

Rexroth IndraMotion MLC 13VRS RegisterControl

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Purpose of Documentation This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.

Record of Revision

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Bgm.-Dr.-Nebel-Str. 2 ■ 97816 Lohr a. Main, Germany

Phone +49 9352 18 0 ■ Fax +49 9352 18 8400

<http://www.boschrexroth.com/>

System Development Automation Motion Logic Control, HoS (FrWe/PiGe)

Note This document has been printed on chlorine-free bleached paper.

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1 About this Documentation

1.1 Validity of the Documentation

Target group This documentation is intended for users wanting to determine the registration mark position by using an evaluation unit (mark stream sensor). The function blocks for register control (automatic controller parameterization, acceleration compensation and decoupling network) are described.

This documentation supports the user during the phases:

- Engineering
- Commissioning

1.2 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-COxx-EN-P, R911336880 This documentation describes the IndraWorks installation.	X	X
/5/	Rexroth IndraWorks 13VRS Engineering DOK-IWORKS-ENGINEE*V13-APxx-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-APxx-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-APxx-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-APxx-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-APxx-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-APxx-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

About this Documentation

IndraWorks		MLC	XLC
/29/	Rexroth IndraLogic XLC IndraMotion MLC 13VRS Project Conversion DOK-XLCMLC-PROCONV*V13-APxx-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-COxx-EN-P, R911336308 This documentation describes the steps required to commission and perform service on the IndraMotion MLC system. It includes checklists for tasks to be frequently performed and a detailed description of the steps.	X	

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Fig. 1-1: XCL/MLC documentation overview

Motion		MLC	XLC
/23/	Rexroth IndraLogic XLC IndraMotion MLC 13VRS PLCopen Libraries DOK-XLCMLC-FUNLIB**V13-LIxx-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-APxx-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-APxx-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-RExx-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**-FKxx-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**-APxx-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.		

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Fig. 1-2: XCL/MLC documentation overview

About this Documentation

Field buses		MLC	XLC
/39/	Rexroth IndraMotion MLC 11VRS PLCopen Field Bus DOK-IM*ML*-PLCFBUS*V11-APxx-EN-P, R911333896 This documentation describes the creation of field bus drives in an IndraWorks project, function blocks, functions and data types of the RIL_CommonTypes.library (excerpt for field bus drives), the RMB_PLCOpenFieldBus.library and the RIL_Utilitys.library (excerpt for field bus drives). It also includes the error reactions of function blocks.	X	X
/4/	Rexroth IndraWorks 13VRS Field Buses DOK-IWORKS-FB*****V13-APxx-EN-P, R911336872 This documentation describes the supported field buses and their diagnostic function blocks.	X	X
/63/	SERCOS System Manual for I/O Devices DOK-CONTRL-ILS3*****-APxx-EN-P, R911333512 This documentation describes the configuration, parameterization, commissioning and diagnostics of I/O devices with a SERCOS interface.	X	X

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Fig. 1-3: XCL/MLC documentation overview

HMI		MLC	XLC
/8/	Rexroth IndraWorks 13VRS HMI DOK-IWORKS-HMI*****V13-APxx-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-APxx-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-APxx-EN-P, R911336362 This documentation describes the visualization systems supported by the IndraLogic XLC and IndraMotion MLC and their connection.	X	X

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Fig. 1-4: XCL/MLC documentation overview

PLC		MLC	XLC
/3/	Rexroth IndraWorks 13VRS IndraLogic 2G Programming Instruction DOK-IWORKS-IL2GPRO*V13-APxx-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-LIxx-EN-P, R911336285 This documentation describes the system-comprehensive PLC libraries.	X	X

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Fig. 1-5: XCL/MLC documentation overview

About this Documentation

Technology		MLC	XLC
/30/	Rexroth IndraMotion MLC 13VRS Technology Libraries DOK-MLC***-TF*LIB**V13-LIxx-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-LIxx-EN-P, R911336306 This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.	X	
/62/	Rexroth IndraMotion MLC 13VRS RegisterControl (Application Manual) DOK-MLC***-REGI*CO*V13-APxx-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-APxx-EN-P, R911336326 This application-related system documentation describes the application of the winder technology functions.	X	

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Fig. 1-6: XCL/MLC documentation overview

Hardware		MLC	XLC
/1/	Rexroth IndraControl L45/L65/L85 Control DOK-CONTRL-ICL45L65L85-PRxx-EN-P, R911332116 This documentation describes the IndraControl L45/L65/L85 controls.	X	X
/2/	Rexroth IndraControl L25 DOK-CONTRL-IC*L25*****-PRxx-EN-P, R911328474 This documentation describes the IndraControl L25 controls.	X	X
/24/	Rexroth IndraControl Lxx 13VRS Function Modules DOK-CONTRL-FM*LXX**V13-APxx-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**-PAxx-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.		

About this Documentation

Hardware		MLC	XLC
/13/	Rexroth IndraDrive MPx-02 to MPx-07 and HMV DOK-INDRV*-GEN-**VRS**-WAxx-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*****-PRxx-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.		

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Fig. 1-7: XCL/MLC documentation overview

Diagnostics and service		MLC	XLC
/26/	Rexroth IndraMotion MLC/MLP/XLC 11VRS IndraMotion Service Tool DOK-IM*ML*-IMST***V11-RExx-EN-P, R911331940 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-RExx-EN-P, R911336358 This documentation includes all control parameters implemented in the control systems IndraLogic XLC and IndraMotion MLC.	X	X

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Fig. 1-8: XCL/MLC documentation overview

System Overview		MLC	XLC
/48/	Rexroth IndraMotion for Printing 13VRS System Overview DOK-IM*PR*-SYSTEM**V13-PRxx-EN-P, R911336289 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	
/48/	Rexroth IndraMotion for Packaging 13VRS System Overview DOK-IM*PA*-SYSTEM**V13-PRxx-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	

About this Documentation

System Overview		MLC	XLC
/9/	Rexroth IndraMotion MLC 13VRS System Overview DOK-MLC***-SYSTEM**V13-PRxx-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-PRxx-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

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Fig. 1-9: XCL/MLC documentation overview

First steps		MLC	XLC
/25/	Rexroth IndraMotion MLC 13VRS, First Steps DOK-MLC***-F*STEP**V13-COxx-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-COxx-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

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Fig. 1-10: XCL/MLC documentation overview

1.3 Information Representation

1.3.1 Safety Instructions

If there are safety instructions, they contain certain signal words (Danger, Warning, Caution, Notice) and if applicable, signal alert symbols (acc. to ANSI Z535.6-2006).

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

The signal alert symbol (warning triangle with exclamation mark) positioned in front of the signal words Danger, Warning and Caution indicates hazards for individuals.

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.

1.3.2 Symbols

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.

1.3.3 Descriptions

Designation	Explanation
Runtime license	A check for the license is carried out at runtime. For each control, on which the function blocks are used, one license is required (runtime license).
Mark stream sensor	Evaluation unit, sampling a mark stream and measuring the mark positions.
Teach-In	Process during which the mark stream sensor measures the threshold values for the mark measurement.
Measurement	Mark positions of the defined marks are determined and send to the control.
Barcode	Sequence of at least 3 blocks that can be found automatically by the sensor.
S-curve	Jerk-limited acceleration phase

Fig. 1-11: Used descriptions

1.3.4 Abbreviations

Abbreviation	Description
OWL	Optical waveguide
I.e.	This means that
mm	Millimeter
e.g.	For example
n.def.	Not defined
cf.	Compare
MLC	MotionLogic Control

About this Documentation

s	Second
m	Meter
%	Percent

Fig. 1-12: Abbreviations used

2 Important Instructions on Use

2.1 Appropriate Use

2.1.1 Introduction

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

The products may only be used in the appropriate way. If they are not used in the appropriate way, situations resulting in property damage and personal injury can occur.



Bosch Rexroth as manufacturer is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for an appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the products take the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Ensure that the products have been installed in the manner described in the relevant documentation.

2.1.2 Areas of Use and Application

Rexroth IndraLogic XLC/
IndraMotion MLC

IndraLogic XLC/IndraMotion MLC and its function modules are intended for Motion/Logic applications.



The IndraLogic XLC/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 is valid for cables and lines.

The operation must only be carried out with the hardware component configurations and combinations that were expressly mentioned and with the software and firmware indicated and specified in the respective documentations and functional descriptions.

IndraLogic XLC/IndraMotion MLC and its function modules have been developed for use in single and multi-axis drive and control tasks.

For the application-specific use of the machine operating and visualization terminals, device models featuring different equipments and different interfaces are available.

Typical scopes of use where IndraLogic XLC/IndraMotion MLC and its function modules can be applied are:

- [Handling and mounting systems]
- [Packaging and food machines]

Important Instructions on Use

- [Printing and paper-processing machines]

Rexroth IndraLogic XLC/IndraMotion MLC and the function modules must only be operated under the mounting and installation conditions, the position, and the ambient conditions (temperature, type of protection, moisture, EMC, etc.) specified in the related documentations.

2.2 Inappropriate Use

The use of Rexroth IndraLogic XLC/IndraMotion MLC and its function modules in applications other than those specified or described in the documentation and the technical data is considered as "improper".

The Rexroth IndraLogic XLC/IndraMotion MLC and its function modules may not be used if it is

- exposed to operating conditions which do not correspond to the specified ambient conditions. Operation under water, extreme temperature fluctuations or extreme maximum temperatures etc. is prohibited.
- Furthermore, the IndraLogic XLC/IndraMotion MLC and its function modules must not be used in any applications not expressly approved by Bosch Rexroth. Therefore, read the statements given in the general safety instructions!

3 RMB_TechRegiExtended

3.1 RMB_TechRegiExtended Library Subject to License



The use of the functions blocks of the RMB_TechRegiExtended library is subject to a license. Depending on the application, one of the three licenses, either FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 or FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 has to be purchased to use the function blocks. For each control, on which the function blocks are used, one license is required each (runtime license).

Einzellizenz Technologiebibliothek
Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.

Single licence for technology library
Authorize the use with exactly one controller firmware.

TechLib RegisterControl Extended TechLib RegisterControl Extended		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig.3-1: FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT license key

Einzellizenz Technologiebibliothek
Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.

Single licence for technology library
Authorize the use with exactly one controller firmware.

TechLib RegisterControl Advanced 1 TechLib RegisterControl Advanced 1		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig.3-2: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 license key

RMB_TechRegiExtended

Einzellizenz Technologiebibliothek Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.		
Single licence for technology library Authorize the use with exactly one controller firmware.		
TechLib RegisterControl Advanced 2 TechLib RegisterControl Advanced 2		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig.3-3: *FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 license key*

The figures show the corresponding license keys. One license has to be purchased for each control authorizing the use of function blocks of the RMB_TechRegiExtended library or the RMB_TechRegiAdvanced on this control system.

The libraries RMB_TechRegiExtended and RMB_TechRegiAdvanced are provided with the three licenses FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 and FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2. The content of the licenses is shown in the following:

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT*

- HMI for narrow web applications (up to twelve printing units, no decoupling and acceleration compensation)
- Firmware Update Tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1*

- HMI for applications with clamping units (such as gravure printing) (up to twelve printing units, with decoupling and acceleration compensation)
- Firmware Update Tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2*

- HMI for applications with clamping units (such as gravure printing) (up to 24 printing units, with decoupling and acceleration compensation)
- Firmware Update Tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

If either the RMB_TechRegiExtended library or the RMB_TechRegiAdvanced library is used, one of the licenses FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 or FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 is required for each control on which one of the function blocks is used.

3.2 General Information

The RMB_TechRegiExtended library provides function blocks required to communicate with the mark stream sensor. The mark stream sensor consists of an evaluation unit connected with an optics via optical fiber cables.



Fig.3-4: Mark stream sensor

The mark stream sensor determines mark positions of up to 12 registration marks simultaneously and returns their measured values. Apart from the hardware of the mark stream sensor, it is a library that has to be purchased. One license is required for each control system used.

To use the functionality of the sensor, the following is required:

- 1 evaluation unit of the mark stream sensor
- 1 sensor optics
- 1 cable set (2 optical fibers, 1 Ethernet cable, 1 incremental encoder cable and 1 electricity cable)
- 1 drive system with MEM card

This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.

The following overview shows all function blocks of the RMB_TechRegiExtended library requiring a license:

Function block	Description
MB_RegiSensor01ConfigType01	Configuration of the mark stream sensor
MB_RegiSensor01SendSpeedAccType01	Sends velocity information to the mark stream sensor
MB_RegiSensor01SendRecvDataType01	Executes an acyclic communication with the mark stream sensor
MB_RegiSensor01ReadDiagType01	Reads diagnostic data of the mark stream sensor
MB_RegiSensor01TeachDataType01	Reads/writes the latest valid measured data of the mark stream sensor
MB_RegiSensor01CycComType01	Evaluates the mark distances and widths of two marks with regard to each other
MB_RegiSensor01CycComType02	Evaluates all mark distances to the zero pulse as well as all mark widths
MB_RegiSensor01SetIPAddressType01	Sets the IP address of the marks stream sensor
MB_RegiSensor01CommType01	Closure function block, executing the communication with the mark stream sensor
MB_ReachVelocityType01	Calculates different velocity characteristics

Fig.3-5: Function blocks of the RMB_TechRegiExtended library that requires a license



The function blocks MB_RegiSensor01SendSpeedAccType01 and MB_RegiSensor01CommType01 have to be called in a Motion-synchronous task to ensure a correction calculation of the acceleration. If this is not possible due to the runtime, the "mMotion-Cyclic()" function of the two function blocks from the Motion-synchronous tasks has to be called and either the MB_RegiSensor01SendSpeedAccType01 function block or the MB_RegiSensor01CommType01 function block can be called in a cyclic task.

3.3 Function Blocks to Communicate with the Mark Stream Sensor

3.3.1 Introduction and Overview

The RMB_TechRegiExtended library contains function blocks to communicate with the sensor. It is distinguished between cyclic and acyclic communication. Acyclic communication means that the control is the client and sensor is the server. Thus, the control requests data and the sensor responds. This includes configuration data, process data and diagnostic data.

The following function blocks are part of the acyclic communication:

- MB_RegiSensor01ConfigType01: Sensor configuration, measurement start, teach-in, etc.
- MB_RegiSensor01SendSpeedAccType01: Sends information on velocity and acceleration
- MB_RegiSensor01SendRecvDataType01: It is responsible for the acyclic communication with the sensor
- MB_RegiSensor01ReadDiagType01: Reads the diagnostic data from the sensor
- MB_RegiSensor01TeachDataType01: Reads/writes the latest valid measured data

Each sensor requires two ports on the control. One port is for the acyclic communication and one port is for the cyclic communication. In the cyclic communication, the sensor sends a data package after each cylinder revolution. This data package contains the measured data defined in the configuration. The control listens on this port and evaluates the measurement results.

Therefore, the following function blocks are used:

- MB_RegiSensor01CycComType01: Evaluates the mark distances and widths of two marks with regard to each other.
- MB_RegiSensor01CycComType02: Evaluates the distances of all marks to the zero pulse as well as all mark widths.

The function block MB_RegiSensor01CycComType01 provides the exact mark distance between the two marks specified and their difference in mark width. The MB_RegiSensor01CycComType02 function block provides all distances of the configured marks to the zero pulse as well as their mark widths. The function blocks can be exchanged with each other depending on the use case. The following communication structure results for each sensor:

RMB_TechRegiExtended

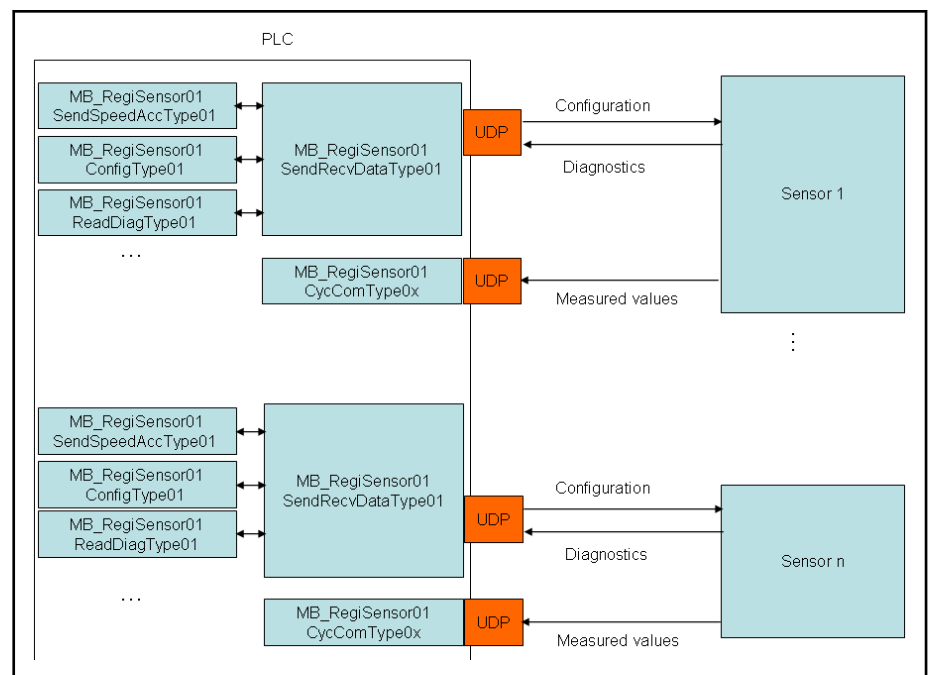


Fig. 3-6: Communication structure

Thus, it can be seen that one function block executes the entire acyclic communication and that it sends all data packages of the other function blocks to the sensor. That means that the MB_RegiSensor01ConfigType01 function block absolutely requires the MB_RegiSensor01SendRecvDataType01 function block to send the data packages.

Another function block in the RMB_TechRegiExtended to set the IP address is:

- MB_RegiSensor01SetIPAddressType01

Only one function block is used per machine.

The following figure shows the minimum wiring of function blocks and their switch-on sequence.

RMB_TechRegiExtended

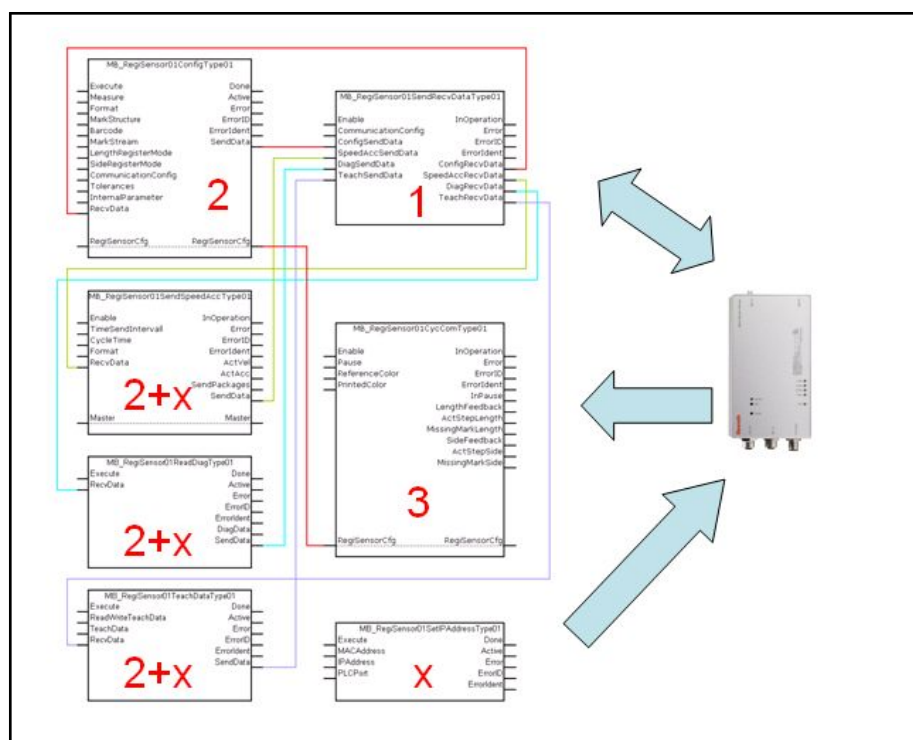


Fig.3-7: Minimum wiring and switch-on sequence.

To execute a measurement with the mark stream sensor, the MB_RegiSensor01SendRecvDataType01 function block has to be activated first. Subsequently, the MB_RegiSensor01ConfigType01 FB can be used to send a configuration to the sensor and to start the measurement and teach-in. The function blocks MB_RegiSensor01SendSpeedAccType01, MB_RegiSensor01ReadDiagType01 and MB_RegiSensor01TeachDataType01 are not absolutely required for a measurement. They can be activated as desired. The only prerequisite is that the MB_RegiSensor01SendRecvDataType01 has already been activated. If a measurement has been started at the sensor, the on of the function blocks MB_RegiSensor01CycComType01 or MB_RegiSensor01CycComType02 has to be subsequently activated to receive the measured values. The MB_RegiSensor01SetIPAddressType01 function block to set the IP address is only required once for each machine and is thus provided with an individual UDP port. It can be activated at any point in time without being dependent on other function blocks. The colored lines indicate the minimum wiring between the function blocks to allow a correct communication with the sensor.

From MLC version 12, the RMB_TechRegiExtended library provides the following function block:

- MB_RegiSensor01CommType01,

The function block contains the individual function blocks MB_RegiSensor01ConfigType01, MB_RegiSensor01CycComType02, MB_RegiSensor01ReadDiagType01, MB_RegiSensor01SendRecvDataType01, MB_RegiSensor01SendSpeedAccType01 and MB_RegiSensor01TeachDataType01. I.e., the individual function blocks are internally connected in the MB_RegiSensor01CommType01 function block. Thus, the sensor configuration and the measurement are more user-friendly.

The function blocks are internally connected in the function block and provide a user-friendly interface to execute the individual functions. The mark stream sensor can be completely controlled using the function block. Only the MB_RegiSensor01SetIPAddressType01 function block for setting the IP ad-

dress is not integrated as it is only required once per machine. Consequently, the communication with the mark stream sensor is rendered more user-friendly, as described in the following.

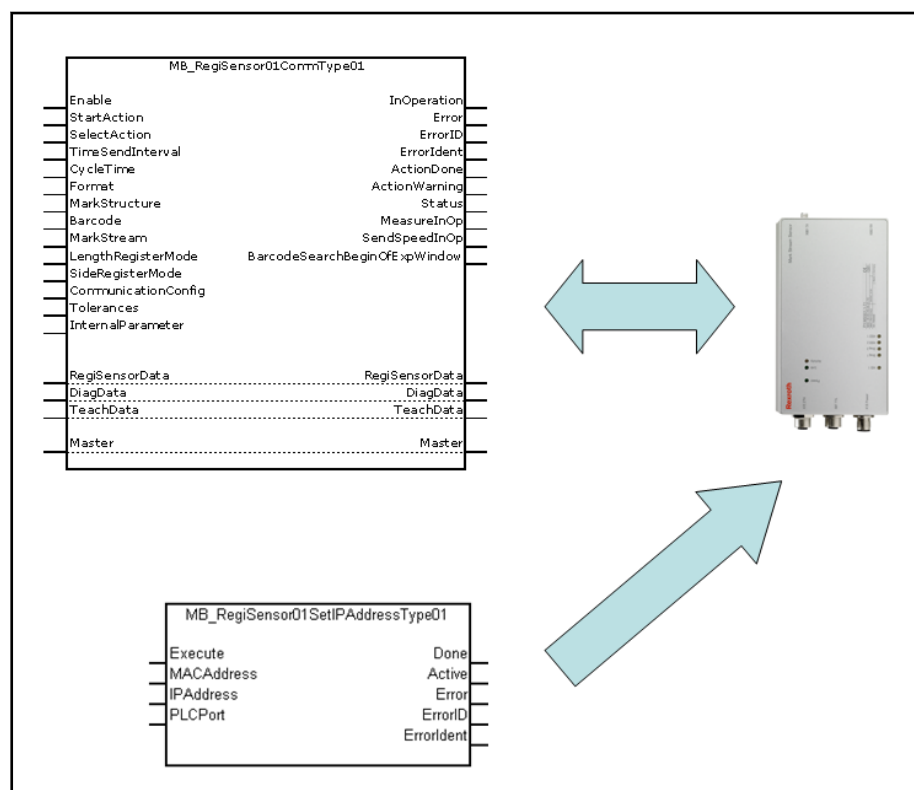


Fig.3-8: Communication structure with the MB_RegiSensor01CommType01 function block

Only one MB_RegiSensor01CommType01 function block and the MB_RegiSensor01SetIPAddressType01 function block is required. The previously specified connection as well as the connecting order are not required anymore.



Due to a fixed, specified internal connection and the simple operation, it is recommended to only use the MB_RegiSensor01CommType01 function block for the mark stream sensor communication.

3.3.2 MB_RegiSensor01ConfigType01

Brief Description

The MB_RegiSensor01ConfigType01 function block is required for the configuration of the mark stream sensor. The function block prepares the configuration data and transmits them to the MB_RegiSensor01SendRecvDataType01 function block that is responsible for sending the package and receiving the response package. The expectation window can be set apart from the configuration, the teach-in and the measurement can be started or the measurement can be stopped. It executes the initial configuration of the sensor and configures the sensor during the measurement.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-9: Reference table of the MB_RegiSensor01ConfigType01 function block

RMB_TechRegiExtended

Interface Description

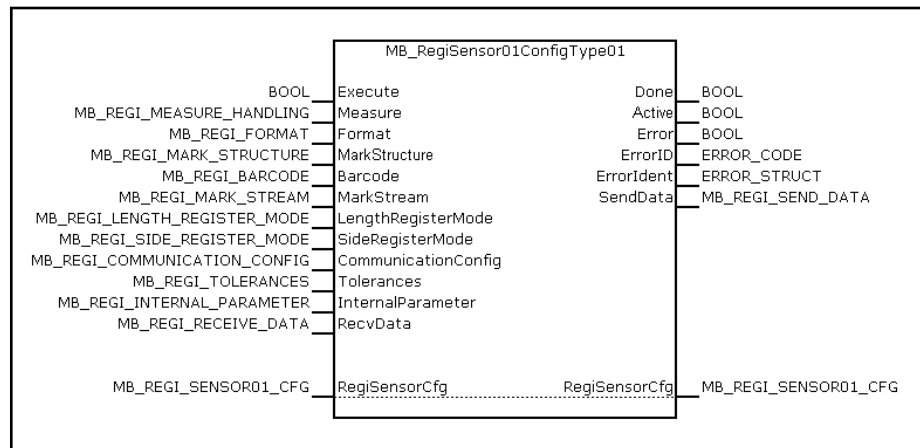


Fig.3-10: MB_RegiSensor01ConfigType01 function block

I/O type	Name	Data type	Explanation
VAR_IN_OUT	RegiSensorCfg	MB_REGI_SENSOR01_CFG	Contains the current configuration data of the sensor
VAR_INPUT	Execute	BOOL	Processing of the function block enabled (edge-controlled)
	Measure	MB_REGI_MEASURE_HANDLING	Transmits the configuration, sets the expectation window, starts the teach-in and measurement or stops the measurement.
	Format	MB_REGI_FORMAT	Defines the format characteristics
	MarkStructure	MB_REGI_MARK_STRUCTURE	Defines the mark structure
	Barcode	MB_REGI_BARCODE	Defines the barcode
	MarkStream	MB_REGI_MARK_STREAM	Defines the mark stream
	LengthRegister-Mode	MB_REGI_LENGTH_REGISTER_MODE	Defines the web measuring principle for the length register
	SideRegister-Mode	MB_REGI_SIDE_REGISTER_MODE	Defines the measuring principle used for the side register
	Communication-Config	MB_REGI_COMMUNICATION_CONFIG	Defines the communication characteristics of the UDP connection
	Tolerances	MB_REGI_TOLERANCES	Defines the tolerances allowed for teaching and measurement
	InternalParameter	MB_REGI_INTERNAL_PARAMETER	Internal sensor parameters that should only be changed if specifically mentioned.
	RecvData	MB_REGI_RECEIVE_DATA	Receives data from the MB_RegiSensor01SendRecvDataType01 function block

I/O type	Name	Data type	Explanation
VAR_OUTPUT	Done	BOOL	Data outputs are valid
	Active	BOOL	Function block is working and currently in an interim state
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	SendData	MB_REGI_SEND_DATA	Data to be sent via the MB_RegiSensor01SendRecvData function block

Fig. 3-11: I/O interface of the MB_RegiSensor01ConfigType01 function block

Data Structures

The following data structures are used by the MB_RegiSensor01ConfigType01 function block:

MB_REGI_SENSOR01_CFG		
CurrentConfig	USINT	Current configuration
Format	MB_REGI_FORMAT	Describes the printing cylinder format
MarkStructure	MB_REGI_MARK_STRUCTURE	Describes the mark structure
Barcode	MB_REGI_BARCODE	Describes the barcode
MarkStream	MB_REGI_MARK_STREAM	Describes the mark stream
LengthRegisterMode	MB_REGI_LENGTH_REGISTER_MODE	Length register mode
SideRegisterMode	MB_REGI_SIDE_REGISTER_MODE	Side register mode
CommunicationData	MB_REGI_COMMUNICATION_CONFIG	Communication ports of the UDP connection
Tolerances	MB_REGI_TOLERANCES	Teaching tolerances and measurement tolerances
InternalParameter	MB_REGI_INTERNAL_PARAMETER	Internal sensor parameters
BarcodeSearchBeginOfExpWindow	REAL	Returns the beginning of the expectation window of the barcode search

Fig. 3-12: MB_REGI_SENSOR01_CFG data structure

MB_REGI_FORMAT		
FormatLength	REAL	Printing cylinder format in [mm]
Increments	UDINT	Number of increments per revolution

Fig. 3-13: MB_REGI_FORMAT data structure

MB_REGI_MARK_STRUCTURE		
MarkType	UDINT	Mark type
SingleMark	ARRAY [0...3] OF REAL	Describes the printed mark

Fig. 3-14: MB_REGI_MARK_STRUCTURE data structure

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MB_REGI_BARCODE		
NumberOfBlocks	UDINT	Number of barcode blocks (0 means that no barcode exists)
BeginExpectationWindow	REAL	Beginning of the expectation window (distance from the beginning of the expectation window to the zero pulse) [mm]
SizeOfExpectationWindow	REAL	Size of the expectation window [mm]
FreeSpaceBeforeBarcode	REAL	Printing-free area in front of the barcode [mm]
BarcodeBlocks	ARRAY [0...19] OF REAL	Barcode description in [mm]

Fig. 3-15: MB_REGI_BARCODE data structure

MB_REGI_MARK_STREAM		
NumberOfMarks	UINT	Number of marks
MarkStream	ARRAY [1...12] OF REAL	Distance of the marks [mm]
MarkDirection	BOOL	First or second mark edge for the length register

Fig. 3-16: MB_REGI_MARK_STREAM data structure

MB_REGI_LENGTH_REGISTER_MODE		
ModeSelect	UDINT	Selected length register mode
LengthProperties	ARRAY [0...4] OF REAL	Characteristics for the length register mode [mm]

Fig. 3-17: MB_REGI_LENGTH_REGISTER_MODE data structure

MB_REGI_SIDE_REGISTER_MODE		
ModeSelect	UDINT	Selected side register mode
MarkSelect	ARRAY [0...1] OF UINT	Marks for the side register

Fig. 3-18: MB_REGI_SIDE_REGISTER_MODE data structure

MB_REGI_COMMUNICATION_CONFIG		
IpSensor	STRING	IP address of the sensor
PortConfiguration	UINT	Port for acyclic communication (configuration, diagnostics, velocity data)
IpPLC	STRING	IP address of the PLC
PortMeasurement	UINT	Port for the measurement results

Fig. 3-19: MB_REGI_COMMUNICATION_CONFIG data structure

MB_REGI_TOLERANCES		
TeachZeroPulseToMark	REAL	Teaching tolerance of the first mark to the zero pulse [mm]
TeachMarkToMark	REAL	Teaching tolerance between the individual marks [mm]
MeasureMarkTolerance	REAL	Measurement tolerance compared to the next measured value [mm]
DeviationOfMarkWidth	REAL	Deviation of the mark width to the last measured value [%]
DeviationOfMarkHight	REAL	Deviation of the mark height to the last measured value [%]

MB_REGI_TOLERANCES		
DeviationOfLastPosition	REAL	Absolute deviation of the measurement tolerance from the last measured value [mm]
ShiftSyncPulse	REAL	The zero pulse is exactly shifted in front of the expectation window by ShiftSyncPulse [mm]

Fig. 3-20: MB_REGI_TOLERANCES data structure

MB_REGI_INTERNAL_PARAMETER		
ColorWeighting	REAL	Color scaling of the sensor
IntensityWeighting	REAL	Intensity scaling of the sensor
Gain	UINT	Sensor gain

Fig. 3-21: MB_REGI_INTERNAL_PARAMETER data structure

MB_REGI_SEND_DATA		
NoOfBytes	UDINT	Number of bytes to be sent
ValueAddr	POINTER TO DWORD	Pointer to data
NewData	UINT	Indicates new data for sending
SensorPort	UINT	Sensor port to which the data should be sent

Fig. 3-22: MB_REGI_SEND_DATA data structure

MB_REGI_RECEIVE_DATA		
NoOfBytes	UDINT	Number of received bytes
ValueAddr	POINTER TO DWORD	Pointer to data
NewData	UINT	Indicates newly received data

Fig. 3-23: MB_REGI_RECEIVE_DATA data structure

Enumeration Type

The enumeration type MB_REGI_MEASURE_HANDLING is used for configuration, measurement start, teach-in start as well as for setting the expectation window and can assume the following values:

Element	Value	Description
START_CONFIG	0	Starts the configuration
START_TEACHING	1	Starts the teaching
START_MEASUREMENT	2	Starts the measurement
STOP_MEASUREMENT	3	Stops the measurement
START_CONFIG_TEACHING	4	Starts the configuration and the teaching
START_TEACHING_MEASUREMENT	5	Starts the teaching and the measurement
START_CONFIG_TEACHING_MEASUREMENT	6	Starts the configuration, the teaching and the measurement
START_SET_EXPECTATION_WINDOW	7	Sets the expectation window
START_EASY_TEACHING	8	Starts an easy teach-in. The gain as well as the beginning and the size of the expectation window have to be transferred.

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Element	Value	Description
START_EASY_TEACHING_MEASUREMENT	9	Starts the each teach-in and then the measurement (cf. 8)
START_BARCODE	10	Starts the barcode search

Fig.3-24: Enumeration type MB_REGI_MEASURE_HANDLING

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
MB_REGI_SENSOR01_CFG					
CurrentConfig	USINT	0	255	0	Rising edge at "Execute"
MB_REGI_FORMAT					
FormatLength	REAL	> 0	n.def.	0	Rising edge at "Execute"
Increments	UDINT	> 0	n.def.	0	Rising edge at "Execute"
MB_REGI_MARK_STRUCTURE					
MarkType	UDINT	1	7	1 (only the marks 1, 3 and 5 are implemented)	Rising edge at "Execute"
SingleMark	ARRAY [0...3] OF REAL	> 0 (for required entries)	n.def.	0	Rising edge at "Execute"
MB_REGI_BARCODE					
NumberOfBlocks	UDINT	0 (1 and 2 blocks are invalid entries)	10	0	Rising edge at "Execute"
BeginExpectationWindow	REAL	0	n.def.	0	Rising edge at "Execute"
SizeOfExpectationWindow	REAL	0	n.def.	1	Rising edge at "Execute"
FreeSpaceBeforeBarcode	REAL	0	n.def.	0	Rising edge at "Execute"
BarcodeBlocks	ARRAY [0...19] OF REAL	> 0 (for required entries)	n.def.		Rising edge at "Execute"
MB_REGI_MARK_STREAM					
NumberOfMarks	UDINT	1	12	1	Rising edge at "Execute"
MarkStream	Array [1...12] OF REAL	> 0 (for required entries)	n.def.	0	Rising edge at "Execute"
MarkDirection	BOOL			FALSE	Rising edge at "Execute"
MB_REGI_LENGTH_REGISTER_MODE					
ModeSelect	UDINT	1	1	1	Rising edge at "Execute"
LengthProperties	ARRAY [0...4] OF REAL	n.def.	n.def.	0	Rising edge at "Execute"
MB_REGI_SIDE_REGISTER_MODE					

RMB_TechRegiExtended

Name	Type	Min. value	Max. value	Default value	Effective
ModeSelect	UDINT	0	1	1	Rising edge at "Execute"
SelectMarks	ARRAY [0...1] OF UINT	n.def.	n.def.	0	Rising edge at "Execute"
MB_REGI_COMMUNICATION_CONFIG					
IpSensor	STRING	LEN > 0	n.def.	""	Rising edge at "Execute"
PortConfigura- tion	UINT	1	n.def.	0	Rising edge at "Execute"
IpPLC	STRING	LEN > 0	n.def.	""	Rising edge at "Execute"
PortMeasure- ment	UINT	1	n.def.	0	Rising edge at "Execute"
MB_REGI_TOLERANCES					
TeachZeroPul- seToMark	REAL	1	n.def.	5	Rising edge at "Execute"
TeachMarkTo- Mark	REAL	1	n.def.	2	Rising edge at "Execute"
MeasureMark- Tolerance	REAL	1	n.def.	10	Rising edge at "Execute"
DeviationOf- MarkWidth	REAL	1	100	20	Rising edge at "Execute"
DeviationOfMar- kHight	REAL	1	100	20	Rising edge at "Execute"
DeviationOfLast- Position	REAL	1	n.def.	10	Rising edge at "Execute"
ShiftSyncPulse	REAL	1	n.def.	5	Rising edge at "Execute"
MB_REGI_INTERNAL_PARAMETER					
ColorWeighting	REAL	0	< 1	0.9999	Rising edge at "Execute"
IntensityWeight- ing	REAL	0	< 1	0.15	Rising edge at "Execute"
Gain	UINT	0	7	0	Rising edge at "Execute"
MB_REGI_RECEIVE_DATA					
NoOfBytes	UDINT	0	n.def.	0	Change at "NewData"
ValueAddr	POINTER TO BYTE	n.def.	n.def.	0	Change at "NewData"
NewData	UINT	0	65535	0	Continuous

Fig. 3-25: Overview on min./max. values and initial values of the inputs



Valid entries are currently only functionalities implemented in the sensor.

RMB_TechRegiExtended

Functional Description

In case of the acyclic communication, the sensor is the client which means the control sends data to the sensor and the sensor responds. The acyclic communication is used to configure the sensor.

The RegiSensorCfg structure contains the current configuration of the sensor. If configuration changes should be made, the changed configuration data can be directly applied at the function block. They are only applied at a rising edge at "Execute". The individual structures are described in the following:

RegiSensorCfg: It includes the current configuration data of the sensor and the current configuration ID transmitted to the cyclic measured data. Additionally, the determined beginning of the expectation window is specified after a barcode search.

Measure: *At a rising edge at "Execute" it is distinguished between 11 processes executed according to the function selected:*

- **START_CONFIG:**

The new configuration is transmitted to the sensor. The expectation window is calculated via mark distances, tolerances and the beginning of the expectation window by the sensor.



Therefore, exact entries are required. It is recommended to determine the beginning and the size of the expectation window via a graphical user interface (HMI) and to transfer these values with the START_SET_EXPECTATION_WINDOW option or to use the barcode search.

- **START_TEACHING:**

Starts the sensor teaching. Therefore, the configuration data sent last to the sensor and the expectation window are applied and the marks are determined with their threshold values in the expectation window. In this mode, the sensor additionally determines the ideal gain.

- **START_MEASUREMENT:**

Starts a measurement without transmitting a configuration or starting a teach-in.

- **STOP_MEASUREMENT:**

Completes a running measurement.

- **START_CONFIG_TEACHING:**

First, it transfers the configuration and subsequently starts a teach-in. If a number higher than 0 was specified in SizeOfExpectationWindow, this value is used for the calculation of the expectation window. If the value is 0, the expectation window is computed via mark distances, the tolerances and the beginning of the expectation window by the sensor.

- **START_TEACHING_MEASUREMENT:**

Starts the sensor teaching and subsequently the measurement. The configuration data transmitted last to the sensor and the expectation window are used for teaching.

- **START_CONFIG_TEACHING_MEASUREMENT:**

First, it transfers the configuration and subsequently starts a teach-in and then the measurement. If a number higher than 0 was specified in SizeOfExpectationWindow, this value is used for the calculation of the

expectation window. If the value is 0, the expectation window is computed via mark distances, the tolerances and the beginning of the expectation window by the sensor.

- **START_SET_EXPECTATION_WINDOW:**

Sets only the expectation window that was for example transferred from a graphical interface. Therefore, a value higher than 0 has to be specified in `SizeOfExpectationWindow` as well as the beginning of the expectation window (`BeginExpectationWindow`).



If a new configuration is started after transferring the expectation window, the transferred expectation window is overwritten. Thus, it is recommended to transfer the configuration first and then the expectation window.

- **START_EASY_TEACHING:**

A teach-in is started without determining the gain. The gain located under "InternalParameters" in "Gain" is applied. This gain was ideally read out with the function block `MB_RegiSensor01ReadDiagType01` after a first normal teach-in. Furthermore, the size and the beginning of the expectation window have to be specified.

- **START_EASY_TEACHING_MEASUREMENT:**

As `START_EASY_TEACHING`, but the measurement is immediately started after teaching.

- **START_BARCODE:**

If this mode is executed, the barcode search is started. Therefore, 3 to 10 barcodes have to be defined. After the barcode search has been completed successfully, the position is right behind the barcode that is the beginning of the expectation window in `RegiSensorCfg.BarcodeSearchBeginOfExpWindow`. This value can be used to define the expectation window.

The following figure shows an exemplary sequence from the configuration of the mark stream sensor to the measurement.

RMB_TechRegiExtended

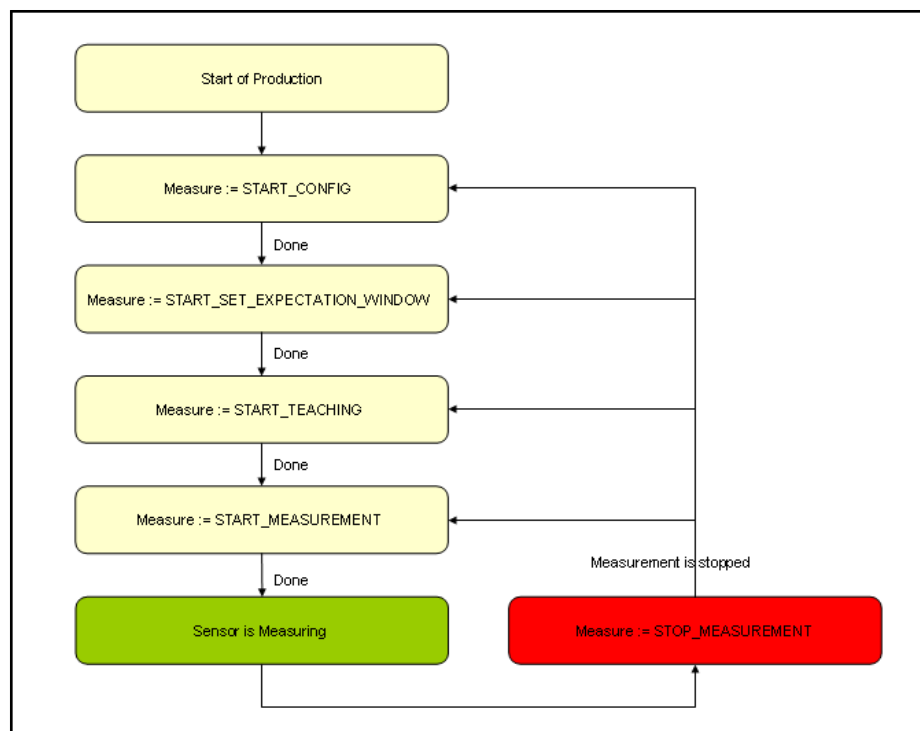


Fig.3-26: Sequence from the configuration to the measurement

The sensor has to be configured first. Subsequently, the expectation window should be preferably set via a visualization or the thus determined values. Subsequently, teaching and measurement can be started. After the measurement has been started, it can be stopped any time and continued at the sensor state desired. The "Measure" functionalities can be called in any combination.

MarkStructure: Contains the predefined mark structure and the dimension of the marks.

The following mark types are supported:

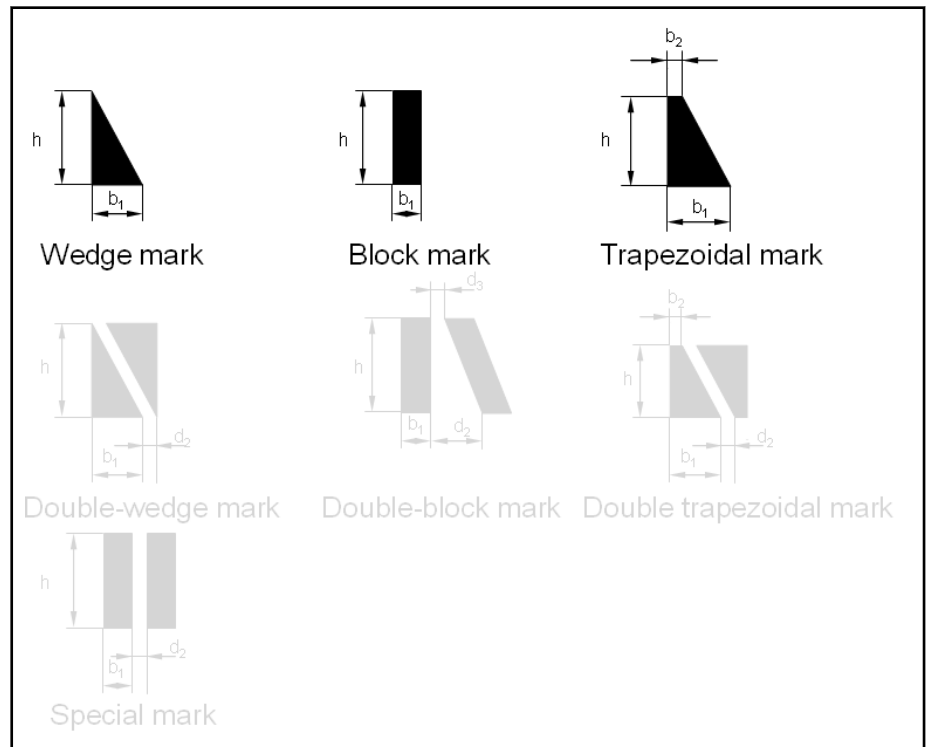


Fig.3-27: Supported mark types

The "MarkType" parameter can be set as follows and the parameters have to be subsequently specified in "SingleMark" according to the mark type:

	MarkType	SingleMark			
Wedge mark	1	Width [mm]	Height [mm]		
Double-wedge marks	2	Width [mm]	Height [mm]	Distance [mm]	
Block marks	3	Width [mm]	Height [mm]		
Double-block marks	4	Width [mm]	Height [mm]	Distance [mm]	Distance2[mm]
Trapezoidal mark	5	Width [mm]	Height [mm]	Width2 [mm]	
Double-trapezoidal marks	6	Width [mm]	Height [mm]	Distance [mm]	Width2 [mm]
Special mark	7	Width [mm]	Height [mm]	Distance [mm]	

Fig.3-28: Mark type parameters

The following shows a configuration example of a triangular mark:

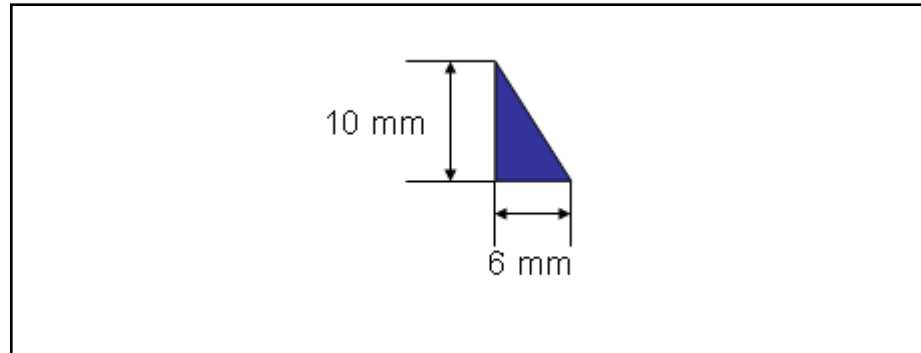


Fig.3-29: Mark structure example

Code example:

```
MarkStruct: MB_REGI_MARK_STRUCTURE := (MarkType:=1, SingleMark:= 6, 10, 0, 0);
```

This is a wedge mark (mark type 1). This is defined by its height and width.



Only the mark types 1, 3 and 5 are allowed up to now in the implementation.

Barcode: Contains the number of barcode blocks and the description of the expectation window. Up to ten barcode blocks are possible. If NumberOfBlocks = 0, there is no barcode available. The user has to set the beginning and the size of the expectation window. This can be carried out either by determining this data via the oscilloscope representation or by calculating the size of the expectation window by the sensor (from the number of marks and their distance as well as the tolerances and the beginning of the expectation window). Therefore, Barcode.SizeOfExpectationWindow has to be set to 0.

If a barcode is available, the sensor can determine the beginning of the expectation window by returning the position of the barcode end. Therefore, START_BARCODE has to be started. If the function block returns "Done", the position of the barcode end is written to RegiSensorCfg.BarcodeSearch-BeginOfExpWindow. The user has to specify the size of the expectation window and can then set the expectation window with START_SET_EXPECTATION_WINDOW. The normal procedure with "teach-in" and "start measurement" can now be continued.

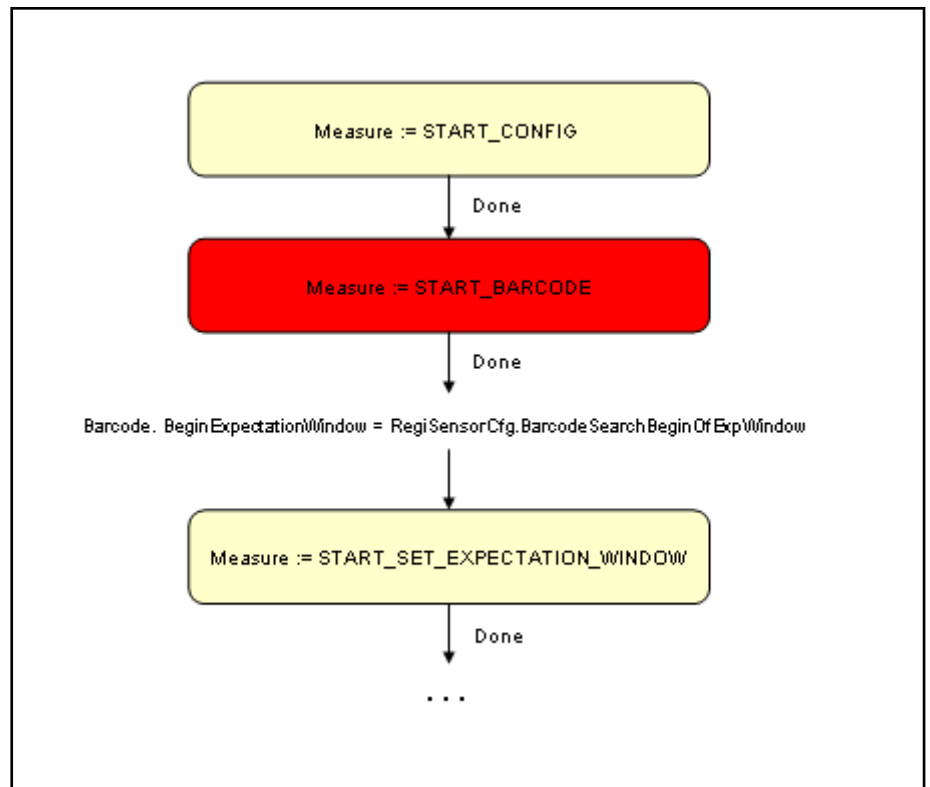


Fig.3-30: Sequence of the barcode search

If a barcode is available, the sensor searches for the beginning of the expectation window. "FreeSpaceBeforeBarcode" indicates the printing-free area in front of the barcode and "BarcodeBlocks" defines the individual barcode blocks. The dimensions of the barcode still have to be specified as follows:

Barcode example:

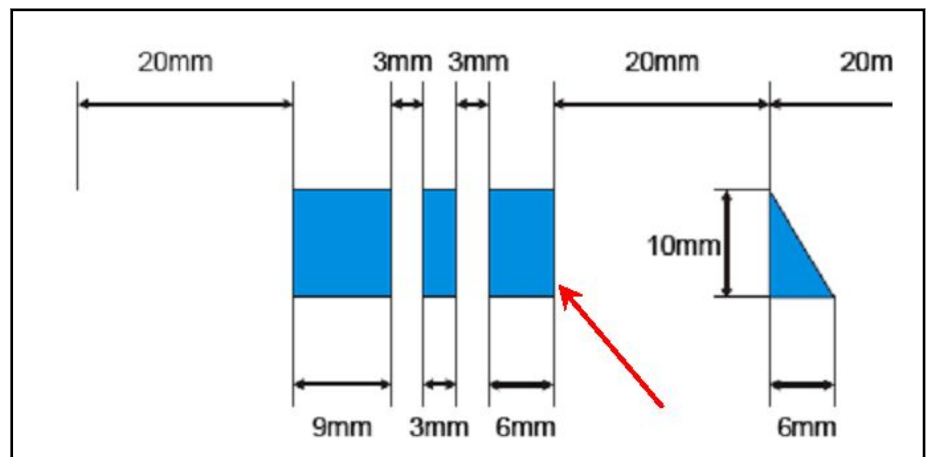


Fig.3-31: Barcode example

The dimensions are given in the array "BarcodeBlocks" in [mm]:

BarcodeBlocks[0]: Width of barcode block 1 in [mm]

BarcodeBlocks[1]: Distance from barcode block 1 to block 2 in [mm]

BarcodeBlocks[2]: Width of barcode block 2 in [mm]

BarcodeBlocks[3]: Distance from barcode block 2 to block 3 in [mm]

.....

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The last distance specified is the distance between the last barcode block and the first mark (in this example, the distance between the barcode block and the registration mark is 20 mm). The position is indicated with the red arrow that is returned by the sensor in RegiSensorCfg.BarcodeSearchBeginOfExpWindow after a successful barcode search. That is the direct position behind the barcode.

MarkStream: Contains the number of marks and the respective distance between the marks. If five marks are available, there are four mark distances and the first defined distance is the distance between mark 1 and mark 2.

Mark stream example:

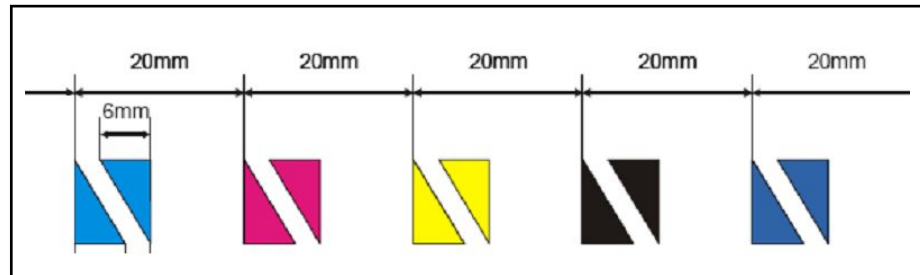


Fig.3-32: Mark stream example

Example of the shown mark stream:

```
MarkStream: MB_REGI_MARK_STREAM := (NumberOfMarks:=5,
MarkStream:=20, 20, 20, 20);
```

The mark stream consists of five marks. These have a distance of 20 mm each.

Furthermore, it can be specified - when defining the mark stream - whether the vertical mark edge is at first or second place.

If MarkDirection = FALSE, the length register value is returned with regard to respective first mark edge. That is the distance between the zero pulse and the first mark edge of the mark.

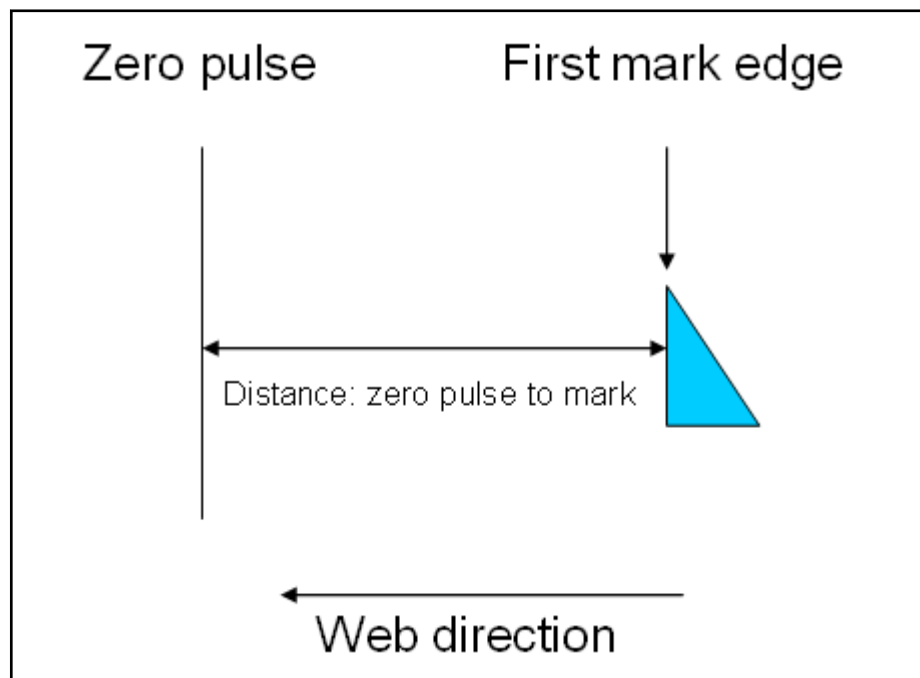


Fig.3-33: First mark edge

If MarkDirection = TRUE , the length register value is returned with regard to respective second mark edge.

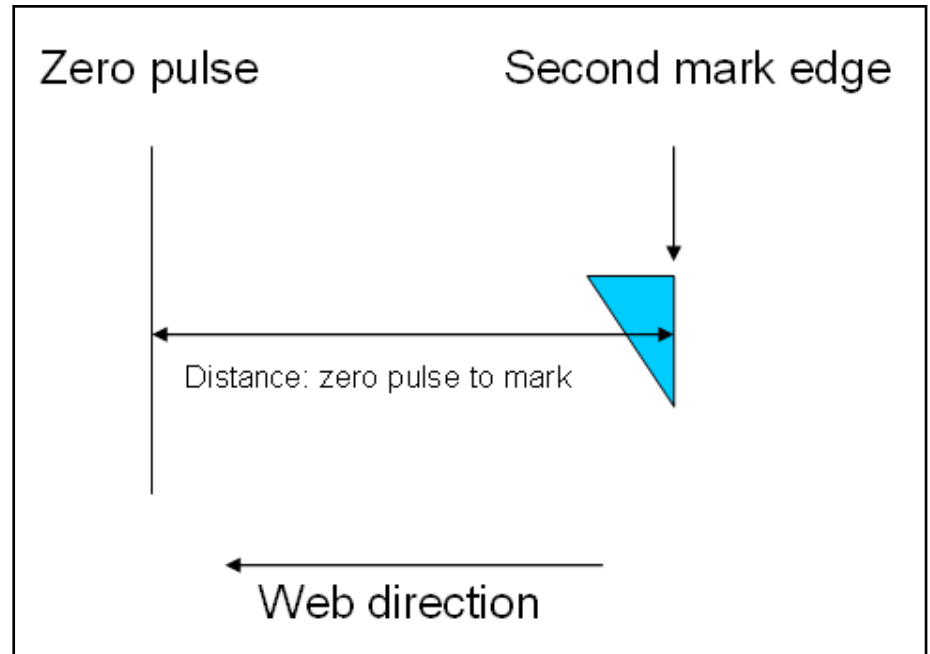


Fig.3-34: Second mark edge



It is recommended to **always** use the vertical edge for the length register control. If the inclined mark edge is used, an adjustment in the side register always results in an offset in the length register.

LengthRegisterMode: Indicates the respective web measuring principle for the length register. Furthermore, all required dimensions are saved for the respective web measuring principle. Currently, only Mode 1 of the return of all mark distances is implemented in the mark stream sensor.

Example:

```
LengthRegisterMode: MB_REGI_LENGTH_REGISTER_MODE := (ModeSelect:=1);
```

ModeSelect := 1 means that all mark distances of all marks are returned.

SideRegisterMode: Indicates which mark widths of which marks should be measured for the side register. If ModeSelect := 0, no mark widths are returned. If ModeSelect := 1, all mark widths are returned.

Example 1:

```
SideRegisterMode: MB_REGI_SIDE_REGISTER_MODE := (ModeSelect:=0);
```

No mark widths are returned.

Example 2:

```
SideRegisterMode: MB_REGI_SIDE_REGISTER_MODE := (ModeSelect:=1);
```

All mark widths are returned.

Currently, there is no function available that can specify two marks whose mark widths should be output.

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CommunicationConfig: Contains the communication settings for the acyclic and the cyclic communication. The port on the PLC for the measured values and the port for the configuration data and diagnostic data as well as the IP address of the sensor and the PLC are specified.

Example:

```
CommunicationCfg: MB_REGI_COMMUNICATION_CONFIG := (IpSensor:='192.168.2.5',
                                                    PortConfiguration:=6001,
                                                    IpPLC:='192.168.2.3', PortMeasurement:=6000);
```

A configuration of the connection data is shown in the example above. The sensor has the IP address 192.168.2.5 and the acyclic communication is executed via the UDP port 6001 of the control. The IP address of the PLC is 192.168.2.3. Thus, the sensor knows that the cyclic measurement results should be sent to this IP address 192.168.2.3 and the UDP port 6000 of the control.

Tolerances:

For the tolerances, the respective default values should be used and only changed in an exceptional case.

Tolerances indicate tolerances for teaching, measuring and the robustness of the measurement:

- **TeachZeroPulseToMark:**
Indicates the maximum tolerance the BeginExpectationWindow may deviate from. The sensor sets its expectation window exactly on one position:
BeginExpectationWindow - TeachZeroPulseToMark.
- **TeachMarkToMark:**
Indicates a tolerance for teaching. That is the number of mm that may be attached as tolerance to the expectation window. This value should be equal to "MeasureMarkTolerance" to avoid that a mark is lost when starting the measurement.
- **MeasureMarkTolerance:**
During a measurement, an individual mark expectation window is used for each mark. That means that it is searched for the mark exactly in this expectation window due to its last position. If the position of the mark kept changing after the last revolution, the mark is not found.
The following three parameters are used for the robustness of the measurement. That means that a mark was detected with a certain width, height and position during the last measurement. If the mark found deviates from the absolute position during the next measurement by the respective percentage, this measurement is ignored and it is searched again with the measured data last valid. This should ensure that a mark can be found during next measurement in case of an disturbance occurring once (e.g. due to a crease).
- **DeviationOfMarkWidth:**
Maximum deviation of the mark width from the last measurement allowed in percent. If this value is set to 100 %, the monitoring of the mark width is switched off.
- **DeviationOfMarkHight:**
Maximum deviation of the mark height from the last measurement allowed in percent. If this value is set to 100 %, the monitoring of the mark height is switched off.

- **DeviationOfLastPosition:**
Maximum absolute deviation of the mark position from the last measurement allowed.
- **ShiftSyncPulse:**
Indicates the distance between the shifted zero pulse and the beginning of the expectation window. To ensure a high measurement accuracy during acceleration phase, the zero pulse is shifted up to the beginning of the expectation window with regard to the hardware. This value indicates the tolerance between the shifted zero pulse and the beginning of the expectation window. If it is to be expected that the mark stream does not keep moving forward, a default value of 5 mm is recommended.

InternalParameter: This data structure includes internal parameters of the sensor that should only be changed if instructed by Bosch Rexroth. Color and intensity can be scaled here. The default values are values from experience. The structure also contains the gain transmitted during easy-teach-in.

- **ColorWeighting:**
Indicates the color scaling in the analog signal.
- **IntensityWeighting:**
Indicates the intensity scaling in the analog signal.
- **Gain:**
Indicates the current gain of the sensor written during easy teach-in. This gain is generally read out via the diagnostic function block MB_RegiSensor01ReadDiagType01.

Sending and receiving data packages

The function block indicates with the incrementation from "NewData" to "SendData" that it wants to send new data. It is sent via the MB_RegiSensor01SendRecvDataType01 function block. If it receives new data, it sets the "NewData" value equal to the "RecvData" value. Thus, the function block knows that it is the respected response package. A response package is expected with each transmitted data package.

Timeout:

If a new data package is sent, an internal timer runs in the function block. If it does not get a response within 10 s, it aborts with an error due to timeout.

A possible error case is that the MB_RegiSensor01SendRecvDataType01 function block is not activated or incorrectly connected.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000000	Timeout; no response from the MB_RegiSensor01SendRecvDataType01 function block within 10 seconds
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000001	Timeout while teaching. Teaching could not be completed in the time specified.
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid plate cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000001	Invalid mark type
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000002	Invalid mark geometry

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ErrorID	Additional 1	Additional 2	Description
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000003	Invalid number of barcode blocks
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000004	Invalid number of marks in the mark stream
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000005	Invalid mark distance
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000006	Invalid length register mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000007	Invalid length register parameter
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000008	Invalid side register mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000009	Invalid sensor IP
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000A	Invalid control IP
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000B	Invalid UDP port for the measurement
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000C	Invalid configuration port
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000D	Invalid number of increments
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000E	Invalid measurement tolerance
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000F	Invalid teaching tolerance of a mark
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000010	Invalid teaching tolerance, beginning of expectation window
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000011	Invalid beginning of expectation window
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000012	Invalid size of expectation window
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000013	Invalid tolerance for mark width
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000014	Invalid tolerance for mark height
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000015	Invalid tolerance for mark position
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000016	Invalid "ShiftSyncPulse" tolerance
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000017	Invalid color scaling
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000018	Invalid intensity scaling
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000019	Invalid "Measurement" mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001A	Invalid gain
COMMUNICATION_ERROR (16#0002)	16#0C001D10	16#00000002	Timeout during barcode search
OTHER_ERROR (16#7FFE)	16#00001D12	16#xxxxxxx	Error handling for the mark stream sensor (see table "Mark stream sensor") is not integrated in "F_RELATED_TABLE"

Fig.3-35: Error codes of the MB_RegiSensor01ConfigType01 function block

Additionally, the function block can output errors of the mark stream sensor.

3.3.3 MB_RegiSensor01CycComType01

Brief Description

The MB_RegiSensor01CycComType01 function block executes the cyclic communication with the sensor via the Ethernet interface. It receives measured sensor values, evaluates them and returns the mark distance or the difference of the mark widths of two registration marks. One measured value is returned for the length register and one for the side register. The communication with the sensor is executed internally. If measured values of several reg-

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istration marks are required, the MB_RegiSensor01CycComType02 function block is to be used.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig. 3-36: Reference table of the MB_RegiSensor01CycComType01 function block

Interface Description

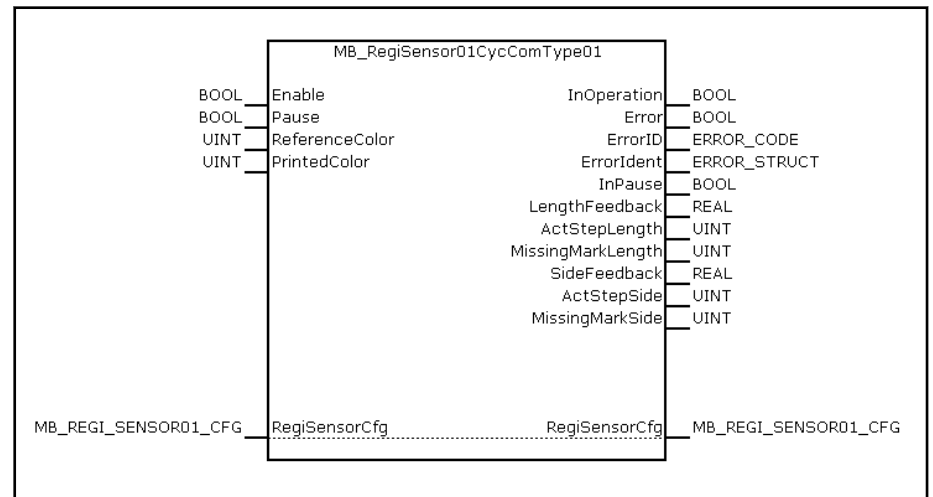


Fig. 3-37: The MB_RegiSensor01CycComType01 function block

I/O type	Name	Data type	Description
VAR_IN_OUT	RegiSensorCfg	MB_REGI_SENSOR01_CFG	Contains the current configuration data of the sensor.
VAR_INPUT	Enable	BOOL	Function block processing enable (level-controlled).
	Pause	BOOL	Cancels the function block processing. The value at "LengthFeedback" and "SideFeedback" remains constant.
	ReferenceColor	UINT	Indicates the reference color with which the currently printed mark is compared to. ReferenceColor = 1 means that the currently printed mark is compared to the first mark of the mark stream.
	PrintedColor	UINT	Indicates the position of the mark printed in the mark stream by the controlling printing unit.

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I/O type	Name	Data type	Description
VAR_OUTPUT	InOperation	BOOL	Function block is operating
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	InPause	BOOL	Indicates that the "Pause" input is active and that the values in "LengthFeedback" and "SideFeedback" do not change.
	LengthFeed-back	REAL	The mark distance calculated for the length register.
	ActStepLength	UINT	Contains the sequence number of the last measurement package if a new valid measured value is present for the length register.
	MissingMarkLength	UINT	Is incremented if an invalid measured value is present for the length register.
	SideFeedback	REAL	The actual value for the side register.
	ActStepSide	UINT	Contains the sequence number of the last measurement package if a new valid measured value is present for the side register.
	MissingMark-Side	UINT	Is incremented if an invalid measured value is present for the side register.

Fig.3-38: I/O interface of the MB_RegiSensor01CycComType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Pause	BOOL			FALSE	Continuous
ReferenceColor	UINT	0	16	0	Continuous
PrintedColor	UINT	0	16	0	Continuous

Fig.3-39: Overview on min./max. values and initial values of the inputs

Data Structures

The data structure [MB_REGI_SENSOR01_CFG](#), page 23 was described for the function block [MB_RegiSensor01ConfigType01](#), page 21.

Functional Description

The function block may only be activated after the MB_RegiSensor01ConfigType01 function block was called to configure at a rising edge at "Enable" since the MB_RegiSensor01CycComType01 function block accesses the UDP port of the RegiSensorCfg structure and then connects. If no configuration has yet been executed, a faulty UDP port is present, since this port has not been written to the structure. In this case, the respective "Error" output of the function block is set.

The PLC works as UDP server in the cyclic communication. That means the control receives the packages of the sensor with its measured values at the UDP port via the acyclic communication. The sensor sends the measured data cyclically after each cylinder revolution (that means after each measurement evaluation). This measured data is evaluated by the function block. When setting "Enable", a bind() is made on UDP port defined in "RegiSen-

sorCfg". Thus, it can be listened on the UDP port and measured values can be received and evaluated.

ReferenceColor und PrintedColor:

The inputs "ReferenceColor" and "PrintedColor" indicate which marks are measured to each other.

If ReferenceColor = 1 and PrintedColor = 4 for example, the mark distance between the marks 1 and 4 of the mark stream is returned. This allows switching from reference color to previous color during operation by selecting ReferenceColor = 3. "PrintedColor" is a mark that is printed from the controlling printing unit.

If a new actual value is calculated, it is output. "ActStepLength" and "ActStepSide" contain the sequence number of the last measurement package. Thus, the register controller knows that a new measured value is present.

If there is an invalid measured value that does not allow the evaluation of the marks "ReferenceColor" and "PrintedColor", "MissingMarkLength/Side" is incremented and "ActStepLength/Side" remains unchanged. If there is a new valid value, "MissingMarkLength/Side" is reset again.

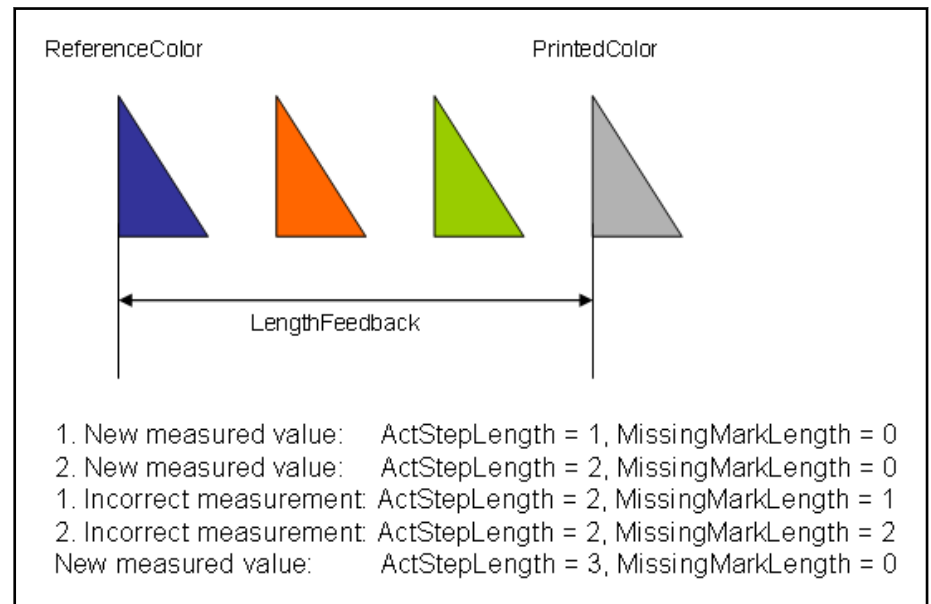


Fig.3-40: Behavior of the outputs in case of incorrect measurements

The figure above shows the behavior of the outputs for the length register measurement as example. The side register behavior is equivalent. Registration mark 1 was selected as reference color, registration mark 4 as printed mark and thus, "LengthFeedback" is the distance between the marks 4 and 1. In case of a new measured value, "LengthFeedback" is updated and "ActStepLength" is incremented. "ActStepLength" and "LengthFeedback" are frozen at the first incorrect measurement and "MissingMarkLength" is incremented. In case of a new valid measurement, "MissingMarkLength" is set to 0, "ActStepLength" is incremented and the current measured value "LengthFeedback" is output.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

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ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000003	Timeout while connecting
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001D	"ReferenceColor" is not within the defined limits
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001E	"PrintedColor" is not within the defined limits
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001F	"PrintedColor" and "ReferenceColor" are equal
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000020	No valid configuration found
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000021	"PrintedColor" or "ReferenceColor" are not within the range of the marks defined
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000B	Invalid UDP port for the measurement

Fig. 3-41: Error codes of the MB_RegiSensor01CycComType01 function block

Additionally, the function block can output errors of the mark stream sensor and of the library RIL_SocketComm.lib.

3.3.4 MB_RegiSensor01CycComType02

Brief Description

The MB_RegiSensor01CycComType02 function block is required to communicate with the mark stream sensor. It executes only the cyclic communication. The sensor is configured by the MB_RegiSensor01ConfigType01 function block. Only after the sensor has been configured directly, it is started with the measurement and the function block can start the measurement evaluation. All measured values are specified for the length register and the side register at the output. This data can be evaluated by the user according to the configuration. This MB_RegiSensor01CycComType02 function block is especially suitable for applications in which several printed marks are measured to each other. This is for example the case if only one mark stream sensor is located at the end of the machine.

An exemplary application is shown in the following figure:

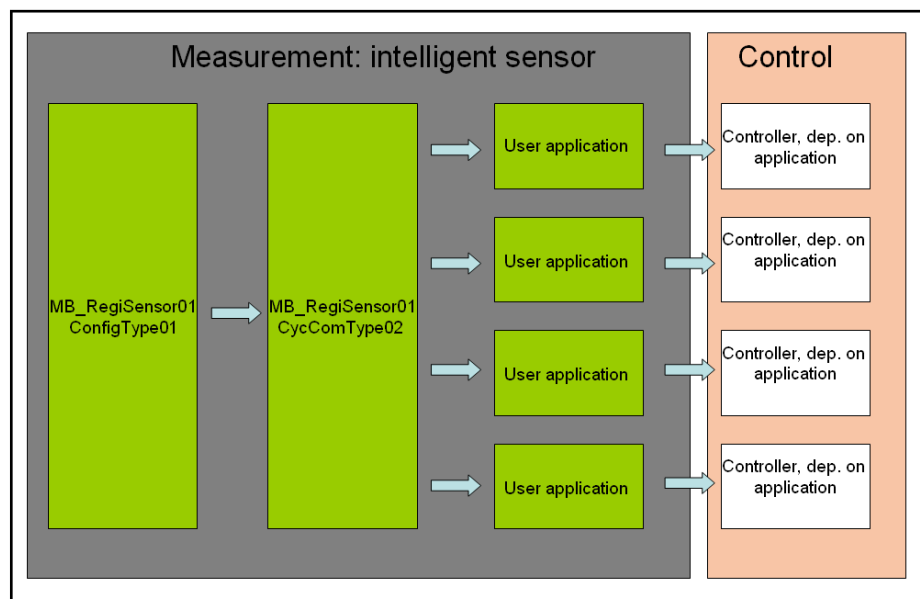


Fig. 3-42: Exemplary application of the MB_RegiSensor01CycComType02 function block

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Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-43: Reference table of the MB_RegiSensor01CycComType02 function block

Interface Description

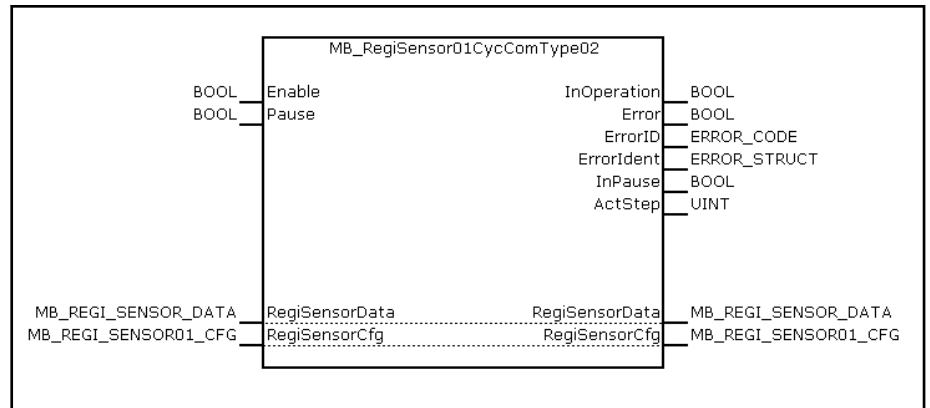


Fig.3-44: The MB_RegiSensor01CycComType02 function block

I/O type	Name	Data type	Description
VAR_IN_OUT	RegiSensorCfg	MB_REGI_SENSOR01_CFG	Contains the current configuration data of the sensor.
	RegiSensorData	MB_REGI_SENSOR01_DATA	Contains the respective measured values of the sensor.
VAR_INPUT	Enable	BOOL	Function block processing enable (level-controlled).
	Pause	BOOL	Cancels the function block processing. No new measured values are evaluated. The last measured data is frozen.
VAR_OUTPUT	InOperation	BOOL	Function block is working.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	InPause	BOOL	Indicates that the "Pause" input is active and that the value in "RegiSensorData" does not change.
	ActStep	UINT	Indicates that a new data package with measured values was received and evaluated.

Fig.3-45: I/O interface of the MB_RegiSensor01CycComType02 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Pause	BOOL			FALSE	Continuous

Fig.3-46: Overview on min./max. values and initial values of the inputs

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Data Structures

MB_REGI_SENSOR01_DATA		
ActStep	UINT	Current step
LengthFeedback	ARRAY [0..16] OF REAL	It contains the mark distance from the zero pulse to the marks 1..16. In [0], the mark distance stands for web/web2 if a mark on the upper side was measured with one on the lower side.
SideFeedback	ARRAY [1..16] OF REAL	Contains the respective mark widths.
MarkState	ARRAY[0..16] OF MB_REGI_MARK_STATE	Status of the registration marks.
SensorState	MB_REGI_SENSOR_STATE	Outputs warnings and diagnostics of the sensor during measurement.

Fig.3-47: MB_REGI_SENSOR01_DATA data structure

The data structure [MB_REGI_SENSOR01_CFG](#), page 23 was described for the function block [MB_RegiSensor01ConfigType01](#), page 21.

Enumeration Type

The enumeration type MB_REGI_MARK_STATE can assume the following values:

Element	Value	Description
FOUND	0	Mark found
ROTATED	1	Mark rotated
LARGE	2	Mark too large
SMALL	3	Mark too small
MISSING	4	Mark missing
NOT_CONFIGURED	5	Mark not configured

Fig.3-48: Enumeration type MB_REGI_MARK_STATE

The enumeration type MB_REGI_SENSOR_STATE can assume the following values:

Element	Value	Description
START	0	Starting state
SEARCHING	1	Search marks
INOP	2	Marks found (operating mode)
STOP	3	Web velocity below 0,4m/s – no evaluation
LAMP	4	Lamp defective
SENSOR	5	Sensor dirty
TEACHING	6	Sensor in teach phase

Fig.3-49: Enumeration type MB_REGI_SENSOR_STATE

Functional Description

The function block may only be activated after the MB_RegiSensor01Config-Type01 function block was called to configure at a rising edge at "Enable" since the MB_RegiSensor01CycComType02 function block accesses the

UDP port of the RegiSensorCfg structure and then connects. If no configuration has yet been executed, a faulty UDP port is present, since this port has not been written to the structure. In this case, the respective "Error" output of the function block is set.

The PLC works as UDP server in the cyclic communication. That means the control receives the measured value packages of the sensor at the UDP port via the acyclic communication. The sensor sends the measured data cyclically after each cylinder revolution (that means after each measurement evaluation). This measured data is evaluated by the function block. When setting "Enable", a bind() is made on UDP port defined in "RegiSensorCfg". Thus, it can be listened on the UDP port and measured values can be received and evaluated.

Each sensor thus requires 2 ports on the control: One for configuration data and diagnostic data and one for the measured value acquisition. The communication with the sensor to receive measured values is internally takes place in the function block.

The **RegiSensorData** contains all measured values.

LengthFeedback[i]: The "LengthFeedback" array contains all measured mark distances with regard to the zero pulse as well as a measured value of the web/web2 procedure that are entered into the array as follows:

LengthFeedback[0]: Mark distance between the defined mark below and the mark above.

LengthFeedback[1]: Mark distance between the zero pulse and mark 1.

LengthFeedback[2]: Mark distance between the zero pulse and mark 2.

...

LengthFeedback[15]: Mark distance between the zero pulse and mark 15.

LengthFeedback[16]: Mark distance between the zero pulse and mark 16.

If a measured value is not available since it has not been configured or if less marks are available, the return value is 0.0 and defined correspondingly as "Missing" or "Not_Configured" in the "MarkState".

SideFeedback[i]: The "SideFeedback" array contains all measured mark widths that are entered in the array as follows:

SideFeedback[1]: Mark width of mark 1

SideFeedback[2]: Mark width of mark 2

...

SideFeedback[16]: Mark width of mark 16

If a measured value is not available since it has not been configured or if less marks are available, the return value is 0.0 and defined correspondingly as "Missing" or "Not_Configured" in the "MarkState".

SensorState: It is not set.

MarkState[i]: Indicates the validity of the values in the arrays "LengthFeedback" and "SideFeedback". If the measured value of mark 1 is valid for example, then, MarkState[1] = FOUND. Thus, the values "LengthFeedback[1]" and "SideFeedback[1]" can be evaluated. Otherwise, MarkState[1] = Missing or Not_Configured. That depends on the fact whether the mark was omitted or not configured.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

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ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000003	Timeout while connecting
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000020	No valid configuration found
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000B	Invalid UDP port

Fig.3-50: Error codes of the MB_RegiSensor01CycComType02 function block
Additionally, the function block can output errors of the mark stream sensor and of the library RIL_SocketComm.lib.

3.3.5 MB_RegiSensor01SendRecvDataType01

Brief Description

The MB_RegiSensor01SendRecvDataType01 function block communicates with the sensor. Therefore, the function blocks transfer their data to be sent and get the respective data packages in return for the following: sensor configuration, sending velocity information and acceleration information. The diagnostic function block sends its data and gets the respective data packages in return during an acceleration phase. The function block prevents a collision of function blocks accessing the same UDP port simultaneously. Prioritization is still implemented. Sending acceleration information is time-critical. Due to this fact, out of the configuration data of the MB_RegiSensor01SendSpeedAccType01 function block, diagnostic data of the MB_RegiSensor01ConfigType01 function block, teach data of the MB_RegiSensor01ReadDiagType01 function block and data packages of the MB_RegiSensor01TeachDataType01 function block, the preference is given to the data packages and they are immediately sent when sending is possible.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-51: Reference table of the MB_RegiSensor01SendRecvDataType01 function block

Interface Description

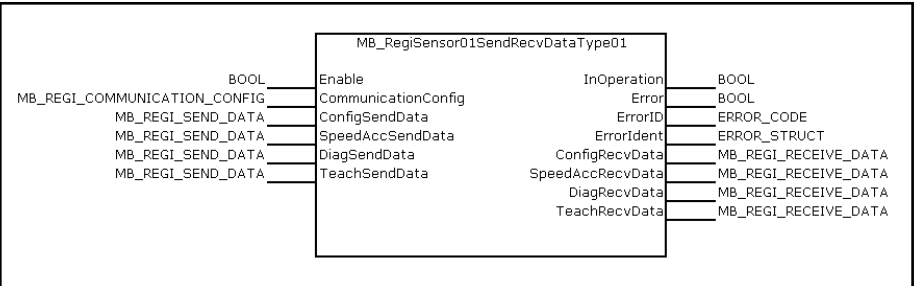


Fig.3-52: MB_RegiSensor01SendRecvDataType01 function block

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I/O type	Name	Data type	Description
VAR_INPUT	Enable	BOOL	Processing of function block enabled.
	CommunicationConfig	MB_REGI_COMMUNICATION_CFG	Contains the UDP port of the control to which the control connects to and to which the sensor sends the measured data.
	ConfigSendData	MB_REGI_SEND_DATA	Includes data that the MB_RegiSensor01ConfigType01 function block wants to send.
	SpeedAccSendData	MB_REGI_SEND_DATA	Includes data that the MB_RegiSensor01SendSpeedAccType01 function block wants to send.
	DiagSendData	MB_REGI_SEND_DATA	Includes data that the MB_RegiSensor01ReadDiagType01 function block wants to send.
	TeachSendData	MB_REGI_SEND_DATA	Includes data that the MB_RegiSensor01TeachData-Type01 function block wants to send.
VAR_OUTPUT	InOperation	BOOL	Function block is working.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	ConfigRecvData	MB_REGI_RECEIVE_DATA	Includes data that was received for the MB_RegiSensor01ConfigType01 function block.
	SpeedAccRecvData	MB_REGI_RECEIVE_DATA	Includes data that was received for the MB_RegiSensor01SendSpeedAccType01 function block.
	DiagRecvData	MB_REGI_RECEIVE_DATA	Includes data that was received for the MB_RegiSensor01ReadDiagType01 function block.
	TeachRecvData	MB_REGI_RECEIVE_DATA	Includes data that was received for the MB_RegiSensor01TeachData-Type01 function block.

Fig. 3-53: I/O interface of the MB_RegiSensor01SendRecvDataType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
MB_REGI_COMMUNICATION_CONFIG					
IpSensor	STRING	LEN > 0	n.def.	""	Rising edge at "Enable"
PortConfiguration	UINT	1	n.def.	0	Rising edge at "Enable"
IpPLC	STRING	LEN > 0	n.def.	""	Rising edge at "Enable"
PortMeasurement	UINT	1	n.def.	0	Rising edge at "Enable"
MB_REGI_SEND_DATA					
NoOfBytes	UDINT	0	n.def.	0	Change at "NewData"
ValueAddr	POINTER TO BYTE	n.def.	n.def.	0	Change at "NewData"

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Name	Type	Min. value	Max. value	Default value	Effective
NewData	UINT	0	65535	0	Continuous
SensorPort	UINT	1	65535	0	Change at "NewData"

Fig.3-54: Overview on min./max. values and initial values of the inputs

Data Structures

The data structures [MB_REGI_SEND_DATA](#), page 25 and [MB_REGI_COMMUNICATION_CONFIG](#), page 24 were described for the function block [MB_RegiSensor01ConfigType01](#), page 21.

Functional Description

If a communication should be established with a sensor, this function block has to be started at a rising edge at "Enable" before or at the same time with the attached function blocks [MB_RegiSensor01SendSpeedAccType01](#), [MB_RegiSensor01ConfigType01](#), [MB_RegiSensor01TeachDataType01](#) and [MB_RegiSensor01ReadDiagType01](#). At a rising edge at "Enable" and after checking the inputs, the respective UDP port "PortConfiguration" is bound to the control. Thus, the respective data can be received on this port. The function block waits for data. That means that it checks during each call whether the "NewData" input changes for the structures "ConfigSendData", "AccelerationSendData", "DiagSendData" and "TeachSendData". If this is the case, the respective data (NoOfBytes) is sent. The function block waits for the respective data if a response package is expected from the sensor (exception: no response package is expected when transmitting acceleration and velocity). A timeout handling also takes place. If no response package has been received after 2 seconds, the data package is sent again. An error is generated after third try and the transmission is aborted. If a package is received, the number of bytes and the address (ValueAddr) at which the data is present are specified. "NewData " at the output is set to the same value "NewData" had at the input when data was sent. Thus, it can be exactly allocated to which sent data package the response belongs to.

Data buffer: No **data buffer** is internally implemented since each created function block (if a handshake takes place) sends the next package only after it received the respective response. Exception: If there is a new package with velocity and acceleration information and if it cannot be sent until a new package is created, the new package is sent and the old one is discarded.

Prioritization:

The transferred configuration data is not time-critical. Only the acceleration and velocity values has to be transferred as fast as possible. Thus, a prioritization is implemented. The data package of the [MB_RegiSensor01SendSpeedAccType01](#) function block has absolute priority and is immediately sent as soon as the "send" function block is empty. If it is waited for a response package of the configuration or diagnostics within this period, it is first stopped, the time-critical package is sent in order to subsequently receive the configuration/diagnostic package. The prioritization is shown in the following figure.

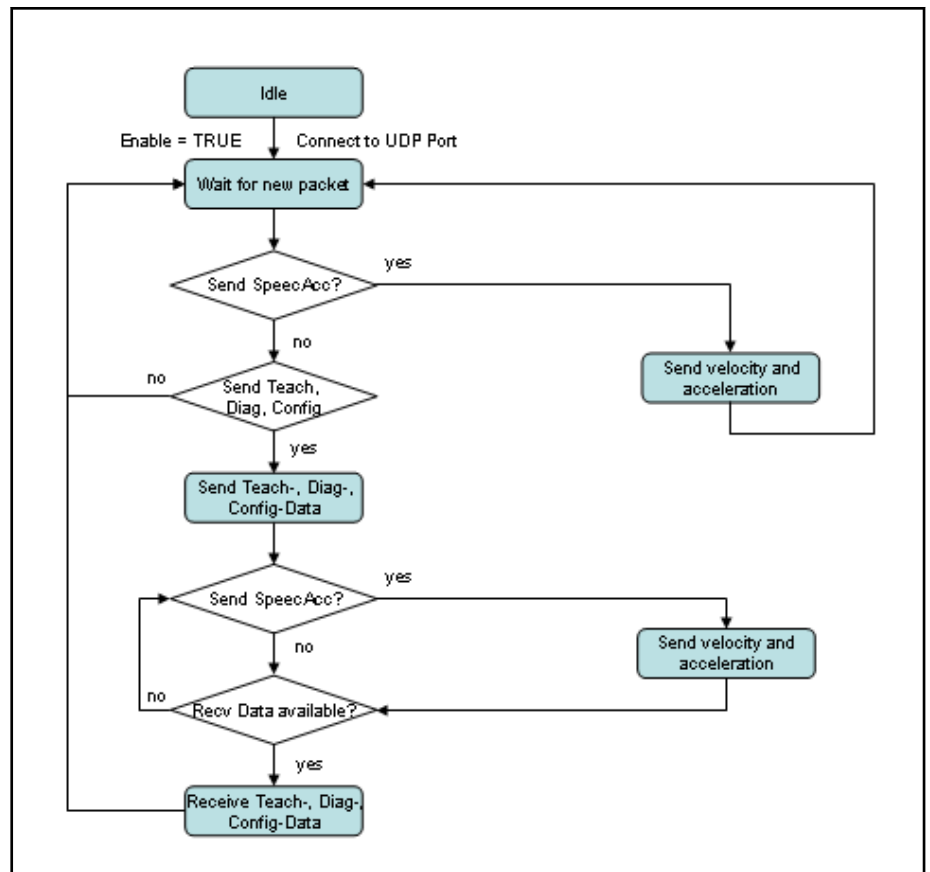


Fig. 3-55: Internal sequence of the MB_RegiSensor01SendRecvDataType01 function block

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000003	Timeout while connecting to the UDP port
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001B	Invalid UDP port, port configuration
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000004	Timeout while sending
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000005	Timeout while receiving
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000001C	Invalid sensor IP

Fig. 3-56: Error codes of the MB_RegiSensor01SendRecvDataType01 function block

Additionally, the function block can output errors of the mark stream sensor and of the library RIL_SocketComm.lib.

3.3.6 MB_RegiSensor01ReadDiagType01

Brief Description

The MB_RegiSensor01ReadDiagType01 function block reads the diagnostic data and the electronic type designation code of the sensor and stores them in the data structure. This function block requires the MB_RegiSensor01Sen-

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dRecvData function block that is responsible for the UDP communication with the sensor to send and receive data.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-57: Reference table of the MB_RegiSensor01ReadDiagType01 function block

Interface Description

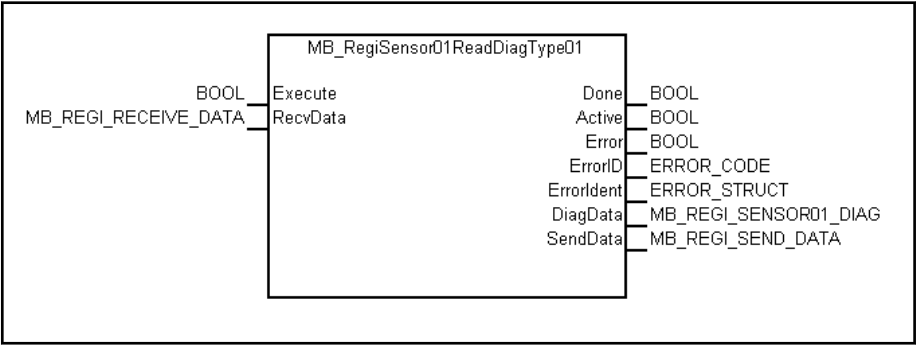


Fig.3-58: MB_RegiSensor01ReadDiagDataType01 function block

I/O type	Name	Data type	Description
VAR_INPUT	Execute	BOOL	Starts reading the diagnostic data,
	RecvData	MB_REGI_RECEIVE_DATA	Received data from the MB_RegiSensor01SendRecvDataType01 function block.
VAR_OUTPUT	Done	BOOL	Reading the diagnostic data was successful.
	Active	BOOL	Diagnostic data is currently read.
	Error	BOOL	Indicates that an error occurred.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed error cause.
	DiagData	MB_REGI_SENSOR01_DIAG	Diagnostic data of the sensor.
	SendData	MB_REGI_SEND_DATA	Data to be sent via the MB_RegiSensor01SendRecvData function block.

Fig.3-59: I/O interface of the MB_RegiSensor01ReadDiagDataType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
MB_REGI_RECEIVE_DATA					
NoOfBytes	UDINT	0	n.def.	0	Change at "NewData"
ValueAdr	POINTER TO BYTE	n.def.	n.def.	0	Change at "NewData"
NewData	UINT	0	65535	0	Continuous

Fig.3-60: Overview on min./max. values and initial values of the inputs

Data Structures

MB_REGI_SENSOR01_DIAG		
ComponentName	STRING(52)	Indicates the component name
VendorName	STRING(28)	Vendor name
VendorCode	DWORD	Vendor code
DeviceName	STRING(40)	Type designation code
VendorDeviceID	STRING(24)	BR parts number
FunctionRevision	WORD	Function version
HardwareRevision	STRING(16)	Hardware version
SoftwareRevision	STRING(16)	Software version
SerialNumber	STRING(24)	Serial number
OperationalHours	DWORD	Operating hour counter in hours
MAC address	STRING(17)	Mac address
ChromaticityX	REAL	Current color intensity x (resolution 1/32768)
ChromaticityY	REAL	Current color intensity y (resolution 1/32768)
Intensity	UDINT	Current intensity
Gain	UINT	Current gain (0..7)
Velocity	UDINT	Current velocity (Inc/s)
Status	WORD	Status (bit-coded)
MeasurementState	WORD	Measurement status (start/stop)
SmoothFactorVel	UINT	Smoothing factor, averaging velocity (0..8)
Acceleration	DINT	Current acceleration = (inc/s ²)
SmoothFactorSensor	UINT	Smoothing factor sensor (0..4)
SensorSignals	UINT	Sensor signals

Fig.3-61: MB_REGI_SENSOR01_DIAG data structure

The data structure [MB_REGI_SEND_DATA, page 25](#) was described for the function block [MB_RegiSensor01ConfigType01, page 21](#).

Functional Description

The function block reads the diagnostic data of the sensor and stores them in the data structure. The first 11 data sets represent the electronic type code. The following parameters are settings and current states of the sensor that can be read out and shown via these.

The evaluation of the non-self-explanatory errors are described in the following:

Status

"LowByte" and "HighByte" are not distinguished. "LowByte" and "HighByte" can be changed independently from each other:

0x0800: Channel Blue, sensor is overdriven

0x1000: Channel Green, sensor is overdriven

0x2000: Channel Red, sensor is overdriven

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0x0001: Idle mode
 0x0002: Configuration mode
 0x0003: Measurement mode
 0x0004: Teach mode
MeasurementState
 0x0000: No measurement started
 0x0001: Measurement started
SensorSignals
 Reserved for further diagnostics

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000000	Timeout while receiving a package.

Fig. 3-62: Error codes of the MB_RegiSensor01ReadDiagDataType01 function block

Additionally, the function block can output errors of the mark stream sensor.

3.3.7 MB_RegiSensor01SendSpeedAccType01

Brief Description

This function block sends the respective velocity and acceleration information to the mark stream sensor in a defined interval. Data is calculated and sent in the respective intervals dependent on a time interval. The smaller the time interval, the more values are sent and the more data traffic is created. Thus, the time interval should be at least the double of the current cycle time of the task during which the function block is called. Thus, the sensor can even guarantee a highly accurate measurement in acceleration phases. The MB_RegiSensor01SendSpeedAccType01 function block calculates the current acceleration and velocity values and creates the respective data package. This data package is applied at the output and is sent via the MB_RegiSensor01SendRecvDataType01 function block. That means that this function block either has to be started at the same time or before. Since it is about time-critical data, the data packages are considered immediately with highest priority or sent as soon as the "send" function block is empty.

It is recommended to use the MB_RegiSensor01SendSpeedAccType01 function block only in acceleration phases and to deactivate it at constant run due to data traffic. If the function block should also work at constant run, a time interval of > 250 ms is recommended. If the function block sends data, the sensor does not determine any acceleration data anymore from the incremental encoder information. Only after a falling edge at "Enable", the sensor determines velocity information from the incremental encoder information.



The function block MB_RegiSensor01SendSpeedAccType01 has to be called in a Motion-synchronous task to ensure a correction calculation of the acceleration. If this is not possible due to the runtime, the "mMotionCyclic()" function of the function block from the Motion-synchronous tasks has to be called and the MB_RegiSensor01SendSpeedAccType01 function block can be called in a cyclic task. The call of the MotionTask has to be provided with the following structure: {CyclicTask}. {fbInstanz}.mMotionCyclic(). The elements in the curly brackets have to be replaced by the program name in the cyclic task and the instance name of the function block. Thus, the method call from a program running in the Motion task could be as follows: PLCProg.fbRegiSensor01SendSpeedAccType01.mMotionCyclic(). If this call is not executed, a correct calculation of the acceleration cannot be ensured.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig. 3-63: Reference table of the MB_RegiSensor01SendSpeedAccType01 function block

Interface Description

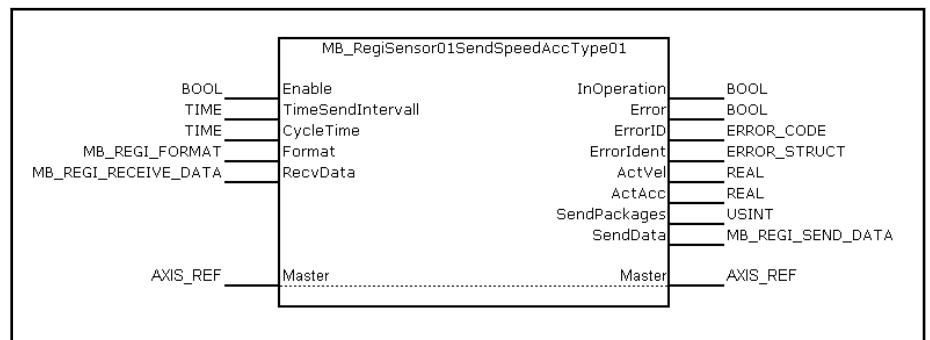


Fig. 3-64: MB_RegiSensor01SendSpeedAccType01 function block

I/O type	Name	Data type	Description
VAR_IN_OUT	Master	AXIS_REF	Axis whose velocity and acceleration information should be sent. Due to the accuracy, it is recommended to create a virtual master axis.
VAR_INPUT	Enable	BOOL	Function block processing enable (level-controlled).
	TimeSendIntervall	TIME	Data is calculated and sent in this interval.
	CycleTime	TIME	Cycle time of the PLC task in which the function block is called.
	Format	MB_REGI_FORMAT	Contains the printing cylinder circumference and the number of increments per revolution.
	RecvData	MB_REGI_RECEIVE_DATA	Received data from the MB_RegiSensor01SendRecvDataType01 function block.

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I/O type	Name	Data type	Description
VAR_OUTPUT	InOperation	BOOL	Function block is working.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	ActVel	REAL	Current velocity in [Inc/s] transmitted to the sensor.
	ActAcc	REAL	Current acceleration in [Inc/s^2] transmitted to the sensor.
	SendPackages	USINT	Package counter if new data is calculated and transferred for sending.
	SendData	MB_REGI_SEND_DATA	Data to be sent via the MB_RegiSensor01SendRecvData function block.

Fig. 3-65: I/O interface of the MB_RegiSensor01SendSpeedAccType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
TimeSendIntervall	TIME	$\geq 2 \cdot \text{CycleTime}$	n.def.	t#100ms	Rising edge at "Enable"
CycleTime	TIME	> 0	n.def.	t#8ms	Rising edge at "Enable"
MB_REGI_FORMAT					
FormatLength	REAL	> 0	n.def.	0	Rising edge at "Enable"
Increments	UDINT	> 0	n.def.	0	Rising edge at "Enable"
MB_REGI_RECEIVE_DATA					
NoOfBytes	UDINT	0	n.def.	0	Change at "NewData"
ValueAddr	POINTER TO MB_REGI_SENSOR01_ACK_BUFFER	n.def.	n.def.	0	Change at "NewData"
NewData	UINT	0	65535	0	Continuous

Fig. 3-66: Overview on min./max. values and initial values of the inputs

Data Structures

The data structures [MB_REGI_FORMAT](#), page 23 and [MB_REGI_RECEIVE_DATA](#), page 25 were described for the function block [MB_RegiSensor01ConfigType01](#), page 21.

Functional Description

The inputs are checked and applied at a rising edge at "Enable". First, a timeout value is transferred to the sensor (c.f. Init package). That means if no new acceleration or velocity value is sent anymore, the velocity is determined again by the sensor after this period. This value is fixedly determined with 10 s. The sensor waits for the response package to subsequently determine the first current acceleration and to provide it to the function block MB_RegiSensor01SendRecvDataType01 so that the value is transferred to the sensor. From this point in time onwards, a new velocity and acceleration is deter-

mined after the time interval has been completed. The time interval has to be at least twice the cycle time of the task in which the function block is called to control data traffic and that other function blocks can still send and receive data. At a falling edge at "Enable", an end package is sent to the sensor. This end package notifies the sensor that it should determine its velocity from the incremental encoder signals. It is waited for the acknowledgement package of the sensor. Thus, it can happen that after a falling edge at "Enable", x cycle times are still present "InOperation".

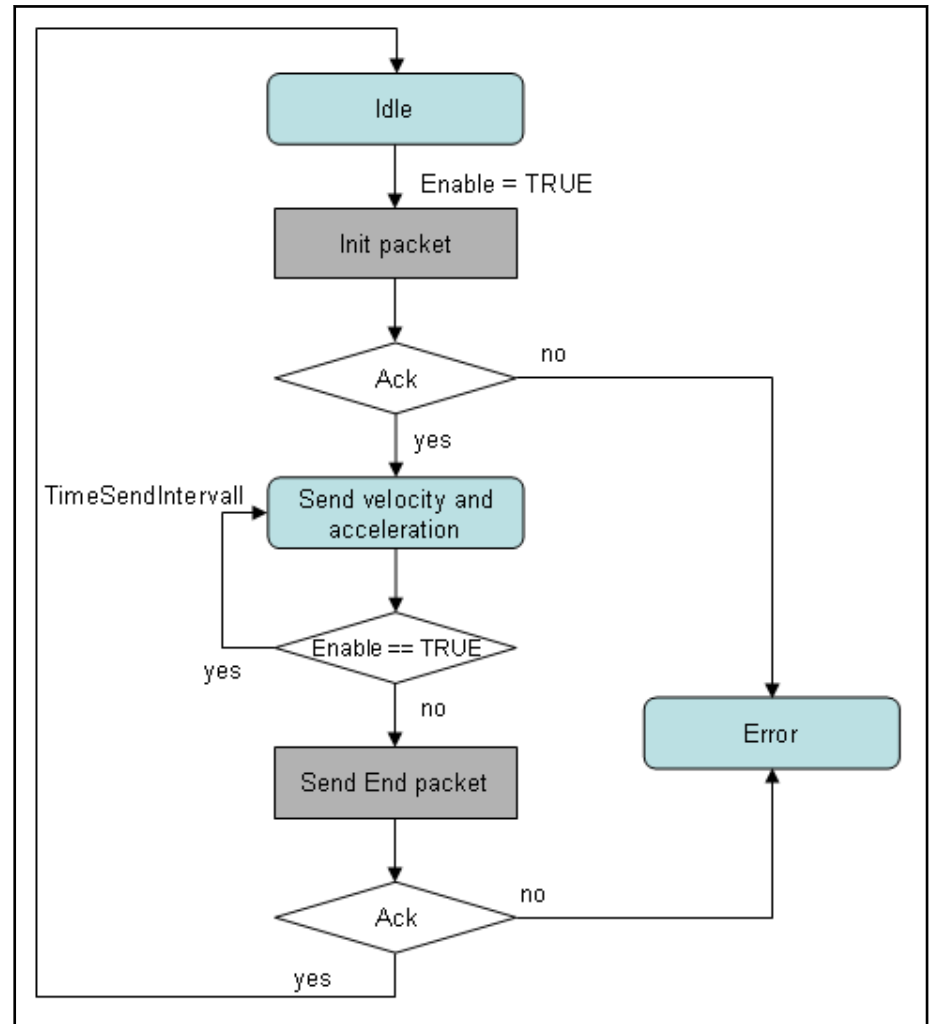


Fig. 3-67: Behavior of the MB_RegiSensor01SendSpeedAccType01 function block

Handshake: The function block indicates with the incrementation from "NewData" to "SendData" that it wants to send new data. This is executed by the MB_RegiSensor01SendRecvDataType01 function block. If it receives new data, it sets the "NewData" value equal to the "RecvData" value. Thus, the function block knows that it is the respected response package. A handshake is only executed when transferring the timeout and the end diagram. When sending the acceleration and velocity, no response package of the sensor is generated, since it is time-critical data and thus, old data would be transferred when repeating the sending.

Timeout: If a new data package is sent, an internal timer runs in the function block. If it gets no response within 10 seconds, it outputs a timeout and aborts with an error. A possible error case is that the MB_RegiSensor01SendRecvDataType01 function block is not activated or incorrectly connected.

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Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00001D11	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000022	Invalid time interval
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000023	Invalid cycle time
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid plate cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000000D	Invalid number of increments
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000006	Timeout; no response from the MB_RegiSensor01SendRecvDataType01 function block within 10 seconds
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Master" is not within the valid range

Fig.3-68: Error codes of the MB_RegiSensor01SendSpeedAccType01 function block

Additionally, the function block can output errors of the mark stream sensor.

3.3.8 MB_RegiSensor01TeachDataType01

Brief Description

The MB_RegiSensor01TeachDataType01 function block reads and writes measured data. Currently valid measured data can be read out from the mark stream sensor and can be directly loaded to the sensor after machine stop or power failure for example. Thus, the measurement can be started immediately without transferring a configuration or teaching again.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-69: Reference table of the MB_RegiSensor01TeachDataType01 function block

Interface Description

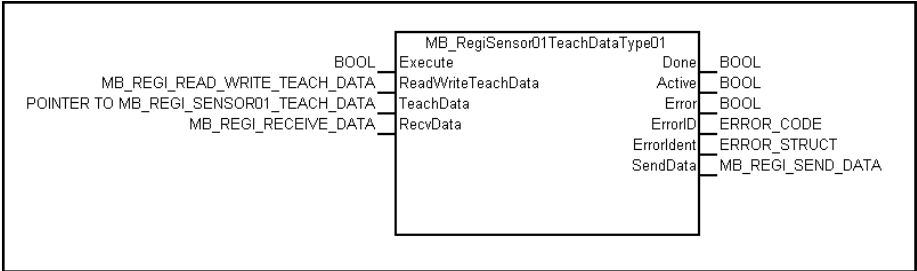


Fig.3-70: MB_RegiSensor01TeachDataType01 function block

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I/O type	Name	Data type	Description
VAR_INPUT	Execute	BOOL	Starts loading or saving of measured data.
	ReadWrite-TeachData	MB_RE-GI_READ_WRITE_TEACH_DATA	Selection whether the data should be uploaded to the sensor or downloaded from it.
	TeachData	POINTER TO MB_REGI_SENSOR01_TEACH_DATA	Address of the data type MB_REGI_SENSOR01_TEACH_DATA in which data is stored and from where data can be loaded.
	RecvData	MB_REGI_RECEIVE_DATA	Received data from the MB_RegiSensor01SendRecvDataType01 function block.
VAR_OUT-PUT	Done	BOOL	Loading or saving measured data was successful.
	Active	BOOL	Loading or saving measured data is currently running.
	Error	BOOL	Indicates that an error occurred.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed error cause.
	SendData	MB_RE-GI_SEND_DATA	Data to be sent via the MB_RegiSensor01SendRecvData function block.

Fig.3-71: I/O interface of the MB_RegiSensor01TeachDataType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
ReadWrite-TeachData	MB_RE-GI_READ_WRITE_TEACH_DATA	0	1	0	At a rising edge at "Execute"
TeachData	POINTER TO MB_REGI_SENSOR01_TEACH_DATA	> 0	n.def.	0	At a rising edge at "Execute"
MB_REGI_RECEIVE_DATA					
NoOfBytes	UDINT	0	n.def.	0	Change at "NewData"
ValueAdr	POINTER TO BYTE	0	n.def.	0	Change at "NewData"
NewData	UINT	0	65535	0	Continuous

Fig.3-72: Overview on min./max. values and initial values of the inputs

Data Structures

MB_REGI_SENSOR01_TEACH_DATA		
TeachData	ARRAY [0..1310] OF BYTE	Measured data (teach data)

Fig.3-73: MB_REGI_SENSOR01_TEACH_DATA data structure

The data structures [MB_REGI_SEND_DATA, page 25](#) and [MB_REGI_RECEIVE_DATA, page 25](#) were described for the function block [MB_RegiSensor01ConfigType01, page 21](#).

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Enumeration Type

The enumeration type **MB_REGI_READ_WRITE_TEACH_DATA** can assume the following values:

Element	Value	Description
READ_TEACH_DATA	0	Reads data from the sensor
WRITE_TEACH_DATA	1	Writes data to the sensor

Fig.3-74: Enumeration type **MB_REGI_READ_WRITE_TEACH_DATA**

Functional Description

The function block reads/writes the current measured data from/to the mark stream sensor at a rising edge.

MB_READ_WRITE_TEACH_DATA:

If **READ_TEACH_DATA** is selected, the measured data valid last is read from the mark stream sensor. Data is stored under the given "TeachData" address.

If **WRITE_TEACH_DATA** is selected, the measured data is written to the mark stream sensor. Therefore, the data at the specified "TeachData" address is sent to the mark stream sensor. After sending the data, the measurement can be started immediately without transferring the configuration data or starting a new teaching.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000029	Enumeration type MB_REGI_READ_WRITE_TEACH_DATA is invalid
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000028	TeachData points to 0 (zero pointer)
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000005	Timeout while receiving a package.

Fig.3-75: Error codes of the **MB_RegiSensor01TeachDataType01** function block

Additionally, the function block can output errors of the mark stream sensor.

3.3.9 MB_RegiSensor01SetIPAddressType01

Brief Description

The **MB_RegiSensor01SetIPAddressType01** function block stores the IP address of the sensor in the permanent sensor memory. The MAC address is required to select the sensor and it is printed on the casing of the evaluation electronics.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-76: Reference table of the **MB_RegiSensor01SetIPAddressType01** function block

Interface Description

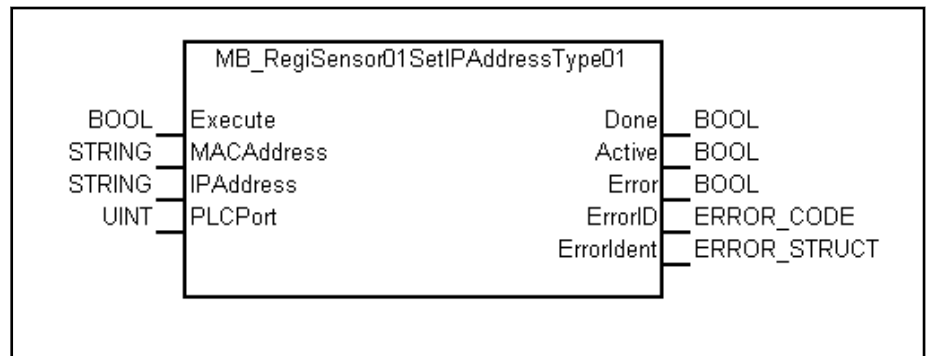


Fig.3-77: MB_RegiSensor01SetIPAddressType01 function block

I/O type	Name	Data type	Description
VAR_INPUT	Execute	BOOL	Initiates the setting of the IP address.
	MACAddress	STRING	MAC address as HEX string. Colon to separate the six hex values allowed.
	IPAddress	STRING	4-digit IP address as string separated with points.
	PLCPort	UINT	Port from which the IP address is sent from the control to the sensor.
VAR_OUTPUT	Done	BOOL	Setting the IP address was successful.
	Active	BOOL	IP address is currently set.
	Error	BOOL	Indicates that an error occurred.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed error cause.

Fig.3-78: I/O interface of the MB_RegiSensor01SetIPAddressType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
MACAddress	STRING	LEN = 0	LEN = 17 (only the lengths 0, 12 and 17 are valid)	""	Rising edge at "Execute"
IPAddress	STRING	LEN > 0	n.def.	""	Rising edge at "Execute"
PLCPort	UINT	> 0	n.def.	6000	Rising edge at "Execute"

Fig.3-79: Overview on min./max. values and initial values of the inputs

Functional Description

The function block sets the IP address of the mark stream sensor. The sensor is selected via the MAC address. The MAC address consists of six hex values that can be separated by colons. Leading zeros may not be omitted. If no MAC address is specified, only one sensor may be in the Ethernet.

The IP address consists of four decimal values between 0 and 255 that are separated by points.

The function starts at a rising edge at "Execute". The sensor sends **no** response on the setting of the IP address. "Done" becomes TRUE after a suc-

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successful execution. The IP address can be permanently saved in the sensor. It is possible to set a new IP address by calling the function block again.

If an error occurs, "Error" is TRUE and "ErrorIdent" contains exact information on the error.



The function block sends the new IP address to the sensor. The sensor does not send any response. The sensor has to be reset after the transmission of the IP address. The "Done" output only means that the package was successfully sent. The user has to find out whether the sensor is provided with the newly assigned IP after reset.

The length of the MAC address may vary between 12 and 17 characters. Other lengths are not allowed. The separator can be arbitrarily selected. There has to be one separator after two characters.

Examples of MAC addresses in the "MACAddress" input:

- "00:60:35:08:35:9E"
- "00603508359E"

It is strongly recommended to always specify the respective MAC address to ensure that the same IP address is not assigned to several sensors. The MAC address can only be omitted in case of a direct point-to-point connection.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000000	Timeout while reading
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000009	Specify invalid IP address
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000026	Invalid PLC port
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000003	Connection error
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000004	Timeout while sending
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000027	MAC address format incorrect

Fig. 3-80: Error codes of the MB_RegiSensor01SetIPAddressType01

Additionally, the function block can output errors of the mark stream sensor and of the library RIL_SocketComm.lib.

3.3.10 MB_RegiSensor01ConfigType01

Brief Description

The MB_RegiSensor01CommType01 function block contains the previously individually implemented function blocks MB_RegiSensor01ConfigType01, MB_RegiSensor01CycComType02, MB_RegiSensor01ReadDiagType01, MB_RegiSensor01SendRecvDataType01, MB_RegiSensor01SendSpeedAccType01 and MB_RegiSensor01TeachDataType01. The function blocks are internally connected in the function block and provide a user-friendly interface to execute the individual functions. The mark stream sensor can be completely controlled using the function block. Only the MB_RegiSen-

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sor01SetIPAddressType01 function block for setting the IP address is not integrated as it is only required once per machine.



The function block MB_RegiSensor01CommType01 has to be called in a Motion-synchronous task to ensure a correction calculation of the acceleration. If this is not possible due to the runtime, the "mMotionCyclic()" function of the function block from the Motion-synchronous tasks has to be called and the MB_RegiSensor01CommType01 function block can be called in a cyclic task. The call of the MotionTask has to be provided with the following structure: {CyclicTask}.fbRegiSensor01CommType01.{fbInstanz}.mMotionCyclic(). The elements in the curly brackets have to be replaced by the program name in the cyclic task and the instance name of the function block. Thus, the method call from a program running in the Motion task could be as follows: PlcProg.fbRegiSensor01CommType01.fbRegiSensor01CommType01.mMotionCyclic(). If this call is not executed, a correct calculation of the acceleration cannot be ensured.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V12	RMB_TechRegiExtended

Fig. 3-81: Reference table of the MB_RegiSensor01CommType01 function block

Interface Description

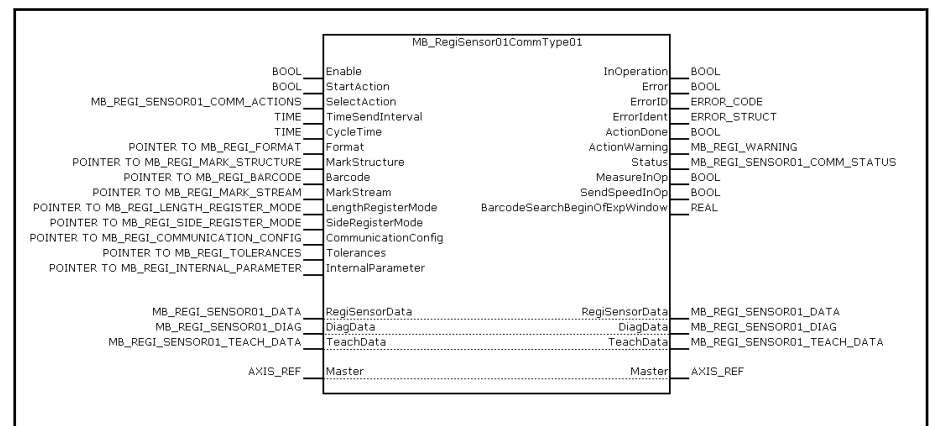


Fig. 3-82: MB_RegiSensor01CommType01 function block

I/O type	Name	Data type	Explanation
VAR_IN_OUT	RegiSensor-Data	MB_REGI_SENSOR01_DATA	Contains the respective measured values of the sensor
	DiagData	MB_REGI_SENSOR01_DIAG	Diagnostic data of the sensor
	TeachData	MB_REGI_SENSOR01_TEACH_DATA	Sensor data to be read or written
	Master	AXIS_REF	Addressing the master axis

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I/O type	Name	Data type	Explanation
VAR_INPUT	Enable	BOOL	Processing of function block enabled (level-controlled)
	StartAction	BOOL	Starts the selected action
	SelectAction	MB_REGI_SENSOR01_COMM_ACTIONS	Selecting the executable actions
	TimeSendInterval	TIME	Data of the velocity and acceleration information is calculated and sent in this interval
	CycleTime	TIME	Cycle time at which the function block is called.
	Format	POINTER TO MB_REGI_FORMAT	Defines the format characteristics
	MarkStructure	POINTER TO MB_REGI_MARK_STRUCTURE	Defines the mark structure
	Barcode	POINTER TO MB_REGI_BARCODE	Defines the barcode
	MarkStream	POINTER TO MB_REGI_MARK_STREAM	Defines the mark stream
	LengthRegisterMode	POINTER TO MB_REGI_LENGTH_REGISTER_MODE	Defines the web measuring principle for the length register
	SideRegisterMode	POINTER TO MB_REGI_SIDE_REGISTER_MODE	Defines the web measuring method for the length register
	CommunicationConfig	POINTER TO MB_REGI_COMMUNICATION_CONFIG	Defines the communication characteristics of the UDP connection
	Tolerances	POINTER TO MB_REGI_TOLERANCES	Defines the tolerances allowed for teaching and measurement
VAR_OUTPUT	InternalParameter	POINTER TO MB_REGI_INTERNAL_PARAMETER	Internal sensor parameters that should only be changed if specifically mentioned.
	InOperation	BOOL	Function block is operating
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Diagnostic description in the event of an error
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	ActionDone	BOOL	Action was completed successfully
	ActionWarning	MB_REGI_WARNING	Contains warnings of failed actions or warnings of the sensor system that do not result in a function block error
	Status	MB_REGI_SENSOR01_COMM_STATUS	Returns the current MB_RegiSensor01Comm-Type01 function block status
	MeasurementOp	BOOL	Measurement running
	SendSpeedOp	BOOL	Transmitting velocity and acceleration values.
	BarcodeSearchBeginOfExpWindow	REAL	This value contains the position of the barcode end

Fig.3-83: I/O interface of the MB_RegiSensor03ConfigType01 function block

Data Structures

The data structures

- MB_REGI_FORMAT (fig. 3-13 Data structure MB_REGI_FORMAT, page 23)
- MB_REGI_MARK_STRUCTURE (fig. 3-14 Data structure MB_REGI_MARK_STRUCTURE, page 23)
- MB_REGI_BARCODE (fig. 3-15 Data structure MB_REGI_BARCODE, page 24)
- MB_REGI_MARK_STREAM (fig. 3-16 Data structure MB_REGI_MARK_STREAM, page 24)
- MB_REGI_LENGTH_REGISTER_MODE (fig. 3-17 Data structure MB_REGI_LENGTH_REGISTER_MODE, page 24)
- MB_REGI_SIDE_REGISTER_MODE (fig. 3-18 Data structure MB_REGI_SIDE_REGISTER_MODE, page 24)
- MB_REGI_COMMUNICATION_CONFIG (fig. 3-19 Data structure MB_REGI_COMMUNICATION_CONFIG, page 24)
- MB_REGI_TOLERANCES (fig. 3-20 Data structure MB_REGI_TOLERANCES, page 24)
- MB_REGI_INTERNAL_PARAMETER (fig. 3-21 Data structure MB_REGI_INTERNAL_PARAMETER, page 25)
- MB_REGI_SENSOR01_DATA (fig. 3-47 Data structure MB_REGI_SENSOR01_DATA, page 44)
- MB_REGI_SENSOR01_DIAG (fig. 3-61 Data structure MB_REGI_SENSOR01_DIAG, page 51)
- MB_REGI_SENSOR01_TEACH_DATA (fig. 3-73 Data structure MB_REGI_SENSOR01_TEACH_DATA, page 57)

have been described in the previous function blocks of the RMB_TechRegiExtended library.

MB_REGI_WARNING		
Warning	BOOL	Shows that a warning is pending
WarningAdditional1	DWORD	Shows Additional 1.
WarningAdditional2	DWORD	Shows Additional 2.

Fig. 3-84: MB_REGI_WARNING data structure

Enumeration Type

The enumeration type MB_REGI_SENSOR01_COMM_STATUS can assume the following values:

Element	Value	Description
WAIT_FOR_NEXT_ACTION	0	Function block waits for the subsequent action
CONFIGURATION_IN_WORK	1	Configuration is transmitted
BARCODE_SEARCH_IN_WORK	2	Barcode search is running
MARKSTREAM_SEARCH_IN_WORK	3	Mark stream search is running
TEACH_IN_IN_WORK	4	TeachIn is running
EASY_TEACH_IN_IN_WORK	5	EasyTeachIn in running

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Element	Value	Description
READ_DIAG_IN_WORK	6	ReadDiagData is running
READ_TEACH_DATA_IN_WORK	7	ReadTeachData is running
WRITE_TEACH_DATA_IN_WORK	8	WriteTeachData is running
MEASUREMENT_STARTING	9	Measurement is started
MEASUREMENT_STOPPING	10	Measurement is stopped
SEND_SPEED_STARTING	11	SendSpeed is started
SEND_SPEED_STOPPING	12	SendSpeed is stopped
SENSOR_OFF	13	The function block is not in state InOperation.
SENSOR_ERROR	14	Sensor in status Error

Fig.3-85: Enumeration type MB_REGI_SENSOR01_COMM_STATUS

The enumeration type MB_REGI_SENSOR01_COMM_ACTIONS can assume the following values:

Element	Value	Description
SET_CONFIG	1	Start configuration transmission
SEARCH_BARCODE	2	Search barcode search
SEARCH_MARK_STREAM	3	Start mark stream search
TEACH_IN	4	Start TeachIn
EASY_TEACH_IN	5	Start Easy TeachIn
READ_DIAG	6	Read diagnostic data
READ_TEACHING_DATA	7	Read Teach data
WRITE_TEACHING_DATA	8	Write Teach data
START_MEASURING	9	Start measurement
STOP_MEASURING	10	Stop measurement
START_SEND_SPEED	11	Start sending velocity information
STOP_SEND_SPEED	12	Stop sending velocity information

Fig.3-86: Enumeration type MB_REGI_SENSOR01_COMM_ACTIONS

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
StartAction	BOOL			FALSE	Continuous
SelectAction	MB_REGI_SENSOR01_COMM_ACTIONS	1	12	1 (SET_CONFIG)	In case of rising edge at StartAction and status = WAIT_FOR_NEXT_ACTION
TimeSendInterval	TIME	$\geq 2 \cdot \text{CycleTime}$	n.def.	t#32ms	Action START_SEND_SPEED is started
CycleTime	TIME	> 0	n.def.	t#8ms	Action START_SEND_SPEED is started

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Name	Type	Min. value	Max. value	Default value	Effective
Format	POINTER TO MB_REGI_FORMAT	> 0	n.def.	0	Rising edge at "Enable"
MarkStructure	POINTER TO MB_REGI_MARK_STRUCTURE	> 0	n.def.	0	Rising edge at "Enable"
Barcode	POINTER TO MB_REGI_BARCODE	> 0	n.def.	0	Rising edge at "Enable"
MarkStream	POINTER TO MB_REGI_MARK_STREAM	> 0	n.def.	0	Rising edge at "Enable"
LengthRegister-Mode	POINTER TO MB_REGI_LENGTH_REGISTER_MODE	> 0	n.def.	0	Rising edge at "Enable"
SideRegister-Mode	POINTER TO MB_REGI_SIDE_REGISTER_MODE	> 0	n.def.	0	Rising edge at "Enable"
Communication-Config	POINTER TO MB_REGI_COMMUNICATION_CONFIG	> 0	n.def.	0	Rising edge at "Enable"
Tolerances	POINTER TO MB_REGI_TOLERANCES	> 0	n.def.	0	Rising edge at "Enable"
InternalParameter	POINTER TO MB_REGI_INTERNAL_PARAMETER	> 0	n.def.	0	Rising edge at "Enable"

Fig. 3-87: Overview on min./max. values and initial values of the inputs

In case of a rising edge at enable, it is checked if all pointers > 0 and thus, if the addresses containing the data structures are created. The data of the created pointers are checked when calling the individual function blocks. The data structures have the following default values and are applied or checked during the following actions:

Name	Type	Min. value	Max. value	Default value	Effective
MB_REGI_FORMAT					
FormatLength	REAL	> 0	n.def.	0	Rising edge at "Enable"
Increments	UDINT	> 0	n.def.	0	Rising edge at "Enable"
MB_REGI_MARK_STRUCTURE					
MarkType	UDINT	1	7	1 (only the marks 1, 3 and 5 are implemented)	Action SET_CONFIG is started
SingleMark	ARRAY [0...3] OF REAL	> 0 (for required entries)	n.def.	0	Action SET_CONFIG is started
MB_REGI_BARCODE					
NumberOfBlocks	UDINT	0 (1 and 2 blocks are invalid entries)	10	0	Action SET_CONFIG is started

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Name	Type	Min. value	Max. value	Default value	Effective
BeginExpectationWindow	REAL	0	n.def.	0	Action SET_CONFIG is started
SizeOfExpectationWindow	REAL	0	n.def.	1	Action SET_CONFIG is started
FreeSpaceBeforeBarcode	REAL	0	n.def.	0	Action SET_CONFIG is started
BarcodeBlocks	ARRAY [0...19] OF REAL	> 0 (for required entries)	n.def.	0	Action SET_CONFIG is started
MB_REGI_MARK_STREAM					
NumberOfMarks	UDINT	1	12	1	Action SET_CONFIG is started
MarkStream	Array [1...12] OF REAL	> 0 (for required entries)	n.def.	0	Action SET_CONFIG is started
MarkDirection	BOOL			FALSE	Action SET_CONFIG is started
MB_REGI_LENGTH_REGISTER_MODE					
ModeSelect	UDINT	1	1	1	Action SET_CONFIG is started
LengthProperties	ARRAY [0...4] OF REAL	n.def.	n.def.	0	Action SET_CONFIG is started
MB_REGI_SIDE_REGISTER_MODE					
ModeSelect	UDINT	0	1	1	Action SET_CONFIG is started
SelectMarks	ARRAY [0...1] OF UINT	n.def.	n.def.	0	Action SET_CONFIG is started
MB_REGI_COMMUNICATION_CONFIG					
IpSensor	STRING	LEN > 0	n.def.	""	Rising edge at "Enable"
PortConfiguration	UINT	1	n.def.	0	Rising edge at "Enable"
IpPLC	STRING	LEN > 0	n.def.	""	Rising edge at "Enable"
PortMeasurement	UINT	1	n.def.	0	Rising edge at "Enable"
MB_REGI_TOLERANCES					
TeachZeroPulseToMark	REAL	1	n.def.	5	Action SET_CONFIG is started
TeachMarkToMark	REAL	1	n.def.	2	Action SET_CONFIG is started
MeasureMarkTolerance	REAL	1	n.def.	10	Action SET_CONFIG is started
DeviationOfMarkWidth	REAL	1	100	20	Action SET_CONFIG is started

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Name	Type	Min. value	Max. value	Default value	Effective
DeviationOfMarkHight	REAL	1	100	100	Action SET_CONFIG is started
DeviationOfLastPosition	REAL	1	n.def.	10	Action SET_CONFIG is started
ShiftSyncPulse	REAL	1	n.def.	5	Action SET_CONFIG is started
MB_REGI_INTERNAL_PARAMETER					
ColorWeighting	REAL	0	< 1	0.9999	Action SET_CONFIG is started
IntensityWeighting	REAL	0	< 1	0.15	Action SET_CONFIG is started
Gain	UINT	0	7	0	Action SET_CONFIG is started

Fig.3-88: Overview of min./max. and default values of the referenced structures

The VAR_IN_OUTs RegiSensorData and DiagData do not have any min./max. and default values, as only internal function blocks and not the user is allowed to write on them. The corresponding data are stored in TeachData when reading the tech data. The created teach data, e.g. originating from a previously saved production, are written on the sensor when writing the teach data. This data structure cannot be interpreted.

Functional Description



For the function description, it is also recommended to consider the individual function block descriptions:

- MB_RegiSensor01ConfigType01 ([chapter: 3.3.2 MB_RegiSensor01ConfigType01, page 21](#))
- MB_RegiSensor01CycComType02 ([chapter: 3.3.4 MB_RegiSensor01CycComType02, page 42](#))
- MB_RegiSensor01ReadDiagType01 ([chapter: 3.3.6 MB_RegiSensor01ReadDiagType01, page 49](#))
- MB_RegiSensor01SendRecvDataType01 ([chapter: 3.3.5 MB_RegiSensor01SendRecvDataType01, page 46](#))
- MB_RegiSensor01SendSpeedAccType01 ([chapter: 3.3.7 MB_RegiSensor01SendSpeedAccType01, page 52](#))
- MB_RegiSensor01TeachDataType01 ([chapter: 3.3.8 MB_RegiSensor01TeachDataType01, page 56](#))

Initialization

In case of a rising edge at Enable, it is checked for created pointers. The pointer contents of the respective data structure are directly transferred at the respective function blocks. Only after this is done, it is checked when the corresponding function block is called. Subsequently, the MB_RegiSensor01SendRecvDataType function block is started, executing the communication with the mark stream sensor. It is checked if the mark stream sensor can be contacted under the specified IP address using the "Ping" command. Subsequently, the function block configuration is transmitted using the MB_RegiSensor01ConfigType01 function block and the MB_RegiSensor01CycCom-

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Type02 function block is started to receive the measured values. The initialization phase is completed and InOperation becomes TRUE. Each error that occurred in the initialization phase immediately results in a transition to the error status and Error = TRUE. In cyclic operation, it is differentiated between errors and warnings. The sensor is in state SENSOR_OFF during the initialization.

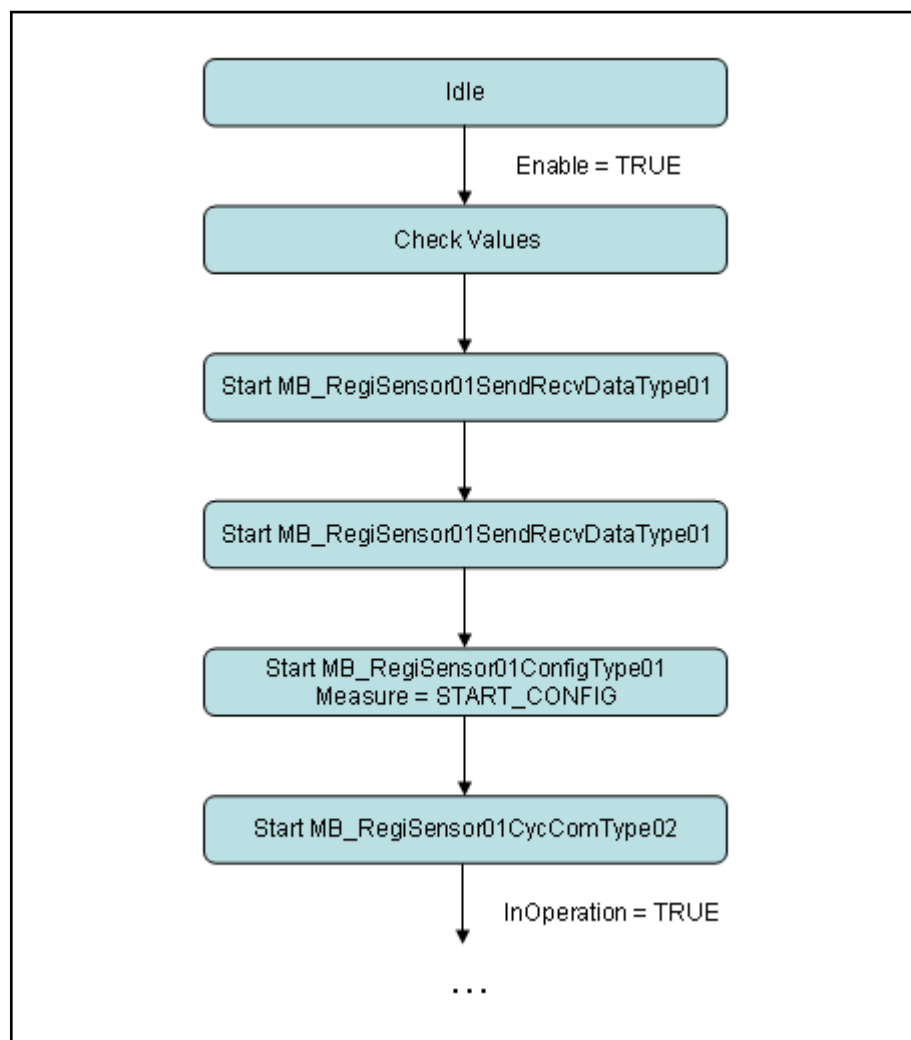


Fig.3-89: Initialization phase sequence



During the initialization, it is checked if a measurement is still running on the mark stream sensor. If this is the case, the measurement is automatically stopped.

Cyclic operation

The following states can be reached in cyclic operation:

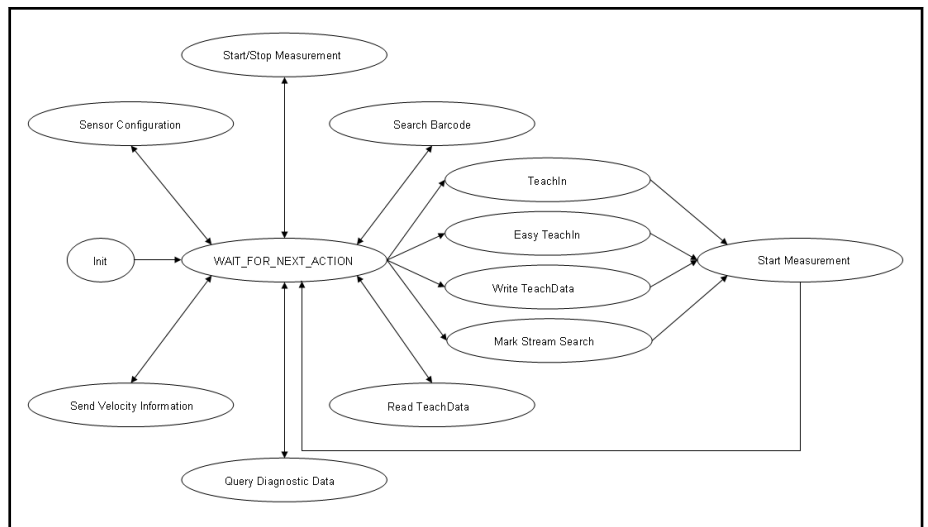


Fig.3-90: State transition in cyclic operation

The function block is in status "WAIT_FOR_NEXT_ACTION" in cyclic operation (i.e. InOperation = TRUE). In this state, all actions defined in the "MB_REGI_SENSOR01_COMM_ACTIONS" enumeration type can be executed. The corresponding action has to be selected in SelectAction. Subsequently, the action has to be started with a rising edge at StartAction. While an action is running, the corresponding status of the function block can be read via status. ActionDone indicates a successfully completed action. No new action can be started if an action is already running. Three events can cause the action to be closed. ActionDone indicates a successfully completed action. If a severe communication error occurred, the function block is in error status (Error = TRUE). If an action was not completed successfully (e.g., not all marks have been found during TeachIn), the function block reports a warning (ActionWarning = TRUE) and returns to status "WAIT_FOR_NEXT_ACTION". The warning is automatically reset upon starting a new action.

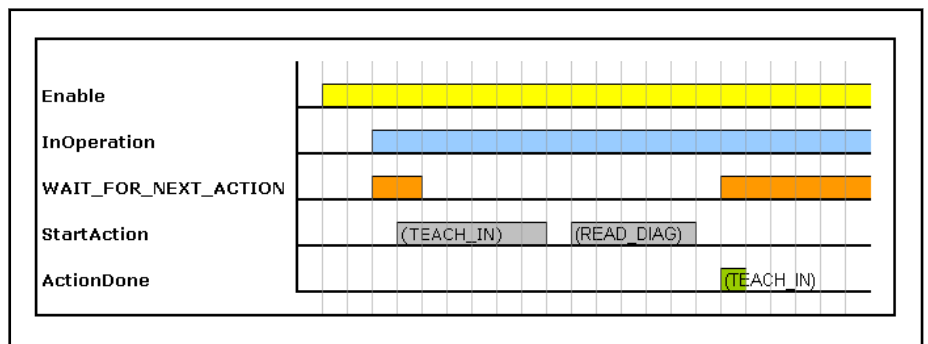


Fig.3-91: Time diagram in cyclic operation

The time diagram shows that InOperation is set after a rising edge at Enable and after a couple of cycles. It is changed to status "WAIT_FOR_NEXT_ACTION". A rising edge at StartAction with SelectAction := TEACH_IN results in leaving the status "WAIT_FOR_NEXT_ACTION". Teaching is executed. However, a new rising edge at StartAction with SelectAction := READ_DIAG is ignored. At this point, the function block is not in status "WAIT_FOR_NEXT_ACTION", as the teaching action is already being executed. ActionDone = TRUE is set for one cycle (as the rising edge at StartAction has already been removed) after teaching has been completed successfully. The function block returns to status "WAIT_FOR_NEXT_ACTION".

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An executed action is completed successfully if the corresponding acknowledgement `ActionDone = TRUE` is reported. It is not possible to execute several operations simultaneously. If the rising edge has already been removed from the input, `ActionDone` is pending for exactly 1 cycle (see the following time diagram).

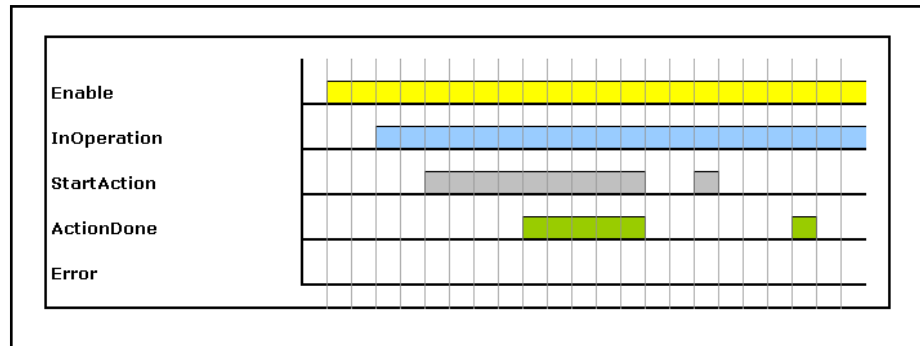


Fig. 3-92: Time diagram of `ActionDone` behavior

As several actions take some time (e.g. `TeachIn`), the function block has the output "Status". If `Status = 0` and `InOperation = TRUE`, the function block is in status "WAIT_FOR_NEXT_ACTION". The next action can be executed. The status can assume the values of the "MB_REGI_SENSOR01_COMM_STATUS" enumeration type. If the function block is not `InOperation = TRUE`, the status is "SENSOR_OFF", except for if the status is in error status. If this is the case, the status is "SENSOR_ERROR".

After starting or stopping the measurement or after starting or stopping the sending of velocity information, the current status is displayed at the `MeasureInOp` and `SendSpeedInOp` outputs. Thus, it is continuously displayed that the measurement and the transmission of the velocity information is running.

Prior to executing the "SET_CONFIG", "SEARCH_BARCODE", "SEARCH_MARK_STREAM", "TEACH_IN" and "EASY_TEACH_IN" actions, it is checked if a measurement is running. If this is the case, the measurement is stopped and the action is subsequently executed.

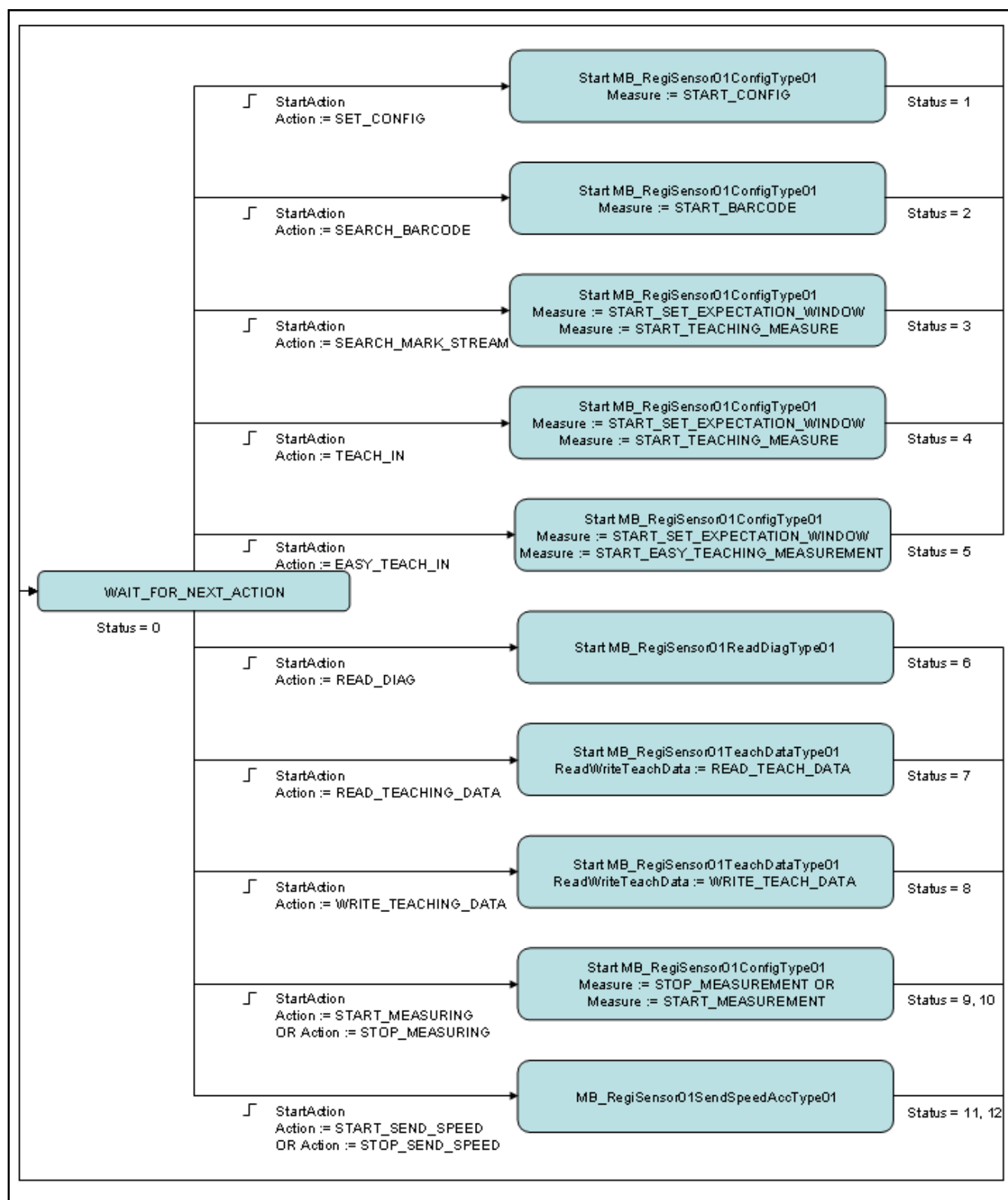


Fig.3-93: Cyclic operation sequence

The figure shows the sketched sequence of the cyclic operation. It is shown, that it can be jumped to the respective actions starting from the "WAIT_FOR_NEXT_ACTION" status. It is returned to the initial state after the action has been completed. It is also possible to jump to the error status (not

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shown). Basic inputs for these actions have been marked. Several function blocks can be called in the states. For example, in case of a rising edge at StartAction (SelectAction := TEACH_IN), the MB_RegiSensor01Config-Type01 function block is initially called to set the expectation window and to subsequently call it again for teaching and starting the measurement.

SEARCH_MARK_STREAM

This function searches for the mark stream without barcode search and without expectation window specification.

The following preconditions have to be fulfilled for this function:

- Only register marks can be found on the 360° rotation that is sampled by the mark stream sensor. This is to say that neither register crosses nor other markings should be on the sampling track of the sensor.
- The register mark stream should take up a maximum of 2/3 of the printing cylinder format. Thus, at least 1/3 of the printing cylinder format has to be an area in which no printing takes place. Example: If 12 register marks are contained on the format to be measured with a distance of 20 mm (mark stream of size 220 mm), the printing cylinder format has to be at least 330 mm.

If one of the specified preconditions is not met, the function cannot be executed or is closed with an error.



The function searches for the mark stream with a maximum of 3 teach actions. Only a valid configuration needs to have been transferred. The expectation window does not need to be specified.

Data/data structures

As not all inputs are required for each action, the following table shows the data applied during the individual actions:

SelectAction	Data	Data changed by the action
SET_CONFIG	Format MarkStructure Barcode MarkStream LengthRegisterMode SideRegisterMode CommunicationConfig Tolerances InternalParameter	ActionDone Status
SEARCH_BARCODE	Barcode.NumberOfBlocks Barcode.FreeSpaceBeforeBarcode Barcode.BarcodeBlocks InternalParameter.Gain	ActionDone Status BarcodeSearchBeginOfExpWindow
SEARCH_MARK_STREAM	-	ActionDone Status
TEACH_IN	Barcode.BeginExpectationWindow Barcode.SizeOfExpectationWindow	ActionDone Status RegiSensorData

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SelectAction	Data	Data changed by the action
EASY_TEACH_IN	Barcode.BeginExpecta- tionWindow Barcode.SizeOfExpecta- tionWindow InternalParameter.Gain	ActionDone Status RegiSensorData
READ_DIAG	-	ActionDone Status DiagData
READ_TEACHING_DATA	-	ActionDone Status TeachData
WRITE_TEACHING_DA- TA	TeachData	ActionDone Status
START_MEASURING	-	ActionDone MeasureInOp Status RegiSensorData
STOP_MEASURING	-	ActionDone MeasureInOp Status RegiSensorData
START_SEND_SPEED	TimeSendIntervall CycleTime Master	ActionDone SendSpeedInOp Status
STOP_SEND_SPEED	-	ActionDone SendSpeedInOp Status

Fig.3-94: Data dependencies

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Exemplary sequence The exemplary sequence from configuration to measurement is described for fbRegiSensor01Comm instance of the MB_RegiSensor01CommType01 function block in the following figure:

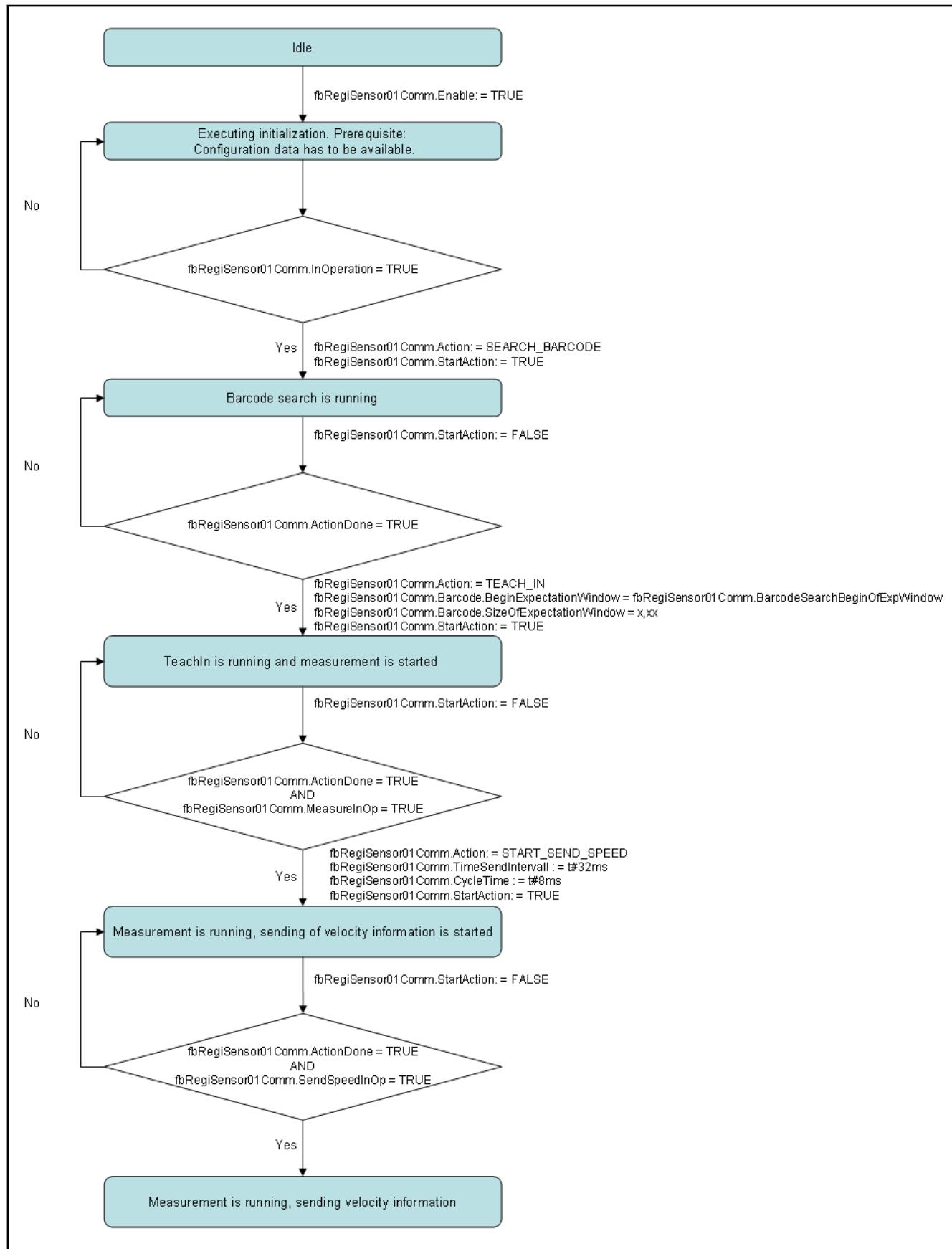


Fig.3-95: Exemplary sequence from configuration to measurement

Initially, a rising edge is set at enable of the fbRegiSensor01Comm instance. The function block MB_RegiSensor01SendRecvDataType01 establishes the communication connection to the sensor. Subsequently, the configuration is transferred using the MB_RegiSensor01ConfigType01 function block. Pre-condition: valid data have to be used. The MB_RegiSensor01CycComType02 measuring block is started and InOperation becomes "TRUE". Subsequently, the function block is in cyclic mode. The barcode search starts. After the search has been completed, the value has to be assigned as expectation window start and a valid value has to be available for the expectation window size. TeachIn is started. The expectation window is set, the teaching is started to subsequently start the measurement. To achieve a higher accuracy during the acceleration phase, transmitting of the velocity information is enabled using the MB_RegiSensor01SendSpeedAccType01 function block. The measurement is started and the measured data can be found in the RegiSensorData structure.

Characteristics of warning and error

The function block has a second diagnostic interface "MB_REGI_WARNING" apart from the standardized error handling. Warnings can be displayed by means of that interface. The second diagnostic structure is needed due to the connection of several function blocks and the external Rexroth mark stream sensor. Thus, it is differentiated between severe error (Error = TRUE and error status) and error that are reported by an internal function block but which should not reset the entire MB_RegiSensor01CommType01 function block. For example, not all marks can be found during a TeachIn. This is reported as warning as it is no severe error and the user can still execute another action.

A warning is defined as follows:

- Warnings are only generated during cyclic operation.
- A warning is set after an action has not been executed successfully.
- No confirmation by ActionDone is output.
- The function block returns to the "WAIT_FOR_NEXT_ACTION" state.
- The warning is automatically reset once a new action is executed.
- In WarningAdditional1, Additional 1 of the "ERROR_STRUCT" error structure and in WarningAdditional2, Additional 2 of the "ERROR_STRUCT" error structure of the internal function block are pending.

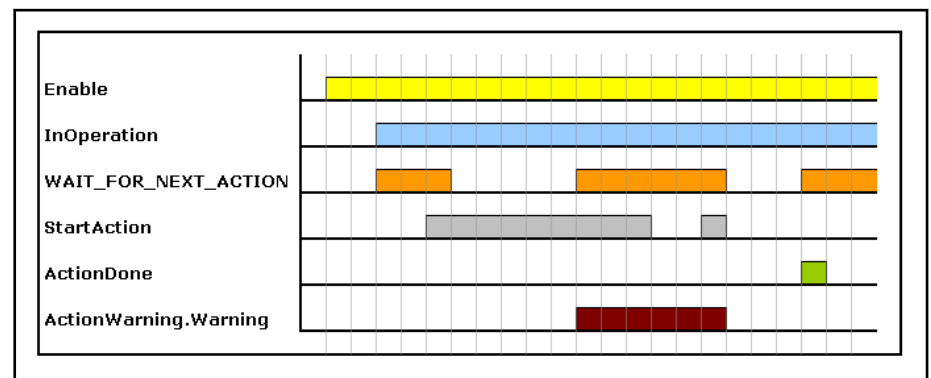


Fig.3-96: Time response of the warning

The diagram shows the time response when a warning occurs. An action is executed in cyclic operation (InOperation=TRUE). The action is not completed successfully. That is the reason why a warning is reported. The function block returns to the "WAIT_FOR_NEXT_ACTION" state when the warning is

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reported. The warning is automatically reset after a start of a new action. This action can be completed successfully and is acknowledged with ActionDone.

Warning and Error during initialization

Each error generated by an internal function block during initialization results in an error of the MB_RegiSensor01CommType01 function block. I.e., a connection has to be re-established to the sensor, a valid configuration has to be transferred and the measuring block has to be started.

Warning and error in cyclic operation

Only connection errors result in an error during cyclic operation as connection errors are severe errors. Severe errors are all errors of the MB_RegiSensor01SendRecvDataType01 and MB_RegiSensor01CycComType02 function blocks.

The following error numbers of other internally used function blocks result in a transition to the error status:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000000	Timeout; no response from the MB_RegiSensor01SendRecvDataType01 function block within 10 seconds
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000005	Timeout while receiving a package.
COMMUNICATION_ERROR (16#0002)	16#00001D10	16#00000006	Timeout; no response from the MB_RegiSensor01SendRecvDataType01 function block within 10 seconds

Fig.3-97: Internal function block errors, resulting in error status

All other internal function block errors are interpreted as warnings. If a warning occurs, Additional1 and Additional2 of "ERROR_STRUCT" of the internal function block is copied to WarningAdditional1 and WarningAdditional2 and the warning bit is set. Internally, the function block in which the error occurs is reset. When executing an action again, the warning is automatically deleted and WarningAdditional1 and WarningAdditional2 are reset to 0.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
OTHER_ERROR (16#7FFE)	16#00001D13	16#00000001	Mark stream search failed
OTHER_ERROR (16#7FFE)	16#00001D13	16#00000002	Measurement has already been started
OTHER_ERROR (16#7FFE)	16#00001D13	16#00000003	Measurement has already been stopped
OTHER_ERROR (16#7FFE)	16#00001D13	16#00000004	Send velocity information has already been started
OTHER_ERROR (16#7FFE)	16#00001D13	16#00000005	Send velocity information has already been stopped
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003C	Zero pointer format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003D	Zero pointer MarkStructure

ErrorID	Additional 1	Additional 2	Description
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003E	Zero pointer barcode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003F	Zero pointer MarkStream
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000040	Zero pointer LengthRegisterMode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000041	Zero pointer SideRegisterMode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000042	Zero pointer CommunicationConfig
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000043	Zero pointer Tolerances
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000044	Zero pointer InternalParameter

*Fig. 3-98: Error codes of the MB_RegiSensor01CommType01 function block
The function block continues to report error messages of the integrated function blocks:*

- MB_RegiSensor01ConfigType01 (fig. 3-35 Error codes of the MB_RegiSensor01ConfigType01 function block, page 37)
- MB_RegiSensor01CycComType02 (fig. 3-50 Error codes of the MB_RegiSensor01CycComType02 function block, page 46)
- MB_RegiSensor01ReadDiagType01 (fig. 3-62 Error codes of the MB_RegiSensor01ReadDiagType01 function block, page 52)
- MB_RegiSensor01SendRecvDataType01 (fig. 3-56 Error codes of the MB_RegiSensor01SendRecvDataType01 function block, page 49)
- MB_RegiSensor01SendSpeedAccType01 (fig. 3-68 Error codes of the MB_RegiSensor01SendSpeedAccType01 function block, page 56)
- MB_RegiSensor01TeachDataType01 (fig. 3-75 Error codes of the MB_RegiSensor01TeachDataType01 function block, page 58)

The corresponding error messages are only generated when the respective function block is enabled. The application of the respective values has to be taken into consideration. Error messages can be generated in case of an active InOperation. Furthermore, these errors can be reported as warnings as described.

3.4 Function Block to Create Defined Velocity Characteristics

3.4.1 Introduction and Overview

To illustrate different velocity characteristics (linear, s-curve), the following function block is provided in the RMB_TechRegiExtended library:

- MB_ReachVelocityType01

This is used to calculate values for acceleration, velocity and jerk depending on the input variables.

3.4.2 MB_ReachVelocityType01

Brief Description

The MB_ReachVelocityType01 function block calculates the respective jerk, acceleration and target velocity to travel along an S-curve. Therefore, a jerk limitation from 0% to 100 % can be selected. If the input value is 0, the velocity is linear. If it is 100%, it is shaped as S-curve. The command values for velocity, acceleration and jerk are calculated from the acceleration period, the current velocity, the target velocity and the JerkFactor. The acceleration phase can be stopped via "StopAcc".

RMB_TechRegiExtended

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiExtended

Fig.3-99: Reference table of the MB_ReachVelocityType01 function block

Interface Description

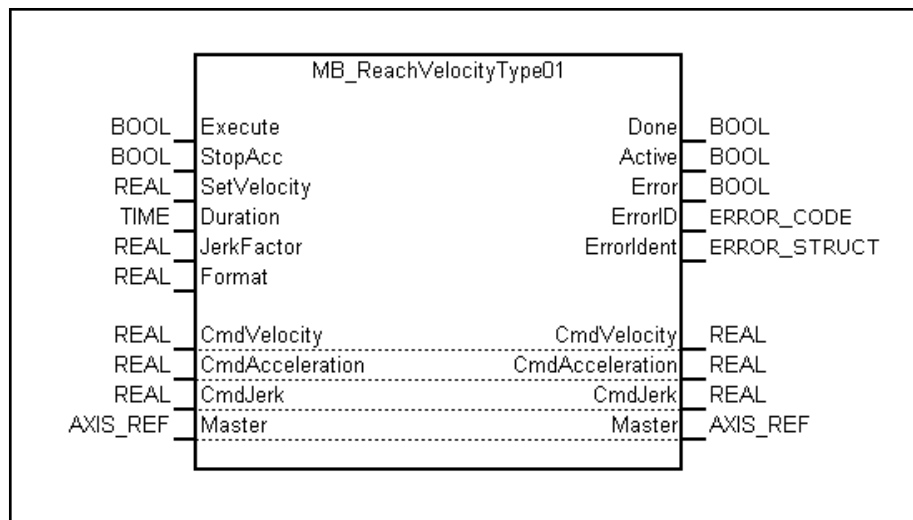


Fig.3-100: MB_ReachVelocityType01 function block

I/O type	Name	Data type	Description
VAR_IN_OUT	CmdVelocity	REAL	Command velocity [rpm]
	CmdAcceleration	REAL	Command acceleration [rad/s ²]
	CmdJerk	REAL	Command jerk [rad/s ³]
	Master	AXIS_REF	Contains information on the axis whose velocity should be changed accordingly. It is recommended to create a virtual master axis.
VAR_INPUT	Execute	BOOL	Processing of function block enabled.
	StopAcc	BOOL	Stops further acceleration.
	SetVelocity	REAL	Target velocity [m/min]
	Duration	TIME	Acceleration period
	JerkFactor	REAL	Jerk limitation of the acceleration profile in %.
	Format	REAL	Format [mm]
VAR_OUTPUT	Done	BOOL	Acceleration phase successfully completed.
	Active	BOOL	Function block is working and currently in an interim state.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Diagnostic description in case of error.

Fig.3-101: I/O interface of the MB_ReachVelocityType01 function block

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
StopAcc	BOOL			FALSE	Continuous
SetVelocity	REAL	n.def.	n.def.	0	Rising edge at "Execute"
Duration	TIME	> t#0s	n.def.	t#30s	Rising edge at "Execute"
JerkFactor	REAL	0	100	50	Rising edge at "Execute"
Format	REAL	> 0	n.def.	1000	Rising edge at "Execute"

Fig.3-102: Overview on min./max. values and initial values of the inputs

Functional Description

The acceleration phase starts at a rising "Execute" edge. The acceleration period (duration), the web velocity to be set (SetVelocity) as well as the acceleration profile (JerkFactor) can be previously specified and applied. A special feature is that "Active" is set at a rising edge at "Execute" but that the acceleration phase starts only after 500 ms. That means that the following function blocks (e.g. the register control) can use "Active" to see the beginning of the acceleration phase in advance. After the target velocity has been reached, "Active" is also present for further 500 ms until the processing is completed with "Done".

The JerkFactor effect is shown in the following figure:

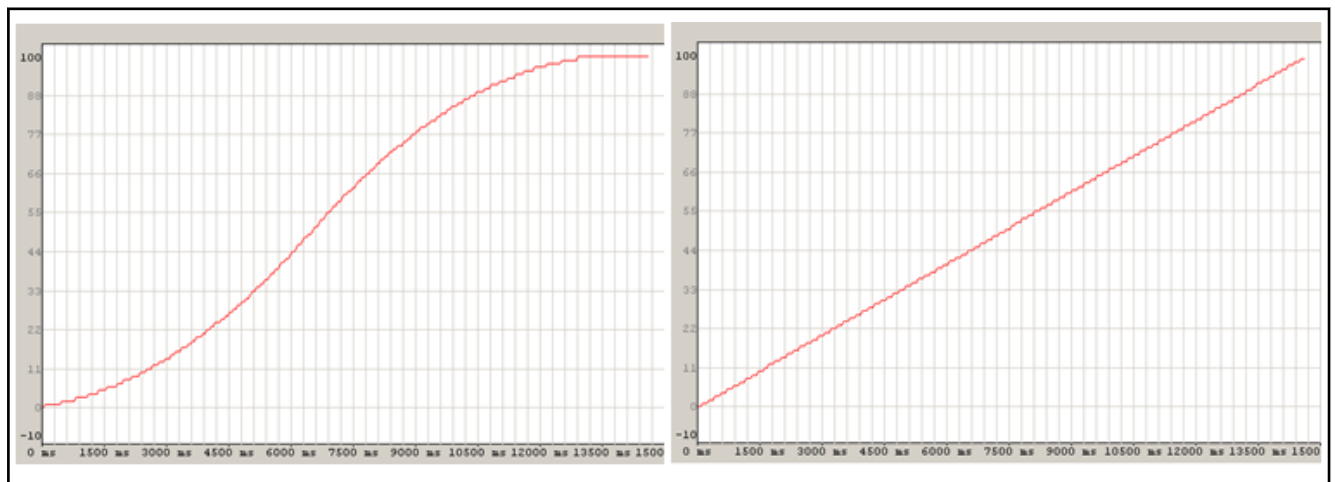


Fig.3-103: Exemplary acceleration phases

The figure on the left shows an S-curve in its velocity characteristics during an acceleration phase from 0 to 100 m/min (SetVelocity) in 15 seconds (duration) with the JerkFactor = 100 % and a format of 1 m.

The figure on the right shows the linear velocity characteristics during an acceleration phase from 0 to 100 m/min (SetVelocity) in 15 s (duration) with the JerkFactor = 0 % and a format of 1 m.

The acceleration phase triggered with "Execute" can only be stopped with "StopAcc". The function block immediately stops further acceleration. "Done" becomes active. If the set velocity value "SetVelocity" should still be approached, "StopAcc" has to be deactivated and another rising edge of "Execute" has to be set.

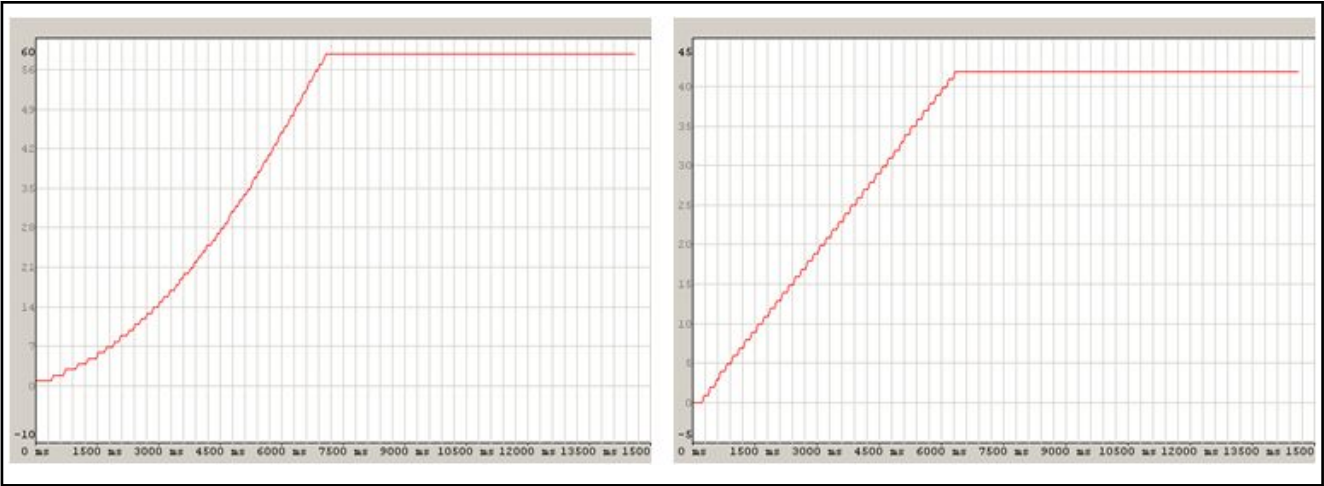


Fig.3-104: *Aborting the acceleration phases (left an abort at 7000 ms, right an abort at 6300 ms)*

The figure shows an abort of the acceleration phase for an S-curve and linear velocity characteristics.

The meaning of the jerk is explained in the following: The jerk is the temporal derivation of the acceleration. The JerkFactor indicates the temporal part of the acceleration phase in percent in which the jerk is not zero. The following figure shows the meaning of the jerk. If the acceleration does not change anymore, the jerk is 0.

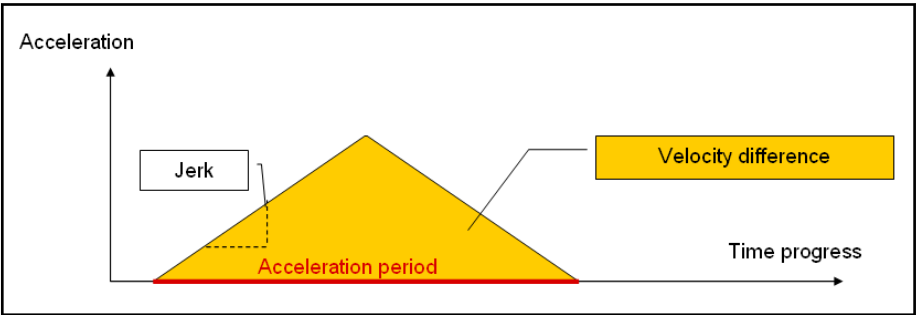


Fig.3-105: *Importance of the jerk in the acceleration phase*

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid printing cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000024	Invalid period
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000025	Invalid jerk factor
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Master" is not within the valid range

Fig.3-106: *Error codes of the MB_ReachVelocityType01 function block*

4 RMB_TechRegiAdvanced

4.1 RMB_TechRegiAdvanced Library: Subject to License



The usage of the functions blocks of the RMB_TechRegiAdvanced is subject to license. Depending on the application, one of the three licenses, either FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 or FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 has to be purchased to use the function blocks. For each control, on which the function blocks are used, one license is required each (runtime license).

Einzellizenz Technologiebibliothek
Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.

Single licence for technology library
Authorize the use with exactly one controller firmware.

TechLib RegisterControl Extended TechLib RegisterControl Extended		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig. 4-1: FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT license key

Einzellizenz Technologiebibliothek
Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.

Single licence for technology library
Authorize the use with exactly one controller firmware.

TechLib RegisterControl Advanced 1 TechLib RegisterControl Advanced 1		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig. 4-2: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 license key

RMB_TechRegiAdvanced

Einzellizenz Technologiebibliothek Berechtigt zur Verwendung mit einer einzigen Steuerungsfirmware.		
Single licence for technology library Authorize the use with exactly one controller firmware.		
TechLib RegisterControl Advanced 2 TechLib RegisterControl Advanced 2		
Licence key (MNR): R911xxxxxx	Serial number: 1234567	Type code: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2
		
Registration key WAHOF2-FBJYZF-8CSB0F-9DQO0D-9E8ZER		

Fig.4-3: FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 license key

The figures show the corresponding license keys. One license has to be purchased for each control authorizing the use of function blocks of the RMB_TechRegiExtended library or the RMB_TechRegiAdvanced on this control system.

The libraries RMB_TechRegiExtended and RMB_TechRegiAdvanced are provided with the three licenses FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 and FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2. The content of the licenses is shown in the following:

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT*

- HMI for narrow web applications (up to twelve printing units, no decoupling and acceleration compensation)
- Firmware Update Tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1*

- HMI for applications with clamping units (such as gravure printing) (up to twelve printing units, with decoupling and acceleration compensation)
- Firmware update tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

*FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2*

- HMI for applications with clamping units (such as gravure printing) (up to 24 printing units, with decoupling and acceleration compensation)
- Firmware update tool
- Documentations: Application manual and library description
- Libraries: RMB_TechRegiExtended and RMB_TechRegiAdvanced

If either the RMB_TechRegiExtended library or the RMB_TechRegiAdvanced library is used, one of the licenses FWS-IM*MLC-TEC-NNVRS-NN-REGI*EXT, FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV1 or FWS-IM*MLC-TEC-NNVRS-NN-REGI*ADV2 is required for each control on which one of the function blocks is used.

4.2 General Information

The RMB_TechRegiAdvanced library provides function blocks to control and optimize rotogravure printing processes. Furthermore, two functions blocks for the communication with a camera system are provided.

It is a library with costs; requiring and containing the RMB_TechRegiExtended library. One license is required for each control system.

This documentation describes the inputs and outputs of the individual function blocks and provides notes on their use.

The following overview shows all function blocks of the RMB_TechRegiAdvanced library requiring a license:

Function block	Description
MB_RegisterControllerAdvType01	Register controller for applications with or without clamping units
MB_RegiAccelerationCompensationType01	Model-based and self-regulating acceleration compensation
MB_RegiGravureRegulateType01	Dynamic decoupling network
MB_RegiGravureRegulateType02	Dynamic decoupling network with preset of an individual printing unit and decoupling values of upstream printing units. The decoupling values can be disabled.
MB_RegiSensor03ConfigType01	Configuration of the camera sensor
MB_RegiSensor03CycComType01	Measured value recording of the camera system

Fig. 4-4: Function blocks of the RMB_TechRegiAdvanced library, subject to license



The function block MB_RegiAccelerationCompensationType01 has to be called in a motion-synchronous task to ensure a correction calculation of the acceleration. If this is not possible due to the runtime, the "mMotionCyclic()" function of the function block from the motion-synchronous tasks has to be called and the MB_RegiAccelerationCompensationType01 function block can be called in a cyclic task.

4.3 Function Blocks to Control and Optimize the Printing Process

4.3.1 Introduction and Overview

The MB_RegisterControllerAdvType01 function block is responsible for controlling the printing process. The user does not have to parameterize the controllers since the controller parameters are calculated independently by taking process data (web length, web velocity, dead times...) into consideration. This ensures that optimal controller parameters are used at any time during the printing process. The user can scale the controller parameters with a damping factor and can also select between different control algorithms via different controller modes.

The MB_RegiAccelerationCompensationType01 FB executes a model-based and adaptively learning compensation during the acceleration phase. Thus, occurring dynamic register errors can be compensated and paper waste can be reduced considerably during the acceleration phase. Due to the self-learning functionality, the compensation value adjusts to the product conditions after each acceleration phase.

The MB_RegiGravureRegulateType01 and MB_RegiGravureRegulateType02 function blocks decouple control movements of register controllers in coupled

RMB_TechRegiAdvanced

subsystems. The function block supports control to the reference color as well as to the previous color. Regulating movements of register controllers located in the front are precontrolled on the following printing units to decouple these printing units from the regulation.

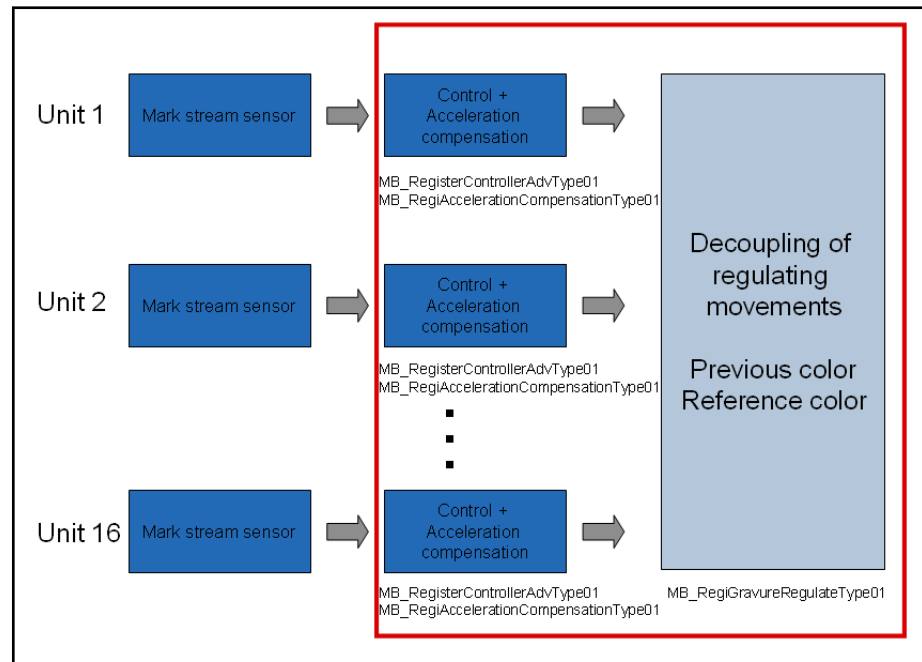


Fig.4-5: Using control function blocks

The figure shows the use of the control function blocks. The measured values of the mark stream sensor determined by the function blocks of the RMB_TechRegiExtended library are provided to the control. The calculated feedforward control values of the velocity compensation and the control variable of the control are transferred to a decoupling network which calculates the regulations for the drive systems and decouples the regulations for following printing units.

4.3.2 MB_RegisterControllerAdvType01

Brief Description

The register controller is intended for applications with clamping units (e.g. for gravure printing) and without clamping units. Therefore, different controller parameterizations can be selected. The parameterizations are adapted according to the velocity. Thus, no controller parameters are applied at the function block. If the controller parameterization of the symmetrical optimum is applied, a prefilter is used for the command value. Furthermore, the control variable of the register controller is adjusted in a ramp shape over a cylinder revolution. This means that the calculated control variable is not regulated in jerks but during the period required for a cylinder revolution. The register controller is divided into the following blocks:

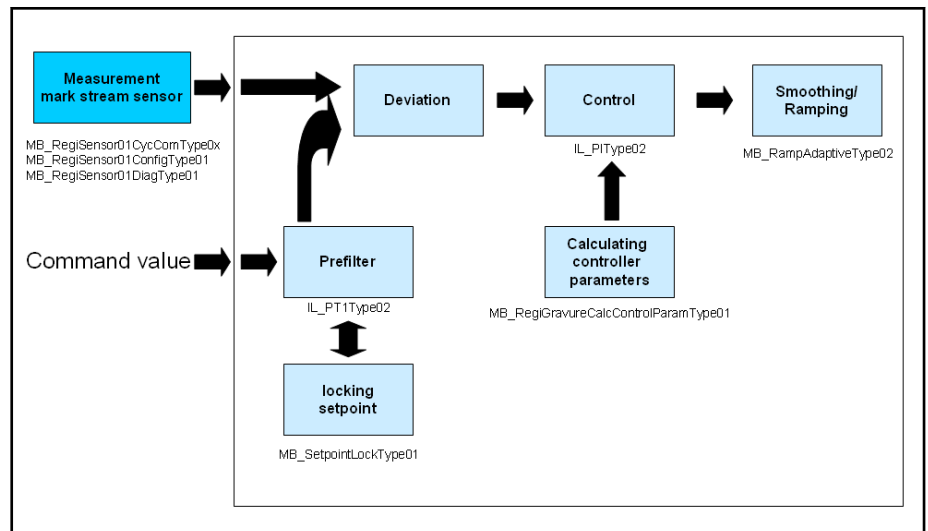


Fig. 4-6: Structure of the MB_RegisterControllerAdvType01 FB

MB_RegiGravureCalcControlParamType01

- Calculation of the controller parameters according to physical parameters.

IL_PT1Type02

- Calculation of the command value filter during controller parameterization according to the symmetrical optimum

IL_PIType02

- PI-controller
- Dead zone
- Limitation

MB_RampAdaptiveType02

- Ramp-shaped modification of the control variable of the register controller over a cylinder revolution.

MB_RegiSetpointLockType01

- Applies the actual value as new command value

The "MB_RegisterControllerAdvType01" register controller function block supports the following functionality:

- Calculation of a controller control variable by a PI-control
- Preset feature
- Pause feature
- Lock setpoint Feature
- Min./Max. limitation of the controller control variable
- Linear ramp-shaped modification of the controller control variable
- Dead zone
- Different controller parameterizations
- Automatic adaptation of the controller parameters at process data
- Calculation of a prefilter for a command value change
- Damping of optimum controller parameters
- Switching to command value response

RMB_TechRegiAdvanced

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiAdvanced

Fig.4-7: Reference table of the MB_RegisterControllerAdvType01 function block

Interface Description

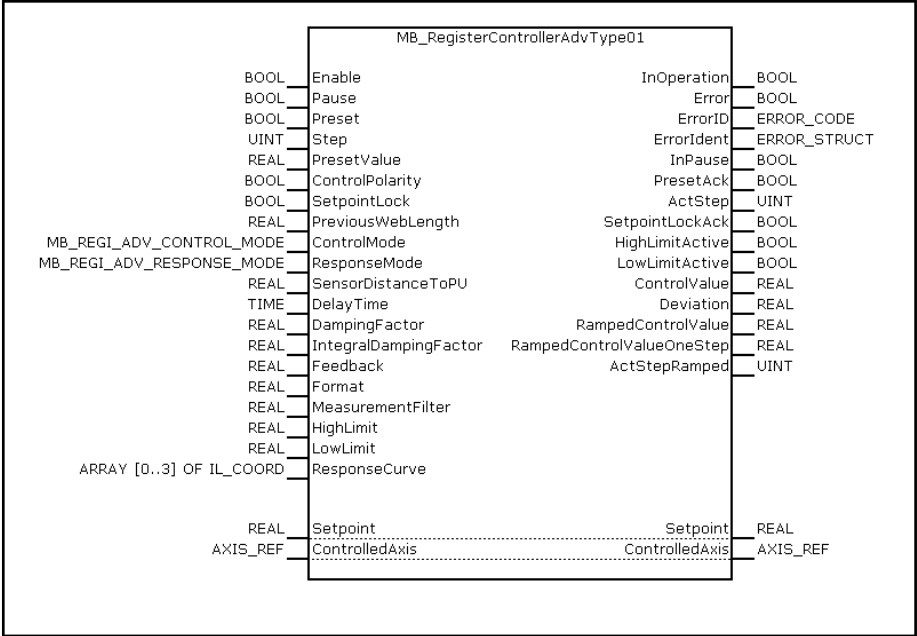


Fig.4-8: MB_RegisterControllerAdvType01 function block

I/O type	Name	Data type	Description
VAR_IN_OUT	Setpoint	REAL	Command value Compared to "Feedback" (actual value) and can be set to the next "Feedback" value (lock setpoint Feature).
	ControlledAxis	AXIS_REF	Reference to the controlled axis

I/O type	Name	Data type	Description
VAR_IN-PUT	Enable	BOOL	If TRUE, the controller parameters are calculated first and "ControlValue" is either set to the preset value of "PresetValue" (if there is a rising edge at "Preset") or to the calculated value. "RampedControlValue" is set to the value of "ControlValue".
	Pause	BOOL	The "Pause" input is only evaluated if the "Enable" input is active. In this case, no new controller parameters are calculated, the value "ControlValue" is not changed and the ramp-shaped modification of this value is stopped which means that "RampedControlValue" remains unchanged. "ActStep" is changed, but "ActStepRamped" is not changed.
	Preset	BOOL	The "Preset" input is only evaluated if the "Enable" input is active. A positive edge of this input sets the I value of the controller to "PresetValue". That means that the controller output is set to the value that can be parameterized in "PresetValue".
	Step	UINT	Controller cycle step. Is increased, a new measured value of the sensor is present. In this case, controller parameters are calculated again and a new "ControlValue" is set at the controller output. This new value is modified in a ramp shape over the new time interval.
	PresetValue	REAL	The "ControlValue" output is set to this value at a rising edge at "Preset"
	ControlPolarity	BOOL	The polarity of "ControlValue" is inverted as long as this value is "TRUE".
	SetpointLock	BOOL	If the input is TRUE, the next actual value (change of "Step") is used as new command value for the register controller.
	PreviousWebLength	REAL	Indicates the web length with regard to the printing unit located in front in [mm].
	ControlMode	MB_REGI_ADV_CONTROL_MODE	Indicates the respective algorithm to calculate the control parameters.
	ResponseMode	MB_REGI_ADV_RESPONSE_MODE	Switches between the command value response and the disturbance response
	SensorDistanceToPU	REAL	Distance from the sensor to the printing unit [mm]
	DelayTime	REAL	Constant dead time occurring in the control loop
	DampingFactor	REAL	Indicates how the optimally calculated controller parameters should be damped
	IntegralDampingFactor	REAL	Specifies, to what degree the integral action time (T_N) is to be dampened
	Feedback	REAL	The actual measured value
	Format	REAL	Printing cylinder format in [mm]
	MeasurementFilter	REAL	Number of measured values to be filtered
	HighLimit	REAL	The upper limit for "ControlValue". If "ControlValue" exceeds this value, it is limited to this value.
	LowLimit	REAL	The lower limit for "ControlValue". If "ControlValue" falls below this value, it is limited to this value.
	ResponseCurve	ARRAY[0..3] OF IL_COORD	Command value curve for the proportional gain

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I/O type	Name	Data type	Description
VAR_OUT PUT	InOperation	BOOL	If TRUE, the PI controller works and the controller outputs "ControlValue" and "RampedControlValue" are valid.
	Error	BOOL	Indicates that an error occurred in the function block.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Error structure with further subdivision of the error.
	InPause	BOOL	It indicates that the "Pause" input is active and that the values in "ControlValue" and "RampedControlValue" do not change.
	PresetAck	BOOL	It indicates that "PresetValue" was applied.
	ActStep	UINT	If a new "ControlValue" was calculated, "Step" value refers to the "Step" input.
	SetpointLockAck	BOOL	New command value was applied
	HighLimitActive	BOOL	"ControlValue" has reached its upper limit
	LowLimitActive	BOOL	"ControlValue" has reached its lower limit
	ControlValue	REAL	The calculated controller output value of the PI controller
	Deviation	REAL	Register deviation = Command value - actual value
	RampedControlValue	REAL	The currently modified value of the register controller in ramp shape.
	RampedControlValueOneStep	REAL	It only returns the change of "RampedControlValue" (differentiated) since the last PLC cycle. This is the interface to the decoupling network.
	ActStepRamped	UINT	"Step" value if a new "RampedControlValueOneStep" was calculated. This value does not depend on "Step", since the ramp-shaped value can change in each cycle.

Fig.4-9: I/O interface of the MB_RegisterControllerAdvType01 FB

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Pause	BOOL			FALSE	Continuous
Preset	BOOL			FALSE	Continuous
Step	UINT	0	65335	0	Continuous
PresetValue	REAL	n.def.	n.def.	0.0	Rising edge at "Preset"
ControlPolarity	BOOL			FALSE	Change at "Step"
SetpointLock	BOOL			FALSE	Change at "Step"
PreviousWebLength	REAL	> 0.0	n.def.	0.0	Rising edge at "Enable"
ControlMode	MB_REGI_ADV_CONTROL_MODE	1	4	1	Rising edge at "Enable"
ResponseMode	MB_REGI_ADV_RESPONSE_MODE	1	2	1	Continuous

Name	Type	Min. value	Max. value	Default value	Effective
SensorDistance-ToPU	REAL	0	n.def.	400	Rising edge at Enable
DelayTime:	TIME	0	n.def.	T#60ms	Rising edge at Enable
DampingFactor	REAL	0	200	100	Change at "Step"
IntegralDampingFactor	REAL	0	1000	100	Change at "Step"
Feedback	REAL	n.def.	n.def.	0.0	Change at "Step"
Format	REAL	> 0		0.0	Rising edge at Enable
MeasurementFilter	REAL	0	n.def.	0	Change at "Step"
HighLimit	REAL	LowLimit	n.def.	20000000	Change at "Step"
LowLimit	REAL	n.def.	HighLimit	-20000000	Change at "Step"
ResponseCurve	ARRAY[0..3] OF IL_COORD	n.def.	n.def.	0.0	Rising edge at "Enable"
Setpoint	REAL	n.def.	n.def.	0.0	Change at "Step"

Fig.4-10: Overview on min./max. values and initial values of the inputs

Enumeration Type

The enumeration type MB_REGI_ADV_CONTROL_MODE can assume the following values:

Element	Value	Description
CONTROL_MODE_CHR	1	CHR method
CONTROL_MODE_AMPLITUDE_OPTIMUM	2	Amplitude optimum
CONTROL_MODE_SYMMETRICAL_OPTIMUM	3	Symmetrical optimum
CONTROL_MODE_WOK_APERIODIC_FAIL	4	Root locus curve method
CONTROL_MODE_LOOP_NO_LAG	5	Control without clamping unit
CONTROL_MODE_CHR_WITH_ADD_INTEGRAL_ADAPTION	6	CHR with automatic adjustment of the P- and I-ration in dependency of the DampingFactor
CONTROL_MODE_LOOP_NO_LAG_WITH_ADD_INTEGRAL_ADAPTION	7	Control without clamping unit with automatic adjustment of the P- and I-value in dependency of the DampingFactor

Fig.4-11: Enumeration type MB_REGI_ADV_CONTROL_MODE

The enumeration type MB_REGI_ADV_RESPONSE_MODE can assume the following values:

Element	Value	Description
RESPONSE_MODE_COMMAND	1	Command value response during setup
RESPONSE_MODE_PRODUCTION	2	Disturbance response in the production

Fig.4-12: Enumeration type MB_REGI_ADV_RESPONSE_MODE

RMB_TechRegiAdvanced

Functional Description

Control algorithm

The control algorithm is represented in the following diagram:

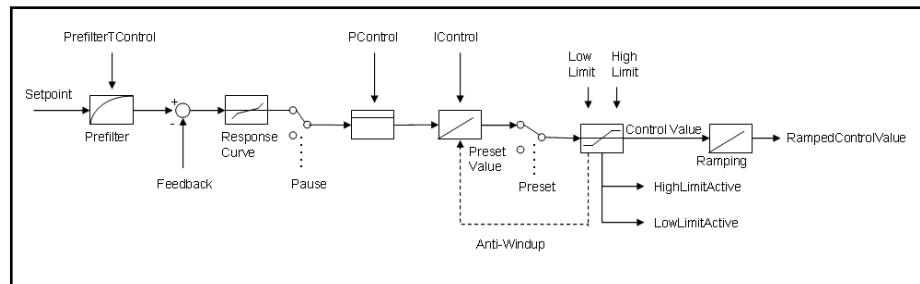


Fig. 4-13: Control algorithm MB_RegisterControllerAdvType01

The input values of the prefilter and the P- and I-input variables of the register controller are calculated in the MB_RegiGravureCalcControlParamType01 FB. Therefore, different parameterization modes can be selected. The controller parameters are calculated again for each change at the "Step" input according to the physical parameters. The register controller and the prefilter also calculate the output variables only again if the "Step" input changes. It has to be considered that the MB_RampAdaptiveType02 FB calculates a new "RampedControlValue" in each cycle. It modifies the control variable of the register controller in a ramp-shape over a cylinder revolution. Thus, the "Step" input and the "ActStepRamped" output change in different cycles. The prefilter is only used if the symmetrical optimum was selected as control mode to impede or minimize overshooting in case of a command value modification.

The difference signal from the filtered "Feedback" input and the "Setpoint" is scaled by a characteristic curve given in "ResponseCurve". The characteristic curve is point-symmetrical to the origin. The x-values of the characteristic curve correspond to the differential signal. The y-values correspond to the scaled difference signal. Up to four points can be specified. The sections between the points are linearly interpolated. If "ResponseCurve" is not applied, there is no scaling.

Initialization

During initialization, the inputs "Setpoint" and "Feedback" have to have valid data. The "ControlValue" is written to the "RampedControlValue" at the output of the PI controller. "RampedControlValue" is only modified in a ramp shape after the second change at the "Step" input, since the period of the cylinder revolution was unknown till then. This means that the first "ControlValue" is not modified in a ramp shape at the first change at the "Step" input.

PresetValue

If the user wishes the controller output "ControlValue" to start up trouble-free, the "Preset" input has to be set if "Enable" is activated.

During this time, the inputs "Setpoint" and "Feedback" have to have valid data.

The checking of the upper/lower limit values is also still active in order to ensure that the "ControlValue" is limited if the preset value ("PresetValue") is outside the limits of "HighLimit" or "LowLimit".

"PresetAck" becomes active if the value at "PresetValue" was applied. "Preset" has priority over "Pause". The value in "PresetValue" is applied at a rising edge at "Preset" if "Enable" is set. A completed value transfer is displayed at the "PresetAck" output.

Pause

The "Pause" input is only evaluated if the "Enable" input is active. In this case, the control deviation ("Setpoint" – "Feedback") is internally set to 0. This leads to the "ControlValue" being fixed. It can be used to keep the output constant in a stable state. The "ActStep" output is updated if the "Pause" input is activated. The "ActStepRamped" does not change. As long as "Pause" is active, the "InPause" output is set. Furthermore, no new controller parameters are calculated and the value at the "RampedControlValue" output is also frozen.

Lock Setpoint

The current "Feedback" value can be applied as command value with the "SetpointLock" feature. If the input becomes "TRUE", the value of "Setpoint" is overwritten with the value of "Feedback" that is present when "Step" is changed next time.

This feature allows the user to switch the controller to "Pause" mode, to jog the system manually to the register and to apply the next "Feedback" value as new "Setpoint".

Dead zone

The deviation calculated from the difference between "Setpoint" and "Feedback" is scaled via "ResponseCurve". That means that the register controller is "frozen" in case of a small register deviation or it takes back the control dynamics. The latter is useful to get "smooth" control characteristics in a steady state and to settle greater deviations fast.

Normal mode

The controller only calculates a new "ControlValue" if the value changes at the "Step" input. This value is modified in a ramp shape over a period of the last cylinder revolution. That means that the value "RampedControlValue" changes in each cycle.

If "ControlValue" exceeds or falls below the value of "HighLimit" or "LowLimit", "ControlValue" is limited to one of these values. If the controller has an integration part, an anti wind-up becomes active. That means that the integral part is not integrated further. In this case, the "HighLimitActive" and "LowLimitActive" outputs are set.

ResponseMode

The default value is set to the command value response (RESPONSE_MODE_COMMAND). This mode should be used when switching on the controller and jogging the command value. At the end of the setup phase, it should be switched to RESPONSE_MODE_PRODUCTION to achieve better control dynamics. In RESPONSE_MODE_PRODUCTION, the mode for the disturbance response set in "ControlMode" is selected. For RESPONSE_MODE_COMMAND, it is only differentiated between the CONTROL_MODE_CHR, CONTROL_MODE_LOOP_NO_LAG, CONTROL_MODE_CHR_WITH_ADD_INTEGRAL_ADAPTION and CONTROL_MODE_LOOP_NO_LAG_WITH_ADD_INTEGRAL_ADAPTION modes when calculating the controller parameters. If another mode is selected, the controller parameters are calculated after CONTROL_MODE_CHR.

Control Mode / Calculating the controller parameters

For the controller parameter calculation, the selected mode, velocity, web length, plate cylinder circumference, distance from the sensor to the printing unit, the measured value filter and a constant dead time have to be considered due to transmission and computing times. The default value for constant dead times of 60 ms is an empirical value that should not be changed at first. The distance of the sensor to the printing unit causes an additional delay and

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should thus be entered. Moreover, the number of measured values used for filtered is to be entered.

Control Mode	Printing process	Influencing the controller parameters
CONTROL_MODE_CHR	With clamping unit	DampingFactor, influences P-value IntegralDampingFactor, influences I-ratio
CONTROL_MODE_AMPLITUDE_OPTIMUM	With clamping unit	DampingFactor, influences P-value IntegralDampingFactor, influences I-ratio
CONTROL_MODE_SYMMETRICAL_OPTIMUM	With clamping unit	DampingFactor, influences P-value IntegralDampingFactor, influences I-ratio
CONTROL_MODE_WOK_APERIODIC_FAIL	With clamping unit	DampingFactor, influences P-value IntegralDampingFactor, influences I-ratio
CONTROL_MODE_LOOP_NO_LAG	Without clamping unit	DampingFactor, influences P-value IntegralDampingFactor, influences I-ratio
CONTROL_MODE_CHR_WITH_ADD_INTEGRAL_ADAPTION	With clamping unit	DampingFactor, influences P- and I-ratio IntegralDampingFactor has no effect
CONTROL_MODE_LOOP_NO_LAG_WITH_ADD_INTEGRAL_ADAPTION	Without clamping unit	DampingFactor, influences P- and I-ratio IntegralDampingFactor has no effect

Fig.4-14: Using Control Modes

In the control modes, it is differentiated between the printing process. If the printing process has a clamping unit (e.g. gravure printing), an adjustment does not become active immediately and special methods for calculating the controller parameters are used (modes 1,2,3,4,6). If the printing process does not have a clamping unit, an adjustment becomes active almost immediately. This is also taken into consideration when calculating the controller parameters (modes 5,7).

The controller parameters are automatically calculated depending on the ControlMode. The user can influence these parameters by means of the DampingFactor or the IntegralDampingFactor. The DampingFactor only has an effect on the P-value and the IntegralDampingFactor on the I-ratio during the first five modes. Example: If the DampingFactor is 50%, the automatically calculated P-value is reduced by half.

Exceptions: "CONTROL_MODE_CHR_WITH_ADD_INTEGRAL_ADAPTION" and "CONTROL_MODE_LOOP_NO_LAG_WITH_ADD_INTEGRAL_ADAPTION". The IntegralDampingFactor does not have any effect. If the DampingFactor is changed, the P- and I-ratio is automatically changed, too. Example: If the DampingFactor is < 100 %, the P-value is reduced and the I-ratio is increased accordingly, as a lower control loop dynamics is to be achieved.

If the DampingFactor is set to 0 for modes 1-5, the P-controller is disabled. If the IntegralDampingFactor is set to 0 for modes 1-5, the I-controller is disabled. If the DampingFactor is set to 0 for mode 6 or 7, the P-controller and the I-controller are disabled. The IntegralDampingFactor does not take any effect in these modes.



It is recommended to use the automatically calculated control parameters. I.e., the DampingFactor and the IntegralDampingFactor are to be set to 100 %. If the control parameters have to be manually adjusted due to the printing process, one of the following modes "CONTROL_MODE_CHR_WITH_ADD_INTEGRAL_ADAPTION" or "CONTROL_MODE_LOOP_NO_LAG_WITH_ADD_INTEGRAL_ADAPTION" are to be used, as the P- and the I-ratio are automatically adjusted in an optimized ratio.

Using output variables

The following figure shows the output variables generated by the controller. The "ControlValue" is the output value of the controller calculated each time after a new measured value is present. It is the already integrated value and does thus not have to be added in the following. "ActStep" is incremented by one with each new measured value. The control variable of the "ControlValue" is modified in a ramp shape over the cylinder revolution period. This value is output with "RampedControlValue". "RampedControlValue" is updated in each computing cycle and the respective "ActStepRamped" is incremented. Furthermore, "RampedControlValueOneStep" is output indicating the change of "RampedControlValue". This value has to be connected to the decoupling network, since this value is integrated into this network. It is also updated in each computing cycle and refers to "ActStepRamped".

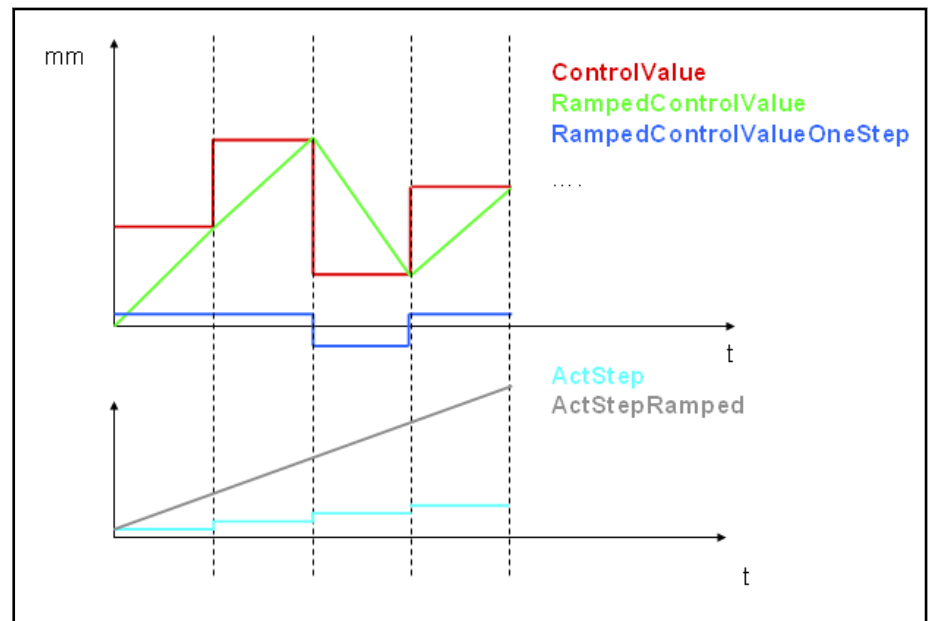


Fig. 4-15: Using controller output variables

HighLimit and LowLimit

This value limits the controller control variable from one step input change to the next change. I.e., if a value of 1 mm is selected as HighLimit, the controller control variable change is limited to a maximum of 1 mm per computing step (one computing step corresponds to a new measured value).

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

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It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002A	Invalid damping factor
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002B	Invalid web length
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002C	Invalid Control mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002D	Invalid velocity
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid plate cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002E	Invalid Response mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002F	Invalid sensor distance
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000030	Invalid delay time
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000045	Invalid integral damping factor
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000046	Invalid measured value filter
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Master" is not within the valid range

Fig. 4-16: Error codes of the MB_RegisterControllerAdvType01 FB

4.3.3 MB_RegiAccelerationCompensationType01

Brief Description

The MB_RegiAccelerationCompensationType01 calculates a feedforward control that compensates the register error in the acceleration phase and in the production phase. A model-based compensation can be carried out if the respective machine data and material data are available. An adaptive and self-adjusting compensation is implemented that determines the compensation values from the controller control variable and the velocity. This compensation is optimized in each acceleration phase.

The MB_RegiAccelerationCompensationType01 feedforward control is located in front of a control loop to minimize the register error. Control signals of the controller and the feedforward control are added first and then added to the plant controlled system.

There are two useful reasons to use a feedforward control:

1. A fatal instationary register error occurred during the acceleration phase that subsequently vanishes completely. The controller is designed for stationary web characteristics.
2. The dynamics of the control loop is increased in each operating phase.



The function block MB_RegiAccelerationCompensationType01 has to be called in a motion-synchronous task to ensure a correction calculation of the acceleration. If this is not possible due to the runtime, the "mMotionCyclic()" function of the function block from the motion-synchronous tasks has to be called and the MB_RegiAccelerationCompensationType01 function block can be called in a cyclic task. The call of the MotionTask has to be provided with the following structure: {CyclicTask}.{fbInstance}.mMotionCyclic(). The elements in the curly brackets have to be replaced by the program name in the cyclic task and the instance name of the function block. Thus, the method call from a program running in the Motion task could be as follows: PLCProg.fbRegiAccelerationCompensationType01.mMotionCyclic(). If this call is not executed, a correct calculation of the acceleration and thus a correct acceleration compensation cannot be ensured.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiAdvanced

Fig. 4-17: Reference table of the MB_RegiAccelerationCompensationType01 FB

Interface Description

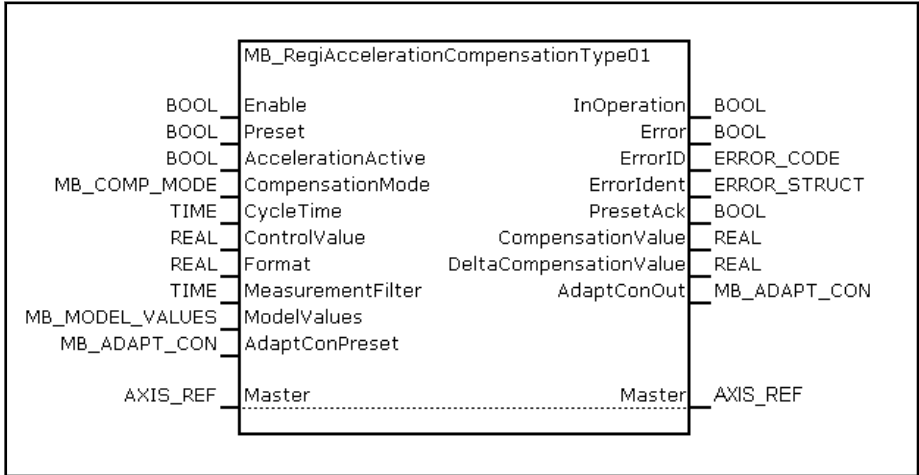


Fig. 4-18: MB_RegiAccelerationCompensationType01 FB

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I/O type	Name	Data type	Description
VAR_IN_OUT	Master	AXIS_REF	Reference to the axis to determine velocity and acceleration compensation. Due to accuracy reasons, it is recommended to create a virtual master axis.
VAR_INPUT	Enable	BOOL	Function block processing enable (level-controlled).
	Preset	BOOL	Preset of adaptive control values.
	AccelerationActive	BOOL	It indicates the function block that the acceleration phase starts or ends.
	CompensationMode	MB_COMP_MODE	Selection between adaptive and/or model-based compensation.
	CycleTime	TIME	Cycle time of the PLC task in which the function block is called to calculate the acceleration.
	ControlValue	REAL	Controller control signal in [mm]
	Format	REAL	Printing cylinder circumference in [mm]
	MeasurementFilter	TIME	Filter for "ControlValue".
	ModelValues	MB_MODEL_VALUES	Physical parameter for model-based compensation.
	AdaptConPreset	MB_ADAPT_CON	Adaptive control signals set at "Preset".
VAR_OUTPUT	InOperation	BOOL	Function block is working.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	PresetAck	BOOL	"Preset" input active
	CompensationValue	DINT	Phase offset (modulo 360°) [degrees]
	DeltaCompensationValue	REAL	Interface to the decoupling network in [mm]. It indicates the differentiated change.
	AdaptConOut	STRUCT	Adaptively improved control signals currently in use.

Fig. 4-19: I/O interface of the MB_RegiAccelerationCompensationType01 FB

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Preset	BOOL			FALSE	Continuous
AccelerationActive	BOOL			FALSE	Continuous
Compensation-Mode	MB_COMP_MODE	0	3	MODEL_AND_ADAPTIVE=0	Enable rising edge
CycleTime	TIME	> 0 ms	n.def.	8 ms	Enable rising edge
ControlValue	REAL	n.def.	n.def.	0	Continuous
Format	REAL	>0	n.def.	0	Enable rising edge

Name	Type	Min. value	Max. value	Default value	Effective
MeasurementValues	TIME	n.def.	n.def.	0ms	Continuously (when entering 0, the filter is deactivated)
MB_MODEL_VALUES					
L_DK	REAL	>=0	n.def.	0	Enable rising edge
R_kuehl	REAL	>0	n.def.	1	Enable rising edge
J_kuehl	REAL	>=0	n.def.	0	Enable rising edge
E	REAL	>0	n.def.	1	Enable rising edge
A	REAL	>0	n.def.	1	Enable rising edge
MB_ADAPT_CON					
CA	REAL	n.def.	n.def.	0	Preset rising edge
CP	REAL	n.def.	n.def.	0	Preset rising edge

Fig. 4-20: Overview on min./max. values and initial values of the inputs

Data Structures

MB_MODEL_VALUES		
L_DK	REAL	Length between DW_links and cooling roll [m]
R_kuehl	REAL	Cooling roll radius [mm]
J_kuehl	REAL	Rotating inertia of cooling roll [kg*m^2]
E	REAL	Modulus of elasticity of the printing web [N/m^2]
A	REAL	Cross-sectional area of the printing web [m^2]

Fig. 4-21: MB_MODEL_VALUES data structure

MB_ADAPT_CON		
CA	REAL	Compensation value for the acceleration compensation
CP	REAL	Compensation value for the velocity compensation

Fig. 4-22: MB_ADAPT_CON data structure

Enumeration Type

The enumeration type **MB_COMP_MODE** can assume the following values:

Element	Value	Description
MODEL_AND_ADAPTIVE	0	Model-based and adaptive compensation
ADAPTIVE	1	Only adaptive compensation
MODELBASED	2	Only model-based compensation
ADAPTIVE_WITHOUT_LEARNING	3	The values CA and CP are used, but not always updated after each acceleration phase.

Fig. 4-23: Enumeration type MB_COMP_MODE

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Functional Description

The FB contains the following functionalities:

- A model-based acceleration compensation and a
- adaptive velocity and acceleration compensation.

This iteratively determines suitable compensation values by evaluating the controller control signal to increase the dynamics of the control loop. The feedforward control is carried out in a linear dependency on acceleration and velocity.

At a rising edge at "Preset" or "Enable", the physical parameters of the physical acceleration compensation MB_MODEL_VALUES are applied and checked for validity. If the printing material has a time-dependent creep and relaxation behavior, a dynamic modulus of elasticity from a fast executed tension test has to be used. If no such value exists, it has to be estimated first. Without specifying the physical parameters, the MB_MODEL_VALUES input is initialized in a way that no model-based compensation takes place.

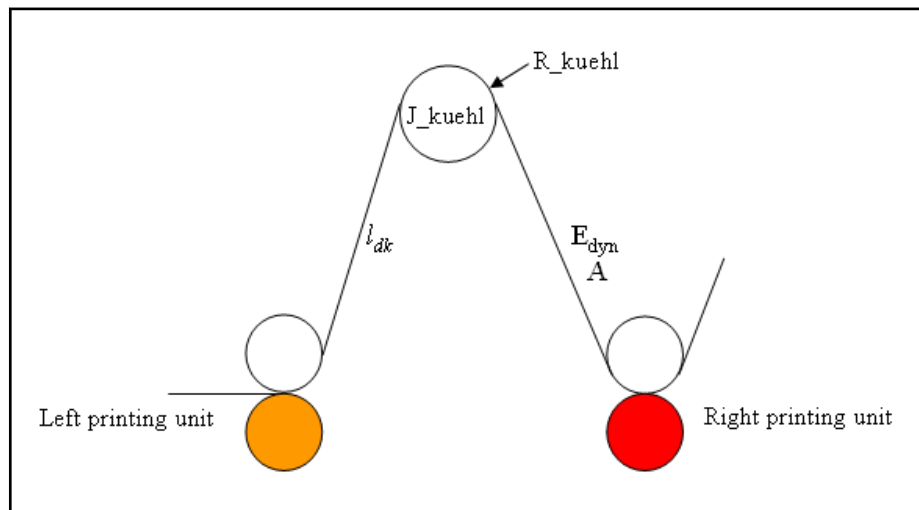


Fig. 4-24: Physical parameters of the model-based compensation

Preset

The adaptive control parameters "AdaptConPreset" are only newly applied at "Preset". This can be useful when exchanging the web.

AccelerationActive

BOOL "AccelerationActive" has to be set to indicate that a new acceleration phase starts. This should be carried out before the acceleration phase is started, since the first controller control variable is applied here. After the completion of the acceleration phase (ideally also a short time span after ~1 s), BOOL is set to FALSE again. When disabling the "AccelerationActive" input, the compensation values (for further accelerations) are updated. As long as "AccelerationActive" is set, the respective compensation values are calculated and output.

The adaptive control values are output as "AdaptConOut". For frequent changes of printing material, it is recommended to save "AdaptConOut" in a receipt file. In case of material re-usage, the compensation parameters can be used again.

MB_REGI_ADV_CONTROL_MODE

It is recommended to use the functionality of the model-based compensation as well as the functionality of the adaptive compensation. Therefore, the "CompensationMode" input is initialized on MODEL_AND_ADAPTIVE. If only

the model-based compensation should be used, the input is to be set to MODELBASED. If a completely adaptive compensation should be used, select ADAPTIVE. If the determined and entered values for CA and CP should be used, but learning should be switched off, the ADAPTIVE_WITHOUT_LEARNING mode has to be selected.

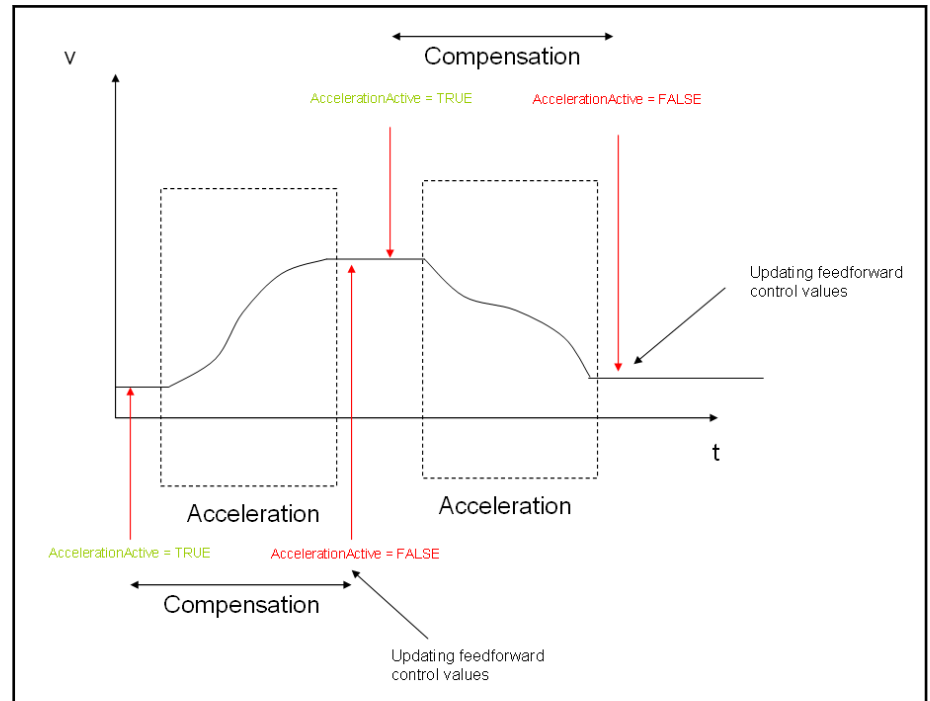


Fig. 4-25: Operating procedure of the MB_RegiAccelerationCompensation-Type01

The operating procedure of the MB_RegiAccelerationCompensationType01 is shown above. As long as AccelerationActive = FALSE, the FB is in its idle phase (Enable = TRUE). If a rising edge is set at "AccelerationActive", the current controller control variable is applied and, when changing acceleration and velocity, the respective compensation is carried out. Therefore, the value is specified in mm at the "DeltaCompensationValue" output. This value is transferred to the decoupling network in which the value is integrated and decoupled. "AccelerationActive" is set to FALSE at the end of the acceleration phase. Thus, the compensation mode is exited and the acceleration phase is evaluated. Values are updated for CA and CP and it will be gone in idle phase again until there is a rising edge at "AccelerationActive".



Ideally, the MB_ReachVelocityType01 FB is used for acceleration. Here, the "Active" output can be connected to "AccelerationActive". The "Active" output is set 500 ms before the acceleration phase starts and is reset 500 ms after the end of the acceleration phase.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

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It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000031	Invalid length between printing unit and cooling roll
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000032	Invalid radius of the cooling roll
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000033	Invalid inertia of the cooling roll
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000034	Invalid modulus of elasticity
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000035	Invalid area of the web
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid plate cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000036	Invalid cycle time
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000037	Invalid compensation mode
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Master" is not within the valid range

Fig. 4-26: Error codes of the MB_RegiAccelerationCompensationType01 FB

4.3.4 MB_RegiGravureRegulateType01

Brief Description

The decoupling network is intended for applications with clamping units at the printing units. It is used to decouple regulating movements in coupled sub-systems. Thus, it can also be used in other applications than rotogravure printing machines in which clamping units are present causing coupled sub-systems. There are different algorithms available describing how control variables of the register controller are cascaded.

The decoupling network is used as follows:

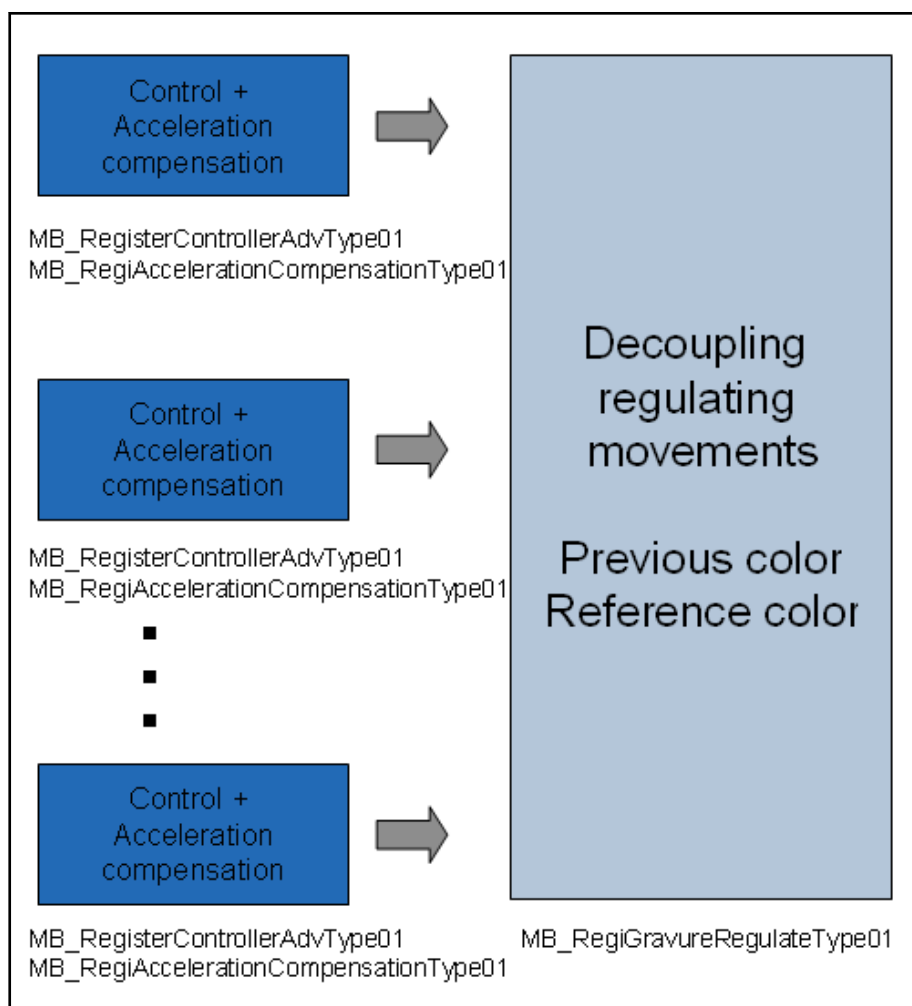


Fig.4-27: Using the decoupling network

The control variables of the register controllers are cascaded in the decoupling network according to the algorithm selected. A phase offset - that is output - is calculated for each printing unit.

The decoupling network MB_RegiGravureRegulateType01 supports the following functionality:

- Dynamic cascading of the control variables of a register controller or of the acceleration compensation
- The dynamic downstream variants are available for the previous color and the reference color
- Preset Feature for preregistration
- Support of one manual mode per printing unit
- Different regulating velocities per mode and per printing unit for manual regulation or usage of an external register controller
- The usage of the Rexroth RegisterControl controller as well as of an external register controller is possible
- Up to 16 printing units (axes) are possible

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiAdvanced

Fig.4-28: Reference table of the MB_RegiGravureRegulateType01 FB

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Interface Description

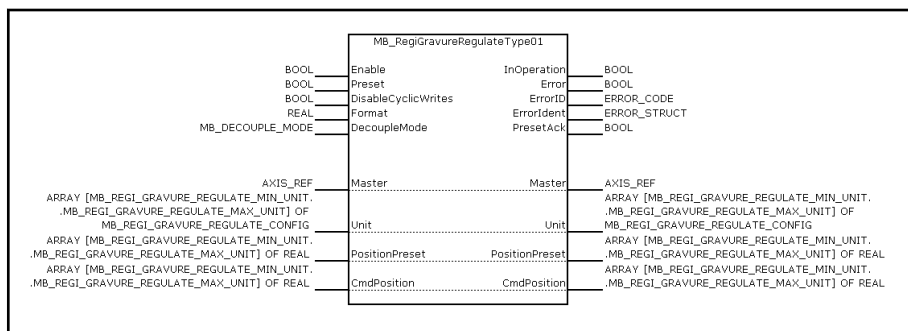


Fig. 4-29: MB_RegiGravureRegulateType01 FB

I/O type	Name	Data type	Description
VAR_IN_OUT	Master	AXIS_REF	Reference to the master axis
	Unit	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT..MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF MB_REGI_GRAVURE_REGULATE_CONFIG	The array contains a data structure for each printing unit. In this data structure, the axis of the respective printing unit is created as well as all other required parameters of a printing unit.
	PositionPreset	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT..MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF REAL	Array with preset values for all printing units in [°].
	CmdPosition	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT..MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF REAL	Array with the offset values for all printing units in [°]. If DisableCyclicWrites = TRUE, this value must be added manually by the user.

I/O type	Name	Data type	Description
VAR_INPUT	Enable	BOOL	Processing of function block enabled
	Preset	BOOL	The array "CmdPosition" is reset and the values from "PositionPreset" are applied. This value will also still be written in the drive in future if DisableCyclicWrites = FALSE.
	DisableCyclicWrites	BOOL	If the input is set, the cyclic data is not written anymore to the axes, but only output in "CmdPosition".
	Format	REAL	Printing cylinder format [mm]
	Decouple-Mode	MB_DECOUPLE_MODE	It indicates the respective algorithm to cascade the controller control variables.
VAR_OUTPUT	InOperation	BOOL	The decoupling function block operates and the outputs are valid.
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	PresetAck	BOOL	Values from "PositionPreset" were written in "CmdPosition" or to the axis.

Fig.4-30: I/O interface of the MB_RegiGravureRegulateType01 FB

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Preset	BOOL			FALSE	Continuous
DisableCyclicWrites	BOOL			FALSE	At a rising edge at "Enable"
Format	REAL	> 0	n.def.	1.0	At a rising edge at "Enable"
DecoupleMode	MB_DECOUPLE_MODE	0	1	COLOR_TO_COLOR := 0	At a rising edge at "Enable"
MB_REGI_GRAVURE_REGULATE_CONFIG					
Slave	AXIS_REF	NoAxis			At a rising edge at "Enable" Rising edge at Enable
Active	BOOL			FALSE	Continuous
Inc	BOOL			FALSE	Continuous
Dec	BOOL			FALSE	Continuous
RegiGravure-Control	BOOL			FALSE	Continuous
RampedControl-ValueOneStep	REAL	n.def.	n.def.	0.0	Continuous
ManualMode	BOOL			FALSE	Continuous
RedSpeed	BOOL			FALSE	Continuous
NormalSpeed	REAL	0.0	n.def.	1	Continuous

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Name	Type	Min. value	Max. value	Default value	Effective
ReducedSpeed	REAL	0.0	n.def.	0.5	Continuous
WebLength	REAL	1.0	n.def.	10000	At a rising edge at "Enable"

Fig.4-31: Overview on min./max. values and initial values of the inputs

Data Structures

MB_REGI_GRAVURE_REGULATE_CONFIG		
Slave	AXIS_REF	Axis of the printing unit
Active	BOOL	Printing unit is active (printing).
Inc	BOOL	Jogging, incrementing the position (manual mode or external register controller).
Dec	BOOL	Jogging, decrementing the position (manual mode or external register controller).
RegiGravureControl	BOOL	The register controller MB_RegiControllerAdvType01 is used if the "Regi-GravureControl " is enabled. Thus, in Automatic and Manual mode, the RampedControlValueOneStep input is applied indicating the register regulation in [mm].
RampedControlValueOneStep	REAL	The differentiated control variable of the register controller in [mm].
ManualMode	BOOL	It activates Manual mode. Thus, the control variable is not decoupled.
RedSpeed	BOOL	Selection of the regulating velocity
NormalSpeed	REAL	Regulating velocity [1/s] in the mode RedSpeed = FALSE.
ReducedSpeed	REAL	Regulating velocity [1/s] in the mode RedSpeed = TRUE.
WebLength	REAL	Web length from the upstream active printing unit to the individual printing unit [mm]

Fig.4-32: MB_GRAV_PRINT_CORR_UNIT_TYPE02 data structure

Enumeration Type

The enumeration type **MB_DECOUPLE_MODE** can assume the following values:

Element	Value	Description
COLOR_TO_COLOR	0	Previous color control
REFERENCE_COLOR	1	Reference color control

Fig.4-33: Enumeration type MB_DECOUPLE_MODE

Definition of the defines:

MB_REGI_GRAVURE_REGULATE_MIN_UNIT := 1;

MB_REGI_GRAVURE_REGULATE_MAX_UNIT := 16;

Functional Description

The MB_RegiGravureRegulateType01 FB is used as an interface between the register controllers and the drives. The register controller used can be an external register controller, but should ideally be the register controller MB_RegisterControllerAdvType01 optimized for rotogravure printing. The control variables are cascaded as feedforward control to the following printing units with different algorithms according to the control strategy.

Initialization

The FB starts with the values in "CmdPosition" at a rising edge at "Enable". This value corresponds to the phase offset for each printing unit.

Preset

To reset the values for "CmdPosition", "Preset" must be set to "TRUE". Thus, the "PositionPreset" values are copied to the "CmdPosition" array.

DisableCyclicWrites

The "DisableCyclicWrites" input determines whether the values calculated by the function block are directly written on the axes (FALSE) or only available at the FB output in "CmdPosition" (TRUE). If the AxisInterface or further functionalities that write on this axis are used, "DisableCyclicWrites" must be enabled. Then, the user can autonomously write the value calculated in "CmdPosition" to the axis (for example with the AxisInterface via PhaseOffset in SyncMode). This allows to autonomously copy the phase offset to the respective parameter by setting "DisableCyclicWrites" to TRUE. Then, only the output array "CmdPosition" is to be used and further modified.

DecoupleMode

It can be chosen between two different cascading algorithms. It is recommended to use the previous color control.

- COLOR_TO_COLOR

In this mode, the correction values are not statically, but dynamically cascaded. That means that the correction values of a register controller are cascaded to the following printing units via several timing elements. Thus, an ideal decoupling of the control variable of a previous register controller can be carried out. Therefore, the web length between the respective printing units has to be specified to calculate the time constants for the dynamic actuators.

The following figure shows the cascading of the controller control variable:

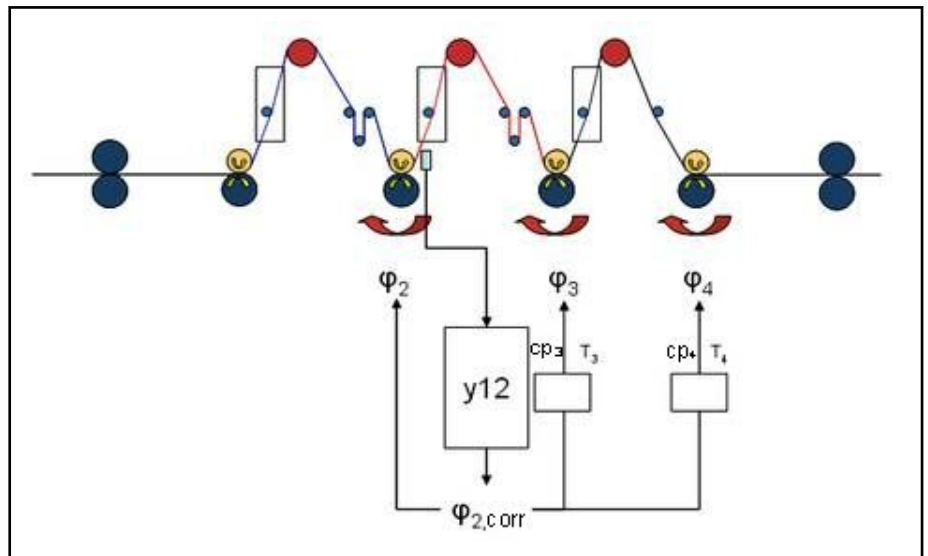


Fig.4-34: Dynamic cascading

The white boxes stand for several dynamic timing elements that completely decouple the regulation of the register controller 2 for the register controllers 3 and 4.

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This mode can only be used if the sensor compares the marks of the printing unit located in the front with the current printing unit and subsequently controls the register.

- REFERENCE_COLOR

This mode can only be used if the sensor compares the marks of the own printing unit with a reference color (mostly printing unit 1).

This mode basically acts like COLOR_TO_COLOR, but is provided with a different combination of dynamic elements. The acceleration compensation can only be used for the COLOR_TO_COLOR mode. Due to this fact, this mode should only be used if no high accuracy is required in the acceleration phase.

Functionalities that can be set for the respective printing unit:

- RegiGravureControl:

If RegiGravureControl = TRUE, the RampedControlValueOneStep input is used as controller control variable in Automatic and Manual mode. This is the interface to the internal rotogravure printing controller MB_RegisterControllerAdvType01.

If RegiGravureControl = FALSE, only the "Inc" and "Dec" inputs are used as controller control variables in Manual as well as in Automatic mode (interface to an external register controller).

- ManualMode

If ManualMode = TRUE, the input variables are not decoupled for subsequent printing units.

If ManualMode = FALSE, the controller control variables are decoupled for subsequent printing units according to the selected control strategy.

- RedSpeed

Two different regulating velocities can be entered for each printing unit. If RedSpeed = TRUE, "ReducedSpeed" is used as regulating velocity, otherwise "NormalSpeed". This only applies if the jog inputs "Inc" and "Dec" are used which is the case when RegiGravureControl = FALSE.

- Active

Each printing unit participating in the printing process has to be enabled with "Active".

- WebLength

Web length between the printing unit located in the front and the printing unit to be controlled. This web length is used to determine the dynamic time constants.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid printing cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003A	Invalid Decouple mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000038	Invalid NormalSpeed
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000039	Invalid ReducedSpeed

ErrorID	Additional 1	Additional 2	Description
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002B	Invalid web length
RESOURCE_ERROR (16#0003)	16#00000001	16#00000000	No power is added to the drive specified in "Slave". A register control is thus not possible.
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Axis" is not in the valid range

Fig. 4-35: Error codes of the MB_RegiGravureRegulateType01 FB

Furthermore, errors can occur in the libraries RIL_LoopControl and MS_TechBase.

4.3.5 MB_RegiGravureRegulateType02

Brief Description

The function block contains the entire functionality of the MB_RegiGravureRegulateType01 function block. Due to this reason, it is recommended to refer to the MB_RegiGravureRegulateType01 function block documentation.

Only the additional functions of the MB_RegiGravureRegulateType02 function block are explained:

- Presetting each printing unit (use case pre-registration).
- Ignoring the pre-control values of upstream printing units (use case machining unit with upstream decoupling for the printing process).

The extensions refer to the MB_REGI_GRAVURE_REGULATE_CONFIG data structure. Additional variables that trigger the corresponding actions are inserted in the derived MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02 data structure.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V13	RMB_TechRegiAdvanced

Fig. 4-36: Reference table of the MS_RegiGravureRegulateType02 function block

Interface Description

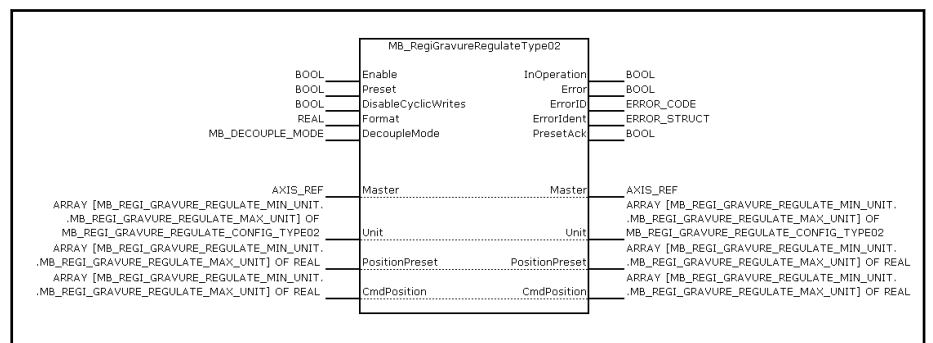


Fig. 4-37: MB_RegiGravureRegulateType02 function block

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I/O type	Name	Data type	Explanation
VAR_IN_OUT	Master	AXIS_REF	Reference to the master axis
	Unit	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT .. MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02	The array contains a data structure for each printing unit. In this data structure, the axis of the respective printing unit is created as well as all other required parameters of a printing unit.
	PositionPreset	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT .. MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF REAL	Array with preset values for all printing units in [°].
	CmdPosition	ARRAY [MB_REGI_GRAVURE_REGULATE_MIN_UNIT .. MB_REGI_GRAVURE_REGULATE_MAX_UNIT] OF REAL	Array with the offset values for all printing units in [°]. If DisableCyclicWrites = TRUE, this value must be added manually by the user.
VAR_INPUT	Enable	BOOL	Processing of function block enabled
	Preset	BOOL	The array "CmdPosition" is reset and the values from "PositionPreset" are applied. This value continues to be written to the drive, if DisableCyclicWrites = FALSE.
	DisableCyclicWrites	BOOL	If the input is set, the cyclic data is not written anymore to the axes, but only output in "CmdPosition".
	Format	REAL	Printing cylinder format [mm]
	Decouple-Mode	MB_DECOUPLE_MODE	It indicates the respective algorithm to cascade the controller control variables.
VAR_OUT-PUT	InOperation	BOOL	The decoupling function block operates and the outputs are valid.
	Error	BOOL	Processing completed with errors.
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	PresetAck	BOOL	Values from "PositionPreset" were written in "CmdPosition" or to the axis.

Fig.4-38: I/O interface of the MB_RegiGravureRegulateType02 function block

Data Structures

The MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02 data structure extends the MB_REGI_GRAVURE_REGULATE_CONFIG data structure:

MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02		
Slave	AXIS_REF	Axis of the printing unit
Active	BOOL	Printing unit is active (printing).
Inc	BOOL	Jogging, incrementing the position (manual mode or external register controller).
Dec	BOOL	Jogging, decrementing the position (manual mode or external register controller).
RegiGravureControl	BOOL	The register controller MB_RegiControllerAdvType01 is used if the "RegiGravureControl" is enabled. Thus, in Automatic and Manual mode, the RampedControlValueOneStep input is applied indicating the register regulation in [mm].
RampedControlValueOneStep	REAL	The differentiated control variable of the register controller in [mm].
ManualMode	BOOL	It activates Manual mode. Thus, the control variable is not decoupled.
RedSpeed	BOOL	Selection of the regulating velocity
NormalSpeed	REAL	Regulating velocity [1/s] in the mode RedSpeed = FALSE.
ReducedSpeed	REAL	Regulating velocity [1/s] in the mode RedSpeed = TRUE.
WebLength	REAL	Web length from the upstream active printing unit to the individual printing unit [mm].
UnitPreset	BOOL	The individual units are preset with the value of UnitPresetValue.
UnitPresetAck	BOOL	Acknowledgment that UnitPreset has been executed successfully.
UnitPresetValue	REAL	Value written to CmdPosition of the respective unit in case of a rising edge at UnitPreset.
NoDecPreviousUnits	BOOL	If the input is enabled, no decoupling values of upstream printing units are taken into consideration.

Fig. 4-39: MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02 data structure

Enumeration Type

Enumeration type in previous RMB_TechRegiAdvanced function blocks:

- MB_DECOUPLE_MODE (fig. 4-33 Data structure MB_DECOUPLE_MODE, page 104)

Default settings definition:

MB_REGI_GRAVURE_REGULATE_MIN_UNIT := 1;

MB_REGI_GRAVURE_REGULATE_MAX_UNIT := 16;

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Preset	BOOL			FALSE	Continuous
DisableCyclicWrites	BOOL			FALSE	At a rising edge at "Enable"
Format	REAL	> 0	n.def.	1.0	At a rising edge at "Enable"
DecoupleMode	MB_DECOUPLE_MODE	0	1	COLOR_TO_COLOR := 0	At a rising edge at "Enable"
MB_REGI_GRAVURE_REGULATE_CONFIG_TYPE02					
Slave	AXIS_REF	NoAxis			At a rising edge at "Enable"

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Name	Type	Min. value	Max. value	Default value	Effective
Active	BOOL			FALSE	Continuous
Inc	BOOL			FALSE	Continuous
Dec	BOOL			FALSE	Continuous
RegiGravureControl	BOOL			FALSE	Continuous
RampedControlValueOneStep	REAL	n.def.	n.def.	0.0	Continuous
ManualMode	BOOL			FALSE	Continuous
RedSpeed	BOOL			FALSE	Continuous
NormalSpeed	REAL	0.0	n.def.	1	Continuous
ReducedSpeed	REAL	0.0	n.def.	0.5	Continuous
WebLength	REAL	1.0	n.def.	10000	At a rising edge at "Enable"
UnitPreset	BOOL			FALSE	Continuous
UnitPresetAck	BOOL			FALSE	Continuous
UnitPresetValue	REAL	n.def.	n.def.	0.0	Rising edge at UnitPreset
NoDecPreviousUnits	BOOL			FALSE	Continuous

Fig.4-40: Overview of min./max. values and initial values of the MB_RegiGravureRegulateType02 inputs

Functional Description



The function block MB_RegiGravureRegulateType02 contains the entire functionality of the MB_RegiGravureRegulateType01 function block.

It is recommended to read the following documentation for the function description:

- MB_RegiGravureRegulateType01 (fig. 4.3.4 MB_RegiGravureRegulateType01 function block, page 100)

Additionally, the function block contains two more functionalities:

Execute a preset for an individual printing unit

Currently, only a global preset of all printing units can be executed. Depending on the application, this can be insufficient, as often only preset values of a printing unit or a unit are written. If Unit.UnitPreset := TRUE (rising edge), the value of Unit.UnitPresetValue is written to CmdPosition for this unit. Unit.UnitPresetAck displays, if the value has been written successfully. If DisableCyclicWrites = FALSE, this value is additionally written to the slave axis.

Do not take any decoupling values of upstream printing units into consideration

A unit with upstream units that are active and do not run in manual mode always received pre-control values of upstream units. Due to process-technical reasons, a unit can be decoupled from adjusted upstream units. All pre-control values of upstream printing units can be ignored using the input NoDecPreviousUnits = TRUE. If NoDecPreviousUnits = FALSE, pre-control values of upstream printing units that are not in manual mode are taken into consid-

eration. Generally, the pre-control values should always be taken into consideration in case of printing units. These pre-control values should only be disabled in the exceptional case.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170. It can generate the following error messages in Additional1/Additional2.

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000000	Invalid printing cylinder format
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000003A	Invalid Decouple mode
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000038	Invalid NormalSpeed
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#00000039	Invalid ReducedSpeed
INPUT_RANGE_ERROR (16#0006)	16#00001D11	16#0000002B	Invalid web length
INPUT_RANGE_ERROR (16#0006)	16#0000000D	16#00000000	AxisNo of "Axis" is not in the valid range
RESOURCE_ERROR (16#0003)	16#00000001	16#00000000	No power is added to the drive specified in "Slave". A register control is thus not possible.

Fig.4-41: Error codes of the MS_RegiGravureRegulateType02 function block
Furthermore, errors can occur in the libraries RIL_LoopControl and MS_TechBase.

4.4 Function Blocks to Communicate with the Camera System

4.4.1 Introduction and Overview

In the library, function blocks are still provided to communicate and evaluate registration marks by a camera system. The area of use of the intelligent camera sensor is the detection of registration marks at printing presses. The exemplary usage is shown in the representation of the 4-color printing machine.

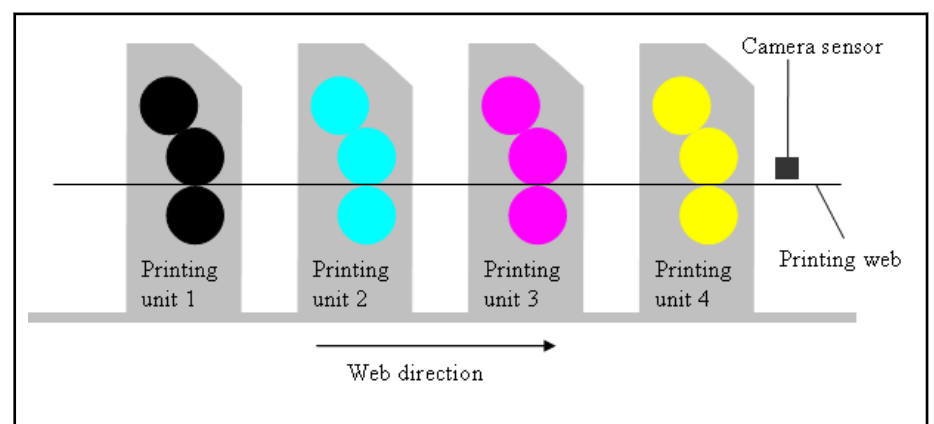


Fig.4-42: Usage of the camera system

The camera sensor can be used behind the printing units of a 4-color printing press. The registration marks of printing unit 1 is not measured, since these registration marks form the mark frame. For the registration marks from printing unit 2 to 4, the deviations to the configured command position are meas-

ured and output and can be forwarded to a register control for correction purposes.



For detailed information on the camera system, please contact your Bosch Rexroth support.

The mark stream can be specified in the mark definition. A standard mark stream for the camera system is shown in the following figure.

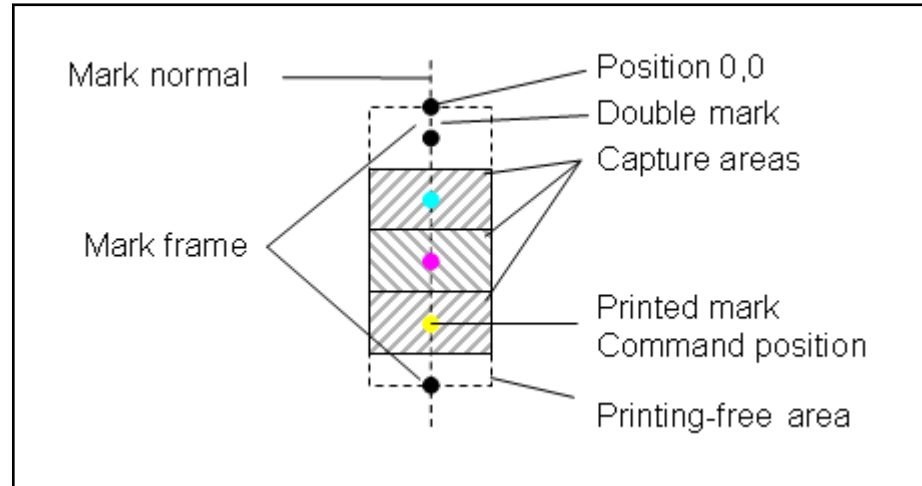


Fig.4-43: Mark stream of the registration marks (enlarged)

The most important part of the definition is the printed mark. It is designed as 1 mm mass tone circle. The printed marks to be measured are framed by the mark frame consisting of three printed marks. The mark frame should be printed by the printing unit with the highest contrast to the substrate. In the example selected here, the mark frame starts with a double mark. These are two marks with a distance of ≤ 2 mm to each other. The printed mark with the greatest distance to the double mark spans the mark frame. All other printed marks have to be located within this mark frame. Since the printing unit that prints the mark frame maps the first partial image on the substrate, these printed marks are not measured. All other printed marks have to be within the mark frame to ensure that the camera sensor detects the printed marks. The distance between the printed marks and the mark frame is 4 mm in this example. A printed mark not belonging to the mark frame is provided with a command position. The measurement result is the difference between the printed mark and the command position. The capture area is around a command position shaped as rectangle. The capture area may not overlap with any other capture area or protrude from the printing-free area. A straight line goes through the mark frame. This straight line is the mark normal. The printing-free area spans vertically to this straight line. Only printed marks may be within this area.

Example interconnection

Both function blocks can be called in the following example interconnection. The MB_RegiSensor03ConfigType01 FB configures and the MB_RegiSensor03CycComType01 evaluates the measurement results.

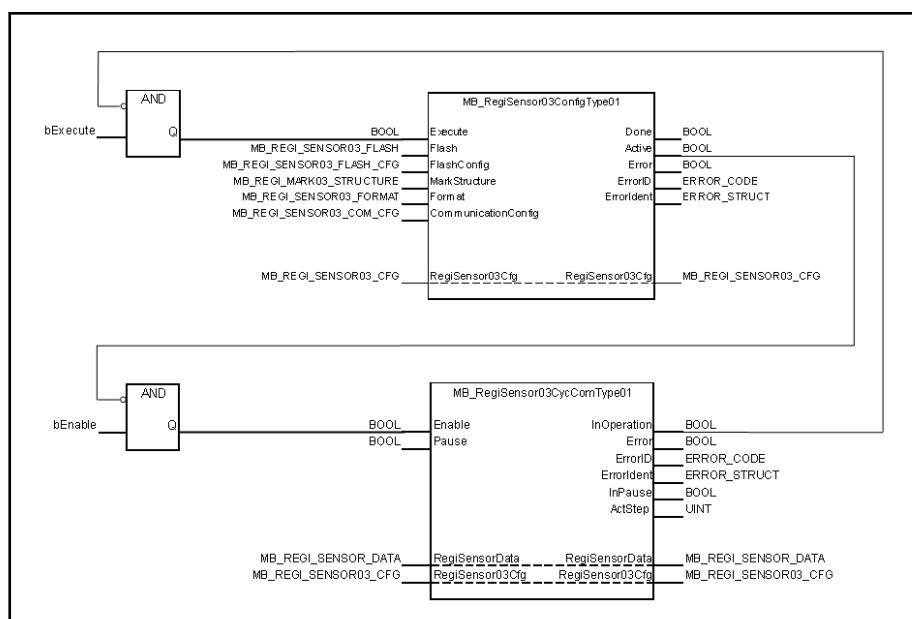


Fig.4-44: Example interconnection of the functions blocks of the camera system

The shown interconnection is the one that can be realized with the lowest circuitry effort to stick to the specified calling sequence of the function blocks. If the function block to configure the camera sensor should be called, the function block for the measured value acquisition may not be enabled. This is ensured by the AND operation with the "InOperation" output of the function block of the measured value acquisition and the Boolean variable "bExecute". It has to be considered that the input of the AND operation has to be negated with the signal of "InOperation". This ensures that the MB_RegiSensor03ConfigType01 FB can only be enabled if the MB_RegiSensor03CycComType01 is not active.

Since the MB_RegiSensor03CycComType01 FB has to know the mark stream to be printed, the function block may only be called after a successful configuration of the camera sensor. To start the function block, the function block for the configuration must have completed its processing. This condition is implemented via an AND operation with the negated "Active" output of the MB_RegiSensor03ConfigType01 FB and the Boolean variable "bEnable".

If the MB_RegiSensor03CycComType01 FB is called first, there is no communication data for the connection establishment to the camera sensor in the MB_REGI_SENSOR03_CFG data structure. This impedes that the function block for the measured value acquisition can be called without a configured camera sensor or after a restart of the automation system.

4.4.2 MB_RegiSensor03ConfigType01

Brief Description

The function block configures the sensor. The sensor may not be configured during the measurement. The rising edge at "Enable" for the MB_RegiSensor03CycComType01 is given after a successful configuration via "Active" = FALSE.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiAdvanced

Fig.4-45: Reference table of the MB_RegiSensor03ConfigType01 FB

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Interface Description

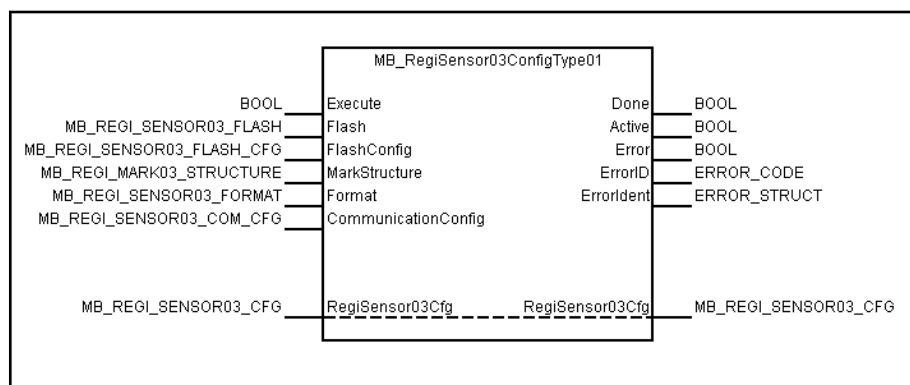


Fig.4-46: MB_RegiSensor03ConfigType01 FB

I/O type	Name	Data type	Description
VAR_IN_OUT	RegiSensor03Cfg	MB_REGI_SENSOR03_CFG	Camera sensor settings
VAR_INPUT	Execute	BOOL	It starts the sensor configuration
	Flash	MB_REGI_SENSOR03_FLASH	Selection of the flash to be used
	FlashConfig	MB_REGI_SENSOR03_FLASH_CFG	Settings of the flash selected
	MarkStructure	MB_REGI_MARK03_STRUCTURE	It defines the mark field
	Format	MB_REGI_SENSOR03_FORMAT	It defines the printing format, trigger position, increments and the length of the hidden substrate at printing start
	CommunicationConfig	MB_REGI_SENSOR03_COM_CFG	It defines the communication parameters of the TCP connection
VAR_OUTPUT	Done	BOOL	Data outputs are valid
	Active	BOOL	Function block is working and currently in an interim state
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics

Fig.4-47: I/O interface of the MB_RegiSensor03ConfigType01 FB

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Execute	BOOL			FALSE	Continuous
Flash	MB_REGI_SENSOR03_FLASH	0	3	0	Rising edge at "Execute"
MB_REGI_SENSOR03_FLASH_CFG					
FlashAlternate	ARRAY [0..3] OF USINT	[0,0,0,0]	[2,2,2,2]	[0,1,2,0]	Rising edge at "Execute"
FlashProperty	ARRAY [0..3] OF WORD	[0,0,0,0]	[1,1,1,1]	[1,0,0,0]	Rising edge at "Execute"

Name	Type	Min. value	Max. value	Default value	Effective
FlashTimeAlternate	ARRAY [0..3] OF UINT	4[0]	4[2 ¹⁶ -1]	[100,100,100,100]	Rising edge at "Execute"
GainAlternate	ARRAY [0..3] OF USINT	4[0]	4[255]	[100,100,100,100]	Rising edge at "Execute"
MB_REGI_MARK03_STRUCTURE					
NumberOfMarks	INT	3	16	3	Rising edge at "Execute"
MaxPrintFree	UINT	2000	2 ¹⁶ -1	4000	Rising edge at "Execute"
MarkDiameter	UINT	1000	2 ¹⁶ -1	1000	Rising edge at "Execute"
MarkfieldX	ARRAY [0..15] OF INT	3[-2 ¹⁵]	16[2 ¹⁵ -1]	[0,0,0]	Rising edge at "Execute"
MarkfieldY	ARRAY [0..15] OF INT	3[-2 ¹⁵]	16[2 ¹⁵ -1]	[0,2000,18000]	Rising edge at "Execute"
MarkCaptAreaX	ARRAY [0..15] OF UDINT	3[0]	16[2 ³² -1]	[0,0,0]	Rising edge at "Execute"
MarkCaptAreaY	ARRAY [0..15] OF UDINT	3[0]	16[2 ³² -1]	[0,0,0]	Rising edge at "Execute"
MarkForm	USINT	0	1	0	Rising edge at "Execute"
MarkDiamX	ARRAY [0..15] OF UDINT	3[1000]	16[2 ¹⁶ -1]	[1000,1000,1000]	Rising edge at "Execute"
MarkDiamY	ARRAY [0..15] OF UDINT	3[1000]	16[2 ¹⁶ -1]	[1000,1000,1000]	Rising edge at "Execute"
MarkColor	ARRAY [0..15] OF UDINT	3[0]	n.def.	[0,0,0]	Rising edge at "Execute"
MB_REGI_SENSOR03_FORMAT					
Increments	UINT	1000	30000	1000	Rising edge at "Execute"
FormatLength	UINT	0	2 ¹⁶ -1	6096	Rising edge at "Execute"
TriggerPosition	UINT	0	Number of configured increments	0	Rising edge at "Execute"
WaitPrintOn	UINT	0	2 ¹⁶ -1	10	Rising edge at "Execute"
MB_REGI_SENSOR03_COM_CFG					
IpSensor	STRING			"192.168.3.70"	Rising edge at "Execute"
PortSensor	UINT	>0	65535	7236	Rising edge at "Execute"

Fig. 4-48: Overview on min./max. values and initial values of the inputs

Data Structures

MB_REGI_SENSOR03_FLASH_CFG					
FlashAlternate	ARRAY [0..3] OF USINT	It indicates the electric output of the flash on the trigger unit			
FlashProperty	ARRAY [0..3] OF WORD	Bit-oriented; bit 0 = 1, the connected flash supports a flash length control (LED flash)			

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MB_REGI_SENSOR03_FLASH_CFG		
FlashTimeAlternate	ARRAY [0..3] OF UINT	It indicates the flash length [μs]
GainAlternate	ARRAY [0..3] OF USINT	It indicates the electric gain for the selected flash configuration

Fig. 4-49: MB_REGI_SENSOR03_FLASH_CFG data structure

MB_REGI_MARK03_STRUCTURE		
NumberOfMarks	USINT	Number of printed marks
MaxPrintFree	UINT	Area vertical to the mark normal; it is searched for printed marks [μm]
MarkDiameter	UINT	Printed mark diameter [μm]
MarkfieldX	ARRAY OF [0..15] INT	X-position; marks of the mark field [μm]
MarkfieldY	ARRAY [0..15] OF INT	Y-position; marks of the mark field [μm]
MarkCaptAreaX	ARRAY [0..15] OF UDINT	Capture area; x-direction
MarkCaptAreaY	ARRAY [0..15] OF UDINT	Capture area; y-direction
MarkForm	USINT	Mark shape, 0 corresponds to mass tone circle
MarkDiamX	ARRAY [0..15] OF UDINT	Expansion of the mark; x-direction [μm]
MarkDiamY	ARRAY [0..15] OF UDINT	Expansion of the mark; y-direction [μm]
MarkColor	ARRAY [0..15] OF UDINT	Color of the marks (is not used yet, but must be specified)

Fig. 4-50: MB_REGI_MARK03_STRUCTURE data structure

MB_REGI_SENSOR03_FORMAT		
Increments	UINT	Number of increments of the rotary encoder (Note: factor 4)
FormatLength	UINT	Print format (24") resolution [1/10 mm]
TriggerPosition	UINT	Current trigger position
WaitPrintOn	UINT	Hidden web distance at printing start in [m]

Fig. 4-51: MB_REGI_SENSOR03_FORMAT data structure

MB_REGI_SENSOR03_COM_CFG		
IpSensor	STRING	IP address of the camera sensor
PortSensor	UINT	TCP communication port

Fig. 4-52: MB_REGI_SENSOR03_COM_CFG data structure

MB_REGI_SENSOR03_CFG		
Flash	MB_REGI_SENSOR03_FLASH	Selection of the flash configuration
FlashConfig	MB_REGI_SENSOR03_FLASH_CFG	It defines the flashes connected
MarkStructure	MB_REGI_MARK03_STRUCTURE	It defines the mark field

MB_REGI_SENSOR03_CFG		
Format	MB_REGI_SENSOR03_FORMAT	It defines the format
CommunicationData	MB_REGI_SENSOR03_COM_CFG	It defines the communication parameters of the TCP connection

Fig.4-53: MB_REGI_SENSOR03_CFG data structure

Enumeration Type

The enumeration type **MB_REGI_SENSOR03_FLASH** can assume the following values:

Element	Value	Description
FLASH1	0	Selecting the flash configuration 1
FLASH2	1	Selecting the flash configuration 2
FLASH3	2	Selecting the flash configuration 3
FLASH4	3	Selection of the flash configuration 4

Fig.4-54: Enumeration type MB_REGI_SENSOR03_FLASH

Functional Description

The communication setting is checked at a rising edge at "Execute". After a successful completion, a TCP socket is opened and it is tried to establish a communication with the camera sensor. Otherwise, "Error" becomes TRUE and "ErrorID" as well as "ErrorIdent" contain the valid error code. The function block does not start.

After a successful communication establishment, the parameters are written one after the other and now explained in detail.

- With "Flash", the flash configuration to be used is selected.

The following parameters are stored in the "FlashConfig" structure:

- "FlashAlternate" defines the electric outputs of the flashes.
- To enable the flash length control for LED flashes, the bit of the selected flash configuration has to be set at "FlashProperty".
- The flash length of the selected flash configuration is written with the parameter "FlashTimeAlternate". The unit is [ms].
- "GainAlternate" is used to set the brightness of the image for the respective selected flash configuration.

The following parameters are stored in the "MarkStructure" structure:

- With "NumberOfMarks", all printed marks have to be specified. These are three marks for the mark frame printed by the first printing unit as well as one mark each for the following printing units. The parameter internally determines the mark structure.
- The printing-free area vertical to the mark normal is specified with "Max-PrintFree". It defines the area in which the marks are expected. In this area, nothing may be printed on the substrate except the marks. The unit is [µm].
- The mark diameter is written with "MarkDiameter". The unit is also [µm].
- The expansion of the mark stream in x-direction is carried out with "MarkfieldX". Positive as well as negative numbers can be used. The unit is [µm].

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- The expansion of the mark stream in y-direction is carried out with "MarkfieldY". Positive as well as negative numbers can be used. The unit is [µm].
- With "MarkCaptAreaX", the expansion of the capture area of a printed mark in x-direction is specified. Only expansions of the printed marks not belonging to the mark frame are entered. Only positive values are possible. The unit is [µm].
- With "MarkCaptAreaY", the expansion of the capture area of a printed mark in y-direction is specified. Only expansions of the printed marks not belonging to the mark frame are entered. Only positive values are possible. The unit is [µm].
- "Markform" defines the shape of the marks. A value of 0 corresponds to a mass tone circle, 1 to a rectangle. However, the rectangular shape is not used.
- The parameter "MarkDiamX" defines the expansion of the mark in x-direction. If the mark shape "mass tone circle" is selected, no value must be entered. For a rectangular shape, a value higher than 0 is expected. The unit is [µm].
- The parameter "MarkDiamY" defines the expansion of the mark in y-direction. If the mark shape "mass tone circle" is selected, no value must be entered. For a rectangular shape, a value higher than 0 is expected. The unit is [µm].
- With "MarkColor", a color can be assigned to the printed marks. This parameter is not supported by the camera. The default values are not to be changed.

The following parameters are stored in the "Format" structure:

- "Increments" sets the number of increments of the rotary encoder used at the drive.



For a four-time evaluation, factor 4 must be considered.

- With "FormatLength", the printing format is set. The unit is [1/10 mm].
- The parameter "TriggerPosition" sets the increment at which position the triggering should take place.
- To hide the web path before the actual printing start, "WaitOnPrint" must be greater than 0. The unit is [m]. If a valid value is entered and the parameters are written into the camera, hiding can be enabled with the global input X13.1 "Print On".

The following parameters are stored in the "CommunicationConfig" structure:

- "IpSensor" specifies the IP address of the camera sensor. It has to be entered as STRING: e.g.: "192.168.3.70"
- "PortSensor" specifies the respective port for the communication. Port 7236 has to be set for parameterization and process data.

"Active" is set to TRUE during the configuration. The socket is closed, "Active" is reset and "Done" is set after a successful communication. If an error occurs, "Error" is TRUE and "ErrorID" as well as "ErrorIdent" contain valid error codes.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000000	No TCP connection
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000001	The received data package is too large for the created receiver buffer
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000002	The data package to be sent is too large for the transmission buffer
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000003	Invalid header received
INPUT_INVALID_ERROR (16#0001)	16#00001D00	16#00000004	No IP configured
INPUT_INVALID_ERROR (16#0001)	16#00001D00	16#00000005	No port configured
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000000	Invalid flash selection
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000001	Invalid flash output
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000002	Invalid flash characteristic
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000003	Invalid flash length
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000004	Invalid brightness value of the selected flash
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000005	Invalid number of entered marks
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000006	Invalid printing-free area
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000007	Invalid mark diameter
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000008	Invalid input of mark frame; x-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000009	Invalid input of mark frame; y-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000A	Invalid mark capture area; x-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000B	Invalid mark capture area; y-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000C	Invalid mark shape
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000D	Invalid mark expansion; x-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000E	Invalid mark expansion; y-direction
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#0000000F	Invalid mark color
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000010	Invalid input of increments
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000011	Invalid input of printing format
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000012	Invalid trigger position
INPUT_INVALID_ERROR (16#0001)	16#00001D01	16#00000013	Invalid print on delay

Fig.4-55: Error codes of the MB_RegiSensor03ConfigType01 FB

Additionally, the function block can output errors of the RIL_SocketComm.lib library.

4.4.3 MB_RegiSensor03CycComType01

Brief Description

The function block cyclically reads the deviation to the command position of the marks from a camera sensor previously configured by the MB_RegiSensor03ConfigType01 and provides measured values for the ongoing register

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control. The camera sensor may not be configured during the measured value acquisition. The MB_RegiSensor03CycComType01 is enabled after a successful execution via "Active" = FALSE by MB_RegiSensor03ConfigType01.

Target system	Library
Rexroth RegisterControl MLC L65/L45 from V11	RMB_TechRegiAdvanced

Fig.4-56: Reference table of the MB_RegiSensor03CycComType01 FB

Interface Description

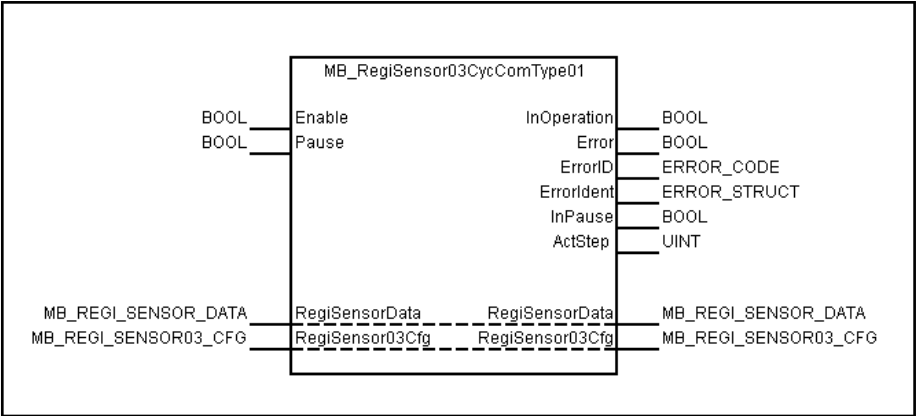


Fig.4-57: The MB_RegiSensor03CycComType01 FB

I/O type	Name	Data type	Description
VAR_IN_OUT	RegiSensor-Data	MB_REGI_SENSOR_DATA	It contains the measured values
	RegiSensor03Cfg	MB_REGI_SENSOR03_CFG	Camera sensor settings
VAR_INPUT	Enable	BOOL	It enables the measured value acquisition
	Pause	BOOL	It aborts the measured value evaluation
VAR_OUT-PUT	InOperation	BOOL	Measured value acquisition is active
	Error	BOOL	Processing completed with error
	ErrorID	ERROR_CODE	Error group
	ErrorIdent	ERROR_STRUCT	Detailed diagnostics
	InPause	BOOL	Pause is set; no new measured values are output
	ActStep	UINT	Current measured value step

Fig.4-58: I/O interface of the MB_RegiSensor03CycComType01 FB

Min./Max. Values and Default Values of the Inputs

Name	Type	Min. value	Max. value	Default value	Effective
Enable	BOOL			FALSE	Continuous
Pause	BOOL			FALSE	Continuous

Fig.4-59: Overview on min./max. values and initial values of the inputs

Data Structures

MB_REGI_SENSOR_DATA		
ActStep	UINT	Current step
LengthFeedback	ARRAY [0.. 16] OF REAL	Deviations in length direction for registration marks; entry 0 is empty, 1... 16 are marks
SideFeedback	ARRAY [1.. 16] OF REAL	Deviation in lateral direction for registration marks; entry 0 is empty, 1... 16 are marks
MarkState	ARRAY [0.. 16] OF MB_REGI_MARK_STATE	Status of the registration marks
SensorState	MB_REGI_SENSOR_STATE	It outputs warnings and diagnostics of the sensor during the measurement

Fig. 4-60: MB_REGI_SENSOR_DATA data structure

Enumeration Type

The enumeration types [MB_REGI_MARK_STATE](#), page 44 and [MB_REGI_SENSOR_STATE](#), page 44 are not defined in the [MB_RegiSensor01Cy-cComType02](#), page 42 function block.

Functional Description

If "Enable" is set, a TCP socket is opened and it is tried to establish a communication with the camera sensor. Subsequently, the measured value transmission is started and set to "InOperation". If the sensor sends values, the deviations from the command position are output in lateral and longitudinal direction.

If the "Pause" input is enabled, the measured value output is paused and the "InPause" output is set. Measured values are detected, but not stored in MB_REGI_SENSOR_DATA. The measured value output is paused until the "Pause" input becomes FALSE again. If "Pause" is TRUE if "Enable" is set, the function block starts normally, but the measured value output is already interrupted at start. The "ActStep" output counts the received measured value logs continuously, even in "Pause" mode. In case of an overflow at 0, counting is continued.

The deviation to the command position, the mark status, the current measured value step as well as the status of the camera sensor is stored in "RegiSensorData".

To disable the function block, "Enable" has to be called with FALSE until "InOperation" becomes FALSE. If an error occurs, "Error" is TRUE and "ErrorID" as well as "ErrorIdent" contain valid error codes.

Error Handling

The function block uses the error table **F_RELATED_TABLE**, 16#0170.

It can generate the following error messages in Additional 1/Additional 2:

ErrorID	Additional 1	Additional 2	Description
STATE_MACHINE_ERROR (16#0005)	16#00000006	16#00000000	Error in the state machine
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000000	No TCP connection
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000001	The received data package is too large for the created receiver buffer
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000002	The data package to be sent is too large for the transmission buffer

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ErrorID	Additional 1	Additional 2	Description
COMMUNICATION_ERROR (16#0002)	16#00001D00	16#00000003	Invalid header received
INPUT_INVALID_ERROR (16#0001)	16#00001D00	16#00000004	No IP configured
INPUT_INVALID_ERROR (16#0001)	16#00001D00	16#00000005	No port configured
COMMUNICATION_ERROR (16#0002)	16#00001D02	16#00000000	Socket connection lost (LIFEGUARD)
COMMUNICATION_ERROR (16#0002)	16#00001D02	16#00000001	Connection lost between camera and trigger unit (it is currently not supported by the camera sensor)

Fig. 4-61: Error codes of the MB_RegiSensor03CycComType01 FB

Additionally, the function block can output errors of the RIL_SocketComm.lib library.

5 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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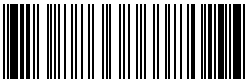
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Support
 See service hotline 123

Notes

Bosch Rexroth AG
Electric Drives and Controls
P.O. Box 13 57
97803 Lohr, Germany
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr, Germany
Tel. +49 9352 18 0
Fax +49 9352 18 8400
www.boschrexroth.com/electrics



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