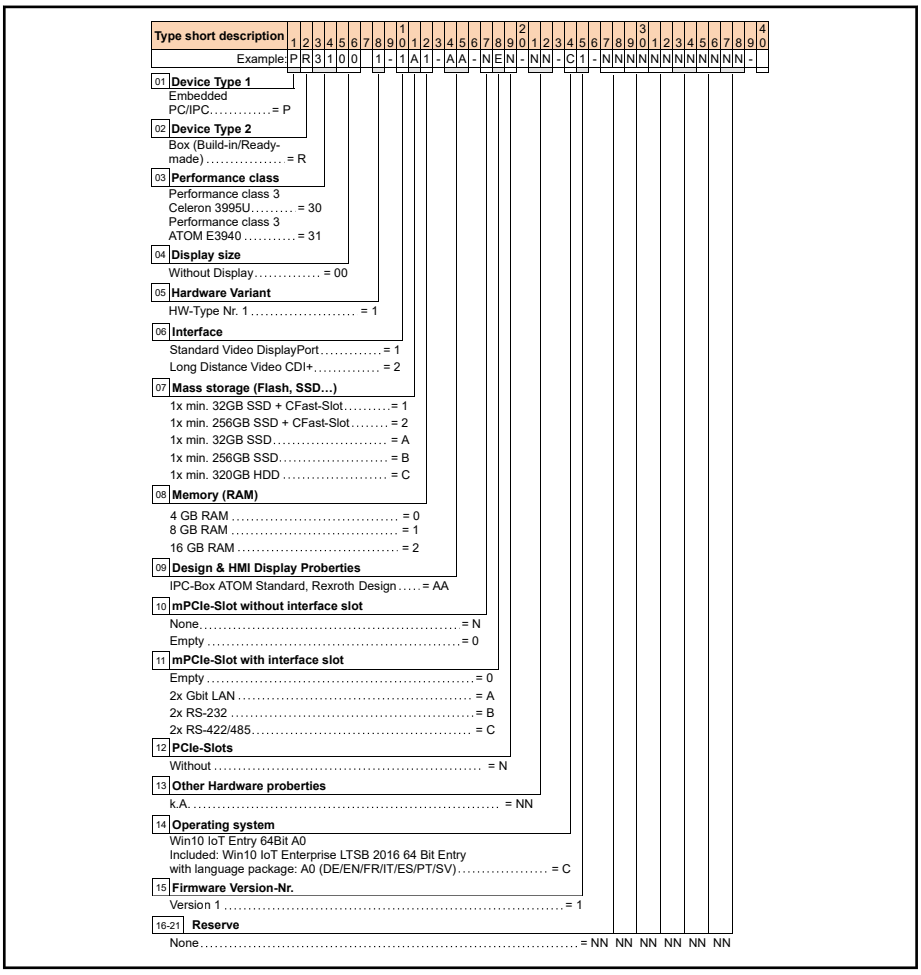


Fig. 11-25: Type code for PR3 devices

F03 (performance class)	F07 (bulk memory)
30	A
31	1, A, B
F03 (performance class)	F08 (memory)
30	0
31	0, 1
F03 (performance class)	F10 (mPCIe without interface)
30	0
31	N
F03 (performance class)	F11 (mPCIe with interface)
30	0
31	0, E
F03 (performance class)	F22 (material identifier)
30	H
31	H, B

Tab. 11-23: Dependency table

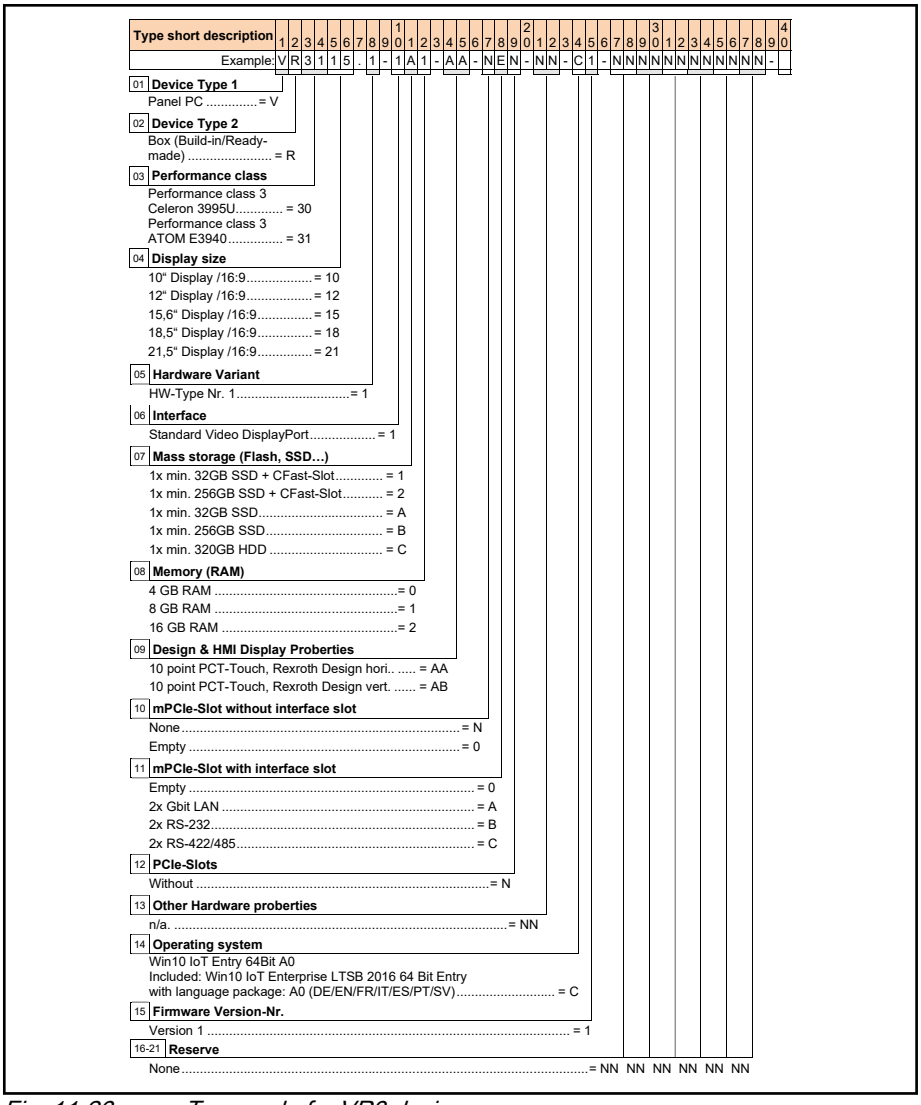


Fig. 11-26: Type code for VR3 devices

F03 (performance classes)	F04 (display size)	F09 (design and display)
30	15	AA
31	10, 15, 21	AA

F03 (performance classes)	F07 (bulk memory)
30	A, B
31	1, A, B

F03 (performance classes)	F08 (memory)
30	0
31	0, 1

F03 (performance classes)	F10 (mPCIe without interface)

30	0
31	N
F03 (performance classes)	F11 (mPCIe with interface)
30	0
31	0, E
F03 (performance classes)	F22 (material identifier)
30	H
31	H, B

Tab. 11-24: Dependency table

Spare parts, accessories and wear parts

External 24 V power supply unit

Ordering code	Part number	Description
VAP01.1H-W23-024-010-NN	R911171065	External 24 V power supply unit for IndraControl V-devices

Tab. 11-25: External 24 V power supply unit for the operator display

Uninterruptible power supply

Ordering code	Part number	Description
VAU02.1S-024-024-072-NN	R911385289	Uninterruptible Power Supply 24 V DC, 72 watt with RS232 interface

Tab. 11-26: Uninterruptible power supply (UPS)

Connecting cables for CDI+ interface

☞ Malfunctions caused by using inappropriate CDI+ cables.
Use only cables listed in the following overview.

Ordering code	Part number	Description
RKB0008/000,5 (*******-*******-*******)	R911171484	Length: 0.5 m
RKB0008/001,0 (*******-*******-*******)	R911171485	Length: 1 m
RKB0008/002,5 (*******-*******-*******)	R911170151	Length: 2.5 m
RKB0008/005,0 (*******-*******-*******)	R911170152	Length: 5 m
RKB0008/007,5 (*******-*******-*******)	R911172971	Length: 7.5 m
RKB0008/010,0 (*******-*******-*******)	R911170153	Length: 10 m
RKB0008/015,0 (*******-*******-*******)	R911171183	Length: 15 m
RKB0008/020,0 (*******-*******-*******)	R911171184	Length: 20 m
RKB0008/025,0 (*******-*******-*******)	R911170154	Length: 25 m

Ordering code	Part number	Description
RKB0008/030,0 (*******-*******-*******)	R911171381	Length: 30 m
RKB0008/035,0 (*******-*******-*******)	R911171369	Length: 35 m
RKB0008/040,0 (*******-*******-*******)	R911171382	Length: 40 m
RKB0008/050,0 (*******-*******-*******)	R911171383	Length: 50 m
RKB0008/055,0 (*******-*******-*******)	R911173779	Length: 55 m
RKB0008/060,0 (*******-*******-*******)	R911173780	Length: 60 m
RKB0008/065,0 (*******-*******-*******)	R911173781	Length: 65 m
RKB0008/070,0 (*******-*******-*******)	R911173782	Length: 70 m

Tab. 11-27: Connecting cables to control cabinet PC, panel PC and operator display. Further cable lengths are available upon request.

☞ Further cable lengths are available upon request.

USB connecting cables (USB 2.0)

Ordering code	Part number	Description
RKB0019/000,5 (*******-*******-*******)	R911171165	USB connecting cable, length 0.5 m
RKB0019/001,0 (*******-*******-*******)	R911171166	USB connecting cable, length 1 m
RKB0019/003,0 (*******-*******-*******)	R911171167	USB connecting cable, length 3 m
RKB0019/005,0 (*******-*******-*******)	R911171168	USB connecting cable, length 5 m

Connecting cables of the display port

The listed display port cables are provided with a special shielding. The display port cables meet the following specifications:

- Conform to the display port 1.2
- Resolutions up to 4096 x 2160
- Supports HDCP 1.3 and DPCP

☞ Malfunctions caused by using inappropriate display port cables.
Use only cables listed in the following overview.

Ordering code	Part number	Description
RKB0063/003,0 (*******-*******-*******)	R911391713	Connecting cable of the display port, length 3 m
RKB0063/005,0 (*******-*******-*******)	R911391714	Connecting cable of the display port, length 5 m

Wear parts

Wear parts are not subject to any warranty.

CMOS battery

The service life of the CMOS battery of type BR2032 is 5 to 7 years.

11.9.5 PC device series PR31/VR31

Technical data

PC box

	PR3100
CPU	ATOM x5 E3940 1.6 GHz Quad Core
GPU	Intel® HD Graphics 500
Memory	DDR3L, 4 GB RAM, 8 GB optional
Audio	Analog output
Bulk memory	32 GByte or 256 GByte SSD
Mini PCIe (internal)	1 × Mini PCIe • mPCIe interface module • 2 x GBit-LAN • Galvanically isolated serial interfaces
Ethernet ports	2 × Gbit i210 with synchronous cycle
Serial ports	1 × RS-232 1 × RS-232, RS-422, RS-485
Serial port speed	115 kbps max.
USB	2 × USB 2.0 2 × USB 3.0
Display port	1 × DP
CDI+tx	1 × CDI+tx operating display connection at a large distance (optional)
TPM	TPM 2.0 (onboard) chip: INFINEON_SLB 9665TT2.0
RTC battery	Button cell BR2032
Mounting	Front upright mounting
Input voltage	24 V DC +25 %, -20 % with IEC 61131-2
Power consumption	60 W max.
Weight	2.8
Degree of protection	IP20

Tab. 11-28: Technical data of PR3100

	2 × GBit LAN (optional)
Controller	Intel® I350-AM2 LAN Controller
Ethernet	10/100/1000 Mbps

Tab. 11-29: Technical data 2 × GBit LAN

	RS-422/485, electrically isolated (optional)
COM interface type	RS-422/485
Host interface	USB 2.0
Plug-in connector	2 x D-Sub, 9-pin, male.
Insulation protection	2,000 V DC
ESD protection	15 KV
EFT protection	2,500 V
Surge protection	1,000 V DC

Tab. 11-30: Technical data RS-422/485, electrically isolated

	RS-232, electrically isolated (optional)
COM interface type	RS-232
Host interface	USB2.0
Plug-in connector	2x D-Sub 9-pin, male.
Insulation protection	2,000 V DC
ESD protection	15 KV
EFT protection	2,500 V
Surge protection	1,000 V DC

Tab. 11-31: Technical data of the RS-232, electrically isolated

Panel PC

	VR3110	VR3115	VR3121
Display	257 mm TFT (10.1") 1280 × 800 pixels 16.2 million colors	396 mm TFT (15") 1366 × 768 pixels 16.2 million colors	546 mm TFT (21") 1920 × 1080 pixels 16.7 million colors
Weight	Approx. 4.1 kg	Approx. 7.0 kg	Approx. 9.4 kg
Operation	Projected capacitive 10-point multitouch		
Surface of the front panel	Chemically strengthened front glass		
Degree of protection	Front panel IP 66		

Tab. 11-32: Technical data of the VR3110, VR3115 and VR3121

Optical characteristic values

TFT

The maximum permissible number and type of pixel errors of TFT displays depends on the manufacturer and is defined by the respective incoming inspection of the vendor.

Input system or multi-touch front

The maximum permissible number, type and size of defects on the front, on the glass or between the display and the front - such as trapped dust, dirt and scratches is defined in the FT quality guideline.

Ordering information

Accessories and spare parts

For ordering information on accessories and spare parts, refer to chapter "Spare parts, accessories and wear parts" on page 193

Type code

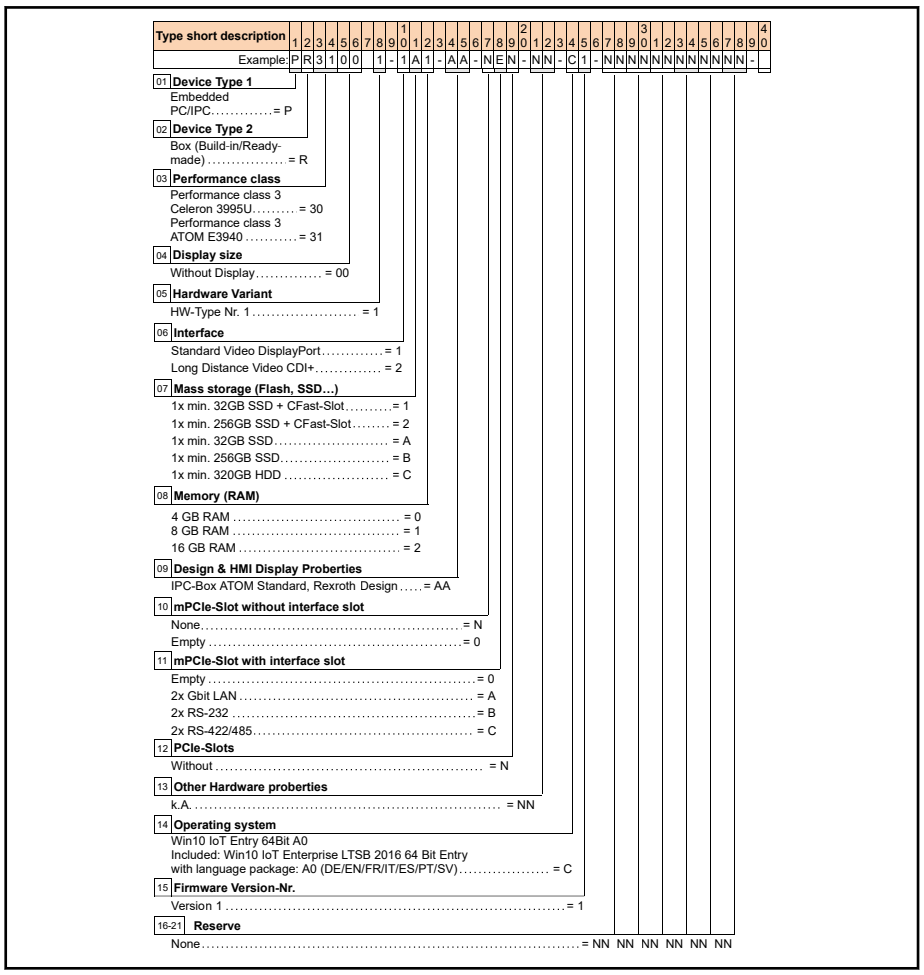


Fig. 11-27: Type code for PR31 devices

F03 (performance class)	F07 (bulk memory)
30	A
31	1, A, B
F03 (performance class)	F08 (memory)
30	0
31	0, 1
F03 (performance class)	F10 (mPCIe without interface)
30	0
31	N

F03 (performance class)	F11 (mPCIe with interface)
30	0
31	0, E

F03 (performance class)	F22 (material identifier)
30	H
31	H, B

Tab. 11-33: Dependency table

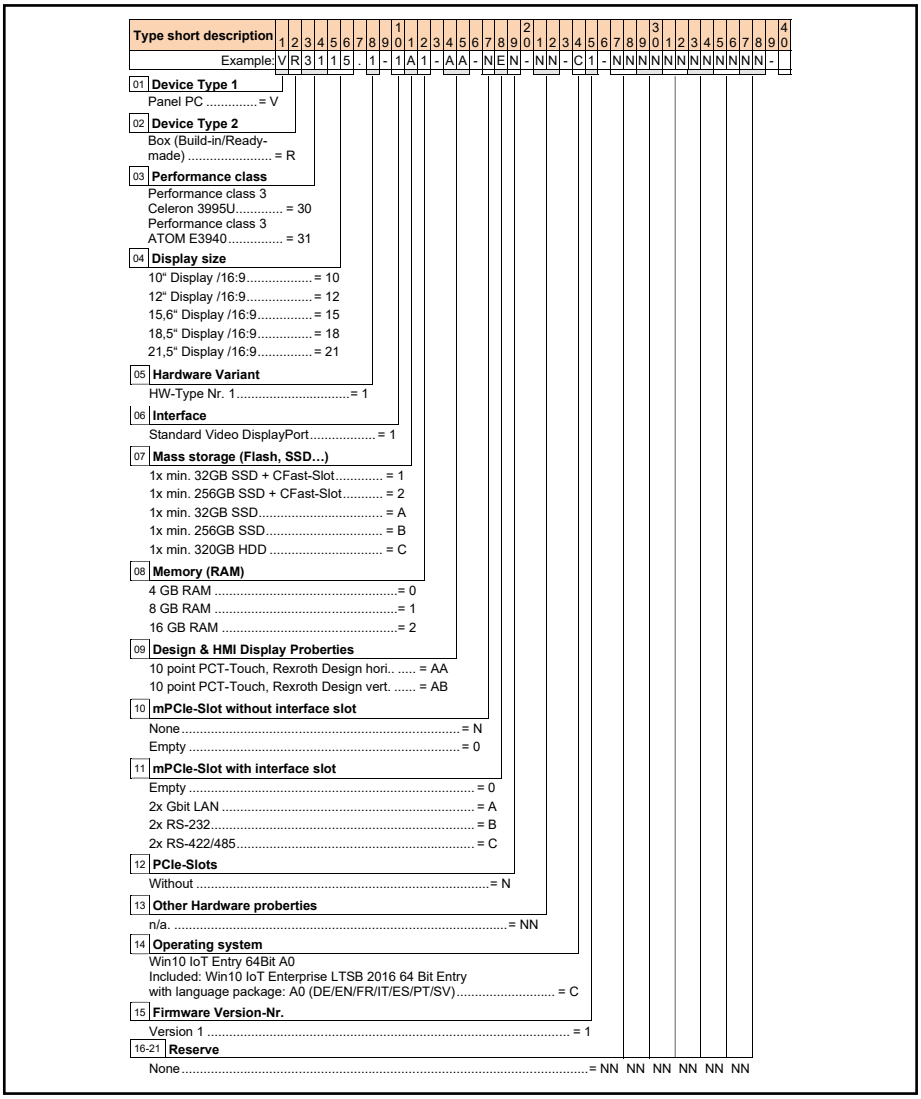


Fig. 11-28: Type code for PR31 devices

F03 (performance classes)	F04 (display size)	F09 (design and display)
30	15	AA
31	10, 15, 21	AA

F03 (performance classes)	F07 (bulk memory)
30	A, B
31	1, A, B
F03 (performance classes)	F08 (memory)
30	0
31	0, 1
F03 (performance classes)	F10 (mPCIe without interface)
30	0
31	N
F03 (performance classes)	F11 (mPCIe with interface)
30	0
31	0, E
F03 (performance classes)	F22 (material identifier)
30	H
31	H, B

Tab. 11-34: Dependency table

Spare parts, accessories and wear parts

External 24 V power supply unit

Ordering code	Part number	Description
VAP01.1H-W23-024-010-NN	R911171065	External 24 V power supply unit for IndraControl V-devices

Tab. 11-35: External 24 V power supply unit for the operator display

Uninterruptible power supply

Ordering code	Part number	Description
VAU02.1S-024-024-072-NN	R911385289	Uninterruptible Power Supply 24 V DC, 72 watt with RS232 interface

Tab. 11-36: Uninterruptible power supply (UPS)

Connecting cables for CDI+ interface

☞ Malfunctions caused by using inappropriate CDI+ cables.
Use only cables listed in the following overview.

Ordering code	Part number	Description
RKB0008/000,5 (*******-*******-*******)	R911171484	Length: 0.5 m
RKB0008/001,0 (*******-*******-*******)	R911171485	Length: 1 m
RKB0008/002,5 (*******-*******-*******)	R911170151	Length: 2.5 m
RKB0008/005,0 (*******-*******-*******)	R911170152	Length: 5 m
RKB0008/007,5 (*******-*******-*******)	R911172971	Length: 7.5 m
RKB0008/010,0 (*******-*******-*******)	R911170153	Length: 10 m
RKB0008/015,0 (*******-*******-*******)	R911171183	Length: 15 m
RKB0008/020,0 (*******-*******-*******)	R911171184	Length: 20 m
RKB0008/025,0 (*******-*******-*******)	R911170154	Length: 25 m
RKB0008/030,0 (*******-*******-*******)	R911171381	Length: 30 m
RKB0008/035,0 (*******-*******-*******)	R911171369	Length: 35 m
RKB0008/040,0 (*******-*******-*******)	R911171382	Length: 40 m
RKB0008/050,0 (*******-*******-*******)	R911171383	Length: 50 m
RKB0008/055,0 (*******-*******-*******)	R911173779	Length: 55 m
RKB0008/060,0 (*******-*******-*******)	R911173780	Length: 60 m
RKB0008/065,0 (*******-*******-*******)	R911173781	Length: 65 m
RKB0008/070,0 (*******-*******-*******)	R911173782	Length: 70 m

Tab. 11-37: Connecting cables to control cabinet PC, panel PC and operator display. Further cable lengths are available upon request.

Further cable lengths are available upon request.

USB connecting cables (USB 2.0)

Ordering code	Part number	Description
RKB0019/000,5 (*******-*******-*******)	R911171165	USB connecting cable, length 0.5 m
RKB0019/001,0 (*******-*******-*******)	R911171166	USB connecting cable, length 1 m
RKB0019/003,0 (*******-*******-*******)	R911171167	USB connecting cable, length 3 m
RKB0019/005,0 (*******-*******-*******)	R911171168	USB connecting cable, length 5 m

Connecting cables of the display port

The listed display port cables are provided with a special shielding. The display port cables meet the following specifications:

- Conform to the display port 1.2
- Resolutions up to 4096 x 2160
- Supports HDCP 1.3 and DPCP

Ordering code	Part number	Description
RKB0063/003,0 (*******-*******-*******)	R911391713	Connecting cable of the display port, length 3 m
RKB0063/005,0 (*******-*******-*******)	R911391714	Connecting cable of the display port, length 5 m

Wear parts

Wear parts are not subject to any warranty.

CMOS battery

The service life of the CMOS battery of type BR2032 is 5 to 7 years.

11.9.6 PC device series PR4/VR4

Technical data

PC box

	PR4100	PR4200	PR4300
CPU	i3-6100U 2.3 GHz Dual Core	i5-6300U 2.4 GHz Dual Core	i7-6600U 2.6 GHz Dual Core
GPU	Intel® HD Graphics 5200		
Memory	DDR4, 8 GB RAM, 16 GB optional		
Audio	Analog output		
Bulk memory	• 32 GByte or 256 GByte SSD *or* 2 × 256 GByte SSD (RAID1) • 320 GByte HDD *or* 2 × 320 GByte HDD (RAID1)		
Mini PCIe (internal)	2 × Mini PCIe • mPCIe interface module • WLAN or G4 extension		
PCIe slot	1 x PCIe, 10 W max., card length: 175 m max.		
Ethernet ports	2 × Gbit i210 with synchronous cycle 1 × Gbit i219		
Serial ports	1 × RS-232 1 × RS-232, RS-422, RS-485		
Serial port speed	115 kbps max.		
USB	2 × USB 2.0 2 × USB 3.0		
Display port	1 × DP		
CDI+tx	1 × CDI+tx operating display connection at a large distance		
TPM	TPM 2.0 (onboard) chip: INFINEON_SLB 9665TT2.0		
RTC battery	Button cell BR2032		

	PR4100	PR4200	PR4300
Mounting	Front uprights mounting		
Input voltage	24 V DC +25 %, -20 % with IEC 61131-2		
Power consumption	70 W max.		
Weight	4.6 kg		
Degree of protection	IP20		

Tab. 11-38: Technical data of the PR4100, the PR4200 and the PR4300

	2 × GBit LAN (optional)
Controller	Intel® I350-AM2 LAN Controller
Ethernet	10/100/1000 Mbps

Tab. 11-39: Technical data 2 × GBit LAN

	RS-422/485, electrically isolated (optional)
COM interface type	RS-422/485
Host interface	USB 2.0
Plug-in connector	2 x D-Sub, 9-pin, male.
Insulation protection	2,000 DC
ESD protection	15 KV
EFT protection	2,500 V
Surge protection	1,000 V DC

Tab. 11-40: Technical data RS-422/485, electrically isolated

	RS-232, electrically isolated (optional)
COM interface type	RS-232
Host interface	USB2.0
Plug-in connector	2x D-Sub 9-pin, male.
Insulation protection	2,000 V DC
ESD protection	15 KV
EFT protection	2,500 V
Surge protection	1,000 V DC

Tab. 11-41: Technical data of the RS-232, electrically isolated

	WLAN + Bluetooth LE (optional)
Chip set	Realtek RTL8821AE
WLAN standard	802.11 a/b/g/n/ac
Bluetooth standard	Bluetooth 4.0 HS
Tx/Rx	1Tx/1Rx
Security	64/128 bit WEP

Tab. 11-42: Technical data WLAN + Bluetooth LE

Panel PC

Display	396 mm TFT (15")	546 mm TFT (21")
	1366 × 768 pixels	1920 × 1080 pixels
	16.2 million colors	16.7 million colors
Weight	Approx. 8.7 kg	Approx. 11.1 kg
Operation	Projected capacitive 10-point multitouch	
Surface of the front panel	Chemically strengthened front glass	
Degree of protection	Front panel IP 66	

Tab. 11-43: Technical data of the VR4x15 and the VR4x21

Optical characteristic values

TFT

The maximum permissible number and type of pixel errors of TFT displays depends on the manufacturer and is defined by the respective incoming inspection of the vendor.

Input system or multi-touch front

The maximum permissible number, type and size of defects on the front, on the glass or between the display and the front - such as trapped dust, dirt and scratches is defined in the FT quality guideline.

Ordering information

Accessories and spare parts

For ordering information on accessories and spare parts, refer to chapter "Spare parts, accessories and wear parts" on page 200

Type code

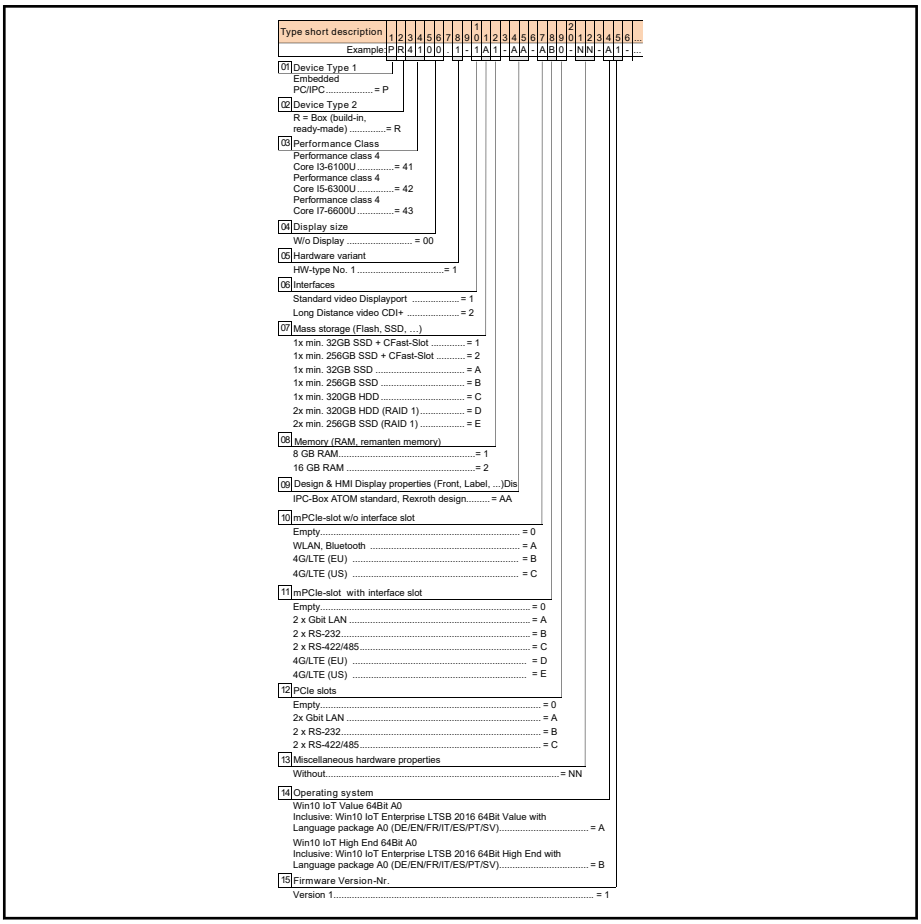


Fig. 11-29: Type code for PR4 devices

F03 (performance classes)	F14 (operating system)
41	A, C
42	A, C
43	B, C

F10 (mPCIe without interface)	F11 (mPCIe with interface)
0, A	0, A, B, C, D, E
B	0, A, B, C, E

Tab. 11-44: Available combinations

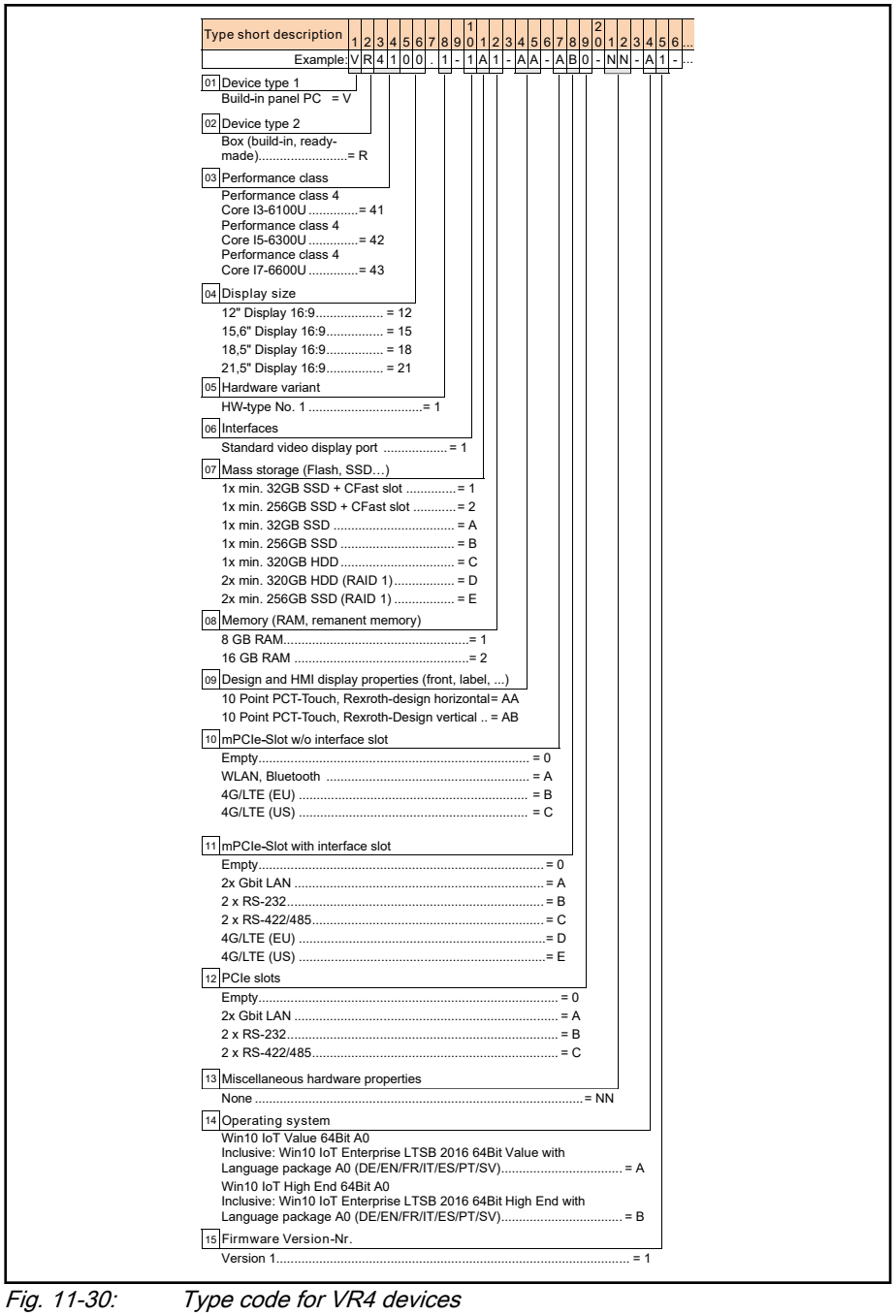


Fig. 11-30: Type code for VR4 devices

F03 (performance classes)	F14 (operating system)
41	A, C
42	A, C
43	B, C

F10 (mPCIe without interface)	F11 (mPCIe with interface)
0, A	0, A, B, C, D, E
B	0, A, B, C, E

Tab. 11-45: Available combinations

Spare parts, accessories and wear parts

External 24 V power supply unit

Ordering code	Part number	Description
VAP01.1H-W23-024-010-NN	R911171065	External 24 V power supply unit for IndraControl V-devices

Tab. 11-46: External 24 V power supply unit for the operator display

Uninterruptible power supply

Ordering code	Part number	Description
VAU02.1S-024-024-072-NN	R911385289	Uninterruptible Power Supply 24 V DC, 72 watt with RS232 interface

Tab. 11-47: Uninterruptible power supply (UPS)

Connecting cables for CDI+ interface

Malfunctions caused by using inappropriate CDI+ cables.
Use only cables listed in the following overview.

Ordering code	Part number	Description
RKB0008/000,5 (*******-*******-*******)	R911171484	Length: 0.5 m
RKB0008/001,0 (*******-*******-*******)	R911171485	Length: 1 m
RKB0008/002,5 (*******-*******-*******)	R911170151	Length: 2.5 m
RKB0008/005,0 (*******-*******-*******)	R911170152	Length: 5 m
RKB0008/007,5 (*******-*******-*******)	R911172971	Length: 7.5 m
RKB0008/010,0 (*******-*******-*******)	R911170153	Length: 10 m
RKB0008/015,0 (*******-*******-*******)	R911171183	Length: 15 m
RKB0008/020,0 (*******-*******-*******)	R911171184	Length: 20 m
RKB0008/025,0 (*******-*******-*******)	R911170154	Length: 25 m
RKB0008/030,0 (*******-*******-*******)	R911171381	Length: 30 m
RKB0008/035,0 (*******-*******-*******)	R911171369	Length: 35 m
RKB0008/040,0 (*******-*******-*******)	R911171382	Length: 40 m
RKB0008/050,0 (*******-*******-*******)	R911171383	Length: 50 m

Tab. 11-48: Connecting cables to control cabinet PC, panel PC and operator display. Further cable lengths are available upon request.

Further cable lengths are available upon request.

USB connecting cables (USB 2.0)

Ordering code	Part number	Description
RKB0019/000,5 (*******-*******-*******)	R911171165	USB connecting cable, length 0.5 m
RKB0019/001,0 (*******-*******-*******)	R911171166	USB connecting cable, length 1 m
RKB0019/003,0 (*******-*******-*******)	R911171167	USB connecting cable, length 3 m
RKB0019/005,0 (*******-*******-*******)	R911171168	USB connecting cable, length 5 m

Connecting cables of the display port

The listed display port cables are provided with a special shielding. The display port cables meet the following specifications:

- Conform to the display port 1.2
- Resolutions up to 4096 x 2160
- Supports HDCP 1.3 and DPCP

Ordering code	Part number	Description
RKB0063/003,0 (*******-*******-*******)	R911391713	Connecting cable of the display port, length 3 m
RKB0063/005,0 (*******-*******-*******)	R911391714	Connecting cable of the display port, length 5 m

Wear parts

Wear parts are not subject to any warranty.

CMOS battery

The service life of the CMOS battery of type BR2032 is 5 to 7 years.

11.9.7 Display of the device series DR

Technical data

	DR0012	DR0015	DR0018	DR0021
Display	307 mm TFT (12") 1280 × 800 pixels 16.2 million colors	396 mm TFT (15") 1366 × 768 pixels 16.2 million colors	470 mm TFT (18") 1366 × 768 pixels 16.7 million colors	546 mm TFT (21") 1920 × 1080 pixels 16.7 million colors
Weight	Approx. 4.4 kg	Approx. 6.2 kg	Approx. 7.7 kg	Approx. 8.4
Power consumption	25 W max.	25 W max.	29 W max.	36 W max.
Input voltage	24 V DC +25 %, -20 % with IEC 61131-2			
Operation	Projected capacitive 10-point multitouch			

	DR0012	DR0015	DR0018	DR0021
Surface of the front panel	Chemically strengthened front glass			
Graphic interfaces	Depending on the configuration: • Interface option "Standard video DP": 1 × display port, 1 × USB 2.0 (type B) • Interface option "CDI+ RX module": 1 × CDI+ (1 x RJ45) • Interface option "CDI+ daisy chain TX module": 2 × CDI+ (2 × RJ45)			
Degree of protection	Front panel IP 66			
USB	2 × USB 2.0 (type A) Max. of 500 mA per USB port, total current of max. 1 A at all USB ports.			

Tab. 11-49: Technical data of the display

Optical characteristic values

TFT

The maximum permissible number and type of pixel errors of TFT displays depends on the manufacturer and is defined by the respective incoming inspection of the vendor.

Input system or multi-touch front

The maximum permissible number, type and size of defects on the front, on the glass or between the display and the front - such as trapped dust, dirt and scratches is defined in the FT quality guideline.

Ordering information

Accessories and spare parts

For ordering information on accessories and spare parts, refer to chapter "Spare parts, accessories and wear parts" on page 203

Type code

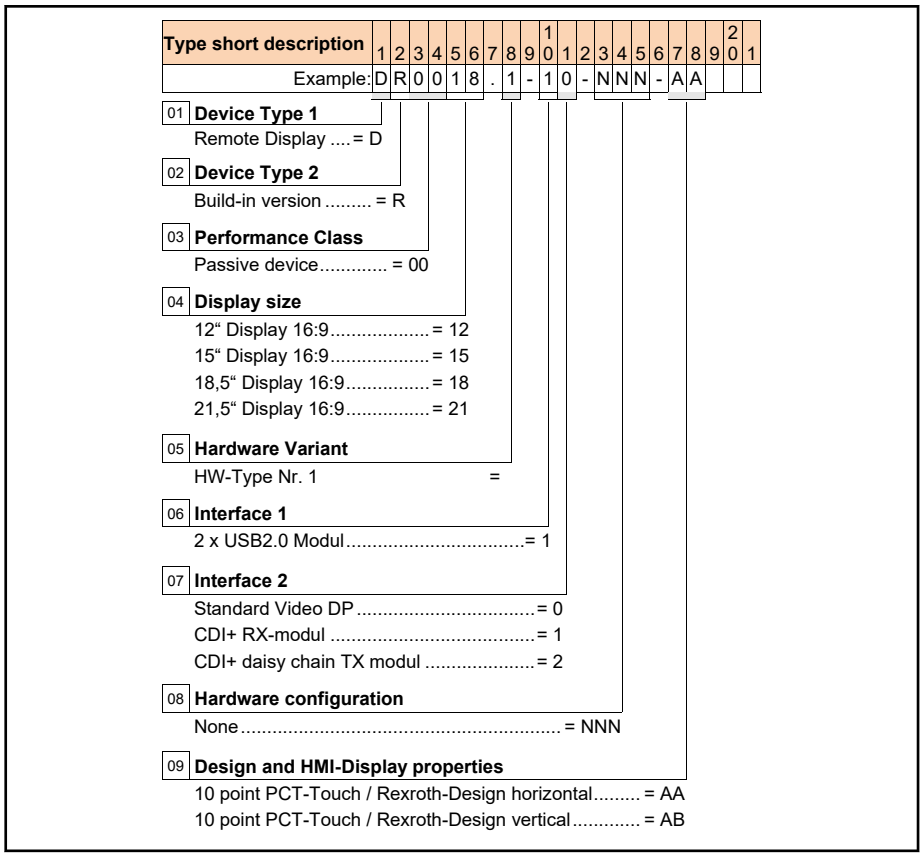


Fig. 11-31: Type code for DR devices

F04 (display size)	F09 (design and HMI display)
12	AA
15	AA
18	AA
21	AA, AB

Tab. 11-50: Available combinations

Spare parts, accessories and wear parts

External 24 V power supply unit

Ordering code	Part number	Description
VAP01.1H-W23-024-010-NN	R911171065	External 24 V power supply unit for IndraControl V-devices

Tab. 11-51: External 24 V power supply unit for the operator display

Uninterruptible power supply

Ordering code	Part number	Description
VAU02.1S-024-024-072-NN	R911385289	Uninterruptible Power Supply 24 V DC, 72 watt with RS232 interface

Tab. 11-52: Uninterruptible power supply (UPS)

Connecting cables for CDI+ interface

☞ Malfunctions caused by using inappropriate CDI cables.
Use only cables listed in the following overview.

Ordering code	Part number	Description
RKB0008/000,5 (*******-*******-*******)	R911171484	Length: 0.5 m
RKB0008/001,0 (*******-*******-*******)	R911171485	Length: 1 m
RKB0008/002,5 (*******-*******-*******)	R911170151	Length: 2.5 m
RKB0008/005,0 (*******-*******-*******)	R911170152	Length: 5 m
RKB0008/007,5 (*******-*******-*******)	R911172971	Length: 7.5 m
RKB0008/010,0 (*******-*******-*******)	R911170153	Length: 10 m
RKB0008/015,0 (*******-*******-*******)	R911171183	Length: 15 m
RKB0008/020,0 (*******-*******-*******)	R911171184	Length: 20 m
RKB0008/025,0 (*******-*******-*******)	R911170154	Length: 25 m
RKB0008/030,0 (*******-*******-*******)	R911171381	Length: 30 m
RKB0008/035,0 (*******-*******-*******)	R911171369	Length: 35 m
RKB0008/040,0 (*******-*******-*******)	R911171382	Length: 40 m
RKB0008/050,0 (*******-*******-*******)	R911171383	Length: 50 m
RKB0008/055,0 (*******-*******-*******)	R911173779	Length: 55 m
RKB0008/060,0 (*******-*******-*******)	R911173780	Length: 60 m
RKB0008/065,0 (*******-*******-*******)	R911173781	Length: 65 m
RKB0008/070,0 (*******-*******-*******)	R911173782	Length: 70 m

Tab. 11-53: Connecting cables to control cabinet PC, panel PC and operator display.

☞ Further cable lengths are available on request.

USB connecting cables (USB 2.0)

Ordering code	Part number	Description
RKB0019/000,5 (*******-*******-*******)	R911171165	USB connecting cable, length 0.5 m
RKB0019/001,0 (*******-*******-*******)	R911171166	USB connecting cable, length 1 m

Ordering code	Part number	Description
RKB0019/003,0 (*******-*******-*******)	R911171167	USB connecting cable, length 3 m
RKB0019/005,0 (*******-*******-*******)	R911171168	USB connecting cable, length 5 m

Connecting cables of the display port

The listed display port cables are provided with a special shielding. The display port cables meet the following specifications:

- Conform to the display port 1.2
- Resolutions up to 4096 x 2160
- Supports HDCP 1.3 and DPCP

Ordering code	Part number	Description
RKB0063/003,0 (*******-*******-*******)	R911391713	Connecting cable of the display port, length 3 m
RKB0063/005,0 (*******-*******-*******)	R911391714	Connecting cable of the display port, length 5 m

Wear parts

Wear parts are not subject to any warranty.

Backlight

The service life of the backlight is limited. After this period, the backlight will produce only 50 % of its original brightness. The service life is 50,000 hours if the ambient temperature is 25 °C.

11.9.8 Documentation

The following documentations provide information on the devices of the series PR/VR/DR:

Title	Part number and document type
Rexroth IndraControl VAP 01 Power Supply Unit	R911339613 Operating Instructions
Rexroth IndraControl PR and VR Devices Software Applications	R911384733 Project Planning Manual
VAU 02.1 Uninterruptible Power Supply	R911384726 Operating Instructions
Rexroth IndraControl PR30 and VR30 Control cabinet PC and panel PC	R911384705 Project Planning Manual
Rexroth IndraControl PR31 and VR31 Control cabinet PC and panel PC	R911397432 Project Planning Manual

Title	Part number and document type
Rexroth IndraControl PR4 and VR4 Control cabinet PC and panel PC	R911384697 Project Planning Manual
Rexroth IndraControl DR Multi-Touch Displays (Built-in Device)	R911384712 Operating Instructions

Tab. 11-54: Related documentations

11.10 Control cabinet PC with display – VPB/VDP

11.10.1 Brief description

Devices of the VPB series are high end industrial Pcs that are an operating and visualization terminal with a high industrial suitability in connection with the passive operator displays of the VDP series.

Devices of the VPB series are intended for installation in a control cabinet.

The operator displays of the VDP series are designed to be installed in a control panel or a control cabinet wall. The VPB industrial PC and the FDP operator display are connected via a CDI interface.

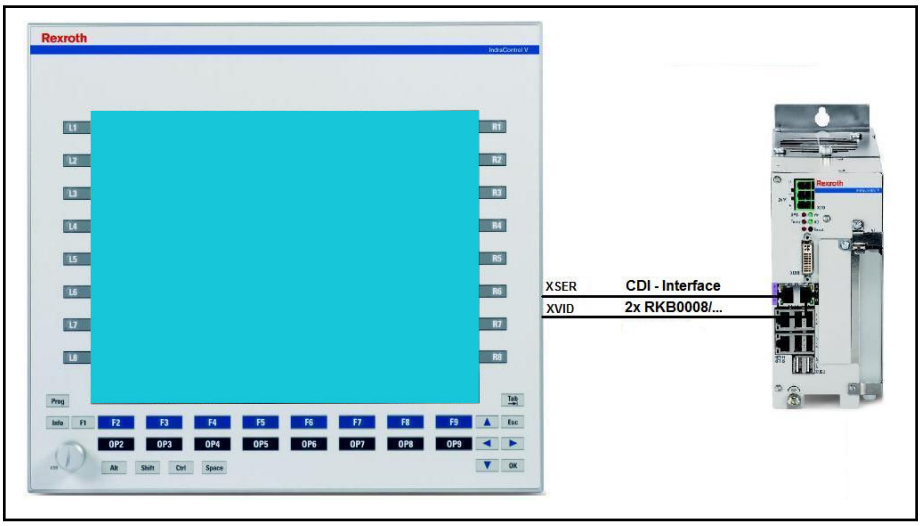


Fig. 11-32: High-end industrial PC VPB 40.3 with the operator display VDP 40.3

11.10.2 Field of application

The compact industrial PC VPB 40.3/40.4 is used in industrial environments with higher vibration and shock requirements.

11.10.3 Operating system

Due to licensing reasons, VPB devices are only delivered with a pre-installed operating system.

- VPB 40.3: Windows XP Professional or Windows Embedded Standard 7
- VPB 40.4: Windows Embedded Standard 7 or Windows 10 IoT Enterprise LTSB 2015

11.10.4 Technical data

VPB 40.3

	VPB 40.3
PC box	1, 2 or 4 slots
Processor	Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz
RAM	2 GB (max. 4 GB)
HDD hard disk	320 GB SATA, alternatively 2 × 320 GB (RAID1) or 192 GB SSD
Optional drives	DVD writer (for 4-slot variant)
Interfaces	2 × RJ45, CDI interface (image and data interface to the VDP xx.3) 6 × USB port (type A) 2 x Ethernet port (RJ 45, 10/100/1000 Base-T) 1 × VGA port
Voltage supply	24 V DC

Tab. 11-55: Technical data for the VPB 40.3

VPB 40.4

	VPB 40.4
PC box	1, 2 or 4 slots
Processor	Intel® Celeron® Dual-Core C3955U, 2.00 GHz Intel® Core™ Dual-Core i5-6300U, 2.40 GHz Intel® Core™ Quad-Core i7-6820EQ, 2.80 GHz
RAM	8 GB (16 GB max.)
HDD hard disk	320 GB SATA HDD, alternatively 2 × 320 GByte HDD (RAID1) or 192 GByte SSD, alternatively 2 × 192 GByte SSD (RAID1)
Optional drives	Without
Interfaces	2 × RJ45, CDI interface (image and data interface to the VDP xx.3) 4 × USB 2.0 port (type A) 2 × USB 3.0 port (type A) 1 × USB 3.0 port (type A) (internal) 2 x Ethernet port (RJ 45, 10/100/1000 Base-T) 1 × DisplayPort XDP port 1 × mSATA connection (internal) 1 × mPCIe connection (internal)
Voltage supply	24 V DC

Tab. 11-56: Technical data for the VPB 40.4

Technical data of the operator display

VDP 16.3/40.3/60.3

	VDP 16.3	VDP 40.3	VDP 60.3
Display	12" color display	15" color display	19" color display
Front panel design	16 machine function keys or touch screen		
Supply voltage	24 V DC		

Tab. 11-57: Technical data for the VDP 16.3/40.3/60.3

VDP 15.3/21.3 (housing devices)

	VDP 15.3GA (Rexroth design)	VDP 21.3GC (Rexroth design)
Display	396 mm TFT (15") 1366 × 768 pixels 16.7 millions of color	546 mm TFT (21") 1920 × 1080 pixels 16.7 millions of color
Operation	Multitouch	
Surface of the front panel	Thermally tempered glass	
Degree of protection	Front panel IP 65 acc. to DIN EN 60 529 Front type 1 acc. to NEMA (UL)	
Voltage supply	24 V DC (use a 24 V industrial power supply unit acc. to DIN EN 60742, classification VDE 0551, for example VAP01.1H-W23-024-010-NN, part number R911171065)	
Current consumption	Approx. 1 A	Approx. 1.5 A
Power loss	Approx. 24 W	Approx. 36 W
USB	Maximum of 500 mA for each USB port. Maximum of total current of 1 A at all USB ports	
Weight	Approx. 4.8 kg	Approx. 7.4 kg

Tab. 11-58: Technical data of the VDP 15.3 and VDP 21.3

VDP 15.3/18.3/21.3 (built-in devices)

	VDP 15.3GA (Rexroth design) VDP 15.3CL (Bosch design)	VDP 18.3GBN (Rexroth design)	VDP 21.3GC (Rexroth design) VDP 21.3CN (Bosch design)
Display	396 mm TFT (15") 1366 × 768 pixels 16.7 millions of color	470 mm TFT (18") 1366 × 768 pixels 16.7 millions of color	546 mm TFT (21") 1920 × 1080 pixels 16.7 millions of color
Operation	Multitouch		
Surface of the front panel	Thermally tempered glass		
Degree of protection	Front panel IP 65 acc. to DIN EN 60 529 Front type 1 acc. to NEMA (UL) Rear panel IP 20		
Voltage supply	24 V DC (use a 24 V industrial power supply unit acc. to DIN EN 60742, classification VDE 0551, for example VAP01.1H-W23-024-010-NN, part number R911171065)		
Current consumption	Approx. 1 A	Approx. 1 A	Approx. 1.5 A

	VDP 15.3GA (Rexroth design) VDP 15.3CL (Bosch design)	VDP 18.3GBN (Rexroth design)	VDP 21.3GC (Rexroth design) VDP 21.3CN (Bosch design)
Power loss	Approx. 24 W	Approx. 24 W	Approx. 36 W
USB	Maximum of 500 mA for each USB port. Maximum of total current of 1 A at all USB ports		
Weight	Approx. 4.8 kg	Approx. 6.5 kg	Approx. 7.4 kg

Tab. 11-59: Technical data of the VDP 15.3, VDP 18.3 and 21.3

11.10.5 Variants

The following models of VPB 40.3 devices are available:

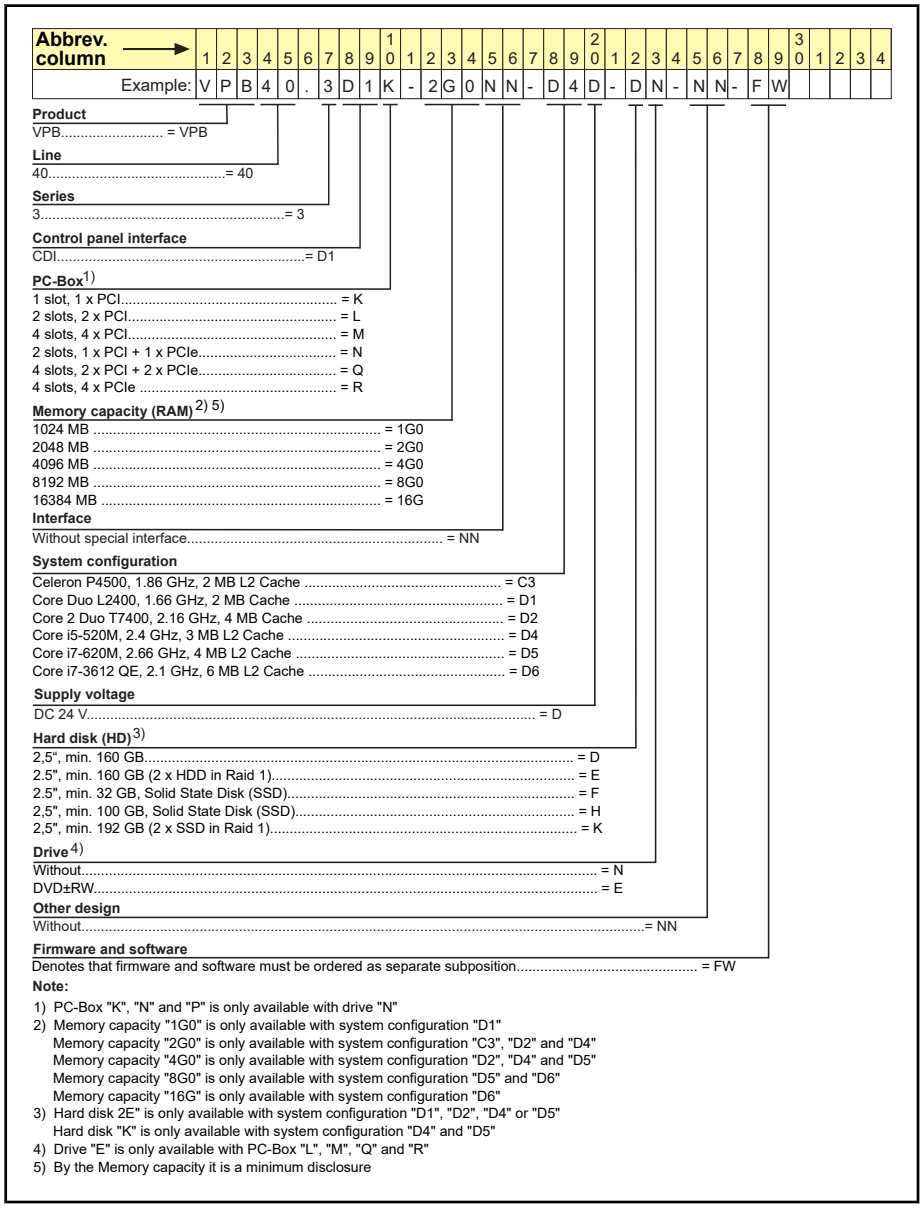


Fig. 11-33: Type code VPB 40.3

The following models of VPB 40.4 devices are available:

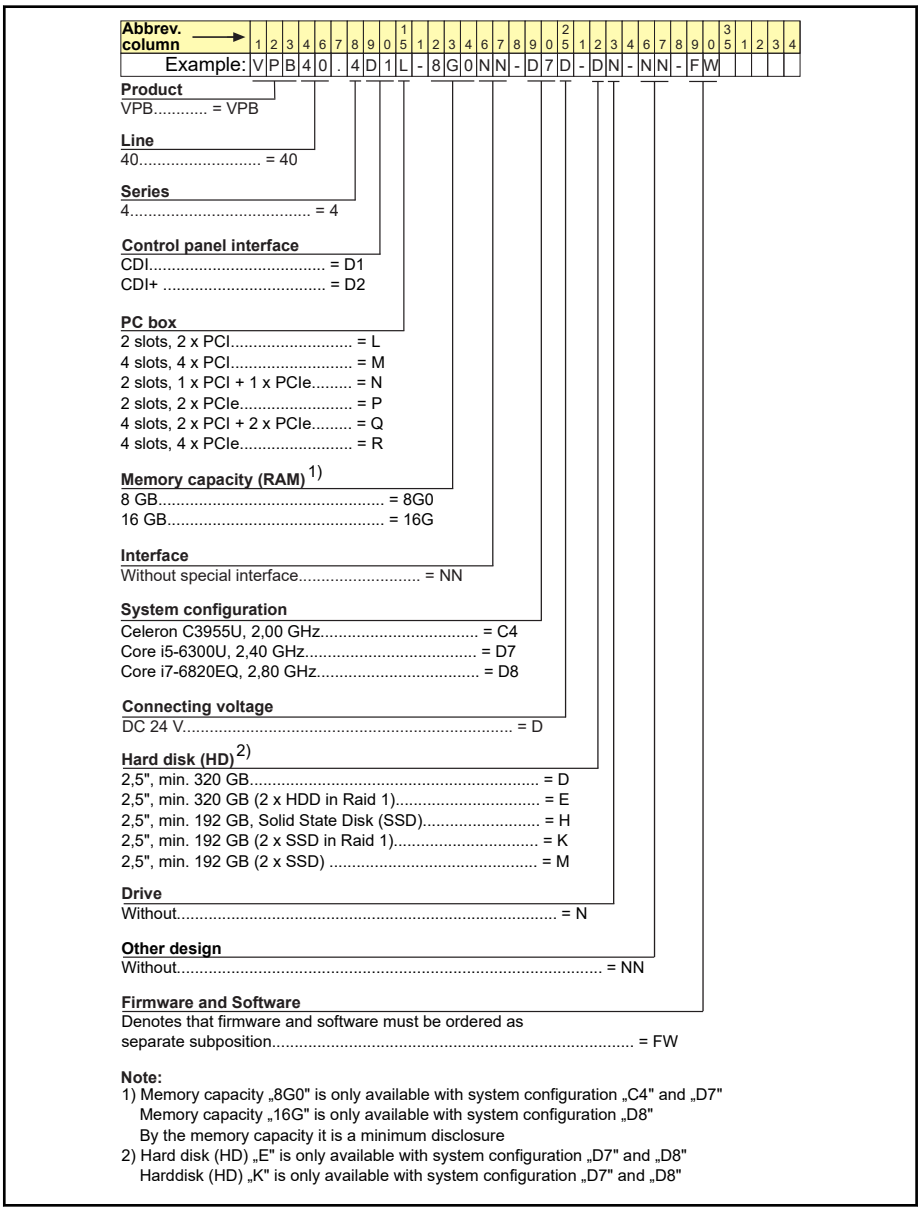


Fig. 11-34: Type code VPB 40.4

VDP xx.3 variants are available:

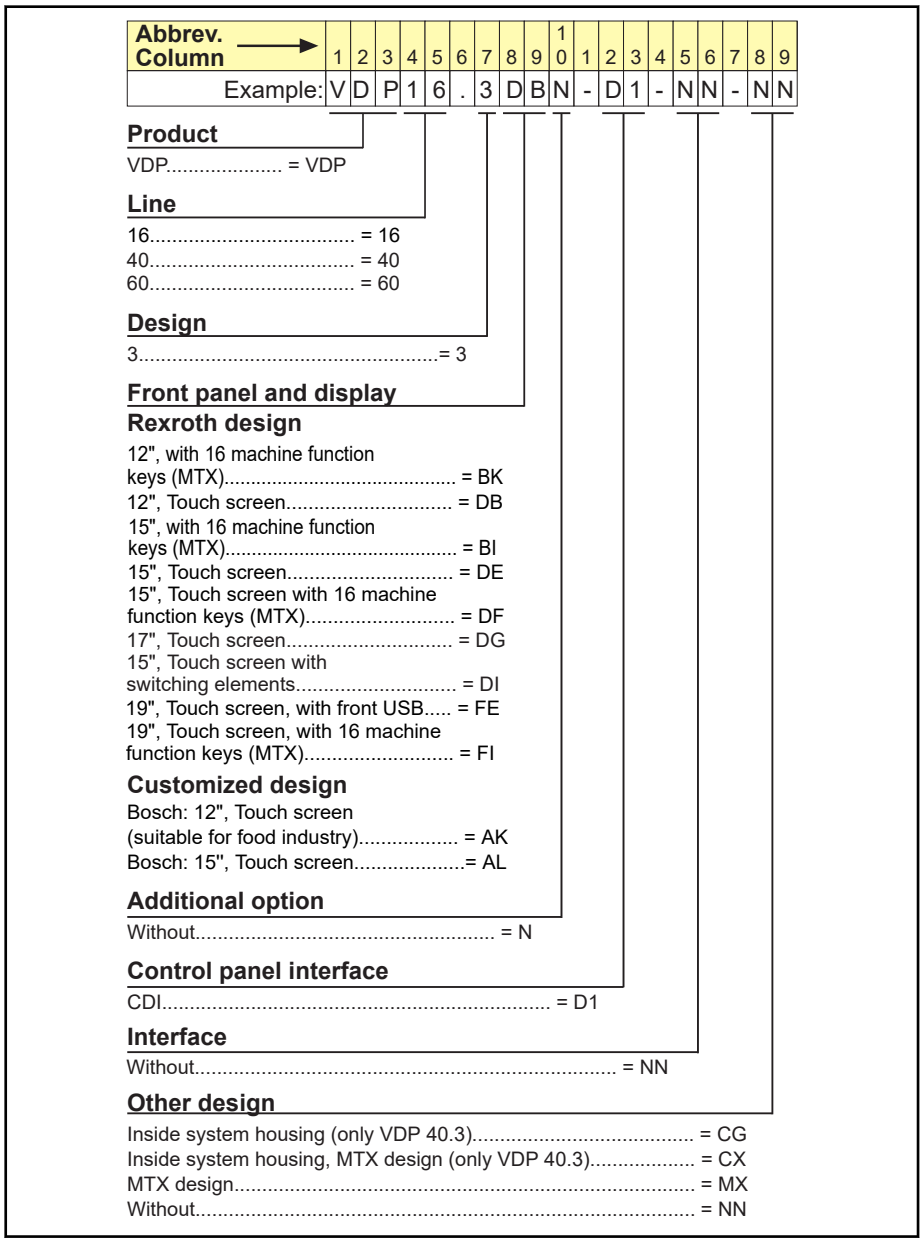


Fig. 11-35: Type code VDP xx.3

The VDP 15.3/21.3 multi-touch housing devices are available in the following variants:

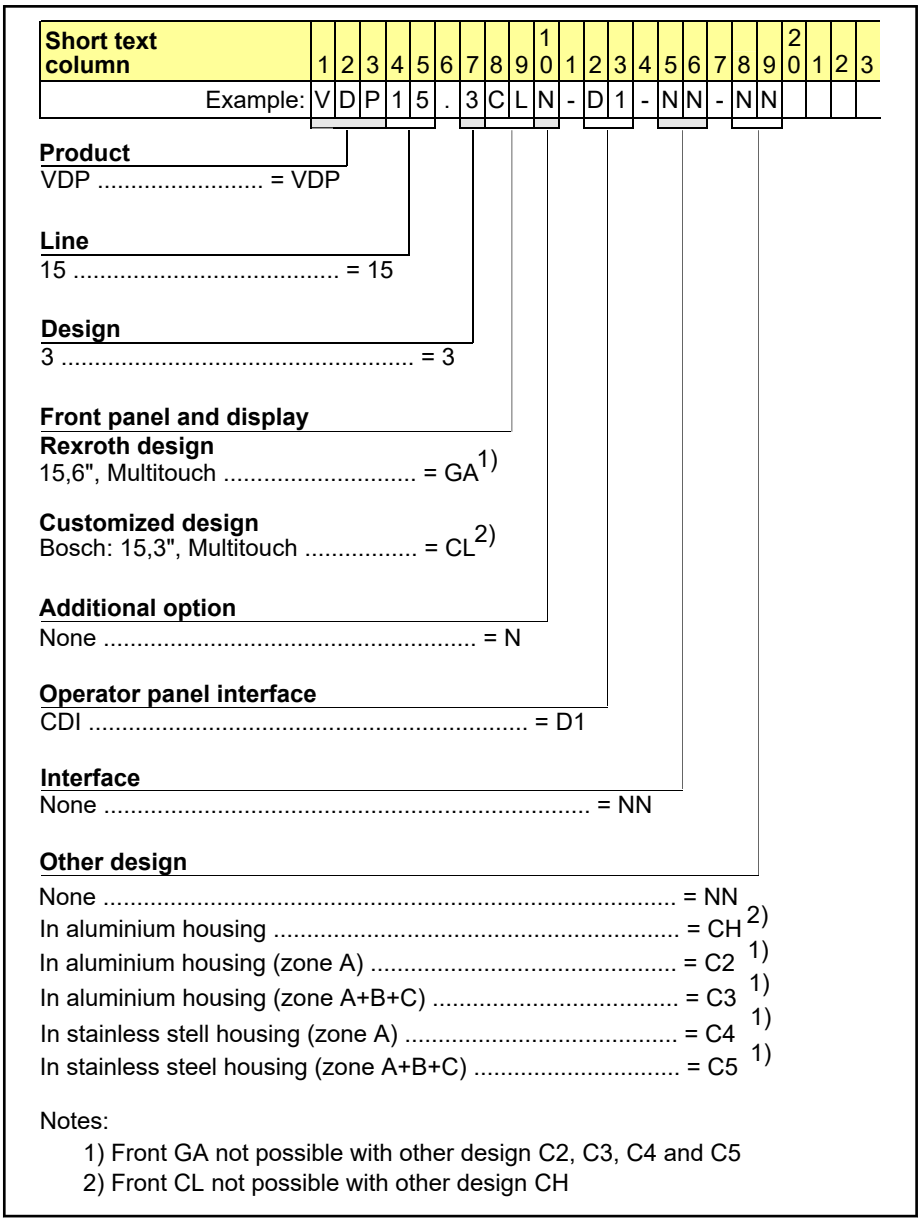


Fig. 11-36: Type code of the VDP 15.3

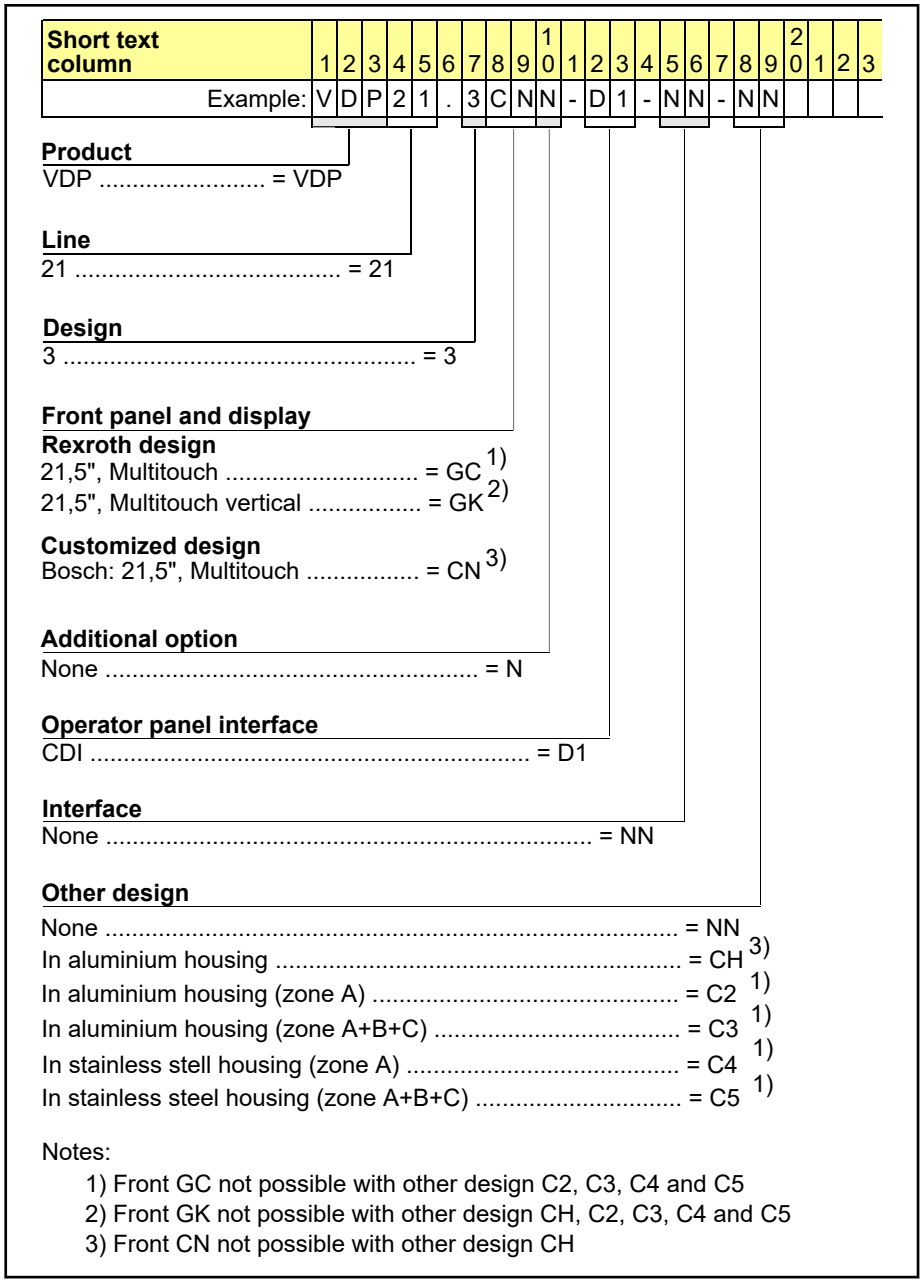


Fig. 11-37: Type code of the VDP 21.3

The VDP xx.3 multi-touch built-in devices are available in the following variants:

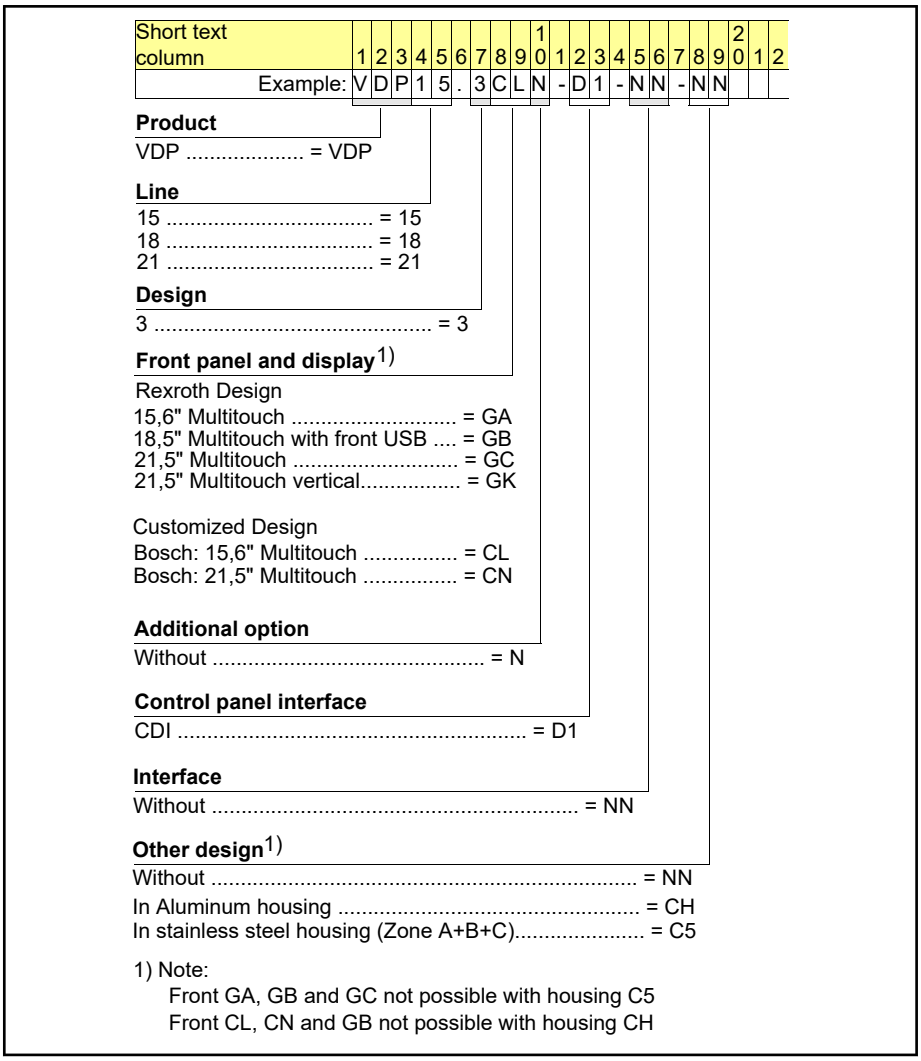


Fig. 11-38: Type code of the VDP 15.3/18.3/21.3

11.10.6 Accessories

Connecting cables (CDI Interface)

The VPB industrial PC and the operating device VDP are connected via the CDI interface.

A Y-repeater is used as connecting unit to connect two operator displays with the same resolution and the same version to one control cabinet PC.

The following ready-made cables are available:

Type	Note
RKB0008/000,5	Bus cable, ready-made Ethernet cable, 100-Base-T, CAT 6+, UL, drag chain-compatible, cable length 0.5 m
RKB0008/001,0	As above, cable length 1 m
RKB0008/002,5	As above, cable length 2.5 m
RKB0008/005,0	As above, cable length 5 m

Type	Note
RKB0008/007,5	As above, cable length 7.5 m
RKB0008/010,0	As above, cable length 10 m
RKB0008/015,0	As above, cable length 15 m
RKB0008/020,0	As above, cable length 20 m
RKB0008/025,0	As above, cable length 25 m
RKB0008/030,0	As above, cable length 30 m
RKB0008/035,0	As above, cable length 35 m
RKB0008/040,0	As above, cable length 40 m
RKB0008/050,0	As above, cable length 50 m
VAC01.1S-YD1-NNNN	Y-repeater for the CDI interface

Tab. 11-60: Connecting cables VPB 40.3/40.4 - VDP xx.3

☞ Two connecting cables of type RKB0008/... are required to connect an VPB 40.3/40.4 and an VDPxx.3.

Power supply unit, UPS

Type	Note
VAP01.1H-W23-024-010-NN	External 24 V power supply unit for devices of the V series
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0050/00...	USB interface cable to connect the UPS; lengths: 1.0 m, 3.0 m

Tab. 11-61: Accessories for VPB 40.3/40.4

11.10.7 Documentation

The following documentations are available for industrial PC VPB 40.3/40.4 and the VDP xx.3 operating devices:

- VPB 40.3 control cabinet PC
  (DOK-SUPPL*-VPB*40.3***-PRRS-EN-P)
- VPB 40.3 control cabinet PC
  (DOK-SUPPL*-VPB*40.3***-ITRS-EN-P)
- VPB 40.4 control cabinet PC
  (DOK-SUPPL*-VPB*40.4***-ITRS-EN-P)
- VPB 40.4 Control cabinet PC control
  (DOK-MLC***-INDRACTRLV4-ITRS-EN-P)
- VDP 16.3/40.3/60.3 operator display
  (DOK-SUPPL*-VDP*XX.3***-PRRS-EN-P)
- VDP 16.3, 40.3, 60.3 operator display
  (DOK-SUPPL*-VDP*XX.3***-ITRS-EN-P)
- VDP 15.3, 21.3 Multi-touch operator display - Housing device
  (DOK-SUPPL*-VDPXX.3MTHU-ITRS-EN-P)

- VDP 15.3, 18.3, 21.3 Multi-touch operator display - Built-in devices
  (DOK-SUPPL*-VDPXX.3MTBU-ITRS-EN-P)
- V-devices operating systems
  (DOK-GENERL-IND* CL*V*SW-PRRS-EN-P)
- VAP 01.1 power supply unit
  (DOK-SUPPL*-VAP*01.1H**-ITRS-EN-P)
- VAU 01.1U USV with USB interface
  (DOK-SUPPL*-VAU*01.1U**-PRRS-EN-P)
- VAU 01.1 USV with communication interface
  (DOK-SUPPL*-VAU*01.1X**-ITRS-EN-P)
- VAC 01.1S Y-repeater
  (DOK-SUPPL*-VAC*01*****-ITRS-EN-P)

11.11 Profibus machine control panels – VAM 10.2 / 40.2

11.11.1 Brief description

Machine control panels are supplementing operator and visualization terminals. They are used to select the operation modes and to operate the machine manually. The machine control panels include operating elements such as keys with LED displays, rotary switches for feed and spindle override, E-STOP button, key switch with authorization system and machine keys.

The machine control panels of the VAM xx.2 series were designed for the use with the devices of the VPB, VPP, Vxx product family and adapted to the design of these devices. VAM 10.2 has the width of the panel PC VPP 16 and VAM 40.2 the width of the panel PC VPP 40.

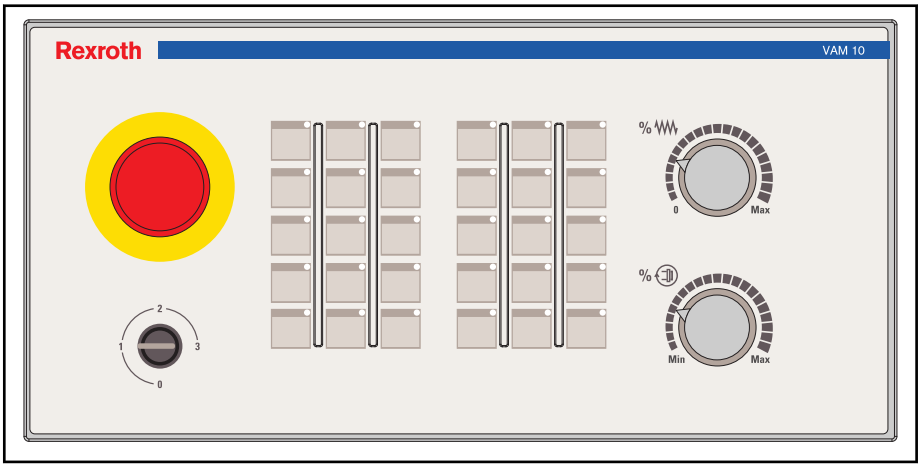


Fig. 11-39: Front view of the VAM 10.2

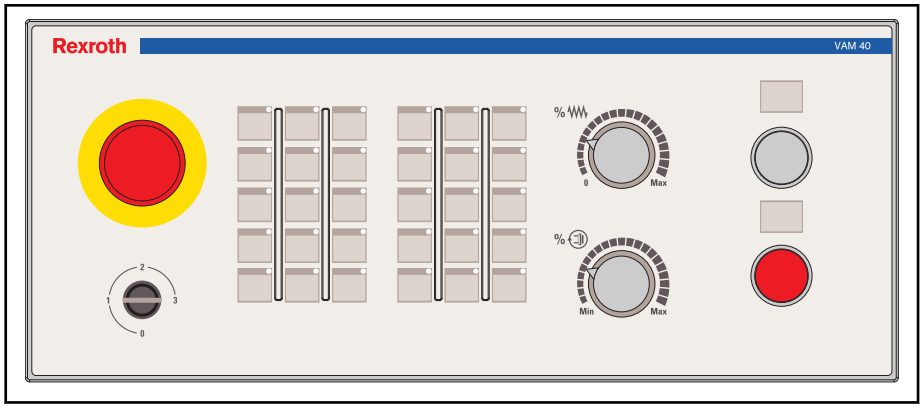


Fig. 11-40: Front view of the VAM 40.2

11.11.2 Fields of application

Machine control panels of the VAM xx.2 series are intended to operate control units.

11.11.3 Technical data

	VAM 10.2	VAM 40.2
Voltage supply	Galvanically insulated	
Logic supply U_L	24 V DC (19.2 V to 30 V), PELV	
Current consumption from U_L	0.5 A max.	
Input and output supply U_Q	24 V DC (19.2 V to 30 V), PELV	
Current consumption from U_Q	1.7 A max.	
Fuse	SMD fuse 3 A	
Reverse voltage protection	Integrated	

Tab. 11-62: Electrical data

The following components are located on the rear side of the devices:

- 25-pin plug to connect a hand-held terminal
- 6-pin plug to connect a handwheel
- 16 digital 24 V inputs
- 8 digital 24 V outputs

GSDML file

For the devices, the .zip file "GSD_VAM_10_40_DE_EN_0411.ZIP" is provided, containing two GSDML files according to EN 50170 part 2 (DP). These two files include all data required to connect the VAM 10.2/40.2 components to any Profibus DP master [according to EN 50170 part 2 (DP)].

RX010123.GSD is a universal GSDML file used to write on the machine control panels VAM xx.2 (and other VAM control panels) as modular Profibus DP slave. The GSDML file is selected in the Profibus DP configuration tool using the station name "VAM". The modules have to be configured in the correct sequence in the Profibus DP configuration tool. The module sequence is described in the two following tables.

RX020123.GSD is a GSDML file used to write on the machine control panels VAM xx.2 as compact Profibus DP slave. The GSDML file is used to easily configure the VAM 10.2 and in the basic design of the VAM 40.2. Select the station name "VAM10, VAM40" in the Profibus DP configuration tool and the correct configuration of the modules is automatically displayed.

For the zipped file "GSD_VAM_10_40_DE_EN_0411.ZIP", go to the Bosch Rexroth internet. You can also contact your local service support.

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	Byte	2	1
1	Manual control unit	Word	4	0
2	Handwheel	Word	2	0
3	Keypad TA	Byte	2	2
4	Keypad TA	Byte	2	2
5	Override VB	Byte	2	0

Tab. 11-63: Variant VAM 10.2-PB-NA-TA-TA-VB-1608-NN

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	Byte	2	1
1	Manual control unit	Word	4	0
2	Handwheel	Word	2	0
3	Keypad TA	Byte	2	2
4	Keypad TA	Byte	2	2
5	Override VB	Byte	2	0

Tab. 11-64: Variant VAM 40.2-PB-NA-TA-TA-VB-1608-NN



To simplify the configuration, use the GSDML file **RX020123.GSD** with the station name "VAM10, VAM40".

Profibus DP address settings

The station address is set via the two BCD rotary switches S1 and S2 for the station addresses 1-99. S1 represents the tens digit and S2 the units digit of the station address.

The address has to be set when no power is applied.

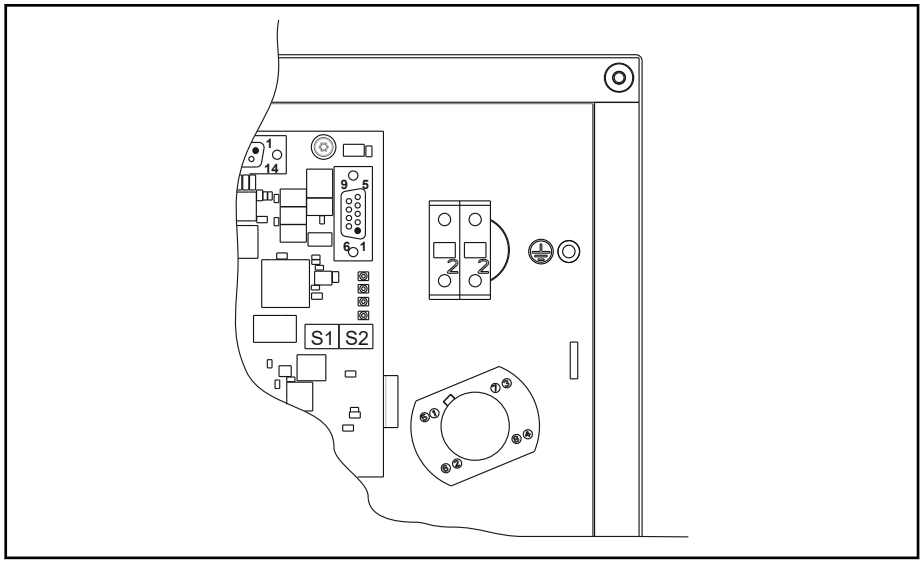


Fig. 11-41: BCD rotary switches S1 and S2

Baud rate setting

The machine control panels of the VAM xx.2 series automatically detect the baud rate set at the Profibus DP. Baud rates from 9.6 kBaud to 12 MBaud are supported:

- 9.6 kBaud
- 19.2 kBaud
- 45.45 kBaud
- 93.75 kBaud
- 187.5 kBaud
- 500 kBaud
- 1.5 MBaud
- 3 MBaud
- 6 MBaud
- 12 MBaud

11.11.4 Variants

The machine control panels of the VAM xx.2 series are available in the following variants:

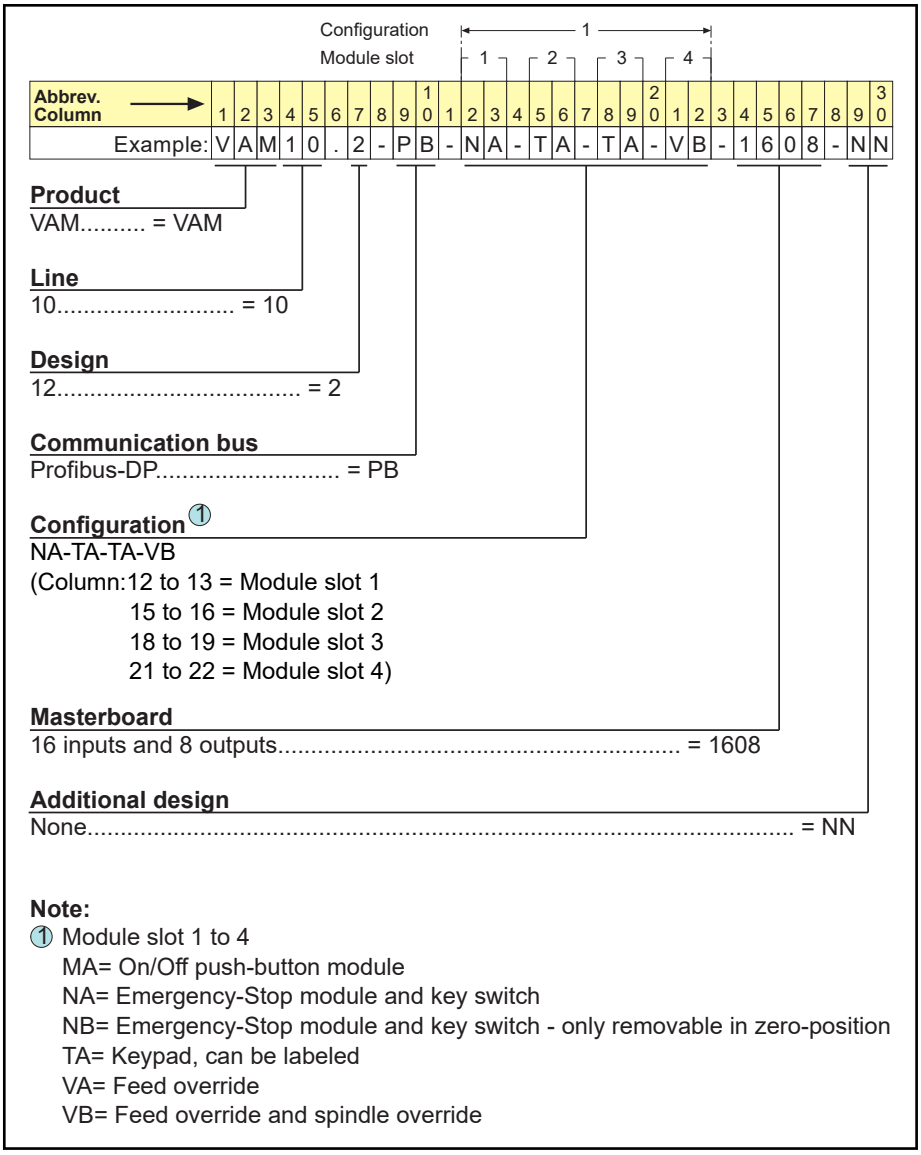


Fig. 11-42: Type code VAM 10.2

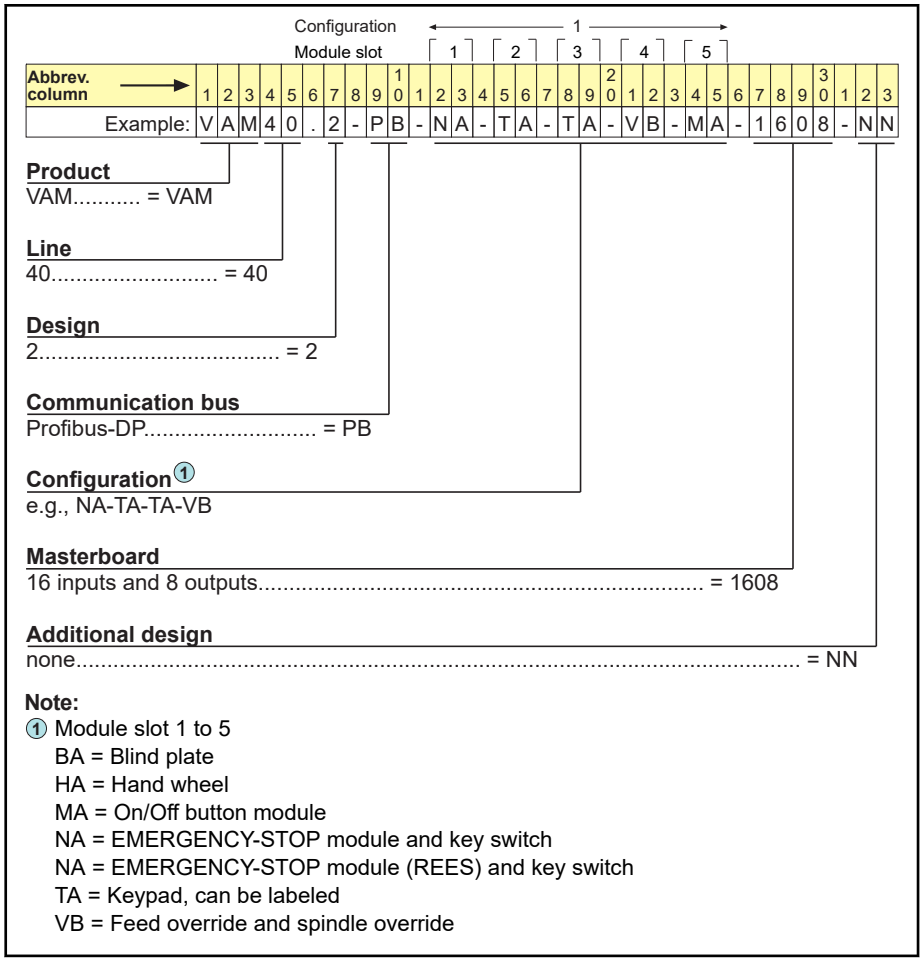
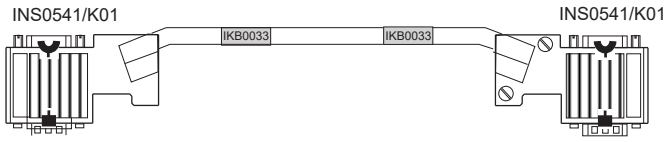
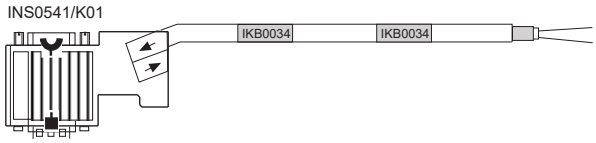


Fig. 11-43: Type code VAM 40.2

11.11.5 Accessories, plugs and ready-made cables

Ordering code Ready-made cable	Mating plug of the device	Rexroth cable	Design of the cable end
IKB0033/000,0 PN: 291808 Profibus cable			
IKB0034/000,0 PN: 291809 Profibus cable			

Tab. 11-65: Cable accessories

11.11.6 Documentation

The following documentation is available for a detailed description of the control panels of the VAM xx.2 series:

- VAM 10.2/40.2 Machine Control Panels, DOK-SUPPL*-VAM*XX.2***-PRxx-EN-P
- VAM 10.2/40.2 Machine Control Panels, DOK-SUPPL*-VAM*X0.2***-ITxx-EN-P

11.12 Profibus machine control panels – VAM 12.1 / 42.1

11.12.1 Brief description

Machine control panels are supplementing operator and visualization terminals. They are used to select the operation modes and to operate the machine manually. The machine control panels include operating elements such as keys with LED displays, rotary switches for feed and spindle override, E-STOP button, key switch with authorization system and machine keys.

The machine control panels VAM 12.1/VAM 42.1 were designed for the use with the devices of the VPB, VPP, Vxx product families and adapted to the design of these devices. The VAM 12.1 has the width of the VSP 16. The VPP 16 and VAM 42.1 have the width of the VSP 40, VPP 40.

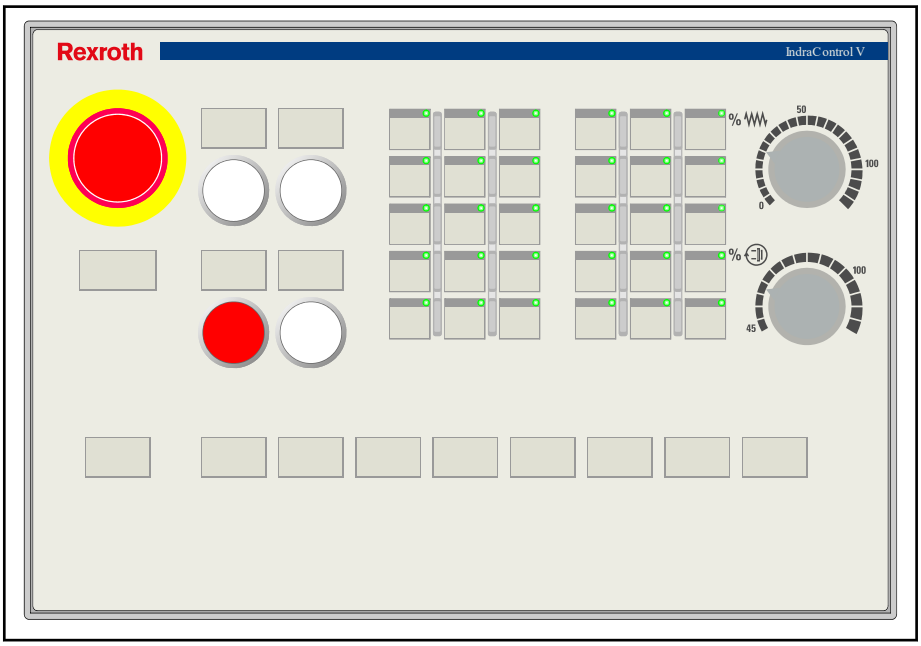


Fig. 11-44: Front view of the VAM 12.1

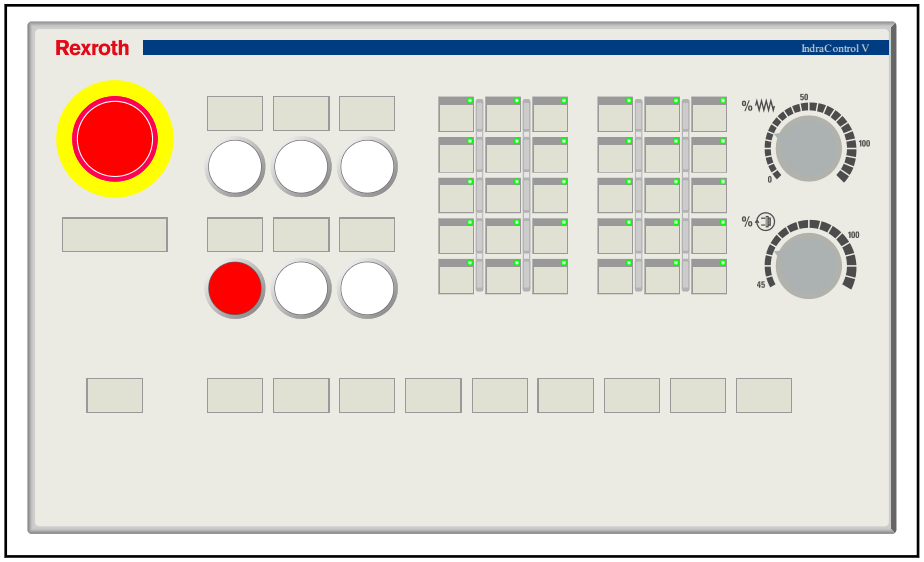


Fig. 11-45: Front view of the VAM 42.1

11.12.2 Fields of application

Machine control panels of the VAM 12.1 and VAM 42.1 series are designed to operate control units.

11.12.3 Technical data

	VAM 12.1	VAM 42.1
Degree of protection	IP 54 (front)	
Color of the front foil	Light grey RAL 7035	
Dimensions (W × H × D) Default device	350 mm × 240 mm × 58 mm	407 mm × 240 mm × 58 mm
Dimensions (W × H × D) Customized variant	350 mm × 240 mm × 70 mm	407 mm × 240 mm × 70 mm
Mounting cut-out (W × H)	324 mm × 215 mm	380 mm × 215 mm
Weight	Approx. 1170 g	Approx. 1380 g
Mounting depth	102 mm (with Profibus DP plug)	
Material of the front panel	Anodized aluminum, completely embedded, chemical resistant polyester foil	
Voltage supply	Galvanically insulated	
Logic supply U_L	24 V DC (19.2 V to 30 V), PELV (Refer to the documentation "VAP 01.1 Power Supply Unit", part no. R911339613)	
Current consumption from U_L Default device	Max. 0.5 A	

	VAM 12.1	VAM 42.1
Current consumption from U_L Customized variant	With VAC 30.2: 1.7 A max.	
Input and output supply U_Q	24 V DC (19.2 V to 30 V), PELV (Refer to the documentation "VAP 01.1 Power Supply Unit", part no. R911339613)	
Current consumption from U_Q	Max. 1.7 A	
Fuse	SMD fuse 3 A	
Reverse voltage protection	Integrated	

Tab. 11-66: Technical data of the basic device

The following components are located on the rear side of the devices:

- 25-pin plug to connect a hand-held terminal
- 6-pin plug to connect a handwheel
- 16 digital 24 V inputs
- 8 digital 24 V outputs
- Power supply connection
- One field bus interface Profibus DP
- LEDs for status displays
- Functional earth connection

Override rotary switch

The default variant of the VAM 21.1 and VAM 42.1 devices is equipped with two override rotary switches.

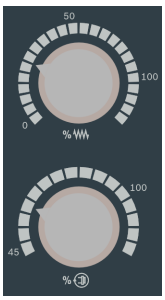


Fig. 11-46: Override rotary switch

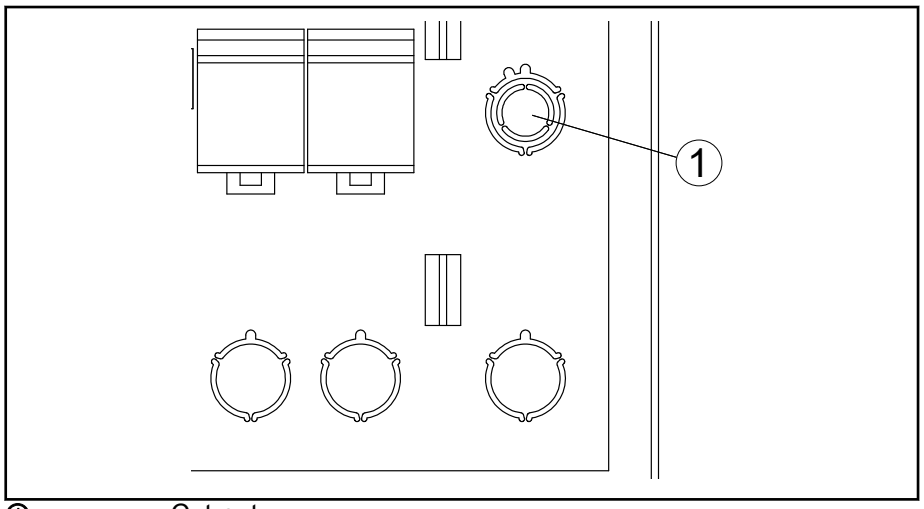
Feed override	24 switch positions from "0" to "Max"
Spindle override	16 switch positions from "Min" to "Max"

Tab. 11-67: Override rotary switch

Equipping with 22.5 mm operating and display elements

The machine control panels can be equipped with 22.5 mm sized operating and display elements. For this purpose, the front panel is provided with pre-milled cut-outs. The switching elements can be application-specific wired by the customer. The number of mounting slots depends on the individual hardware configurations.

The VAM12.1-PB-NF-NN-TB-VD-NN-1608-NN and VAM42.1-PB-NF-NN-TB-VD-NN-1608-NN device variants are provided with a mounting slot, where either a 16 mm or a 22.5 mm hole can be cut-out.



① Cut-out

Fig. 11-47: Position of the mounting slot for a 16 mm or 22.5 mm operating or display element

Only 24 V (safety extra-low voltage) may be connected to the control elements!

E-STOP button

The connections of the both NC contacts ("NC") are labeled with "1" and "2" in the following illustration. An additional N/O contact "NO" with the connector name "3" and "4" is available. This N/O contact can for example be used as signal contact for the state evaluation of the E-STOP button via a PLC.

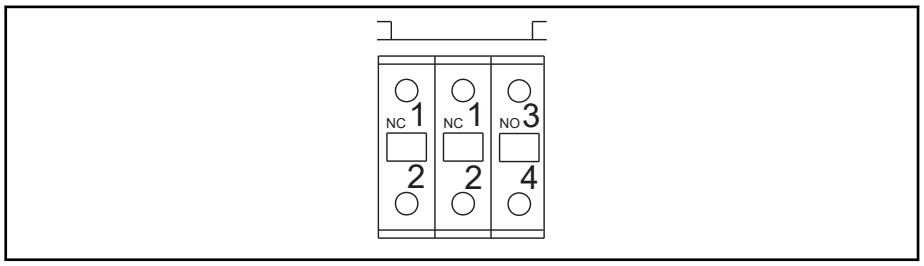


Fig. 11-48: N/C contacts ("NC") and N/O contacts ("NO") of the E-STOP button

Only 24 V (safety extra-low voltage) may be connected to the E-STOP button!

Connection module VAC 30.2

Device variants with the "AB" abbreviation in the type code are provided with an integrated VAC 30.2 connection module to connect a VEH 30.1, VEH 30.2 or VCH 08.1 hand-held terminal in STOP button variant.

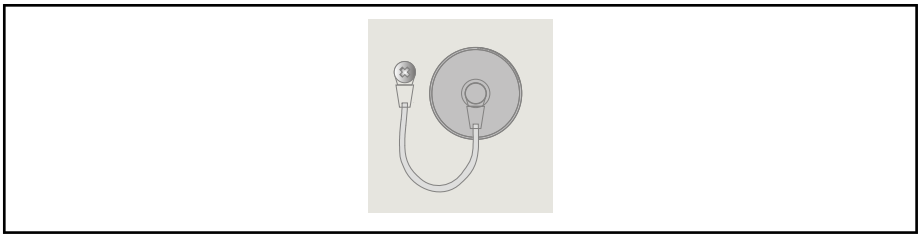


Fig. 11-49: Connection module VAC 30.2

All ports required for a fixedly wired connection to the control are provided on the rear side. The front panel is provided with a 17-pin socket with screwed plug. At this socket, the hand-held terminals VEH 30.1, VEH 30.2 or VCH 08.1 can be connected in a user-friendly way in the stop button variant.

Personality function (VAC 30.2)

In most of the cases, the system is provided with a continuous Ethernet network. However, M-keys, STOP buttons or enabling buttons are specifically assigned to one control. The STOP button and the enabling button are fixedly wired to the connection module VAC 30.2 (= the VAM connection module). The network data of VEH 30.1, 30.2 or VCH 08.1 as well as the IP address of the control are saved in the VAC 30.2 connection module via the memory function.

Thus, different system section can be visualized using a VEH 30.1, VEH 30.2 or VCH 08.1 device via multiple VAC 30.2 connection modules. Upon each replugging, the VEH 30.1, VEH 30.2 or the VCH 08.1 are assigned a new target IP address or UDP address.

The VEH 30.1, VEH 30.2 or VCH 08.1 device applies the network settings retrieved from the VAC 30.2 connection module upon each restart. These settings can be adjusted in the "Rexroth settings" of the VEH 30.1, VEH 30.2 or VCH 08.1 hand-held terminals. These changes are subsequently stored in the VAC 30.2. connection module.



For more information on the “Personality” function, refer to the documentations on the hand-held terminals VEH 30.1 (part no. R911318643), VEH 30.2 (part no. R911331585) or VCH 08.1 (part no. R911320190).

Commissioning with the engineering tool "IndraWorks"

The Bosch Rexroth engineering tool "IndraWorks" can be used for commissioning. In this engineering tool, the devices VAM 12.1 and VAM 42.1 are already in the "Periphery" device library.

Electronic Key System (EKS)

Device variants with "EK" in the type code are provided with an (Electronic Key System) electronic key adapter with USB interface integrated in the "FSA" variant.

Device variants with "EK" in the type code (only available for VAM 42.1) are provided with an (Electronic Key System) electronic key adapter with Ethernet interface integrated in the "FSA" variant.

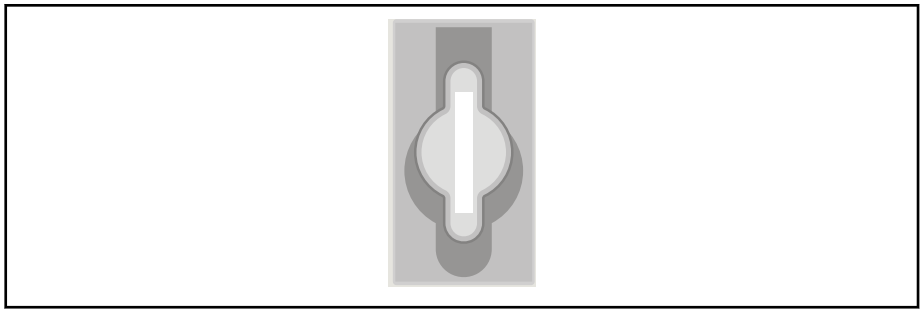


Fig. 11-50: Euchner EKS key adapter

Connection for external hand-held terminal

Next to the inputs for the handwheel of the hand-held terminal (A, /A, B, /B), 12 inputs (IN0 - IN11) are provided for the keys of the hand-held terminal. The keys are supplied with "+24 V" at the X81 plug.

The "+24 V" supply is internally generated by the supply "UL". The "+24 V" supply may only be used to connect the keys of the hand-held terminal. The connection X81 for the hand-held terminal is located on the logic circuit board.

The states of the inputs and the counter value of the handwheel are transmitted to the master control via Profibus DP.

Connection for internal handwheel

The connection X82 for the internal handwheel is located on the logic circuit board.

The counter value of the handwheel is transmitted to the master control via Profibus DP.

GSDML file

A Profibus device description file (GSDML file) is required for the commissioning with another engineering tool.

Bosch Rexroth provides two zipped GSDML files:

- GSD_VAM12_42_WITH_OVERRIDE_RX070123.ZIP
- GSD_VAM_12_42DE_EN_WITHOUT_OVERRIDE.ZIP

Configuration specifications

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	BYTE	2	1
1	Manual control unit	WORD	4	0
2	Handwheel	WORD	2	0
3	Keypad TA	BYTE	2	2
4	Keypad TA	BYTE	2	2
5	Override VD	BYTE	2	0

Tab. 11-68: VAM12.1-PB-NF-NN-TB-VD-NN-1608-NN / VAM12.1-PB-NF-AB-TB-VD-EK-1608-D1

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	BYTE	2	1
1	Manual control unit	WORD	4	0
2	Handwheel	WORD	2	0
3	Keypad TA	BYTE	2	2
4	Keypad TA	BYTE	2	2

Tab. 11-69: VAM12.1-PB-NF-AB-TB-NN-EK-1608-D1

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	BYTE	2	1
1	Manual control unit	WORD	4	0
2	Handwheel	WORD	2	0
3	Keypad TA	BYTE	2	2
4	Keypad TA	BYTE	2	2
5	Override VD	BYTE	2	0

Tab. 11-70: VAM42.1-PB-NF-NN-TB-VD-NN-1608-NN / VAM42.1-PB-NF-AB-TB-VD-EK-1608-D1

Module number	Module	Data format	Inputs (in bytes)	Outputs (in bytes)
0	16DI, 8DO	BYTE	2	1
1	Manual control unit	WORD	4	0
2	Handwheel	WORD	2	0
3	Keypad TA	BYTE	2	2
4	Keypad TA	BYTE	2	2

Tab. 11-71: VAM42.1-PB-NF-AB-TB-NN-EK-1608-D1 / VAM42.1-PB-NF-AB-TB-NN-EE-1608-D1

Profibus DP address settings

The station addresses 1-99 are set via the two BCD rotary switches S1 and S2 (refer to the following figure). S1 represents the tens digit and S2 the units digit of the station address.

The address has to be set when no power is applied.

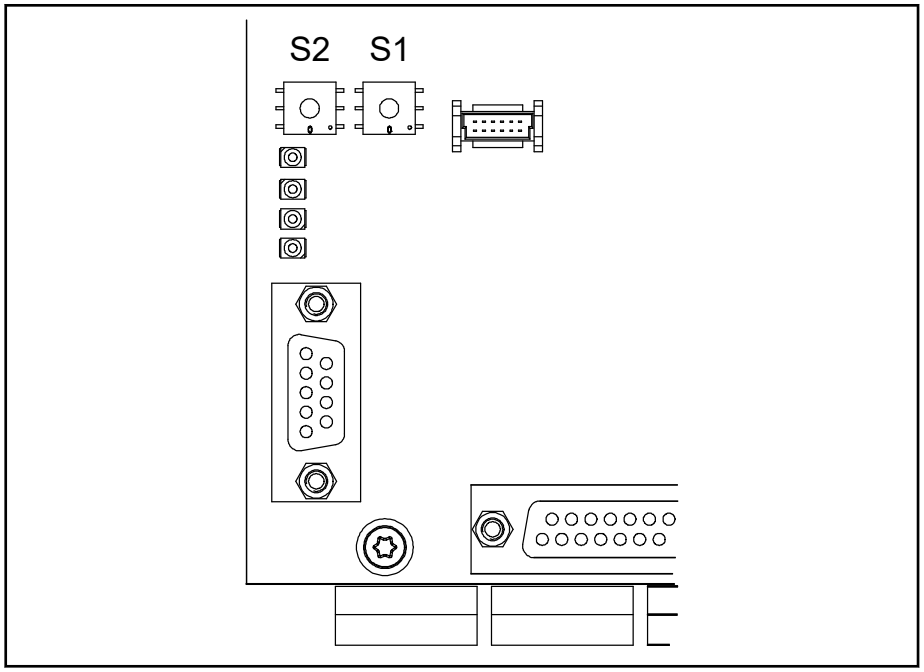


Fig. 11-51: BCD rotary switches S1 and S2

The machine control panels VAM 12.1/VAM 42.1 automatically detect the baud rate set at the Profibus DP. Baud rates from 9.6 kBaud to 12 MBaud are supported:

- 9.6 kBaud
- 19.2 kBaud
- 45.45 kBaud
- 93.75 kBaud
- 187.5 kBaud
- 500 kBaud
- 1.5 MBaud
- 3 MBaud
- 6 MBaud
- 12 MBaud

11.12.4 Variants

The machine control panels of the VAM 12.1 and VAM 42.1 are available in the following variants:

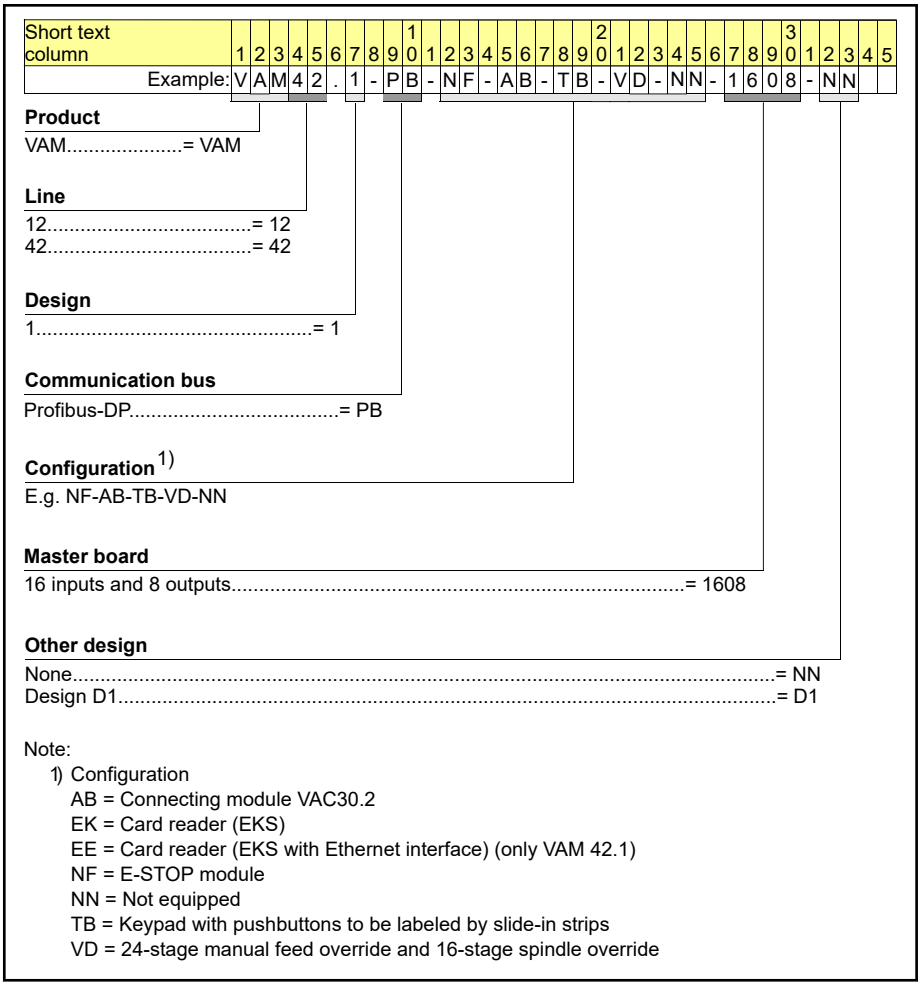
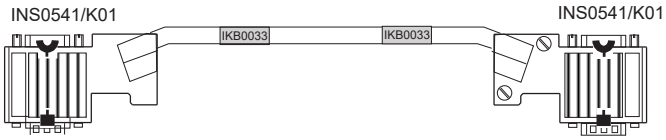
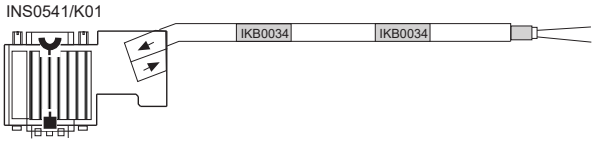


Fig. 11-52: Type code of the VAM 12.1/VAM 42.1

11.12.5 Accessories, plugs and ready-made cables

Ordering code Ready-made cable	Mating plug of the device	Rexroth cable	Design of the cable end
Profibus cable IKB0033/000,0 Part no.: R911291808			
Profibus cable IKB0034/000,0 Part no.: R911291809			

Tab. 11-72: Cable accessories

11.12.6 Documentation

The following documentation is available for a detailed description of the VAM AM 12.1 and VAM 42.1:

- VAM 12.1, VAM 42.1 Machine Control Panels, DOK-SUPPL*-VAM*X2.1***-ITxx-EN-P

11.13 Sercos machine control panels – VAM 10.3 / 40.3

11.13.1 Brief description

Machine control panels are supplementing operator and visualization terminals. They are used to select the operation modes and to operate the machine manually. The machine control panels include operating elements such as keys with LED displays, rotary switches for feed and spindle override, E-STOP button and machine keys.

The machine control panels of the VAM 10.3 and VAM 40.3 series have been designed for the use with devices of the VPP, VSP and Vxx product family and are adapted to the design of these devices. VAM 10.3 has the width of the panel PCs VPP/VSP 16 and VAM 40.3 the width of the panel PCs VPP/VSP 40.

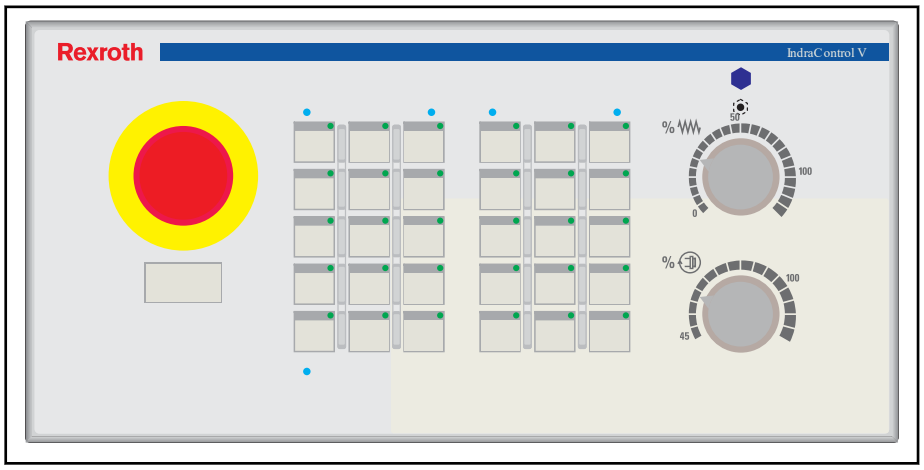


Fig. 11-53: Front view of the VAM 10.3

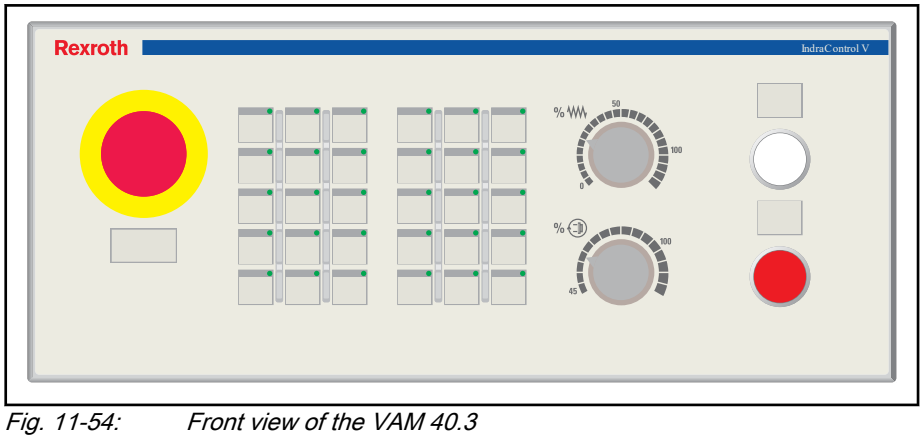


Fig. 11-54: Front view of the VAM 40.3

11.13.2 Fields of application

Machine control panels of the VAM 10.3 and VAM 40.3 series are designed to operate control units.

11.13.3 Technical data

	VAM 10.3	VAM 40.3
Voltage supply	Galvanically insulated	
Logic supply U_L	24 V DC (19.2 V to 30 V), PELV	

	VAM 10.3	VAM 40.3
Current consumption from U_L	Typically 0.3 A	
Input and output supply U_M	24 V DC (19.2 V to 30 V), PELV	
Current consumption from U_M	3.5 A max.	
Fuse for U_L and U_M	SMD fuse 4 A	
Reverse voltage protection	Integrated	

Tab. 11-73: Electrical data

The following components are located on the rear side of the devices:

- 25-pin plug to connect a hand-held terminal
- 6-pin plug to connect a handwheel
- 16 digital 24 V inputs
- 8 digital 24 V outputs

SDDML file

A Sercos device description file (SDDML file) is required for the commissioning at the Sercos III master. The zipped file "SDDML file VAM10_40.zip" is provided for the VAM 10.3 and VAM 40.3 devices. It contains two SDDML files (refer to the following table). For the file, go to the Bosch Rexroth internet. You can also contact your local service support.

Device	SDDML file
VAM10.3-S3-NF-TA-TA-VD-1616-NN	SDDML-Vx.x-Bosch Rexroth AG-VAM10_3_S3_NF_TA_TA_VD_1616_NN-JJJJMMDD.xml
VAM40.3-S3-NF-TA-TA-VD-MA-1616-NN	SDDML-Vx.x-Bosch Rexroth AG-VAM40_3_S3_NF_TA_TA_VD_MA_1616_NN-JJJJMMDD.xml

YYYY Year
MM month
DD Day

Tab. 11-74: SDDML files

Sercos address

- The Sercos address 254 is preset upon delivery
- Automatic address allocation according to Sercos III is supported
- The Sercos address is remanently saved in the device

Device exchange

The behavior of the Sercos III ring after exchanging a VAM 10.3 or VAM 40.3 depends on the master used. Since the devices support an automatic address allocation and remanent saving of the Sercos address, the device can be exchanged without replacing the configuration tool. For more information, refer to the documentation of the master.

11.13.4 Variants

The machine control panels of the VAM 10.3 and VAM 40.3 series are available in the following variants:

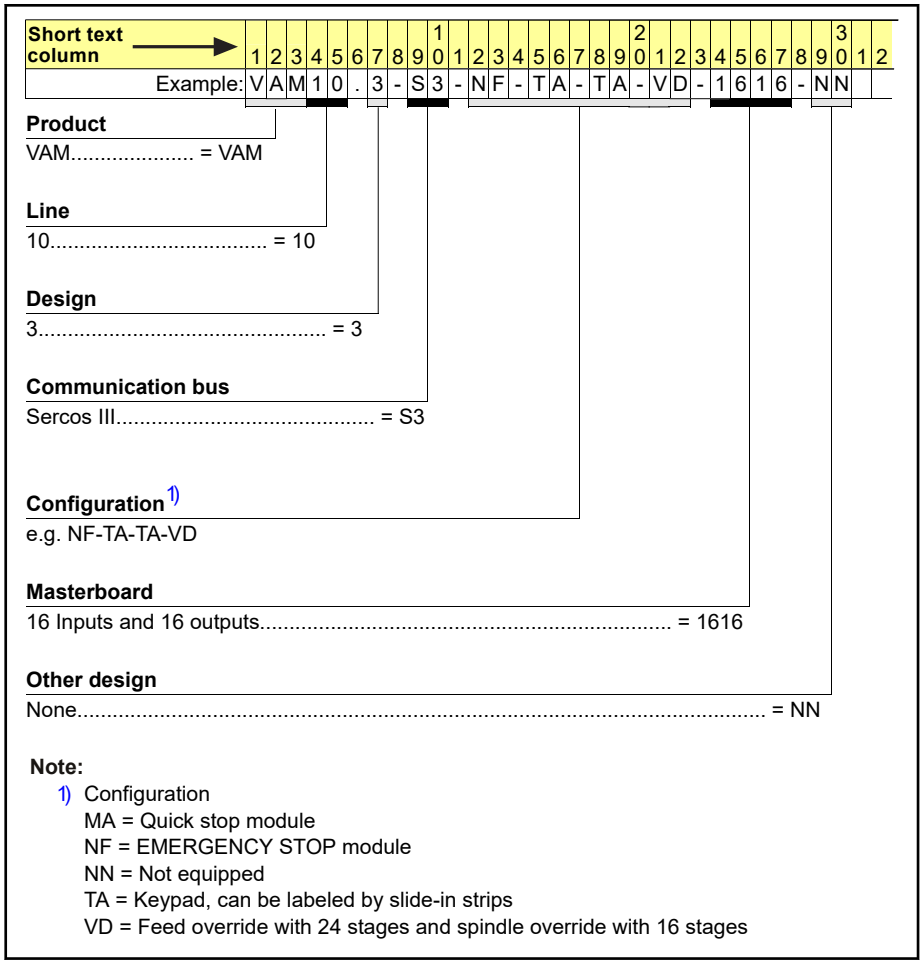


Fig. 11-55: Type code VAM 10.3

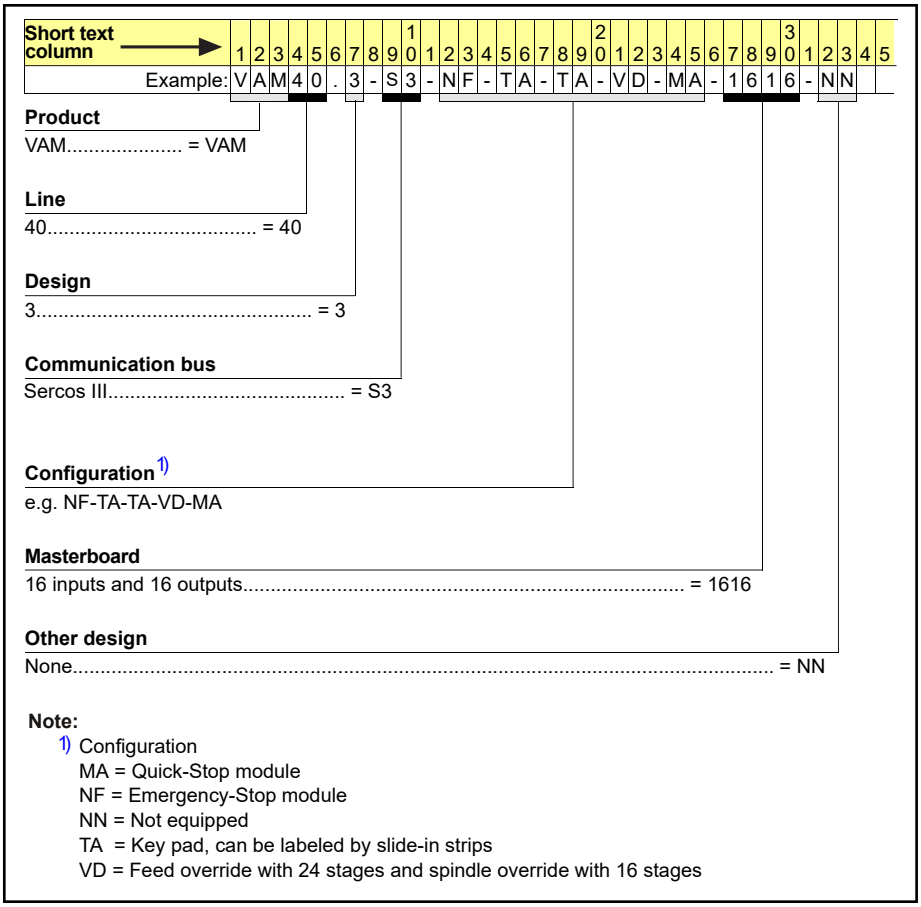


Fig. 11-56: Type code VAM 40.3

11.13.5 Accessories, plugs and ready-made cables

Ordering code	Part number	Description
RKB0013/00,19 (*******-*******-*******)	R911329741	Bus cable, length 0.19 m, RJ45/RJ45 plug
RKB0013/00,25 (*******-*******-*******)	R911317797	Bus cable, length 0.25 m, RJ45/RJ45 plug
RKB0013/00,35 (*******-*******-*******)	R911317800	Bus cable, length 0.35 m, RJ45/RJ45 plug
RKB0013/00,55 (*******-*******-*******)	R911317801	Bus cable, length 0.55 m, RJ45/RJ45 plug
RKB0013/001,0 (*******-*******-*******)	R911340679	Bus cable, length 1.0 m, RJ45/RJ45 plug
RKB0013/002,0 (*******-*******-*******)	R911338023	Bus cable, length 2.0 m, RJ45/RJ45 plug
RKB0013/003,0 (*******-*******-*******)	R911338011	Bus cable, length 3.0 m, RJ45/RJ45 plug
RKB0013/005,0 (*******-*******-*******)	R911347157	Bus cable, length 5.0 m, RJ45/RJ45 plug
RKB0013/007,0 (*******-*******-*******)	R911347158	Bus cable, length 7.0 m, RJ45/RJ45 plug

Ordering code	Part number	Description
RKB0011/xxx,x		Bus cable, variable length, RJ45/ RJ45 plug
RKB0044/xxx,x		Bus cable, variable length, RJ45/M12 plug

Tab. 11-75: Interface cable – Sercos III

Ordering code	Part number	Description
RBS0016	R911315797	Field-assembly RJ45 plug, IP 20 with straight cable outlet
RBS0022/S01 (CP-0008K-RJ45-SNAP*-****)	R911333124	Field-assembly RJ45 plug, IP 20 with angled cable outlet

Tab. 11-76: Field-assembly RJ45 plug

11.13.6 Documentation

The following documentation is available for a detailed description of the VAM AM 10.3 and VAM 40.3:

- VAM 10.3/40.3, DOK-SUPPL*-VAM*XX.3***-PRxx-EN-P

11.14 Sercos machine control panels – VAM 15.1 / 21.1

11.14.1 Brief description

Machine control panels are supplementing operator and visualization terminals. They are used to select the operation modes and to operate the machine manually. These devices include control elements such as keys with LED displays, rotary switches for feed and spindle override, E-STOP button and machine keys.

The machine control panels of the VAM 15.1 and VAM 21.1 series have been designed for the use of devices of the Vxx product family and are adapted to the design of these devices. The VAM 15.1 has the width of the panel PC VPP 15.3 and the VDP 15.3 and VAM 21.1 have the width of the panel PC VPP 21.3 and VDP 21.3 respectively in vertical position.

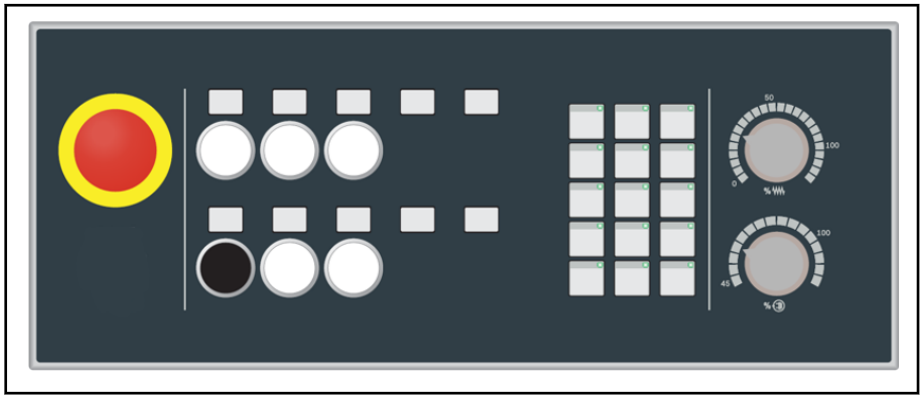


Fig. 11-57: Front view of the VAM 15.1

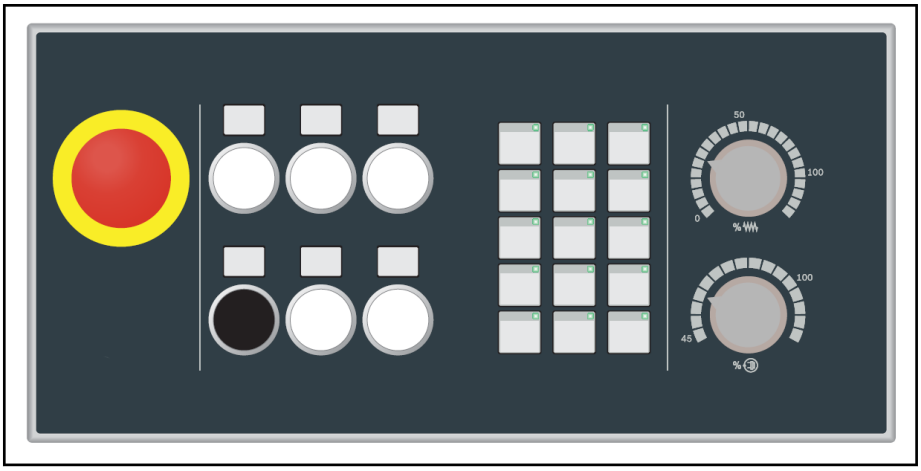


Fig. 11-58: Front view of the VAM 21.1

11.14.2 Fields of application

Machine control panels of the VAM 15.1 and VAM 21.1 series are designed to operate control units.

11.14.3 Technical data

	VAM 15.1	VAM 21.1
Degree of protection	IP 54 (front)	
Color of the front foil	Graphite grey RAL 7024	
Dimensions (W × H × D)	422 mm × 169 mm × 84.1 mm	350 mm × 169 mm × 84.1 mm
Weight	Approx. 2120 g	Approx.1940 g
Material of the front panel	Anodized aluminum, completely embedded, chemical resistant polyester foil	
Voltage supply	Galvanically insulated	
Logic supply U_L	24 V DC (19.2 V to 30 V), PELV (Refer to the documentation "VAP 01.1 Power Supply Unit", part no. R911339613)	
Current consumption from U_L	Typically 0.3 A	
Input and output supply U_M	24 V DC (19.2 V to 30 V), PELV (Refer to the documentation "VAP 01.1 Power Supply Unit", part no. R911339613)	
Current consumption from U_M	3.5 A max.	
Fuse for U_L and U_M	SMD fuse 4 A each	
Reverse voltage protection	Integrated	

Tab. 11-77: Basic device – General technical data

The following components are located on the rear side of the devices:

- 25-pin plug to connect a hand-held terminal

- 6-pin plug to connect a handwheel
- 16 digital 24 V inputs
- 16 digital 24 V outputs
- Power supply connection
- Functional earth connection
- Voltage tapping for front elements
- Two RJ45 sockets for Sercos III
- One service interface
- LEDs for status displays
- Two Dip switches to set the operating mode

Digital 24 V inputs and outputs

The digital I/Os are mapped at the field bus in module "16DI, 16DO".

Override rotary switch

The default variant of 15.1/VAM 21.1 is equipped with two override rotary switches.

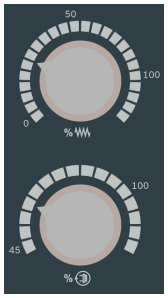


Fig. 11-59: Override rotary switch

Feed override	24 switch positions from "0" to "Max"
Spindle override	16 switch positions from "Min" to "Max"

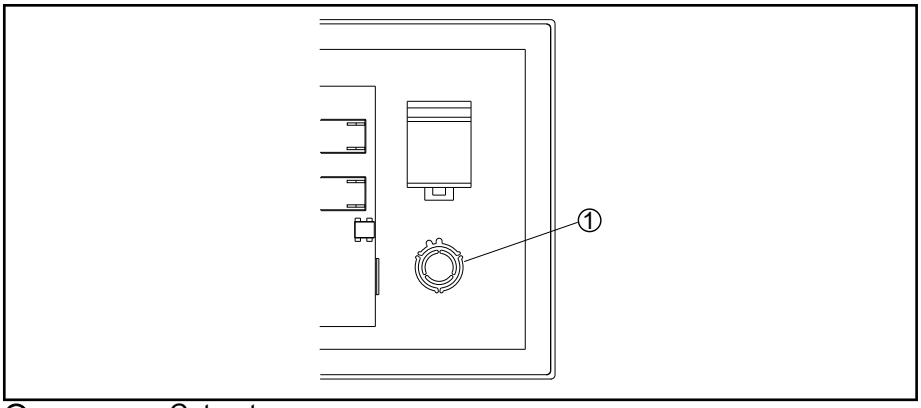
Tab. 11-78: Override rotary switch

Combined mounting slot for a 16 mm or 22.5 mm operating or display element

The devices VAM 15.1/VAM 21.1 provide a mounting slot, where either a 16 mm or a 22.5 mm hole can be cut out (refer to the following figures).



Fig. 11-60: Combined mounting slot for a 16 mm or 22.5 mm operating or display element



① Cut-out

Fig. 11-61: Position of the cut-out for a 16 mm or 22.5 mm operating or display element

☞ Only 24 V (safety extra-low voltage) may be connected to the control elements!

E-STOP button

The connections of the both NC contacts ("NC") are labeled with "1" and "2" in the following illustration. The N/O contacts "NO" with the connection label "3" and "4" can for example be used as message contact for the state evaluation of the E-STOP button via a PLC.

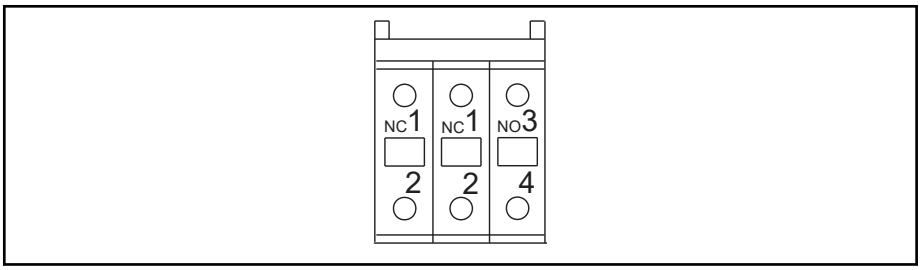


Fig. 11-62: Connection figure: N/C contacts ("NC") and N/O contacts ("NO") of the E-STOP button

☞ Only 24 V (safety extra-low voltage) may be connected to the E-STOP button!

Labeling templates for slide-in strips

For the labeling templates, go to the Bosch Rexroth internet. You can also contact your local service support.

Use the templates to create the labels for the machine operating keys. They can be printed out on foil or paper using a laser printer.

After cutting out the slide-in strips, they can be inserted on the rear side of the device.

22.5 mm switching elements

☞ The 22.5 mm switching elements (① in the following figure) are available on both the machine control panels VAM 15.1 and VAM 21.1.

The four additional combined pre-break-outs for the 16 mm/22.5 mm switching elements (② in the following figure) are only provided on the VAM 15.1.

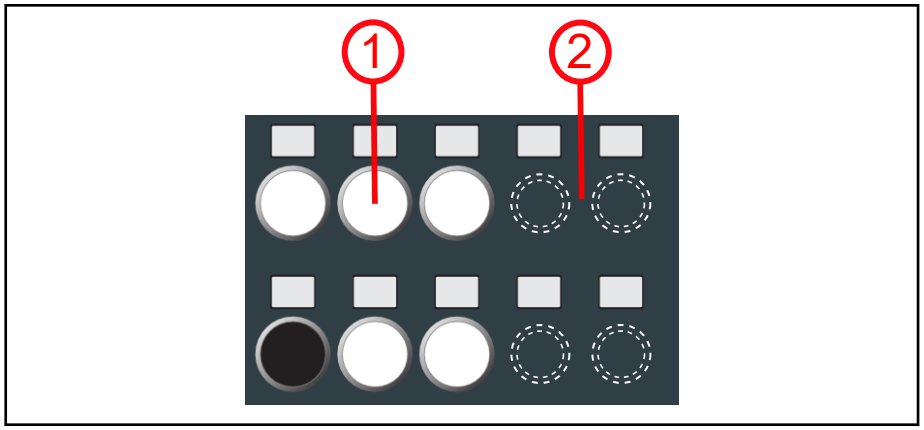


Fig. 11-63: 22.5 mm switching elements and combined pre-break-outs 6 mm/ 22.5 mm

22.5 mm switching elements can be wired user-specifically.

Switching element	Contact loadings	Backlight
Illuminated pushbutton, while	2× N/O contacts (Contact name 3 and 4)	24 V LED (Contact name X1 and X2)
Pushbutton, black	2× N/C contacts (Contact name 1 and 2)	No

Tab. 11-79: Contact loadings 22.5 mm switching elements

Only 24 V (safety extra-low voltage) may be connected to the switching elements!

Keypad

A green LED Hx.y (output) is assigned to each Sx.y button (input). The keypads are connected to the logic circuit board via the internal shift register bus. At the field bus, the inputs (pushbuttons) and the outputs (LED) of the keypad are mapped to the "Keypad TA" module.

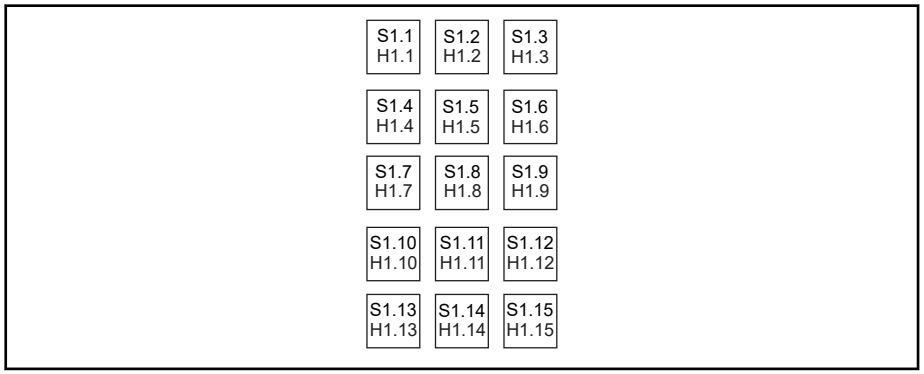


Fig. 11-64: LED and key assignment of the module "Keypad TA"

Connection for external hand-held terminal

Next to the inputs for the handwheel of the hand-held terminal (A, /A, B, /B), 12 inputs (IN0 - IN11) are provided for the keys of the hand-held terminal. The keys are supplied with "+24 V" at the X81 plug.

The "+24 V" are internally generated by the "U_L" supply and may only be used to connect the keys of the hand-held terminal.

The "X81" connection for the hand-held terminal is located on the logic circuit board.

The states of the inputs and the counter value of the handwheel are transmitted to the master control via the field bus.

Connection for internal handwheel

The connection "X82" for the internal handwheel is located on the logic circuit board.

The counter value of the handwheel is transmitted to the master control via the field bus.

Sercos address

- The Sercos address 254 is preset upon delivery
- Automatic address allocation according to Sercos III is supported
- The Sercos address is remanently saved in the device

Device exchange

The behavior of the Sercos III ring after exchanging a VAM 15.1/ VAM 21.1 depends on the master used. Since the devices support an automatic address allocation and remanent saving of the Sercos address, the device can be exchanged without replacing the configuration tool. For more information, refer to the documentation of the master.

Commissioning with the engineering tool "IndraWorks"

The Bosch Rexroth engineering tool "IndraWorks" can be used for commissioning. In this engineering tool, the devices VAM 15.1 and VAM 21.1 are already in the "Periphery" device library.

SDDML file

A Sercos device description file (SDDML file) is required for the commissioning with another engineering tool. The device description files can be downloaded in the Rexroth product portal.

11.14.4 Variants

The machine control panels of the VAM 15.1 and VAM 21.1 series are available in the following variants:

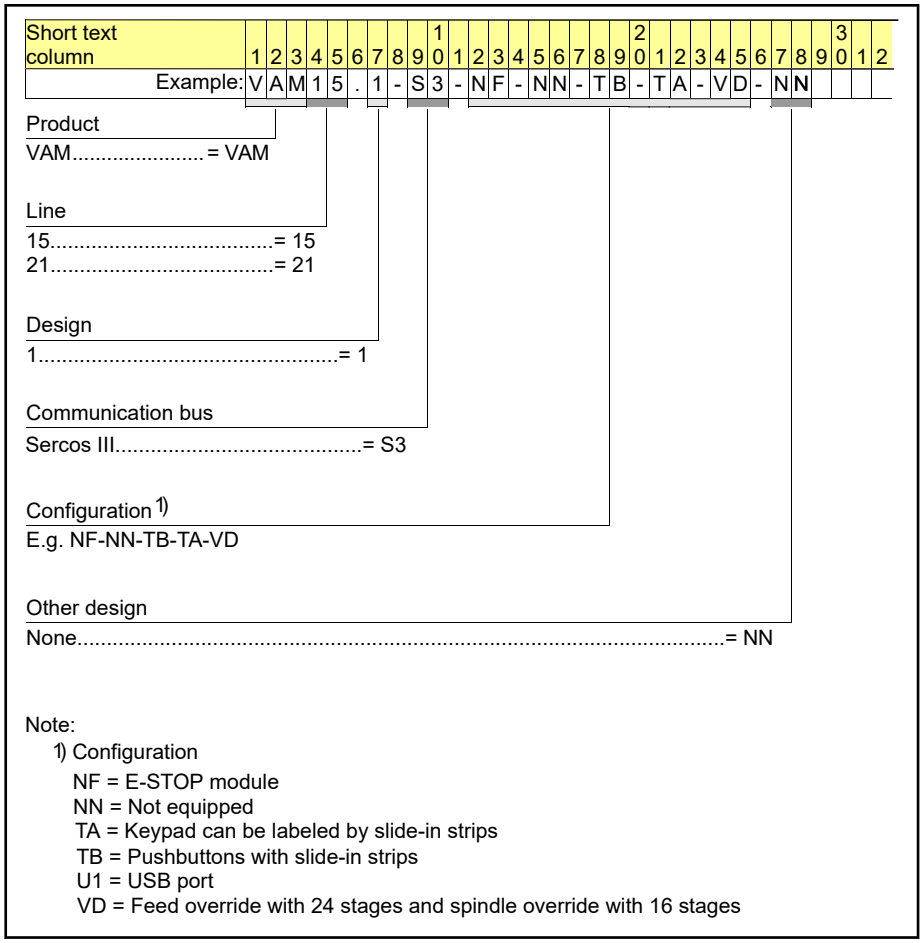


Fig. 11-65: Type code of the VAM 15.1/VAM 21.1

11.14.5 Accessories, plugs and ready-made cables

Ordering code	Part number	Description
RKB0013/00,19 (*******-*******-*******)	R911329741	Bus cable, length 0.19 m, RJ45/RJ45 plug
RKB0013/00,25 (*******-*******-*******)	R911317797	Bus cable, length 0.25 m, RJ45/RJ45 plug
RKB0013/00,35 (*******-*******-*******)	R911317800	Bus cable, length 0.35 m, RJ45/RJ45 plug
RKB0013/00,55 (*******-*******-*******)	R911317801	Bus cable, length 0.55 m, RJ45/RJ45 plug
RKB0013/001,0 (*******-*******-*******)	R911340679	Bus cable, length 1.0 m, RJ45/RJ45 plug
RKB0013/002,0 (*******-*******-*******)	R911338023	Bus cable, length 2.0 m, RJ45/RJ45 plug
RKB0013/003,0 (*******-*******-*******)	R911338011	Bus cable, length 3.0 m, RJ45/RJ45 plug
RKB0013/005,0 (*******-*******-*******)	R911347157	Bus cable, length 5.0 m, RJ45/RJ45 plug

Ordering code	Part number	Description
RKB0013/007,0 (*******-*******-*******)	R911347158	Bus cable, length 7.0 m, RJ45/RJ45 plug
RKB0011/xxx,x		Bus cable, variable length, RJ45/ RJ45 plug
RKB0044/xxx,x		Bus cable, variable length, RJ45/M12 plug

Tab. 11-80: Interface cable – Sercos III

Ordering code	Part number	Description
RBS0016	R911315797	Field-assembly RJ45 plug, IP 20 with straight cable outlet
RBS0022/S01 (CP-0008K-RJ45-SNAP*-****)	R911333124	Field-assembly RJ45 plug, IP 20 with angled cable outlet

Tab. 11-81: Field-assembly RJ45 plug

11.14.6 Documentation

The following documentation is available for a detailed description of the VAM 15.1 and VAM 21.1 series:

- VAM 15.1, VAM 21.1 Machine Control Panels, DOK-SUPPL*-VAM*15*21*1-ITxx-EN-P

11.15 PC keyboards VAK

11.15.1 General information

Insertable or mountable keyboards with a foil-based design are available to operate the industrial PC according to the requirements.

11.15.2 Drawer keyboards



Fig. 11-66: Insertable keyboard VAK 10.1



Fig. 11-67: Insertable keyboard VAK 40.1

The VAK 10.1 and VAK 40.1 insertable keyboards are AT-compatible PS/2 keyboards with 86 keys and an integrated mouse pointer. Both devices vary only in their different front panel widths. In terms of function and design, the devices are ideally adjusted to the VSP, VDP and VPP operating device series. The integrated mouse and mouse keys allow to navigate easily in graphical user interfaces. The drawer is designed with sliding tracks and a ball/notch lock.

11.15.3 Drawer keyboards



Fig. 11-68: Mountable Keyboard VAK 11.2



Fig. 11-69: Mountable Keyboard VAK 41.2

The VAK 11 and VAK 41 mountable keyboards are AT-compatible PS/2 foil keyboards with 106 keys. Both devices vary only in their different front panel widths. In terms of function and design, the devices are ideally adjusted to the VSP, VDP and VPP operating device series and are characterized by their minimum height.

11.15.4 Variants

The following keyboard variants is available for the industrial PC:

Model	Type	Remarks
Insertable keyboard	VAK10.1E-EN-P-MPNN	Acc. to VSP 16, VDP 16, VPP 16
	VAK40.1E-EN-P-MPNN	Acc. to VSP 40, VDP 40, VPP 40
	VAK40.1E-DE-P-MPNN	Acc. to VSP 40, VDP 40, VPP 40
Mountable key-board (foil-based design)	VAK11.2F-EN-P-NNNN	Acc. to VSP 16, VDP 16, VPP 16
	VAK41.2F-EN-P-NNNN	Acc. to VSP 40, VDP 40, VPP 40

Tab. 11-82: VAK 10/11/40/41 selection

11.15.5 Documentation

The following documentation is available for drawer keyboards VAK xx.1 and VAK xx.2:

- VAK 11.2 and VAK 41.2, DOK-SUPPL*-VAK*11/41**-PRxx-EN-P
- VAK 11.2, 41.2 Foil Keyboard, DOK-SUPPL*-VAK*X1.2***-ITxx-EN-P
- VAK 10.1/40.1 Drawer Keyboard, DOK-SUPPL*-VAK*40.1***-PRxx-EN-P
- VAK 10.1/40.1 Drawer Keyboard, DOK-SUPPL*-VAK*X0.1***-ITxx-EN-P

12 Axis types and axis operating types

12.1 Overview on axis types and axis modes

This chapter provides a brief overview on the different axis types and its operation modes.

Axes are elementary Motion objects in the MLC system. The axes are controlled from the PLC program.

The axes are mainly parameterized via A-parameters. In some applications, S-/P-parameters of real axes are also required.

Overview

The following topics are covered in this chapter:

- chapter 12.2 "Axis types" on page 245
- chapter 12.3 "Single-axis modes" on page 246
- chapter 12.4 "Kinematic axes" on page 254
- chapter 12.5 "Controlling axes of the PLC program" on page 256

Related documentation

For further documentation, refer to the chapter "chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3". This chapter provides more detailed information on this topic.

12.2 Axis types

12.2.1 Overview

Overview

This chapter describes commonalities and differences of the axis types.

As mentioned, the following axis types of interest for focused applications are distinguished:

- Virtual axis

  Axis in the control; not assigned to any drive and can execute motion commands. Used as virtual master axis for example (vertical shaft)
- Real axis

  Axis assigned to a drive, e.g. IndraDrive, SercosDrive, HydraulicDrive; can execute motion commands
- Controller axes (only MLC)

  Axis whose controllers are implemented into the PLC
- Encoder axis

  Axis only providing actual values (e.g. from an additional drive encoder)
- Link axes (only MLC)

  Axis providing position values of another control (Sercos II CrossComm, not for Sercos III C2C)

A set of parameters (A-parameters) is available for each axis. These parameters can be immediately read and written in the IndraWorks Engineering environment or in the PLC project via respective access functions. The meaning of an A-parameter is identical for each axis type. Thus, axis types can be exchanged without modifying the programming of this axis in the PLC project. Not all A-parameters exist for each axis type (refer to the following table).

Each axis type provides special functionalities described in detail in the following chapters.

	Real Axis	Virtual Axis	Encoder axis	Link axis[1)]	Controller axis[1)]
Commanding	X	X			X
Use as master axis	X	X	X	X	X
Use as slave axis	X	X			X
Use as axis of a kinematics	X	X			X

1) Only for MLC

Tab. 12-1: Overview on the functional scope of axis types

12.3 Single-axis modes

12.3.1 Overview

This chapter describes the different operation mode of the axes.

The operation mode specified by the PLC program defines the axis motion.

The following topics are covered in this chapter:

- chapter 12.3.2 "Positioning types" on page 247
  - Positioning (absolute, additive or relative)

    The axis moves to a specific position. The position value can be specified absolutely or relatively to the command or actual position. This operation mode is not available for drives without encoders
  - Velocity control

    Continuous axis motion with defined velocity
  - Torque/force control

    Continuous axis motion with defined torque/force
- chapter 12.3.3 "Operation modes for synchronous motions with electronic gear function" on page 248
  - Velocity synchronization

    In the "velocity synchronization" mode, the axis velocity-synchronously follows a specified master axis velocity
  - Phase synchronization

    In the "phase synchronization" mode, the axis follows a specified master axis position either absolutely or relatively phase-synchronous. This operation mode is not available for drives without encoders
  - Electronic cam

    In the "electronic cam" mode, there is a fixed relationship between the master axis position and the slave axis. This relationship is defined in a cam table by points. This operation mode is not available for drives without encoders
  - Electronic FlexProfile MotionProfile

    The "FlexProfile" belongs to the group of "electronic motion laws". The FlexProfile is described by mathematical motion laws as analytical functions. This operation mode is not available for drives without encoders

12.3.2 Positioning types

Absolute positioning

This operation mode enables the time-optimum positioning of a single axis. In "absolute positioning" mode, a target position is directly specified for the axis. In the interpolator, a position command value characteristic is created as input variable for the position controller using the specified value for the target position including the specified positioning data (velocity, acceleration and jerk).

Typical applications

- Control of infeed axes
- Manually triggered positioning for setup tasks
- Positioning a virtual master axis...

☞ This operation mode is not available for drives without encoders.

Additive positioning

This operation mode enables the time-optimum positioning of a single axis. A distance is specified in the "additive positioning" mode. The distance is added to the current **target position** and transmitted to the interpolator as new target position. The interpolator calculates a position command value sequence for the position controller considering the given positioning data (velocity, acceleration and jerk).

Typical applications

- Clocking a stacker

☞ This operation mode is not available for drives without encoders.

Relative positioning

This operation mode enables the time-optimum positioning of a single axis. A distance is specified in the "relative positioning" mode. The distance is added to the current **actual position** and transferred to the interpolator as new target position. The interpolator calculates a position command value sequence for the position controller considering the given positioning data (velocity, acceleration and jerk).

Typical applications

- Clocked feed

☞ This operation mode is not available for drives without encoders.

Velocity control

In the "velocity control" mode, a velocity command value for an "endless" motion to the next motion command is defined for the axis.

Typical applications

- Control of the virtual master axis speed
- Continued execution of paint application or paste rolling at machine standstill
- Continuous product feed...

Torque/force control

In the "torque/force control" mode, a torque/force command value is specified for the drive.

Typical applications

- Torque coupling for mechanically coupled ("switched in parallel") axes
- Hydraulic applications

☞ The "torque/force control" is only available for real axes with interpolation in the drive.

12.3.3 Operation modes for synchronous motions with electronic gear function

Velocity synchronization

In the "velocity synchronization" mode, the axis velocity-synchronously follows a specified master axis velocity. The master axis velocity can be specified by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is a velocity-synchronous (drift-free) run between the master axis and the selected slave axis.

Typical applications

- Simple transport axes
- Draw rollers in winder applications
- Cooling rolls
- Impression cylinders
- Paint application rollers
- Film/paper drawing...

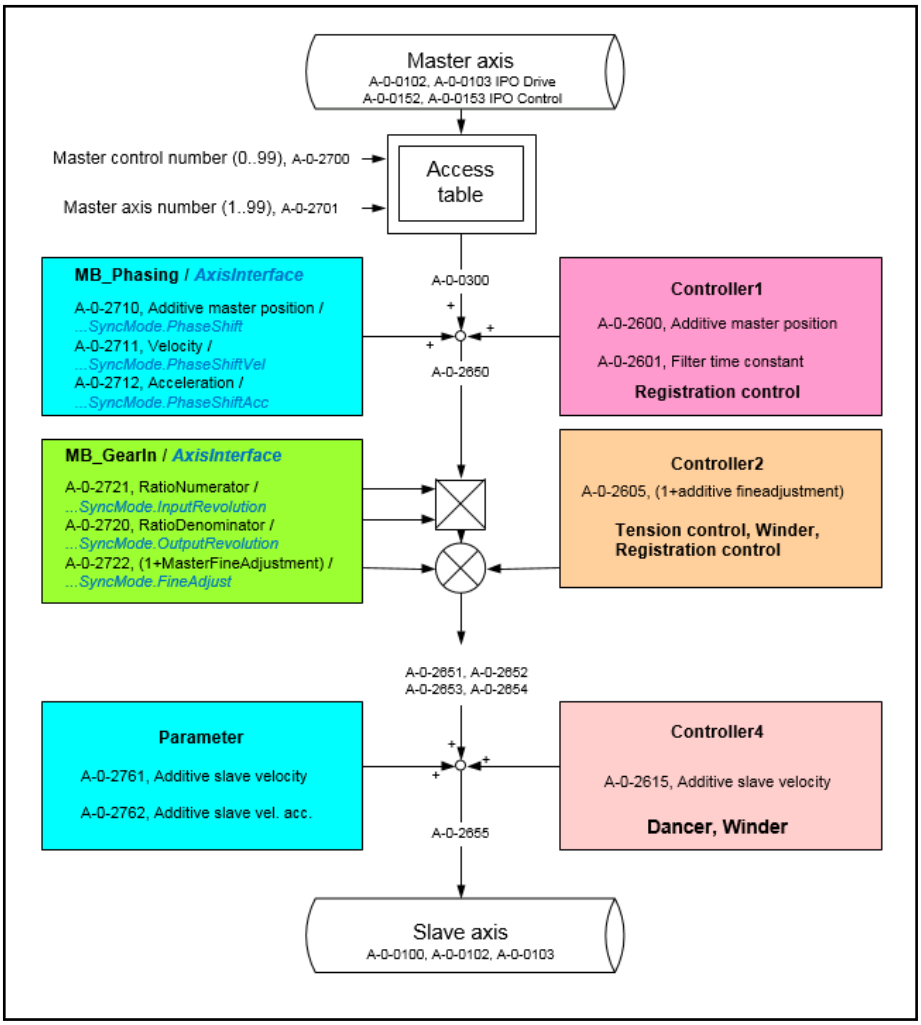


Fig. 12-1: MotionControl functional chain "velocity synchronization"

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, Master axis, additive position command value" can be specified via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, Master drive gear output revolutions" and "A-0-2720, Master drive gear input revolutions" and the "A-0-2722, Gear fine adjustment". The fine adjustment value is specified in percent and calculated as (1 + fine adjustment). These values are specified via "MC_GearIn" or the AxisInterface
- The additive command velocity of the slave axis defined by "A-0-2761, Slave axis, additive command velocity"

Phase synchronization

In the "phase synchronization" mode, the axis follows a specified master axis position either absolutely or relatively phase-synchronous. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is a phase-synchronous and velocity-synchronous (drift-free) run between the master axis and the selected slave axis.

Typical applications

- Processing units for stamping, embossing, perforating ...
- Printing cylinders
- Material transportation ...

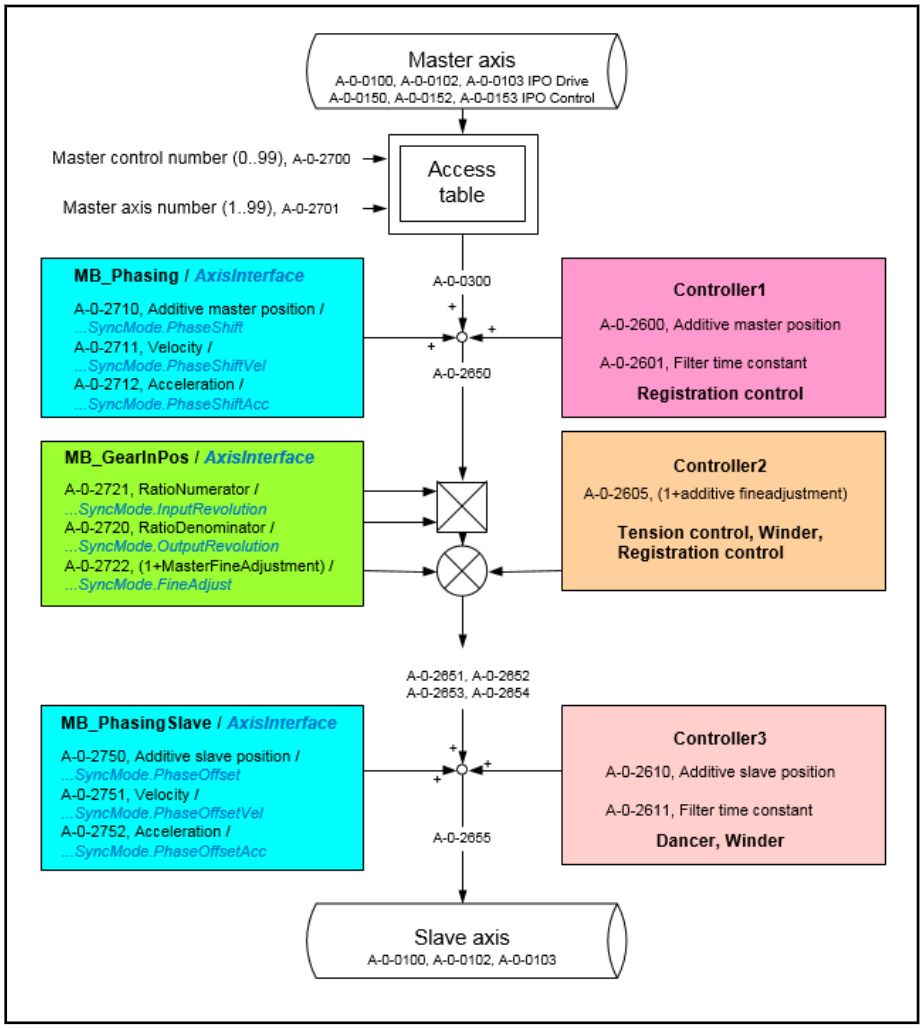


Fig. 12-2: MotionControl functional chain "phase synchronization"

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, Master axis, additive position command value" can be specified via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, Master drive gear output revolutions" and "A-0-2720, Master drive gear input revolutions" and the "A-0-2722, Gear fine adjustment". The fine adjustment value is specified in percent and calculated as (1 + fine adjustment). These values are specified via MB_GearInPos or the AxisInterface
- The additive slave axis position defined by "A-0-2750, Slave axis, additive position command value" can be specified via MB_PhasingSlave or the AxisInterface



This operation mode is not available for drives without encoders.

Electronic cam

In the "electronic cam" mode, the axis follows a specified master axis position defined by a fixed relationship between the master axis position and the slave axis. This relationship is defined in a cam table by points. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is to implement the dependency between the master axis and the selected slave axis. This dependency is stored in the cam table.

Typical applications

- CrossCutter
- FlyingShear
- Cycle-synchronous lock-on and lock-off...

The cam tables can be generated and loaded using the "CamBuilder" integrated in IndraWorks. Furthermore, PLC function blocks to generate cam tables for specific applications such as cross cutting and cross sealing are provided by the MLC system.



The "electronic cam" is only available for real axes with interpolation in the drive.

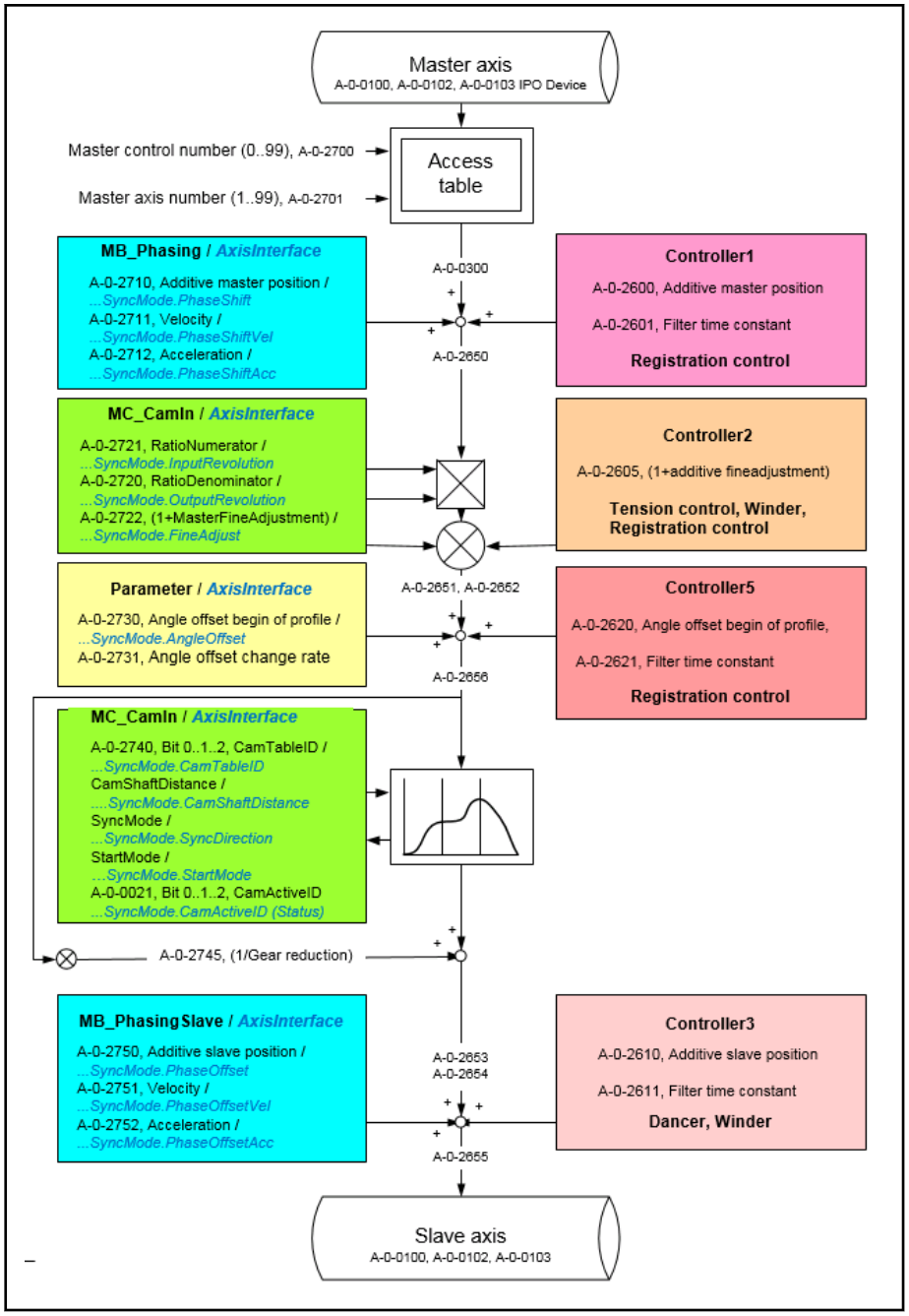


Fig. 12-3: MotionControl functional chain "Electronic cam"

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, Master axis, additive position command value" can be specified via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, Master drive gear output revolutions" and "A-0-2720, Master drive gear input revolutions" and the "A-0-2722, Gear fine adjustment". The fine adjustment value is specified in percent and calculated as (1 + fine adjustment).

  One of the possible cam tables to be stored in the drive before can be selected via "A-0-2740, Cam preselection".

  These values are specified via MC_CamIn or the AxisInterface

- The additive slave axis position defined by "A-0-2750, Slave axis, additive position command value" can be specified via MB_PhasingSlave or the AxisInterface



This operation mode is not available for drives without encoders.

Electronic FlexProfile MotionProfile

In the "FlexProfile" mode, the axis follows a specified master axis position defined as analytic functions by mathematical motion laws. The master axis position can be specified either by an encoder axis (real master axis), a virtual axis (virtual master axis) or a real axis.

The objective is to implement a dependency between the master axis and the selected slave axis. This dependency is stored in the FlexProfile.

Typical applications

- Time-controlled profiles for thermoforming machines
- Sealing axis with bagging machines
- FlyingShear/bottle fillers ...

FlexProfiles can be generated and loaded with the "CamBuilder" integrated in IndraWorks.



The "FlexProfiles" in the MLC system are only provided for virtual axes and real axes with interpolation in the control.

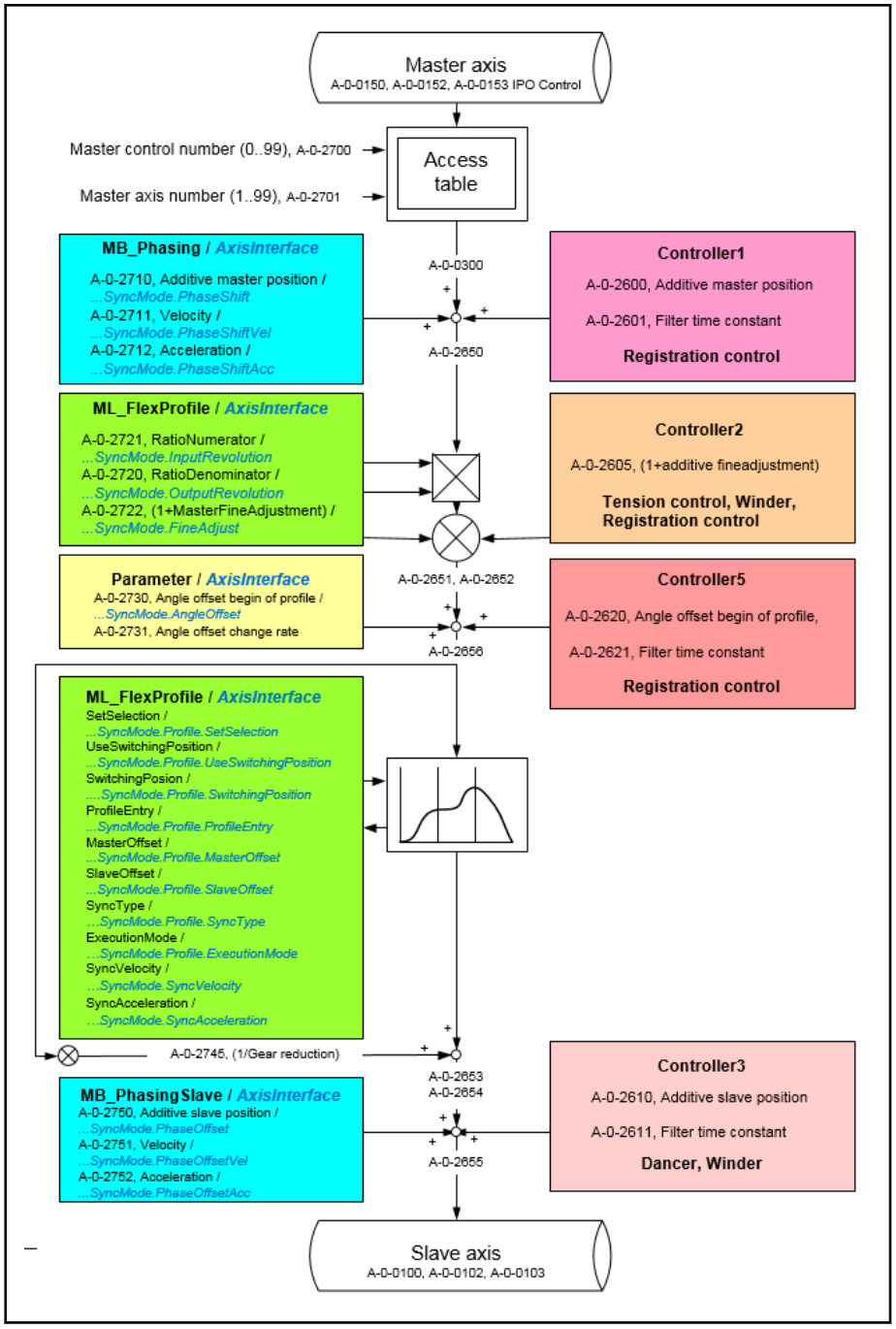


Fig. 12-4: "Electronic MotionProfile FlexProfile" MotionControl functional chain

The operation mode provides the following access points:

- The additive master axis position defined by "A-0-2710, Master axis, additive position command value" can be specified via MB_Phasing or the AxisInterface
- Electronic gear defined by the ratio of "A-0-2721, Master drive gear output revolutions" and "A-0-2720, Master drive gear input revolutions" and the "A-0-2722, Gear fine adjustment". The fine adjustment value is specified in percent and calculated as (1 + fine adjustment).

  One of the two possible FlexProfiles to be stored in the control before is selected via "A-0-2740, Cam preselection".

These values are specified via ML_Flexprofile or the AxisInterface

- The additive slave axis position defined by "A-0-2750, Slave axis, additive position command value" can be specified via MB_PhasingSlave or the AxisInterface



This operation mode is not available for drives without encoders.

12.4 Kinematic axes

12.4.1 Overview



Kinematic axes are only available in the MLC.

In the MLC system, complex kinematics can be traversed in a coordinated manner (coordinated motion) as axis groups via the integrated Robot Control.

Kinematic axes are individual axes belonging to a kinematics.

The kinematics is configured via the kinematic dialogs in IndraWorks.

This chapter describes the individual types of the kinematic axes and their commanding options.

Axis types

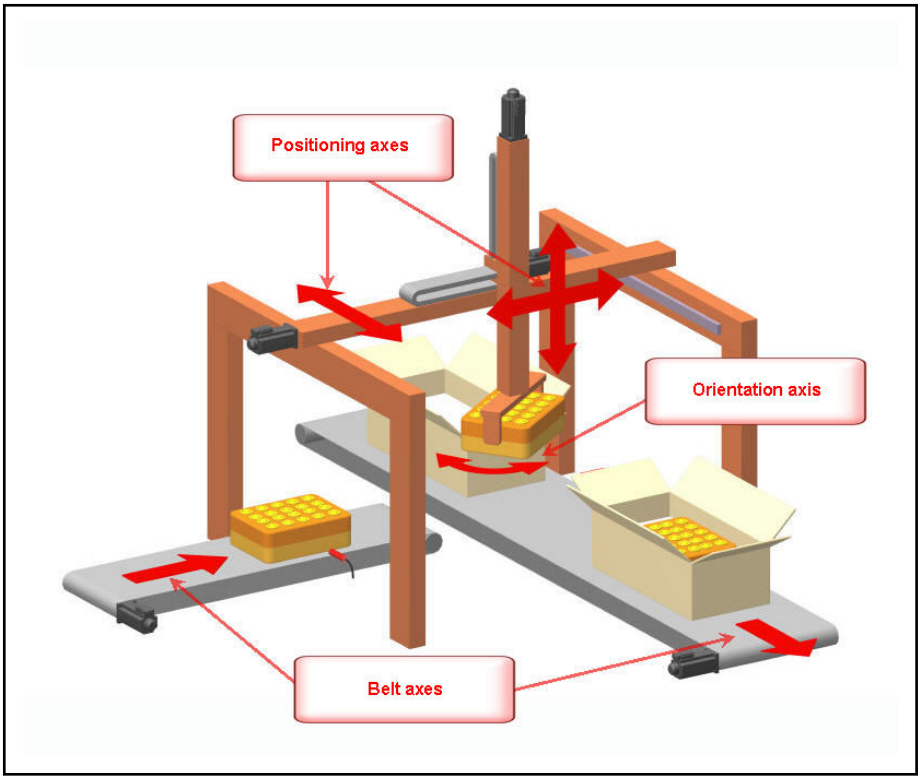


Fig. 12-5: Cartesian kinematics with belt axes

- chapter 12.4.2 "Positioning axes" on page 255

  Positioning axes are used for spatial positioning of the **T**ool **C**enter **P**oint of the kinematics (only called TCP in the following) (e.g. x-axis, y-axis and z-axis of a Cartesian portal)

- chapter 12.4.3 "Orientation axes" on page 255

Orientation axes are optional axes of the kinematics. Orientation axes are used to orient the TCP (e.g. c-axis of a Cartesian portal → orientation around the z-axis)

- chapter 12.4.4 "Belt axes" on page 256

  Belt axes are optional axes used to synchronize the motion of the TCP to the assembly or conveyor belt with regard to the position

12.4.2 Positioning axes

Positioning axes are primarily kinematic axes participating in the path interpolation. These axes execute the motion of the TCP of a robot with regard to its position in space. Depending on the kinematic type, a different number of positioning axes can be required.

The following axis types can be used as positioning axes:

- Real axis
- Virtual axis



For a coordinate movement of the positioning axes using the Robot Control, the positioning axes have to be added to the respective kinematics (axis group) first.

For this purpose, the function block "ML_GroupAllAxes" from the "ML_Robot" library has to be used. The axis is then in the "Coordinated Motion" state.

Interpolation methods

There are different interpolation methods available for the coordinated motion of the TCP in space:

- **Linear** - Motion on a straight line between two spatial points
- **Circular** - Motion on a circular path in space
- **PTP** - Motion in axis coordinates (all participating axes start the motion at the same time and reach the target position at the same time)

As an alternative to coordinated traversing by means of Robot Control, the individual positioning axes of the kinematics can also be operated in the above-mentioned single-axis modes.

12.4.3 Orientation axes

Orientation axes are optional and used to orientate the TCP.

A change in orientation of the TCP can be executed either a separate movement or during a position change of the TCP. That means that the limit values of the orientation axes also limit velocity or acceleration of the position change of the TCP at simultaneous change in orientation. That means that the limit values of the orientation axes also limit velocity or acceleration of the position change of the TCP at simultaneous change in orientation.

The following axis types can be used as orientation axes:

- Real axis
- Virtual axis



Orientation axes can only be traversed in a coordinated manner by means of Robot Control if they have been added to the appropriate kinematics (axis group).

For this purpose, the function block "ML_GroupAllAxes" from the "ML_Robot" library has to be used. The axis is then in the "Coordinated Motion" state.

As an alternative to coordinated traversing by means of Robot Control, the individual orientation axes of the kinematics can also be operated in the above-mentioned single-axis modes.

12.4.4 Belt axes

Belt axes are optional axes which are not actively commanded by Robot Control. Belt axes synchronize the coordinated motion of the TCP to the assembly or conveyor belt with regard to the position.

The following axis types can be used as belt axes:

- Real axis
- Virtual axis
- Encoder axes



Since belt axes may not be actively commanded by the kinematics, belt axes may **not** be added to the respective kinematics (axis group).

A call of the "MC_AddAxisToGroup" function block for this axes is acknowledged with an error.

A call of the "ML_GroupAllAxes" function block for this axes is acknowledged with an error.

12.5 Controlling axes of the PLC program

12.5.1 Overview

Motion sequences of the axes are specified in the PLC program in the MLC system.

This chapter describes the interfaces to the coordinated motion of the axes and the cyclic data channels between control and drive to specify further command values.

Overview

The following topics are covered in this chapter:

- chapter 12.5.2 "AxisInterface" on page 257

  The **AxisInterface** pools and extends PLCopen motion function blocks and provides an easy-to-operate interface for the drive functionality. Less code and commands with a higher performance accelerate the development of the application programs. The AxisInterface includes control signals and parameters for the various operation modes of the master and slave axis as well as the setting options for the selected process values

- chapter 12.5.3 "PLCopen" on page 262

  There are many incompatible systems and solutions on the MotionControl market. If different systems are used in one field, these incompatibilities increase costs for the end user. Initial skill adaptation is confusing and commissioning become more difficult. The interface for different MotionControl solutions is standardized using the PLCopen. The basic idea of the PLCopen is to allow the PLC access to the controlled drives to control motion processes for the user according to the PLC possibilities and its programming philosophy

- chapter 12.5.4 "Kinematics" on page 267

  In the MLC system, complex kinematics can be traversed in a coordinated manner (coordinated motion) as axis groups via the integrated Ro-

bot Control. Similar to the AxisInterface, a **kinematic interface** is provided. It pools and extends PLCopen function blocks and provides an easy-to-operate interface for the kinematic functionalities.

Depending on the control hardware, up to 16 kinematics are possible. Each kinematics can contain a different robot type (e.g. Cartesian portal, Scara, Delta, kinematic parallelogram, ...)

- chapter 12.5.5 "Cyclic data channels between control and drives" on page 275

  All drives in the Sercos ring communicate with the control in each Sercos cycle. The most important components are the "master data telegram" (MDT) and the "drive telegram" (AT). The MDT is the control telegram. Command values are specified via the master data telegram. The AT is the response telegram. Actual values are received via the response telegram. Both telegrams have a specified number of places for the parameter specification. Most of the positions are assigned by the MLC control firmware to control the drives. However, several places can be freely assigned by the user. Self-selected parameters can be transferred in the Sercos cycle to send command values of process controllers to the real drive for example. Apart from the complete parameters, individual parameter bits can also be transferred. For the parameters or parameter bits, go to the PLC program via the "functional variables" of each axis (AxisData[]).

12.5.2 AxisInterface

The **AxisInterface** pools and extends PLCopen motion function blocks and provides an easy-to-operate interface for the drive functionality. Less code and commands with a higher performance accelerate the development of the application programs. The AxisInterface contains control signals and parameters for the various operation modes of the master axis and slave axis as well as the setting options for the process values selected.

The AxisInterface consists of the PLC function block (FB) running in the user program. The MB_AxisInterfaceType01 function block is cyclically called for each axis. It checks the inputs of arAxisCtrl_gb[ ] and generates internally the requested commands for the axis. The outputs of arAxisStatus_gb[ ] are updated depending on the result of this command.

Setting the operation mode specification arAxisCtrl_gb[ ].Admin._OpMode from ModeAb to ModePosAbs leads to the following procedure:

- Check the required states to activate a motion command such as "Axis in Ab"
- Enable the PLCopen function block MC_Power
- Wait for the acknowledgement that the power of the axis has been added (AH/AF)
- Activate PLCopen function block MC_MoveAbsolute with the command values of PosModeCtrl
- Acknowledge arAxisStatus_gb[ ].Admin._OpModeAck to ModePosAbs (Bit MODE_POS_ABS)
- Scan the values of PosModeCtrl.Position and PosModeCtrl.Velocity and reactivate MC_MoveAbsolute in the case of modifications

The AxisInterface is provided as an programming template or as a stand-alone interface for the axis functionality.

If the axis interface is used with the programming template GAT (**G**eneric **A**pplication **T**emplate) or GAT compact, instance calls of the function blocks in the project are not important. This functionality is completely integrated into the template - the user just needs to write a few lines of code.

If the AxisInterface is used as a stand-alone functionality, create the instances of both function blocks "MB_AxisInitType01" and "MB_AxisInterfaceType01" for each axis.

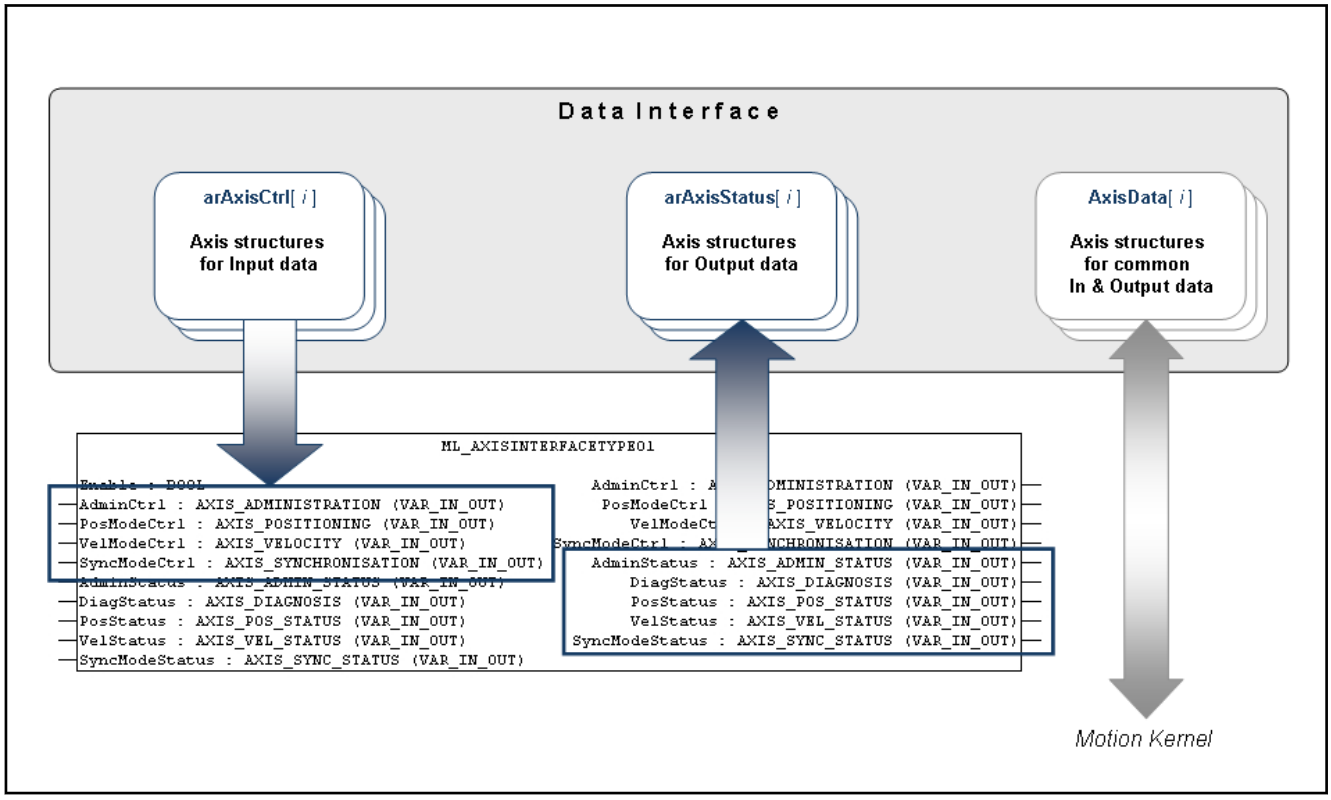


Fig. 12-6: AxisInterface data structure

User interface	Type	Description
arAxisCtrl[ ]_gb	MB_AXIS_CONTROL_TYPE01	Control structure, including command values and variables to activate the operation modes
arAxisStatus[ ]_gb	MB_AXIS_STATUS_TYPE01	Status structure, including diagnostic information and acknowledgements for the operation modes
AxisData[ ]		Status structure and control structure, including actual values, status bits and access to cyclically configurable user data (processed by the MotionControl in the firmware)

Tab. 12-2: User interface to the AxisInterface data structure

Use the AxisNo of the AXIS_REF structure as an index for the array, e.g. arAxisCtrl_gb[MyVirtualAxis.AxisNo].Admin. etc.

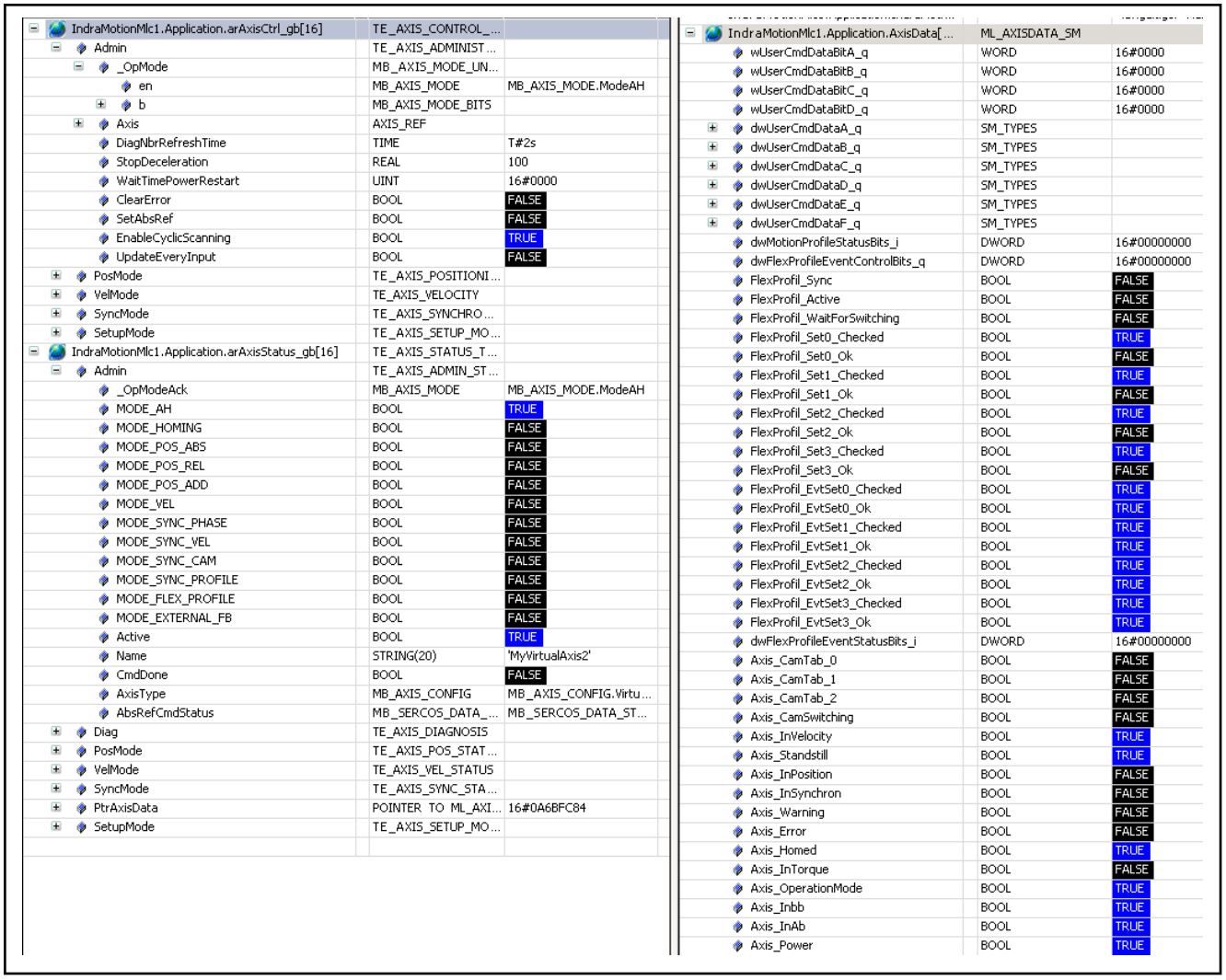


Fig. 12-7: Overview on the data structures of the AxisInterface

Functionality	Specifications	Status messages
Axis information	-	arAxisStatus_gb[ ].Admin
Troubleshooting	arAxisCtrl_gb[ ].Admin.ClearError	arAxisStatus_gb[ ].Diag
Diagnostics	-	arAxisStatus_gb[ ].Diag
Referencing/homing	arAxisCtrl_gb[ ].Admin	arAxisStatus_gb[ ].Admin
Positioning modes	arAxisCtrl_gb[ ].Admin._OpMode arAxisCtrl_gb[ ].PosMode	arAxisStatus_gb[ ].Admin._OpModeAck arAxisStatus_gb[ ].Admin.CmdDone arAxisStatus_gb[ ].PosMode AxisData[ ]

Functionality	Specifications	Status messages
Velocity control	arAxisCtrl_gb[ ].Admin._OpMode arAxisCtrl_gb[ ].VelMode	arAxisStatus_gb[ ].Admin._OpModeAck arAxisStatus_gb[ ].VelMode AxisData[ ]
Synchronous modes	arAxisCtrl_gb[ ].Admin._OpMode arAxisCtrl_gb[ ].SyncMode	arAxisStatus_gb[ ].Admin._OpModeAck arAxisStatus_gb[ ].SyncMode AxisData[ ]

Tab. 12-3: Overview on the AxisInterface functionalities

Operation mode selection

The operation mode is selected via arAxisCtrl_gb[ ].Admin._OpMode and provides two variants:

1. **Selection of Enum values**

   Assigning a value of TYPE MB_AXIS_MODE to arAxisCtrl_gb[ ].Admin._OpMode.en:

   ```
   arAxisCtrl_gb[].Admin._OpMode.en := ModePosAbs;
   ```

   - or -

   ```
   arAxisCtrl_gb[].Admin._OpMode.en := ModeAB;
   ```

2. **Using the bit access**

   First delete the "_OpMode" in the programming...

   ```
   arAxisCtrl_gb[].Admin._OpMode.en := ModeAB;
   ```

   Then set a bit using the bit access functionality.

   ```
   arAxisCtrl_gb[].Admin._OpMode.b.MODE_POS_ABS := TRUE;
   ```

☞ Setting several bits in `arAxisCtrl_gb[].Admin._OpMode` causes an error and the drive switches to AB.

Thus, select with Enum values.

Before an operation mode can be activated, values must be assigned to every attribute. All attributes are provided with default values. Some are provided with values not equal to zero while others are defined as 0. Due to the special demands, a value has to be assigned to them.

☞ Only attributes (e.g. position, velocity) that are used or whose default values were changed have to be declared before the current operation mode switch is executed.

The following example shows the correct programming sequence when changing the operation mode:

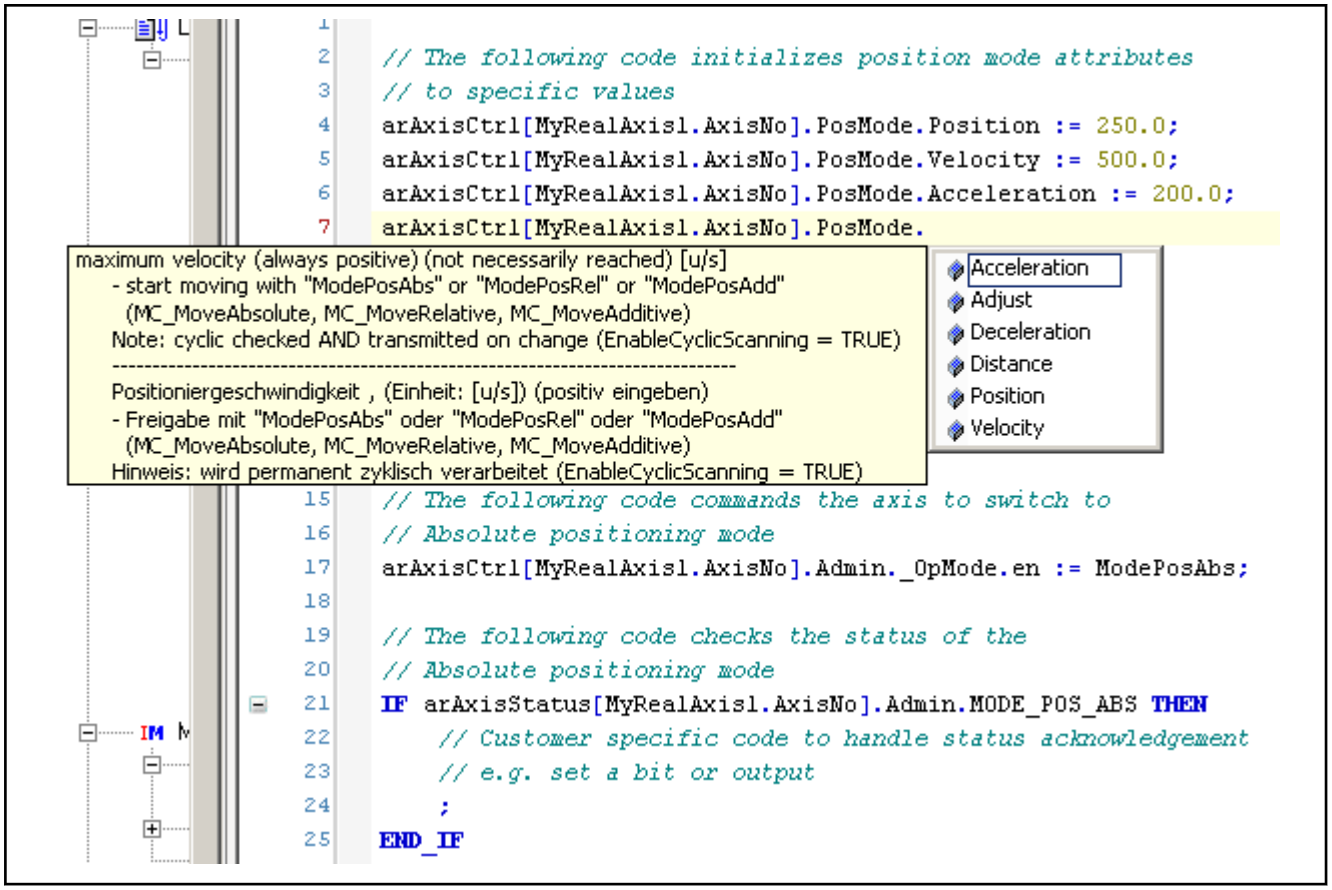


Fig. 12-8: Example of an absolute positioning mode changeover

User extension

The AxisInterface allows almost any structural extension. Additional substructures can also be added and the existing substructures extended.

As an example, the following structure elements are programmed as user extensions in the AxisCtrl structure or in the GAT or GAT^{compact}:

- SetupMode: Additional substructure in the AxisCtrl structure
  - Enable: Enable Setup mode
  - JogPlus: Jog +
  - JogMinus: Jog -
  - Vel: Jog / reference travel velocity
  - Accel: Jog/Reference travel deceleration/acceleration
  - Homing: Activates ModeHoming|SetAbsRef|ModesPosAbs depending on axis type/configuration
- SyncMode: Extension of the existing substructure in the AxisCtrl structure
  - AngleOffset: Phase offset start of table -> parameter A-0-2730 is described with this value
  - PhaseShift: Offset relative to the master axis before the gear (PhaseOffset: Offset relative to the master axis after the gear)
  - PhaseShiftVel: Velocity for adjusting the PhaseShift
  - PhaseShiftAcc: Acceleration for adjusting the PhaseShift

  - SyncVelocity: Phase shift velocity -> parameter A-0-2790 is described with this value
  - SyncAcceleration: Phase shift acceleration -> this value is written on parameter A-0-2791

As an example, the following structure elements are programmed as user extensions in the AxisStatus structure:

- SetupMode: Additional substructure in the AxisStatus structure
  - EnableAck: Setup mode is active
  - Homingack: Homing is finished
- SyncMode: Extension of the existing substructure in the AxisStatus structure
  - AngleOffsetDone: Transfer of phase offset start of table is completed -> it was written on parameter A-0-2730
  - PhasingMasterDone: PhaseShift was traversed
  - SyncVelocityDone: Transfer of synchronization velocity -> parameter A-0-2790 was transferred
  - SyncAccelerationDone: Transfer of synchronization acceleration -> parameter A-0-2791 was transferred

The code for these extensions can be found in the actions of the TE_AxisInterface() function block in the GAT or GAT^{compact}/AxisInterface folder. The corresponding structures can be found in the GAT or GAT^{compact}/AxisInterface/Type/Control and GAT or GAT^{compact}/AxisInterface/Type/Status folders.

12.5.3 PLCopen

Overview

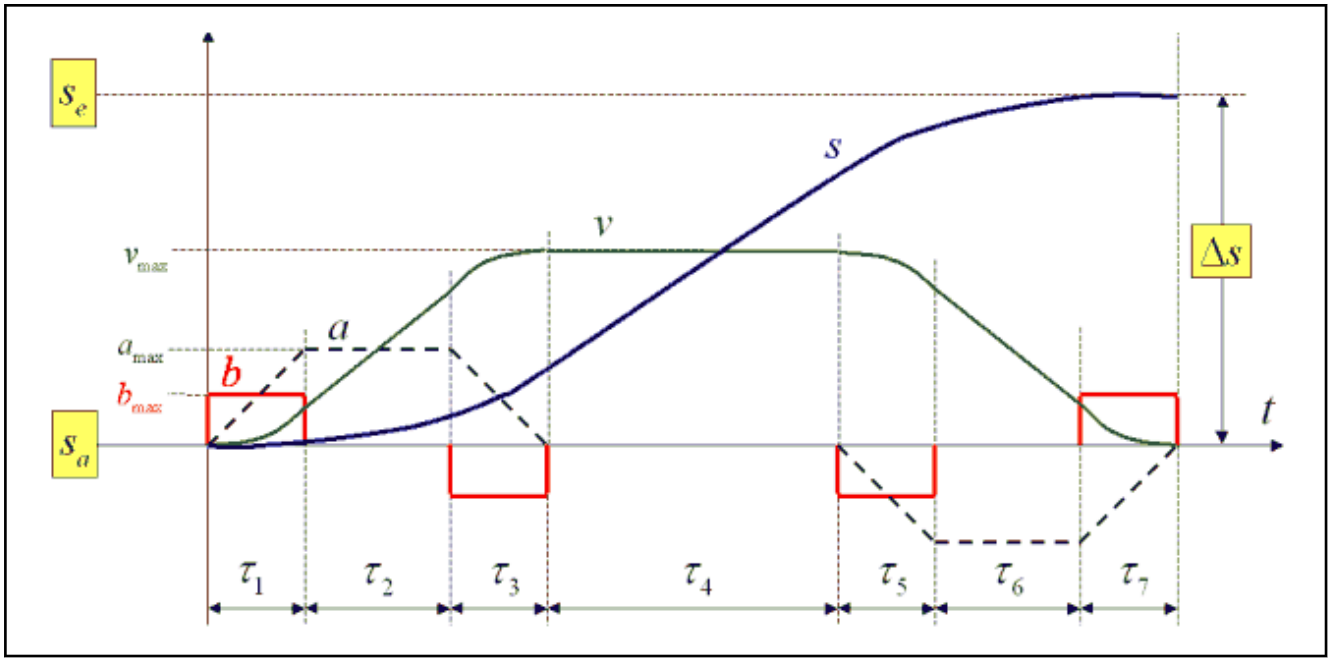
The basic idea of the PLCopen is to allow the PLC access to the controlled drives to control motion processes for the user **according to the PLC possibilities and its programming philosophy**.

Seen from the **drive technology point of view** (Motion), the data assigned to a drive/an axis such as actual values, limit values, command values and controller parameters is named as **parameters** and provided according to the parameter application (read-only and/or write access). The data type of the respective parameter is specified by the Sercos standard for example.

Seen from the PLC technology point of view, it is about the variables representing the content of the parameters based on a data type allowed in EN 6 1131-3.

Example of a motion from point "Sa" to point "Se" using the MC_MoveAbsolute function block

The value transfer from the PLC to the axis/drive and from the axis/drive to the PLC is now described in detail:



v_{max}	Maximum velocity value specified by the user
a_{max}	Maximum acceleration value specified by the user
b_{max}	Maximum jerk value specified by the user

Fig. 12-9: Motion from point Sa to point Se

The PLC is to control the motion from point S_a to point S_e.

The maximum values for velocity, jerk, acceleration and deceleration are required as additional information. These maximum values have to be lower than the maximum values allowed for the drive.

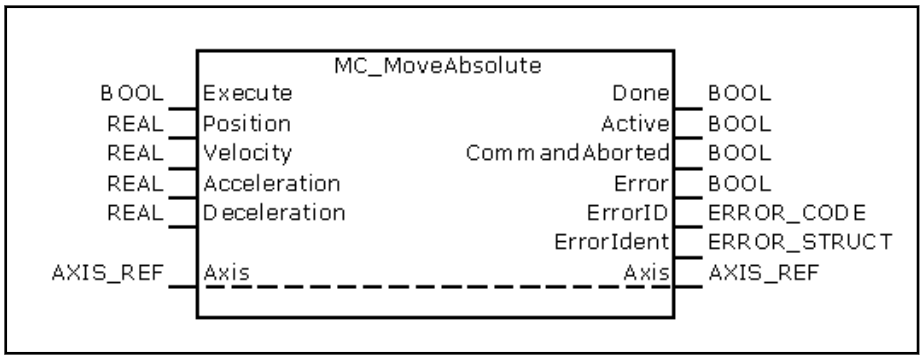


Fig. 12-10: PLCopen function block MC_MoveAbsolute

At a rising edge at the "Execute" input, the input values at the function block instance are applied to the "command" parameters:

- Position: "A-0-2200, Command position"
- Velocity: "A-0-2202, Command velocity"
- Acceleration: "A-0-2203, Command acceleration"
- Deceleration: "A-0-2204, Command deceleration"

The specification of the command jerk is not requested by the function block. The value of the parameter "A-0-2205, Command jerk" is applied without any modifications.

The complete motion process is calculated:

- At IndraDrive or HydraulicDrive devices on the drive after copying the values from the inputs of the function block instance to the A-parameters of the axis and to the S- and P-parameters of the drive

  - or -

- At axes calculated on the control after copying the values from the inputs of the function block instances to the A-parameters with following command value transfer to the drives

☞ To execute the motion command successfully, call the MC_Power function block before.

Axis types and function blocks supported by these axis types

The following table provides an overview on the current state of the function block support by the individual axis types on the respective systems.

If these function blocks require a master and a slave axis, the statement relates to the slave axis.

☞ If a real axis (IndraDrive) is calculated on the control using the command value interface to the drive, refer to the specifications in the "SercosDrive" column.

☞ Non-supported function blocks generate the error: "F2229204, Command not supported by axis."

Function block	MLC system				
	IndraDrive	HNC3x	Sercos Drive	Virtual axis	Controller axis[1)]
MC_Power	X	X	X		X
MC_Reset	X	X	X	X	X
MC_Stop	X	X	X	X	X
MB_Home	X	X	X	X	
MC_GearIn	X		X	X	X
MB_GearInPos	X		X	X	X
MC_GearOut	X		X	X	X
MC_CamIn	X				
MC_CamOut	X				
MB_MotionProfile			X	X	X
ML_FlexProfile			X	X	X
MC_MoveAbsolute	X	X	X	X	X
MC_MoveAdditive	X	X	X	X	X
MC_MoveRelative	X	X	X	X	X

Function block	MLC system				
	IndraDrive	HNC3x	Sercos Drive	Virtual axis	Controller axis[1)]
MC_MoveVelocity	X	X	X	X	X
MC_TorqueControl	X	X			X
MB_Phasing	X		X	X	X
MB_PhasingSlave	X		X	X	X

1) Only for MLC

Tab. 12-4: Supported function blocks in the MLC system

State diagram of a real axis

The state diagram below defines the behavior of Motion axes from the user's point of view if several Motion function blocks are activated at the same time. This combination of MotionProfiles is useful to generate complicated profiles and to respond to exceptional situations in programs.

In principle, motion commands are given and processed sequentially, even if the PLC is capable of parallel processing. The motion commands follow the state diagram of the MLC axes.

Each axis is in exactly one of the states defined (see the state diagram below). Each motion command represents a state transition for the axis concerned. The sequence of these transitions describes the entire behavior of the axis.

The possible states are indicated in the PLC structure AxisData[] and can be read via the MC_ReadStatus function block.

The diagram describes the behavior of a single axis.

From the user’s point of view with regard to multi-axis function blocks such as MB_MotionProfile, MC_CamIn, MC_GearIn and MB_GearInPos, each axis is in its special state in the state diagram. The cam master axis can be in the "Continuous Motion" state while the corresponding slave axis is in the "Synchronized Motion" state.

The attachment of a slave axis to a master axis does not affect the behavior of the master axis.

Function blocks with "administrative character", such as function blocks for writing and reading parameters, do not have any influence on the state diagram.

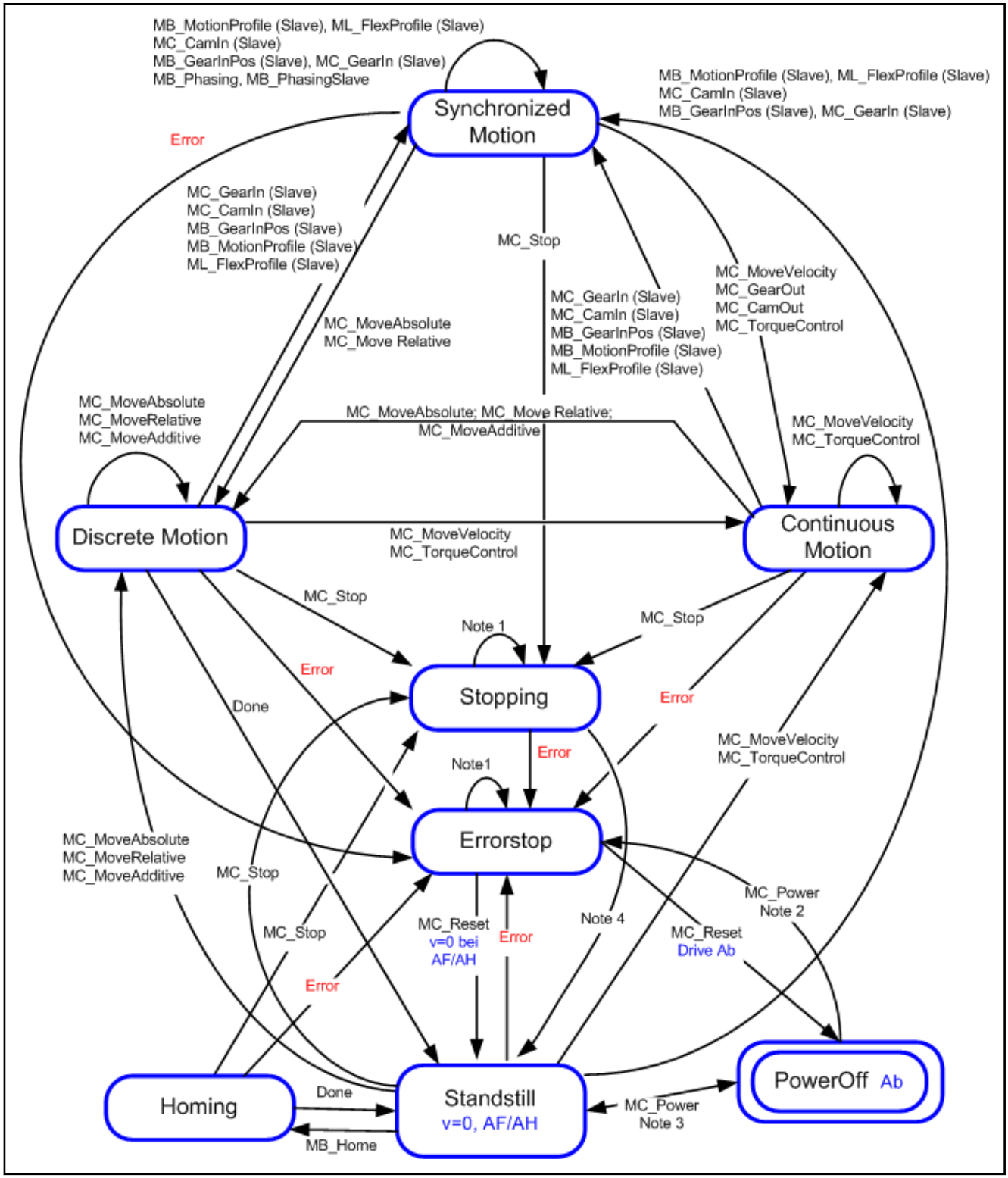


Fig. 12-11: Motion - State diagram of a real axis

Legend (Note 1) - All function blocks can be called without being processed except for MC_Reset and Error. They create the respective transitions to StandStill or ErrorStop.

(Note 2) - Power.Enable = TRUE and error in the axis.

(Note 3) - Power.Enable = TRUE and error-free axis.

(Note 4) - MC_Stop.Done AND NOT MC_Stop.Execute.

An error in the drive results in a power switch off after a certain period, depending on the programmed error reaction. However, the state machine remains in "ErrorStop" and when the power is switched off, "MC_Reset" goes into power-off state.

12.5.4 Kinematics

System overview

In addition to single-axis motions, the MLC also provides coordinated three-dimensional multi-axis motions.

Single-axis motions only enable coordinated motions of several axes by calculating the positions of the slave axes from the position of a master axis.

Multi-dimensional motions go beyond this. Here, axes are combined in a kinematics. No additional master axis is required. A path in space is defined for this kinematics.

Therefore, paths can be planned in a more flexible way than with simple master/slave relations. Furthermore, there may be problems with master/slave relations if an error occurs in one slave axis and the other axes do not detect it and keep moving. A kinematics knows which axes belong to the group and can therefore better react to errors.



The Robot Control functionality is only available in the MLC.

The MLC system can calculate several kinematics at the same time.

Number of kinematics, depending on the control type:

- IndraMotion MLC L45: 16 Kinematics
- IndraMotion MLC L65: 16 kinematics
- IndraMotion MLC L75: 16 kinematics
- IndraMotion XM2: 16 kinematics
- IndraMotion XM4: 16 kinematics
- IndraMotion VPx: 16 kinematics



One kinematics may comprise up to 16 axes.



There are two Robot Control versions:

- Robot Control V1
- Robot Control V2

Up to version 13VRS of the MLC firmware, Robot Control V1 is supported. From version 13VRS of the MLC firmware, Robot Control V2 is supported.

In case of new projects, only use Robot Control V2. Robot Control V1 is available in version 13VRS only due to compatibility reasons.

To upgrade from Robot Control V1 to Robot Control V2, refer to the documentation "Rexroth IndraMotion MLC 14VRS Robot Control V2", chapter "Switching from Robot Control V1 to Robot Control V2".

State diagram of a kinematics

A kinematics has a state diagram, just as a single axis.

The state diagram describes the states and state transitions of a kinematics.

The active state of a kinematics is described by parameter K-0-0022, Extended kinematic status.

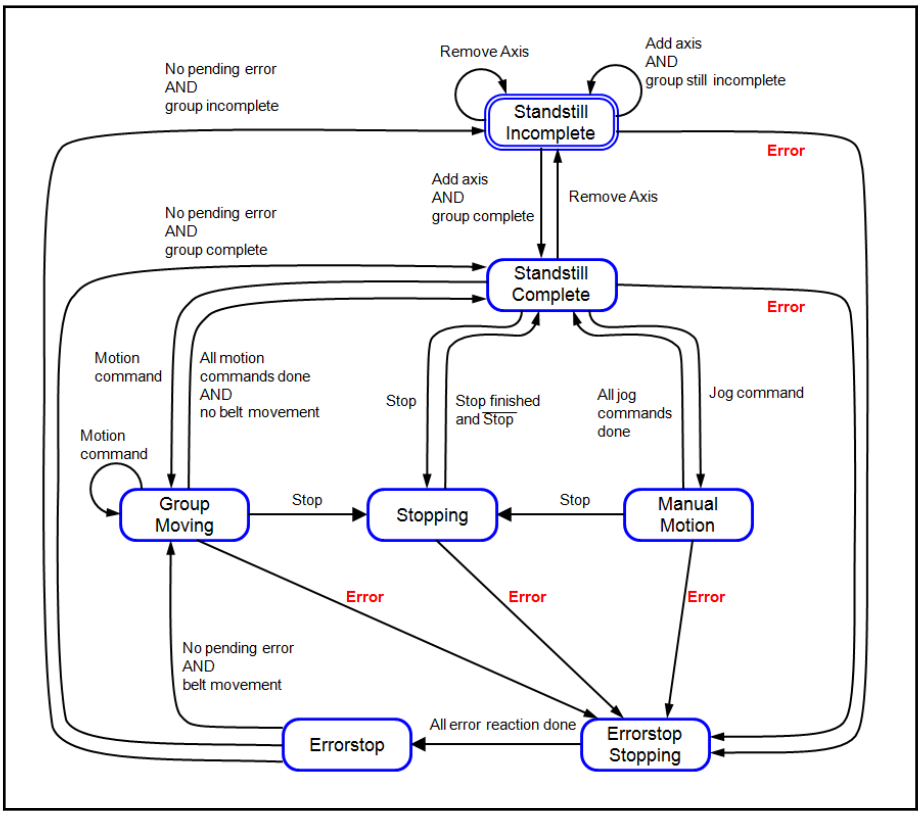


Fig. 12-12: State diagram of a kinematics

States of a kinematics

- **Standstill Incomplete**

  "Standstill Incomplete" is the initial state.

  In state "Standstill Incomplete" some of the axes configured in parameter K-0-0008 have not yet been added to the kinematics.

  Use the commands Group Axis on page 272 and Group All Axes on page 272 to add axes to the kinematics. If all configured axes are added to the kinematics, the state switches to "Standstill Complete" active

- **Standstill Complete**

  In state "Standstill Complete" all axes configured in parameter K-0-0008 are added to the kinematics.

  Use the commands Remove Axis on page 272 and Remove All Axes on page 272 to remove axes from the kinematics. If an axis is removed from the kinematics, the state switches to "Standstill Incomplete" active

- **Group Moving**

  In the state "Group Moving", at least one motion command (see tab. 12-7 "List of all motion commands and functions" on page 271) or belt-synchronous motion is active.

  If all motion commands are done and no belt-synchronous motion is active, the state switches to "Standstill Complete"

- **Stopping**

  In state "Stopping" a "Stop" command is active (see Stop on page 271).

  Once the kinematics is in standstill and stopping is complete, the state switches to "Standstill Complete" active

- **Manual Motion**

  In state "Manual Motion" at least one manual mode command (jog command) ("Jog Step on page 271" or "Jog Cont on page 271") is active.

  If all manual mode commands are done, the state switches to "Standstill Complete" active

- **Errorstop Stopping**

  In the "Errorstop Stopping" state, all error reactions of the kinematics and the belts are executed.

  The "Errorstop Stopping" state becomes active if a kinematics error occurs.

  When all error reactions are completed, the state switches to "Errorstop" active

- **Errorstop**

  In "Errorstop" state, a kinematics error occurred and the error reactions are completed.

  When the errors were acknowledged using "Clear error", the state switches to "Standstill Incomplete", "Standstill Complete" or "Group Moving" active depending on the conditions met

Robot Control, commands and functions

Robot Control, commands and functions, overview

There are two types of actions regarding a kinematics:

- Commands
- Functions

Commands

The command is processed asynchronously. This means that issuing a command only gives the order to execute a certain action. The action itself is carried out at a later time. For this purpose, the command is put into the command buffer. This command buffer uses the FIFO principle (First In First Out). Commands that are issued first are processed prior to commands that are issued later. A command is prepared first. This preparation can take several motion cycles depending on the system load. If a command is prepared, it can be executed.

Set the maximum number of commands in the command buffer using parameter K-0-0097, Maximum command buffer size.

Parameter K-0-0098, Current command buffer size contains the number of commands currently in the command buffer.

Parameter K-0-0096, Peak value of command buffer size contains the maximum number of commands that ever were in the command buffer.

In order to blend motions, the commands have to be buffered.

The command state indicates the processing step of the command (see Command state, page 270).

Functions

In contrast to commands, functions do not use the command buffer.

Functions are processed directly when they are called (synchronous processing). This means that the result is available directly after processing the function.

Types of commands and functions

	Description
List of all motion commands and functions on page 271	Motion of a kinematics in space
List of all configuration commands on page 272	Configuration of a kinematics
List of all information functions on page 272	Information on a kinematics
List of all teach-in commands and functions on page 273	Save kinematics positions as points and reuse them

Tab. 12-5: Types of commands and functions

Motion commands

A motion command issued for a kinematics causes the "Tool Center Point" (TCP) to move in the space.

The TCP is a designated kinematics point that usually refers to the kinematics top. The user sets the new TCP target position. The type of motion command determines the path used to reach the new TCP position.



The new target position can be set in any coordinate system.

The coordinate system has no impact on the path used to reach the point.

The TCP position can be determined using the function Read Pos on page 271. It is differentiated between two positions.

- **Prepare:** TCP position of the last prepared motion command
- **Execute:** Last position commanded by the robot

The prepare position jumps to the next target position after a motion command has been prepared. In contrast, the execution position is continuous.

A motion command consists of the following:

- **End point and/or intermediate points:** Points on the motion path
- **Maximum values:** Maximum values for the velocity profile, such as maximum velocity and maximum acceleration
- **Motion type:** Type of path used to reach the intermediate points and the end point
- **Blending and/or buffer type:** Type to start and/or blend the block

Command state

The command state indicates the processing step of the command in relation to the command buffer. A command can be in one of the following states:

Command state

State	Meaning
InTransmission	The command was issued and written to the command buffer
InBuffer	The command was prepared, it is in the command buffer and waits for activation
Active	Command is enabled
Done	The command was executed successfully
Aborted	The command was aborted
Error	A command error occurred

Tab. 12-6: Command state

List of all commands and functions

The same function/command can be called via several interfaces. The following table lists the call names in the respective interface and the reference name of the functional description.

The following interfaces are used:

- **PLC:** PLC function block name
- **MLPI core:** Function name of the C/C++ Motion Logic Programming Interface
- **MLPI COM:** Function name of the COM Motion Logic Programming Interface
- **MLPI Java:** Function name of the Java Motion Logic Programming Interface

List of all motion commands and functions

Reference description	PLC	MLPI core	MLPI COM MLPI Java
Move Linear Absolute	MC_MoveLinearAbsolute	mlpiRobotMoveLinearAbs	MoveLinearAbsolute
Move Linear Relative	MC_MoveLinearRelative	mlpiRobotMoveLinearRel	MoveLinearRelative
Move Circular Absolute	MC_MoveCircularAbsolute	mlpiRobotMoveCircularAbs	MoveCircularAbsolute
Move Circular Relative	MC_MoveCircularRelative	mlpiRobotMoveCircularRel	MoveCircularRelative
Move Direct Absolute	MC_MoveDirectAbsolute	mlpiRobotMoveDirectAbs	MoveDirectAbsolute
Move Direct Relative	MC_MoveDirectRelative	mlpiRobotMoveDirectRel	MoveDirectRelative
Move Jump Absolute	ML_RobotMoveJumpAbsolute	mlpiRobotMoveJumpAbs	MoveJumpAbsolute
Synchronization with Limits	ML_BeltSynchronizationWithLimits	mlpiRobotSyncOnWithLimits	SyncOnWithLimits
Desynchronization with Limits	ML_BeltDeSynchronizationWithLimits	mlpiRobotSyncOffWithLimits	SyncOffWithLimits
Jog Cont	ML_GroupJogCont	mlpiRobotJogCont	JogCont
Jog Step	ML_GroupJogStep	mlpiRobotJogStep	JogStep
Open Cyclic Position	ML_RobotOpenCyclicChannel	mlpiRobotOpenCyclicChannel	
Open Direct Cyclic Channel	ML_RobotOpenDirectCyclicChannel		
Write Cyclic Position (function)	ML_RobotWriteCyclicChannel	mlpiRobotWriteCyclicChannel	
Stop	MC_GroupStop	mlpiRobotStop	Stop
Interrupt	MC_GroupInterrupt	mlpiRobotInterrupt	Interrupt
Continue	MC_GroupContinue	mlpiRobotContinue	Continue
Wait	ML_GroupWait	mlpiGroupWait	Wait

Tab. 12-7: List of all motion commands and functions

List of all configuration commands

Reference description	PLC	MLPI core	MLPI COM MLPI Java
Group Reset	MC_GroupReset	mlpiRobotReset	Reset
Group Axis	MC_AddAxisToGroup	mlpiMotionAddAxisToGroup	
Remove Axis	MC_RemoveAxisFromGroup	mlpiMotionRemAxis-FromGroup	
Group All Axes	ML_GroupAllAxes	mlpiRobotAddAllAxisToGroup	AddAllAxisToGroup
Ungroup All Axes	MC_UngroupAllAxes	mlpiRobotRemAllAxis-FromGroup	RemAllAxisFromGroup
Set Kinematic Transformation	MC_SetKinTransform		
Set Kinematic Transform Extended	MC_SetKinTransformExt		
Set Cartesian Transformation	MC_SetCartesianTransform	mlpiRobotSetCartesianTransform	SetCartesianTransform
Set Cylindric Transformation	ML_SetCylindricTransform	mlpiRobotSetCylindricTransform	SetCylindricTransform
Set Belt Configuration	ML_SetBeltConfiguration	mlpiRobotSetBeltConfiguration	SetBeltConfiguration
Set Belt Desync Relative Configuration	ML_SetBeltDesyncRelConfiguration	mlpiRobotSetBeltDesyncRelConfiguration	SetBeltDesyncRelConfiguration
Set Rotary Table Configuration	ML_SetRotaryTableConfiguration	mlpiRobotSetRotaryTableConfiguration	SetRotaryTableConfiguration
Set Belt Error Reaction	ML_SetBeltErrorReaction	mlpiRobotSetBeltErrorReaction	SetBeltErrorReaction
Set Safe Zone	ML_GroupSetSafeZone	mlpiRobotSetSafeZone	SetSafeZone
Set Move ID	ML_RobotSetMoveID	mlpiRobotSetMoveId	SetMoveId

Tab. 12-8: List of all configuration commands

List of all information functions

Reference description	PLC	MLPI core	MLPI COM MLPI Java
Read Pos	MC_GroupReadActualPosition	mlpiReadPos	ReadPos
Switch On Path	ML_SwitchOnPath		
Read Cyclic Position	ML_RobotReadCyclicChannel	mlpiRobotReadCyclicChannel	
Move Point	ML_RobotMovePoint	mlpiRobotMovePoint	MovePoint
Transform Point	ML_RobotTransformPoint	mlpiTransformPoint	TransformPoint
Set Performance Enable	ML_RobotSetPerformanceEnable	mlpiRobotSetPerformanceEnable	SetPerformanceEnable
Get Performance	ML_RobotGetPerformance	mlpiRobotGetPerfomanceResult	GetPerformanceResult
Get Mechanic	ML_RobotGetMechanic	mlpiRobotGetMechanicalData	GetMechanicData

Reference description	PLC	MLPI core	MLPI COM MLPI Java
Get Trafo Values	ML_RobotGetTrafoValues	mlpiRobotGetTrafoValues	GetTrafoValues
Get Belt Configuration	ML_RobotGetBeltConfiguration	mlpiRobotGetBeltConfiguration	GetBeltConfiguration
Get Belt Desync Relative Configuration	ML_RobotGetBeltDesyncRelConfiguration	mlpiRobotGetBeltDesyncRelConfiguration	GetBeltDesyncRelConfiguration
Get Belt Error Reaction	ML_RobotGetBeltErrorreaction	mlpiRobotGetBeltErrorReaction	GetBeltErrorReaction
Get Safe Zone	ML_RobotGetSafeZones	mlpiRobotGetSafeZones	GetSafeZones
Get Move ID	ML_RobotGetMoveID	mlpiRobotGetMoveId	GetMoveId

Tab. 12-9: List of all information functions

List of all teach-in commands and functions

Reference description	PLC	MLPI core	MLPI COM MLPI Java
Write point	ML_GroupWritePoint	mlpiRobotTeachInWritePoint	
Read Point	ML_GroupReadPoint	mlpiRobotTeachInReadPoint	
Read Next Point	ML_GroupReadNextPoint	mlpiRobotTeachInReadNextPoint	
Delete Points	ML_GroupDeletePoints	mlpiRobotTeachInDeletePoints	
Save Point File	ML_GroupSavePointFile	mlpiRobotTeachInSavePointFile	
Load Point File	ML_GroupLoadPointFile	mlpiRobotTeachInLoadPointFile	
Delete Point File	ML_GroupDeletePointFile	mlpiRobotTeachInDeletePointFile	

Tab. 12-10: List of all teach-in commands and functions

Motion types

The MLC Robot Control supports kinematics motions in three motion types:

- Linear (straight line in space)
- Circular (circle segment in space)
- Point to point (PTP)



With interpolation, orientation motions are controlled fully synchronously.

It is also differentiated between absolute and relative positioning.

Motion types with absolute and relative positioning

	Absolute	Relative
Linear (straight line in space)	Move Linear Absolute	Move Linear Relative
Circular (circle segment in space)	Move Circular Absolute	Move Circular Relative
Point to point (PTP)	Move Direct Absolute	Move Direct Relative

Tab. 12-11: Overview on motion types



For detailed information on the topic "Robot Control", refer to the documentation "MLC 14VRS Robot Control V2" (see chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3).

Kinematic interface

The Kinematic Interface is provided as a plug-in for the MLC programming template AxisInterface programming template. Thus, the structural design and mode of operation is similar to that of the AxisInterface. What in the AxisInterface constitutes the axis are the kinematics in the Kinematic interface.

The following figure shows the data structure of the Kinematic interface:

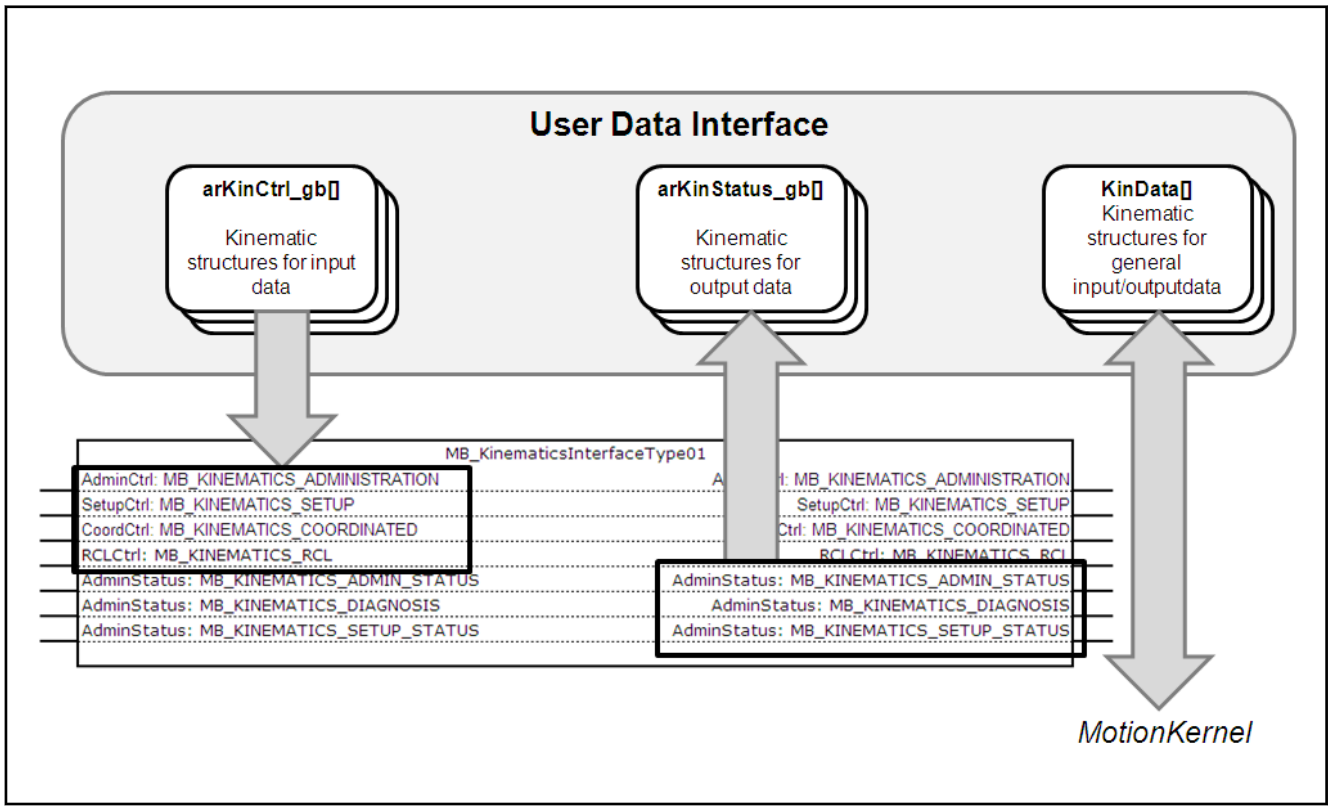


Fig. 12-13: Kinematic interface – Data structure of the interface

The following table shows the user interface for the Kinematic interface data structure:

User interface	Type	Description
arKinCtrl[ ]_gb	MB_KINEMATICS_CONTROL_TYPE01 (user extension: TE_KINEMATICS_CONTROL_TYPE01	Control structure, including command values and variables to activate the operation modes
arKinStatus[ ]_gb	MB_KINEMATICS_STATUS_TYPE01 (user extension: TE_KINEMATICS_CONTROL_TYPE01)	Status structure, including diagnostic information and acknowledgements for the operation modes
KinData[ ]		Status structure and control structure, including actual values and status bits (this is processed by MotionControl in the firmware)

Tab. 12-12: Kinematic interface – Data structure of the user interface

Like the AxisInterface, the kinematic interface also consists of PLC function blocks running in the application program. The ML_KinematicsInterface-Type01 function block is cyclically called for each kinematics. It checks the inputs of arKinCtrl_gb[] and generates internally the requested commands for the axis. The outputs of arKinStatus_gb[ ] are updated depending on the result of these commands.



For detailed information on the topic " Kinematic interface", refer to the documentation "MLC Robot Control V2" (see chapter 1.2 "Required and supplementing documentation XLC/MLC" on page 3).

12.5.5 Cyclic data channels between control and drives

The control and the drives exchange data via the Sercos bus using:

- he master data telegram (control ⇒ drives) and the
- Drive telegrams (drive ⇒ control)

This data exchange is used in the operating mode (Sercos phase 4).

Apart from the parameters specified by the control, further drive parameters or individual bits can be parameterized from the drive parameters via cyclic telegrams.

The cyclically created parameters are also available in the AxisData structure of the respective axis. The actual values are specified in the UserActualDataX entries. The command values are written using UserCmdDataX. The correct data type has to be specified as well with regard to the entered parameter attribute.

The following rule applies:

If the decimal places are not equal to zero in the parameter attribute, use type REAL_.

If the decimal places are equal to zero in the parameter attribute, specify the type using the data length and the format in the parameter attribute.

Possible are:

- DINT_ (4 bytes with sign)
- INT_ (2 bytes with sign)
- REAL_ (floating point)
- UDINT_ (4 bytes without sign)

- UINT_ (2 bytes without sign)

Alternatively to the access via "AxisData", the function blocks MB_ReadCyclicParameter and MB_WriteCyclicParameter can be used to access the cyclically created data. The access via the function blocks MB_ReadCyclicParameter and MB_WriteCyclicParameter permits an abstract access from the user function blocks and is automatically converted to the correct data type.

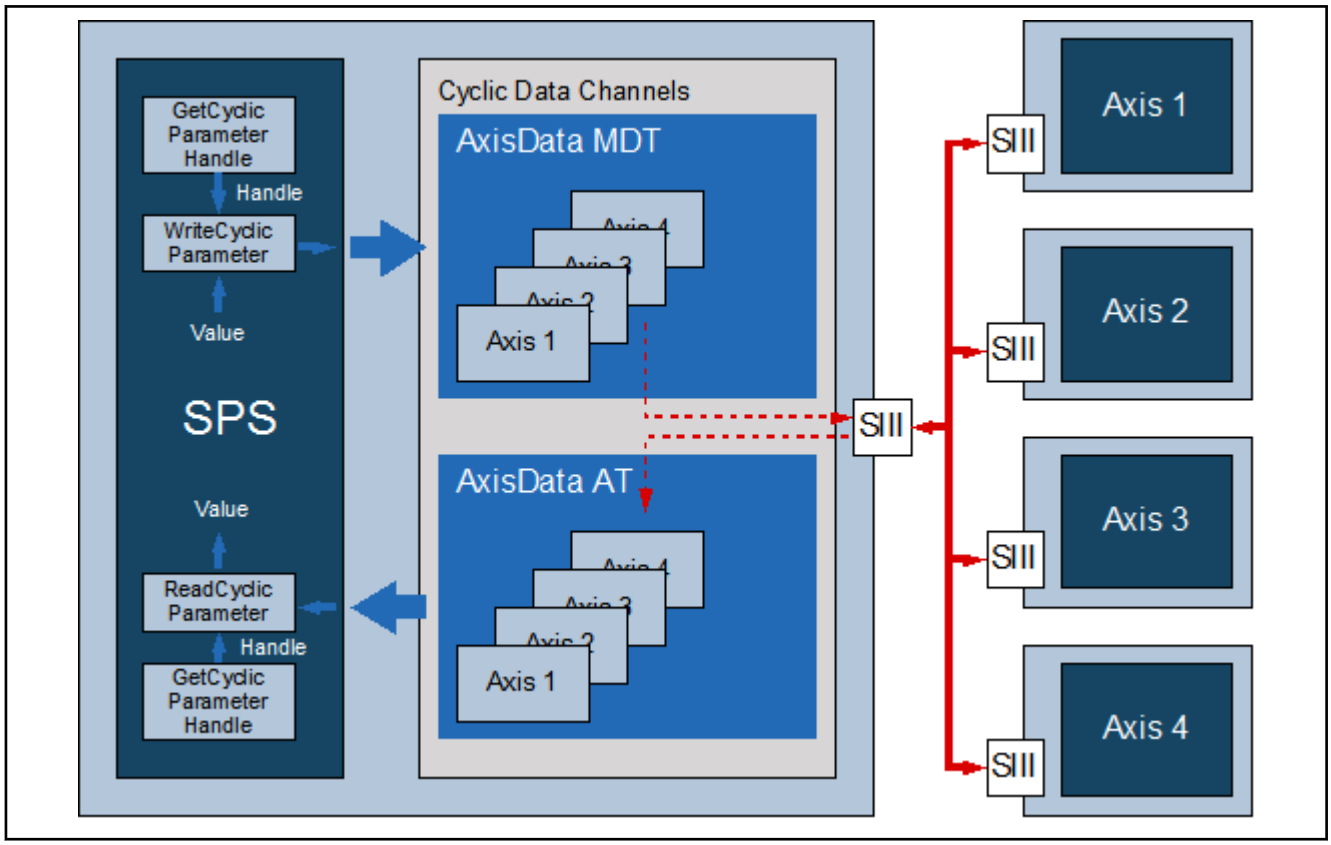


Fig. 12-14: Accessing the cyclic data using the "CyclicParameter" function blocks and functions

MDT (control ⇒ drives): S-0-0145, Signal control word

Due to its use, the signal control word is split into twelve specified bits and four bits that can be preselected using the parameter editor or the IndraWorks interface (**Real axis (IndraDrive) ▸ PopUp menu ▸ Communication ▸ Signal control word**).

The signal control word can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the configuration, refer to the MB_AllocCyclicParameter() function block.

The parameter "A-0-0598, List of freely configurable parameters in the signal control word" contains the possible parameters whose values may be transferred.

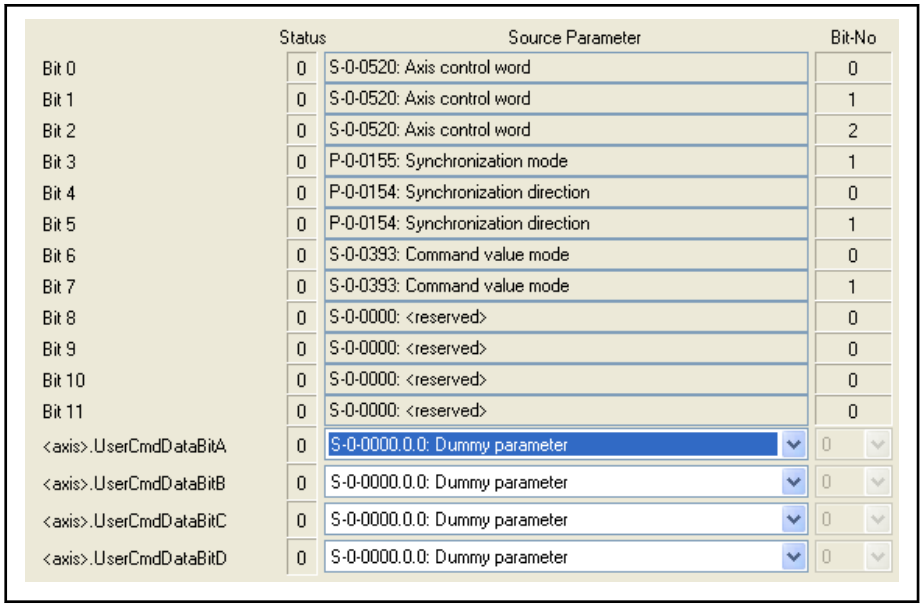


Fig. 12-15: S-0-0145, Signal control word (IndraWorks dialog)

The configured bits are transferred from the control to the drive in each Sercos cycle. When controlling from the MotionTask of the PLC, the bit in the drive parameter (if desired and reasonable) can be changed in each Sercos cycle. Furthermore, cyclically configured parameters are not backed up irrespective of the storage mode set (S-0-0269). In case of frequent changes, the drive memory cannot be damaged.

Use case: The touch probe function of the drive should be enabled from the PLC program. Bit 0 of the parameter "S-0-0405, Touch probe 1 enable" is configured in the signal control word.

To use the touch probe function, the IndraMotion provides ready function blocks (e.g. MB_TouchProbe) that control from the PLC. The bit can also be controlled directly:

PLC example code to set the external trigger signal of the drive oscilloscope (configuration as above):

Declaration:

```
bTriggerOskar: BOOL; // Triggers the drive oscilloscope
```

Implementation:

```
AxisData[Drive1.AxisNo].wUserCmdDataBitB_q.0 := bTrigger-
Oskar;
```

The signal control word can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the access, refer to the function block MB_GetCyclicParameterHandle() and the function MB_WriteCyclicParameter().

MDT (control ⇒ drives): User-configurable 4-byte containers

This is completed by six containers, each of four bytes that can either be preselected via the parameter editor or the IndraWorks interface (**Real Axis (IndraDrive) ▸ PopUp Menu ▸ Communication ▸ Cyclic Sercos Data Channel**).

The data containers can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the configuration, refer to the MB_AllocCyclicParameter() function block.

The parameter "A-0-0596, List of freely configurable parameters in the MDT" contains the possible parameters whose values may be transferred.

The configured parameters are transferred from the control to the drive in each Sercos cycle. When controlling from the MotionTask of the PLC, the drive parameter (if desired and reasonable) can be changed in each Sercos cycle. Furthermore, cyclically configured parameters are not backed up irrespective of the storage mode set (S-0-0269). In case of frequent changes, the drive memory cannot be damaged.

Use case: The expectation window to the touch probe function of the drive should be changed from the PLC program. The parameter "P-0-0204, Starting position touch probe function 1 active" is configured for the MDT in the cyclic data containers.

To use the touch probe function, the MLC system provides function blocks (e.g. MB_TouchProbe). The parameter can also be controlled directly:

PLC example code to write at the lower limit of the expectation window (P-0-0204 configured for UserCmdDataA in the MDT):

Declaration:

```
rExpectationWindowLow: REAL; // Lower Limit of the expectation window
```

Implementation:

```
AxisData[Drive1.AxisNo].dwUserCmdDataA_q.REAL_ := rExpectationWindowLow;
```

Since P-0-0204 has decimal places, access it with "REAL_".

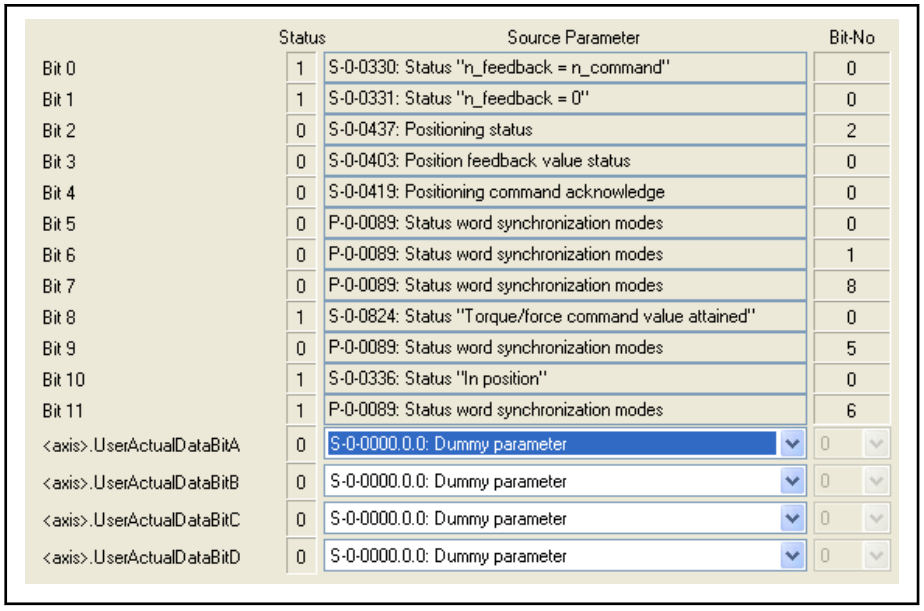
The data container can also be configured and accessed via the library ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the access, refer to the function block MB_GetCyclicParameterHandle() and the functions MB_WriteCyclicParameter() or MB_WriteCyclicRealParameter().

AT (drive ⇒ control): S-0-0144, Signal status word

Due to its use, the signal status word is split into twelve specified bits and four bits that can be preselected using the parameter editor or the IndraWorks interface (**Real Axis (IndraDrive) ▸ PopUp menu ▸ Communication ▸ Signal Status Word**).

The signal status word can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the configuration, refer to the MB_AllocCyclicParameter() function block.

The parameter "A-0-0599, List of freely configurable parameters in signal status word" contains the possible parameters whose values can be transferred.



	Status	Source Parameter	Bit-No
Bit 0	1	S-0-0330: Status "n_feedback = n_command"	0
Bit 1	1	S-0-0331: Status "n_feedback = 0"	0
Bit 2	0	S-0-0437: Positioning status	2
Bit 3	0	S-0-0403: Position feedback value status	0
Bit 4	0	S-0-0419: Positioning command acknowledge	0
Bit 5	0	P-0-0089: Status word synchronization modes	0
Bit 6	0	P-0-0089: Status word synchronization modes	1
Bit 7	0	P-0-0089: Status word synchronization modes	8
Bit 8	1	S-0-0824: Status "Torque/force command value attained"	0
Bit 9	0	P-0-0089: Status word synchronization modes	5
Bit 10	1	S-0-0336: Status "In position"	0
Bit 11	1	P-0-0089: Status word synchronization modes	6
<axis>.UserActualDataBitA	0	S-0-0000.0.0: Dummy parameter	0
<axis>.UserActualDataBitB	0	S-0-0000.0.0: Dummy parameter	0
<axis>.UserActualDataBitC	0	S-0-0000.0.0: Dummy parameter	0
<axis>.UserActualDataBitD	0	S-0-0000.0.0: Dummy parameter	0

Fig. 12-16: S-0-0144, Signal status word (IndraWorks dialog)

The configured bits are transferred from the drive to the control in each Sercos cycle. When reading the information from the MotionTask of the PLC, the bit from the drive parameter (if desired and reasonable) can be changed in each Sercos cycle.

Use case: The touch probe function of the drive should be evaluated from the PLC program. Bit 0 of the parameter "S-0-0409, Touch probe 1, positively detected" is configured in the signal status word.

To use the touch probe function, IndraMotion MLC and IndraLogic XLC provide ready function blocks (e.g. MB_TouchProbe) retrieved from the PLC. The bit can also be read directly:

PLC example code to read the positioning status of the drive (configuration as above):

Declaration:

```
bTargetPositionAttained: BOOL; // The drive reached the target position
```

Implementation:

```
bTargetPositionAttained := AxisData[Drive1.AxisNo].wUserActualDataBitA_i.0;
```

The signal status word can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the access, refer to the function block MB_GetCyclicParameterHandle() and the function MB_ReadCyclicParameter().

AT (drive ⇒ control): User-configurable 4-byte containers

This is completed by six containers, each of four bytes that can either be preselected via the parameter editor or the IndraWorks interface (**Real Axis (IndraDrive) ▸ PopUp Menu ▸ Communication ▸ Cyclic Sercos Data Channel**).

The data containers can also be configured and accessed via the ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the configuration, refer to the MB_AllocCyclicParameter() function block.

The parameter "A-0-0597, List of freely configurable parameters in the AT" contains the possible parameters whose values may be transferred.

The configured parameters are transferred from the drive to the control in each Sercos cycle. When reading the information from the MotionTask of the PLC, the drive parameter (if desired and reasonable) can change in each Sercos cycle.

Use case: The measured value on the touch probe function of the drive should be evaluated from the PLC program. The parameter "S-0-0130, Measured value 1, positive edge" is configured for the AT in the cyclic data containers.

To use the touch probe function, IndraMotion MLC and IndraLogic XLC provide ready function blocks (e.g. MB_TouchProbe) controlling from the PLC. The parameter can also be controlled directly:

PLC example code to read the measured value at a positive edge of the touch probe 1 input (S-0-0130 configured for UserActualDataA in the MDT):

Declaration:

```
rProbeValue1PosEdge: REAL; // Measured value probe 1 positive edge
```

Implementation:

```
rProbeValue1PosEdge := AxisData[Drive1.AxisNo].dwUserActualDataA_i.REAL_;
```

Since S-0-0130 has decimal places, access it with "REAL_".

The data container can also be configured and accessed via the library ML_TechMotionBase.library (subfolder Utilities->CyclicData). For the access, refer to the function block MB_GetCyclicParameterHandle() and the functions MB_ReadCyclicParameter() or MB_ReadCyclicRealParameter().

13 Ordering example

13.1 System configuration

The ordering example is based on the following system configuration.

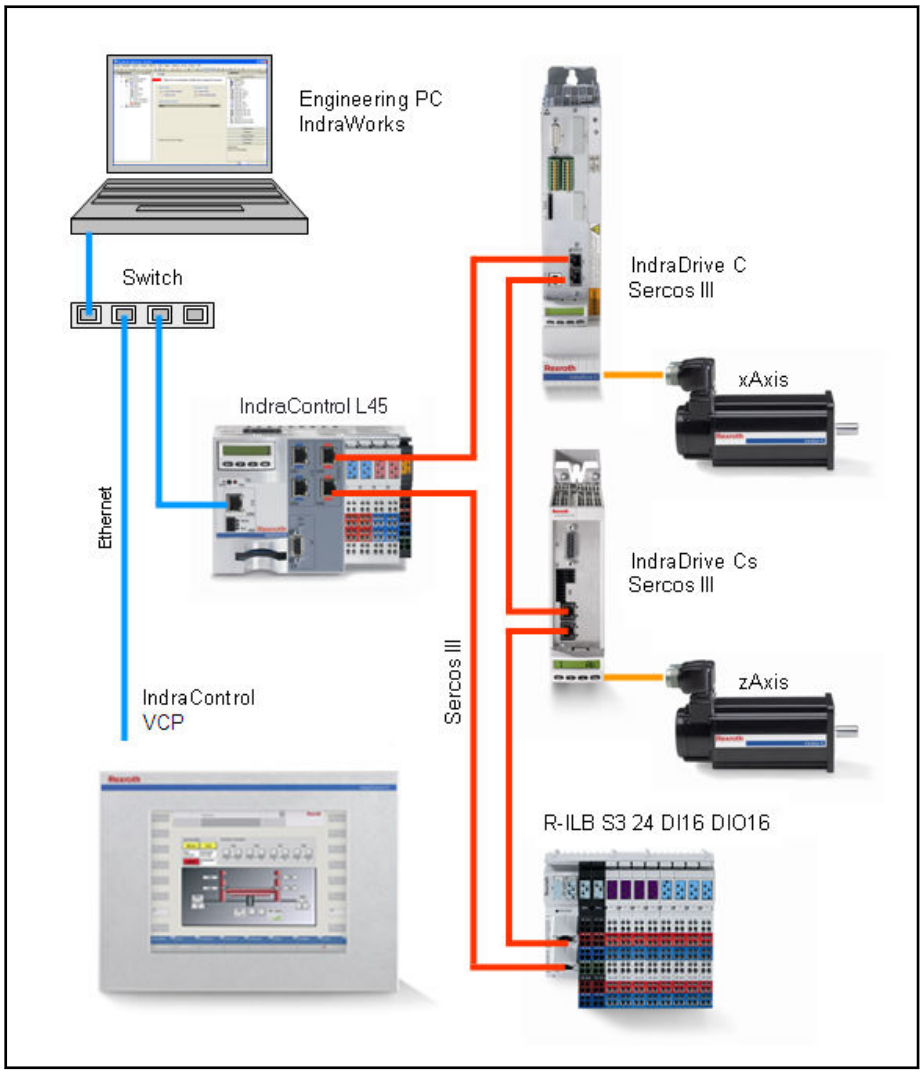


Fig. 13-1: System configuration

13.2 Material list

Number	Name	Ordering/part no.	Description
Computer:			
1	PC or laptop	Commercial	Prerequisites: 1 GB RAM (4 GB recommended), 5 GB hard disk capacity, Windows XP with SP3 or Windows 7, 64 bits
Engineering software: IndraMotion MLC or IndraLogic XLC			
1	Software	SWA-IWORKS-ML*-14VRS-D0-DVD** SWA-IWORKS-XLC-14VRS-D0-DVD**	DVD data carrier
1	Software license	SWL-IWORKS-ML*-14VRS-D0-ENG	Single license with activation code for the IndraMotion MLC
		SWL-IWORKS-XLC-14VRS-D0-ENG	Single license with activation code for the IndraLogic XLC, IndraLogic L/V
CamBuilder (optional):			
1	Software options	SWS-IWORKS-CAM-14VRS-D0	Single license for the IndraWorks Tool CamBuilder
Control: IndraMotion MLC or IndraLogic XLC			
1	Control	CML45.1-3P-504-NA-NNNN-NW	IndraControl L45.1 Control: x86-compatible, 500 MHz 256 MB RAM, 8 MB SRAM battery-buffered Interfaces: Ethernet, Profibus DP, RT-Ethernet, Sercos III, digital onboard I/O: 8DI/8DO
1	Firmware	FWA-CML45*-MLC-14VRS-D0	IndraMotion MLC Runtime installed on memory module (CF)
		FWA-CML45*-XLC-14VRS-D0	IndraLogic XLC Runtime installed on memory module (CF)
1	Rexroth Inline	R-IB IL CML S01-PLSET	Rexroth Inline plug set IndraControl L
Visualization device: IndraControl VCP 35.2			
1	Operator terminal	VCP35.2ECN-003-NN-NN-PW	10.4" TFT touch display IndraControl VCP 35
1	Cable, assembly	RKB0007/002,5	Bus cable assembly, Ethernet cable, 100-Base-T, CAT.7 assembly, crosslink, UL, cable length 2.5 m
WinStudio visualization (optional):			
1	Software options	SWS-WINSTU-RUN-07VRS-D0-WCE1K5	WinStudio 07VRS Runtime single license WIN CE, 1.5 K variables
1	Software options	SWS-WINSTU-RUD-07VRS-D0-1K5	WinStudio 07VRS Engineering and Runtime, single license, 1.5 K variables
IndraDrive C drive: IndraDrive HCS02			

Number	Name	Ordering/part no.	Description
1			Consisting of • IndraDrive compact converter, single-axis • IndraDrive control section BASIC, single-axis • IndraDrive firmware • IndraDrive accessories
	IndraDrive compact converter, single-axis	HCS02.1E-W0012-A-03-NNNN	Eff. maximum current 12 A, braking transistor and braking resistance integrated
	IndraDrive control section BASIC, single-axis	CSB01.1C-ET-ENS-NNN-NN-S-NN-FW	Multi-Ethernet (ET), encoder BRC Standard/ Hiperface/1Vss (ENS), standard display (S)
	IndraDrive firmware	FWA-INDRV*-MPB-07VRS-D5-1-NNN-NN	Single-axis basic, closed-loop
	IndraDrive accessories	PFM02.1-016-FW	Multimedia card for digital IndraDrive drive controllers
1	IndraDrive accessories	HAS01.1-065-NNN-CN	IndraDrive basic accessory, fits 65 mm wide devices, compact devices
1	IndraDrive accessories	HAS02.1-002-NNN-NN	Shielded connector
IndraDrive Cs drive: IndraDrive HCS02			
1	IndraDrive compact converter, single-axis	HCS01.1E-W0008-A-03-B-ET-EC-NN-NN-NN-FW	Maximum current 8 A, BASIC, Multi-Ethernet
1	IndraDrive firmware	FWA-INDRV*-MPB-16VRS-D5-1-NNN-NN	Single-axis basic, closed-loop
I/O device:			
1	Rexroth Inline	1 R-ILB S3 24 DI16 DIO16	Sercos III, Inline block IO digital input/output module, 16/32 inputs, DC 24 V, 16 outputs DC 24 V, 500 mA, 2- , 3-wire connection technology, complete with accessories (plug, labeling field)
Accessories:			
4	Sercos III cable, assembled	RKB0011/001,0	Sercos III bus cable, assembled, Ethernet cable, assembled, flexible lengths, cable length 1.0 m
1	Optional switch with power supply unit	Commercial	
1	If necessary, 24 V power supply unit	Commercial	
1	Optional screwdriver	Commercial	

Tab. 13-1: Material list

14 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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