Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth Bosch Group

Rexroth IndraMotion MLC 13VRS System Overview

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Edition 02

Project Planning Manual

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MLC 13VRS
System Overview

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Purpose of Documentation
This documentation provides an overview on the hardware and software components of the automation system IndraMotion MLC in the mentioned version. It helps assembling a system.

Record of Revision

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Note
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1 About this Documentation

1.1 Validity of the Documentation

This documentation provides an overview on hardware/software components of the automation system IndraMotion MLC in the corresponding version.

Target Group

This documentation is intended for

- Project engineers
- System integrators

Application phases

This documentation supports the user during the following phases:

- System selection and composition
- Installation
- Commissioning

1.2 Documentation Structure

The first part of the document provides important instructions on use and safety (chapter 2 "Important Instructions on Use" on page 17 and chapter 3 "Safety Instructions for Electric Drives and Controls" on page 19).

The chapter 4 "Brief Description" on page 29 provides a brief overview on the system IndraMotion MLC.

The chapter 5 "Control Hardware" on page 31 provides an overview on hardware and technical system data.

The chapter 6 "Firmware/Software Control " on page 41 provides an overview on firmware and software.

The chapter 7 "Ports and Operating Elements" on page 47 describes interfaces and operating elements.

The chapter 8 "IndraDrive and HydraulicDrive – Drive Technology" on page 65 provides a brief overview on the drive system "IndraDrive".

The chapter 9 "I/O Periphery" on page 87 provides an overview on the I/O components for IndraMotion MLC.

The chapter 10 "Function Modules" on page 101 describes the function modules for the IndraMotion MLC.

The chapter 11 "IndraControl V – Visualization Devices" on page 135 provides an overview on the visualization devices for the IndraMotion MLC.

The chapter 12 "Axis Types and Axis Modes" on page 187 provides notes on the supported axis types and drive types of the IndraMotion MLC.

The chapter 13 "Ordering Example" on page 221 shows an ordering example of the system IndraMotion MLC.

chapter 14 "Service and Support" on page 225 provides information on the Bosch Rexroth customer service help desk.

1.3 Required and Supplementing Documentations

Documentation titles with type codes and parts numbers

IndraWorks		MLC	XLC
/36/	**Rexroth IndraWorks 13VRS Software Installation** DOK-IWORKS-SOFTINS*V13-CORS-EN-P, R911336880 This documentation describes the IndraWorks installation.	X	X
/5/	**Rexroth IndraWorks 13VRS Engineering** DOK-IWORKS-ENGINEE*V13-APRS-EN-P, R911336870 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.	X	X
/20/	**Rexroth IndraMotion MLC 13VRS Functional Description** DOK-MLC***-FUNC****V13-APRS-EN-P, R911336295 This documentation describes wizards, context menus, dialogs, control commissioning, device configuration and functionalities of the IndraMotion MLC.	X	
/20/	**Rexroth IndraLogic XLC 13VRS Functional Description** DOK-XLC***-FUNC****V13-APRS-EN-P, R911336352 This documentation describes wizards, context menus, dialogs, control commissioning, device configuration and functionalities of the IndraLogic XLC.		X
/7/	**Rexroth IndraWorks 13VRS CamBuilder** DOK-IWORKS-CAMBUIL*V13-APRS-EN-P, R911336291 This documentation describes the basic principles and operation of the CamBuilder, the cam editing tool.	X	X
/37/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS Automation Interface** DOK-XLCMLC-AUT*INT*V13-APRS-EN-P, R911336356 This documentation describes the script-based access to IndraWorks project data via the interface of the Automation Interface.	X	X
/38/	**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.	X	X
/29/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS Project Conversion** DOK-XLCMLC-PROCONV*V13-APRS-EN-P, R911336366 This documentation describes the project conversion of IndraLogic 04VRS and IndraMotion MLC04VRS on IndraWorks version 12 with IndraLogic 2G. Changes with regard to Motion and PLC are described in detail.	X	X
/28/	**Rexroth IndraMotion MLC 13VRS Commissioning** DOK-MLC***-STARTUP*V13-CORS-EN-P, R911336308 This documentation describes the steps to commission and service the IndraMotion MLC system. It includes checklists for frequent tasks and a detailed description of the steps.	X	

Fig.1-1: XCL/MLC documentation overview

Motion		MLC	XLC
/23/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS PLCopen Libraries** DOK-XLCMLC-FUNLIB**V13-LIRS-EN-P, R911336360 This documentation describes the function blocks, functions and data types of the RIL_Common-Types, ML_Base and ML_PLCopen libraries for the IndraLogic XLC/IndraMotion MLC. It also includes the error reactions of function blocks.	X	X
/27/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS Generic Application Template** DOK-XLCMLC-TF*GAT**V13-APRS-EN-P, R911336370 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.	X	X
/31/	**Rexroth IndraMotion MLC 13VRS RCL Programming Instruction** DOK-MLC***-RCL*PRO*V13-APRS-EN-P, R911336297 This documentation provides information on the RobotControl. The programming language RCL (RobotControl Language) is focused. The program structure, variables, functions, motion statements and the required system parameters are described.	X	
/21/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS Parameters** DOK-XLCMLC-PARAM***V13-RERS-EN-P, R911336364 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.	X	X
/10/	**Rexroth IndraDrive Firmware for Drive Controllers MPH-, MPB-, MPD-, MPC-07** DOK-INDRV*-MP*-07VRS**-FKRS-EN-P, R911328670 This documentation describes all functional properties of the IndraDrive firmware in the variants MPH-07, MPB-07, MPD-07 and MPC-07.		
/11/	**Rexroth IndraDrive MPx-17 Functions** DOK-INDRV*-MP*-17VRS**-APRS-EN-P, R911331236 This documentation describes all functional properties of the IndraDrive firmware in the variants MPB-17, MPM-17, MPC-17 and MPE-17.		

Fig. 1-2: XCL/MLC documentation overview

Field Buses		MLC	XLC
/4/	**Rexroth IndraWorks 13VRS Field Buses** DOK-IWORKS-FB******V13-APRS-EN-P, R911336872 This documentation describes the supported field buses and their diagnostic function blocks.	X	X
/4a/	**Rexroth IndraWorks 13VRS Field Buses Libraries** DOK-IWORKS-FB*LIB**V13-LIRS-EN-P, R911337857 This manual 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.	X	X
/63/	**SERCOS System Manual for I/O Devices** DOK-CONTRL-ILS3*******-APRS-EN-P, R911333512 This documentation describes the configuration, parameterization, commissioning and diagnostics of I/O devices with a SERCOS interface.	X	X

Fig. 1-3: XCL/MLC documentation overview

About this Documentation

HMI		MLC	XLC
/8/	**Rexroth IndraWorks 13VRS HMI** DOK-IWORKS-HMI*****V13-APRS-EN-P, R911336874 This documentation describes the functions, configuration and operation of the user interfaces IndraWorks HMI Engineering and IndraWorks HMI Operation.	X	X
/6/	**Rexroth IndraWorks 13VRS WinStudio** DOK-IWORKS-WINSTUD*V13-APRS-EN-P, R911336882 This documentation describes the installation of the software, working with WinStudio and the creation and operation of applications.	X	X
/50/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS HMI Connection** DOK-XLCMLC-HMI*****V13-APRS-EN-P, R911336362 This documentation describes the visualization systems supported by the IndraLogic XLC and IndraMotion MLC and their connection.	X	X

Fig.1-4: XCL/MLC documentation overview

PLC		MLC	XLC
/3/	**Rexroth IndraWorks 13VRS IndraLogic 2G Programming Instruction** DOK-IWORKS-IL2GPRO*V13-APRS-EN-P, R911336876 This documentation describes the PLC programming tool IndraLogic 2G and its use. It includes the basic use, first steps, visualization, menu items and editors.	X	X
/33/	**Rexroth IndraWorks 13VRS Basic Libraries IndraLogic 2G** DOK-IL*2G*-BASLIB**V13-LIRS-EN-P, R911336285 This documentation describes the system-comprehensive PLC libraries.	X	X

Fig.1-5: XCL/MLC documentation overview

Technology		MLC	XLC
/30/	**Rexroth IndraMotion MLC 13VRS Technology Libraries** DOK-MLC***-TF*LIB**V13-LIRS-EN-P, R911336324 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.	X	
/60/	**Rexroth IndraMotion MLC 13VRS RegisterControl (Library)** DOK-MLC***-REGI*CO*V13-LIRS-EN-P, R911336306 This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.	X	

Technology		MLC	XLC
/62/	**Rexroth IndraMotion MLC 13VRS RegisterControl (Application Manual)** DOK-MLC***-REGI*CO*V13-APRS-EN-P, R911336304 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.	X	
/49/	**Rexroth IndraMotion MLC 13VRS Winder Function Application** DOK-MLC***-TF*WIND*V13-APRS-EN-P, R911336326 This application-related system documentation describes the application of the winder technology functions.	X	

Fig.1-6: XCL/MLC documentation overview

Hardware		MLC	XLC
/1/	**Rexroth IndraControl L45/L65/L85 Control** DOK-CONTRL-ICL45L65L85-PRRS-EN-P, R911332116 This documentation describes the IndraControl L45/L65/L85 controls.	X	X
/2/	**Rexroth IndraControl L25** DOK-CONTRL-IC*L25*****-PRRS-EN-P, R911328474 This documentation describes the IndraControl L25 controls.	X	X
/24/	**Rexroth IndraControl Lxx 13VRS Function Modules** DOK-CONTRL-FM*LXX**V13-APRS-EN-P, R911336283 This documentation describes all function modules of the Lxx controls including engineering and diagnostics.	X	X
/12/	**Rexroth IndraDrive Drive Controllers MPx-02 to MPx-07** DOK-INDRV*-GEN-**VRS**-PARS-EN-P, R911297317 This documentation describes all parameters implemented in the firmware for drive controllers of the IndraDrive family. It supports the parameterization of the drive controllers.		
/13/	**Rexroth IndraDrive MPx-02 to MPx-07 and HMV** DOK-INDRV*-GEN-**VRS**-WARS-EN-P, R911297319 This documentation describes all diagnostics implemented in the following firmwares: • Drive controller firmwares from MPx-02 to MPx-08 and • firmwares of the supply devices of the type "HMV". It supports the operating crew as well as the programmer at troubleshooting.		
/35/	**Rexroth IndraDrive Drive Controller Control Sections CSB01, CSH01, CDB01** DOK-INDRV*-CSH********-PRRS-EN-P, R911295012 This documentation is a project planning manual to select and use the control sections CSB01, CDB01 and CSH01 for drive controllers of the product families Rexroth IndraDrive M and Rexroth IndraDrive C.		

Fig.1-7: XCL/MLC documentation overview

About this Documentation

Diagnostics and service		MLC	XLC
/26/	**Rexroth IndraWorks 13VRS IndraMotion Service Tool** DOK-IWORKS-IMST****V13-RERS-EN-P, R911337707 This documentation describes the IndraMotion Service Tool (IMST). It is a web-based diagnostic tool to access the control systems IndraMotion MLC L25, L45 or 65 as well as the MLP via an Ethernet high-speed connection. The IMST allows OEMs, end users and service engineers to access and remotely diagnose a system. A PC with Internet Explorer version 6 or 7 is required.	X	X
/22/	**Rexroth IndraLogic XLC IndraMotion MLC 13VRS Diagnostics** DOK-XLCMLC-DIAG****V13-RERS-EN-P, R911336358 This documentation includes all control parameters implemented in the control systems IndraLogic XLC and IndraMotion MLC.	X	X

Fig.1-8: XCL/MLC documentation overview

System Overview		MLC	XLC
/48/	**Rexroth IndraMotion for Printing 13VRS System Overview** DOK-IM*PR*-SYSTEM**V13-PRRS-EN-P, R911336289 This documentation describes the product IndraMotion for Printing. It introduces the control systems, drive systems and I/O systems as well as the commissioning and programming.	X	
/48/	**Rexroth IndraMotion for Packaging 13VRS System Overview** DOK-IM*PA*-SYSTEM**V13-PRRS-EN-P, R911336287 This documentation describes the product IndraMotion for Packaging. It introduces the control systems, drive systems and I/O systems as well as the commissioning and programming.	X	
/9/	**Rexroth IndraMotion MLC 13VRS System Overview** DOK-MLC***-SYSTEM**V13-PRRS-EN-P, R911336310 This documentation provides an overview on the hardware/software components of the automation system IndraMotion MLC in the mentioned version. It helps assembling a system.	X	
/9/	**Rexroth IndraLogic XLC 13VRS System Overview** DOK-XLC***-SYSTEM**V13-PRRS-EN-P, R911336354 This documentation provides an overview on hardware/software components of the automation system IndraLogic XLC in the respective version. It helps assembling a system.		X

Fig.1-9: XCL/MLC documentation overview

First Steps		MLC	XLC
/25/	**Rexroth IndraMotion MLC 13VRS, First Steps** DOK-MLC***-F*STEP**V13-CORS-EN-P, R911336293 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.	X	
/25/	**Rexroth IndraLogic XLC 13VRS, First Steps** DOK-XLC***-F*STEP**V13-CORS-EN-P, R911336350 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.		X

Fig.1-10: XCL/MLC documentation overview

1.4 Information Representation

1.4.1 Safety Instructions

If there are the safety instructions in the documentation, they 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 three 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 or property 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

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 99/92/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 control unit
sercos	sercos (SErial Realtime COmmunication System) interface is a world-wide standardized interface for the communication between controls and drives
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

Fig.1-11: Names and abbreviations used

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 they are not used as intended, situations occur that can result in damage to property and injury to persons.

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

Before using Bosch Rexroth products, ensure that all prerequisites are met to ensure the intended use of the products:

- Anybody handling Bosch Rexroth products in any way is obliged to read and consent to the relevant safety instructions and the intended use.
- 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 IndraMotion MLC and its function modules are suitable for

- Motion and Logic applications

☞ The Rexroth IndraMotion MLC and its function modules may 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 for cables and lines.

Operation must only be carried out with the hardware component configurations and combinations that are expressly specified and with the software and firmware indicated and specified in the respective documentation and functional descriptions.

Rexroth IndraMotion MLC and its function modules is suitable for use in single and multi-axis drive and control tasks.

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

Typical areas of application of the IndraMotion MLC are:

- Handling and mounting systems
- Packaging and food machines
- Printing and paper-processing machines

Rexroth IndraMotion MLC and the function modules 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 Rexroth IndraMotion MLC outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "unintended".

The Rexroth IndraMotion MLC must not be used if

- subjected to operating conditions that do not comply with the specified ambient conditions. For example, operation under water, under extreme temperature fluctuations or extreme maximum temperatures is prohibited.
- Furthermore, the Rexroth IndraMotion MLC must not be used in any applications not expressly approved by Bosch Rexroth. Therefore, please read the information given in the general safety instructions!

3 Safety Instructions for Electric Drives and Controls

3.1 Definitions of Terms

Application Documentation Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: User Guide, Operation Manual, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Manual, etc.

Component A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.

Control System A control system comprises several interconnected control components placed on the market as a single functional unit.

Device A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.

Electrical Equipment Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.

Electric Drive System An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.

Installation An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.

Machine A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Manufacturer The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess the required authority to take responsibility for the product.

Product Examples of a product: Device, component, part, system, software, firmware, among other things.

Project Planning Manual A project planning manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.

Qualified Persons In terms of this application documentation, qualified persons are those persons who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work

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

1) to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them

2) to be trained or instructed to maintain and use adequate safety equipment

3) to attend a course of instruction in first aid

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

3.2 General Information

3.2.1 Using the Safety Instructions and Passing Them on to Others

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

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

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

3.2.2 Requirements for Safe Use

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

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

gy". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.

- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturers must

  – make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,

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

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user must take into account

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

3.2.3 Hazards by Improper Use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!

- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.3 Instructions with Regard to Specific Dangers

3.3.1 Protection Against Contact With Electrical Parts and Housings

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

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

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

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:

  Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).

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

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

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the components of the electric drive and control system permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm^2 (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1,5 mm^2 (AWG 16)	10 mm^2 (AWG 8)	2 × 1,5 mm^2 (AWG 16)
2,5 mm^2 (AWG 14)		2 × 2,5 mm^2 (AWG 14)
4 mm^2 (AWG 12)		2 × 4 mm^2 (AWG 12)
6 mm^2 (AWG 10)		2 × 6 mm^2 (AWG 10)
10 mm^2 (AWG 8)		-
16 mm^2 (AWG 6)	16 mm^2 (AWG 6)	-
25 mm^2 (AWG 4)		-
35 mm^2 (AWG 2)		-
50 mm^2 (AWG 1/0)	25 mm^2 (AWG 4)	-
70 mm^2 (AWG 2/0)	35 mm^2 (AWG 2)	-
...	...	...

Fig.3-1: Minimum Cross Section of the Equipment Grounding Connection

3.3.2 Protective Extra-Low Voltage as Protection Against Electric Shock

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

On components of an electric drive and control system provided by Bosch Rexroth, all connections and terminals with voltages between 5 and 50 volts are PELV ("Protective Extra-Low Voltage") systems. It is allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections.

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

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

3.3.3 Protection Against Dangerous Movements

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

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

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

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

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

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

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

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machine’s range of motion and moving machine parts. Prevent personnel from accidentally entering the machine’s range of motion by using, for example:
  - Safety fences
  - Safety guards
  - Protective coverings
  - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equip-

ment works. Do not operate the machine if the emergency stopping switch is not working.

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

3.3.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors or permanent magnets of electric motors represent a serious danger to persons with heart pacemakers, metal implants and hearing aids.

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric components!

- Persons with heart pacemakers and metal implants are not allowed to enter the following areas:
  - Areas in which components of the electric drive and control systems are mounted, commissioned and operated.
  - Areas in which parts of motors with permanent magnets are stored, repaired or mounted.
- If it is necessary for somebody with a heart pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of implanted heart pacemakers differs so greatly that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above.

Safety Instructions for Electric Drives and Controls

3.3.5 Protection Against Contact With Hot Parts

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

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C** (140 °F) during or after operation.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can require **up to 140 minutes**! The time required for cooling down is approximately five times the thermal time constant specified in the technical data.
- After switching chokes, supply units and drive controllers off, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

3.3.6 Protection During Handling and Mounting

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

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

3.3.7 Battery Safety

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

Risk of injury by improper handling!

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

- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.

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

3.3.8 Protection Against Pressurized Systems

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

Risk of injury by improper handling of pressurized lines!

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

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

3.4 Explanation of Signal Words and the Safety Alert Symbol

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

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

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

⚠ DANGER

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

Safety Instructions for Electric Drives and Controls

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

4 Brief Description

4.1 IndraMotion MLC

Using the compact Rexroth Motion Logic System IndraMotion MLC, users have complete freedom in terms of continuous and modern machine automation. Innovative software and firmware functions, simple Engineering and open system interfaces guarantee maximum flexibility in all Motion applications.

By combining MotionControl, RobotControl and LogicControl with technology functions, users can synchronize multi-axis applications particularly easily - freely scalable for central or decentral solutions on a flexible control platform. Users can also use Motion functions, such as master axes, electronic gears, cams and the innovative FlexProfile for complex motion sequences, quickly and transparently.

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 standard 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

Brief Description

4.2 Topology

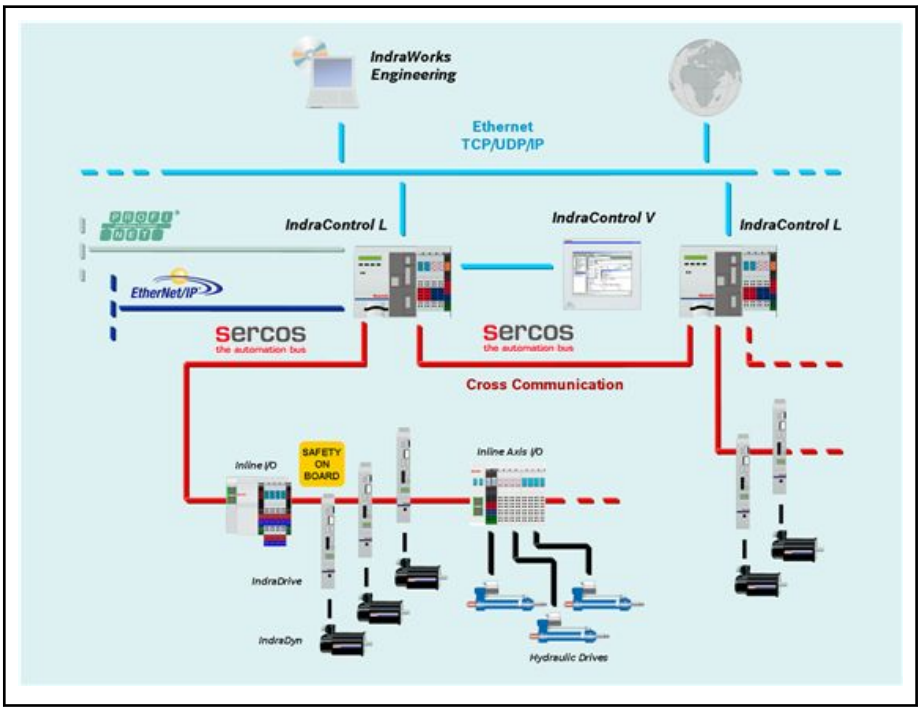

Fig.4-1: Example of IndraMotion MLC topology

5 Control Hardware

5.1 General Information

With regard to its hardware, the IndraMotion MLC is based on the IndraControl L device family that provides the variants L25, L45 and L65 according to performance and functions.

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

5.2 Control Variants of the IndraMotion MLC

IndraControl L45/L65

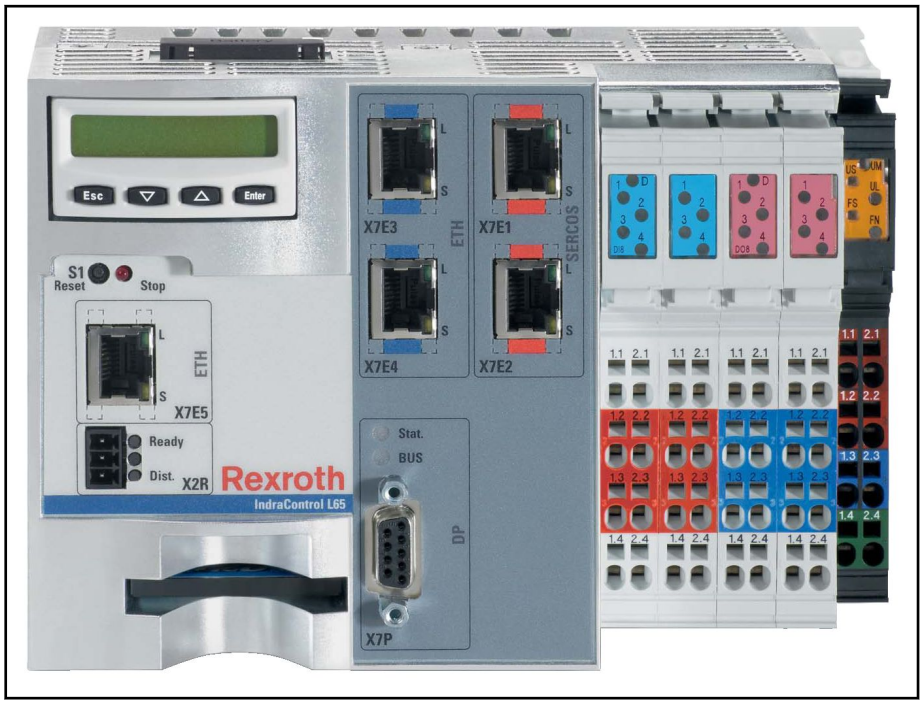

Fig.5-1: IndraControl L45/L65

IndraControl L25

Control Hardware

Fig.5-2: IndraControl L25

The IndraMotion MLC supports the following device variants:

Description	Hardware type code	Remarks
IndraControl L25 (lower performance segment)		
IndraControl CML25.1	CML25.1-3N-400-NA-NNC1-NW	sercos III, 128 MB RAM
IndraControl L45 (medium performance segment)		
IndraControl CML45.1	CML45.1-3P-500-NA-NNNN-NW	Ethernet, RT-Ethernet, Profibus, sercos III, 256 MB RAM
IndraControl CML45.1 (with 8 MB S-RAM)	CML45.1-3P-504-NA-NNNN-NW	Ethernet, RT-Ethernet, 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, Profibus, sercos III, 256 MB RAM
IndraControl CML65.1 (with 8 MB S-RAM)	CML65.1-3P-504-NA-NNNN-NW	Ethernet, RT-Ethernet, Profibus, sercos III, 256 MB RAM, 8 MB SRAM battery-buffered

Fig.5-3: 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
- Link axes (sercos II via function module)

- Controller Axes

5.3 Technical Data IndraMotion MLC

Control

		IndraControl L25	IndraControl L45	IndraControl L65
System				
Runtime system	Integrated Motion Logic 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	2	4	4
	System events	•	•	•
Touch probe		•	•	•
User memory	Total: code, data	12 MB	24 MB	36 MB
Remanent memory	Total: system, user	256 KB	256 KB	256 KB
Onboard diagnostics and settings				
Status display (booting, sercos, testing)	Display	•	•	•
Errors, warnings, messages, system reset	Display, buttons	•	•	•
EtherNet settings (IP address)	Display, buttons	•	•	•
Voltage control, watchdog	LED	•	•	•
Ready for operation relay output		•	•	•

Control Hardware

		IndraControl L25	IndraControl L45	IndraControl L65
Interface onboard				
sercos III	Master	●	●	●
Profibus	Master	-	●	●
	Slave	-	●	●
Profinet I/Os	Controller (master)	○	●	●
	Device (slave)	○	●	●
Ethernet IP	Scanner (master)	-	-	-
	Adapter (slave)	○	●	●
Ethernet TCP/IP 100 MBit/s		●	●	●
Function modules				
Max. number		2	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				
IndraControl VCP, VCH	Ethernet TCP/IP, OPC	○	○	○
IndraControl VEP, VEH	Ethernet TCP/IP, OPC	○	○	○
IndraControl VSP, VPP, VSB/VDP, VPB/VDP	Ethernet TCP/IP, OPC	○	○	○

● Default
○ Option

Inputs/outputs

		IndraControl L25	IndraControl L45	IndraControl L65
On board the control hardware				
Fast digital inputs	Interruptible, typ. 50 µs	-	8	8
Fast digital outputs	0.5 A, typ. 500 µs	-	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

Control Hardware

Communication interfaces

		Indra-Control L25	Indra-Control L45	Indra-Control L65
Interfaces				
sercos III	Real-time Ethernet bus	●	●	●
	Max. number of sercos devices (drives + I/O)	48	64	99
	Max. number of drives	16	32	64
	Max. number of I/Os in case of max. number of axes	32	32	35
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
Profibus	Master	-	●	●
	Slave	-	●	●
Profinet I/Os	Controller (master)	○	●	●
	Device (slave)	○	●	●
Standard EtherNet	EtherNet TCP/UDP/IP	● X7E3	● X7E5	● X7E5
Ethernet IP	Scanner (master)	-	-	-
	Adapter (slave)	○	●	●

● Default
○ Option

Firmware

		Indra-Control L25	Indra-Control L45	Indra-Control L65
LogicControl				
Runtime system	Integrated MotionLogic system	●	●	●
IndraLogic 2G kernel	IEC 61131-3-compliant with object-oriented extensions	●	●	●
Freely configurable tasks	Cyclic, free, event-controlled	10	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	●	●	●

		Indra-Control L25	Indra-Control L45	Indra-Control L65
Min. PLC cycle time	Synchronous to the system cycle	1 ms	1 ms	1 ms
	Synchronous to the sercos cycle	1 ms	0.5 ms	0.25 ms
Min. Motion cycle time	Command value generator	2 ms	1 ms	0.5 ms
PLC processing times				
Typical processing time for 1000 instructions	Command mix (Real, Integer, Boolean, etc.)	35 µs	30 µs	5 µs
	Boolean operations	20 µs	30 µs	5 µs
	Word operation	20 µs	30 µs	5 µs
MotionControl				
Maximum number of axes	Real, virtual, encoder, link	16	32	64
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		•	•	•
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

Control Hardware

		IndraControl L25	IndraControl L45	IndraControl L65
Motion command according to PLCopen (selection)	MC_MoveAbsolute	●	●	●
	MC_MoveRelative	●	●	●
	MC_MoveVelocity	●	●	●
	MC_Home	●	●	●
	MC_CamIn, MC_CamOut	●	●	●
	MC_GearIn, MC_GearOut	●	●	●
Synchronization ELS – Electronic Line Shaft	Dynamic synchronization	●	●	●
	Master axis cascading	●	●	●
	Velocity synchronization	●	●	●
	Phase synchronization	●	●	●
	Electronic MotionProfile (Control-internal, MotionProfiles with 16 segments max.)	2 profiles	2 profiles	2 profiles
	FlexProfile (Control-internal, master/time-based MotionProfiles with 16 segments max.)	4 profiles	4 profiles	4 profiles
	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 of which four have reduced resolution (max. 128 data points)		

		Indra-Control L25	Indra-Control L45	Indra-Control L65
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		●	●	●
RobotControl				
Number of axes for each kinematics		16	16	16
Multi-axis kinematics	Incl. auxiliary axes	4	16	16
Kinematic transformations		●	●	●
Interpolation methods LINEAR, CIRCULAR, PTP		●	●	●
Configurable block transitions		●	●	●
Override		●	●	●
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	●	●	●

Control Hardware

		Indra-Control L25	Indra-Control L45	Indra-Control L65
Safe zones		•	•	•
Technology functions (selection)				
Printed mark controller		•	•	•
FlyingShear		•	•	•
Measuring Wheel		•	•	•
Touch probe		•	•	•
Programmable limit switch		•	•	•
CrossCutter		•	•	•
Sag Controller		•	•	•
Winders		•	•	•
Tension Controller		•	•	•
Web-based engineering				
IndraMotion Service Tool		•	•	•

• Default

6 Firmware/Software Control

6.1 Firmware IndraMotion MLC

The IndraMotion MLC firmware has to be ordered device-specifically.

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

Description	Hardware type code	Firmware type codes
IndraMotion MLC based on IndraControl L25		
IndraControl CML25.1	CML25.1-3N-400-NN-NNC1-NW	FWA-CML25*-MLC-13VRS-D0
IndraMotion MLC based on IndraControl L45		
IndraControl CML45.1	CML45.1-3P-500-NA-NNNN-NW	FWA-CML45*-MLC-13VRS-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-13VRS-D0
IndraControl CML65.1 (with 8 MB S-RAM)	CML65.1-3P-504-NA-NNNN-NW	

Fig.6-1: Firmware for the control hardware variants

6.2 Software

The IndraMotion MLC is continuously engineered using the "IndraWorks Engineering" software framework. This includes integrated elements such as:

- 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*-13VRS-D0-DVD**
IndraWorks Engineering single license	SWL-IWORKS-ML*-13VRS-D0-ENG
25 single licenses for IndraWorks Engineering	SWL-IWORKS-ML*-13VRS-D0-ENG*M25

Firmware/Software Control

Description	Type code
Version-comprehensive single license for IndraWorks Engineering for IndraMotion MLC	SWL-IWORKS-ML*-NNVRS-D0-ENG
25 version-comprehensive single licenses for IndraWorks Engineering for IndraMotion MLC (multi-license package)	SWL-IWORKS-ML*-NNVRS-D0-ENG*M25

Fig.6-2: 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 IndraMotion MLC target system:

  – 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
- Technology-based function blocks extend the basic functionality of the IndraMotion MLC target system and provide application-specific functionalities such as cam function blocks, programmable limit switch, PID controller and a secure key transmission (library: ML_TechBase.library)
- Technology function blocks extend the basic functionality and provide application-specific functionalities like e.g. FlyingShear, CrossCutter, RegisterController etc. (library: ML_TechMotion.library)
- Functions supporting hydraulic components provide the following tools:

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

6.3 Software Add-Ons

The following additional software is available for the IndraMotion MLC:

Description	Type code
IndraWorks Operation	
Version-related	
IndraWorks Operation single license with activation code	SWL-IWORKS-ML*-13VRS-D0-OPD
25 IndraWorks Operation single licenses with activation code	SWL-IWORKS-ML*-13VRS-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-13VRS-D0
25 CamBuilder single licenses	SWS-IWORKS-CAM-13VRS-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*-13VRS-D0-TEAMSERVER
TeamClient	
TeamClient single license	SWS-IWORKS-VCS-13VRS-D0
10 TeamClient single licenses	SWS-IWORKS-VCS-13VRS-D0-M10
25 TeamClient single licenses	SWS-IWORKS-VCS-13VRS-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
WinStudio visualization engineering license	

Firmware/Software Control

Description	Type code
WinStudio 07VRS Engineering single license WIN CE, 512 K variables	SWS-WINSTU-RUD-07VRS-D0-512K
WinStudio 07VRS Engineering single license WIN CE, 64 K variables	SWS-WINSTU-RUD-07VRS-D0-64K
WinStudio 07VRS Engineering 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

Fig.6-3: Additionally available software

6.4 Diagnostic and Service Tools

6.4.1 IndraMotion Service Tool

The IndraMotion Service Tool (IMST) is a web-based diagnostic tool used to connect to an IndraMotion/IndraLogic control system via a high-speed Ethernet connection.

The IMST allows OEMs, end users and service engineers to access and remotely diagnose a system. The PC has to use at least the Internet Explorer 8 or Firefox 3.5.

☞ No installation or setup is required with the IMST. All necessary files and tools are embedded in the firmware of the control.

A detailed description can be found in the "Rexroth IndraLogic XLC IndraMotion MLC 13VRS IndraMotion Service Tool" manual.

6.4.2 I-Remote

I-Remote permits connection to an IndraMotion/IndraLogic control system by Ethernet or modem.

The task of enabling remote access by a service PC to the services of the control consists of connecting two spatially separate IP networks.

Different standardized methods are thus available:

- To connect via internet, see "Connection via the Internet" on page 46
- To connect point-to-point (analog/digital telephone network, GSM or UMTS mobile network), see "Point-to-point connection" on page 46

☞ I-Remote is not released for the operation on Windows 7.

Firmware/Software Control

Connection via the Internet

When establishing a connection via internet, the networks of both communication partners are connected to the internet. As soon as a connection has been established, the services of the control can be used by every other internet user. This is a risk of unauthorized access to the control. "VPN connections" use the "unsecure" internet but the data is encrypted by "tunneling".Thus, a secure connection is established.

There are many tunnel variants (for instance: PPTP, OpenVPN, IPsec). These different tunneling procedures are based on different protocols. These variants differ in configuration complexity and security.

Point-to-point connection

With a point-to-point connection, one of the communication partners specifically logs on to the remote network via a dial-up connection. The dial-in server can either be a correspondingly configured PC (client PC) or a stand-alone device (for instance the INSYS Microelectronics "MoRoS"). In both cases, the control network is connected to the dial-up connection network. It is important that both communication partners use the same technology (analog or ISDN).

☞ A dial-up connection between ISDN and analog telephone connections is not possible.

The cabled point-to-point connection is preferably used due to its excellent availability, simple configuration and minor security risks.

Term definitions

Service PC	A PC that can either remotely control a remote client PC or establish a direct connection to a control via a router in the remote network
Client PC	A PC that can be remotely controlled from the service PC
I-Remote	Remote maintenance software that is subject to license, a component of the IndraWorks automation platform
MoRoS	Modem Router Switch. A router-switch combination with integrated modem manufactured by INSYS Microelectronics GmbH. Data telegrams are routed between modem and switch

Fig.6-4: Definition of terms

More information

The following documentation is available for a detailed description of the remote maintenance "I-Remote" software:

- Rexroth IndraWorks I-Remote Remote Maintenance Software, DOK-IWORKS-IREMOTE*V01-AW01-EN-P

7 Ports and Operating Elements

7.1 IndraControl L

7.1.1 Overview

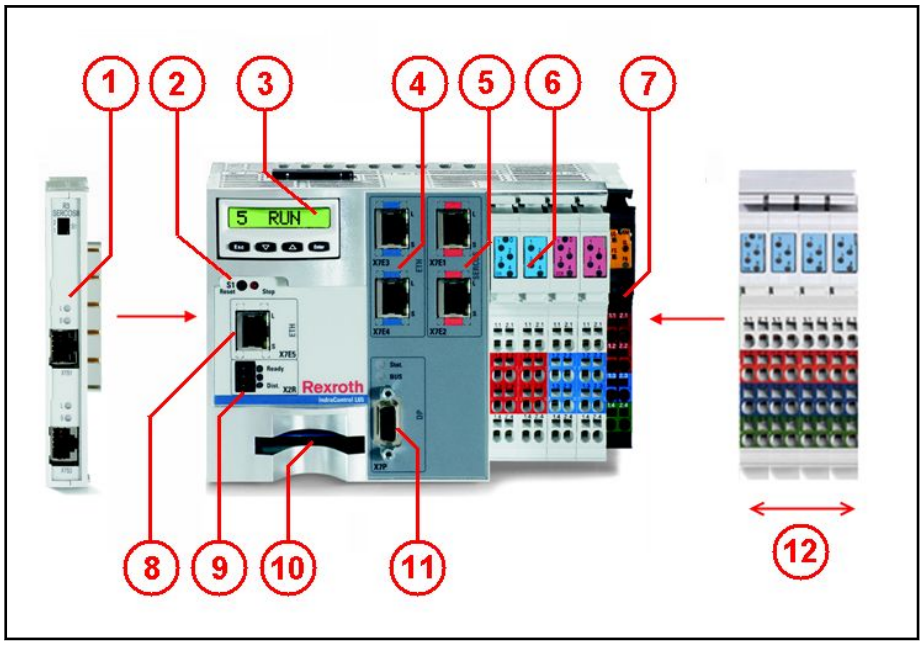

Fig.7-1: Example figure of the IndraControl L45/65

No.	Function	Description
1	Function modules	Up to four extension modules (up to two with IndraControl L25) can be connected to the left side of the IndraControl L using the function module plug connected there
2	Reset button and status LED	Reset button to reset the control and status LED to display the control status. To the functions of the "Reset" button and status LED
3	Display with operating keys	Integral display with operating keys to display diagnostic and status information and 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 port for Ethernet-based bus systems
5	Ethernet interfaces X7E1/X7E2 **	Ethernet interfaces for connection of the 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

Ports and Operating Elements

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 **Note:** **This interface is named X7E3 on the IndraControl L25**
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 IndraMotion MLC 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. A maximum of 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", DOKCONTRL- ILSY-SINS***-AWxx-EN-P, R911317021. xx - Edition

* Optional for IndraControl L25
** only IndraControl L with sercos III

Fig.7-2: 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!

7.1.2 Interfaces

Ethernet Interface X7E5

X7E5 Ethernet network port

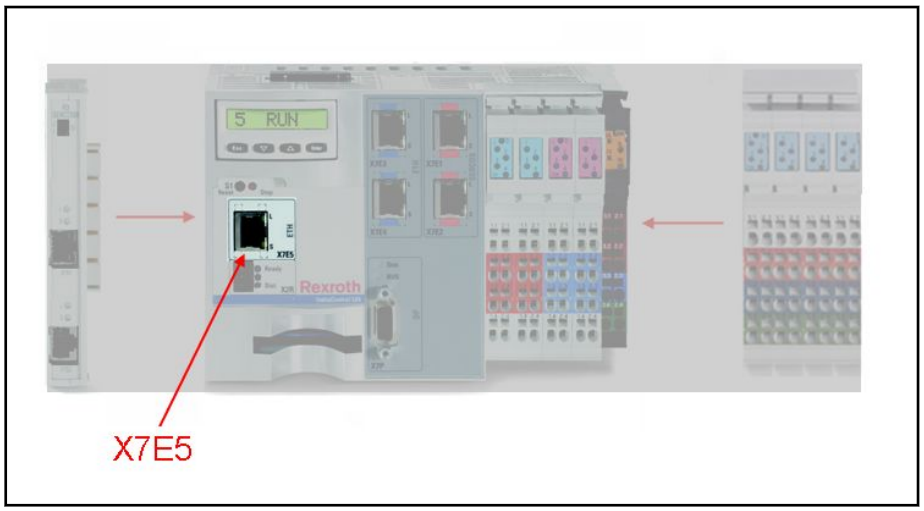

Fig.7-3: Ethernet interface X7E5

This interface is labeled with X7E3 on the IndraControl L25.

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.

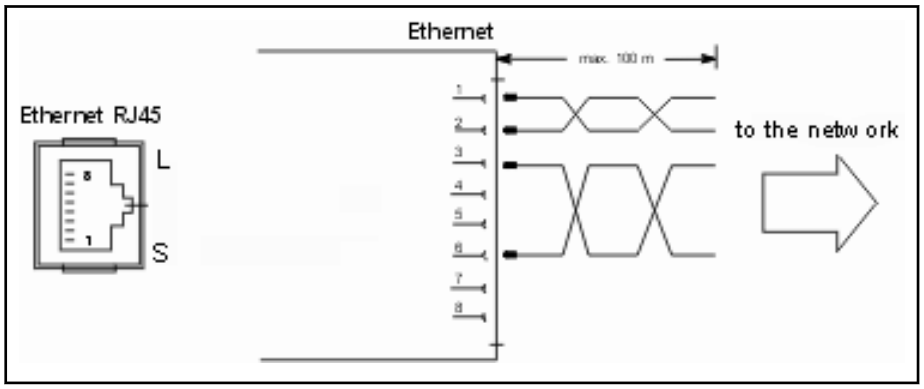

Fig.7-4: Ethernet interface X7E5

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

Fig.7-5: Pin assignment of the RJ45 female connector

Ports and Operating Elements

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

Fig.7-6: 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 (Optional for L25)

X7E3/X7E4 real-time Ethernet network port

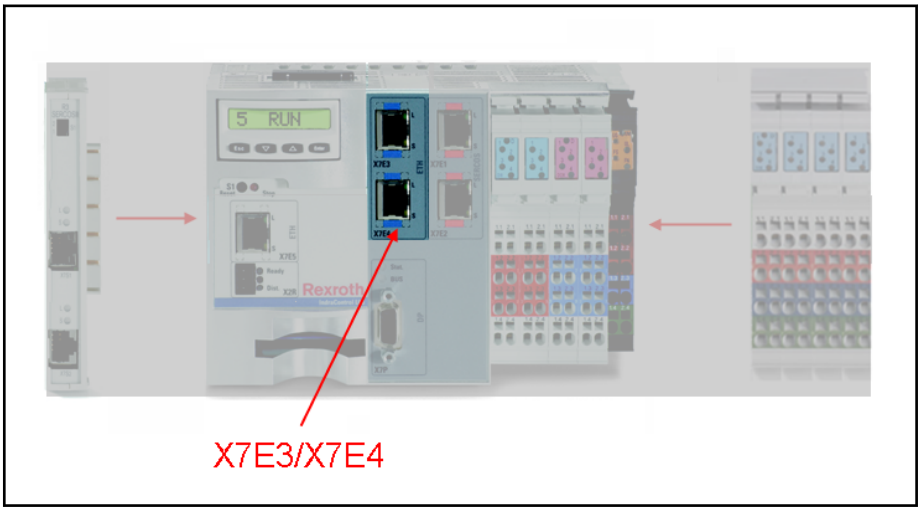

Fig.7-7: Real-time Ethernet interfaces X7E3/X7E4

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

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

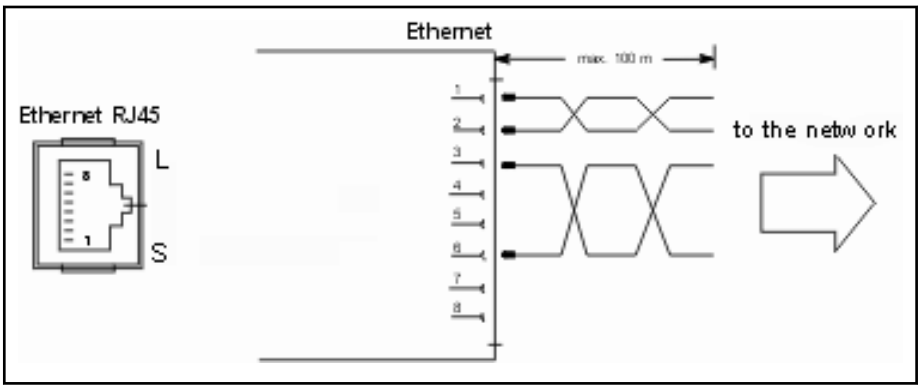

Fig.7-8: Ethernet interfaces X7E3/X7E4

RJ45, female connector, 8-pin	
Type	Ethernet 100BaseT
Cable length	Max. 100 m

RJ45, female connector, 8-pin	
Cable type	CAT5e with S/STP
Transmission rate	10 or 100 MBit/s

Fig.7-9: 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

Fig.7-10: 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

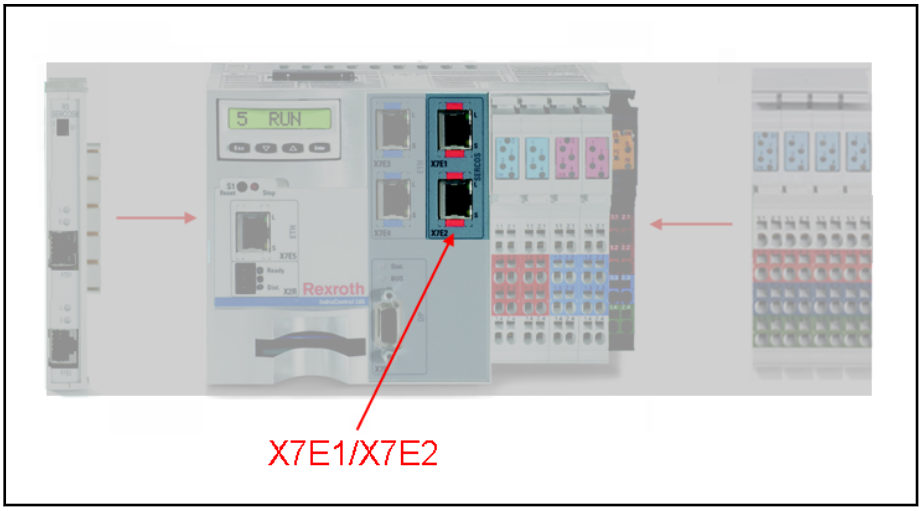

Fig.7-11: sercos III interfaces X7E1/X7E2

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

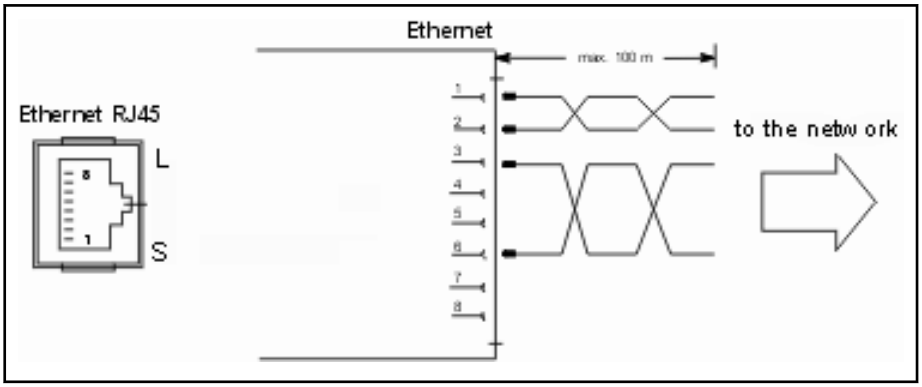

Fig.7-12: sercos III interface X7E1/X7E2

Ports and Operating Elements

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

Fig.7-13: 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

Fig.7-14: Status and diagnostic displays of the Ethernet interface

Profibus DP X7P (Optional for IndraControl L25)

X7P Profibus DP interface

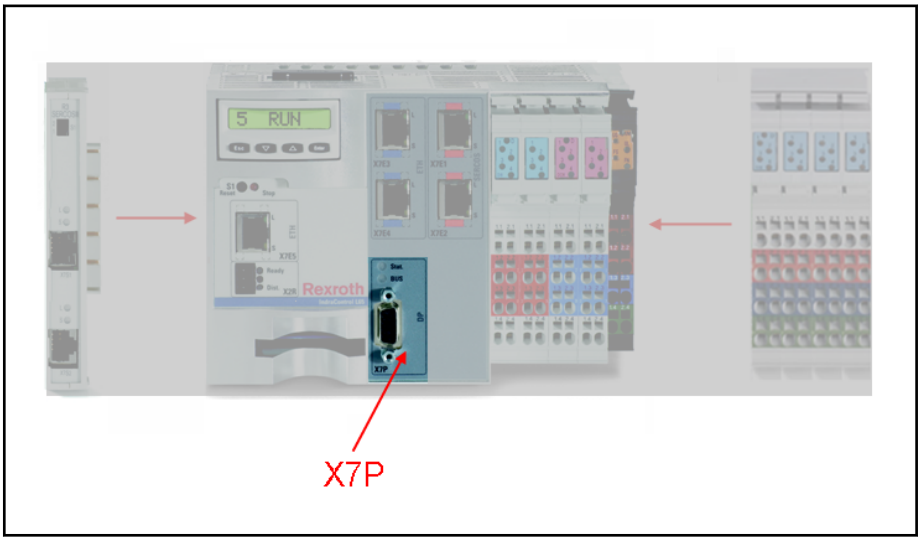

Fig.7-15: Profibus DP interface X7P

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

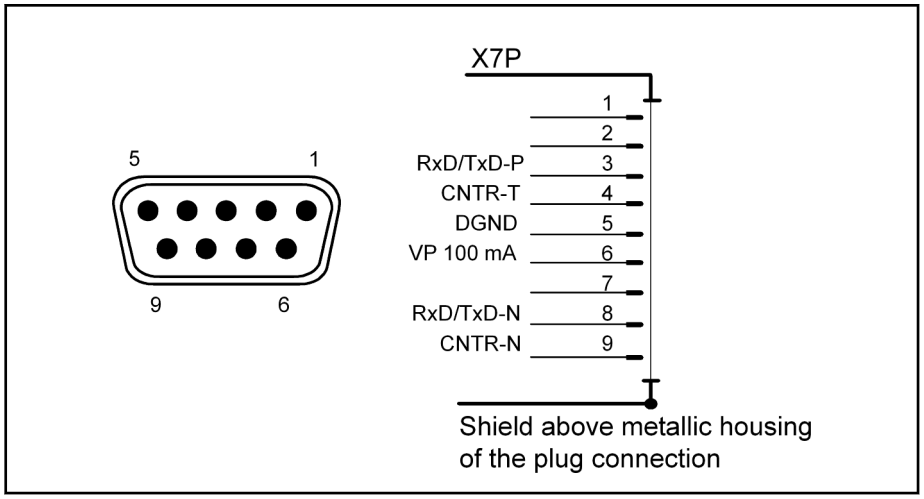

Fig.7-16: Profibus DP interface X7P

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

Fig.7-17: 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

Fig.7-18: 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

Fig.7-19: Profibus DP cable parameters

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

Ports and Operating Elements

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

Fig.7-20: Maximum segment length depending on transmission rate

Ready Contact

Ready contact X2R

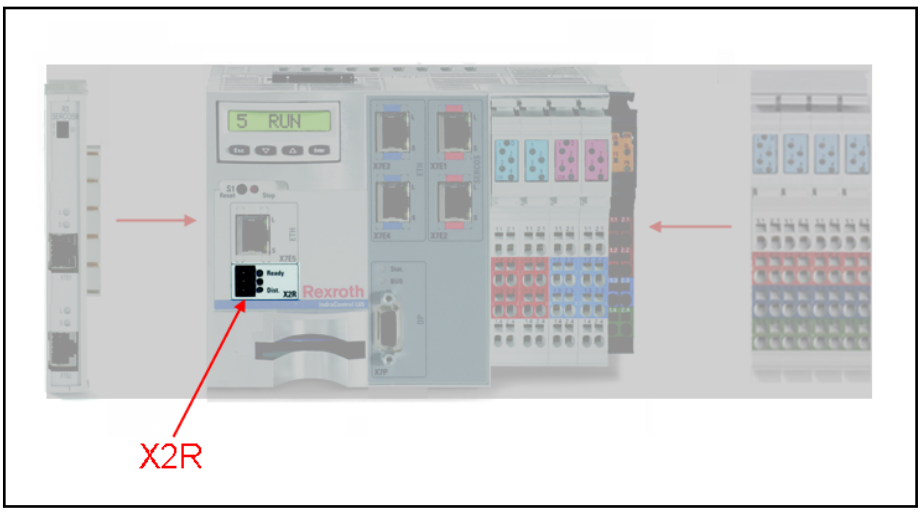

Fig.7-21: Ready contact X2R

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 %

Fig.7-22: Characteristic values of the Ready contact

The Ready contact is open in an idle state. It 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. It can assume the following states:

Ready "LED"	Description
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

Fig.7-23: Ready LED

The "Dist." LED has currently no function.

Compact Flash Slot

Slot for firmware

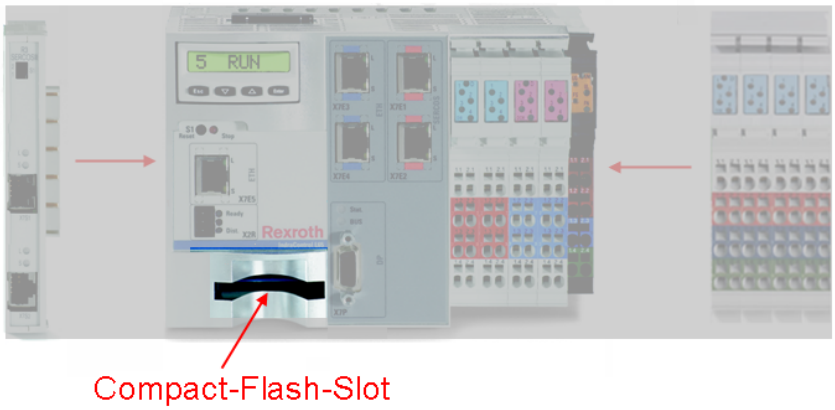

Fig.7-24: Compact flash slot

A slot for a Compact Flash card is located on the IndraControl L and 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 caused by operation without memory card!**

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

Ports and Operating Elements

7.1.3 Inline Bus

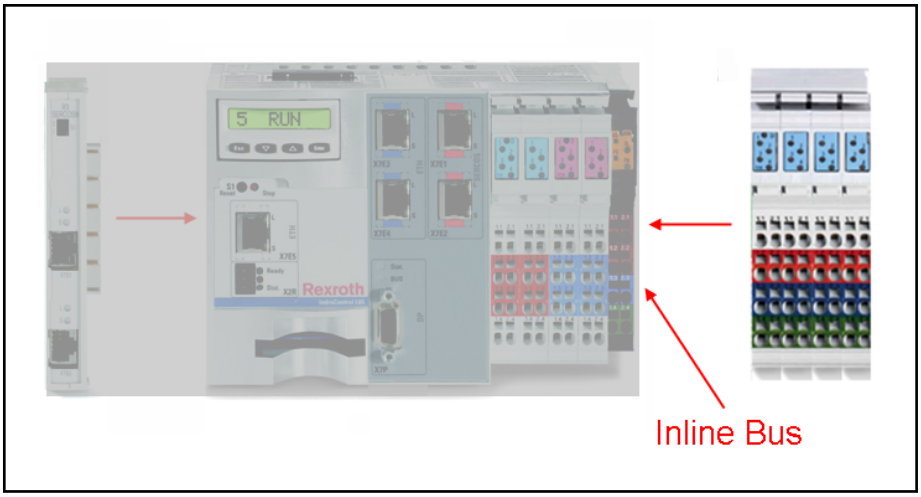

Fig.7-25: Inline bus

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.

7.1.4 Function Module Plug

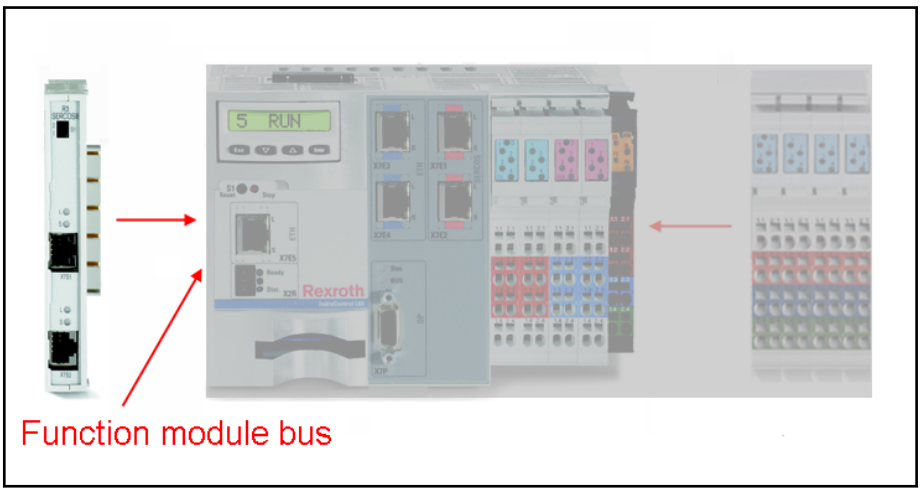

Fig.7-26: Function module bus

Extension modules (up to two with IndraControl L25 and up to four with IndraControl L45/L65) can be connected to the left side of the IndraControl L using 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.

7.1.5 Digital Onboard Inputs and Outputs (IndraControl L45/L65 Only)

General Information

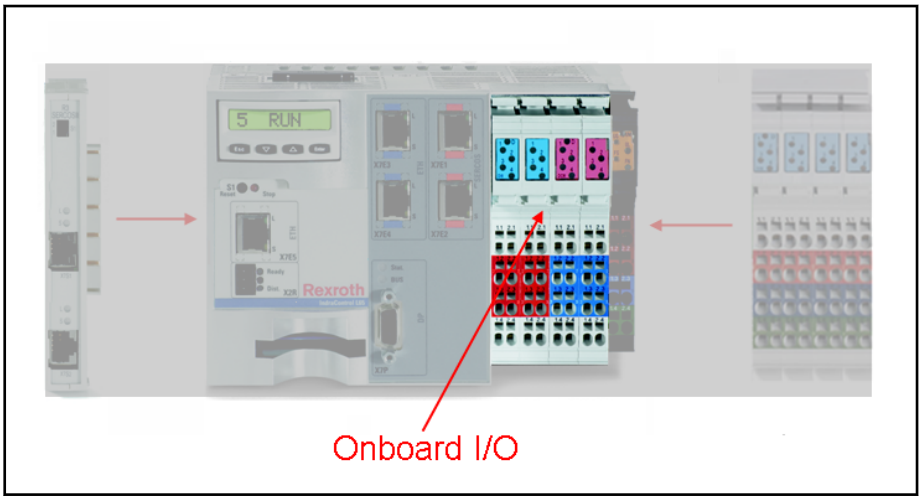

Fig.7-27: Onboard I/O

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.

Slots 1 and 2:

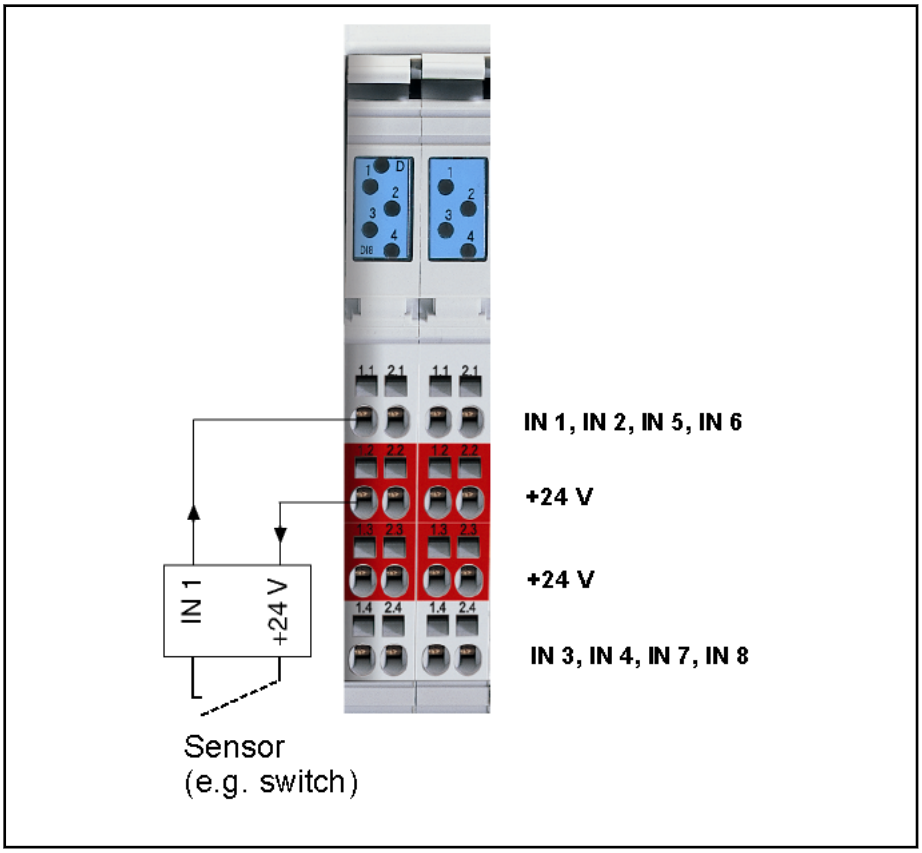

Fig.7-28: Digital inputs

Note the color coding on the plugs!

Ports and Operating Elements

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" to "1" - At "1" to "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 ULS via a PTC fuse
Output voltage	Typ. Uext. – 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

Fig.7-29: Data of the digital inputs

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

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

Fig.7-30: 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	Description
Off	24 V missing
Green	24 V present
Red	Short circuit or overload

Fig.7-31: LED D

Digital Onboard Outputs

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

Slots 3 and 4:

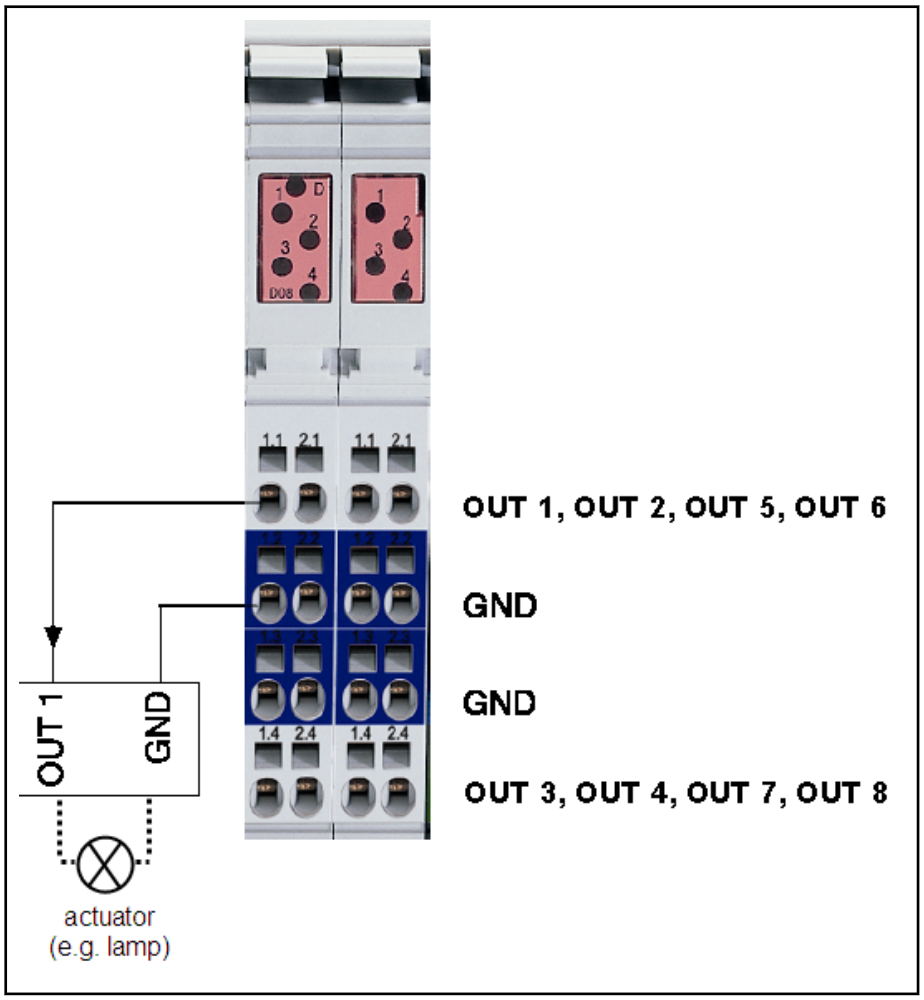

Fig.7-32: Digital outputs

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

Ports and Operating Elements

Rated output current: - Nominal value - Maximum value according to DIN EN 61131-2 - Signal 1 - Signal 0 (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
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

Fig.7-33: Data of digital outputs

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

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

Fig.7-34: 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	Description
Off	24 V missing
Green	24 V present
Red	Short circuit or overload

Fig.7-35: 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.

7.1.6 Power Supply

Externally Connectable Power Supply

General Information

PWR IN

Fig.7-36: 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!

Ports and Operating Elements

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)

Fig.7-37: Plug assignment on the voltage terminal

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

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

Fig.7-38: Diagnostic LED of the infeed terminal

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

Fig.7-39: Diagnostic LED of the segment terminal

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

Fig.7-40: Diagnostic LED of the power supply

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

Fig.7-41: 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 further information, refer to the "Rexroth IndraControl L45/L65" and "Rexroth IndraControl L25" manuals (see chapter 1.3 "Required and Supplementing Documentations" on page 10).

7.1.7 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.

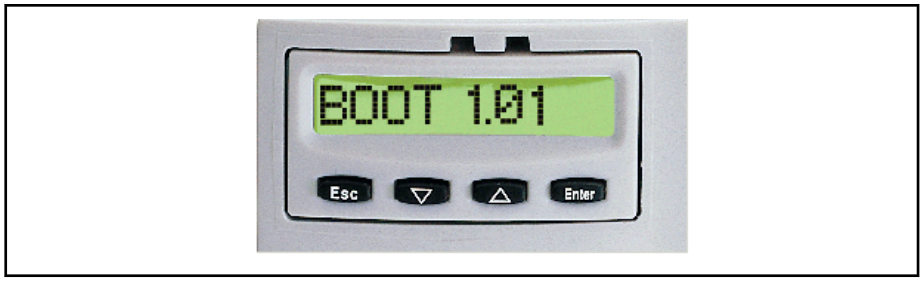

Fig.7-42: Display with operating keys

The following figure shows the standard menu of the display:

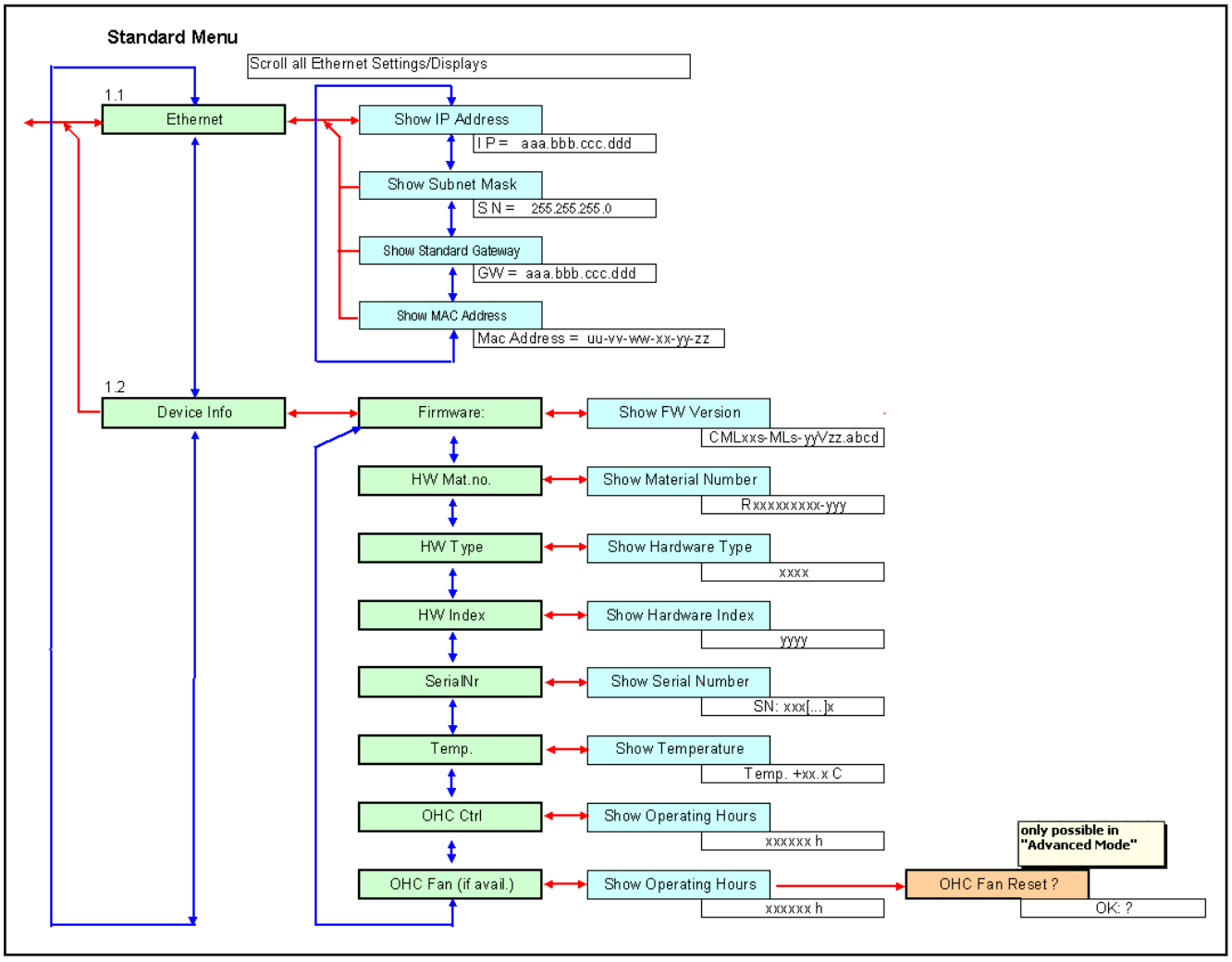

Fig.7-43: Standard menu overview to operate display and keyboard

8 IndraDrive and HydraulicDrive – Drive Technology

8.1 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 8.2.1 "Brief description" on page 65)
- 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

8.2 Compact System IndraDrive Cs

8.2.1 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.

IndraDrive and HydraulicDrive – Drive Technology

Fig.8-1: Compact system IndraDrive Cs

8.2.2 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	

Fig.8-2: Technical data of the IndraDrive Cs

8.2.3 Firmware

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

- 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

8.2.4 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

8.3 IndraDrive Control Section

8.3.1 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 8.4 "IndraDrive C Converters" on page 72) and IndraDrive M inverters (see chapter 8.5 "IndraDrive M Inverters" on page 77).

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.8-3: IndraDrive BASIC UNIVERSAL control section

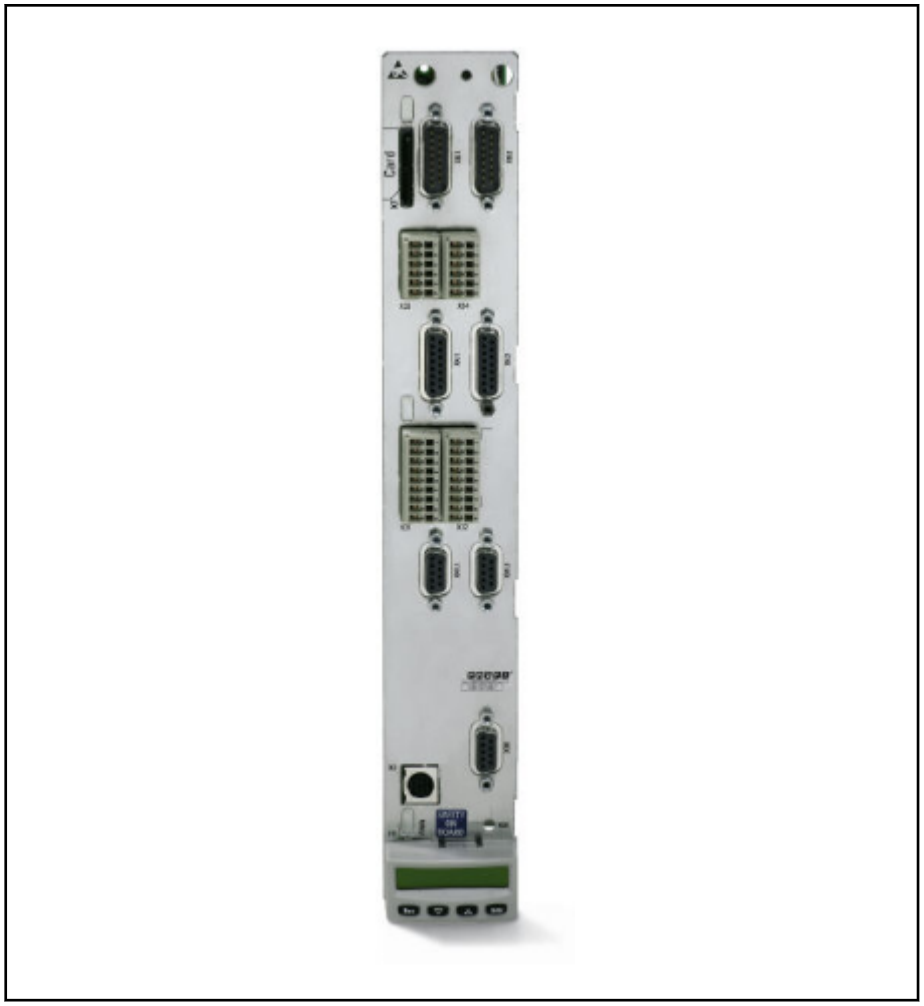

Fig.8-4: Control section IndraDrive BASIC UNIVERSAL double axis

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

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Fig.8-5: IndraDrive ADVANCED control section

8.3.2 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

Fig.8-6: Technical data of IndraDrive control sections

8.3.3 Firmware

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

- FWA-INDRV*-MPH-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-06VRS-D5-1-SNC-NN

- FWA-INDRV*-MPC-06VRS-D5-1-SNC-NN
- FWA-INDRV*-MPH-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-07VRS-D5-1-SNC-NN
- FWA-INDRV*-MPH-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPD-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-08VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-17VRS-D5-1-SNC-NN
- FWA-INDRV*-MPB-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPM-18VRS-D5-1-SNC-NN
- FWA-INDRV*-MPC-18VRS-D5-1-SNC-NN

8.3.4 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

8.4 IndraDrive C Converters

8.4.1 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.8-7: IndraDrive HCS02 converters

IndraDrive and HydraulicDrive – Drive Technology

Fig.8-8: IndraDrive HCS03 converters

8.4.2 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	In case of U_{LN} < 400 V: 1 % of power reduction per 4 V In case of U_{LN} > 400 V: 1 % of increase in power 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	DC 24 V ±20 % (DC 24 ±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

IndraDrive and HydraulicDrive – Drive Technology

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

Fig.8-9: IndraDrive C HCS03 converters

IndraDrive C – Compact converters HCS02

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	In case of U_{LN} < 400 V: 1 % of 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	DC 24 V ±20 % (DC 24 ±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

Fig.8-10: IndraDrive C HCS03 converters

8.4.3 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

8.5 IndraDrive M Inverters

8.5.1 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.

IndraDrive and HydraulicDrive – Drive Technology

Fig.8-11: IndraDrive M HMS

Fig.8-12: IndraDrive M HMD

8.5.2 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

IndraDrive and HydraulicDrive – Drive Technology

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	DC 24 V ±20 % (DC 24 ±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

Fig.8-13: 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

Fig.8-14: IndraDrive M HMD converter

8.5.3 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

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8.6 IndraDrive M Supply Units

8.6.1 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.

IndraDrive and HydraulicDrive – Drive Technology

Fig.8-15: IndraDrive M HMV

8.6.2 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 supply voltage	In case of U_{LN} < 400 V: 1 % of power reduction per 4 V							
	In case of U_{LN} > 400 V: 1 % of increase in power 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	DC 24 V ±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

Fig.8-16: IndraDrive M HMV supply units

8.6.3 Documentation

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

IndraDrive and HydraulicDrive – Drive Technology

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

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8.7 HydraulicDrive HDB

8.7.1 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
Valve direct 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

Fig.8-17: Overview of operation modes and possible types of controls

8.7.2 Firmware

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

- FWA-HYDRV*-HDB-17VRS-D5-1-SNC-NN
- FWA-HYDRV*-HDB-18VRS-D5-1-SNC-NN

8.7.3 Documentation

The following documentation provides comprehensive descriptions of the HydraulicDrive devices:

- Rexroth HydraulicDrive HDx-18 Functions, DOK-HYDRV*-HD*-17VRS**-AP01-EN-P
- Rexroth HydraulicDrive HDx-18 Functions, DOK-HYDRV*-HD*-18VRS**-AP01-EN-P
- Rexroth HydraulicDrive HDB-17 Diagnostic Description, RD 30330-WA/04.12
- Rexroth HydraulicDrive HDB-18 Diagnostic Description, RD 30330-WA/04.13
- Rexroth HydraulicDrive HDB-17 Parameter Description, RD 30330-PA/03.12
- Rexroth HydraulicDrive HDB-18 Parameter Description, RD 30330-PA/03.13

9 I/O Periphery

9.1 General Information

The following I/O components extend the hardware of the IndraMotion MLC

- Central Rexroth Inline I/Os (Inline terminals mounted on the control, maximum 512 inputs/outputs) (see chapter 9.3 "Rexroth Inline Terminals" on page 87)
- Decentral Rexroth IndraControl S20 I/Os via Profinet and sercos (see chapter 9.4 "Rexroth IndraControl S20" on page 93)
- Decentral Rexroth IndraControl S67 I/Os via Profibus DP, Profinet and sercos (see chapter 9.5 "Rexroth IndraControl S67" on page 95)
- Decentral Rexroth Fieldline I/Os via Profibus DP (see chapter 9.6 "Rexroth Fieldline M8 (Modular)" on page 99)
- Decentral Rexroth Block I/O via Profibus DP and sercos (see chapter 9.7 "Rexroth Block I/O" on page 100)
- Function modules (see chapter 10 "Function Modules" on page 101)
- HMI devices (see chapter 11 "IndraControl V – Visualization Devices" on page 135)

9.2 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.

9.3 Rexroth Inline Terminals

IndraControl L25, L45, L65

The Inline bus of the IndraControl Lxx controls integrates I/O modules (Inline terminals) of the IndraControl Inline bus. Up to 63 I/O modules can be connected. The maximum number depends on the user data of the connected I/O modules.

Feature overview:

- Extendable with modules up to 63 external I/O modules
- Maximum of 244 bytes in each data direction of the process data

I/O Periphery

Profibus coupler

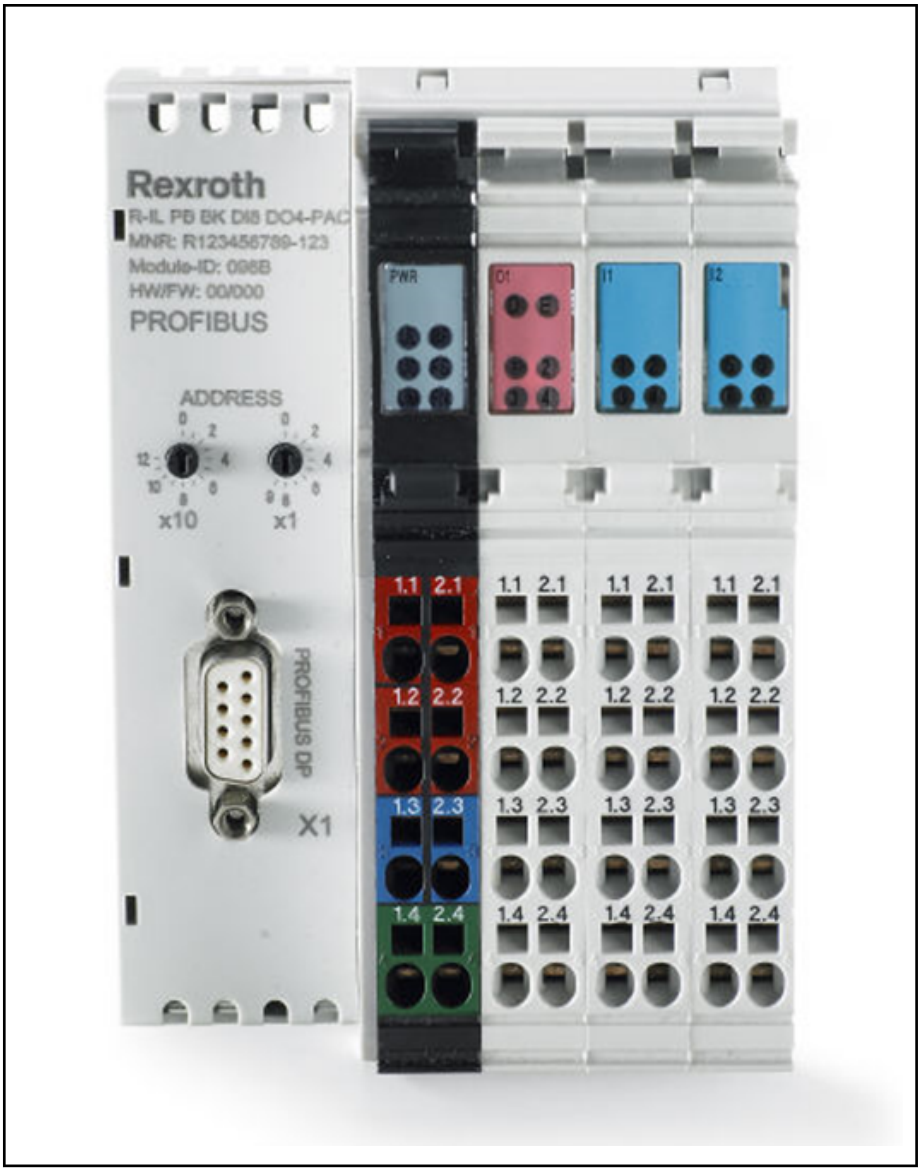

Fig.9-1: Rexroth Profibus Inline coupler

The field bus coupler integrates the IndraControl Inline bus I/O modules into the Profibus DP. The 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

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A
- Extendable with modules 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
- Lockable control panel for the operating mode and address switch

For a detailed description, refer to the manual

- Rexroth Inline Bus Couplers for Profibus-DP R-IL PB BK DI8 DO4-PAC , DOK-CONTRL-ILPBBKDI8DO4-AWxx-EN-P

  xx - Edition

Profinet coupler

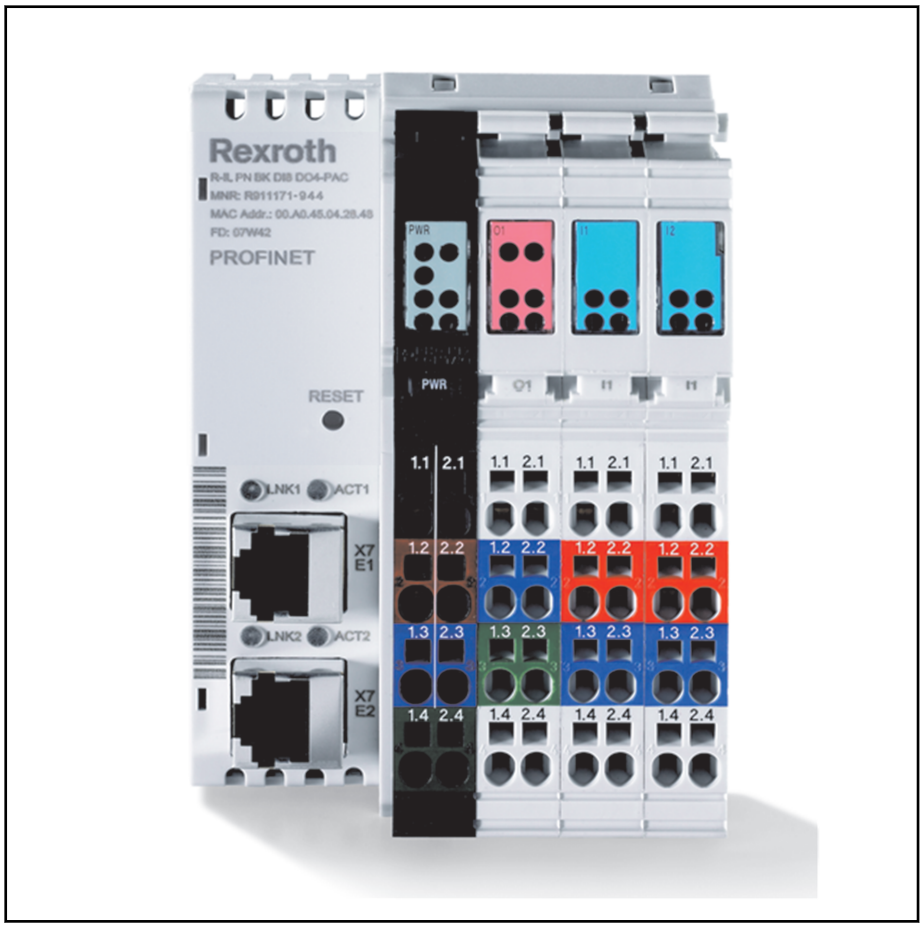

Fig.9-2: Rexroth Profinet Inline coupler

The field bus coupler integrates the IndraControl Inline bus I/O modules into Profinet. Profinet structurally permits the connection of up to 225 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

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A
- Extendable with modules up to 61 external I/O modules
- Maximum of 244 bytes in each data direction of the process data
- Parameterization and configuration via GSDML including diagnostics
- Lockable control panel for the operating mode and address switch

The documentation on this device is currently prepared.

I/O Periphery

sercos III coupler

Fig.9-3: Rexroth sercos III Inline coupler

The field bus coupler integrates I/O modules of the IndraControl Inline bus into sercos III. With regard to its structure, sercos III allows the connection of up to 255 field bus couplers with 61 additional 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

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Four digital outputs, 24 V DC, 0.5 A
- Extendable with modules up to 61 external I/O modules
- Maximum of 244 bytes in each data direction of the process data
- Parameterization and configuration via SDDML including diagnostics
- Lockable control panel for the operating mode and address switch

For a detailed description, refer to the manual

- Rexroth Inline Bus Couplers for sercos III with Digital Inputs and Outputs DOK-CONTRL-ILS3BKDI8DO-KBxx-EN-P

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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; DC 24 V; 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; DC 24 V; 4 inputs
R-IB IL 24 DI 8-PAC	Digital input module; DC 24 V; 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; DC 24 V; 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; DC 24 V; 32 inputs; npn-switching
R-IB IL 24 DI 8/HD-PAC	Digital input module; DC 24 V; 8 inputs
Digital output modules	
R-IB IL 24 DO 2-2A-PAC	Digital output module; DC 24 V / 2.0 A; 2 outputs
R-IB IL 24 DO 4-PAC	Digital output module; DC 24 V / 0.5 A; 4 outputs
R-IB IL 24 DO 8-PAC	Digital output module; DC 24 V / 0.5 A; 8 outputs
R-IB IL 24 DO 8-2A	Digital output module; DC 24 V / 2.0 A; 8 outputs
R-IB IL 24 DO 8-2A-PAC	Digital output module; DC 24 V / 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; DC 24 V / 0.5 A; 32 outputs
R-IB IL 24 DO 2-NPN-PAC	Digital output module; DC 24 V / 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; DC 24 V / 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
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

I/O Periphery

Type code	Brief description
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 element; 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 I/O link ports; 12 digital inputs

Fig.9-4: I/O module and supply module

Block I/O modules

Block I/O modules are bus couplers with integrated I/Os. No further modules can be attached to Block I/O modules.

Type code	Brief description
R-ILB S3 24 DI16 DO16	Digital sercos I/O module; 16+16 digital inputs; 16 digital outputs, 1 A
R-ILB S3 AI4 AO2	Analog sercos I/O modules; 4 analog inputs; 2 analog outputs
R-ILB PB 24 DI16 DO16	Digital Profibus I/O module; 16+16 digital inputs; 16 digital outputs, 1 A

Fig.9-5: Block I/O modules

Documentation

The Rexroth Inline system is described in detail in the manual

- The Automation Terminals of the Product Family Rexroth Inline, DOK-CONTRL-ILSYSINS***-AWxx-EN-P

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9.4 Rexroth IndraControl S20

Profinet coupler

Fig.9-6: Rexroth Profinet S20 coupler

The field bus coupler integrates the IndraControl S20 I/O modules into the Profinet. 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.

Overview on the field bus coupler features:

- Extendable with modules up to 63 external I/O modules
- Maximum of 1485 bytes in each data direction of the process data
- Parameterization and configuration via GSDML including diagnostics
- Lockable control panel for the operating mode and address switch

The documentation on this device is currently prepared.

I/O Periphery

sercos III coupler

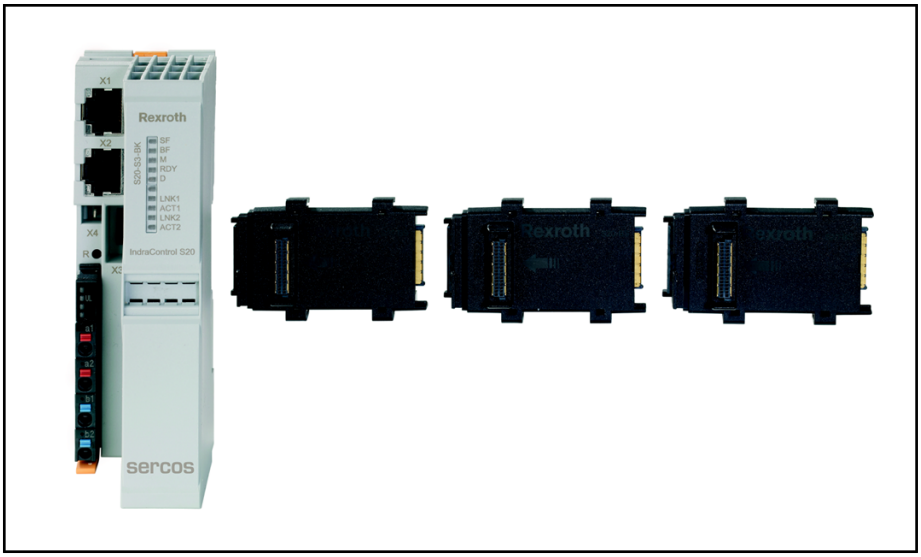


Fig.9-7: Rexroth sercos III S20 coupler

The field bus coupler integrates I/O modules of the IndraControl S20 into sercos III. With regard to its structure, sercos III allows the connection of up to 255 field bus couplers with 63 additional I/O modules each. The maximum number depends on the user data of the connected I/O modules.

Overview on the field bus coupler features:

- Extendable with modules up to 63 external I/O modules
- Maximum of 244 bytes in each data direction of the process data
- Parameterization and configuration via SDDML including diagnostics
- Lockable control panel for the operating mode and address switch

The documentation on this device is currently prepared.

Modules

The following modules are available as bus coupler extension:

Type code	Brief description
Digital input modules	
S20-DI16/4	Digital input module; DC 24 V; 16 inputs; 2-, 3-, 4-wire connection technology
S20-DI32/1	Digital input module; DC 24 V; 32 inputs; 1-wire connection technology
Digital output modules	
S20-DO16/3	Digital output module; DC 24 V / 0.5 A; 16 outputs; 2-, 3-wire connection technology
S20-DO32/1	Digital output module; DC 24 V / 0.5 A; 32 outputs; 1-wire connection technology
Analog modules	
S20-AI8	Analog input module; voltage/current; 8 inputs; 2-wire connection technology
S20-AO8	Analog output module; voltage/current; 8 outputs; 2-wire connection technology
S20-RTD8	Analog input module; RTD; 8 inputs

Type code	Brief description
Function modules	
S20-CNT/INC-2/2	Function module; counting input/incremental encoder; 2 inputs/2 outputs

Fig.9-8: I/O module and supply module

Documentation The documentation on these modules is currently prepared.

9.5 Rexroth IndraControl S67

Profibus coupler

Fig.9-9: Rexroth Profibus S67 coupler

The field bus coupler integrates the IndraControl S67 I/O modules into the Profibus DP. Profibus structurally permits the connection of up to 125 field bus couplers with 63 I/O modules each. The maximum number depends on the DP master and the user data of the connected I/O modules.

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Extendable with modules up to 63 external I/O modules

I/O Periphery

- Parameterization and configuration via GSD including diagnostics
- Lockable control panel for the operating mode and address switch

For a detailed description, refer to the manual

- Rexroth IndraControl S67 Profibus Coupler 8 Digital Inputs (M8), DOK-CONTRL-S67PBBKDI8*-APxx-EN-P

  xx - Edition

Profinet coupler

Fig.9-10: Rexroth Profinet S67 coupler

The field bus coupler integrates the IndraControl S67 I/O modules into the Profinet. 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.

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Extendable with modules up to 63 external I/O modules
- Parameterization and configuration via GSD including diagnostics
- Lockable control panel for the operating mode and address switch

For a detailed description, refer to the manual

- Rexroth IndraControl S67 Profinet Coupler 8 Digital Inputs (M8), DOK-CONTRL-S67PNBKDI8*-APxx-EN-P

  xx - Edition

sercos III coupler

Fig.9-11: Rexroth sercos S67 coupler

The field bus coupler integrates I/O modules of the IndraControl S67 into sercos III. With regard to its structure, sercos III allows the connection of up to 255 field bus couplers with 63 additional I/O modules each. The maximum number depends on the user data of the connected I/O modules.

Overview on the field bus coupler features:

- Eight digital inputs, type 1, 24 V DC
- Extendable with modules up to 63 external I/O modules
- Parameterization and configuration via GSD including diagnostics
- Lockable control panel for the operating mode and address switch

For a detailed description, refer to the manual

- Rexroth IndraControl S67 sercos Coupler 8 Digital Inputs (M8), DOK-CONTRL-S67S3BKDI8*-APxx-EN-P

  xx - Edition

Modules The following modules are available as bus coupler extension:

I/O Periphery

Type code	Brief description
Digital input modules	
S67-DI8-M8	Digital input module; DC 24 V; 8 inputs (8 x M8)
S67-DI8-M12	Digital input module; DC 24 V, 8 inputs (4 x M12, double assignment)
Digital output modules	
S67-DO8-M8	Digital output module; DC 24 V / 0.5 A; 8 outputs (8 x M8)
S67-DO8-M12	Digital output module; DC 24 V / 0.5 A; 8 outputs (4 x M12, double assignment)
S67-DO8-M8-2A	Digital output module; DC 24 V / 2.0 A; 8 outputs (8 x M8)
S67-DO8-M12-2A	Digital output module; DC 24 V / 2.0 A; 8 outputs (4 x M12, double assignment)
Digital input/output modules	
S67-DIO8-M8	Digital input/output module; DC 24 V, 0.5 A; 8 inputs/outputs (8 x M8)
S67-DIO8-M12x8	Digital input/output module; DC 24 V, 0.5 A; 8 inputs/outputs (8 x M12)
Analog modules	
S67-AI4-U/I-M12	Analog input module; voltage / current; 4 inputs (4 x M12)
S67-AI4-RTD-M12	Analog input module; resistance temperature device (RTD); 4 inputs (4 x M12)
S67-AI4-UTH-M12	Analog input module for thermal element (TC); 4 inputs (4 x M12)
S67-AO4-U/I-M12	Analog output module; voltage / current; 4 outputs (4 x M12)
Module with serial interfaces	
S67-RS-UNI-M12	2 serial interfaces RS-232, RS-422/-485 (2 x M12); 4 digital inputs/outputs DC 24 V, 0.5 A (2 x M12, double assignment)
Supply module	
S67-PWR-IN-M12	Supply module (1 x M23 + 6 x M12 connection)

Fig.9-12: I/O module and supply module

9.6 Rexroth Fieldline M8 (Modular)

Profibus coupler

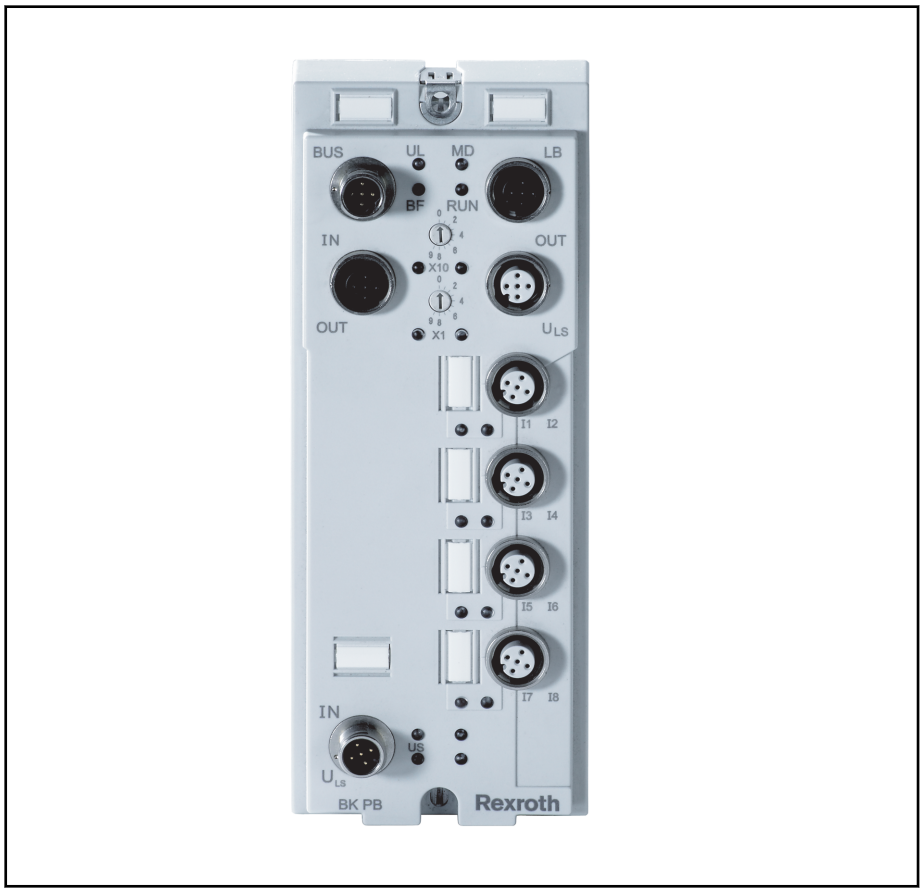


Fig.9-13: Rexroth Profibus Fieldline coupler (modular)

This Profibus DP coupler and the corresponding input and output modules of the Rexroth Fieldline M8 product family are designed for decentral automation tasks under rough ambient conditions. The modules comply with the degree of protection IP65/IP67. The input and output modules allow a direct connection of sensors and actors to the environment closed to the station. Communication with the control takes place via Profibus DP.

Components

There are three available modules of Rexroth Fieldline modules:

Type code	Description
RF-FLM BK PB DI8 M12	8 inputs 24V
RF-FLM DIO 8/4 M8	8 inputs 24V; 4 outputs 24V/2A
RF-FLM DI 8 M8	8 inputs 24V

Fig.9-14: Module selection

Documentation

The following data sheets are available for the Fieldline modules:

- Rexroth Fieldline Modular Bus Coupler for Profibus with Eight Digital Inputs, DOK-CONTRL-FLMBKPBDI8*-KBxx-EN-P
- Rexroth Fieldline Modular M8 Local Bus Device with Digital I/O, DOK-CONTRL-FLMDIO8/4**-KBxx-EN-P
- Rexroth Fieldline Modular M8 Device with 8 Digital Inputs, DOK-CONTRL-FLMDI8*****-KBxx-EN-P

xx - Edition

I/O Periphery

9.7 Rexroth Block I/O

Brief description

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.

Modules

The following Block I/O modules are available:

Type code	Field bus	Description
R-ILB S3 24 DI16 DIO16	sercos III	16 digital inputs 24V; 8 digital outputs 1A
R-ILB S3 24 DI16 DO16/F	sercos III	16 digital inputs 24V; 8 digital outputs 1A, response time 1ms
R-ILB S3 AI4 AO2	sercos III	4 analog inputs +/-10V; 2 analog outputs
R-ILB S3 AI6 AO4/F	sercos III	6 analog inputs +/-10V; 4 analog outputs, response time 1ms
R-ILB PB 24 DI16 DO16	Profibus	16 digital inputs 24V; 8 digital outputs 1A

Fig.9-15: Module selection

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-S3DI16DIO16-KBxx-EN-P
- Rexroth Inline Block IO for sercos III with Analog Inputs and Outputs, DOK-CONTRL-S3AI4AO2***-KBxx-EN-P
- Rexroth Inline Block IO Module for Profibus, DOK-CONTRL-PBDI16/DO16-KBxx-EN-P

xx - Edition

10 Function Modules

10.1 General Information

To extend the functionality, up to four (two max. for the IndraControl L25) function modules can be connected to the function module bus on the left side of the IndraControl L.

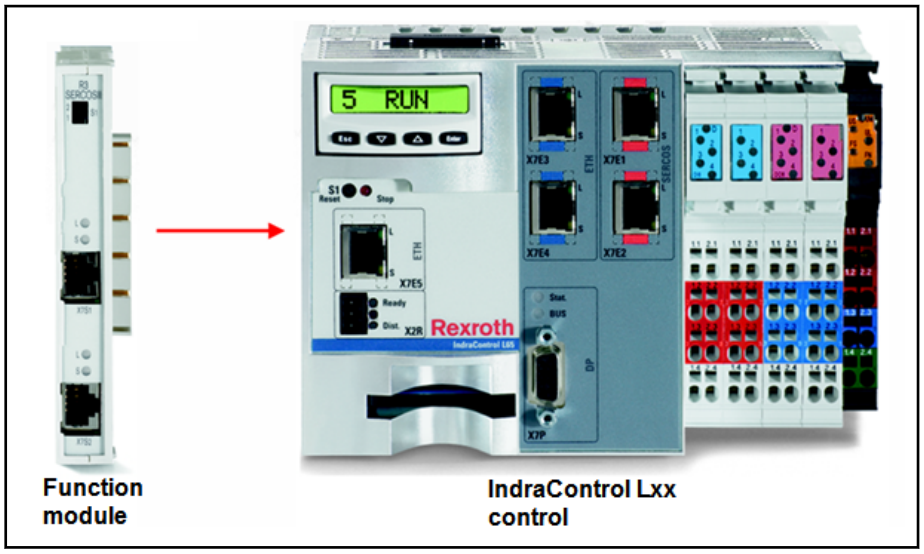


Fig. 10-1: Connecting a function module to the IndraControl L

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

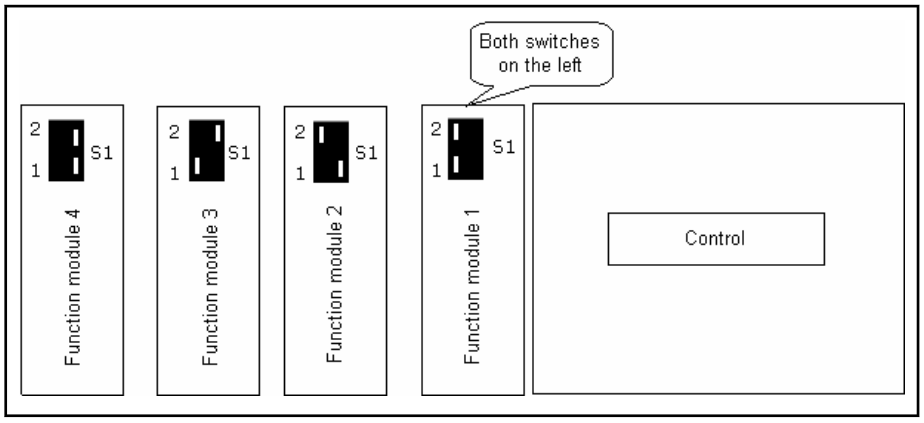


Fig. 10-2: Addressing function modules on an IndraControl L

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 on the control.

The Safety function module cannot be used at the IndraControl L25.

NOTICE **Do not connect the function module if voltage is applied!**

When installing a function module, disconnect the IndraControl L from the power supply.

The following function modules are currently supported by the IndraMotion MLC:

- **CrossComm sercos II (CFL01.1-Q2)**

  Permits the creation of an MLC cross link via sercos fiber optic cable rings (single or double ring) on an IndraMotion MLC equipped with an onboard sercos III interface (see chapter 10.4 "CrossComm sercos II (CFL01.1-Q2), sercos II Cross Communication" on page 109)

- **CrossComm sercos III (CFL01.1-R3)**

  Permits the creation of an MLC cross link ring (C2C) via sercos III (see chapter 10.3 "CrossComm sercos III (CFL01.1-R3) - sercos III Cross Communication" on page 104)

- **sercos II (CFL01.1-Q2)**

  Permits the connection of sercos II drives to the IndraMotion MLC equipped with onboard sercos III interface (see chapter 10.5 "sercos II (CFL01.1-Q2) – Master Communication" on page 114)

- **S-RAM modules (CFL01.1-Y1)**

  8 MB memory extension, battery-buffered to save RoCo projects (see chapter 10.6 "S-RAM Modules (CFL01.1-Y1) - Memory Extension for the IndraMotion MLC" on page 115)

- **PLS (CFL01.1-N1)**

  High-performance programmable limit switch with a sampling rate of 125 µs and 16 outputs (see chapter 10.7 "PLS (CFL01.1-N1) - Programmable Limit Switch" on page 117)

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

  8 inputs, 8 outputs, 8 freely programmable I/Os (see chapter 10.8 "Fast I/O (CFL01.1-E2)" on page 122)

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

  Real-time Ethernet and Profibus DP master or Profibus DP slave functionality (see chapter 10.9 "RT-Ethernet/Profibus DP (CFL01.1-TP)" on page 127)

- **Safety CPU (CFL01.1-F1)**

  Safety engineering according to SIL3 (see chapter 10.10 "Safety Function Module (CFL01.1-F1)" on page 129)

10.2 Characteristics of the sercos Interface

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)

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

Type	Master communication	Cross communication
sercos II	sercos II (CFL01.1-Q2)	CrossComm sercos II (CFL01.1-Q2)
sercos III		CrossComm sercos III (CFL01.1-R3)

Fig.10-3: 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

Fig.10-4: Configuration options for sercos II and sercos III function modules

Only the configuration options listed are supported by the IndraMotion MLC.

The IndraMotion MLC detects the sercos modules during startup, so that they can also be plugged into 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 H or I (two modules) are selected for the sercos II function modules.

Function Modules

10.3 CrossComm sercos III (CFL01.1-R3) - sercos III Cross Communication

10.3.1 General Information

The controls are connected to an MLC link to distribute the master axis positions of different IndraMotion MLC controls across any local axes in various drive rings. The cross communication distributes the configured master axis positions to locally selected axes in the different controls.

The function module can be ordered via parts number R911170008.

As an alternative to the CrossComm sercos II (CFL01.1-Q2) function module, the controls can be interconnected using the **CrossComm sercos III (CFL01.1-R3)** function module.

The following features are new compared to sercos II:

- The connection is established via an Ethernet CAT5 cable instead of a fiber optic cable
- Higher data transfer rate, 100 MBaud
- Central configuration of the control link via link master
- Free configuration of up to 42 (128 in preparation) master axes via all link devices
- No local link axes are required to consume the master axis positions
- Direct master axis access of the consuming device (without link axis) via AXIS_REF structure
- Additionally to the axis position (A-0-0101) and to the axis velocity (A-0-0102), each produced axis provides the modulo value (A-0-0045), the feed distance of the slave axis (A-0-0046) and the axis status (A-0-0021) to the link
- All axis data can be accessed from the PLC via direct variables
- Apart from the control status in the link (ControlValid bits in C-0-0712), bit 30 "position data of the (external) master axis is valid" is provided as an individual status bit in the parameter A-0-0021

The use of sercos III for master communication and cross link with an IndraMotion MLC L25/L45/L65 requires that the function modules are arranged as follows:

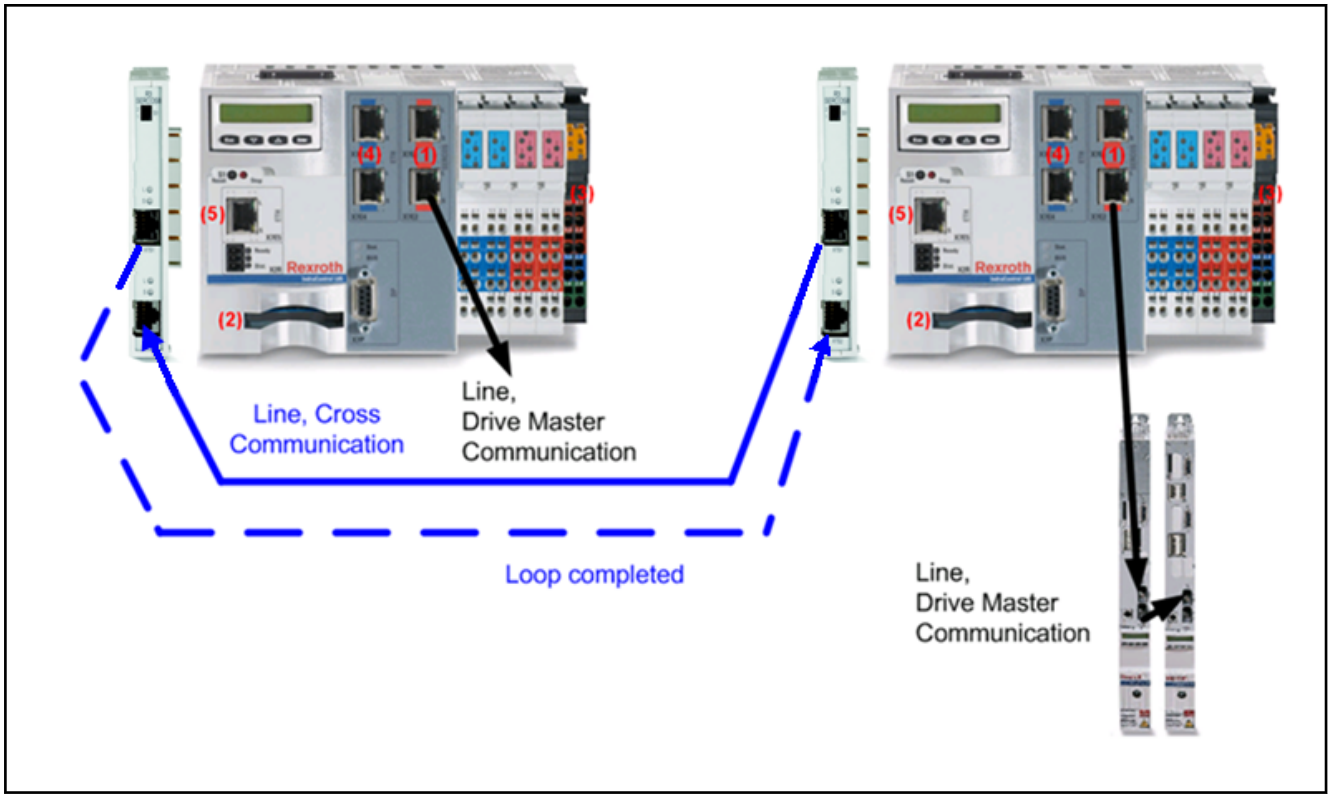


Fig. 10-5: sercos III for master communication (onboard) and cross link via function module

Maximum of 32 IndraMotion MLCs in the link

When using the CrossComm sercos III (CFL01.1-R3) function module, up to 32 IndraMotion MLC controls can be interconnected to an MLC link. The maximum number of possible controls depends on the number of master axes in the link and the cycle time selected.

Maximum of 42 master axes in the link

For each IndraMotion MLC, the actual positions of any local axes can be produced in the MLC link. A maximum of 42 different master positions is allowed in the MLC link for all link devices. The maximum number of master axes possible depends on the number of controls in the link and the cycle time selected.

Number of controls	Number of master axes in the link
8	≤ 42
16	≤ 31
24	≤ 20
32	≤ 9

Fig. 10-6: Dependency between the number of controls/master axes with the CrossComm sercos III (CFL01.1-R3)

Cycle time in the link

The link cycle time is specified in the link master. During the 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, the number of drives in the individual drive rings and the enabled functionalities 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 "MC cycle time (Tcyc) command value", C-0-0503 "sercos cycle time" and C-0-0700 "MC link - Cycle time (Tcyc) command value" must be identical.
- The highest cycle time in the drive rings of all link devices therefore specifies the link cycle time.

Line(s) or ring

The MLC link can be operated either as line, double line or ring (see chapter 10.3.3 "MLC Link as Line, Double Line or Ring" on page 107).

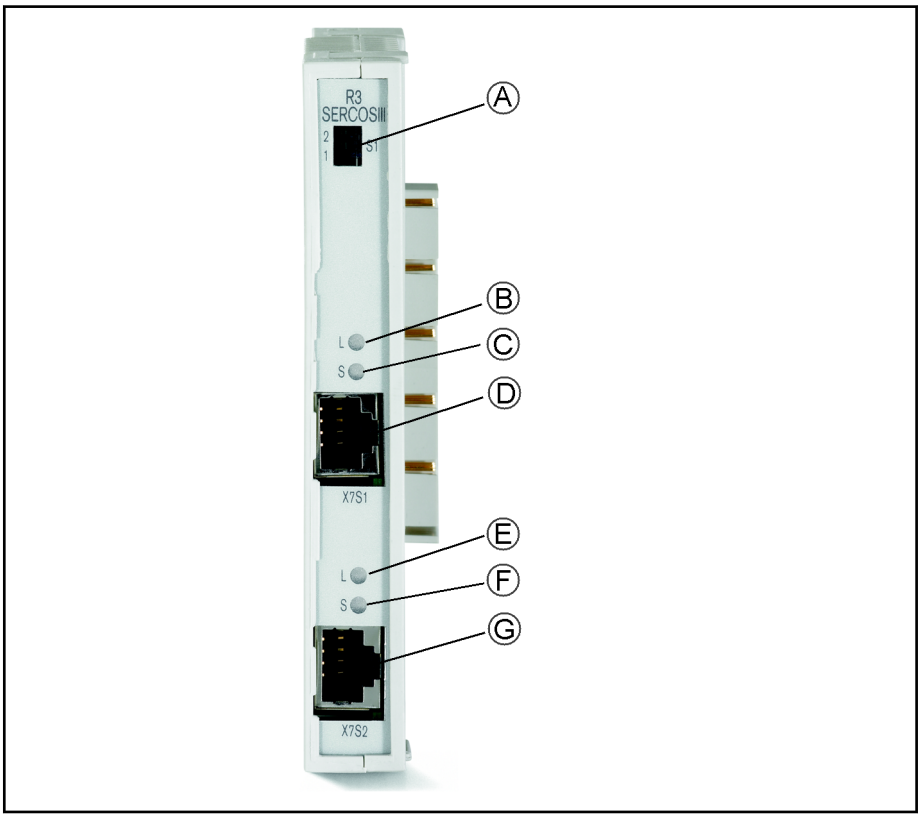
The ring provides the following advantages:

- Higher error tolerance, a failed transmission distance between two IndraMotion MLCs 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

10.3.2 Hardware

Front view

The front view of the sercos III function module shows the connections (primary ring/secondary ring), the display elements and switch to set the bus address.



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.10-7: Front view of the CrossComm sercos III (CFL01.1-R3) function module

Hardware detection by the firmware

At next startup, the firmware detects the new function module automatically.

Link displays

The status of the MLC link is displayed on the 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).

10.3.3 MLC Link as Line, Double Line or Ring

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

The MLC link can either 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 ports X7S1 and X7S2 can be freely used.

Function Modules

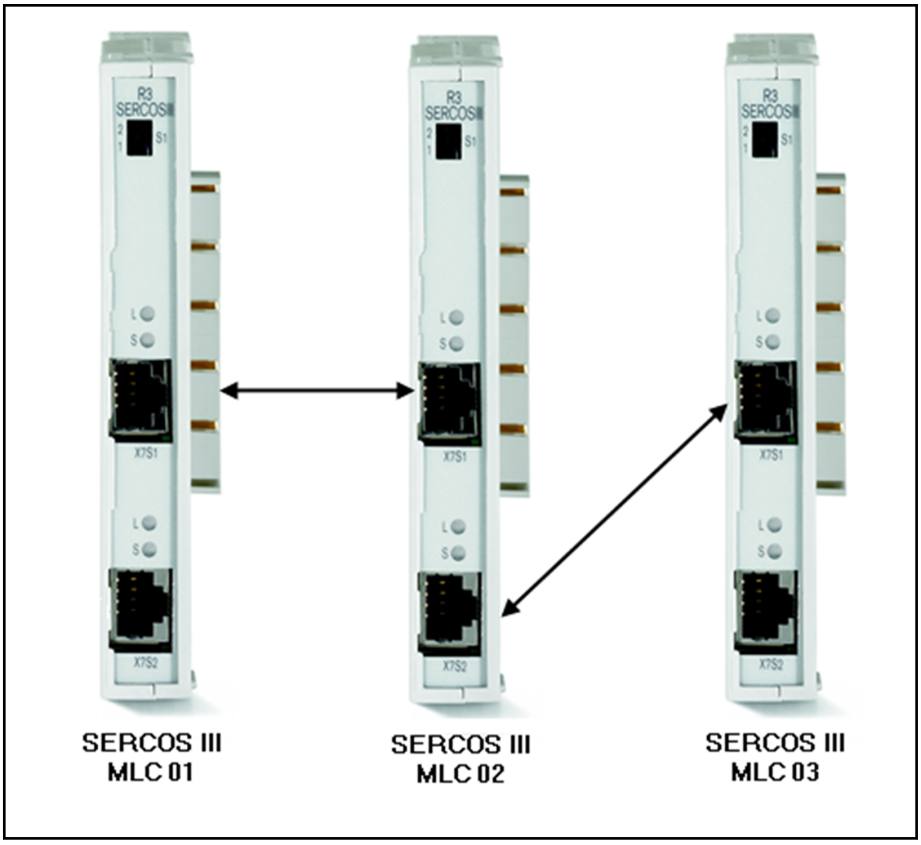


Fig.10-8: Line, wiring example

If only one port is assigned at the link master, it is the final device in a line. This is the case if either the MLC01 or the MLC03 is the link master.

As device in the middle, like the MLC02, both ports are assigned to the link master and thus supports a double line.

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

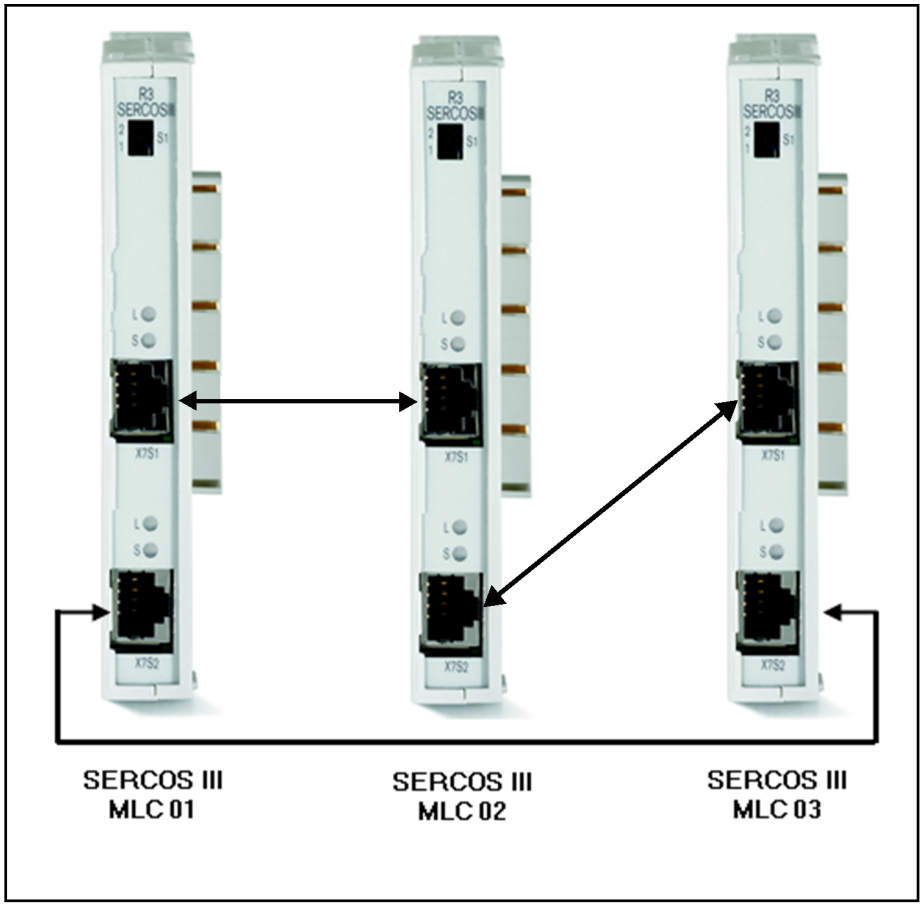


Fig. 10-9: Ring, wiring example

10.4 CrossComm sercos II (CFL01.1-Q2), sercos II Cross Communication

10.4.1 General Information

The controls are connected to an MLC link to distribute the master axis positions of different IndraMotion MLC controls across any local axes in various drive rings. 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 IndraMotion MLC 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 MLC link.

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

☞ 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 MLCs in the link

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

Maximum of 128 master axes in the link

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

Function Modules

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 MLC 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

Fig.10-10: Typical link cycle times with 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 on the enabled functionalities in the individual controls.

- The link cycle time set **has to be** identical for all controls in the MLC 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 MLC link can be established either with a single or a double fiber optic cable ring.

The double ring provides

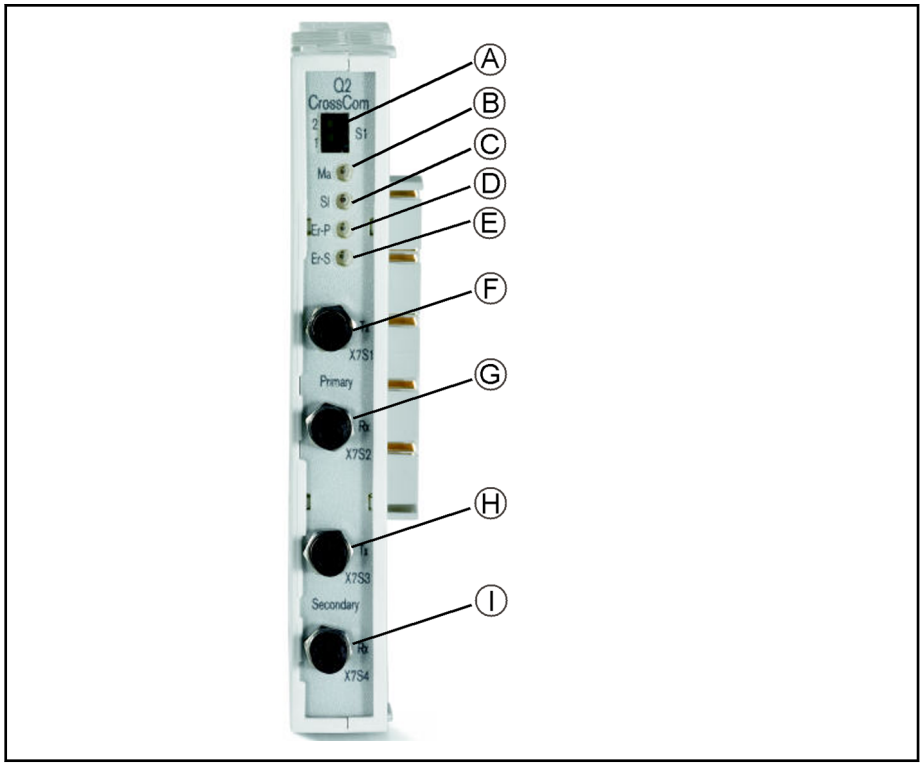
- Higher error tolerance as a failed transmission distance between two controls is tolerated for example
- Greater availability, even when a control is switched off, cross communication with the rest of the drive rings remains established for example

10.4.2 Hardware

Front view

The front view of the sercos II function module shows the connections (primary ring/secondary ring) and the display elements and switch to set the bus address.

The following figure shows the front view of the CrossComm 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.10-11: Front view of the function module CrossComm sercos II (CFL01.1-Q2)

Hardware detection by the firmware

At next startup, the firmware detects the new function module automatically.

Link displays

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

10.4.3 MLC Link as Single or Double Ring

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

At each IndraMotion MLC in the parameterized MLC link, the active MLC link is indicated by 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 (correct state).

Function Modules

Single ring: Primary ring

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

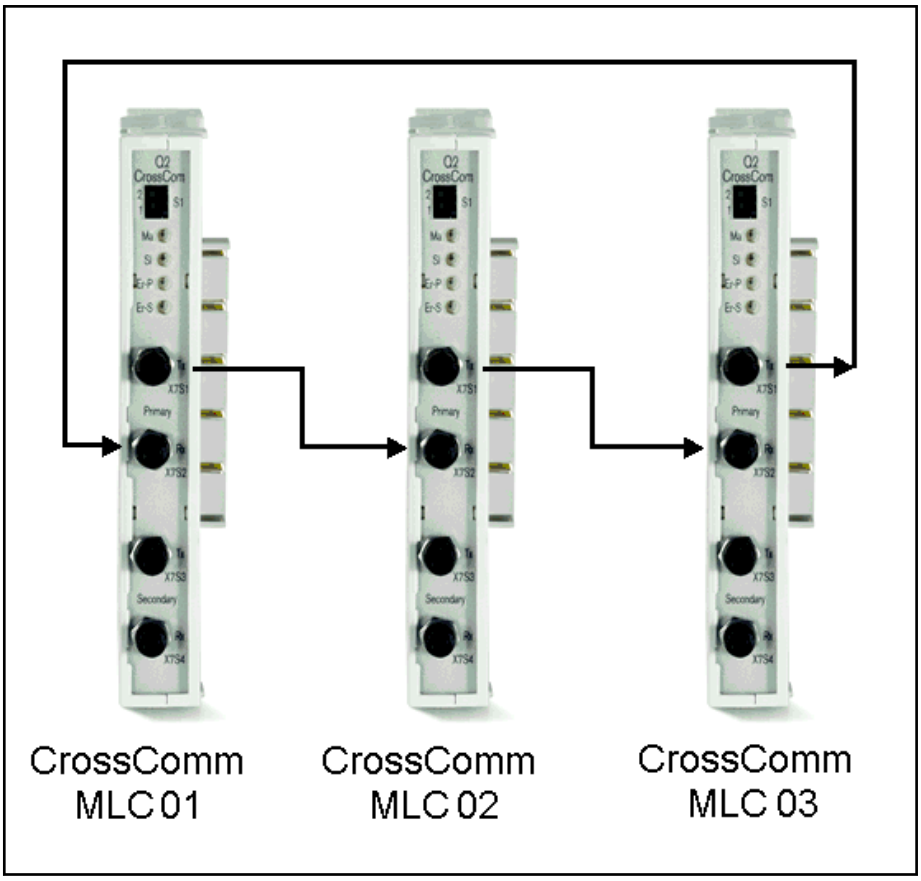


Fig. 10-12: FOC connection in the single ring

Primary ring, secondary ring

The primary ring is normally used for communication purposes. The redundant signals are transmitted via the secondary ring.

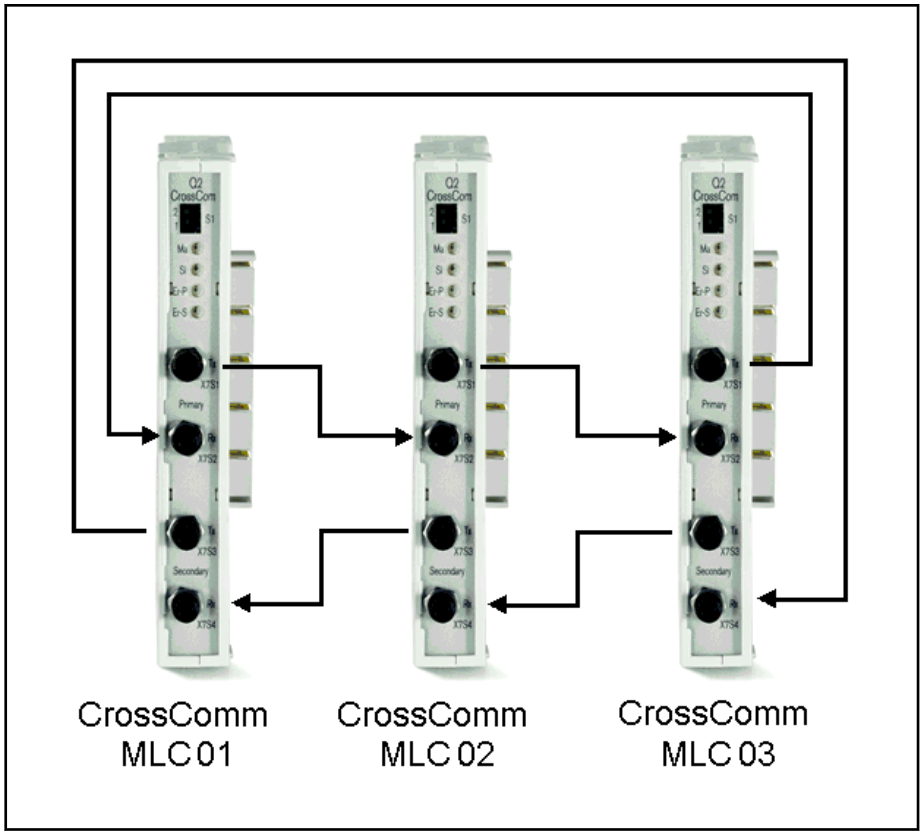


Fig. 10-13: FOC connections in the double ring

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

10.4.4 Optical Ring Adjustment

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

Function Modules

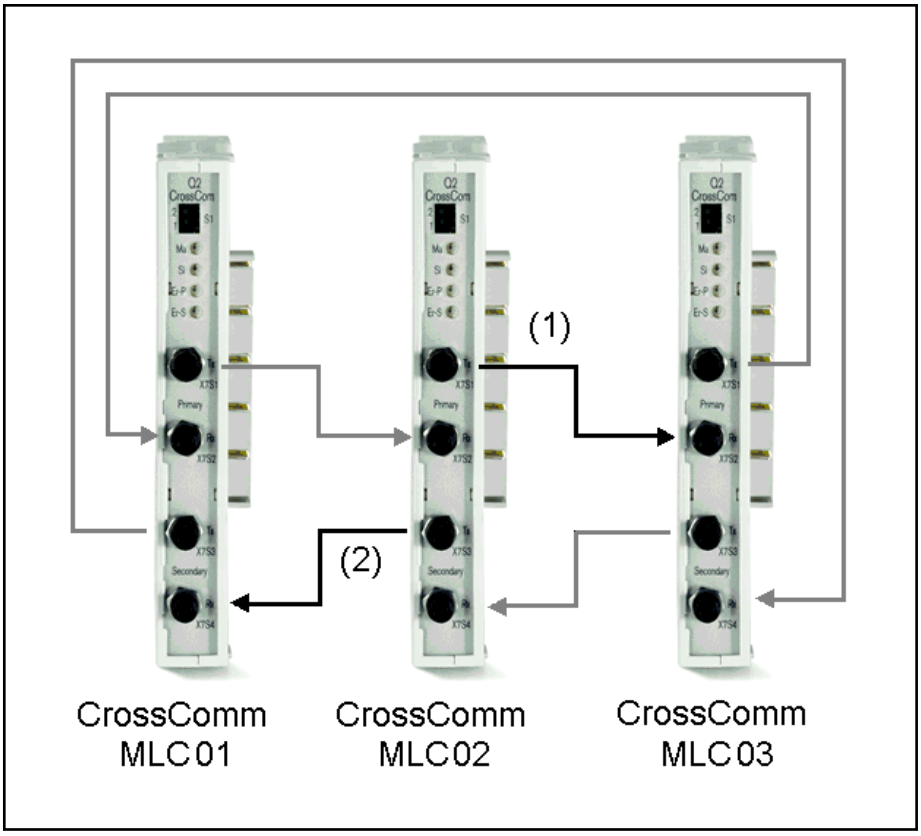


Fig.10-14: MLC 02 transmission cables

Optical transmission power - single ring

The transmission power is set in the parameter "C-0-0702, MLC link - Configuration of FOC lengths".

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 the parameter "C-0-0702, MLC link - Configuration FOC lengths".

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 in the second list element is relevant for the secondary ring ②.

10.5 sercos II (CFL01.1-Q2) – Master Communication

10.5.1 General Information

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.

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

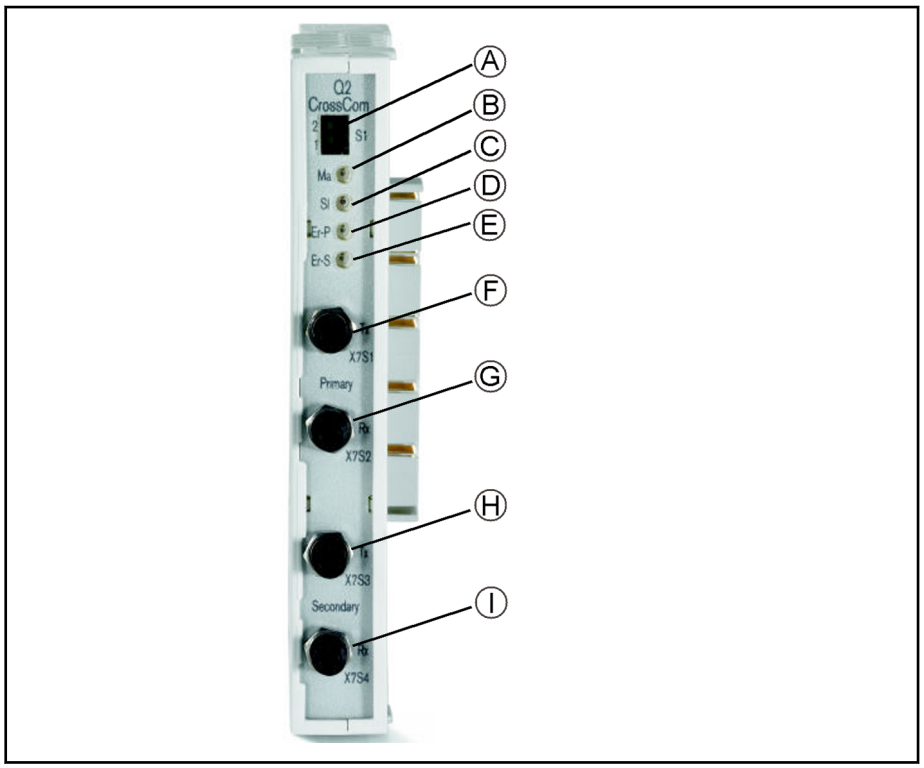
☞ The module for the master communication has to be plugged in on the right in front of the cross link module.

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

10.5.2 Hardware

Front view

The front view of the sercos II function module shows the connections (primary ring/secondary ring) and the display elements and switch to set the bus address.



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.10-15: Front view of the function module CrossComm sercos II (CFL01.1-Q2)

Status displays

The Ma LED indicates an active IndraMotion MLC ring on the sercos II (CFL01.1-Q2).

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.

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

10.6.1 General Information

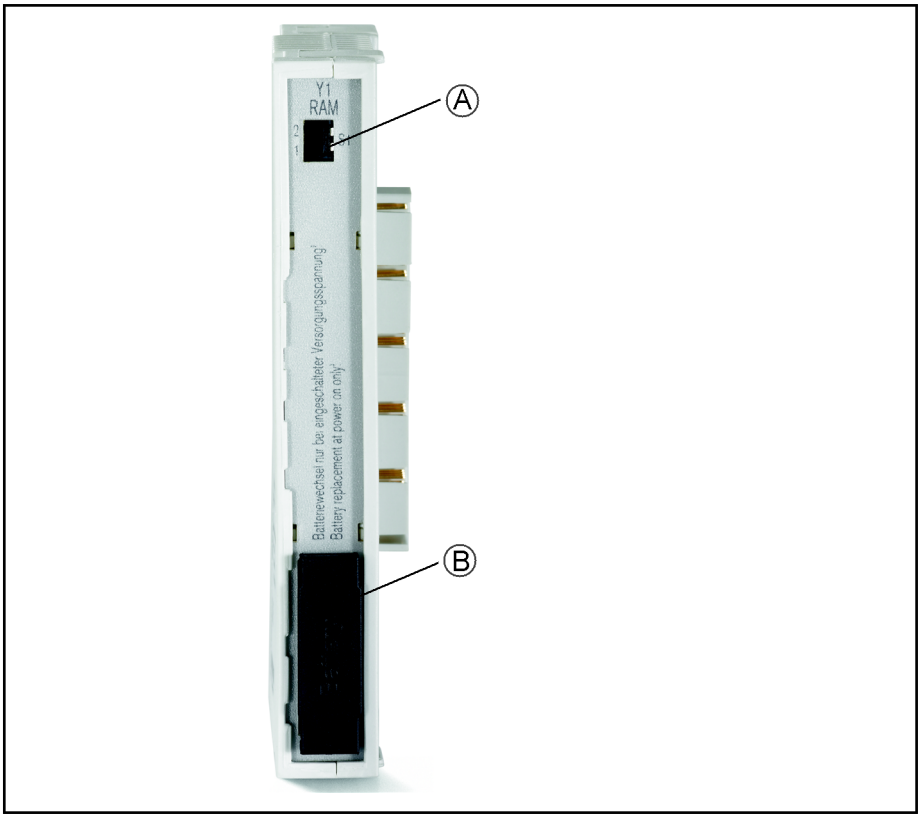
The 8 MB S-RAM module (CFL01.1-Y1) stores kinematic programs for the IndraMotion MLC control.

Function Modules

10.6.2 Hardware

Front view

The front view of the S-RAM function module shows the battery compartment and the switch to set the bus address.



A S1, address switch of the function module
B Battery
Fig.10-16: Front view of the S-RAM modules (CFL01.1-Y1)

10.6.3 Battery

Battery Buffer

Data is managed via a CR2450 3V lithium battery (Sony CR2450 is UL approved).

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.

10.7 PLS (CFL01.1-N1) - Programmable Limit Switch

10.7.1 General Information

The PLS (CFL01.1-N1) is a hardware-based programmable limit switch function module (PLS = **P**rogrammable **L**imit **S**witch).

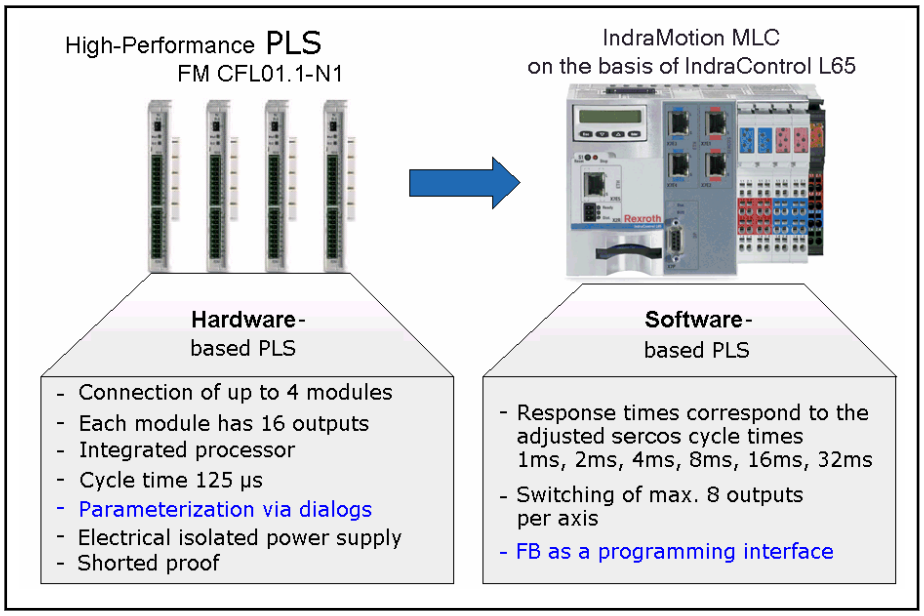
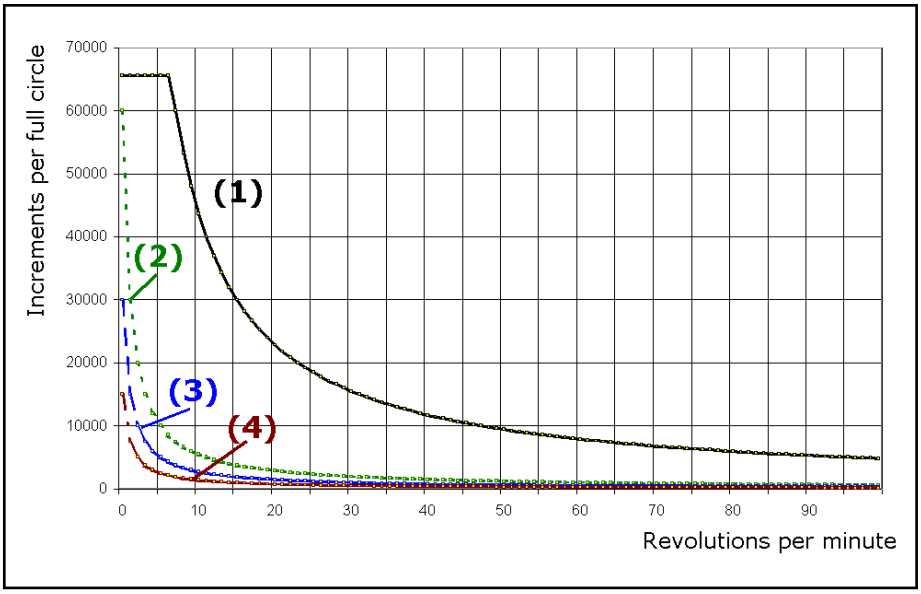


Fig.10-17: Comparison of hardware and software based programmable limit switches

The essential differences from the software-based switches include:

- The cycle time of 125 µs irrespective of the corresponding sercos cycle time of 1 to 32 ms and
- Parameterization using dialogs instead of a function block (FB) as programming interface

Function Modules



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.10-18: Resolution as function of speed and cycle time

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

10.7.2 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 at least control all 16 switch tracks 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).

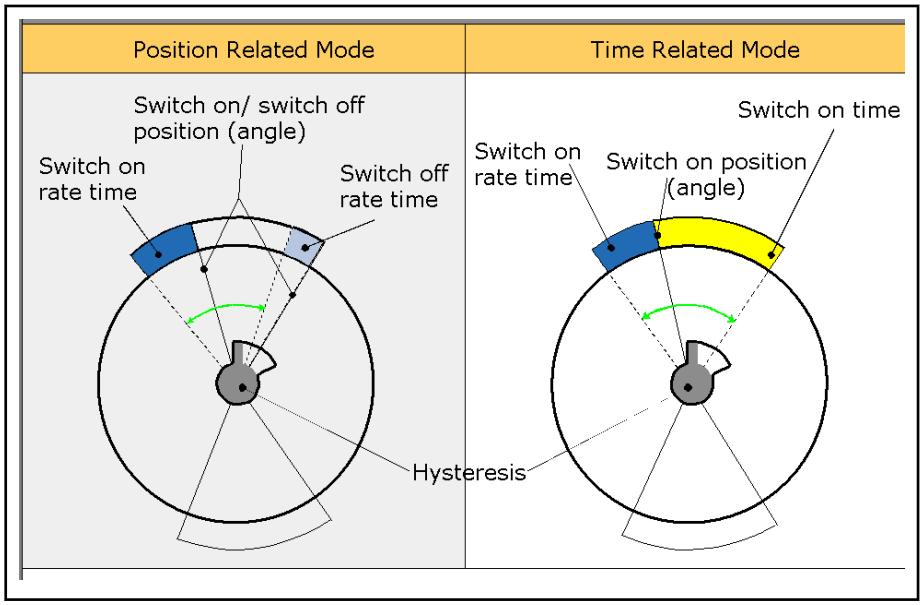


Fig. 10-19: PLS operating states

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).

Positive 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

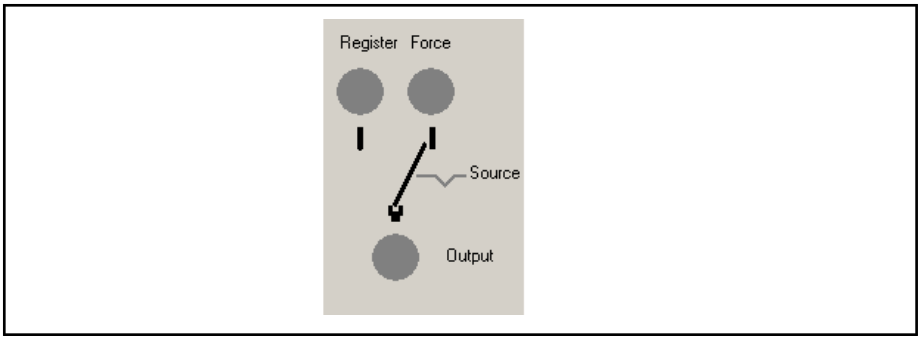
Negative hysteresis:

- 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.



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

Fig.10-20: Postprocessing switching principle

Depending on the "Source" bit, either the "Register" bit or the "Force" bit is switched as an "Output" bit.

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

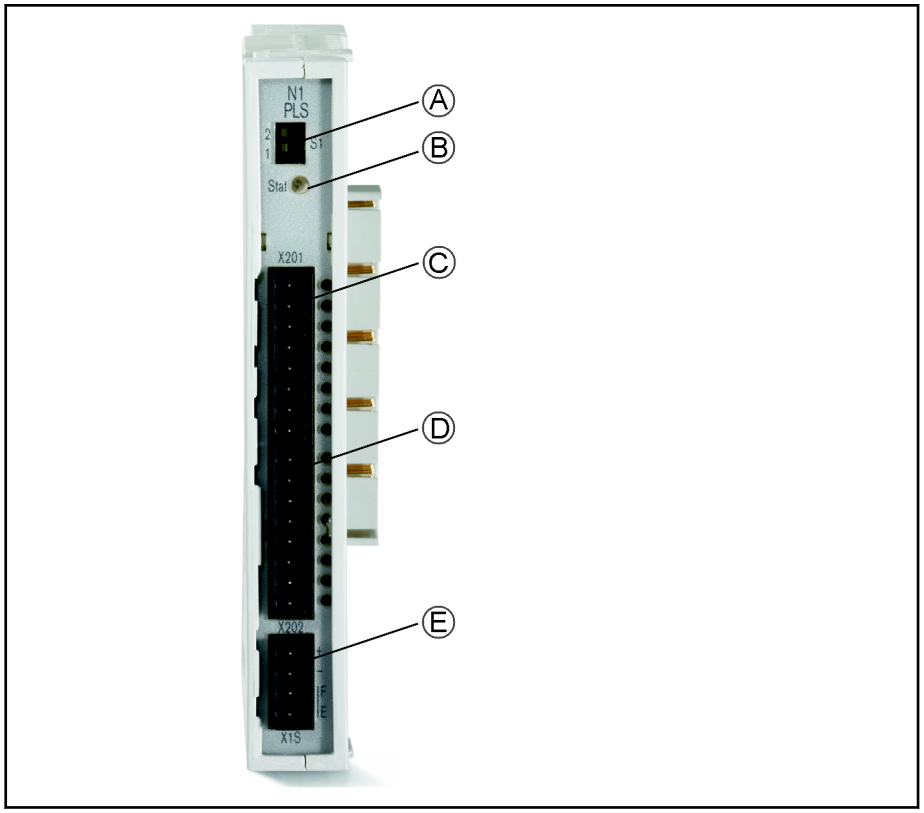
Now, a PLC-controlled cleaning cycle is to be performed, independently of the programmable limit switch.

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

10.7.3 Hardware

Front view

The front view of the PLS function module shows the connections and the display elements and the switch to set the bus address.



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

Fig. 10-21: Front view of the PLS function module (CFL01.1-N1)

XS1 Infeed terminal for external 24 V voltage supply.

Stat Status display of the function module:

- Green - Power supply present
- Red - Short circuit or overload
- OFF - No power supply

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

X2O2 Digital outputs 9..16 (incl. status LED).

PLS addressing of the function modules

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.

Type	Function module address	PLS address
PLS (CFL01.1-N1)	00	PLS1
Fast I/O (CFL01.1-E2)	01	-
PLS (CFL01.1-N1)	10	PLS2
PLS (CFL01.1-N1)	11	PLS3

Fig. 10-22: Example of address assignment

Function Modules

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

10.8.1 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.

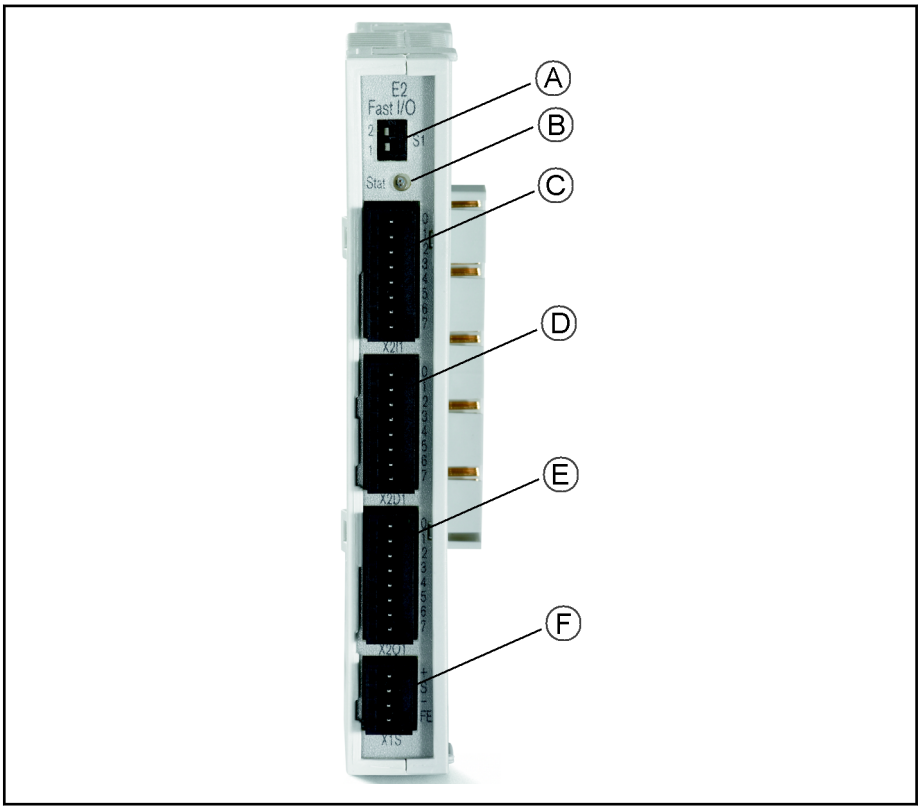
Every Fast I/O function module is equipped as follows:

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

10.8.2 Hardware

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.10-23: Fast I/O function module (CFL01.1-E2)

Ports

Input connector X2I1 connection	Input/output connector X2D1 connection	Output connector 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
Output 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

Fig. 10-24: Input and output pins X2I1/X2D2 and X2O1

Feeder connector X1S connection
DC 24 V (+)
S (sensor supply)
GND (–)
FE

Fig. 10-25: Feeder connector X1S

The function module has to be grounded with two 0.5 mm² 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. and protects people 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

Fig. 10-26: States of the status LED

Function Modules

Wiring the assembly

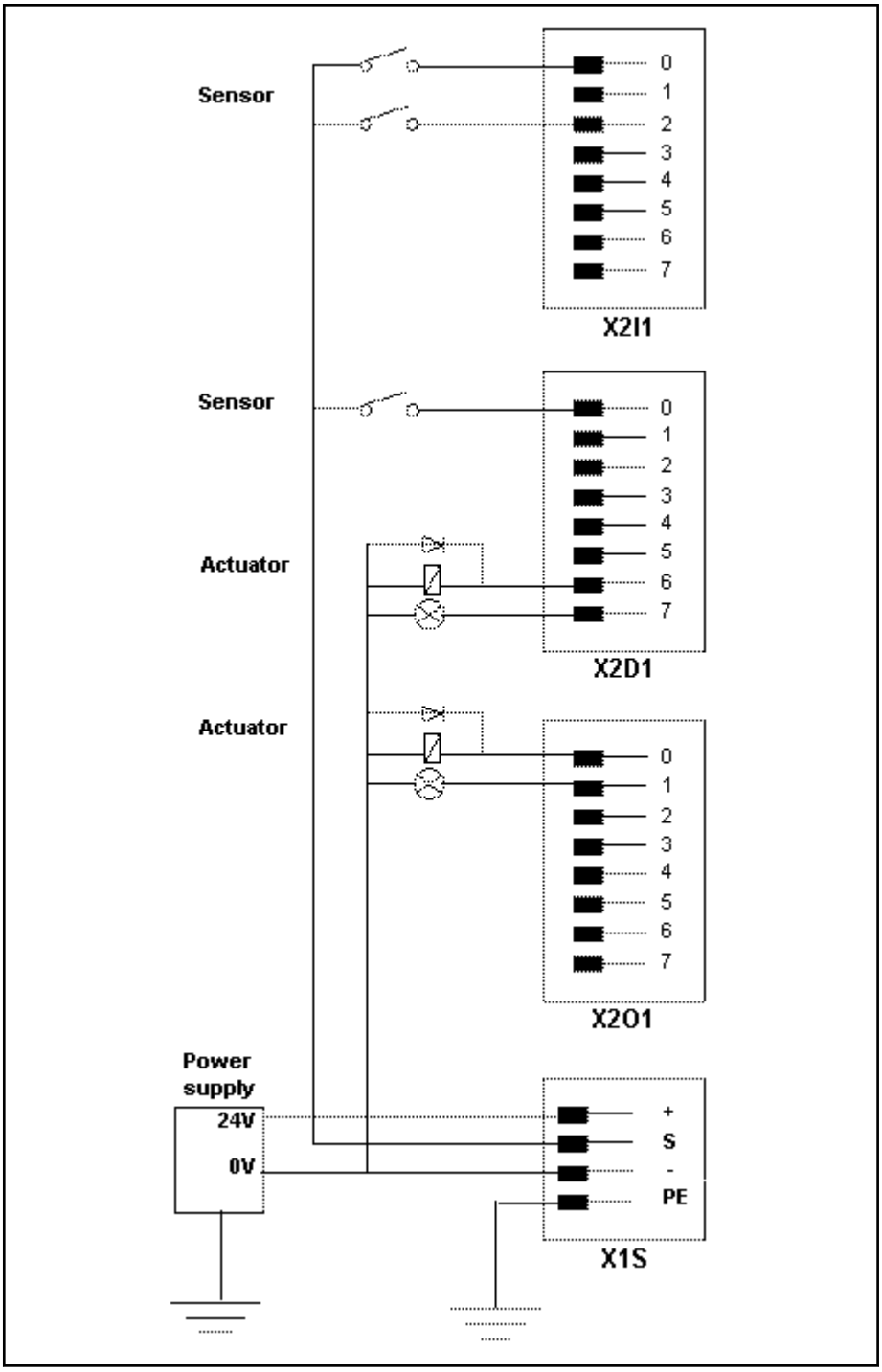


Fig.10-27: Wiring the assembly

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 of the 16 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. 45 µs, max. 55 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

Fig.10-28: Data of the digital inputs

Digital outputs X2O1/X2D1

Number of outputs	16 (8 of the 16 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

Function Modules

Rated output current: Nominal value Maximum value acc. to DIN EN 61131-2 Signal 1 Signal 0 (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 µs 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	DC 24 V
Open-circuit current consumption from 24 V	Typ. 50 mA
Cable length (unshielded)	< 100 m

Fig.10-29: 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 load

Interference levels may cause malfunctions of the installation. Very high noise levels are triggered by cable breakages, by removing a pin to the in-

ductive 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

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 %
Umax	30 V
Umin	19.2 V
Current consumption	max. 4 A

Fig.10-30: 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 to be designed for the highest existing voltage (see EN 60 204-1: 1997, section 14.1.3

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.

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

10.9.1 General Information

The function module is equipped with a real-time Ethernet and Profibus DP master or slave functionality. Depending on the configuration, the different Ethernet protocols on the module can be executed together with the Profibus DP. The Profinet RT, for example, is available as Ethernet protocol.

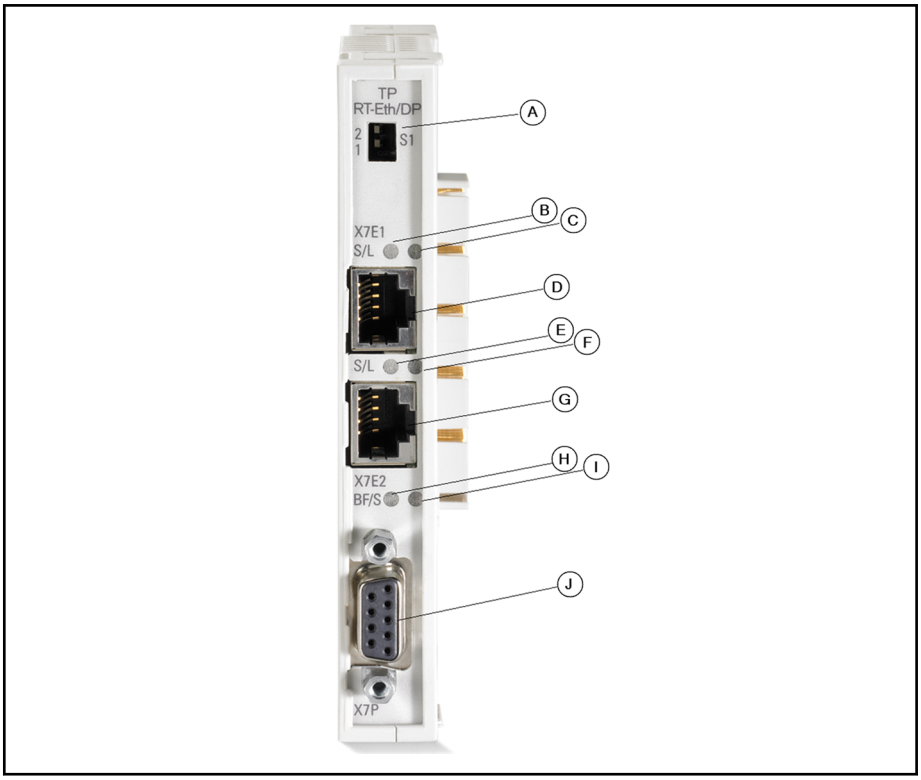
The protocols Ethernet-IP and Standard TCP/IP are also available.

Function Modules

10.9.2 Hardware

Front view

The following figure shows the front view of the real-time Ethernet/Profibus DP 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 female connector port 1-2
H	BF, bus error display DP-Port
I	S, status display DP-Port
J	X7P, Profibus DP female connector

Fig.10-31: Function module RT-Ethernet/Profibus DP (CFL01.1-TP)

10.9.3 Ports and Displays

X7E1/2 Ethernet interfaces

Pin	Description
1	TD+
2	TD-
3	RD+
4	Reserved
5	Reserved
6	RD-
7	Reserved
8	Reserved

Fig.10-32: Pin assignment of the RJ45 female connector X7E1/2

X7P Profibus DP interfaces

Pin	Description
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.

Fig. 10-33: Pin assignment of the 9-pin sub-D female connector X7P

Cable fixing during installation!

Use copper wires only.

For a more detailed description and possible settings, refer to the system-specific manual.

10.9.4 LED Display

Ethernet LED	Color	Status	Description
L	green	On	Ethernet connection detected
		Off	No Ethernet connection
S	Yellow	Flashing	Ethernet data traffic
		Off	No Ethernet data traffic

Fig. 10-34: Ethernet LED

Profibus DP LED	Color	Status	Description
S	green	On	Bus communication
		Acyclic	No configuration
		Cyclic	Configured
		Off	Bus communication stopped
BF	Red	On	No DP connection
		Flashing	Slave diagnostics
		Off	No bus error

Fig. 10-35: Profibus DP LED

10.10 Safety Function Module (CFL01.1-F1)

10.10.1 General Information

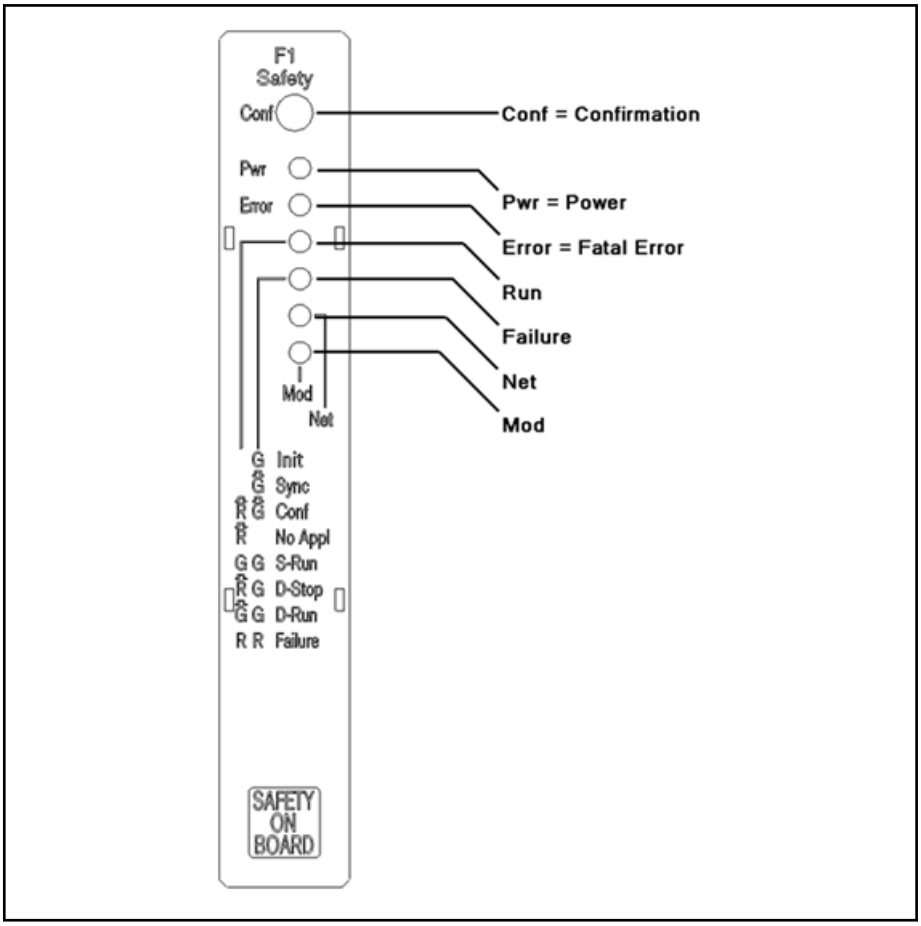
The function module contains a Safety PLC control according to SIL3. It can communicate via ProfiSafe and CIP Safety on sercos with safe inputs and outputs.

The Safety function module is not supported by the IndraControl L25 hardware.

10.10.2 Hardware

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.10-36: Safety function module (CFL01.1-F1)

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

Status displays

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

LED	Color and 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 during the initialization phase. If the LED is still on after the initialization (approx. 1 min) or if the LED is permanently switched on at runtime, integrated self-tests determined a "fatal error" (e.g. hardware error). The Safety function module is then probably defective and has to be replaced. Contact your Bosch Rexroth Service

Fig.10-37: LED for operational readiness

LED "Run" (Color and status)	LED "Failure" (Color and status)	Operating state of the Safety function module
Off	Off	No power supply provided or hardware reset triggered
Off	Green	Initialization phase; first part (ca. 30s) is running
Red	Off	Initialization phase; second part (ca. 10s) is running
Red, flashing	Off	Ready for download. The Safety function module contains no valid application or a download is not yet completed
Red	Green, flashing	Request to press the "Conf" button
Red	Green	SAFETY STOP
Green	Green	SAFETY RUN

Function Modules

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

Fig.10-38: Display of the operating state of the Safety function module

LED	Color and status	Description
Mod	Off	No power supply present or no CSos configuration loaded
	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 present or no CSos configuration loaded
	Green, flashing	No valid bus connection
	Green	Bus connection OK
	Red, flashing	Timeout
	Red	Critical connection error
	Red/green, flashing	Communication error

Fig.10-39: Special displays for CIP Safety on sercos

10.10.3 Documentation

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

Title	Type code/parts number	Description
Rexroth IndraControl CFL01.1-F1 Safety Function Module	DOK-CONTRL-SL**FM*****-ITxx-EN-P	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 13VRS SafeLogic Project Configuration	DOK-IWORKS-SL**PRJ*V13-APxx-EN-P R911336684	Application Description This documentation is intended as guideline when creating of a safety-related application
Rexroth IndraWorks SafeLogic 13VRS First Steps	DOK-IWORKS-SL*STEP*V13-COxx-EN-P R911339471	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 13VRS • Information on the diagnostics and troubleshooting • Programming under SafeLogic
Rexroth IndraLogic XLC IndraMotion MLC 13VRS SafeLogic System Overview	DOK-XLCMLC-SL**SYS*V13-PRxx-EN-P R911336574	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 13VRS SafeLogic System Overview	DOK-MTX***-SL**SYS*V13-PRxx-EN-P R911336572	Project Planning Manual This documentation describes the project planning and configuration of safety-related devices in the IndraMotion MTX
Rexroth IndraControl L25*, 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

xx Edition
* The Safety function module is not supported by the IndraControl L25

Fig. 10-40: Required and supplementing documentation

11 IndraControl V – Visualization Devices

11.1 General Information

Rexroth IndraControl V is the comprehensive HMI device portfolio for the individual control, operation and monitoring in all industrial sectors. With scalable hardware and software, IndraControl V can be precisely adapted to your machine-specific requirements.

IndraControl V integrates all necessary functions for efficient automation - starting with convenient operation and clear and transparent visualization right, then integrated controls and finally diagnostics. Together with Rexroth system solutions, you get a complete automation solution for:

- Transfer machinery
- Printing and paper-processing machines
- Packaging and food machines
- Metal forming machinery
- Wood working machinery
- Textile machinery
- Handling and mounting systems

The following IndraControl V variants are available:

- Controller-based
  - IndraControl VCP (chapter 11.2 "Small Control Panel VCP" on page 136)
  - IndraControl VCH (chapter 11.3 "IndraControl VCH 08 – Compact Hand-Held Terminal for Mobile Use" on page 140)
- Embedded PC-based
  - IndraControl VEP xx.3 (chapter 11.4 "IndraControl VEP 30.3/40.3/50.3 – Embedded PC-Based Operator Terminals" on page 141)
  - IndraControl VEP xx.4 (chapter 11.5 "IndraControl VEP 30.4 / 40.4 / 50.4 – Embedded PC-Based Operator TerminalsIndraControl VEP 30.4 / 40.4 / 50.4 – Embedded PC-Based Operator Terminals" on page 143)
  - IndraControl VEH 30.2 (chapter 11.6 "IndraControl VEH 30.2 Embedded PC-Based, Portable Operating and Visualization Device" on page 146)
- PC-based
  - IndraControl VPP (chapter 11.7 "Panel PCs VPP 16.3/40.3/60.3" on page 148)
  - IndraControl VPB (chapter 11.9 "Compact Industrial PC VPB 40.3 with the Operating Devices VDP 08.3/16.3/40.3" on page 159)
  - IndraControl VSB (chapter 11.10 "Standard Industrial PC VSB 40.3 with the Operating Devices VDP 16.3/40.3/60.3" on page 165)
  - IndraControl VDP (chapter 11.9 "Compact Industrial PC VPB 40.3 with the Operating Devices VDP 08.3/16.3/40.3" on page 159 or chapter 11.10 "Standard Industrial PC VSB 40.3 with the Operating Devices VDP 16.3/40.3/60.3" on page 165)
- Control panels

  - IndraControl VAM 10.2/40.2(chapter 11.11 "IndraControl VAM 10.2/40.2" on page 172)
  - IndraControl VAM 10.3/40.3(chapter 11.12 "IndraControl VAM 10.3/40.3" on page 179)
- Keyboards
  - IndraControl VAK (chapter 11.13 "PC Keyboards VAK" on page 183)

11.2 Small Control Panel VCP

11.2.1 Brief Description

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

Fig.11-1: Small control panel VCP 02

Fig.11-2: Small control panel VCP 05

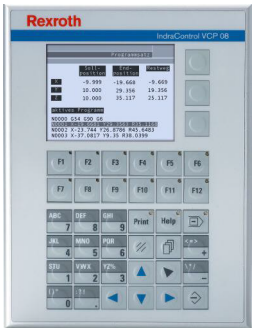


Fig.11-3: Small control panel VCP 08

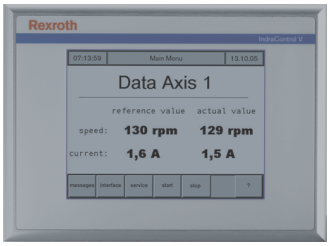


Fig. 11-4: Small control panel VCP 11

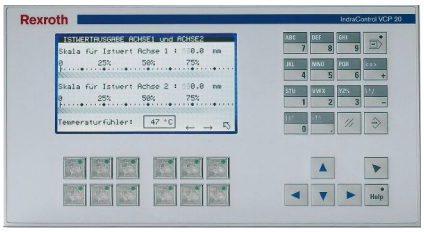


Fig. 11-5: Small control panel VCP 20

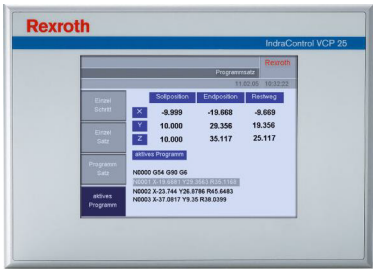


Fig. 11-6: Small control panel VCP 25

Fig. 11-7: Small control 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	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	249 x 328 mm
Function/system buttons	4 / 7	6 / 24		Touch screen	16 / 22	Touch screen	Touch screen

IndraControl V – Visualization Devices

Processor	ARM 200 MHz
Application memory	3 MB
Interfaces	1x Ethernet (10/100 Base T) 2x USB host 2.0 Profibus DP interface
Power supply	DC 24 V

Fig.11-8: Technical data for VCP small control terminal

11.2.3 Variants

The following variants of the VCP small control panels are available:

Type	Remarks
VCP02.2DRN-003-NN-NN-PW	Pushbutton, communication via Ethernet
VCP02.2DRN-003-PB-NN-PW	Pushbutton, communication via Profibus DP
VCP05.2DSN-003-NN-NN-PW	Pushbutton, communication via Ethernet
VCP05.2DSN-003-PB-NN-PW	Pushbutton, communication via Profibus DP
VCP08.2DTN-003-NN-NN-PW	Pushbutton, communication via Ethernet
VCP08.2DTN-003-PB-NN-PW	Pushbutton, communication via Profibus DP
VCP11.2DWN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP11.2DWN-003-PB-NN-PW	Touch screen, communication via Profibus DP
VCP20.2DUN-003-NN-NN-PW	Pushbutton, communication via Ethernet
VCP20.2DUN-003-PB-NN-PW	Pushbutton, communication via Profibus DP
VCP25.2DVN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP25.2DVN-003-PB-NN-PW	Touch screen, communication via Profibus DP
VCP35.2ECN-003-NN-NN-PW	Touch screen, communication via Ethernet
VCP35.2ECN-003-PB-NN-PW	Touch screen, communication via Profibus DP

Fig.11-9: VCP device variants

11.2.4 Accessories

Connecting Cable

The VCPs communicate with the controls either using Profibus DP or the Ethernet. The following cable is available for Profibus DP:

Type	Remark
IKB0034/000,0	Connection between control and VCP; assembled on one side, variable length

Fig.11-10: Profibus connecting cable

The following cables are available to communicate via Ethernet:

Type	Remark
RKB0008/002.5	Bus cable, Ethernet cable assembly, 100-Base-T, CAT 6+ assembly, 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

Fig.11-11: Ethernet connecting cable

Battery kit

A battery kit is available under the following designation:

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

Fig.11-12: Battery kit for VCP devices

11.2.5 Documentation

The following documentation is available to provide comprehensive descriptions of the VCP small control panels:

- Rexroth IndraControl VCP 02, DOK-SUPPL*-VCP02******-PRxx-EN-P
- Rexroth IndraControl VCP 05, DOK-SUPPL*-VCP05******-PRxx-EN-P
- Rexroth IndraControl VCP 08.2, DOK-SUPPL*-VCP*08.2***-PRxx-EN-P
- Rexroth IndraControl VCP 11.2, DOK-SUPPL*-VCP*11.2***-PRxx-EN-P
- Rexroth IndraControl VCP 20.2, DOK-SUPPL*-VCP*20.2***-PRxx-EN-P
- Rexroth IndraControl VCP 25.2, DOK-SUPPL*-VCP*25.2***-PRxx-EN-P
- Rexroth IndraControl VCP 35.2, DOK-SUPPL*-VCP*35.2***-PRxx-EN-P

xx - Edition

IndraControl V – Visualization Devices

11.3 IndraControl VCH 08 – Compact Hand-Held Terminal for Mobile Use

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 unplugging, 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 integral 3-stage enabling button and 2-circuit design of the Stop button are looped through the VAC 30 switch-on box and thus ensure maximum safety.

Special features:

- Safety functions for operators and machinery
- Handles with integral 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 foil keyboard for convenient operation and visualization

Fig.11-13: IndraControl VCH 08

11.3.2 Field of Application

The VCH 08 is designed for use in handling applications.

11.3.3 Technical Data

	VCH 08
Display	3.8" grayscale, 320 x 240 pixels
Front panel design	15 function keys 25 system keys 40 operating keys
Enable key	Number: 2 2-circuit, 3-stage

Stop button	Number: 1 2-circuit
Handwheels	Number: 1
Override potentiometer	Number: 1
Processor	CPU PXA 270/416 MHZ (Standard)
Memory	64 MB (application) 64 MB (flash)

Fig.11-14: Technical data for VCH 08

11.3.4 Variants

The following VCH 08 variants are available:

Type	Remarks
VCH08.1EAB-064ET-A1D-064-CS-E2-PW	With handwheel (0.5 m Ethernet control cable)
VCH08.1EAB-064ET-A1D-064-CS-E1-PW	(8 m Ethernet control cable)
VCH08.1EAB-064ET-A1D-064-DS-E1-PW	With handwheel (8 m Ethernet control cable)

Fig.11-15: VCH 08 variants

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

Fig.11-16: 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***-PRxx-EN-P

xx - Edition

11.4 IndraControl VEP 30.3/40.3/50.3 – Embedded PC-Based Operator Terminals

11.4.1 Brief Description

These terminals allow to operate the machine easily and conveniently using a touch screen or a virtual keyboard. These devices, similar to PCs, use only embedded components for a robust construction.

Thanks to the large number of interfaces and slots, the IndraControl VEP devices can be ideally adapted to comply with machine and system requirements. This flexibility allows to use the devices only for visualization purposes or as control hardware.

IndraControl V – Visualization Devices

Special features:

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

Fig.11-17: IndraControl VEP variants

11.4.2 Field of Application

The standard industrial operator terminals VEP 30.3/40.3/50.3 are primarily used for all tasks in the PC-based automation.

11.4.3 Technical Data

	VEP 30.3	VEP 40.3	VEP 50.3
Display	8.4" color display	12" color display	15" color display
Keyboard	via virtual keyboard		
Module slots	1 slot		
Interfaces	• 2 x USB 2.0 - Connection (type A) • 1 x Ethernet port (RJ 45, 10/100 Base-T) • 1 x serial standard interface RS232 (9-pin; D-Sub)		
Processor	Celeron 600 MHz		
Primary memory	256 MB, 512 MB, 1 GB RAM		
Compact Flash	128 MB		
Supply voltage	DC 24 V		

Fig.11-18: Technical data for VEP 30.3/40.3/50.3

11.4.4 Wear Parts

Parts with a limited service life are installed in the standard industrial terminals VEP 30.3/40.3/50.3 and are therefore not subject to warranty. This applies to the following components:

- Hard drive
- CMOS battery

- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.4.7 "Documentation" on page 143).

11.4.5 Variants

The following variants of the standard industrial operator terminals VEP 30.3/40.3/50.3 are available:

Type	Slots	Remarks
VEP30.3CCN-256NN-MAD-128-NN-FW	1	Touch screen (suitable for use in the food industry)
VEP30.3DKN-256NN-MAD-128-CG-FW	1	Touch screen (suitable for the food industry), mounted in an IP 54 aluminum casing, 3 keys and E-Stop.
VEP40.3CEN-256NN-MAD-128-NN-FW	1	Touch screen (suitable for use in the food industry)
VEP50.3CHN-256NN-MAD-128-NN-FW	1	Touch screen (suitable for use in the food industry)

Fig.11-19: Designs VEP 30.3/40.3/50.3

11.4.6 Accessories

The following accessories are available for the VEP xx.3 devices:

Type	Remarks
VAS02.1-001-NNN-NN	Keyboard extension VAS 02

Fig.11-20: Accessories for VEP 30.3/40.3/50.3

11.4.7 Documentation

The following documentations describe the compact industrial PCs VEP 30.3/40.3/50.3 in detail:

- Rexroth IndraControl VEP **.3, Embedded Terminal, DOK-SUPPL*-VEP**.3****-PRxx-EN-P

xx - Edition

11.5 IndraControl VEP 30.4 / 40.4 / 50.4 – Embedded PC-Based Operator TerminalsIndraControl VEP 30.4 / 40.4 / 50.4 – Embedded PC-Based Operator Terminals

11.5.1 Brief Description

These terminals allow to operate the machine easily and conveniently using a touch screen, a virtual keyboard and or a foil keyboard. These devices, similar to PCs, use only embedded components for a robust construction.

The operation of WinStudio or Operation Desktop applications depends on the operating system (see chapter 11.5.5 "Variants" on page 145)

IndraControl V – Visualization Devices

With the large number of interfaces, the IndraControl VEP devices can be ideally adapted to comply with 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 the Operation Desktop or WinStudio applications

Fig.11-21: IndraControl VEP variants

11.5.2 Field of Application

The standard industrial operator terminals VEP 30.4/40.4/50.4 are primarily used for all tasks in the PC-based automation.

11.5.3 Technical Data

	VEP 30.4	VEP 40.4	VEP 50.4
Display	8.4" color display	12.1" color display	15" color display
Keyboard	Virtual keyboard and/or foil keys		
Interfaces	• 2 x USB 2.0 - Connection (type A) • 1 or 2 x Ethernet ports (RJ 45, 10/100 Base-T)		
Processor	Celeron M, min. 600 MHz / Intel Atom, min. 1.1 GHz		
Primary memory	512 MB, 1 GB RAM		
Compact Flash	1 GB / 4 GB		
Supply voltage	DC 24 V		

Fig.11-22: Technical data for VEP 30.4/40.4/50.4

11.5.4 Wear Parts

Parts with a limited service life are mounted in the standard industrial terminals VEP 30.4/40.4/50.4 and are therefore not subject to warranty. This applies to the following components:

- CMOS battery
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.5.6 "Documentation" on page 146).

11.5.5 Variants

The following variants of the standard industrial operator terminals VEP 30.4/40.4/50.4 are available:

Type	Remarks	Operating system	HMI application
VEP30.4EFN-512NN-A2D-NNN-NN-FW	Atom processor, 8.4" touch screen with front USB	Win CE 6.0	WinStudio
VEP30.4EFN-512NN-MAD-1G0-NN-FW	Celeron processor, 8.4" touch screen with front USB	Win CE 6.0	WinStudio
VEP40.4DBN-512NN-A2D-NNN-NN-FW	Atom processor, 12" touch screen with front USB	Win CE 6.0	WinStudio
VEP40.4DBN-512NN-MAD-1G0-NN-FW	Celeron processor, 12" touch screen with front USB	Win CE 6.0	WinStudio
VEP50.4DEN-512NN-A2D-NNN-NN-FW	Atom processor, 15" touch screen with front USB	Win CE 6.0	WinStudio
VEP50.4DEN-512NN-MAD-1G0-NN-FW	Celeron processor, 15" touch screen with front USB	Win CE 6.0	WinStudio
VEP30.4EFN-512NN-A2D-NNN-NN-FW	Atom processor, 8.4" touch screen with front USB	Win XPe	WinStudio
VEP40.4DBN-512NN-A2D-NNN-NN-FW	Atom processor, 12" touch screen with front USB	Win XPe	WinStudio
VEP50.4DEN-512NN-A2D-NNN-NN-FW	Atom processor, 15" touch screen with front USB	Win XPe	WinStudio
VEP40.4BKN-512NN-A2D-NNN-NN-FW	Atom processor, 12" with 16 machine function keys	Win XPe	WinStudio
VEP50.4BIN-512NN-A2D-NNN-NN-FW	Atom processor, 15" with 16 machine function keys	Win XPe	WinStudio
VEP40.4EIN-512NN-MAD-1G0-NN-FW	Celeron processor, 12" touch screen with front USB and machine function keys	Win XPe	Operation Desktop
VEP50.4DFN-512NN-MAD-1G0-NN-FW	Celeron processor, 15" touch screen with front USB and machine function keys	Win XPe	Operation Desktop
VEP40.4BKN-512NN-A2D-NNN-NN-FW	Atom processor, 12" with 16 machine function keys	Win XPe	Operation Desktop
VEP50.4BIN-512NN-A2D-NNN-NN-FW	Atom processor, 15" with 16 machine function keys	Win XPe	Operation Desktop
VEP40.4EIN-512NN-A2D-NNN-NN-FW	Atom processor, 12" touch screen with front USB and machine function keys	Win XPe	Operation Desktop
VEP50.4DFN-512NN-A2D-NNN-NN-FW	Atom processor, 15" touch screen with front USB and machine function keys	Win XPe	Operation Desktop

Fig. 11-23: Technical data for VEP 30.4/40.4/50.4

IndraControl V – Visualization Devices

11.5.6 Documentation

The following documentation is available for the detailed description of the compact industrial PCs VEP 30.4/40.4/50.4:

- Rexroth IndraControl VEP ** .4, Embedded Terminal, DOK-SUPPL*-VEP*XX.4***-PR0xx-EN-P

xx - Edition

11.6 IndraControl VEH 30.2 Embedded PC-Based, Portable Operating and Visualization Device

11.6.1 Brief Description

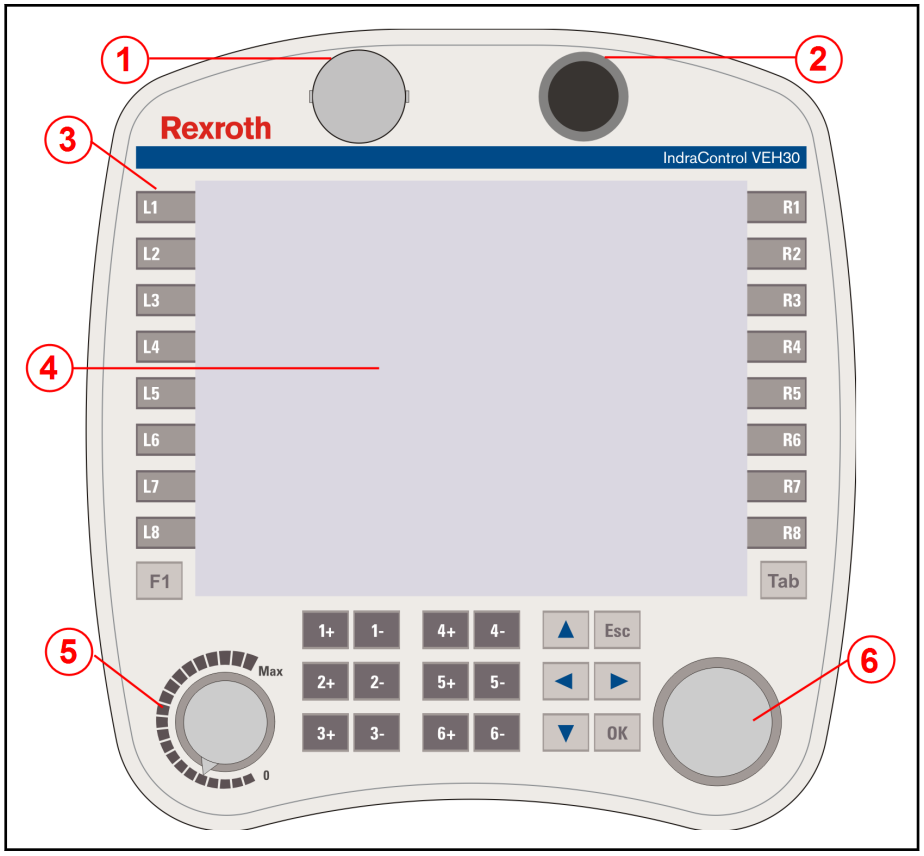
The hand-held terminal VEH 30.2 is a portable, PC-based operating and visualization device.

The two-circuit, three-stage enabling pushbutton as well as a two-circuit STOP pushbutton ensure a safe handling of IndraLogic and IndraMotion controls. VEH 30.2 facilitates the setup of machines and systems that can be distributed across different connection points.

All device variants are provided with a 8.4" (213.36 mm) TFT display with eight function keys to the right and left of the monitor as well as jog keys for up to six axes for a user-friendly operation of the system. A USB interface is additionally available on the front. An Ethernet interface on the VAC 30.2 connection module is available as service interface. Different cable variants allow customized working.

The following table chapter 11.6.3 "Technical Data" on page 147 provides an overview on the most important characteristics of the VEH 30.2.

The differences between the device variants are described in chapter 11.6.5 "Variants" on page 148.



① USB connection
② STOP button
③ Membrane keyboard
④ Display
⑤ Module slot for override
⑥ Mounting position for electronic handwheel

Fig. 11-24: Front view of VEH 30.2

11.6.2 Field of Application

The VEH 30.2 can be used for the following fields of application:

- Operating and visualizing the Operation Desktop and WinStudio applications
- Setting up machines and systems
- Operating and the diagnostics of large handling systems
- Remote visualization of installation control panels
- Visualizing basic operator control panels of mounting lines

11.6.3 Technical Data

	VEH 30.2
Operating system	Windows XPe
Display	8.4" color display
Resolution	1024x768 / 800x600
Keyboard	Yes
Touch screen	Yes

Enable key	Two-circuit, three-stage
STOP button	Two-circuit
Interfaces	1 x Ethernet port (RJ 45, 10/100 Base-T)
Supply voltage	DC 24 V

Fig.11-25: Technical data VEH 30.2

Depending on the installed visualization software, the IndraControl VEH 30.2 can either be operated with the Operation Desktop or WinStudio applications.

11.6.4 Wear Parts

Parts with a limited service life are installed in the VEH 30.2 hand-held terminal and are therefore not subject to warranty. This applies to the following components:

- CMOS battery
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.6.6 "Brief Description" on page 148).

11.6.5 Variants

The hand-held terminals VEH 30.2 are available as:

Device	Option elements, characteristics	Safety Engineering
VEH30.2BNN-512ET-A2D-4G0-BS-E4-FW	Connecting cable 8 m	STOP button, enabling pushbutton
VEH30.2BNN-512ET-A2D-4G0-DS-E4-FW	Handwheel, override connecting cable 8m	STOP button, enabling pushbutton
VEH30.2BNN-512ET-A2D-4G0-DS-E2-FW	Hand-wheel, override, connecting cable 0.5 m for extension	STOP button, enabling pushbutton
VEH30.2BNN-512ET-A2D-4G0-BS-E2-FW	Connecting cable 0.5m for extension	STOP button, enabling pushbutton

Fig.11-26: Device variants VEH 30.2

11.6.6 Brief Description

The following documentation is available for the comprehensive description of the VEH 30.2 hand-held terminal:

- Rexroth IndraControl VEH 30.2 Hand-Held Terminal, DOK-SUPPL*-VEH*30.2***-PRxx-EN-P

xx - Edition

11.7 Panel PCs VPP 16.3/40.3/60.3

11.7.1 Brief Description

The VPP 16.3/40.3 panel PCs are active PC-based operating and visualization terminals with excellent industrial capability. These panel PCs are predominantly mounted on a control panel or on the wall of a control cabinet.

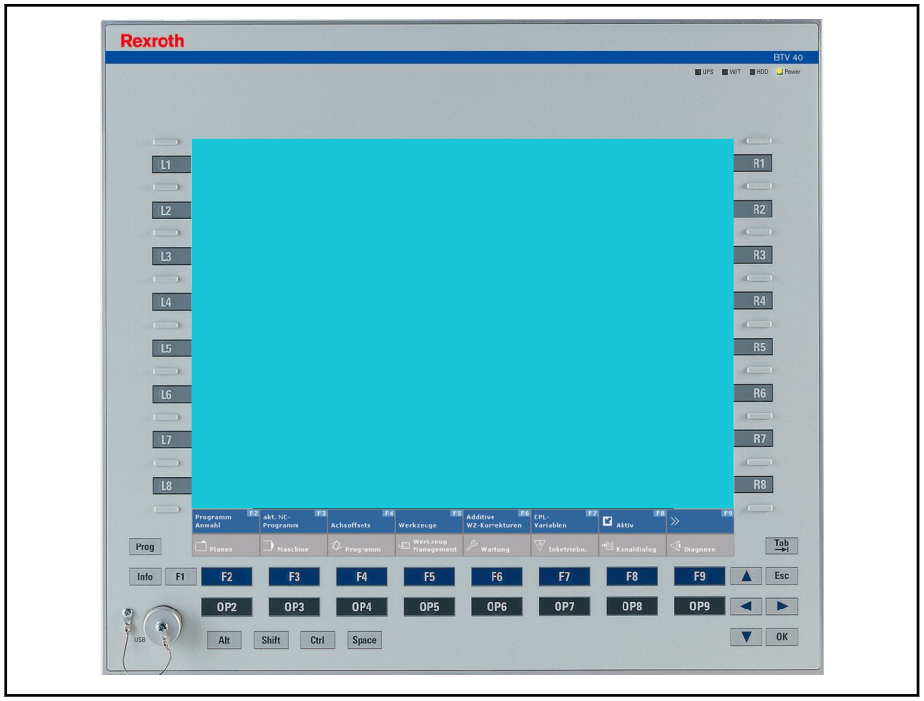


Fig.11-27: Panel PC VPP XX.3 with color display

11.7.2 Field of Application

The panel PCs VPP 16.3/40.3/60.3 are used from standard applications to high-end applications.

11.7.3 Operating System

Due to licensing reasons, the devices VPP 16.3/40.3/60.3 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™ Duo L2400 1.66 GHz Intel® Core2™ Duo T7400 2.16 GHz Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz		
RAM	1 GB (4 GB max.)		
HDD hard disk	80 GB SATA, alternatively 2 × 80 GB (RAID1) or 32 GB SSD		
Optional drives	DVD writer (for 4-slot variant)		

IndraControl V – Visualization Devices

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

Fig.11-28: Technical data for the VPP 16.3/40.3/60.3

11.7.5 Wear Parts

Parts with a limited service life are installed in the VPP 16.3/40.3 panel PCs and are therefore not subject to warranty. This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.7.8 "Documentation" on page 154).

11.7.6 Variants

The following variants of the panel PCs VPP 16.3/40.3/60.3 are available:

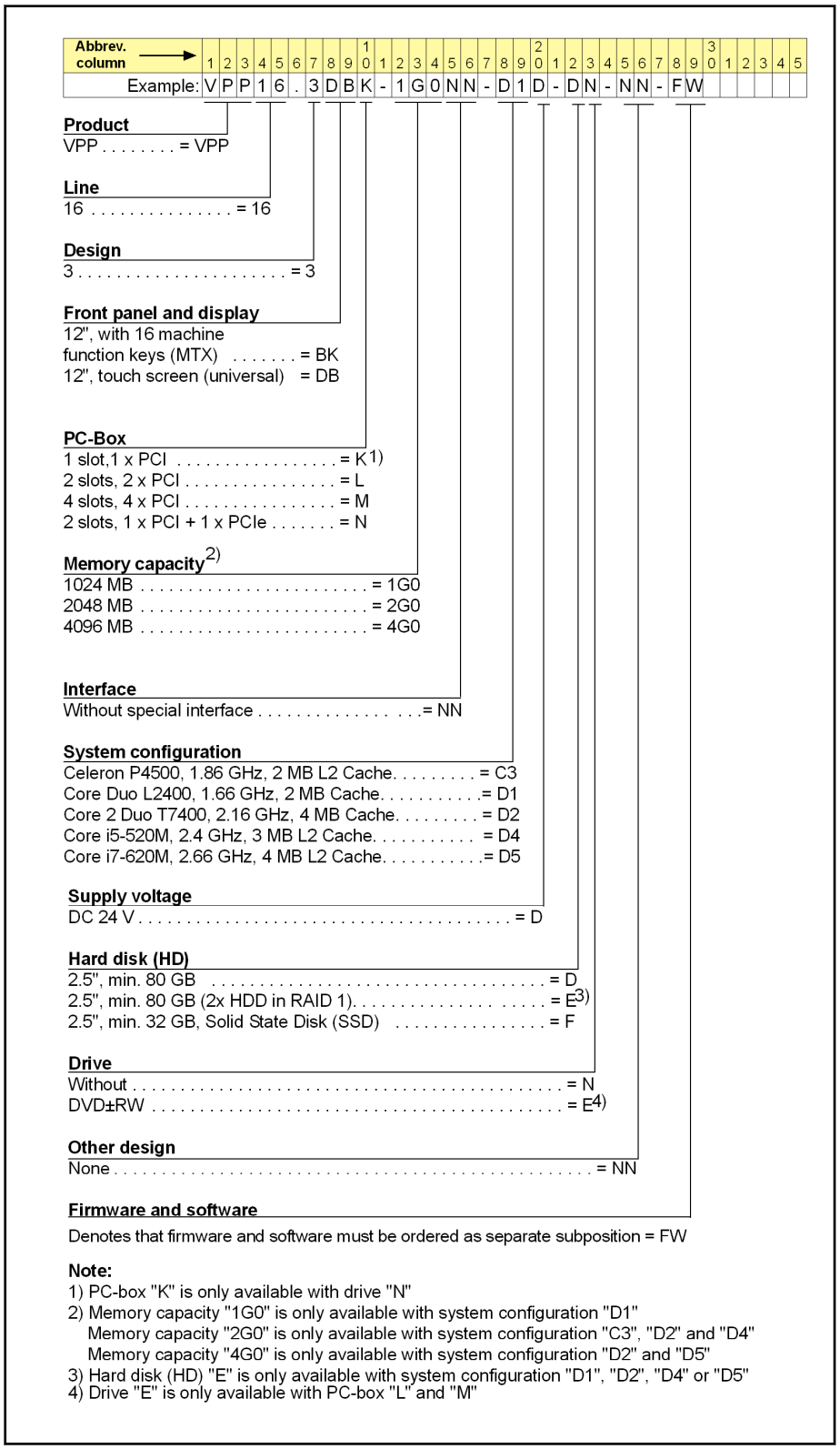


Fig.11-29: Type code VPP 16.3

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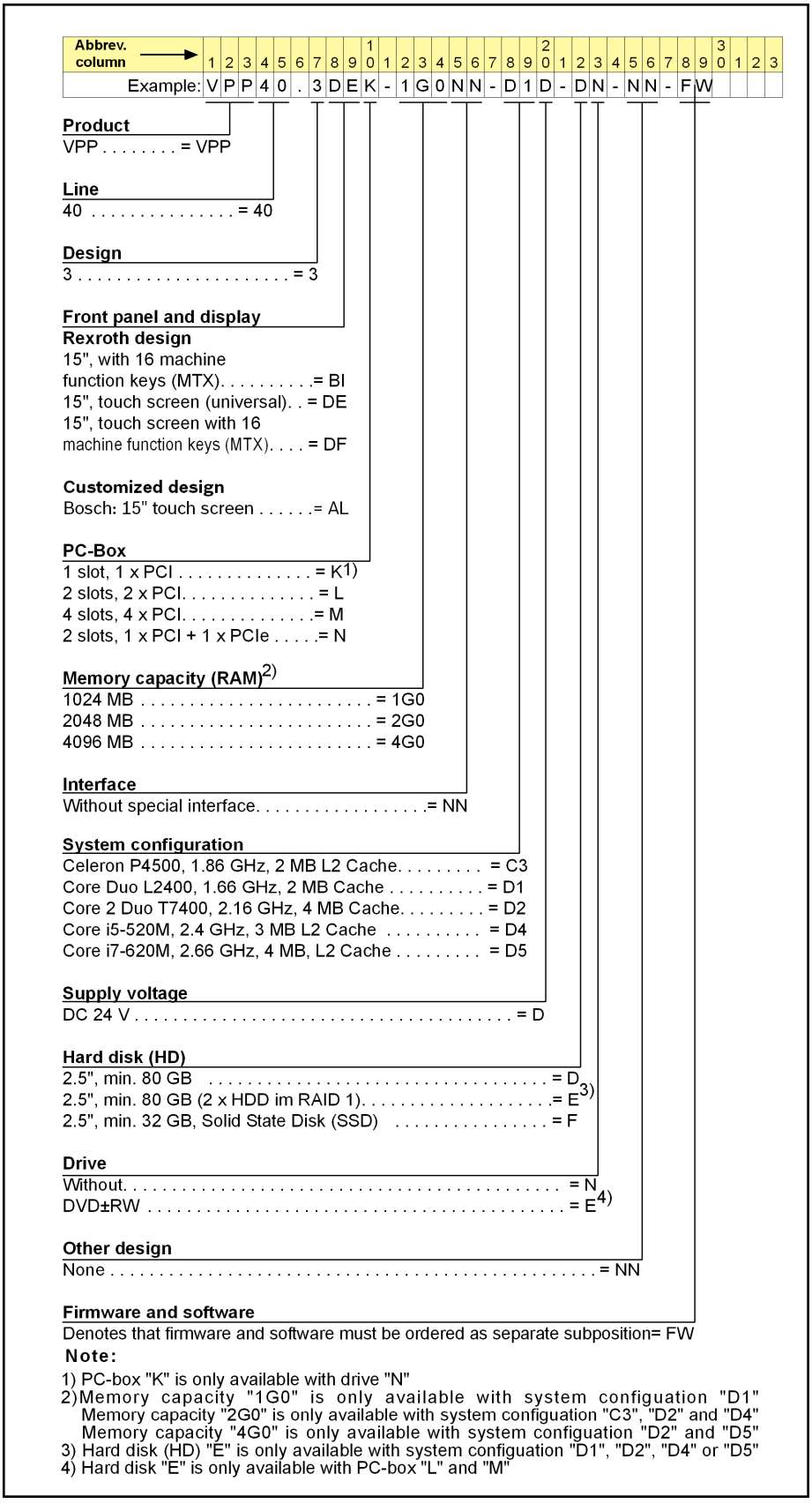

Fig.11-30: Type code VPP 40.3

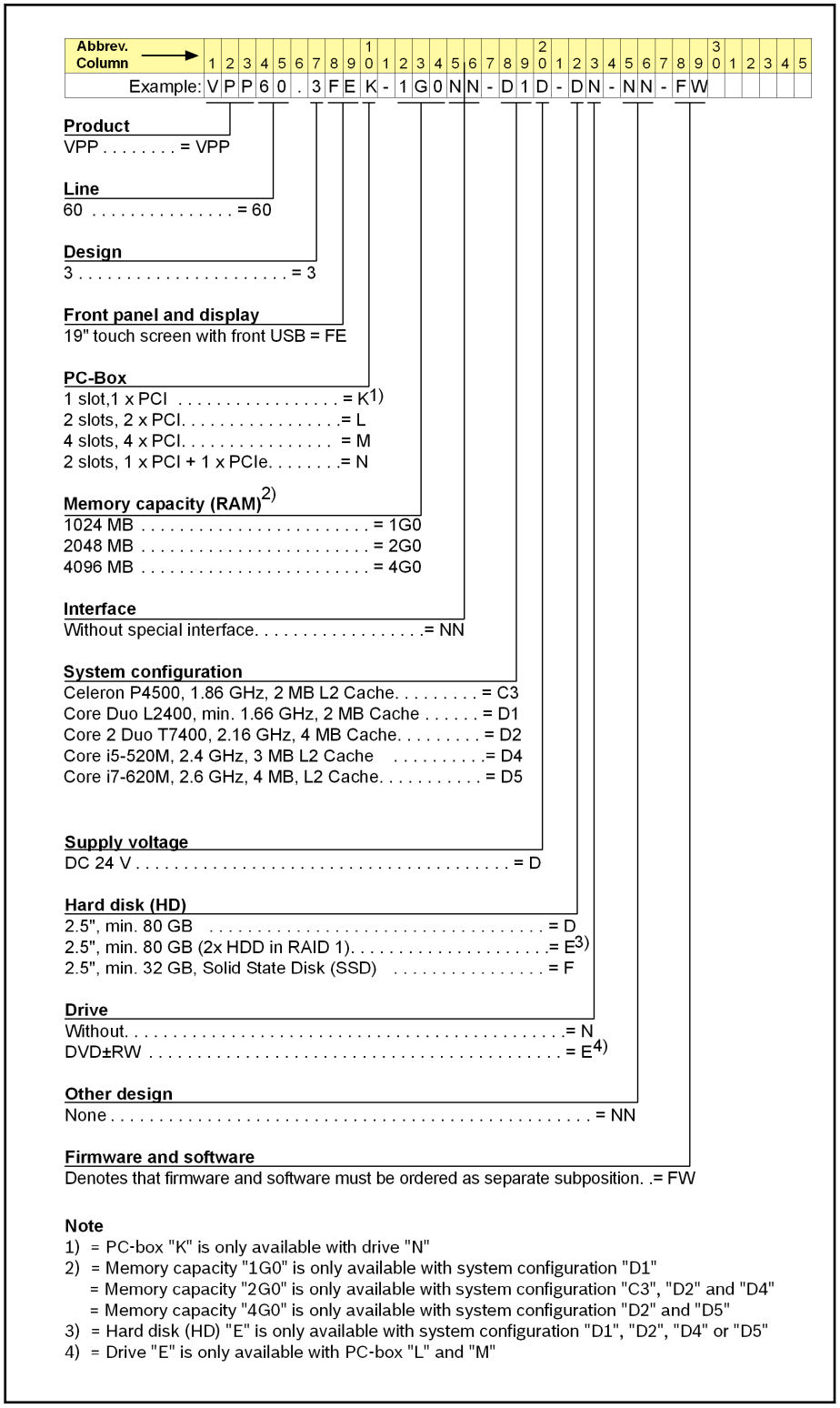

Fig.11-31: Type code VPP 60.3

IndraControl V – Visualization Devices

11.7.7 Accessories

The following accessories are available for VPP devices:

Type	Remarks
VAP01.1H-W23-024-010-NN	Power supply unit 24 V DC; 10 A
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0019/...	USB interface cable to connect the uninterruptible power supply; length: 0.5 m; 1.0 m; 3.0 m; 5.0 m

Fig.11-32: Accessories for the VPP 16.3/40.3/60.3

11.7.8 Documentation

The following documentation is available for the detailed description of the panel PCs VPP 16.3/40.3/60.3:

- Rexroth IndraControl VPP 16.3/40.3/60.3 Panel-PC, DOK-SUPPL*-VPP*XX.3***-PRxx-EN-P
- Rexroth IndraControl VAU 01.1U UPS with USB Interface, DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P

xx - Edition

11.8 Standard Industrial PCs VSP 16.3/40.3

11.8.1 Brief Description

The standard industrial PCs VSP 16.3/40.3 are the economical alternative for PC-based operating and visualization devices. These standard industrial PCs are predominantly mounted on a control panel or on the wall of a control cabinet.

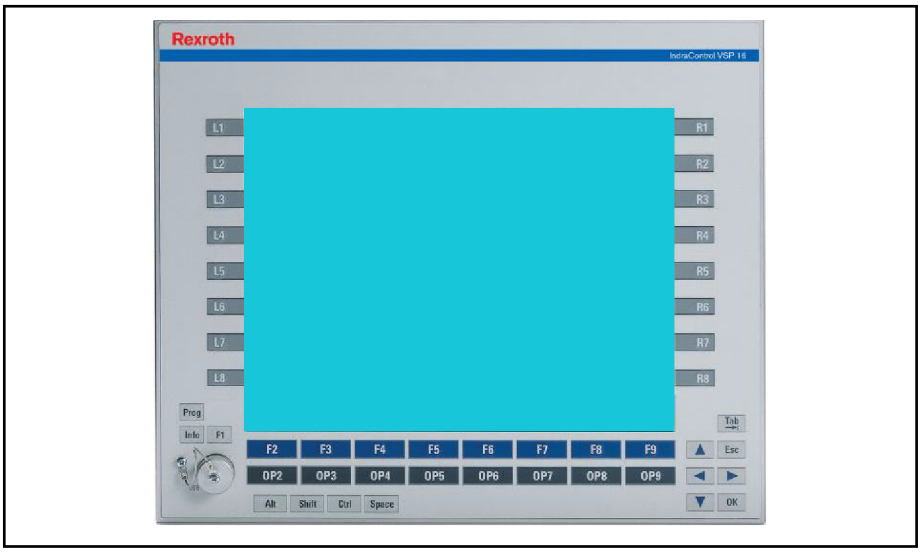

Fig.11-33: VSP 16.3 with 12” color display

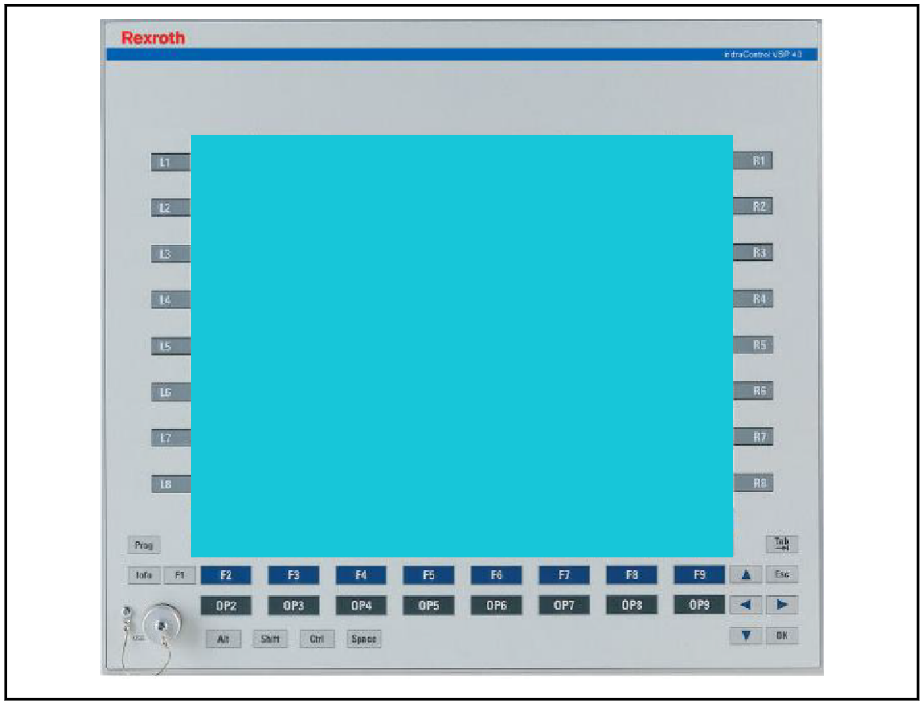

Fig.11-34: VSP 40.3 with 15" color display

11.8.2 Field of Application

The standard industrial PCs VSP 16.3/40.3 are primarily used for all tasks in the PC-based automation.

11.8.3 Operating System

Due to licensing reasons, the devices VSP 16.3/40.3 are only delivered with an already installed operating system (either Windows XP Professional or Windows Embedded Standard 7 P).

11.8.4 Technical Data

	VSP 16.3	VSP 40.3
Display	12" color display	15" color display
Front panel design	16 machine function keys Front USB port	
PC box	1, 2 or 4 slots	
Processor	Intel® Core™ Duo L2400 1.66 GHz Intel® Core2™ Duo T7400 2.16 GHz Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz	
RAM	1 GB (4 GB max.)	
HDD hard disk	80 GB SATA, alternatively 2 × 80 GB (RAID1) or 32 GB SSD	
Optional drives	DVD writer (for 4-slot variant)	

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

Fig.11-35: Technical data for VSP 16.3/40.3

11.8.5 Wear Parts

Parts with a limited service life are installed in the standard industrial PCs VSP 16.3/40.3 and are therefore not subject to warranty. This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.8.8 "Documentation" on page 159).

11.8.6 Variants

The following variants of the standard industrial PCs VSP 16.3/40.3 are available:

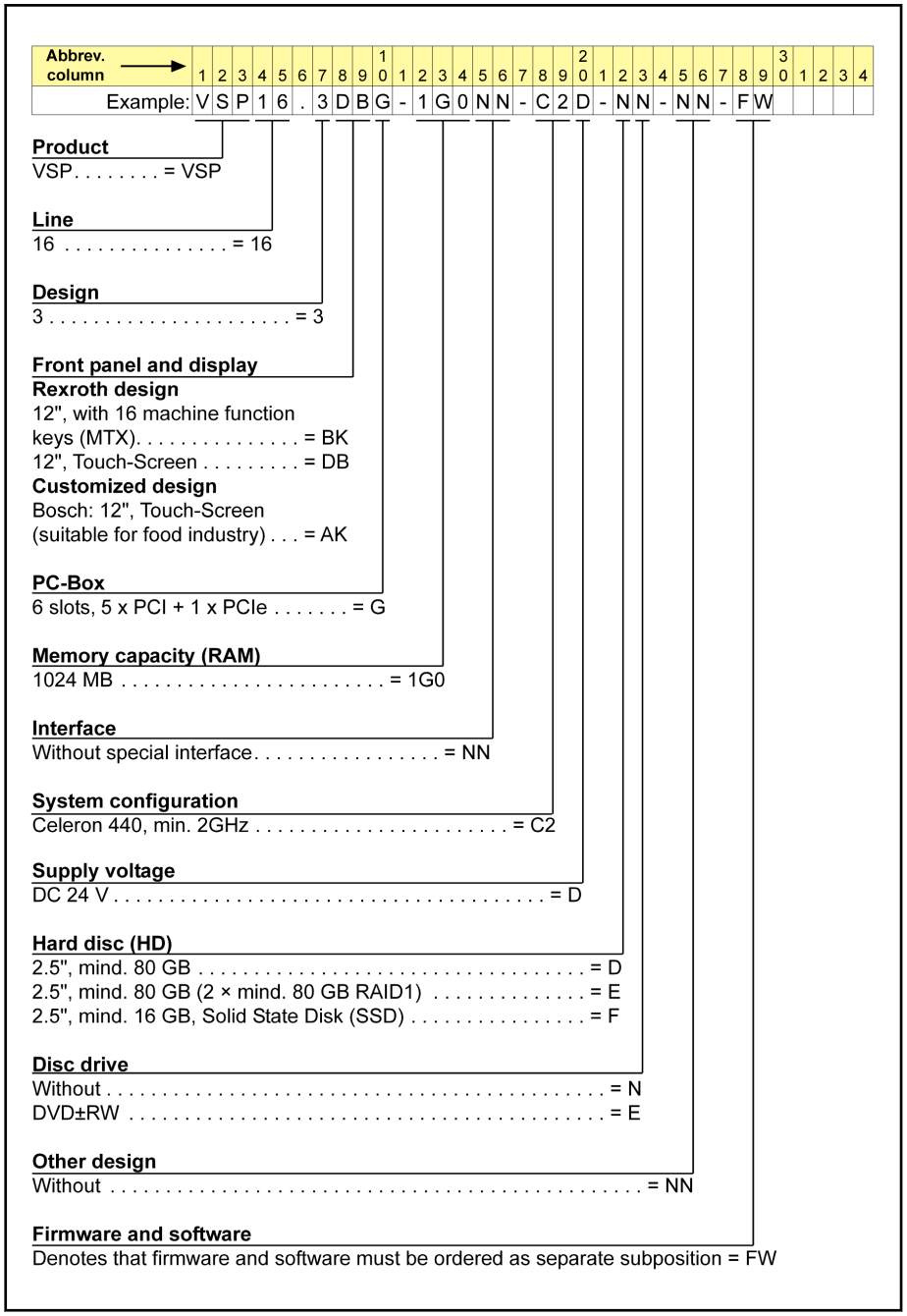

Fig. 11-36: Type code VSP 16.3

IndraControl V – Visualization Devices

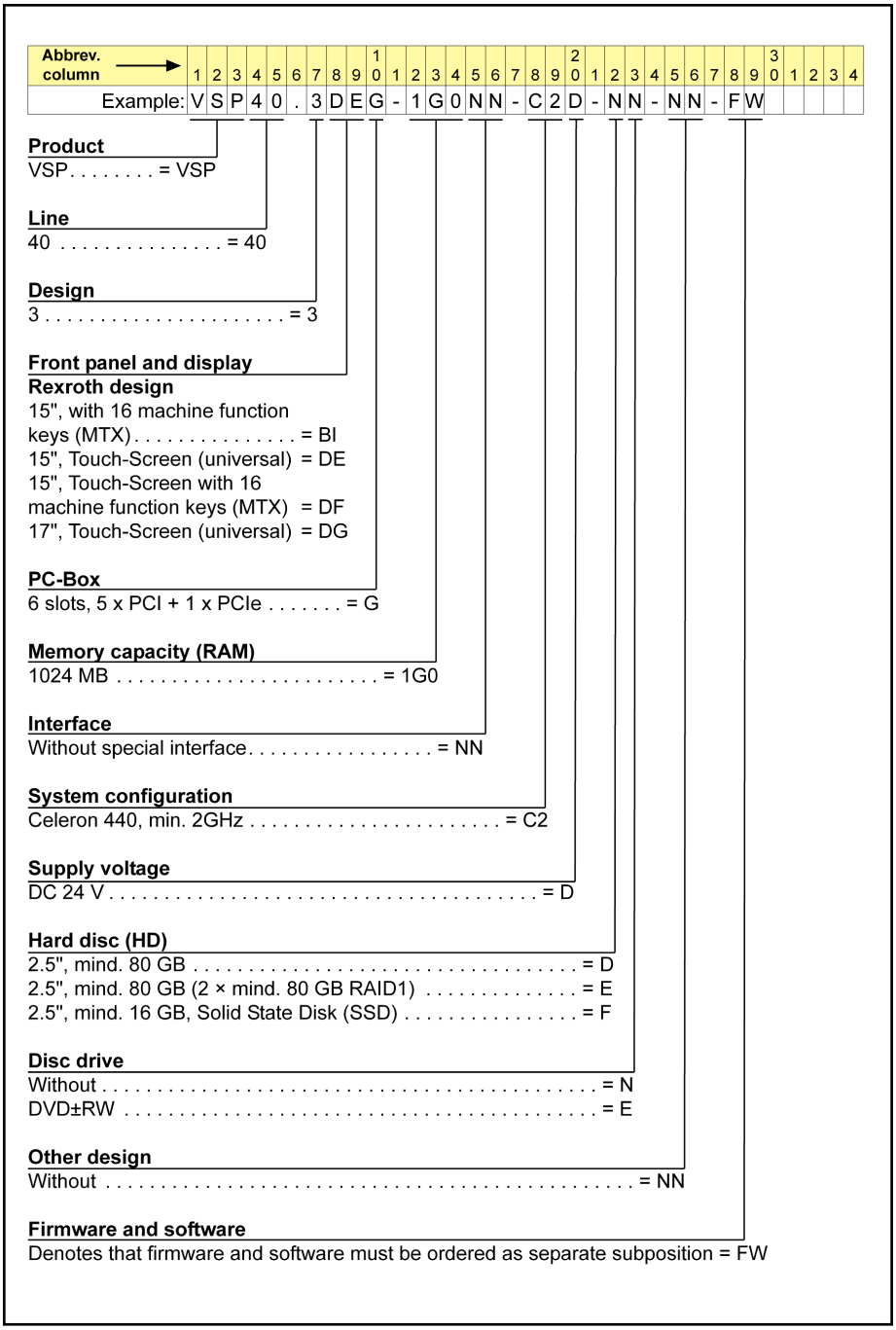

Fig.11-37: Type code VSP 40.3

11.8.7 Accessories

The following accessories are available for VSP XX.3 devices:

Type	Remark
VAP01.1H-W23-024-010-NN	Power supply unit 24 V DC; 10 A
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0019/...	USB interface cable to connect the uninterruptible power supply; length: 0.5 m; 1.0 m; 3.0 m; 5.0 m

Fig.11-38: Accessories for the VSP 16.3/40.3

11.8.8 Documentation

The following documentation is available for the detailed description of the operating devices VSP 16.3/40.3:

- Rexroth IndraControl VSP 16.3/40.3 Panel-PC, DOK-SUPPL*-VSP*XX.3***-PRxx-EN-P
- Rexroth IndraControl VAU 01.1U UPS with USB Interface, DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P

xx - Edition

11.9 Compact Industrial PC VPB 40.3 with the Operating Devices VDP 08.3/16.3/40.3

11.9.1 Brief Description

The VPB 40.3 is a high-end industrial PC, which is - together with the passive VDP 16.3, VDP 40.3 or VDP 60.3 operating panels - a PC-based operating and visualization terminal with excellent industrial capability. The VPB 40.3 is intended to be mounted in a control cabinet. The operating devices are designed to be mounted to a control panel or in a wall-mounted control cabinet. The connection between the VDP 16.3/40.3/60.3 and the VPB 40.3 is established via a CDI interface.

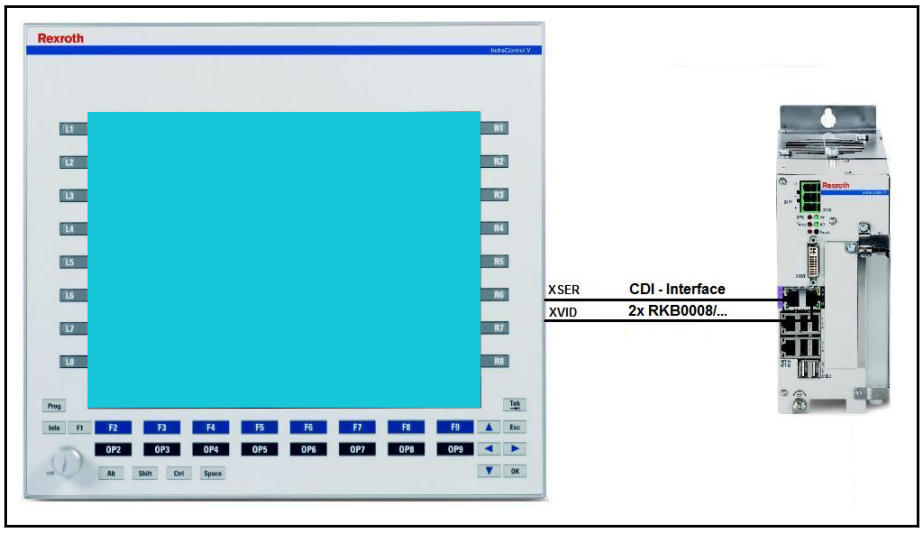

Fig.11-39: High-end industrial PC VPB 40.3 with the operating device VDP 40.3

IndraControl V – Visualization Devices

11.9.2 Field of Application

The compact industrial PC VPB 40.3 is used in industrial environments with higher vibration and shock requirements.

11.9.3 Operating System

Due to licensing reasons, the devices VPP 16.3, VPP 40.3 and VPP 60.3 are only delivered with an already installed operating system (either Windows XP Professional or Windows Embedded Standard 7 P).

11.9.4 Technical Data

	VPB 40.3
PC box	1, 2 or 4 slots
Processor	Intel® Core™ Duo L2400 1.66 GHz Intel® Core2™ Duo T7400 2.16 GHz Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz
RAM	1 GB (4 GB max.)
HDD hard disk	80 GB SATA, alternatively 2 × 80 GB (RAID1) or 32 GB SSD
Optional drives	DVD writer (for 4-slot variant)
Interfaces	6 × USB port (type A) 1 x Ethernet port (RJ 45, 10/100/1000 Base-T) 1 × VGA port
Power supply	DC 24 V

Fig.11-40: Technical data for the VPB 40.3

11.9.5 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	DC 24 V		

Fig.11-41: Technical data for the VDP 16.3/40.3/60.3

11.9.6 Wear Parts

Parts with a limited service life are installed in the compact industrial PC VPB 40.3 and the operating devices VDP 08.3/16/3/40.4 and are therefore not subject to warranty. This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.9.9 "Documentation" on page 165).

11.9.7 Variants

The following variants of high-end industrial PC VPB 40.3 are available:

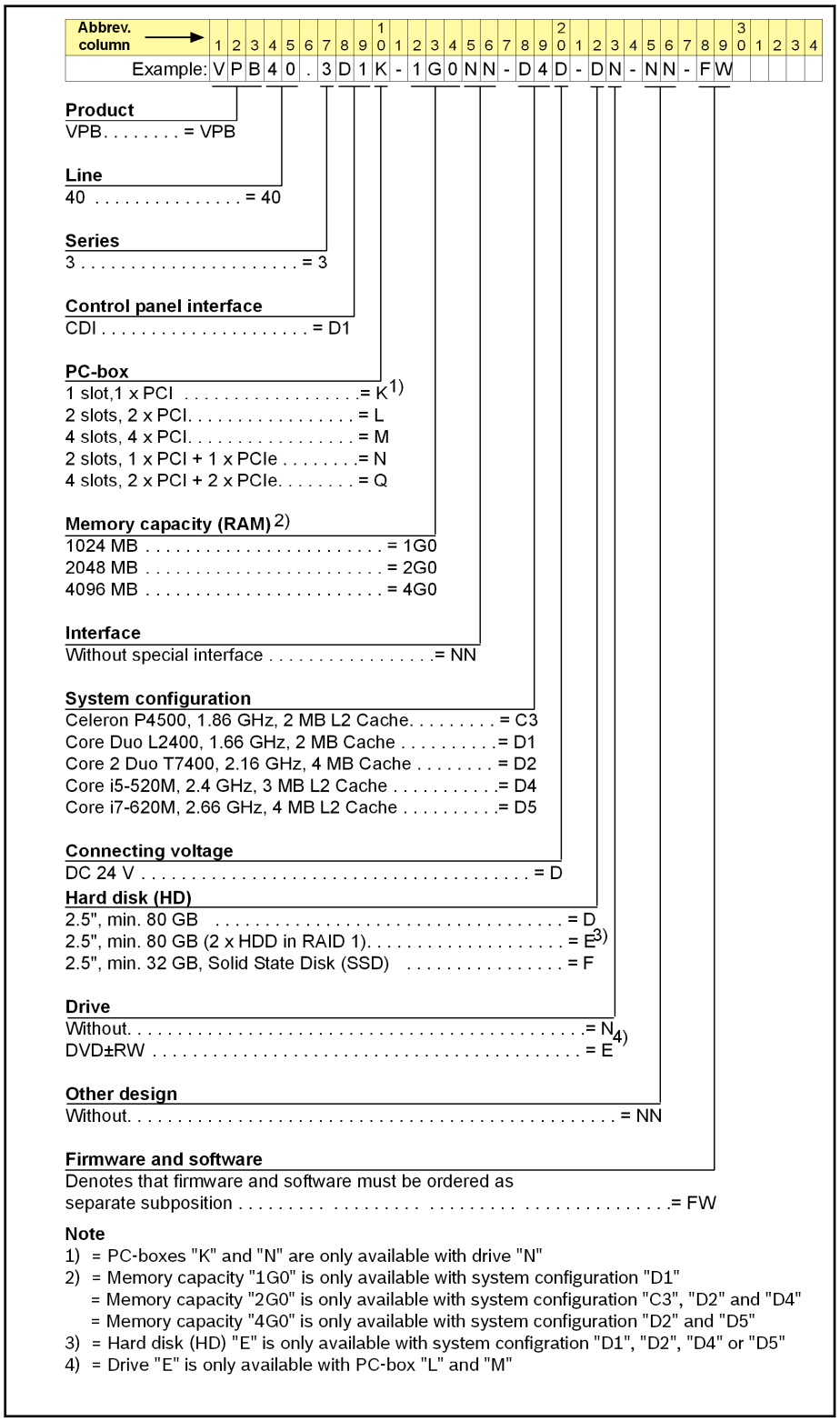

Fig.11-42: Type code VPB 40.3

The following VDP 16.3/40.3/60.3 variants are available:

IndraControl V – Visualization Devices

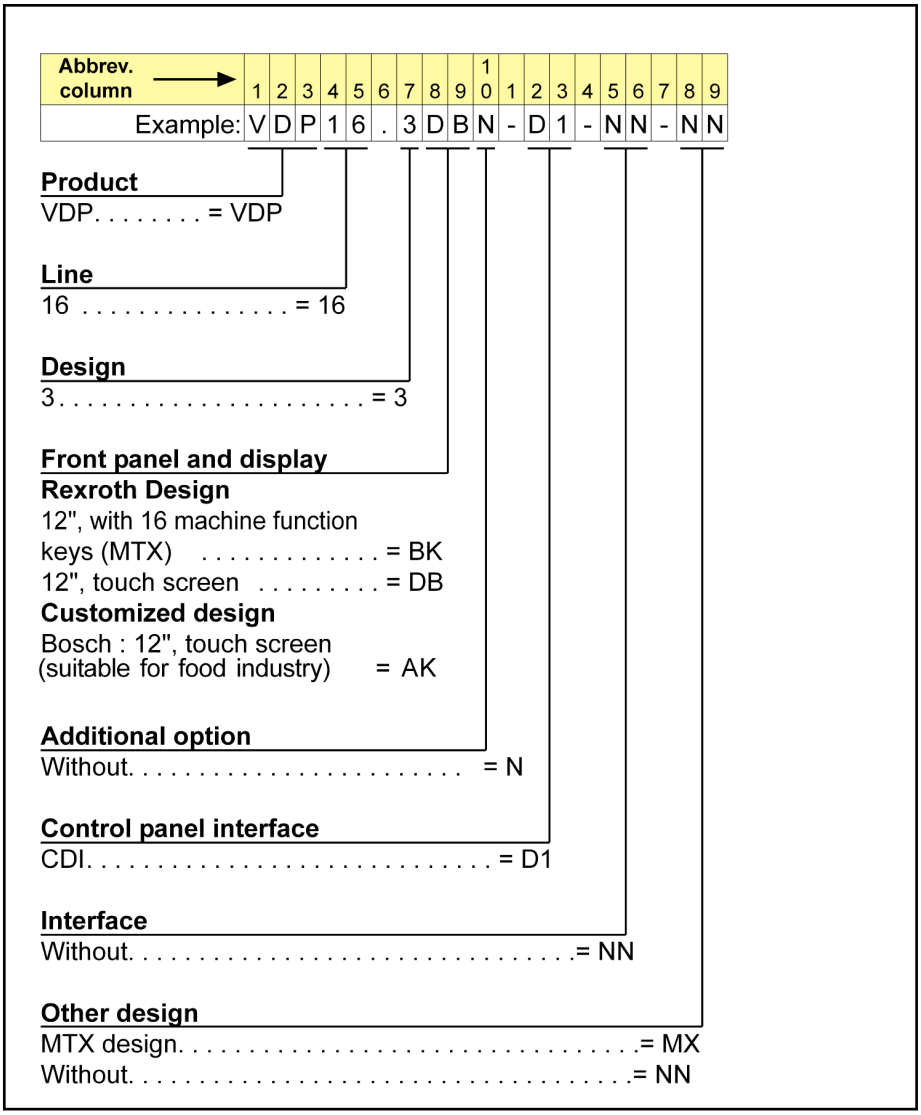

Fig.11-43: Type code VDP 16.3

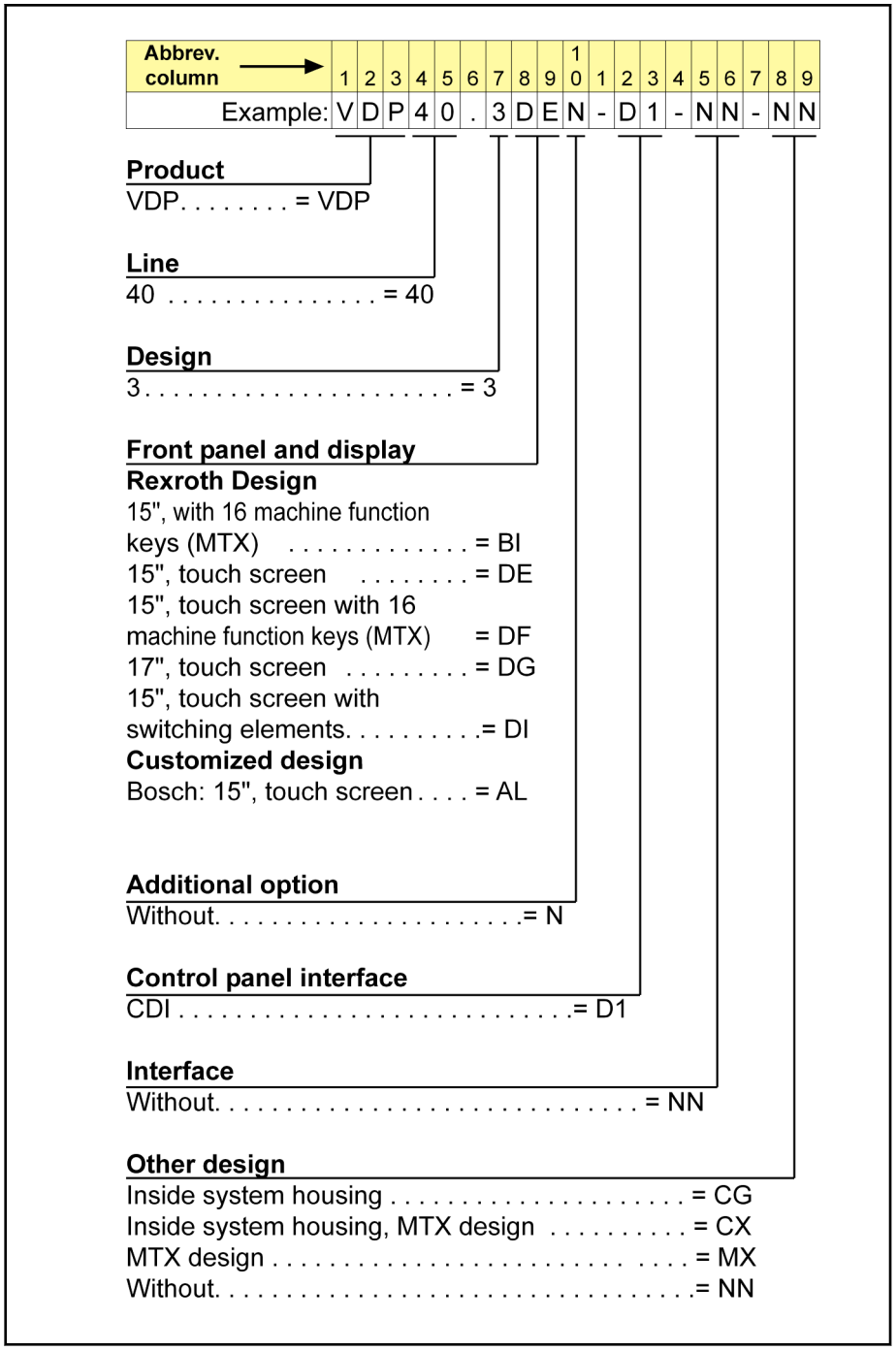

Fig.11-44: Type code VDP 40.3

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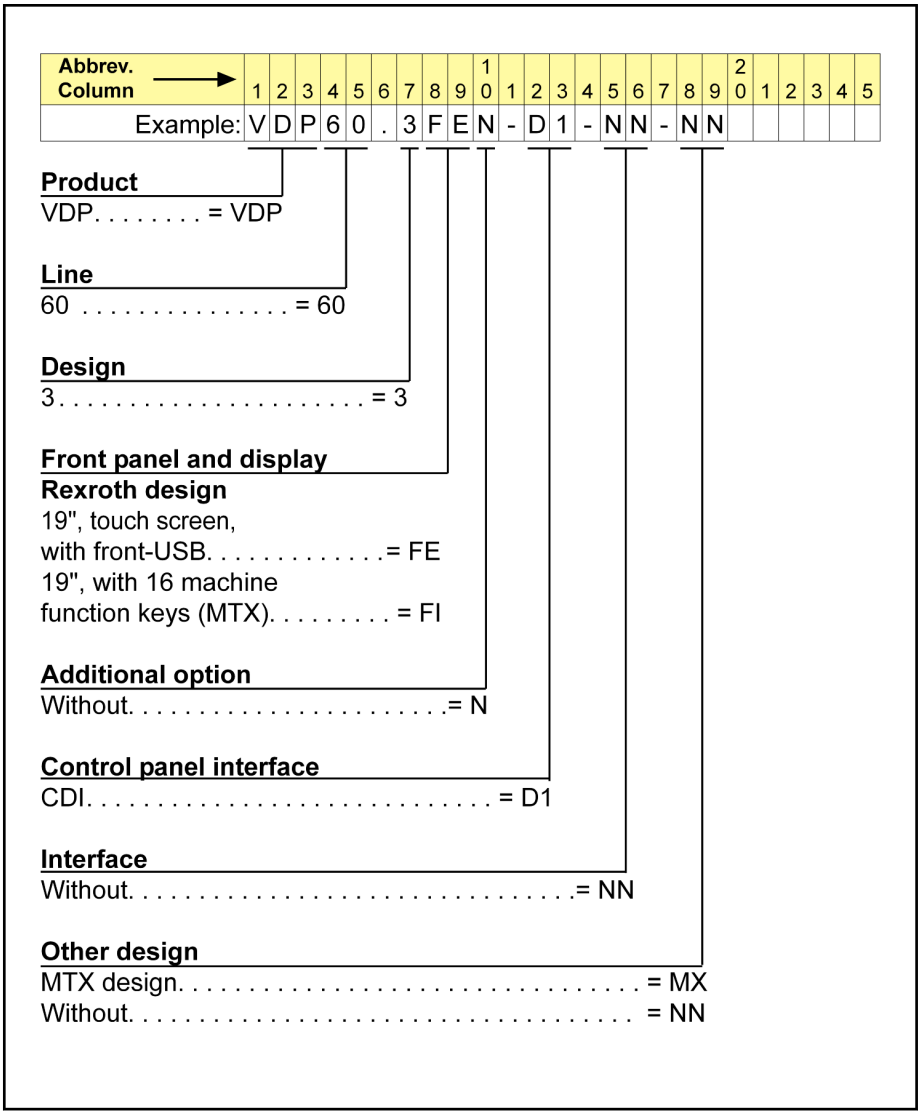

Fig.11-45: Type code VDP 60.3

11.9.8 Accessories

Connecting Cable (CDI Interface)

The industrial PC VPB 40.3 and the operating devices VDP 16.3/40.3/60.3 are connected via CDI interface. The following cable assemblies are available:

Type	Remark
RKB0008/002.5	Bus cable, Ethernet cable assembly, 100-Base-T, CAT 6+ assembly, 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

Type	Remark
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

Fig.11-46: Connecting cable VPB 40.3 - VDP 16.3/40.3/60.3

☞ Two connecting cables type RKB0008/... are required to connect a VPB 40.3 and a VDP 16.3/40.3/60.3.

Accessories for VPB 40.3

Type	Remark
VAP01.1H-W23-024-010-NN	24V DC mains adapter; 10 A
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0019/...	USB interface cable for connection of the UPS; lengths: 0.5 m; 1.0 m; 3.0 m; 5.0 m

Fig.11-47: Accessories for VPB 40.3

11.9.9 Documentation

The following documentation is available for a detailed description of the high-end industrial PC VPB 40.3:

- Rexroth IndraControl VPB 40.3 Control Cabinet PC, DOK-SUPPL*-VPB*40.3***-PRxx-EN-P
- Rexroth IndraControl VAU 01.1U UPS with USB Interface, DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P

The following documentation is available for a detailed description of the operating devices VDP 08.3/16.3/40.3:

- Rexroth IndraControl VDP 16.3/40.3/60.3 operator terminal, DOK-SUPPL*-VDP*XX.3***-PRxx-EN-P

xx - Edition

11.10 Standard Industrial PC VSB 40.3 with the Operating Devices VDP 16.3/40.3/60.3

11.10.1 Brief Description

The VSB 40.3 is an industrial PC which is - together with the passive operating devices VDP 16.3, VDP 40.3 or VDP 60.3 - a PC-based operating and visualization terminal with normal industrial capability. The VSB 40.3 is to be mounted to a control cabinet. The operating devices are designed to be mounted to a control panel or in a wall-mounted control cabinet. The connection between the VDP 16.3/40.3/60.3 and the VSB 40.3 is established via a CDI interface.

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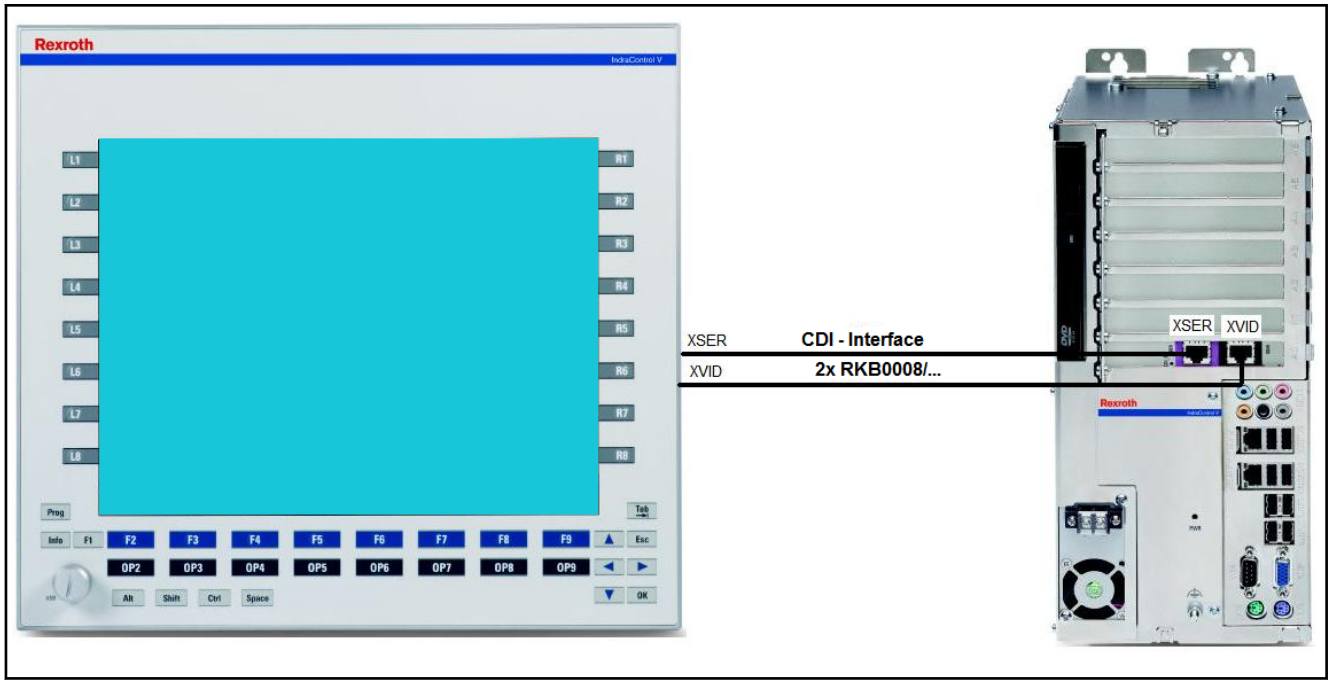

Fig.11-48: Standard industrial PC VSB 40.3 with the operating device VDP 40.3

11.10.2 Field of Application

The standard industrial PC VSB 40.3 is used for all tasks in the PC-based automation.

11.10.3 Operating System

Due to licensing reasons, the devices VPP 16.3/40.3/60.3 are only delivered with an already installed operating system (either Windows XP Professional or Windows Embedded Standard 7 P).

11.10.4 Technical Data

	VSB 40.3
PC box	1, 2 or 4 slots
Processor	Intel® Core™ Duo L2400 1.66 GHz Intel® Core2™ Duo T7400 2.16 GHz Intel® Core™ i7-620M, 2.66 GHz Intel® Core™ i5-520M, 2.4 GHz Intel® Celeron® Dual-Core P4500, 1.86 GHz
RAM	1 GB (4 GB max.)
HDD hard disk	80 GB SATA, alternatively 2 × 80 GB (RAID1) or 32 GB SSD
Optional drives	DVD writer (for 4-slot variant)
Interfaces	6 × USB port (type A) 1 x Ethernet port (RJ 45, 10/100/1000 Base-T) 1 × VGA port
Power supply	DC 24 V

Fig.11-49: Technical data for VSB 40.3

11.10.5 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	DC 24 V		

Fig.11-50: Technical data for the VDP 16.3/40.3/60.3

11.10.6 Wear Parts

Parts with a limited service life are installed in the standard industrial PC VSB 40.3 and in the operating devices VDP 16.3/40.3/60.3 and are therefore not subject to warranty. This applies to the following components:

- Hard drive
- CMOS battery
- Fan
- Background lighting

The service life of the individual components is described in the device documentations (see chapter 11.10.9 "Documentation" on page 172).

IndraControl V – Visualization Devices

11.10.7 Variants

The following variant of the standard industrial PC VSB 40.3 is available:

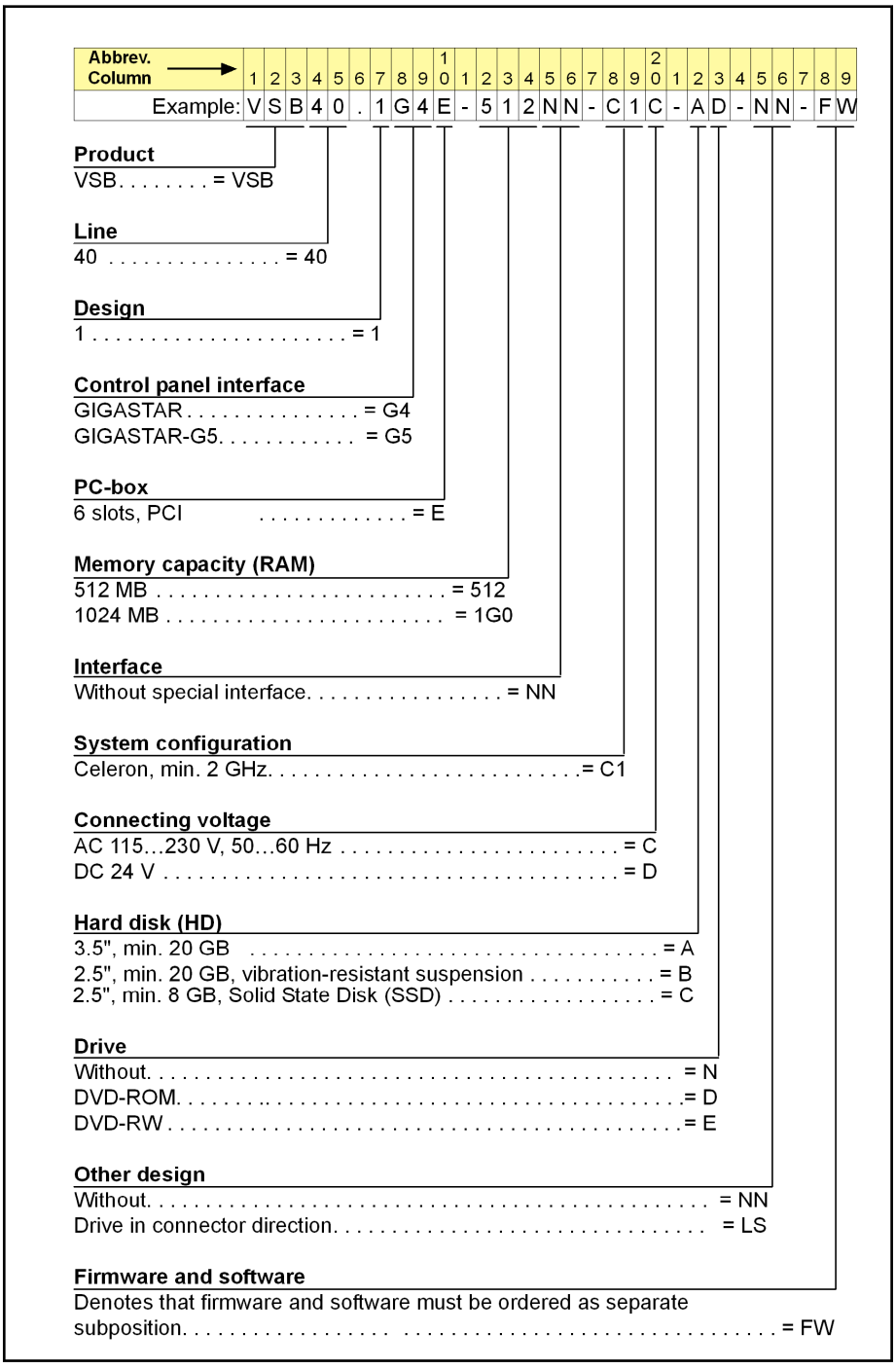

Fig.11-51: Type code VSB 40.3

The following VDP 16.3/40.3/60.3 variants are available:

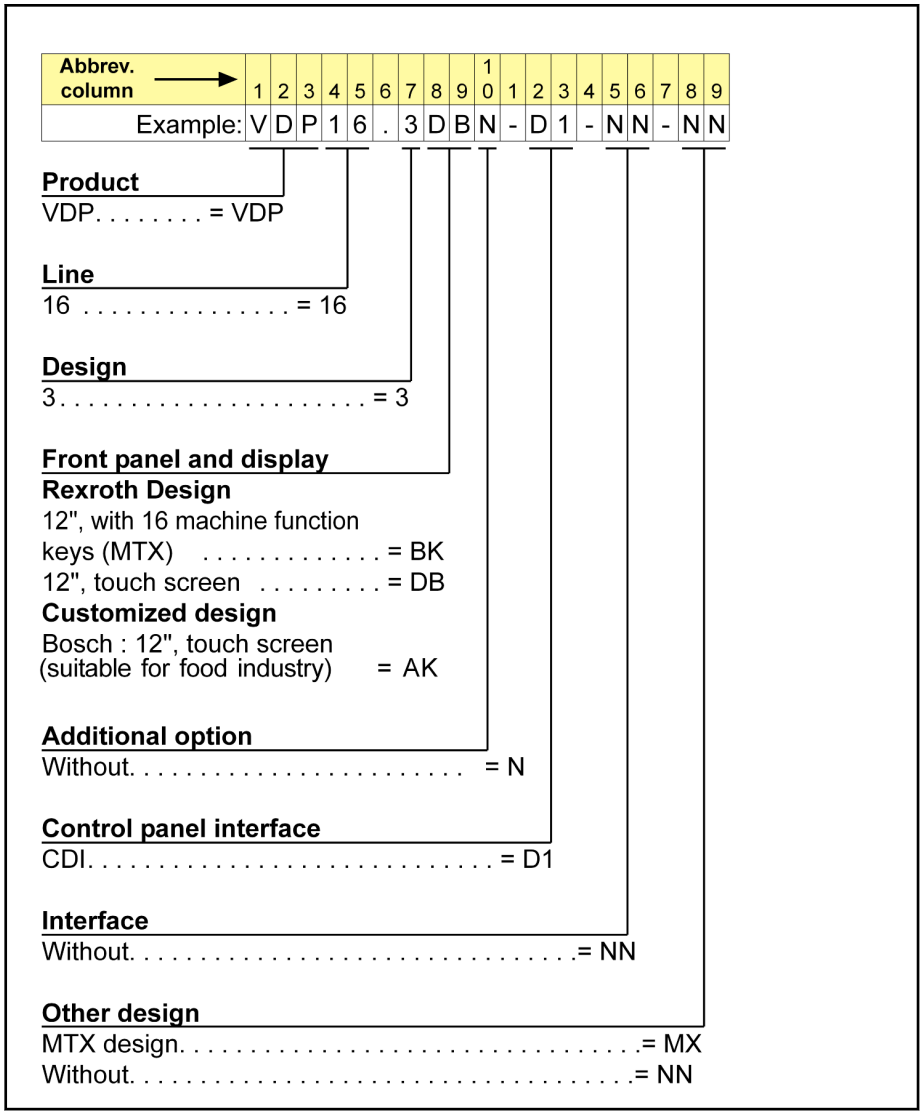

Fig.11-52: Type code VDP 16.3

IndraControl V – Visualization Devices

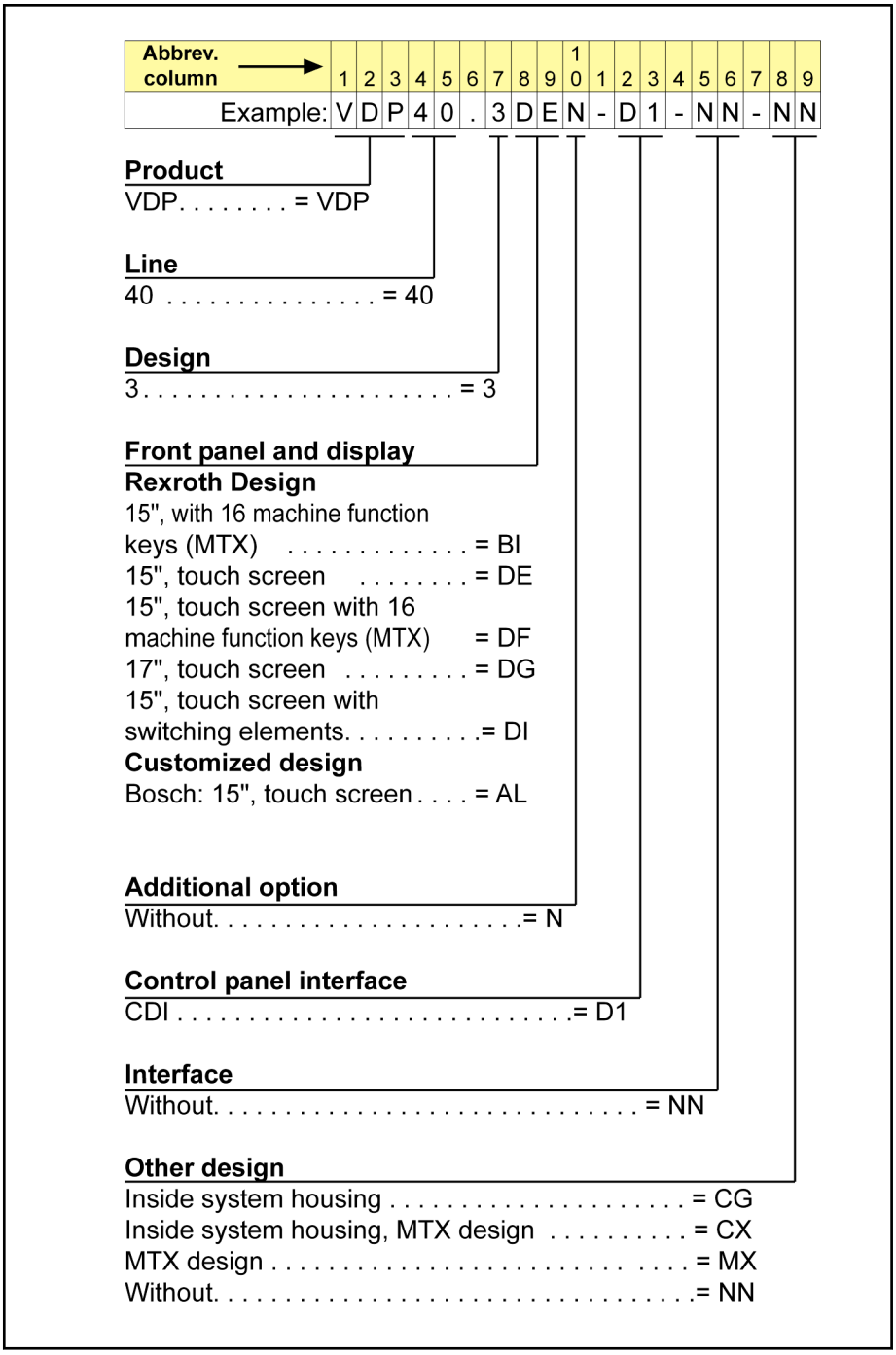

Fig.11-53: Type code VDP 40.3

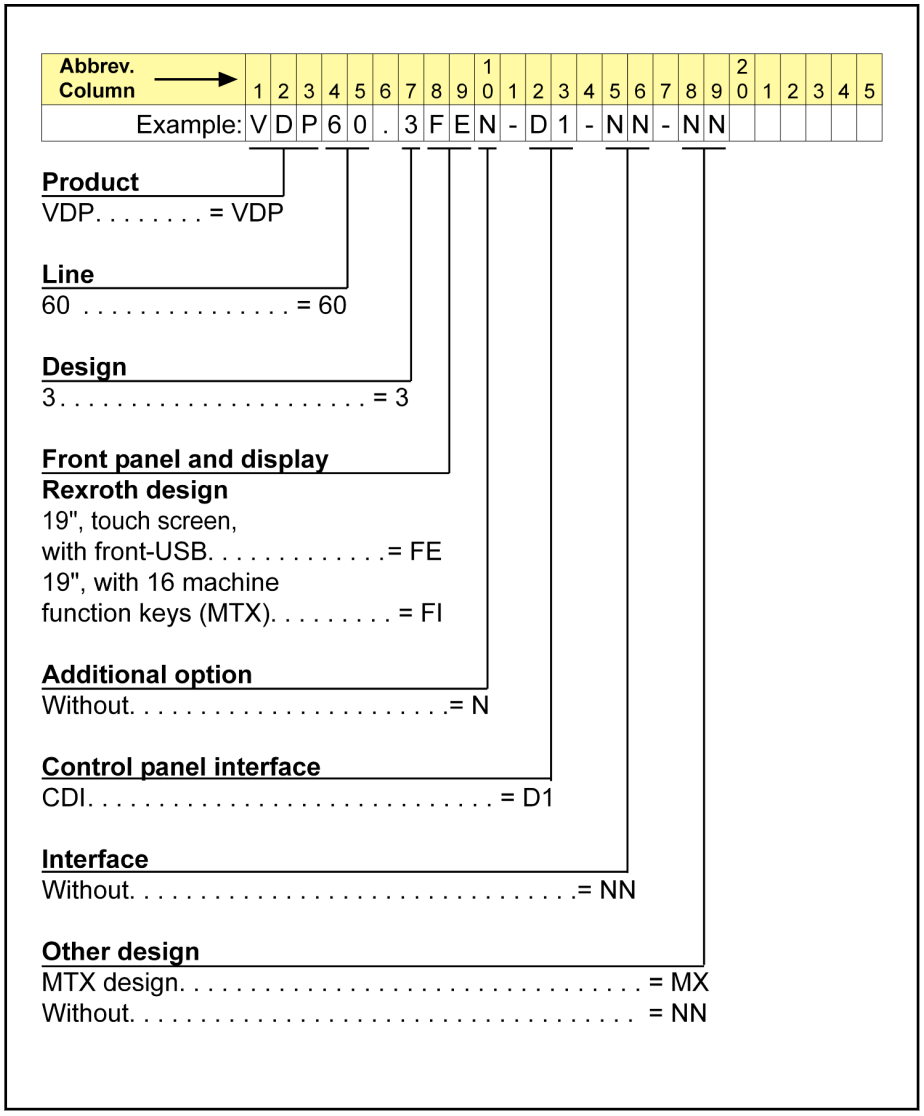

Fig.11-54: Type code VDP 60.3

11.10.8 Accessories

Connecting Cable (CDI Interface)

The industrial PC VSB 40.3 and the operating devices VDP 16.3/40.3/60.3 are connected via CDI interface. The following cable assemblies are available:

Type	Remark
RKB0008/002.5	Bus cable, Ethernet cable assembly, 100-Base-T, CAT 6+ assembly, 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

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Type	Remark
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

Fig.11-55: Connecting cable VSB 40.3 - VDP 16.3/40.3/60.3

☞ Two connecting cables type RKB0008/... are required to connect a VSB 40.3 and a VDP 16.3/40.3/60.3.

Accessories for VSB 40.3

Type	Remark
VAP01.1H-W23-024-010-NN	24V DC mains adapter; 10 A
VAU01.1U-024-024-240-NN	Uninterruptible power supply with 24 V input/24 V output 240 W
RKB0019/...	USB interface cable to connect the uninterruptible power supply; length: 0.5 m; 1.0 m; 3.0 m; 5.0 m

Fig.11-56: Accessories for VSB 40.3

11.10.9 Documentation

The following documentation is available for a detailed description of the standard industrial PC VSB 40.3:

- Rexroth IndraControl VSB 40.3 Control Cabinet PC, DOK-SUPPL*-VSB*40.3***-PRxx-EN-P
- Rexroth IndraControl VAU 01.1U UPS with USB Interface, DOK-SUPPL*-VAU*01.1U**-PRxx-EN-P

The following documentation is available for a detailed description of the operating devices VDP 16.3/40.3/60.3:

- Rexroth IndraControl VDP 16.3/40.3/60.3 operator terminal, DOK-SUPPL*-VDP*XX.3***-PRxx-EN-P

xx - Edition

11.11 IndraControl 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 control elements such as keys with LED displays, rotary switch for feed and spindle override, E-STOP pushbutton, key switch with authorization system and machine keys.

The machine control panels VAM 10.2/40.2 were designed for the use with devices from the VPB, VPP, Vxx product families 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.

There are machine control panels with Profibus connection for the devices VAM 10.2 and VAM 40.2.

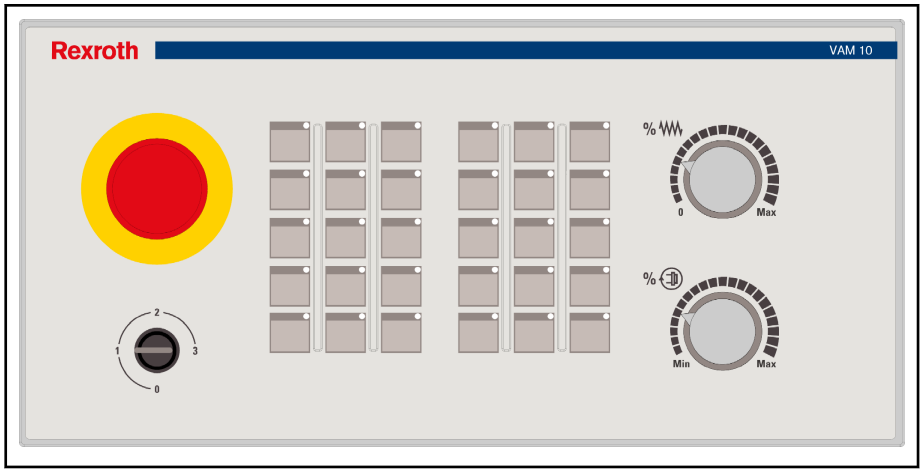


Fig. 11-57: Front view VAM 10.2

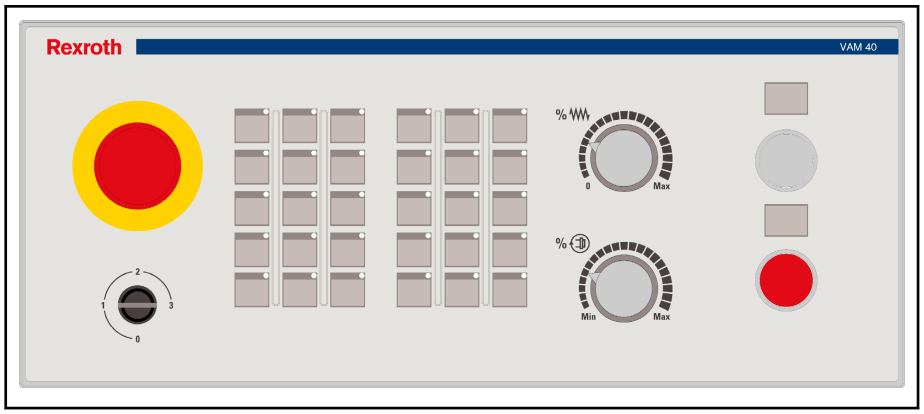


Fig. 11-58: Front view VAM 40.2

11.11.2 Fields of Application

Machine control panels of the VAM 10.2/40.2 design operate control units.

11.11.3 Technical Data

	VAM 10.2	VAM 40.2
Power supply	Galvanically insulated	
Logic supply U_L	DC 24 V (19,2 ... 30 V), PELV	
Current consumption from U_L	0.5 A max.	
Input and output voltage U_Q	DC 24 V (19,2 ... 30 V), PELV	
Logic consumption from U_Q	1.7 A max.	
Fuse	SMD fuse 3 A	
Reverse voltage protection	Integrated	

Fig. 11-59: Electrical data

NOTICE **Destruction of the filter choke in the input range due to continuous operation outside a range of 19.2 V to 30 V.**

Operate the device only in the permitted range from 19.2 V to 30 V.

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

GSD file

Two GSD files are provided for the devices according to EN 50170 part 2 (DP). These files include all data required to connect the components VAM 10.2/40.2 to any Profibus DP master [according to EN 50170 part 2 (DP)].

RX010123.GSD is a universal GSD file used to write on the machine control panels VAM 10.2/40.2 (and other VAM control panels) as modular Profibus DP slave. The GSD 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.

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

Fig.11-60: 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

Fig.11-61: VAM 40.2-PB-NA-TA-TA-VB-1608-NN

☞ To simplify the configuration, use the GSD file **RX020123.GSD** with the station name "VAM10, VAM40".

RX020123.GSD is a GSD file used to write on the machine control panels VAM 10.2/40.2 as compact DP slave. This GSD 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.

The GSD files are located on the Bosch Rexroth internet pages. You can also contact your local service support.

Profibus DP address settings

The station address is set via the two BCD rotary switches 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 at de-energized state.

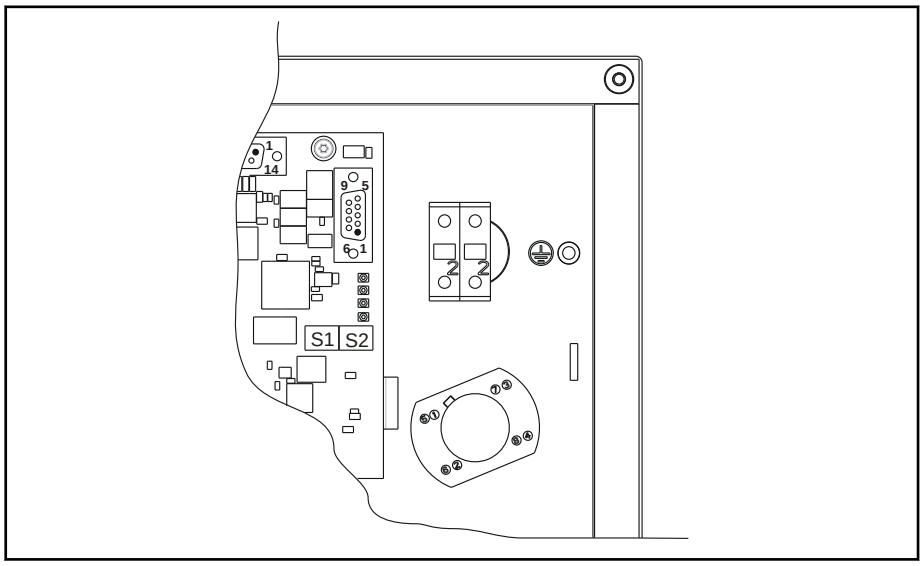


Fig.11-62: BCD rotary switches S1 and S2

Baud rate setting

The machine control panels VAM 10.2/40.2 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

IndraControl V – Visualization Devices

11.11.4 Variants

	Keypad with labeled, freely-programmable keys and LED	More elements	Order numbers and type codes
VAM 10.2	2 keypads with 15 keys each	• E-STOP pushbutton • Priority switch • Two override rotary switches for feed and spindle • Fast-stop module with two machine keys	R911170770 VAM10.2-PB-NA-TA-TA-VB-1608-NN
VAM 40.2	2 keypads with 15 keys each	• E-STOP pushbutton • Priority switch • Two override rotary switches for feed and spindle	R911170772 VAM40.2-PB-NA-TA-TA-VB-MA-1608-NN

Fig.11-63: Designs of IndraControl VAM 10.2/40.2

11.11.5 Order Information

Type code

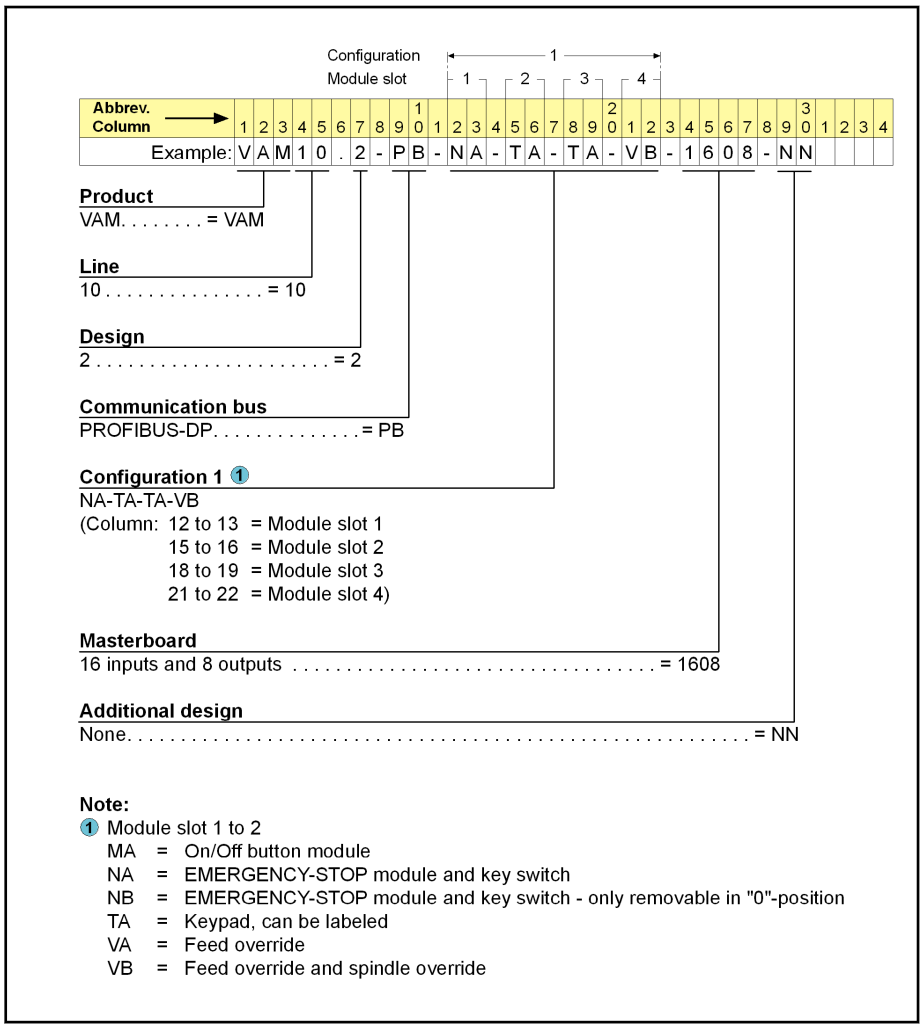


Fig.11-64: Type code of the VAM 10.2

IndraControl V – Visualization Devices

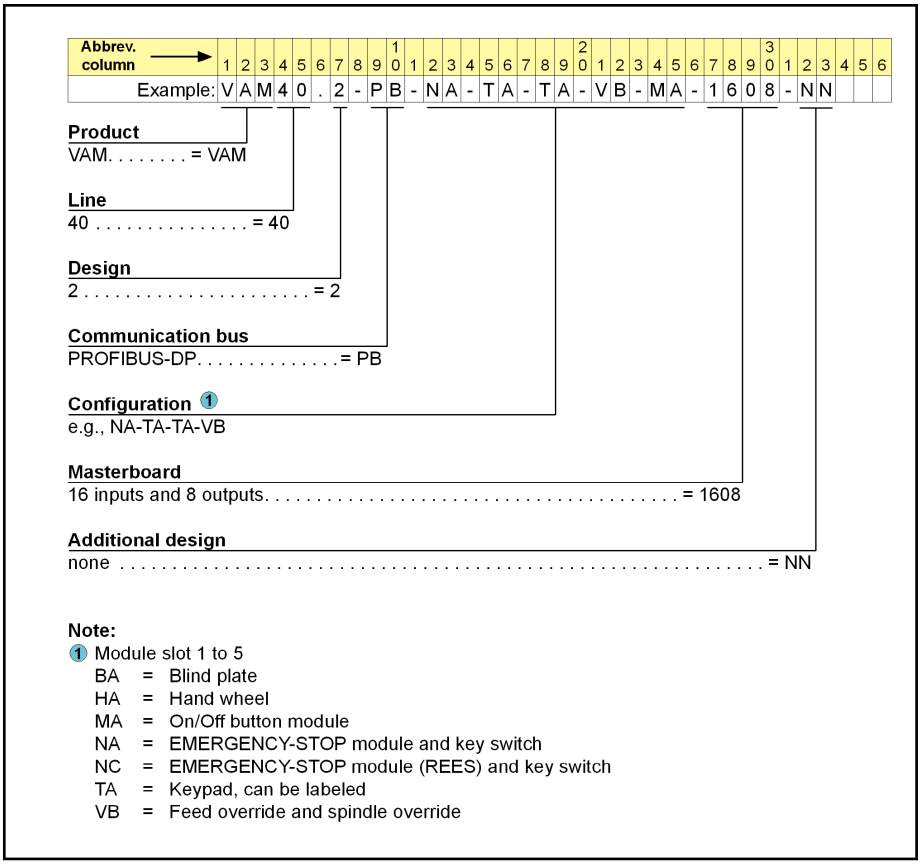


Fig. 11-65: Type code of the VAM 40.2

11.11.6 Accessories, Plugs and Prefabricated Cables

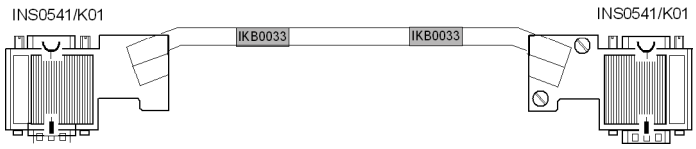
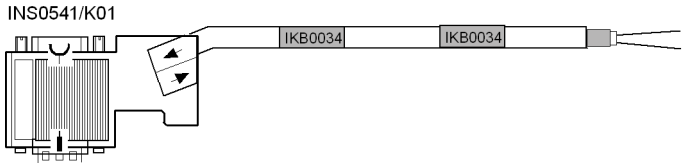
Order code Prefabricated cable	Mating plug of the device	Rexroth cable	Design of the cable end
IKB0033/000,0 PN: 291808 Profibus cable			
IKB0034/000,0 PN: 291809 Profibus cable			

Fig. 11-66: Cable accessories

11.11.7 Documentation

The following documentation is available for a detailed description of the VAM 10.2/40.2:

- Rexroth IndraControl VAM 10.2/40.2, DOK-SUPPL*-VAM*XX.2***-PR02-EN-P

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11.12 IndraControl VAM 10.3/40.3

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 control elements such as keys with LED displays, rotary switch for feed and spindle override, E-STOP pushbutton and machine keys.

The machine control panels VAM 10.3/40.3 were designed for the use with devices from the VPP, VSP and Vxx product families and adapted to the design of these devices. VAM 10.3 has the width of the panel PCs VPP/VSP and VAM 40.3 the width of the panel PCs VPP/VSP 40.

There are machine control panels with sercos III or Profinet connection for the devices VAM 10.3 and VAM 40.3.

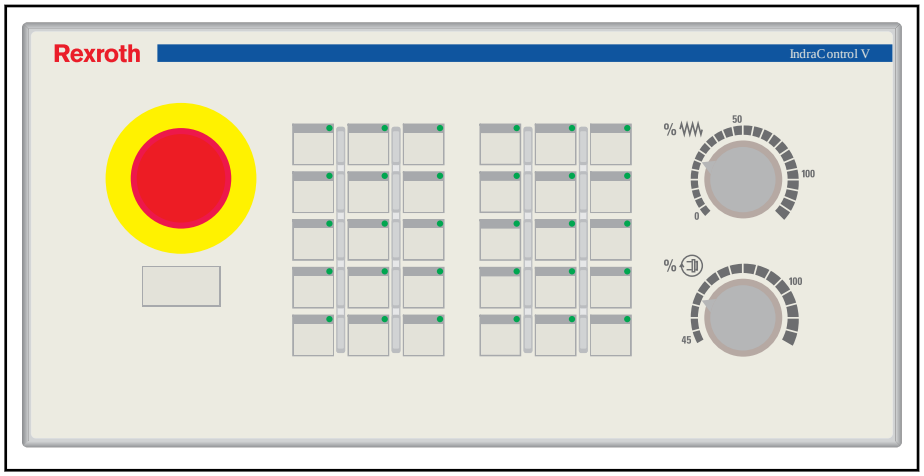

Fig. 11-67: Front view of the VAM 10.3

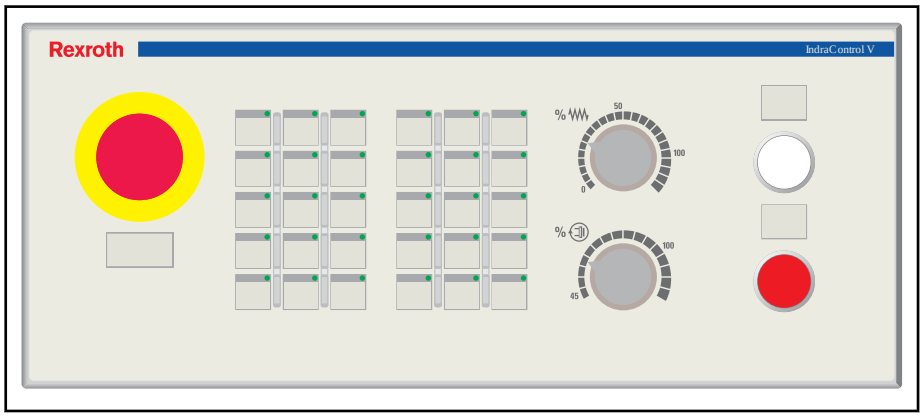

Fig. 11-68: Front view of the VAM 40.3

IndraControl V – Visualization Devices

11.12.2 Fields of Application

Machine control panels of the VAM 10.3/40.3 design operate control units.

11.12.3 Technical Data

	VAM 10.3	VAM 40.3
Power supply	Galvanically insulated	
Logic supply U_L	DC 24 V (19.2 V to 30 V), PELV	
Current consumption from U_L	Typically 0.3 A	
Input and output voltage U_M	DC 24 V (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	

Fig.11-69: Electrical data

NOTICE **Destruction of the filter choke in the input range due to an incorrect input voltage.**

Operate the device only in the permitted voltage range from 19.2 V to 30 V.

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

sercos III

A sercos device description file (SDDML file) is required for the commissioning at the sercos III master. Two SDDML files are available for the VAM 10.3/40.3 (refer to the following table). The files are located on the Bosch Rexroth internet pages. 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
Fig.11-70: 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 reaction of the sercos III ring after a VAM 10.3/40.3 replacement 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.

Profinet

A device description file (GSDML file) is required for the commissioning at a Profinet I/O controller. A GSDML file is available for the VAM 10.3/40.3. The files are located on the Bosch Rexroth internet pages. You can also contact your local service support.

Device	GSDML file
VAM10.3-N1-NF-TA-TA-VD-1616-NN VAM40.3-N1-NF-TA-TA-VD-MA-1616-NN	GSDML-Vx.x-Bosch Rexroth AG-IndraControl-VAM-JJJJMMDD.xml

YYYY Year
MM month
DD Day

Fig.11-71: GSDML file

11.12.4 Variants

	Keypad with labeled, freely-programmable keys and LED	More elements	Order numbers and type codes
VAM 10.3 (sercos III)	2 keypads with 15 keys each	• E-STOP pushbutton • Two override rotary switches for feed and spindle	R911172210 VAM10.3-S3-NF-TA-TA-VD-1616-NN
VAM 10.3 (Profinet)	2 keypads with 15 keys each	• E-STOP pushbutton • Two override rotary switches for feed and spindle	R911172613 VAM10.3-N1-NF-TA-TA-VD-1616-NN
VAM 40.3 (sercos III)	2 keypads with 15 keys each	• E-STOP pushbutton • Two override rotary switches for feed and spindle • Fast-stop module with two machine keys	R911172211 VAM40.3-S3-NF-TA-TA-VD-MA-1616-NN
VAM 40.3 (Profinet)	2 keypads with 15 keys each	• E-STOP pushbutton • Two override rotary switches for feed and spindle • Fast-stop module with two machine keys	R911172614 VAM40.3-N1-NF-TA-TA-VD-MA-1616-NN

Fig.11-72: Standard variants

IndraControl V – Visualization Devices

11.12.5 Order Information

Type code

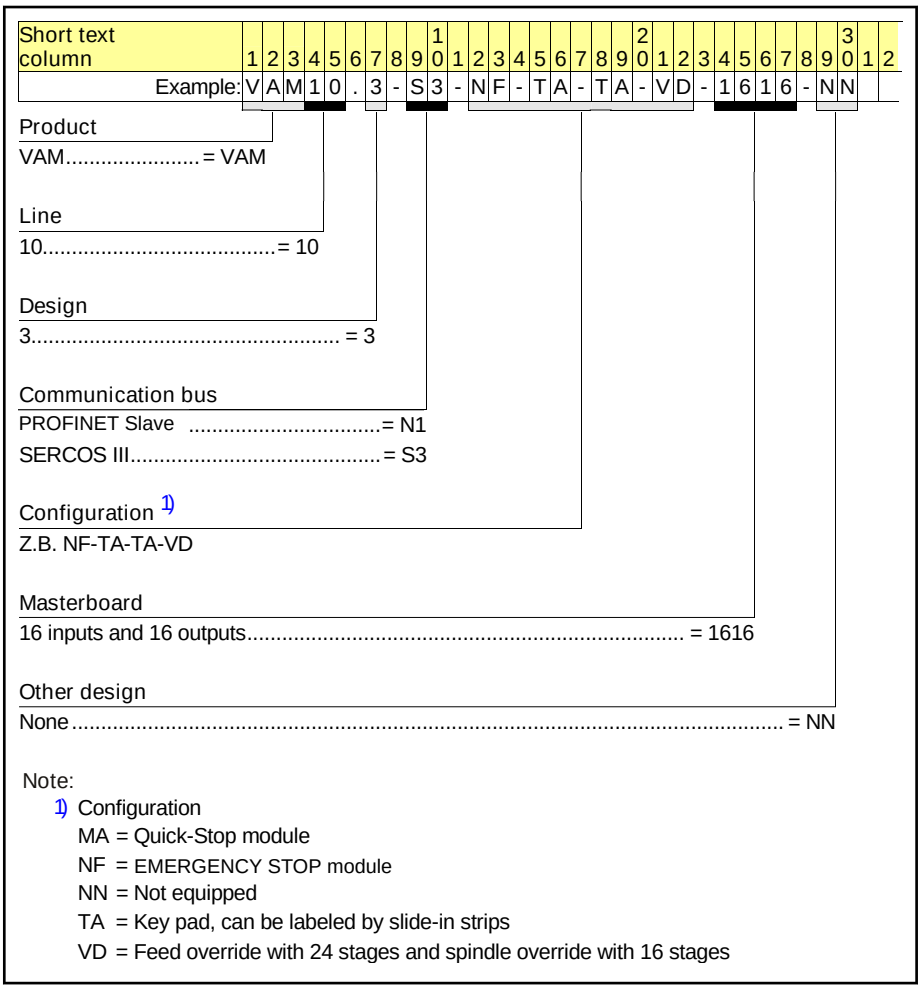

Fig.11-73: Type code of the VAM 10.3

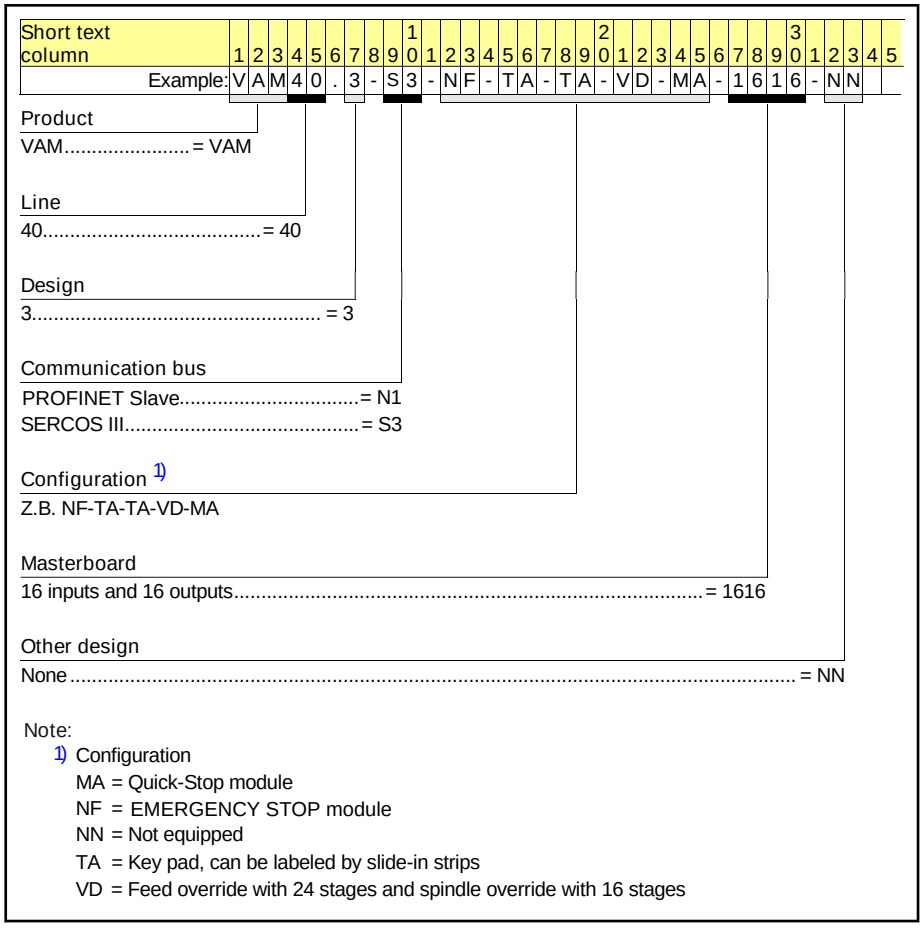

Fig.11-74: Type code of the VAM 40.3

11.12.6 Documentation

The following documentation is available for a detailed description of the VAM 10.3/40.3:

- Rexroth IndraControl VAM 10.3/40.3, DOK-SUPPL*-VAM*XX.3***-PR01-EN-P

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11.13 PC Keyboards VAK

11.13.1 General Information

Insertable or mountable keyboards with a foil-based design are available to operate the industrial PC according to the requirements.

IndraControl V – Visualization Devices

11.13.2 Insertable Keyboards

Fig.11-75: Insertable keyboard VAK 10.1

Fig.11-76: 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, they 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.

11.13.3 Mountable Keyboards

Fig.11-77: Insertable keyboard VAK 11.2

Fig.11-78: 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.

11.13.4 Variants

The following keyboard variants is available for the industrial PC:

Model	Type	Remarks
Insertable Keyboard	VAK10.1E-EN-P-MPNN	Adjusted to VSP 16, VDP 16, VPP 16
	VAK40.1E-EN-P-MPNN	Adjusted to VSP 40, VDP 40, VPP 40
	VAK40.1E-DE-P-MPNN	Adjusted to VSP 40, VDP 40, VPP 40
Mountable keyboard (foil-based design)	VAK11.2F-EN-P-NNNN	Adjusted to VSP 16, VDP 16, VPP 16
	VAK41.2F-EN-P-NNNN	Adjusted to VSP 40, VDP 40, VPP 40

Fig.11-79: VAK 10/11/40/41 selection

11.13.5 Documentation

For a detailed description of the mountable (drawer) keyboards VAK 10/40 and VAK 11/41, refer to the following documentations:

- Rexroth VAK 11.2 Rexroth VAK 41.2, DOK-SUPPL*-VAK*11/41**-PRxx-EN-P
- Rexroth VAK 10.1 Rexroth VAK 40.1, DOK-SUPPL*-VAK*40.1***-PRxx-EN-P

xx - Edition

12 Axis Types and Axis Modes

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 IndraMotion. 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:

- Axis Types (see page 187)
- Single-Axis Modes (see page 188)
- Kinematic Axes (see page 197)
- Controlling Axes from the PLC Program (see page 199)

Related documentation

For further documentation, refer to the chapter "Required and Supplementing Documentations on page 10". More detailed information on this topic is given in further manuals.

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

  Axis whose controllers are implemented into the PLC
- Encoder axis

  Axis only providing actual values (e.g. from an additional drive encoder)
- Link axis

  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	Controller axis
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

Fig.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:

- Positioning Modes (see page 189)
  - Positioning (absolute, additive or relative)

    Motion of the axis 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 a defined velocity
  - Torque/force control

    Continuous axis motion with defined torque/force
- Operation Modes for Synchronous Motions with Electronic Gear Function (see page 190)
  - Velocity synchronization

    In the "velocity synchronization" mode, the axis follows a specified master axis velocity velocity-synchronously
  - 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. These are described by mathematical motion laws as analytical functions. This operation mode is not available for drives without encoders

12.3.2 Positioning Modes

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 operations 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 ("parallely switched") 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 follows a specified master axis velocity velocity-synchronously. 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 ...

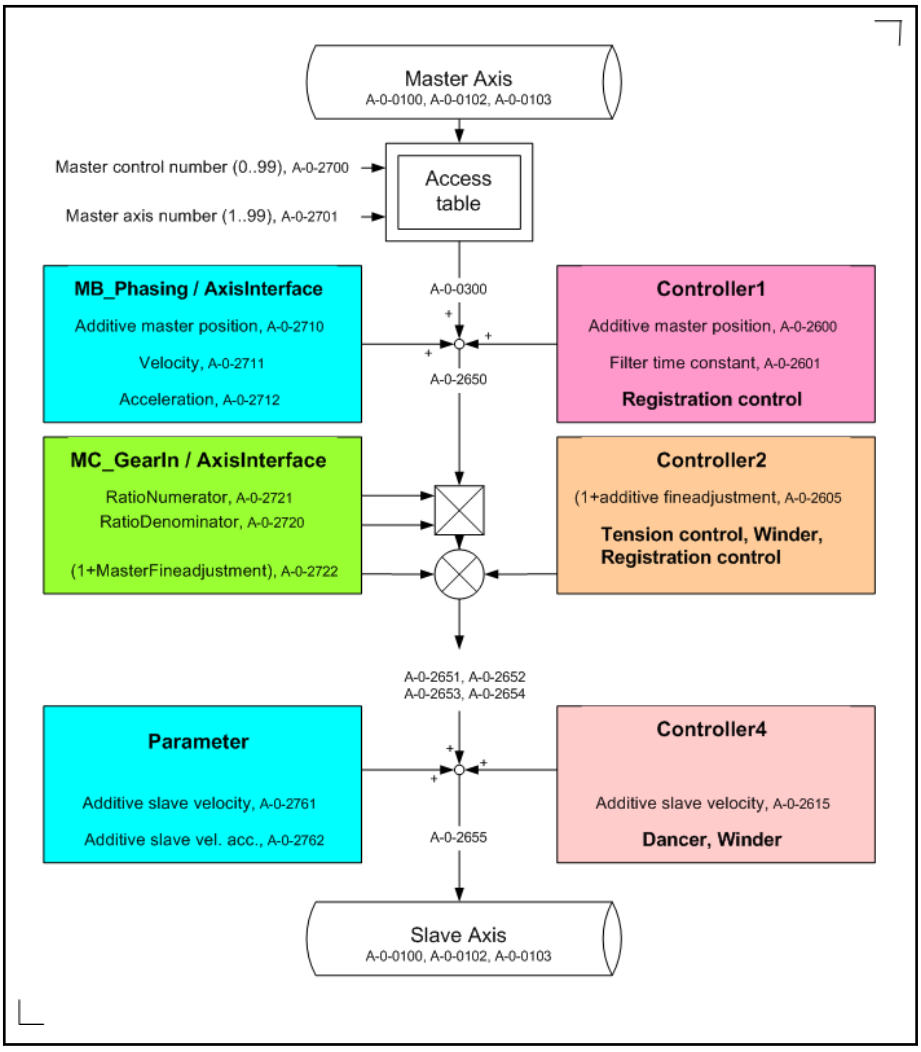


Fig. 12-2: MotionControl functional chain "velocity synchronization"

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 ...

Axis Types and Axis Modes

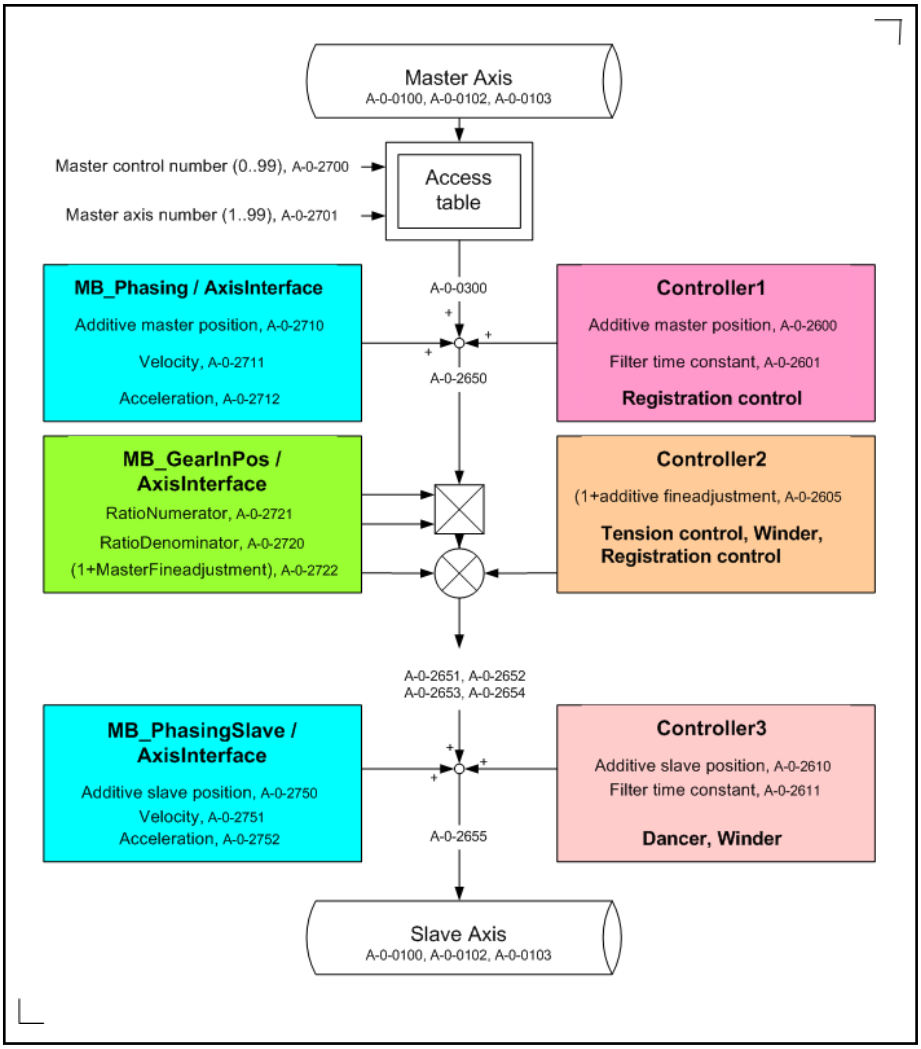


Fig. 12-3: MotionControl functional chain "phase synchronization"

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 IndraMotion.

The "electronic cam" is only available for real axes with interpolation in the drive.

Axis Types and Axis Modes

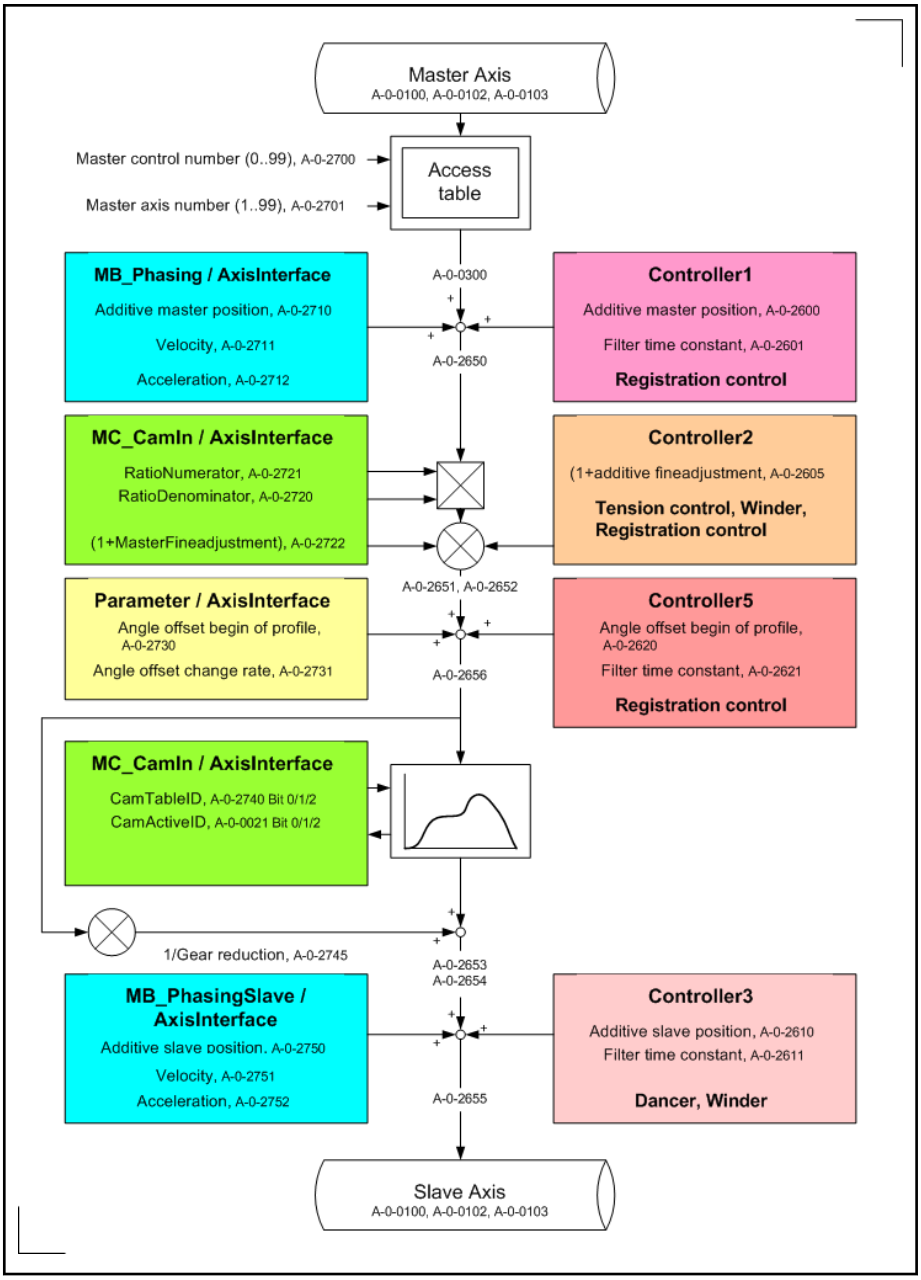


Fig.12-4: MotionControl functional chain "Electronic cam"

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" on the IndraMotion MLC are only provided for virtual axes and real axes with interpolation in the control.

Axis Types and Axis Modes

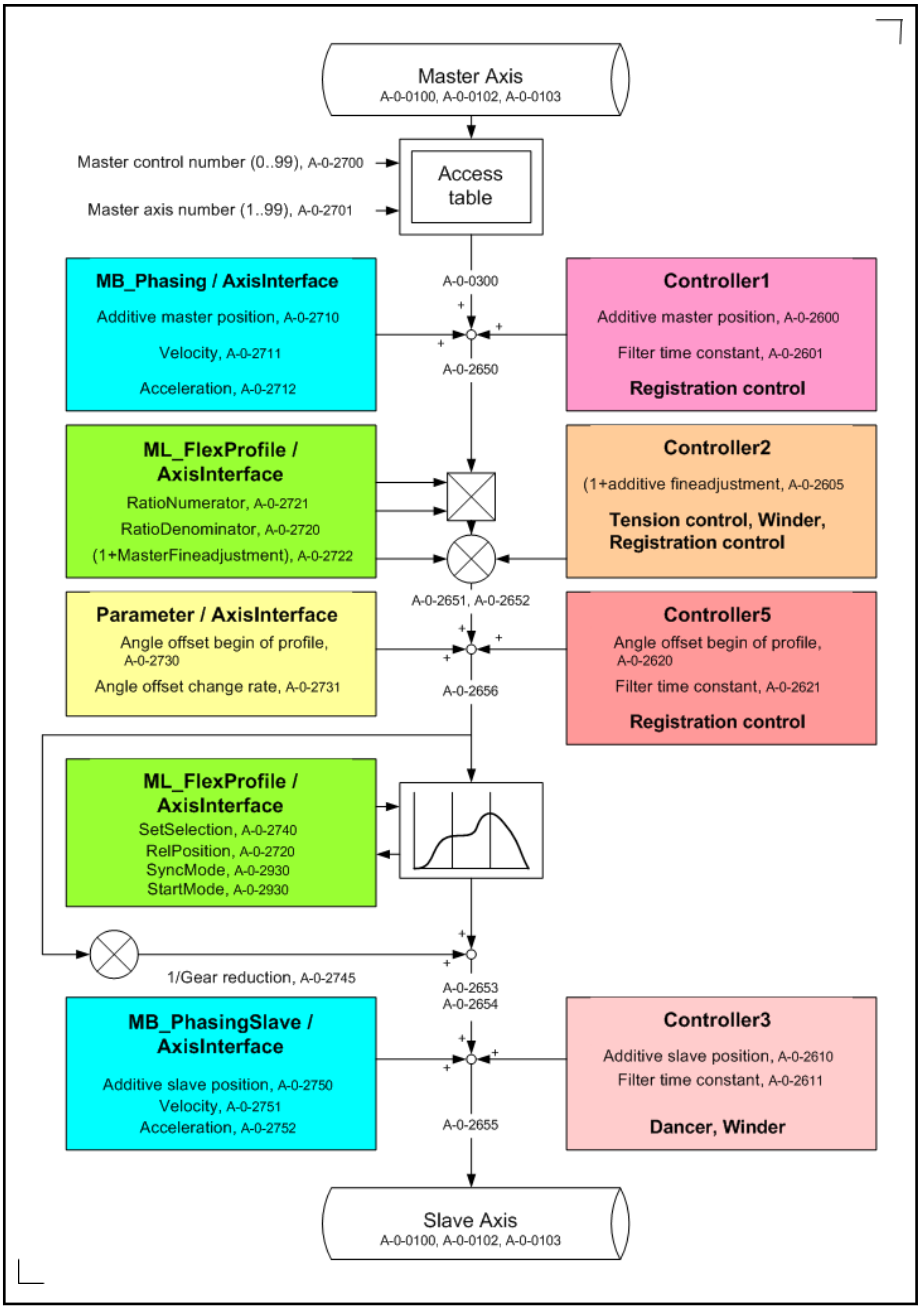


Fig.12-5: "Electronic MotionProfile FlexProfile" MotionControl functional chain

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

In the IndraMotion MLC system, there can be a coordinated motion for complex kinematics as axis groups via the integrated RobotControl.

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

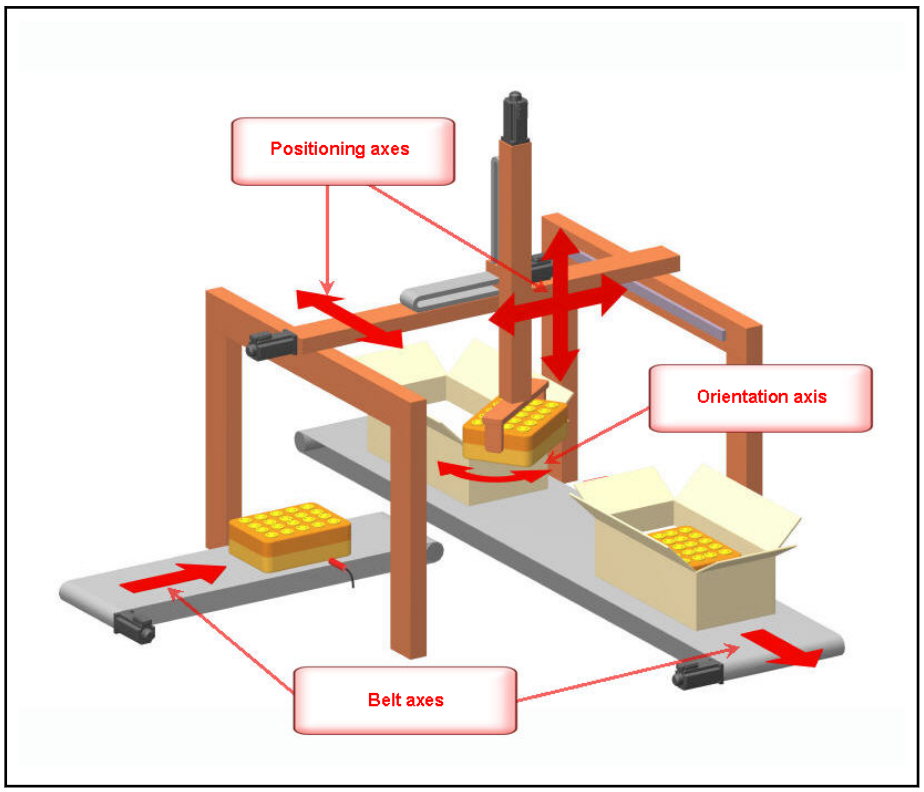


Fig. 12-6: Cartesian kinematics with belt axes

- Positioning axes (see page 198)

  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)

- Orientation axes (see page 198)

  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)

- Belt Axes (see page 199)

  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 RobotControl, the axes have to be added to the respective kinematics (axis group) first.

For this purpose, the function block "MC_AddAxisToGroup" 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).

Alternatively to the coordinated motion using RobotControl, the individual positioning axes of the kinematics can also be operated in the previously 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. The velocity and acceleration limit values of the orientation axes are considered for the path interpolation. 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

For a coordinated motion of the orientation axes using the RobotControl, they axes have to be added to the respective kinematics (axis group) first.

For this purpose, the MC_AddAxisToGroup function block has to be used. The axis is then in the "Coordinated Motion" state.

Alternatively to the coordinated motion using RobotControl, the individual orientation axes of the kinematics can also be operated in the previously mentioned single-axis modes.

12.4.4 Belt Axes

Belt axes are optional axes that are not actively commanded by the RobotControl. They 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, they 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.

12.5 Controlling Axes from the PLC Program

12.5.1 Overview

Motion sequences of the axes are specified in the IndraMotion system by the PLC program.

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:

- AxisInterface (see page 200)

  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

- PLCopen (see page 204)

  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 commissionings 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

- Kinematics (see page 209)

  In the IndraMotion MLC system, there can be a coordinated motion for the complex kinematics as axis groups via the integrated RobotControl.

  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, ...)

- Cyclic Data Channels Between Control and Drives (see page 214)

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. The majority of these places is covered by the IndraMotion 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 IndraMotion programming template or as a stand-alone interface for the axis functionality.

If it 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.

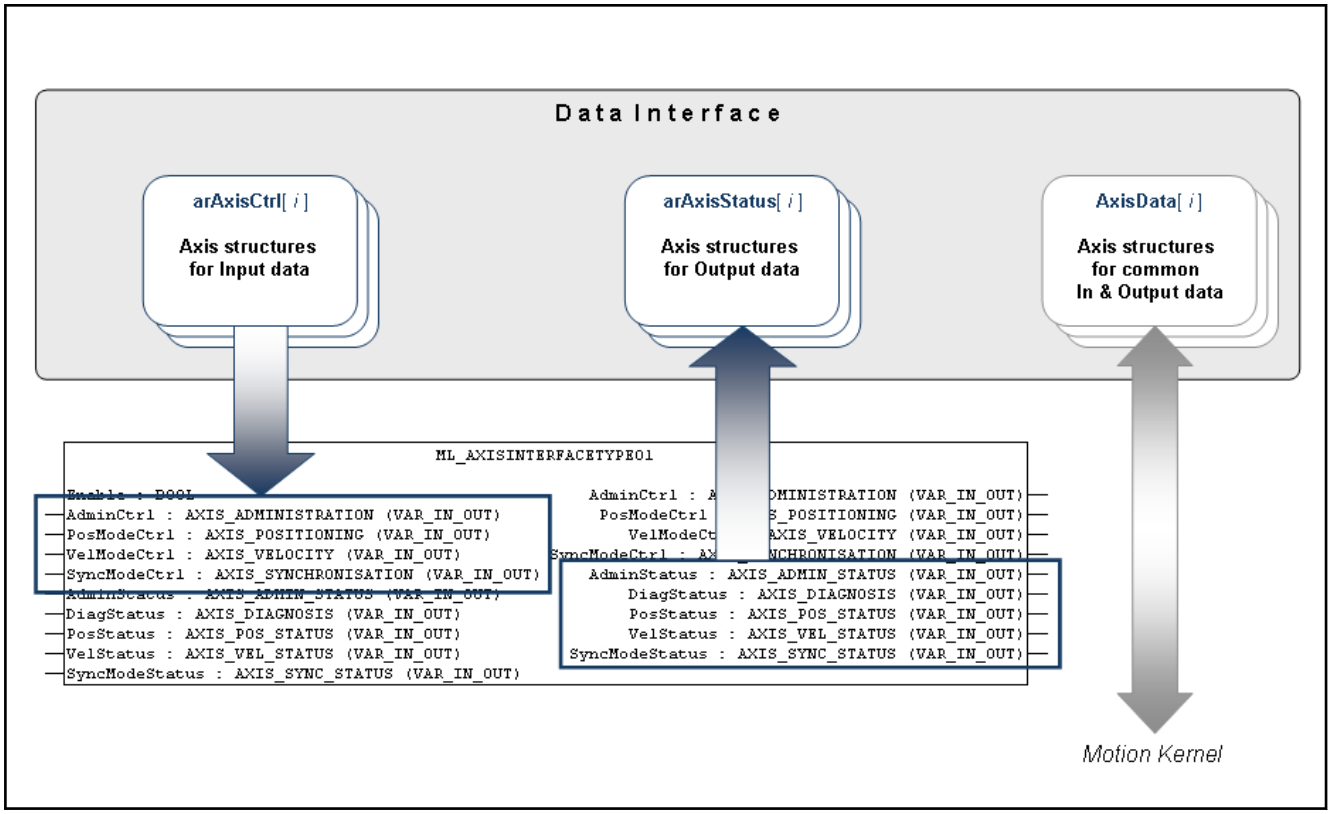


Fig. 12-7: AxisInterface data structure

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).

Fig. 12-8: 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.

Axis Types and Axis Modes

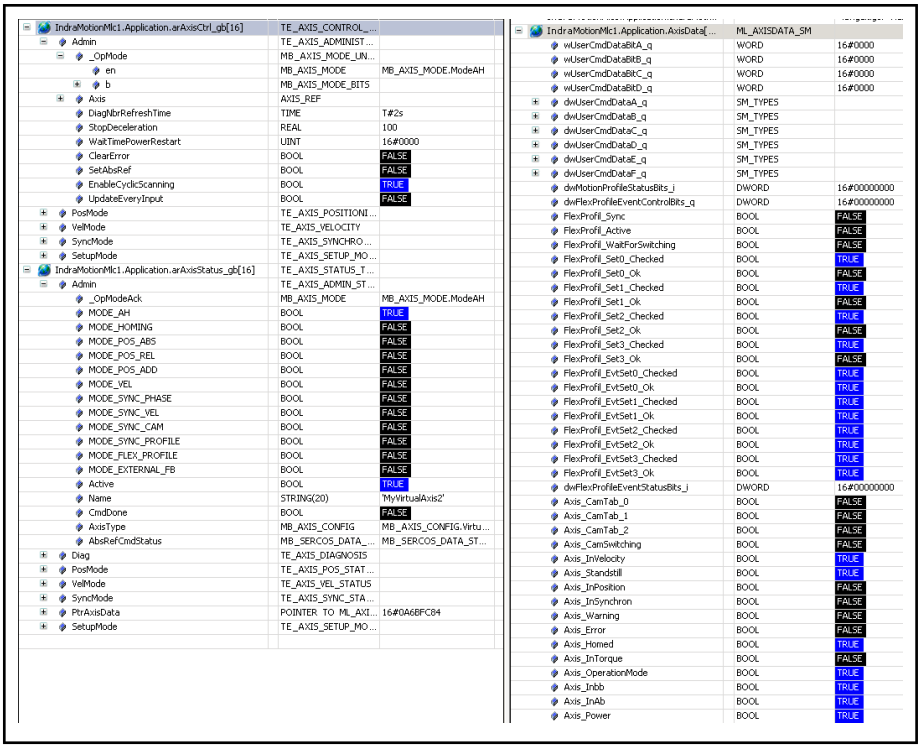


Fig. 12-9: Overview on the data structures of the AxisInterface

Functionality	Specifications	Status messages
Axis information	-	arAxisStatus_gb[].Admin
Error handling	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[ ]
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[ ]

Fig. 12-10: 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;
```

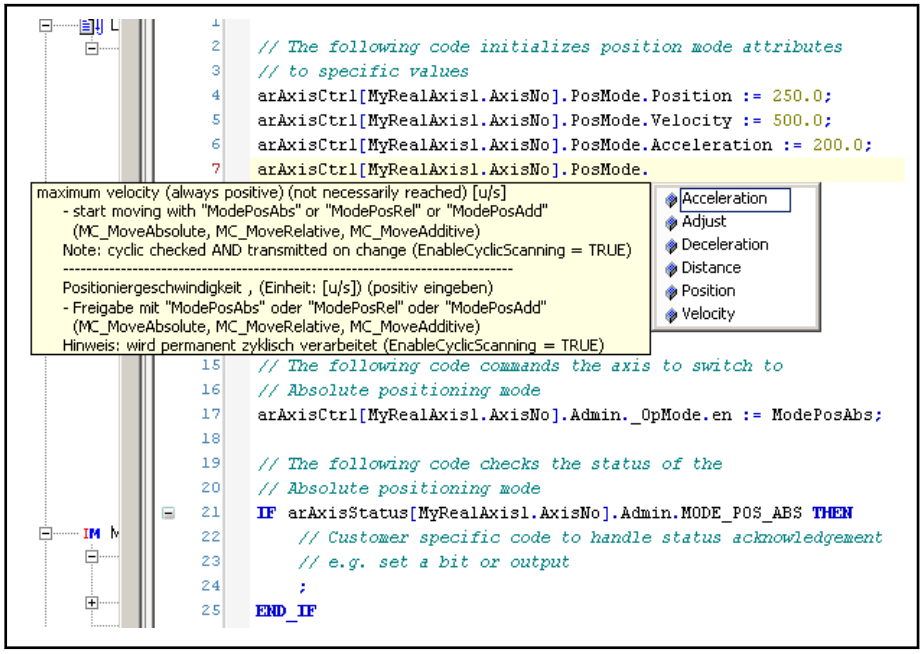
2. **Using the bit access**

   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 the attributes (e.g. position, velocity) that are used or that have default values that were changed must be declared before the current operation mode switch is executed.

The following example shows the correct programming sequence when changing the operation mode:

Fig. 12-11: 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 -> this value is written on parameter A-0-2730
  - 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: Synchronization velocity -> this value is written on parameter A-0-2790
  - SyncAcceleration: Synchronization 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 -> 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.

Individual extensions can be added. For this purpose, refer to the chapter "AxisInterface User Extension" in the "Rexroth IndraLogic XLC IndraMotion 13VRS Generic Application Template" documentation.

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**.

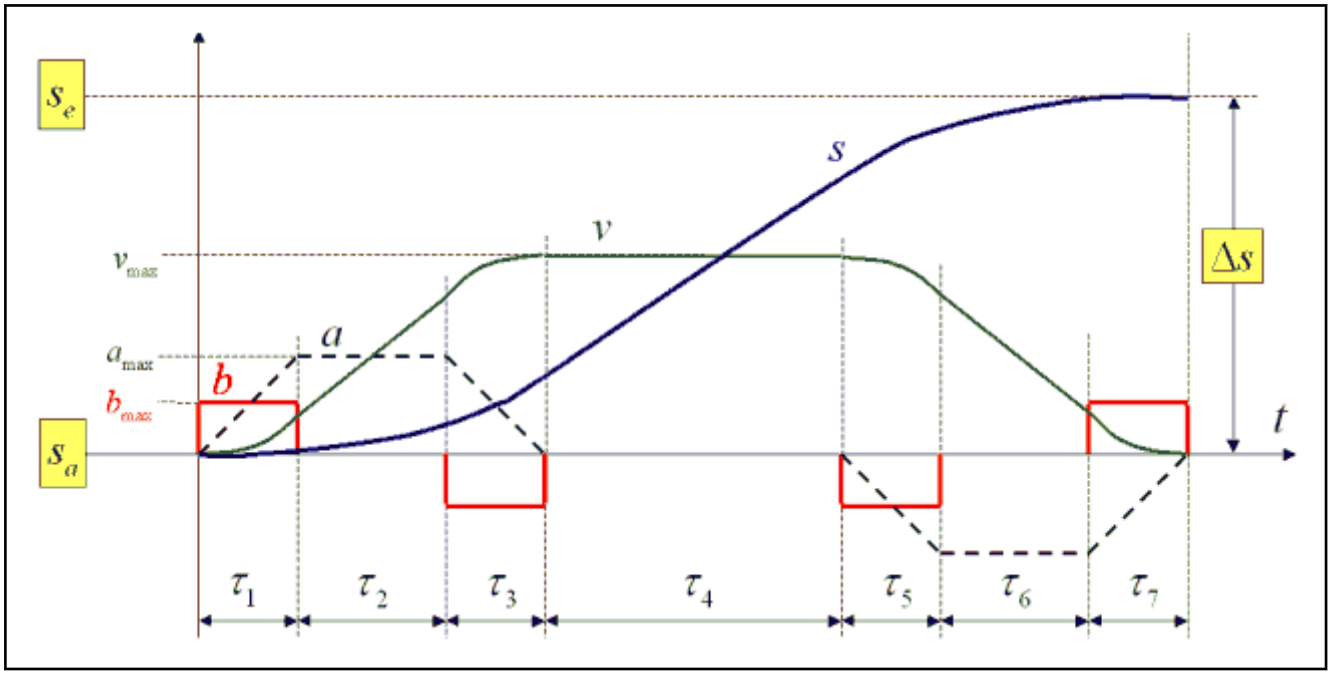
Seen from the **drive technology point of view** (Motion), the data assigned to a drive/an axis such as actual values, limit values, command values and con-

troller 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 according to 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. 12-12: 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.

The limitation of the values permitted for the drive is always automatically ensured.

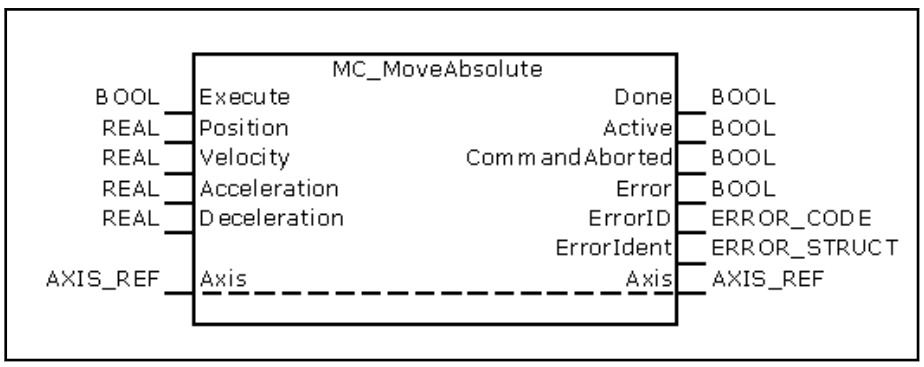


Fig. 12-13: PLCopen function block "MC_MoveAbsolute"

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 the Function Blocks They Support

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	IndraMotion MLC				
	Indra-Drive	HNC3x	Sercos Drive	Virtual axis	Control-ler axis
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				

Function block	IndraMotion MLC				
	Indra-Drive	HNC3x	Sercos Drive	Virtual axis	Control-ler axis
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
MC_MoveVelocity	X	X	X	X	X
MC_TorqueControl	X	X			X
MB_Phasing	X		X	X	X
MB_PhasingSlave	X		X	X	X

Fig.12-14: Function blocks supported by IndraMotion MLC

State Diagram of a Real Axis

The state diagram below defines the behavior of IndraMotion axes from the user's point of view if several IndraMotion 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. These motion commands follow the state diagram of the IndraMotion 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.

Axis Types and Axis Modes

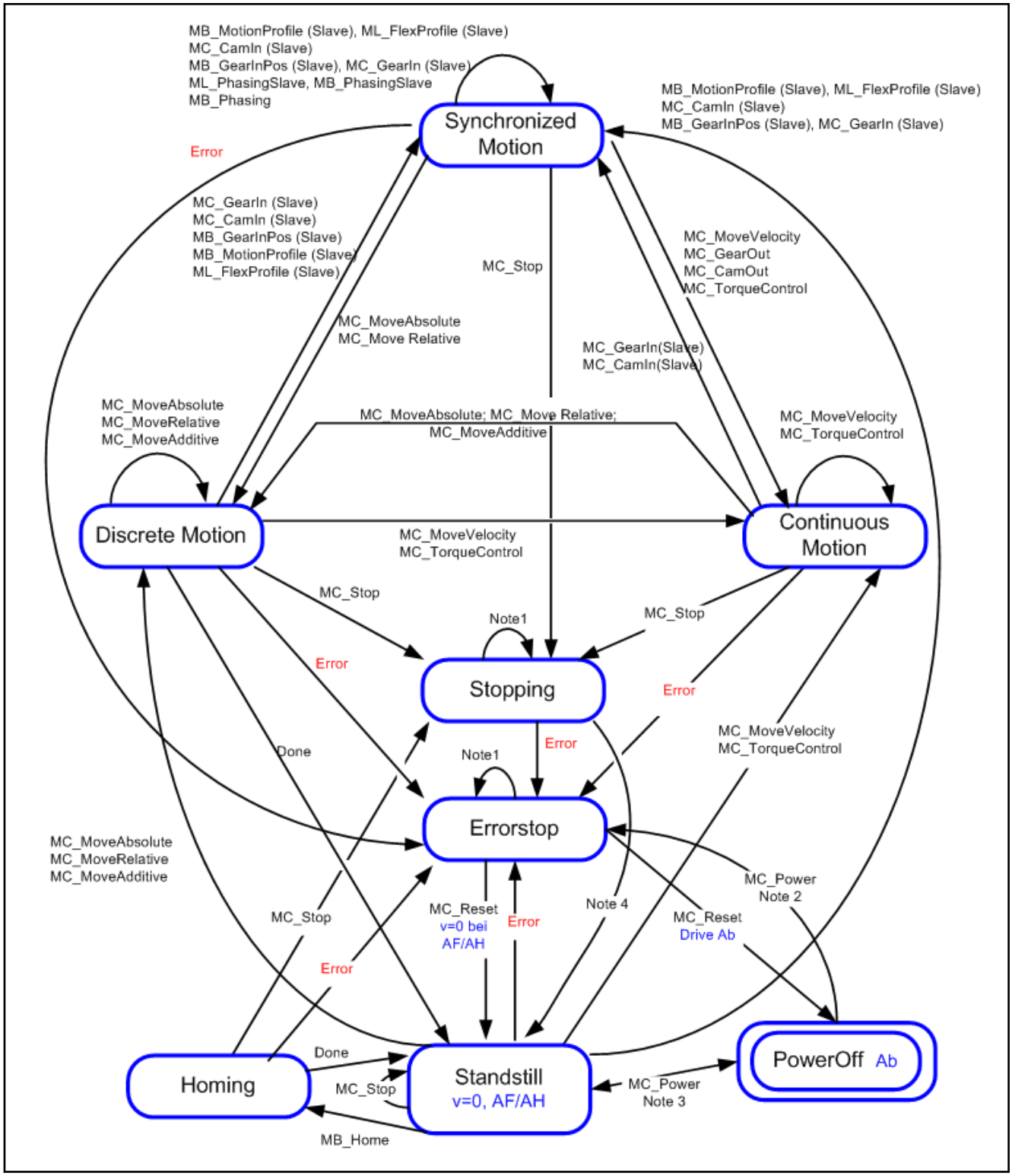


Fig.12-15: IndraMotion state diagram of a real axis (IndraMotion MLC)

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 fault-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 time, 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

General Information

In the IndraMotion MLC system, there can be a coordinated motion for complex kinematics as axis groups via the integrated RobotControl.

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, ...)

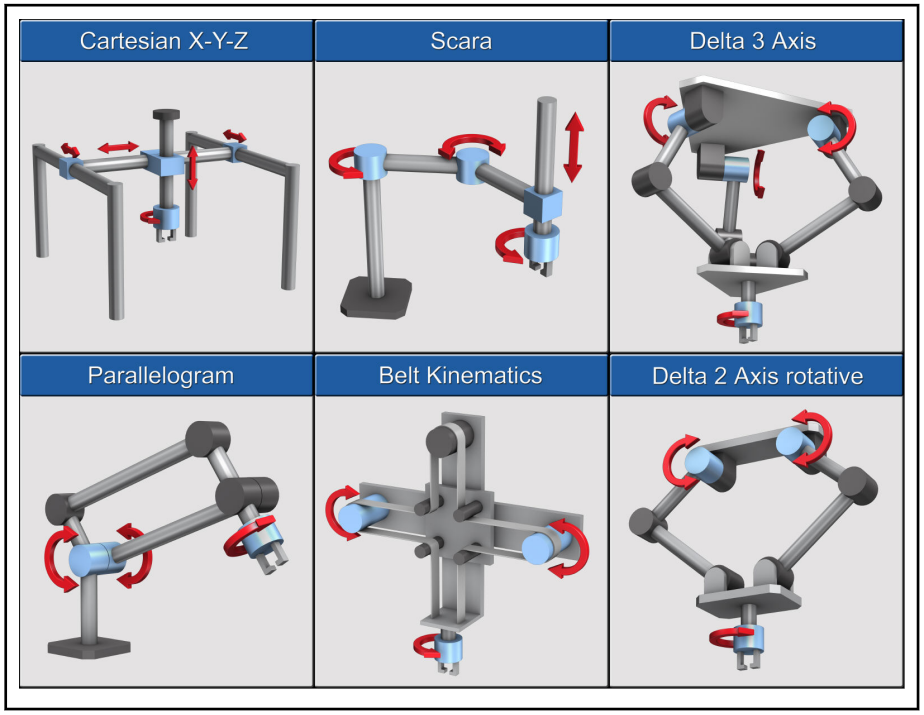


Fig. 12-16: Examples of available kinematics

The kinematics are managed from the PLC while a motion sequence can be sequentially programmed in an RCL program (RCL = **R**obot **C**ontrol **L**anguage).

To exchange data between the PLC and the RCL program, an individual PLC shared memory interface (KinData[xy]) exists for each kinematics.

Configuration and parameterization

A kinematics is configured in IndraWorks via the kinematic wizard. This wizard is opened via the "Robot" item in the project tree. The kinematic-specific characteristics configured are stored in a set of K-parameters.

These are, for example:

- Axis configuration of the kinematics
- Transformation scheme
- Transformation lengths
- Motion limit values
- ...

Axis Types and Axis Modes

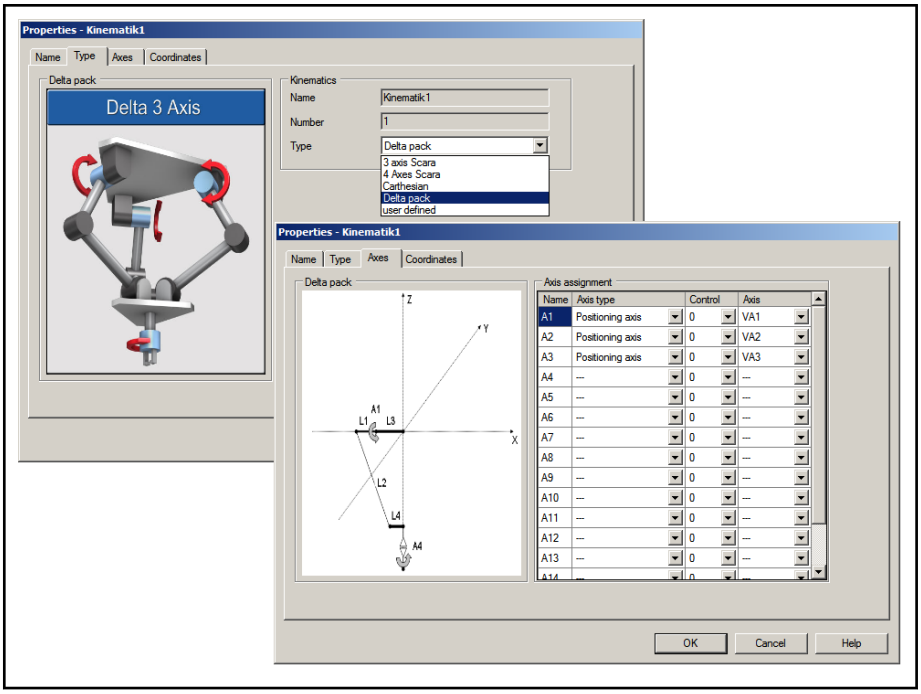


Fig.12-17: Kinematic wizard – Overview

Each kinematics is provided with an individual set of K-parameters.

Managing the kinematics in the PLC program

Multiple different function blocks are available to manage a kinematics. These function blocks are included in the PLC library **"ML_Robot"**. The PLC shared memory interface "KinData[xy]" of the kinematics is located in this library under "Global Variables".

For a coordinated motion of a kinematics, the axes belonging to the kinematics have to be added to the PLC program (only positioning and orientation axes) first.

For this purpose, the "MC_AddAxisToGroup" function block has to be used. The axis is then in the "Coordinated Motion" state.

To add an axis to the kinematics, the axis has to be referenced, error-free, in standstill and provided with power.

After all positioning and orientation axes have been added to the kinematics, the kinematics is in the "Standstill Complete" state.

To provide an overview on possible kinematic states, the state diagram of a kinematics is shown in the following. The diagram shows the essential states and the respective function blocks required for a change in state.

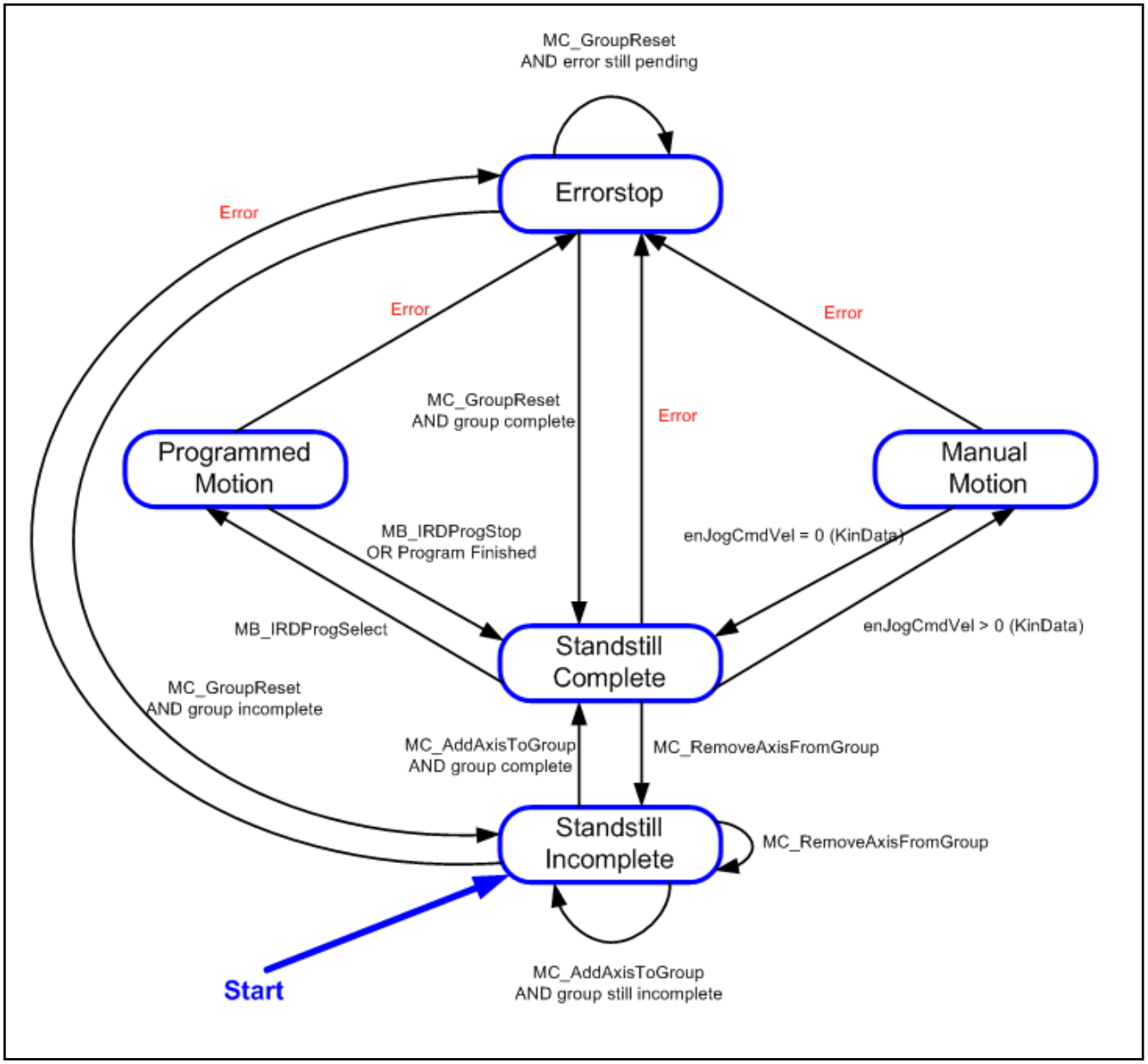


Fig. 12-18: Kinematics – State diagram

There are the following options to move the kinematics to the "Standstill Complete" state:

- **"Manual Motion"**

  In the "Manual Motion" state, the kinematics can be manually moved via the jog interface.

  Reach the individual elements of the jog interface via the structure "Kindata[xy].stJogCmd_q".

  With the jog interface, the kinematics can be moved incrementally or continuously in world or axis coordinates.

  At incremental/continuous jogging, two different parameterizable step widths are available

- **"Programmed Motion"**

Axis Types and Axis Modes

An RCL program is processed in the "Programmed Motion" state. The RCL program to be processed has to be selected first and then started.

Use the "MB_IRDProgSelect" function block to select the RCL program. After executing the function block "MB_IRDProgSelect", the kinematics is in the "Programmed Motion - Program Selected" state.

The RCL program is started via the "MB_IRDProgStart" function block. After executing the function block "MB_IRDProgStart", the kinematics is in the "Programmed Motion - Program Running" state.

The following figure provides an overview on the substates in the "Programmed Motion" mode

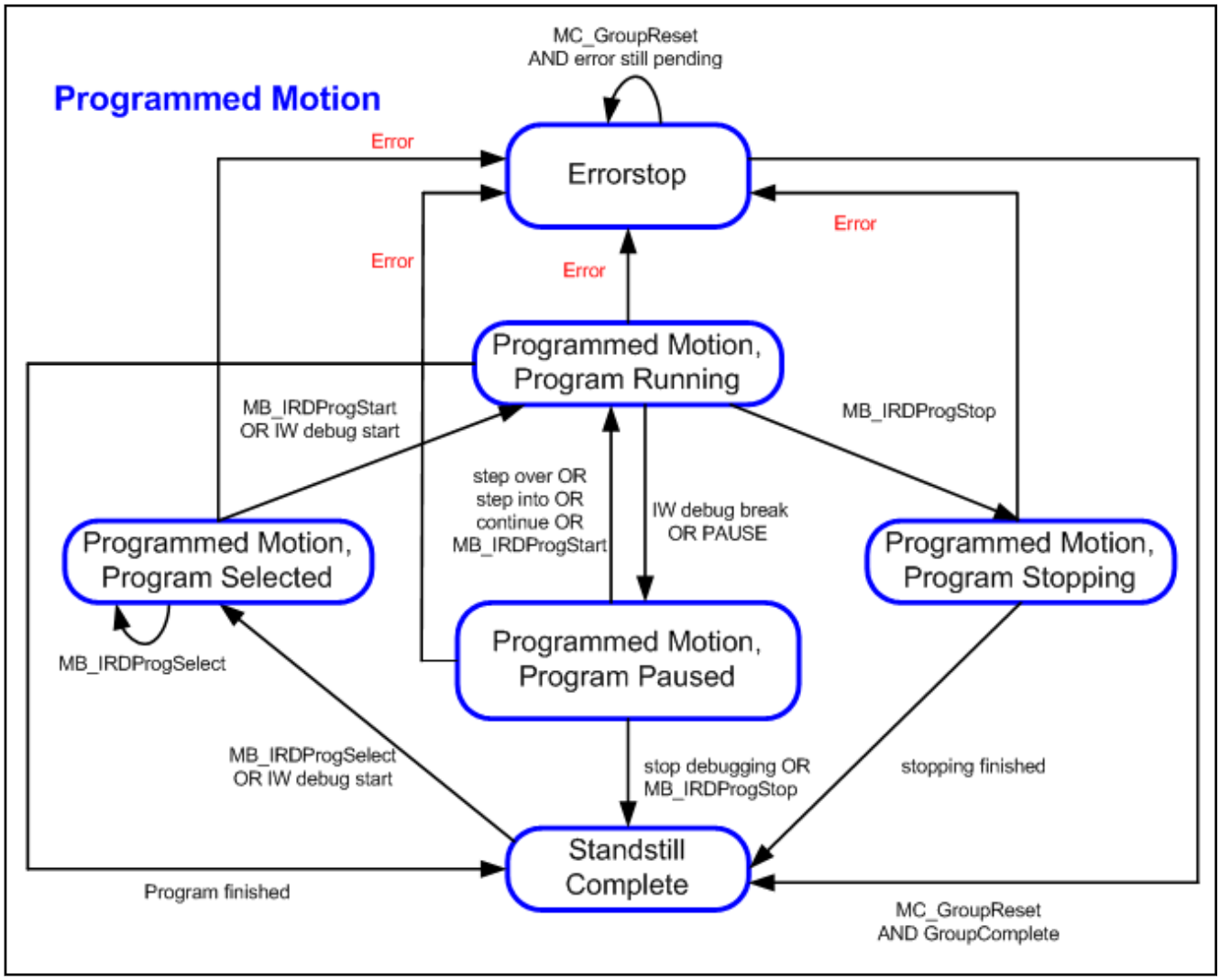


Fig. 12-19: "Programmed Motion" state machine

Use the PLC shared memory interface (KinData[xy]) to exchange data between the PLC and the RCL program.

The PLC-shared memory interface is updated in the Motion cycle and includes the following information:

Program:

```
TYPE  ML_KINEMATICSDATA_SM :
STRUCT
 uiCoordSum_i               :UINT;           (* K-0-0007 -RD- Sum of coord. (number of axes) *)
 uiUpdateCount_i            :UINT;           (* x-x-xxxx -RD- Odd=begin of updating, *)
                                             (*Even= ready *)
 arPositionJointCoord_i     :ML_ARR_COORDS;  (* A-0-0100 -RD- Kin. pos. in joint coord. *)
 arPositionOriginalCoord_i  :ML_ARR_COORDS;  (* K-0-0100 -RD- Kin. pos. in carth. original coord. *)
 arPositionWorkpieceCoord_i :ML_ARR_COORDS;  (* K-0-0105 -RD- Kin. pos. in carth. workpiece coord. *)

 strToolName_i              :ML_ROCO_NAME;      (* K-0-0140 -RD- Tool name *)
 arToolCoord_i              :ML_ARR_PLACEMENT;  (* K-0-0106 -RD- Coordinate values of tool *)

 strWorkpieceName_i         :ML_ROCO_NAME;      (* K-0-0141 -RD- Workpiece name *)
 arWorkpieceCoord_i         :ML_ARR_PLACEMENT;  (* K-0-0107 -RD- Coordinate values of workpiece *)

 Kin_OpMode_Auto            :BIT;  (* K-0-0021.00 -RD- Operating mode Automatic active *)
 Kin_OpMode_Manual          :BIT;  (* K-0-0021.01 -RD- Operating mode Manual active *)
 Kin_JogCoord1              :BIT;  (* K-0-0021.03 -RD- Jog Coordinate System *)
 Kin_JogCoord2              :BIT;  (* K-0-0021.04 -RD- Jog Coordinate System *)
 Kin_StandStill             :BIT;  (* K-0-0021.05 -RD- All axes in Stand Still *)
 Kin_InPosition             :BIT;  (* K-0-0021.06 -RD- All axes in position *)
 Kin_BeltSynchron           :BIT;  (* K-0-0021.07 -RD- Belt synchron movement active *)
 Kin_Warning                :BIT;  (* K-0-0021.08 -RD- Warning *)
 Kin_Error                  :BIT;  (* K-0-0021.09 -RD- Error *)
 Kin_NotHomed               :BIT;  (* K-0-0021.10 -RD- Not all axes in reference *)
 Kin_TrafoValuesInvalide    :BIT;  (* K-0-0021.12 -RD- Not all axes in reference *)
 Kin_JogEnable              :BIT;  (* K-0-0021.13 -RD- Jog motion enabled *)
 Kin_DriveOn                :BIT;  (* K-0-0021.14 -RD- All axes drive on, torque on axis *)
 Kin_FeedEnabled            :BIT;  (* K-0-0021.15 -RD- Feed enabled *)
 Kin_BlockEnabled           :BIT;  (* K-0-0021.16 -RD- Block transfer enabled *)
 Kin_ErrorReaction          :BIT;  (* K-0-0021.17 -RD- Error reaction active *)
 Kin_JogMode1               :BIT;  (* K-0-0021.18 -RD- Jog Mode *)
 Kin_JogMode2               :BIT;  (* K-0-0021.19 -RD- Jog Mode *)
 Kin_ProgSelected           :BIT;  (* K-0-0021.21 -RD- RCL program selected *)
 Kin_ResetActive            :BIT;  (* K-0-0021.23 -RD- Reset is active *)
 Kin_ProgEnded              :BIT;  (* K-0-0021.24 -RD- RCL program ended *)
 Kin_ProgStarted            :BIT;  (* K-0-0021.25 -RD- RCL program started *)
 Kin_ProgPaused             :BIT;  (* K-0-0021.26 -RD- RCL program paused *)

 Kis_ErrorStop              :BIT;  (* K-0-0022.00 -RD- State "Error" *)
 Kis_Stopping               :BIT;  (* K-0-0022.01 -RD- State "Stopping" *)
 Kis_Incomplete             :BIT;  (* K-0-0022.03 -RD- State "Incomplete", not all axes grouped *)
 Kis_ProgrammedMotion       :BIT;  (* K-0-0022.05 -RD- State "Programmed Motion" *)
 Kis_StandStill             :BIT;  (* K-0-0022.07 -RD- State "Stand Still" *)
 Kis_ProgramSelected        :BIT;  (* K-0-0022.08 -RD- State "Program Selected" *)
 Kis_Running                :BIT;  (* K-0-0022.09 -RD- State "Program Running" *)
 Kis_ManualMotion           :BIT;  (* K-0-0022.10 -RD- State "Manual Motion" *)
 Kis_ProgramPaused          :BIT;  (* K-0-0022.11 -RD- State "Program Paused" *)

 arProgrEndPos_i     :ARRAY[1..2] OF ML_ARR_COORDS; (* K-0-2200/2201 -RD- Current act. progr. pos.*)
 wProgrEndPosType_i  :WORD;                  (* K-0-2202 -RD- Current active programmed pos. type*)
                                             (* 0 = notvalid (e.g. non moving block active)
                                                1 = arProgrEndPos_i in WC (world coordinates)
                                                2 = arProgrEndPos_i in JC (joint coordinates) *)
 wIpoType_i                  :WORD;          (* K-0-2203 -RD- current Interpolation Type*)
                                             (* bit 0, 1:0=Nointerpolationactive
                                                bit 0, 1 : 1 = Linear
                                                bit 0, 1 : 2 = Circular
                                                bit 2, 3 : Reserved
                                                bit 4, 5 : 0 = No slope active
                                                bit 4, 5 : 1 = Block slope
                                                bit 4, 5 : 2 = Program slope *)
 strQLLFileName_i    :ML_ROCO_NAME;   (* K-0-2204 -RD- Name of the current active QLL-file *)
 dwQLLLnNumber_i     :DWORD;          (* K-0-2205 -RD- Current act. line number of act. QLL-file *)

 dwUserBits_i    :DWORD;                (* -RD- User data, PLC inp. / RoCo outp. *)
 adiUserDInt_i   :ARRAY[1..4] OF DINT;  (* -RD- User data, PLC inp. / RoCo outp. *)
 arUserReals_i   :ARRAY[1..4] OF REAL;  (* -RD- User data, PLC inp. / RoCo outp. *)

 stJogCmd_q                  :ML_KIN_JOG;        (* x-x-xxxx -RW- Command interface for jog mode *)

 dwUserBits_q    :DWORD;                         (* -RW- User data, PLC outp. / RoCo inp. *)
 adiUserDInt_q   :ARRAY[1..4] OF DINT;           (* -RW- User data, PLC outp. / RoCo inp. *)
 arUserReals_q   :ARRAY[1..4] OF REAL;           (* -RW- User data, PLC outp. / RoCo inp. *)
 arUserPoints_q  :ARRAY[1..4] OF ML_ARR_COORDS; (* -RW- User data, PLC outp. / RoCo inp. *)
END_STRUCT
END_TYPE
```

Programming the motion in the RCL program

Each kinematics is controlled by its own RCL program.

The motion sequence of the robot is sequentially programmed via motion statements in the RCL program. Motion statements describe the motion of a robot from a current position and orientation to a target point.

A motion statement consists of the following single statements:

- Motion command
- Interpolation method
- Additional information
- Abort condition (optional)
- Approaching method
- Target position

The following table provides an overview on possible entries.

Motion statements				
Motioncommand	**Interpolation method**	**Additional information**	**Abort condition**	**Approaching method**
MOVE	LINEAR	A	UNTIL	TO
MOVE_REL	CIRCULAR	V		VIA
	PTP	R		APPROX
		VFACTOR		EXACT
		AFACTOR		
		DFACTOR		
		V_PTP		
		R_PTP		
		T		

Fig. 12-20: Overview on motion statements

Programming an abort condition is optional.

Approaching method and target position have to be specified for each motion command.

For more information on the RCL programming, the kinematic parameters and the KinData[xy] - Interface, refer to the manual "Rexroth IndraMotion MLC 13VRS RCL Programming Instructions" (see chapter 1.3 "Required and Supplementing Documentations" on page 10).

12.5.5 Cyclic Data Channels Between Control and Drives

The control and the drives exchange data via the sercos bus using:

- the 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.

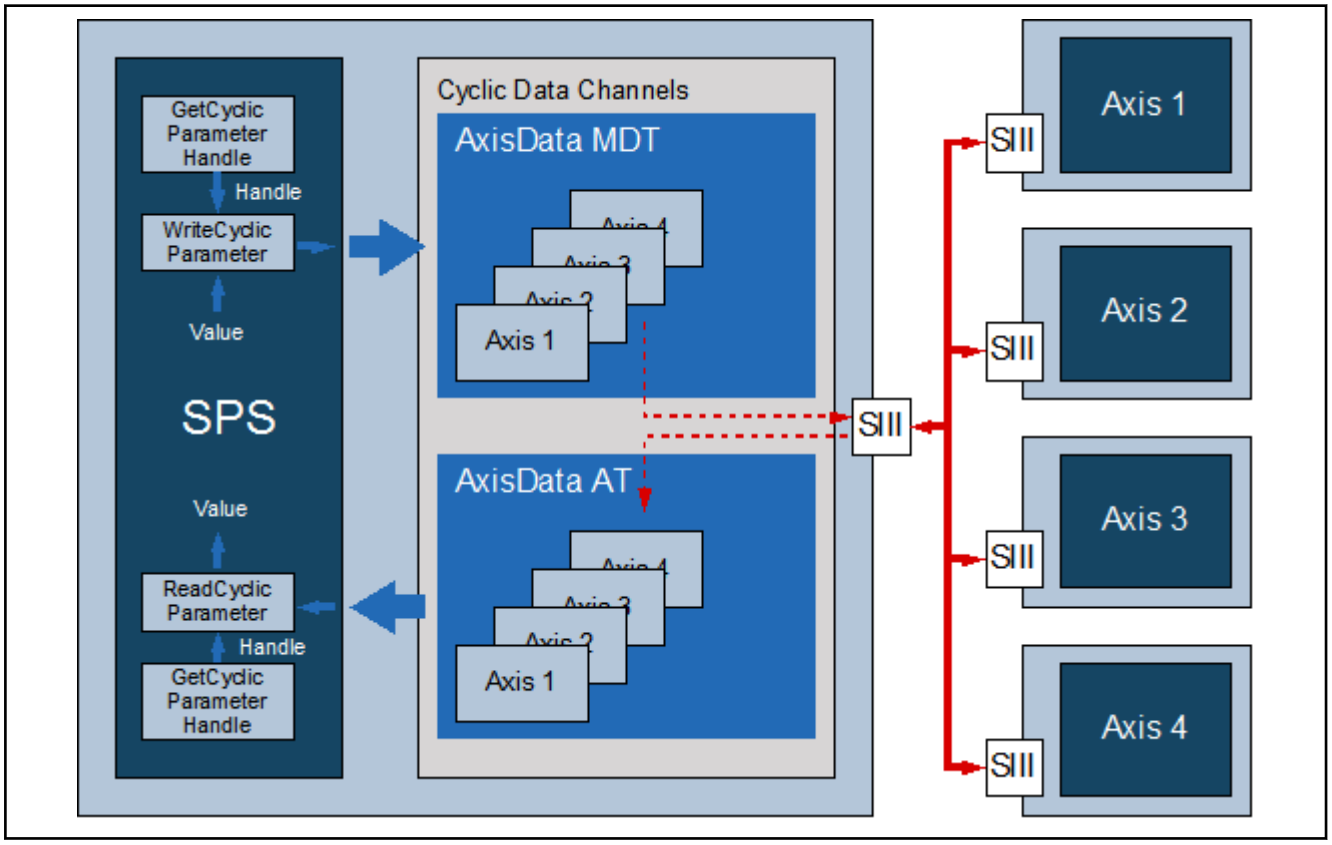


Fig. 12-21: Accessing the cyclic data using the "CyclicParameter" function blocks and functions

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 library ML_TechBase (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 parameters whose values may be transferred.

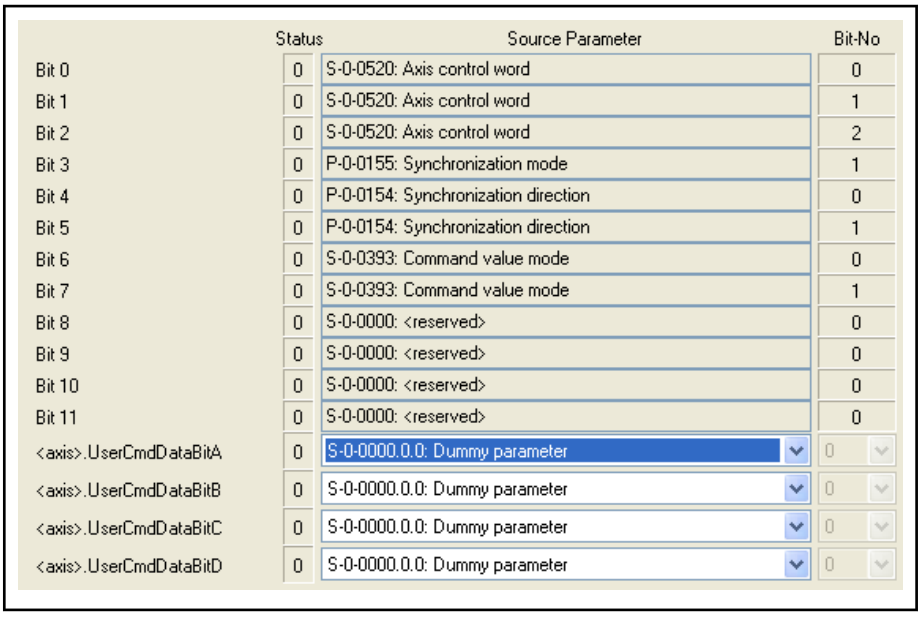


Fig.12-22: S-0-0145, Signal control word (IndraWorks dialog at IndraMotion MLC)

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 library ML_TechBase (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 library ML_TechBase (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 IndraMotion provides ready function blocks (e.g. MB_TouchProbe) that control from the PLC. 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_TechBase (subfolder Utilities → CyclicData). For the access, refer to the function block MB_GetCyclicParameterHandle() and the functions MB_WriteCyclicParameter() or MB_WriteCyclicRealParameter().

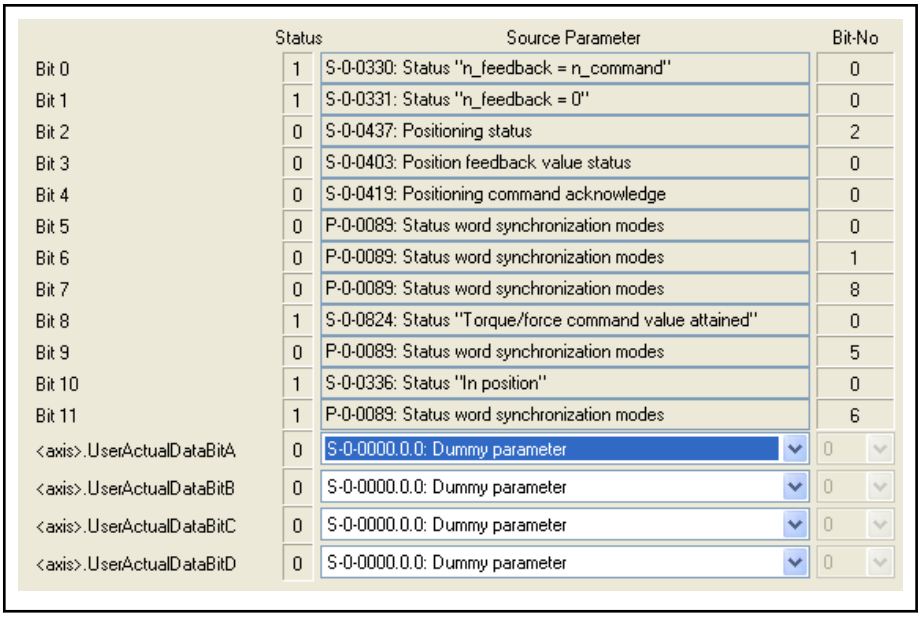
AT (drive ⇒ control): S-0-0144, Signal status word

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 library ML_TechBase (subfolder Utilities → CyclicData). For the configuration, refer to the MB_AllocCyclicParameter() function block.

The parameter "A-0-0599, List of freely configurable parameters in the signal status word" contains the possible parameters whose values can be transferred.

Axis Types and Axis Modes



	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.12-23: S-0-0144, Signal status word (IndraWorks dialog IndraMotion MLC)

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 provides ready function blocks (e.g. MB_TouchProbe) that read 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 library ML_TechBase (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 library ML_TechBase (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 can 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, the IndraMotion provides ready function blocks (e.g. MB_TouchProbe) that control 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 pos-
itive edge
```

Implementation:

```
rProbeValue1PosEdge := AxisData[Drive1.AxisNo].dwUserAc-
tualDataA_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_TechBase (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.

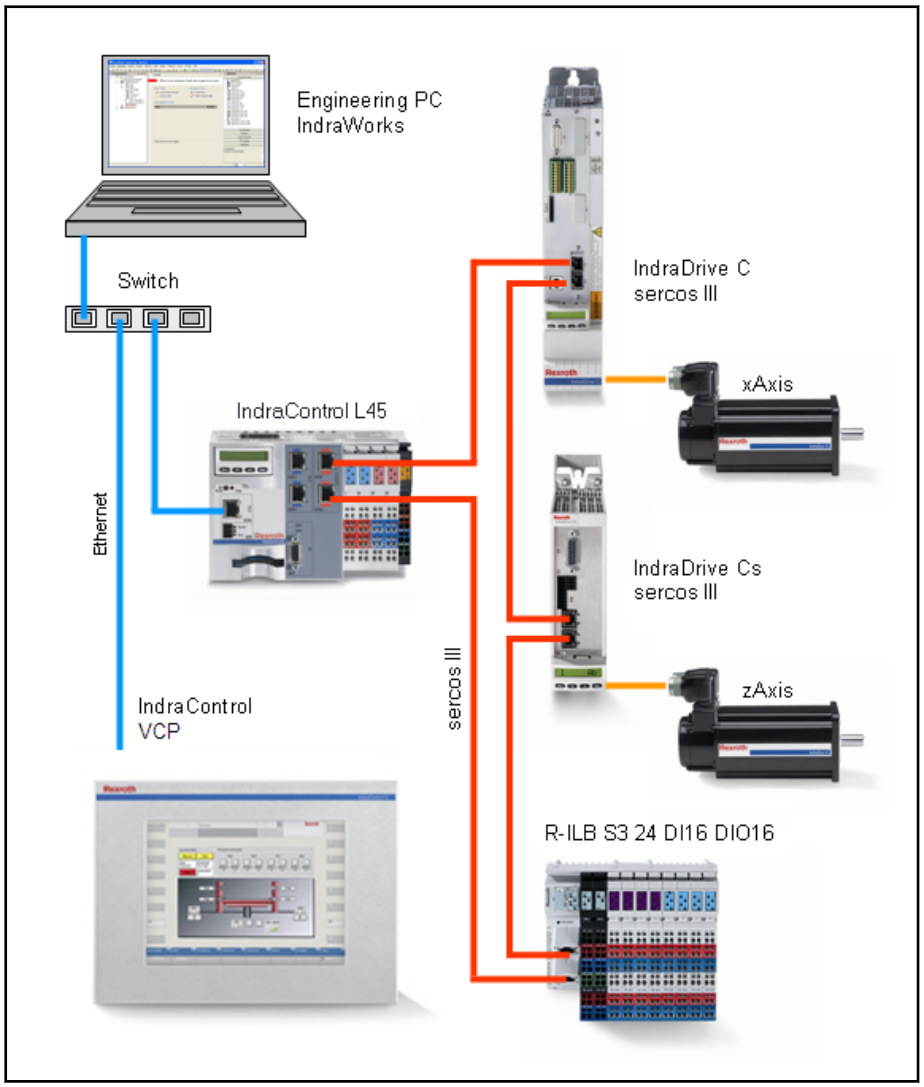


Fig. 13-1: System configuration

Ordering Example

13.2 Material List

Number	Designation	Ordering/parts 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: IndraWorks Engineering Framework			
1	Software	SWA-IWORKS-ML*-13VRS-D0-DVD**	DVD data carrier
1	Software license	SWL-IWORKS-ML*-13VRS-D0-ENG	Single license with activation code for the IndraMotion MLC
CamBuilder (optional):			
1	Software options	SWS-IWORKS-CAM-13VRS-D0	Single license for the IndraWorks Tool CamBuilder
Control: IndraMotion MLC			
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-13VRS-D0	IndraMotion MLC 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			

Ordering Example

Number	Designation	Ordering/parts 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	MultiMediaCard 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
Drive IndraDrive Cs: 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, label panel)
Accessories:			
4	sercos III cable, assembly	RKB0011/001,0	Bus cable, sercos III assembly, Ethernet cable, assembly, flexible lengths, cable length 1,0 m
1	Switch optionally with power supply unit	Commercial	
1	Optional 24 V power supply unit	Commercial	
1	Optional screwdriver	Commercial	

Fig. 13-2: 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 Helpdesk & Hotline** 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 resulting in the malfunction
- Type plate name of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your email address)

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